



**ROSS** ENGINEERING CORP.

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# HIGH VOLTAGE DEVICES



**208V TO 1,000,000V DC TO 10MHz**

## ROSS ENGINEERING CORPORATION

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# HIGH VOLTAGE DEVICES

## HV RELAYS 1KV TO 300KV 1mA to 600 AMPS

3"  




**EC12-NC-12KV PK TEST**



**E25-NC-25KV PK TEST**



**E30-DT-30KV PK TEST**



**E40-NC-40KV PK TEST**



**E60-DT-60KV PK TEST**



**ED120-NC-120KV PK TEST**

12"  


**ACTUATORS 12V TO 250V DC, 24V TO 480V 25-800Hz OR AIR PRESSURE 40-125 PSI**

### HV RELAYS

1"  

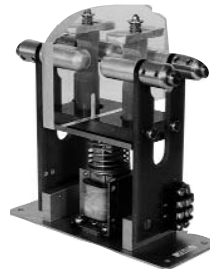



**E25-NC-25-1-0  
25KV PK TEST**

Air insulated types for isolating loads, tap selection, safety discharge & grounding to help meet OSHA & other safety regulations. Ratings from 1mA to 600 amps continuous, to 100,000 amps capacitor discharge. Peak 1 minute test voltages from 5 to 300KV. Single or multi-pole. Auxiliary contacts optional on all types. Options include latching, extended life, and tungsten contacts available for high current closing. DC, 25-800Hz & air pressure actuation available. Also usable in oil or insulating gas with increased ratings.

### AIRPORT LIGHTING HV CONTROL RELAYS

3"  

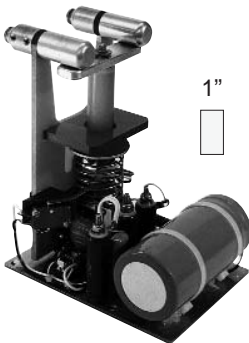
**E-25-2PNO-25-25KV PK TEST**

For line and voltage regulator load selection and control. 2400V AC to 20 amps, 5000V AC to 12 amps interrupt, 100A continuous.

*Single or Multi-pole,  
to 60KV PK test 1 minute*

### DELAYED OPEN OR CLOSE HV RELAYS

1"  

**E-40-NC-40-1-0-ZA,  
1-3 SECONDS DELAY TO CLOSE  
40KV PK TEST**

High Voltage relays with automatic delay but positive closing or opening after turn on, turn-off, or loss of power. They are designed for safety shorting, or current flow which must not be initiated or interrupted accidentally before a prescribed time after actuation or shutdown.

### HIGH VOLTAGE REED RELAYS 5,000V TO 15,000V PK TEST

3 Amps Continuous. 50 to 100 Volt Amps Max Interrupt. 6V DC to 115V 50/60 Hz coil. Choice of terminal type or HV leads.



**RR1A15P6  
SPNO  
15KV PK TEST  
PCB PIN TERMINALS  
6V DC ACTUATOR**

1"  




**RR2A15Q12S  
2PNO  
15KV PK TEST  
QUICK DISCONNECT TERMINAL  
12V DC ACTUATOR  
MOUNTING STUDS**



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## HIGH VOLTAGE DEVICES

### HV MEGMETER®, HIPOT TO 50KV

HV Insulation Leakage Current & HV Resistance Measurement Meter. Vacuum Switch Tester. Portable, 12V battery or 115V AC operated. 0-15KV DC 0.001uA to 260uA or to 1000uA. 0-42KV DC 0.001uA to 130uA or to 500uA. 0-50KV RMS 60Hz to 10mA, 115V/230V AC operated.



VMT-15, 0-15KV DC  
VMT-42, 0-42KV DC

**FOR TESTING VACUUM INTERRUPTERS,  
HV CABLES & HV INSULATION**

### Hi-Z® HV VOLTMETERS SAFE POWER LINE USE AC / DC TO 100KV

For phasing, capacitance tap or direct line measurement and hot line indication. Power class safe, portable all solid state, 0.5% to 5% accuracy. Shielded high voltage measurement with minimum circuit loading. 0.001V to 100KV AC or AC/DC. 125KV to 300KV BIL. Ideal for use with Elbow capacitance tap voltage test points. For cable test points and direct line voltage and phasing, or differential measurement. Analog or Digital available.



VM50EE-ALP-6  
ranges 0-250V, 5KV, 10KV,  
25KV, 50KV RMS AC

**ALSO HOT LINE  
INDICATION**

**FOR UTILITIES, CONTRACTORS & EMERGENCY SERVICES**

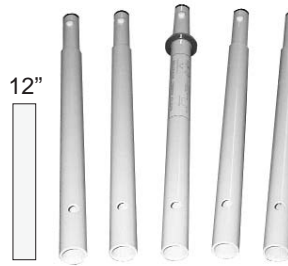
### PERSONAL GROUNDING RODS

Personal grounding rods temporarily ground or discharge (with current limiting if required) 50V-400KV electronic equipment that could present a safety problem. Rods are hooked on to HV terminals, or other points where contact will ground the device. Designs conform to OSHA clearance requirements and provide the correct handle and cable length to keep personnel away from hazardous high voltage



**NOT FOR HIGH  
CURRENT UTILITY  
POWER LINE USE**

### COLLAPSIBLE HOTSTICKS



**INSULATED HANDLES**

Designed to maintain proper safety clearances from hazardous High Voltage while hand holding a test instrument. The 1 or 1.5 foot sections of the Hotstick form a rigid handle from 1 to 12 feet in length with 100KV/foot test voltage, depending on your specific needs.

### WIDEBAND HV VOLTAGE DIVIDERS DC-10 MHz 1KV to 1000KV



Precision compensated resistive-capacitive voltage dividers for DC up to 10MHz or to 0.02 microsecond rise time pulse. 1000/1 ratio matched to 1 megohm 20 to 50pF display or recorder. Other ratios and loads as required. Accuracy and stability: 0.01% to 0.1% DC, 0.2% to 1% AC, 3% DC-1MHz, 3DB 10MHz. For use in air, oil, or gas. Contact Ross Eng. Corp. for complete accuracy specifications.

VD60-6.2-A-LB-A, 60KV PK OPERATE

### HV CALIBRATION AND TEST LAB To 400KV AC/DC

Calibration of HV Voltmeters, Wideband HV Probes, Voltage Dividers and HV Equipment to NIST standards. AC and DC includes multiple test points and certificate.



1KV up to  
450KV Peak  
AC &  
Impulse,  
400KV DC.



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# HIGH VOLTAGE DEVICES

## LOW PROFILE VACUUM CONTACTOR 208V to 15.5V 50/60Hz

12"



**HG3 Low Profile**  
200, 400, 600, 1200 Amp  
2000 to 28000 Amp Interrupt

1-1/2 to 2 cycle interrupt. Highly reliable vacuum interrupting capability of up to 750MVA at 15.5KV, with momentary current to 20,000 amps RMS, 56,000 amps Pk-Pk for 10 cycles, and 40,000 amps RMS for one cycle fuse protected. Three SPDT form C, 15A, 480V AC auxiliary contacts are standard and up to four may be specified.

## HV VACUUM CONTACTORS & CIRCUIT BREAKERS



12"



**HB-204-**  
200KV  
PK TEST  
200-600 AMP

**HA3-73-110-600-AMP**  
5-15.5KV CLASS

208V TO 300KV AC OR DC, 50A TO 2000A CONTINUOUS, 10A DC TO 28000A AC 1/2 TO 1 CYCLE INTERRUPT.

## POWERCLASS™ HV VACUUM CIRCUIT BREAKERS & HV VACUUM CONTACTORS 208V to 300KV, 50 to 2000 Amps Continuous

12"



Vacuum switches: single phase, three phase, upright or low profile, for high reliability sealed arc interrupting or crobar shorting. 50 to 2,000 amps continuous, 2,000 to 28,000 amps AC, 10 amps DC interrupt, 5,000 to 40,000 amps momentary and to 100,000 amps capacitor discharge.

**HC3-75-**  
5KV TO 38KV POWER CLASS

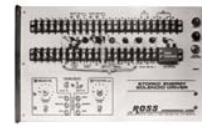
1/2 to 2 Cycle Interrupt

## VACUUM CONTACTORS WITH HIGH SPEED CONTACT OPENING AND ENERGY STORAGE DRIVERS

12"



**HAF-73-**



**ENERGY STORAGE SCR CONTROL**  
HCB-5-C-E-E

Energy Storage Driver, 400 joules or more, 115V or 240V AC powered, 50V to 1000V 20 microsecond trigger.

## HIGH POWER, HIGH SPEED HIGH VOLTAGE CONTROL AND STEP-START SYSTEM

60"

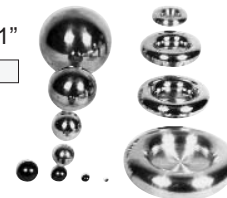


1/2 to 1 cycle sensing and interrupting vacuum circuit breakers. Metal enclosed for indoor or outdoor applications. 5KV-38KV. Step-Start systems to minimize inrush current. 200-1200A Continuous, 2000-28000A Interrupt.

**HD3-79-110-**  
5-15 KV CLASS, 95-110KV BIL  
1200A CONTINUOUS, 28,000A INTERRUPT.

## TOROIDS, SPHERES, CORONA NUTS & SHIELDS

1"



Spheres Sizes 0.2" to 22" 0.5cm to 56cm	Toroids sizes 0.75" to 52" 1.9cm to 132cm
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Geometrically designed to avoid excessive voltage gradients at connecting points and other areas needing shielding or balancing of electrostatic fields to increase withstand voltage and minimize corona. Many diameters are to international standard metric sizes.

**Non melting solid carbon spheres available for long life spark gaps**

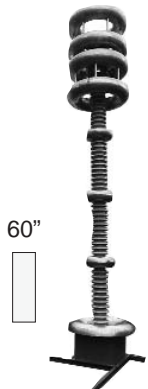


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## HIGH VOLTAGE DEVICES

### WEATHERPROOF WIDEBAND HIGH VOLTAGE DIVIDERS



High accuracy 5KV RMS to 345KV RMS power class. 30KV PK to 1000KV PK operate. 60KV to 1350KV basic impulse level. DC to over 1MHz frequency response. For DC, AC power quality, line disturbance & transient measurement and recording.

**VD1000-20-T-KB-B**  
1,000,000V DC OR PK AC OPERATE

### HV PROBES & VOLTMETERS FOR OSCILLOSCOPES, DVMS, RECORDERS

HV DC, AC, & Wideband DC-10MHz. Safety probes for any scope, digital display or recorder. Also available complete with large 4 1/2 digit display 0.1% to 5% DC/AC accuracy digital voltmeter, with safety handles for OSHA recommended personnel clearances. With attached or separate digital display or multimeter 0.00001V to 400KV.



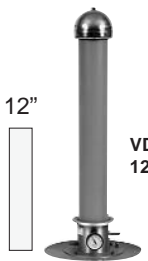
**VMD2A-200-DC-10MHz DVM**  
BATTERY/AC POWERED

**WIDEBAND HV PROBE TO 400KV DC-1MHz**

### POWER QUALITY AND LINE DISTURBANCE 1KV-1000KV MEASUREMENT & RECORDING

Power class sensors, wideband voltage dividers for use with DRANETZ / BMI, RPM, FLUKE, TEKTRONIX & other recorders.

*Matched to:*  
**DRANETZ / BMI**



**VD120 120KV**

**INDOOR**



**OUTDOOR**



**626 Recorder**



**8800 Recorder Powerscope**



**TEKTRONIX**



**FLUKE**

**123 & 190 Series Scopemeter**

### HV DIGITAL MULTIMETERS

Wideband DC-10MHz. VMD2A 4 1/2 digit portable meter has accuracies to 0.01% DC, 0.1% 50/60Hz, 3% to 1MHz -3dB 10MHz. true RMS, Avg, True +PK, -PK, PK to PK, 0.2 microsecond, 1/2 sine single pulse capture & hold. 0.00001V - 1000V DC or PK AC and for use with HV Probes to 400KV and Voltage Dividers to 1,000,000V. Has 2V output to scope, recorder.



**VD60-6.2-A-LB-A, 60KV PK OPERATE VOLTAGE DIVIDER**



**VMD2A MULTIMETER**



### WIDEBAND FIBER OPTIC TRANSMISSION DC-1MHz & 50-75 OHM COAXIAL CABLE DRIVER DC-35MHz

AC or 12V DC rechargeable battery/AC operated. Systems have a maximum output of 10V PK (20V PK to PK) 10mA and a maximum signal input of 10V PK. Useful from 0.1V, and to over 1000KV when used with Ross HV wideband dividers. Single or multiple ranges.

**FIBER OPTIC TRANSMITTER AND RECEIVER**



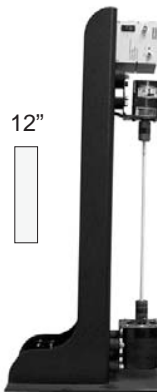
**DC - 1MHz**  
1000Ω 30pF INPUT IMPEDANCE

**COAXIAL CABLE DRIVER**



**DC - 35MHz**  
1MΩ 30pF INPUT IMPEDANCE

### INSTRUMENT POWER ISOLATOR TO 400KV ISOLATION, VERY LOW CAPACITANCE, ELIMINATES BATTERIES



Isolated Instrumentation

5-50VA  
Motor / Generator Type  
> 150KV PK  
Isolation  
< 1 Picofarad

115V, 230V AC  
Motor



50-1000VA  
115/230V 50/60Hz  
Transformer Type  
60KV PK  
Isolation  
< 20 Picofarad



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# HIGH VOLTAGE DEVICES

## HIGH SHOCK RELAYS



1"



Developed and manufactured for shipboard explosion resistance 250G shock, 27KV, double throw, DC-400Hz actuator. 100 Amp Continuous

**E30-DT-40-G**  
30KV PK TEST

## HV SPHERICAL RELAYS



12"



Ultra high voltage, low corona, transfer, polarity reversing, and grounding relays of the air insulated type. Ratings up to 600KV PK at 100 amps continuous. Solenoid, motor or air cylinder operated and spring or gravity return.

**DH-300-NC-40-2-0**  
300KV PK TEST

## MOTOR OPERATED RELAY / SWITCH 100 AMPS

1"



To 120KV in SF<sub>6</sub>. High Shock and Vibration Resistance

120KV PK TEST  
IN SF<sub>6</sub> GAS  
24V DC OPERATE

**R50-DTM-**

## HV ROTARY SWITCHES

Ratings from 5 to 150KV, 1 to 200 amps. Either manual or electrical operators, depending upon requirements. Position detents and interlocks to prevent opening under load.

1"



**R15-2P6T**  
15KV PK 100A

## HIGH POWER RF SWITCHES



High voltage RF switch designed and manufactured for high power communication transmitters. Up to 400KV PK test 6000 amps RMS. Motor or air actuated. Single throw or double throw.

6000 Amps Continuous 60Hz  
3000 Amps Continuous 13Hz  
1500 Amps Continuous 30Hz

**GD350-DOUBLETHROW**  
350KV PK TEST  
1500 AMPS,  
30KHz

## HIGH CURRENT SWITCHES

12"



Models are available up to 20,000 amps continuous, and over 1,700,000 amps 20usec pulse, with voltage ratings of 6 volts to 400KV peak test. Many are air cylinder or motor operated for high contact force. DC to 1MHz.

**GD27-DTP-40-1600-2-43,**  
27KV PK TEST  
1600A CONTINUOUS



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# HIGH VOLTAGE DEVICES

## CONTROL & SAFETY DEVICES

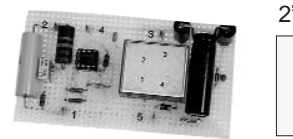
### SOLENOID-SAVER®

For high pull-in current, low holding current 25-800Hz AC or DC solenoid actuators to prevent coil burnout, lower coil temperature rise and increase pull-in and holding forces. Eliminates AC hum. Can provide optional low current, low voltage control with 5mA 4-10V or other signal, optional delayed activation or deactivation, or optional high speed energy storage activation. Will allow any DC or AC solenoid to be used at DC or 25-800Hz.

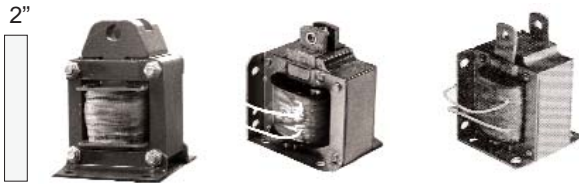


### VOLTAGE LEVEL SENSOR

Provides 24V to 1000KV with internal voltage divider. Sensing & control for max/min voltage levels. For interlocking, charging voltage limiting, and indicating.



### AC SOLENOIDS



AC Quiet. DC to 800Hz. Class B or H Insulation. Extendable Stroke. Universal Mounting. Higher Holding Force. Environment resistant. Optional Electronic Controller. 120V, 208V, 240V, 480V, 60Hz coil voltages are standard. Other voltages and frequencies (including DC) are also available.

### HV ADJUSTABLE SPARK GAPS

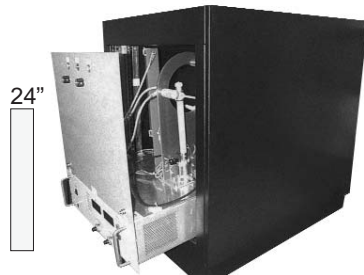


Non-melting carbon spheres, and heavy wall aluminum spheres, .2" to 22", 0.5cm to 56cm DIA. With dust tight transparent covers 2KV to 88KV. Open style to 670KV. Micrometer type calibrating devices.

SG-40-H  
4-40KV PK

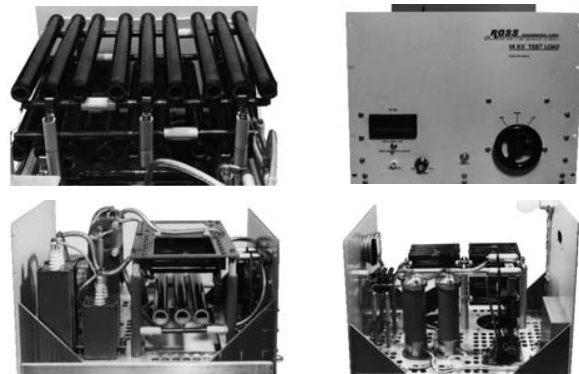
### ESD TESTER

For static discharge testing 0-5KV, 0-30KV. It incorporates high voltage relays to safety ground, charge, and dump a 500PF, 25KV capacitor into the appropriate device under test. Portable system utilizing 120V AC power to operate. It is a high reliability device capable of many thousands of cycles.



ESD-40

### HV LOADS 1KV TO 300KV 100 WATTS TO 50 KILOWATTS



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Fax: 31-320-413-133  
Email: info@eemc.nl

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Additional Product Photos Appear Courtesy Of:  
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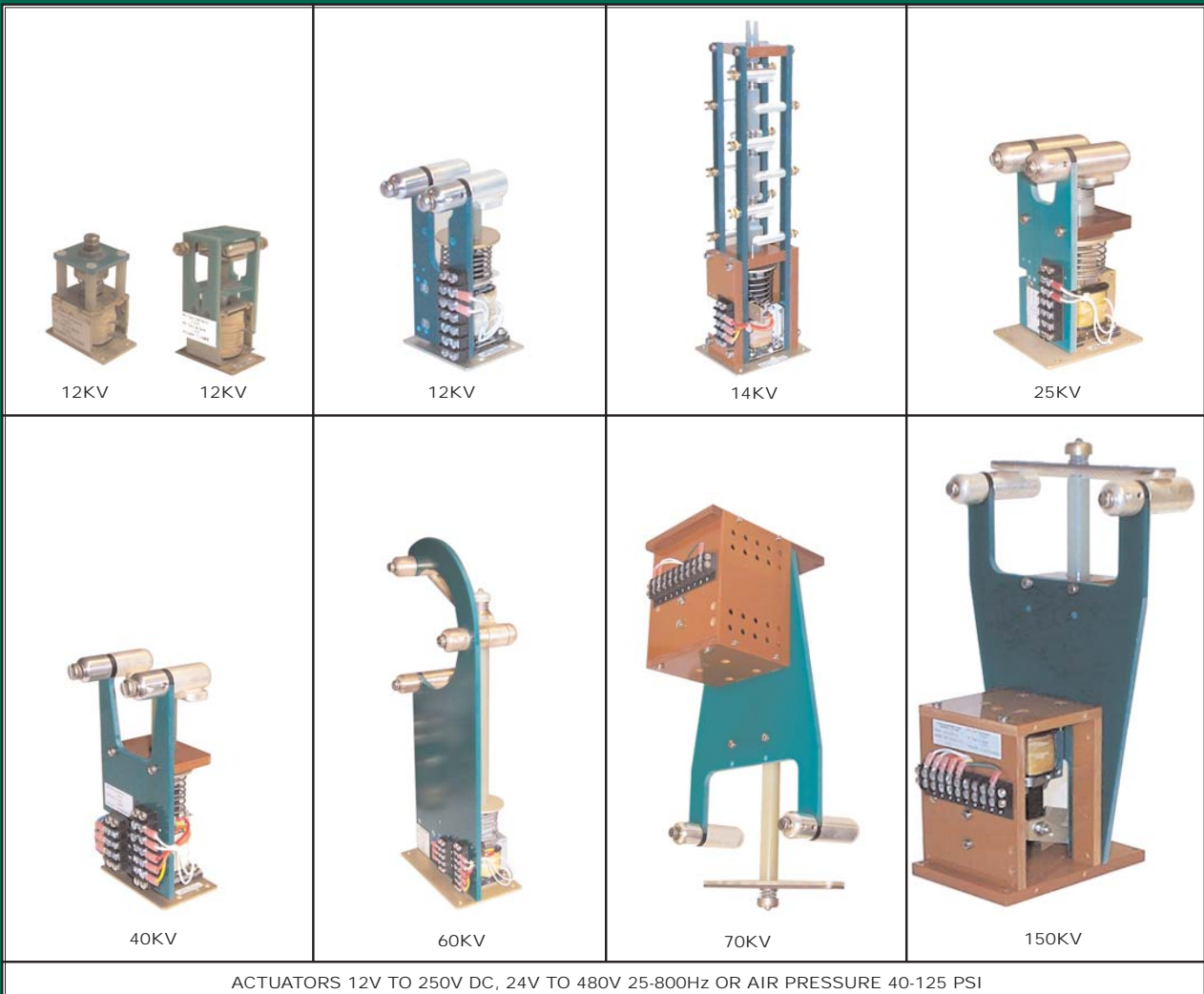
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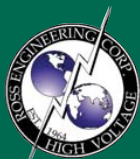
# HIGH VOLTAGE RELAYS



ACTUATORS 12V TO 250V DC, 24V TO 480V 25-800Hz OR AIR PRESSURE 40-125 PSI

- 1KV TO 300KV PEAK TEST
- SINGLE OR MULTI-POLE
- HIGH CURRENT CLOSING
- HIGH CURRENT CARRYING
- LONG LIFE
- RUGGED AND RELIABLE
- ELECTRONIC APPLICATION
- POWER APPLICATION
- HV TRANSFER
- SAFETY GROUNDING
- TAP OR LOAD SELECTION
- CAPACITOR DISCHARGE

**ISO 9001:2000  
QMS CERTIFIED**



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**ACTUATORS**

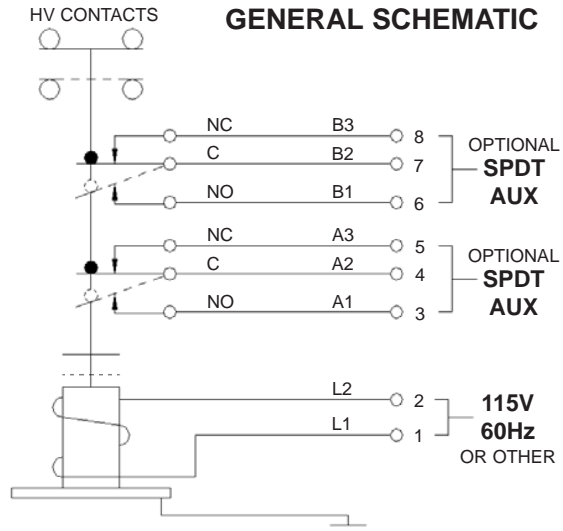
115V, 60Hz actuators are standard for pull-in currents less than 10A. Higher actuator voltages are recommended for pull-in currents over 10A to minimize momentary voltage drop. It is recommended that source impedance allow no more than 6% drop at the coil terminals during pull-in. Most models can be supplied with actuators for 24V, 48V, 70V, 100V, 115V, 200V, 208V, 230V or 480V, and 60Hz or 50Hz power. 400Hz or 24V, 48V, 100V, 115V or 125V DC actuators are available at additional cost. Latching type actuators are also available requiring only momentary current. Special actuators and relay drivers are available for high speed operation of 0.5 to 10 milliseconds, or delayed operation upon loss of power. Air or hydraulic pressure actuated relays are available for applications requiring complete electrical isolation of the actuator, very high contact pressure for high current or very long strokes for higher withstand voltage ratings. Electric motor actuators are also available for special applications. A small PC board is available to be inserted at the coil input which will eliminate AC HUM and prevent coil burn-out on failure to pull in.

**MOUNTING**

Most of the Ross Engineering Corporation high voltage relays with ratings through 60KV can be adjusted to be mounted in any attitude unless otherwise indicated. Where maximum reliability, minimum noise (HUM), minimum contact resistance, or minimum pull-in voltage is required, consult the Applications Engineering Department for mounting recommendations. Please specify mounting position; base down is standard and will be optimum unless otherwise noted. Most of the Ross Engineering Corporation solenoid operated high voltage relays with ratings of 70KV or higher are designed to return to their normal position by gravity when the actuator is de-energized. These relays must be mounted in the recommended attitude. Ross Engineering Corporation switches operated by air or oil pressure, or by electric motors, generally may be mounted in any attitude.

**HIGH CURRENT CLOSING AND CONTINUOUS HOLDING CAPABILITIES**

High contact closing force enables high momentary current closing capabilities ranging from 10A to 50,000A. Special tungsten contacts are available to increase momentary discharge current ratings by many times, but with reduced continuous current ratings. Continuous current ratings drop and contact resistance may increase with standard copper alloy contacts when arcing occurs or in a dusty environment, therefore special silver contacts are available to maintain continuous current ratings when closing or opening under load.



**CONTINUOUS CURRENT RATINGS**

Continuous current ratings are as of new and clean condition for a maximum of 40°C ambient at sea level. Relays are suitable up to 70°C ambient with forced ventilation. Current ratings as specified are continuous for 60Hz RMS and DC, but should be derated 3% per 1,000ft above sea level. Continuous current ratings of standard copper alloy contacts are reduced after arcing. Special silver contacts must be used where continuous current is required after arcing if current ratings are to be maintained. Type of application should be considered when determining current rating required. In most cases, continuous currents for long time duty should not be more than 3/4 the current rating of the new relay. In open industrial or dusty atmosphere it may be necessary to derate by 50%, further if arcing occurs unless silver insets are used. Some units can be used in applications above 60Hz at reduced current and voltage ratings. All RF applications should be submitted to our Applications Engineering Department for review.

**INTERRUPT AND CLOSE CURRENT RATINGS**

These air insulated relays are not rated for current interrupting. Most are capable of interrupting 10 milliamps or more depending on type of wave, load, and recovery voltage. Much higher currents can be interrupted in insulating gas or oil and with certain other applications and models. High voltage air insulated relays can close on high short time capacitor discharge currents and are rated for safety grounding or high current capacitor dumping. They have long life and little or no maintenance in these applications. Tungsten contacts are available for longer life capacitor discharge use. Fail-safe grounding or shorting relays of this type with fully visible contacts are ideally suited for use in all types of power supplies. Relays, contactors and switches for higher interrupting capabilities are covered in other brochures.



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## HIGH VOLTAGE PEAK TEST

Ratings are for air at 760mmHg, 20°C. Derate 3% per 1,000ft above sea level. All peak test voltages are 1 minute 60Hz peak hold voltages, unless otherwise noted. The first figure in the model number is the peak test rating between open contacts. The number following the contact configuration designation is the rated peak test voltage to ground. On most non-spherical contacts, transient pulse withstand may be considerably higher than the 60Hz test level. Actual flashover values, for spherical types, are approximately 10% greater than rated peak test hold values for DC, 60Hz, and most transients.

## HIGH VOLTAGE OPERATE

The peak test rating of high voltage relays should be 1.2 to 5 times the normal high voltage circuit operating voltage, depending upon the application. For lower power systems, where transients are unlikely or intermittent flashover is of no consequence, a safety factor of 1.2 to 1.5 may be suitable. For medium power systems, or where moderate transients are likely, a safety factor of 1.5 to 3 is desirable and 2 to 3 recommended. For higher power systems, or where transient over-voltages are expected, a safety factor of 2.5 to 5 should be considered and the factor should be based on the maximum probable transient. The peak test voltage to ground rating should be selected in the same way as is the contact to contact value. If a value other than the published rating is required, it can normally be supplied as an extra cost option. On most grounding relays, even though one contact is grounded, the insulation to ground should be 10KV to 40KV to prevent HV ground current from flowing in solenoid circuits during capacitor discharge, or transients.

## INSULATION

Standard insulation used on Ross Engineering Corporation high voltage relays and switches is fire retardant FR-4, G-10 or G-11 Epoxy glass laminate. G-7 silicone glass insulation is recommended as an extra cost option for RF applications, particularly above 300KHz. It also may be necessary to increase insulation length for RF Applications.

## OIL OR GAS INSULATION

The voltage withstand value is at least doubled or tripled and the interrupt capability is much greater when the relay is immersed in insulating oil, fluid, or gas. No modification is necessary for operation in an insulating gas atmosphere; however, oil or fluid immersion requires modifications and is an extra cost option. For maximum performance in an insulating medium, where high voltage is impressed directly across solid insulation, it may be necessary to increase insulation length to prevent puncture at levels above the test rating in air.

## AUXILIARY CONTACTS SPDT

Auxiliary contacts are available on request on all relays. Most smaller relays are optionally available with at least two 10A, 250V AC or 3A, 24V DC auxiliaries. Larger units are available with at least two 15A, 480V AC auxiliaries, and some have provision for as many as eight. 10A, 115V DC auxiliaries are available interchangeably with the 15A, 480V AC units. Oil-immersed relays require special auxiliaries. Optional auxiliary contacts can indicate fully open or fully closed HV relay.

## HELPS MEET REGULATIONS

OSHA and other safety regulations indicate safety grounding of all HV power supplies and systems for personnel protection. Ross Engineering helps meet these requirements with its line of high voltage grounding and discharge relays and accessories.

## RUGGED AND RELIABLE

Thousands of trouble free high voltage applications in the past 42 plus years have established Ross Engineering Corporation's reputation for dependable, quality engineered products. Fire retardant high strength epoxy glass laminate insulation with a moisture resistant coating is standard on most units. Heavy duty contacts, which are specially designed to minimize corona, are made of highly conductive but weld resistant alloys. Ross Relays are noted for their ability to withstand high shock and vibration as well as other severe environmental conditions.

## LONG LIFE

Simplicity of mechanical design and conservative stress levels result in long trouble-free life. Contacts on most relays may be rotated to renew the contact area, resulting in even longer service life.

## COMPACT DESIGN

Ross Engineering Corporation manufactures some of the most compact air insulated high voltage relays available. The best qualities of mechanical and electrical design are combined to create these highly efficient and reliable relays with as many as six poles or more.

## DANGER

*These may have high voltage at the HV contact area. Safe high voltage procedures must be followed by personnel when close to any of these relays. Clearances and grounding rules must be observed.*



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# E SERIES

# 12KV - 60KV

For transfer, safety grounding, or tap selection at 12KV to 60KV peak test in air. Most HV contacts have full insulation above ground. A higher insulation level to ground is optional. Most units are spring return and are designed to mount base down (other mounting positions must be specified) or may also be used with gravity return by mounting in the proper position.

E series units are also available with replaceable tungsten alloy contacts for high current capacitor discharge applications. Large radiused are used to minimize corona. For holding or indicating, one, two or more SPST 11A, 250V AC auxiliary contacts are available on the E12, E15, E25, E30 and E40. The E60 normally uses 15A, 250V AC and 1/2A, 125V DC auxiliary contacts. Other auxiliary contact ratings are available.



Typical E Series  
Model E40-NC-40-

Available up to 300KV PK.

SPECIFICATIONS							760MMHg 20°C AMBIENT				
RELAY MODEL	CONTACT FORM	1 MINUTE PK TEST RATING DC OR AC PK		* CURRENT RATINGS NEW & DUST FREE			MAX CONTACT RESISTANCE NEW & CLEAN	OPERATE TIME MAX MILLI-SEC	RE-LEASE TIME MAX MILLI-SEC	** STANDARD 115V, 60Hz COIL	
		HV CONTACTS	INSULATION TO GROUND	CONTINUOUS AMPS RMS	MOMENTARY 10 CYCLE AMPS RMS	MOMENTARY CAPACITOR DISCHARGE, 20 μSEC				MAX RMS INRUSH CURRENT	MAX RMS HOLD CURRENT
E12-NC	SPNC	12KV	12KV	50A	1,000A	2,500A	.001Ω	20	50/90	2A	0.4A
E12-NO	SPNO	12KV	12KV	50A	1,000A	2,500A	.001Ω	20/40	30	2A	0.4A
E12-DT	SPDT	12KV	12KV	50A	1,000A	2,500A	.001Ω	20/40	50/90	2A	0.4A
E15-NC	SPNC	15KV	15KV	125A	1,000A	2,500A	.0008Ω	20	50/90	2A	0.4A
E15-NO	SPNO	15KV	15KV	125A	1,000A	2,500A	.0008Ω	20/40	30	2A	0.4A
E15-DT	SPDT	15KV	15KV	125A	1,000A	2,500A	.0008Ω	20/40	50/90	4A	0.5A
E25-NC	SPNC	25KV	25KV	125A	1,000A	2,500A	.0008Ω	20	50/90	3A	0.4A
E25-NO	SPNO	25KV	25KV	125A	1,000A	2,500A	.0008Ω	20/40	30	3A	0.4A
E25-DT	SPDT	25KV	25KV	125A	1,000A	2,500A	.0008Ω	20/40	50/90	5A	0.5A
E30-DT-40	SPDT	30KV	40KV	125A	1,000A	2,500A	.0008Ω	30/50	100/140	5A	0.5A
E40-NC	SPNC	40KV	40KV	125A	1,000A	2,500A	.0008Ω	20	60/100	5A	0.5A
E40-NO	SPNO	40KV	40KV	125A	1,000A	2,500A	.0008Ω	20/40	30	5A	0.5A
E60-NC-80	SPNC	60KV	80KV	125A	1,000A	2,500A	.0008Ω	40	60/100	7A	0.7A
E60-NO-80	SPNO	60KV	80KV	125A	1,000A	2,500A	.0008Ω	40	60/100	7A	0.7A

\* Silver alloy contacts are optional for maximum continuous closed current ratings. Tungsten alloy contacts are optional for high current capacitor discharge closing currents.

\*\* DC, 50Hz, 400Hz, and other voltages available. Coil current is approximately inversely proportional to voltage, I.E. 230V AC is half of that at 115V. Auxiliary contacts available on all models. Additional insulation to ground and RF insulation available for frequencies to 30MHz. Recommend 208V or 230V AC operation for pull-in currents greater than 10A unless a low impedance source can maintain at least 94% rated voltage during pull-in.

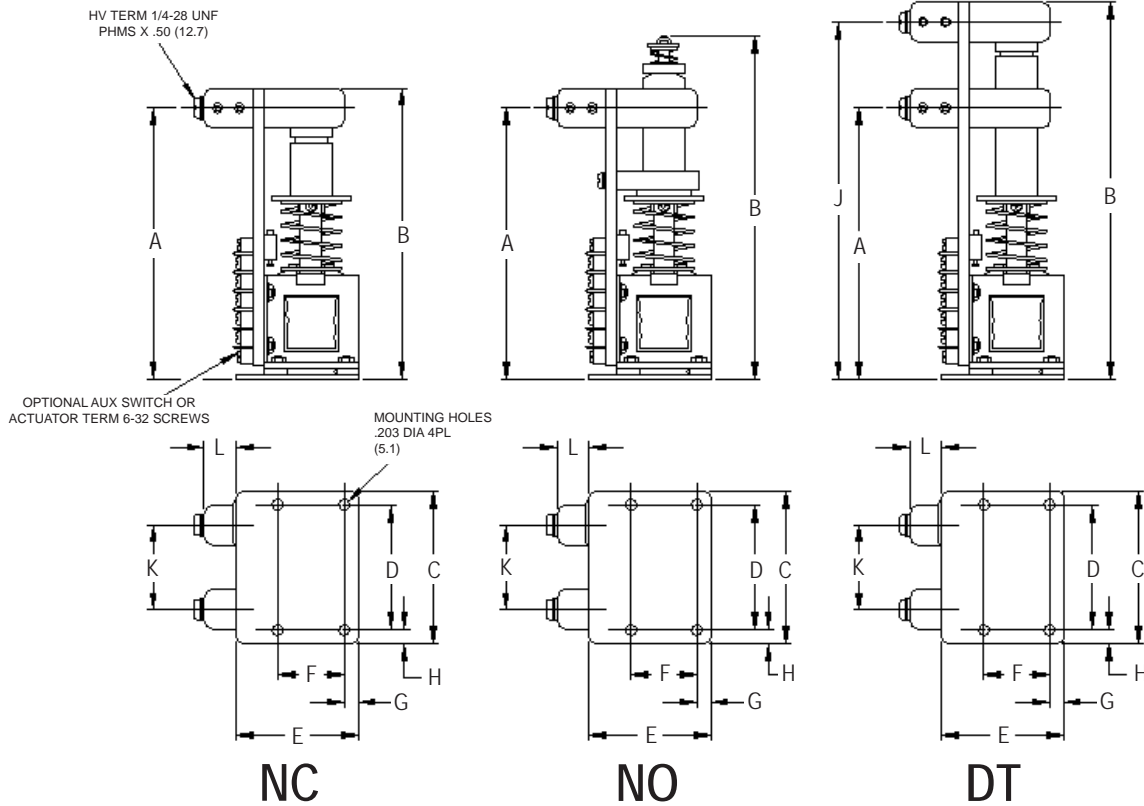
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DIMENSIONS INCHES (MILLIMETERS)											
RELAY MODEL	A	MAX B HEIGHT	MAX C WIDTH	D	BASE E DEPTH	F	G	H	J	K	L
E12-NC	4.41 (112.0)	4.72 (119.8)	2.50 (63.5)	2.125 (53.9)	1.88 (47.7)	1.187 (30.1)	.25 (6.3)	.19 (4.8)		1.12 (28.4)	.69 (17.5)
E12-NO	4.41 (112.0)	5.67 (144.0)	2.50 (63.5)	2.125 (53.9)	1.88 (47.7)	1.187 (30.1)	.25 (6.3)	.19 (4.8)		1.12 (28.4)	.69 (17.5)
E12-DT	4.41 (112.0)	5.97 (151.6)	2.75 (69.8)	2.250 (57.1)	2.19 (55.6)	1.187 (30.1)	.25 (6.3)	.25 (6.3)	5.65 (143.5)	1.12 (28.4)	.38 (9.6)
E15-NC	4.88 (123.9)	5.25 (133.3)	2.75 (69.8)	2.250 (57.1)	2.19 (55.6)	1.187 (30.1)	.25 (6.3)	.25 (6.3)		1.50 (38.1)	.56 (14.2)
E15-NO	4.88 (123.9)	6.25 (158.7)	2.75 (69.8)	2.250 (57.1)	2.19 (55.6)	1.187 (30.1)	.25 (6.3)	.25 (6.3)		1.50 (38.1)	.56 (14.2)
E15-DT	4.88 (123.9)	6.75 (171.4)	3.38 (85.8)	2.875 (73.0)	2.19 (55.6)	1.125 (28.5)	.25 (6.3)	.25 (6.3)	6.38 (162.0)	1.50 (38.1)	.56 (14.2)
E25-NC	5.48 (139.1)	5.85 (148.5)	2.75 (69.8)	2.250 (57.1)	2.19 (55.6)	1.187 (30.1)	.25 (6.3)	.25 (6.3)		1.50 (38.1)	.56 (14.2)
E25-NO	5.48 (139.1)	7.06 (179.3)	2.75 (69.8)	2.250 (57.1)	2.19 (55.6)	1.187 (30.1)	.25 (6.3)	.25 (6.3)		1.50 (38.1)	.56 (14.2)
E25-DT	5.48 (139.1)	7.67 (194.8)	3.38 (85.8)	2.875 (73.0)	2.19 (55.6)	1.125 (28.5)	.25 (6.3)	.25 (6.3)	7.31 (185.6)	1.50 (38.1)	.65 (16.5)
* E30-DT-40	6.72 (170.6)	9.03 (229.3)	4.38 (111.2)	3.875 (98.4)	3.50 (88.9)	1.562 (39.6)	.97 (24.6)	.25 (6.3)	8.65 (219.7)	2.62 (66.5)	
E40-NC	6.72 (170.6)	7.18 (182.3)	3.38 (85.8)	2.875 (73.0)	2.19 (55.6)	1.125 (28.5)	.25 (6.3)	.25 (6.3)		2.62 (66.5)	.56 (14.2)
E40-NO	6.72 (170.6)	8.79 (223.2)	3.38 (85.8)	2.875 (73.0)	2.19 (55.6)	1.125 (28.5)	.25 (6.3)	.25 (6.3)		2.62 (66.5)	.56 (14.2)
E60-NC-80	11.50 (292.1)	12.00 (304.8)	5.00 (127.0)	4.500 (114.3)	4.00 (101.6)	3.000 (76.2)	.50 (12.7)	.25 (6.3)		5.00 (127.0)	.06 (1.52)
E60-NO-80	11.50 (292.1)	14.25 (361.9)	5.00 (127.0)	4.500 (114.3)	4.00 (101.6)	3.000 (76.2)	.50 (12.7)	.25 (6.3)		5.00 (127.0)	.06 (1.52)

E60-DT see page 6

\* For outline drawing see page 9, \*DT

Specifications and Dimensions are for reference only and are subject to change. Contact Ross Engineering Corporation for specific application data.



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# E SERIES - SPDT

# 40KV - 150KV

These highly reliable compact air insulated HV relays are used for HV transfer, safety grounding, tap selection and capacitor discharge at 40KV to 150KV PK test in air. They have fire-retardant epoxy glass laminate insulation with track resistant coating as well as heavy duty contacts to minimize corona and contact resistance. All models are also available with tungsten alloy contacts for high current capacitor discharge use. Basic units are designed to mount base down, other mounting positions must be specified. They can withstand high shock, vibration, and severe environmental conditions. One, two or more optional auxiliary SPDT contacts are also available for holding or indicating as follows: E40, 11A, 250V AC; E60, 15A, 250V AC and 1/2A, 125V DC; E100 and E150, 15A, 480V AC and 1/2A, 125V DC. Other auxiliary contact ratings are available.



Typical E Series  
Model E60-DT-80-

SPECIFICATIONS							760MMHg 20°C AMBIENT				
RELAY MODEL	CONTACT FORM	1 MINUTE PK TEST RATING DC OR AC PK		* CURRENT RATINGS NEW & DUST FREE			MAX CONTACT RESISTANCE NEW & CLEAN	OPERATE TIME MAX MILLI-SEC	RE-LEASE TIME MAX MILLI-SEC	** STANDARD 115V, 60Hz COIL	
		HV CONTACTS	INSULATION TO GROUND	CONTINUOUS AMPS RMS	MOMENTARY 10 CYCLE AMPS RMS	MOMENTARY CAPACITOR DISCHARGE, 20 $\mu$ SEC				MAX RMS INRUSH CURRENT	MAX RMS HOLD CURRENT
E40-DT-40	SPDT	40KV	40KV	50A	1,000A	2,500A	.001 $\Omega$	20/40	30	5A	0.5A
E40-DT-60	SPDT	40KV	60KV	50A	1,000A	2,500A	.001 $\Omega$	20/40	30	5A	0.5A
E60-DT-80	SPDT	60KV	80KV	30A	500A	2,500A	.002 $\Omega$	25/50	30	6A	0.8A
E100-DT-100	SPDT	100KV	100KV	30A	400A	2,500A	0.1 $\Omega$	40/60	60	6A	0.27A
E120-DT-120	SPDT	120KV	120KV	30A	400A	2,500A	0.1 $\Omega$	40/60	60	12A	0.3A
E150-DT-150	SPDT	150KV	150KV	30A	400A	2,500A	0.1 $\Omega$	60/100	60	30A	0.5A

\* Silver alloy contacts are optional for maximum continuous closed current ratings. Tungsten alloy contacts are optional for high current capacitor discharge closing currents.

\*\* DC, 50Hz, 400Hz, and other voltages available. Coil current is approximately inversely proportional to voltage, I.E. 230V AC is half of that at 115V. Auxiliary contacts available on all models. Additional insulation to ground and RF insulation available for frequencies to 30MHz. Recommend 208V or 230V AC operation for pull-in currents greater than 10A unless a low impedance source can maintain at least 94% rated voltage during pull-in.

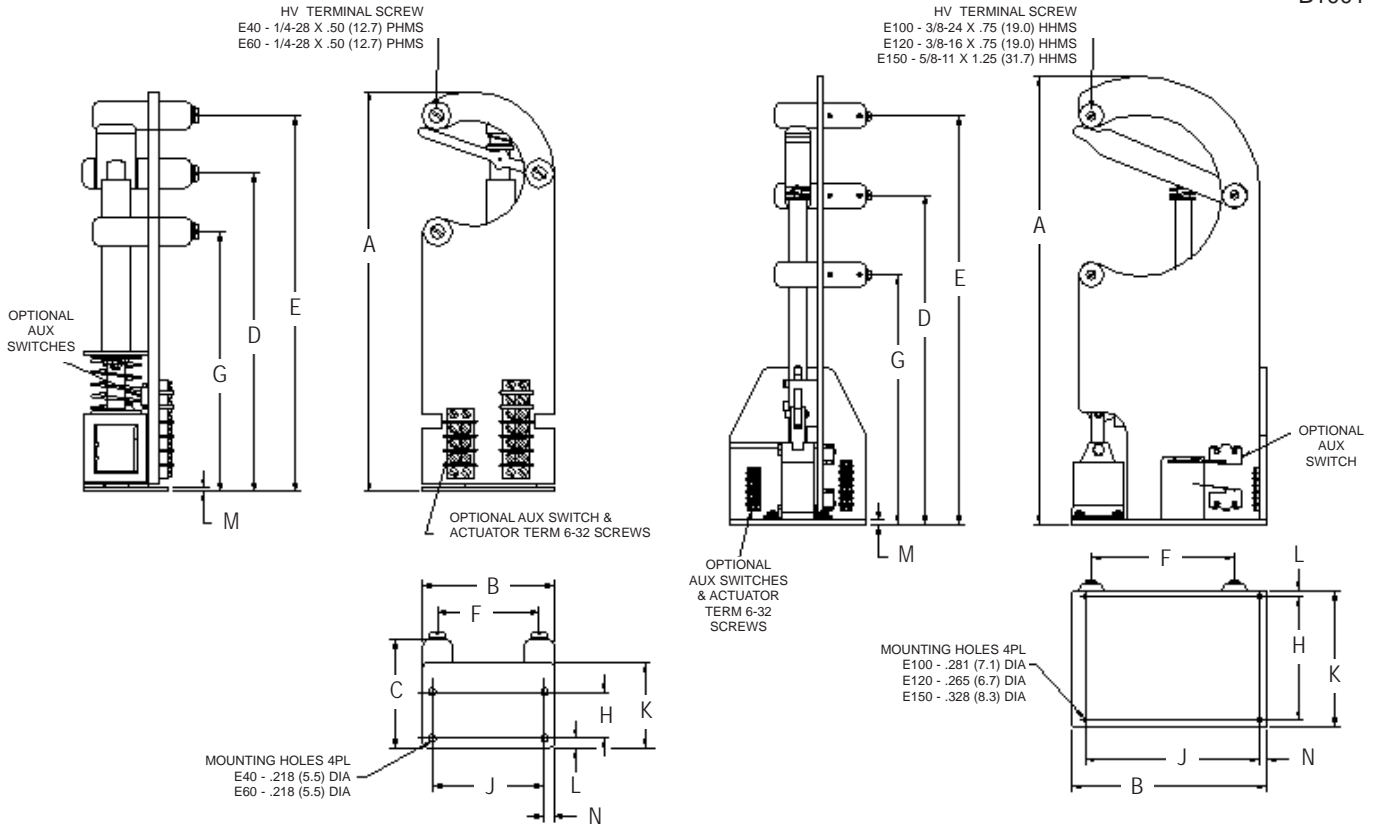
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E40-DT-40  
E60-DT-80

E100-DT-100  
E120-DT-120  
E150-DT-150

RELAY MODEL	DIMENSIONS												
	INCHES (MILLIMETERS)												
	MAX A HEIGHT	MAX B WIDTH	MAX C DEPTH	D	E	F	G	H	J	BASE K DEPTH	L	M	N
E40-DT-40	10.35 (262.9)	3.38 (85.8)	2.87 (72.9)	8.22 (208.7)	9.72 (246.8)	2.62 (66.5)	6.72 (170.6)	1.188 (30.1)	2.875 (72.9)	2.19 (55.6)	.25 (6.35)	.09 (2.2)	.25 (6.3)
E40-DT-60	12.35 (313.6)	3.38 (85.8)	2.87 (72.9)	10.22 (259.5)	11.72 (297.6)	2.62 (66.5)	8.72 (221.4)	1.188 (30.1)	2.875 (72.9)	2.19 (55.6)	.25 (6.35)	.09 (2.2)	.25 (6.3)
E60-DT-80	17.12 (434.8)	6.50 (165.1)	3.88 (98.5)	12.81 (325.3)	15.75 (400.0)	5.06 (128.5)	9.88 (250.9)	3.000 (76.2)	5.750 (146.0)	3.75 (95.2)	.38 (9.6)	.18 (4.5)	.38 (9.6)
E100-DT-100	27.25 (692.1)	11.40 (289.5)	7.25 (184.1)	19.35 (491.4)	24.01 (609.8)	8.41 (213.6)	14.69 (373.1)	7.250 (184.1)	10.250 (260.3)	8.00 (203.2)	.38 (9.6)	.25 (6.3)	.40 (10.16)
E120-DT-120	38.50 (977.9)	24.00 (609.6)	9.00 (228.6)	27.75 (704.8)	35.17 (893.3)	13.39 (340.1)	20.33 (516.3)	8.315 (211.2)	22.750 (577.8)	10.00 (254.0)	1.00 (25.4)	.38 (9.6)	1.00 (25.4)
E150-DT-150	55.25 (1,403.3)	25.75 (654.0)	14.25 (361.9)	40.13 (1,019.3)	51.25 (1,301.7)	20.08 (510.0)	24.00 (609.6)	14.250 (361.9)	23.750 (603.2)	15.00 (381.0)	.38 (9.6)	.38 (9.6)	1.00 (25.4)

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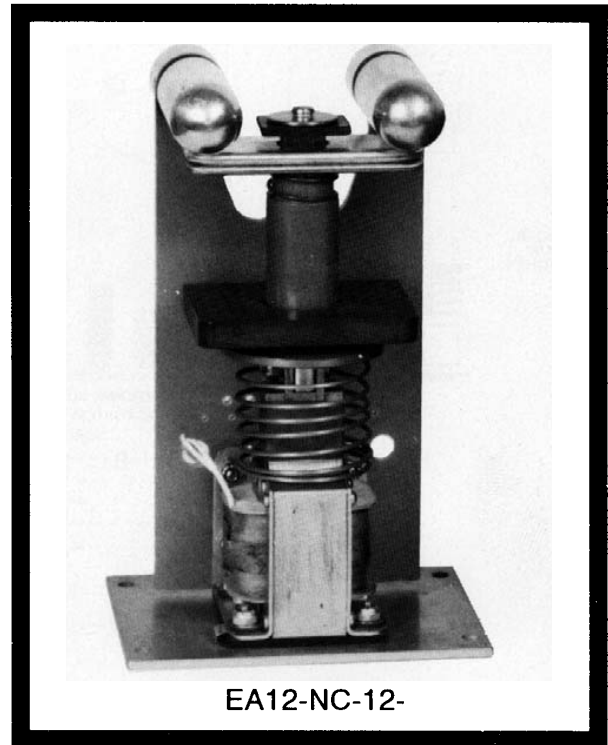


# EA SERIES

# 12KV - 40KV

The EA series of air insulated HV Relays is provided for higher continuous and momentary currents, yet is still within a compact size for 12KV to 40KV PK test in air. It has higher opening and closing forces which minimize contact resistance and closing bounce. Where no HV current interrupting rating is required, it is widely used for high power load and tap selection, circuit isolation, and grounding or shorting. It has standard, weld resistant, silver plated, easily renewable copper alloy contacts.

When supplied with the optional special heavy duty arcing contacts of tungsten alloy, this series is excellent for closing in on high capacitor discharge and momentary fault currents with long life capability. As on most Ross HV Relays, one, two or more sets of SPDT 15A, 250V AC and 1/2A, 125V DC auxiliary contacts are optionally available, if required. Other auxiliary contact ratings are available.



EA12-NC-12-

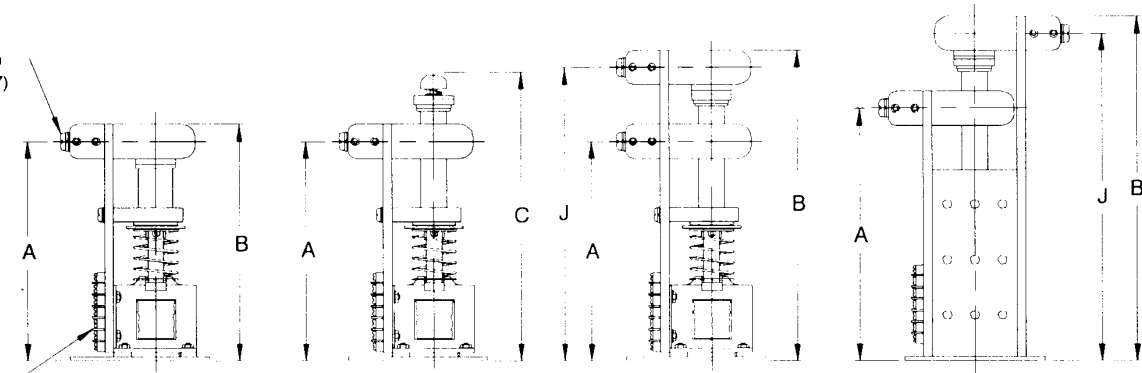
SPECIFICATIONS 760MMHg 20°C Ambient											
RELAY MODEL	CONTACT FORM	1 MINUTE PEAK TEST RATING DC OR AC PK		*CURRENT RATINGS NEW & DUST FREE			MAX CONTACT RESISTANCE NEW & CLEAN	OPERATE TIME	RELEASE TIME	**STANDARD 115V, 60Hz COIL	
		HV CONTACTS	INSULATION TO GROUND	CONTINUOUS AMPS RMS	MOMENTARY 10 CYCLE AMPS RMS	MOMENTARY CAPACITOR DISCHARGE, 20 USEC		MAX MILLI-SEC	MAX MILLI-SEC	MAX RMS INRUSH CURRENT	MAX RMS HOLD CURRENT
EA-12-NC	SPNC	12KV	20KV	200A	5,000A	50,000A	.0005 OHM	20	50	6A	0.8A
EA-12-NO	SPNO	12KV	20KV	200A	5,000A	50,000A	.0005 OHM	20	50	6A	0.8A
EA-12-DT	SPDT	12KV	20KV	200A	5,000A	50,000A	.0005 OHM	25	60	6A	0.8A
EA-25-NC-40	SPNC	25KV	40KV	200A	5,000A	50,000A	.0005 OHM	30	70	10A	0.8A
EA-25-NO-40	SPNO	25KV	40KV	200A	5,000A	50,000A	.0005 OHM	30	70	10A	0.8A
EA-25-DT-40	SPDT	25KV	40KV	200A	5,000A	50,000A	.0005 OHM	40	80	***12A	0.8A
EA-40-NC-60	SPNC	40KV	60KV	200A	5,000A	50,000A	.0005 OHM	40	80	10A	0.8A
EA-40-NO-60	SPNO	40KV	60KV	200A	5,000A	50,000A	.0005 OHM	40	80	10A	0.8A
EA-40-DT-60	SPDT	40KV	60KV	200A	5,000A	50,000A	.0005 OHM	50	100	***12A	0.8A

\*SILVER ALLOY CONTACTS ARE OPTIONAL FOR MAXIMUM CONTINUOUS CLOSED CURRENT RATINGS. TUNGSTEN ALLOY CONTACTS ARE OPTIONAL FOR HIGH CURRENT CAPACITOR DISCHARGE CLOSING CURRENTS. \*\*DC, 400HZ, AND OTHER VOLTAGES AVAILABLE. COIL CURRENT IS APPROXIMATELY INVERSELY PROPORTIONAL TO VOLTAGE, I.E. 230V AC IS HALF OF THAT AT 115V. AUXILIARY CONTACTS AVAILABLE ON ALL MODELS. ADDITIONAL INSULATION TO GROUND AND RF INSULATION AVAILABLE FOR FREQUENCIES TO 30MHz. \*\*\*RECOMMEND 208V OR 230V AC OPERATION FOR PULL-IN CURRENTS GREATER THAN 10 AMPS UNLESS A LOW IMPEDANCE SOURCE CAN MAINTAIN AT LEAST 94% RATED VOLTAGE DURING PULL-IN.

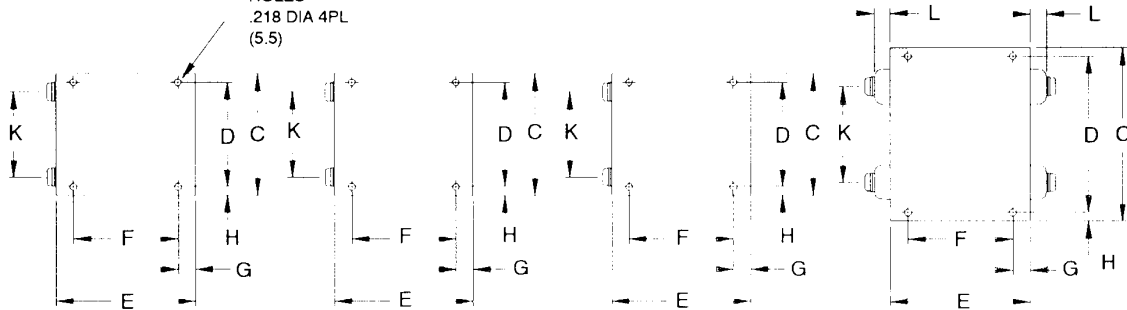


HV TERM  
1/4-28 UNF  
PHMS X .50  
(12.7)

OPTIONAL  
AUX SWITCH &  
ACTUATOR  
TERM  
5-40 SCREWS



MOUNTING  
HOLES  
.218 DIA 4PL  
(5.5)



**NC**

**NO**

**DT**

**\*DT**

IN INCHES (IN MILLIMETERS)											
DIMENSIONS											
RELAY MODEL	A	MAX B HEIGHT	MAX C WIDTH	D	BASE E DEPTH	F	G	H	J	K	L
EA-12-NC	6.30 (160.0)	6.80 (172.7)	3.50 (88.9)	3.000 (76.2)	4.00 (101.6)	3.000 (76.2)	.50 (12.7)	.25 (6.3)		2.00 (50.8)	
EA-12-NO	6.30 (160.0)	8.27 (210.0)	3.50 (88.9)	3.000 (76.2)	4.00 (101.6)	3.000 (76.2)	.50 (12.7)	.25 (6.3)		2.00 (50.8)	
EA-12-DT	6.30 (160.0)	9.05 (229.8)	3.50 (88.9)	3.000 (76.2)	4.00 (101.6)	3.000 (76.2)	.50 (12.7)	.25 (6.3)	8.55 (217.1)	2.00 (50.8)	
EA-25-NC-40	7.30 (185.4)	7.80 (198.1)	5.00 (127.0)	4.500 (114.3)	4.00 (101.6)	3.000 (76.2)	.50 (12.7)	.25 (6.3)		2.75 (69.8)	
EA-25-NO-40	7.30 (185.4)	9.87 (250.6)	5.00 (127.0)	4.500 (114.3)	4.00 (101.6)	3.000 (76.2)	.50 (12.7)	.25 (6.3)		2.75 (69.8)	
*EA-25-DT-40	7.18 (182.3)	10.24 (260.0)	5.00 (127.0)	4.500 (114.3)	4.00 (101.6)	3.000 (76.2)	.50 (12.7)	.25 (6.3)	9.74 (247.3)	2.75 (69.8)	.88 MAX (22.3)
EA-40-NC-60	9.30 (236.2)	9.80 (248.9)	5.00 (127.0)	4.500 (114.3)	4.00 (101.6)	3.000 (76.2)	.50 (12.7)	.25 (6.3)		2.75 (69.8)	
EA-40-NO-60	9.30 (236.2)	11.69 (296.9)	5.00 (127.0)	4.500 (114.3)	4.00 (101.6)	3.000 (76.2)	.50 (12.7)	.25 (6.3)		2.75 (69.8)	
*EA-40-DT-60	7.88 (200.1)	11.44 (290.5)	5.00 (127.0)	4.500 (114.3)	4.50 (114.3)	4.000 (101.6)	.25 (6.3)	.25 (6.3)	10.94 (277.8)	2.75 (69.8)	.51 MAX (12.9)

Dimensions are for reference only  
and are subject to change.  
Contact: Ross Engineering Corporation  
for specific application data.

**ROSS** ENGINEERING CORP.

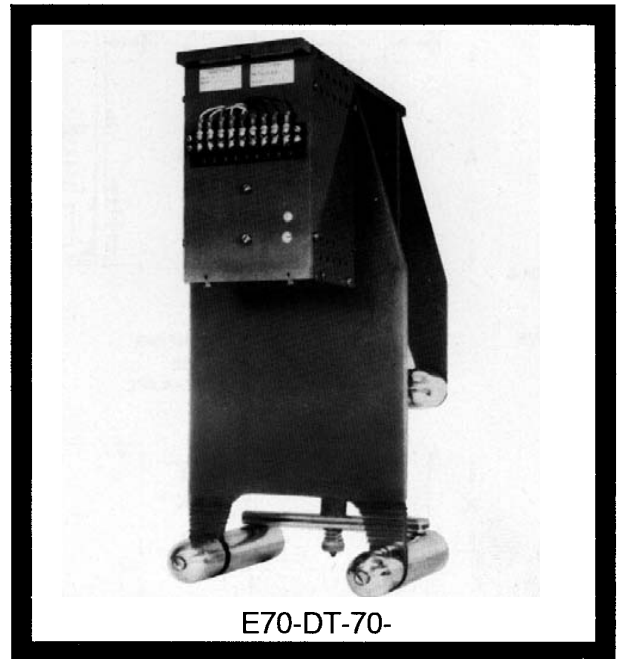
CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182

# E SERIES

# 70KV - 300KV

## GRAVITY RETURN, MOUNT BASE UP.

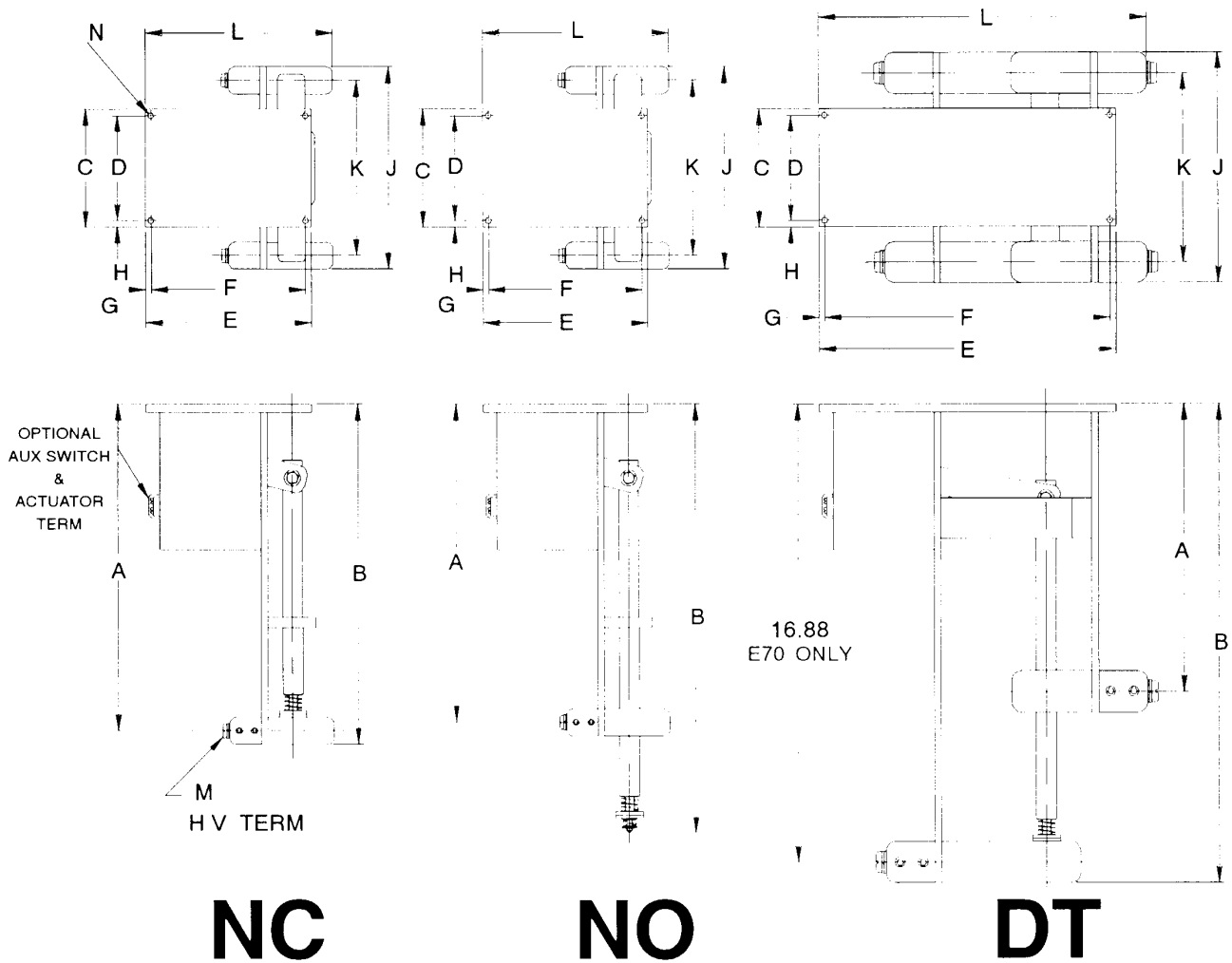
For high voltage transfer, safety grounding, tap selection, or capacitor discharge at 70KV to 300KV peak test in air. Ratings are more than doubled when used in oil or insulating gas. Auxiliary contacts are optional to a maximum of eight SPDT, 15A, 480V AC, or 1/2A, 125V DC. Other auxiliary contact ratings are available.



E70-DT-70-

SPECIFICATIONS							760MMHg 20°C Ambient				
RELAY MODEL	CONTACT FORM	1 MINUTE PEAK TEST RATING DC OR AC PK		*CURRENT RATINGS NEW & DUST FREE			MAX CONTACT RESISTANCE NEW & CLEAN	OPERATE TIME	RELEASE TIME	**STANDARD 115V, 60Hz COIL	
		H V CON-TACTS	INSULATION TO GROUND	CONTINUOUS AMPS RMS	MOMENTARY 10 CYCLE AMPS RMS	MOMENTARY CAPACITOR DIS-CHARGE, 20 μSEC	MAX MILLI-SEC	MAX MILLI-SEC	MAX RMS INRUSH CURRENT	MAX RMS HOLD CURRENT	
E-70-NC	SPNC	70KV	70KV	100A	1,000A	5,000A	.001 OHM	80	120	10A	0.8A
E-70-NO	SPNO	70KV	70KV	100A	1,000A	5,000A	.001 OHM	80	120	10A	0.8A
E-70-DT	SPDT	70KV	70KV	100A	1,000A	5,000A	.001 OHM	100	140	***12A	0.8A
E-100-NC	SPNC	100KV	100KV	150A	1,500A	7,500A	.0007 OHM	100	150	***15A	1.4A
E-100-NO	SPNO	100KV	100KV	150A	1,500A	7,500A	.0007 OHM	100	150	***15A	1.4A
E-120-NC	SPNC	120KV	120KV	200A	2,000A	10,000A	.0005 OHM	100	180	***35A	2A
E-120-NO	SPNO	120KV	120KV	200A	2,000A	10,000A	.0005 OHM	100	180	***35A	2A
E-150-NC	SPNC	150KV	150KV	200A	2,000A	10,000A	.0005 OHM	100	200	***40A	2A
E-150-NO	SPNO	150KV	150KV	200A	2,200A	10,000A	.0005 OHM	100	200	***40A	2A
E-200-NCM	SPNC	200KV	200KV	200A	2,000A	10,000A	.0005 OHM	14sec	2sec	***20A	2A
E-200-NOM	SPNO	200KV	200KV	200A	2,000A	10,000A	.0005 OHM	14sec	2sec	***20A	2A
E-300-NCAir	SPNC	300KV	300KV	200A	2,000A	10,000A	.0005 OHM	2sec	2sec	80-120PSIG AIR	
E-300-NOAir	SPNO	300KV	300KV	200A	2,000A	10,000A	.0005 OHM	2sec	2sec	80-120PSIG AIR	
****E-300-NCM	SPNC	300KV	300KV	200A	2,000A	10,000A	.0005 OHM	18sec	3sec	***20A	2A
****E-300-NOM	SPNO	300KV	300KV	200A	2,000A	10,000A	.0005 OHM	18sec	3sec	***20A	2A

\*SILVER ALLOY CONTACTS ARE OPTIONAL FOR MAXIMUM CONTINUOUS CLOSED CURRENT RATINGS. TUNGSTEN ALLOY CONTACTS ARE OPTIONAL FOR HIGH CURRENT CAPACITOR DISCHARGE CLOSING CURRENTS. \*\*DC, 400HZ, AND OTHER VOLTAGES AVAILABLE. COIL CURRENT IS APPROXIMATELY INVERSELY PROPORTIONAL TO VOLTAGE, I.E. 230V AC IS HALF OF THAT AT 115V. AUXILIARY CONTACTS AVAILABLE ON ALL MODELS. ADDITIONAL INSULATION TO GROUND AND RF INSULATION AVAILABLE FOR FREQUENCIES TO 30MHz. \*\*\*RECOMMEND 208V OR 230V AC OPERATION FOR PULL-IN CURRENTS GREATER THAN 10 AMPS UNLESS A LOW IMPEDANCE SOURCE CAN MAINTAIN AT LEAST 94% RATED VOLTAGE DURING PULL-IN. \*\*\*\*MOTOR ACTUATED UNITS.



**NC**

**NO**

**DT**

RELAY MODEL	IN INCHES (IN MILLIMETERS)		DIMENSIONS										
	A	MAX HEIGHT B	BASE WIDTH C	D	BASE DEPTH E	F	G	H	J	K	L	M	N
E-70-NC	11.75 (298.4)	12.25 (311.1)	4.38 (111.2)	3.875 (98.4)	6.25 (158.7)	5.750 (146.0)	25 (6.3)	.25 (6.3)	7.50 (190.5)	6.50 (165.1)	6.75 (171.4)	1/4-28-UNF PHMS X .50 (12.7)	.203 Dia (5.1)
E-70-NO	11.75 (298.4)	15.27 (387.8)	4.38 (111.2)	3.875 (98.4)	6.25 (158.7)	5.750 (146.0)	25 (6.3)	.25 (6.3)		6.50 (165.1)	6.75 (171.4)	"	"
E-70-DT	10.88 (276.3)	17.63 (447.8)	4.38 (111.2)	3.625 (92.0)	10.72 (272.2)	9.968 (253.1)	38 (9.6)	.38 (9.6)		6.50 (165.1)	10.72 (272.2)	"	.281 Dia (7.1)
E-100-NC	14.81 (376.1)	15.56 (395.2)	6.75 (171.4)	6.000 (152.4)	7.50 (190.5)	6.759 (171.6)	38 (9.6)	.38 (9.6)	10.25 (260.3)	8.75 (222.2)	7.50 (190.5)	3/8-24-UNF HHMS X .75 (19.0)	.265 Dia (6.7)
E-100-NO	14.81 (376.1)	19.38 (492.2)	6.75 (171.4)	6.000 (152.4)	7.50 (190.5)	6.750 (171.4)	38 (9.6)	.38 (9.6)		8.75 (222.2)	7.50 (190.5)	"	"
E-120-NC	19.75 (501.6)	20.75 (527.0)	8.00 (203.2)	7.000 (177.8)	12.62 (320.5)	11.625 (295.2)	50 (12.7)	.50 (12.7)	13.95 (354.3)	10.00 (254.0)	13.25 (336.5)	3/8-16-UNC HHMS X .75 (19.0)	.281 Dia (7.1)
E-120-NO	19.75 (501.6)	25.88 (657.3)	8.00 (203.2)	7.000 (177.8)	12.62 (320.5)	11.625 (295.2)	50 (12.7)	.50 (12.7)		10.00 (254.0)	13.25 (336.5)	"	"
E-150-NC	22.75 (577.8)	24.25 (615.9)	8.00 (203.2)	7.000 (177.8)	12.62 (320.5)	11.625 (295.2)	50 (12.7)	.50 (12.7)	15.88 (403.3)	12.88 (327.1)	14.00 (355.6)	5/8-11-UNC HHMS X 1.25 (31.7)	"
E-150-NO	22.75 (577.8)	30.73 (780.5)	8.00 (203.2)	7.000 (177.8)	12.62 (320.5)	11.625 (295.2)	50 (12.7)	.50 (12.7)		12.88 (327.1)	14.00 (355.6)	"	"
E-200-NCM	35.25 (895.3)	38.25 (971.5)	22.00 (558.8)	10.500X2 (266.7)	17.50 (444.5)	16.500 (419.1)	50 (12.7)	.50 (12.7)	26.00 (660.4)	20.00 (508.0)	19.09 (484.8)	"	.406 Dia (10.3)
E-200-NOM	35.25 (895.3)	50.25 (1,276.3)	22.00 (558.8)	10.500X2 (266.7)	17.50 (444.5)	16.500 (419.1)	50 (12.7)	.50 (12.7)	26.00 (660.4)	20.00 (508.0)	19.09 (484.8)	"	"
E-300-NCAIR	35.11 (891.7)	39.04 (991.6)	12.77 (324.3)	11.000 (279.4)	17.50 (444.5)	12.000 (304.8)	2.69 (68.3)	.88 (22.3)	36.00 (914.4)	28.00 (711.2)	25.56 (649.2)	"	"
E-300-NOAIR	35.11 (891.7)	51.04 (1,296.4)	12.77 (324.3)	11.000 (279.4)	17.50 (444.5)	12.000 (304.8)	2.69 (68.3)	.88 (22.3)	36.00 (914.4)	28.00 (711.2)	25.56 (649.2)	"	"
E-300-NCM	46.88 (1,190.7)	48.88 (1,241.5)	28.00 (711.2)	13.500X2 (342.9)	21.50 (546.1)	20.500 (520.7)	50 (12.7)	.50 (12.7)	36.00 (914.4)	28.00 (711.2)	24.00 (609.6)	"	"
E-300-NOM	46.88 (1,190.7)	67.88 (1,724.1)	28.00 (711.2)	13.500X2 (342.9)	21.50 (546.1)	20.500 (520.7)	50 (12.7)	.50 (12.7)	36.00 (914.4)	28.00 (711.2)	24.00 (609.6)	"	"

Dimensions are for reference only and are subject to change.  
Contact: Ross Engineering Corporation for specific application data.

**ROSS ENGINEERING CORP.**

CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182

# ED SERIES

# 70KV - 300KV

**GRAVITY RETURN,  
MOUNT BASE DOWN.**

For high voltage transfer, safety grounding, tap selection, capacitor discharge at 70KV to 300KV peak test in air. Ratings are more than doubled when used in oil or insulating gas. Auxiliary contacts are optional to a maximum of eight SPDT 15A, 480V AC, and 1/2A, 125V DC. Other auxiliary contact ratings are available.



ED70-NC-70-

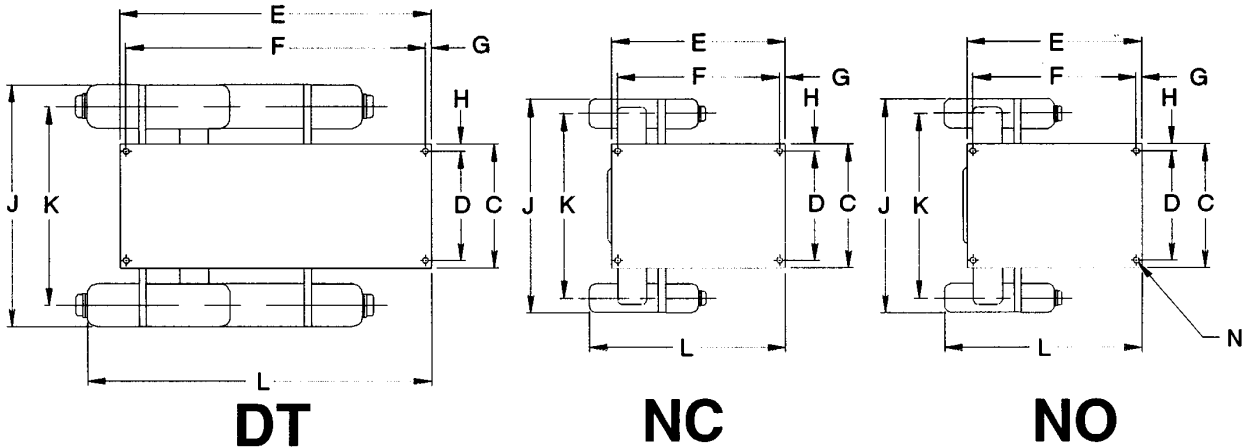
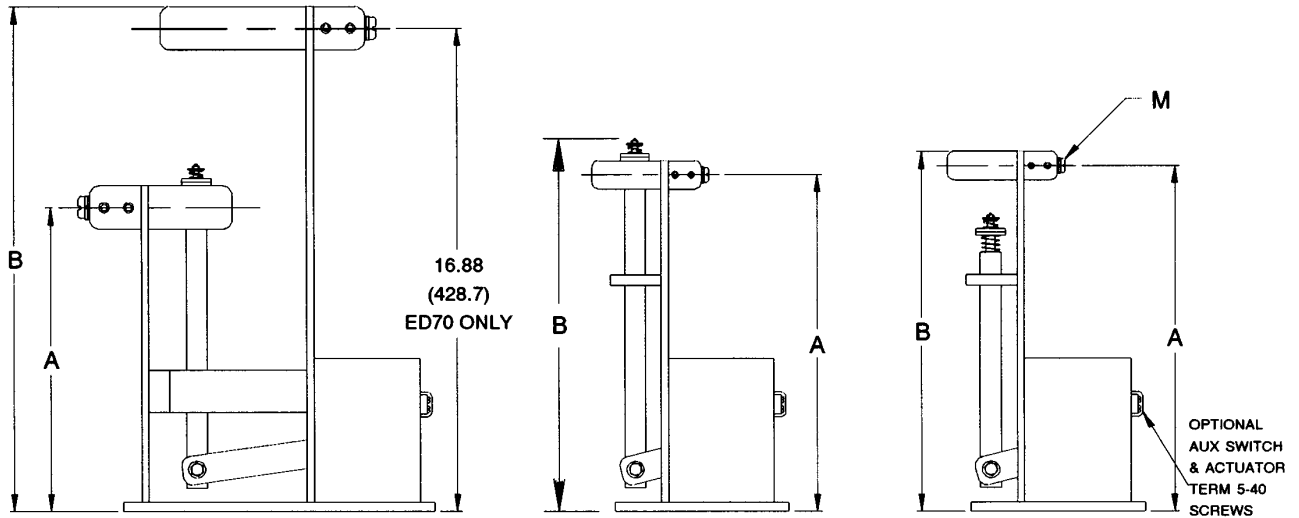
SPECIFICATIONS											760MMHg 20°C Ambient	
		1 MINUTE PEAK TEST RATING DC OR AC PK		*CURRENT RATINGS NEW & DUST FREE			MAX CONTACT RESISTANCE NEW & CLEAN	OPERATE TIME	RELEASE TIME	**STANDARD 115V, 60Hz COIL		
RELAY MODEL	CONTACT FORM	H V CONTACTS	INSULATION TO GROUND	CONTINUOUS AMPS RMS	MOMENTARY 10 CYCLE AMPS RMS	MOMENTARY CAPACITOR DISCHARGE, 20 USEC		MAX MILLI-SEC	MAX MILLI-SEC	MAX RMS INRUSH CURRENT	MAX RMS HOLD CURRENT	
ED-70-NC	SPNC	70KV	70KV	100A	1,000A	5,000A	.001 OHM	80	120	10A	0.8A	
ED-70-NO	SPNO	70KV	70KV	100A	1,000A	5,000A	.001 OHM	80	120	10A	0.8A	
ED-70-DT	SPDT	70KV	70KV	100A	1,000A	5,000A	.001 OHM	100	140	***12A	0.8A	
ED-100-NC	SPNC	100KV	100KV	150A	1,500A	7,500A	.0007 OHM	100	150	***15A	1.4A	
ED-100-NO	SPNO	100KV	100KV	150A	1,500A	7,500A	.0007 OHM	100	150	***15A	1.4A	
ED-120-NC	SPNC	120KV	120KV	200A	2,000A	10,000A	.0005 OHM	120	180	***35A	2A	
ED-120-NO	SPNO	120KV	120KV	200A	2,000A	10,000A	.0005 OHM	120	180	***35A	2A	
ED-150-NC	SPNC	150KV	150KV	200A	2,000A	10,000A	.0005 OHM	140	200	***40A	2A	
ED-150-NO	SPNO	150KV	150KV	200A	2,000A	10,000A	.0005 OHM	140	200	***40A	2A	
ED-200-NC	SPNC	200KV	200KV	200A	2,000A	10,000A	.0005 OHM	14sec	2sec	***20A	2A	
ED 200-NO	SPNO	200KV	200KV	200A	2,000A	10,000A	.0005 OHM	14sec	2sec	***20A	2A	
ED-300-NCair	SPNC	300KV	300KV	200A	2,000A	10,000A	.0005 OHM	2sec	2sec	80-120PSIG Air		
ED-300-NOair	SPNO	300KV	300KV	200A	2,000A	10,000A	.0005 OHM	2sec	2sec	80-120PSIG Air		
****ED-300-NCM	SPNC	300KV	300KV	200A	2,000A	10,000A	.0005 OHM	18sec	3sec	***20A	2A	
****ED-300-NOM	SPNO	300KV	300KV	200A	2,000A	10,000A	.0005 OHM	18sec	3sec	***20A	2A	

\*SILVER ALLOY CONTACTS ARE OPTIONAL FOR MAXIMUM CONTINUOUS CLOSED CURRENT RATINGS. TUNGSTEN ALLOY CONTACTS ARE OPTIONAL FOR HIGH CURRENT CAPACITOR DISCHARGE CLOSING CURRENTS. \*\*DC, 400HZ, AND OTHER VOLTAGES AVAILABLE. COIL CURRENT IS APPROXIMATELY INVERSELY PROPORTIONAL TO VOLTAGE, I.E. 230V AC IS HALF OF THAT AT 115V. AUXILIARY CONTACTS AVAILABLE ON ALL MODELS. ADDITIONAL INSULATION TO GROUND AND RF INSULATION AVAILABLE FOR FREQUENCIES TO 30MHZ. \*\*\*RECOMMEND 208V OR 230V AC OPERATION FOR PULL-IN CURRENTS GREATER THAN 10 AMPS UNLESS A LOW IMPEDANCE SOURCE CAN MAINTAIN AT LEAST 94% RATED VOLTAGE DURING PULL-IN. \*\*\*\*MOTOR ACTUATED UNITS.

**ROSS ENGINEERING CORP.**

CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182





IN INCHES (IN MILLIMETERS)		DIMENSIONS											
RELAY MODEL	A	MAX B HEIGHT	C	D	E	F	G	H	MAX J WIDTH	K	MAX L DEPTH	M	N
ED-70-NC	11.75 (298.4)	15.30 (388.6)	4.38 (111.2)	3.875 (98.4)	6.25 (158.7)	5.750 (146.0)	.25 (6.3)	.25 (6.3)	7.50 (190.5)	6.50 (165.1)	6.75 (171.4)	1/4-28-UNF PHMS X .50 (12.7)	.203 DIA (5.1)
ED-70-NO	11.75 (298.4)	12.25 (311.1)	4.38 (111.2)	3.875 (98.4)	6.25 (158.7)	5.750 (146.0)	.25 (6.3)	.25 (6.3)		6.50 (165.1)	6.75 (171.4)	"	"
ED-70-DT	10.88 (276.3)	17.63 (447.8)	4.38 (111.2)	3.625 (92.0)	10.72 (272.2)	9.968 (253.1)	.38 (9.6)	.38 (9.6)		6.50 (165.1)	10.72 (272.2)	"	.281 DIA (7.1)
ED-100-NC	14.81 (376.1)	19.50 (495.3)	6.75 (171.4)	6.000 (152.4)	7.50 (190.5)	6.750 (171.4)	.38 (9.6)	.38 (9.6)	10.25 (260.3)	8.75 (222.2)	7.50 (190.5)	3/8-24-UNF HHMS X .75 (19.0)	.265 DIA (6.7)
ED-100-NO	14.81 (376.1)	15.56 (395.2)	6.75 (171.4)	6.000 (152.4)	7.50 (190.5)	6.750 (171.4)	.38 (9.6)	.38 (9.6)		8.75 (222.2)	7.50 (190.5)	"	"
ED-120-NC	19.75 (501.6)	26.32 (668.5)	8.00 (203.2)	7.000 (177.8)	12.62 (320.5)	11.625 (295.2)	.50 (12.7)	.50 (12.7)	13.95 (354.3)	10.00 (254.0)	13.25 (336.5)	"	.281 DIA (7.1)
ED-120-NO	19.75 (501.6)	20.75 (527.0)	8.00 (203.2)	7.000 (177.8)	12.62 (320.5)	11.625 (295.2)	.50 (12.7)	.50 (12.7)		10.00 (254.0)	13.25 (336.5)	"	"
ED-150-NC	22.75 (577.8)	29.50 (749.3)	8.00 (203.2)	7.000 (177.8)	12.62 (320.5)	11.625 (295.2)	.50 (12.7)	.50 (12.7)	15.88 (403.3)	12.88 (327.1)	14.00 (355.6)	"	"
ED-150-NO	22.75 (577.8)	24.25 (615.9)	8.00 (203.2)	7.000 (177.8)	12.62 (320.5)	11.625 (295.2)	.50 (12.7)	.50 (12.7)		12.88 (327.1)	14.00 (355.6)	"	.406 DIA (10.3)
ED-200-NCM	35.25 (895.3)	50.25 (1,276.3)	22.00 (558.8)	10.500x2 (266.7)	17.50 (444.5)	16.500 (419.1)	.50 (12.7)	.50 (12.7)	26.00 (660.4)	20.00 (508.0)	19.09 (484.8)	"	"
ED-200-NOM	35.25 (895.3)	38.25 (971.5)	22.00 (558.8)	10.500x2 (266.7)	17.50 (444.5)	16.500 (419.1)	.50 (12.7)	.50 (12.7)	26.00 (660.4)	20.00 (508.0)	19.09 (484.8)	"	"
ED-300-NC AIR	35.11 (891.7)	67.88 (1,724.1)	12.77 (324.3)	11.000 (279.4)	17.38 (441.4)	12.000 (304.8)	2.69 (68.3)	.88 (22.3)	36.00 (914.4)	28.00 (711.2)	25.56 (649.2)	"	"
ED-300-NO AIR	35.11 (891.7)	39.04 (991.6)	12.77 (324.3)	11.000 (279.4)	17.38 (441.4)	12.000 (304.8)	2.69 (68.3)	.88 (22.3)	36.00 (914.4)	28.00 (711.2)	25.56 (649.2)	"	"
ED-300-NCM	46.88 (1,190.7)	67.88 (1,724.1)	28.00 (711.2)	13.500x2 (342.9)	21.50 (546.1)	20.500 (520.7)	.50 (12.7)	.50 (12.7)	36.00 (914.4)	28.00 (711.2)	24.00 (609.6)	"	"
ED-300-NOM	46.88 (1,190.7)	48.88 (1,241.5)	28.00 (711.2)	13.500x2 (342.9)	21.50 (546.1)	20.500 (520.7)	.50 (12.7)	.50 (12.7)	36.00 (914.4)	28.00 (711.2)	24.00 (609.6)	"	"

Dimensions are for reference only and are subject to change. Contact: Ross Engineering Corporation for specific application data.

**ROSS ENGINEERING CORP.**  
CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182

# EE & ES SERIES

# 12KV - 25KV

This series is useful from 1KV to 25KV peak test in air, 1 amp to 25 amps continuous current capacity. Applications include transfer, safety grounding, shorting, and tap selection. All high voltage contacts have full insulation above ground. HV insulation is generally G-10 epoxy glass or equivalent.

Moving contacts make with extra closing force to insure continuing low contact resistance and high momentary current capabilities. Special silver contacts can be provided for maximum continuous current rating. Available with auxiliary SPDT 11A, 250V AC contacts for holding, indication, or interlocking. Other auxiliary contact ratings are available. Standard actuator is 115V, 60Hz on most models, 24V DC standard on some models. 230V, 60Hz, 115V, 400Hz, and others are also available.

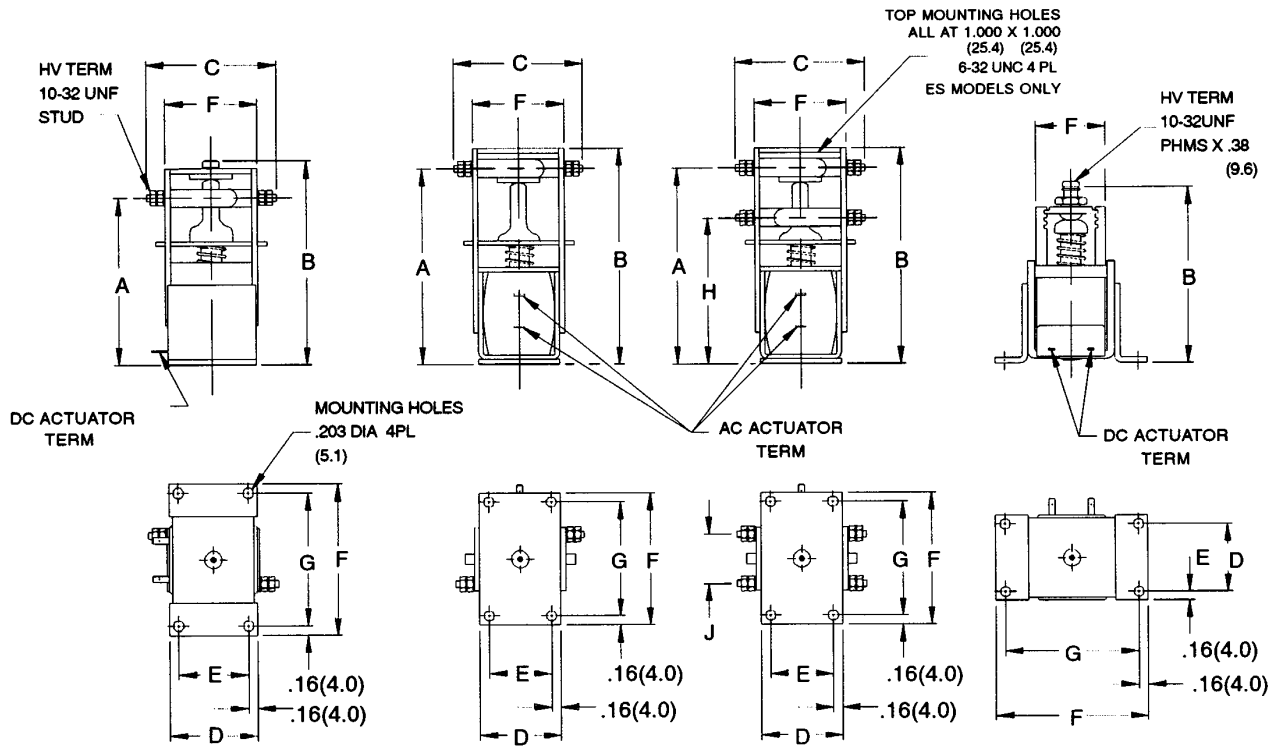
**SEE OTHER PAGES OR BROCHURES FOR MULTI-POLE RELAYS.**



ES25-DT-25-

SPECIFICATIONS							760MMHg 20°C Ambient				
RELAY MODEL	CONTACT FORM	1 MINUTE PEAK TEST RATING DC OR AC PK		*CURRENT RATINGS NEW & DUST FREE			MAX CONTACT RESISTANCE NEW & CLEAN	OPERATE TIME	RELEASE TIME	**STANDARD 115V,60Hz COIL	
		H V CONTACTS	INSULATION TO GROUND	CONTINUOUS AMPS RMS	MOMENTARY 10 CYCLE AMPS RMS	MOMENTARY CAPACITOR DISCHARGE, 20 USEC		MAX MILLI-SEC	MAX MILLI-SEC	MAX RMS INRUSH CURRENT	MAX RMS HOLD CURRENT
EE-12-NC	SPNC	12KV	None	10A	50A	200A	.05 OHM	20	40	0.4A	0.1A
EE-12-NC24DC	SPNC	12KV	None	10A	50A	200A	.005 OHM	40	20	0.45A	0.45A
ES-12-NC	SPNC	12KV	12KV	35A	300A	500A	.005 OHM	20	40	0.8A	0.2A
ES-12-NC24DC	SPNC	12KV	12KV	35A	300A	500A	.005 OHM	50	40	0.45A	0.45A
***ES-12-NC-FF24DC	SPNC	12KV	12KV	35A	300A	500A	.005 OHM	25	25	0.45A	0.45A
ES-12-N0	SPNO	12KV	12KV	35A	300A	500A	.005 OHM	40	20	0.8A	0.2A
ES-12-N024DC	SPNO	12KV	12KV	35A	300A	500A	.005 OHM	50	20	0.45A	0.45A
***ES-12-N0-FF24DC	SPNO	12KV	12KV	35A	300A	500A	.005 OHM	25	20	0.45A	0.45A
ES-12-DT	DT	12KV	12KV	35A	300A	500A	.005 OHM	25	50	0.8A	0.2A
ES-12-DT24DC	DT	12KV	12KV	35A	300A	500A	.005 OHM	50	20	0.45A	0.45A
***ES-12-DT-FF24DC	DT	12KV	12KV	35A	300A	500A	.005 OHM	25	20	0.45A	0.45A
ES-25-NC	SPNC	25KV	25KV	25A	300A	500A	.005 OHM	30	60	0.8A	0.2A
ES-25-NC24DC	SPNC	25KV	25KV	25A	300A	500A	.005 OHM	60	60	1.6A	0.15A
ES-25-N0	SPNO	25KV	25KV	25A	300A	500A	.005 OHM	30	40	0.8A	0-2A
ES-25-N024DC	SPNO	25KV	25KV	25A	300A	500A	.005 OHM	60	40	1.6A	0.15A
ES-25-DT	DT	25KV	25KV	25A	300A	500A	.008 OHM	50	120	1.0A	0.2A
ES-25-DT24DC	DT	25KV	25KV	25A	300A	500A	.008 OHM	60	120	1.6A	0.15A

\*SILVER ALLOY CONTACTS ARE OPTIONAL FOR MAXIMUM CONTINUOUS CLOSED CURRENT RATINGS. TUNGSTEN ALLOY CONTACTS ARE OPTIONAL FOR HIGH CURRENT CAPACITOR DISCHARGE CLOSING CURRENTS. \*\*DC, 400HZ, AND OTHER VOLTAGES AVAILABLE. COIL CURRENT IS APPROXIMATELY INVERSELY PROPORTIONAL TO VOLTAGE, I.E. 230V AC IS HALF OF THAT AT 115V. AUXILIARY CONTACTS AVAILABLE ON ALL MODELS. ADDITIONAL INSULATION TO GROUND AND RF INSULATION AVAILABLE FOR FREQUENCIES TO 30MHz. RECOMMEND 208V OR 230V AC OPERATION FOR PULL-IN CURRENTS GREATER THAN 10 AMPS UNLESS A LOW IMPEDANCE SOURCE CAN MAINTAIN AT LEAST 94% RATED VOLTAGE DURING PULL-IN. \*\*\*FASTER DC OPERATE OR RELEASE TIME.



**ES-NO (DC)    ES-NC (AC)    ES-DT (AC)    EE-NC (DC)**

IN INCHES (IN MILLIMETERS)		DIMENSIONS						
MODEL RELAY	A	MAX B HEIGHT	MAX C WIDTH	MAX D DEPTH	E	F	G	H
EE-12-NC		2.38 (60.4)		1.19 (30.2)	.875 (22.2)	2.06 (52.3)	1.75 (44.4)	
EE-12-NC 24DC		2.76 (70.1)		1.50 (38.1)	1.187 (30.1)	2.63 (66.8)	2.31 (58.6)	
ES-12-NC	3.35 (85.0)	3.76 (95.5)	2.78 (70.6)	1.50 (38.1)	1.187 (30.1)	2.31 (58.6)	2.000 (50.8)	
ES-12-NC 24DC	3.38 (85.8)	3.80 (96.5)	2.78 (70.6)	1.50 (38.1)	1.187 (30.1)	2.63 (66.8)	2.31 (58.6)	
ES-12-NO	2.81 (71.3)	3.95 (100.3)	2.78 (70.6)	1.50 (38.1)	1.187 (30.1)	2.31 (58.6)	2.000 (50.8)	
ES-12-NO 24DC	2.82 (71.6)	3.91 (99.3)	2.78 (70.6)	1.50 (38.1)	1.187 (30.1)	2.63 (66.8)	2.31 (58.6)	
ES-12-DT	3.56 (90.4)	3.96 (100.5)	2.78 (70.6)	1.50 (38.1)	1.187 (30.1)	2.31 (58.6)	2.000 (50.8)	2.81 (71.3)
ES-12-DT 24DC	3.57 (90.6)	4.00 (101.6)	2.28 (57.9)	1.50 (38.1)	1.187 (30.1)	2.63 (66.8)	2.31 (58.6)	2.82 (71.6)
ES-25-NC	4.27 (108.4)	4.80 (121.9)	2.83 (71.8)	1.50 (38.1)	1.187 (30.1)	2.31 (58.6)	2.000 (50.8)	
ES-25-NC 24DC	4.75 (120.6)	5.25 (133.3)	2.83 (71.8)	1.50 (38.1)	1.187 (30.1)	2.63 (66.8)	2.31 (58.6)	
ES-25-NO	4.59 (116.5)	4.97 (126.2)	2.78 (70.6)	1.50 (38.1)	1.187 (30.1)	2.31 (58.6)	2.000 (50.8)	
ES-25-NO 24DC	4.39 (111.5)	5.65 (143.5)	2.83 (71.8)	1.50 (38.1)	1.187 (30.1)	2.63 (66.8)	2.31 (58.6)	
ES-25-DT	4.88 (123.9)	5.43 (137.9)	2.78 (70.6)	1.50 (38.1)	1.187 (30.1)	2.31 (58.6)	2.000 (50.8)	3.60 (91.4)
ES-25-DT 24DC	5.78 (146.8)	6.30 (160.0)	2.79 (70.8)	1.50 (38.1)	1.187 (30.1)	2.63 (66.8)	2.31 (58.6)	4.49 (114.0)

Dimensions are for reference only and are subject to change. Contact: Ross Engineering Corporation for specific application data.

**ROSS ENGINEERING CORP.**  
 CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182

# ET SERIES MULTIPOLE

## 14KV - 25KV

ET series is a continuation of the rugged single pole E and ES series for 14KV TO 25KV peak test in air, with the addition of up to 6 poles (or more on special order). This compact series is open style, with high momentary current capabilities. Air insulated; no interrupting ratings are assigned, however continuous currents range to 35 amps. Available with one, two or more sets of SPDT 11A, 250V AC optional auxiliary contacts. Other auxiliary contact ratings are available.

Multipole ET series relays are useful for high voltage polarity reversing, multiple-load grouping, or safety grounding. These are used in applications where it is desirable that all contacts be controlled from a single actuator.

**FOR 3 AND 6 POLE ET RELAYS SEE PAGE 18.**

**SEE ADDITIONAL ROSS RELAY BROCHURES FOR OTHER TYPES OF MULTIPOLE RELAYS.**

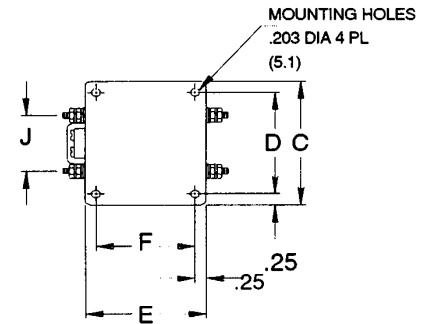
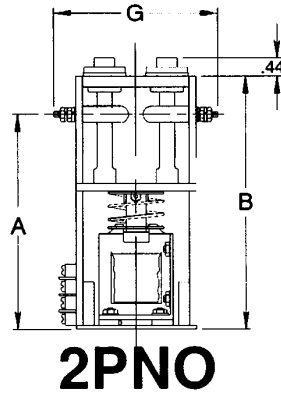
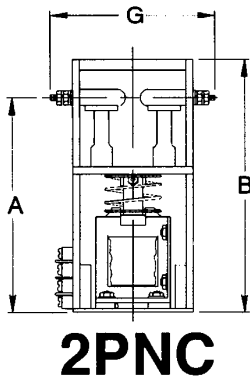
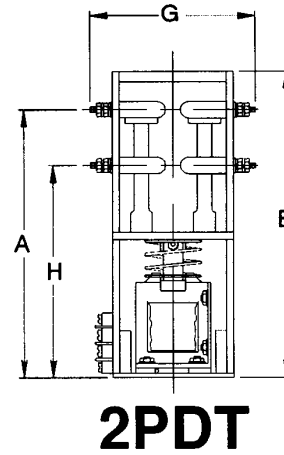
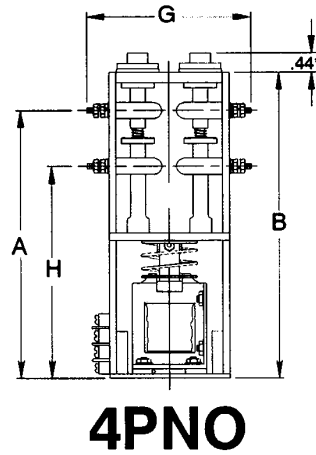
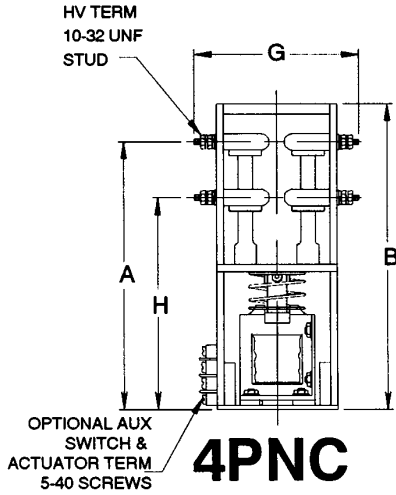


ET2-14-2PDT-14-

SPECIFICATIONS 760MMHg 20°C Ambient											
		1 MINUTE PEAK TEST RATING DC OR AC PK		*CURRENT RATINGS NEW & DUST FREE			MAX CONTACT RESISTANCE NEW & CLEAN	OPERATE TIME	RELEASE TIME	**STANDARD 115V, 60Hz COIL	
RELAY MODEL	CONTACT FORM	H V CONTACTS	INSULATION TO GROUND	CONTINUOUS AMPS RMS	MOMENTARY 10 CYCLE AMPS RMS	MOMENTARY CAPACITOR DISCHARGE, 20 USEC		MAX MILLI-SEC	MAX MILLI-SEC	MAX RMS INRUSH CURRENT	MAX RMS HOLD CURRENT
ET2-14-2PNC	2PNC	14KV	14KV	35A	400A	500A	.003 OHM	20	40	4.0A	0.5A
ET2-14-2PNO	2PNO	14KV	14KV	35A	400A	500A	.003 OHM	20	40	4.0A	0.5A
ET2-14-2PDT	2PDT	14KV	14KV	35A	400A	500A	.003 OHM	20	40	4.0A	0.5A
ET4-14-4PNC	4PNC	14KV	14KV	35A	400A	500A	.003 OHM	20	40	4.0A	0.5A
ET4-14-4PNO	4PNO	14KV	14KV	35A	400A	500A	.003 OHM	20	40	4.0A	0.5A
ET2-25-2PNC	2PNC	25KV	25KV	35A	400A	500A	.003 OHM	30	80	5.0A	0.5A
ET2-25-2PNO	2PNO	25KV	25KV	35A	400A	500A	.003 OHM	30	80	5.0A	0.5A
ET2-25-2PDT	2PDT	25KV	25KV	35A	400A	500A	.003 OHM	30	80	5.0A	0.5A
ET4-25-4PNC	4PNC	25KV	25KV	35A	400A	500A	.003 OHM	30	80	5.0A	0.5A
ET4-25-4PNO	4PNO	25KV	25KV	25A	200A	400A	.005 OHM	30	80	5.0A	0.5A

\*SILVER ALLOY CONTACTS ARE OPTIONAL FOR MAXIMUM CONTINUOUS CLOSED CURRENT RATINGS. TUNGSTEN ALLOY CONTACTS ARE OPTIONAL FOR HIGH CURRENT CAPACITOR DISCHARGE CLOSING CURRENTS. \*\*DC, 400HZ, AND OTHER VOLTAGES AVAILABLE. COIL CURRENT IS APPROXIMATELY INVERSELY PROPORTIONAL TO VOLTAGE, I.E. 230V AC IS HALF OF THAT AT 115V. AUXILIARY CONTACTS AVAILABLE ON ALL MODELS. ADDITIONAL INSULATION TO GROUND AND RF INSULATION AVAILABLE FOR FREQUENCIES TO 30MHz. RECOMMEND 208V OR 230V AC OPERATION FOR PULL-IN CURRENTS GREATER THAN 10 AMPS UNLESS A LOW IMPEDANCE SOURCE CAN MAINTAIN AT LEAST 94% RATED VOLTAGE DURING PULL-IN.

**ROSS ENGINEERING CORP.**



**BOTTOM VIEW TYPICAL**

IN INCHES (IN MILLIMETERS)		DIMENSIONS							
RELAY MODEL	A	*MAX B HEIGHT	MAX C WIDTH	D	BASE E DEPTH	F	MAX G DEPTH	H	J
ET2-14-2PNC	4.03 (102.3)	4.22 (107.1)	2.88 (73.1)	2.375 (60.3)	2.75 (69.8)	2.250 (57.1)	3.37 (85.5)		1.50 (38.1)
ET2-14-2PNO	4.03 (102.3)	4.22 (107.1)	2.88 (73.1)	2.375 (60.3)	2.75 (69.8)	2.250 (57.1)	3.37 (85.5)		1.50 (38.1)
ET2-14-2PDT	5.03 (127.7)	5.37 (136.3)	2.88 (73.1)	2.375 (60.3)	2.75 (69.8)	2.250 (57.1)	3.37 (85.5)	4.03 (102.3)	1.50 (38.1)
ET4-14-4PNC	5.03 (127.7)	5.37 (136.3)	2.88 (73.1)	2.375 (60.3)	2.75 (69.8)	2.250 (57.1)	3.37 (85.5)	4.90 (124.4)	1.50 (38.1)
ET4-14-4PNO	5.03 (127.7)	6.12 (155.4)	2.88 (73.1)	2.375 (60.3)	2.75 (69.8)	2.250 (57.1)	3.37 (85.5)	4.90 (124.4)	1.50 (38.1)
ET2-25-2PNC	5.43 (137.9)	5.93 (150.6)	2.88 (73.1)	2.375 (60.3)	3.70 (93.9)	3.200 (81.2)	4.82 (122.4)	5.22 (132.5)	1.50 (38.1)
ET2-25-2PNO	4.86 (123.4)	5.93 (150.6)	2.88 (73.1)	2.375 (60.3)	3.70 (93.9)	3.200 (81.2)	4.82 (122.4)	5.22 (132.5)	1.50 (38.1)
ET2-25-2PDT	6.60 (167.6)	7.60 (193.0)	2.88 (73.1)	2.375 (60.3)	3.70 (93.9)	3.200 (81.2)	4.82 (122.4)	5.22 (132.5)	1.50 (38.1)
ET4-25-4PNC	6.60 (167.6)	7.60 (193.0)	2.88 (73.1)	2.375 (60.3)	3.70 (93.9)	3.200 (81.2)	4.82 (122.4)	5.22 (132.5)	1.50 (38.1)
ET4-25-4PNO	6.60 (167.6)	7.60 (193.0)	2.88 (73.1)	2.375 (60.3)	3.70 (93.9)	3.200 (81.2)	4.82 (122.4)		1.50 (38.1)

\* ET2-14 SERIES IS SMALLER AND REPLACES OBSOLETE ET12 SERIES.

Dimensions are for reference only  
and are subject to change.  
Contact: Ross Engineering Corporation  
for application data.

**ROSS ENGINEERING CORP.**  
CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182

# ET SERIES MULTIPOLE

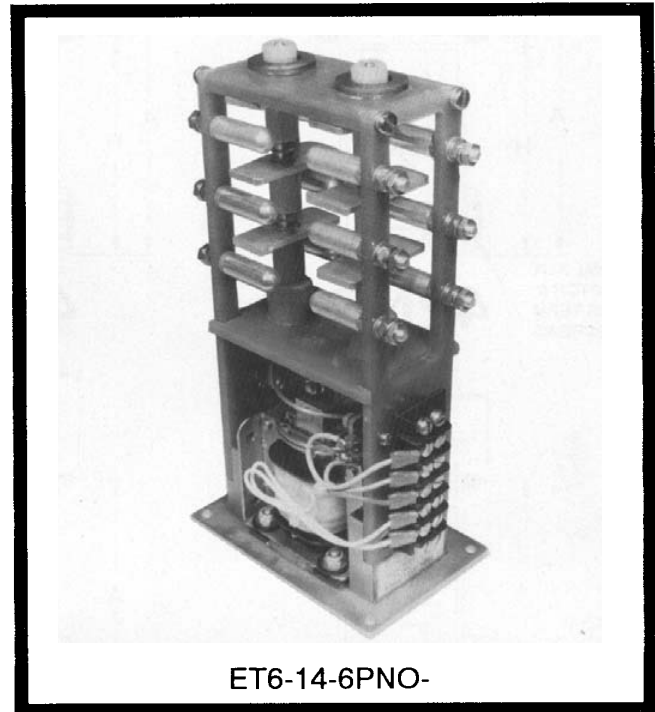
## 14KV - 25KV

ET series is a continuation of the rugged single pole E and ES series for 14KV TO 25KV peak test in air, with the addition of up to 6 poles (or more on special order). This compact series is open style, with high momentary current capabilities. Air insulated; no interrupting ratings are assigned, however continuous currents range to 35 amps. Available with one, two or more sets of SPDT 11A, 250V AC optional auxiliary contacts. Other auxiliary contact ratings are available.

Multipole ET series relays are useful for high voltage polarity reversing, multiple-load grouping, or safety grounding. These are used in applications where it is desirable that all contacts be controlled from a single actuator.

**FOR 2 AND 4 POLE ET RELAYS SEE PAGE 16.**

**SEE ADDITIONAL ROSS RELAY BROCHURES FOR OTHER TYPES OF MULTIPOLE RELAYS.**



ET6-14-6PNO-

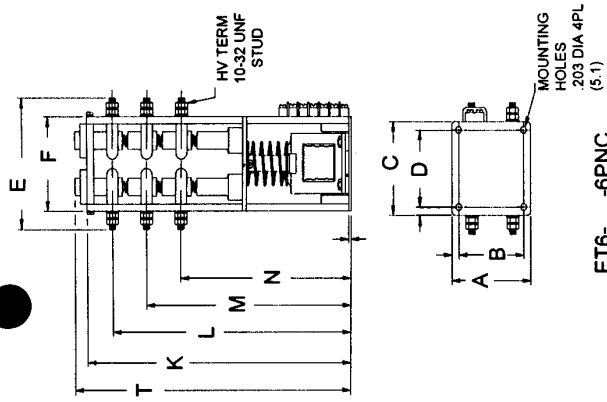
SPECIFICATIONS 760MMHg 20°C Ambient											
		1 MINUTE PEAK TEST RATING DC OR AC PK		*CURRENT RATINGS NEW & DUST FREE			MAX CONTACT RESISTANCE NEW & CLEAN	OPERATE TIME	RELEASE TIME	**STANDARD 115V, 60Hz COIL	
RELAY MODEL	CONTACT FORM	H V CONTACTS	INSULATION TO GROUND	CONTINUOUS AMPS RMS	MOMENTARY 10 CYCLE AMPS RMS	MOMENTARY CAPACITOR DISCHARGE, 20 USEC		MAX MILLI-SEC	MAX MILLI-SEC	MAX RMS INRUSH CURRENT	MAX RMS HOLD CURRENT
ET3-14-3PNC	3PNC	14KV	14KV	35A	400A	500A	.003 OHM	20	40	5A	0.5A
ET3-14-3PNO	3PNO	14KV	14KV	35A	400A	500A	.003 OHM	20	40	5A	0.5A
ET3-14-3PDT	3PDT	14KV	14KV	35A	400A	500A	.003 OHM	20	40	5A	0.5A
ET6-14-6PNC	6PNC	14KV	14KV	35A	400A	500A	.003 OHM	20	40	5A	0.5A
ET6-14-6PNO	6PNO	14KV	14KV	35A	400A	500A	.003 OHM	20	40	5A	0.5A
ET6-14-6PDT	6PDT	14KV	14KV	35A	400A	500A	.003 OHM	20	40	5A	0.5A
ET6-25-6PNC	6PNC	25KV	25KV	35A	400A	500A	.003 OHM	30	80	5A	0.5A
ET6-25-6PNO	6PNO	25KV	25KV	35A	400A	500A	.003 OHM	30	80	5A	0.5A
ET6-25-6PDT	6PDT	25KV	25KV	35A	400A	500A	.003 OHM	30	80	5A	0.5A

\*SILVER ALLOY CONTACTS ARE OPTIONAL FOR MAXIMUM CONTINUOUS CLOSED CURRENT RATINGS. TUNGSTEN ALLOY CONTACTS ARE OPTIONAL FOR HIGH CURRENT CAPACITOR DISCHARGE CLOSING CURRENTS. \*\*DC, 400HZ, AND OTHER VOLTAGES AVAILABLE. COIL CURRENT IS APPROXIMATELY INVERSELY PROPORTIONAL TO VOLTAGE, I.E. 230V AC IS HALF OF THAT AT 115V. AUXILIARY CONTACTS AVAILABLE ON ALL MODELS. ADDITIONAL INSULATION TO GROUND AND RF INSULATION AVAILABLE FOR FREQUENCIES TO 30MHz. RECOMMEND 208V OR 230V AC OPERATION FOR PULL-IN CURRENTS GREATER THAN 10 AMPS UNLESS A LOW IMPEDANCE SOURCE CAN MAINTAIN AT LEAST 94% RATED VOLTAGE DURING PULL-IN.

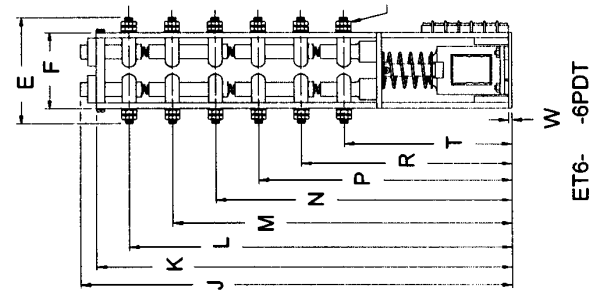
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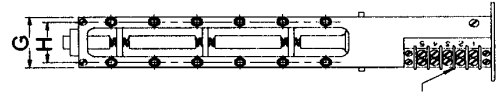




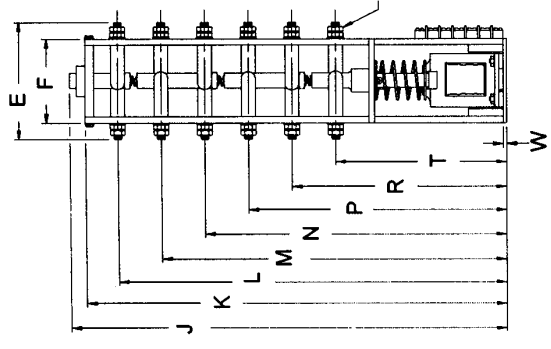
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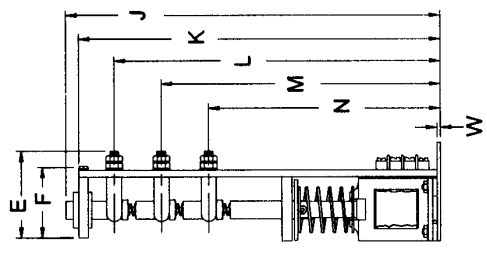
ET6-6PDT



ET3-3PNC



ET3-3PDT



ET3-3PNC

**DIMENSIONS**

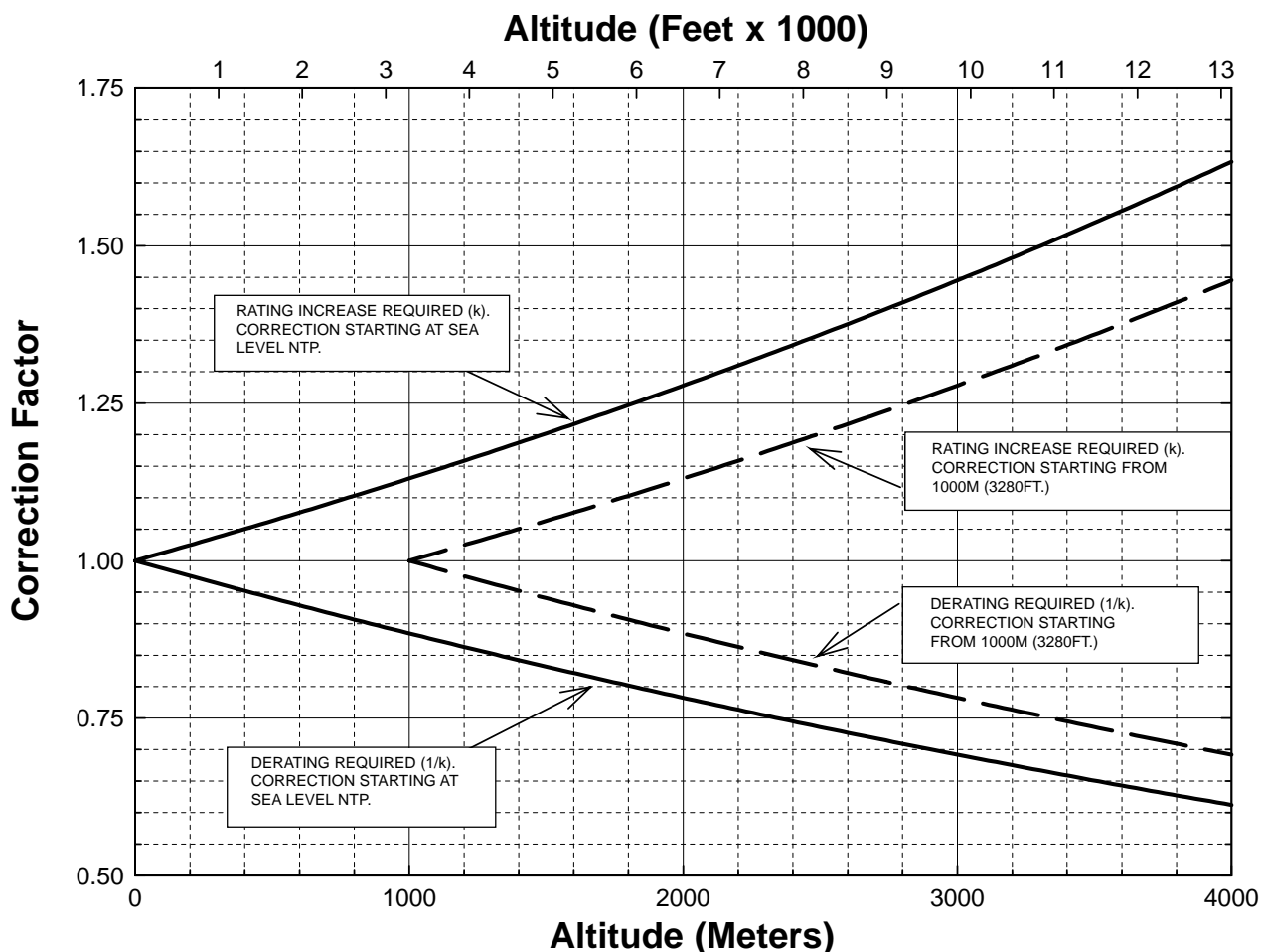
IN INCHES (IN MILLIMETERS)																
MODEL	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	T
ET3-14-3PNC	2.88 (73.1)	2.375 (60.3)	2.44 (61.9)	1.937 (49.4)	2.53 (64.2)	1.88 (47.7)	1.88 (47.7)	1.50 (38.1)	6.90 (175.2)	7.63 (193.8)	6.90 (175.2)	5.78 (146.8)	4.65 (118.1)			
ET3-14-3PNO	2.88 (73.1)	2.375 (60.3)	2.44 (61.9)	1.937 (49.4)	2.53 (64.2)	1.88 (47.7)	1.88 (47.7)	1.50 (38.1)	5.90 (149.8)	7.63 (193.8)	6.90 (175.2)	5.78 (146.8)	4.65 (118.1)			
ET3-14-3PDT	2.88 (73.1)	2.375 (60.3)	2.75 (69.8)	2.250 (57.1)	2.53 (64.2)	1.88 (47.7)	1.88 (47.7)	1.50 (38.1)	8.90 (226.0)		8.90 (226.0)					
ET6-14-6PNC	2.88 (73.1)	2.375 (60.3)	2.75 (69.8)	2.250 (57.1)	3.88 (98.5)	5.14 (130.5)	1.88 (47.7)	1.50 (38.1)	9.60 (243.8)	8.85 (224.7)	7.41 (188.2)	6.16 (156.4)	4.91 (124.7)			
ET6-14-6PNO	2.88 (73.1)	2.375 (60.3)	2.75 (69.8)	2.250 (57.1)	3.88 (98.5)	5.14 (130.5)	1.88 (47.7)	1.50 (38.1)	10.80 (274.3)	8.85 (224.7)	7.41 (188.2)	6.16 (156.4)	4.91 (124.7)			
ET6-14-6PDT	2.88 (73.1)	2.375 (60.3)	2.75 (69.8)	2.250 (57.1)	3.88 (98.5)	5.14 (130.5)	1.88 (47.7)	1.50 (38.1)	14.50 (368.3)	13.50 (342.9)	12.25 (311.1)	10.87 (276.0)	9.49 (241.0)	8.11 (205.9)	6.73 (170.9)	5.35 (135.8)
ET6-25-6PNC	2.88 (73.1)	2.375 (60.3)	3.70 (93.9)	3.200 (81.2)	4.66 (118.3)	3.70 (93.9)	1.88 (47.7)	1.50 (38.1)	9.53 (242.0)	8.53 (216.6)	7.53 (191.2)	6.15 (156.2)	4.78 (121.4)			
ET6-25-6PNO	2.88 (73.1)	2.375 (60.3)	3.70 (93.9)	3.200 (81.2)	4.66 (118.3)	3.70 (93.9)	1.88 (47.7)	1.50 (38.1)	9.53 (242.0)	8.53 (216.6)	7.53 (191.2)	6.15 (156.2)	4.78 (121.4)			
ET6-25-6PDT	2.88 (73.1)	2.375 (60.3)	3.70 (93.9)	3.200 (81.2)	4.66 (118.3)	3.70 (93.9)	1.88 (47.7)	1.50 (38.1)	14.25 (361.9)	13.26 (338.8)	12.25 (311.1)	10.88 (276.3)	9.49 (241.0)	8.11 (205.9)	6.73 (170.9)	5.35 (135.8)

Dimensions are for reference only and are subject to change. Contact: Ross Engineering Corporation for application data

**ROSS ENGINEERING CORP.**

CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182

# ALTITUDE CORRECTION FACTOR



FOR CORRECTION FACTOR STARTING AT 1000M  
 $k = e^{m(H-1000)/8150}$   
 H = Altitude  
 m = 1 see IEC94  
 m = 0.9 see IEC94  
 m = 0.75 see IEC94

FOR CORRECTION FACTOR STARTING AT SEA LEVEL  
 $k = e^{m(H)/8150}$   
 H = Altitude  
 m = 1 see IEC94  
 m = 0.9 see IEC94  
 m = 0.75 see IEC94

ALTITUDE IN METERS (FEET)	RATING INCREASE REQUIRED STARTING FROM 1000 METERS (m = 1)	DE-RATING REQUIRED STARTING FROM 1000 METERS (m = 1)	RATING INCREASE REQUIRED STARTING FROM SEA LEVEL (m = 1)	DE-RATING REQUIRED STARTING FROM SEA LEVEL (m = 1)
0			1.000	1.000
500 (1641)			1.063	0.940
1000 (3281)	1.000	1.000	1.131	0.885
1500 (4923)	1.063	0.940	1.202	0.832
2000 (6562)	1.131	0.885	1.278	0.782
2500 (8203)	1.202	0.832	1.359	0.736
3000 (9843)	1.278	0.782	1.445	0.692
3500 (11484)	1.359	0.736	1.536	0.651
4000 (13124)	1.445	0.692	1.634	0.612



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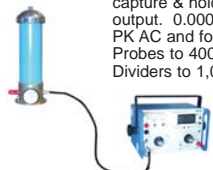



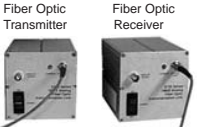







# HIGH VOLTAGE DEVICES

RELAYS  
SWITCHES  
MEASUREMENT  
SAFETY AND ACCESSORIES

**ISO 9001:2000  
QMS CERTIFIED**



208V TO 1000KV  
HV CALIBRATION  
ENERGY STORAGE  
ELECTRONIC AND POWER

<p>HV MEGMETER® HIPOT HV Insulation Leakage Current &amp; HV Resistance Measurement Meter. Portable, battery operated, 12V DC or 115V AC. 0-15KV DC 0.001µA to 260µA or to 1000µA. 0-42KV DC 0.001µA to 100µA or to 400µA.</p>  <p><b>For testing HV Cables, HV Insulation &amp; Vacuum Interrupters</b></p> <p>VMT-15, 0-15KV DC VMT-42, 0-42KV DC</p>	<p>HIGH CURRENT SWITCHES Models are available up to 20,000A continuous, and over 1,700,000A 20µsec pulse, with voltage ratings of 6 volts to 400KV peak test. Many are air cylinder or motor operated for high contact force. DC to 1MHz.</p> 	<p>HV RELAYS HV relays of the air insulated type for both low and high current. This series has ratings from 1 to 600A continuous, 100 to 100,000A momentary and capacitor discharge. Peak test voltages from 5 to 300KV. Single or Multipole. NO, NC, DT or Latching. Auxiliary contacts optional on all types. Extended life, and tungsten contacts also available for high current closing. Also usable in oil or insulating gas.</p> 
<p>HI-Z® POWERCLASS™ HV VOLTMETERS SAFE POWER LINE USE AC/DC FOR UTILITIES, CONTRACTORS &amp; EMERGENCY SERVICES Fully safe, portable, all solid state, 1% to 5% accuracy. Analog or digital shielded high voltage measurement with minimum circuit loading. 10V to 100KV AC and DC. Ideal for use with Elbow capacitance tap voltage test points. For cable test point or direct line voltage and phasing, or differential measurement.</p> 	<p>HV DIGITAL MULTIMETERS Wideband DC-10MHz. Portable meters have accuracies to 0.01% DC, 0.1% 50/60Hz, true RMS, Avg, True PK, ±PK, PK to PK. 3% to 1MHz, -3dB 10MHz. 0.2 microsecond 1/2 sine single pulse capture &amp; hold. ±2V 50 ohm output. 0.00001V-1000V DC or PK AC and for use with HV Probes to 400KV and Voltage Dividers to 1,000,000V.</p> 	<p>HV WIDEBAND VOLTAGE DIVIDERS FOR POWER AND ELECTRONIC USES DC-10MHz 1KV-1000KV PK, to 20 nanosecond rise time, for oscilloscopes, digital meters, or recorders such as Dranetz/BMI, Le Croy, etc. Ratios and load matching as required 0.01% to 0.3% DC, 0.5% to 3% wideband.</p>  <p>ISO/IEC 17025:2005 A2LA ACCREDITED HIGH VOLTAGE CALIBRATION 1KV to 450KV DC &amp; AC</p>
<p>HV ROTARY SWITCHES Ratings from 2 to 450KV, 1mA to over 200A. Either manual or electrical operators, depending upon requirements. Position detents and optional interlocks to prevent opening under load.</p> 	<p>HV PROBES &amp; VOLTMETERS HV DC, AC, &amp; Wideband DC-10MHz Safety Probes for any scope or digital display. Also available complete with large 4 1/2-digit display DMM 0.1% to 5% AC/DC accuracy, with safety handles for OSHA recommended personnel clearances. Battery/AC. Attached or separate digital display. DC-10MHz DVM 0.00001V to 400KV with HV Probe.</p>  <p>4 1/2 DIGIT DC-10MHz 5KV to 400KV</p>	<p>WIDEBAND FIBER OPTIC TRANSMISSION ANALOG DC-1MHz SYSTEMS AC or 12V DC rechargeable battery/AC operated. DC to 1MHz system has a maximum output of 10V PK (20V PK to PK) and a maximum input of 1V, 5V, or 10V PK into 1 gigohm, 30pF direct from signal source. Useful from 0.1V, and to 1000KV when used with Ross HV wideband dividers. Single or multiple ranges.</p>  <p>High Voltage Isolated 12V DC or 115/230V AC Power sources available.</p>
<p>VACUUM CONTACTORS WITH HIGH SPEED CONTACT OPENING AND ENERGY STORAGE DRIVERS As low as 1 millisecond contact opening, is available with ratings from 300V to 300KV and 50 to 1200A continuous, 10A DC to 12,000A AC interrupt.</p>   <p>Energy Storage Driver, 400 joules or more, 115V or 240V AC powered, has 50V to 1000V 20 microsecond trigger.</p>	<p>HIGH POWER CONTROL HIGH SPEED HIGH VOLTAGE CONTROL AND STEP-START SYSTEMS 1/2 to 1 cycle sensing and interrupt vacuum circuit breakers. Metal enclosed for indoor or outdoor applications. 5KV-38KV, 50-1200A.</p>  <p>POWER CLASS</p>	<p>POWERCLASS™ VACUUM CIRCUIT BREAKERS &amp; CONTACTORS 1/2 TO 2 CYCLE INTERRUPT Vacuum switches, single-phase, three-phase, upright or low profile, for high reliability sealed arc interrupting or crobar shorting. 208V to 200KV RMS operate. 50 to 2,000A continuous, 2,000 to 28,000A AC, 10 to 20,000A (with counter pulse) DC interrupt, to 40,000A momentary, to 100KA capacitor discharge.</p> 
<p>PERSONAL GROUNDING RODS Temporarily ground or discharge (with optional current limiting) electronic equipment. Designs conform to OSHA clearance requirements and provide the correct insulated handle and insulated cable length to keep personnel away from hazardous high voltage.</p> 	<p>SOLENOID-SAVER® For high pull-in current, low holding current 25-800Hz AC or DC solenoid actuators to prevent coil burnout, lower coil temperature rise and increase pull-in and holding forces. Eliminates AC hum. Can provide optional low current, low voltage control with 5mA 4-10V or other signal, optional delayed activation or deactivation, or optional high speed energy storage activation. Will allow any DC or AC solenoid to be used at DC or 25-800Hz.</p> 	<p>TOROIDS, SPHERES, CORONA SHIELDS, NUTS Geometrically designed to avoid excessive voltage gradients at connecting points and other areas needing shielding or balancing of electrostatic fields to increase withstand voltage and minimize corona. Diameters are to international standard metric sizes.</p> 



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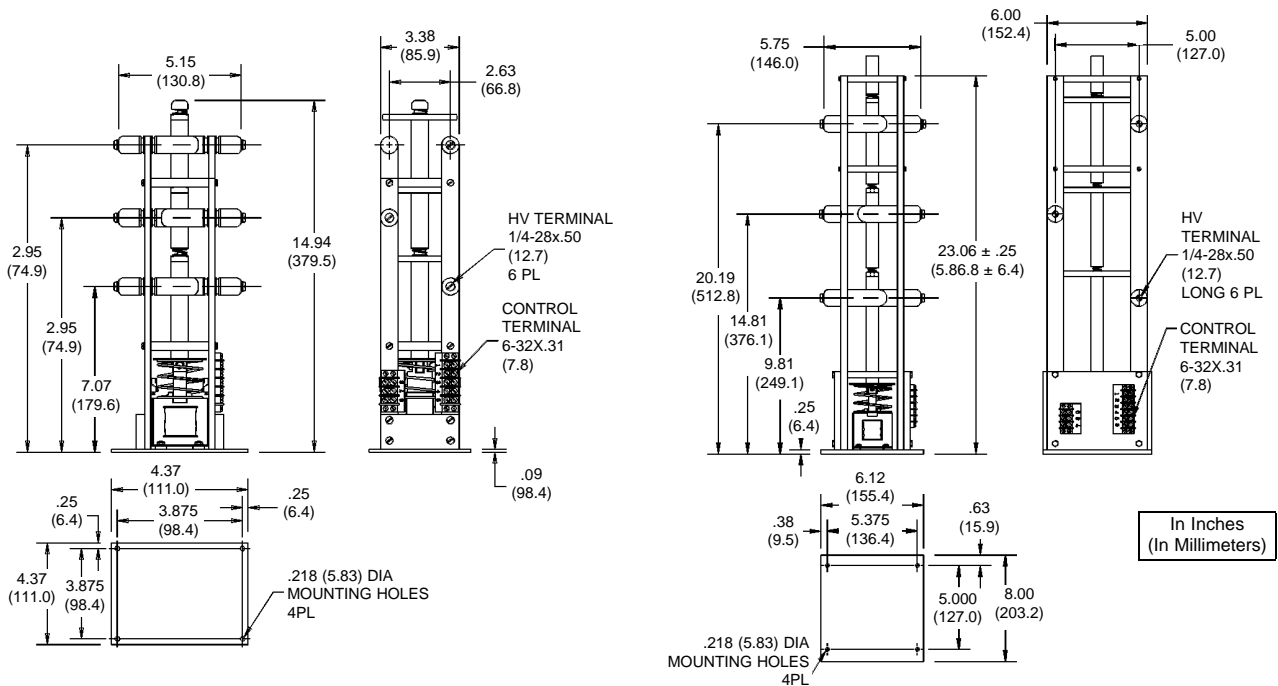
# 3 POLE HIGH VOLTAGE RELAYS



## E40-3PNO & E60-3PNO RELAYS, 40-60 PEAK TEST

The E60-3PNO & E40-3PNO relays are designed for high voltage applications where 3 poles are required. These air insulated relays are constructed using fire retardant, moisture sealed anti-tracking epoxy glass laminate of the highest quality. Environment resistant materials are standard throughout to increase its long-life, rugged characteristics.

Applications for these relays include: 3 phase tap or load selection, transfer, safety grounding, and shorting. Also, they can be used for any low or high power application where 3 poles are required. These units can be used in air, or in oil at twice its voltage rating or in other insulating mediums and is designed to be mounted base down. They can also be used in other positions if specified. Other HV ratings and multiple pole HV relays also available.



In Inches  
(In Millimeters)

RELAY MODEL	CONTACT FORMS AVAILABLE	* PK TEST RATING		**CURRENT RATING CLOSED NOT RATED FOR INTERRUPTING CURRENT			**MAX CONTACT RESISTANCE	OPERATE TIME MAX MS	RELEASE TIME MAX MS	*** STANDARD 115V, 60Hz COIL	
		HV CONTACT	INSULATION TO GROUND	CONTINUOUS	MOMENTARY 10 CYCLE	MOMENTARY CAPACITOR DISCHARGE 20 μSEC				MAX INRUSH CURRENT	MAX HOLD CURRENT
E40-3PNO-	3PNO/NC	40 KV	40 KV	125 A	1,000A	2,500A	.001Ω	20/40	30	12A	0.8 A
E60-3PNO-	3PNO/NC	60 KV	60 KV	100 A	1,000A	2,500A	.001Ω	20/40	30	12A	0.8 A

\* 1 minute 60Hz 20°C 29.92mmHG

\*\* Current ratings can be increased, and contact resistance and minimum pull-in voltage decreased, with optimum mounting position, and special contact material.

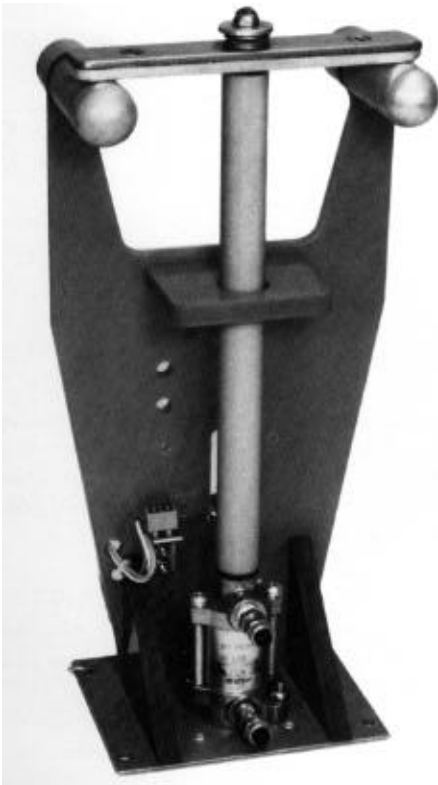
\*\*\* Other coil voltages and frequencies, including DC to 400Hz, are available. AC pull-in and hold current are approximately inversely proportional to coil voltage rating. Auxiliary contacts available on all models. Additional insulation to ground and RF insulation available for frequencies to 30MHz. Specifications are for reference only and are subject to change. Contact Ross Engineering Corporation for current dimensions



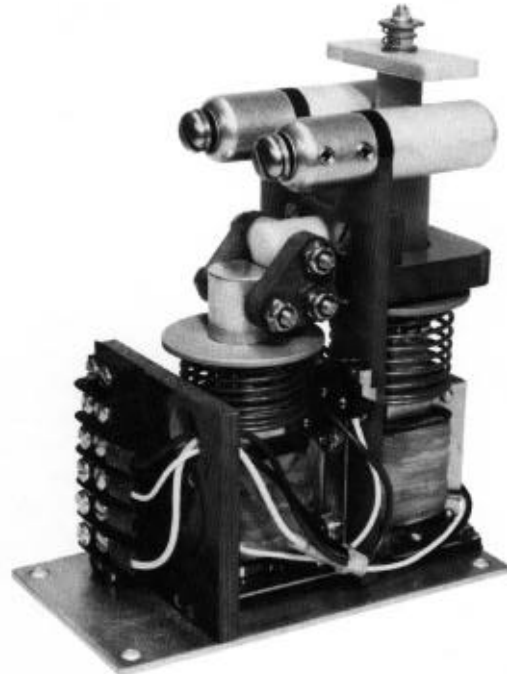
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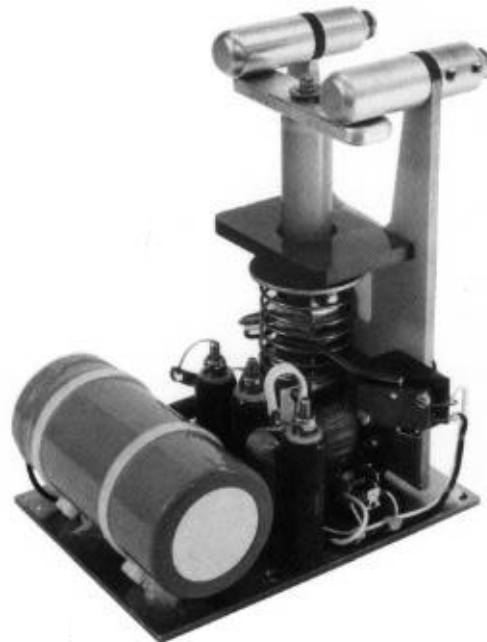
# HIGH VOLTAGE RELAYS



**HIGH VOLTAGE  
AIR OPERATED  
RELAYS**



**HIGH VOLTAGE  
LATCHING RELAYS**



**HIGH VOLTAGE  
DELAYED OPENING  
AND / OR CLOSING RELAYS**

## HIGH VOLTAGE PEAK TEST

Ratings are for air at 760mmHg, 20 C. Derate 1.5% per 1,000ft above sea level. All peak test voltages are 1 minute, 60Hz peak hold voltages, unless otherwise noted. The first figure in the model number is the peak test rating between open contacts. The number following the contact configuration designation is the rated peak test voltage to ground. On most non-spherical contacts, transient pulse withstand may be considerably higher than the 60Hz test level. Actual flashover values, for spherical types, are approximately 10% greater than rated peak test hold values for DC, 60Hz and most transients.

## HIGH VOLTAGE OPERATE

The peak test rating of high voltage relays should be 1.2 to 5 times the normal high voltage circuit operating voltage, depending upon the applications. For lower power systems where transients are unlikely or intermittent flashover is of no consequence, a safety factor of 1.2 to 1.5 may be suitable. For medium power systems or where moderate transients are likely, a safety factor of 1.5 to 3 is desirable, and 2 to 3 recommended. For higher power systems or where transient over-voltages are expected, a safety factor of 2.5 to 5 should be considered and the factor should be based on the maximum probable transient. The peak test voltage to ground rating should be selected in the same way as is the contact to contact value. If a value other than the published rating is required, it can normally be supplied as an extra cost option. On most grounding relays, even though one contact is grounded the insulation to ground should be 10KV to 40KV to prevent HV ground current from flowing in solenoid circuits during capacitor discharge or transients.

## INSULATION

Standard insulation used on Ross Engineering Corporation high voltage relays and switches is fire retardant FR-4, G-10 or G-11 Epoxy glass laminate. G-7 silicone glass insulation is recommended as an extra cost option for RF & high temperature applications, particularly above 100-300KHz. It also may be necessary to increase insulation length for RF applications.

## OIL OR GAS INSULATION

The voltage withstand value is at least doubled or tripled and the interrupt capability is much greater when the relay is immersed in insulating oil, fluid, or gas. No modification is necessary for operation in an insulating gas atmosphere; however, oil or fluid immersion requires modifications and is an extra cost option.

For maximum performance in an insulating medium where high voltage is impressed directly across solid insulation, it may be necessary to increase insulation length to prevent puncture at levels above the test rating in air.

## AUXILIARY CONTACTS SPDT

Auxiliary contacts are available on request on all relays. Most smaller relays are optionally available with at least two 10 amp, 250V AC or 3 amp, 24V DC auxiliaries. Larger units are available with at least two 15 amp, 480V AC auxiliaries, and some have provision for as many as eight. 10 amp, 115V DC auxiliaries are available interchangeably with the 15 amp, 480V AC units. Oil-immersed relays require special auxiliaries. Optional auxiliary contacts can indicate latched or unlatched, fully open or fully closed.

## HELPS MEET REGULATIONS

OSHA and other safety regulations indicate safety grounding of all HV power supplies and systems for personnel protection. Ross Engineering helps meet these requirements with its line of high voltage grounding and discharge relays and accessories.

## RUGGED AND RELIABLE

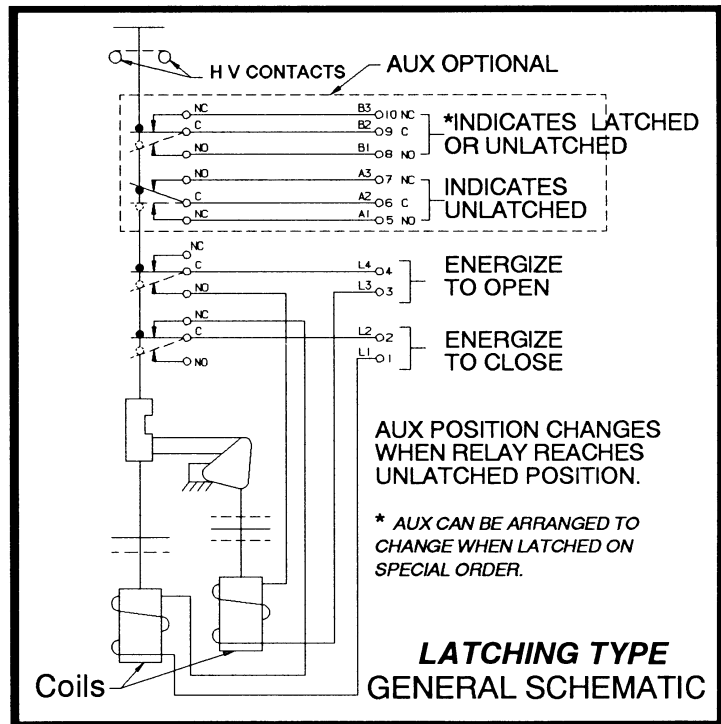
Thousands of trouble free high voltage applications in the past 26 years have established Ross Engineering Corporation's reputation for dependable, quality engineered products. Fire retardant high strength epoxy glass laminate insulation with a moisture resistant surface is standard on most units. Heavy duty contacts, which are specially designed to minimize corona, are made of highly conductive but weld resistant alloys. Ross Relays are noted for their ability to withstand high shock and vibration as well as other severe environmental conditions.

## LONG LIFE

Simplicity of mechanical design and conservative stress levels result in long, trouble-free life. Contacts on most relays may be rotated to renew the contact area, resulting in even longer service life. See paragraph on tungsten & silver contacts.

## COMPACT DESIGN

Ross Engineering Corporation manufactures some of the most compact air insulated high voltage relays available. The best qualities of mechanical and electrical design are combined to create these highly efficient and reliable relays with as many as six poles or more.



# HIGH VOLTAGE LATCHING RELAYS

## ACTUATORS

115V, 60Hz actuators are standard for pull in currents less than 10 amps. Higher actuator voltages are recommended for pull-in currents over 10 amps to minimize momentary voltage drop. It is recommended that source impedance allow no more than 6% drop at the coil terminals during pull-in. Most models can be supplied with 24V, 48V, 70V, 100V, 115V, 200V, 208V, 230V, 480V, 60Hz or 50Hz. 400Hz or 24V, 48V, 100V, 115V or 125V DC actuators are available at additional cost. Latching type actuators require only momentary control current. Special actuators and relay drivers are available for high speed operation of 0.5 to 10 milliseconds or delayed operation upon loss of power. Air or hydraulic pressure actuated relays are available for applications requiring complete electrical isolation of the actuator, very high contact pressure for high current, or very long strokes for higher withstand voltage ratings. Electric motor actuators are also available for special applications.

## MOUNTING

Most of the Ross Engineering Corporation high voltage relays with ratings through 60KV can be adjusted to be mounted in any attitude unless otherwise indicated. Where maximum reliability, minimum noise (HUM), minimum contact resistance, or minimum pull-in voltage is required, consult the Applications Engineering Department for mounting recommendations. Please specify mounting position; base down is standard and will be optimum unless otherwise noted. Most of the Ross Engineering Corporation solenoid operated high voltage relays with ratings of 70KV or higher are designed to return to their normal position by gravity when the actuator is de-energized. These relays must be mounted in the recommended attitude. Ross Engineering Corporation switches operated by air or oil pressure, or by electric motors, generally may be mounted in any attitude.

## HIGH CURRENT CLOSING AND CONTINUOUS HOLDING CAPABILITIES

High contact closing force enables high momentary current closing capabilities ranging from 10 to 50,000 amps. Special tungsten contacts are available to increase momentary discharge current ratings by many times but with reduced continuous current ratings. Continuous current ratings decrease and contact resistance may increase with standard weld resistant copper alloy contacts when arcing occurs or in a dusty environment, therefore special silver contacts are available to maintain continuous current ratings when closing or opening under load.

## CONTINUOUS CURRENT RATINGS

Continuous Current ratings are as of new and clean condition for a maximum of 40 C ambient at sea level. Relays are suitable up to 70 C ambient with forced ventilation. Current ratings as specified are continuous for 60Hz RMS and DC, but should be derated 1.5% per 1,000ft above sea level. Continuous current ratings of standard silver plated weld resistant copper alloy contacts are reduced after arcing. Special silver contacts must be used where continuous current is required after arcing if current ratings are to be maintained. Tungsten contacts used for high current arcing on closure have reduced continuous currents. Type of application should be considered when determining current rating required. In most cases, continuous currents for long time duty should not be more than 3/4 the current rating of the new relay. In open industrial or dusty atmosphere it may be necessary to derate by 50%, further if arcing occurs unless silver inserts are used. Some units can be used in applications above 60Hz at reduced current and voltage ratings. All RF applications should be submitted to our Applications Engineering Department for review.

## INTERRUPT AND CLOSE CURRENT RATINGS

Air insulated relays are not rated for current interrupting. Most are capable of interrupting 10 milliamps or more depending on type of wave, contact material, load, and recovery voltage. Much higher currents can be interrupted in insulating gas or oil and certain other applications, 10 to 20amps at 2400V AC FOR EXAMPLE: High voltage air insulated relays can close on high currents and standard weld resistant contacts are rated for safety grounding or high current capacitor discharge and have long life and little or no maintenance in these applications. Fail-safe grounding or shorting relays of this type with fully visible contacts are ideally suited for use in all types of power supplies. Relays, contactors and switches for higher interrupting capabilities are covered in other brochures.

# E-SERIES LATCHING

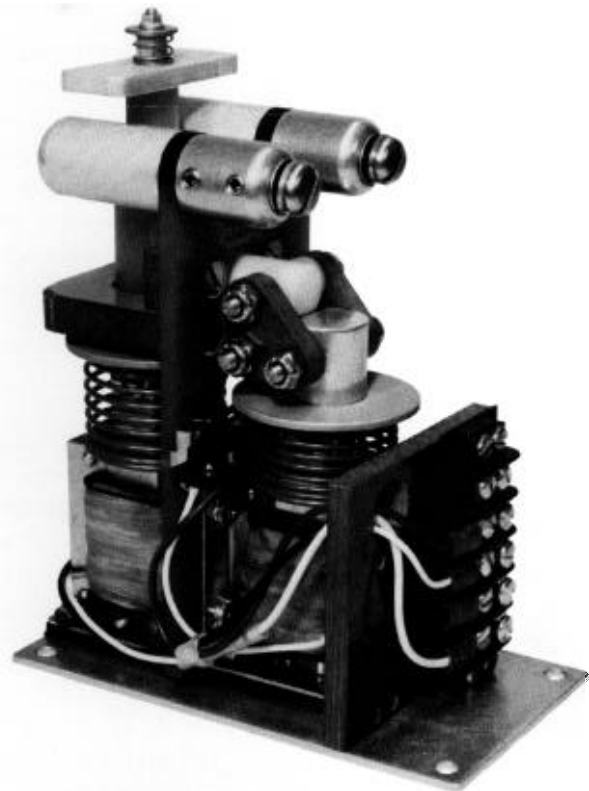
# 12-60 KV

For transfer, safety grounding, or tap selection, at 12 to 60KV peak test. Most HV contacts have full insulation above ground. a higher insulation level to ground is optional. Most units are spring return and can mount in any position, or may also be used with gravity return by mounting in the proper position. E series units are also available with replaceable tungsten alloy contacts for high current capacitor discharge use. Current interrupting relays, contactors, and circuit breakers are also available in higher voltages and currents for DC, AC, RF, pulse, and capacitor discharge.

See brochures No. B-1002 High Current Switches, B-1004 Single Pole Vacuum Contactors, B-1005 Three-Phase Vacuum Contactors and Circuit Breakers, B-1006 Low Profile Vacuum Contactors and Circuit Breakers, B-1007 HV Grounding Relays, and B-1008 RF Relays. High momentary and continuous current ratings are a natural result of large radiuses used to minimize corona.

SEE OTHER PAGES FOR MULTIPOLE TYPES.

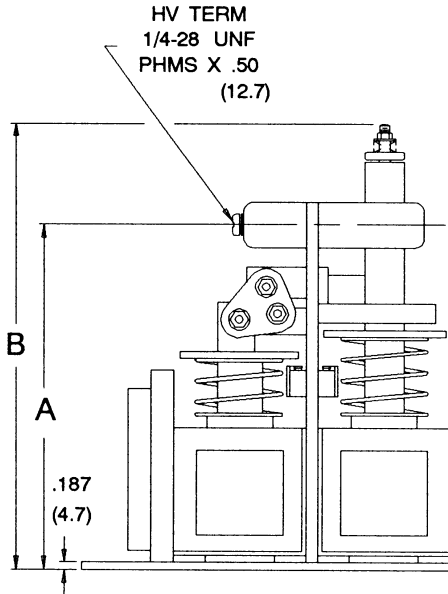
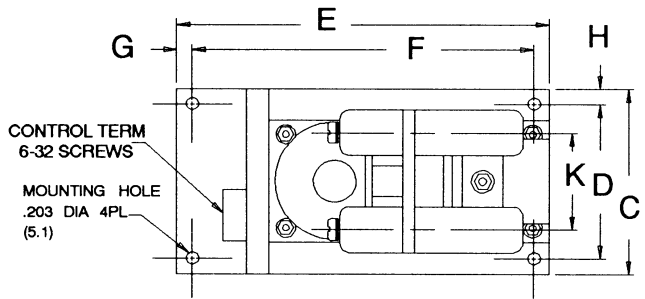
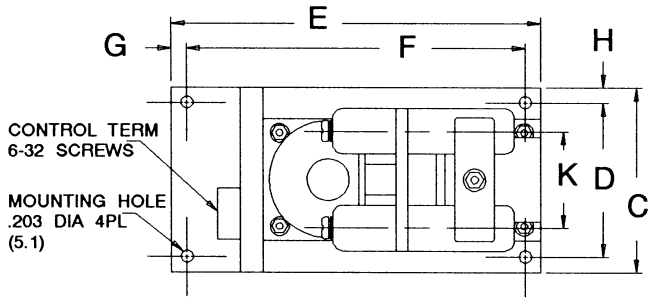
**AVAILABLE UP TO 300KV PK.**



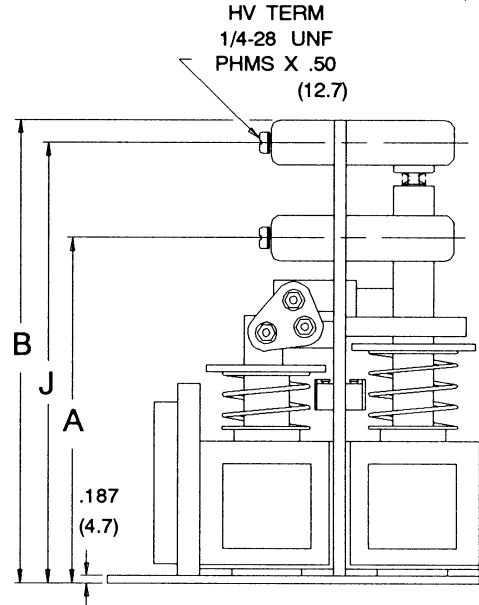
SPECIFICATIONS												760MMHg 20°C Ambient	
RELAY MODEL	CONTACT FORM	1 MINUTE PEAK TEST RATING DC OR AC PK		*CURRENT RATINGS NEW & DUST FREE			*NON ARCING CONTACT MAX CONTACT RESISTANCE	OPERATE TIME	RELEASE TIME	**STANDARD 115V, 60Hz COIL			
		H V CONTACT	INSULATION TO GROUND	CONTINUOUS AMPS RMS	MOMENTARY 10 CYCLE AMPS RMS	MOMENTARY CAPACITOR DISCHARGE 20USEC		MAX MILLI-SECONDS	MAX MILLI-SECONDS	MAX INRUSH CURRENT	MAX HOLD CURRENT		
E-12-LC	SPLC	12KV	12KV	50A	1,000A	2,500A	0.001 ohm	20	50/90	2A	—		
E-12-LO	SPL0	12KV	12KV	50A	1,000A	2,500A	0.001 ohm	20/40	30	2A	—		
E-12-DTL	SPDTL	12KV	12KV	50A	1,000A	2,500A	0.001 ohm	20/40	50/90	2A	—		
E-15-LC	SPLC	15KV	15KV	125A	1,000A	2,500A	0.0008 ohm	20	50/90	2A	—		
E-15-LO	SPL0	15KV	15KV	125A	1,000A	2,500A	0.0008 ohm	20/40	30	2A	—		
E-15-DTL	SPDTL	15KV	15KV	125A	1,000A	2,500A	0.0008 ohm	20/40	50/90	4A	—		
E-25-LC	SPLC	25KV	25KV	125A	1,000A	2,500A	0.0008 ohm	20	50/90	3A	—		
E-25-LO	SPL0	25KV	25KV	125A	1,000A	2,500A	0.0008 ohm	20/40	30	3A	—		
E-25-DTL	SPDTL	25KV	25KV	125A	1,000A	2,500A	0.0008 ohm	20/40	50/90	5A	—		
E-30-DTL-40	SPDTL	30KV	40KV	125A	1,000A	2,500A	0.0008 ohm	30/50	100/140	5A	—		
E-40-LC	SPLC	40KV	40KV	125A	1,000A	2,500A	0.0008 ohm	20	80/100	5A	—		
E-40-LO	SPL0	40KV	40KV	125A	1,000A	2,500A	0.0008 ohm	20	40 30	5A	—		
E-60-LC-80	SPLC	60KV	80KV	125A	1,000A	2,500A	0.0008 ohm	40	60/100	7A	—		
E-60-LO-80	SPL0	60KV	80KV	125A	1,000A	2,500A	0.0008 ohm	40	60/100	7A	—		

\*STANDARD WELD RESISTANT CONTACTS ARE SILVER PLATED COPPER ALLOY. IF ARCING OCCURS, CONTINUOUS CURRENT CAN BE GREATLY REDUCED, THEREFORE THE COPPER ALLOY CONTACTS ARE BEST FOR "COLD" SWITCHING, OR CAPACITOR DISCHARGE WITH MINIMUM CONTINUOUS CURRENT. \*FOR ARCING CONTACTS WITH HIGH MAXIMUM CONTINUOUS OR CLOSED CURRENT RATINGS, LOW RESISTANCE SILVER ALLOY CONTACTS ARE OPTIONAL. FOR SHORT TIME HIGH HV CLOSING CURRENTS, (REDUCED HOLDING CURRENT) TUNGSTEN ALLOY CONTACTS ARE OPTIONAL. \*\*DC, 400HZ, AND OTHER VOLTAGES AVAILABLE. COIL CURRENT APPROXIMATELY INVERSELY PROPORTIONAL TO VOLTAGE, I.E. 230V AC IS HALF OF THAT AT 115V. AUXILIARY CONTACTS AVAILABLE ON ALL MODELS. ADDITIONAL INSULATION TO GROUND AND RF INSULATION AVAILABLE FOR FREQUENCIES TO 30MHz. RECOMMEND 208V OR 230V AC OPERATION FOR PULL-IN CURRENTS GREATER THAN 10 AMPS UNLESS A LOW IMPEDANCE SOURCE CAN MAINTAIN AT LEAST 94% RATED VOLTAGE DURING PULL IN.





**SPLC**



**SP DLT**

DIMENSIONS										
In Inches (In Millimeters)										
MODEL	A	HEIGHT B	WIDTH C	D	DEPTH E	F	G	H	J	K
E-12-LC	4.88 (123.9)	5.75 (146.0)	2.75 (69.8)	2.250 (57.1)	4.94 (125.4)	4.437 (112.6)	.25 (6.4)	.25 (6.4)		1.12 (28.4)
E-12-LO	5.65 (143.5)	6.75 (171.4)	2.75 (69.8)	2.250 (57.1)	4.94 (125.4)	4.437 (112.6)	.25 (6.4)	.25 (6.4)		1.12 (28.4)
E-12-DTL	4.88 (123.9)	6.75 (171.4)	2.75 (69.8)	2.250 (57.1)	4.94 (125.4)	4.437 (112.6)	.25 (6.4)	.25 (6.4)	6.44 (163.5)	1.12 (28.4)
E-15-LC	5.44 (138.2)	5.75 (146.0)	2.75 (69.8)	2.250 (57.1)	4.94 (125.4)	4.437 (112.6)	.24 (6.4)	.25 (6.4)		1.50 (38.1)
E-15-LO	6.88 (174.7)	6.75 (171.4)	2.75 (69.8)	2.250 (57.1)	4.94 (125.4)	4.437 (112.6)	.25 (6.4)	.25 (6.4)		1.50 (38.1)
E-15-DTL	5.44 (138.1)	6.25 (158.7)	2.75 (69.8)	2.250 (57.1)	4.94 (125.4)	4.437 (112.6)	.25 (6.4)	.25 (6.4)	6.88 (174.7)	1.50 (38.1)
E-25-LC	6.33 (160.7)	7.50 (190.5)	2.75 (69.8)	2.250 (57.1)	4.94 (125.4)	4.437 (112.6)	.25 (6.4)	.25 (6.4)		1.50 (38.1)
E-25-LO	6.33 (160.7)	8.51 (216.1)	2.75 (69.8)	2.250 (57.1)	4.94 (125.4)	4.437 (112.6)	.25 (6.4)	.25 (6.4)		1.50 (38.1)
E-25-DTL	6.33 (160.7)	8.51 (216.1)	2.75 (69.8)	2.250 (57.1)	4.94 (125.4)	4.437 (112.6)	.25 (6.4)	.25 (6.4)	8.14 (206.7)	1.50 (38.1)
E-30-DTL-40	6.72 (170.6)	9.03 (229.3)	3.38 (85.8)	2.88 (73.1)	4.94 (125.4)	4.437 (112.6)	.25 (6.4)	.25 (6.4)	8.65 (219.7)	2.62 (66.5)
E-40-LC	6.72 (170.6)	7.18 (182.3)	3.38 (85.8)	2.875 (73.0)	5.94 (150.8)	5.437 (138.0)	.25 (6.4)	.25 (6.4)		2.62 (66.5)
E-40-LO	6.72 (170.6)	8.79 (223.2)	3.38 (85.8)	2.875 (73.0)	5.94 (150.8)	5.437 (138.0)	.25 (6.4)	.25 (6.4)		2.62 (66.5)
E-60-LC-80	11.50 (292.1)	14.25 (361.9)	5.00 (127.0)	4.500 (114.3)	5.88 (149.3)	4.88 (123.9)	.50 (6.4)	.25 (6.4)		5.00 (127.0)
E-60-LO-80	11.50 (292.1)	12.00 (304.8)	5.00 (127.0)	4.500 (114.3)	5.88 (149.3)	4.88 (123.9)	.50 (6.4)	.25 (6.4)		5.00 (127.0)

DIMENSIONS ARE FOR REFERENCE ONLY AND ARE SUBJECT TO CHANGE. CONTACT: ROSS ENGINEERING CORPORATION FOR APPLICATION DATA.

**ROSS ENGINEERING CORP.**

CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182

# EA-SERIES LATCHING

# 12-40 KV



The EA series of air insulated HV Relays is provided for higher continuous and momentary currents, yet is still within a compact size. It has higher opening and closing forces which minimize contact resistance and closing bounce. It is widely used (where no HV current interrupting rating is required) for high power load and tap selection, circuit isolation, and grounding or shorting. It has standard, weld resistant, silver plated, easily renewable copper alloy contacts.

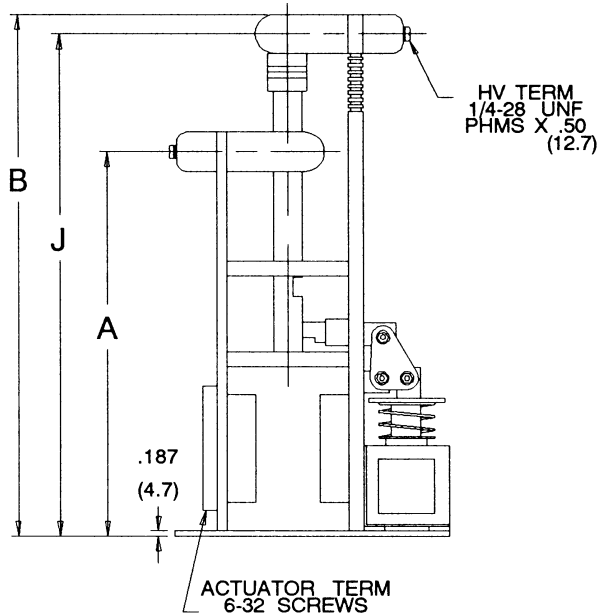
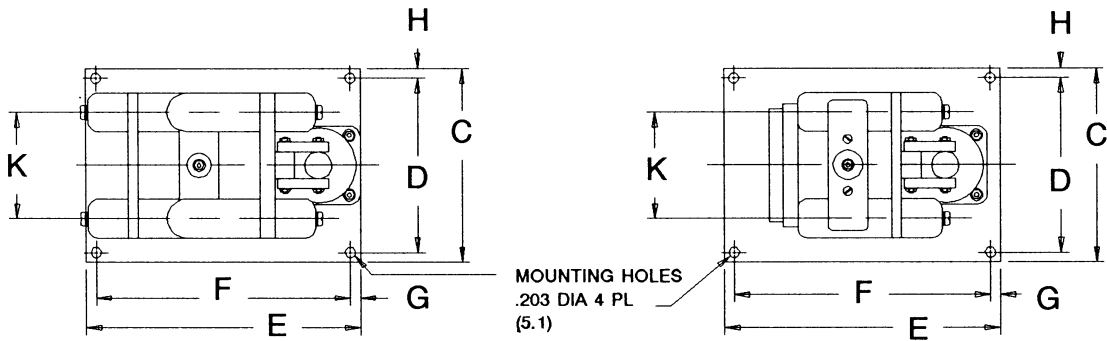
Also optionally available with special heavy duty arcing contacts of Tungsten alloy, this series is excellent for closing in on high capacitor discharge and momentary fault currents with long life capability in these applications. As on most Ross HV Relays, two or more sets of SPDT auxiliary contacts are optionally available, if required.

SPECIFICATIONS												760MMHg 20°C Ambient	
RELAY MODEL	CONTACT FORM	1 MINUTE PEAK TEST RATING DC OR AC PK		*CURRENT RATINGS NEW & DUST FREE			*NON ARCING CONTACT MAX CONTACT RESISTANCE	OPERATE TIME	RELEASE TIME	**STANDARD 115V, 60Hz COIL			
		H V CONTACT	INSULATION TO GROUND	CONTINUOUS AMPS RMS	MOMENTARY 10 CYCLE AMPS RMS	MOMENTARY CAPACITOR DISCHARGE 20USEC		MAX MILLI-SECONDS	MAX MILLI-SECONDS	MAX INRUSH CURRENT	MAX HOLD CURRENT		
EA-12-LC	SPLC	12KV	20KV	200A	5,000A	50,000A	0.0005 ohm	20	50	6A	-----		
EA-12-LO	SPLO	12KV	20KV	200A	5,000A	50,000A	0.0005 ohm	20	50	6A	-----		
EA-12-DTL	SPDTL	12KV	20KV	200A	5,000A	50,000A	0.0005 ohm	25	60	6A	-----		
EA-25-LC-40	SPLC	25KV	40KV	200A	5,000A	50,000A	0.0005 ohm	30	70	10A	-----		
EA-25-LO-40	SPLO	25KV	40KV	200A	5,000A	50,000A	0.0005 ohm	30	70	10A	-----		
EA-25-DTL-40	SPDTL	25KV	40KV	200A	5,000A	50,000A	0.0005 ohm	40	80	12A	-----		
EA-40-LC-60	SPLC	40KV	60KV	200A	5,000A	50,000A	0.0005 ohm	40	80	10A	-----		
EA-40-LO-60	SPLO	40KV	60KV	200A	5,000A	50,000A	0.0005 ohm	40	80	10A	-----		
EA-40-DTL-60	SPDTL	40KV	60KV	200A	5,000A	50,000A	0.0005 ohm	50	100	12A	-----		

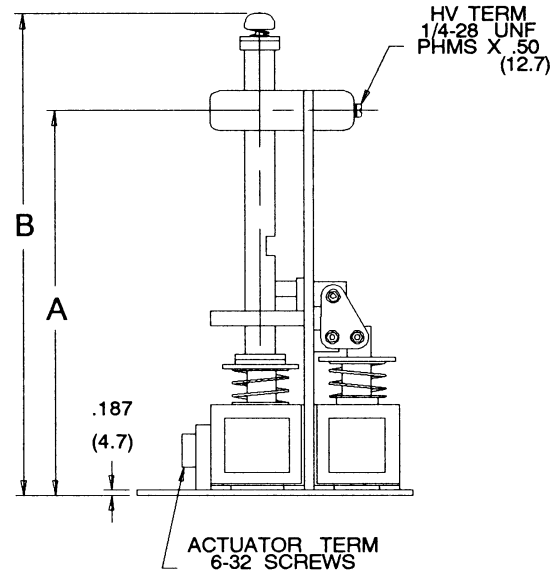
\*STANDARD WELD RESISTANT CONTACTS ARE SILVER PLATED COPPER ALLOY. IF ARCING OCCURS, CONTINUOUS CURRENT CAN BE GREATLY REDUCED, THEREFORE THE COPPER ALLOY CONTACTS ARE BEST FOR "COLD" SWITCHING, OR CAPACITOR DISCHARGE WITH MINIMUM CONTINUOUS CURRENT. \*FOR ARCING CONTACTS WITH HIGH MAXIMUM CONTINUOUS OR CLOSED CURRENT RATINGS, LOW RESISTANCE SILVER ALLOY CONTACTS ARE OPTIONAL. FOR SHORT TIME HIGH HV CLOSING CURRENTS, (REDUCED HOLDING CURRENT) TUNGSTEN ALLOY CONTACTS ARE OPTIONAL. \*\*DC, 400HZ, AND OTHER VOLTAGES AVAILABLE. COIL CURRENT APPROXIMATELY INVERSELY PROPORTIONAL TO VOLTAGE, I.E. 230V AC IS HALF OF THAT AT 115V. AUXILIARY CONTACTS AVAILABLE ON ALL MODELS. ADDITIONAL INSULATION TO GROUND AND RF INSULATION AVAILABLE FOR FREQUENCIES TO 30MHZ. RECOMMEND 208V OR 230V AC OPERATION FOR PULL-IN CURRENTS GREATER THAN 10 AMPS UNLESS A LOW IMPEDANCE SOURCE CAN MAINTAIN AT LEAST 94% RATED VOLTAGE DURING PULL IN.

**ROSS ENGINEERING CORP.**

CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182



**DTL**



**LO/LC**

DIMENSIONS										
In Inches (In Millimeters)										
MODEL	A	HEIGHT B	WIDTH C	D	DEPTH E	F	G	H	J	K
EA-12-LC	6.30 (160.0)	8.27 (210.0)	3.50 (88.9)	3.000 (76.2)	7.00 (177.8)	6.500 (165.1)	.25 (6.3)	.25 (6.3)		2.00 (50.8)
EA-12-LO	6.30 (160.0)	6.80 (172.7)	3.50 (88.9)	3.000 (76.2)	7.00 (177.8)	6.500 (165.1)	.25 (6.3)	.25 (6.3)		2.00 (50.8)
EA-12-DTL	7.68 (195.0)	10.43 (264.9)	3.50 (88.9)	3.000 (76.2)	7.00 (177.8)	6.500 (165.1)	.25 (6.3)	.25 (6.3)	9.93 (252.2)	2.00 (50.8)
EA-25-LC-40	7.30 (185.4)	9.87 (250.6)	5.00 (127.0)	4.500 (114.3)	7.00 (177.8)	6.500 (165.1)	.25 (6.3)	.25 (6.3)		2.75 (69.8)
EA-25-LO-40	7.30 (185.4)	7.80 (198.1)	5.00 (127.0)	4.500 (114.3)	7.00 (177.8)	6.500 (165.1)	.25 (6.3)	.25 (6.3)		2.75 (69.8)
EA-25-DTL-40	8.50 (215.9)	11.50 (292.1)	5.00 (127.0)	4.500 (114.3)	7.00 (177.8)	6.500 (165.1)	.25 (6.3)	.25 (6.3)	11.00 (279.4)	2.75 (69.8)
EA-40-LC-60	9.30 (236.2)	11.69 (296.9)	5.00 (127.0)	4.500 (114.3)	7.00 (177.8)	6.500 (165.1)	.25 (6.3)	.25 (6.3)		2.75 (69.8)
EA-40-LO-60	9.30 (236.2)	9.80 (248.9)	5.00 (127.0)	4.500 (114.3)	7.00 (177.8)	6.500 (165.1)	.25 (6.3)	.25 (6.3)		2.75 (69.8)
EA-40-DTL-60	9.93 (252.2)	12.50 (317.5)	5.00 (127.0)	4.500 (114.3)	7.00 (177.8)	6.500 (165.1)	.25 (6.3)	.25 (6.3)	12.00 (304.8)	2.75 (69.8)

DIMENSIONS ARE FOR REFERENCE ONLY AND ARE SUBJECT TO CHANGE. CONTACT: ROSS ENGINEERING CORPORATION FOR APPLICATION DATA.

**ROSS ENGINEERING CORP.**

CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182

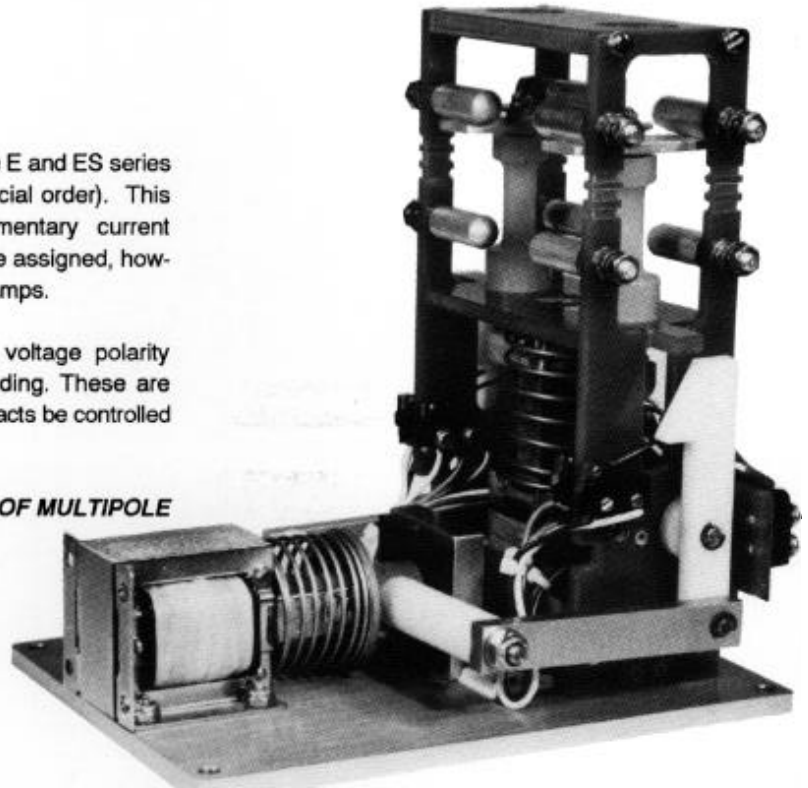
# ET-SERIES LATCHING

# 12-25 KV

ET series is a continuation of the rugged single pole E and ES series with the addition of up to 6 poles (or more on special order). This compact series is open style, with high momentary current capabilities. Air insulated; no interrupting ratings are assigned, however continuous currents range from 1 amp to 50 amps.

Multipole ET series relays are useful for high voltage polarity reversing, multiple-load grouping, or safety grounding. These are used in applications where it is desirable that all contacts be controlled from a single actuator.

**SEE ADDITIONAL SHEETS FOR OTHER TYPES OF MULTIPOLE RELAYS.**

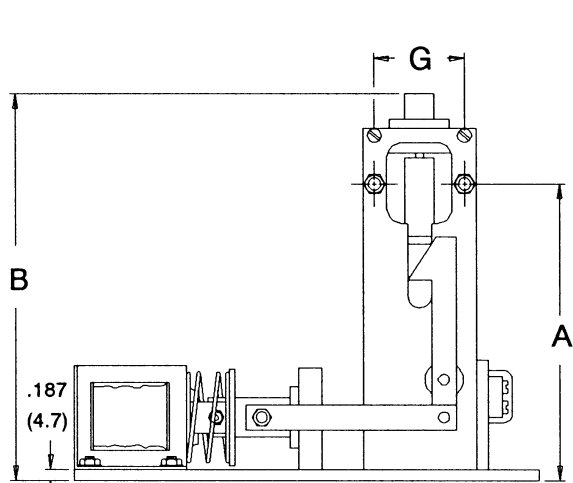


SPECIFICATIONS												760MMHg 20°C Ambient	
RELAY MODEL	CONTACT FORM	1 MINUTE PEAK TEST RATING DC OR AC PK		*CURRENT RATINGS NEW & DUST FREE			*NON ARCING CONTACT MAX CONTACT RESISTANCE	OPERATE TIME	RELEASE TIME	**STANDARD 115V, 60Hz COIL			
		H V CONTACT	INSULATION TO GROUND	CONTINUOUS AMPS RMS	MOMENTARY 10 CYCLE AMPS RMS	MOMENTARY CAPACITOR DISCHARGE 20USEC		MAX MILLI-SECONDS	MAX MILLI-SECONDS	MAX INRUSH CURRENT	MAX HOLD CURRENT		
ET2-14-2PLC	2PLC	14KV	14KV	35A	400A	500A	.003 ohm	20	40	4.0A	---		
ET2-14-2PLO	2PLO	14KV	14KV	35A	400A	500A	.003 ohm	20	40	4.0A	---		
ET2-14-2PDTL	2PDTL	14KV	14KV	35A	400A	500A	.003 ohm	20	40	4.0A	---		
ET4-14-4PLC	4PLC	14KV	14KV	35A	400A	500A	.003 ohm	20	40	4.0A	---		
ET4-14-4PLO	4PLO	14KV	14KV	35A	400A	500A	.003 ohm	20	40	4.0A	---		
ET4-25-4PLC	4PLC	25KV	25KV	35A	400A	500A	.003 ohm	30	80	5.0A	---		
ET4-25-4PLO	4PLO	25KV	25KV	35A	400A	500A	.003 ohm	30	80	5.0A	---		
ET2-25-2PDTL	2PDTL	25KV	25KV	35A	400A	500A	.003 ohm	30	100	5.0A	---		

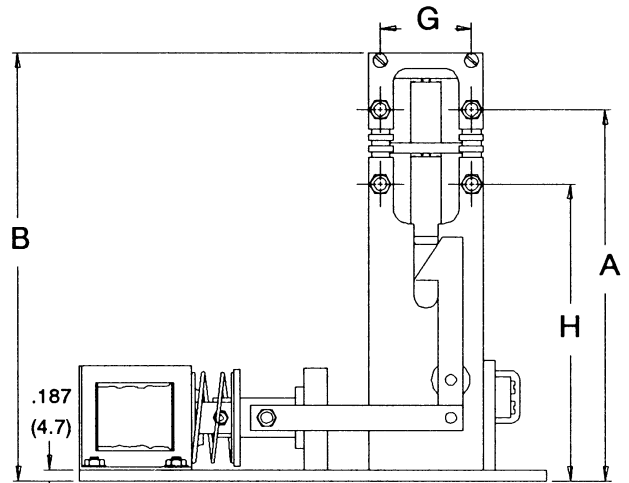
\*STANDARD WELD RESISTANT CONTACTS ARE SILVER PLATED COPPER ALLOY. IF ARCING OCCURS, CONTINUOUS CURRENT CAN BE GREATLY REDUCED, THEREFORE THE COPPER ALLOY CONTACTS ARE BEST FOR "COLD" SWITCHING, OR CAPACITOR DISCHARGE WITH MINIMUM CONTINUOUS CURRENT. \*FOR ARCING CONTACTS WITH HIGH MAXIMUM CONTINUOUS OR CLOSED CURRENT RATINGS, LOW RESISTANCE SILVER ALLOY CONTACTS ARE OPTIONAL. FOR SHORT TIME HIGH HV CLOSING CURRENTS, (REDUCED HOLDING CURRENT) TUNGSTEN ALLOY CONTACTS ARE OPTIONAL. \*\*DC, 400HZ, AND OTHER VOLTAGES AVAILABLE. COIL CURRENT APPROXIMATELY INVERSELY PROPORTIONAL TO VOLTAGE, I.E. 230V AC IS HALF OF THAT AT 115V. AUXILIARY CONTACTS AVAILABLE ON ALL MODELS. ADDITIONAL INSULATION TO GROUND AND RF INSULATION AVAILABLE FOR FREQUENCIES TO 30MHz. RECOMMEND 208V OR 230V AC OPERATION FOR PULL-IN CURRENTS GREATER THAN 10 AMPS UNLESS A LOW IMPEDANCE SOURCE CAN MAINTAIN AT LEAST 94% RATED VOLTAGE DURING PULL IN.

**ROSS ENGINEERING CORP.**

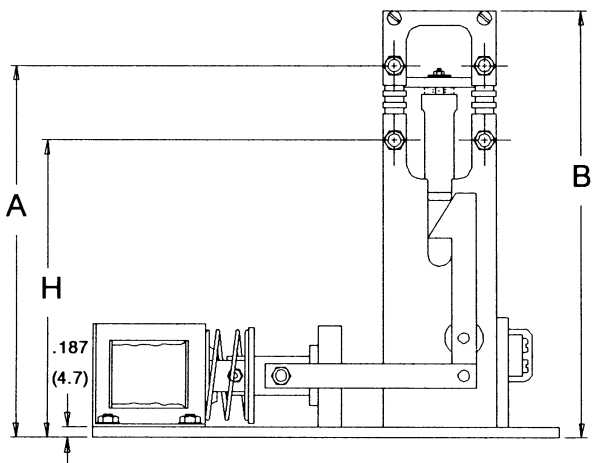
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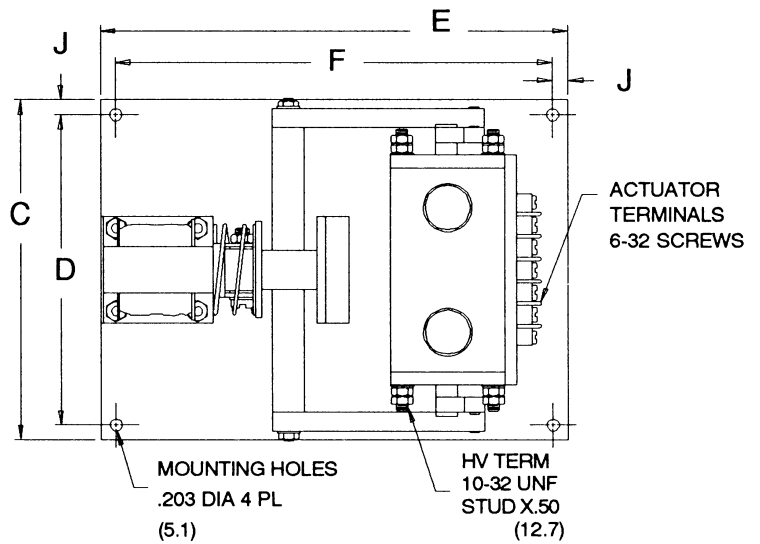
**2PLC**



**4PLC**



**2PDTL**



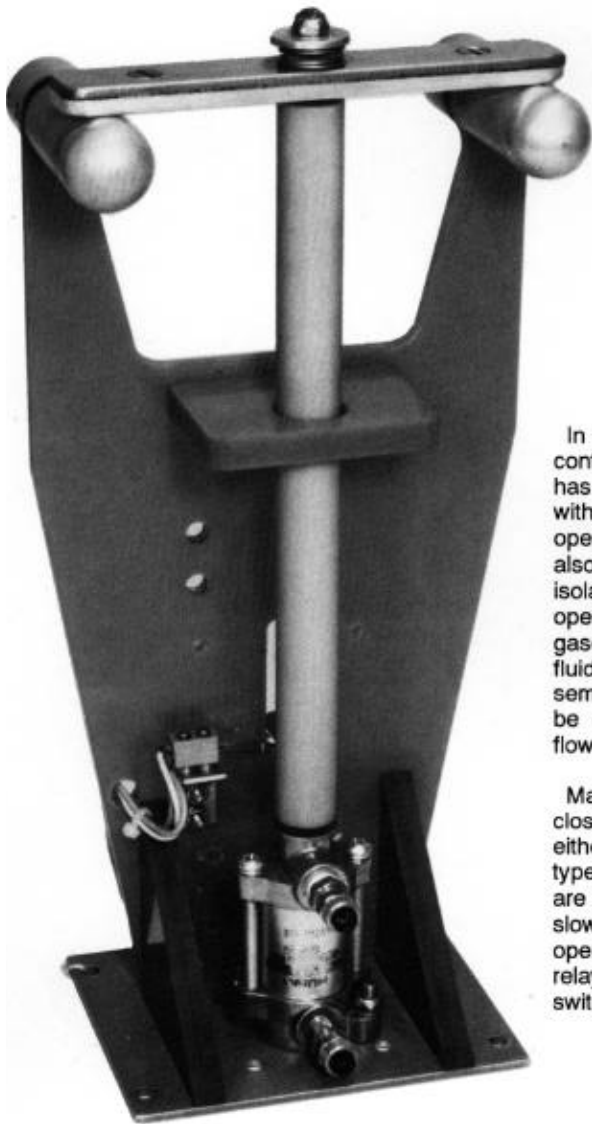
<b>DIMENSIONS</b>									
In Inches (In Millimeters)									
MODEL	A	HEIGHT B	WIDTH C	D	DEPTH E	F	G	H	J
ET2-14-2PLC	4.03 (102.3)	4.22 (107.1)	4.20 (106.6)	3.700 (93.9)	7.10 (180.3)	6.600 (167.6)	3.37 (85.5)	-	.25 (6.3)
ET2-14-2PLO	4.03 (102.3)	4.22 (107.1)	4.20 (106.6)	3.700 (93.9)	7.10 (180.3)	6.600 (167.6)	3.37 (85.5)	-	.25 (6.3)
ET2-14-2PDTL	5.03 (127.7)	5.37 (136.3)	4.20 (106.6)	3.700 (93.9)	7.10 (180.3)	6.600 (167.6)	3.37 (85.5)	4.03 (102.3)	.25 (6.3)
ET4-14-4PLC	5.03 (127.7)	5.37 (136.3)	4.20 (106.6)	3.700 (93.9)	7.10 (180.3)	6.600 (167.6)	3.37 (85.5)	4.90 (124.4)	.25 (6.3)
ET4-14-4PLO	5.03 (127.7)	6.12 (155.4)	4.20 (106.6)	3.700 (93.9)	7.10 (180.3)	6.600 (167.6)	3.37 (85.5)	4.90 (124.4)	.25 (6.3)
ET4-25-4PLC	6.60 (167.6)	7.60 (193.0)	5.20 (132.0)	4.700 (119.3)	7.10 (180.3)	6.600 (167.6)	4.82 (122.4)	5.22 (132.5)	.25 (6.3)
ET4-25-4PLO	6.60 (167.6)	7.60 (193.0)	5.20 (132.0)	4.700 (119.3)	7.10 (180.3)	6.600 (167.6)	4.82 (122.4)	5.22 (132.5)	.25 (6.3)
ET2-25-2PDTL	6.60 (167.6)	7.60 (193.0)	5.20 (132.0)	4.700 (119.3)	7.10 (180.3)	6.600 (167.6)	4.82 (122.4)	5.22 (132.5)	.25 (6.3)

DIMENSIONS ARE FOR REFERENCE ONLY AND ARE SUBJECT TO CHANGE. CONTACT: ROSS ENGINEERING CORPORATION FOR APPLICATION DATA.

**ROSS ENGINEERING CORP.**

CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182

# ***HIGH VOLTAGE AIR OPERATED RELAYS***



**E60-NC-80-1-40-P**

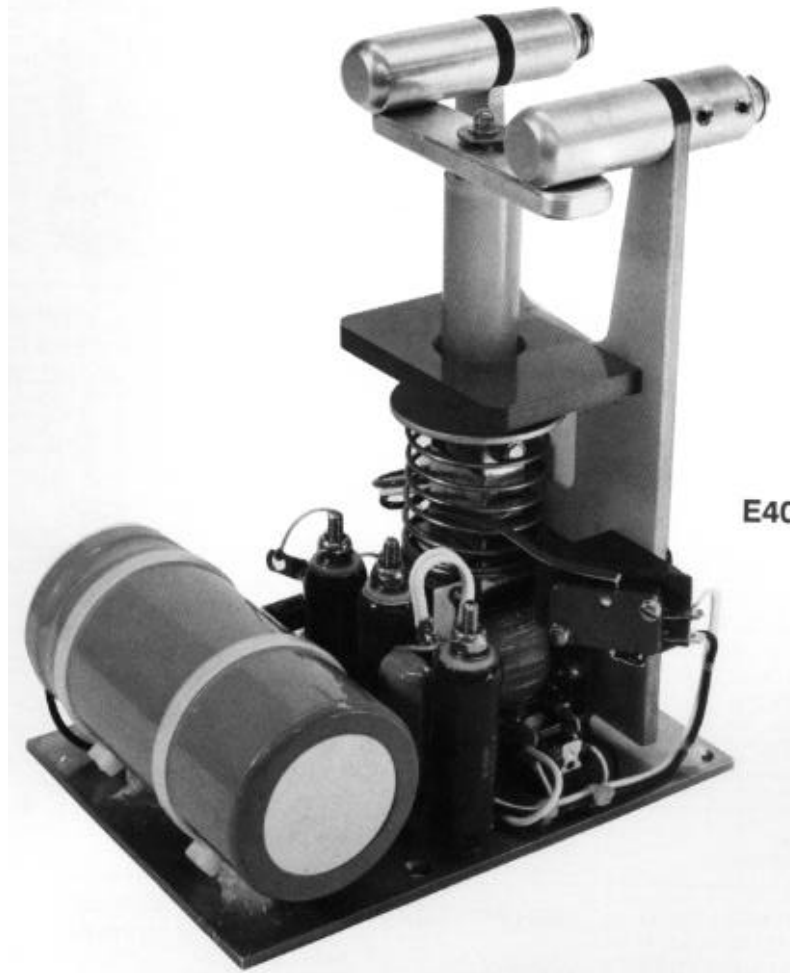


**E40-NO-40-2-40A**

In some high voltage applications it is desirable to have full isolation between control power source and a high voltage relay or switch. Ross Engineering Corporation has developed a wide line of high voltage relays and switches which can be operated with compressed air or other gas at pressures of 80 to 120PSI. Some can be operated at pressures as low as 30PSI. Auxiliary air valve type indicators can also be provided in place of auxiliary electrical type contacts to provide complete isolation for main contact, and also auxiliary control answer backs to indicate full open or closed, or for holding. Units are also available for use in oil or insulating gases, with air exhaust outlets to exterior to avoid contaminating the insulating fluids. Units can be normally open or normally closed with loss of air, or can be semi-latching types requiring air pressure to move in either direction. They can be equipped with quick dump valves for faster action, or with ballast tanks or flow control valves for delayed action.

Manual valves or 3-way control solenoid valves for normally open or normally closed types and 4-way control solenoid valves for operation requiring force in either direction can be provided in a variety of coil voltages. High voltage insulating type polypropylene air tubing rated to 250PSI can be supplied. Moisture traps are also available if necessary. Use of air pressure operation, although usually slower than an electrical solenoid, provides faster action and longer life than motor operation and higher forces than solenoids. Use of air pressure allows the standard relay current range of 1ma to 200 AMPS to be extended to a line of high current switches up to 36,000 AMPS continuous.

# HIGH VOLTAGE DELAYED OPENING AND/OR CLOSING RELAYS



**E40-NC-40-1-ZA**

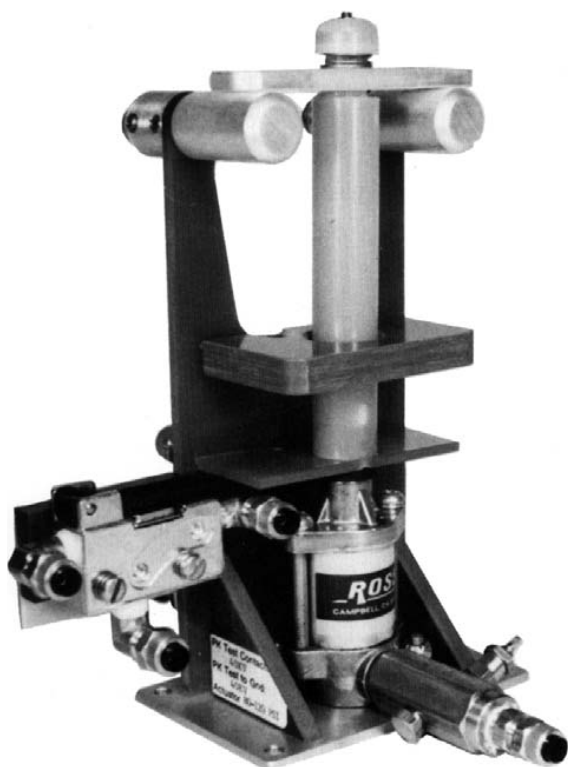
For some applications in high voltage control and safety, a delayed action but positive automatic closing (normally closed) or opening (normally open) of high voltage relays or contactors upon accidental loss or normal shut down of control power is desirable if not mandatory. In some cases these are desirable in place of latching types which require momentary power to both close and open, rather than automatically changing positions with deliberate removal or accidental loss of control power. Ross Engineering Corporation has developed a line of High Voltage relays with automatic delay, but positive closing or opening on turn-off or loss of power. They are designed for safety shorting and for use with HV power supplies having stored energy which must not be discharged, or current flow which must not be interrupted accidentally before a prescribed time after shut down or loss of power, even though the units must be held in position only when there is control voltage applied. These relays cover the useful range of 1KV to 200KV DC or PK AC with peak test voltages up to 300KV. These HV relays/contactors have useful continuous current ratings from 0.001 AMP to 200 AMPS. They are available in both open types and sealed vacuum types. The open type has current closing capability only, the sealed vacuum type has a 10 AMP DC interrupt capability and up to 2,000 AMP AC interrupt capability. Higher continuous current and AC interrupt capabilities are also available in heavy duty units.

**ROSS ENGINEERING CORP.**

CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182

# AIR OPERATED RELAY

# 12 TO 40 KV



In some high voltage applications it is desirable to have full isolation between control power source and a high voltage relay or switch. Ross Engineering Corporation has developed a wide line of high voltage relays and switches which can be actuated with compressed air or other gas at pressures of 80 to 120 PSI. Some can be actuated at pressures as low as 30 PSI. UP TO 300 KV PK TEST UNITS ARE ALSO AVAILABLE.

Auxiliary air valve type indicators can also be provided in place of auxiliary electrical type contacts to provide complete isolation for main contact, and also auxiliary control answer-backs to indicate full open or closed, or for holding.

Units are also available for use in oil or insulating gases. When placed in oil or insulating gases voltage ratings are increased up to 3 times. Air exhaust outlets to exterior are provided to avoid contaminating the insulating fluids or impeding the cylinder action. Units can be normally open or normally closed with loss of air pressure or can be semi-latching types requiring air pressure to move in either direction.

They can be equipped with quick dump valves for faster action, or with ballast tanks or flow control valves for delayed action.

Manual or 3 way control solenoid valves for normally open or normally closed types and 4 way control solenoid valves for 2 way operation can be provided in a variety of coil voltages as well as high voltage insulating type polypropylene air tubing rated to 250 PSI. Moisture traps are also available if necessary.

Use of air pressure operating although usually slower than an electrical solenoid, provides faster action and longer life than motor operation and higher forces than solenoids. In the switch types use of air pressure allows the standard relay current range of 1ma to 200 AMPS also to be extended to a line of high current switches up to 36,000 AMPS continuous.

## SPECIFICATIONS

760MMHg 20°C Ambient

RELAY MODEL	CONTACT FORM	1 MINUTE PEAK TEST RATING DC OR AC PK		*CURRENT RATINGS NEW & DUST FREE			MAX CONTACT RESISTANCE	OPERATE TIME	RELEASE TIME	ACTUATOR PRESSURE
		H V CONTACT	INSULATION TO GROUND	CONTINUOUS AMPS RMS	MOMENTARY 10 CYCLE AMPS RMS	MOMENTARY CAPACITOR DISCHARGE 20USEC		MAX MS	MAX MS	
E-12-NC	SPNC	12 KV	12 KV	50 A	1,000 A	2,500 A	0.001 ohm	20	50/90	80 TO 120 PSI AIR
E-12-NO	SPNO	12 KV	12 KV	50 A	1,000 A	2,500 A	0.001 ohm	20/40	30	80 TO 120 PSI AIR
E-12-DT	SPDT	12 KV	12 KV	50 A	1,000 A	2,500 A	0.001 ohm	20/40	50/90	80 TO 120 PSI AIR
E-15-NC	SPNC	15 KV	15 KV	125 A	1,000 A	2,500 A	0.0008 ohm	20	50/90	80 TO 120 PSI AIR
E-15-NO	SPNO	15 KV	15 KV	125 A	1,000 A	2,500 A	0.0008 ohm	20/40	30	80 TO 120 PSI AIR
E-15-DT	SPDT	15 KV	15 KV	125 A	1,000 A	2,500 A	0.0008 ohm	20/40	50/90	80 TO 120 PSI AIR
E-25-NC	SPNC	25 KV	25 KV	125 A	1,000 A	2,500 A	0.0008 ohm	20	50/90	80 TO 120 PSI AIR
E-25-NO	SPNO	25 KV	25 KV	125 A	1,000 A	2,500 A	0.0008 ohm	20/40	30	80 TO 120 PSI AIR
E-25-DT	SPDT	25 KV	25 KV	125 A	1,000 A	2,500 A	0.0008 ohm	20/40	50/90	80 TO 120 PSI AIR
E-30-DT-40	SPDT	30 KV	40 KV	125 A	1,000 A	2,500 A	0.0008 ohm	30/50	100/140	80 TO 120 PSI AIR
E-40-NC	SPNC	40 KV	40 KV	125 A	1,000 A	2,500 A	0.0008 ohm	20	60/100	80 TO 120 PSI AIR
E-40-NO	SPNO	40 KV	40 KV	125 A	1,000 A	2,500 A	0.0008 ohm	20/40	30	80 TO 120 PSI AIR

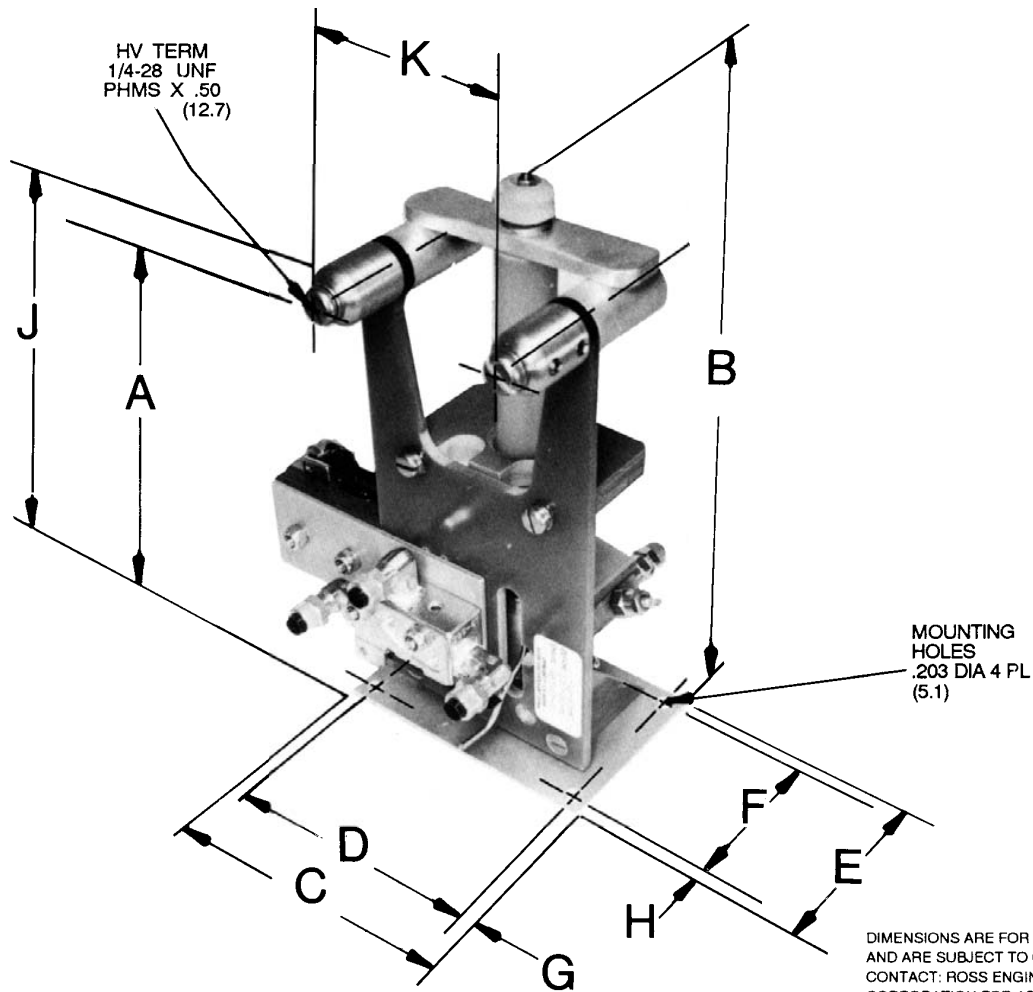
HIGHER VOLTAGES AND CURRENTS AVAILABLE TO 300 KV PK TEST. (Refer to Brochure B-1001.) EITHER ELECTRICAL OR AIR VALVE TYPE AUXILIARY CONTACTS AVAILABLE ON ALL MODELS. ADDITIONAL INSULATION TO GROUND AND RF INSULATION AVAILABLE FOR FREQUENCIES TO 30 MHz OR MORE. FOR MAXIMUM CONTINUOUS CURRENT RATINGS, SILVER ALLOY CONTACTS ARE OPTIONAL. FOR HIGH CLOSING CURRENTS, TUNGSTEN ALLOY CONTACTS ARE OPTIONAL. TUNGSTEN ALLOY CONTINUOUS CURRENT RATINGS ARE REDUCED.

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*DIMENSIONS										
MODEL	In Inches (In Millimeters)									
	A	HEIGHT B	WIDTH C	D	DEPTH E	F	G	H	J	K
E-12-NC	4.41 (112.0)	4.72 (119.8)	2.50 (63.5)	2.125 (53.9)	1.88 (47.7)	1.187 (30.1)	.25 (6.3)	.19 (4.8)		1.12 (28.7)
E-12-NO	4.41 (112.0)	5.67 (144.0)	2.50 (63.5)	2.125 (53.9)	1.88 (47.7)	1.187 (30.1)	.25 (6.3)	.19 (4.8)		1.12 (28.7)
E-12-DT	4.41 (112.0)	5.97 (151.6)	2.75 (69.8)	2.250 (57.1)	2.19 (55.6)	1.187 (30.1)	.25 (6.3)	.25 (6.3)	5.65 (143.5)	1.12 (28.7)
E-15-NC	4.88 (123.9)	5.25 (133.3)	2.75 (69.8)	2.250 (57.1)	2.19 (55.6)	1.187 (30.1)	.25 (6.3)	.25 (6.3)		1.50 (38.1)
E-15-NO	4.88 (123.9)	6.25 (158.7)	2.75 (69.8)	2.250 (57.1)	2.19 (55.6)	1.187 (30.1)	.25 (6.3)	.25 (6.3)		1.50 (38.1)
E-15-DT	4.88 (123.9)	6.75 (171.4)	3.38 (85.8)	2.875 (73.0)	2.19 (55.6)	1.125 (28.8)	.25 (6.3)	.25 (6.3)	6.38 (162.0)	1.50 (38.1)
E-25-NC	5.48 (139.1)	5.85 (148.5)	2.75 (69.8)	2.250 (57.1)	2.19 (55.6)	1.187 (30.1)	.25 (6.3)	.25 (6.3)		1.50 (38.1)
E-25-NO	5.48 (139.1)	7.06 (179.3)	2.75 (69.8)	2.250 (57.1)	2.19 (55.6)	1.187 (30.1)	.25 (6.3)	.25 (6.3)		1.50 (38.1)
E-25-DT	5.48 (139.1)	7.67 (194.8)	3.38 (85.8)	2.875 (73.0)	2.19 (55.6)	1.125 (28.8)	.25 (6.3)	.25 (6.3)	7.31 (185.6)	1.50 (38.1)
**E-30-DT-40	6.72 (170.6)	9.03 (229.3)	4.38 (111.2)	3.875 (98.4)	3.50 (88.9)	1.562 (39.6)	.97 (24.6)	.25 (6.3)	8.65 (219.7)	2.62 (66.5)
E-40-NC	6.72 (170.8)	7.18 (182.3)	3.38 (85.8)	2.875 (73.0)	2.19 (55.6)	1.125 (28.8)	.25 (6.3)	.25 (6.3)		2.62 (66.5)
E-40-NO	6.72 (170.6)	8.79 (223.2)	3.38 (85.8)	2.875 (73.0)	2.19 (55.6)	1.125 (28.8)	.25 (6.3)	.25 (6.3)		2.62 (66.5)

\* If air valve type auxiliary contacts are added consult Engineering Dept. for increase in dimensions.

\*\* FOR DIMENSIONS REFER TO  
BROCHURE B-1001. (E30-DT-40)

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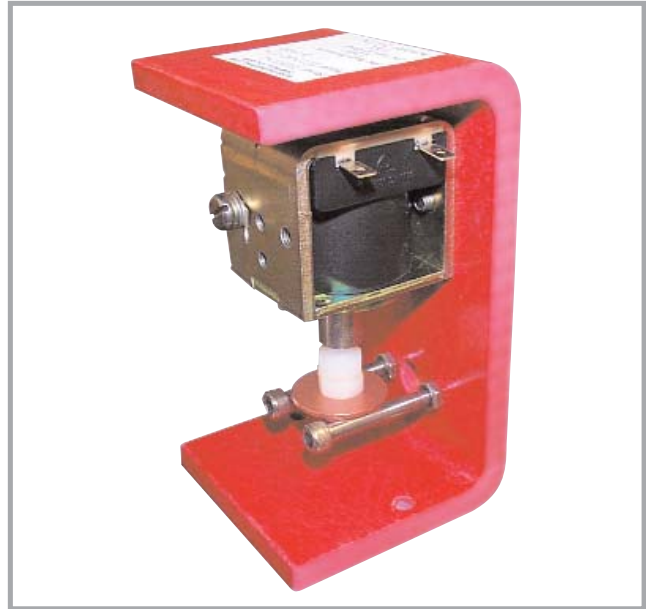


# EC12 HIGH VOLTAGE RELAY

B-1001-G

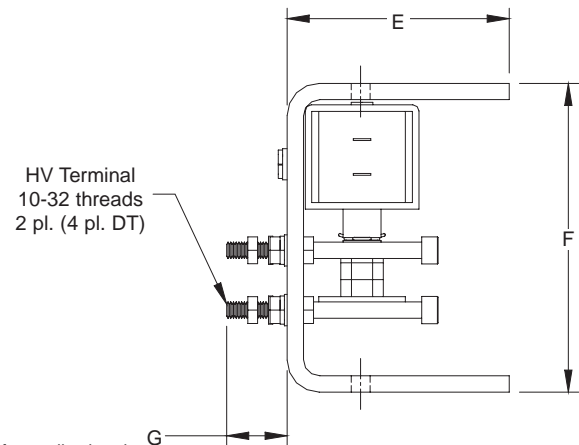
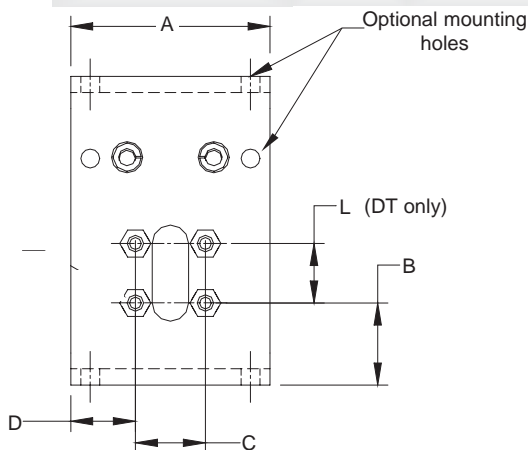
## LOWCOST SAFETYTRANSFER, SHORTING OR GROUNDING FOR LOW ENERGY HV SOURCES

The EC Series is a low cost gravity closing High Voltage safety transfer or shorting relay, for use with HV sources where currents and energy are low but voltages are high enough to cause injury to personnel, or damage to instrumentation if not dissipated solidly, short circuited, or grounded. The EC series relays are designed to be mounted on a floor or optionally to a ceiling or a wall with proper clearances to HV terminals of at least 3/8 through air, more if across insulating surfaces. It can be optionally modified by Ross Engineering Corp. at additional cost or by the user by adding mounting holes and by cutting off sections if necessary to reduce size to fit. Actuation life is more than 250,000 close-open operations in a 0°C to 40°C ambient. Operate time is approximately 20 milliseconds. New contact resistance is approximately 0.1 ohm.



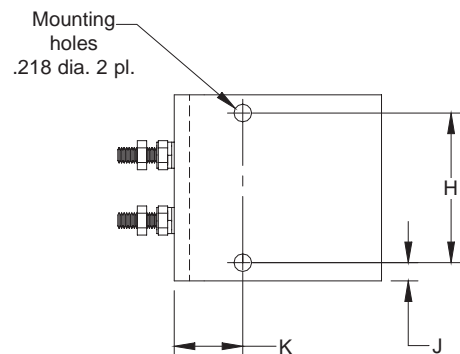
### SPECIFICATIONS

MODEL	PK TEST 1 Min. NTP	Max Operate DC or PK AC	Max Continuous Current	Max Shorting Current		Actuator Voltage	Current 20°C	
				20 uSec RC PK	170 Millisec PK		In-Rush	Hold
EC12-NC/NO/DT-12-0-0-BD	12KV	10KV	10A RMS	500A PK	20A PK	115V 50/60 Hz	0.4A	0.1A
EC12-NC/NO/DT-12-0-5-BD	12KV	10KV	10A RMS	500A PK	20A PK	24V DC	0.45A	0.45A



Dimensions are for reference only and are subject to change. Contact: Ross Engineering Corp. for application data.

MODEL	Standard Dimensions			Inches (Millimeters)							
	A	B	C	D	E	F	G	H	J	K	L
EC12-NC/NO-12-0-0-BD	2.30 (58.4)	.95 (24.1)	.81 (20.5)	.75 (18.9)	2.56 (65.1)	3.56 (60.5)	.68 (17.3)	1.850 (46.99)	.23 (5.7)	.85 (21.5)	
EC12-DT-12-0-0-BD	2.30 (58.4)	.95 (24.1)	.81 (20.5)	.75 (18.9)	2.56 (65.1)	3.56 (60.5)	.68 (17.3)	1.850 (46.99)	.23 (5.7)	.85 (21.5)	.75 (18.9)
EC12-NC/NO-12-0-5-BD	2.50 (63.5)	.95 (24.1)	.81 (20.5)	.85 (18.9)	2.50 (63.5)	4.50 (114.3)	.62 (15.7)	2.050 (52.07)	.22 (5.7)	1.10 (27.9)	
EC12-DT-12-0-5-BD	2.50 (63.5)	.95 (24.1)	.81 (20.5)	.85 (18.9)	2.50 (65.1)	4.50 (114.3)	.62 (15.7)	2.050 (52.07)	.22 (5.7)	1.10 (27.9)	.75 (18.9)



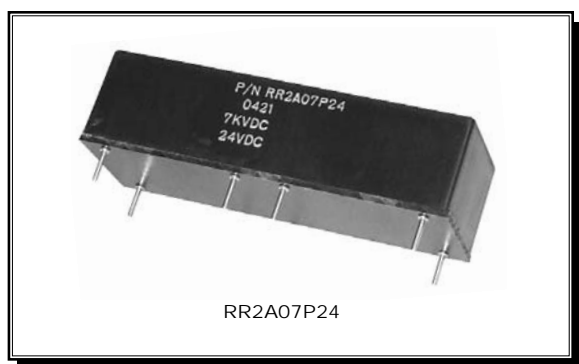
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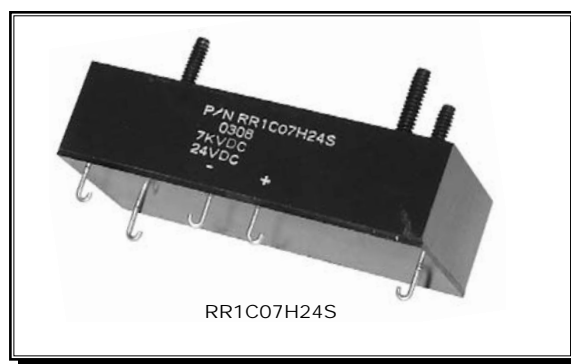
# HIGH VOLTAGE REED RELAYS



RR1A07Q24



RR2A07P24



RR1C07H24S

- 5KV TO 15KV PEAK TEST
- 3A CONTINUOUS
- 50VA MAX INTERRUPT
- NO, NC, DT SINGLE & MULTI-POLE
- HIGH VIBRATION / SHOCK RESISTANCE
- TAPPED BASE, TURRET OR HOOK TERMINALS, PC BOARD MOUNTING, QUICK DISCONNECT OR HV LEADS AVAILABLE
- SAFETY ENCAPSULATION
- HV LEADS AVAILABLE
- COMPACT
- LONG LIFE



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## APPLICATION DATA

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### RR SERIES

Ross Engineering Corp. RR Series compact, long life HV reed relays are encapsulated coil/reed types. They are built for HV switching applications with low current requirements. Normal use includes isolated contact to contact or contact to ground, HV tap or load selection, HV transfer or grounding applications; for over 10 million cold switching operations.

NOTE: These units are not for capacitor discharge unless PK current is limited to current within volt amp rating or 3A RMS (4.2A peak)

### AC & DC OPERATE

Ross HV reed relays are rated PK test 1 minute from 5KV to 15KV AC PK or DC; 3A continuous; max 50VA current make or break. Operate times are 1 to 10 milliseconds, depending on model. Continuous use up to 1/2 to 3/4 of peak test voltage depending on application.

Current ratings are with contacts firmly closed and not subject to extreme vibration or shock at the time of current flow. Switched volt amp (or watt) ratings must be observed and are for both closing and interrupting. Care must be taken that energy in charged lines, capacitors or inductors cannot create high peak discharge or inrush currents, or excessive recovery over-voltages. If closing PK currents are exceeded, contacts may weld or have excessive erosion. If interrupting currents or recovery voltages are excessive, contacts may not interrupt or will have excessive erosion and loss of with-

stand voltage. When used as interrupters, transient suppression consisting of a capacitor, in series with an inrush limiting resistor, or other suppressor, across the load side, is possible if closing inrush is limited to contact rating 50VA, 3A max.

### MAXIMUM CREEP DISTANCE

To avoid flashover, shorting due to over-voltage, and environmental or moisture contamination, Ross provides its HV reed relays with maximum creep distance between actuator terminals and HV terminals. Units are designed with as much as 2.20 inches per 10KV creep distance between HV terminals .

### SAFETY ENCAPSULATION

Most coil and reed components are encapsulated in void-free, low-loss flexible insulating compound for blocking out contaminants, minimizing corona and serving as a buffer against high shock and vibration.

### MOUNTING & TYPES

Ross RR SERIES Reed Relays are available in NO, NC, DT, single or multi-pole designs. They are built in four styles: for PC board pin mounting (type P); for universal base mounting with tapped holes; with sealed HV insulated leads to eliminate exposed high voltage connections (type L); for base mounting with solder turret terminals (type T), tapped terminals or quick disconnect terminals.

Variations of Ross HV reed relays for special applications may be ordered by contacting the factory.



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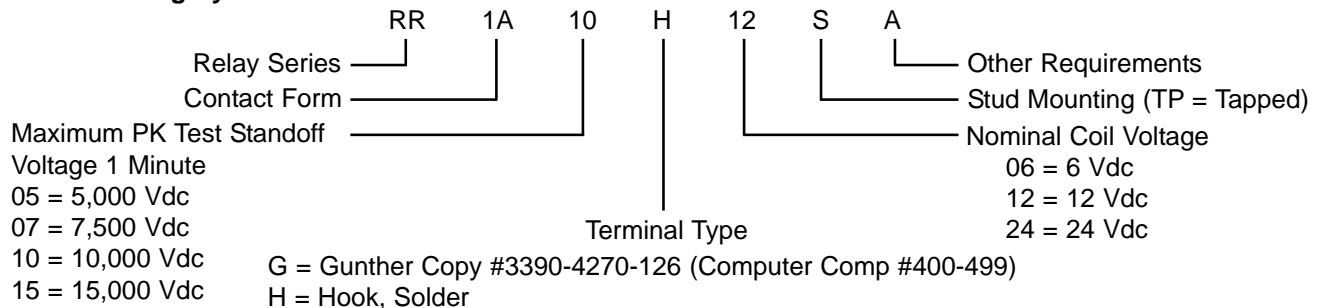
# HIGH VOLTAGE REED RELAYS

Contact Form			1 Minute PK Test Standoff Max Vdc	50 Watts Switching Max Vdc	Width Inches	Terminal Layout	*DC Coil Resistance Ohms		
# Poles	PK Test	Contacts					6 Vdc	12 Vdc	24 Vdc
1A	7	NO	7,500	5,000	0.750	1A	60	240	1000
1A	10	NO	10,000	7,500	0.750	1A	45	180	720
1A	15	NO	15,000	10,000	0.750	1A	35	125	500
1B	7	NC	7,500	5,000	1.000	1B	50	200	800
1B	10	NC	10,000	7,500	1.000	1B	40	150	600
1B	15	NC	15,000	10,000	1.000	1B	25	100	400
1C	5	DT	5,000	2,500	0.750	1C05	60	240	1000
1C	7	DT	7,500	5,000	1.375	1C07	50	200	800
1C	10	DT	10,000	7,500	1.375	1C10	45	180	720
1C	15	DT	15,000	10,000	1.800	1C15	35	125	500
2A	7	NO	7,500	5,000	1.000	2A	50	200	800
2A	10	NO	10,000	7,500	1.000	2A	40	150	600
2A	15	NO	15,000	10,000	1.000	2A	25	100	400
2B	5	NC	5,000	2,500	1.000	2B	60	240	1000
2C	5	DT	5,000	2,500	1.000	2C	60	240	1000

### Contact Ratings:

Maximum Switching Power: 50 watts/volt amps, see table above. 200 watts also available. Add /200VA to Model #  
 Maximum Switching Current: 3.0 amps  
 Maximum Switching Voltage: see table above  
 Standoff Voltage: see table above

### Part Numbering System:



- 05 = 5,000 Vdc
- 07 = 7,500 Vdc
- 10 = 10,000 Vdc
- 15 = 15,000 Vdc
- G = Gunther Copy #3390-4270-126 (Computer Comp #400-499)
- H = Hook, Solder
- L = HV Leads, 12" Std. Also designate what LV terminals are: such as L/P, L/LV, etc.
- LV = LV Leads, 12" Std.
- P = PC Pin
- Q = Quick Disconnect
- S = Stud Mounting
- T = Turret, Solder
- TP = Tapped Mounting Holes

Example: RR1A10P12 is a One Pole, Form A, 10 KVdc, Pin Terminal, 12 Volt Coil, High Voltage Relay

\* AC Coils also available 24V - 120V 50/60Hz using full wave bridge rectified.

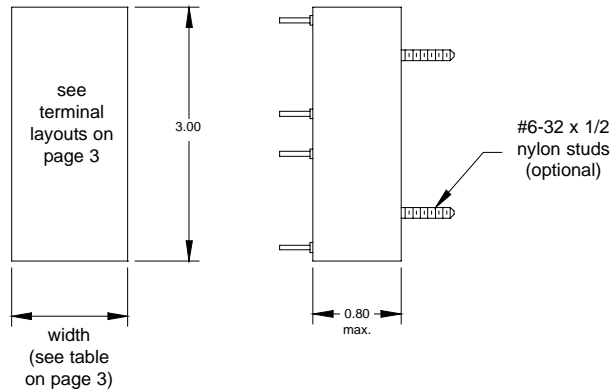
\* XA special higher current 5KV operate 6.5KV max 5 sec test, 2.5KV 200VA max interrupt.



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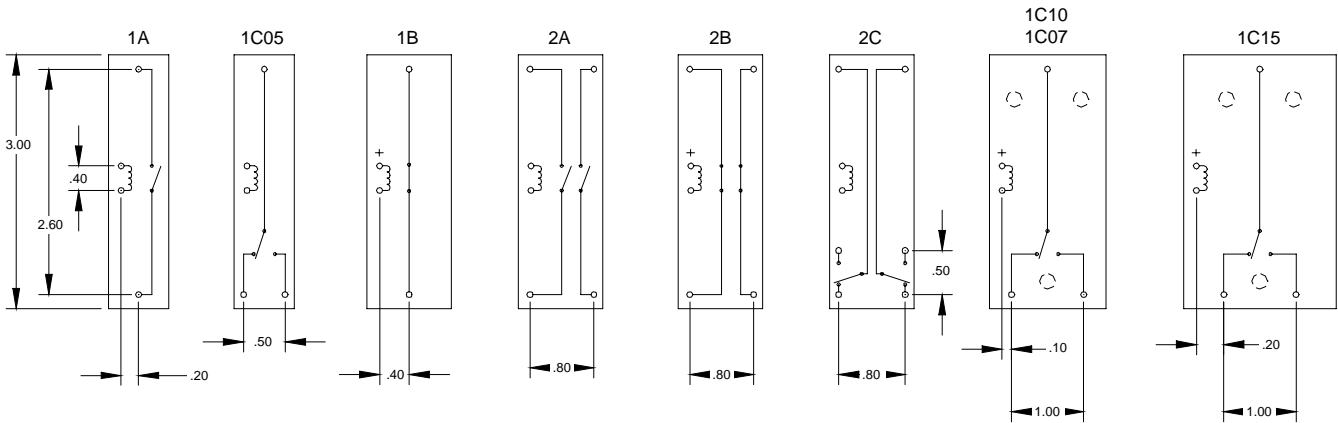
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# HIGH VOLTAGE REED RELAYS TO 15KV

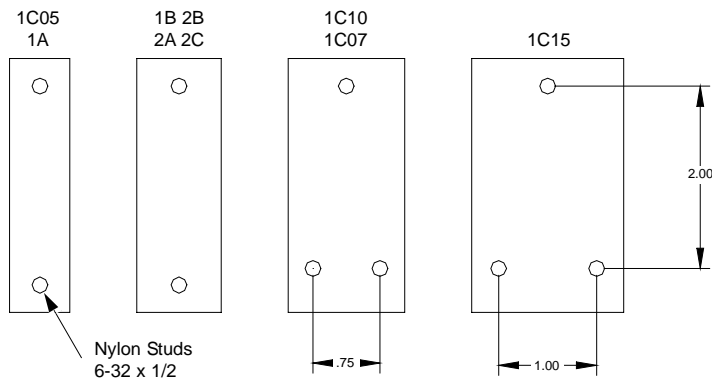


## CONTACT FORMS A, B & C

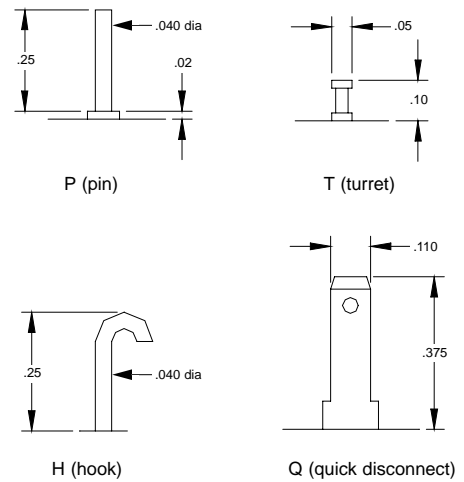
### TERMINAL LAYOUTS (bottom view)



### MOUNTING LAYOUTS (optional)



### TERMINAL OPTIONS



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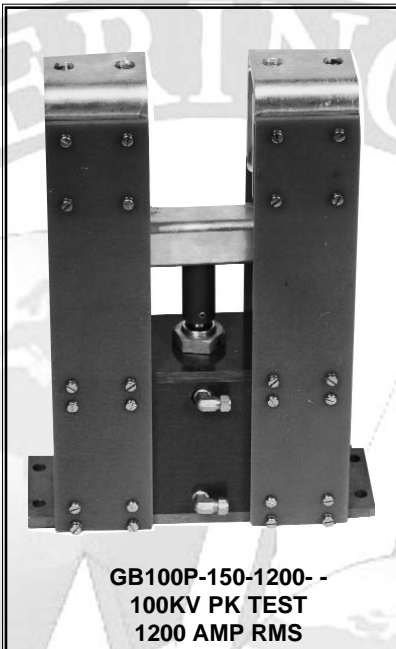
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# HIGH CURRENT SWITCHES



**GD-27-DTP-27-4000- -  
27KV PK TEST  
4000 AMP RMS**

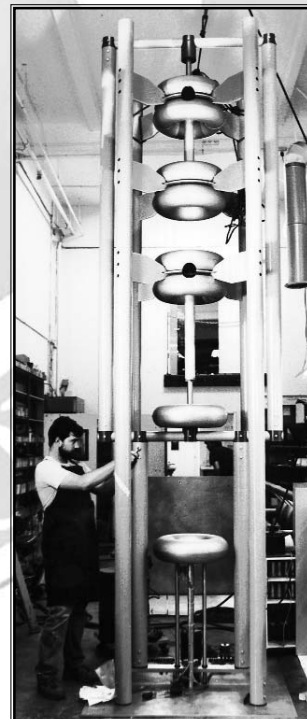


**GB100P-150-1200- -  
100KV PK TEST  
1200 AMP RMS**



**GA-25-DTP-25-600- -  
25KV PK TEST  
600 AMP RMS**

- 6V TO 450KV DC/AC PEAK TEST
- TO 8,000A CONTINUOUS
- LONG LIFE
- OVER 1,000,000A PULSE
- AIR, OR MOTOR OPERATED
- MULTI-POLE, DT & LATCHING TYPES
- FOR ELECTRONIC, POWER, RF
- HV TRANSFER, GROUNDING, TAP, LOAD SELECTION & CAPACITOR DISCHARGE
- ARCING CONTACTS OPTIONAL FOR CLOSING CURRENT



**GD350-DTM-350-6000- -  
DOUBLE THROW  
350KV PK TEST  
6000 AMP RMS DC-60Hz  
3000 AMP RMS 10KHz  
1700 AMP RMS 30KHz**



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# APPLICATION DATA

## GENERAL-USES

Ross Engineering's high current switches have very low contact resistance. They are used for power, RF, capacitor discharge, pulse, transfer, and tap selection. They are used on low and high voltage power loads or with multiple capacitor banks for isolated no-load selection, transfer or grounding. By using non-conductive air or hydraulic lines, no electrical or mechanical ties to contact mechanism are required. Also, when specially built, the units can be used for high current RF applications. Units are built with G-10 epoxy glass laminate insulation for standard applications and G-7 silicone glass insulation for RF applications above 100KHz. Heavy duty contacts, specially designed to minimize corona, are built of highly conductive but weld resistant alloys. Units are able to withstand high shock, vibration, and severe environmental conditions. Simple mechanical design and conservative stress levels result in long life, and trouble-free performance. Additionally, units are built of light-weight material and are of the smallest dimensions possible for full performance within their power ranges. They are easily installed and used in the most compact compartments.

## HIGH CONTACT CLOSING FORCE

High contact closing force enables high momentary current. When required, special arcing contacts allow closing capabilities.

## ACTUATORS

Standard Ross high current switches are built with 80 to 120PSI air cylinder actuators. Hydraulic cylinder or motor operated models are also available.

## PEAK TEST VOLTAGE

Ratings are for air at 760 mmHg, 20°C. Derate voltage withstand approx. 3 to 4% per 1000ft above sea level. See page 3. All peak test voltages are 1 minute, 60Hz peak hold voltages unless otherwise noted. The first figure in the model number is the peak test rating between open contacts. If there is only one figure in the model number, the insulation level to ground is the same as that between open contacts. If there is a number following the contact configuration designation, that is the rated peak test voltage to ground. On most nonspherical contacts, transient pulse withstand may be considerably higher than 60Hz test level. Actual flashover values, are at least 10% greater than rated 1 minute peak test hold values for DC & 60Hz, or transients. Corona starts at approximately 2/3 peak test voltage.

## OPERATE VOLTAGE

Rated voltages should be derated approximately 3 to 4% per 1000ft above sea level. The peak test rating of high current switches should be 1.2 to 5 times the normal circuit operating voltage, depending upon the application. For lower power systems where transients are unlikely or intermittent flashover is of no consequence, a safety factor of 1.2 to 1.5 may be suitable. For medium power systems or where moderate tran-

sients are likely, a safety factor of 1.5 to 3 is desirable and 2 to 3 recommended. For higher power systems or where transient over-voltages are expected, a safety factor of 2.5 to 5 should be considered and the factor should be based on the maximum probable transient. The rated peak test voltage to ground should be selected in the same way, as was the contact to contact value. If a value other than the published rating is required, it can normally be supplied as an extra cost option.

## CURRENT RATINGS

Specified current ratings are continuous for 60Hz RMS and DC, but should be derated at higher frequencies as well as approximately 0.5% per 1000ft above sea level. Some units can be used in RF applications at reduced current ratings. At 10KHz, derate current by 50%. Above 10KHz, derate to approximately  $\frac{1}{2}(10/f \text{ KHz})^{-1/2}$ , (i.e. at 30KHz derate to 29% of 60Hz rating). All RF applications should be submitted to Ross' application engineering department for review. Air or motor actuated high current switches are normally capable of interrupting or making only very low currents depending on type of wave, load, and recovery voltage. HV high current switches are also rated for safety grounding and high current capacitor discharge with special arcing contacts. They have long life and little or no maintenance in most applications.

## INSULATION

G-10 epoxy glass laminate is standard insulation on most models. G-7 silicone glass is used in models for RF applications above 100KHz. Most Ross high current switches are available with additional lengths of insulation where the high voltage contacts need to be spaced at a greater distance from the actuator and control circuit.

## OIL OR GAS INSULATION

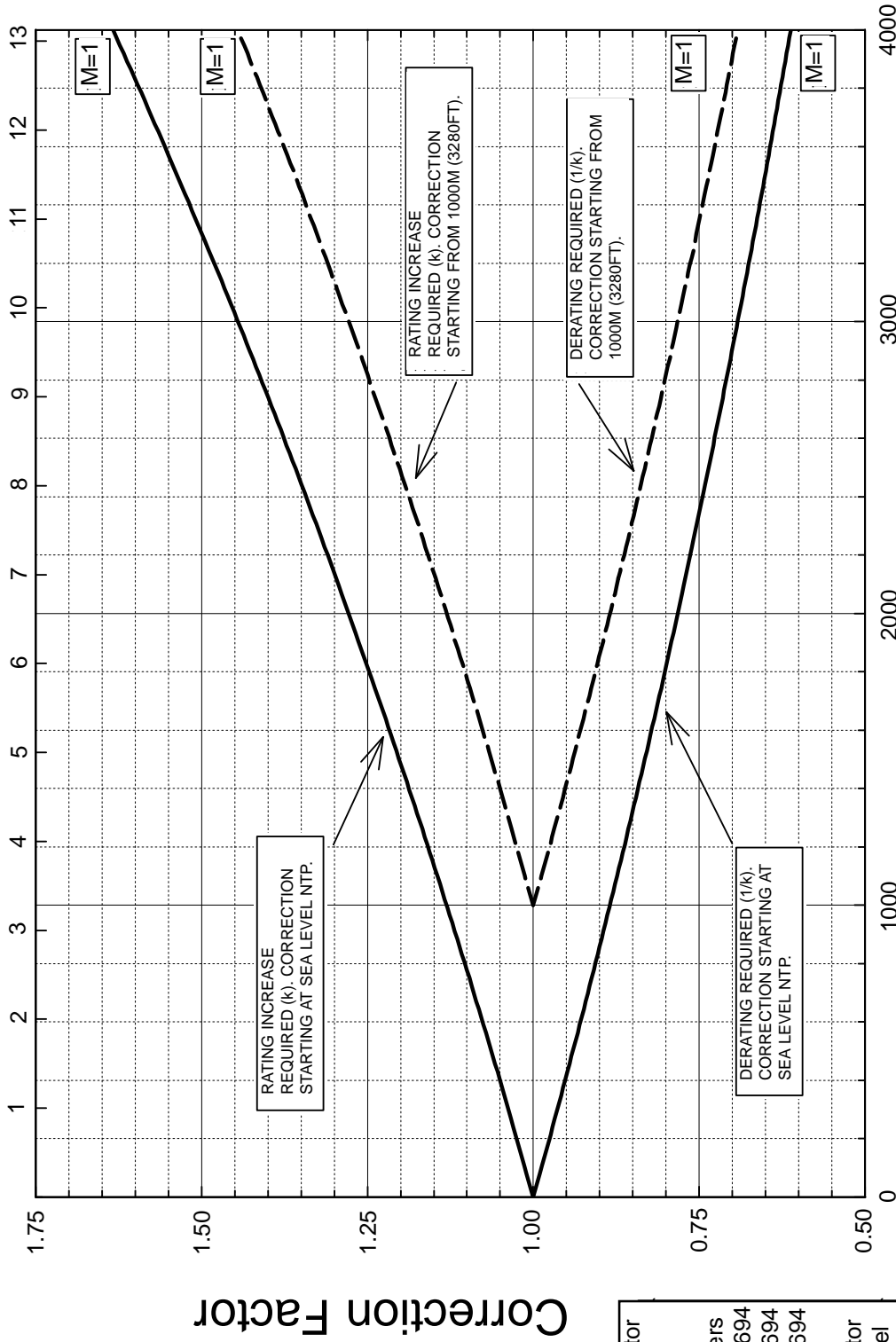
Voltage withstand value is at least doubled and the interrupt capability is much greater when high current switches are immersed in insulating oil, or SF6 gas. For gas atmospheres no modification is necessary, however oil or fluid immersion requires modification at a slight extra cost. For maximum performance, where high voltage and high current is impressed directly across solid insulation, it may be necessary to increase insulation length to prevent puncture at levels above the test rating in air. Additionally, most Ross high current switches can be mounted in any attitude. Contact the factory's application engineering department for mounting recommendations, and for ratings in gases at higher pressures (see IEEE, IEC, or ANSI standards).

## AUXILIARY CONTACTS

Air type SPDT valves or SPDT 15 amp 450V auxiliary contacts for position indicating or interlocking are available on request on all Ross high current switches.

# ALTITUDE CORRECTION FACTOR

Altitude (Feet x 1000)



Altitude (Meters)

Correction Factor

For correction factor starting at 1000M  
 $k=e^{m(H)/8190}$   
 H=Altitude in meters  
 m=1 see IEC60694  
 m=0.9 see IEC60694  
 m=.75 see IEC60694

For correction factor starting at sea level  
 $k=e^{m(H)/8190}$   
 H=Altitude in meters\*  
 m=1 see IEC60694  
 m=0.9 see IEC60694  
 m=.75 see IEC60694

\*See also IEEE Standard 1247

This series is used for moderate to high power applications. The compact GA series high current switches are butt contact types and are air cylinder operated. Ratings are 12 to 80 KV PK test with current level ranges of 400 or 600 amps continuous; to 10,000 amps RMS momentary,

10 cycle; and to 50,000 amps capacitor discharge, 20 uSEC. Units are designed with 2 or more SPDT auxiliary contacts or air valve type position indicators as optional accessories.

SPECIFICATIONS ARE FOR REFERENCE ONLY AND ARE SUBJECT TO CHANGE.  
CONTACT ROSS ENGINEERING CORP. FOR APPLICATION DATA.

SPECIFICATIONS									
MODEL	CONTACT FORM	PEAK TEST KV RATING		CURRENT RATING AMPS MAX (CLOSED)			NOMINAL CONTACT RESISTANCE OHMS	ACTUATOR 80-120PSI AIR PRESSURE	
		CONTACT TO CONTACT	*CONTACT TO ACTUATOR	CONTINUOUS RMS AMPS	MOMENTARY 10 CYCLE OR 160mS	CAPACITOR DISCHARGE		TO CLOSE	TO OPEN
GA-12-NCP	SPNC	12	12	400	8,000	40,000	.0001	AIR/SPRING RETURN	AIR PRESSURE
GA-12-NOP	SPNO	12	12	600	10,000	50,000	.00005	AIR PRESSURE	AIR/SPRING RETURN
GA-12-DTP	SPDT	12	12	600/400	10,000/8,000	50,000/40,000	.00005/.0001	AIR PRESSURE	AIR PRESSURE
GA-12-P	SPST	12	12	600	10,000	50,000	.00005	AIR PRESSURE	AIR PRESSURE
GA-25-NCP	SPNC	25	25	400	8,000	40,000	.0001	AIR/SPRING RETURN	AIR PRESSURE
GA-25-NOP	SPNO	25	25	600	10,000	50,000	.00005	AIR PRESSURE	AIR/SPRING RETURN
GA-25-DTP	SPDT	25	25	600/400	10,000/8,000	50,000/40,000	.00005/.0001	AIR PRESSURE	AIR PRESSURE
GA-25-P	SPST	25	25	600	10,000	50,000	.00005	AIR PRESSURE	AIR PRESSURE
GA-50-NCP	SPNC	50	50	400	8,000	40,000	.0001	AIR/SPRING RETURN	AIR PRESSURE
GA-50-NOP	SPNO	50	50	600	10,000	50,000	.00005	AIR PRESSURE	AIR/SPRING RETURN
GA-50-DTP	SPDT	50	50	600/400	10,000/8,000	50,000/40,000	.00005/.0001	AIR PRESSURE	AIR PRESSURE
GA-50-P	SPST	50	50	600	10,000	50,000	.00005	AIR PRESSURE	AIR PRESSURE
GA-80-NCP	SPNC	80	80	400	8,000	40,000	.0001	AIR/SPRING RETURN	AIR PRESSURE
GA-80-NOP	SPNO	80	80	600	10,000	50,000	.00005	AIR PRESSURE	AIR/SPRING RETURN
GA-80-DTP	SPDT	80	80	600	10,000	50,000	.00005	AIR PRESSURE	AIR PRESSURE
GA-80-P	SPST	80	80	600	10,000	50,000	.00005	AIR PRESSURE	AIR PRESSURE

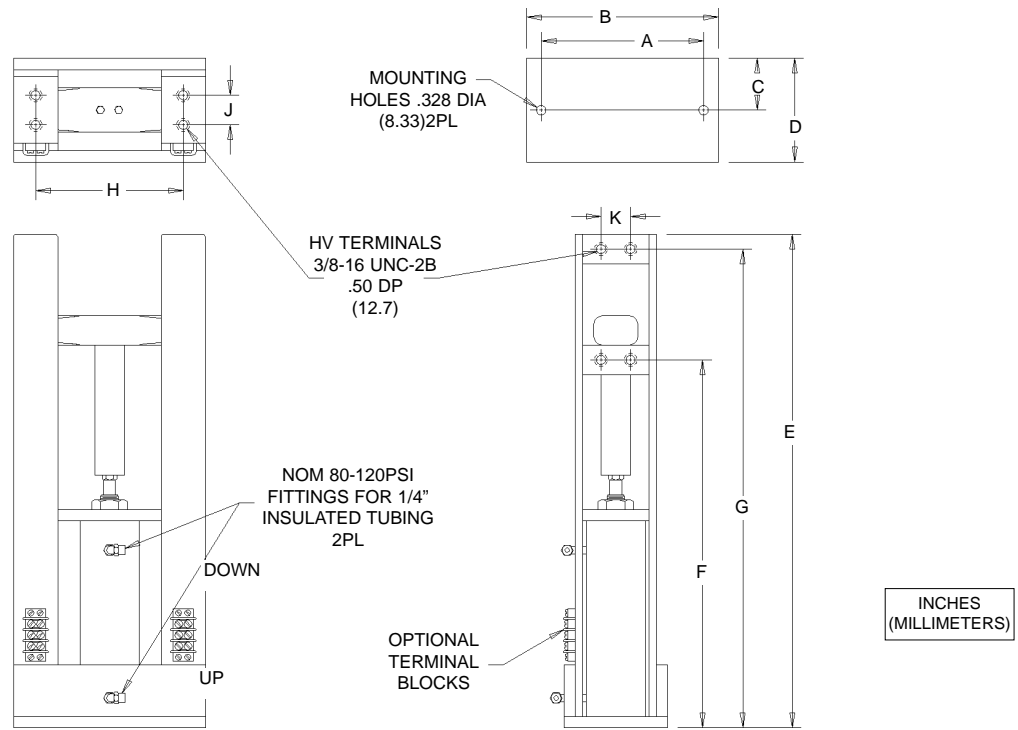
\*Higher voltage insulation to actuator available.  
Units are not rated to break current.  
Optional silver or tungsten contacts are available for high momentary closing current.

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e-mail: info@rossengineeringcorp.com

# GA SERIES



DIMENSIONS										
MODEL	A	B	C	D	E	F	G	H	J	K
GA-12-NCP	3.50 (88.90)	4.50 (114.3)	1.75 (44.5)	3.50 (88.9)	11.68 (296.7)		11.19 (284.2)	3.00 (76.2)	1.000 (25.40)	1.000 (25.40)
GA-12-NOP	3.50 (88.9)	4.50 (114.3)	1.75 (44.5)	3.50 (88.9)	11.68 (296.7)		11.19 (284.2)	3.00 (76.2)	1.000 (25.40)	1.000 (25.40)
GA-12-DTP	3.50 (88.9)	4.50 (114.3)	1.75 (44.5)	3.50 (88.9)	11.68 (296.7)	8.50 (215.9)	11.19 (284.2)	3.00 (76.2)	1.000 (25.40)	1.000 (25.40)
GA-12-P	3.50 (88.9)	4.50 (114.3)	1.75 (44.5)	3.50 (88.9)	10.68 (271.3)		10.19 (258.8)	3.00 (76.2)	1.000 (25.40)	1.000 (25.40)
GA-25-NCP	4.000 (101.60)	5.00 (127.0)	1.75 (44.5)	3.50 (88.9)	14.12 (358.6)		13.62 (345.9)	3.50 (88.9)	1.000 (25.40)	1.000 (25.40)
GA-25-NOP	4.000 (101.60)	5.00 (127.0)	1.75 (44.5)	3.50 (88.9)	14.12 (358.6)		13.62 (345.9)	3.50 (88.9)	1.000 (25.40)	1.000 (25.40)
GA-25-DTP	4.000 (101.60)	5.00 (127.0)	1.75 (44.5)	3.50 (88.9)	14.12 (358.6)	10.38 (263.7)	13.62 (345.9)	3.50 (88.9)	1.000 (25.40)	1.000 (25.40)
GA-25-P	4.000 (101.60)	5.00 (127.0)	1.75 (44.5)	3.50 (88.9)	12.12 (307.8)		11.62 (295.1)	3.50 (88.9)	1.000 (25.40)	1.000 (25.40)
GA-50-NCP	5.500 (139.70)	6.50 (165.1)	1.75 (44.5)	3.50 (88.9)	16.68 (423.7)		16.19 (411.2)	5.00 (127.0)	1.000 (25.40)	1.000 (25.40)
GA-50-NOP	5.500 (139.70)	6.50 (165.1)	1.75 (44.5)	3.50 (88.9)	16.68 (423.7)		16.19 (411.2)	5.00 (127.0)	1.000 (25.40)	1.000 (25.40)
GA-50-DTP	5.500 (139.70)	6.50 (165.1)	1.75 (44.5)	3.50 (88.9)	16.68 (423.7)	12.44 (316.1)	16.19 (411.2)	5.00 (127.0)	1.000 (25.40)	1.000 (25.40)
GA-50-P	5.500 (139.70)	6.50 (165.1)	1.75 (44.5)	3.50 (88.9)	14.68 (372.9)		14.19 (360.4)	5.00 (127.0)	1.000 (25.40)	1.000 (25.40)
GA-80-NCP	8.000 (203.20)	9.00 (228.6)	1.75 (44.5)	3.50 (88.9)	19.88 (505.1)		19.38 (492.3)	7.50 (190.5)	1.000 (25.40)	1.000 (25.40)
GA-80-NOP	8.000 (203.20)	9.00 (228.6)	1.75 (44.5)	3.50 (88.9)	19.88 (505.1)		19.38 (492.3)	7.50 (190.5)	1.000 (25.40)	1.000 (25.40)
GA-80-P	8.000 (203.20)	9.00 (228.6)	1.75 (44.5)	3.50 (88.9)	17.48 (443.9)		16.97 (431.0)	7.50 (190.5)	1.000 (25.40)	1.000 (25.40)
GA-80-DTP	8.000 (203.20)	9.00 (228.6)	1.75 (44.5)	3.50 (88.9)	29.55 (742.95)	20.25 (514.35)	28.75 (730.25)	7.50 (190.5)	1.000 (25.40)	1.000 (25.40)

Heavier-duty, high power GB series is designed with sliding multiple finger contacts. These contacts minimize power loss due to environmental contamination because of the cleaning action of the wiping contact fingers. Standard units are for low current make or break. Arcing contacts can be added for higher current make only. They do not have an interrupting rating.

Available in single pole, single throw, single or multi-pole, and double throw types, these switches are rated at 27 to 150KV PK test and 400 to 2000 amps RMS continuous; to 60,000 amps momentary, 10 cycle, and to 400,000 amps capacitor discharge, 20uSEC RC. Also available with 2 or more SPDT electrical auxiliary contacts or air valve type position indicators as optional accessories.

SPECIFICATIONS							
MODEL	CONTACT FORM	PEAK TEST RATINGS KV		CURRENT RATING AMPS MAX			NOMINAL CONTACT RESISTANCE OHMS
		CONTACT TO CONTACT	*CONTACT TO ACTUATOR	CONTINUOUS RMS OR DC	MOMENTARY 10 CYCLE OR 167mS	CAPACITOR DISCHARGE 20 uSEC	
GB-27-400	SPST/DT	27	27	400	12,000	120,000	.000025
GB-27-800	SPST/DT	27	27	800	30,000	300,000	.000020
GB-27-1,200	SPST/DT	27	27	1,200	40,000	400,000	.000015
GB-50-400	SPST/DT	50	50	400	12,000	120,000	.000025
GB-50-800	SPST/DT	50	50	800	30,000	300,000	.000020
GB-50-1,200	SPST/DT	50	50	1,200	40,000	400,000	.000015
GB-100-400	SPST/DT	100	100	400	12,000	120,000	.000025
GB-100-800	SPST/DT	100	100	800	30,000	300,000	.000020
GB-100-1,200	SPST/DT	100	100	1,200	40,000	400,000	.000015
GB-150-400	SPST/DT	150	150	400	12,000	120,000	.000025
GB-150-800	SPST/DT	150	150	800	30,000	300,000	.000020
GB-150-1,200	SPST/DT	150	150	1,200	40,000	400,000	.000015
GB-27-400	DPST/DT	27	27	400	12,000	120,000	.000025
GB-27-800	DPST/DT	27	27	800	30,000	300,000	.000020
GB-27-1,200	DPST/DT	27	27	1,200	40,000	400,000	.000015
GB-50-400	DPST/DT	50	50	400	12,000	120,000	.000025
GB-50-800	DPST/DT	50	50	800	30,000	300,000	.000020
GB-50-1,200	DPST/DT	50	50	1,200	40,000	400,000	.000015
GB-100-400	DPST/DT	100	100	400	12,000	120,000	.000025
GB-100-800	DPST/DT	100	100	800	30,000	300,000	.000020
GB-100-1,200	DPST/DT	100	100	1,200	40,000	400,000	.000015
GB-150-400	DPST/DT	150	150	400	12,000	120,000	.000025
GB-150-800	DPST/DT	150	150	800	30,000	300,000	.000020
GB-150-1,200	DPST/DT	150	150	1,200	40,000	400,000	.000015

SPECIFICATIONS ARE FOR REFERENCE ONLY AND ARE SUBJECT TO CHANGE. CONTACT ROSS ENGINEERING CORP. FOR APPLICATION DATA.

\* Higher insulation to actuator available. Inquire about units rated for 1,600 amps to 4,000 amps continuous.

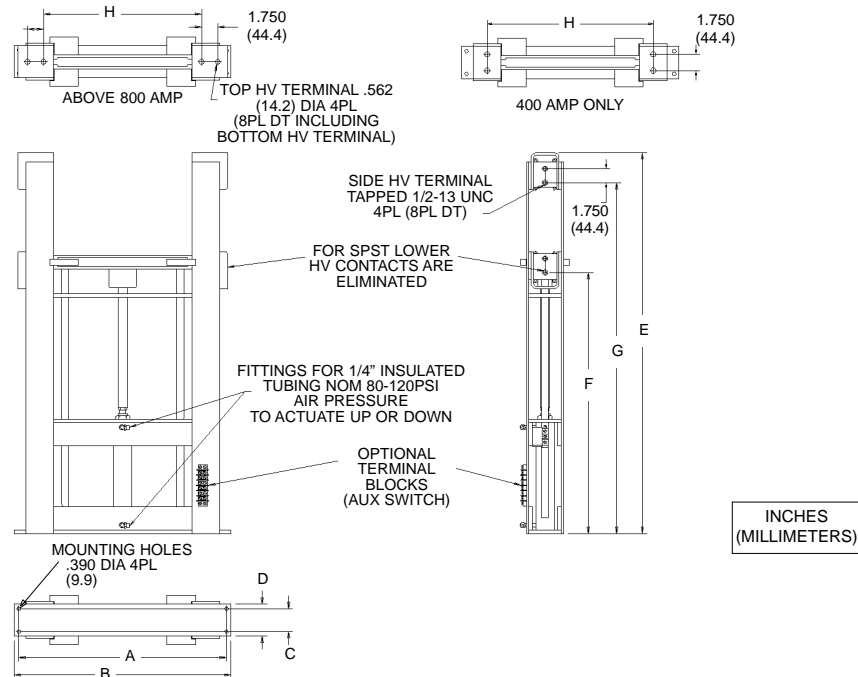
Units are not rated to break current. Optional arcing contacts available to make current.



# GB SERIES

**FOR 400 - 1200 AMP MODELS  
SINGLE POLE SINGLE THROW  
AND DOUBLE THROW**

SHOWN  
SINGLE POLE  
DOUBLE THROW



INCHES  
(MILLIMETERS)

DIMENSIONS											
MODEL	A	B	C	D	E	F	G	H	J	K	L
GB-27-400	7.000 (177.80)	7.75 (196.9)	2.000 (50.80)	3.50 (88.9)	14.44 (366.8)	11.44 (290.6)	3.50 (88.9)	6.00 (152.4)	21.88 (555.8)	13.94 (354.1)	--
GB-27-800/1,200	10.000 (254.00)	10.75 (273.0)	2.000 (50.80)	3.50 (88.9)	14.44 (366.8)	11.44 (290.6)	3.50 (88.9)	4.25 (107.9)	21.88 (555.8)	13.94 (354.1)	--
GB-50-400	7.000 (177.80)	7.75 (196.9)	2.000 (50.80)	3.50 (88.9)	18.44 (468.4)	15.44 (392.2)	5.50 (139.7)	7.00 (177.8)	30.69 (779.5)	20.69 (525.5)	--
GB-50-800/1,200	10.000 (254.00)	10.75 (273.0)	2.000 (50.80)	3.50 (88.9)	18.44 (468.4)	15.44 (392.2)	5.50 (139.7)	5.25 (133.4)	30.69 (779.5)	20.69 (525.5)	--
GB-100-400	12.000 (304.8)	12.75 (323.9)	2.000 (50.80)	3.50 (88.9)	29.38 (746.3)	26.38 (670.0)	9.50 (241.3)	11.00 (279.4)	47.00 (1,193.8)	33.00 (838.2)	--
GB-100-800/1,200	15.000 (381.0)	15.75 (400.0)	2.000 (50.80)	3.50 (88.9)	29.38 (746.3)	26.38 (670.0)	9.50 (241.3)	9.25 (235.1)	47.00 (1,193.8)	33.00 (838.2)	--
GB-150-400	17.000 (431.8)	17.75 (450.9)	2.000 (50.80)	3.50 (88.9)	38.75 (984.3)	35.62 (904.7)	14.00 (355.6)	16.00 (406.4)	64.25 (1,632.1)	45.75 (1,162.0)	--
GB-150-800/1,200	20.000 (508.0)	20.75 (527.0)	2.000 (50.80)	3.50 (88.9)	38.75 (984.3)	35.62 (904.7)	14.00 (355.6)	14.25 (362.1)	64.25 (1,632.1)	45.75 (1,162.0)	--
GB2-27-400	9.00 (228.6)	9.75 (247.7)	10.25 (260.4)	11.00 (279.4)	14.81 (376.2)	11.81 (300.0)	3.50 (88.9)	6.00 (152.4)	22.25 (565.1)	14.32 (363.7)	6.00 (152.4)
GB2-27-800/1,200	12.00 (304.8)	12.75 (323.9)	10.25 (260.4)	11.00 (279.4)	14.81 (376.2)	11.81 (300.0)	3.50 (88.9)	4.25 (107.9)	22.25 (565.1)	14.32 (363.7)	6.00 (152.4)
GB2-50-400	9.00 (228.6)	9.75 (247.7)	11.25 (285.8)	12.00 (304.8)	18.81 (477.8)	15.81 (401.6)	5.50 (139.7)	7.00 (177.8)	31.06 (788.9)	21.06 (534.9)	7.00 (177.8)
GB2-50-800/1,200	12.00 (304.8)	12.75 (323.9)	11.25 (285.8)	12.00 (304.8)	18.81 (477.8)	15.81 (401.6)	5.50 (139.7)	5.25 (133.4)	31.06 (788.9)	21.06 (534.9)	7.00 (177.8)
GB2-100-400	14.00 (355.6)	14.75 (374.7)	15.25 (387.3)	16.00 (406.4)	29.75 (755.7)	26.75 (679.5)	9.50 (241.3)	11.00 (279.4)	47.38 (1,203.5)	33.38 (847.9)	11.00 (279.4)
GB2-100-800/1,200	17.00 (431.8)	17.75 (450.9)	15.25 (387.3)	16.00 (406.4)	29.75 (755.7)	26.75 (679.5)	9.50 (241.3)	9.25 (234.0)	47.38 (1,203.5)	33.38 (847.9)	11.00 (279.4)

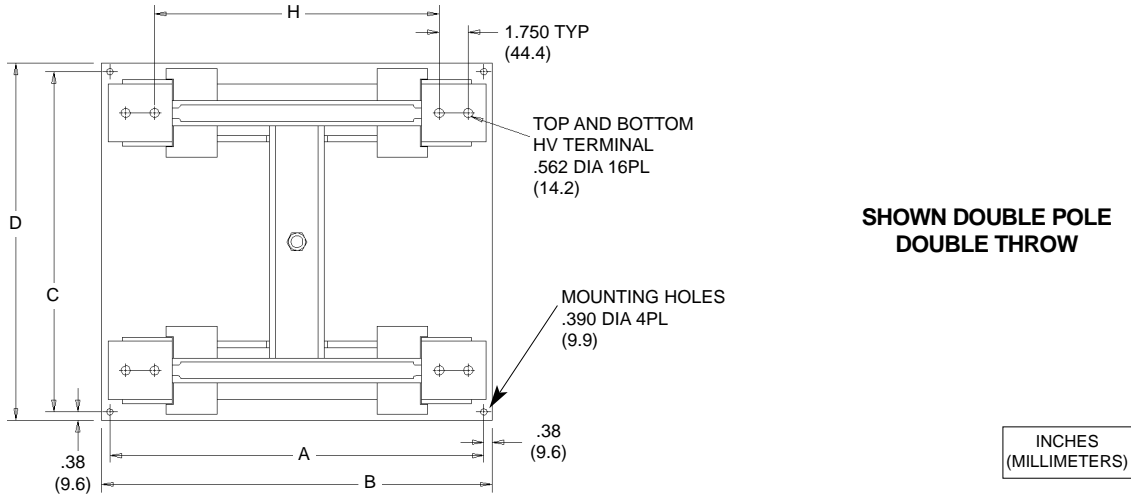
DIMENSIONS ARE FOR REFERENCE ONLY AND ARE SUBJECT TO CHANGE.  
CONTACT ROSS ENGINEERING CORP. FOR APPLICATION DATA.

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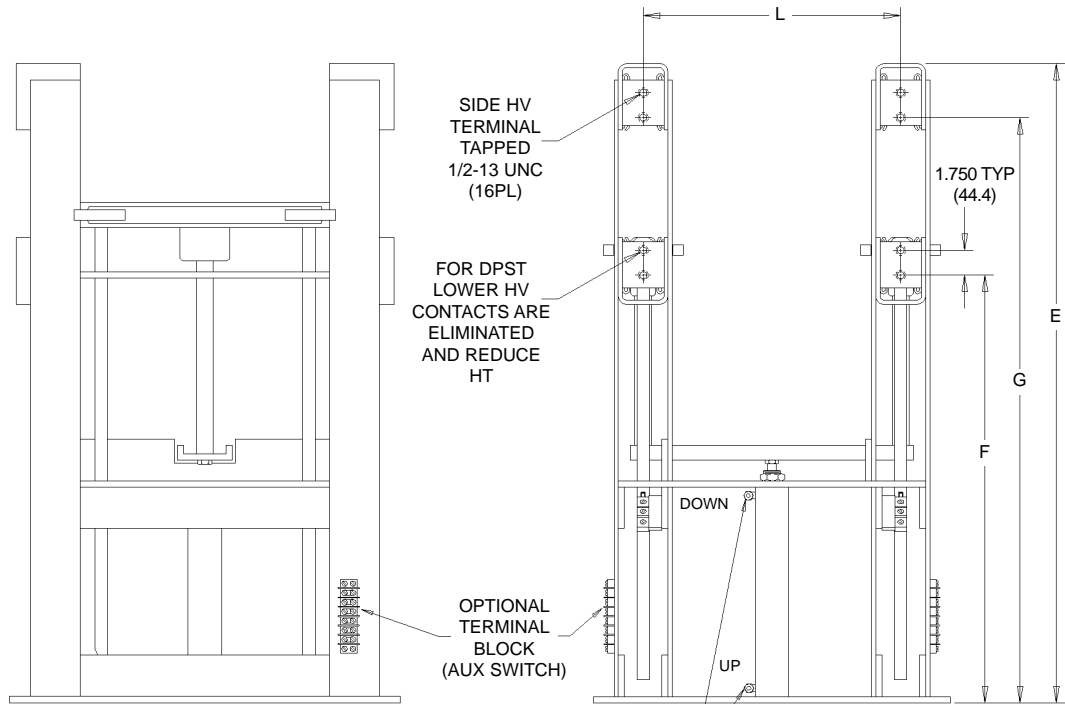
# GB2 SERIES

# DOUBLE POLE SINGLE THROW AND DOUBLE THROW

DIMENSIONS ARE FOR REFERENCE ONLY AND ARE SUBJECT TO CHANGE.  
CONTACT ROSS ENGINEERING CORP. FOR APPLICATION DATA.



SHOWN DOUBLE POLE  
DOUBLE THROW



FITTINGS FOR 1/4" INSULATED TUBING NOM 80-120  
PSI AIR PRESSURE TO ACTUATE UP OR DOWN

ROSS HIGH POWER, HIGH CURRENT SWITCHES: The GD series, 80-120PSI air actuated, single pole/single or double throw switches can be water or oil cooled in some models. Available are maximum continuous ratings of up to 8000 amps continuous in air, higher with cooling or paralleling. Contact ratings reduced to 70%

when paralleled. Extremely compact for their rating, this series is available in modular block form and can be stacked in parallel for increasing current handling capabilities. Many other models are available.

SPECIFICATIONS										
*MODEL	CONTACT FORM	** KV PEAK TEST RATINGS DC OR 60Hz		CLOSED CURRENT RATING AMPS						NOMONAL CONTACT RESISTANCE
		CONTACT TO CONTACT	CONTACT TO ACTUATOR	DC - 60Hz RMS FREE AIR CONTINUOUS	SHORT TIME		MOMENTARY 170 MILLISEC DC OR RMS	MOMENTARY 1 MILLISEC PULSE PK	MOMENTARY 20MICROSEC RC PULSE PK	
GD-27-P-40-800	ST, DT	27	40	800	11,000	20,000	40,000	80,000	200,000	.000019
GD-60-P-60-800	ST, DT	60	60	"	"	"	"	"	"	"
GD-100-P-100-800	ST, DT	100	100	"	"	"	"	"	"	"
GD-150-P150-800	ST, DT	150	150	"	"	"	"	"	"	"
GD-200-P-200-800	ST, DT	200	200	"	"	"	"	"	"	"
GD-350-P-350-800	ST, DT	350	350	"	"	"	"	"	"	"
GD-450-P-110-800	ST, DT	400	110	"	"	"	"	"	"	"
GD-450-M-110-800	ST, DT	450	110	"	"	"	"	"	"	"
GD-450-M-450-800	ST, DT	450	450	"	"	"	"	"	"	"
GD-27-P-40-1,200	ST, DT	27	40	1,200	14,000	25,000	60,000	120,000	300,000	.000012
GD-60-P-60-1,200	ST, DT	60	60	"	"	"	"	"	"	"
GD-100-P-100-1,200	ST, DT	100	100	"	"	"	"	"	"	"
GD-150-P150-1,200	ST, DT	150	150	"	"	"	"	"	"	"
GD-200-P-200-1,200	ST, DT	200	200	"	"	"	"	"	"	"
GD-350-P-350-1,200	ST, DT	350	350	"	"	"	"	"	"	"
GD-27-P-40-1,600	ST, DT	27	40	1,600	20,000	36,000	90,000	180,000	450,000	.0000094
GD-60-P-60-1,600	ST, DT	60	60	"	"	"	"	"	"	"
GD-100-P-100-1,600	ST, DT	100	100	"	"	"	"	"	"	"
GD-150-P150-1,600	ST, DT	150	150	"	"	"	"	"	"	"
GD-200-P-200-1,600	ST, DT	200	200	"	"	"	"	"	"	"
GD-350-P-350-1,600	ST, DT	350	350	"	"	"	"	"	"	"
GD-27-P-40-2,000	ST, DT	27	40	2,000	23,000	40,000	105,000	210,000	500,000	.0000078
GD-60-P-60-2,000	ST, DT	60	60	"	"	"	"	"	"	"
GD-100-P-100-2,000	ST, DT	100	100	"	"	"	"	"	"	"
GD-150-P150-2,000	ST, DT	150	150	"	"	"	"	"	"	"
GD-200-P-200-2,000	ST, DT	200	200	"	"	"	"	"	"	"
GD-350-P-350-2,000	ST, DT	350	350	"	"	"	"	"	"	"
GD-27-P-40-3,000	ST, DT	27	40	3,000	36,000	60,000	150,000	250,000	600,000	.0000051
GD-60-P-60-3,000	ST, DT	60	60	"	"	"	"	"	"	"
GD-100-P-100-3,000	ST, DT	100	100	"	"	"	"	"	"	"
GD-150-P150-3,000	ST, DT	150	150	"	"	"	"	"	"	"
GD-200-P-200-3,000	ST, DT	200	200	"	"	"	"	"	"	"
GD-350-P-350-3,000	ST, DT	350	350	"	"	"	"	"	"	"
GD-27-P-40-4,000	ST, DT	27	40	4,000	44,000	80,000	200,000	340,000	850,000	.0000039
GD-60-P-60-4,000	ST, DT	60	60	"	"	"	"	"	"	"
GD-100-P-100-4,000	ST, DT	100	100	"	"	"	"	"	"	"
GD-150-P150-4,000	ST, DT	150	150	"	"	"	"	"	"	"
GD-200-P-200-4,000	ST, DT	200	200	"	"	"	"	"	"	"
GD-350-P-350-4,000	ST, DT	350	350	"	"	"	"	"	"	"
GD-27-P-40-6,000	ST, DT	27	40	6,000	60,000	100,000	300,000	500,000	1,200,000	.0000026
GD-60-P-60-6,000	ST, DT	60	60	"	"	"	"	"	"	"
GD-100-P-100-6,000	ST, DT	100	100	"	"	"	"	"	"	"
GD-150-P150-6,000	ST, DT	150	150	"	"	"	"	"	"	"
GD-200-P-200-6,000	ST, DT	200	200	"	"	"	"	"	"	"
GD-350-P-350-6,000	ST, DT	350	350	"	"	"	"	"	"	"
GD-27-P-40-8,000	ST, DT	27	40	8,000	85,000	150,000	400,000	680,000	1,700,000	.0000019
GD-60-P-60-8,000	ST, DT	60	60	"	"	"	"	"	"	"
GD-100-P-100-8,000	ST, DT	100	100	"	"	"	"	"	"	"
GD-150-P150-8,000	ST, DT	150	150	"	"	"	"	"	"	"
GD-200-P-200-8,000	ST, DT	200	200	"	"	"	"	"	"	"
GD-350-P-350-8,000	ST, DT	350	350	"	"	"	"	"	"	"

\*For Air Pressure Operated "P" in model No. will change to "DTP" for double throw or "M" or "DTM", etc. For more information, contact Ross Engineering Corporation.  
 \*\*Available with 27KV PK (19KV RMS) 60KV PK (36KV RMS) 100KV PK (70KV RMS), 150KV PK (106KV RMS), 200KV PK (141KV RMS), 350KV PK (247KV RMS), and 450KV PK (318KV RMS), one minute test, contact to contact and contact to ground.  
 Units are air or hydraulic operated or can be motor operated at slower speeds. Units are not rated to break current. Optional contacts for making current are available.  
 For frequencies other than DC-60Hz derating or cooling is required. (ie. at 10 KHz derate 50%. Over 10KHz derate to approx.  $\frac{1}{2}(10/f \text{ KHz})^{1/2}$ . ie. at 30KHz derate to 29% of 60Hz rating.  
 Double throw and multiple pole units have same rating as single throw units.  
 Specifications are for reference only and are subject to change. Contact Ross Engineering Corporation for current dimensions.

# GD SERIES

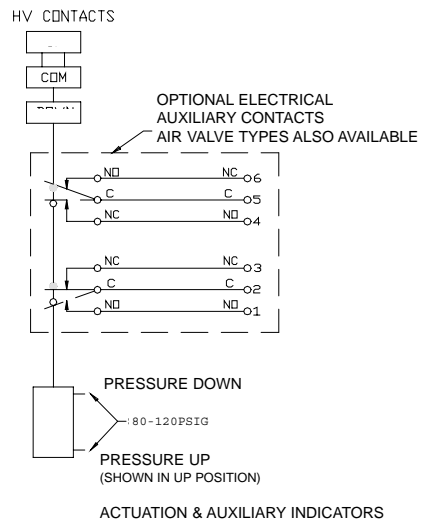
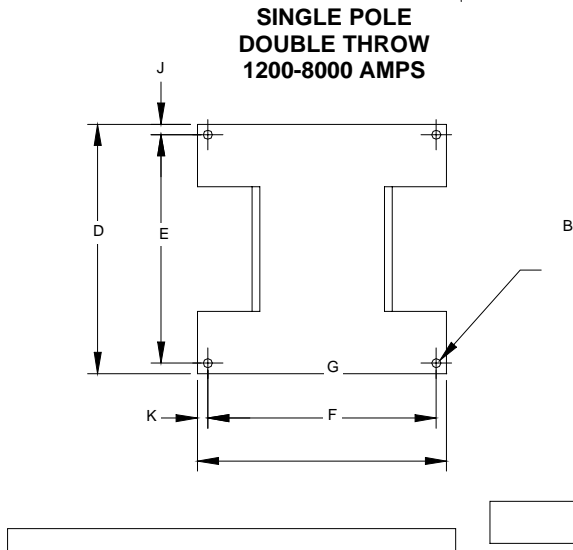
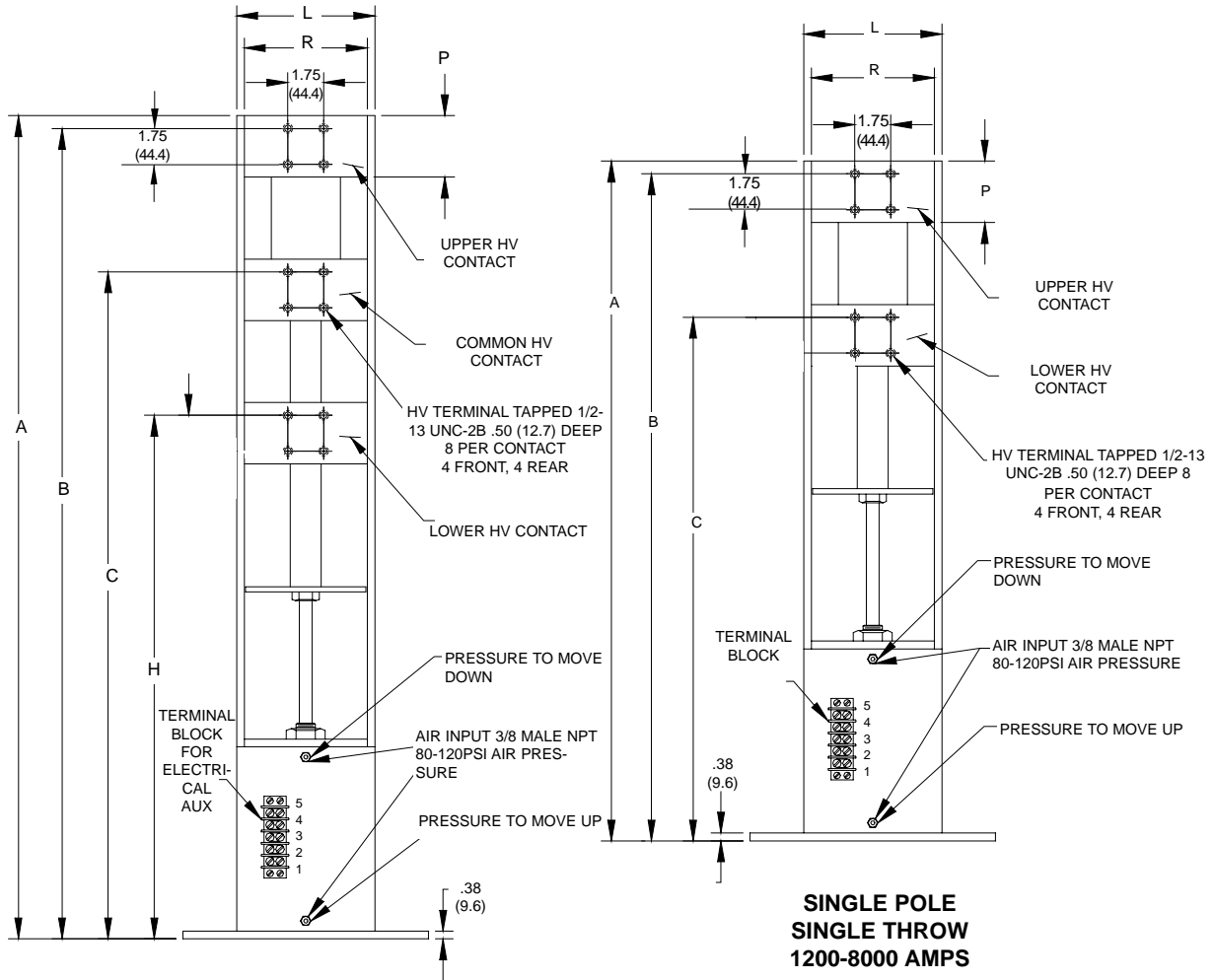
400 - 8000 AMP CONT.  
27KV PK - 450KV PK TEST

INCHES  
(MILLIMETERS)

*DIMENSIONS														
MODEL	A	B	C	D	E	F	G	H	J	K	L	P	R	FIG.
GD27-P-60-800	18.75 (476.3)	18.13 (460.5)	14.88 (378.0)	5.500 (139.70)	4.500 (114.30)	4.50 (114.3)	3.500 (88.90)	--	.50 (12.7)	.50 (12.7)	3.90 (99.0)	1.25 (31.7)	2.75 (69.8)	B
GD60-P-60-800	25.0 (635.0)	24.39 (619.2)	19.14 (486.1)	8.0 (203.2)	7.000 (177.80)	8.0 (203.2)	7.000 (177.80)	--	.50 (12.7)	.50 (12.7)	3.90 (99.0)	1.25 (31.7)	2.75 (69.8)	B
GD100-P-100-800	40.50 (1,028.7)	39.88 (1,012.9)	30.63 (778.0)	12.00 (304.8)	11.000 (279.40)	12.00 (304.8)	11.00 (279.4)	--	.50 (12.7)	.50 (12.7)	3.90 (99.0)	1.25 (31.7)	2.75 (69.8)	B
GD450-M-110-800	126.73 (3,218.9)	--	121.71 (3,091.4)	124.26 (3,156.2)	84.500 (2,146.30)	--	48.00 (1,219.2)	40.00 (1,016.0)	48.00 (1,219.2)	40.00 (1,016.0)	4.00 (101.6)	4.00 (101.6)	--	--
GD450-M-450-800	230.45 (5,853.4)	224.01 (5,689.9)	218.45 (5,548.6)	191.64 (4,867.7)	159.270 (4,045.50)	--	48.00 (1,219.2)	40.00 (1,016.0)	48.00 (1,219.2)	40.00 (1,016.0)	4.00 (101.6)	4.00 (101.6)	--	--
GD27-DTP-27-800	17.70 (449.5)	17.07 (433.5)	14.43 (366.5)	5.50 (139.7)	4.500 (114.30)	4.50 (114.3)	3.500 (88.90)	11.78 (299.2)	.50 (12.7)	.50 (12.7)	3.90 (99.0)	1.25 (31.7)	2.75 (69.8)	B
GD60-DTP-60-800	31.88 (809.7)	31.25 (793.7)	26.00 (660.4)	10.00 (254.0)	9.000 (228.60)	10.00 (254.0)	9.000 (228.60)	20.75 (527.0)	.50 (12.7)	.50 (12.7)	3.90 (99.0)	1.25 (31.7)	2.75 (69.8)	B
GD100-DTP-100-800	50.00 (1,270.0)	49.38 (1,254.3)	40.13 (1,019.3)	16.00 (406.4)	15.000 (381.00)	16.00 (406.4)	15.000 (381.00)	30.25 (768.4)	.50 (12.7)	.50 (12.7)	3.90 (99.0)	1.25 (31.7)	2.75 (69.8)	B
GD100-DTP-100-1200														
GD27-P-60-1600	23.30 (591.8)	22.93 (582.4)	19.03 (483.3)	7.25 (184.1)	6.250 (158.70)	4.00 (101.6)	3.000 (76.20)	--	.50 (12.7)	.50 (12.7)	5.25 (133.3)	2.50 (63.5)	4.00 (101.6)	A
GD60-P-60-1600	31.00 (787.4)	30.63 (778.0)	24.13 (612.9)	12.00 (304.8)	11.000 (279.40)	12.00 (304.8)	11.000 (279.40)	--	.50 (12.7)	.50 (12.7)	5.25 (133.3)	2.50 (63.5)	4.00 (101.6)	A
GD100-P-100-1600	47.00 (1,193.8)	46.62 (1,184.2)	36.13 (917.7)	18.00 (457.2)	17.000 (431.80)	18.00 (457.2)	17.000 (431.80)	--	.50 (12.7)	.50 (12.7)	5.25 (133.3)	2.50 (63.5)	4.00 (101.6)	A
GD27-DTP-60-1600	31.10 (789.9)	27.53 (699.2)	23.63 (600.2)	12.00 (304.8)	11.000 (279.4)	12.00 (304.8)	11.000 (279.40)	19.73 (501.1)	.50 (12.7)	.50 (12.7)	5.25 (133.3)	2.50 (63.5)	4.00 (101.6)	A
GD60-DTP-60-1600	37.5 (952.5)	37.13 (943.1)	30.63 (778.0)	14.00 (355.6)	13.000 (330.20)	14.00 (355.6)	13.000 (330.20)	24.13 (612.9)	.50 (12.7)	.50 (12.7)	5.25 (133.3)	2.50 (63.5)	4.00 (101.6)	A
GD100-DTP-100-1600	57.5 (1,460.5)	57.13 (1,451.1)	46.63 (1,184.4)	18.00 (457.2)	17.000 (431.80)	18.00 (457.2)	17.000 (431.80)	36.13 (917.7)	.50 (12.7)	.50 (12.7)	5.25 (133.3)	2.50 (63.5)	4.00 (101.6)	A
GD60-DTP-60-2000														
GD100-DTP-100-3000														
GD27-P-60-4000	20.40 (518.1)	19.78 (502.4)	15.38 (390.6)	10.00 (254.0)	9.000 (228.6)	6.00 (152.4)	5.000 (127.00)	--	.50 (12.7)	.50 (12.7)	7.50 (190.5)	3.00 (76.2)	6.00 (152.4)	A
GD60-P-60-4000	33.00 (838.2)	32.38 (822.4)	25.38 (644.6)	12.00 (304.8)	11.000 (279.40)	12.00 (304.8)	11.000 (279.40)	--	.50 (12.7)	.50 (12.7)	7.50 (190.5)	3.00 (76.2)	6.00 (152.4)	A
GD100-P-100-4000	48.50 (1,231.9)	47.88 (1,216.1)	36.80 (934.7)	24.00 (609.6)	23.000 (584.20)	24.00 (609.6)	23.000 (584.20)	--	.50 (12.7)	.50 (12.7)	7.50 (190.5)	3.00 (76.2)	6.00 (152.4)	A
GD27-DTP-60-4000	29.30 (744.2)	28.68 (728.4)	24.28 (616.7)	12.00 (304.8)	11.000 (279.40)	12.00 (304.8)	11.000 (279.40)	19.88 (504.9)	.50 (12.7)	.50 (12.7)	7.50 (190.5)	3.00 (76.2)	6.00 (152.4)	A
GD60-DTP-60-4000	39.00 (990.6)	38.38 (974.8)	31.38 (797.0)	10.00 (254.0)	9.000 (228.6)	6.00 (152.4)	5.000 (127.00)	24.38 (619.2)	.50 (12.7)	.50 (12.7)	7.50 (190.5)	3.00 (76.2)	6.00 (152.4)	A
GD100-DTP-100-4000	59.50 (1,511.3)	58.88 (1,495.5)	47.88 (1,216.1)	24.00 (609.6)	23.000 (584.20)	24.00 (609.6)	23.000 (584.20)	36.88 (936.7)	.50 (12.7)	.50 (12.7)	7.50 (190.5)	3.00 (76.2)	6.00 (152.4)	A
GD150-DTM-150-4000	130.02 (3,302.5)	117.91 (2,994.9)	109.95 (2,792.7)	102.75 (2,609.8)	90.620 (2,301.70)	78.50 (1,993.9)	36.000 (914.40)	32.00 (812.8)	36.00 (914.4)	32.00 (812.8)	2.00 (50.8)	2.00 (50.8)	--	C
GD 200-DTM-150-4000														
GD350-DTM-350-4000	195.88 (4,975.3)	172.25 (4,375.1)	168.00 (4,267.2)	152.45 (3,872.2)	128.820 (3,272.00)	105.19 (2,671.8)	48.000 (1,219.2)	40.00 (1,016.0)	48.00 (1,219.2)	40.00 (1,016.0)	4.00 (101.6)	4.00 (101.6)	--	C
GD27-DTP-40-6000	37.00 (939.8)	36.38 (924.1)	23.38 (593.8)	13.00 (330.2)	12.000 (304.80)	15.00 (381.5)	14.000 (355.75)	22.38 (568.4)	.50 (12.7)	.50 (12.7)	8.75 (222.2)	3.00 (76.2)	8.00 (203.2)	A
GD200-DTM-200-6000	CALL FOR MORE INFORMATION													
GD350-DTM-350-6000	CALL FOR MORE INFORMATION													
GD350-DTM-350-8000	CALL FOR MORE INFORMATION													

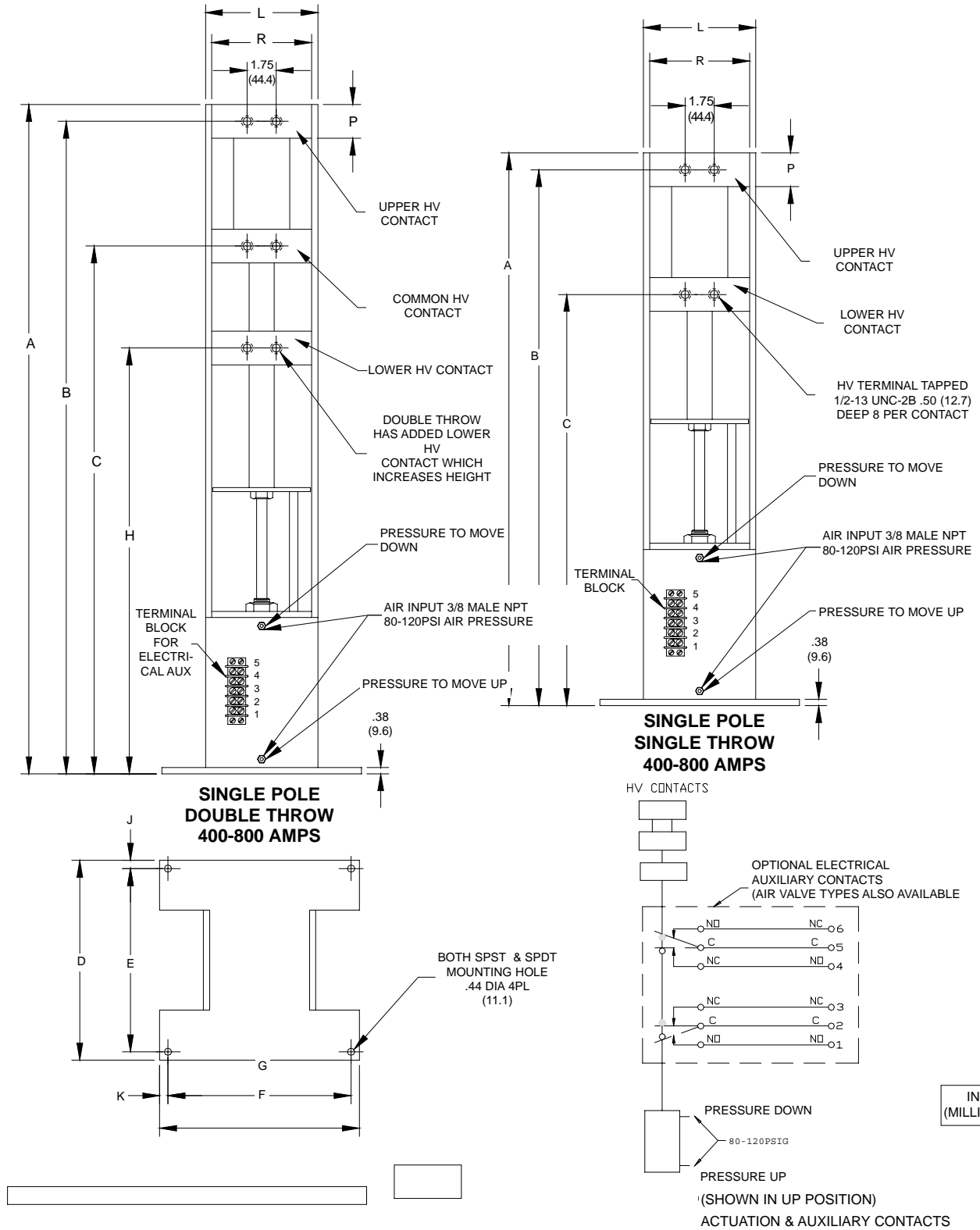
\*Any unit can be Double throw or multiple pole if required.  
Higher currents and voltages available.

**FIGURE A**



INCHES  
(MILLIMETERS)

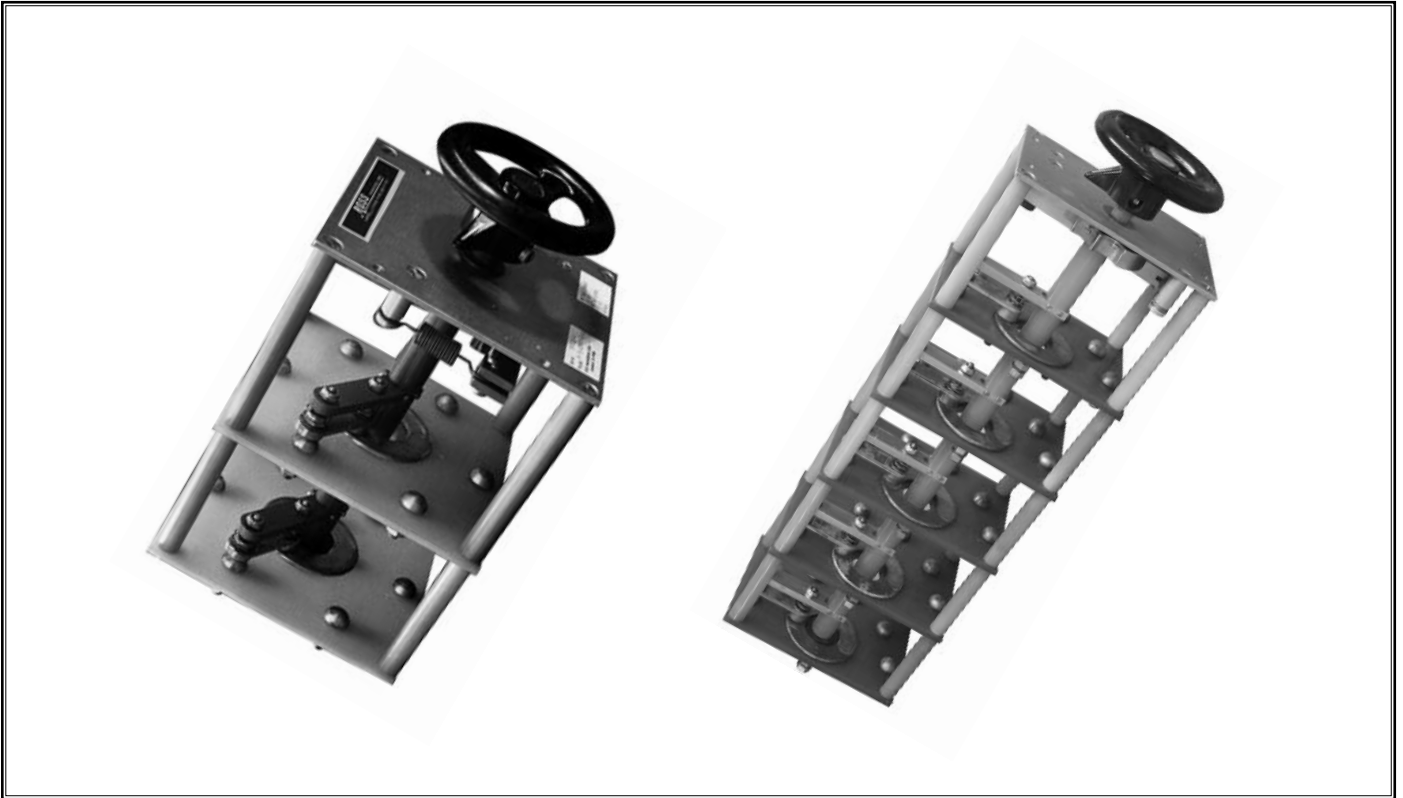
## FIGURE B



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# HIGH VOLTAGE ROTARY SWITCHES

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- 2 TO 450KV
- 1 TO 200A
- 2 TO 12 THROW
- 1 TO 5 POLE
- LONG LIFE
- ELECTRONIC APPLICATION
- POWER APPLICATION
- HV TRANSFER
- TAP OR LOAD SELECTION
- INCLUDES SAFETY INTERLOCK



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## **About Ross Engineering Corporation**

Since 1964, we at Ross Engineering Corporation have been incorporating experienced technology, high voltage application know-how, and precision engineering into each of our high voltage devices. The result is highly reliable, long life HV devices used on 0.01 millivolt to 900KV control and measurement applications worldwide.

## **Simple & Rugged Design**

A key feature of our rotary switches is their simple mechanical design which results in conservative stress levels for trouble-free, long-life use. In addition, each rotary switch has a reinforced chassis design utilizing G-10 or G-11 fire retardant anti-tracking coated epoxy glass insulation. G-7 silicone glass is used for special applications where RF or high temperatures are involved.

Heavy duty contacts, specifically designed to minimize corona in the Ross rotaries, are made of highly conductive yet weld resistant alloy with high contact closing force. This high force gives our rotary switches high momentary current capability and a reputation for their ability to withstand high shock and vibration as well as other severe environmental conditions.

## **Safe Operation**

The Ross HV Rotary Switches can help engineers and specifiers meet OSHA and other safety organization regulations concerning protection for personnel from the danger of high voltage. To accomplish this, we design our rotary switches with manually or electrically operated actuators that include safety cam detent for positive contact positioning and safety interlocks.

Complementing this feature is a design concept unique to the Ross rotaries. We built our HV rotary switches with a SPDT auxiliary contact which is used as an interlock to protect an operator from "switching hot." This means during contact separation, power can be automatically shut off and interconnected systems can be made safe from accidental shorting due to arcing between poles. If additional protection is desired, our rotary switches can be designed with multiple SPDT auxiliary contacts and solenoid type locking devices.

---

## **Rotary Switch Application Data**

---

The Ross HV rotary switches are used in a wide variety of applications worldwide. Among these are hipot voltage selectors, load and source selectors, power transformer tap changers, at either the high or low voltage end of transformer windings.

At RF levels, the higher current rotary switches can be used for tuning coil, alternate antenna, or dummy load selection.

## **High Voltage Rating**

The Ross rotaries are built for 2KV to 450KV operation or more at 1mA to 200A or more continuous. All PK test voltages are 1 minute, 60Hz peak hold voltages in air unless otherwise noted. Ratings are for air at 760mmHg, 20°C. Derate 3% per 1,000ft. above sea level. Voltage ratings can be doubled (or more) when used in oil or insulating gas.

## **Safety Factors**

For proper safety factor, PK test rating should be 1.2 to 5 times the normal circuit PK operating voltage, depending on applications. For lower power systems in air where transients are unlikely or moderate corona or intermittent flashover is of no conse-

quence, a safety factor of 1.5 to 3 is desirable, and 2 to 3 is recommended. For higher power systems or where transient over-voltages are expected, and for minimum corona in air, a safety factor of 2.5 to 5 should be considered and the factor should be based on the maximum probable transient or impulse voltage requirement. The PK voltage to ground rating is similar to impulse ratings and should be selected in the same way as the contact to contact or pole to pole value. If a value other than the published rating is required, it can normally be supplied as an option, i.e., contact to contact or pole to pole voltages may be less than contact to ground, and size may be reduced.

## **Air/Oil/Gas Atmospheres**

When immersed in insulating oil, fluid or gas, the voltage withstand value is at least doubled and the interrupt capability is much greater. In a gas atmosphere, no modification is required. However, immersion in oil or fluid may require modifications in some cases, at extra cost (optional). For peak performance where high voltage is impressed directly across short lengths of solid insulation, increased length to prevent internal puncture at levels above the test rating in air may be required.

## **Current Rating DC to RF**

Current ratings in air, as well as voltage ratings should be derated 3% per 1,000ft above sea level. Specified current ratings are continuous for 60Hz RMS and DC.

Some units can be used in RF applications, particularly those with G-7 silicone glass or steatite insulation, at reduced current ratings. All RF applications for these rotaries should be submitted to the Ross application engineers for review.

## **Epoxy Glass Insulation**

G-10 or G-11 Epoxy glass laminate is standard insulation on most Ross HV rotaries. G-7 silicone glass insulation is recommended as an extra cost option for RF applications. Steatite insulation is used on some models. Extra lengths of insulation are available where high voltage contacts need to be spaced a greater distance from the actuator and interlock control circuit and ground.

## **Actuators**

Each unit is either manually or electrically operated. They are designed with a positive detent operating mechanism, with a low friction safety cam follower bearing. The cam detent feature allows positive contact positioning for greater safety when switch is in operation.

## **Auxiliary Contacts**

One SPDT auxiliary contact is standard on most units. The auxiliary contact is used as an interlock for protection against "Switching Hot" and accidental shorting due to arcing. They can also be designed with multiple SPDT auxiliary interlock contacts and/or solenoid type locking devices for extra safety. For in air use, most auxiliary contacts handle 250V to 480V, 15A, 60Hz or ½A, 125V DC.

Our oil-immersed units are built either with sealed, oil-resistant auxiliaries rated 5 to 7A maximum at 250V AC, or heavy duty open type contacts.

## **Mounting and Support**

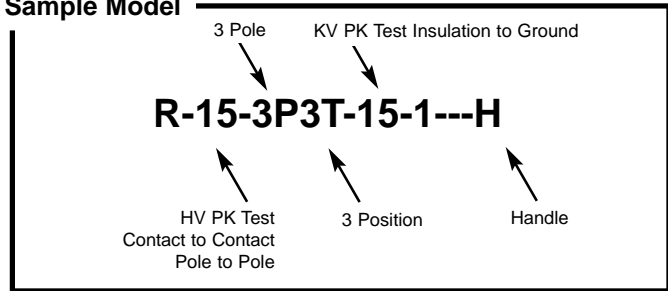
The Ross rotaries can be mounted in any attitude in either air, oil, fluid or gas atmosphere. Most units will withstand 10G or more shock. End support is recommended for longer units and high shock and vibration resistance.

# R Series Rotary Switches - 2-350KV

Ross Engineering Corporation R series multi-pole, multi-position high voltage rotary switches are manually operated hand-wheel or lever types which operate at 2KV to 450KV, 1mA to 200A continuous to 2,500A momentary 10 cycle and up to 10,000A momentary capacitor discharge, 20ms RC. Specially designed units can operate to over 600A continuous and to 6,000A or more, momentary 10 cycle. Two types of manually operated HV rotary switches in the R series are available. Type 1 is generally for full voltage contact to contact. Type 2 is for fewer positions or applications where contact to contact voltage is considerably less than pole to pole or HV contact to ground, thus allowing much smaller size.

Higher voltage or electrically operated Ross HV Rotary Switches can be ordered upon special request. For RF applications, submit data to Ross applications engineers for review.

## Sample Model

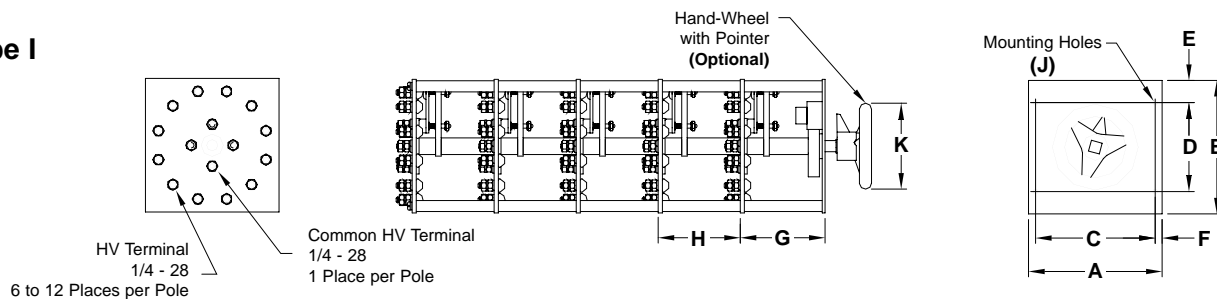


## Dimensions

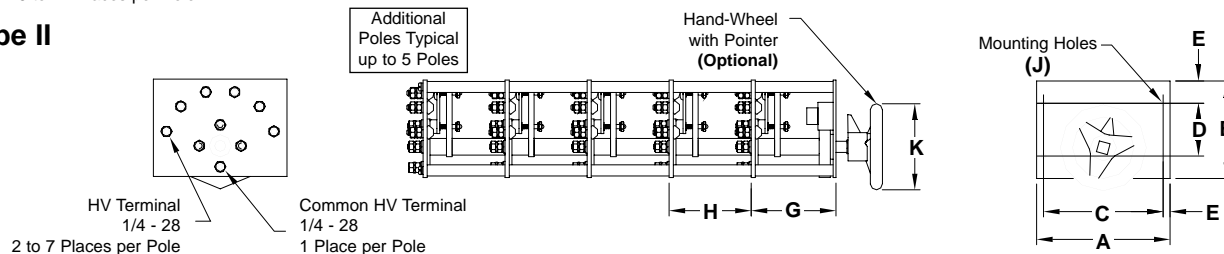
Model	Type	A	B	C	D	E	F	G	H	J	K
R-12	1	4.00	4.00	2.500	3.500	.25	.75	4.00	3.38	.203	3.94
	2	4.00	3.50	2.500	3.500	.25	.75	4.00	3.38	.203	3.94
R-15	1	6.00	6.00	5.375	4.000	1.00	.31	4.38	3.19	.203	3.94
	2	6.00	4.38	5.375	2.375	1.00	.31	4.38	3.19	.203	3.94
R-30	1	7.25	7.25	4.750	6.625	.31	1.25	4.88	3.69	.203	3.94
	2	7.25	4.88	4.750	4.250	.31	1.25	4.88	3.69	.203	3.94
R-45	1	11.00	11.00	8.500	10.000	.50	1.25	8.00	6.75	.265	4.92
	2	11.00	7.25	8.500	6.250	.50	1.25	8.00	6.75	.265	4.92
R-60	1	18.00	18.00	12.000	16.000	1.00	3.00	10.00	8.75	.390	6.30
	2	18.00	10.75	12.000	8.750	1.00	3.00	10.00	8.75	.390	6.30
R-80	1	24.00	24.00	17.000	21.000	1.50	3.50	12.50	11.25	.390	7.88
	2	24.00	14.63	17.000	11.650	1.50	3.50	12.50	11.25	.390	7.88
R-100	1	27.00	27.00	20.000	24.000	1.50	3.50	14.50	13.25	.500	9.84
	2	27.00	16.12	20.000	13.125	1.50	3.50	14.50	13.25	.500	9.84
R-125		Dimensions are for reference only and are subject to change. Contact Ross Engineering Corporation for application data.									
R-150		Dimensions are for reference only and are subject to change. Contact Ross Engineering Corporation for application data.									

## Outline

### Type I



### Type II



**NOTE:** End support may be necessary for multiple pole units.

Dimensions are for reference only and are subject to change. Contact Ross Engineering Corporation for application data.

## Specifications

Model	1 MINUTE Test Rating KV Peak					Current Rating A RMS			Max Contact Resistance Ohms	*** Standard Max # Contacts Available		*** Standard Max # Poles Available					
	HV Contact		** Pole to Pole		** Insulation to Ground or Handle		Continuous	Momentary 10 Cycles		Momentary Capacitor Discharge 20μsec	Type 1		Type 2				
	Contact to Contact	air	oil	air	oil	air								oil			
R-12	12	air	35	oil	12	air	35	oil	12	35	50	1,000	5,000	.001	8 - 12	2 - 7	5
R-15	15	air	45	oil	15	air	45	oil	15	45	50	1,000	5,000	.001	8 - 12	2 - 7	5
R-30	30	air	90	oil	30	air	90	oil	30	90	100	2,000	10,000	.001	7 - 10	2 - 6	5
R-45	45	air	135	oil	45	air	135	oil	45	135	100	2,000	10,000	.001	6 - 8	2 - 5	5
R-60	60	air	180	oil	60	air	180	oil	60	180	125	2,500	10,000	.001	6 - 8	2 - 5	5
R-80	80	air	240	oil	80	air	240	oil	80	240	125	2,500	10,000	.001	6 - 8	2 - 5	5
R-100	100	air	300	oil	100	air	300	oil	100	300	125	2,500	10,000	.001	6 - 8	2 - 5	5
R-125	125	air	375	oil	125	air	375	oil	125	375	125	2,500	10,000	.001	6 - 8	2 - 5	4
R-150	150	air	450	oil	150	air	450	oil	150	450	125	2,500	10,000	.001	6 - 8	2 - 5	4

**Detents and electrical interlock prevent opening under load.**

\* Can operate continuously in oil or SF6 at twice the peak test rating in air.

\*\*\* Insulation Pole to Pole and Pole to Ground can be increased.

\*\*\* Larger numbers of contacts and poles are available on special order.

# SINGLE POLE HV VACUUM CONTACTORS AND RELAYS



- 5 TO 300KV DC/AC PEAK TEST
- 50 TO 1,200 AMP CONTINUOUS
- 2,000 TO 28,000 AMP AC INTERRUPT
- HIGH SPEED STORED ENERGY CLOSING AND OPENING
- NC/NO/DT/LATCHING
- 1 TO 20 MILLISECOND OPERATE TIME
- 10 TO 40,000 AMP DC INTERRUPT



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## COMPACT DESIGN

Compared with other devices of the same power interruption range, the Ross contactors and relays are much lighter in weight and more compact in structure. Ross designed these devices especially for installation in indoor equipment and metal-clad enclosures of the smallest and lightest configurations. Also, because of the reliable actuator design and Ross Engineering's standard vacuum sealed HV contacts, each unit can operate quietly and efficiently in air, oil, or insulating gas atmospheres.

## LONG LIFE VACUUM INTERRUPTERS

To insure minimum maintenance and extremely long life, these Ross HV current interrupting contactors and relays are built with sealed vacuum interrupters. These versatile components assure high dielectric strength and rapid recovery after arc extinction. This high dielectric strength exhibits comparatively low arc energy during high current interruption, and thus minimizes contact erosion. The vacuum medium provides a very rapid but controlled arc extinction due to high velocity radial diffusion of vaporized special metal alloy contact surfaces during contact separation. Consequently, this allows the very rapid but controlled recovery of dielectric strength and minimizes over voltages. The interruption capability is not affected by adverse conditions such as altitude, extreme temperature or humidity. Of major importance, the high speed interruption reduces possible fault damage to equipment.

In addition to the extended life characteristics of the vacuum interrupters, the Ross HV vacuum contactors and relays are built with highly moisture resistant G-10 Epoxy glass as standard insulation (special insulation and insulation lengths can be ordered by contacting the factory.)

## VARIETY OF USES

Ross Engineering basic HV contactors and relays with sealed vacuum contacts are available in single pole, two-pole, and three-pole variations. Models include normally open, normally closed, or double throw units. Latching actuators are also available. (See brochure B-1005/6 for information on Ross Engineering's three-phase vacuum contactors and circuit breakers.) The Ross contactors and relays are used in many high voltage power supplies for capacitor bank charging and discharging, current transfer, tap or load selection, or sealed arc interruption. The units are excellent for high speed interruption of up to 10 amps DC or up to 28,000 amps AC. They are also very reliable for high speed crobar or fault diversion to protect sensitive electronic devices. These different functions are accomplished with 1 to 4 milliseconds contact closing or parting time when the vacuum contactor is driven by an SCR triggered stored energy driver. This combination, aided by a high speed vacuum power interrupter, can crobar in 2 milliseconds, divert the fault, then interrupt up to its maximum rated current in approximately 3 to 16 milliseconds total, depending on type of system and current zero timing.

## HIGH VOLTAGE PROTECTION

OSHA and other safety organizations require high voltage and line to ground current protection. Ross Engineering's lines of HV vacuum contactors and relays help users and manufacturers meet these regulations. In as little as 2 to 16 milliseconds the unit's high speed trip, driven by a Ross relay driver, can close the contact(s) and divert the fault current, or open the contact(s) and interrupt the load current, or both, thus minimizing damage to the controlled equipment. When proper ground fault or leakage current sensing is used, this may be fast enough to reduce injury to personnel from accidental electrocution as a result of contact with one line and ground or voltages developed in the ground circuit from ground current.

# APPLICATION DATA

## VACUUM CONTACTORS

Ross Engineering's HV contactors and relays require only a 1/16" to 1/2" contact opening to obtain voltage withstand of 20KV to 70KV PK (or more for series contacts) Operate times of 1 to 16 milliseconds are easily obtained using the simple reliable Ross operating mechanism to move the lightweight contacts the short travel required.

Contact resistance is consistently very low, usually less than 10 microhms to 1 milliohm, depending on the type of contact used. Higher continuous currents are also available with the use of Ross high current shunting switches with capacities of up to 36,000 amps. The contacts are readily adaptable to series placement for higher voltages, with a maximum operating voltage of 30KV to 45 KV PK per contact, enabling withstand voltage capabilities to 300KV or more.

Each unit's vacuum contact mechanical life is generally at least 10,000 operations to several million operations depending on type of unit, speed of operation, and contact opening distance. Contact electrical life is 1 to 10 operations at maximum interrupt to several million at lower currents; and is much more dependent on closing

current than on interrupt currents up to several times rated load current. Closing bounce and amp-seconds during arcing are the biggest electrical life determining factors.

## OPERATE VOLTAGES

Ross Engineering's single contact, normally open, normally closed, latching and trip free type HV vacuum contactors and relays are used at 208V RMS to 30,000V PK, and 50 to 1,200 amps continuous. In most standard applications, voltage ratings are raised in multiples of 30KV (operating) above 15KV (operating) by placing contacts in series. For example, two 15KV rated HB type contacts in series per phase are suitable for 45KV, three contacts in series per phase are suitable for 75KV applications.

## CURRENT RATINGS

Continuous current ratings are 50, 200, 400, 600, 900, and 1,200 amps RMS, with up to 36,000 amps RMS continuous with the use of a shunt switch to carry the continuous current while using the vacuum interrupter's capability for the actual interruption. This switchgear has 60Hz interrupt ratings of 2,000 to 28,000 amps, 10 cycle momentary ratings of 5,000 to 60,000 amps and capacitor discharge to 100,000 amps. Some 50Hz maximum interrupt ratings are derated 10%.

## AC/DC CURRENT INTERRUPTION

The Ross Engineering single pole HV vacuum contactors and relays can be used on both AC and DC current interruption. The units' DC rated vacuum contacts can normally be used for limited current interruption to 10 amps DC. Some AC rated contacts can interrupt DC at much higher currents with carefully controlled counter-pulses to create current zeros, and slow recovery voltage rates similar to those of 60Hz to 400Hz waveforms. Ross utilizes special tungsten contacts for limited DC current interruption. In some cases, the interruption can be carried to as high as 20 to 40 amps DC. When interrupting DC, transient suppression such as non-linear resistance or the proper size of capacitor in series with a 1 ohm per KV inrush limiting resistor should be used in parallel with the Ross vacuum contacts and the load.

For higher DC current interruption, i.e. several hundred to several thousand amps or more at 15KV DC per contact, or 40KV DC for 2 contacts in series, Ross AC rated contactors with copper alloy vacuum contacts can be satisfactory. This is possible if multiple counter-pulses are applied with a carefully controlled rate of recovery voltage that approximates 60Hz current zero and recovery voltage characteristics by means of a resistor/capacitor and switching network or if in combination with an inductive ringing circuit. For AC interruption, the Ross contacts are designed with copper alloy combinations to limit current chopping to less than a 1 to 8 amp level to minimize switching transients. AC current interruption generally occurs at the first current zero after contact parting. If contacts are not parted sufficiently for the rate of recovery voltage, or arc energy is very high, current may carry over to the second current zero before clearing. At higher contact voltages and currents, care is taken to insure that contacts do not bounce back after opening, thus reducing contact spacing temporarily. Ross mechanisms are designed to be easily checked for contact erosion limits and overtravel to insure that proper overtravel and positive contact closing are maintained as erosion continues.

## INDUCTIVE LOAD SWITCHING

With highly inductive loads, wherever possible, transient suppressing non-linear resistance or protective capacitors should be placed across the line as close to the load equipment terminals as possible. Standard lightning arresters have not been found as effective as a protective capacitor with approximately 1 ohm per KV of inrush damping resistor in series directly connected across the load. This is particularly essential for repeatedly switched inductive loads such as arc furnaces, motors, and many low current, transient generating inductive loads. Most switching devices can create overvoltages on switching and Ross Engineering experience has shown that for iron core reactive loads, normal switching overvoltages of 2 to 2-1/2 times operating voltage are to be expected with almost any type of interrupter. Air core inductive loads can generate higher overvoltages if there is insufficient shunt capacitance.

## CLOSING AND INRUSH CURRENTS

When closing-in on transformers and other iron core inductive loads, normal inrush currents of 5 to 10 times rated load current are expected, depending on the degree of magnetic retentivity from the previous interrup-

tion. If iron core inductive loads can be re-energized on the opposite polarity from which they were de-energized, then inrush is minimized, otherwise, it is limited primarily by the circuit and winding resistance. Repeated high inrush closing causes great mechanical stress on the transformer windings as well as rapid erosion of the vacuum contact (which can be over 10 times as great on closing as on interrupting even the same current). Therefore, transformers that have marginal insulation and bracing can deteriorate with repeated switching, regardless of type of switch. A much larger number of transformer failures have probably occurred because of these high inrush currents and poor bracing than from overvoltages.

## CONTACT EROSION

Contact erosion and resultant internal vaporized metal deposit distribution generally determines end of electrical life. 1/16" to 1/4" of total erosion is generally the limit. With the proper selection of contact material and with currents under 600 to 1,000 amps, erosion should be very small. At currents between 1,000 and 3,500 amps, erosion should be moderate. At currents approaching maximum interruption rating, life may only be 1 to 100 operations. Even at low to moderate currents, closing generally causes 2 to 10 times as much erosion as interrupting the same currents. Thus, for best long-life current closing, the closing current should be limited. Step-start dual closing contactors which use inrush current limiting resistors are available. Voltage zero and current zero sensing devices for closing or opening are under development.

## ACTUATOR TYPES AND CONTACTOR CONFIGURATIONS

They are available with line or stored energy driver opening or closing and antipump or automatic reset actuators. Normally open, normally closed, double throw and latching type configurations are available. Standard actuator voltages are 115V, 60Hz for smaller units, 230V, 60Hz is recommended for larger, heavy-duty solenoid actuated units. 208V, 480V, 24V, 60Hz, 50Hz; and 24V DC, 100/125V DC, 400Hz, and other voltages are available. Application information should be furnished along with contact configuration requirements. When ordering or requesting recommendations, actuator voltage should be specified as well as the applicable HV contact operating voltage and current, basic impulse level (BIL), insulation level for HV contacts and HV contacts to actuator or ground, maximum RMS current interrupt, 1 cycle (17 milliseconds) momentary RMS current, 10 cycle RMS momentary current, or peak capacitor discharge current and the RC time constant of the current decay to 35% of peak. Other information such as type of load, number of operations per year, maximum current levels on closing and opening, speed of opening and closing, and number and type of auxiliary contacts required is also necessary for the best application recommendation.

## AUXILIARY CONTACTS

Two auxiliary SPDT contacts are standard on each model. Additional contacts can be ordered.



# HB AND HBDC SERIES

This series is the smallest and lightest of the vacuum contactors, useful up to 400 amps continuous, to 2,000 amps AC interrupt, and with some models, 10 amps DC interrupt. They are designed for medium duty and medium to long life with moderate AC and DC current interrupting capability. Minimum expected mechanical life is generally 50,000 operations to millions of operations depending on type. Electrical life at moderate load currents is close to mechanical life. At highest currents, life can be one to a few thousand operations depending on how close to maximum rating is required.

The HB series has a copper alloy type, very low current chop contact recommended for AC type loads where current zeros occur or DC loads and capacitor discharge, where no interruption is required. It has no DC interruption rating unless a special counter-pulse system is used which creates artificial current zeros across the contacts during contact opening.

The HBDC series uses tungsten contacts. It has a more rapid rate of dielectric recovery enabling it to interrupt up to 10 amps DC without assistance, or more with assistance of only a parallel capacitor/resistor combination used to slow the rate of rise of recovery voltage and minimize transient voltages which could be generated during switching. Capacitors and/or non-linear resistors should be placed across the load.



**MODEL HB-51 200 AMP CONTINUOUS**

This series is also used for very high speed interruption or crobarring of moderate AC or DC currents within its ratings when driven by a Ross SCR controlled stored energy driver. Contact parting times from 1 to 4 milliseconds and contact closing times from 2 to 6 milliseconds are available with the use of this driver.

See other pages and other brochures on HBF, HBDCF & HAF high speed series and stored energy driver. Two SPDT auxiliary contacts are standard on each model. Additional auxiliary contacts can be ordered.

SPECIFICATIONS ARE FOR REFERENCE ONLY AND ARE SUBJECT TO CHANGE.  
CONTACT: ROSS ENGINEERING CORP. FOR APPLICATION DATA.

SPECIFICATIONS													
MODEL	*CONTACT FORMS AVAILABLE	PEAK TEST RATING KV		MAX OPERATE VOLTAGE	CURRENT RATINGS AMPS				CONTACT RESISTANCE	OPERATE TIME	RELEASE TIME	**115V 60Hz COIL	
		HV CONTACT	INSULATION TO GND		AC/DC KV PK	CONTINUOUS RMS	MOMENTARY 10 CYCLE RMS	MOMENTARY CAP DIS 20 USEC PK				MAX INTERRUPT RMS SYMMETRIC	MAX OHMS
HB-27	NC/NO/DT	25	25/40	15	200	5,000	50,000	2,000	.002	20	40	7	0.7
HB-28	NC/NO/DT	50	40/60	25	400	10,000	75,000	2,000	.0002	20	40	15	1.4
HB-51	NC/NO/DT	50	40/60	35	200	5,000	50,000	2,000	.0005	20	40	7	0.7
HB-102	NC/NO	100	40/120	70	200	5,000	50,000	2,000	.001	20	40	15	1.4
HB-153	NC/NO	150	40/120	100	200	5,000	50,000	2,000	.002	20	40	**30	2
HB-204	NC/NO	200	40/200	130	200	5,000	50,000	2,000	.002	20	40	**30	2
HB-255	NC/NO	250	40/250	160	200	5,000	50,000	2,000	.003	20	40	**60	4
HB-306	NC/NO	300	40/300	190	200	2,500	50,000	2,000	.003	20	40	**60	4

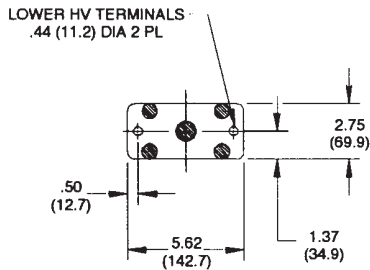
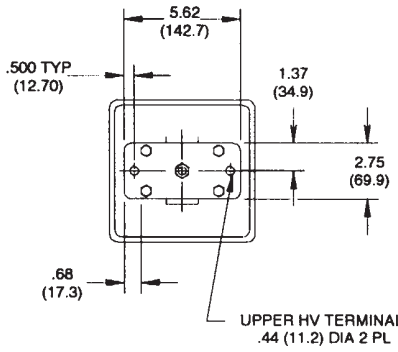
FOR DC CURRENT INTERRUPTION SPECIFICATIONS														
MODEL	*CONTACT FORMS AVAILABLE	PEAK TEST RATING KV		MAX OPERATE VOLTAGE	CURRENT RATINGS AMPS				CONTACT RESISTANCE	OPERATE TIME	RELEASE TIME	**115V 60Hz COIL		
		HV CONTACT	INSULATION TO GND		AC/DC KV PK	CONTINUOUS RMS	MOMENTARY 10 CYCLE RMS	MOMENTARY CAP DIS 20 USEC PK				MAX INTERRUPT DC	MAX INTERRUPT AC RMS	MAX OHMS
HBDC-51	NC/NO/DT	50	40/60	35	50/200	200/2,000	5,000/10,000	10	2,000	.0005	20	40	7	0.7
HBDC-102	NC/NO	100	40/120	70	50/200	200/2,000	5,000/10,000	10	2,000	.001	20	40	15	1.4
HBDC-153	NC/NO	150	40/150	100	50/200	200/2,000	5,000/10,000	10	2,000	.002	20	40	**30	2
HBDC-204	NC/NO	200	40/200	130	50/200	200/2,000	5,000/10,000	10	2,000	.002	20	40	**30	2
HBDC-255	NC/NO	250	40/250	160	50/200	200/2,000	5,000/10,000	10	2,000	.003	20	40	**60	4
HBDC-306	NC/NO	300	40/300	190	50/200	200/2,000	5,000/10,000	10	2,000	.004	20	40	**60	4

INRUSH AND HOLD CURRENTS ARE INVERSELY PROPORTIONAL TO COIL VOLTAGE. MAXIMUM INTERRUPT AT 0.6 OF MAXIMUM OPERATE VOLTAGE. VOLTAGE SAFETY FACTOR TO ACTUATOR CAN BE INCREASED BY IMMERSING IN INSULATING OIL OR GAS.

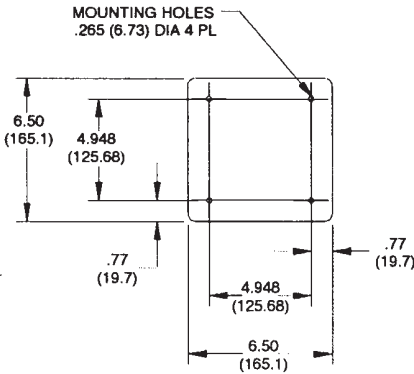
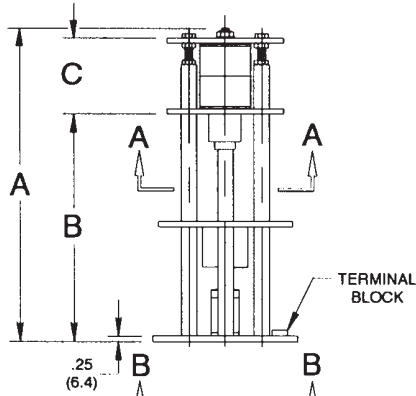
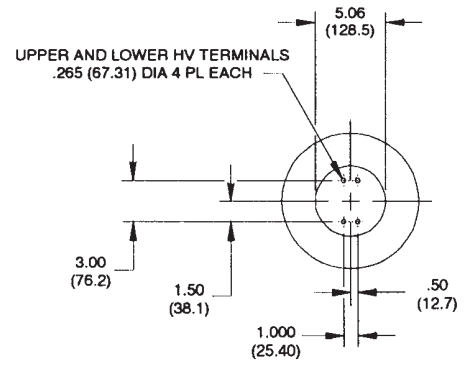
\* DOUBLE THROW AND LATCHING SEE PAGE 10. HIGHER INSULATION LEVELS ARE AVAILABLE.

\*\* RECOMMEND 230V ACTUATOR WHEN 115V INRUSH EXCEEDS 20 AMPS. STORED ENERGY CLOSING AND OPENING ARE AVAILABLE.

**ROSS ENGINEERING CORP.**



**SECTION A A**

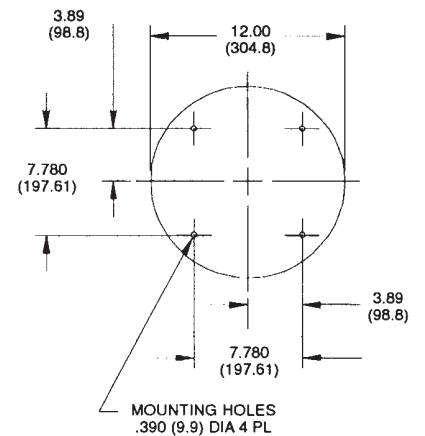
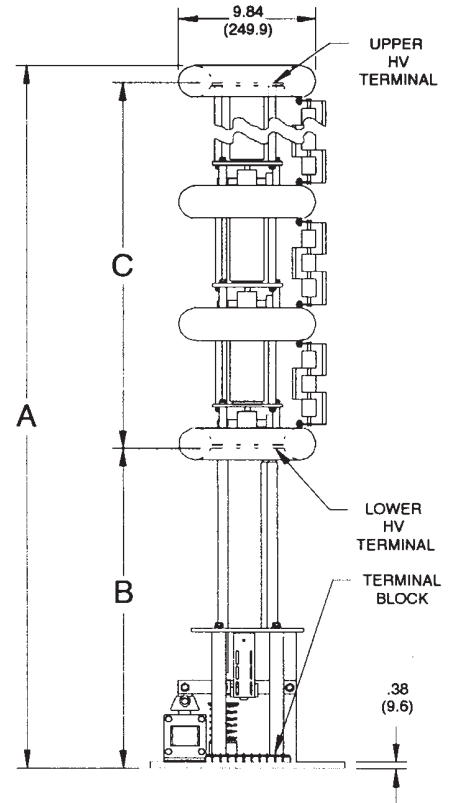


**SECTION B B**

**TYPE 1**

DIMENSIONS ARE FOR REFERENCE ONLY AND ARE SUBJECT TO CHANGE.  
CONTACT: ROSS ENGINEERING CORP. FOR APPLICATION DATA.

DIMENSIONS						
MODEL	MODEL	PK INS TO GND	TYPE	A	B	C
HB-27-NC/NO (mm)		40 KV	1	17.34 (440.3)	12.56 (319.0)	4.03 (102.4)
HB-28-NC/NO		60 KV	1	19.34 (492.2)	14.56 (369.8)	4.03 (102.4)
HB-51-NC/NO	HBDC-51-NC/NO	40 KV	1	16.75 (425.5)	9.88 (251.0)	6.12 (155.4)
HB-51-NC/NO	HBDC-51-NC/NO	60 KV	1	18.75 (476.3)	11.88 (301.8)	6.12 (155.4)
HB-102-NC/NO	HBDC-102-NC/NO	40 KV	5	32.39 (822.7)	13.14 (333.8)	17.99 (456.9)
HB-102-NC/NO	HBDC-102-NC/NO	120 KV	5	40.39 (1025.9)	21.14 (537.0)	17.99 (456.9)
HB-153-NC/NO	HBDC-153-NC/NO	40 KV	5	41.28 (1048.0)	13.14 (333.8)	26.87 (682.5)
HB-153-NC/NO	HBDC-153-NC/NO	150 KV	5	54.26 (1378.2)	26.14 (664.0)	26.87 (682.5)
HB-204-NC/NO	HBDC-204-NC/NO	40 KV	5	50.14 (1273.6)	13.14 (333.8)	35.75 (908.1)
HB-204-NC/NO	HBCD-204-NC/NO	200 KV	5	68.14 (1730.8)	31.14 (791.0)	35.75 (908.1)
HB-255-NC/NO	HBDC-255-NC/NO	40 KV	5	59.01 (1498.9)	13.14 (333.8)	44.62 (1133.3)
HB-255-NC/NO	HBDC-255-NC/NO	250 KV	5	82.01 (2083.1)	35.14 (892.6)	44.62 (1133.3)
HB-306-NC/NO	HBDC-306-NC/NO	40 KV	5	67.88 (1724.2)	13.14 (333.8)	53.49 (1358.6)
HB-306-NC/NO	HBDC-306-NC/NO	300 KV	5	95.88 (2435.4)	41.14 (1045.0)	53.49 (1358.6)



**TYPE 5**

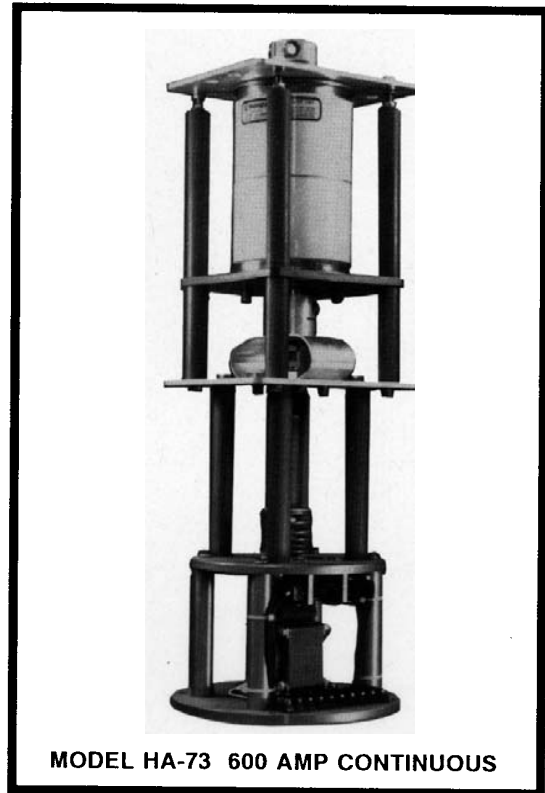


# HA SERIES

This series of vacuum contactors includes heavy and very heavy duty types normally used at 400 to 2,000 amps continuous and 4,000 to 28,000 amps AC interrupt. Some are also used in conjunction with higher current shunt switches to give continuous duty as high as 36,000 amps RMS where only moderate current is present during interruption. Some types are also used for higher current DC interruption aided by a counter-pulse system which creates artificial current zeros across the contacts during contact parting. Up to 40,000 amps DC at 40,000 volts has been interrupted by this method.

Units in this series have mechanical lives from 10,000 operations to over 3 million operations depending on contact spacing and opening speed. Most of the HA series uses contacts made of copper alloy with a refractory metal base to minimize erosion rate. This combination of materials provides minimum welding, minimum current chopping and rapid recovery rate of high dielectric strength after interruption.

Several units have a type of copper alloy without refractory metal which provides lower contact resistance and high interruption ratings but allows a higher erosion rate. Very high speed crobarring and current interrupting models are also available with contact parting time of 1 to 6 milliseconds and contact closing times as short as 2 to 8 milliseconds when used in conjunction with Ross Engineering SCR controlled stored energy drivers.



**MODEL HA-73 600 AMP CONTINUOUS**

SPECIFICATIONS ARE FOR REFERENCE ONLY AND ARE SUBJECT TO CHANGE.  
CONTACT: ROSS ENGINEERING CORP. FOR APPLICATION DATA.

SPECIFICATIONS													
MODEL	*CONTACT FORMS AVAILABLE	PEAK TEST RATING KV		MAX OPERATE VOLTAGE	CURRENT RATINGS AMPS				CONTACT RESISTANCE	OPERATE TIME	RELEASE TIME	**115V 60Hz COIL	
		HV CONTACT	INSULATION TO GND		AC/DC KV PK	CONTINUOUS RMS	MOMENTARY 10 CYCLE RMS	MOMENTARY CAP DIS 20 USEC PK				*** MAX INTERRUPT RMS SYMMETRIC	MAX OHMS
HA-25	NC/NO/DT	25	25	15	400/600	20,000	100,000	4,000/13,500	.0002	20	30	13	1
HA-37	NC/NO/DT	37	40/60	25	400/600	20,000	100,000	4,000/13,500	.0002	20	30	13	1
HA-73	NC/NO/DT	70	100	45	400/600	20,000	100,000	12,000	.0001	20	30	**30	2
HA-75	NC/NO	70	100	45	600/1,200	20,000	100,000	18,000	.00003	20	40	**60	4
HA-79	NC/NO	70	100	45	600/1,200	20,000	200,000	28,000	.00002	20	40	**60	4
HA-146	NC/NO	140	40/140	90	400/600	10,000	100,000	4,000	.0005	30	40	**30	2
HA-219	NC/NO	210	40/210	135	400/600	10,000	100,000	4,000	.001	30	40	**60	4
HA-292	NC/NO	280	40/280	175	400/600	10,000	100,000	4,000	.002	30	40	**60	4
HA-365	NC/NO	350	40/350	215	400/600	5,000	100,000	4,000	.004	30	40	**60	4
HA-438	NC/NO	420	40/420	250	400/600	5,000	100,000	4,000	.005	30	40	**60	4

INRUSH AND HOLD CURRENTS ARE INVERSELY PROPORTIONAL TO COIL VOLTAGES

MODELS ARE AVAILABLE WITH INTERRUPT RATINGS TO 28,000 AMPS; 800 TO 36,000 AMP CONTINUOUS, STORED ENERGY CLOSING AND OPENING

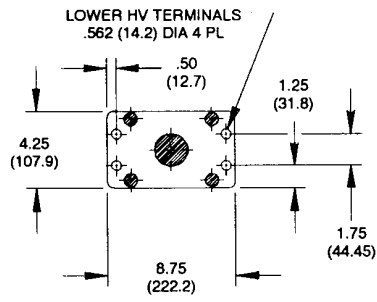
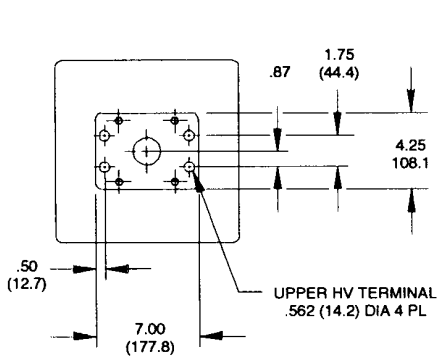
\* ALSO AVAILABLE IN DOUBLE THROW AND LATCHING SEE PAGE 10

\*\* RECOMMEND 230V ACTUATOR WHEN 115V INRUSH EXCEEDS 20 AMPS AT 115V

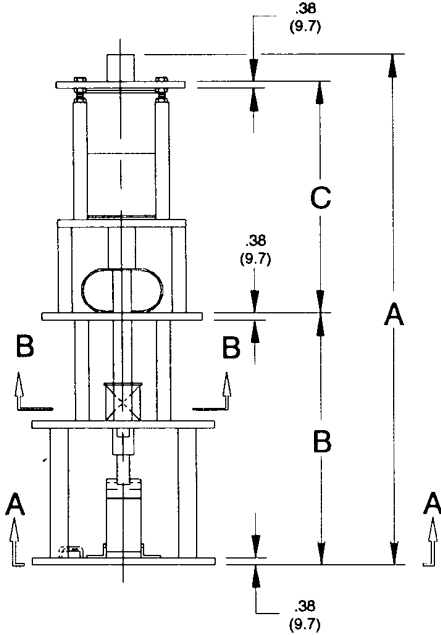
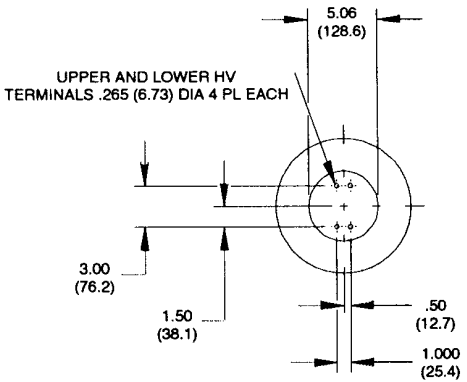
\*\*\* MAX INTERRUPT AT 1/3 OF MAX OPERATE VOLTAGE

**ROSS ENGINEERING CORP.**

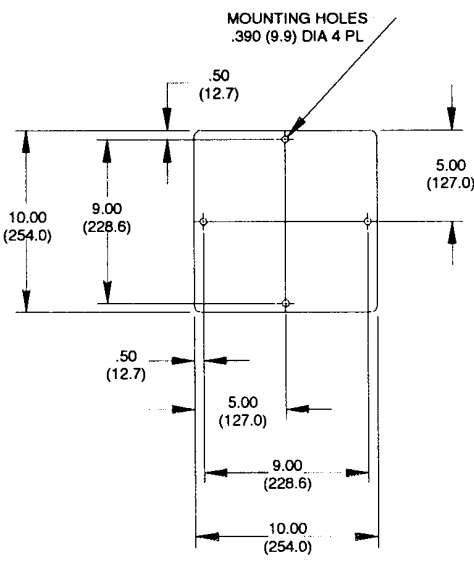
CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX: (408) 377-5182



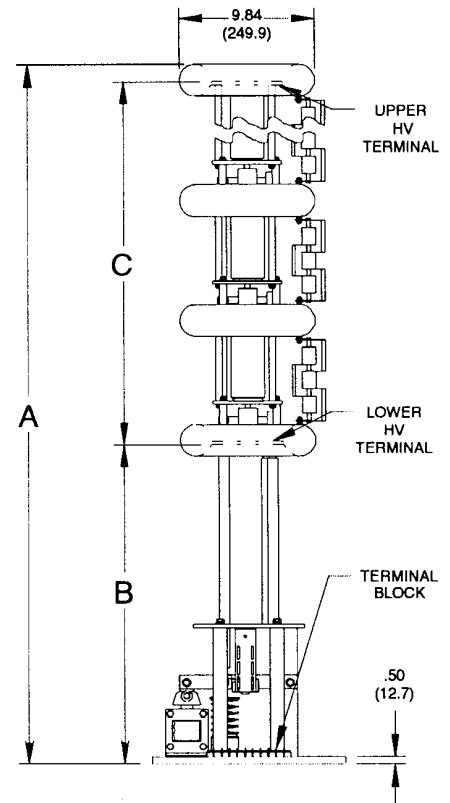
**SECTION B B**



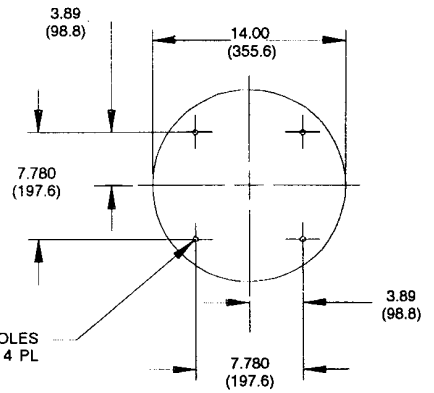
**TYPE 4**



**SECTION A A**



**TYPE 5**



DIMENSIONS					
MODEL	PK INS TO GND	TYPE	A	B	C
HA-37-NC/NO	40KV/60KV	4	17.18/19.18 (436.4/487.2)	12.33/14.33 (313.2/364.0)	3.35/3.35 (85.1/85.1)
HA-73-NC/NO	40KV/110KV	4	26.65/33.65 (676.9/854.7)	12.33/19.33 (313.2/491.0)	12.72/12.72 (323.1/323.1)
HA-75-NC/NO	40KV/110KV	4	28.00/35.00 (711.2/889.0)	12.33/19.33 (313.2/491.0)	14.08/14.08 (357.6/357.6)
HA-79-NC/NO	40KV/110KV	4	28.08/35.08 (713.2/891.0)	12.33/19.33 (313.2/491.0)	14.16/14.16 (359.7/359.7)
HA-146-NC/NO	40KV/140KV	5	43.76/54.76 (1111.5/1390.9)	13.14/27.14 (333.8/689.4)	29.12/29.12 (739.6/739.6)
HA-219-NC/NO	40KV/210KV	5	58.14/76.14 (1476.8/1934.0)	13.14/34.14 (333.8/867.2)	43.49/43.49 (1104.6/1104.6)
HA-292-NC/NO	40KV/280KV	5	72.51/97.51 (1841.8/2476.8)	13.14/41.14 (333.8/1045.0)	57.86/57.86 (1496.6/1496.6)
HA-365-NC/NO	40KV/350KV	5	86.90/118.90 (2207.3/3020.1)	13.14/48.14 (333.8/1222.8)	72.24/72.24 (1834.9/1834.9)
HA-438-NC/NO	40KV/420KV	5	101.25/140.25 (2571.8/3562.4)	13.14/55.14 (333.8/1400.6)	86.61/86.61 (2199.9/2199.9)

# HIGH SPEED SERIES HBF, HAF AND HBDCF

The high speed vacuum contactor and relay series consists of selected types of vacuum contacts and actuators specially designed with low inertia and high shock resistance to allow contact parting times from 1 to 6 milliseconds and contact closing times from 2 to 12 milliseconds. Maximum speed is attainable in conjunction with a Ross Engineering SCR controlled stored energy solenoid driver. Actuator solenoid resistance and inductance is carefully matched with the stored energy level to provide the highest speed, yet reasonable mechanical life. Expected mechanical life is generally 5,000 to 50,000 operations at the highest speeds. The highest speed models in the series have somewhat reduced voltage and current ratings compared to similar standard Ross vacuum contactors. Contact travel and overtravel is reduced to a minimum to attain highest speed with short mechanism travel.

Standard units are available with operating voltages from 5KV to 190KV AC PK or DC, with peak test voltage to 300KV PK, continuous currents to 1,200 amps and interrupt currents to 28,000 amps. Capacitor discharge closing currents up to 100,000 amps are possible depending on time constant of discharge down to 37% level.

With repeated high speed DC interruptions or crobar type operations in DC circuits, both transformers and loads must be protected from possible transient overvoltages and inrush currents. Transformers must be well braced and end turns especially well insulated. Loads, especially inductive loads, must have capacitance and/or non-linear resistance in parallel at their terminals and on the output terminals of the transformer. Capacitors with at least 1.5 times voltage rating (in the order of .01 to 0.25 mfd) in series with 1 to 2 ohms per KV, are recommended. GE Thyrite or similar non-linear resistance carefully rated for appropriate operating current is also helpful.



**MODEL HAF-75  
600 TO 1,200 AMP CONTINUOUS**

To limit inrush on re-energizing after a crobar has tripped a primary breaker, a dual step-start contactor or circuit breaker is recommended. See brochure B-1005/6 on Ross Engineering's three-phase vacuum contactors and circuit breakers for further power control information.

Two auxiliary SPDT contacts are standard on each model. Additional auxiliary contacts can be ordered.

SPECIFICATIONS ARE FOR REFERENCE ONLY AND ARE SUBJECT TO CHANGE.  
CONTACT: ROSS ENGINEERING CORP. FOR APPLICATION DATA.

MODEL	*CONTACT FORMS AVAILABLE	PEAK TEST RATING KV		MAX OPERATE VOLTAGE KV PK	CURRENT RATINGS AMPS				CONTACT RESISTANCE MAX OHMS	OPERATE TIME MAX MS		RELEASE TIME MAX MS	ACTUATOR STORED ENERGY TYPE	
		HV CONTACT	INSULATION TO GND		CONTINUOUS RMS	CLOSING MOMENTARY 20 MS RMS	MOMENTARY CAP DIS 20 USEC PK	***MAX INTERRUPT SYMMETRIC AC RMS		NC	NO		MAX INRUSH AMPS/MS	MAX HOLD AMPS
HBF-51	NC/NO/DT	25/50	40/60	5/33	200	2,500	50,000	2,000	.0005	1-4	2-10	20-40	200/50	1-8
HAF-73	NC/NO/DT	30/70	40/100	5/38	600/900	20,000	100,000	4,000-13,200	.0002	2-4	2-12	20-40	300/50	1.5
HAF-75	NC/NO/DT	30/75	40/100	15/38	600/1,200	20,000	100,000	4,000-18,000	.0002	2-6	2-12	20-40	300/50	1.5
HAF-79	NC/NO	30/75	40/100	15/38	600/1,200	20,000	100,000	4,000-28,000	.0001	2-6	2-12	20-40	300/50	1.5
HBF-102	NC/NO	50/100	40/120	20/70	200	2,500	50,000	2,000	.0005	2-6	2-10	20-40	300/50	1.8
HBF-153	NC/NO	75/150	40/150	40/100	200	2,500	50,000	2,000	.0005	2-6	2-10	20-40	300/50	1.8
HBF-204	NC/NO	100/200	40/200	60/130	200	2,500	50,000	2,000	.0005	2-6	2-10	20-40	300/50	1-8
HBF-255	NC/NO	125/250	40/250	75/160	200	2,500	50,000	2,000	.0005	2-8	2-12	20-40	300/50	1-8
HBF-306	NC/NO	150/300	40/300	90/190	200	2,500	50,000	2,000	.0005	2-8	2-12	20-40	300/50	1-8
HBDCF-51	NC/NO	25/50	40/60	5/33	200	2,500	20,000	DC 2,000 AC ***10 2,000	.0005	2-6	2-10	20-40	300/50	1-8

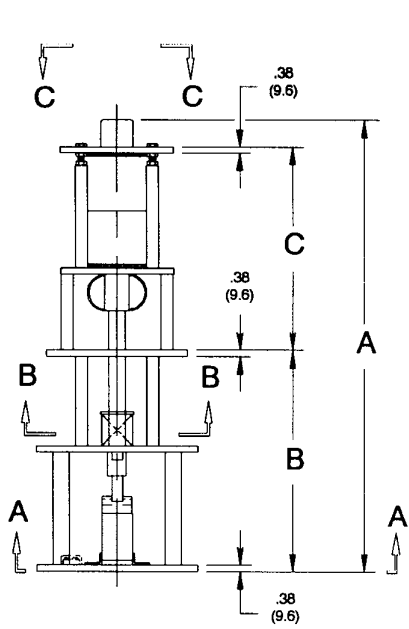
HIGH SPEED OPERATE TIMES ARE OBTAINED WITH A ROSS ENGINEERING CORP. stored energy SOLENOID DRIVER. OPERATE SPEED DEPENDS ON VOLTAGE WITHSTAND REQUIRED, AND DRIVER HBDCF SERIES HAS A 10 AMP DC MAXIMUM INTERRUPT AT 0.6 MAXIMUM VOLTAGE RATING WITHOUT COUNTER PULSE ASSISTANCE. STORED ENERGY CLOSING AND OPENING ARE AVAILABLE.

\* ALSO AVAILABLE IN DOUBLE THROW AND LATCHING, SEE PAGE 10. AVAILABLE WITH HIGHER INSULATION LEVELS.

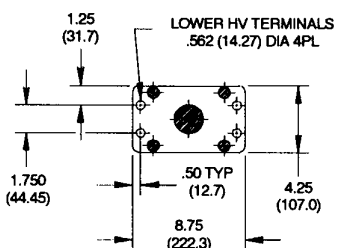
\*\* ALSO HAS LIMITED DC INTERRUPT CAPABILITY. TRANSIENT SUPPRESSION RECOMMENDED WHEN INTERRUPTING DC.

\*\*\* MAX AC INTERRUPT AT 1/3 TO 1/2 MAX OPERATE VOLTAGE. TRANSIENT SUPPRESSION RECOMMENDED DURING HIGH SPEED INTERRUPTION.

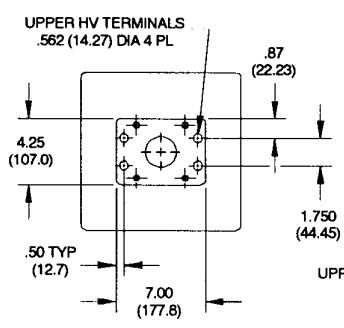
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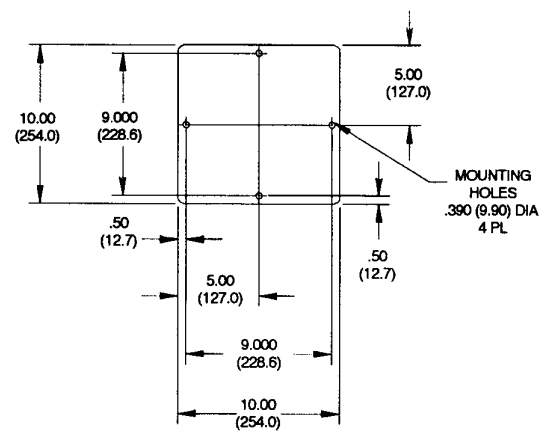
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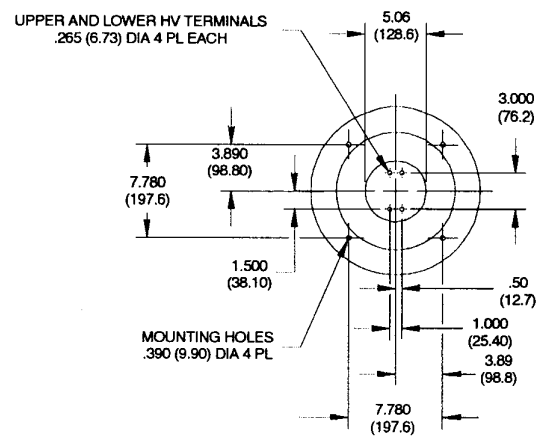
## SECTION B B



## SECTION C C

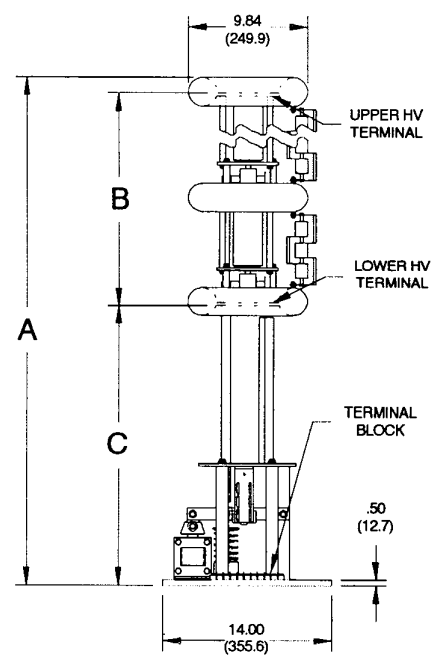


## SECTION A A



DIMENSIONS ARE FOR REFERENCE ONLY AND ARE SUBJECT TO CHANGE.  
CONTACT: ROSS ENGINEERING CORP. FOR APPLICATION DATA.

DIMENSIONS					
MODEL	PK INS TO GND	TYPE	A	B	C
HBF-51-NC/NO	40KV	1	16.75	9.88	6.12
(mm)			(425.5)	(251.0)	(155.4)
HBF-51-NC/NO	60KV	1	18.75	11.88	6.12
			(476.3)	(301.8)	(155.4)
HAF-73-NC/NO	40KV	4	26.65	12.33	12.72
			(676.9)	(313.2)	(323.1)
HAF-73-NC/NO	110KV	4	33.65	19.33	12.72
			(854.7)	(491.0)	(323.1)
HAF-75-NC/NO	40KV	4	28.00	12.33	14.08
			(711.2)	(313.2)	(357.6)
HAF-75-NC/NO	110KV	4	35.00	19.33	14.08
			(889.0)	(491.0)	(357.6)
HAF-79-NC/NO	40KV	4	28.08	12.33	14.16
			(713.2)	(313.2)	(359.7)
HAF-79-NC/NO	110KV	4	35.08	19.33	14.16
			(891.0)	(491.0)	(359.7)
HBF-102-NC/NO	40KV	5	32.39	13.14	17.99
			(822.7)	(333.8)	(456.9)
HBF-102-NC/NO	120KV	5	40.39	21.14	17.99
			(1025.9)	(537.0)	(456.9)
HBF-153-NC/NO	40KV	5	41.28	13.14	28.87
			(1048.0)	(333.8)	(682.5)
HBF-153-NC/NO	150KV	5	54.26	26.14	26.87
			(1378.2)	(664.0)	(682.5)
HBF-204-NC/NO	40KV	5	50.14	13.14	35.75
			(1273.6)	(333.8)	(908.1)
HBF-204-NC/NO	200KV	5	68.14	31.14	35.75
			(1730.8)	(791.0)	44.62
HBF-255-NC/NO	40KV	5	59.01	13.14	(1133.9)
			(1498.9)	(333.8)	(908.1)
HBF-255-NC/NO	250KV	5	82.01	35.14	44.62
			(2083.1)	(892.6)	(1133.3)
HBF-306-NC/NO	40KV	5	67.88	13.14	53.49
			(1724.2)	(333.8)	(1358.6)
HBF-306-NC/NO	300KV	5	95.88	41.14	53.49
			(2435.4)	(1045.0)	(1358.6)
*HBDCF-51-NC/NO	40KV	1	16.75	9.88	6.12
			(425.5)	(251.0)	(155.4)
*HBDCF-51-NC/NO	60KV	1	18.75	11.88	6.12
			(476.3)	(301.8)	(155.4)



# TYPE 5

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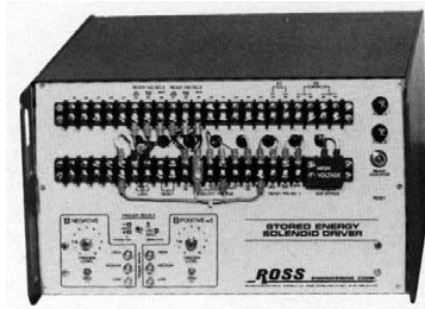
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# STORED ENERGY SOLENOID DRIVERS

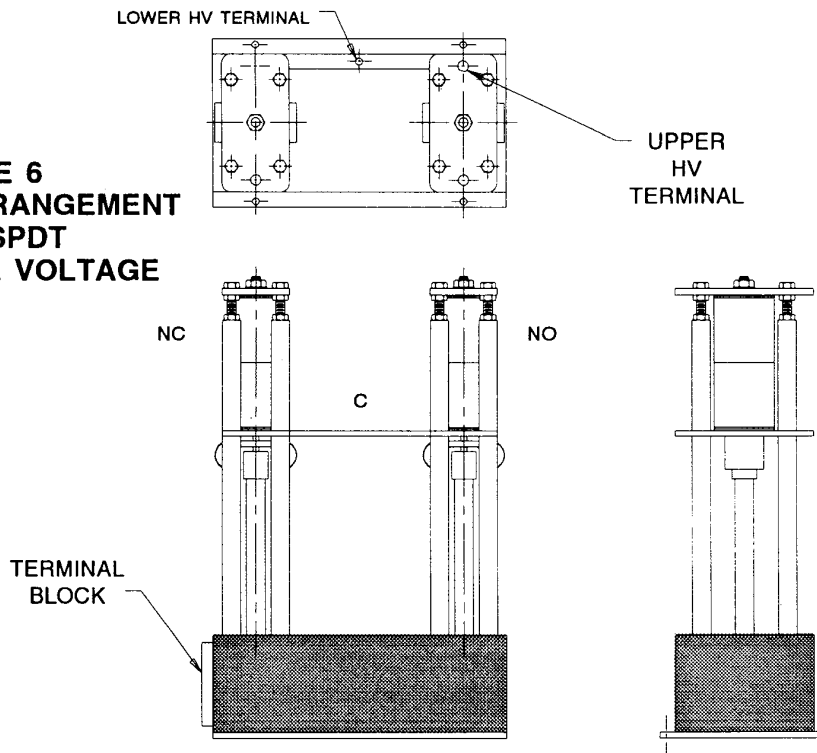
Drivers have been developed for precise, high-speed control of crobars, circuit breakers, contactors, or relays. They are also useful for other types of actuator or capacitor discharge pulse applications. Stored energy units provide up to 400 joules, or more, at 150 to 700 volts, or more, 100 to 2,100 mfd, or more. Contact closing or opening times of 0.5 to 10 milliseconds can be achieved with properly matched drivers and actuators. A 5 to 100 volt pulse or other signal voltage developed by excessive current, loss of power, over-voltage, under-voltage, or any other control source may be used to trigger the SCR controlled solenoid driver. Also available for control by an external relay contact closure or opening. See brochure number B-1014 for high speed drivers.



MODEL HAF-73-NO  
70KV PK TEST CROBAR OR  
OVERLOAD INTERRUPTER  
WITH STORED ENERGY  
SOLENOID DRIVER



TYPE 6  
UPRIGHT ARRANGEMENT  
FOR SPDT  
OR DOUBLE VOLTAGE



**ROSS** ENGINEERING CORP.

## EXTRA HIGH VOLTAGE CONTACTORS TO 300KV

Units with many contacts in series for higher voltage use are available for AC and DC operation. Both normal speed and also super fast with 1 to 6 millisecond contact closing or parting times can be supplied.

## RELIABLE HIGH SPEED CONTROL

Using and controlling electrical power efficiently is the essence of electrical conservation. Companies today are taking steps to avoid shortages and wasted energy. To help keep electricity under control, Ross Engineering Corporation is building HV devices for use in industry and utilities. The Ross Engineering HV vacuum contactors and relays are just a few of these devices.

Over 30 years manufacturing and over 45 years application experience go into every Ross HV device. From concept to shipping, the Ross HV vacuum contactors and relays are carefully monitored during designing, manufacturing and testing to insure peak performance and long life.

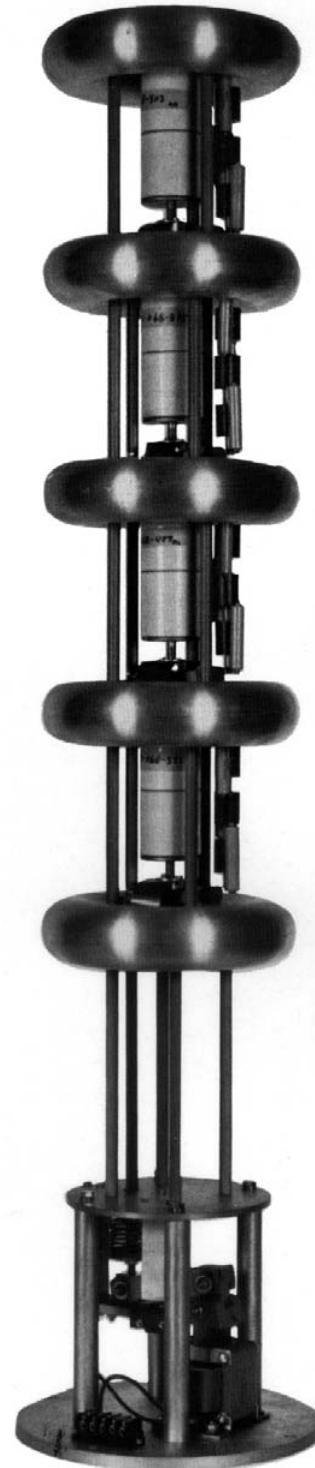
Where the Ross Engineering contactors and relays, equipped with vacuum-sealed HV contacts, are at work, you can expect both reliability and rapid circuit interruption. This high speed switching capability, due to the sealed vacuum contacts, not only controls electrical energy but also saves expensive high powered equipment which might otherwise be destroyed with lengthy short circuit interruption time.

## DOUBLE THROW

Ross vacuum contactors are available for, or can be designed for, nearly any application where a vacuum contact is desirable.

Double throw units can be either break before make (standard) or make before break (special).

Latching configuration can be furnished in most styles of single pole, 2 pole, 3 pole, and single or double throw. Stored energy positive action closing and/or tripping is available in some models to provide minimum bounce or chatter-free operation over a wide variation of actuator line voltage. See HB and HBDC models for ratings, and type 6 for outline

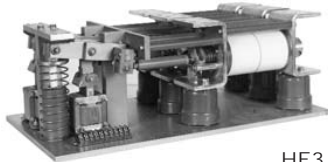


MODEL HB-204  
200KV PK TEST  
HIGH VOLTAGE VACUUM RELAY  
SEE PAGE 4 FOR SPECIFICATIONS

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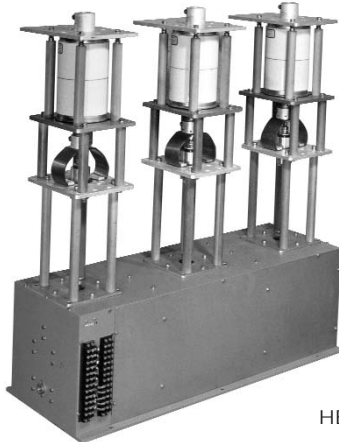
# THREE-PHASE HIGH VOLTAGE VACUUM CONTACTORS & CIRCUIT BREAKERS



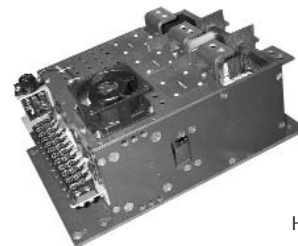
HE3 LOW PROFILE



HA3 UPRIGHT



HB3 UPRIGHT



HN3 LOW PROFILE

- *THREE-PHASE*
- *UPRIGHT OR LOW PROFILE FOR HIGH RELIABILITY*
- *½ TO 2 CYCLE TRIP & INTERRUPT*
- *208V TO 38KV OPERATE*
- *200 TO 1,200A CONTINUOUS*
- *2,000 TO 28,000A INTERRUPT*
- *LINE OR ENERGY STORAGE CLOSE & TRIP*
- *IDEAL FOR HIGH POWER ELECTRONICS*
- *HIGH SPEED SEALED ARC INTERRUPTING*
- *HIGH SPEED CROBAR SHORTING*
- *COMPACT*
- *LIGHT WEIGHT*
- *LONG LIFE*
- *MINIMUM REIGNITIONS*
- *MINIMUM RESTRIKES*



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 e-mail: info@rossengineeringcorp.com



# ADVANTAGES

## PERSONNEL PROTECTION:

Ross Engineering's HV control devices help users and manufacturers meet OSHA and other safety regulations for high voltage and line to ground current protection. In as little time as 2 to 16 milliseconds ( 1/8 to 1 cycle at 60Hz), the integral high speed trip mechanism, driven by a Ross relay driver, will open the Ross breaker and interrupt the load current, thus minimizing damage to the controlled equipment. When proper ground fault or leakage current sensing is used, this can be fast enough to possibly reduce injury and may possibly protect personnel from accidental electrocution as a result of contact with one line and ground, or voltages developed in the ground from ground current.

## ESSENTIALLY RESTRIKE FREE, MINIMUM REIGNITIONS

These characteristics are ideal for capacitive and inductive loads.

## LONG LIFE WITH NO MAINTENANCE:

These are proven, well-known characteristics of HV vacuum interrupter devices that are standard on all Ross upright and low profile HV vacuum contactors and circuit breakers. Vacuum interrupters are used because of their extremely high dielectric strength and rapid recovery after arc extinction. This high dielectric strength exhibits comparatively low arc energy during high current interruption, and thus minimizes contact erosion. The vacuum medium provides a very rapid but controlled arc extinction due to high velocity radial diffusion of vaporized special metal alloy contact surfaces during contact separation, thus allowing a very rapid but controlled recovery of dielectric strength. Under adverse conditions such as altitude, extreme temperatures or humidity, the interruption capability is not affected. Also, of major importance, the high speed interruption reduces possible fault damage to equipment.

In addition to the extended life characteristics of the vacuum interrupters, the Ross HV vacuum contactors and circuit breakers are built with moisture resistant G-10 Epoxy glass as standard insulation.

## COMPACT-LIGHTWEIGHT & QUIET:

Simplicity of design and careful use of material makes many of the Ross Engineering three-phase HV vacuum contactors and circuit breakers the most compact, lightweight devices in their class. Both the upright and low profile models are built especially for indoor equipment and metal-clad enclosures of the smallest configurations. Despite extra strong operating forces to insure positive operation with no contact welding, the Ross low profile models are less than one-third the height, weight and size of most switchgear in the same power interruption range. And because of the reliable actuator design and the use of vacuum-sealed HV contacts, both types operate quietly and efficiently whether in air, oil or insulating atmospheres.

## MULTIPLICITY OF USE:

The Ross Engineering Corp. HV vacuum contactors and circuit breakers, in both the upright and low profile models, are built of precision made, high vacuum interrupters and electromagnetic, or other type, actuators linked together by an insulating rod and high voltage standoffs. These features, along with a flexible current transfer design that insures positive current transfer, makes these HV devices ideal for use in one, two or three-phase applications for 1/2 to 2-cycle current interruption, shorting, or transferring to emergency standby or alternate lines. The Ross three-phase vacuum contactors are suitable for AC high power and industrial controls in ranges of 208V to 38KV and to 300KV in special applications. The light-weight, low profile models are designed especially for fixed or mobile applications including use in transportation vehicles. They can be mounted in any attitude in equipment or metal-clad enclosures, in oil, air or insulating gas. All units have excellent performance characteristics for high speed ground fault tripping and for use in mines, in portable equipment control, or in long life, minimum maintenance load control. In addition, the latching units can be fitted with a loss of control device to automatically open with control power failure.

# APPLICATION DATA

## OPERATE VOLTAGES FOR HV INTERRUPTERS:

Ross Engineering's normally open, normally closed, latching, and trip free type HV vacuum contactors and circuit breakers operate at 208V to 38KV or more. In most standard applications, voltage ratings can be raised in multiples of 30KV (line to line) above 15KV by placing contacts in series. For example, two 15KV rated contacts in series per phase are suitable for 38KV; three to four contacts in series per phase are suitable for 75KV applications. Capacitive grading may be required.

## CONTINUOUS RATINGS:

Continuous current ratings are 200, 400, 600, 900, and 1,200A RMS, with up to 20,000A continuous with the use of a shunt switch to carry the continuous current while using the interrupt ability for the actual interruption. This switchgear has 60Hz interrupt ratings of 2,000 to 28,000A, 50,000 to 830,000KVA at 15.5KV. Some 50Hz maximum interrupt ratings may be derated. Also 5,000 to 20,000A RMS, 10 cycle momentary, and 100,000A 20µsec AC capacitor discharge.

## AC & DC INTERRUPTION:

Contacts are designed with copper alloy combinations to limit chopping current to less than a 1 to 3A level on AC circuits to minimize switching transients. The copper alloy type of vacuum contact has no appreciable DC interrupt capability by itself, but it can interrupt high DC currents by use of a properly timed counter-pulse system which can simulate current zeroes. (See other brochures for DC interrupting contactors). Transient suppression, a 0.25 to 5µF capacitor in series with

a 2 to 5 ohm resistor per KV should be used in parallel with some types of inductive loads. Self resonance possibilities must be considered.

For higher DC current interruption, i.e.10,000A or more at 20KV DC per contact, or 40KV DC for 2 contacts in series, Ross AC rated contactors with copper alloy vacuum contacts can be satisfactory. This is possible if a multiple current zero creating counter-pulse is applied with a carefully controlled rate of recovery voltage. This recovery should approximate 60Hz current zero and recovery voltage characteristics by means of a resistor-capacitor and switching network or in combination with an inductive ringing circuit.

## TRANSFORMER SWITCHING:

Transformer switching can create overvoltages in the transformer during both interrupting and closing depending on prestrike reignitions on closing and high frequency virtual current zeroes, current chopping, restrike or excessive reignitions on opening.

Dry type transformers or inductors are particularly vulnerable since the lack of oil fully impregnating between windings reduces the capacitance between those windings and also reduces high frequency losses during recovery voltage, and allows faster recovery voltage rise time resonances and overshoot. Winding resonances from below 100KHz to over 1MHz can respond to fast rise times of recovery voltage or current and create overvoltage.



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Interrupters that have multiple reignitions on closing prestrike or bounce, or reignitions, restrikes, or excessive current chopping during interruption can create severe repetitive overvoltages within the transformer windings. The application of approximately 1/4 to 1/2 microfarad capacitors in series with a low ohmic resistor, such as approximately 2 to 5 ohms per KV, connected as close to the load terminals as possible is very effective at reducing the overvoltages occurring during closing or opening. Capacitors can be full voltage rated Delta phase to phase, or WYE grounded or ungrounded to reduce the capacitor voltage rating requirement. Station type MOV type arresters have also been helpful but are not as effective since they do not reduce the fast rise times, although they help to reduce peaks.

#### **INDUCTIVE LOAD SWITCHING:**

With highly inductive loads, wherever possible, station class transient suppressing non-linear resistance and lightning protective capacitors in series with 2 to 5 ohms per KV should be placed across the load as close to the load equipment terminals as possible. Older lightning arresters with internal spark gaps or even MOV types have not been found as effective as closely connected protective capacitors in series with low ohmic value resistors for this duty. This is particularly essential for repeatedly switched inductive loads such as dry type transformers, arc furnaces, motors and low current, transient generating inductive loads.

*Caution: capacitor values must be selected to prevent self resonance.*

Most switching devices can create overvoltages on switching. Experience has shown that for iron core oil filled reactive loads, normal switching overvoltages of 2 to 2½ times operating voltage are to be expected with almost any type of interrupter. Air or gas insulated and particularly air core inductive loads can generate even higher overvoltages if there is insufficient shunt partially damped capacitance.

On transformers and other iron core inductive loads, normal inrush currents of 5 to 10 times rated load current are expected, depending on the degree of magnetic retentivity from the previous interruption. If iron core inductive loads can be re-energized on the opposite polarity from

which they were de-energized, then inrush is minimized, otherwise it is limited primarily by the winding resistance only. Repeated high inrush closing causes great mechanical stress on the transformer windings, as well as rapid erosion of the vacuum contact (which can be over 10 times greater on closing than on interrupting even the same current). Therefore, transformers that have marginal insulation and bracing can deteriorate from mechanical movement with repeated switching. Probably a number of transformer failures occur because of these high inrush currents and poor bracing, not from overvoltages.

#### **CLOSING & INRUSH CURRENTS:**

Where the high inrush and repeated switching problem is serious, Ross Engineering recommends a step start arrangement with a dual vacuum contact system. In this instance, one contact unit is equipped with an inrush limiting resistor of about 30% to 60% of the value of the full load impedance, which is inserted initially for a few cycles before the main vacuum contact is closed.

#### **ACTUATOR TYPES & VOLTAGES:**

These units are available with line or energy storage close and trip with either trip and anti-pump or automatic reset actuators. 230V or 480V, 60Hz is the standard non stored energy actuation voltage; 115V, 208V, 240V and 480V, AC, 125V DC, and 290V DC, 700 microfarad capacitor trip is also common when applicable. Many other actuator voltages can also be accommodated. When ordering, actuator should be specified as well as HV operating voltage and current, basic impulse level, maximum interrupt, continuous RMS current, 1 cycle (17 milliseconds) fuse protected or 10 cycle (167 milliseconds asymmetric) momentary RMS currents, number of auxiliary contacts required, type of load, number of operations per year, speed of opening and closing and any other specific requirements should be stated.

## **ROSS HIGH SPEED TRANSFER BREAKER IN ACTION**

To help solve high speed alternate source transfer problems, Lockheed's Satellite Test Center in Sunnyvale, California, installed two Ross Engineering Corp. mechanically interlocked 12KV three-phase power transfer circuit breakers (photo to right). The Test Center's huge computers control missile launches from Southern California's Vandenberg Air Force Base. During power line failures, the Ross breakers automatically separated the entire center and transferred it to another 12KV line within milliseconds, thus avoiding major computer and launch recycling

#### **DATA:**

Generally, the high speed HV power transfer breakers are used for AC loads 1,000V, or less, to 15KV, 600A continuous or less; and for instantaneous or delayed transfer to alternate or standby power source, or for high speed system separation. Power outage time can be held to as low as 1 cycle (17 milliseconds) or can be 1/2 cycle to 1 1/2 cycles trip + interrupt, or make before break on return where suitable. Optional delay system will give adjustable delays of 2 cycles to 30 seconds or more before transfer to prevent unnecessary transfers, if desired. Some units can be mechanically, as well as electrically, interlocked to prevent possibility of two alternate power sources being tied together at any time. Contact Ross Engineering for further data.



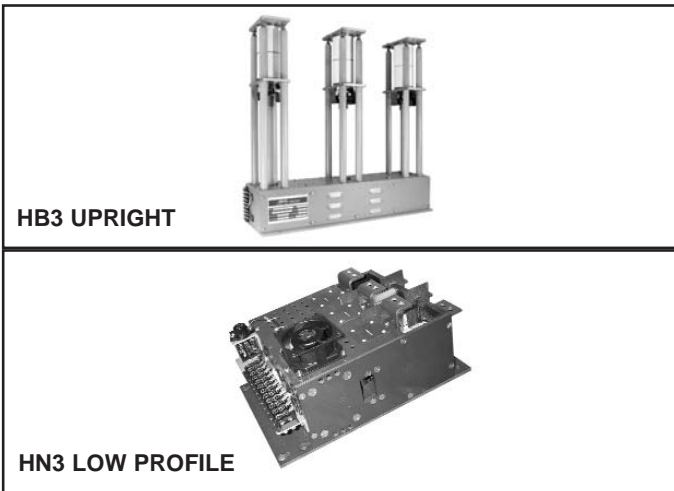
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# HB3 AND HN3 SERIES CONTACTORS, NORMALLY OPEN

AC SOLENOID CLOSING AND HOLDING

The HB3 and HN3 series vacuum contactors are the smallest and lightest weight of Ross Engineering's high voltage three-phase contactors. Their 2-cycle total dropout and interrupt time and their level of current and voltage ratings make them ideal for moderate power, high voltage loads such as electronic rectifiers or other medium-size power supplies or industrial loads with 1 to 400A, 2.5 to 15KV, 50/60Hz input levels. Both units, in many applications, are built directly into oil-filled rectifier transformers as the primary or secondary control unit. Its light weight allows it to be mounted in the transformer or supply cabinets without excessive foundation requirements. Two SPDT form C auxiliary contacts rated 15A, 480V AC are standard and up to four are optional; 10A, 125V DC auxiliaries are also available. Single-pole and two-pole units are available as well as units for voltages up to 300KV. See the following pages for heavier duty requirements.



SPECIFICATIONS																
MODEL		WITHSTAND VOLTAGE				OPERATE VOLTAGE		CURRENT RATINGS IN AMPERES				CONTACT RESISTANCE	OPERATE TIME		ACTUATOR 230V 60Hz COIL	
		HV CONTACTS		INS TO GND		KV RMS		MAX CONTINUOUS RMS	MAX MOMENTARY 17ms	MAX MOMENTARY 170ms	MAX INTERRUPT SYMMETRIC RMS	MAX OHMS	OPEN	CLOSE	INRUSH MAX A	HOLD MAX A
UPRIGHT	LOW PROFILE	KV RMS 60Hz	KV IMPULSE BIL	KV RMS 60Hz	KV IMPULSE BIL	IN AIR	IN OIL						MAX CYCLES	MAX CYCLES		
	HN3-28-15	15	45	5	10	0.6	2.5	400	12,000	10,000	4,000	0.0002	2	2	18	1.5
HB3-28-60	HN3-28-60	36	95	26	60	5	15	400	20,000	10,000	4,000	0.0002	2	2	18	1.5
	HN3-37-15	15	45	5	10	0.6	2.5	(600, 800, 1000)	30,000	20,000	13,200	0.0001	2	2	18	1.5
HB3-51-60	HN3-51-60	36	95	26	60	5	15	200	10,000	6,000	2,000	0.002	2	2	18	1.5
HB3-51-110	HN3-51-110	36	95	50	110	15	15	200	10,000	6,000	2,000	0.002	2	2	18	1.5
	HN3-73-15	50	110	5	10	0.6	2.5	600	30,000	20,000	12,000	0.0001	2	2	18	1.5

See brochure B-1006 for smaller low profile units for 115V to 600V operate.  
Other actuator voltages 208V (20A inrush, 1.7A hold), 115V (36A inrush, 3A hold).  
50 or 60Hz available.

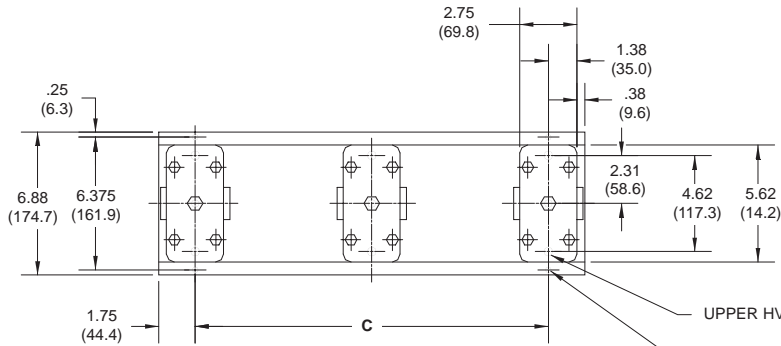
DIMENSIONS																		
MODEL	A	B	C	D	E	H	K	L	M	N	P	R	T	U	V	W	X	Y
HB3-28-60	16.75 (425.5)	17.78 (451.6)	13.250 (336.55)	3.72 (94.4)	6.63 (168.4)	--	--	--	--	--	--	--	--	--	--	--	--	--
HB3-51-60	16.75 (425.5)	17.13 (435.1)	13.250 (336.55)	6.19 (157.2)	6.63 (168.4)	--	--	--	--	--	--	--	--	--	--	--	--	--
HB3-51-110	20.50 (520.7)	21.13 (536.7)	17.000 (431.80)	6.19 (157.2)	8.50 (215.9)	--	--	--	--	--	--	--	--	--	--	--	--	--
HN3-28-15	13.85 (351.8)	9.12 (231.6)	6.46 (164.1)	12.84 (326.1)	8.000 (203.2)	3.53 (89.7)	2.88 (73.2)	14.25 (362.0)	1.69 (42.9)	6.73 (170.9)	4.46 (113.3)	10.33 (262.4)	.75 (19.1)	.780 (19.81)	1.75 (44.4)	.562 (14.27)	.265 (6.73)	5.23 (132.8)
HN3-28-60	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HN3-37-15	15.64 (397.3)	14.53 (369.1)	7.88 (200.2)	15.50 (393.7)	12.500 (317.5)	4.29 (109.0)	4.56 (115.8)	17.38 (441.5)	2.71 (68.8)	7.62 (193.5)	7.26 (184.4)	11.92 (302.8)	1.75 (44.5)	1.125 (28.58)	4.00 (101.6)	1.016 (25.81)	.344 (8.74)	6.12 (155.4)
HN3-51-60	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HN3-51-110	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HN3-73-15	18.75 (476.3)	14.53 (369.1)	7.88 (200.2)	18.61 (472.6)	12.500 (317.5)	7.40 (188.0)	4.56 (115.8)	20.49 (520.4)	2.71 (68.8)	7.62 (193.5)	7.26 (184.4)	11.92 (302.8)	1.75 (44.5)	1.125 (28.58)	4.00 (101.6)	1.016 (25.81)	.344 (8.74)	6.12 (155.4)

Dimensions are for reference only and are subject to change. Contact Ross Engineering Corporation for current dimensions

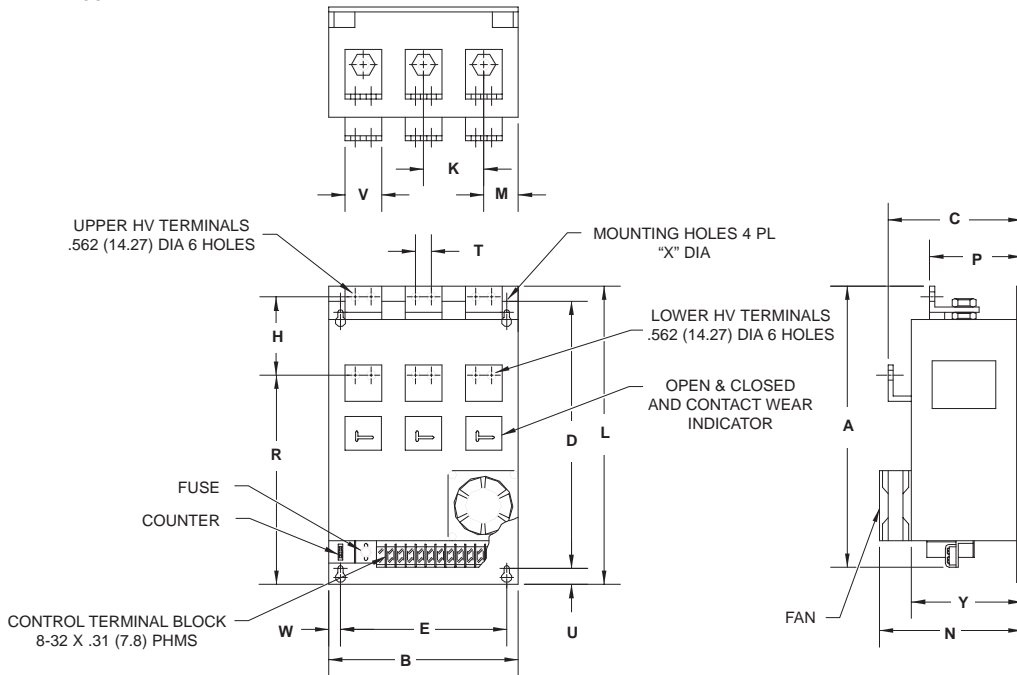
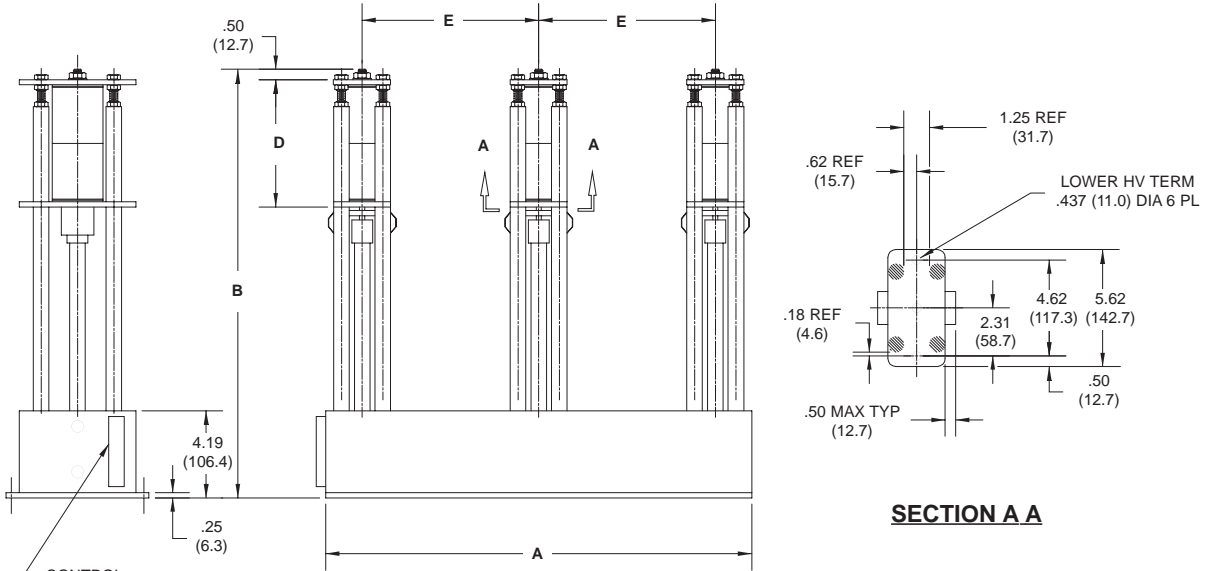


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In Inches  
(In Millimeters)



**HB3  
UPRIGHT**



**HN3  
LOW  
PROFILE**

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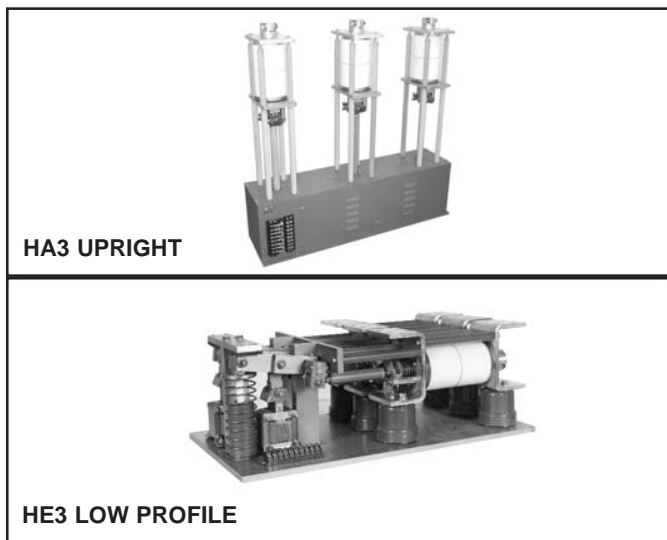
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# HA3 AND HE3 SERIES CONTACTORS, NORMALLY OPEN

AC SOLENOID CLOSING AND HOLDING

Ross Engineering's HA3 and HE3 series HV three-phase vacuum contactors are designed for AC high power and industrial control applications in the voltage range of 240V to 15.5KV. Each can be used in air, oil or insulating gas.

Both the upright and the low profile units use highly moisture resistant G-10 Epoxy glass with anti-track surface coating as standard insulation (if special insulation or insulation lengths are required, consult Ross Engineering). Each long life contactor is supplied with 2 form C, SPDT auxiliary contacts rated at 15A, 480V AC. 10A, 125V DC auxiliaries and up to 4 contacts are available. All Ross contactors have vacuum sealed HV contacts for quiet, explosion-proof, high voltage switching. Each unit is designed to be lightweight, compact, and maintenance-free. Most contactors have a five-digit counter, and open-closed and contact wear indicators that are readily visible from the front of the unit. Single-pole and two-pole units are available as well as units for voltages up to 300KV. Also see brochures on single-pole vacuum circuit breakers, relays and high current switches.



## SPECIFICATIONS

MODEL		WITHSTAND VOLTAGE				OPERATE VOLTAGE		CURRENT RATINGS IN AMPERES				CONTACT RESISTANCE	OPERATE TIME		ACTUATOR 230V *60Hz COIL	
		HV CONTACTS		INS TO GND		KV RMS		MAX CONTINUOUS RMS	MAX RMS MOMENTARY 17ms	MAX RMS MOMENTARY 170ms	MAX INTERRUPT SYMMETRIC RMS		OPEN	CLOSE	INRUSH MAX A	HOLD MAX A
UPRIGHT	LOW PROFILE	KV RMS 60Hz	KV IMPULSE BIL	KV RMS 60Hz	KV IMPULSE BIL	IN AIR	IN OIL									MAX OHMS
HA3-37-60	HE3-37-60	19	60	26	60	5	5	400-600	30,000	20,000	9,500	0.0001	2	2	30	2
HA3-37-110	HE3-37-110	19	60	50	110	5	5	400-600	30,000	20,000	9,500	0.0001	2	2	30	2
HA3-73-60	HE3-73-60	36	95	26	60	5	15.5	400-600	30,000	20,000	12,000	0.0001	2	2	30	2
HA3-73-110	HE3-73-110	50	110	50	110	15.5	15.5	400-600	30,000	20,000	12,000	0.0001	2	2	30	2
HA3-75-60	HE3-753-60	36	95	36	60	5	15.5	600-1200	30,000	20,000	18,000	0.0005	2	2	35	2
HA3-75-110	HE3-75-110	50	110	50	110	15.5	15.5	600-1200	30,000	20,000	18,000	0.0005	2	2	35	2

\*230V, 60Hz actuator is standard with 30A inrush and 2A holding. 208V or 115V is also available with inversely proportional inrush & hold requirement. See brochure B-1006 for smaller low profile units for 115V to 600V operate. See brochure B-1006-A for 115V-3KV compact and lightweight units.

## DIMENSIONS

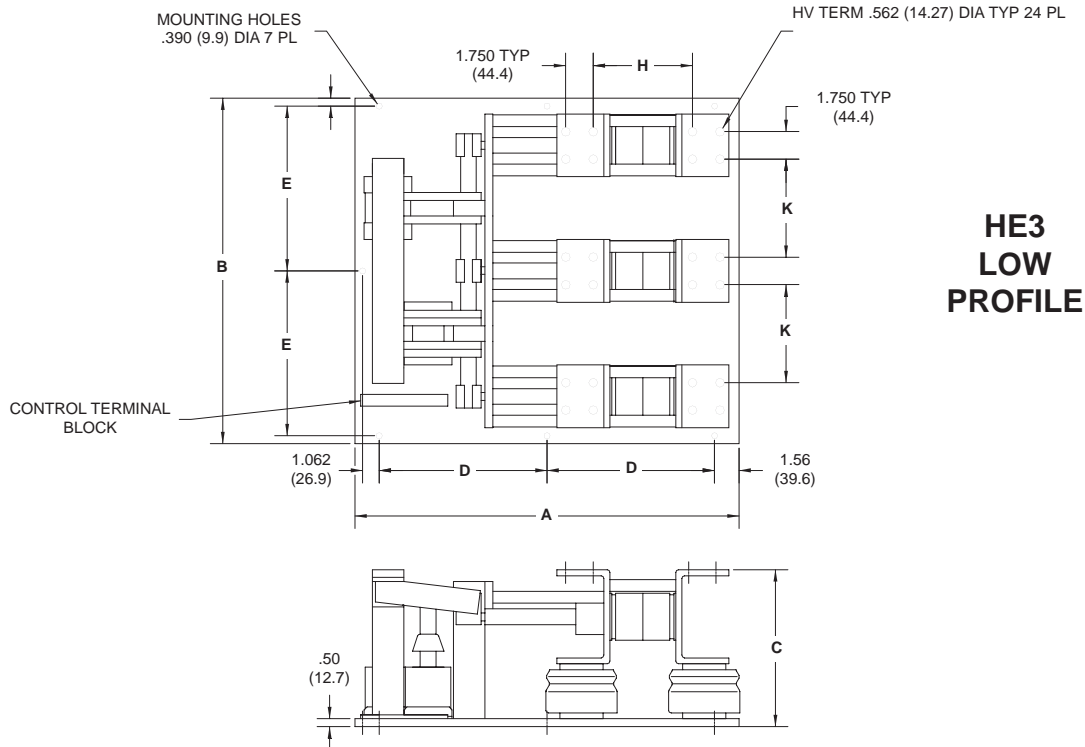
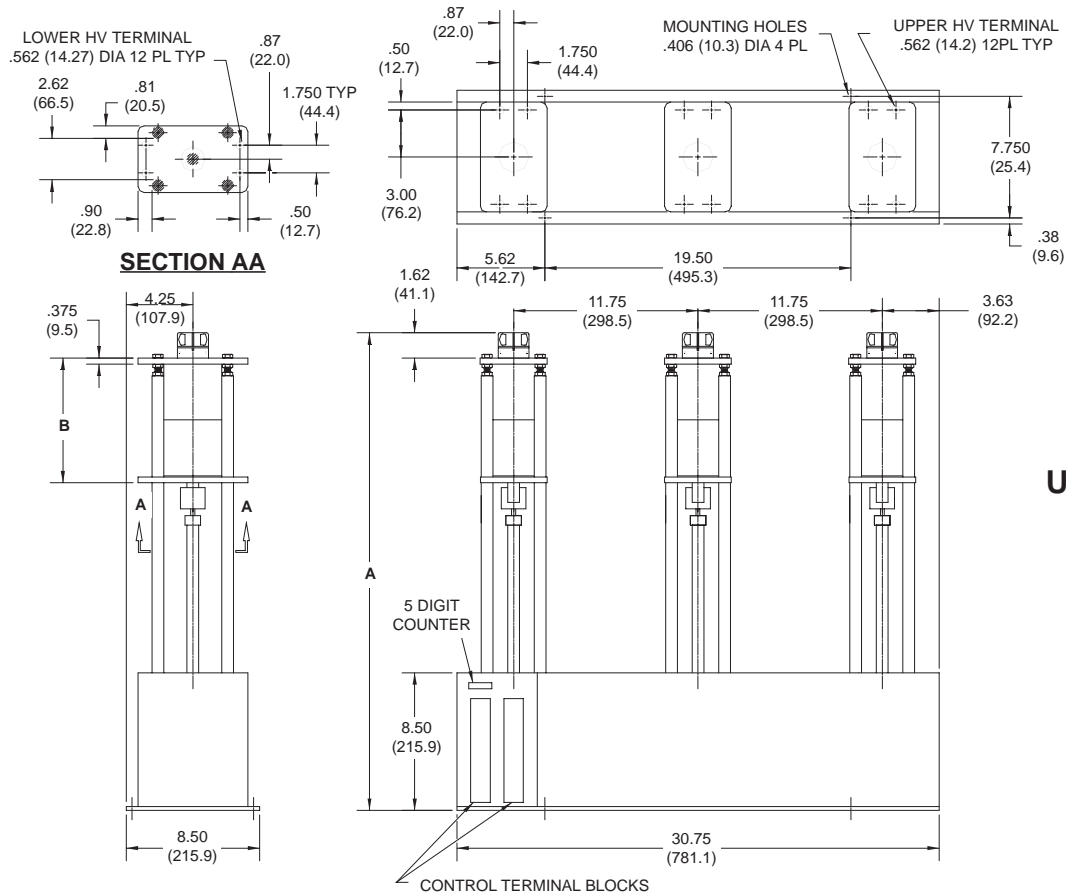
MODEL	A	B	C	D	E	H	K
HA3-37-60	22.85 (580.6)	4.86 (123.4)	--	--	--	--	--
HA3-37-110	26.86 (682.2)	4.86 (123.4)	--	--	--	--	--
HA3-73-60	26.21 (665.7)	7.97 (202.4)	--	--	--	--	--
HA3-73-110	30.21 (767.3)	7.97 (202.4)	--	--	--	--	--
HE3-37-60	24.50 (622.3)	22.00 (558.8)	12.50 (317.5)	10.687 (271.4)	10.500 (266.7)	6.23 (158.2)	6.25 (158.7)
HE3-37-110	28.50 (723.9)	30.00 (762.0)	12.50 (317.5)	12.687 (322.2)	14.50 (368.3)	6.23 (158.2)	10.25 (260.3)
HE3-73-60	27.50 (698.5)	22.00 (558.8)	12.50 (317.5)	12.187 (309.5)	10.500 (266.7)	9.34 (237.2)	6.25 (158.7)
HE3-73-110	31.50 (800.1)	30.00 (762.0)	12.50 (317.5)	14.187 (360.3)	14.500 (368.3)	9.34 (237.2)	10.25 (260.3)

Dimensions are for reference only and are subject to change. Contact Ross Engineering Corporation for current dimensions



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In Inches  
(In Millimeters)



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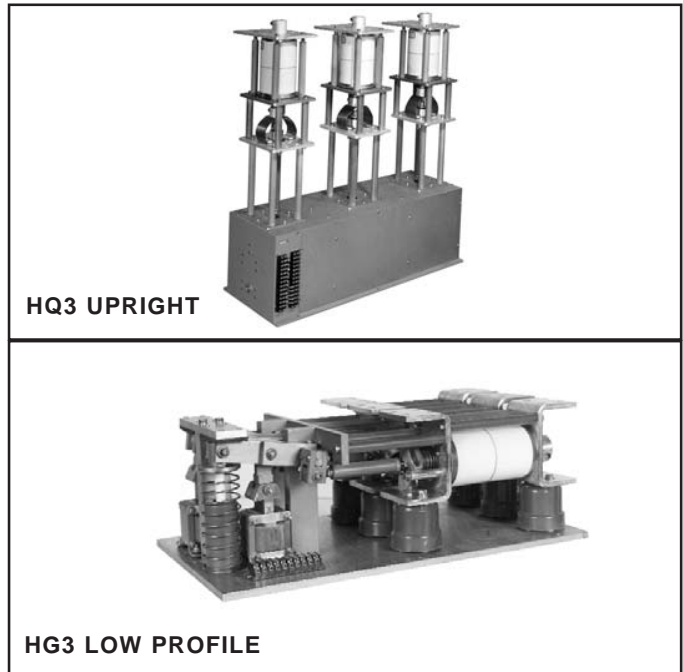
# HQ3 AND HG3 SERIES CONTACTORS, NORMALLY OPEN

STORED ENERGY  
CLOSING  
AC/DC HOLDING

The stored energy closing, upright and low profile HV vacuum contactor models, HQ3 and HG3, are ideally suited for high power electronic supplies and for use in AC high power industrial control systems. The upright HQ3 model is designed for indoor systems or metal-clad enclosures. Its compact, light-weight characteristics make it easy for engineers to design smaller, lighter enclosures to insure more space for other apparatus.

The HG3 low profile model is designed for fixed or mobile applications such as electrically powered transit vehicles or for use in ships or mines. Both types can be mounted directly into the equipment or built into metal-clad enclosures. G-10 Epoxy glass is standard insulation for both models. For special insulation or insulation length requirements consult the factory. Some models can be mounted in oil or insulating gas. Most models have 1-1/2 to 2 cycle opening times. They also have a highly reliable vacuum interrupting capability of up to 750MVA at 15.5KV, with momentary current to 20,000A for 10 cycles, and 40,000A for one cycle fuse protected. Three SPDT form C, 15A, 480V AC auxiliary contacts are standard and up to four may be specified. Optional 10A, 125V DC auxiliary contacts are available. Single-pole and two-pole units are available as well as units for voltages up to 300KV.

Stored energy closing requires 115V AC 8A during charging, 1/2A holding.



HQ3 UPRIGHT

HG3 LOW PROFILE

## SPECIFICATIONS

MODEL		WITHSTAND VOLTAGE				OPERATE VOLTAGE		CURRENT RATINGS IN AMPERES				CONTACT RESISTANCE	OPERATE TIME	
		HV CONTACTS		INS TO GND				MAX CONTINUOUS RMS	MAX MOMENTARY 17ms	MAX MOMENTARY 170ms	MAX INTERRUPT SYMMETRIC RMS		MAX OHMS	OPEN
UPRIGHT	LOW PROFILE	KV RMS 60Hz	KV IMPULSE BIL	KV RMS 60Hz	KV IMPULSE BIL	KV RMS IN AIR	KV RMS IN OIL							
HQ3-37-60	HG3-37-60	19	60	26	60	5	5	600/900	40,000	20,000	9500/13200	0.0001	5	2
HQ3-73-60	HG3-73-60	50	60	26	60	5	15.5	600/900	40,000	20,000	12,000	0.0001	5	2
HQ3-73-110	HG3-73-110	50	110	26	110	15.5	15.5	600/900	40,000	20,000	12,000	0.0001	5	2
HQ3-75-110	HG3-75-110	50	110	26	110	15.5	15.5	1200/2000	50,000	40,000	18,000	0.00003	5	5
HQ3-79-110	HG3-79-60	50	110	26	110	15.5	15.5	1200/2000	50,000	40,000	28,000	0.00002	5	5

Some units can be ordered for higher continuous currents when used in oil.  
See brochure B-1014 for energy storage units.

## DIMENSIONS

For HQ3 Dimensions see page 14

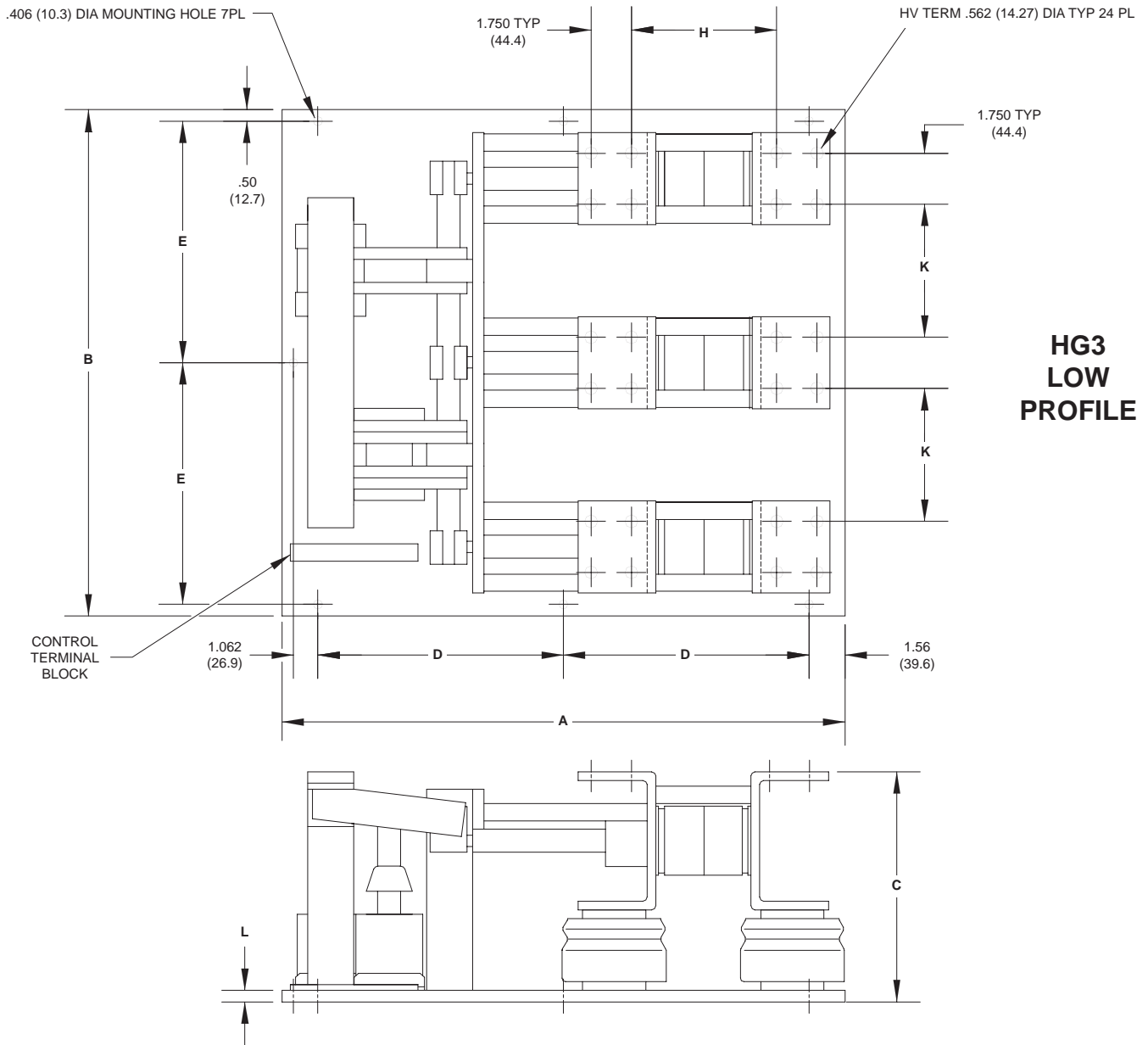
MODEL	A	B	C	D	E	H	K	L
HG3-37-60	29.50 (749.3)	22.00 (558.8)	12.50 (317.5)	13.187 (334.9)	10.500 (273.0)	6.23 (158.2)	6.25 (158.7)	.50 (12.7)
HG3-73-60	32.70 (830.6)	22.00 (558.8)	12.50 (317.5)	14.788 (375.6)	10.500 (273.0)	9.34 (237.2)	6.25 (158.7)	.50 (12.7)
HG3-73-110	36.70 (932.2)	30.00 (762.0)	12.50 (317.5)	16.788 (426.4)	14.500 (368.3)	9.34 (237.2)	10.25 (260.3)	.50 (12.7)
HG3-75-110	38.00 (965.2)	34.50 (876.3)	12.75 (323.9)	17.44 (442.9)	16.750 (425.4)	10.69 (271.5)	11.75 (298.4)	.75 (19.0)
HG3-79-110	38.00 (965.2)	40.50 (1028.7)	12.75 (323.9)	17.438 (442.9)	19.750 (501.6)	10.77 (273.5)	13.75 (349.2)	.75 (19.0)

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In Inches  
(In Millimeters)



**HG3  
LOW  
PROFILE**

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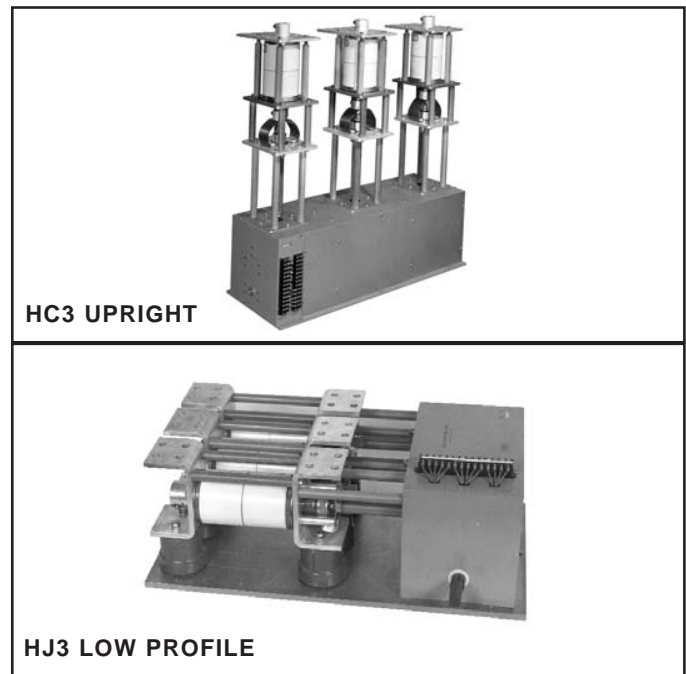
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# HC3 AND HJ3 SERIES CIRCUIT BREAKERS, LATCHING

**SOLENOID  
CLOSING  
AND TRIP**

Designed for very long life and low maintenance control for medium to heavy-duty loads, the HC3 and HJ3 series of three-phase HV vacuum circuit breakers have proven to be a workhorse for a majority of the 5 to 15KV, 2 to 12 megawatt magnet rectifier loads in the major accelerators in the United States, as well as many other often switched loads. Both series are built for severe repetitive duty within their interrupting and momentary ratings. Control power can be 125V DC, 208/240V AC or high speed capacitor trip giving approximately 1/2 cycle contact parting time with a total trip and interrupt time of approximately one cycle. Closing times of less than one cycle are common for these vacuum breakers, making them ideal for very high speed back-to-back source transfer switching in as short a time as 1/2 cycle. Three SPDT form C, 15A, 480V AC auxiliary contacts are standard and up to five are optional; 10A, 125V DC auxiliaries are also available. Single-pole and two-pole units are available as well as units for voltages up to 300KV. Energy storage closing & tripping units require only 8A and 115V 50/60Hz are available. See brochure B-1014 solenoid drivers.



SPECIFICATIONS																
MODEL		WITHSTAND VOLTAGE				OPERATE VOLTAGE		CURRENT RATINGS IN AMPERES				CONTACT RESISTANCE	OPERATE TIME		ACTUATOR 230V *60Hz COIL	
		HV CONTACTS		INS TO GND		KV RMS		MAX CONTINUOUS RMS	MAX MOMENTARY 17ms	MAX MOMENTARY 170ms	MAX INTERRUPT SYMMETRIC RMS	MAX OHMS	OPEN	CLOSE	INRUSH MAX A	HOLD MAX A
UPRIGHT	LOW PROFILE	KV RMS 60Hz	KV IMPULSE BIL	KV RMS 60Hz	KV IMPULSE BIL	IN AIR	IN OIL						MAX CYCLES	MAX CYCLES		
HC3-37-60	HJ3-37-60	19	60	26	60	5	5	600/1,000	40,000	20,000	9,500/13,200	0.0001	0.5-1.5	1	60	-
HC3-73-60	HJ3-73-60	50	95	26	60	5	15	600	40,000	20,000	12,000	0.0001	0.5-1.5	1	60	-
HC3-73-110	HJ3-73-110	50	110	50	110	15.5	15.5	600	40,000	20,000	12,000	0.0001	0.5-1.5	1	60	-

\*Optional stored energy close and trip requires only 8A 115V AC. With energy storage close and trip unit. With 208-230V 50/60Hz or 125V DC, 1-1.5 cycles depending on model and control system. For momentary storage closing 60A for 20-50 milliseconds is required. For energy storage closing only 8A is required with 1/2A storage maintenance required. Standard 300V capacitor or 125V DC trip is 1.5 cycle trip and interrupt. High speed trip and interrupt using special SCR controlled energy storage trip unit (8A 115V AC) can provide less than 1 cycle trip and interrupt. See brochure B-1014 for energy storage units.

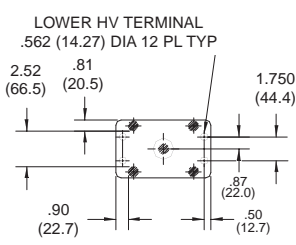
DIMENSIONS						
MODEL	A	B	D	E	H	K
HC3-37-60	26.73 (678.9)	4.86 (123.4)	--	--	--	--
HC3-73-60	29.84 (757.9)	7.97 (202.4)	--	--	--	--
HC3-73-110	33.84 (859.5)	7.97 (202.4)	--	--	--	--
HJ3-37-60	31.39 (797.3)	22.00 (558.8)	14.133 (360.0)	10.500 (266.7)	6.23 (158.2)	6.25 (158.7)
HJ3-73-60	34.50 (876.3)	22.00 (558.8)	15.688 (398.5)	10.500 (266.7)	9.34 (237.2)	6.25 (158.7)
HJ3-73-110	38.50 (977.9)	30.00 (762.0)	17.688 (449.3)	14.500 (368.3)	9.34 (237.2)	10.25 (260.4)

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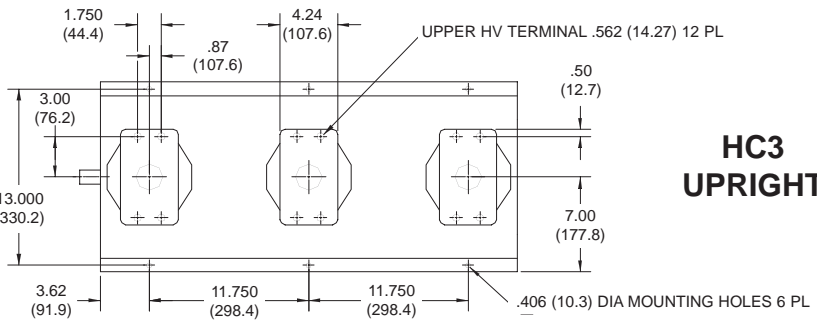


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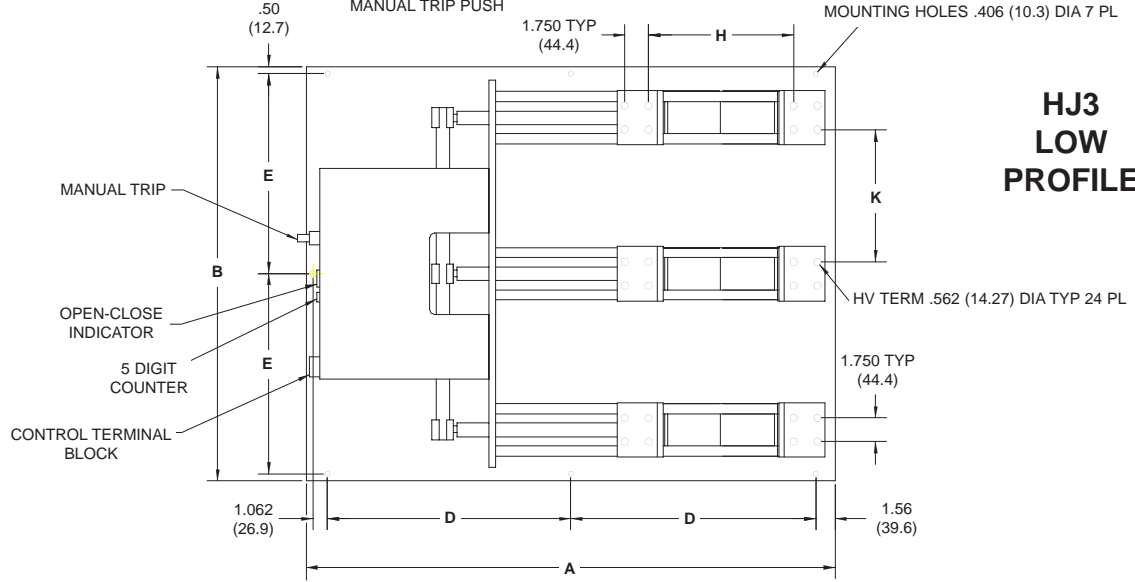
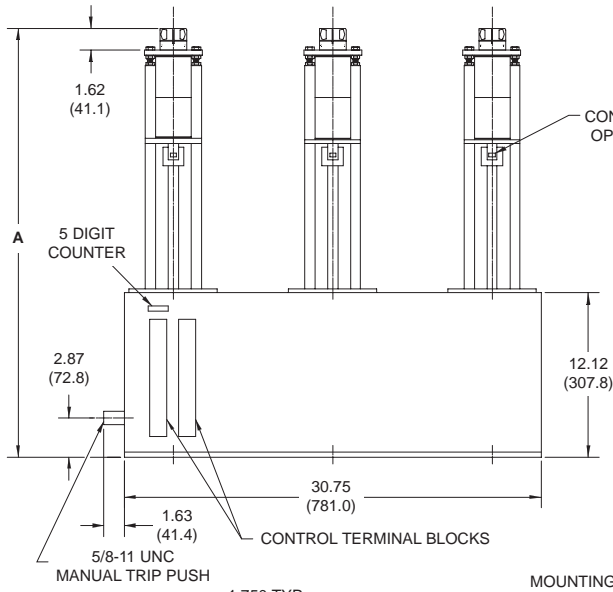
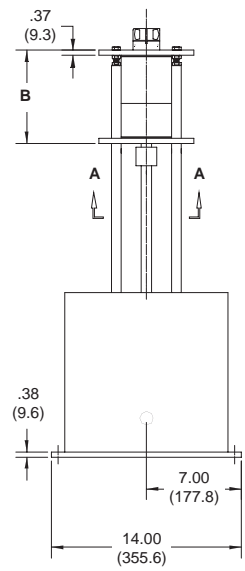
In Inches  
(In Millimeters)



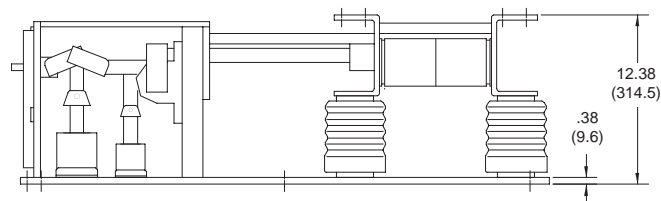
**SECTION AA**



**HC3  
UPRIGHT**



**HJ3  
LOW  
PROFILE**



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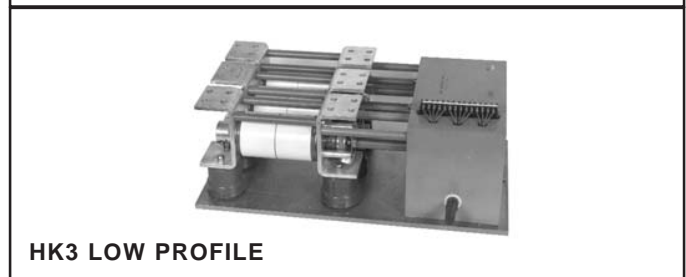
# HD3 AND HK3 SERIES CIRCUIT BREAKERS, LATCHING

**STORED ENERGY  
CLOSING AND TRIP**

The HD3 series mounts upright; the HK3 series has the low profile form. These extra heavy duty, stored energy closing, vacuum circuit breakers are ideal devices for quiet, high speed ground fault or line fault protection with minimum maintenance for mine equipment control, portable equipment control, or other load control. Using energy storage close & trip requiring only 8A at 115V 50/60Hz. Their trip and interrupt times are 1/2 to 1 cycle.

Both series are designed for a minimum of 50,000 mechanical operations and for extremely heavy repetitive duty within their interrupt or momentary ratings. Units in these series are designed for 5 to 38KV, 600, 900, 1,200 and 1,600A continuous rating, and 35MVA to 1,850MVA, 4,000 to 28,000A maximum symmetric interrupt capability. Higher voltages are also available.

The high performance stored energy mechanism insures positive close and latch combined with high speed trip. These units may be mounted in any attitude in air, oil (some models), or insulating gas. Three form C SPDT, 15A, 480V AC auxiliary contacts are standard for these models and up to five are optional; 10A, 125V DC auxiliaries are also available. Single-pole and two-pole units are also available as well as units for voltages up to 300KV.



## SPECIFICATIONS

MODEL		WITHSTAND VOLTAGE				OPERATE VOLTAGE		CURRENT RATINGS IN AMPERES				CONTACT RESISTANCE	OPERATE TIME		ACTUATOR 230V ***60Hz COIL	
		HV CONTACTS		INS TO GND		KV RMS		*MAX CONTINUOUS RMS	MAX RMS MOMENTARY 17ms	MAX RMS MOMENTARY 170ms	MAX INTERRUPT SYMMETRIC RMS		MAX OHMS	**MAX CYCLES	MAX CYCLES	INRUSH MAX A
UPRIGHT	LOW PROFILE	KV RMS 60Hz	KV IMPULSE BIL	KV RMS 60Hz	KV IMPULSE BIL	IN AIR	IN OIL									
HD3-37-60	HK3-37-60	19	60	26	60	5	5	600/1,000	40,000	20,000	9,500/13,200	0.0001	1	1	60	-
HD3-73-60	HK3-73-60	50	110	26	60	5	15.5	600	40,000	20,000	12,000	0.0001	1	1	60	-
HD3-73-110	HK3-73-110	50	110	50	110	15.5	15.5	600	40,000	20,000	12,000	0.0001	1	1	60	-
HD3-75-60	HK3-75-60	50	110	26	60	5	15.5	600/1,200	40,000	20,000	18,000	0.00003	1	1	60	-
HD3-75-110	HK3-75-110	50	110	50	110	15.5	15.5	1,200/1,600	40,000	20,000	18,000	0.00003	1	1	60	-
HD3-79-60	HK3-79-60	50	110	26	60	5	15.5	1,200/1,600	40,000	20,000	28,000	0.00002	1	1	60	-
HD3-79-110	HK3-79-110	50	110	50	110	15.5	15.5	1,200/1,600	40,000	20,000	28,000	0.00002	1	1	60	-
HD3-85-150		60	150	80	150	27	27	1,200	40,000	20,000	16,000	0.00003	1.5	2	60	-
HD3-146-200		95	200	80	200	38	38	600	40,000	20,000	12,000	0.00004	1.5	2	60	-

\* Units rated 600/1000A continuous can be ordered at 1,200A continuous when used in oil.

\*\* With high speed energy storage system. With 208-240V 50/60Hz or 125V DC, 1 to 2 cycles depending on model. See brochure B-1014 Solenoid Drivers for energy storage control units with adjustable trip levels for increasing or pulse control signals.

\*\*\* Using optional energy storage trip and close requires only 8A inrush 1/2A continuous. 115V AC.

## DIMENSIONS

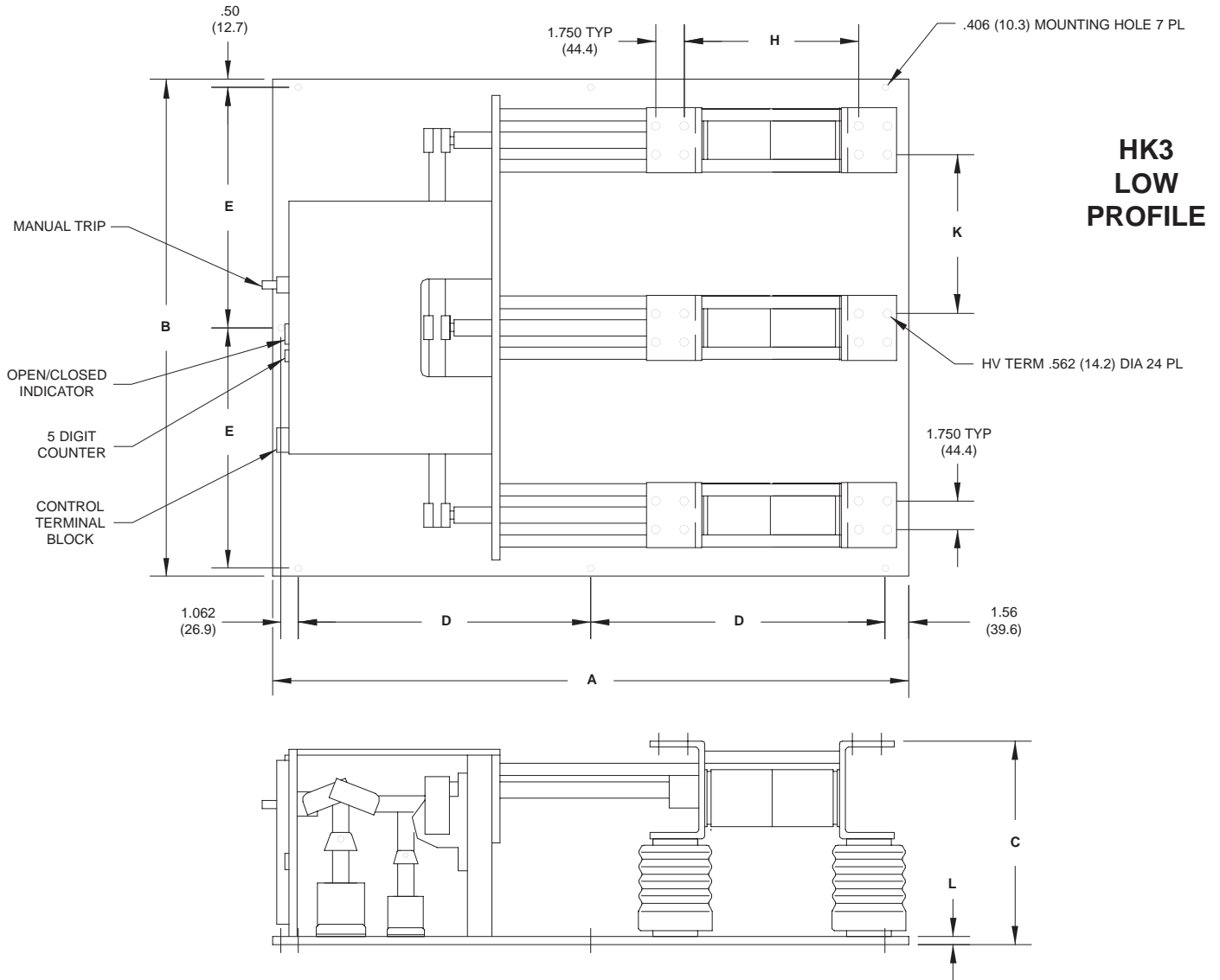
MODEL	A	B	C	D	E	H	K	L
HK3-37-60	31.39 (797.3)	22.00 (558.8)	12.50 (317.5)	13.187 (334.9)	10.500 (266.7)	6.23 (158.2)	6.25 (158.7)	.50 (12.7)
HK3-73-60	32.70 (830.6)	22.00 (558.8)	12.50 (317.5)	14.788 (375.6)	10.500 (266.7)	9.34 (237.2)	6.25 (158.7)	.50 (12.7)
HK3-73-110	36.70 (932.2)	30.00 (762.0)	12.50 (317.5)	16.788 (426.4)	14.500 (368.3)	9.34 (237.2)	10.25 (260.3)	.50 (12.7)
HK3-75-60	34.00 (863.6)	30.00 (762.0)	12.75 (323.9)	15.438 (392.1)	14.500 (368.3)	10.69 (271.5)	7.75 (196.8)	.75 (19.1)
HK3-75-110	38.00 (965.2)	34.50 (876.3)	12.75 (323.9)	17.438 (442.9)	16.750 (425.4)	10.69 (271.5)	11.75 (298.4)	.75 (19.1)
HK3-79-60	34.00 (863.6)	36.00 (914.4)	12.75 (323.9)	15.438 (392.1)	17.500 (444.5)	10.77 (273.6)	9.75 (274.7)	.75 (19.1)
HK3-79-110	38.00 (965.2)	40.50 (1028.7)	12.75 (323.9)	17.438 (442.9)	19.750 (501.6)	10.77 (273.5)	13.75 (349.3)	.75 (19.1)

Dimensions are for reference only and are subject to change. Contact Ross Engineering Corporation for current dimensions



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e-mail: info@rossengineeringcorp.com

In Inches  
(In Millimeters)



**HK3  
LOW  
PROFILE**

Dimensions are for reference only and are subject to change. Contact Ross Engineering Corporation for current dimensions



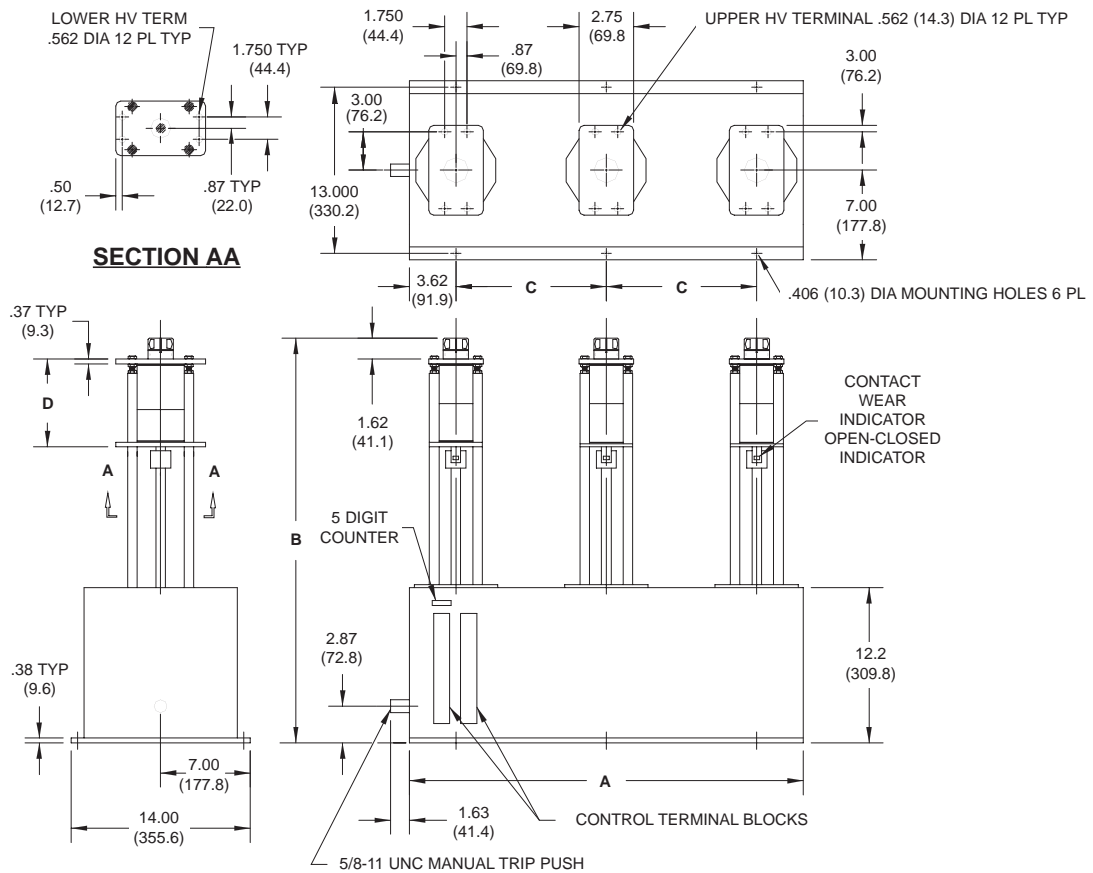
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In Inches  
(In Millimeters)

DIMENSIONS						
MODEL	MODEL	TYPE	A	B	C	D
HD3-37-60	HQ3-37-60	1	30.75 (781.0)	27.79 (705.9)	11.75 (298.5)	4.86 (123.4)
HD3-73-60	HQ3-73-60	1	30.75 (781.0)	10.500 (266.7)	9.34 (237.2)	6.25 (158.7)
HD3-73-110	HQ3-73-110	1	30.75 (781.0)	34.90 (886.5)	11.75 (298.4)	7.97 (202.4)
HD3-75-60	HQ3-75-60	2	37.25 (946.2)	32.13 (816.1)	14.75 (374.7)	12.44 (316.0)
HD3-75-110	HQ3-75-110	2	37.25 (946.2)	36.13 (917.7)	14.75 (374.7)	12.44 (316.0)
HD3-79-60	HQ3-79-60	3	37.25 (946.2)	32.21 (818.1)	14.75 (374.7)	12.52 (318.0)
HD3-79-110	HQ3-79-110	3	37.25 (946.2)	36.21 (919.7)	14.75 (374.7)	12.52 (318.0)
HD3-85-150	--	3	37.25 (946.2)	36.21 (919.7)	14.75 (374.7)	12.52 (318.0)
HD3-146-200	--	3	37.25 (946.2)	61.38 (1559.1)	14.75 (374.7)	32.00 (812.8)

**HD3  
TYPE 1  
UPRIGHT**



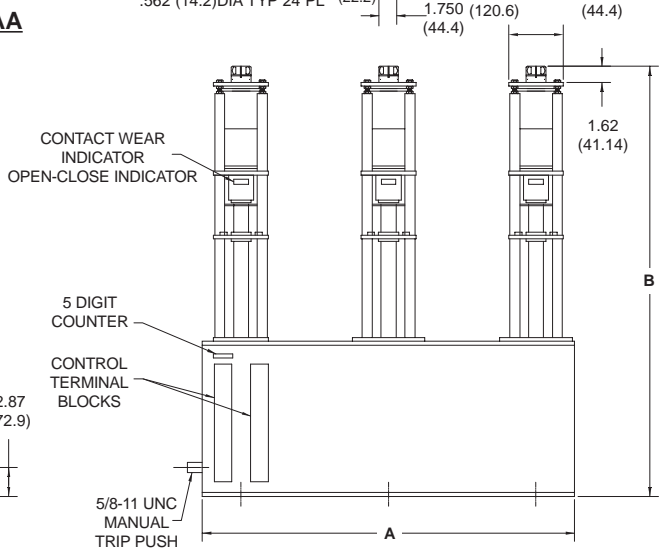
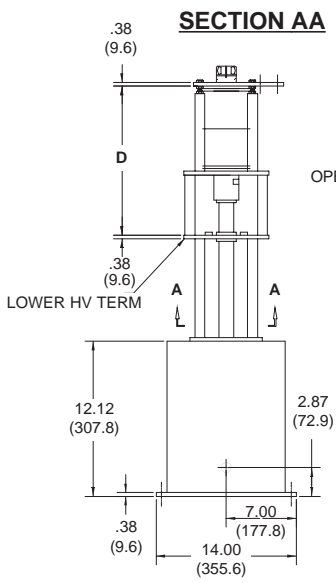
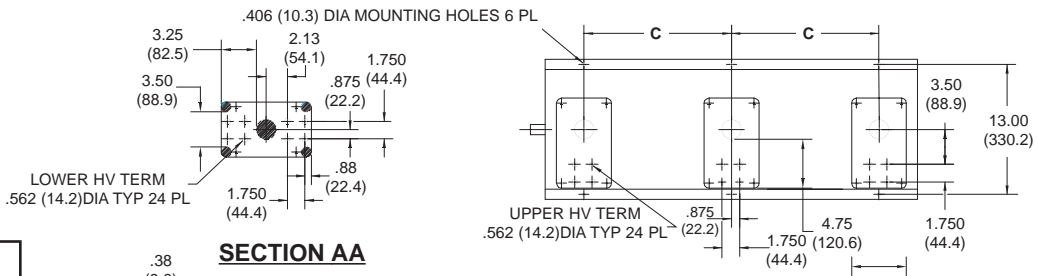
Dimensions are for reference only and are subject to change. Contact Ross Engineering Corporation for current dimensions



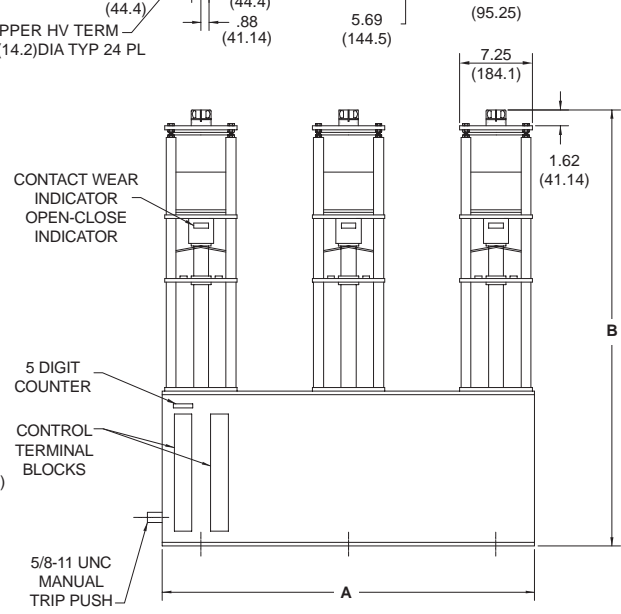
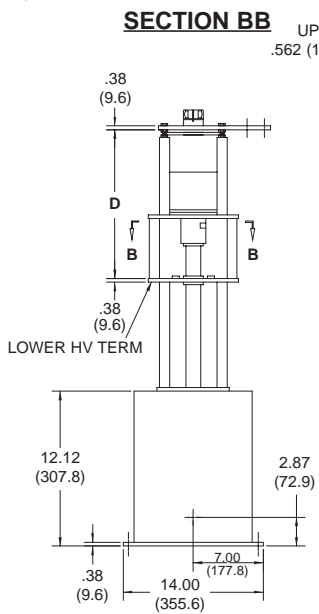
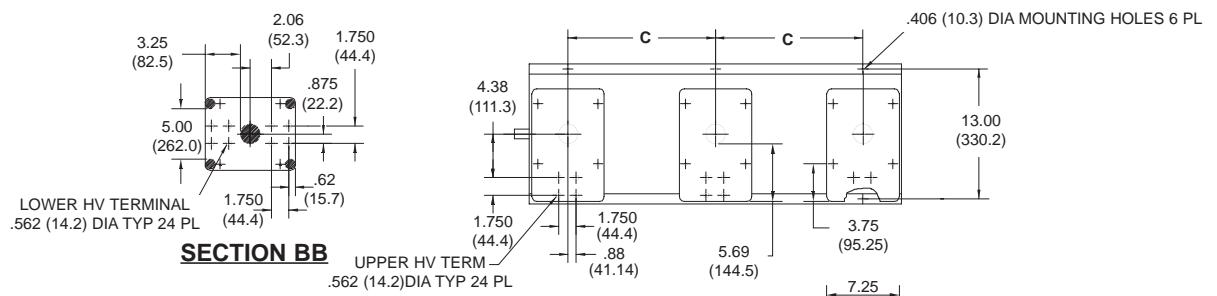
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In Inches  
(In Millimeters)



**HD3  
TYPE 2  
UPRIGHT**



**HD3  
TYPE 3  
UPRIGHT**

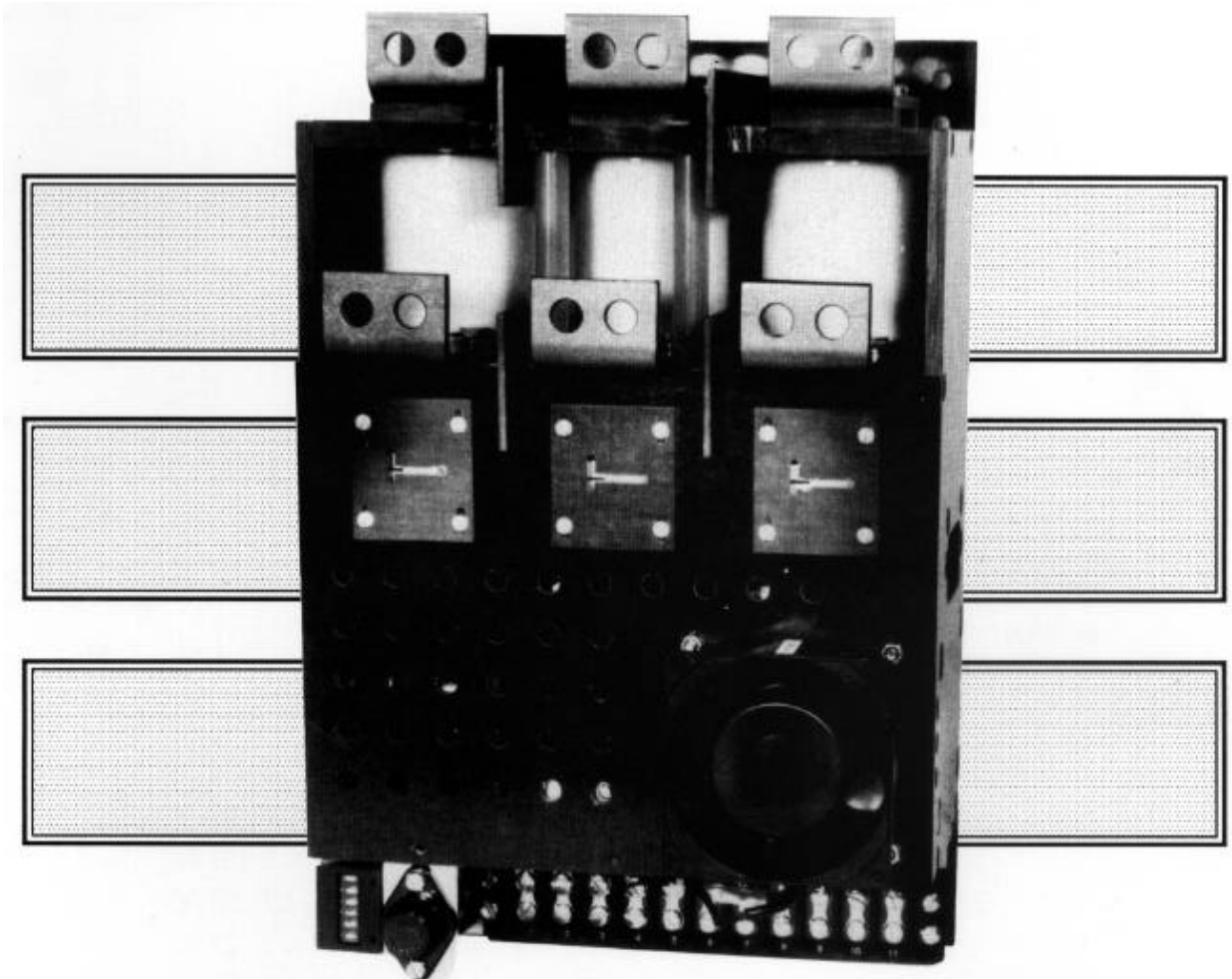
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**HIGH - SPEED**

# VACUUM CONTACTORS

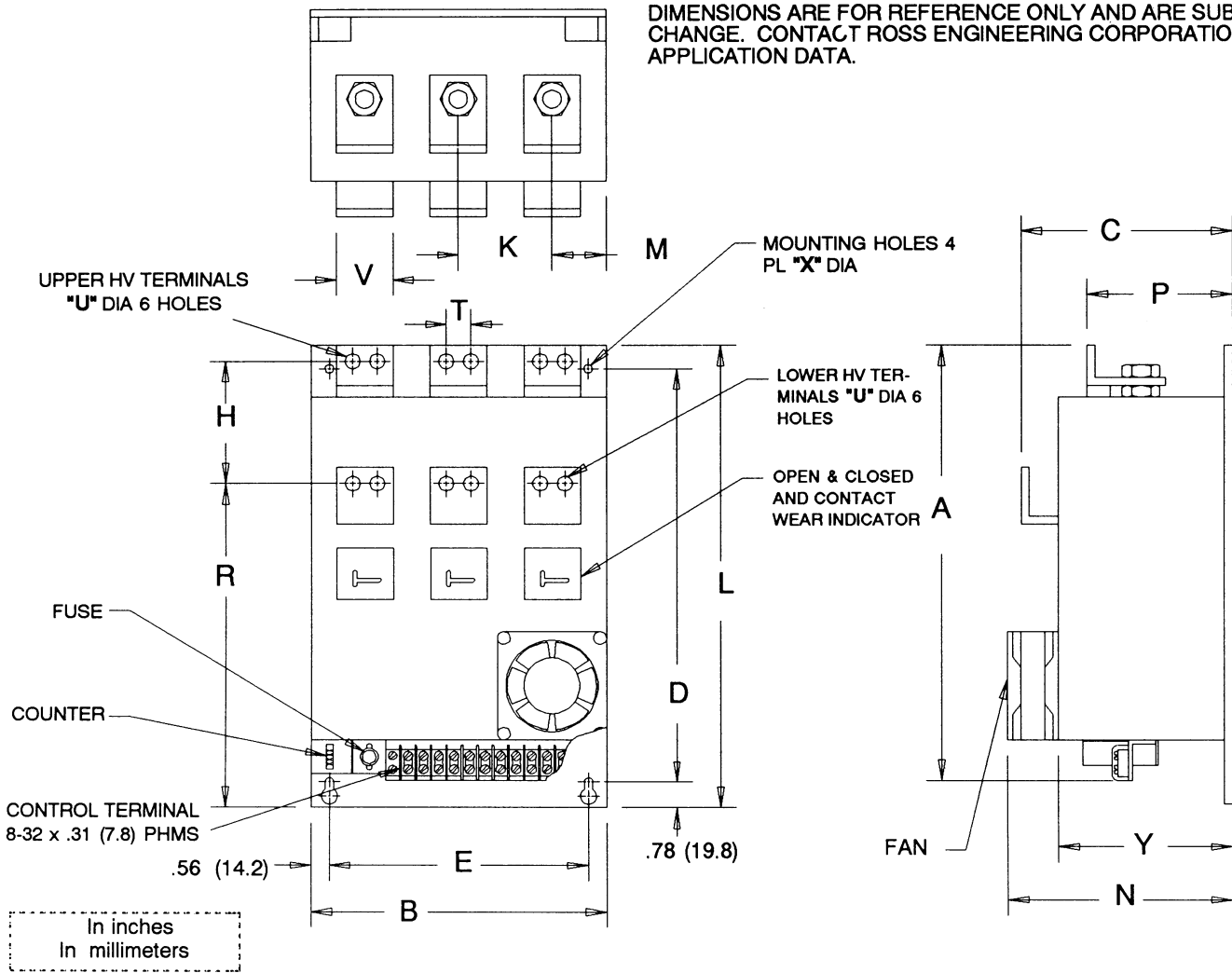


- 115 V TO 600 V AC
- 50 HZ TO 800 HZ
- 30 MILLISECOND DROPOUT & INTERRUPT TIME
- 2 AND 3 POLE
- COMPACT / LIGHTWEIGHT
- 200, 400, 600, 800 A
- 2,000 TO 18,000 A I C

**ROSS** ENGINEERING CORP.

CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182

DIMENSIONS ARE FOR REFERENCE ONLY AND ARE SUBJECT TO CHANGE. CONTACT ROSS ENGINEERING CORPORATION FOR APPLICATION DATA.



MODEL	DIMENSIONS																WEIGHT LESS (KGRAMS)	
	A	B	C	D	E	H	K	L	M	N	P	R	T	U	V	X		Y
HN3-27-15- (METRIC)	12.92 328.1	9.12 231.6	6.44 163.5	10.78 273.8	8.000 203.2	3.78 96.0	2.90 73.6	12.19 309.6	1.74 44.1	5.35 135.8	4.44 112.7	8.64 219.4	.76 19.3	.563 14.3	1.75 44.4	.265 6.73	6.85 173.9	24 (.74)
HN3-28-15- (METRIC)	13.52 343.4	9.12 231.6	6.44 163.5	12.84 326.1	8.000 203.2	3.78 96.0	2.90 73.6	12.19 309.6	1.74 44.1	6.85 173.9	4.44 112.7	8.64 219.4	.76 19.3	.563 14.3	1.75 44.4	.265 6.73	6.85 173.9	25 (.77)
HN3-37-15- (METRIC)	16.94 434.8	14.28 362.7	8.00 201.6	15.50 393.7	12.500 317.5	4.75 146.8	4.56 118.1	17.88 454.8	2.56 65.2	6.85 173.9	7.25 181.8	11.63 290.2	1.75 44.4	.563 14.3	4.00 101.6	.344 8.7	6.12 155.4	60 (1.86)
HN3-73-15- (METRIC)	20.01 508.2	14.28 362.7	7.94 201.6	18.75 476.2	12.500 317.5	8.87 225.2	4.65 118.1	19.28 489.7	2.49 63.2	6.85 173.9	5.19 131.8	10.64 270.2	1.75 44.4	.563 14.3	4.00 101.6	.406 10.3	6.12 155.4	75 (2.33)

MODEL	SPECIFICATIONS														CONTACT RES.		OPERATE TIME		*ACTUATOR 230V 60 Hz COIL	
	WITHSTAND VOLTAGE TEST				OPERATE VOLTAGE		600 VAC CURRENT RATINGS													
	HV CONTACTS		TO GROUND				50 Hz TO 800 Hz						MAX. OHMS	MAX. CYCLES @ 60 Hz	MAX. CYCLES @ 60 Hz	INRUSH MAX. AMPS	HOLD MAX. AMPS			
	KV RMS 60 Hz	KV IM-PULSE	KV RMS	KV IM-PULSE	KV RMS IN AIR	KV RMS IN OIL	MAX INTERRUPT SYMMETRIC AMPS RMS	MAXIMUM ASYMMETRY RATIO	CONTINUOUS AMPS RMS	**MOMENTARY 17 MILLISEC AMPS PK-TO-PK	**MOMENTARY 170 MILLISEC AMPS PK-TO-PK									
HN3-27-15	15	45	5	10	0.6	2.5	2,000	1.4	50,100,200	27,000	16,200	0.005	2	2	18	1				
HN3-28-15	15	45	5	10	0.6	2.5	4,000	1.1	200,400	81,000	54,000	0.0002	2	2	18	1				
HN3-37-15	15	45	5	10	0.6	2.5	13,200	1.0	400,600,800	81,000	54,000	0.0001	2	2	18	1				
HN3-73-15	15	45	5	10	0.6	2.5	18,000	1.2	400,600	81,000	54,000	0.0002	2	2	18	1				

\*230V, 60 Hz ACTUATOR IS STANDARD WITH 18 AMP INRUSH AND 1.0 AMP HOLDING. 208V, 60 Hz (20 AMP INRUSH 1.1 A HOLD), 115V, 60 Hz 36 A INRUSH 2 A HOLDING), 480V, 60 Hz (9 A INRUSH 0.5 A HOLDING) AVAILABLE. OTHER VOLTAGES AND FREQUENCIES ALSO AVAILABLE.

\*\*FUSE PROTECTED BY USER.

**ROSS ENGINEERING CORP.**

Printed in USA



# HIGH VOLTAGE VACUUM CONTACTOR

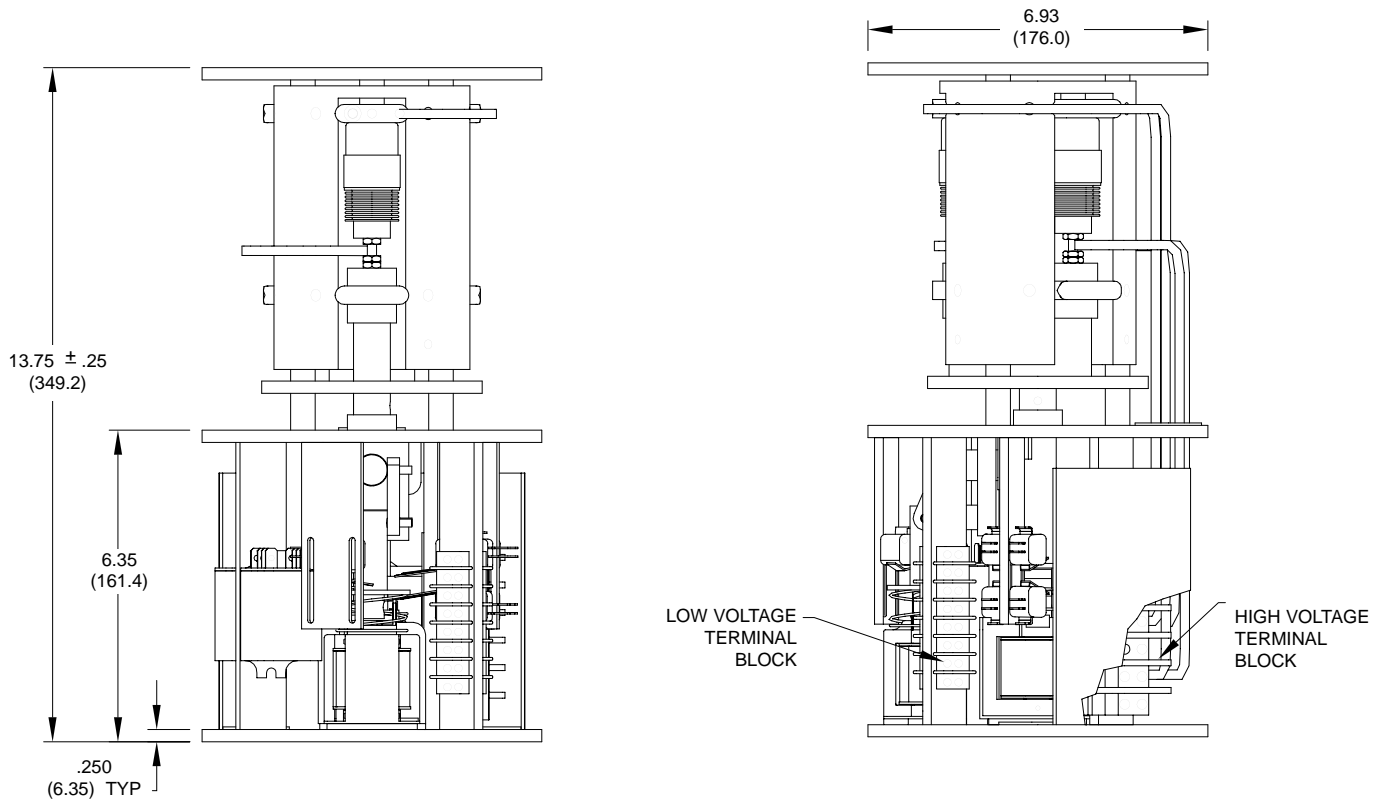


- 115V TO 3000V AC
- 50Hz TO 800Hz
- 1, 2 AND 3 POLE
- 30 MILLISECOND OPEN AND INTERRUPT TIME
- FOR MINIMUM CHOP TRANSIENT HV MOTOR CONTROL
- 50A, 100A, 200A
- 1,000A TO 3,000A INTERRUPT
- COMPACT / LIGHTWEIGHT



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e-mail: info@rossengineeringcorp.com



**INCHES  
(MILLIMETERS)**

DIMENSIONS ARE FOR REFERENCE ONLY  
AND ARE SUBJECT TO CHANGE. CONTACT  
ROSS ENGINEERING CORPORATION FOR  
APPLICATION DATA.

SPECIFICATION																
MODEL	WITHSTAND VOLTAGE TEST				OPERATE VOLTAGE		600 VAC CURRENT RATINGS IN AMPERES					CONTACT RES. OHMS	OPERATE TIME		*ACTUATOR 230V 60Hz COIL	
	HV CONTACTS		TO GROUND		KV RMS IN AIR	KV RMS IN OIL	MAX. INTERRUPT SYMMETRIC RMS	MAXIMUM SYMMETRIC RATIO	CONTINUOUS RMS	**MOMENTARY 17 MILLISEC. PK-TO-PK	**MOMENTARY 170 MILLISEC. PK-TO-PK		MAX. CYCLES @ 60Hz	MAX. CYCLES @ 60Hz	INRUSH MAX. A	HOLD MAX. A
	KV RMS 60Hz	KV IMPULSE	KV RMS 60Hz	KV IMPULSE												
HB3-3-10	7.5	10	7.5	10	3	3	1500	1.0	50, 100, 200	12000	6000	0.005	2	2	12	1
HB3-3-LO-10	7.5	10	7.5	10	3	3	1500	1.0	50, 100, 200	8000	4000	0.005	2	2	12	LATCH

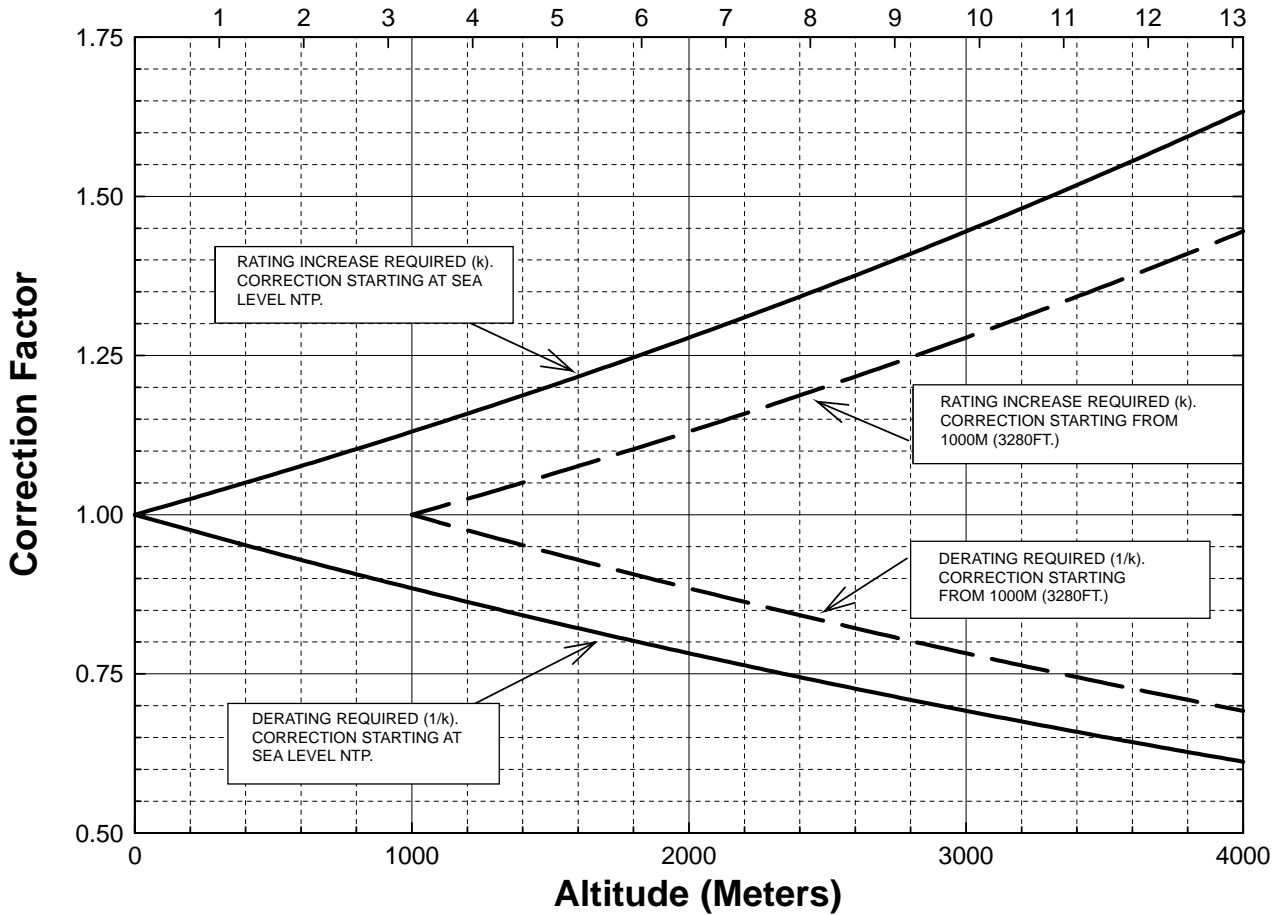
\* 230V, 60Hz ACTUATOR IS STANDARD WITH 12A INRUSH AND 1.0A HOLDING .208V, 60Hz (15A INRUSH 1.1A HOLD), 115V 60Hz 25A INRUSH 2A HOLDING), 480V, 60Hz (6A INRUSH 0.5A HOLDING) AVAILABLE. OTHER VOLTAGES AND FREQUENCIES ALSO AVAILABLE.  
\*\* FUSE PROTECTED BY USER.



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# ALTITUDE CORRECTION FACTOR

Altitude (Feet x 1000)



FOR CORRECTION FACTOR STARTING AT 1000M  
 $k = e^{m(H-1000)/8150}$   
 H = Altitude  
 m = 1 see IEC94  
 m = 0.9 see IEC94  
 m = 0.75 see IEC94

FOR CORRECTION FACTOR STARTING AT SEA LEVEL  
 $k = e^{m(H)/8150}$   
 H = Altitude  
 m = 1 see IEC94  
 m = 0.9 see IEC94  
 m = 0.75 see IEC94

ALTITUDE IN METERS (FEET)	RATING INCREASE REQUIRED STARTING FROM 1000 METERS (m = 1)	DE-RATING REQUIRED STARTING FROM 1000 METERS (m = 1)	RATING INCREASE REQUIRED STARTING FROM SEA LEVEL (m = 1)	DE-RATING REQUIRED STARTING FROM SEA LEVEL (m = 1)
0			1.000	1.000
500 (1641)			1.063	0.940
1000 (3281)	1.000	1.000	1.131	0.885
1500 (4923)	1.063	0.940	1.202	0.832
2000 (6562)	1.131	0.885	1.278	0.782
2500 (8203)	1.202	0.832	1.359	0.736
3000 (9843)	1.278	0.782	1.445	0.692
3500 (11484)	1.359	0.736	1.536	0.651
4000 (13124)	1.445	0.692	1.634	0.612



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# HIGH VOLTAGE GROUNDING RELAYS



- LOW CORONA
- UP TO 600 KV
- VISIBLE CONTACTS
- ENERGY DISSIPATION RESISTORS
- ADJUSTABLE SPHERICAL CONTACTS
- GRAVITY OR SPRING RETURN

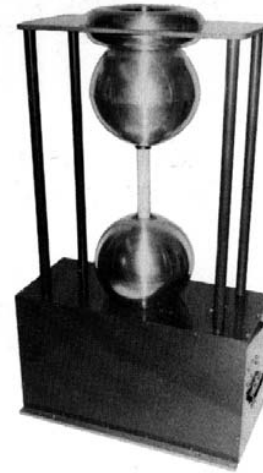
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# DH SERIES

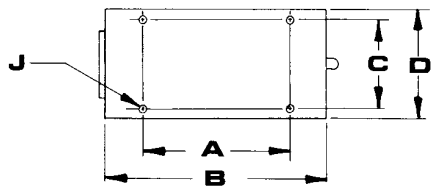
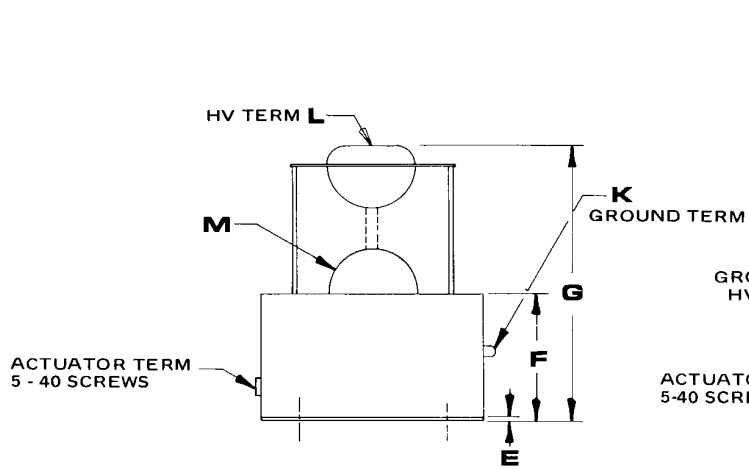
Extra high voltage, low corona, grounding relays of the air insulated type. Peak test ratings up to 600 KV and 100 amps continuous. Units can be operated either by solenoid, motor, or air cylinder, with spring or gravity return. All models have spherical contacts. When voltage transient limiting is required, some models have an adjustable sphere gap. Also available are units with built-in high voltage discharge resistors with energy dissipation capabilities from 50 to 500 kilojoules, or more, at 50 to 10,000 ohms. Some units can be reduced in height if full line to ground voltage is connected to the top high voltage contact only and the other high voltage terminal is operating at, or near, ground potential. Line to ground voltage can also be increased by adding insulation between lower high voltage contact and ground. Normally mounted base down. Base up mounting if specified.



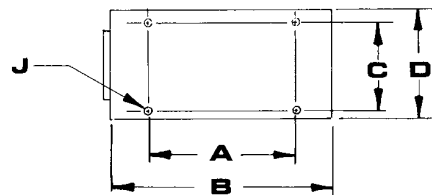
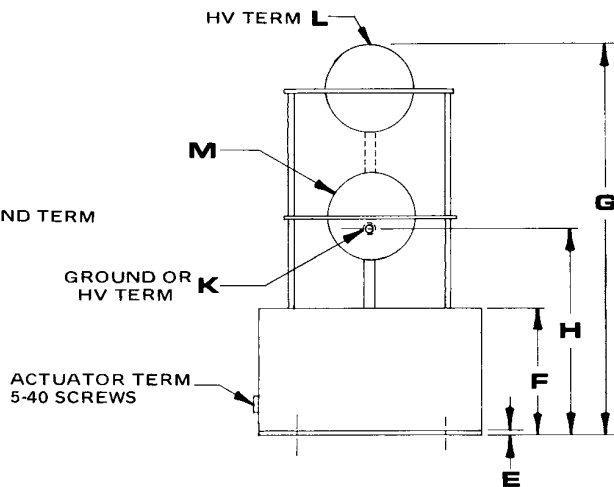
Dimensions are for reference only and are subject to change. Contact: Ross Engineering Corporation for application data.													
<b>DIMENSIONS</b>													
MODEL	TYPE	A	B	C	D	E	F	G	H	J	K	L	M
D-120-NC-10	1	6.250	10.00	6.250	7.00	.12	5.81	14.44		.266 DIA	1/4-28	3/8-24	3.94 DIA
DH-120-NC-20	1	12.000	18.00	8.000	9.00	.25	8.00	18.06		.406 DIA	1/4-28	5/8-11	4.92 DIA
DH-120-NC-120	2	12.000	18.00	8.000	9.00	.25	8.00	30.67	19.46	.406 DIA	5/8-11	5/8-11	4.92 DIA
DH-120-NO-120	2	12.000	18.00	8.000	9.00	.25	8.00	30.67	19.46	.406 DIA	5/8-11	5/8-11	4.92 DIA
* DH-150-NC-150-A	1												
* DH-150-NO-150-A	1												
* DH-150-P-150-A	1												
DH-150-NC-40-B	1	12.000	18.00	8.000	9.00	.25	8.00	18.63		.406 DIA	1/4-28	5/8-11	4.92 DIA
DH-150-NC-150-B	2	12.000	18.00	8.000	9.00	.25	8.00	34.33	22.46	.406 DIA	5/8-11	5/8-11	4.92 DIA
DH-150-NO-150-B	2	12.000	18.00	8.000	9.00	.25	8.00	34.33	22.46	.406 DIA	5/8-11	5/8-11	4.92 DIA
* DH-150-L-150-B	2												
* DH-200-NC-40-A	1												
* DH-200-NO-40-A	1												
* DH-200-P-40-A	1												
DH-200-NC-40-B	1	16.000	24.00	11.000	12.00	.38	14.00	29.50		.406 DIA	1/4-28	5/8-11	9.84 DIA
DH-200-NO-40-B	1	16.000	24.00	11.000	12.00	.38	14.00	29.50		.406 DIA	1/4-28	5/8-11	9.84 DIA
* DH-200-L-40-B	1												
DH-200-NC-40-200-C	3	16.000	24.00	11.000	12.00	.38	14.00	72.00		.406 DIA	1/4-28	5/8-11	9.84 DIA
DH-200-NC-40-200-D	4	16.000	24.00	11.000	12.00	.38	14.00	77.12		.406 DIA	1/4-28	5/8-11	9.84 DIA
* DH-300-NC-40-A	1												
* DH-300-NO-40-A	1												
* DH-300-P-40-A	1												
DH-300-NC-40-B	1	16.000	24.00	11.000	12.00	.38	14.00	37.00		.406 DIA	1/4-28	5/8-11	9.84 DIA
DH-300-NO-40-B	1	16.000	24.00	11.000	12.00	.38	14.00	37.00		.406 DIA	1/4-28	5/8-11	9.84 DIA
DH-300-NC-40-100-C	3	16.000	24.00	11.000	12.00	.38	14.00	79.50		.406 DIA	1/4-28	5/8-11	9.84 DIA
DH-300-NC-40-200-C	3	16.000	24.00	11.000	12.00	.38	14.00	79.50		.406 DIA	1/4-28	5/8-11	9.84 DIA
DH-300-NC-40-200-D	4	16.000	24.00	11.000	12.00	.38	14.00	84.62		.406 DIA	1/4-28	5/8-11	9.84 DIA

\* DIMENSIONS SUPPLIED UPON REQUEST.

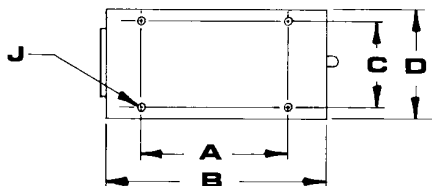
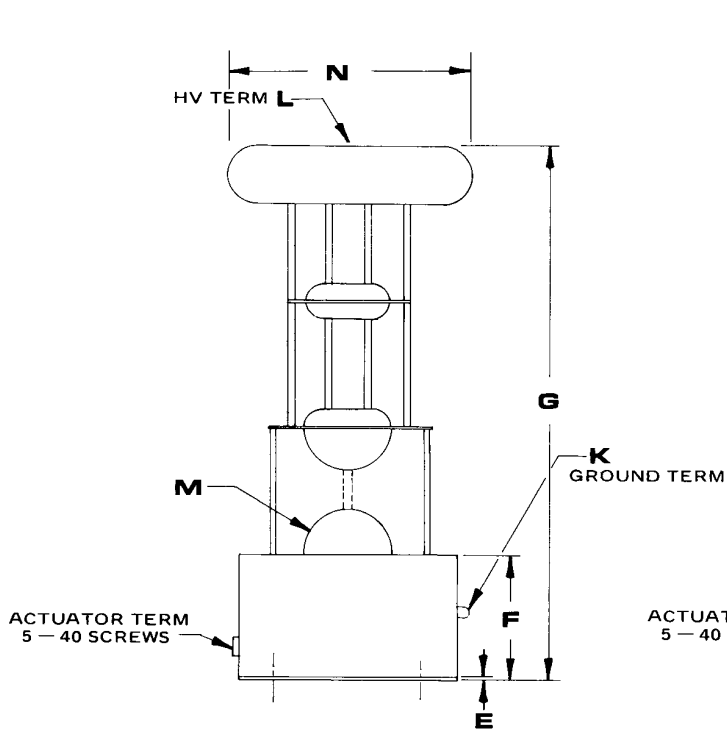
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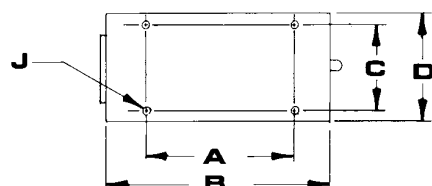
**TYPE 1**



**TYPE 2**



**TYPE 3** **ROSS** **ENGINEERING CORP.** **TYPE 4**



## SPECIFICATIONS

		PEAK TEST RATINGS KV		CURRENT RATING				
MODEL	CONTACT FORM	H V CONTACT	INSULATION TO GROUND	CONTINUOUS	MOMENTARY 10 CYCLE	MOMENTARY CAP DISCHARGE 20 USEC	MAX CONTACT RESISTANCE	ACTUATOR
D-120-NC-10	SPNC	120	10	100 A	1,000 A	5,000 A	0.001 ohm	Solenoid
DH-120-NC-20	SPNC	120	20	100 A	1,000 A	5,000 A	0.001 ohm	Solenoid
DH-120-NC-120	SPNC	120	120	100 A	1,000 A	5,000 A	0.001 ohm	Solenoid
DH-120-NO-120	SPNO	120	120	100 A	1,000 A	5,000 A	0.001 ohm	Solenoid
DH-150-NC-150-A	SPNC	150	150	100 A	1,000 A	5,000 A	0.001 ohm	Air Operated
DH-150-NO-150-A	SPNO	150	150	100 A	1,000 A	5,000 A	0.001 ohm	Air Operated
DH-150-P-150-A	***	150	150	100 A	1,000 A	5,000 A	0.001 ohm	Air Operated
DH-150-NC-40-B	SPNC	150	40	100 A	1,000 A	5,000 A	0.001 ohm	Motor/Solenoid
DH-150-NC-150-B	SPNC	150	150	100 A	1,000 A	5,000 A	0.001 ohm	Motor/Solenoid
DH-150-NO-150-B	SPNO	150	150	100 A	1,000 A	5,000 A	0.001 ohm	Motor/Solenoid
DH-150-L-150-B	Latching	150	150	100 A	1,000 A	5,000 A	0.001 ohm	Motor/Solenoid
DH-200-NC-40-A	SPNC	200	40	100 A	1,000 A	5,000 A	0.001 ohm	Air Operated
DH-200-NO-40-A	SPNO	200	40	100 A	1,000 A	5,000 A	0.001 ohm	Air Operated
DH-200-P-40-A	***	200	40	100 A	1,000 A	5,000 A	0.001 ohm	Air Operated
DH-200-NC-40-B	SPNC	200	40	100 A	1,000 A	5,000 A	0.001 ohm	Motor/Solenoid
DH-200-NO-40-B	SPNO	200	40	100 A	1,000 A	5,000 A	0.001 ohm	Motor/Solenoid
DH-200-L-40-B	Latching	200	40	100 A	1,000 A	5,000 A	0.001 ohm	Motor/Solenoid
* DH-200-NC-40-200-C	SPNC	200	40	100 A	1,000 A	5,000 A	0.001 ohm	Motor/Solenoid
** DH-200-NC-40-200-D	SPNC	200	40	100 A	1,000 A	5,000 A	0.001 ohm	Motor/Solenoid
DH-300-NC-40-A	SPNC	300	40	100 A	1,000 A	5,000 A	0.001 ohm	Air Operated
DH-300-NO-40-A	SPNO	300	40	100 A	1,000 A	5,000 A	0.001 ohm	Air Operated
DH-300-P-40-A	***	300	40	100 A	1,000 A	5,000 A	0.001 ohm	Air Operated
DH-300-NC-40-B	SPNC	300	40	100 A	1,000 A	5,000 A	0.001 ohm	Motor/Solenoid
DH-300-NO-40-B	SPNO	300	40	100 A	1,000 A	5,000 A	0.001 ohm	Motor/Solenoid
* DH-300-NC-40-100-C	SPNC	300	40	100 A	1,000 A	5,000 A	0.001 ohm	Motor/Solenoid
* DH-300-NC-40-200-C	SPNC	300	40	100 A	1,000 A	5,000 A	0.001 ohm	Motor/Solenoid
** DH-300-NC-40-200-D	SPNC	300	40	100 A	1,000 A	5,000 A	0.001 ohm	Motor/Solenoid

\* HAVE BUILT-IN H V LIMITING DISCHARGE RESISTORS WITH ENERGY DISSIPATION CAPABILITY OF 50 TO 500 KILOJOULES, OR MORE, AT 50 TO 10,000 OHMS.

\*\* HAVE BUILT-IN H V LIMITING DISCHARGE RESISTORS WITH ENERGY DISSIPATION CAPABILITY OF 50 TO 500 KILOJOULES, OR MORE, AT 50 TO 10,000 OHMS, PLUS ADJUSTABLE SPHERICAL CONTACT SPACING.

\*\*\* AIR OPERATED BOTH DIRECTIONS.

SPECIFY MOUNTING POSITION WHEN ORDERING, I.E: BASE UP, BASE DOWN.

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CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182



5000-11/93

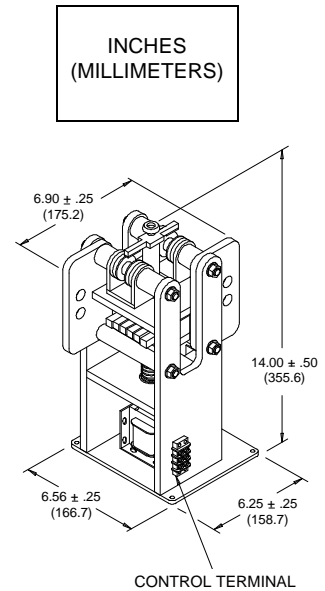


# HIGH CURRENT AC & DC CONTACTORS

## 12V TO 600V AC OR DC

*RELATED NEMA SIZE	SINGLE POLE NORMALLY OPEN *MODEL	CONTINUOUS OPERATE CONTACTS	CONTINUOUS AMPS RESISTIVE	*MAX INTERRUPT AMPS RESISTIVE
	C-12-NO-12-200/800-	12V	200	800
	C- -400/1200-		400	1200
	C- -600/1200-		600	1200
	C-24-NO-24-200/800-	24V	200	800
	C- -400/1200-		400	1200
	CA- -600/1200-		600	1200
	C-28-NO-28-200/800-	28V	200	800
	C- -400/1200-		400	1200
	CA- -600/1200-		600	1200
	C-125-NO-125-200/800-	125V	200	800
5	C- -300/1200-		300	1200
	C- -400/1200-		400	1200
6	CA- -600/1200-		600	1200
	C-250-NO-250-200/800-	250V	200	800
5	C- -300/1200-		300	1200
	C- -400/1200-		400	1200
6	CA- -600/1200-		600	1200
	C-300-NO-300-200/800-	300V	200	800
5	C- -300/1200-		300	1200
	C- -400/1200-		400	1200
6	CA- -600/1200-		600	1200
	C-600-NO-600-200-	600V	200	*
5	C-600-NO-600-300-	600V	300	*
	C-600-NO-600-400-	600V	400	*
	CA-600-NO-40-200			
	CA-750-NO-750-600/500	750V	600	800

CA300-NO-300-600/1200



Single Pole  
Non Enclosed Style

SOLENOID-SAVER® is included.

Coil voltages or control voltages can be different from contact operating voltage if required.

Optional SOLENOID-SAVER™/CONTROLLER available for 4-12V, 5MA control of solenoid of solenoid coil power.

Optional enclosed style available. Replacement contacts available.

Add \$50.00 for 15 amp 250V AC SPDT aux contact.

Expected life: 10,000 Full load close-open operations. 50,000 50% full load close-open operations.

100 max interrupt close-open operations.

100,00 no load operations.

1-minute peak test dielectric 1,700 DC or peak 60Hz to 125V operate.

2,100 DC or peak 60HZ, 250V to 300V operate.

\*Depending on application. Also available without interrupter with reduced size and cost.

Change interrupter rating in model # to "O." Consult Engineering Department. See also EA Series.



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# HI POWER

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## STEP-START POWER SWITCHING SYSTEM

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### STEP-START OVERVIEW

HB3-51 5-15KV, 200 AMP Continuous, 2,000 Amp Symmetric Interrupt  
 HC3-73 5-15KV, 600 AMP Continuous, 12,000 Amp Symmetric Interrupt  
 HC3-75 5-15KV, 600-1200 AMP Continuous, 18,000 Amp Symmetric Interrupt  
 HD3-79 5-15KV, 600-1200 AMP Continuous, 28,000 Amp Symmetric Interrupt  
 HD3-85 16-38KV, 600 AMP Continuous, 16,000 Amp Symmetric Interrupt



#### 1 Cycle Interrupt Time

The Step-Start Vacuum Circuit Breaker/ Power Controller is designed for extra heavy duty repeated fault, crobar and load interruption for sensitive equipment. It is designed to limit initial closing inrush current to approximately load or other maximum current with an adjustable step delay.

It is also designed for high speed crobar and other load fault interruption. A 50 volt 10 microsecond or longer pulse signal initiates a vacuum contact parting time of 7 to 10 milliseconds. Most faults will be interrupted in less than 1 cycle (17 milliseconds).

If required, line-side over-current sensing CT's can be built-in. Also, if required, instantaneous and very inverse time line over-current relays can be set to coordinate with HV fuses to prevent unnecessary HV fuse damage. Potential transformers, meters, loss of phase tripping, and a complete fused load break air disconnect switch system are also available.

In addition to the high speed 1/2 to 1 cycle load side fault tripping, instantaneous line side trip contact parting times can be deliberately delayed approximately 1 to 2 cycles, depending on the requirements, and as a result, backup tripping is in the order of 20 to 40 milliseconds. Full interruption is nominally within 8 milliseconds or less (usually first current zero) after vacuum contact parting, providing 2 to 3 cycles interrupt from the line or ground fault-sensing relays. Where required, Vacuum Circuit Breaker Contacts are automatically locked out from opening for line faults above 50% to 80% interrupt capacity to reduce unnecessary erosion of Vacuum Circuit Breaker Contacts, although the Circuit Breaker is actually capable of interrupting it's full current rating if necessary. Operations counters are supplied, with fault trips and total operations counted separately.

Automatic dropout with loss of control power or interlocks is incorporated. Loss of stored energy will not prevent it from dropping out. Loss of voltage dropout can be delayed 80 to 120 milliseconds to prevent unnecessary dropouts from momentary loss of control power due to relay, microswitch, or other interlock contact bounce. Loss of control voltage can activate the anti-pump reset relay without adding to the trip count.

The metal enclosure is designed with hinged front door and removable side, rear, and top panels (where required) for easy access. It is available for cable entrance, bushing entrance or direct bus connection.

Please read on for a more detailed description and philosophy of the Step-Start Vacuum Circuit Breaker System.



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## STEP-START SYSTEM

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The idea behind a step-start system is simple: to reduce large current surges when energizing high power inductive iron core or large capacitive components from low impedance sources. Developing a system to accomplish this, however, can lead to problems. Sensing, timing, step impedance, reliability, and life of the system must all come together in the smallest and lightest package possible. The creative use of vacuum interrupters and energy storage closing and tripping work together to solve some of the problems of space and weight. Special sensing, timing and safeties help make the unit effective. But why use a step-start arrangement instead of a single contactor or circuit breaker? The answer is in the inherent characteristics of the devices to be energized.

### Energizing a Device

Normally, a device such as a transformer or reactor with an iron core, or a capacitor will have retentivity or require charging energy. When the reactive device is energized, the only limit to initial charging current may be its series resistive component. This creates very low initial impedance for 1/2 to many cycles on AC or many milliseconds on DC. When being energized from a low impedance source, these momentary low impedance loads can create high current surges and oscillations, which can result in over-voltages, unnecessary trippings, or induced currents and over-voltages in surrounding objects or equipment. Unless these current surges and oscillations are reduced or eliminated, contacts in the controller, the windings or insulation of the load device, and surrounding electrical equipment could sustain damage.

Closing inrush currents can approach the same level as fault currents. In iron core magnetic components where resistive factors are generally less than 10% of the total impedance, normal charging inrush currents easily reach 5 to 7, even 10 times their steady state full load currents or 100 times steady state excitation currents. These will cause momentary fluctuations in the voltage levels and phase relations that can cause severe problems in the entire vicinity connected to the same power source. High frequency charging currents, particularly in bank to bank capacitor switching with low impedance and closely associated banks, can reach many thousands of amps. This especially occurs while switching on the second bank when the first bank is already energized. Since these currents generally are oscillatory at frequencies in the order of 10's of kilohertz, extreme currents are likely to be induced in surrounding equipment and even transmitted into the airwaves causing major problems in computers and other sensitive electronic apparatus. Switching pre-strikes and re-strikes causing repeated high inrush currents can also cause the same condition.

### The Results of Energizing a Device

Accumulated load equipment deterioration occurs from repeated initial charging, inrush, or high frequency charging currents. These currents can also shorten the life of the switching device to less than 10% its expected operating life. Fault interrupting life will also be decreased to some degree due to this condition. Erosion from closing the contacts is usually 2 to 10 times greater than erosion from interrupting the same current. To reduce load equipment deterioration and increase the life of the switching device, initial charging, inrush, and high frequency charging currents must be minimized by some means.

### Reducing Deterioration and Increasing Life

For iron core components, inrush currents can be minimized by closing on the opposite polarity from which the unit was interrupted. The proper retentive polarity will then be present, generating immediate back electromotive force. This eliminates the high charging current, which would continue until the field is up to the level of the previous interruption. Synchronizing is not easily done however.

Uncharged capacitors are also essentially zero impedance when waiting to be charged. If capacitors could be energized at the instant the source voltage was zero or the same polarity and at or lower than the voltage of any partial charge level remaining after previous interruption, capacitive inrush currents could be reduced. Capacitors may retain a charge for some time after interruption and if re-energized with a source of opposite polarity, can create tremendous inrush currents. Again, synchronization is complicated if not impossible.

### The Step-Start Solution

Accomplishing reliable, repeatable timing requirements to minimize these inrush problems without a step-start is an almost insurmountable task where long life timing reliability would be required. The extreme complexity of the many electronic components and the exacting mechanical coordination make precise timing extremely difficult. The easiest and most reliable solution is to use a step-start system where precise timing is not a serious problem and inrush current levels can be set as required by inserted step impedance.

The basic unit consists of a main contactor or circuit breaker and a step contactor with a series current limiting device of a sufficient short time kilojoule capacity. The current limiting device generally is a low inductance resistance to minimize oscillatory tendencies. However, small air core reactors



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(with their reduced heat producing problems) are excellent for limiting high frequency inrush of bank to bank capacitors if the ringing frequency is not a problem. Due to their high price and size, air core reactors are generally not economical for the step limiting impedance requirements of power frequencies. They may also cause over voltages on interruption or pre-strikes. The two switching devices and the current limiting device with the addition of step timing, safeties (along with normal control circuitry), and an enclosure if required comprise the step-start system.

### Operation of the System

To begin energizing, the step contactor is first closed, placing the inrush current limiting device in the circuit until the load is partially charged. Usually 0.1 second is sufficient unless it is in the primary of a power supply with a large DC capacitive load. If this is the case, it will need a longer time to reach a satisfactory level of charge. The main contactor or circuit breaker is then closed, bypassing the step unit. In some cases more than one step may be desirable.

In some systems the step impedance is in series with the main switching unit and the step contactor is used to bypass the limiting impedance. This is less desirable since it requires both switching units to have full momentary current ratings, a more expensive arrangement. In special applications, a two step interruption as well as closing may be desirable. Again the timing safeties must be used to protect the momentary rated current limits of the step unit.

### Protecting the System

Safeties have been designed into the step-start system to prevent damage to the unit. Included are safeties to prevent the main contactor from closing if the step contactor has not been closed for the required time, and to prevent it from closing if the step contactor drops out at any time prior to the main contactor closing. Safeties will also automatically drop out the step system after a selected maximum time (usually 0.15 seconds) after the main breaker is told to close. This prevents overheating or destruction of the current limiting unit that usually does not have a continuous capability, if the mainbreaker has not closed.

Consideration must be made for the total momentary capability of the step system. Minimum cooling times between each operation must be established. When safeties and proper allowances have been made, the possibility of damage to the unit is minimal.

It is recommended that most step-start systems be protected by fused load-break air disconnects rather than the slower backup breakers. Fuses have some current limiting ability and their interrupting setting cannot be easily tampered with. They do not require control power for operation.

In many cases a more economical system can be supplied where the step-start system breakers are locked out above a stated fault current level allowing smaller breakers to be used. These breakers do not interrupt if the fault current is above that level but allow the backup systems to activate.

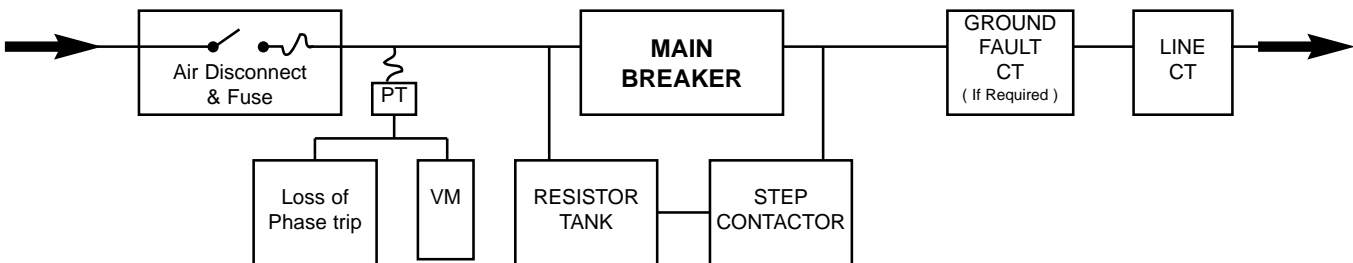
Fault sensing for the step-start system, in some cases, is done only on the load side, letting the backup handle any line side faults. With the possible exception of ground faults, most cases will use the high current lockout if line fault availability is above a stated level.

### The Results

When the step-start system is installed and functioning, it will effectively reduce large current surges when energizing high power iron core or large capacitive components from low impedance sources. By reducing these currents, the step-start system effectively decreases deterioration in load equipment and in turn increases the life of the switching device. At the same time it reduces the disturbances to other equipment. Size, weight, and simplicity make the step-start a cost-effective alternative to much more complex and expensive devices for the same purpose.

Ross Engineering Corp. Step-Start Vacuum Contactors and Circuit Breakers, when used with air disconnects, are usually not drawout units since all components are relatively lightweight and have easy accessibility. Complete drawout units have been constructed where required, although the additional complications will increase size, complexity and expense considerably.

### Step-Start Block Diagram



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# HIGH VOLTAGE VOLTMETERS

FOR LOW AND HIGH VOLTAGE

DC-10MHz, 0.0001V-1,000,000V



**4 1/2 Digit DVM  
Battery Powered**



Multipurpose Digital Voltmeter/Amplifier Wideband DC-10MHz, 0.00001V to 1000V DC, True RMS, AVG, True Peak follow, and 200 nanosecond Peak Pulse Capture & Store. ±2V PK Output to drive as low as 50 ohms. 0.01% DC, 0.1% 50/60Hz, 3% to 1MHz, 1dB to 10MHz, 3dB to 20MHz.

**HV Electronic Class  
VMDPE Series**



**HV Probe with  
multimeter to  
400KV DC to  
20KHz-1MHz\***

Ross Eng. Corp. VMP HV Probe with Fluke® 8060A or similar Digital Meter to 400KV, 0.1% DC, 1% 50/60Hz AC accuracy. Wideband DC up to 20KHz - 10MHz.\* depending on meter model.

*with*

**HV Voltage  
Divider to  
1,000,000V wide-  
band DC up to  
10MHz**



Voltage Dividers available with 0.1% or 0.01% DC, 0.2% 50/60Hz, 3% to 1MHz or more.

**HV POWER CLASS VM  
HiZ® Series  
0-250V to 100KV AC/DC**

**For Power  
Line use**



With Analog or Digital Meter for 50/60Hz. 25KV, 50KV, 100KV or DC. 125KV to 300KV Basic Impulse Level.



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# MULTIMETERS

For Low and High Voltage  
DC-10MHz 0.0001V - 1,000,000V

## BASIC METERS

The sturdy, compact and portable Ross VMD and VMDP series voltmeters are available with 3 1/2, 4 1/2 or 5 1/2 digit readouts. Some units feature accuracies as good as 0.01% on DC and 0.1% on AC measurements. Meters with frequency responses from DC to 10MHz are available. The capability to follow voltage peaks from DC to over 5MHz or capture and store peak pulses as short as 200 nanoseconds is built into the revolutionary new VMD2A Multimeter. These basic stand alone meters can measure voltages from 10 microvolts to 1000 volts, and to 1,000,000V with Ross voltage dividers.

## HIGH VOLTAGE METER SYSTEMS

Most Ross Meters are supplied as systems consisting of one of the basic meters matched to the VMP series voltage probes or VD series voltage dividers. The VMP series hand held probes extend the voltage measuring capabilities safely to 400,000 volts. The base mounted VD series dividers can extend capabilities, safely, to as high as 1,000,000 volts. Most of the Systems utilizing the VMD2A can use it's amplifier output to drive shielded cable and instrumentation at frequencies from DC to 10MHz with useful accuracy.

Meter systems are also available, featuring a portable combination voltmeter and oscilloscope to provide voltage waveforms as well as voltage levels.

## HIGH MARGINS OF SAFETY

The models utilizing the VMP series probes or VM and HiZ® Power Class series voltage dividers and voltmeters are carefully designed to provide utmost safety when measuring high voltage, whether it be low power electronic systems, high voltage industrial equipment or high voltage power lines. Extremely high OSHA and power class safety factors are provided. These high voltage, high power probes have impulse ratings providing safety factors well in excess of two times their rated voltages.

## OTHER ROSS PRODUCTS

Wideband Fiber Optic transmission systems are also available to transmit the outputs of voltage dividers over non-conductive fiber optic cables up to 1 kilometer to provide the ultimate in operator safety and elimination of electrical pick-up and ground currents. A wide range of high voltage power control products are also available: High voltage relays, high current switches, vacuum contactors, spark gaps, high power control and step-start systems, high voltage safety devices.

## Meeting Specific Applications

Customers for Ross Engineering Corporation products include: Manufacturers and users of medical X-Ray & MRI equipment, Integrated Circuits, high power lasers & Particle Beams, HV Power Supplies, Television & other high power Transmitters, Aerospace systems, Radar, Airport lighting, Cyclotrons, Power Utilities.

# WIDEBAND MULTIPURPOSE DIGITAL VOLTMETER

## FEATURES AVAILABLE *DEPENDING ON MODEL:*

**Readout:** 4 1/2 digit.

**Functions:** DC, Avg (RMS), true RMS, true positive or negative peak follow and store, positive or negative single pulse capture and store . Peak to peak follow and pulse store.

**Basic meter voltage range:**  $\pm 10\mu\text{V}$  to  $\pm 1000\text{V}$  DC;  $\pm 100\mu\text{V}$  to  $\pm 700\text{V}$  RMS,  $\pm 20\text{mV}$  to  $\pm 1000\text{V}$  peak readings.

**DC Accuracy:**  $\pm 0.01\%$   $\pm 1$  digit. (Depending on range).

**AC Accuracy:**  $\pm 0.1\%$   $\pm 10$  digit 50Hz to 60KHz,  $\pm 3\%$  to 1MHz,  $\pm (1\text{dB})$  at 10MHz. (Depending on range & level).

**Peak pulse store:** To 200 nanoseconds pulse width or 1/2 sine wave to 2MHz.

**Coupling:** Selectable AC or DC+AC.

**Input Impedance:** Selectable 1 megohm, 40pF or 10 megohm, 100pF to match probes or dividers.

**Inputs:** BNC for shielded cable or banana jacks for test leads.

**Output:**  $\pm 2\text{V}$  PK line driver amplifier output capable of driving as low as 50 ohm shielded cables as well as external instrumentation such as oscilloscopes & recorders.

**Amplifier frequency response:** DC to 1MHz  $\pm 3\%$ ; 1MHz to 10MHz  $\pm 10\%$  (1dB), to 20MHz (3dB).

**Power Supply:** AC line and rechargeable battery providing from 24 hours with full load up to 40 hours, quiescent conditions.

**Size:** 8"x5"x5". Rugged all metal, fully shielded case.

**Weight:** 5.5 lbs. including rechargeable battery.

## Model VMD2A



Matches any R.E.C. HV Probe or Voltage Divider



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# MULTIMETERS FOR HIGH VOLTAGE USE



Probe or Voltage  
Divider

**VMD3**



Fluke® 8840 or other  
meter

VMD3 has Ross 0.01% high accuracy Voltage Divider with Fluke®, Keithley® or other 5 1/2 Digit or more portable Matching Meter with 0.01% DC, 0.1 to 0.5% 50/60Hz True RMS accuracy, 3% 20Hz to 100KHz up to 1,000,000V PK. 115V AC powered only.



FLUKE® 8060A  
or other meter

**VMD4A**

Selector Box for  
matching meter  
and/or other device

Scope or  
Recorder

VMD4A has Ross HV Probe or Voltage Divider with FLUKE® 8060A or other 3 1/2 or 4 1/2 Digit Matching Meter & selector control box to allow simultaneous use of meter, and/or scope or recorder up to 1,000,000V PK. 0.1% DC, 0.5% 50/60Hz, 3% 20Hz-100KHz, to 10MHz with Ross VMD2A.



Probe or Voltage  
Divider

**VMD6**



VMP200  
Probe

FLUKE® 93, 95, or  
97 Series Scopemeter  
or other meter

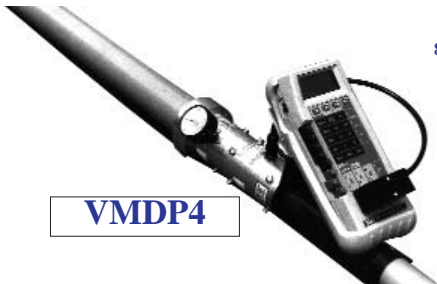


VMD6 has Ross Voltage Divider and Fluke® Scopemeter incorporating Battery/AC operated 3 1/2 Digit Meter/DC-50MHz storage oscilloscope. Ranges to 1,000,000V PK with Probe or Divider.



**VMP2A**

VMDP2A has Ross Engineering Corporation 3 1/2 or 4 1/2 Digit Meter mounted on Ross HV probe with OSHA recommended insulated handle. Ranges to 200KV PK.



**VMDP4**

FLUKE®  
8060A or other  
Meter

VMDP4 has Fluke® 8060A or other 4 1/2 Digit Meter mounted on Ross HV probe with insulated handle meeting OSHA recommendations for personnel clearance to high voltage. Ranges to 200KV PK.



**VMDP6**

FLUKE® 93, 95, or  
97 Series Scopemeter

VMDP6 has Ross HV Probe and FLUKE® Scopemeter incorporating Battery/AC operated 3 1/2 Digit Meter and DC-50MHz Storage Oscilloscope similar to VMD6 scope is mounted on HV probe with insulated handle meeting OSHA recommendations for personnel clearance to high voltage. To 200KV PK.

*For Emergency  
Crews*



**Digital VM50DE Power Class**

With 3 1/2 or 4 1/2 digit Ross Engineering Meter for 50/60Hz and/or DC. Insulated handle for use with underground and over head HV power line safety factors. 125KV basic impulse level. 0-200V, 0-2KV, 0-20KV, 0-50KV RMS ranges. Also 100KV RMS, 300KV BIL available.



**VM25E, VM50E, Power Class**

With Analog Meter for 50/60Hz. For underground and overhead use. Power line safety factors. 0-250V, 0-5KV, 0-10KV, 0-25KV, Or 0-50KV RMS ranges with 125KV basic impulse level. Also 100KV RMS, 300KV BIL available.



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# VMD2A MULTIPURPOSE DIGITAL VOLTMETER / AMPLIFIER

## EXCEPTIONAL FREQUENCY RESPONSE

### DC-10MHz 0.00001V to 1,000,000V\*

- 4 1/2 Digit Read-out
- Up to 0.01% DC Accuracy and 0.1% AC Accuracy (see specifications below)
- True Peak Follow Up To 10MHz
- Peak Pulse Capture & Store to 200 Nanosec
- True RMS and Average (RMS) AC Readings
- Dual Inputs, BNC & Banana
- 1 Megohm & 10 Megohm Input Resistance
- Internal Amplifier With 50 Ohm Output
- Read-Out Hold Switch
- 40 Hour Rechargeable Battery Power

#### FEATURES OF VMD2A VOLTMETER

**Functions:** Volts DC, True RMS and average volts AC, positive and negative peak follow and store, positive or negative single pulse capture and store, peak-to-peak follow and pulse store.

**Basic Meter:** DC Voltages from  $\pm 10\mu\text{V}$  to  $\pm 1000\text{V}$ , and AC voltages from  $100\mu\text{V}$  to  $700\text{V RMS}$ , or  $20\text{mV}$  to  $1000\text{V peak}$ .

**DC Accuracy:** From 0.01% of reading  $\pm 4$  digits on  $200\text{mV}$  range, and 0.01% of reading  $\pm 2$  digits on 2 volt range, to 0.03% of reading  $\pm 2$  digits on 20, 200, and 1000 volt range.

**AC Accuracy True RMS:** 0.3% of reading  $\pm 10$  digits on  $200\text{mV}$  range and 0.1%  $\pm 10$  digits on all other ranges up to 750 volts RMS. The meter will read up to 1MHz depending on the selected range and input signal level. Best accuracy 50-3000Hz.

**AC Accuracy Average (in RMS):** 0.75%  $\pm 10$  digits above half-scale on  $200\text{mV}$  range, 0.1%  $\pm 10$  digits on the 2 through 200 volt ranges, 0.5%  $\pm 10$  digits above 1/4 scale up to 750 volts (RMS) on the 1000 volt range. The meter will read up to 5MHz with accuracies depending on the selected range, and input signal level. Best accuracy 50-3000Hz.

**Peak Follow:**  $\pm 5\%$ , DC to 1MHz,  $\pm 18\%$  1 to 10MHz with input voltage above 10% of the selected range.

**Peak pulse store:** 200 nanoseconds or half cycle of 5MHz sine wave

**Coupling:** Selectable; AC only or DC+AC.

**Input impedance:** Switch selectable; 1 megohm, 40pF or 10 megohm, 100pF to match Ross probes or dividers.

**Dual Inputs:** Both BNC and banana jacks switch selectable. Provides rapid comparison of two separate signals.

**Output:**  $\pm 2\text{V PK}$ , 4V PK-PK amplifier output is capable of driving shielded cables terminated in 50 ohms when used with instrumentation such as oscilloscopes & recorders.

**Amplifier frequency response:** DC to 1MHz  $\pm 3\%$ , to 10MHz  $\pm 10\%$  (1dB), to 20MHz -3dB.

**Power supply:** AC line or rechargeable battery providing 24 hours under full load and up to 40 hours, quiescent conditions.

**Size:** 8" X 5" X 5". Rugged all metal, fully shielded case.

**Weight:** 5.5 lbs. including rechargeable battery.



#### APPLICATIONS

The VMD2A meter can be used alone for voltage measurement, from 0.00001V to 1000V, or in combination with the Ross Engineering Corp. 0.01% or 0.1% high voltage probes and voltage dividers. The following matched systems are available up to 1,000,000 volts:

##### \*5KV to 400KV: WITH HV PROBE

DC and 50 or 60Hz - Resistance coupled probe.

DC to over 10MHz - Resistance-capacitance compensated probe for wide-band performance.

##### \*5KV to 1,000KV: WITH HIGH VOLTAGE DIVIDER

DC up to 10MHz - Resistance-capacitance compensated voltage divider for wide-band performance.

The probes and voltage dividers can be matched to the VMD2A and/or many other types of instrumentation or computers.

These systems are specifically designed to provide maximum accuracy and safety for measurements of low power electronic systems, high power industrial installations and high voltage power lines. OSHA and power class safety factors are provided. The HV power class impulse rated probes and dividers have at least 2 to 1 safety factors for transient voltages above their continuous HV ratings.

##### Wide-band Fiber Optic and Coaxial Cable Transmission Systems

Available for transmitting the output of voltage dividers over coaxial cable, or over non-conductive fiber optic cables up to 1KM in length for greater isolation, operator safety and minimization of unwanted electrical noise pick-up or ground current distortion.



## ROSS ENGINEERING CORP.

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# HIGH VOLTAGE VOLTAGE DIVIDERS AND PROBES

VOLTAGE DIVIDERS  $\pm 0.01-0.1\%$ DC,  $\pm 0.2-3\%$ AC 50/60Hz,  $\pm 3-10\%$ DC-1MHz, specials through 30MHz



300KV-1000KV

30KV-240KV

30KV-240KV

10KV-30KV

1KV-5KV

15KV-400KV DC-1MHz PROBES

15KV-150KV DC, 50/60Hz PROBES

DC-10MHz  
4½ DIGIT  
0.01% DC, 0.1% AC  
MULTIMETER  
0.00001V-1000V TO  
1,000,000KV WITH VD.  
DC, AC RMS, PEAK,  
PULSE CAPTURE,  
100 NANoseconds

- DC UP TO 10MHz
- 1KV TO 1000KV DC OR PK AC
- TO 1500KV IMPULSE
- TO  $\pm 0.01\%$  DC ACCURACY
- TO  $\pm 0.2\%$  AC ACCURACY (50/60Hz)
- TO  $\pm 3\%$  DC-1MHz WIDEBAND
- COMPACT & LIGHT WEIGHT
- FOR OSCILLOSCOPES
- FOR RECORDERS
- FOR DIGITAL MULTIMETERS
- LOW CORONA
- RESISTIVE & CAPACITIVE
- COMPENSATED WIDEBAND
- INDOOR & OUTDOOR
- ELECTRONIC & POWER CLASS
- MATCHED WIDEBAND DIFFERENTIAL
- HV POWER QUALITY INSTRUMENTATION



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# APPLICATION DATA HIGH VOLTAGE VOLTAGE DIVIDERS AND PROBES

**CAUTION:** For best AC accuracy HV clearances should be a radius equal to twice the height of the unshielded divider. HV withstand clearance should be at least 1 inch (2.54cm) for each 5KV to 10KV for DC or peak AC (RMS x 1.414), to nearest HV or ground. Maximum operating voltages are limited by voltage withstand of internal components, external flashover withstand and temperature rise limits of types with resistive components. On lower resistance units, steady state DC and PK AC may be limited to less than the rated peak short time operating voltage. For withstand test purposes, an impulse rating is also given to indicate the safety factor for transients above rated maximum operating PK voltage which could occur unintentionally. Flashovers may destroy attached measuring and display equipment and endanger personnel associated with it. Therefore safety factors must be observed.

If in a confined area with proximity clearances marginal, the AC divider should be calibrated in place or in a simulated area. DC accuracy is not affected unless corona is present.

For best results when working with fast rise time pulses (particularly 10 usec or less) a single, common, system ground plane should be used at the base of the voltage divider. Display or recording equipment, cables attached to the output of the voltage divider, and personnel near the equipment should be isolated from conductive surfaces or leads with a minimum of capacitance to ground to prevent multiple ground returns which can distort the signal. Where output cable is longer than 20ft, or load is low impedance, Ross fiber optic transmission systems or cable driver 50 or 75 ohm matching amplifiers are available.

**Versatility, Wideband And High Accuracy:** Ross Engineering Corporation's lightweight, base-mounted high voltage dividers or hand-held probes are designed for use from 1KV to 1000KV with accuracies of 0.01 % to 3% DC, 0.2% to 10% AC with some model bandwidths to over 20MHz, or pulse to 10 nanosecond rise times. They can be used at any attitude and many are self-supporting up to 10G's shock. They are available in compensated resistance-capacitance types or uncompensated resistive or capacitive types. Applications include use with panel meters, recorders, digital voltmeters, oscilloscopes, or computers for viewing and recording DC, CW (Continuous Wave), AC, pulse, or modulated frequencies. They can also be used as simple, high-accuracy meter multipliers.

High voltage resistances are usually 2 megohms or 4 megohms per KV to minimize heating and voltage coefficients consistent with compact sizes. High Voltage resistances of 50 ohms or less and as high as 1000 megohms or more per KV are available. High voltage capacitance is usually maintained at low picofarad values to minimize circuit effects.

DC and 60Hz calibration is traceable to the N.I.S.T. Units are matched for 1 megohm, 20 to 50pF typical oscilloscope input impedance or other instrumentation impedances as required, with up to 20 feet (please specify length, the shorter the better for optimum frequency response) of RG59 coaxial cable or special Ross Engineering Corporation coaxial cable. For longer wide-band distances, fiber optic or 50 or 75 ohm coaxial transmission can be supplied for up to 1 kilometer or more. Ross's fiber optic transmission systems are ideal for full isolation to eliminate multiple ground paths or pick-up at the instrumentation level. High voltage terminations are designed for minimum corona. For units with ratings at very high voltage, additional corona and grading rings or toroids are utilized, further minimizing corona and maintaining proper voltage distribution. Insulating surfaces are sealed with anti-track, moisture-resistant material for further corona reduction and environmental protection.

Although the Ross voltage dividers can be ordered for use in oil or other atmosphere, the standard models are designed for use indoors or outdoors in air. Each model is hermetically sealed and filled with a non-toxic insulating gas at low pressure to exclude moisture. The high dielectric strength of the gas makes it ideal for use in voltage dividers. More desirable than heavy solid encapsulation, insulating gas minimizes internal corona by eliminating the possibility of isolated voids or bubbles which could occur if internal components were potted in solid material. Gas also eliminates the weight and less stable dielectric constants and losses of oil, other liquids, or solids, and allows easy dismantling for modification or repair if required. Ross can supply a gas refill kit if needed. See brochure B-1010 and B-1012-A for additional use with digital multimeter or digital panel meter. See brochure B-1020-B for fiber optic transmission systems, or B-1020 for coaxial cable drivers, and matching systems.

**Voltage Ratings:** Standard maximum operating voltages are from 3KV to 1000KV DC or PK AC, and to 1,500KV impulse, in steps of 2KV to 15KV. It should be noted that transient and intermittent single short pulse operating voltage can be 50% or more beyond the low frequency or DC steady-state rating, depending on the type of divider.

**Derating for CW RF:** With frequencies above 100KHz, steady state CW (Continuous Wave) voltage derating depends on the type of compensating capacitors and the type of insulation. Maximum RF voltage operation is

generally limited by dielectric heating of insulation, therefore, units with special insulation are available for CW at these higher frequencies. Please inquire about special insulation if your application may require its use.

See also "HV Divider and Probes proximity effects and HV clearances" Multimeters, Oscilloscopes, Power Quality Recorders, Fiber Optic Transmitters, 50 or 75 Ohm Matching Amplifiers and Instrumentation Systems: Ross Engineering Corporation can supply wide-band DC-1MHz fiber optic, or coaxial transmission DC to over 35MHz and matched recorder or display systems to provide you with a complete measurement or display system. Please see brochures: B-1010, B-1010-A, B-1012-A Digital Multimeters, B-1020 Matching Amplifiers and B-1020-B Fiber Optic Transmission Systems for more information on our transmission, display, and recorder systems.

**Accuracy and Stability:** Accuracy and stability in standard Ross voltage divider units is generally better than ±0.1% DC, ±0.5% 50/60Hz, and 3% to 10% to 1MHz-10MHz, at better than 30PPM/°C Temperature coefficient and 0.1 to 0.5PPM/V Voltage coefficient. Accuracies to 0.01% DC at less than 5PPMTC, low voltage coefficients and 0.2% AC or better (over specific frequencies) available on many models. See brochure B-1011-B.

Calibration charts related to N.I.S.T. can be furnished for each 10% or 20% Voltage Point to allow Correction factors to better than 0.1%, or better than 0.01% for the 0.01% types, Frequency charts DC-20MHz are available as well as temperature stability (drift) with warm-up time. Useful frequency response is generally DC to 5MHz (to 10MHz and up to 20MHz on some models) with 250 to 10 nanosecond rise times. Wide-band accuracy is generally better than 3% to 10% over the frequency range, but can be to 0.2% or better at some specific frequencies and with proper proximity or shielding. Phase shift is generally minimal below 100KHz for wide-band types and negligible at 60Hz.

For highest accuracy in high impedance, low input capacitance types, consideration must be given to induced voltage pick-up in leads, contact potential, corona, effective capacitance, and voltage gradient and capacitance shift related to proximity to high voltage sources, ground planes, walls, enclosures, and loads. Preferably the divider should be calibrated with the specific instrument being used and specific proximities if extreme accuracy is required. Greatest accuracy, particularly AC accuracy, is attained with proper ground plane and if maximum clearance to conductive materials, which can cause capacitance variation and corona. If available, user's proximity dimensions will be simulated when calibrating.

Maximum accuracy is centered around two-thirds to three-quarters of the DC or PK AC rating, unless otherwise requested. For higher frequencies, the lower capacitance, lower ratio models with shortest output cables have fewer resonances above 1MHz, but proximity effects are greater and must be considered for best AC accuracy and wave shape transfer. If larger diameters are allowable, special shields are available to eliminate proximity variations for extremely high accuracy AC or pulse wave shape requirements and to provide better voltage grading. Operating temperatures range from -80°C to +65°C ambient. Some units can be built to withstand up to +75°C ambient and vibration and shock of up to 50G's or more.

**Ratio and Loading:** In the standard 1000/1 or 10,000/1 Ross voltage dividers the low voltage capacitors and resistors are selected to provide correct ratios when shunted by 1 megohm, 20-50pF oscilloscope (or other load), plus 2, 3, 6, 15, or 20 feet (please specify the shortest practicable length) of low capacitance RG59 or special Ross Engineering Corporation coaxial cable unless otherwise required. Standard cable lengths are 3 or 6 feet for 15KV or 30KV dividers, 15 feet for dividers above 30KV. For the compact types, with metal oxide resistors, DC ratio is generally stable within better than 0.1% to 1% in an operating range of over 80 degrees C ambient temperature change for most models, and even better than 3-5 PPM/°C (0.0003%) for most high accuracy types. In 0.1% dividers with less than 4 megohms per KV, units can drift up to 0.1% - 0.3% as they warm up when used continuously at maximum rating, less at below maximum rating. However, repeatability remains at 0.1% after stabilizing. The actual voltage divider ratio is determined by the following formula:

$$N = \frac{R_1 (1 + \omega^2 C_2^2 R_2^2)^{1/2}}{R_2 (1 + \omega^2 C_1^2 R_1^2)^{1/2}} + 1$$

$N =$  voltage ratio     $R_2 =$  low end effective res.  
 $\omega =$  2PIf     $C_1 =$  high end effective capacitance  
 $R_1 =$  high end res.     $C_2 =$  low end effective capacitance

If the high voltage input resistance is high and the HV capacitance and ratio selected are low, normal external and added load capacitance including coaxial cable and resistance of many display or recording devices can seriously affect the ratios. The relationships in the ratio formula will indicate where and to what extent low frequency response or ratio becomes affected. Special ratios, capacitances, and resistances are available to satisfy most matching problems, however output cable length and instrumentation load must always be considered.



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# WIDEBAND VD SERIES

These compact, high impedance resistance-capacitance type high voltage dividers are frequency compensated from DC to above 1MHz, some to 5, 10 and 20MHz. They have properly matched resistive and capacitive elements, and retain excellent accuracy under fixed or portable applications. Each can be used when matched with proper frequency response panel meter, power quality recorder, digital multimeter, or oscilloscope for measuring, viewing, or recording DC, AC, pulse, and modulated frequencies (see brochure B-1010 and B-1012).

Most units are designed for indoor use in air, however, special units are available for use in oil, other atmospheres, or outdoors. For fast rise time, low duty cycle and high power pulse work, low HV impedances of 50Ω to 10KΩ are available. Special extra high accuracy 0.01% DC with less than 5PPMTC (0.0005%) or 0.2% AC or better (with special external shielding) units are available. Calibration charts are supplied.

TYPICAL UNITS - MANY OTHERS AVAILABLE BASE MOUNTED RESISTANCE - CAPACITANCE TYPE, COMPENSATED WIDEBAND										
MODEL +	MAXIMUM OPERATE **DC OR PK 60Hz CONTINUOUS WITHOUT COOLING STD 2 OR 4MΩ OR MORE PER KV	*RATIO ACCURACY, SPECIFIED CONDITIONS AND PROXIMITY, WITH CAL CHART			*NORMAL FREQUENCY RANGE	ELECTRONIC CLASS MAX TEST IMPULSE 1X50μSEC PULSE	STANDARD NOMINAL HV INPUT **IMPEDANCE			***STANDARD RATIO TO LOAD OF 1MΩ 50pF AND SPECIAL ROSS COAXIAL RG59 CABLE. 6' TO 30KV, 15' ABOVE 30KV
		DC %	60Hz AC%	STABILITY %			RESISTANCE MEG OHMS		NOMINAL CAPACITANCE PF	
							2M/KV	4M/KV		
VD5-15-DH-	5KV	0.1	0.5	0.1	DC-5MHz	10KV	10	20	15	1,000/1
VD15-8.3-A-	15KV	0.1	0.5	0.1	DC-5MHz	30KV	30	60	8.3	1,000/1
VD30-12.5-A-	30KV	0.1	0.5	0.1	DC-5MHz	45KV	60	120	12.5	1,000/1
VD30-8.3-A-	30KV	0.1	0.5	0.1	DC-5MHz	60KV	60	120	8.3	1,000/1
*VD30-4.1-A-	30KV	0.1	1	0.1	DC-5MHz	60KV	60	120	4.1	1,000/1
VD45-8.3-A-	45KV	0.1	0.5	0.1	DC-2MHz	90KV	90	180	8.3	1,000/1
VD50-8.3-AC-	50KV PULSE	0.1	0.5	0.1	DC-5MHz	60KV	100	200	8.3	1,000/1
*VD50-4.1-AC-	50KV PULSE	0.1	1	0.1	DC-5MHz	60KV	100	200	4.1	1,000/1
VD60-12.5-B-	60KV	0.1	0.5	0.1	DC-2MHz	120KV	120	240	12.5	1,000/1
VD60-6.2-B-	60KV	0.1	0.5	0.1	DC-2MHz	120KV	120	240	6.2	1,000/1
VD60-6.2-A-	60KV	0.1	0.5	0.1	DC-2MHz	120KV	120	240	6.2	1,000/1
VD75-10-C-	75KV	0.1	0.5	0.1	DC-1MHz	150KV	150	300	10	1,000/1
*VD75-5-A-	75KV	0.1	1	0.1	DC-1MHz	150KV	150	300	5	1,000/1
*VD75-5-C-	75KV	0.1	1	0.1	DC-1MHz	150KV	150	300	5	1,000/1
VD90-8.3-A-	90KV	0.1	1	0.1	DC-1MHz	180KV	180	360	8.3	1,000/1
*VD90-8.3-B-	90KV	0.1	1	0.1	DC-1MHz	180KV	180	360	8.3	1,000/1
*VD90-8.3-C-	90KV	0.1	1	0.1	DC-1MHz	180KV	180	360	8.3	1,000/1
VD120-12.5-B-	120KV	0.1	0.5	0.1	DC-1MHz	240KV	240	480	12.5	1,000/1
VD120-12.5-T-	120KV	0.1	0.5	0.1	DC-1MHz	240KV	240	480	12.5	1,000/1
VD120-12.5-C-	120KV	0.1	0.5	0.1	DC-1MHz	240KV	240	480	12.5	1,000/1
VD120-6.2-A-	120KV	0.1	1	0.1	DC-1MHz	240KV	240	480	6.2	1,000/1
*VD120-3.1-A-	120KV	0.1	1	0.1	DC-1MHz	240KV	240	480	3.1	1,000/1
*VD120-3.1-B-	120KV	0.1	1	0.1	DC-1MHz	240KV	240	480	3.1	1,000/1
*VD120-3.1-T-	120KV	0.1	1	0.1	DC-1MHz	240KV	240	480	3.1	1,000/1
*VD120-3.1-C-	120KV	0.1	1	0.1	DC-1MHz	240KV	240	480	3.1	1,000/1
VD150-10-C-	150KV	0.1	0.5	0.1	DC-1MHz	280KV	300	600	10	1,000/1/10,000/1 ●
VD150-10-T-	150KV	0.1	0.5	0.1	DC-1MHz	280KV	300	600	10	1,000/1/10,000/1 ●
*VD150-2.5-B-	150KV	0.1	2	0.1	*DC	280KV	300	600	2.5	1,000/1/10,000/1 ●
*VD195-7.7-B-	195KV	0.1	1	0.1	DC-1MHz	350KV	390	780	7.7	1,000/1/10,000/1 ●
*VD195-7.7-C-	195KV	0.1	1	0.1	DC-1MHz	350KV	390	780	7.7	1,000/1/10,000/1 ●
VD225-40-T-	225KV	0.1	1	0.1	DC-1MHz	400KV	450	900	40	1,000/1/10,000/1 ●
VD240-37-C-	240KV	0.1	0.5	0.1	DC-1MHz	450KV	480	960	37	1,000/1/10,000/1 ●
VD240-6.2-C-	240KV	0.1	2	0.1	DC-1MHz	450KV	480	960	6.2	1,000/1/10,000/1 ●
*VD240-1.5-B-	240KV	0.1	5	0.1	*DC	450KV	480	960	1.5	1,000/1/10,000/1 ●
*VD240-1.5-C-	240KV	0.1	3	0.1	*DC	450KV	480	960	1.5	1,000/1/10,000/1 ●
VD300-30-D-	300KV	0.2	1	0.2	DC-1MHz	550KV	600	1200	30	1,000/1/10,000/1 ●
*VD300-1.2-D-	300KV	0.2	3	0.2	*DC	550KV	600	1200	1.2	1,000/1/10,000/1 ●
VD450-40-D-	450KV	0.5	2	0.3	DC-1MHz	850KV	900	1800	40	1,000/1/10,000/1 ●
VD450-40-T-	450KV	0.5	2	0.3	DC-1MHz	850KV	900	1800	40	1,000/1/10,000/1 ●
VD450-20-D-	450KV	0.5	3	0.3	DC-1MHz	850KV	900	1800	20	1,000/1/10,000/1 ●
VD900-20-D-	900KV	0.5	3	0.5	DC-1MHz	1,450KV	1,800	-	20	1,000/1/20,000/1 ●
VD900-20-T-	900KV	0.5	3	0.5	DC-1MHz	1,450KV	1,800	-	20	1,000/1/20,000/1 ●
VD1000-18-T-	1,000KV	0.5	3	0.5	DC-1MHz	1,550KV	2,000	-	18	1,000/1/20,000/1 ●

- \* Many units will have frequency response better than ±3% to ±10% over the normal frequency range specified, but some units will only meet a ±3dB specification. Some units can have better high frequency response if a wider tolerance (chart correctable) at 50 or 60Hz can be tolerated. Extended frequency response may require a different coaxial cable, a top grading shield and sometimes a bottom shield also. Optimum response may require a small accessory box at one end or both ends of the coaxial cable. Some units can meet ±3% to 20MHz by using some or all of the above solutions. Low frequency response and proximity effects can be improved by using higher input capacitance but with the possibility of increased resonance at lower than normal frequencies, (requiring special filters at additional cost) or by greater shielding, by limiting proximity of conductive materials, and by calibrating in place with proper matching. Units with lower input capacitance normally have fewer resonances and may be more desirable and still sufficiently accurate for most applications if proximity rules are observed. Calibration correction charts and certification to NIST standards are supplied.
- \*\* Other input resistances and ratios are available. 2MΩ per KV and 4MΩ per KV are standard which will allow continuous DC operation without excessive heating and drift at PK rating. 1MΩ per KV is an option, but continuous DC or AC is limited to 1/2 the PK rating. Over 1,000 megohms per KV is available for minimum circuit loading. DC to 1MHz fiber optic system for complete isolation, or 50 or 75 ohm coaxial cable matching battery/AC operated amplifiers and transmission systems are available for driving coaxial cables longer than 20ft, or low impedance loads. Ross standard fiber optic systems are suitable to 1 kilometer at 1MHz.
- \*\*\* Special ratios, loads, and cable lengths and types may be specified. For optimum frequency response the coaxial cable should be as short as practicable. For distances of over 20ft a fiber optic system or a 50-75 ohm impedance cable driver will normally improve the overall frequency response with long cables. Loads with low impedance require higher ratios.
- Optional Std. ratios. Lower ratios may not be feasible depending on load impedance. 1000/1 is commonly used with 10 Megohm input digital meters, with a 2/1 to 10/1 additional accessory box to make 2,000/1 to 10,000/1 into a 1 Megohm oscilloscope.
- + 'A' models are minimum size. 'B' models are larger size, 'C' and 'D' models are largest and have extensive voltage grading, external shielding, and large corona shields for minimum corona also to minimize proximity sensitivity and have better frequency accuracy. '-T' models are weatherproof outdoor units with high strength stack-able skirted housings. Most units are hermetically sealed and also filled with low pressure insulating gas to minimize moisture and corona, although most can be filled with dry air or nitrogen if necessary, and are generally safe to use even if the insulating gas pressure is zero, as long as no moisture is allowed to enter.

RF current is limited by dielectric heating effects. With special insulation and components, allowable CW RF voltage and current can be higher. Low duty cycle pulse currents can be considerably higher, within the limits of PK operating voltage and frequency.

Specifications are for reference only and are subject to change. Contact Ross Engineering Corporation for current dimensions.



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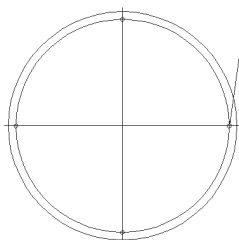
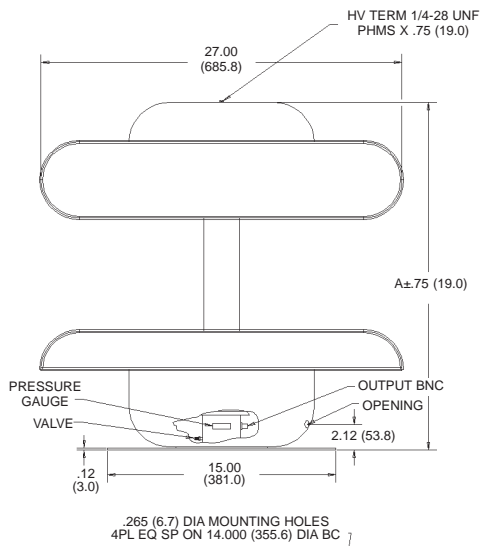
TYPE 4

VD150-C



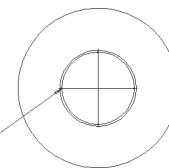
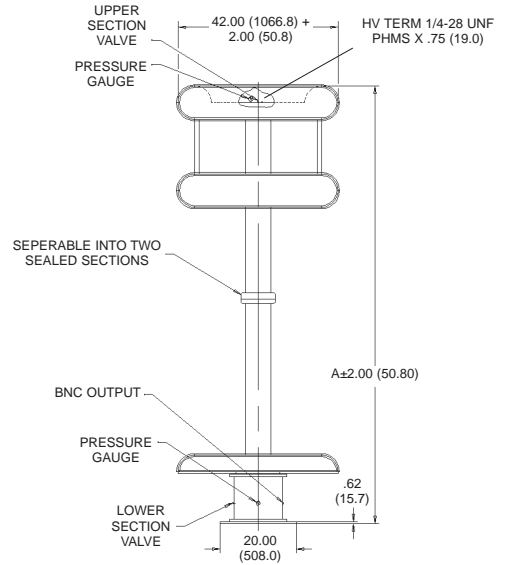
TYPE 6

VD450-D



TYPE 4

INCHES  
(MILLIMETERS)



TYPE 6

.390 (9.9) DIA MOUNTING HOLES  
4PL EQ SP ON 19.250 (488.90) DIA BC  
LARGER BASES AVAILABLE



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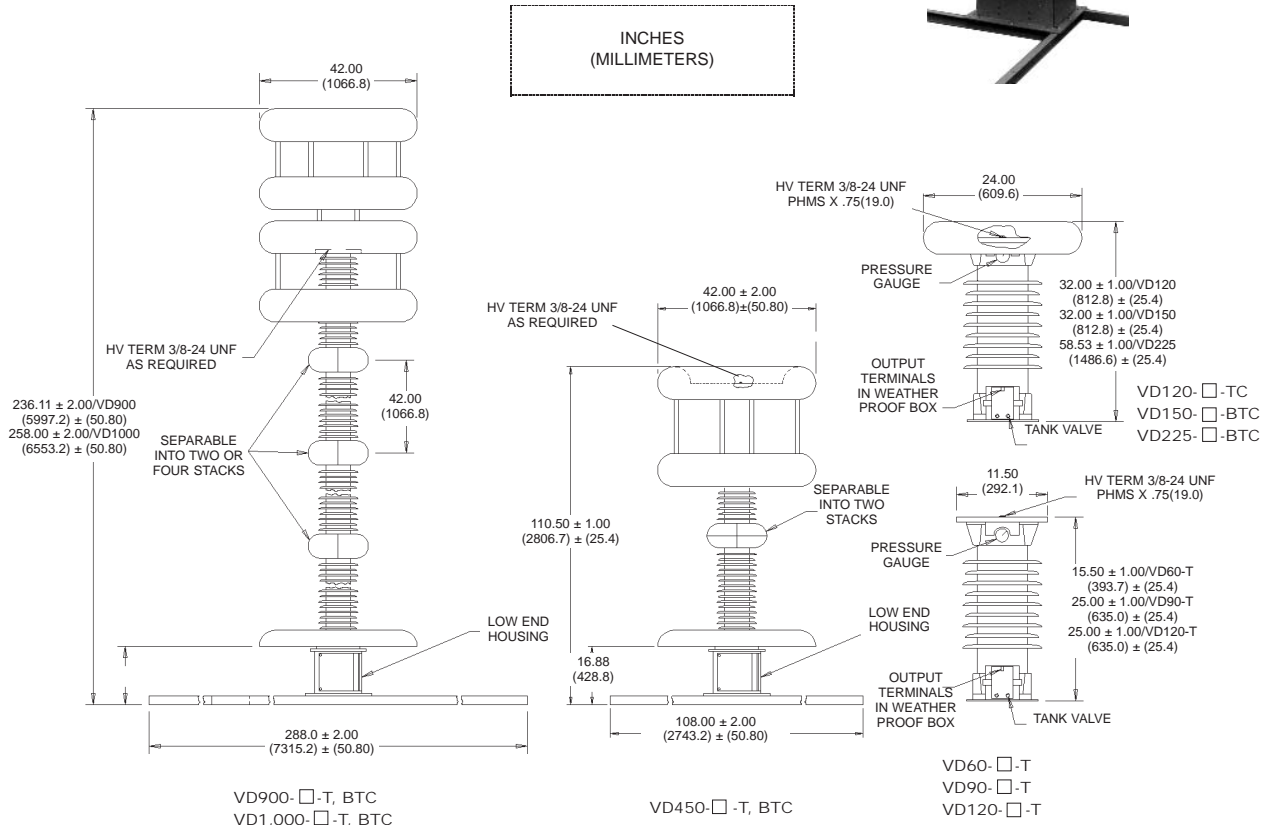
# OUTDOOR VD SERIES

These models are designed to be weatherproof for indoor/outdoor use up to 1000KV DC or AC PK. They are compensated resistance-capacitance wideband DC to 1MHz and are balanced to provide safe voltage gradients with low capacitance, better high frequency accuracy (if calibrated for proximity effects), and low corona. The use of low-loss precision ceramic capacitors and exceptionally stable metal film or wire wound resistors results in stability and accuracies of 0.01% to 3% with temperature coefficients typically less than 3 PPM/°C to 40 PPM/°C and voltage coefficients from very low to zero.

Applications include use with panel meters, power quality recorders, digital voltmeters, oscilloscopes or computers to measure, view and record DC, AC, transient pulse or pulse train and modulated CW. Ross Engineering Corp. dividers can be used in conjunction with Ross Engineering Corp. AC or AC/battery operated fiber optic systems or 50 or 75 ohm matching amplifier/coaxial cable drivers to create complete DC to 1MHz (or more) wideband systems for driving long fiber optic or coaxial cables. Fiber optics are particularly desirable to eliminate ground current return, pick-up and isolation problems, although Ross Engineering Corp. coaxial cable drivers provide considerable isolation between source and load also.



VD900-T



\* ENCLOSED OPTIONAL COAXIAL OR FIBER OPTIC DRIVER / TRANSMITTER



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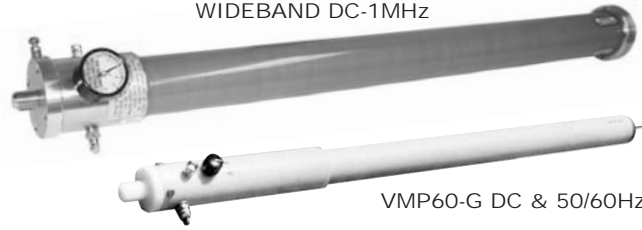


# VMP PROBE SERIES

(Please see also digital multimeter and VM probes brochure B-1010 or B-1012-A for multiple match and multiple ratio to match digital voltmeters and accessories.) The Ross VMP HV probes are designed for hand-held portable applications with insulated handle, or mounting in a fixed position. The portable capacitive, resistive, or compensated types are used with digital multimeters, oscilloscopes, and various types of panel meters. Resistive types are used primarily for DC and 50 or 60Hz AC or other specific single frequency sine wave, while the capacitive types are used for wideband and pulse work. Compensated resistance/capacitance wideband DC to 1MHz (or more) models are preferred for general use in both the VMP and VD Series.

Standard calibration is centered around 2/3 to 3/4 of the maximum rating and is matched for 1 megohm, 20 to 50pF or 10 megohms 75-100pF of load input impedance of display or recording device and optional 3, 6, or 15 feet (please specify the shortest practicable length) of RG-59 or special Ross Engineering Corporation

VMP200A  
WIDEBAND DC-1MHz



VMP60-G DC & 50/60Hz

coaxial cable. Fiber optic system or 50-75 ohm matching amplifier/coaxial cable driver is recommended for wide-band transmission over 20 feet. Any type can be calibrated with best accuracy and specified stability at specific frequencies, voltages and loads within their capabilities. Unless rules of shielding and proximity are followed, VMP series models may not be as accurate as the VD models due to wider variation in possible proximity of walls, equipment, etc. Other ratios and matchings are available.

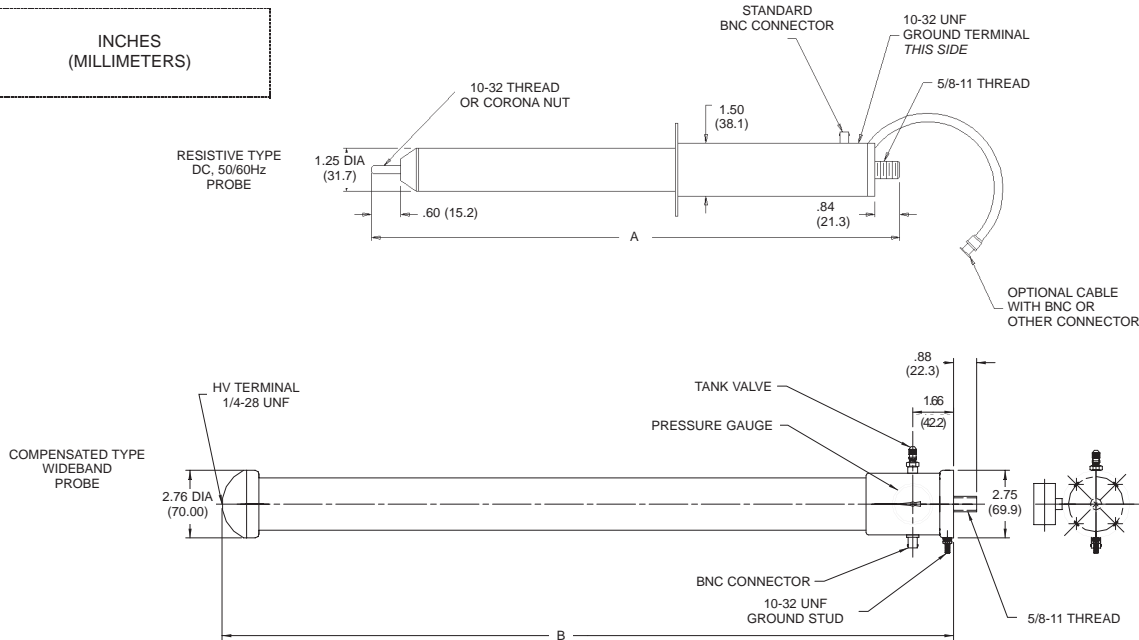
SEE BROCHURE B-1012-A FOR INSULATED HANDLES FOR HAND HELD REQUIREMENTS.

TYPICAL UNITS - MANY OTHERS AVAILABLE		SPECIFICATIONS							HV PROBE TYPE VOLTAGE DIVIDER OR SERIES MULTIPLIER							
● MODEL		● KV MAXIMUM OPERATE CONTINUOUS		* ACCURACY ±%			NORMAL FREQUENCY RANGE	● KV MAXIMUM IMPULSE 1.2X50 uSEC TEST SINGLE PULSE	NOMINAL HV INPUT		** STANDARD RATIO TO LOAD AND 15' SPECIAL ROSS COAX CABLE.		+ RECOMMENDED MINIMUM ALLOWABLE HANDLE LENGTH IN FEET INCLUDING HAND HOLD			
MODEL ELECTRONIC CLASS	MODEL POWER CLASS	ELEC-TRONIC CLASS DC OR PK AC	POWER CLASS RMS L-L	* KV BEST ACCURACY	DC %	*50 OR 60Hz %			* WIDE-BAND %	RESISTANCE MEGOHMS	CAPACITANCE PF NORMAL	LOAD		OSHA MIN. CLEAR-ANCE	RECOM-MENDED LENGTH	NOM. POWER CLASS
VMP30E-G	VMP15-G	30KV	5KV	20KV	.1	1	-	DC, 50/60Hz	60KV	300	RES ONLY	1,000/1	1,000/1	27"	31" - 47"	6'-9"
VMP30EA-25Y-H	VMP15-25Y-H	30KV	5KV	20KV	.1	1	3dB	DC-1MHz	60KV	300	25	1,000/1	1,000/1			
VMP60E-G	VMP30-G	60KV	8.25KV	45KV	.1	1	-	DC, 50/60Hz	120KV	600	RES ONLY	1,000/1	1,000/1	34"	48" - 54"	7.5' - 9'
VMP60EA-12.5Y-H	VMP30-12.5Y-H	60KV	8.25KV	45KV	.1	1	3dB	DC-1MHz	120KV	600	12.5	1,000/1	1,000/1			
VMP90E-G	VMP60-G	90KV	25.8KV	60KV	.1	1	-	DC, 50/60Hz	150KV	900	RES ONLY	1,000/1	10,000/1	34"	48" - 54"	7.5' - 9'
VMP90EA-8.3Y-H	VMP60-8.3Y-H	90KV	25.8KV	60KV	.1	1	3dB	DC-1MHz	150KV	900	8.3	1,000/1	10,000/1			
VMP120-G		120KV	38KV	80KV	.1	1	-	DC, 50/60Hz	200KV	1200	RES ONLY	1,000/1	10,000/1	38"	50" - 57"	
VMP120A-6.2Y-H		120KV	38KV	80KV	.1	1	3dB	DC-1MHz	200KV	1200	6.2	1,000/1	10,000/1			
VMP150-G		150KV	48KV	100KV	.1	1	-	DC, 50/60Hz	250KV	1500	RES ONLY	1,000/1	10,000/1	50"	64" - 611"	
VMP150A-10Y-H		150KV	48KV	100KV	.1	1	3dB	DC-1MHz	250KV	1500	10	1,000/1	10,000/1			
VMP200A-7.6Y-H		200KV	72KV	150KV	.1	1	3dB	DC-1MHz	300KV	1950	7.6	1,000/1	10,000/1	70"	84" - 811"	
VMP250A-6.2Y-H		250KV	95KV	187KV	.1	2	3dB	DC-1MHz	400KV	2400	6.2	1,000/1	10,000/1	70"	84" - 811"	
VMP300A-5Y-H		300KV	121KV	225KV	.2	3	3dB	DC-1MHz	500KV	3000	5	1,000/1	10,000/1	70"	84" - 811"	
VMP400A-3.8Y-H		400KV	145KV	300KV	.2	5	3dB	DC-1MHz	600KV	3900	3.8	1,000/1	10,000/1	110"	124" - 1211"	

- \* With proper proximity of nearby conducting surface and test point size. Accuracy can be improved by calibrating with known proximity. Accuracy is at 2/3 to 3/4 of max rating unless otherwise required. Calibration points are every 10 to 20% and are included with instruction manual. Other calibration points are optional.
- \* Some probes are subject to limits on frequency, and proximity of HV and conductive surfaces, to obtain stated accuracies.
- \*\* Most standard models are single ratio, single or dual load matching to oscilloscope or DMM. Higher input resistance or capacitance and other ratios available including multiple matching and multiple ratios.
- Power class is rated on the basis of 3 phase line to line and BIL (basic impulse level) with high safety factor. Electronic class is rated on max continuous operate without overheating, but with less safety factor. Impulse is a test rating only.

- + Handle length includes handhold of 12" to 24" based on OSHA regulations. See OSHA Title 8, Page 390, Table 2940.2.
- Insulating handles and heavy superflex insulated ground leads are available. See brochure B-1010, B-1012, and B-1017 for additional information on handles, digital probes and digital displays.
- Note: Change -H to -J and -G to -GJ if insulated handles are required. See B-1012A or B-1017B for recommended handle lengths.
- Specifications are for reference only and are subject to change. Contact Ross Engineering Corporation for current dimensions.

INCHES  
(MILLIMETERS)

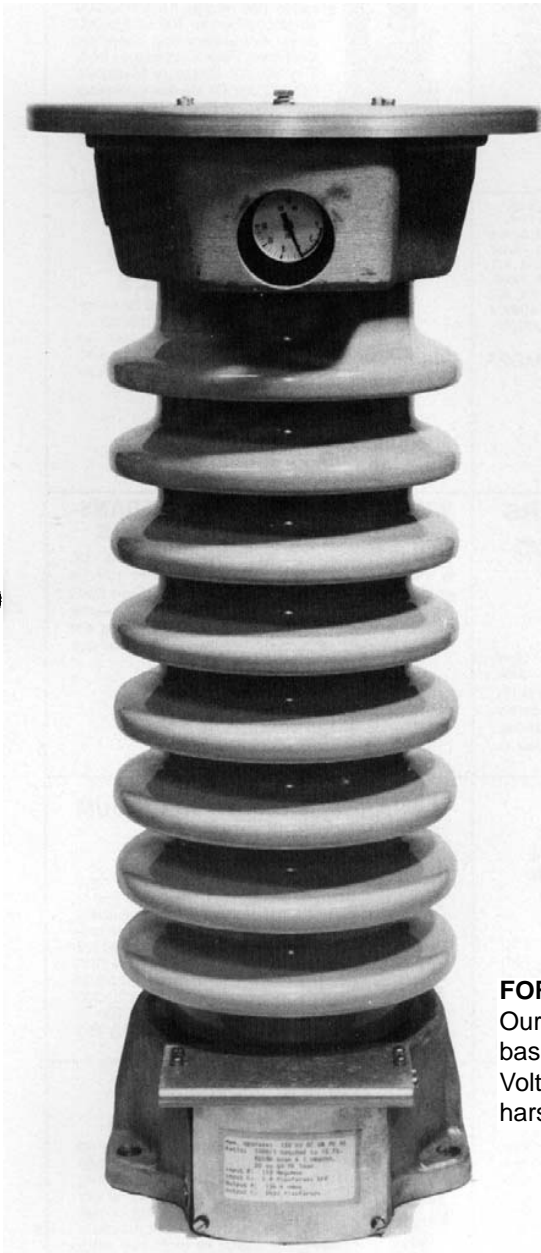


DIMENSIONS		
MODEL	A	B
VMP 15-G	12.09 (307.0)	-
VMP 15-25-H	-	8.91 (228.3)
VMP 30-G	16.75 (425.4)	-
VMP 30-H	-	12.91 (327.9)
VMP 60-G	24.00 (609.6)	-
VMP 60-H	-	16.95 (430.5)
VMP 120-G	31.50 (800.1)	-
VMP 120-H	-	21.12 (536.9)
VMP 150-G	56.5 (1,435.1)	-
VMP 150-H	-	24.68 (626.8)
VMP 200-H	-	30.53 (775.4)
VMP 250-H	-	33.50 (850.9)
VMP300-H	-	43.46 (1103.8)
VMP 400-H	-	-

# HIGH VOLTAGE DIVIDERS

**POWER CLASS  
INDOOR / OUTDOOR  
STACKABLE**

DC-5MHz WIDEBAND  
ENVIRONMENT RESISTANT  
OPERATE TO 900KV PK AC/DC  
600V TO 345KV RMS POWER CLASS  
20KV TO 1300KV BASIC IMPULSE LEVEL  
POWER QUALITY RECORDING & MEASUREMENT



With over 30 years experience in DC, AC, and Wideband Voltage Divider design, manufacturing, and testing behind us, Ross Engineering Corporation is offering Outdoor and Indoor Voltage Dividers with linear frequency response from DC to over 5MHz. These units extend our existing line of 15KV PK to over 900KV PK compensated resistance/capacitance Wideband Voltage Dividers to include major outdoor applications such as power quality and line disturbance monitoring.

We have designed our Voltage Divider housings to withstand harsh outdoor conditions. To assure an environmental resistant enclosure, high voltage components are hermetically sealed in porcelain housing sections with an extra long external creep distance. The enclosure is then pressurized with insulating SF6 gas, increasing the internal insulation and minimizing corona although they are safe to full voltage even if gas pressure is lost. Convenient sections may (if applications require) be stacked for portable or fixed use to over 900KV AC PK or DC operate.

Applications for these units include: Outdoor Power line, DC, or AC measurement, transient and harmonic detection, for power quality measurement and recording. Industrial power supply monitoring and HV Pulse Display to 0.25 microsecond or better rise time are also possible with the Ross Dividers. Standard ratios are 1,000 and 10,000 to 1, or 120V output for any line to ground voltage with other ratios available. Designs are available to match most loads. Standard accuracy is held to 0.2% DC, 0.5% to 3% AC. Accuracies to 0.01% DC are available. 75ohm coaxial cable signal transmission is standard matching coaxial cable driver is available.

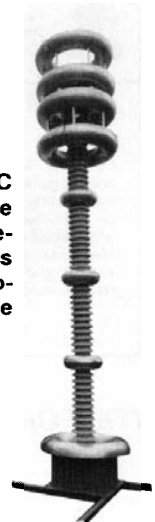
Fiber Optic transmission to eliminate long coaxial cables and ground current is available as an option. Please specify the line to ground, or line to line operating voltage, the basic impulse level, the ratio, DC and AC accuracy, type of output signal transmission and distance desired, and the instrumentation load impedance both resistance and capacitance to ground, and type of load when ordering.

Please refer to Ross Engineering Corporation Brochure No. B-1011 for application data and dimensions for our outdoor 30, 60, 120, 225, 450, 675, and 900 KV peak models. For dimensions on other Outdoor Voltage Dividers, please inquire.

## FOR EXAMPLE:

Our 2 foot tall, 120 KV PK AC or DC, 200KV basic impulse level High Voltage Outdoor Voltage Divider (left) is designed to be used in harsh outdoor conditions.

Our 18 foot tall, 900 KV PK AC or DC 1350KV basic impulse level High Voltage Outdoor Voltage Divider (right) is designed to be environment resistant and is comprised of 4 separable stacked components. Corona reduction toroids and base supports have been added.



**ROSS ENGINEERING CORP.**  
CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182



# 1KV TO 900KV MEASUREMENT

B-1011-B

**EXTRA HIGH ACCURACY**  
**0.01% DC, 0.1% 50/60Hz**  
**WIDEBAND TO 10MHz (3dB).**  
**HIGH VOLTAGE DIVIDERS,**  
**PROBES, METER MULTIPLIERS,**  
**AND VOLTMETERS.**

SEE OTHER BROCHURES FOR STANDARD  
0.1% DC 0.5% AC, WIDE-BAND UP TO 10MHz

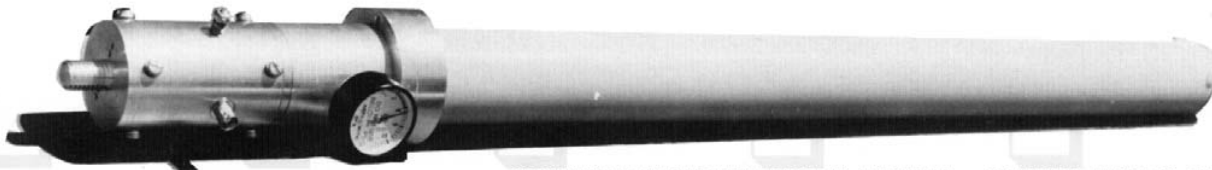


0-1,000V  
WIDEBAND  
DIFFERENTIAL  
MULTIMETER  
DC-10MHz  
WITH MATCHING  
AMPLIFIER  
DC-20MHz  
0-4V PK-PK OUTPUT  
INTO 50Ω LOAD  
BATTERY POWERED.

FOR USE WITH HV PROBES & VOLTAGE DIVIDERS



120 KV OPERATE.  
WIDEBAND DC-5MHz  
HV VOLTAGE DIVIDER  
OTHERS  
1KV TO 900KV



200KV WIDEBAND HV PROBE DC-5MHz. OTHERS 5KV TO 400KV.

## APPLICATION DATA

Ross Engineering Corporation's line of lightweight, base-mounted High Voltage Dividers and High Voltage Probes are designed for use from 1KV to 900KV PK with accuracies of 0.01% to 0.2% DC, 0.2% to 3% 50Hz-400Hz and 3% to 3db wide-band at frequencies from DC to over 5MHz or pulse to 10 nanosecond rise times in some models. This special extra high DC accuracy line is accurate to 0.01% DC and 0.2% to 1% 50Hz to 400Hz, to 3% wide-band DC to 1MHz useful up to 10MHz. Both the standard accuracy and these extra high DC accuracy dividers can be used in any attitude and many are self-supporting up to 10G, shock, higher if supported. They are available in resistive types and in wide-band compensated resistance-capacitance types. Applications include use with panel meters, recorders, digital voltmeters, oscilloscopes or computers for accurate viewing and recording of DC, AC, CW, pulse or modulated frequencies. They are available for both indoor and weatherproof outdoor use.

### WIDEBAND DIGITAL MULTIMETERS:

0.01% DC, 0.1% 50/60Hz, true RMS, true PK, Avg, battery powered, 4 1/2 digit multimeter model VMD2A. See brochure B-1010, B-1010-A. 1/2 sine pulse capture + hold to 10MHz. Includes matching amplifier for 50 ohm load or coaxial cable, DC-20MHz.

### HV INPUT RESISTANCE:

In the standard divider, high voltage resistance is usually 2MΩ to 4MΩ per KV at maximum rated operating voltage to minimize heating and voltage coefficients. Lower resistances and higher resistances at reduced accuracies are available.

### LOW INPUT CAPACITANCE:

High voltage capacitance is at low picofarad values to minimize AC circuit loading, resonances and peaking, yet maintain safe AC or transient voltage gradients.

### TRACEABLE TO NIST:

Calibration is traceable to the National Institute of Standards and Technology, and is generally matched for loads of 1MΩ, 20 to 50pF or 10MΩ, 75-100pF input impedance instrumentation, with 2 to 15ft of low capacitance coaxial cable.

### ISOLATING WIDEBAND AMPLIFIERS:

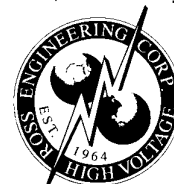
Matching amplifiers DC-35MHz, 0.5V to 1000V single or differential input, 0-12V PK-PK output into 75 ohms.

### WIDEBAND FIBER OPTIC TRANSMISSION SYSTEMS:

Fiber Optic systems. Accurate, Stable FM type. DC to 1MHz.

**ROSS** ENGINEERING CORP.

CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182



### LONG DISTANCE FIBER OPTIC TRANSMISSION:

For longer distances beyond 15ft approximately, especially with extra HV isolation requirements or wide-band requirements over 5KHz, fiber optic transmission can be supplied for up to 1 kilometer without repeaters. Ross Engineering's fiber optic transmission systems at  $\pm 10$  volts (20V<sub>PK-PK</sub>) with 0.2% DC, 0.5% 50Hz-400Hz, 3% to 1MHz wide-band accuracy are ideal for full isolation to provide high voltage safety and to eliminate multiple ground paths or pick-up at the instrumentation level.

### FOR EXTRA HIGH ACCURACY AND STABILITY:

0.01% DC accuracy types are more limited in resonance free band width than 0.1% types, generally being DC to 1MHz instead of the DC to 5MHz or more for most 0.1% DC accuracy units. 0.1% DC units have in the order of 20-25PPM per degree C temperature coefficient and less than 0.1PPM/volt voltage coefficients. Extra high accuracy types have much lower temperature and voltage coefficients, being in the order of 1 to 5 PPM/°C temperature coefficient (0.0001% to 0.0005% per degree C). 0.01% DC and 0.5% to 3% AC units may be used without full shielding if proximity rules are observed, but for higher AC accuracy full shielding is used to obtain accuracies better than 0.5%. Calibration correction charts are provided for all dividers and probes, increasing the accuracy even more if the correction factors are applied to readings.

### ACCURACY CONSIDERATION:

For highest accuracy in high impedance low input capacitance types, consideration must be given to induced voltage pick-up in leads, corona, effective capacitance, and voltage gradient and capacitance shift related to proximity to ground planes, walls, enclosures, and equipment. Load resistance, and contact potential in cable connectors and switches must also be considered for DC. Both load resistance and capacitance in cables and loads must be considered for AC. The divider should be calibrated with the specific instrument to be used or at least the accurately simulated load, and also with accurately simulated proximity to ground planes, walls and nearby equipment if extreme AC accuracy is required for unshielded or partially shielded dividers. Fully shielded dividers for AC are available but are much larger and heavier. Absolute maximum accuracy is usually centered around 2/3 of maximum DC or PK AC voltage rating unless otherwise required. Certified calibration charts are supplied for approximately 10% to 20% steps from 10% to 100% rated PK operating voltage.

### MAXIMUM CLEARANCE RECOMMENDED:

Greatest accuracy, particularly AC accuracy, is attained if maximum clearance of conductive materials, which can cause capacitance variation and corona, is maintained surrounding the divider. For AC accuracies better than 10% if space is critical or ground planes are remote, or if used in oil, users proximity dimensions should be simulated when calibrating. HV leads should be brought in vertically and no larger in diameter than necessary to prevent corona. Satisfactory AC accuracy can usually be obtained without complete shielding by clearances approximating an inverted cone or a cylinder with a height of 1.5 times, and a base plane diameter of at least twice, the height of the divider, particularly if moderately large grading or corona shields are present on both top and bottom of the divider.

### LOW CAPACITANCE AND LOW RATIOS TO MINIMIZE RESONANCES:

For higher frequencies the lower capacitance, lower ratio models have fewer resonances, but proximity effects are greater for low capacitance, and output loading effects are greater for lower ratios, therefore they must be balanced for best accuracy and wave shape transfer. If much larger voltage divider total diameters are allowable, special grounded shields are available to minimize proximity variations for extremely high accuracy AC or pulse wave shape requirements.

### OPERATING AMBIENT TEMPERATURES AND OTHER ENVIRONMENT:

Operating temperatures range from -80 degrees C to + 50 degrees C ambient. Some units can be built to withstand up to + 75 degrees C ambient and vibration and shock of up to 50G's or more. All units are salt spray and corrosion resistant. For extreme moisture and weatherproofing, units with skirted porcelain housings are available. Most units are hermetically sealed, and pressurized with an insulating gas which also allows for easy leak checking. Units are designed to operate even if the gas pressure is lost as long as the leak is not large enough to allow appreciable moisture to enter. A gas refill kit is available if required, although in most cases gas pressure is maintained for many years.

### RATIO AND LOAD MATCHING:

In the standard 1000/1 and 10,000/1 ratio Ross Voltage Dividers, the low voltage capacitors and resistors are selected to provide correct ratios when shunted by 1M $\Omega$ , 20-50pF oscilloscope (or other specified load), plus 2,3,6, or 15 feet of RG-59 or special Ross Engineering Corporation coaxial cable. Other ratios including selectable multiple ratios, and selectable matching for multiple loads are also available. Other common loads are 10M $\Omega$  100pF, 40M $\Omega$  40pF, and 1000M $\Omega$  100pF, plus cable capacitance. Standard coaxial cable lengths are 3 or 6 feet for up to 30KV dividers, 15 feet for dividers above 30KV. If being used with a cable driver or fiber optic transmitter, cable length is usually 2 feet. Minimum allowable cable length should be specified by the user.

### RATIO FORMULA

THE ACTUAL VOLTAGE DIVIDER RATIO IS DETERMINED BY THE FOLLOWING FORMULA

$$N = \frac{R_1(1 + \omega^2 C_1^2 R_1^2)^{1/2}}{R_2(1 + \omega^2 C_2^2 R_2^2)^{1/2}} + 1$$

N = voltage ratio  
 $\omega = 2 \pi f$   
R = high end res.

R = low and effective res.  
C = high end effective cap.  
C = low end effective cap.

If the high voltage input impedance is high and the voltage ratio selected is low, external cables and added load capacitance and resistance of most display or recording devices can seriously effect the ratios. The relationship in the ratio formula will indicate where and to what extent low frequency response or ratio becomes affected by load impedance. Special ratios, capacitances, and resistances are available to satisfy most matching problems.

The VD series of compact, high accuracy  $\pm 0.01\%$  DC,  $\pm 0.2-1\%$  AC  $\pm 3\%$  DC-1MHz (Some to over 5MHz) resistance-capacitance type HV voltage dividers are frequency compensated from DC to above 1MHz. They have properly matched resistive and capacitive elements, and retain excellent accuracy under fixed or portable applications. Each can be used with proper frequency response panel meter, recorder, digital multimeter, VTVM, or oscilloscope for measuring, viewing, or recording DC, AC, pulse within frequency response range, and modulated frequencies (see brochure B-1010/B-1012,B-1012-A). Most units are designed for indoor use in air, however, special units are available for use in oil, other atmospheres, or outdoors.

TYPICAL $\pm 0.01\%$ DC UNITS - MANY OTHERS AVAILABLE										SEE OTHER LISTINGS FOR $\pm 0.1\%$ DC ACCURACY				
MODEL	MAXIMUM OPERATE **DC CONTINUOUS WITHOUT COOLING		ELECTRONIC CLASS *RATIO ACCURACY SPECIFIED CONDITIONS $\pm$			MAXIMUM OPERATE AC		*** NORMAL FREQUENCY RANGE FOR $\pm 3\%$ PEAKING WIDE BAND ACCURACY	MAX TEST IMPULSE 1x50 $\mu$ SEC PULSE	STANDARD NOMINAL INPUT			** STANDARD RA- TIO TO LOAD OF 1 M $\Omega$ 50PF RG59 AND SPE- CIAL ROSS COAX- IAL CABLE 6' 30KV. 15' ABOVE 30KV	
	OPTIONAL 1 M $\Omega$ PER KV	STD 2 or 4 M $\Omega$ PER KV	DC %	*60Hz AC %	STA- BILITY %	ELEC- TRONIC CLASS PK	POWER CLASS RMS L-L			**RESISTANCE MEGOHMS		NOMINAL CAPACI- TANCE PF		
										2/KV	4/KV			
VD-15-8.3-BD	7.5 KV	15 KV	0.01	0.5	0.01	15 KV	2.5 KV	DC-1 MHz	20 KV	30	60	8.3	1,000/1	
VD-30-33-BD	15 KV	30 KV	0.01	0.5	0.01	30 KV	5 KV	DC-1 MHz	60 KV	60	120	33	1,000/1	
VD-30-12.5-BD	15 KV	30 KV	0.01	0.5	0.01	30 KV	5 KV	DC-1 MHz	60 KV	60	120	12.5	1,000/1	
VD-30-8.3-BD	15 KV	30 KV	0.01	0.5	0.01	30 KV	5 KV	DC-1 MHz	60 KV	60	120	8.3	1,000/1	
VD-30-4.1-BD	15 KV	30 KV	0.01	0.5	0.01	30 KV	5 KV	DC-1 MHz	60 KV	60	120	4.1	1,000/1	
VD-45-33-BD	22 KV	45 KV	0.01	0.5	0.01	45 KV	7.2 KV	DC-1 MHz	85 KV	90	180	33	1,000/1	
VD-45-8.3-BD	22 KV	45 KV	0.01	0.5	0.01	45 KV	7.2 KV	DC-1 MHz	85 KV	90	180	8.3	1,000/1	
VD-50-6.2-BD	30 KV	60 KV	0.01	0.5	0.01	60 KV	15.5 KV	DC-1 MHz	110 KV	100	200	6.2	1,000/1	
VD-60-25-BD	30 KV	60 KV	0.01	0.5	0.01	60 KV	15.5 KV	DC-1 MHz	110 KV	120	240	25	1,000/1	
VD-60-25-CBD	30 KV	60 KV	0.01	0.5	0.01	60 KV	15.5 KV	DC-1 MHz	110 KV	120	240	25	1,000/1	
VD-60-6.2-BD	30 KV	60 KV	0.01	0.5	0.01	60 KV	15.5 KV	DC-1 MHz	120 KV	120	240	6.2	1,000/1	
VD-60-6.2-CBD	30 KV	60 KV	0.01	0.5	0.01	60 KV	15.5 KV	DC-1 MHz	125 KV	120	240	6.2	1,000/1	
VD-75-20-CBD	38 KV	75 KV	0.01	0.5	0.01	75 KV	21 KV	DC-1 MHz	125 KV	150	300	20	1,000/1	
VD-75-5-BD	38 KV	75 KV	0.01	0.5	0.01	75 KV	21 KV	DC-1 MHz	125 KV	150	300	5	1,000/1	
VD-75-5-CBD	38 KV	75 KV	0.01	0.5	0.01	75 KV	21 KV	DC-1 MHz	150 KV	150	300	5	1,000/1	
VD-90-16-BD	45 KV	90 KV	0.01	0.5	0.01	90 KV	25.8 KV	DC-1 MHz	150 KV	180	360	16	1,000/1	
VD-90-4-BD	45 KV	90 KV	0.01	1	0.01	90 KV	25.8 KV	DC-1 MHz	150 KV	180	360	4	1,000/1	
VD-90-4-CBD	45 KV	90 KV	0.01	1	0.01	90 KV	25.8 KV	DC-1 MHz	150 KV	180	360	4	1,000/1	
VD-120-12-BD	60 KV	120 KV	0.01	0.5	0.01	120 KV	38 KV	DC-1 MHz	200 KV	240	480	12	10,000/1	
VD-120-12-BDT	60 KV	120 KV	0.01	0.5	0.01	120 KV	38 KV	DC-1 MHz	200 KV	240	480	12	10,000/1	
VD-120-12-CBD	60 KV	120 KV	0.01	0.5	0.01	120 KV	38 KV	DC-1 MHz	200 KV	240	480	12	10,000/1	
VD-120-3.1-BD	60 KV	120 KV	0.01	1	0.01	120 KV	38 KV	DC-1 MHz	200 KV	240	480	3.1	10,000/1	
VD-120-3.1-BDT	60 KV	120 KV	0.01	1	0.01	120 KV	38 KV	DC-1 MHz	200 KV	240	480	3.1	10,000/1	
VD-120-3.1-CBD	60 KV	120 KV	0.01	0.5	0.01	120 KV	38 KV	DC-1 MHz	200 KV	240	480	3.1	10,000/1	
VD-150-10-CBD	75 KV	150 KV	0.01	0.5	0.01	150 KV	48.3 KV	DC-1 MHz	250 KV	300	600	10	10,000/1	
VD-150-2.5-BD	75 KV	150 KV	0.01	2	0.01	150 KV	48.3 KV	DC-1 MHz	250 KV	300	600	2.5	10,000/1	
VD-195-7.7-BD	100 KV	195 KV	0.01	1	0.01	195 KV	72.5 KV	DC-1 MHz	350 KV	390	600	7.7	10,000/1	
VD-195-7.7-CBD	100 KV	195 KV	0.01	0.5	0.01	195 KV	72.5 KV	DC-1 MHz	350 KV	390	600	7.7	10,000/1	
VD-225-3.4-BD	112 KV	225 KV	0.01	2	0.01	225 KV	95 KV	DC-1 MHz	400 KV	450	900	3.4	10,000/1	
VD-225-6.7-CBD	112 KV	225 KV	0.01	0.5	0.01	225 KV	95 KV	DC-1 MHz	400 KV	450	900	6.7	10,000/1	
VD-225-6.7-BDT	112 KV	225 KV	0.01	0.5	0.01	225 KV	95 KV	DC-1 MHz	400 KV	450	900	6.7	10,000/1	
VD-240-6.2-BD	120 KV	240 KV	0.01	0.5	0.01	240 KV	95 KV	DC-1 MHz	450 KV	480	960	6.2	10,000/1	
VD-240-6.2-CBD	120 KV	240 KV	0.01	2	0.01	240 KV	95 KV	DC-1 MHz	450 KV	480	960	6.2	10,000/1	
VD-240-3-BD	120 KV	240 KV	0.01	3	0.01	240 KV	95 KV	DC-1 MHz	450 KV	480	960	3	10,000/1	
VD-240-3-CBD	120 KV	240 KV	0.01	3	0.01	240 KV	95 KV	DC-1 MHz	450 KV	480	960	3	10,000/1	
VD-300-5-DBD	150 KV	300 KV	0.01	1	0.01	300 KV	121 KV	DC-1 MHz	550 KV	600	1200	5	10,000/1	
VD-300-2.4-DBD	150 KV	300 KV	0.01	3	0.01	300 KV	121 KV	DC-1 MHz	550 KV	600	1200	2.4	10,000/1	
VD-450-5.6-DBD	225 KV	450 KV	0.01	2	0.01	450 KV	145 KV	DC-1 MHz	750 KV	900	1800	6.6	10,000/1	
VD-450-3.4-DBD	225 KV	450 KV	0.01	3	0.01	450 KV	145 KV	DC-1 MHz	750 KV	900	1800	3.4	10,000/1	
VD-450-5.6-BDT	225 KV	450 KV	0.01	3	0.01	450 KV	145 KV	DC-1 MHz	750 KV	900	1800	6.6	10,000/1	
VD-675-8.8-DBD	338 KV	675 KV	0.01	2	0.01	675 KV	242 KV	DC-1 MHz	1050 KV	1350	2700	8.8	10,000/1	
VD-675-8.8-BDT	338 KV	675 KV	0.01	3	0.01	675 KV	242 KV	DC-1 MHz	1050 KV	1350	2700	8.8	10,000/1	
VD-900-6.8-DBD	450 KV	900 KV	0.01	3	0.01	900 KV	362 KV	DC-1 MHz	1350 KV	1800	3600	3.4	10,000/1	
VD-900-6.8-BDT	450 KV	900 KV	0.01	3	0.01	900 KV	362 KV	DC-1 MHz	1350 KV	1800	3600	3.4	10,000/1	
VD-1000-6-DBD	500 KV	1000 KV	0.01	3	0.01	1000 KV	550 KV	DC-1 MHz	1550 KV	2000	4000	3.4	10,000/1	

\* AC accuracy can be obtained by greater shielding, sufficient ground plane, by limiting proximity of conductive materials and by calibrating in place with proper matching. Units with lower input capacitance and lower ratios are more affected by proximity but have fewer resonance possibilities and may be more desirable for high frequency and still sufficiently accurate for many lower frequency applications if proximity rules are observed. Resistance above or below 2 megohms per KV is at additional cost and possible reduction in accuracy. Fully shielded, high accuracy 0.001%DC & 50-400Hz units to 0.2% are available.

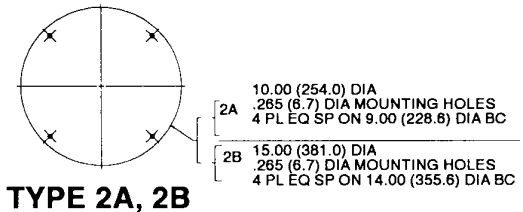
\*\* Other input resistances and ratios are available. 2M $\Omega$ /KV and 4M $\Omega$ /KV are standards which will allow continuous DC operation without excessive heating at AC PK rating although for best accuracy continuous use should be from 10% to 67% of maximum rating. 1M $\Omega$ /KV is a special option, but continuous DC or RMS AC is limited to 1/2 the PK AC rating. DC to 10MHz fiber optic or 50 ohm coaxial cable matching, battery/AC operated, amplifiers and transmission systems are available for driving long cables, or low impedance loads. Ross standard DC-10MHz fiber optic systems are suitable to 1,000ft, farther with repeaters, or lower frequencies.

\*\*\* Frequency range can be better on low capacitance low ratio units. ALSO SEE STANDARD 0.1% DC 0.5% AC ACCURACY UNITS FOR WIDER FREQUENCY RESPONSE TO OVER 5MHz. RF current is limited by dielectric heating effects. Low duty cycle pulse currents can be considerably higher, to the limits of PK operating voltage and frequency. "T" models are weatherproof outdoor units with high strength stackable skirted porcelain housings. Most units are hermetically sealed and filled with insulat-

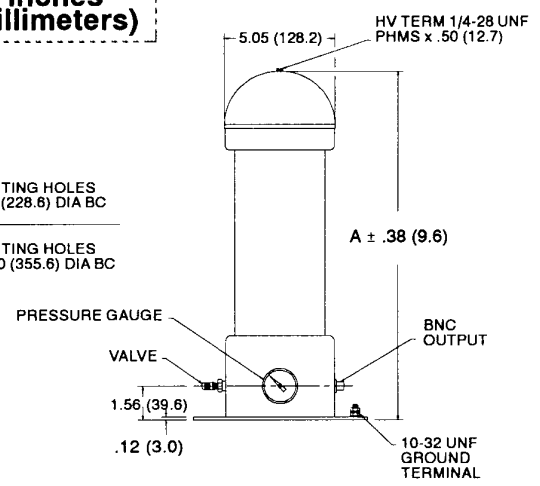


VD60-BD

In inches  
(In millimeters)

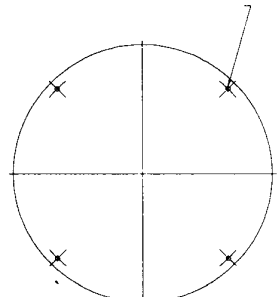


TYPE 2A, 2B

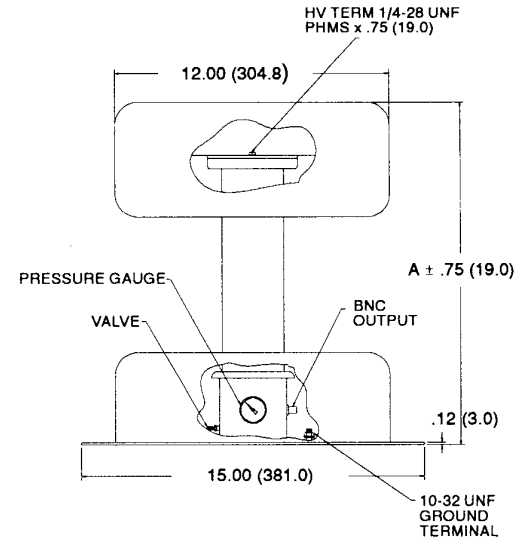


VD75-CBD

.265 (6.7) DIA MOUNTING HOLES  
4 PL EQ SP ON 14.000 (355.6) DIA BC

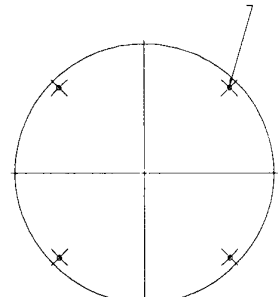


TYPE 3A

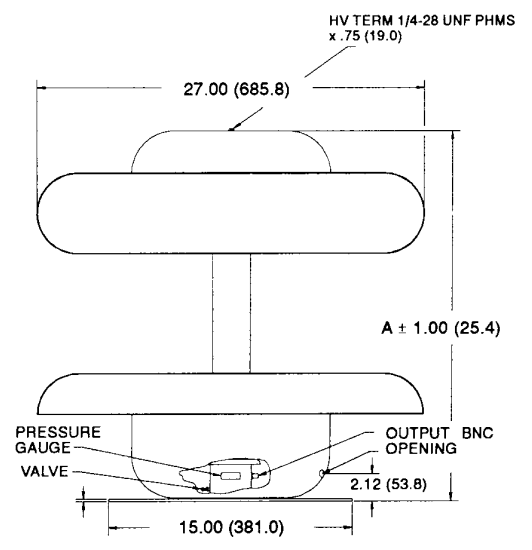


VD240-CBD

.265 (6.7) DIA MOUNTING HOLES  
4 PL EQ SP ON 14.000 (355.6) DIA BC



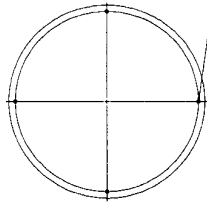
TYPE 4



**ROSS** ENGINEERING CORP.

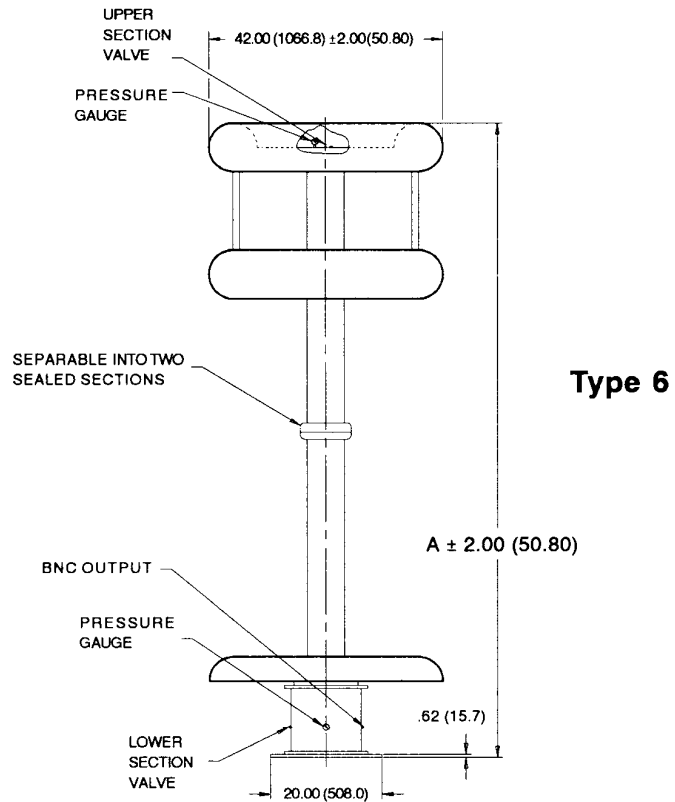
CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182

.390 (9.91) DIA MOUNTING HOLES  
4 PL EQ SP ON 19.250 (488.95) DIA BC

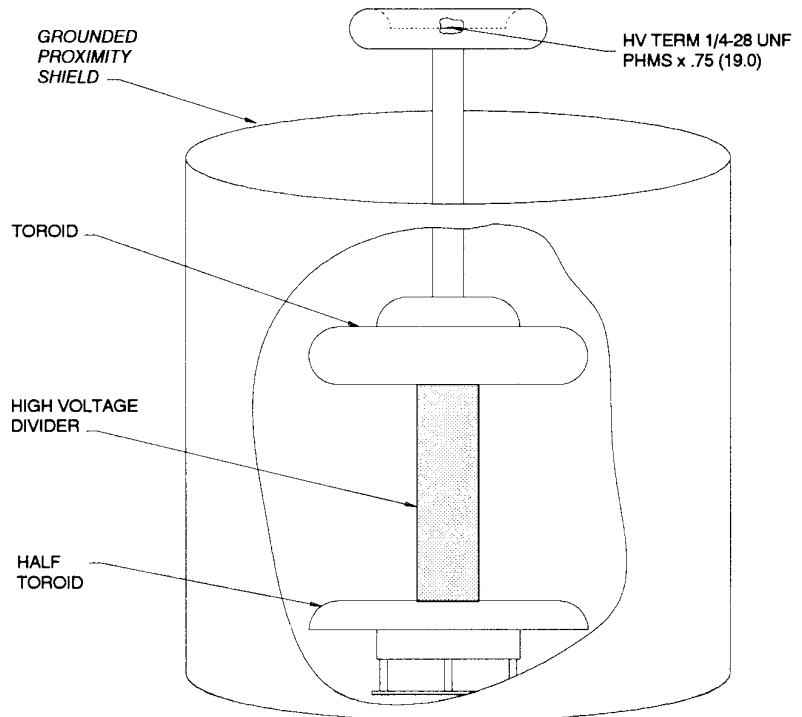


Type 6 Base

DIMENSIONS		
MODEL*	TYPE	A*
VD15-BD	2A	9.82 (249.4)
VD30-BD	2A	11.63 (295.4)
VD45-BD	2A	13.94 (354.0)
VD50-BD	2A	16.25 (412.7)
VD60-BD	2A	16.25 (412.7)
VD60-CBD	3A	15.19 (385.8)
VD75-BD	2A	18.57 (471.6)
VD75-CBD	3A	19.19 (487.4)
VD90-BD	2A	20.88 (530.3)
VD90-CBD	3A	19.94 (506.4)
VD120-BD	2B	25.65 (651.5)
VD120-CBD	4	23.42 (594.8)
VD120-BDT	SEE PAGE 6	25.00 (635.0)
VD150-BD	2B	30.28 (769.1)
VD150-CBD	4	32.00 (812.8)
VD195-BD	2B	37.22 (945.3)
VD195-CBD	4	35.23 (894.8)
VD225-BD	2B	41.88 (1,063.7)
VD225-CBD	4	58.53 (1,486.6)
VD225BDT	SEE PAGE 6	42.00 (1,066.8)
VD240-BD	2B	44.19 (1,122.4)
VD240-CBD	4	60.84 (1,545.3)
VD300-DBD	6	87.38 (2,219.4)
VD450-DBD	6	110.50 (2,806.7)
VD450-CBD	6	110.50 (2,806.7)
VD450-BDT	SEE PAGE 6	110.50 (2,806.7)
VD675-DBD	6	145.18 (3,687.5)
VD675-BDT	SEE PAGE 6	145.18 (3,687.5)
VD900-DBD	6	236.00 (5,994.4)
VD900-BDT	SEE PAGE 6	236.00 (5,994.4)
VD1000-DBD	6	250.0 (6,350.0)



In inches (In millimeters)



**PROXIMITY SHIELD**

Special functions for high AC accuracy dividers are provided by the proximity shield. It's protective design eliminates external capacitive effects on the divider as well as reducing noise pick-up. The proximity shield also increases the divider's overall size in addition to protecting personnel from high voltage. The shield is used only where very accurate AC readings are required and is available on special order only.

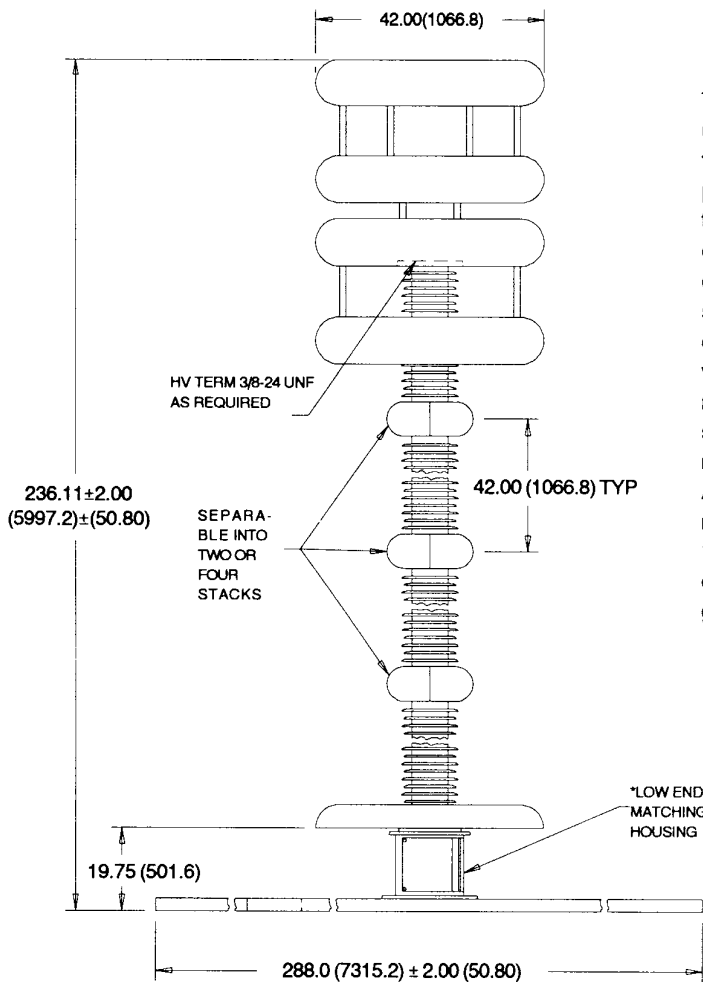
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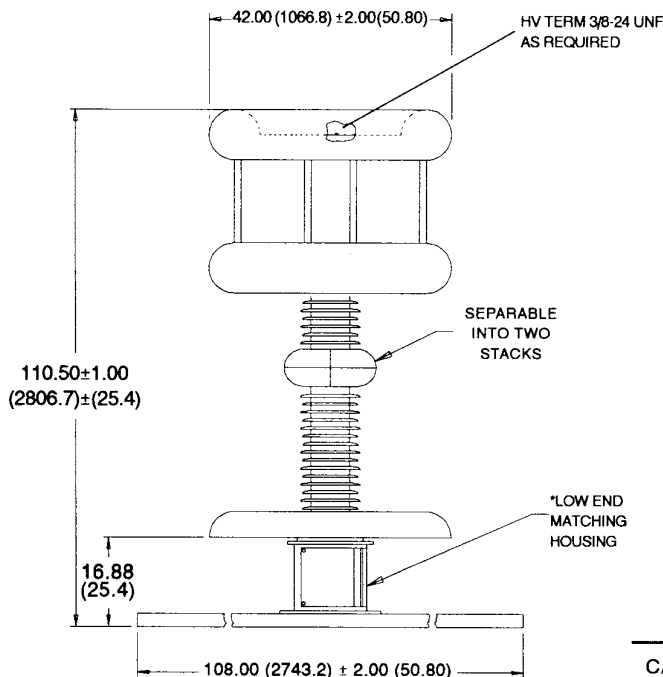


# Outdoor VD Series

These models are designed to be weatherproof for indoor/out-door use up to 1000KV DC or AC PK. They are compensated resistance-capacitance wide-band DC to 1MHz and are balanced to provide safe voltage gradients with low capacitance, better high frequency accuracy (if proximity effects are calibrated for), and low corona. The use of low-loss precision ceramic capacitors and exceptionally stable metal film or wire wound resistors results in stability and accuracy of 0.01% with temperature coefficients typically less than 3 PPM/°C to 5 PPM/°C and voltage coefficients from very low to zero. Applications include use with panel meters, recorders, digital voltmeters, oscilloscopes or computers to measure, view and record DC, AC, transient pulse or pulse train and modulated CW. Ross dividers can be used in conjunction with Ross AC or AC/battery operated fiber optic systems or 50 or 75 ohm matching amplifier/coaxial cable drivers to create complete DC to 1MHz (or more) wide-band systems for driving long fiber optic or coaxial cables. Fiber optics are particularly desirable to eliminate ground current return, pick-up and isolation problems.

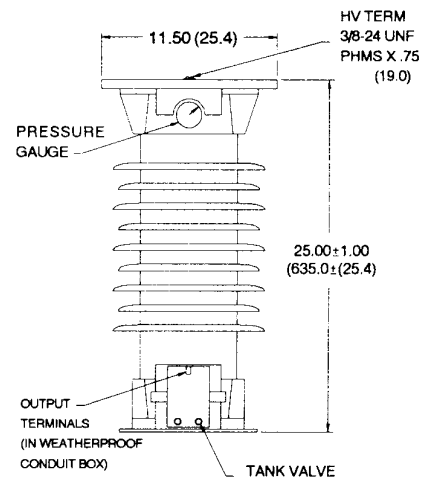


**VD900-□-BDT**



**VD450-□-BDT**

In inches (In millimeters)



**VD120-□-BDT**

**ROSS ENGINEERING CORP.**

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**VD900-20-BDT-K-**

# 5 TO 900KV PK

B-1011-C

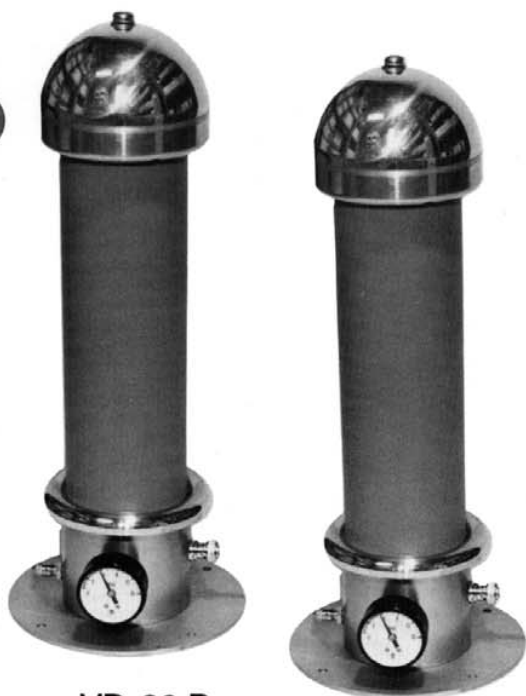
## MATCHED PAIRS HIGH VOLTAGE VOLTAGE DIVIDERS

Matched pairs high voltage dividers for high voltage differential measurements. Precision wide-band 1KV to 900KV 0.1%DC and 0.01%DC, 0.2% to 3% AC accuracies linear within 3%, DC up to 5 MHz.

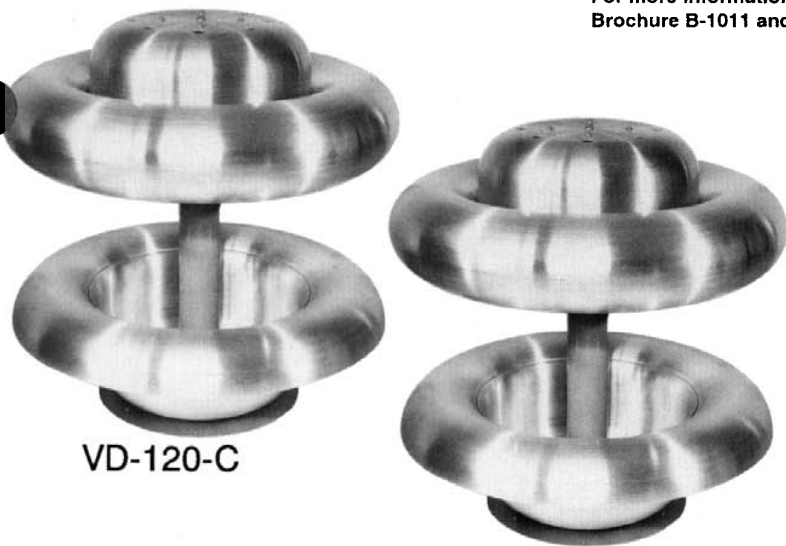
Output difference as small as 0.1V at any input voltage 1KV to 900KV depending on model. For measuring small continuous, pulsed or transient voltage differences, point to point, or across resistive current shunts with both terminals at the high voltage level and instrumentation at ground level.

These Voltage Dividers can be adjustable to zero out any differential error or extraneous pickup and they are available in any ratio and can be made to match most loads. Matching differential fiber-optic transmission systems are also available for full isolation and minimum pickup for transmission of signals up to one kilometer, further with repeaters.

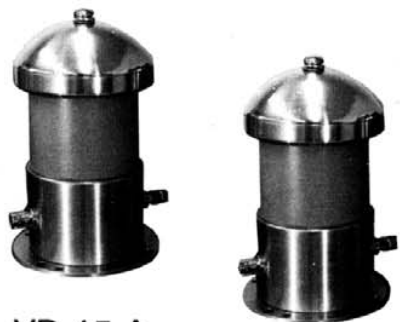
**For more information on specifications and dimensions refer to Brochure B-1011 and B-1011-B or contact Ross Engineering Corporation.**



VD-60 B



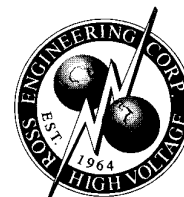
VD-120-C



VD-15-A



VD-120- - - -BDT



1-94/5000

PRINTED IN U.S.A.

540 WESTCHESTER DRIVE
CAMPBELL, CA 95008
TEL (408) 377-4621
FAX (408) 377-5182



HIGH VOLTAGE DIVIDERS FOR DRANETZ POWER ANALYSIS SYSTEM

Ross Engineering Corporation's high voltage wideband DC to over 1 megahertz voltage dividers are recommended for indoor or outdoor measurements. These dividers can be designed to match most instrument impedances and with ratios to match their sensitivities, or with multiple ratios. Examples are: the DRANETZ 626 with 40 megohm 40pF impedance to grounded neutral, or other transient recorders with various input impedances, oscilloscopes (usually 1 megohm 20-50pF), digital voltmeters (usually 1 or 10 megohms 75-150pF), other specialized instrumentation, or high impedance relaying. Units are normally supplied with a 6, 15, or 20 foot coaxial cable, but other lengths are available. The 20 foot coaxial cable is the longest recommended for full frequency response. Wideband (DC-1MHZ) fiber optic transmission systems are also available for longer distances and isolation from high voltage and ground currents. Standard voltage divider accuracies are 0.1% DC, 0.5% or 1% 50/60HZ, 3% DC to over 1MHZ. 0.01% DC is available. NOTE: For lower power applications, which have lower basic impulse requirements, continuous operate voltage may be higher, not exceeding 50% of rated short time PK operate. Higher input resistances are available for higher continuous voltages within safety factor limits.

Table with columns: AC POWER CLASS LINE TO LINE VOLTAGE, OPERATING VOLTAGE CONTINUOUS, MAXIMUM OPERATE VOLTAGE, MAXIMUM OPERATE VOLTAGE, POWER CLASS IMPULSE, SUGGESTED RATIOS FOR RECORDERS WITH 12-600V AC RMS CONTINUOUS RANGE, VOLTAGE DIVIDER HV INPUT IMPEDANCE, OUTPUT CABLE LENGTH, and VD MODEL NUMBER. The table lists various model numbers and their specifications for indoor and outdoor use.

**540 WESTCHESTER DRIVE  
CAMPBELL, CA 95008  
TEL (408) 377-4621  
FAX (408) 377-5182**



**HIGH VOLTAGE DIVIDERS FOR BMI POWER ANALYSIS SYSTEM**

Ross Engineering Corporation's high voltage wideband DC to over 1 megahertz voltage dividers are recommended for indoor or outdoor measurements. These dividers can be designed to match most instrument impedances and with ratios to match their sensitivities, or with multiple ratios. Examples are: the BMI 4800 with 2 megohm 33pF impedance to grounded neutral, or other transient recorders with various input impedances, oscilloscopes (usually 1 megohm 20-50pF), digital voltmeters (usually 1 or 10 megohms 75-150pF), other specialized instrumentation, or high impedance relaying. Units are normally supplied with a 6, 15, or 20 foot coaxial cable, but other lengths are available. The 20 foot coaxial cable is the longest recommended for full frequency response. Wideband (DC-1MHZ) fiber optic transmission systems are also available for longer distances and isolation from high voltage and ground currents. Standard voltage divider accuracies are 0.1% DC, 0.5% or 1% 50/60HZ, 3% DC to over 1MHZ. 0.01% DC is available. NOTE: For lower power applications, which have lower basic impulse requirements, continuous operate voltage may be higher, not exceeding 50% of rated short time PK operate. Higher input resistances are available for higher continuous voltages within safety factor limits.

AC POWER CLASS LINE TO LINE VOLTAGE KV RMS	OPERATING VOLTAGE CONTINUOUS				MAXIMUM OPERATE VOLTAGE	MAXIMUM OPERATE VOLTAGE	POWER CLASS IMPULSE	SUGGESTED RATIOS FOR RECORDERS WITH 12-600V AC RMS CONTINUOUS RANGE			VOLTAGE DIVIDER HV INPUT IMPEDANCE		OUTPUT CABLE LENGTH	VD MODEL NUMBER. (OTHER MODEL NUMBERS AVAILABLE FOR OTHER LOADING OR RATIOS)		
								AC RMS NOMINAL CONTINUOUS OPERATING VOLTAGE RATIOS. OTHER RATIOS AVAILABLE FOR OTHER NOMINAL OUTPUT VOLTAGES						FOR RECORDER SIMILAR TO BMI 8800 WITH 12V RMS AC, 25V DC MINIMUM SENSITIVITY AND 2 MEGOHM, 33 PICOFARAD INPUT IMPEDANCE TO GROUND. UNITS CAN MATCH OTHER LOAD IMPEDANCES AND RATIOS AS REQUIRED. FOR PQ WITH 1MEGOHM > 50pF, CHANGE "J" TO "H" WHERE NECESSARY TO MEET RATIO, AND CHANGE "B" TO "Q".		
	3 PHASE LINE TO LINE KV RMS		3 PHASE LINE TO GND KV RMS		LINE TO GND MAX CONTINUOUS KV RMS AC & KV DC	LINE TO GND SHORT TIME PK AC OR DC, 5 SEC MAX	BASIC IMPULSE LEVEL KV PK 1.2X50 μSEC	NOMINAL RATIO (OTHER RATIOS AVAILABLE)	LINE TO GND INPUT/OUTPUT LOWER AC RMS VOLTAGE OUT		LINE TO GND INPUT/OUTPUT NOMINAL VOLTS RATIO	TOTAL HV CAPITANCE PICOFARADS	TOTAL HV RESISTANCE MΩ	RG59 COAX WITH BNC CONNECTORS. FT	WEATHERPROOF OUTDOOR	
	NOM	MAX	NOM	MAX					50V OUT	12V OUT					INDOOR	INDOOR
1.5	0.6	2.6	0.346	1.5	2.1	5	20	2.88/1	133/50	34.6/12	346/120	100	7.5	6	VD15-100Y-A-H-HOB	VD15-100Y-AT-H-HOB
1.5	0.6	2.6	0.346	1.5	2.1	5	20	2.88/1	133/50	34.6/12	346/120	50	15	15	VD15-50Y-A-J-HOAB	VD15-100Y-AT-J-HOAB
2.5	2.4	4.1	1.4	3.3	3.3	10	45	11.55/1	578/50	139/12	1,386/120	50	15	20	VD30-50Y-A-H-HAB	VD30-50Y-AT-H-HAB
5	3.3	4.1	1.9	3.3	3.3	30	60	15.88/1	793/50	191/12	1,905/120	25	30	20	VD30-25Y-A-J-HAAB	VD30-50Y-AT-J-HAAB
5	4.16	5.7	2.4	3.3	4.7	30	60	20/1	1,000/50	240/12	2,400/120	25	30	20	VD30-25Y-A-J-HBB	VD30-25Y-AT-J-HBB
5	5	5.7	2.9	3.3	4.7	30	60	24.05/1	1,203/50	289/12	2,887/120	25	30	20	VD30-25Y-A-J-HCB	VD30-25Y-AT-J-HCB
6.6	6.6	7.2	3.8	4.2	5.9	45	75	31.75/1	1,588/50	381/12	3,810/120	16	45	6/6	VD45-16.6Y-A-J-HDAB	VD45-16.6Y-AT-J-HDAB
8.25	7.2	16.5	4.2	9.5	13.4	60	110	34.64/1	1,732/50	416/12	4,157/120	25	60	20	VD60-25Y-A-J-HECB	VD60-25Y-AT-J-HECB
8.25	7.5	16.5	4.3	9.5	13.4	60	110	36.08/1	1,804/50	433/12	4,330/120	25	60	20	VD60-25Y-A-J-HEB	VD60-25Y-AT-J-HEB
15.5	10	16.5	5.8	9.5	13.4	60	110	48.11/1	2,406/50	577/12	5,774/120	25	60	20	VD60-25Y-A-J-HEDB	VD60-25Y-AT-J-HEDB
15.5	11.5	16.5	6.6	9.5	13.4	60	110	55.33/1	2,767/50	664/12	6,640/120	25	60	20	VD60-25Y-A-J-HEAB	VD60-25Y-AT-J-HEAB
15.5	12.5	16.5	7.2	9.5	13.4	60	110	60.14/1	3,007/50	722/12	7,217/120	25	60	20	VD60-25Y-A-J-HGAB	VD60-25Y-AT-J-HGAB
15.5	13.8	16.5	8	9.5	13.4	60	110	66.4/1	3,307/50	797/12	7,968/120	12	60	20	VD60-12.5Y-A-J-HFB	VD60-12.5Y-AT-J-HFB
15.5	15.5	16.5	8.9	9.5	13.4	60	110	72.17/1	3,609/50	895/12	8,949/120	6	60	20	VD60-6.2Y-A-J-HGB	VD60-6.2Y-AT-J-HGB
25.8	19.9	30	11.5	17.3	24.5	90	150	95.74/1	4,787/50	1,149/12	11,490/120	16	90	20	VD90-16.5Y-A-J-HHAB	VD90-16.5Y-AT-J-HHAB
25.8	21.6	30	12.5	17.3	24.5	90	150	103.9/1	5,195/50	1,247/12	12,471/120	16	90	20	VD90-16.5Y-A-J-HHCB	VD90-16.5Y-AT-J-HHCB
25.8	23	30	13.3	17.3	24.5	90	150	110.7/1	5,535/50	1,328/12	13,279/120	16	90	20	VD90-16.5Y-A-J-HHDB	VD90-16.5Y-AT-J-HHDB
25.8	25	30	14.4	17.3	24.5	90	150	120.3/1	6,015/50	1,443/12	14,434/120	16	90	20	VD90-16.5Y-A-J-HHBB	VD90-16.5Y-AT-J-HHBB
34.5	34.5	43	19.9	24.8	31.8	90	150	166/1	8,300/50	1,992/12	19,919/120	16	90	20	VD90-16.5Y-A-J-HHEB	VD90-16.5Y-AT-J-HHEB
34.5	34.5	43	19.9	24.8	31.8	90	150	166/1	8,300/50	1,992/12	19,919/120	16	90	20	VD105-14.4Y-A-J-HHEB	VD105-14.4Y-AT-J-HHEB
38	34.5	43	19.9	24.8	35.1	120	200	166/1	8,300/50	1,992/12	19,919/120	12	120	20	VD120-12.5Y-AK-J-HIAB	VD120-12.4-ATK-J-HIAB
38	38	43	21.9	24.8	35.1	120	200	182.8/1	9,140/50	2,194/12	21,940/120	12	120	20	VD120-12.5Y-AK-J-HIB	VD120-12.4-ATK-J-HIB
48.3	44	51	25.4	29.3	41.4	150	250	60/1	3,000/50	720/12	7,200/120	10	150	20	VD150-10Y-AK-J-HJAB	VD150-10Y-BTB-J-HJAB
48.3	44	51	25.4	29.3	41.4	150	250	211.7/1	10,585/50	2,540/12	25,404/120	10	150	20	VD150-10Y-AK-J-HJB	VD150-10Y-BTB-J-HJB
72.5	69	80	39.8	46.2	65.3	195	350	332/1	16,600/50	3,984/12	39,838/120	15	195	20	VD195-15Y-C-J-HKB	VD195-15Y-TC-J-HKB
95	92	100	53.1	57.7	81.6	225	400	442.6/1	22,130/50	5,312/12	53,118/120	40	225	20	VD225-40Y-C-J-HLB	VD225-40Y-TC-J-HLB
121	115	130	66.4	75.1	106.2	300	550	553.3/1	27,665/50	6,640/12	66,397/120	30	300	20	VD300-30-D-J-HMB	VD300-30-TC-J-HMB
145	138	150	79.7	86.6	122.5	375	650	664/1	33,200/50	7,968/12	79,677/120	24	375	20	VD375-24-D-J-HNB	VD375-24-TC-J-HNB
169	161	175	92.9	97.6	160	450	750	744.8/1	38,732/50	9,296/12	92,956/120	20	450	20	VD450-20-D-J-HRB	VD450-20-TC-J-HRB
242	230	250	132.8	144.3	204	675	1,050	1,106.61/1	55,330/50	13,279/12	132,794/120	30	675	20	VD675-26-D-J-HPB	VD675-30-TC-J-HPB
362	345	370	199.2	213.6	302	900	1,300	1,660/1	83,000/50	19,919/12	199,192/120	20	900	20	VD900-20-D-J-HQB	VD900-20-TC-J-HQB
425	400	450	231	260	360	1,000	1,450	1,925/1	96,228/50	23,095/12	230,947/120	18	1,000	20	VD1000-18-D-J-HUB	VD1000-18-TC-J-HUB

**540 WESTCHESTER DRIVE  
CAMPBELL, CA 95008  
TEL (408) 377-4621  
FAX (408) 377-5182**



**POWER CLASS HIGH VOLTAGE DIVIDERS FOR TRANSIENT RECORDERS OR DISPLAYS**

Ross Engineering Corporation's high voltage wideband DC to over 1 megahertz voltage dividers are recommended for indoor or outdoor measurements. These dividers can be designed to match most instrument impedances and with ratios to match their sensitivities, or with multiple ratios. Examples are: transient recorders with various input impedances, oscilloscopes (usually 1 megohm 20-50pF), digital voltmeters (usually 1 or 10 megohms 75-150pF), other specialized instrumentation, or high impedance relaying. Units are normally supplied with a 6, 15, or 20 foot coaxial cable, but other lengths are available. The 20 foot coaxial cable is the longest recommended for full frequency response. Wideband (DC-1MHZ) fiber optic transmission systems are also available for longer distances and isolation from high voltage and ground currents. Standard voltage divider accuracies are 0.1% DC, 0.5% or 1% 50/60HZ, 3% DC to over 1MHZ. 0.01% DC is available. NOTE: For lower power applications, which have lower basic impulse requirements, continuous operate voltage may be higher, not exceeding 50% of rated short time PK operate. Higher input resistances are available for higher continuous voltages within safety factor limits.

AC POWER CLASS LINE TO LINE VOLTAGE  KV RMS	OPERATING VOLTAGE CONTINUOUS				MAXIMUM OPERATE VOLTAGE	MAXIMUM OPERATE VOLTAGE	POWER CLASS IMPULSE	SUGGESTED RATIOS FOR OSCILLOSCOPES		VOLTAGE DIVIDER HV INPUT IMPEDANCE		OUTPUT CABLE LENGTH	VD MODEL NUMBER. (OTHER MODEL NUMBERS AVAILABLE FOR OTHER LOADING)	
								NOMINAL LINE TO GROUND CONTINUOUS OPERATING VOLTAGE RATIOS. OTHER RATIOS AVAILABLE FOR OTHER NOMINAL OUTPUT VOLTAGES		TOTAL HV CAPITANCE PICOFARADS	TOTAL HV RESISTANCE MΩ		FOR RECORDERS, DIGITAL VOLTMETERS AND OSCILLOSCOPES. UNITS CAN MATCH OTHER LOADS AS REQUIRED. MATCHES EITHER 1MEG 10-50pF OR 10MEG 75-100pF.	
	3 PHASE LINE TO LINE KV RMS		3 PHASE LINE TO GND KV RMS		LINE TO GND MAX CONTINUOUS KV RMS AC & KV DC	LINE TO GND SHORT TIME PK AC OR DC, 5 SEC MAX	BASIC IMPULSE LEVEL BIL KV PK	NOMINAL RATIO (OTHER RATIOS AVAILABLE)	NOMINAL LINE TO GND INPUT/OUTPUT VOLTS			RG59 COAX WITH BNC CONNECTORS. FT	INDOOR	WEATHERPROOF OUTDOOR
	NOM	MAX	NOM	MAX										
1.5	0.6	2.6	0.346	1.5	2.1	5	20	10/1	346/34.6	100	7.5	6	VD15-100Y-A-J-HOD	
1.5	0.6	2.6	0.346	1.5	2.1	5	20	10/1	346/34.6	50	15	15	VD15-50Y-A-J-HOAD	VD15-50Y-AT-J-HOAD
2.5	2.4	4.1	1.4	3.3	3.3	10	45	100/1	1,386/13.86	50	30	20	VD30-50Y-A-J-HAD	VD30-25Y-AT-J-HAD
5	3.3	5.7	1.9	3.5	4.7	30	60	100/1	1,905/19.05	50	30	20	VD30-50Y-A-J-HAAD	VD30-25Y-AT-J-HAAD
5	4.16	5.7	2.4	3.3	4.7	30	60	100/1	2,400/24.00	50	30	20	VD30-50Y-A-J-HBD	VD30-50Y-AT-J-HBD
5	5	5.7	2.9	3.3	4.7	30	60	100/1	2,887/28.87	25	30	20	VD30-50Y-A-J-HCD	VD30-50Y-AT-J-HCD
6.6	6.6	7.2	3.8	4.2	5.9	45	85	100/1	3,810/38.1	16	45	6/6	VD45-16.6Y-A-J-HDAD	VD30-16.6Y-AT-J-HDAD
8.25	7.2	16.5	4.2	9.5	13.4	60	110	100/1	4,157/41.57	25	60	20	VD60-25Y-A-J-HECD	VD60-25Y-AT-J-HECD
8.25	7.5	16.5	4.3	9.5	13.4	60	110	100/1	4,330/43.30	25	60	20	VD60-25Y-A-J-HED	VD60-25Y-AT-J-HED
15.5	10	16.5	5.8	9.5	13.4	60	110	1,000/1	5,774/5.77	25	60	20	VD60-25Y-A-J-HEDD	VD60-25Y-AT-J-HEDD
15.5	11.5	16.5	6.6	9.5	13.4	60	110	1,000/1	6,640/6.64	25	60	20	VD60-25Y-A-J-HEAD	VD60-25Y-AT-J-HEAD
15.5	12.5	16.5	7.2	9.5	13.4	60	110	1,000/1	7,217/7.21	25	60	20	VD60-25Y-A-J-HGAD	VD60-25Y-AT-J-HGAD
15.5	13.8	16.5	8	9.5	13.4	60	110	1,000/1	7,968/7.96	12	60	20	VD60-12.5Y-A-J-HFD	VD60-12.5Y-AT-J-HFD
15.5	15.5	16.5	8.9	9.5	13.4	60	110	1,000/1	8,949/8.94	6	60	20	VD60-6.2Y-A-J-HGD	VD60-6.2Y-AT-J-HGD
25.8	19.9	30	11.5	17.3	24.5	90	150	1,000/1	11,490/11.49	16	90	20	VD90-16.5Y-A-J-HHAD	VD90-16.5Y-AT-J-HHAD
25.8	21.6	30	12.5	17.3	24.5	90	150	1,000/1	12,471/12.47	16	90	20	VD90-16.5Y-A-J-HHCD	VD90-16.5Y-AT-J-HHCD
25.8	23	30	13.3	17.3	24.5	90	150	1,000/1	13,279/13.27	16	90	20	VD90-16.5Y-A-J-HHDD	VD90-16.5Y-AT-J-HHDD
25.8	25	30	14.4	17.3	24.5	90	150	1,000/1	14,434/14.43	16	90	20	VD90-16.5Y-A-J-HHHD	VD90-16.5Y-AT-J-HHHD
34.5	34.5	43	19.9	24.8	31.8	90	150	1,000/1	19,919/19.91	16	90	20	VD90-16.5Y-A-J-HHED	VD90-16.5Y-AT-J-HHED
34.5	34.5	43	19.9	24.8	31.8	90	150	1,000/1	19,919/19.91	14	100	20	VD105-14.4Y-A-J-HHED	VD105-14.4Y-AT-J-HHED
38	34.5	43	19.9	24.8	35.1	120	200	1,000/1	19,919/19.91	12	120	20	VD120-12.5Y-AK-J-HIAD	VD120-12.5Y-ATK-J-HIAD
38	38	43	21.9	24.8	35.1	120	200	1,000/1	21,940/21.94	12	120	20	VD120-12.5Y-AK-J-HID	VD120-12.5Y-ATK-J-HID
48.3	44	51	25.4	29.3	41.4	150	250	1,000/1	25,404/25.40	10	150	20	VD150-10Y-AK-J-HJAD	VD150-10Y-BTB-J-HJAD
48.3	44	51	25.4	29.3	41.4	150	250	1,000/1	25,404/25.40	10	150	20	VD150-10Y-AK-J-HJD	VD150-10Y-BTB-J-HJD
72.5	69	80	39.8	46.2	65.3	195	350	1,000/1	39,838/39.83	15	195	20	VD195-15Y-TC-J-HKD	VD195-15Y-TC-J-HKD
95	92	100	53.1	57.7	81.6	225	400	1,000/1	53,118/53.11	40	225	20	VD225-40Y-C-J-HLD	VD225-40Y-TC-J-HLD
121	115	130	66.4	75.1	106.2	300	550	10,000/1	66,397/6.639	30	300	20	VD300-30-D-J-HMD	VD300-30-TC-J-HMD
145	138	150	79.7	86.6	122.5	375	650	10,000/1	79,677/7.967	24	375	20	VD375-24-D-J-HND	VD375-24-TC-J-HND
169	161	175	92.9	97.6	160	450	750	10,000/1	92,956/9.296	20	450	20	VD450-20-D-J-HRD	VD450-20-TC-J-HRD
242	230	250	132.8	144.3	204	675	1,050	10,000/1	132,794/13.27	30	675	20	VD675-26-D-J-HPD	VD675-30-TC-J-HPD
362	345	370	199.2	213.6	302	900	1,300	10,000/1	199,192/19.91	20	900	20	VD900-20-D-J-HQD	VD900-20-TC-J-HQD
425	400	450	231	260	360	1,000	1,450	10,000/1	230,947/23.09	18	1,000	20	VD1000-18-D-J-HUD	VD1000-18-TC-J-HUD

**HIGH VOLTAGE DIVIDERS FOR RPM POWER ANALYSIS SYSTEM**

Ross Engineering Corporation's high voltage wideband DC to over 1 megahertz voltage dividers are recommended for indoor or outdoor measurements. These dividers can be designed to match most instrument impedances and with ratios to match their sensitivities, or with multiple ratios. Examples are: the RPM OMEGA SYSTEM with 2 megohm 10-50pF impedance to grounded neutral, or other transient recorders with various input impedances, oscilloscopes (usually 1 megohm 20-50pF), digital voltmeters (usually 1 or 10 megohms 75-150pF), other specialized instrumentation, or high impedance relaying. Units are normally supplied with a 6, 15, or 20 foot coaxial cable, but other lengths are available. The 20 foot coaxial cable is the longest recommended for full frequency response. Wideband (DC-1MHZ) fiber optic transmission systems are also available for longer distances and isolation from high voltage and ground currents. Standard voltage divider accuracies are 0.1% DC, 0.5% or 1% 50/60HZ, 3% DC to over 1MHZ. 0.01% DC is available. NOTE: For lower power applications, which have lower basic impulse requirements, continuous operate voltage may be higher, not exceeding 50% of rated short time PK operate. Higher input resistances are available for higher continuous voltages within safety factor limits.

B-1011-DR  
**ROSS ENGINEERING CORPORATION**  
**540 WESTCHESTER DRIVE**  
**CAMPBELL, CA 95008**  
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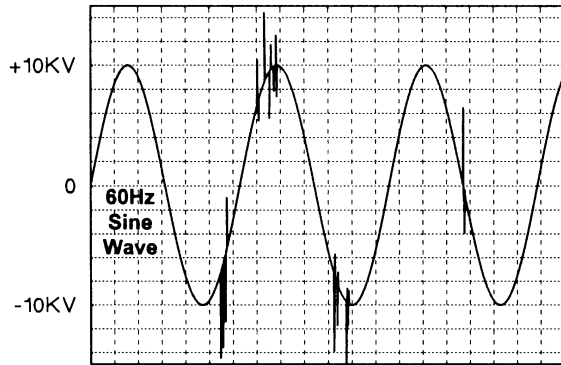


AC POWER CLASS LINE TO LINE VOLTAGE  KV RMS	OPERATING VOLTAGE CONTINUOUS				MAXIMUM OPERATE VOLTAGE	MAXIMUM OPERATE VOLTAGE	POWER CLASS IMPULSE	SUGGESTED RATIOS FOR RECORDERS WITH 12-600V AC RMS CONTINUOUS RANGE				VOLTAGE DIVIDER HV INPUT IMPEDANCE		OUTPUT CABLE LENGTH	VD MODEL NUMBERS FOR 2 MEGOHM 10-50pF TO NEUTRAL GROUND INCLUDE SPECIFIED COAXIAL OUTPUT CABLE. OTHER MODELS AVAILABLE FOR OTHER LOADS AND RATIOS.	
								AC RMS NOMINAL CONTINUOUS OPERATING ACTUAL VOLTAGE RATIOS. OTHER RATIOS AVAILABLE FOR OTHER NOMINAL OUTPUT VOLTAGES		LINE TO GND INPUT/OUTPUT LOWER AC RMS VOLTAGE OUT	LINE TO GND INPUT/OUTPUT NOMINAL VOLTS RATIO	TOTAL HV CAPITANCE PICO FARADS	TOTAL HV RESISTANCE MΩ			
	3 PHASE LINE TO LINE KV RMS		3 PHASE LINE TO GND KV RMS					NOMINAL RATIO (OTHER RATIOS AVAILABLE)	50V OUT							
	NOM	MAX	NOM	MAX						LINE TO GND MAX CONTINUOUS KV RMS AC & KV DC	LINE TO GND SHORT TIME PK AC OR DC, 5 SEC MAX	BASIC IMPULSE LEVEL KV PK 1.2X50 μSEC				
1.5	0.6	2.6	0.346	1.5	2.1	5	20	2.88/1	133/50	34.6/12	346/120	100	7.5	6	VD15-100Y-A-H-HOR	VD15-100Y-AT-H-HOR
1.5	0.6	2.6	0.346	1.5	2.1	5	20	2.88/1	133/50	34.6/12	346/120	50	15	15	VD15-50Y-A-J-HOAR	VD15-100Y-AT-J-HOAR
2.5	2.4	4.1	1.4	3.3	3.3	10	45	11.55/1	578/50	139/12	1,386/120	50	15	20	VD30-50Y-A-H-HAR	VD30-50Y-AT-H-HAR
5	3.3	4.1	1.9	3.3	3.3	30	60	15.88/1	793/50	191/12	1,905/120	25	30	20	VD30-25Y-A-J-HAAR	VD30-50Y-AT-J-HAAR
5	4.16	5.7	2.4	3.3	4.7	30	60	20/1	1,000/50	240/12	2,400/120	25	30	20	VD30-25Y-A-J-HBR	VD30-25Y-AT-J-HBR
5	5	5.7	2.9	3.3	4.7	30	60	24.05/1	1,203/50	289/12	2,887/120	25	30	20	VD30-25Y-A-J-HCR	VD30-25Y-AT-J-HCR
6.6	6.6	7.2	3.8	4.2	5.9	45	75	31.75/1	1,588/50	381/12	3,810/120	16	45	6/6	VD45-16.6Y-A-J-HDAR	VD45-16.6Y-AT-J-HDAR
8.25	7.2	16.5	4.2	9.5	13.4	60	110	34.64/1	1,732/50	416/12	4,157/120	25	60	20	VD60-25Y-A-J-HECR	VD60-25Y-AT-J-HECR
8.25	7.5	16.5	4.3	9.5	13.4	60	110	36.08/1	1,804/50	433/12	4,330/120	25	60	20	VD60-25Y-A-J-HER	VD60-25Y-AT-J-HER
15.5	10	16.5	5.8	9.5	13.4	60	110	48.11/1	2,406/50	577/12	5,774/120	25	60	20	VD60-25Y-A-J-HEDR	VD60-25Y-AT-J-HEDR
15.5	11.5	16.5	6.6	9.5	13.4	60	110	55.33/1	2,767/50	664/12	6,640/120	25	60	20	VD60-25Y-A-J-HEAR	VD60-25Y-AT-J-HEAR
15.5	12.5	16.5	7.2	9.5	13.4	60	110	60.14/1	3,007/50	722/12	7,217/120	25	60	20	VD60-25Y-A-J-HGAR	VD60-25Y-AT-J-HGAR
15.5	13.8	16.5	8	9.5	13.4	60	110	66.4/1	3,307/50	797/12	7,968/120	12	60	20	VD60-12.5Y-A-J-HFR	VD60-12.5Y-AT-J-HFR
15.5	15.5	16.5	8.9	9.5	13.4	60	110	72.17/1	3,609/50	895/12	8,949/120	6	60	20	VD60-6.2Y-A-J-HGR	VD60-6.2Y-AT-J-HGR
25.8	19.9	30	11.5	17.3	24.5	90	150	95.74/1	4,787/50	1,149/12	11,490/120	16	90	20	VD90-16.5Y-A-J-HHAR	VD90-16.5Y-AT-J-HHAR
25.8	21.6	30	12.5	17.3	24.5	90	150	103.9/1	5,195/50	1,247/12	12,471/120	16	90	20	VD90-16.5Y-A-J-HHCR	VD90-16.5Y-AT-J-HHCR
25.8	23	30	13.3	17.3	24.5	90	150	110.7/1	5,535/50	1,328/12	13,279/120	16	90	20	VD90-16.5Y-A-J-HHDR	VD90-16.5Y-AT-J-HHDR
25.8	25	30	14.4	17.3	24.5	90	150	120.3/1	6,015/50	1,443/12	14,434/120	16	90	20	VD90-16.5Y-A-J-HHR	VD90-16.5Y-AT-J-HHR
34.5	34.5	43	19.9	24.8	31.8	90	150	166/1	8,300/50	1,992/12	19,919/120	16	90	20	VD90-16.5Y-A-J-HHER	VD90-16.5Y-AT-J-HHER
34.5	34.5	43	19.9	24.8	31.8	105	200	166/1	8,300/50	1,992/12	19,919/120	14	105	20	VD105-14.4Y-A-J-HHER	VD105-14.4Y-AT-J-HHER
38	34.5	43	19.9	24.8	35.1	120	200	166/1	8,300/50	1,992/12	19,919/120	12	120	20	VD120-12.5Y-AK-J-HIAR	VD120-12.4-ATK-J-HIAR
38	38	43	21.9	24.8	35.1	120	200	182.8/1	9,140/50	2,194/12	21,940/120	12	120	20	VD120-12.5Y-AK-J-HIR	VD120-12.4-ATK-J-HIR
48.3	44	51	25.4	29.3	41.4	150	250	60/1	3,000/50	720/12	7,200/120	10	150	20	VD150-10Y-AK-J-HJAR	VD150-10Y-BTB-J-HJAR
48.3	44	51	25.4	29.3	41.4	150	250	211.7/1	10,585/50	2,540/12	25,404/120	10	150	20	VD150-10Y-AK-J-HJR	VD150-10Y-BTB-J-HJR
72.5	69	80	39.8	46.2	65.3	195	350	332/1	16,600/50	3,984/12	39,838/120	15	195	20	VD195-15Y-C-J-HKR	VD195-15Y-TC-J-HKR
95	92	100	53.1	57.7	81.6	225	400	442.6/1	22,130/50	5,312/12	53,118/120	40	225	20	VD225-40Y-C-J-HLR	VD225-40Y-TC-J-HLR
121	115	130	66.4	75.1	106.2	300	550	553.3/1	27,665/50	6,640/12	66,397/120	30	300	20	VD300-30-D-J-HMR	VD300-30-TC-J-HMR
145	138	150	79.7	86.6	122.5	375	650	664/1	33,200/50	7,968/12	79,677/120	24	375	20	VD375-24-D-J-HNR	VD375-24-TC-J-HNR
169	161	175	92.9	97.6	160	450	750	744.8/1	38,732/50	9,296/12	92,956/120	20	450	20	VD450-20-D-J-HRR	VD450-20-TC-J-HRR
242	230	250	132.8	144.3	204	675	1,050	1,106.61/1	55,330/50	13,279/12	132,794/120	30	675	20	VD675-26-D-J-HPR	VD675-30-TC-J-HPR
362	345	370	199.2	213.6	302	900	1,300	1,660/1	83,000/50	19,919/12	199,192/120	20	900	20	VD900-20-D-J-HQR	VD900-20-TC-J-HQR
425	400	450	231	260	360	1,000	1,450	1,925/1	96,228/50	23,095/12	230,947/120	18	1,000	20	VD1000-18-D-J-HUR	VD1000-18-TC-J-HUR

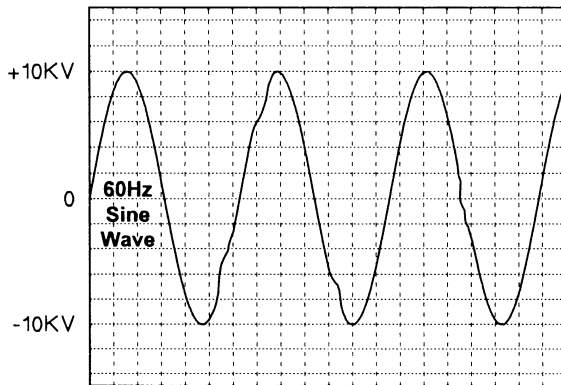
# HIGH VOLTAGE DIVIDERS FOR POWER QUALITY RECORDING SYSTEMS



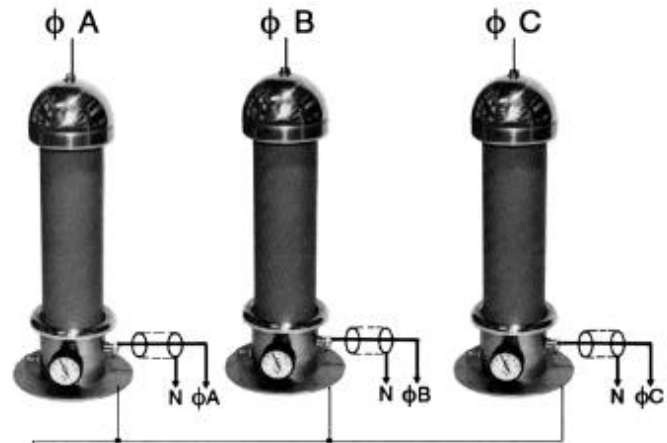
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RECORDER  
TRANSIENT RESPONSE USING  
WIDEBAND VOLTAGE DIVIDER



RECORDER  
TRANSIENT RESPONSE USING POTENTIAL TRANSFORMER  
OR NON COMPENSATED RESISTOR



Power Class High Voltage Dividers  
Wide Band DC-10MHz  
2.5KV to 362KV Line to Line



DRANETZ  
626 Recorder



FLUKE  
Scopemeter™

or others!



BMI  
4800 Recorder



TEKTRONIX  
222 PowerScout  
Oscilloscope

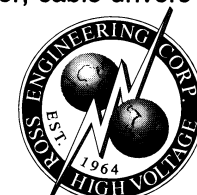
Ross Engineering Corporation has developed high voltage power line disturbance transducers that are compact, portable and user friendly for observing or recording to over 900KV PK. It utilizes state of the art Ross Engineering Corporation wide band power class, high frequency (DC up to 10MHz) high voltage dividers (VD's). In conjunction with DRANETZ, RPM, COOPER POWER, TEKTRONIX, BMI, FLUKE and many other analyzers/recorders these wide band VD's allow the recorders to accurately monitor voltages beyond the recorder's normal limits.

These new systems are on the leading edge of HARMONICS recording and are essential to accurately analyze power "glitches" to frequencies up to 10MHz. The previous technology that utilized frequency limited potential transformers (PT'S) was not able to accurately sense the higher frequency harmonics and transients needed to detect power quality problems that interfere with computers and sensitive controls, as well as harmonics which can cause overloads and equipment damage.

The Ross voltage dividers are available for purchase or weekly rental. They are easily used by attaching a lead from each phase of the HV power line directly to the top of each voltage divider and grounding each base. The 20ft low voltage output coax cable is connected to any suitable recorder, oscilloscope or computer. For greater distances, matching amplifier, cable drivers and Fiber Optic Transmission systems are available.

**ROSS ENGINEERING CORP.**

CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182

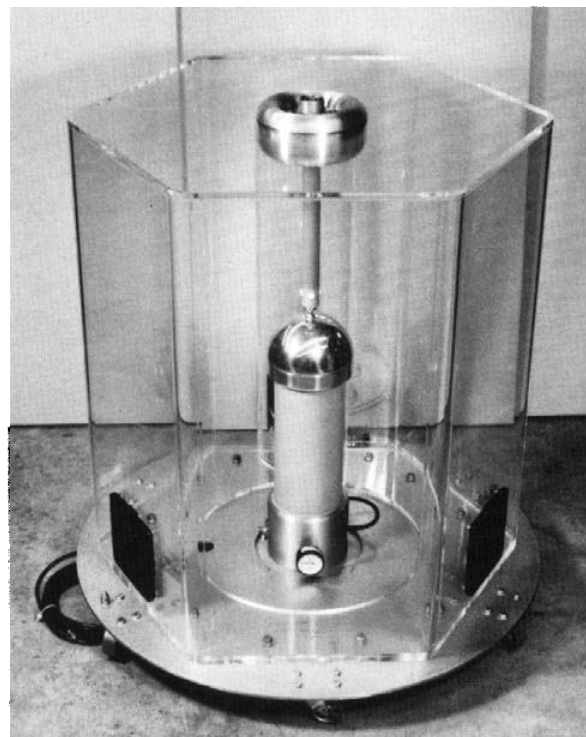
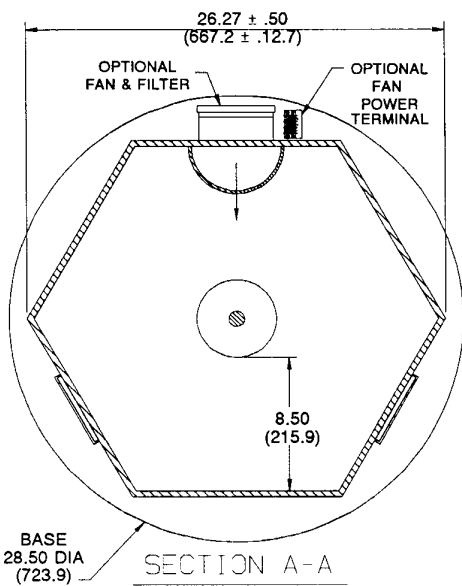


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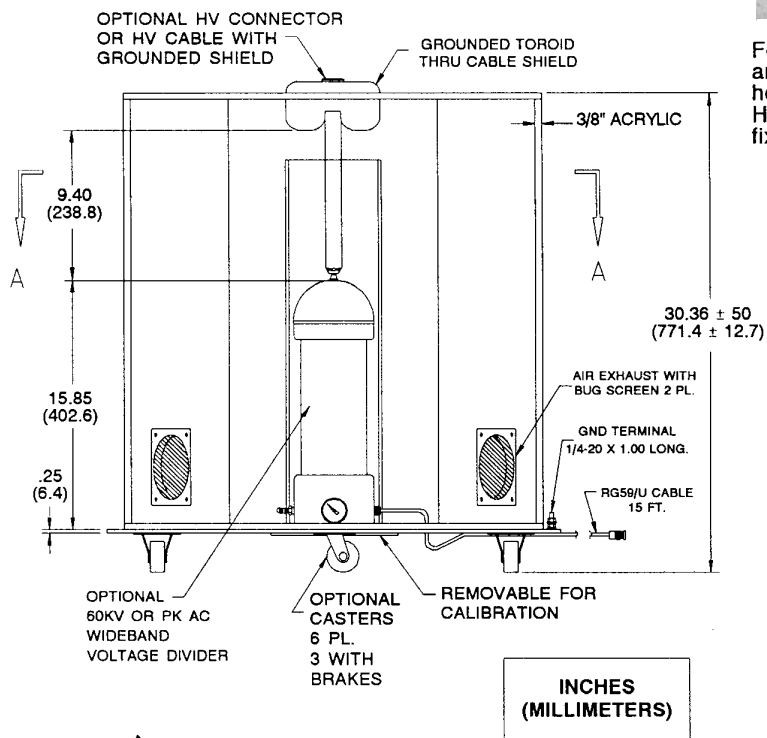


# TRANSPARENT INSULATED HOUSING FOR HIGH VOLTAGE DIVIDERS

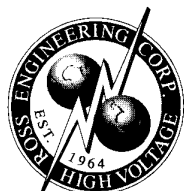
TYPICAL 60KV DC OR PK AC SIZE  
OTHER SIZES AND VOLTAGES AVAILABLE



For safe but visible operation thick wall acrylic housings are available. Sealed type Poly propylene and metallic housings with oil or insulating gas fill are also available. High voltage cable connectors or high voltage cable direct fixed input available.



15KV 30KV 60KV 120KV  
VD15 VD30 VD60 VD120



**ROSS ENGINEERING CORP.**  
CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182

# VOLTAGE LEVEL SENSOR / INTERLOCK

**USEFUL FOR POWER SUPPLY VOLTAGE LIMITER, CAPACITOR CHARGE LEVEL AND, UNDER OR OVER VOLTAGE CONTROL, OR INDICATING. STANDARD OR CUSTOM BUILT TO SPECIFIC APPLICATIONS**

Ross Engineering Corporation will custom build your voltage level sensor/indicator/interlock from our basic building blocks.

## DESCRIPTION:

For limiting, setting or indicating voltage levels of power supplies, required charge level for energy storage capacitors, and voltage level interlocking.

Some of the many options available are:

- High accuracy adjustable trip point.
- High sensor input impedance for internal line or external sensing.
- Extremely fast response or adjustable delay.
- Voltage level sensor can be powered from your AC line or DC source, 5 to 150V DC (If DC source voltage being sensed it must have a common connection), actuate from voltage whose level is being sensed (requires about 0.01 ampere for trip). Can have isolated trip input.
- Voltage level sensor can have transient protection installed.
- AC or positive, zero or negative voltage level can be sensed.
- Voltage levels to  $\pm 750$  volts can be sensed using resistors mounted internally on printed circuit board.
- Voltage levels greater than  $\pm 750$  volts can be sensed using external voltage dividers.
- Voltage levels less than  $\pm 1$  microvolt can be sensed under optimum conditions.
- Fixed trip point can be built into voltage level sensor.
- External resistor, or a trimmer potentiometer, or a remote conventional potentiometer may be used to set variable trip point.
- Hysteresis can be built into voltage level sensor, or a trimmer potentiometer, or conventional potentiometer may be used to adjust hysteresis.



Time delay on turn on or turn off can be built into voltage level sensor, or a trimmer potentiometer, or a conventional potentiometer may be used to adjust time delay.

Voltage level sensor can be provided on a printed circuit board for use in your equipment, or enclosed, or potted for protection from the environment.

Voltage level sensor can be designed for the temperature range of your equipment.

Voltage level sensor can be designed to have contacts of a mechanical relay to the output terminals, or it can be designed to drive an optical solid state relay, or it can be designed to drive the coil of a mechanical relay.

Voltage level sensor can be designed as a pin for pin replacement for obsolete voltage level detectors no longer available.

Give Ross Engineering Corporation your requirements and we will provide you with a price for a standard unit or to custom design and build a voltage level sensor to your specific requirements.



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# VOLTAGE LEVEL SENSOR / INTERLOCK STANDARD MODEL

## FOR FIXED TRIP SETTING

Trip point set with external selected resistor(s) for:

- Internal line or external source sensing.
- Internal trip range set (1V to 200V available).
- Sense polarity set + or AC, - optional.
- Power 115V AC non-isolated, common ground and neutral. Isolated inputs & outputs also available.

Set point repeatability 1% AC  
0.1% DC

Temperature range -10°C to 55°C.

Basic reset time 100 milliseconds.

Over-voltage withstand 200V to 2500V PK transient impulse, depending on model.

Output drives average 115V relay coil.  
Internal trip basic input resistance 78KΩ, 55V PK.  
Add external resistor for external trip sensing and omit R2. 0.7mA DC or AC PK into 78KΩ basic input to develop 55V DC or 39V RMS AC sense voltage across 78KΩ, 1/2 watt input resistor to trip. Sense voltages 1V to 200V available.

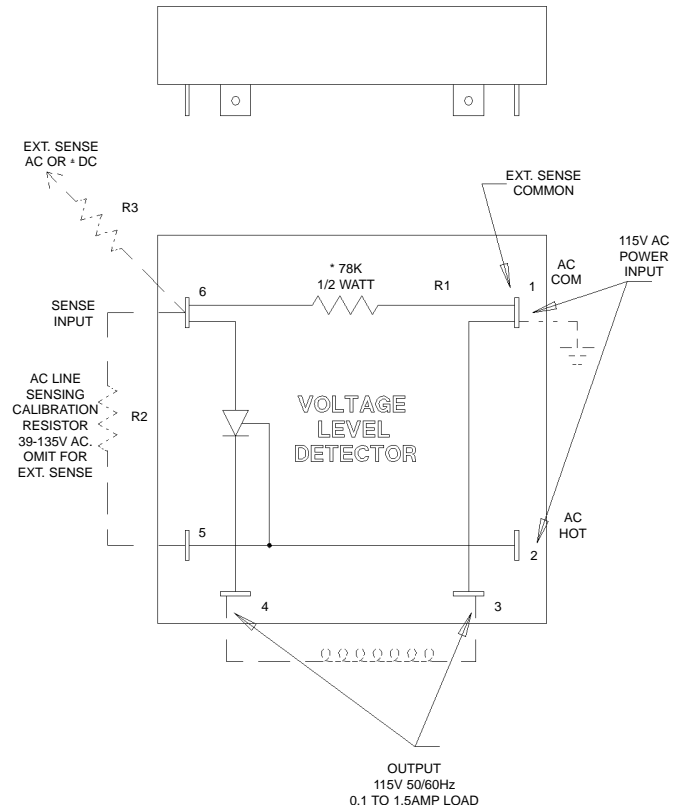
For adjustable trip, hysteresis, delay, isolated input, see Deluxe Model.

Note: For internal 115V AC line sensing, select resistance of R2 for desired operating point.

- ie \* For internal 100V AC RMS trip use 122K 1/2 watt for R2.
- \* For internal 39V AC RMS or 55V DC or AC PK trip use 0 ohms for R2.
- \* For external 1000V AC RMS or 1414V AC PK trip use 1.92MΩ 2 watts for R3 if R1 is 78K, omit R2.
- \* For external +1000V DC trip use 1.35MΩ 2 watts for R3 if R1 is 78K, omit R2.
- \* For external +10,000V DC trip use 14.1MΩ 20 watts for R3 if R1 is 78K, omit R2.
- \* For external 100,000V DC trip use 142MΩ 200 watts for R3 if R1 is 78K, omit R2.
- \* 78K R1 is basic internal resistor for line sensing.

To reduce external HV resistor wattage internal R1 can be increased to reduce required sensing current and external resistor wattage. Also internal sensitivity can be changed for very low sensing voltages.

For external sense select resistance of R3 and omit R2.



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# VOLTAGE LEVEL SENSOR / INTERLOCK DELUXE MODEL

## FOR VARIABLE TRIP, HYSTERESIS & DELAY SETTING WITH DIFFERENTIAL INPUT

**With:**

- Adjustable trip point.
- Adjustable hysteresis.
- Adjustable delay on turn off or turn on.  
Typical 0-2 seconds.
- Differential input (difference of two voltages floating about a common voltage).
- Trip point may be set for a negative, zero, positive, or AC voltage.
- Hysteresis may be set for any value within voltage range.

Delay on turn off or on (SPDT output) may be set for zero to minutes.

Power line isolation. Sense voltage common may be off ground by up to 1,000V DC.

**Power source:**

- 5 or 12 or 24V DC.
- 115, 208 or 230 Volt, 50/60Hz (specify)
- Non-isolated commons or isolated commons for power neutral and sense inputs.

Output, isolated mechanical relay. NC and NO contacts.

**Rated:**

- 8 amps 250V AC
- 8 amps 30V DC

Internal input trip range: specify on order,  $\pm 1$  Volt AC PK to +200 Volt into 1M $\Omega$ .

**Typical:**

- 0 to 127V AC
- OR
- 0 to 100V DC
- OR
- 10 to -5V DC
- OR
- 5 to +5V DC
- OR

Any higher voltage with external resistor.

Maximum allowable continuous sensor input current: 0.7mA into 1M $\Omega$  basic input to develop +, -, AC PK 1V to 200V.

Internal trip input resistance: 1M $\Omega$ .

Hysteresis: min. trip to max. turn on. Specify on order.

Typical range: 0 to 2 volt DC decrease to 40% of basic internal trip.

Set point repeatability 1% AC.  
0.1% DC.

Temperature range -10°C to +55°C.

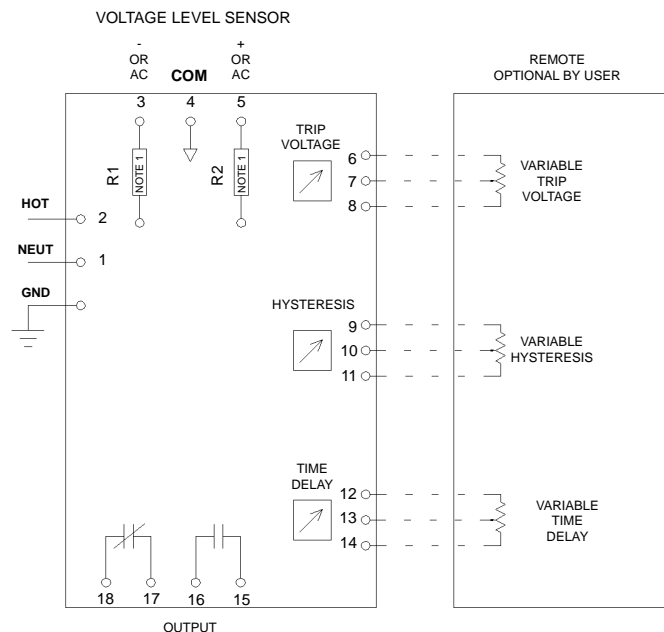
Basic reset time 100 milliseconds.

Over-voltage withstand 200V to 2500V, depending on model.

**Note:**

1. Select internal resistance of R1 and R2 for desired operating range.
2. To trip off AC line connect 1 to 4, 2 to 3, 4 to 5 and set function switch to AC.
3. If higher than 200V add external HV resistor to develop 1V to 200V, 0.7mA max across 1M $\Omega$  input resistor R1 or R2.

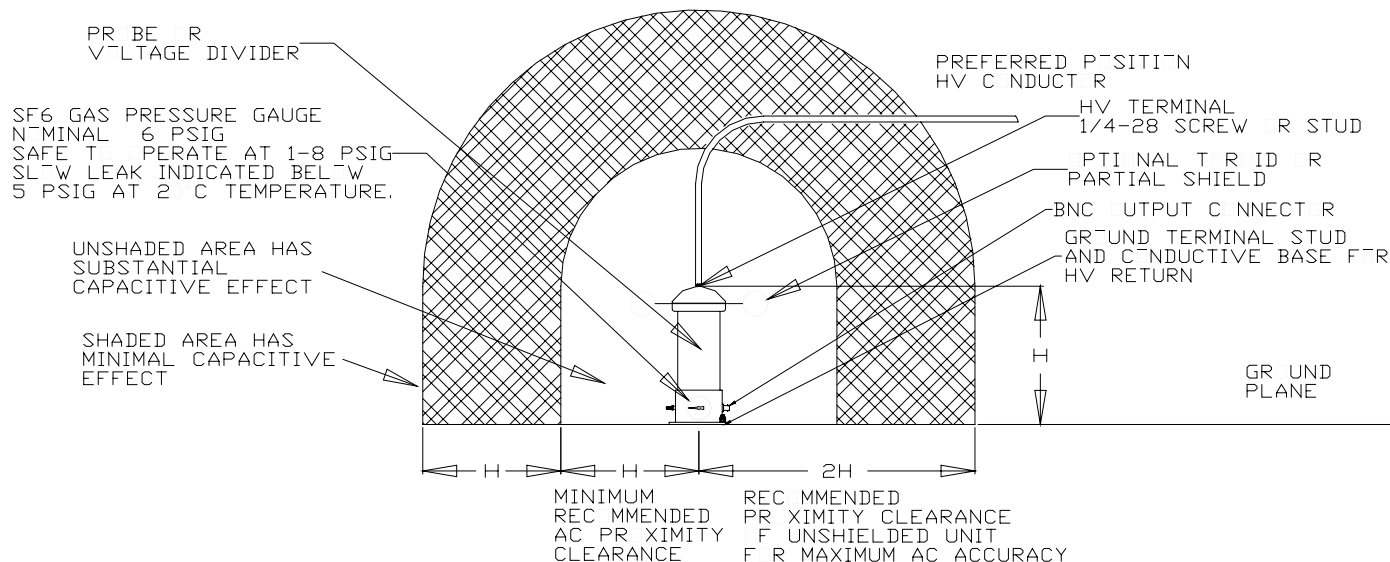
(Pin out & Block wiring diagram)



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# VOLTAGE DIVIDER & PROBE PROXIMITY EFFECTS & HV CLEARANCES



**HV CLEARANCE:** Spacing between HV and grounded objects or opposite polarity should be at least 1 inch (2.54cm) per 5KV to 10KV Peak (RMS x 1.414) AC or DC. No sharp edges or projections should be in the HV field. Large radiuses will reduce HV corona.

**PROXIMITY:** Proximity capacitive effects can reduce the accuracy of AC voltage readings. To minimize AC error, there should be no conductive materials nearer than H (distance equal to divider/probe height). For best AC accuracy radius should be 2H if possible unless calibrated in place or in a simulated proximity. Some insulating materials may also affect AC readings. Objects in the area above the plane at the top of the divider will also affect readings, but not as much as those in cylindrical area around the divider. HV conductor routing going to the top of the voltage divider/probe above the plane at the top can also affect accuracy. VMP probe units are usually more sensitive in this area and the high voltage conductor should follow the probe's center line at least 9 inches above the high voltage connection. Larger HV or grounded objects will have greater AC effect. Toroids will provide partial AC shielding, and reduce both AC proximity and AC or DC corona.

AC error is caused by capacitive effects. The smaller the object and the farther from the voltage divider or probe, the less the AC accuracy is affected. Near the base of the cylinder and beyond the radius equal to the height H, the AC effect should be less than 0.5%. Corona can affect both AC and DC. DC accuracy is not affected by capacitance effects.

For probes the HV point of contact at which the measurement is made should optimally be spherical and of large enough diameter to minimize corona at the existent voltage. When tubing or wire is used to connect to the high voltage terminal, the tubing diameter or wire insulation should be adequate to minimize corona. See document number 070980-B, entitled NORMAL AC CALIBRATION CONNECTIONS, for recommended high voltage input conductor routing and details of our standard calibration configurations.



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11/04-1500

# HIGH VOLTAGE PROBES

## *FOR ION IMPLANTATION*

USED TO MEASURE VOLTAGES ON ION IMPLANTERS FOR SEMICONDUCTOR MANUFACTURING



VMP 200 PROBE KIT WITH INSULATED HANDLES AND VMD2A 4 1/2 DIGIT WIDEBANDVOLTMETER FOR 200KV PK DC TO 1MHZ. AVAILABLE TO 400KV PK

### HV PROBES FOR OSCILLOSCOPES, DIGITAL METERS, AND RECORDERS

The Ross VMP high voltage probe with its OSHA safety complying HV insulated handle accurately measures high voltage with as low as 0.1% DC and 0.5% AC accuracy, wideband, DC to 1MHz up to as high as 10MHz when matched with the appropriate meter or oscilloscope. Voltages can be read at a convenient 1000:1 ratio or 10,000:1 ratio. Other ratios or multiple ratios also available. Ideal for power supply DC voltage and ripple measurements, pulse viewing and measurement with wave form display, measurement or recording devices. Ross collapsible insulated handle "Hot Stick" is supplied according to OSHA recommendations to maintain the proper clearance between HV and personnel. Insulated 100KV per ft. for protection, the Ross "Hot Stick" handles easily connect to the VMP probe as well as collapse to fit into an optional protective carrying case. Hand held probes 5KV PK to 400KV PK and base mounted high accuracy compensated wideband voltage dividers are available for both indoor and outdoor use from 5KV to 1,000KV DC or AC PK. Also available are base mounted high voltage precision Voltage Dividers to  $\pm .01$  % DC and 0.2% 50/60Hz. Allow 8 weeks for delivery. Specify Power class RMS, or Electronic Class DC or PK AC operate voltage, ratio, length of coaxial output cable, instrumentation load input resistance and capacitance, DC and/or AC accuracy and frequency range desired. Complete voltmeters, waveform recording, and fiber optic transmission systems are available.



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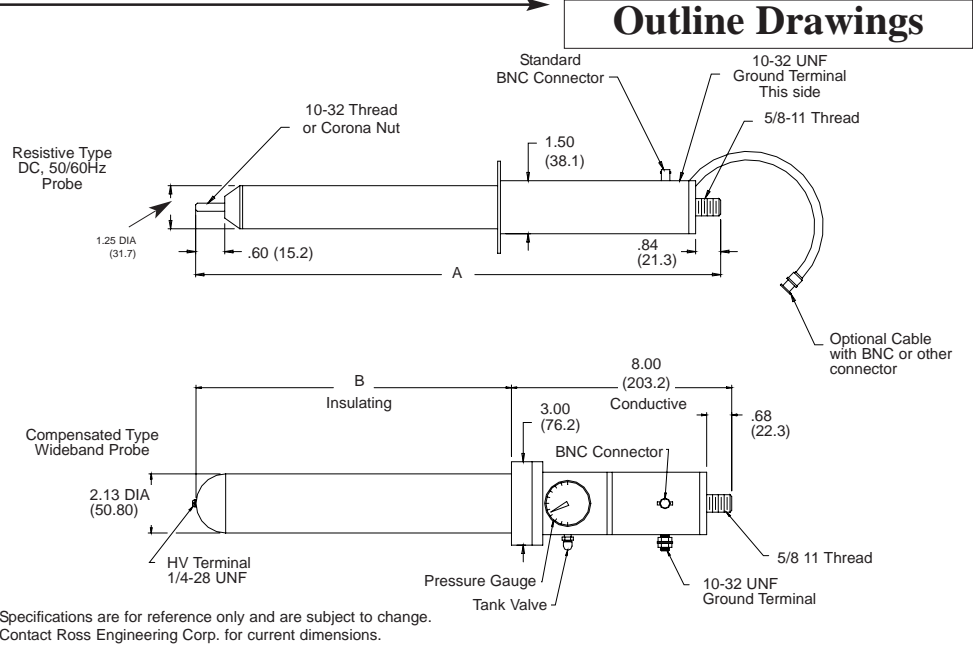
# HV PROBES

Ross HV probes are designed for hand-held portable applications with insulated handles or base mount use. Portable capacitive, resistive, or compensated types are used with digital multimeters, oscilloscopes, and panel meters. Resistive types are primarily for DC and 50 or 60Hz AC or other specific single frequency sine wave, while the capacitive types are for higher frequencies and pulse work. Resistance/capacitance wide-band DC to 10MHz (or more) models work preferred for general use.

Standard calibration is centered around 2/3 to 3/4 of the maximum rating and is matched for 1 megohm, 20 to 50pF oscilloscopes or

recording devices, or 10 Megohm 75-100pF input impedance multimeter and 3, 6 or 15 feet (91.4, 182.9 or 457.2 Centimeters) (please specify) of RG-59 coaxial cable. Fiber optic or 50-75 ohm coaxial transmission is recommended for wideband transmission over 20 feet (609.6 Centimeters). Any type can be calibrated and matched for best accuracy at specific frequencies and voltages within their capabilities. Other ratios and matching are available. Unless rules of shielding and proximity are followed, VMP series models may not be as accurate on AC as the VD models due to proximity of walls, ground plane equipment, etc. Complete voltmeter & recording or display systems are available.

DIMENSIONS		
MODEL	A	B
VMP 5-8.3-C-J **	7.00 (177.8)	---
VMP 7-8.3-C-J	11.22 (284.9)	---
VMP 15-G-J VMP30-E	12.09 (307.0)	---
VMP 15-25-J	---	4.63 (117.6)
VMP 30-G-J VMP60-E	16.75 (425.4)	---
VMP 30-12.5-J	---	9.13 (231.9)
VMP 60-G VMP90-E	25.75 (654.05)	---
VMP 60-8.3-J	---	14.96 (379.9)
VMP 120-G-J	25.75 (654.05)	---
VMP 120-6.2-J	---	17.34 (440.4)
VMP 150-5-J	---	20.19 (512.8)
VMP 200-3.8-J	---	26.75 (679.4)
VMP 300-2.5-J	---	40.41 (1,026.4)
VMP 400-J	---	56.75 (1,441.4)



Specifications are for reference only and are subject to change. Contact Ross Engineering Corp. for current dimensions.

TYPICAL UNITS - MANY OTHERS AVAILABLE				SPECIFICATIONS				HV PROBE TYPE VOLTAGE DIVIDER OR SERIES MULTIPLIER								
★ MODEL		★ MAXIMUM OPERATE CONTINUOUS		*ACCURACY ± %				NORM. FREQUENCY RANGE	MAXIMUM CW RF CURRENT	★ KV MAXIMUM IMPULSE 1.2X50 μSEC TEST SINGLE PULSE	*** NOMINAL INPUT		**STANDARD RATIO TO LOAD AND 15 FT. SPECIAL ROSS COAX CABLE		RECOMMENDED MINIMUM ALLOWABLE HANDLE LENGTH IN FEET	
ELECTRONIC CLASS	POWER CLASS	ELEC-TRONIC CLASS DC OR PK AC	POWER CLASS RMS L-L	* BEST ACCURACY	DC %	*50 OR 60Hz %	*WIDE-BAND %				RESISTANCE MEGOHMS	CAPACITANCE PF NORMAL	10 MEG 100pF	1 MEG 30pF	Related to OSHA MIN	NOM. POWER CLASS
VMP30E-G VMP30E-25H	VMP15-G VMP15-25Y-H	30KV 30KV	5KV 5KV	20KV 20KV	.1	1	3	DC, 50/60Hz DC-1MHz	7.5A	60 KV 60 KV	300 300	RES ONLY 25	1,000/1 1,000/1	1,000/1 1,000/1	4 4	6 6
VMP60E-G VMP60E-25H	VMP30-G VMP30-125Y-H	60KV 60KV	8.25KV 8.25KV	45KV 45KV	.1	1	3	DC, 50/60Hz DC-1MHz	7.5A	120KV 120KV	600 600	RES ONLY 12.5	1,000/1 1,000/1	1,000/1 1,000/1	4.5 4.5	6 6
VMP90E-G VMP90-E	VMP60-G VMP60-8.3Y-H	90KV 90KV	25.8KV 25.8KV	60KV 60KV	.1	1	3	DC, 50/60Hz DC-1MHz	7.5A	150 KV 150 KV	900 900	RES ONLY 8.3	1,000/1 1,000/1	10,000/1 10,000/1	5 5	9 9
VMP120-G VMP120-62H		120KV 120KV	38KV 38KV	80KV 80KV	.1	1	3	DC, 50/60Hz DC-1MHz	7.5A	200 KV 200 KV	1200 1200	RES ONLY 6.2	1,000/1 1,000/1	10,000/1 10,000/1	6 6	9 9
VMP150-G VMP150-10Y-H		150KV 150KV	48KV 48KV	100KV 100KV	.1	1	3	DC, 50/60Hz DC-1MHz	7.5A	250 KV 250 KV	1500 1500	RES ONLY 10	1,000/1 1,000/1	10,000/1 10,000/1	7.5 7.5	9 9
VMP200-7.6Y-H		200KV	72KV	150KV	.1	1	3dB	DC-1MHz	7.5A	300 KV	1950	7.6	1,000/1	10,000/1	7.5	9
VMP250-6.2Y-H		250KV	95KV	187KV	.1	2	3dB	DC-1MHz	7.5A	400 KV	2400	6.2	1,000/1	10,000/1	10	12
VMP300-5Y-H		300KV	121KV	225KV	.2	3	3dB	DC-1MHz	7.5A	500 KV	3000	5	1,000/1	10,000/1	13	14
VMP400-3.8Y-H		400KV	145KV	300KV	.2	5	3dB	DC-1MHz	7.5A	600 KV	3900	3.8	1,000/1	10,000/1	13	14

\* With proper proximity of nearby conducting surface. Accuracy can be improved by calibrating with known proximity. Accuracy is at 2/3 of max rating unless otherwise required. Calibration points are every 10 to 20% and are included with instruction manual. Other calibration points are optional. Some probes are subject to limits on frequency, and proximity of HV and conductive surfaces, to obtain stated accuracies.  
\*\* Most standard models are single ratio, single or dual load matching to oscilloscope or DMM.

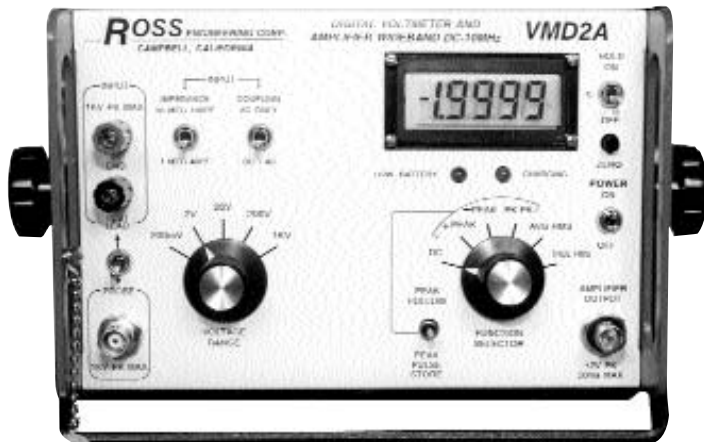
Higher input resistance or capacitance and other ratios available including multiple matching and multiple ratios. Insulating handles and heavy superflex insulated ground leads are available.  
★ Electronic class is rated on max continuous operate without overheating, but with less safety factor for over-voltage. Impulse is a test rating only. Power class has more safety factor.  
See brochure B-1010, B-1012, and B-1017 for more information on handles, digital probes and digital displays. Note: Change -H to -J and -G to -GJ if insulated handles are required.



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# VOLTMETERS



## DC-10MHz AC, DC & Peak Reading Meter

Designed especially for wideband use with high voltage probes and HV voltage dividers, portable ROSS VMD/VMDP series digital multimeters or matched oscilloscopes are high-accuracy units capable of 0.01% to 0.3% on most functions. Large 4 1/2 digit display is easily read indoors or out. Models are designed for safe use on high power industrial circuits or electronic circuits up to 1000V DC or PK AC. If more than 1,000 volts DC or 700 volts AC RMS (1000V PK) is possible, HV probes, which have up to 2 to

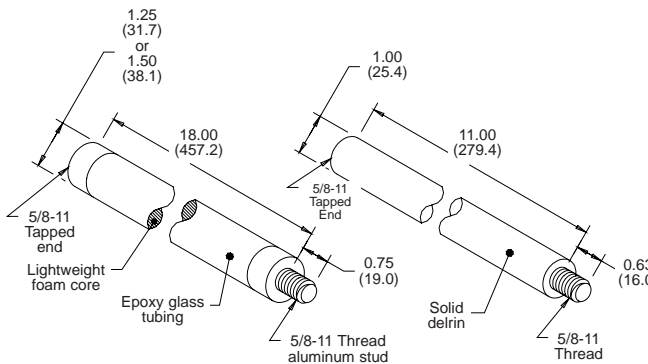
1 safety factors for transient voltages above their HV ratings, are used. Special meter units to match 0.01% dividers are also available.

### Features VMD2A: 4 1/2 Digit DC-10MHz

Wideband Digital Voltmeter DC-10MHz with True RMS and True Peak Capability. Matches HV resistive probe for DC and 50 or 60Hz, HV compensated wideband resistance capacitance probe or base mounting Voltage Divider. Will measure up to 1,000,000V with proper Ross Probe or Divider.

- Basic Unit 0.000010V to 1000V PK, 700V RMS, to 1,000,000V with proper Ross Probe or Divider. 0.01% DC, 0.1% 50/60Hz, to 3% to 1 MHz, 1DB at 10MHz.
- 0.01% to 3% DC-1 MHz accuracy with HV probes or Voltage Dividers for most HV uses. 1 meg 40pF and 10meg 100pF selectable input impedances.
- DC, AC True RMS, avg (in RMS), True + Peak, -Peak, Peak to Peak.
- As fast as 200 nanosec pulse 1/2 sine 2MHz capture & hold.
- AC and DC coupled inputs.
- 50 ohm  $0 \pm 2V$  PK output for scope or other instrumentation and driving 50 ohm coaxial cable, AC/Battery operated. Includes 40 hour or more rechargeable battery and AC charger/adaptor 115V or 230V 50/60Hz (please specify voltage).
- 8"x5"x5" (203.2x127.0x127.0 millimeters). 5.5 Lbs.(2.5 Kg.).
- Fully Portable, Rugged Design. BNC and standard banana input. See Brochure B-1010 Multimeters.

## Outline Drawings



Ross Engineering Collapsible Hot sticks are designed to maintain proper safety clearances from hazardous High Voltage while handholding a test instrument. The 1 or 1 1/2 foot (30.4 or 45.7 Centimeters) sections of the Hot stick form a rigid handle from 1 to 12 feet (30.4 to 365.7 Centimeters) in length, with at least 100KV withstand per foot, depending on your specific needs. \*Please see the OSHA table to define what clearance is appropriate for your applications. Each 1 to 1 1/2 inch (25.4 to 38.1 millimeters) diameter section is constructed using high strength solid insulating rod or G-10 Epoxy-glass tubing. Hot sticks using tubing are sealed and filled with lightweight plastic foam to form a rigid insulating support. These 1 or 1 1/2 foot (30.4 and 45.7 Centimeters) sections can be joined easily to create the desired length of Hot stick. Disassembled, hot sticks store easily in a carrying case. The size and weight of the Collapsible Hot sticks make them ideal for use in portable test sets. 5/8-11 threaded or tapped ends are standard and fit most standard equipment. 1 inch diameter Hot stick are also available in lengths to 3 feet.

## Insulated Handles

### Standard Handle Lengths

Model	Handle Length (feet)	Handle Diameter (inches)	Number of sections
VMHSC-3-A	3.0	1.00	1 or 3
VMHSC-3	3.0	1.25	2
VMHSC-4.5	4.5	1.25	3
VMHSC-6	6.0	1.25	4
VMHSC-7.5	7.5	1.25-1.5	5
VMHSC-9	9.0	1.25-1.5	6
VMHSC-12	12.0	1.25-1.5	8

### Recommended OSHA Clearances from Title 8 Electrical Safety Orders, page 390 dated 12-22-95

Minimum voltage and clear Hot Stick distance. 100KV/FT withstand when clean and dry. Ross Engineering Corp. is not responsible for user's choice of length.

*OSHA Table 2940.2. For alternating current minimum clearances voltage range phase to phase Kilovolts RMS	Voltage Range Line to Ground		*OSHA Minimum Clear Hot stick Distance Add 16"-24" to allow for handhold
	Kilovolts RMS	Kilovolts PK or DC	
1.0 to 15.0KV	0.635 to 8.7KV	0.9 to 12.3KV	2ft. 1in.
15.0 to 36.0KV	8.7 to 20.8KV	12.3 to 29.4KV	2ft. 4in.
36.0 to 46.0KV	20.8 to 26.6KV	29.4 to 37.4KV	2ft. 7in.
46.0 to 72.5KV	26.6 to 41.8KV	37.5 to 59.1KV	3ft. 0in.
72.5 to 121.0KV	41.8 to 69.8KV	59.2 to 98.7KV	3ft. 4in.
121.0 to 145.0KV	69.8 to 83.7KV	98.7 to 118.4KV	3ft. 7in.
145.0 to 169.0KV	83.7 to 97.6KV	118.4 to 138.0KV	4ft. 0in.
169.0 to 242.0KV	97.6 to 139.7KV	138.0 to 197.5KV	5ft. 3in.
242.0 to 362.0KV	139.7 to 209.0KV	197.5 to 295.5KV	*8ft. 6 n.
362.0 to 552.0KV	209.0 to 318.7KV	295.5 to 450.6KV	*11ft. 3in.
552.0 to 765.0KV	318.7 to 439.9KV	450.6 to 622.0KV	*15ft. 0in.

\*\*Hot sticks should be long enough to allow at least the clear distance after necessary hand hold. It is recommended that a guard be positioned on the hot stick to indicate the minimum clear length. Where possible faults or arcing may occur, longer lengths than OSHA recommends should be used, i.e. : Many utilities require at least 6' total length even below 38KV RMS Line to Line.

\*See OSHA for further Details.




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# HIGH VOLTAGE PROBES

FOR OSCILLOSCOPES, DIGITAL METERS, RECORDERS

- 1KV TO 1,000KV PK.
- DC, AC.
- WIDEBAND DC - 10MHz.
- 0.01% - 0.1% DC
- 0.2% - 1% 50/60Hz.
- 3% - 3dB WIDEBAND




**VMDP120 HV MULTIMETER**  
120KV DC AND 85KV RMS  
AVAILABLE 15KV TO 400KV PK

**VMP30 PROBE**  
30KV DC OR PK AC

**VMP60 PROBE**  
60KV DC OR PK AC


**VMP 200 PROBE WITH INSULATED HANDLES**  
FOR 200KV PK DC TO 1MHz. AVAILABLE TO 400KV PK

**WIDEBAND HV VOLTAGE DIVIDERS**  
AVAILABLE 5KV TO 1,000KV PK



	VD15	VD30	VD60	VD75	VD120	OUTDOOR
POWER CLASS RMS	1.5KV	5KV	15KV	22KV	38KV	5KV-425
BIL	20KV	60KV	110KV	130KV	200KV	60KV-1450KV
ELECTRONIC CLASS DC OR PK AC	15KV	30KV	60KV	75KV	120KV	30KV - 1,000KV

**VMD2A 4 1/2 DIGIT WIDEBAND MULTIMETER**  
DC-10MHz,  
TRUE RMS, AVG RMS  
TRUE PEAK FOLLOW,  
1uSEC PULSE HOLD,  
10uV TO 1000V, TO  
1000KV WITH PROBE



The Ross VMP high voltage probe with its OSHA safety complying HV insulated handle accurately measures high voltage with as low as 0.1% DC and 0.5% AC accuracy, wideband, DC to 1MHz up to as high as 10MHz when matched with the appropriate meter or oscilloscope. Voltages can be read at a convenient 1000:1 ratio or 10,000:1 ratio. Other ratios or multiple ratios also available. Ideal for power supply DC voltage and ripple measurements, pulse viewing and measurement with waveform display, measurement or recording device. Ross collapsible insulated handle "Hot Stick" is supplied according to OSHA recommendations to maintain the proper clearance between HV and personnel. Insulated 100KV per ft. for protection, the Ross "Hot Stick" handles easily connect to the VMP probe as well as collapse to fit into an optional protective carrying case.

Hand held probes 5KV PK to 400KV PK and base mounted high accuracy compensated wideband voltage dividers for both indoor and outdoor use from 5KV to 1,000KV DC or AC PK are available. Also available are base mounted high voltage precision Voltage Dividers to  $\pm .01\%$  DC and 0.2% 50/60Hz. Allow 8 weeks for delivery. Specify Powerclass RMS or Electronic Class DC or PK AC operate voltage, ratio, length of coaxial output cable, instrumentation load input resistance and capacitance, DC and/or AC accuracy and frequency range desired. Complete voltmeters, display recording and fiber optic transmission systems are available.



**ROSS ENGINEERING CORP.**

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# HV PROBES

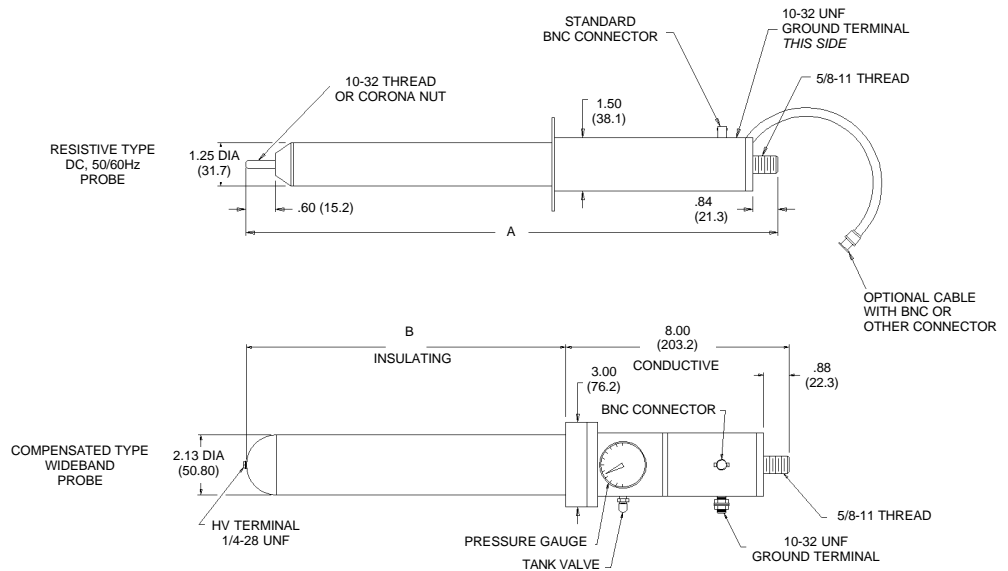
Ross HV probes are designed for hand-held portable applications with insulated handle or base mount use. Portable capacitive, resistive, or compensated types are used with digital multimeters, oscilloscopes, and panel meters. Resistive types are primarily for DC and 50 or 60Hz AC or other specific single frequency sine wave, while the capacitive types are for higher frequencies and pulse work. Resistance/capacitance wide-band DC to 10MHZ (or more) models are preferred for general use.

Standard calibration is centered around 2/3 to 3/4 of the maximum rating and is matched for 1 megohm, 20 to 50 pF oscilloscopes or

recording devices or 10 Megohm 75-100 pF input impedance multi-meter and 3, 6 or 15 feet (91.4, 182.9 or 457.2 Centimeters) (please specify) of RG-59 coaxial cable. Fiber-Optic or 50-75 ohm coaxial transmission is recommended for wide-band transmission over 20 feet (609.6 Centimeters). Any type can be calibrated and matched, for best accuracy at specific frequencies and voltages within their capabilities. Other ratios and matching are available. Unless rules of shielding and proximity are followed, VMP Series models may not be as accurate on AC as the VD models due to proximity of walls, ground plane equipment, etc. Complete Voltmeter & recording or display systems are available.

## Outline Drawings

DIMENSIONS		
MODEL	A	B
VMP 5-8.3-C-J **	7.00 (177.8)	--
VMP 7-8.3-C-J	11.22 (284.9)	--
VMP 15-G-J VMP30-E	12.09 (307.0)	--
VMP 15-25-J	--	4.63 (117.6)
VMP 30-G-J VMP60-E	16.75 (425.4)	--
VMP 30-12.5-J	--	9.13 (231.9)
VMP 60-G VMP90-E	25.75 (654.05)	--
VMP 60-8.3-J	--	14.96 (379.9)
VMP 120-G-J	25.75 (654.05)	--
VMP 120-6.2-J	--	17.34 (440.4)
VMP 150-5-J	--	20.19 (512.8)
VMP 200-3.8-J	--	26.75 (679.4)
VMP 300-2.5-J	--	40.41 (1,026.4)
VMP 400-J	--	56.75 (1,441.4)



Specifications are for reference only and are subject to change. Contact Ross Engineering Corporation for current dimensions.

TYPICAL UNITS - MANY OTHERS AVAILABLE		SPECIFICATIONS						HV PROBE TYPE VOLTAGE DIVIDER OR SERIES MULTIPLIER								
I MODEL		I KV MAXIMUM OPERATE CONTINUOUS		*ACCURACY ±%			NORMAL FREQUENCY RANGE	MAXIMUM CW RF CURRENT	I KV MAXIMUM IMPULSE 1.2X50 uSEC TEST SINGLE PULSE	***NOMINAL INPUT		**STANDARD RATIO TO LOAD AND 15' SPECIAL ROSS COAX CABLE.		RECOMMENDED MINIMUM ALLOWABLE HANDLE LENGTH IN FEET		
MODEL ELECTRONIC CLASS	MODEL POWER CLASS	ELECTRONIC CLASS DC OR PK AC	POWER CLASS RMS L-L	*KV BEST ACCURACY	DC %	*50 OR 60Hz %				*WIDE-BAND %	RESISTANCE MEGOHMS	CAPACITANCE PF NORMAL	10 MEG 100pF	1 MEG 30pF	OSHA MIN	NOM. POWER CLASS
VMP30E-G VMP30E-25-H	VMP15-G- VMP15-25Y-H	30 KV 30 KV	5 KV 5 KV	20 KV 20 KV	.1	1	3	DC, 50/60Hz DC-1MHz	7.5A	60 KV 60 KV	300 300	RES ONLY 25	1,000/1 1,000/1	1,000/1 1,000/1	3 3	6 6
VMP60E-G VMP60E-25-H	VMP30-G- VMP30-12.5Y-H	60 KV 60 KV	8.25 KV 8.25 KV	45 KV 45 KV	.1	1	3	DC, 50/60Hz DC-1MHz	7.5A	120 KV 120 KV	600 600	RES ONLY 12.5	1,000/1 1,000/1	1,000/1 1,000/1	4.5 4.5	6 6
VMP90E-G VMP90E-	VMP60-G- VMP60-8.3Y-H	90 KV 90 KV	25.8 KV 25.8 KV	60 KV 60 KV	.1	1	3	DC, 50/60Hz DC-1MHz	7.5A	150 KV 150 KV	900 900	RES ONLY 8.3	1,000/1 1,000/1	10,000/1 10,000/1	6 6	9 9
VMP120-G- VMP120-6.2-H		120 KV 120 KV	38 KV 38 KV	80 KV 80 KV	.1	1	3	DC, 50/60Hz DC-1MHz	7.5A	200 KV 200 KV	1200 1200	RES ONLY 6.2	1,000/1 1,000/1	10,000/1 10,000/1	6 6	9 9
VMP150-G- VMP150-10Y-H		150 KV 150 KV	48 KV 48 KV	100 KV 100 KV	.1	1	3db	DC, 50/60Hz DC-1MHz	7.5A	250 KV 250 KV	1500 1500	RES ONLY 10	1,000/1 1,000/1	10,000/1 10,000/1	7.5 7.5	9 9
VMP200-7.6YH		200 KV	72 KV	150 KV	.1	1	3db	DC-1MHz	7.5A	300 KV	1950	7.6	1,000/1	10,000/1	7.5	9
VMP250-6.2Y-H		250 KV	95 KV	187 KV	.1	2	3db	DC-1MHz	7.5A	400 KV	2400	6.2	1,000/1	10,000/1	9	12
VMP300-5Y-H		300 KV	121 KV	225 KV	.2	3	3db	DC-1MHz	7.5A	500 KV	3000	5	1,000/1	10,000/1	10.5	12
VMP400-3.8Y-H		400 KV	145 KV	300 KV	.2	5	3db	DC-1MHz	7.5A	600 KV	3900	3.8	1,000/1	10,000/1	12	14

\* With proper proximity of nearby conducting surface. Accuracy can be improved by calibrating with known proximity. Accuracy is at 2/3 of max rating unless otherwise required. Calibration points are every 10 to 20% and are included with instruction manual. Other calibration points are optional.  
\* Some probes are subject to limits on frequency, and proximity of HV and conductive surfaces, to obtain stated accuracies.

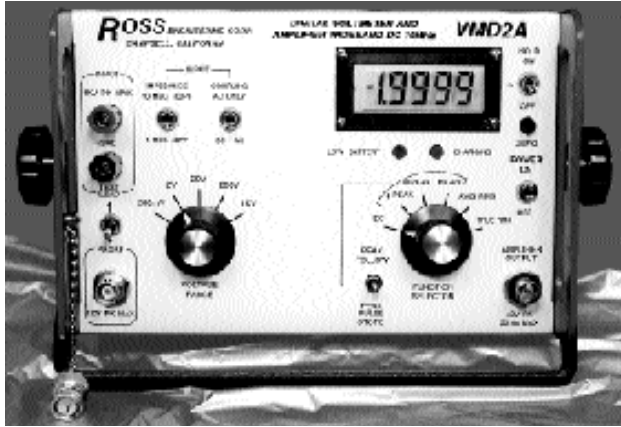
\*\* Most standard models are single ratio, single or dual load matching to oscilloscope or DMM. Higher input resistance or capacitance and other ratios available including multiple matching and multiple ratios. Insulating handles and heavy superflex insulated ground leads are available.  
I Power class is rated on the basis of 3 phase line to line and BLL (basic impulse level) with high safety factor. Electronic class is rated on max continuous operate without overheating, but with less safety factor. Impulse is a test rating only.  
See brochure B-1010, B-1012, and B-1017 for more information on handles, digital probes and digital displays.  
Note: Change -H to -J and -G to -GJ if insulated handles are required.



**ROSS ENGINEERING CORP.**

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# VOLTMETERS



## DC-10MHz AC, DC & PEAK READING METER

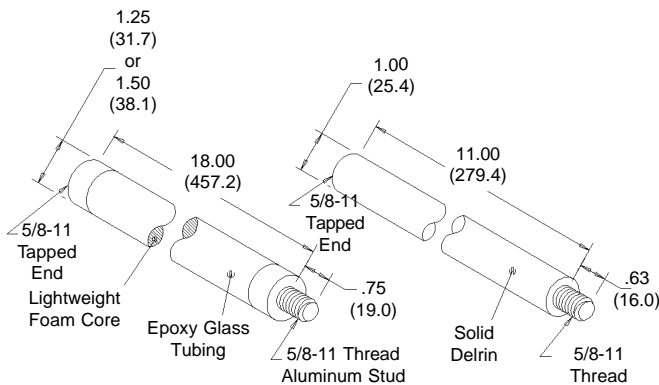
Designed especially for wideband use with high voltage probes and HV voltage dividers, portable ROSS VMD/VMDP series digital multimeters or matched oscilloscopes are high-accuracy units capable of 0.01 % to 0.3% on most functions. Large 4 1/2 digit display is easily read indoors or out. Models are designed for safe use on high power industrial circuits or electronic circuits up to

1000V DC or PK AC. If more than 1,000 volts DC or 700 volts AC RMS (1000V PK) is possible, HV probes, which have up to 2 to 1 safety factors for transient voltages above their HV ratings, are used. Special meter units to match 0.01 % dividers to 1,000,000V and differential inputs are also available.

### Features VMD2A: 4 1/2 Digit DC-10MHz

- Wideband Digital Voltmeter DC-10MHz with True RMS and True Peak Capability. Matches HV resistive probe for DC and 50 or 60Hz or with HV compensated wideband resistance capacitance probe or base mounting Voltage Divider.
- Basic Unit 0.000010V to 1000V DC, 1000V PK, 700V RMS, to 1,000,000V with proper Ross Probe or Divider. 0.001 % DC, 0.1 % 50/60Hz to 3% to 1 MHz, 3DB at 10MHz.
- 0.01 % to 3% DC-1 MHz accuracy with HV probes or Voltage Dividers for most HV uses. 1 meg 40pF and 10meg 100pF selectable input impedances.
- DC, AC True RMS, Avg (in RMS), True + Peak, -Peak, Peak to Peak.
- As fast as 200 nanosec 1/2 sine pulse capture & hold.
- AC and DC coupled inputs.
- 50 ohm 0±2V PK output for scope or other instrumentation and driving 50 ohm coaxial cable or 50 ohm loads. 115V AC/Battery operated. Includes 40 hour or more rechargeable battery and AC charger/adaptor 115V or 230V 50/60Hz (please specify voltage).
- 8" X 5" X 5" (203.2 X 127.0 X 127.0 millimeters). 5.5 Lbs. (2.5 Kg).
- Fully Portable, Rugged Design. BNC and standard banana input. See Brochure B-1010 Multimeters.

## Outline Drawings



Ross Engineering Collapsible Hotsticks are designed to maintain proper safety clearances from hazardous High Voltage while handholding a test instrument. The 1 or 1 1/2 foot (30.4 or 45.7 (Centimeters) sections of the Hotstick form a rigid handle from 1 to 12 feet (30.4 to 365.7 Centimeters) in length, with at least 100KV withstand per foot, depending on your specific needs. \*Please see the OSHA table to define what clearance is appropriate for your applications. Each 5/8 to 1 1/2 inch (15.9 to 38.1 millimeters) diameter section is constructed using high strength solid insulating rod or G-10 Epoxy-glass tubing. Hotsticks using tubing are sealed and filled with lightweight plastic foam to form a rigid insulating support. These 1 and 1 1/2 foot (30.4 and 45.7 Centimeters) sections can be joined easily to create the desired length of Hotstick. Disassembled, hotsticks store easily in a carrying case. The size and weight of the Collapsible Hotsticks make them ideal for use in portable test sets. 5/8-11 threaded or tapped ends are standard and fit most standard equipment.

# INSULATED HANDLES

## Standard Handle Lengths

Model	Handle Length (feet)	Handle Diameter (inches)	Number of sections
VMHSC-3	3.0	1.00	1 or 3
VMHSC-3	3.0	1.25	2
VMHSC-4.5	4.5	1.25	1 or 3
VMHSC-6	6.0	1.25	4
VMHSC-7.5	7.5	1.25-1.5	5
VMHSC-9	9.0	1.25-1.5	6
VMHSC-12	12.0	1.25-1.5	8

## Recommended OSHA Clearances from Title 8 Electrical Safety Orders, page 390 dated 12-22-95

Minimum voltage and clear Hot Stick distance. 100KV/FT withstand when clean and dry. Ross Engineering Corp. is not responsible for user's choice of length.

*OSHA Table 2940.2. For alternating current - Minimum clearances Voltage Range Phase to Phase Kilovolts RMS	Voltage Range Line to Ground		*OSHA Minimum Clear Hotstick Distance
	Kilovolts RMS	Kilovolts PK or DC	Add 16"-24" to allow for Handhold
1.0 to 15.0 KV	0.635 to 8.7 KV	0.9 to 12.3 KV	2 ft. 1 in.
15.0 to 36.0 KV	8.7 to 20.8 KV	12.3 to 29.4 KV	2 ft. 4 in.
36.0 to 46.0 KV	20.8 to 26.6 KV	29.4 to 37.4 KV	2 ft. 7 in.
46.0 to 72.5 KV	26.6 to 41.8 KV	37.5 to 59.1 KV	3 ft. 0 in.
72.5 to 121.0 KV	41.8 to 69.8 KV	59.2 to 98.7 KV	3 ft. 4 in.
121.0 to 145.0 KV	69.8 to 83.7 KV	98.7 to 118.4 KV	3 ft. 7 in.
145.0 to 169.0 KV	83.7 to 97.6 KV	118.4 to 138.0 KV	4 ft. 0 in.
169.0 to 242.0 KV	97.6 to 139.7 KV	138.0 to 197.5 KV	5 ft. 3 in.
242.0 to 362.0 KV	139.7 to 209.0 KV	197.5 to 295.5 KV	*8 ft. 6 in.
362.0 to 552.0 KV	209.0 to 318.7 KV	295.5 to 450.6 KV	*11 ft. 3 in.
552.0 to 765.0 KV	318.7 to 439.9 KV	450.6 to 622.0 KV	*15 ft. 0 in.

\*\* Hotsticks should be long enough to allow at least the clear distance after necessary hand hold. It is recommended that a guard be positioned on the hotstick to indicate the minimum clear length. Where possible faults or arcing may occur, longer distances are advisable. Many organizations may have regulations requiring longer lengths than OSHA listed here, i.e.: Many utilities require at least 6' total length below 38KV RMS Line to Line.

\*See OSHA for further Details



# ROSS ENGINEERING CORP.

Campbell, CA 95008 PHONE:(408)377-4621 - FAX:(408)377-5182



# HI-Z<sup>®</sup> PROBES

High Voltage Probes for Very Low Current Power Supply Voltage

Measurement to 120KV, such as Electrostatic Paint Spray Applications...



120KV  
Probe

Optional  
insulated  
handle  
available

- Up to 120KV DC, 85KV AC RMS 50/60 Hz or more.
- 10,000 megohms or more HV input resistance.
- Usable with any digital meter of 10 megohms input.
- Higher voltage, higher resistance, lower current also available.
- Available with insulated handle meeting OSHA recommendations.
- Only draws 12 microamps at 120KV DC, minimizing power supply loading.
- 1000/1 ratio with 10 megohm output load, 10,000/1 ratio with 1 megohm output load.
- Available with 0.5% or better DC accuracy when supplied complete with meter or calibrated with user's digital meter.



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e-mail: [info@rossengineeringcorp.com](mailto:info@rossengineeringcorp.com)

## Hi-Z<sup>®</sup> HIGH VOLTAGE AC OR AC/DC VOLTMETERS

**HIGH IMPEDANCE POWERCLASS™  
PORTABLE ANALOG OR DIGITAL  
FOR POWER LINE USE  
FOR BOTH CAPACITANCE TAP VOLTAGE TEST POINTS AND DIRECT  
HIGH VOLTAGE LINE OR OTHER HV SOURCES**

HV Power Line Measurement

0-200V to 0-100KV Line to Ground

0-200V to 0-100KV Line to Line

Phasing

Hot Line Indication

AC only

AC & DC



VM50D METER

**COMPLETE KITS INCLUDE:**

- 25KV, 50KV OR 100KV METER WITH INTEGRAL LINE TO GROUND PROBE
- PHASING OR LINE TO LINE WITH ADDITIONAL PROBE
- OPTIONAL 6FT OR 9FT COLLAPSIBLE HOTSTICKS
- VOLTAGE SOURCE FOR TESTING VOLTMETERS AND PROBES
- OPTIONAL TEST POINT CONTAMINATION INDICATING MEGMETER<sup>®</sup>
- HIGH VOLTAGE CABLE CLAMPS OR HOOKS
- HEAVY DUTY CARRYING CASE



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**MODELS VM25E & VM50E WITH A LARGE ANALOG DISPLAY, 250V, 5KV, 10KV, 25KV, 50KV & 100KV RMS AC RANGES**

Excellent for accurate cable elbow and other capacitance voltage tap test point measurement, phasing, energized line or switch open or closed indication, as well as direct HV line voltage measurement. The VM25 measures very low current high source impedance voltages in three or more ranges to 25KV. The VM50 measures up to 50KV in four or more ranges. The VM100 measures up to 100KV in four or more ranges. HV input is high impedance, 20 megohms to over 1,000 megohms as required. They are partially shielded against stray electrical fields and have a 125KV, 150KV or 300KV basic impulse test level, as required. They utilize a large 2.88" long standard meter scale for accurate voltage measurement. Basic accuracy is  $\pm 3\%$ . 3 1/2 or 4 1/2 digit LCD digital display also available where greater accuracy is required.

LINE TO GROUND PROBE

0-25KV, 0-50KV OR  
0-100KV METER

METER WITH INTEGRAL LINE TO GROUND PROBE

OPTIONAL HOTSTICKS

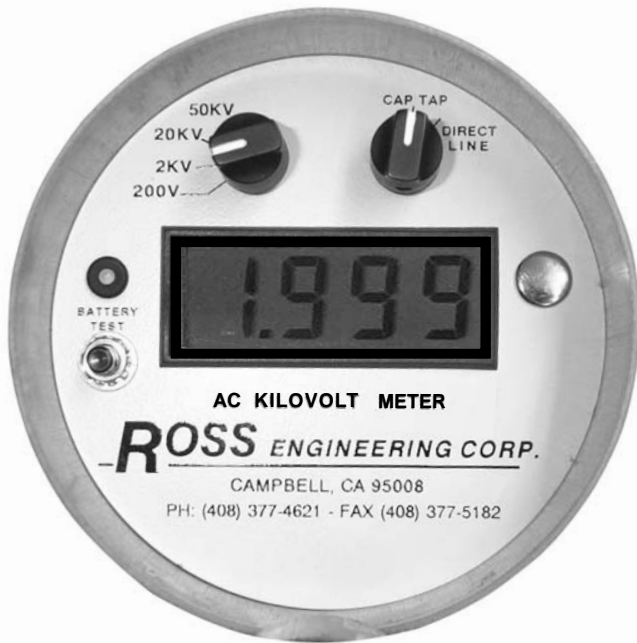
PHASING & LINE TO LINE PROBE

REMOVABLE HOOKS



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 e-mail: info@rossengineeringcorp.com





**DIGITAL MODEL VM25D, VM50D OR VM100D  
200V, 2KV, 20KV, 25KV, 50KV OR 100KV RMS AC  
RANGES**

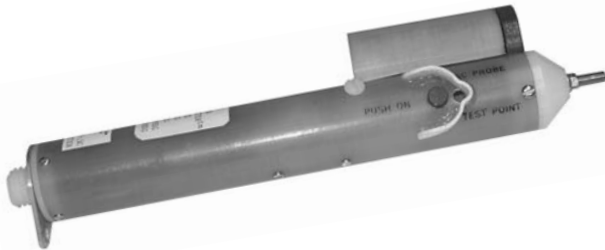
For capacitance tap voltage test points on cable connectors and for direct HV lines in the range of 10 volts up to 100KV RMS, 50/60Hz. Optionally incorporated for higher accuracy in Ross Engineering Corporation's proven Hi-Z® Voltmeter.

These meters are widely used for voltage sensing, accurate measurement and phasing. They can be used with capacitance tap voltage test points on cable elbows and other voltage test point terminals as well as on overhead lines. They are rated for 125KV, 150KV or 300KV PK basic impulse test level.



**MODEL VMTS-.4**

Solid state AC voltage source for testing voltmeters and probes.



**MODEL VMT-5 VOLTMETER TESTER, MEGMETER®**

Solid state voltmeter verifier, insulation tester and voltage test point contamination detector. This device provides 400V AC to test VM and also includes a pocket insulation leakage indicator for the range of 20-2000 megohms at 500V DC. Hotstick adapted 600V maximum withstand. 15KV maximum withstand when used with 30 megohms adapter. Very useful for determining if low readings at voltage test points are caused by contamination or insulation leakage.



**VMT-.5C HV ADAPTER FOR MEGMETER®**

Provides limiting resistors for 15KV withstand, if megmeter is placed on hot line. Subtract 30 megohms from resistance reading.



**ROSS ENGINEERING CORP.**

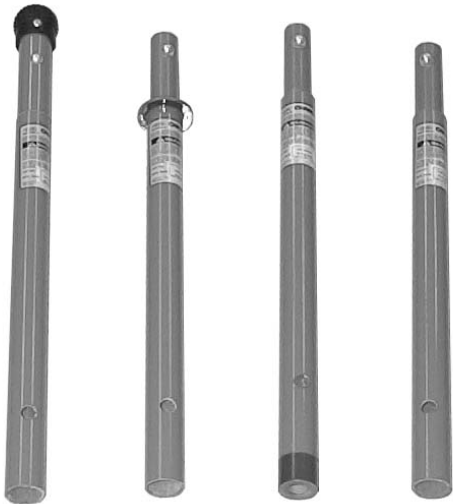
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e-mail: info@rossengineeringcorp.com



Special probes, meters and adapters are available with choice of voltage and input impedance for line to ground, line to line measurement, or phasing differential measurement. These meters are recommended for accurate voltage measurement (depending on capacitance voltage tap accuracy) on Elastimold, Burndy, Joy, RTE, KEARNY, GE or other cable termination capacitance taps and high impedance voltage sources as well as direct HV AC lines.

## COLLAPSIBLE HOTSTICKS

1.5ft sections



Ross Engineering Corporation's collapsible hotsticks are designed to maintain proper safety clearances from hazardous high voltage while hand holding a test instrument. The 1.5 foot 1.25 or 1.5 inch dia. sections of the hotstick form a rigid handle from 1.5 to 12 feet in length depending on your specific needs. Please see the OSHA clearance table to determine what clearance is appropriate for your applications. Each section is constructed using high strength insulating tubing. Hotsticks are sealed and filled with lightweight plastic foam to form a rigid insulating support. These 1.5 foot sections can be joined easily to create the desired length of hotstick. Disassembled, hotsticks store easily in a carrying case. The collapsible hotsticks' size and weight make them ideal for use in portable test sets. A 5/8 - 11 tapped end is standard and fits most standard equipment.

**6 foot model VMHSC-6-B/C 1.25" DIA**  
**9 foot model VMHSC-9-C/C 1.5" DIA**



**VMPA-TED for 8-15KV dead-break terminal**

*Plug in terminals for direct HV line voltage measurement on ESNA or GE transformer or switch terminals and cable Elbows or Tees.*

### ANSI STANDARD INTERFACE #3

HV probe extension to allow VMP25, VMP50 or VMP100 probes to plug directly on to ESNA type dead-break transformer or switch terminal & touch HV conductor.



**VMPA-CED for 8-15KV dead-break terminal**

HV probe extension to allow VMP25, VMP50 or VMP100 probes to plug directly on to ESNA type dead-break Elbow or Tee & touch HV conductor.



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# PORTABLE TEST SET FOR VOLTMETERS



## MODEL VMTS.-4

400 Volt AC voltage source for verification of HV voltmeter or other types of AC voltmeters, requiring less than 500 microamps.

Battery operated solid state, safe low power AC test source with built-in indicator light and automatic switch for HV voltmeter test probe application.

Indicates either open or shorted probes or erratic meter or ground lead operation by means of combination visible light and meter indication.

HV meter with VM-25 or VM-50 probe should indicate approximately 2 to 4KV on voltmeter capacitance tap setting or 200-400V on direct line setting when probe is pressed into test set probe terminal and ground clip is in contact with test set ground terminal. Visible light on tester indicates at least 60 volts is present at test set terminal. If meter does not read 4KV when light is on, erratic operation is indicated in meter, probe or ground lead.

If test set light does not come on when test probe is applied, erratic operation is indicated in either meter or test set. Test set can be checked by disconnecting ground lead from test set ground terminal. If light goes on when probe terminal is depressed, test set is generating at least 60 volts.

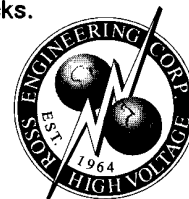
Test can also be run without ground lead connected to test set. Meter will indicate approximately 2KV to 4KV (not recommended for precise calibration, because of variations possible due to effective load capacitances). Test light will not light below approximately 60 volts or for loads which have lower than approximately 600,000 ohms resistive, or over approximately 800 Picofarad capacitive.

Voltage will drop off proportionately with decrease in load resistance (increase in load current), but will drop only very little if load is pure (wattless) capacitance until over the 800 Picofarad level. The supply will then rapidly saturate, reducing the voltage to a very low value.

See also Model VMT.-5-C for combination voltmeter verifier and capacitance tap verifier--megohm leakage indicator to 2000 megohms.

Caution: test sets are capable of several milliamps which can cause slight shocks.

**ROSS** ENGINEERING CORP.  
CAMPBELL, CA 95008 PH: (408) 377-4621 - FAX (408) 377-5182



# MEGMETER™

**VOLTMETER TESTER-CAPACITANCE TAP VOLTAGE TEST POINT VERIFIER**  
**MEGOHM INDICATOR TO 2,000 MEGOHMS**



VMT-.5-C

## MODEL VMT-.5 MEGMETER™

For portable hotstick operation, this is a combination source of 400V AC and 500V DC voltmeter tester-megohm leakage indicator in one small flashlight size unit. Supplies 400V AC to and VM-25 & VM 50 capacitance tap probes plus 500V DC megohm indicator which will indicate contamination or leakage on the capacitance tap or any insulation, even in the presence of an AC voltage as high as 15KV AC with an ungrounded source. Unit will indicate in the range of from over 2,000 megohms down to 20 megohms and less by means of a flashing neon lamp. Critical leakage resistance values in capacitance taps and most HV insulation are in the order of 20 megohms to over 2,000 megohms, and this unit is designed for this range as well as short circuits. 400V AC test section is similar to Portable Tester VMTS-.4.

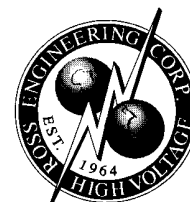
Delivery of the VMT-.5-C is 4 to 8 weeks, depending on quantity and type.

The hotstick adapted VMT-.5-C is available as a combination 500V DC megohm indicator 400V AC tester for voltmeters, capable of withstanding up to 15KV AC on capacitance taps or direct AC lines and reading DC leakage resistance even on the energized capacitance tap or ungrounded high voltage AC line.

**Caution:** With 15KV isolation limiter test set output current is limited to approx 50 microamps at tip but is capable of several milliamps at 400V AC VM test point which can cause slight shocks.

**Caution:** Safety rules apply when using in the possible presence of high voltage.

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# VOLTAGE SENSING, MEASUREMENT, & PHASING

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**HUGH C. ROSS**

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## Abstract

Sensing of energized lines, accurate voltage measurement, and phasing by portable isolated instrumentation has proved practical and reliable on modern underground systems. Specifically designed solid state HV voltmeters and accompanying test and verification devices have proved useful and reliable in conjunction with the capacitance Voltage Test Point now found on many devices. Standardization on practical values of capacitance and surface leakage on voltage test points is still a consideration to achieve maximum usefulness.

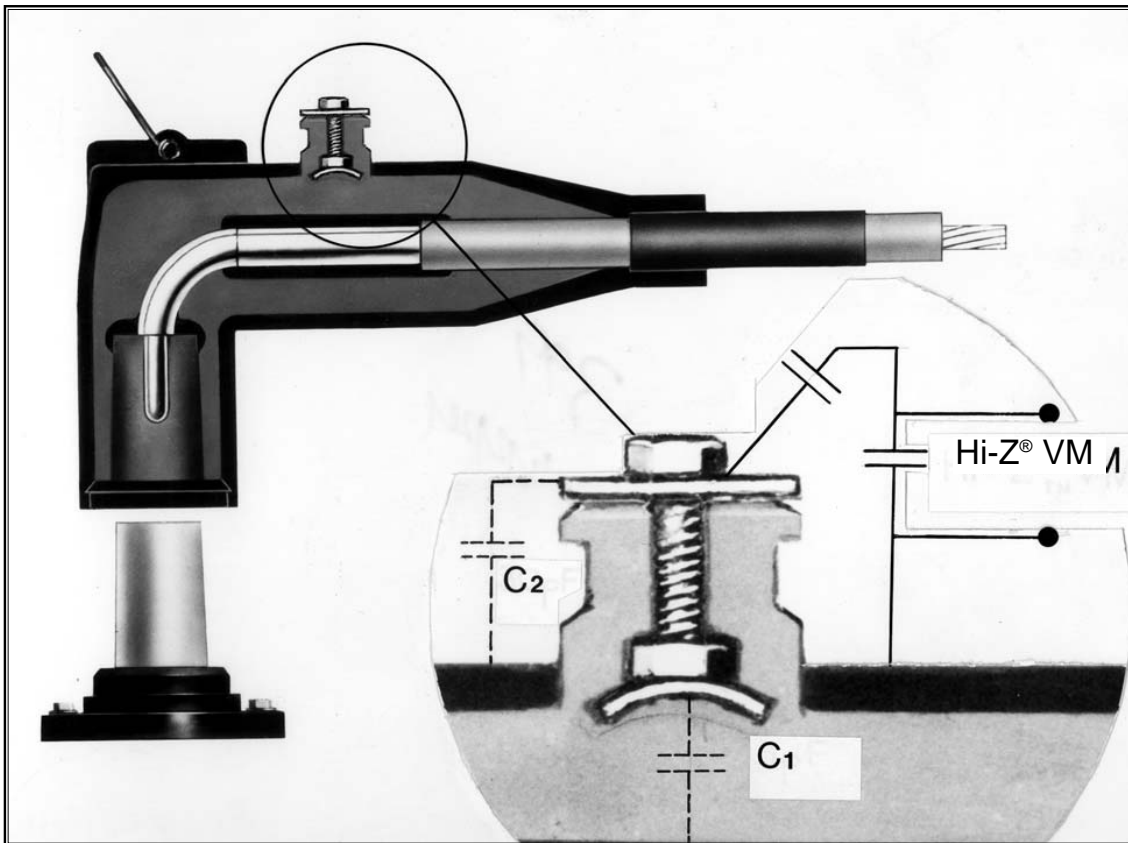


Figure 1: Typical voltage test point; C1 HV end capacitance; C2 LV end capacitance



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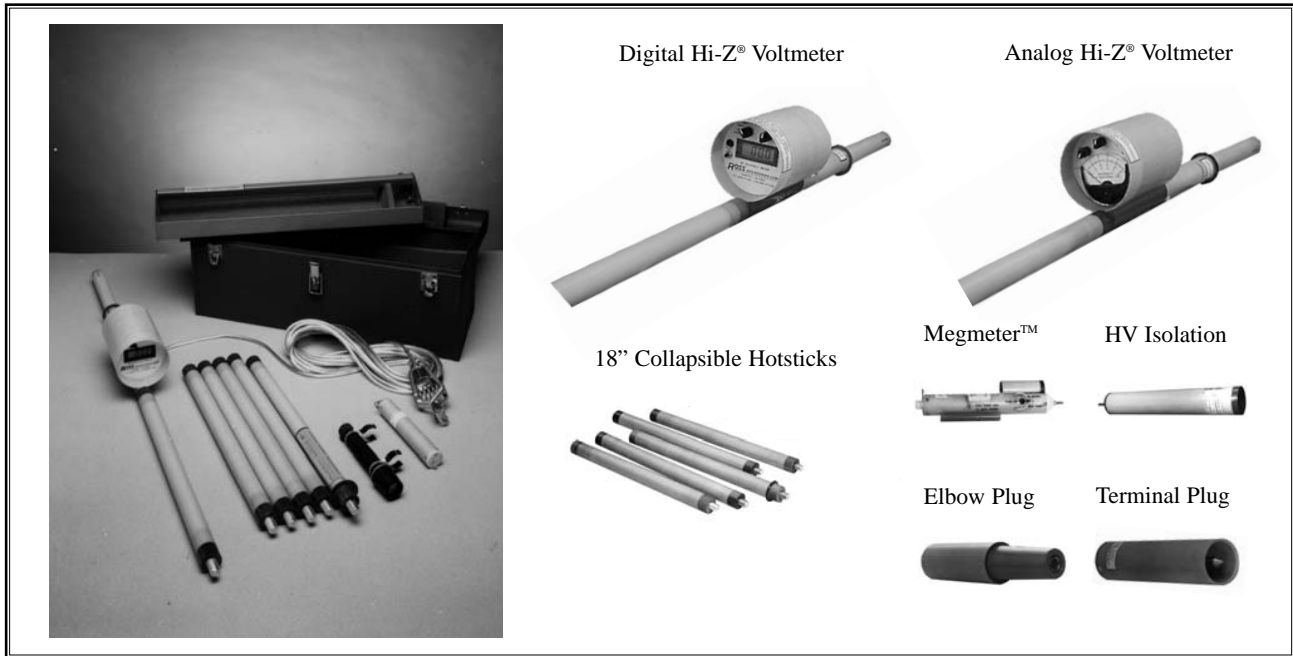


Figure 2: Portable Hi-Z<sup>®</sup> HV voltmeter and accessories for measuring line to ground, line to line, and phasing voltages from capacitance voltage test points and direct HV line.

Underground systems with shielded cables and connectors provided few points for direct hot line measurement. This presents considerable difficulty in determining the presence of voltage on an energized line and even more difficulty in accurate voltage measurement and phasing with a portable voltmeter. Considerable help has had been provided by the voltage test point, a capacitance type voltage tap now being used in several types of cable connectors, elbows, splices, and equipment. This type of tap is essentially a capacitive voltage divider which makes use of the cable's, connector's, or bushing's high voltage insulation between the HV conductor and a conductive, isolated, plate or band to create a useful HV capacitor under the outer shield (see Fig. 1).

### Capacitance Ratios

In many of the cable terminations now being used, the HV capacitance of the Voltage Test Point between the HV conductor and the isolated tap plate is in the order of 1.6 to 1.8 picofarad (C<sub>1</sub> of Fig. 1). This value is obtained by choosing the proper size of a pickup plate or band, its distance from the HV conductor, and the arrangement of shielding in the molded connector or equipment.

Accompanying this HV capacitance

is low voltage end capacitance in the order of 6 to 8 picofarads to ground (to shield) (C<sub>2</sub> of Fig.1), thus creating a combination of two capacitances giving a voltage divider effect. These values give a basic average ratio of  $(7+1.7) / (1.7)$  or  $(8.7) / (1.7)$  which reduces to approximately  $(5.1) / 1$ . Larger values of the LV end capacitance could also be used as a standard. For a 10 to 1 ratio approximately 15.75PF would be necessary, or it can be even larger. The low voltage end capacitance is not critical if the HV end is standard. Voltmeter impedances can be low enough to "swamp out" a 6 to even a 50PF capacitance, the voltmeter itself then establishing its own ratio independent of the LV end capacitance.

If the voltmeter impedance must be kept very high, to more easily match the variations in the HV end and is then dependent on the capacitance ratio, then this LV end capacitance also becomes critical in establishing the ratio.

### Design Considerations

In the design of the capacitances of the voltage test point, shielding positions as well as sizes of conductors, and thickness, dielectric constant and operating temperature of the dielectric must be considered. Capacitance variation, with variation in applied voltage level,

can also be a consideration.

In order to obtain the desired HV end capacitances, the size of the pickup plate, which is generally at a required distance from the conductor due to required insulation level, is the major variable available. This plate can be enlarged to a band around the entire conductor insulation, since the size of the HV conductor plays a critical part in determining the capacitance.

In the plug-in cable connectors, if internal grading shields are not shaped properly to shield the tap plate from the cable conductor, variations in size of cable conductor and dielectric constant of cable insulation will appreciably change the HV end capacitance to the tap plate.

One utility found it could even determine the size of a conductor by the voltage reading. The larger the cable conductor, the higher the voltage reading with the same style of elbow connector and a fixed line voltage. Some brands show considerably more variations due to conductor size variation since the plate is not as remote from the incoming cable.

A major design consideration of a voltage test point also is the external insulation path to ground. Some present designs have extremely short paths for an area that should maintain over 1,000 megohms leakage resistance if a

very high input impedance voltmeter is used. A long skirted path is desirable. On one of the widely used elbows, the voltage output of the test point unloaded is 1/5 of the 7.2KV line to ground voltage, or approximately 1.4KV for a 12.5KV system. This, of course, is so limited in current output (5 to 10 microamps) by the low source capacitance that it in itself is not dangerous, but it can cause leakage paths to form on the short insulation path if cleanliness is not constantly observed.

Some brands and models of taps have somewhat different capacitances and therefore somewhat different ratios, some varying as much as 2 or 3 times these amounts. This creates considerable difficulty in designing a universal voltmeter to use these taps and an effort is being made to standardize on at least the most important, the HV end capacitance in the order of 1.75 picofarad. The low voltage end capacitance is less important; however, it has been suggested that it be standardized in the value of 7PF to give a basic minimum ratio of 5 to 1, which then can be padded externally to give any higher ratios desired.

A much higher HV end capacitance would be considerably better, perhaps in the order of 3PF or even 10 or 15PF, since the very low value of 1.75PF presents considerable difficulty for accurate voltage measurement with an economical device. The higher capacitance would also reduce the effect of moisture or dirt which could cause low or even zero readings if the test point were not cleaned properly. However, it appears that increasing this HV capacitance involves changing present production molds and adds considerable development expense to the connectors. Thus it may be economically unfeasible for an established item to be modified to meet the desired value.

#### Sensing Energized Lines

Using this capacitance voltage tap, or voltage test point as has been suggested for a standard name, for merely indicating an energized line is relatively easily done with a moderately priced high impedance sensing and indicating device. Using it for accurately measuring actual voltages line to ground is more difficult because of meter loading and external interference. Further, using it for line to line voltage measurement and phasing becomes even

more difficult with added external capacitance problems. However, with proper matching impedance, input voltages, and shielding in an objectively designed high impedance voltmeter, all of these measurements can be made generally within better than 10%, usually better than 5%, depending primarily on the accuracy of the voltage test point capacitances themselves.

At this time there are different capacitances in some manufacturers' models. For accurate measurement the voltmeter then must have different input matching and ratios for voltage test points on some of the different brands and types of connectors and equipment.

#### Portable HV Voltmeter

A solid state portable voltmeter and associated accessories, called the Hi-Z® HV Voltmeter, has been developed for hot stick use by Ross Engineering Corporation to match the voltage test point on the Elastimold 15KV elbow. It also matches the Burndy 15KV load break elbow test point, the ITT Blackburn elbow test point and others, without need for changing voltmeter probes, but will also match the brands and models with different capacitances in their test points by changing either the voltmeter's removable probe or a selector switch. Experience with production units in the field for the past three years has shown this method is

reliable for portable voltage and phasing measurement.

With such an extremely high impedance source (1.75 picofarad is approximately 1,500 megohms 7PF is approximately 370 megohms at 60Hz) extreme care must be taken in shielding the higher impedance (100-1000 megohm) pickup probes and voltage test points, particularly if exposed HV taps or lines are near the test point. External pickup is not nearly as critical when using the 1 megohm to 85 megohm probes which can be used with specific brands of connectors or equipment.

#### Phasing

For line to line phasing by use of test points, capacitance loading must be carefully balanced to prevent pickup or unequal changes in capacitance ratios, which could cause serious errors in line to line or phasing differential readings.

The voltmeter is provided with both line to ground (Figure 3) and line to line and phasing probes (Figure 4) which are shielded and balanced for accurate measurement by voltage test points for lines from a few volts to 25KV, as a line to ground, a line to line, or a phase differential voltage.

This has increased its versatility considerably, since it also can detect the presence of AC voltage, even at the surface of many semi-conductive shielded concentric neutral cables, thus



Figure 3: Application of voltmeter probe for line to ground voltage measurement on voltage test point.





Figure 4: Application of voltmeter probes for phasing or line to line measurement on voltage test points.

indicating voltage existing on the internal conductor when there is no voltage test point available. Due to the variations in semi-conductive shielding resistance in various brands of cables, not all cables will indicate properly. If voltage presence is indicated, the cable is definitely energized. However, for some types of semi-conductive shielded cables with very low or very high surface resistance, or for metallic shielded cables, insufficient indication may result.

#### Contamination Sensing

Since most voltage test points have such high impedance, they can be subject to leakage contamination if care is not taken to keep the tap clean and dry while making a test. Usually a protective grounding cap is provided and silicone grease is liberally applied to the external insulating portion of the tap. Leakage resistance in the order of 1,000 megohms (in some types 100 megohms) or less can seriously effect the voltage test point calibration. Leakage resistance under 20 megohms on a voltage test point can indicate practically zero reading when using the higher impedance voltmeters.

A voltmeter supplied with a combi-

nation AC voltmeter tester-verifier and DC leakage current-megohmmeter, provides both 400V AC for testing the voltmeter before and after a measurement, and 500V DC for measuring the leakage resistance of the voltage test point or any other HV insulation in the range of 20 megohms to 2,000 megohms. This leakage or contamination testing unit for verifying voltage test points is designed for portable hotstick use. While the standard unit is rated for 600V maximum, some models can safely contact an energized HV line directly. They can also measure insulation leakage resistance at 500V DC to 2000 megohms, or 0-15KV DC or 0-36KV DC for higher voltage insulation to 30,000,000 megohms, even with the presence of up to 15,000V AC, if the 85 megohm or higher HV probe is used as a limiting resistance.

#### Conclusion

With the increased use of capacitive voltage test points, sensing of energized lines and accurate voltage measurements and phasing has been shown to be practical and desirable for underground systems.

Test point capacitance values still

leave much to be desired for uniformity and greater reliability. One suggested method of standardizing on only a ratio of HV to LV capacitance is considerably less desirable than standardizing on a fixed value of HV end capacitance and also a ratio, although a ratio is less critical.

The HV end capacitance should be established at as high a value as practical to minimize contamination and external shielding problems.

Voltmeters with accessories have shown it is feasible and reliable to safely and accurately measure voltages on and phase underground systems with the capacitive test point. Sufficient varieties of hotstick designed measuring and testing devices now exist to obtain most HV conductor information by use of portable isolated devices.

#### References

1. Proposed IEEE - NEMA Joint Standard for Separable Insulated Connectors January, 1970

Sponsored by The Task Force on Switching and Overcurrent Protection, Underground Distribution Subcommittee, IEEE Transmission and Distribution Committee

and

The Primary Connector Working Group, Technical Committee, Electrical Connector Section, NEMA

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*Mr. Hugh C. Ross is President and Chief Engineer for Ross Engineering Corporation.*



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## HIGH VOLTAGE POWER CLASS SAFETY AC/DC VOLTMETER FOR EMERGENCY CREWS

# HIGH VOLTAGE



This special 0 to 50KV high voltage powerline class voltmeter is currently being used by **EMERGENCY CREWS** to determine if a downed high voltage power line or trolley is still energized and at what voltage level. It has both visual flashing light and audible alarm as a voltage presence warning. It will also measure voltages as low as the normal outlet voltage of 115 volts. Ross Engineering Corporation designs model VM50DE-DDL-9 high voltage probe with a digital voltmeter to read directly in volts or kilovolts. It has a full scale accuracy of  $\pm 1\%$  AC at 60Hz and DC 200V to 50KV and up to  $\pm 5\%$  on 0-200V which is suitable for detecting dangerous voltage levels. The VM50DE meter also contains a four range switch (0-200V, 0-2KV, 0-20KV, or 0-50KV) to select the appropriate working range. It is supplied with a test voltage source to check meter operation as well as a four section 6ft. or six section 9ft. collapsible insulated hotstick to provide the 3 1/3 ft. or more personnel clearance for 50KV RMS or DC as required by OSHA. The 6ft. to 9ft. insulated handle also provides a hook which can be used safely to lift HV wires. The battery normally lasts 2 years, (BAT) is displayed when it needs replacing. The VM50DE comes complete in a metal carrying case for easy storage and portability.



VM50DE-DDL-9L-T  
AC/DC HV VOLTMETER

### FEATURES INCLUDE:

- 0 to 50,000 Volts
- 125KV Impulse Test Level
- Heavy Duty Carrying Case.
- Collapsible Hotsticks.
- AC Voltage Source tester.
- Heavy Duty Grounding Clamp.
- Water Resistant Illumination.



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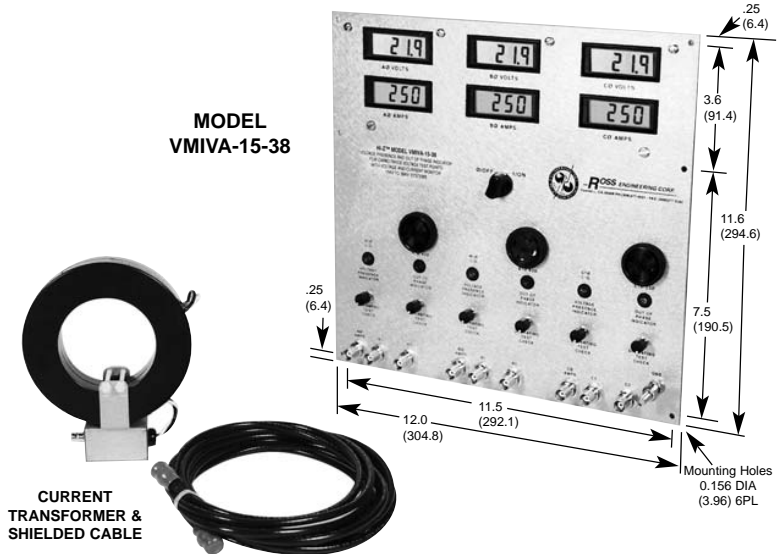
# HI-Z CAPACITANCE TEST POINT MONITOR PHASING AND LOSS OF PHASE INDICATOR

WITH VISIBLE VOLTAGE PRESENCE INDICATOR & VISIBLE AND AUDIBLE LOSS AND OUT OF PHASE ALARM. WITH OPTIONAL DIGITAL VOLTMETER AND AMMETER.

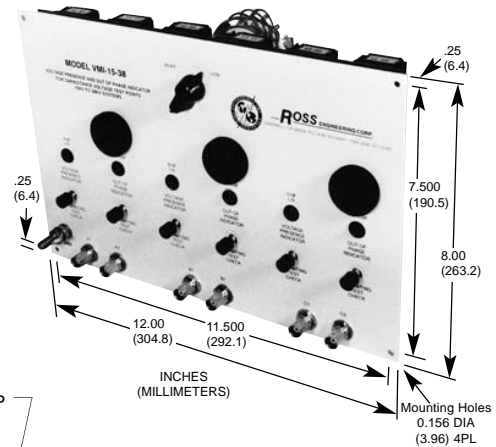
## SPECIFICATIONS AND OPERATION NOTES HI-Z® MODEL VMI AND VMIVA VOLTAGE, PHASING AND CURRENT INDICATOR FOR CAPACITANCE VOLTAGE TAPS

1. For 5 to 15KV and 15 to 38KV class systems using Elastimold or other cable elbow and tee capacitance tap voltage test points. Also available for higher or lower voltage systems and direct HV line with proper HV probes.
2. Minimum differential voltage or out of phase detection approximately 2KV L-G for 5KV to 15KV system or 8KV L-G for 15KV to 38KV system. Other detection levels available.
3. For operation with capacitance tap HV capacitance as low as 1.5 picofarads such as Elastimold elbow voltage test points. Can be calibrated to other values.
4. Maximum operate voltage with standard capacitance tap 38KV L-L. Minimum operate voltage for 15-38KV type 12KV L-L (7KV L-G) (Lower available). Also available with high voltage probes to operate with direct HV line to 72KV, 300KV BIL.
5. Special individually shielded connection cables 15 feet long for both voltage and current and monitoring. Cables can be longer if required.
6. Test circuits for both voltage presence and phasing indicators provided by push button to indicate unit is operable for each phase.
7. Model VMI has phasing, loss of phase and voltage presence indicator. Model VMIVA in addition has integral 3 1/2 digit voltmeters and ammeters for monitoring each phase, 0-25KV L-G 0 to 250 amps (with 1000/5 CT. of at least 10VA). Other voltage and current levels available.
8. VMI requires 6 and model VMIVA require 12 standard alkaline or lithium 9 volt transistor batteries. A special AC powered model can also be supplied.
9. Operation test indicates if 9V battery voltage is above 7V. Operations range 12.5V max. to 7V min. battery voltage for 9 volt type. Estimated nominal 9V alkaline battery life: phasing monitor, 80 hours fully activated, 3 to 5 years quiescent; voltage and current monitors, 8000 hours. 9 volt lithium battery estimated life twice that of alkaline.

MODEL VMIVA-15-38

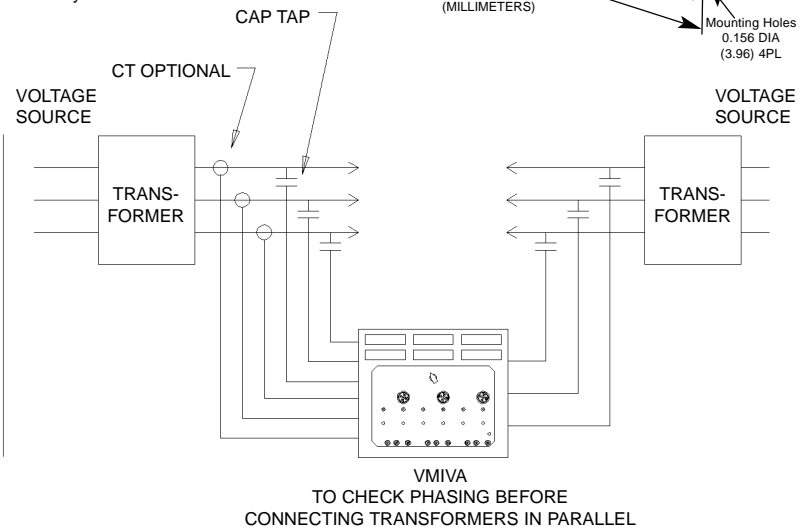
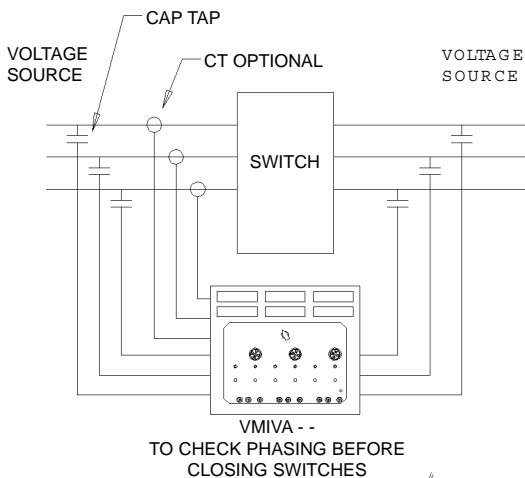


MODEL VMI-15-38



**SAFETY NOTE:**

Unit should be solidly grounded at the panel accessible to personnel although it will work with only the capacitance tap test point ground connections grounded. Accuracy is dependent on accuracy of the test point capacitance or current transformer. Test points can vary up to 10% or 20%, depending on accuracy class.



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# PHASING NOTES

FIG - 1  
TYPICAL MEASUREMENT SETUP  
WITH ROSS ENGINEERING CORPORATION'S  
HI-Z\* VOLT-METER

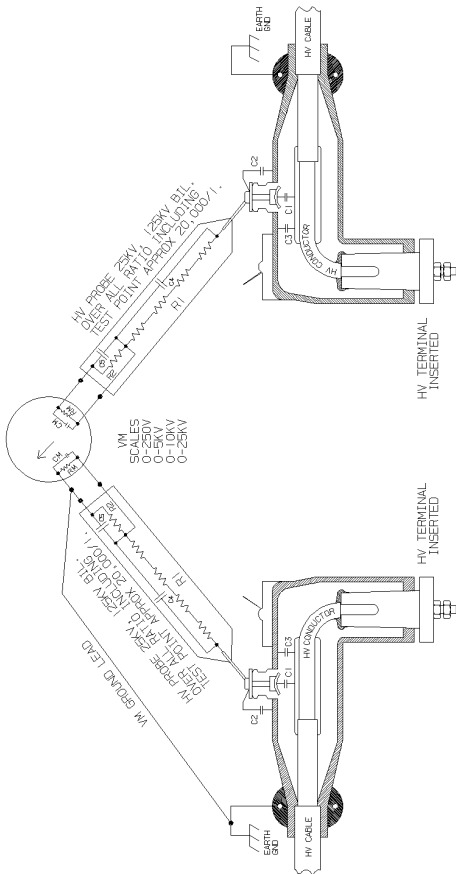
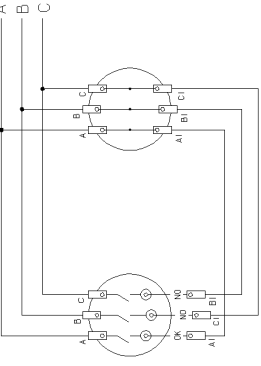
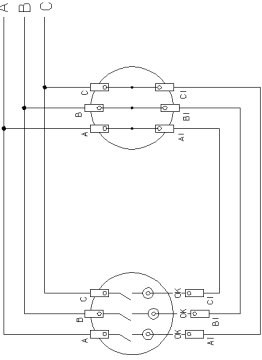


FIG - 5  
RING BUS NOT IN PHASE AND  
OPPOSITE PHASE ROTATIONS.



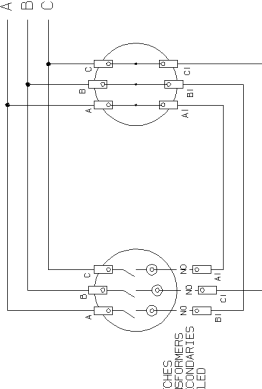
ALL WILL INDICATE FULL LINE TO GROUND VOLTAGE.  
A1 IS IN PHASE WITH A AND WILL INDICATE VERY LITTLE VOLTAGE BETWEEN THEM. B1 IS NOT IN PHASE WITH C AND WILL INDICATE LINE TO LINE VOLTAGE BETWEEN THEM. C1 MUST NOT BE CONNECTED TO "B" OR B1 TO C WHEN APPRECIABLE VOLTAGE EXISTS BETWEEN THEM.  
PHASE ROTATION IS ABC BUT REVERSED WITH A1 C1 B1.

FIG - 3  
IN PHASE AND  
SAME PHASE ROTATION



A1, B1 AND C1 ARE IN PHASE WITH ABC AND CAN BE SAFELY CONNECTED SINCE THERE IS VERY LITTLE VOLTAGE DIFFERENCE BETWEEN A & A1, B & B1, OR C & C1. ALL SIX WILL HAVE ABC PHASE ROTATION. A1, B1 AND C1 WILL CONTINUE TO ROTATE IN ABC DIRECTION.

FIG - 4  
RING BUS NOT IN PHASE EVEN THOUGH  
BOTH HAVE SAME PHASE ROTATION.



ALL SIX ARE OUT OF PHASE BUT HAVE SAME ABC COUNTERWISE ROTATION. ALL SIX WILL MEASURE FULL LINE TO GROUND VOLTAGE AND LINE TO LINE VOLTAGE BETWEEN A & B, B & C, C & A. ALL SIX WILL HAVE ABC PHASE ROTATION, THEY MUST NOT BE CONNECTED.

FIG - 6  
MOTOR LOADS

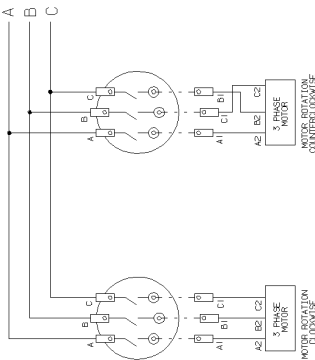
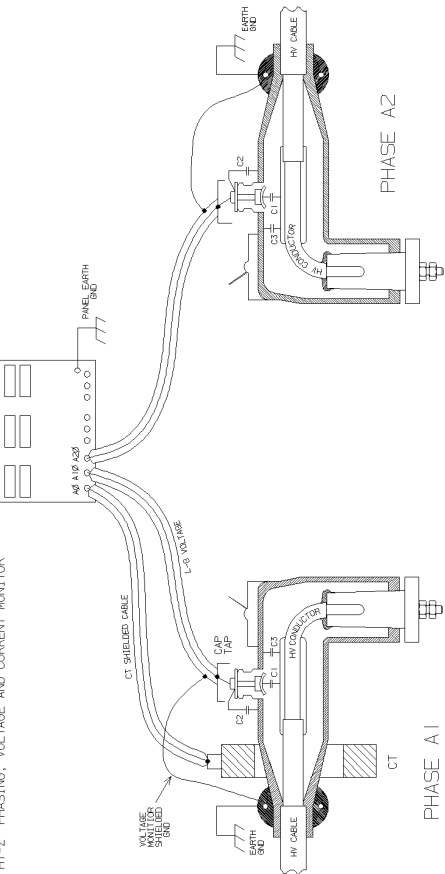
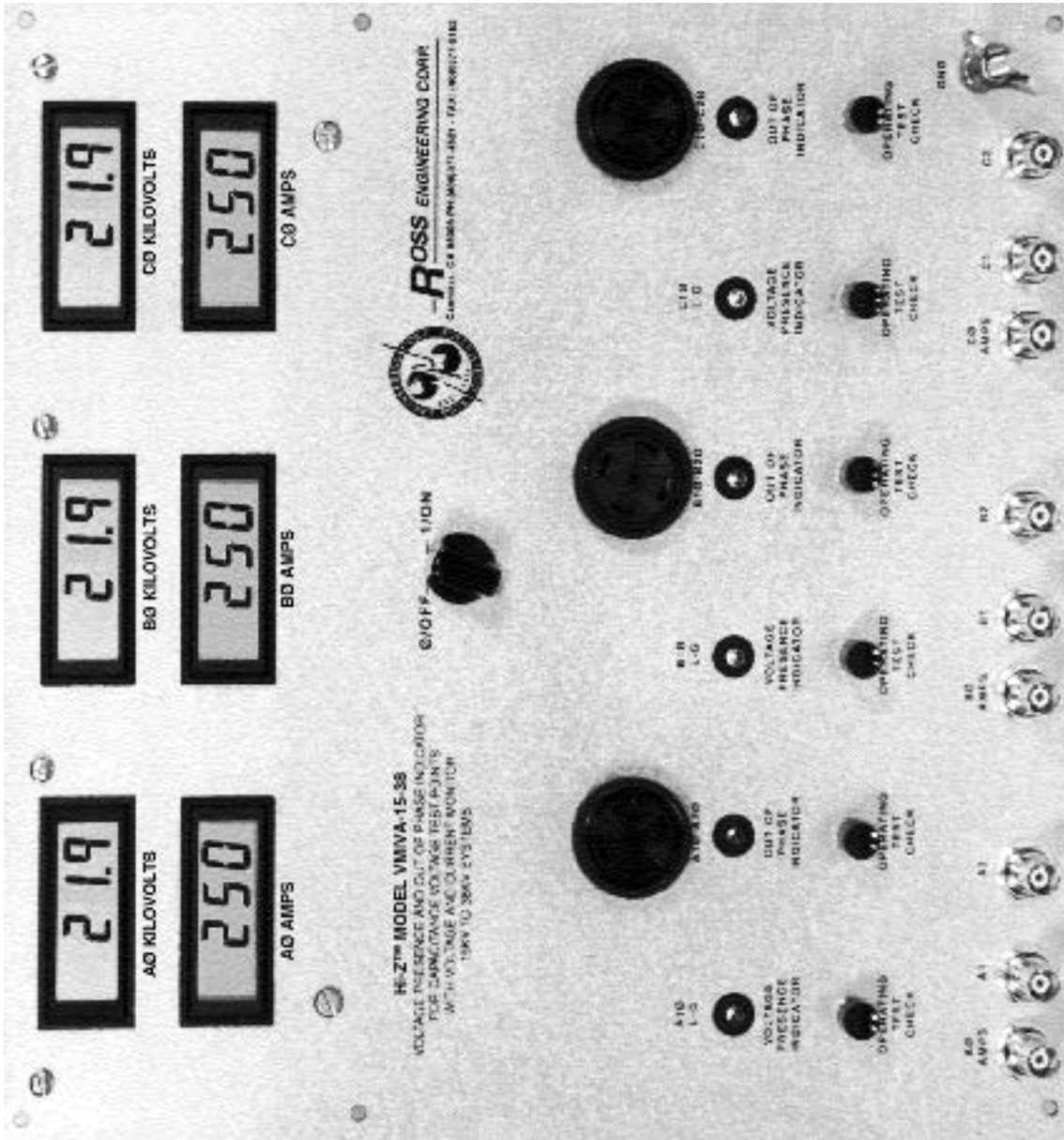


FIG - 2  
TYPICAL MONITOR SETUP  
WITH ROSS ENGINEERING CORPORATION'S  
HI-Z\* PHASING, VOLTAGE AND CURRENT MONITOR



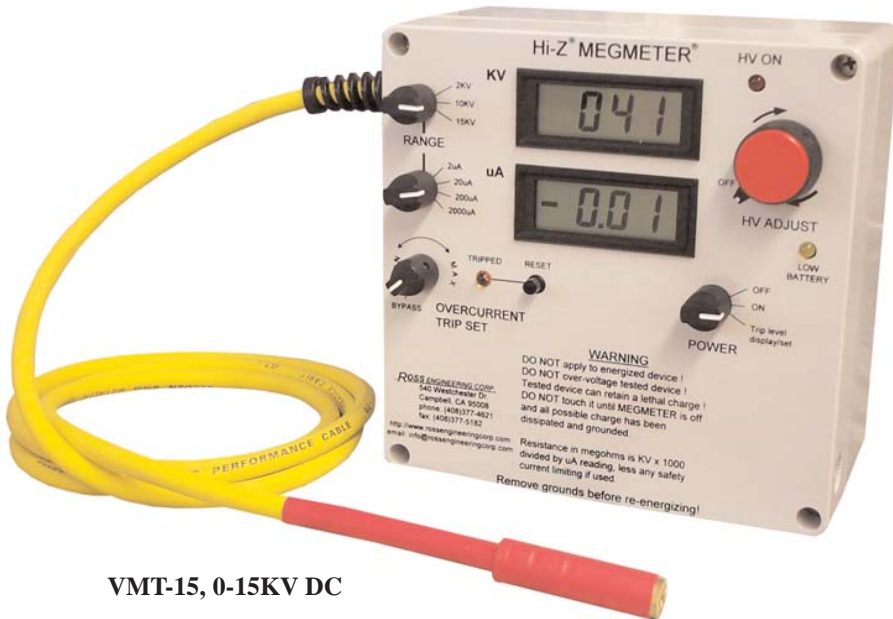
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# HIGH VOLTAGE MEGMETER®

## DC Hipot, Vacuum Interrupter Tester, Insulation Leakage Current Meter and HV Resistance Measurement



### VMT-15, 0-15KV DC

Portable model VMT15, 0-2KV, 0-10KV, 0-15KV DC, 0.001-260 or 1000 microamps, or model VMT42, 0-2KV, 0-15KV, 0-42KV DC, 0.001-130 or 500 microamps. All models have programable overcurrent trip limit to minimize arcing damage.

12 Volt Battery powered for isolated field use.

Can be used as a HV low current source. Can measure leakage current in HV cables and any HV insulation or HV device.

Can measure megohms of dielectric leakage resistance.

$\frac{KV \times 1000}{\mu A} = \text{megohms insulation or HV Resistor resistance.}$

For high voltage power as well as electronic class use. Options available include: 20 to 300 megohm HV current limiting resistive probe, and HV underground cable plug adapter for safe use up to 25KV or 50KV RMS if HV probe tip accidentally contacts HV energized line. Compatible with Ross Hi-Z® Powerclass™ Voltmeter Kit.

Includes 6ft HV output cable, 115V AC charger, and adapter to allow operation and recharge from 12V DC vehicle battery in the field.

Available as an accessory with VM25E and VM50EE Hi-Z® Powerclass™ Voltmeters which provide HV safety probes for up to 100KV RMS.

### VMT-15, 0-15KV DC & VMT-42, 0-42KV DC

The Hi-Z® Megmeter® from Ross Engineering Corporation is a portable battery powered HVDC source and meter. Models are available for withstand testing of insulation up to 42KV DC, and measuring leakage current as low as 0.001 microamp when testing underground cable, safety gloves, vacuum interrupters, HV resistors and all other types of insulation.

- VMT-15, size 6.3" x 6.3" x 3.58" (159 x 159 x 90mm), weight 5lbs (2.2kg)

- VMT-42, size 9.8" x 6.8" x 3.91" (249 x 173 x 99mm), weight 7.5lbs (3.4kg)



**HV SAFETY  
PROBE**



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# Solenoid Drivers Application Data

The remote contact controlled HCA Series and the SCR controlled HCB Series of Stored Energy Solenoid Drivers produced by Ross Engineering Corporation are used for high speed opening or closing of Ross Circuit Breakers and Contactors. They perform high speed microseconds to milliseconds actuation of various electromechanical devices. The units feature minimum internal time delay, trigger signal overload protection, and up to 3000 joules of energy storage.

## The HCA Solenoid Drivers

*(Remote Contact Controlled)*

The HCA Solenoid Drivers are controlled by an external relay or switch. The HCA's front panel is equipped with "ready lamps" and fuses and can be opened to expose all components. When the front panel is opened, a safety interlock automatically discharges the capacitors for safe entry. The HCA drivers are generally dual energy storage units designed to either close or trip (or both) Ross Engineering Corporation HV Vacuum Circuit Breakers. These energy storage units are available with voltage sensors and relays for remote indication of ready condition and to preclude closing the circuit breaker when the trip voltage is low. Automatic trip on failure of control voltage or on failure of the charge circuit is also available for specific applications.

## The HCB Solenoid Drivers

*(SCR Controlled)*

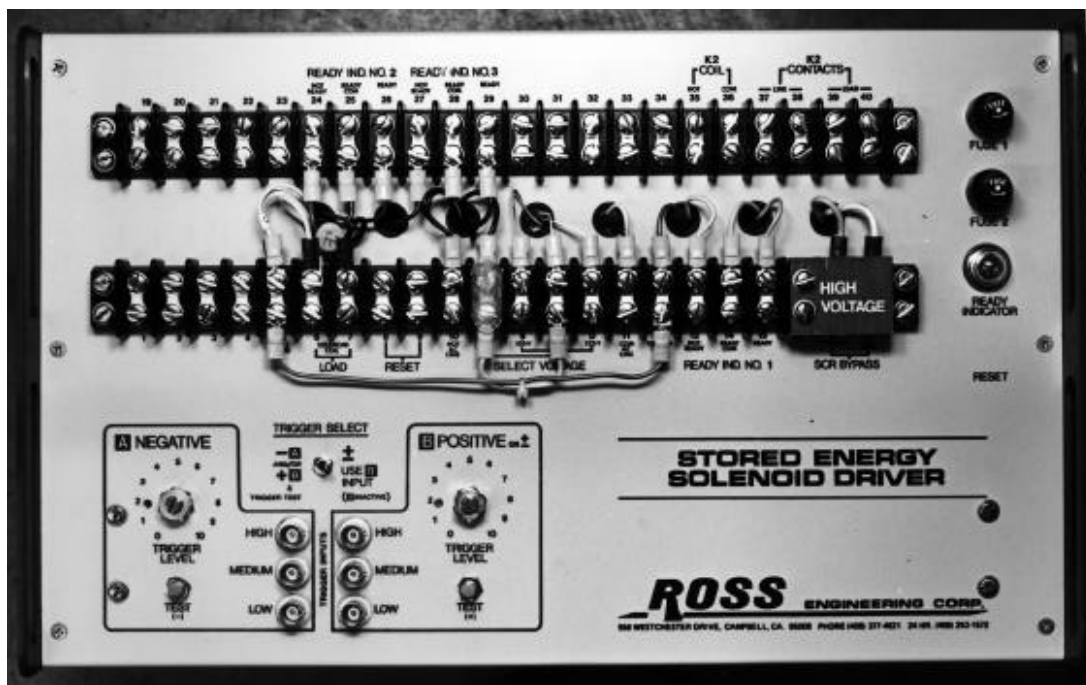
The HCB Series are SCR controlled with an external low power 10 to 100V signal 4K ohms. The HCB Driver Signal Input is sensitive to either a pulse or a slowly changing voltage level which triggers the unit at a preset level. Standard HCB Solenoid Drivers are available in selectable trigger sensing voltages that are positive (+), negative (-), or both

positive and negative. Three input terminals are used for three selectable voltage ranges. Intermediate values are adjusted with a Trigger Voltage Level Control. The input circuit of the driver is protected against accidental over-voltage or transients up to 1000V. All terminals and controls are mounted on the front panel for easy access.

An internal voltage sensor operates a double pole, double throw (DPDT), 10 amp relay as well as the panel mounted "ready lamp." This relay operates when the energy storage capacitors are charged to near the maximum output voltage. Full charge is reached in approximately 3 to 15 seconds depending on the recharge time requirement. This relay can be used to control an external ready indicator and also be used as a ready interlock which can control external circuitry so that specified remote controls cannot operate unless the driver is properly charged.

The most widely used Ross SCR Controlled Energy Storage Solenoid Drivers have charges of 80 to 350 joules (watt seconds) at 700V nominal with a line supply voltage of 115V 50/60 Hz. Stored energy is released by any Trigger Level voltage above 5 volts although a 50 to 100 volt signal with a 15 to 30 volt sensitivity setting is recommended to minimize unwanted operations.

With the Ross Driver, mechanical motion can be started precisely and completed in from less than 100 microseconds to 10 milliseconds or more, depending on requirements. Used in conjunction with Ross Vacuum Contactors or Circuit Breakers, close or trip and interrupt times of 2 to 12 milliseconds are possible. Sensing elements and a high speed switch or mechanical device to be driven are also available from Ross.





# Solenoid Driver Models

## HCA Series

External Relay or Switch Controlled  
Energy Storage Drivers

For capacitor trip circuit breakers or other types of drive or trip requirements where control switching is supplied by external circuitry.

Model	Input 60HZ (voltage)	Storage Capacitance (MFD)	Storage Volts DC
HCA-2-A	115	250	320
HCA-2-B	230	250	320
HCA-2-C	115	700	320
HCA-2-CA	115	700	320
<i>(Isolated)</i>			
HCA-2-CD	208/240	700	290/320
HCA-2-D	115	700/4900	350 Trip & Close
HCA-2-D	230	700/4900	350 Trip & Close
HCA-2-D	208	700/4900	350 Trip & Close
HCA-2-E	115	2100	320
HCA-2-F	208/240	2100	290/330
HCA-2-G	115	350	700
HCA-2-H	115	700	700
HCA-2-J	115/208/240	350/700	700 opening
		350/700	700 Closing
HCA-2-K	230	700/3500	350 Trip & Close
HCA-2-L	115	700/3500	350 Trip & Close
HCA-2-M	208	700/3500	290 Closing
HCA-2-N	115		350 Closing
HCA-2-P	115 for HAF	4900 w/holding	350 Closing
HCA-2-R	115 for HA3	2100 w/holding	320 Closing
HCA-2-T	208/230 for HA3	2100 w/holding	290/320 Closing



**HCA  
Energy  
Storage  
Driver**

**HCB Series** - Full adjustable input and trigger voltages  
**HCE Series** - Fixed input trigger voltage  
**SCR Controlled Energy Storage Drivers**

Basic Model	Trigger Signal	Capacitance (MFD)	Nominal Volts DC	Energy Joules
HCB or HCE-5-C-( )-( )	±	350	700	86
HCB or HCE-5-D-( )-( )	±	700	700	172
HCB or HCE-5-E-( )-( )	±	1050	700	257
HCB or HCE-5-F-( )-( )	±	1400	700	343

## Second Dash Letter / Function

- A For High Speed latching mechanism. Latch closed or latch open. No holding current provided. Limit holding available from recharging circuit.
- B For High Speed opening or High Speed closing. Provides holding current to maintain actuated position.
- C For High Speed opening or closing (short time holding, has holding circuit built-in, no switch on front panel). When ready light comes on, holding circuit turns off.
- D For High Speed close and latch mechanism and high speed opening or trip.
- E For High Speed trip, similar to "A" except with added interlocked 230V size 1 closing contactor with 115V 60Hz coil-no holding current.
- F For High Speed trip, similar to "B" except with added interlocked 230V size 1 closing contactor with 115V 60Hz coil and holding current.
- G Same as "C" with addition of 230V size 1 closing contactor with 115V 60Hz coil.
- ( )R Includes 1/2% regulator for precise timing or varying line voltage.

## Second Dash Number / Input Voltage

*(Suggest 112% Regulator for More Consistent Timing)*

- 26 105 V, 115 V, 125 V 50 / 60 Hz AC
- 25 208 V, 230 V, 250 V 50 / 60 Hz AC
- 26A 115V/115V 60Hz with 1/2% regulator for precise timing or varying line voltage.
- 2A 230 V/1 1 5V 60 Hz with 112% regulator for precise timing or varying line voltage.
- 77 200, 220, 240 50 / 60 Hz AC

## Sample:

### HCB-5-C-A-26

Basic Model      Second Dash Letter      Second Dash Number

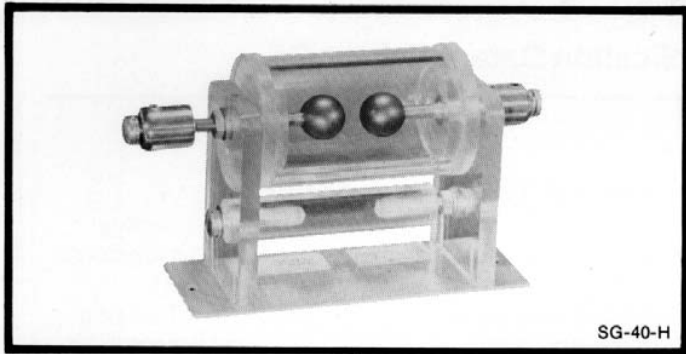
Basic Model HCB-5-C-A-26 accepts positive and/or negative trigger signals with 350 MFD capacitance at 700 nominal volts DC. -A is for high speed latching mechanism and high speed opening of trip. -26 is for 105V, 115V, 125V, 50/60Hz AC input.



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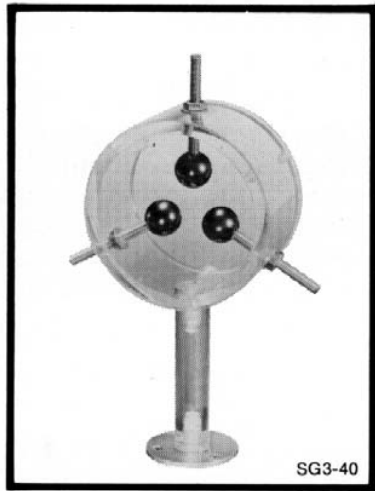
**Ross Engineering Corporation**



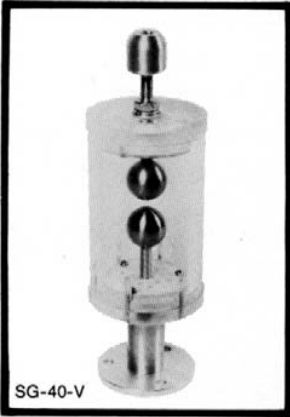
SG-40-H



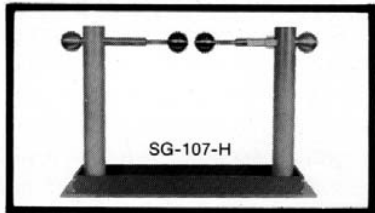
SG-40-P



SG3-40



SG-40-V



SG-107-H

**High Voltage  
SPARK  
GAPS**

**Adjustable Spheres  
1 KV to 370 KV Peak Test**

**Features:**

- Spark gaps are enclosed in dust tight transparent enclosures with replaceable non-melting carbon spheres, up to 88 KV PK.
- Above 88KV, open style with hollow aluminum spheres is standard
- Applications for these units include over-voltage limiting, voltage measurement, capacitor discharge, and pulse forming.
- Horizontal unit housings are removable.
- Vertical unit housings are not removable.
- Micrometer Vernier adjustment is standard for maximum accuracy on most models. Economy units without micrometer Vernier adjustment are available as an option.
- Insulation to ground is available at standard and optional levels.
- Spark gaps to 370 KV, with motor operation available.

**Specifications**

Model	Usable Range PK	Sphere Diameter		Type "H" Horizontal H x W x D	Type "V" Vertical Base DIA x H
		cm	inches		
SG-20-A-H, VC, VI	1-20 KV	1.00	0.396	3.65 x 5.85 x 2.29	2 x 7
SG-20-B-H, VC, VI	1-20 KV	2.00	0.787	3.64 x 6.3 x 2.29	2 x 7
SG-40-H, VC, VI	2-40 KV	2.00	0.787	6.82 x 6.125 x 2.31	2 x 9.75
SG-40-P	2-40 KV	2.00	0.787	2.75 dia. x 5	—
SG3-40	2-40 KV	2.00	0.787	—	3 x 8
SG-60-H, VC, VI	5-60 KV	3.75	1.48	9.62 x 11.41 x 3.88	3 x 10.75
SG-88-H, VC, VI	6-88 KV	5.00	1.97	11.75 x 9.56 x 5	3 x 12.75
SG-107-H	8-107 KV	6.25	2.46	19 x 29.38 x 6	—
SG-122-H	12-122 KV	7.50	2.95	21.75 x 32.25 x 6	—
SG-155-H	16-155 KV	10.00	3.94	27.62 x 26 x 7	—
SG-195-H	16-195 KV	12.50	4.92	33.15 x 55.87 x 8.5	—
SG-230-H	16-230 KV	15.00	5.90	40.75 x 60.25 x 8.5	—
SG-270-H	16-270 KV	20.00	7.87	48.91 x 40.5 x 12	—
SG-270-HM	16-270 KV	20.00	7.87	55.91 x 40.5 x 12	—
SG-370-H	16-370 KV	25.00	9.84	68 x 48 x 12	—

over

# Spark Gap Application Data

---

## Clearance Standards

Clearances recommended by the International Electrotechnical Commission (IEC) Publication 52, are standard.

## Diameter Standards

International Electrotechnical Commission (IEC) heavy wall hollow is standard in aluminum over 4" in diameter. Solid non-melting carbon alloy is used for diameters of 4" or less, although larger diameters in solid carbon are available. A copy of the latest international high voltage standards, including charts for calibration and sphere-gap spacing vs. spark-over voltage, is available at extra cost.

## Accuracy

Accuracy is approximately  $\pm 2\%$  when barometric pressure and temperature conditions are applied (see "Adjustments") and the gap is conditioned by spark-overs until consistent breakdown is reached. Considerable variation may occur over long periods of inactivity if gaps are not conditioned or free ions are lacking or excessive.

## Current Limitations

To prevent damaging the precision voltage measurement type sphere-gap surfaces, current should be limited. Less than 5,000 amps discharge PK current and less than the equivalent of approximately 15,000 joules total system energy at 100 microseconds time constant should be used. Correspondingly, less energy should be used at longer time periods. Long time DC and 60 cycle current of 50 milliamps or even more, depending on the total time, are allowable. Usually values of 100,000 ohms or more are inserted in series with precision gaps. Carbon spheres can handle higher currents and longer time Power arcs where metal gaps would be damaged. Current must be limited as to maximum current level and time for required life (see catalog description section for coulomb capacity).

## Transient Suppression

Where sphere-gaps are used for transient suppression: some resistance in series can be used in order to provide energy dissipation and to reduce oscillatory action which tends to allow the arc to extinguish too early by creating current zeros. To limit peak current flow, 1 to 2 ohms resistive per KV, possibly more, should be inserted in series with any transient limiting device such as spark-gaps and suppression capacitors. Care must be taken, however, not to have excessive resistance which will limit the clamping effect. 5 to 10 ohms per KV appears to be the upper limit in most cases, usually considerably less than the critical damping values would be.

## Interrupt Time Requirements

Where power follow current is available, total sensing and interrupt time should be less than 33-40 milliseconds (2 cycles). An interrupt time of less than 8 to 16 milliseconds (1/2 to 1 cycle) is preferred. This will help to minimize destructive effects, particularly if the current or time can be limited to allow less than 10 to 20 coulombs (amp-seconds), depending on the electrode material and arc spinning arrangement. Carbon and Tungsten alloys have the higher coulomb capacity.

## Elevation-Temperature-Pressure Adjustments

Ratings for these spark-gap units are 760 mmHg, 25°C. Derate, approximately 1.5% per 1,000 feet elevation. Pressure and temperature adjustments can be made according to the following formula:

$$V_{act} = V_{ntp}[(0.386 P)/(273+T)]$$

where P is barometric pressure in Torr (mmHg, 0°C) and T is ambient temperature in degrees centigrade.

See IEC Publication 52 for more accurate correction factors if correction is more than  $\pm 5\%$ .

## Increased Accuracy

Standard spheres and sphere-gap units contain no added radioactive materials and are not hermetically sealed. The carbon spheres do contain slight amounts of naturally occurring radioactive carbon isotopes. If greater accuracy is required, particularly with close spacings and lower voltages, sparking surfaces can be illuminated with an ultra-violet bulb of at least 35 watts, 1 amp. Accuracy at low voltages can also be improved by inserting radioactive material in the order of 0.2 to 0.6 millicurie in the surface of the spheres. Safety rules must be followed in the handling of radioactive materials.

## Options

Some optional features include: calibrated sphere-gap systems with adjustable positioning holder; solenoids for automatic closing; complete current sensing systems to crobar (closing gaps in case of spark-over); motor and air operated units.

## Peak Test to Ground

Standard peak test to ground is approximately 120% of maximum sphere spark-over rating or more.

**Note:** Sphere-gap spark-over will be non-linear at wider spacings for various conditions of AC, DC, polarity, grounding, and proximity of other objects. Consult standards for accurate settings for these conditions.

# TOROIDS, SPHERES, AND CORONA NUTS

Many of Ross Engineering's line of toroids, spheres, and corona nuts have been designed to meet metric dimensions. The Ross toroids are made of aluminum while most spheres are made of either hollow aluminum or solid non-melting carbon with other materials optional. A satin finish is standard with a high polish finish available. Aluminum toroids and spheres are used to minimize corona and for adjusting voltage gradients on long stacks of high voltage components. Spheres are also used for spark gaps and corona eliminating terminations. Carbon spheres are desirable where high current arcing is involved since they do not melt or develop pits or projections but tend to remain a smooth surface. Also, with the presence of slight amounts of Carbon 14, they have a tendency to have more consistent spark-over levels than metallic types. Sphere gaps can be even more consistent if illuminated with a strong ultra violet source or have radioactive material present.

Sphere and toroid maximum voltage ratings are proportional to temperature (referred to °K) and inversely proportional to Barometric pressure.

Ross Toroids come in two separable halves as standard. A one piece toroid is formed by heliarcing two halves together. Toroids, or hemisphere-toroid configurations, can be used in place of spheres where height is limited. Available toroid diameters range from 10 cm to 106.7 cm (3.94 in to 42 in). Mounting holes are optional and other sizes can be provided.

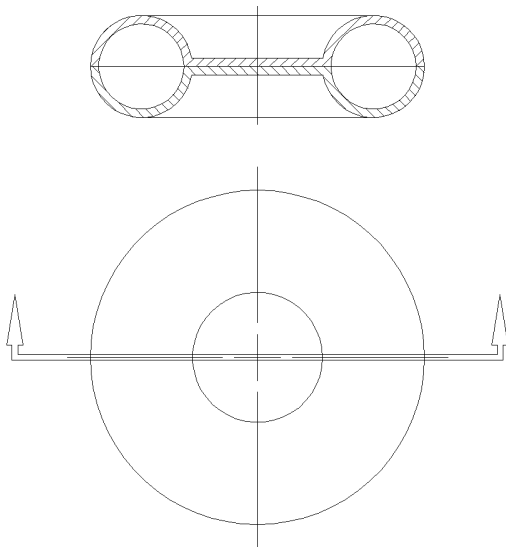
Ross Spheres are available in solid or hollow aluminum, solid carbon, or other materials upon request. Most sizes recommended by the International Electro Technical Commission (IEC) are standard. The aluminum spheres are usually used for limited cur-



rent spark gaps or for terminations. Diameters of the standard spheres range from 2.5 cm to 50 cm (.98 in to 19.68 in). The non-melting carbon spheres are used for calibrated spark gaps, lightning arresters on antennas, power supply overvoltage, and other transient suppression and high current spark discharge in pulse forming networks. The solid carbon sphere diameters vary from 1 cm to 30.48 cm (.396 in to 12 in).

Ross Corona Nuts are a modification of a sphere or toroid shape and are widely used in moderate high voltage applications. Their recommended operating voltages are up to 300 KV. Diameters of the corona nuts range from .64 cm to 3.8 cm (.25 in to 1.5 in). For additional information on spark gaps see Brochure B-1015.

## TOROIDS



**TOROID DIMENSIONS**

MODEL NO.	OVERALL DIA.		RING DIA. in.	CENTER FLAT DIA-in.	MAX. KV PK NTP
	cm.	in.			
T10	1.9	0.75	0.12	0.50	10
T39	7.5	2.95	0.48	2.0	40
T40	11.4	4.5	0.5	3.5	40
T50	*10	*3.94	1	2	50
T60	*12.5	*4.92	*1.25	2.5	60
T80	*15.0	*5.91	1.5	3	80
T81	35.6	14.0	1.0	12.0	75
T85	15.9	6.25	1.50	3.25	80
T90	17.8	7	1.75	3.5	90
T91	*25	*9.84	1	7.84	75
T92	30.5	12	1	10	75
T101	40.6	15.75	1.50	12.75	80
T125	*25	*9.84	2.35	5.14	125
T126	30.5	12	2.63	7	130
T201	53.4	21	3	15	200
T210	66	26	3	20	210
T220	30.5	12	4	4	220
T251	38.1	15	5	5.145	250
T280	*50	*19.68	5.75	8	280
T290	45.7	18	6	6.145	290
T301	61	24	6	12	300
T310	68.6	27	6	15	310
T350	*132.1	*52	6	40	350
T375	71.2	28	7	14	375
T390	81.3	32	8	16	390
T510	106.7	42	10	22	510
T510-0	106.7	42	10	OPEN RING	510



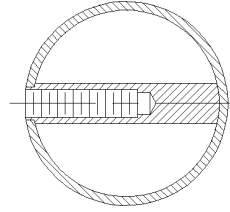
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# SPHERES

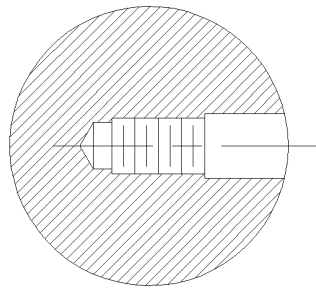
SOLID CARBON			
DIAMETER		THREAD	MAX KV PK NTP
cm.	in.		
1.00	0.396	10-32	20
*2.00	*0.787	1/4-20	40
*2.00	*0.787	1/4-28	40
2.54	1.00	1/4-28	60
3.75	1.48	3/8-24	68
*5.00	*1.97	3/8-24	88
*6.25	*2.46	1/2-20	107
7.50	2.95	1/2-20	122
*10.00	*3.94	5/8-18	155
*10.00	*3.94	1/2-13	155
10.00	HEMIS.	1-12	122
*12.50	*4.92	5/8-18	195
*15.00	*5.91	1-12	229
20.00	7.87	1-12	283
*25.00	*9.84	1-12	366
30.48	12.00	1-12	410



**IMPROVED  
HOLLOW  
SPHERE  
DESIGN**

**REINFORCED  
NOSE**

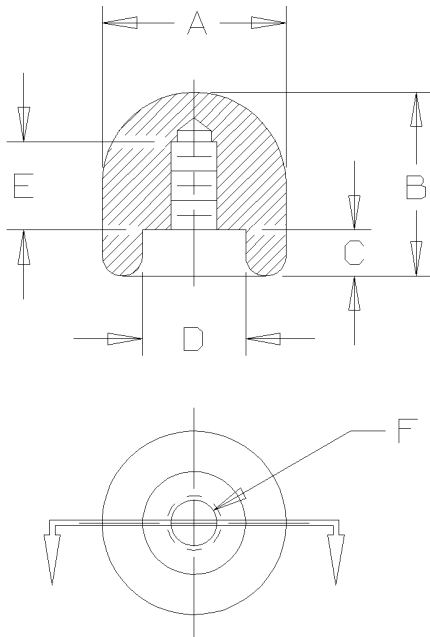
ALUMINUM			
DIAMETER		THREAD	MAX KV PK NTP
cm.	in.		
**0.51	**20	6-32	10
**0.64	**25	6-32	15
**0.95	**38	6-32	20
**1.25	**50	6-32	30
**2.54	**1.00	10-32	60
**2.54	**1.00	1/4-20	60
*5.00	*1.97	1/4-28	88
*5.00	*1.97	3/8-24	88
*6.25	*2.46	3/8-24	107
7.50	2.95	3/8-24	122
*10.00	*3.94	3/8-16	155
*10.00	*3.94	3/8-24	155
*12.50	*4.92	5/8-18	195
*15.00	*5.91	5/8-18	229
20.00	7.87	5/8-18	283
*25.00	*9.84	3/4-16	366
30.48	12	3/4-16	410
38.00	15	3/4-16	475
*50.00	*19.68	1-12	670



**IMPROVED  
SOLID  
CARBON  
SPHERE  
DESIGN**

Other thread sizes available.  
\* Sphere diameters in international standard sizes as recommended in IEC Standard #52.  
\*\* Solid aluminum.

# CORONA NUTS



SOLID ALUMINUM							
PART NO.	A	B	C	D	E	THREAD *F	MAX KV PK NTP
302750	.25	.38	.06	.21	.19	2-56	10
302751	.38	.50	.09	.25	.25	4-40	12
302752	.50	.63	.13	.31	.31	6-32	15
302753	.63	.75	.16	.38	.38	8-32	20
302754	.75	.88	.19	.44	.44	10-32	25
302755	1.00	1.00	.25	.56	.50	1/4-20	35
302756	1.00	1.00	.25	.56	.50	1/4-28	35
302757	1.13	1.19	.31	.63	.63	5/16-18	40
302758	1.13	1.19	.31	.63	.63	5/16-24	40
302759	1.25	1.38	.38	.75	.75	3/8-16	45
302760	1.25	1.38	.38	.75	.75	3/8-24	45
302761	1.50	1.75	.50	1.00	1.00	1/4-20	50
302762	1.50	1.75	.50	1.00	1.00	1/4-28	50

\* Other thread sizes available.

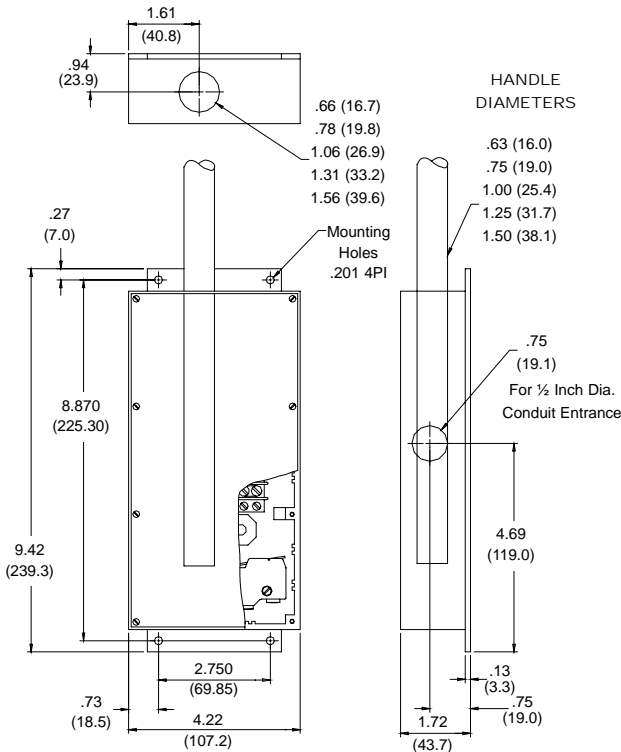
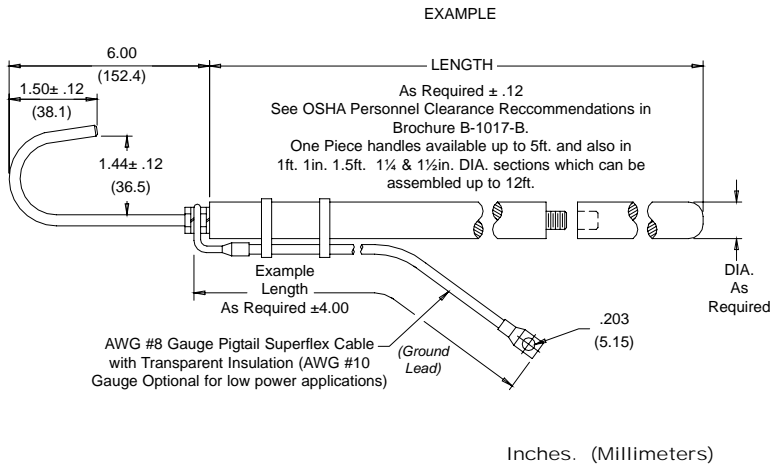


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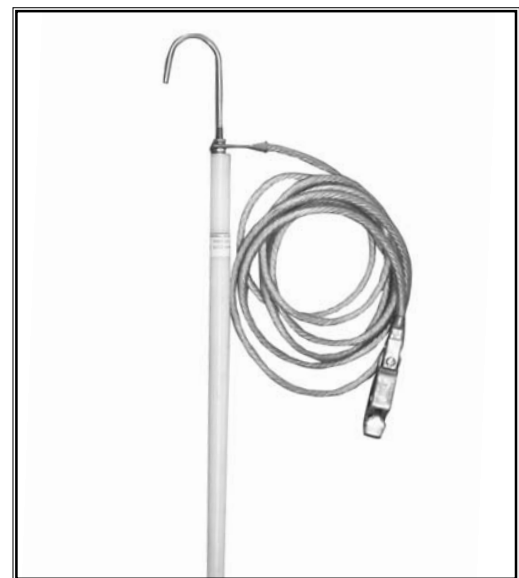
# PERSONAL GROUNDING RODS

OSHA Conforming  
Optional Handle Lengths  
Optional Cable Lengths



OPTIONAL HANDLE HOLDER & INTERLOCK with SPDT contacts rated 480V AC 15 amps to prevent power turn on if handle is not in socket.

Ross Engineering Personal Grounding Rods are designed to temporarily ground or discharge (with current limiting at higher currents) electronic equipment and apparatus that could present a safety problem to personnel. They are not for powerline use. The rods can be hooked on to HV cables, terminals, and other points where contact will ground the devices involved. They are designed to conform to OSHA clearance requirements and can be provided with the correct handle and cable length to keep personnel away from hazardous high voltage. Handles to 12 feet and any length grounding cable are available. Handles over 5 feet are in sections of 1.5ft. which can be assembled up to 12ft. Grounding cable is AWG #8 or #10 Gauge Superflex with transparent PVC insulation with up to 30KV PK test. Translucent white Fluorinated Ethylene Propylene insulation is also available for wide ambient temperature requirements from -65°C to +200°C. For information on handle length/voltage and maximum discharge current safety requirements, please contact Ross Engineering Corporation. Handles with current limiting resistance included for discharging 20KV 20 Kilojoules, up to 100KV 50 Kilojoules/are available.



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# COLLAPSIBLE HOTSTICKS

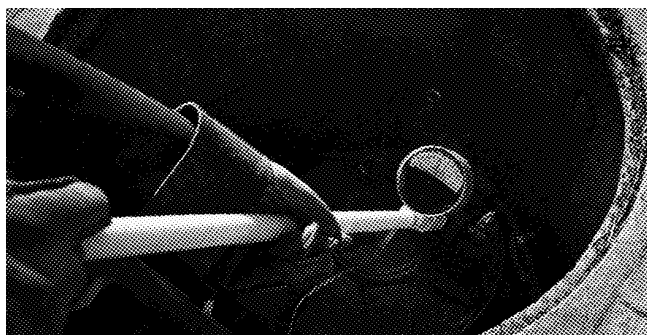
OSHA Referenced



Ross Engineering Collapsible Hotsticks are designed to maintain proper safety clearances from hazardous High Voltage while hand holding a test instrument. The 1 or 1.5 foot sections of the Hotstick form a rigid handle from 1 to 12 feet in length with 100 KV/foot test voltage, depending on your specific needs. Please see the table below to define what clearance is appropriate for your applications.

Each 5/8 to 1.5 inch diameter section is constructed using high strength solid insulating rod or G-10 Epoxy-glass tubing. Hotsticks using tubing are sealed and filled with lightweight plastic foam to form a rigid insulating support. These 1 and 1.5 foot sections can be joined easily to create the desired length of Hotstick. Disassembled, hotsticks store easily in a carrying case. The size and weight of the Collapsible Hotsticks make them ideal for use in portable test sets. 5/8-11 threaded ends are standard and fit most standard equipment.

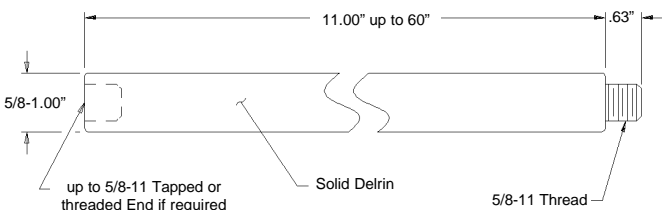
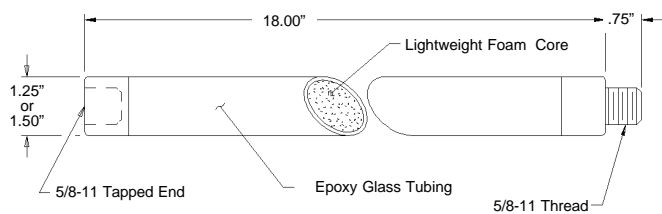
Ross Engineering is not responsible for user's choice of length. Please refer to Ross Engineering Corporation for further information on our Collapsible Hotsticks.



### Standard Handle Lengths

Model	Handle Length (feet)	Handle Diameter (inches)	Number of sections
VMHSC-3	3.0	1.00	1 or 3
VMHSC-3	3.0	1.25	2
VMHSC-4.5	4.5	1.25	1 or 3
VMHSC-6	6.0	1.25	4
VMHSC-7.5	7.5	1.25-1.5	5
VMHSC-9	9.0	1.25 / 1.5	6
VMHSC-12	12.0	1.25 / 1.5	8

### Outline Drawings



### Recommended OSHA Clearances from Title 8 Electrical Safety Orders, page 390 dated 12-22-95

Minimum voltage and clear Hot Stick distance. 100KV/FT withstand. When clean and dry. Ross Engineering Corp. is not responsible for user's choice of length.

*OSHA Table 2940.2. For alternating current - Minimum clearances Voltage Range Phase to Phase Kilovolts RMS	Voltage Range Line to Ground		*OSHA Minimum Clear Hotstick Distance
	Kilovolts RMS	Kilovolts PK or DC	Add 16"-24" to allow for Handhold
1.1 to 15.0 KV	0.635 to 8.7 KV	0.9 to 12.3 KV	2 ft. 1 in.
15.1 to 36.0 KV	8.8 to 20.8 KV	12.4 to 29.4 KV	2 ft. 4 in.
36.1 to 46.0 KV	20.9 to 26.6 KV	29.5 to 37.4 KV	2 ft. 7 in.
46.1 to 72.5 KV	26.7 to 41.8 KV	37.5 to 59.1 KV	3 ft. 0 in.
72.6 to 121.0 KV	41.9 to 69.8 KV	59.2 to 98.7 KV	3 ft. 4 in.
121.1 to 145.0 KV	69.9 to 83.7 KV	98.8 to 118.4 KV	3 ft. 7 in.
145.1 to 169.0 KV	83.8 to 97.6 KV	118.5 to 138.0 KV	4 ft. 0 in.
169.1 to 242.0 KV	97.7 to 139.7 KV	138.1 to 197.5 KV	5 ft. 3 in.
242.1 to 362.0 KV	139.8 to 209.0 KV	197.6 to 295.5 KV	*8 ft. 6 in.
362.1 to 552.0 KV	209.1 to 318.7 KV	295.6 to 450.6 KV	*11 ft. 3 in.
552.1 to 765.0 KV	318.8 to 439.9 KV	450.7 to 622.0 KV	*15 ft. 0 in.

\*\* Hotsticks should be long enough to allow at least the clear distance after necessary hand hold. It is recommended that a guard be positioned on the hotstick to indicate the minimum clear length. Where possible faults or arcing may occur, longer distances are advisable. Many organizations may have regulations requiring longer lengths than OSHA listed here, i.e.: Many utilities require at least 6' total length below 38KV RMS Line to Line.

\*See OSHA for further Details

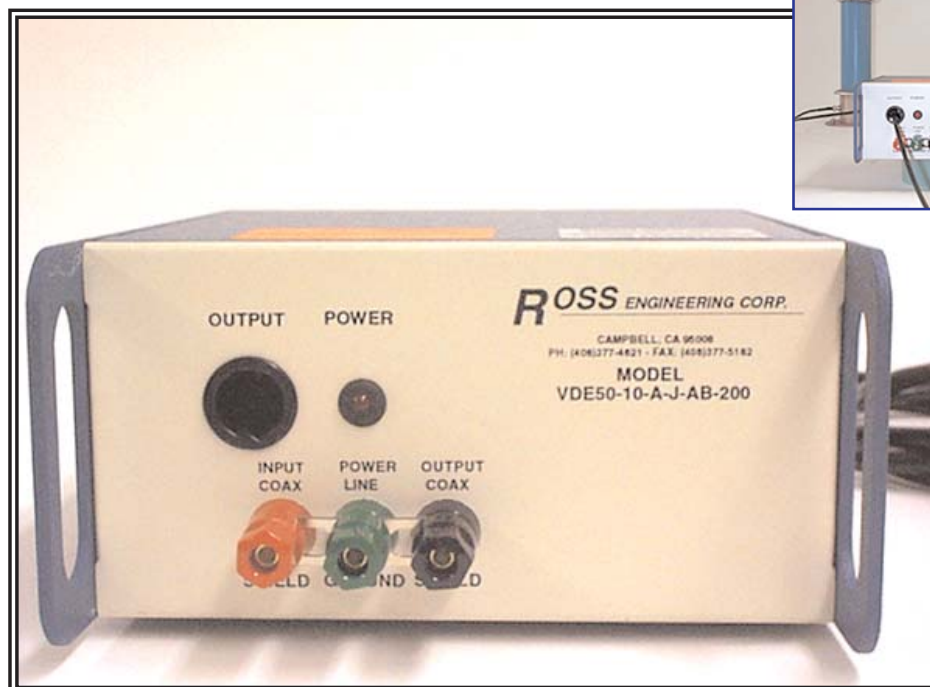


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# COAXIAL CABLE DRIVER & MATCHING AMPLIFIERS

*FIBER OPTIC TRANSMISSION ALSO AVAILABLE*



**WIDE BAND**  
**DC TO OVER 30 MHz**

**MAXIMUM OUTPUT**  
**TO 10V PK, 20V PK-PK**

**MAXIMUM INPUT**  
**+ - 5V TO + - 200V P-P AS  
REQUIRED. ALSO TO 900KV PK  
WITH ROSS VOLTAGE DIVIDER**

**SIGNAL ISOLATION**  
**500,000 OHM 450V PK**

**INPUT IMPEDANCE**  
**UP TO 2 MEGOHMS**

**LOAD IMPEDANCE**  
**50 OHM OR GREATER**

**WILL DRIVE OVER 500 FEET OF  
COAXIAL CABLE**

**POWER SOURCE**  
**AC OR OPTIONAL BATTERY**



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# Matching Amplifier

## Model VDE-

Wide Band: DC to over 25MHz

---

### Signal Input

0 to +- 50 volt peak differential.  
(0-100V PK-PK) standard. Other available.  
Peak common mode voltage that will not  
damage amplifier or distort the output.

200 volt steady state  
450 volt transient

Impedance

1.0 megohm in parallel with 10 pF  
or 2.0 megohm in parallel with 15  
pF as ordered.

### Signal Output

0 to +- 10 volts (20 volts PK-PK) into 50  
ohm or greater load.  
+- 200 mA. Peak Maximum load current  
Matching amplifier isolation of signal output  
from signal input is 500 Kohm in parallel  
with 20 pF.

-Gain / frequency  
see figure #1

-Undistorted output voltage swing  
see figure #2

-Square wave input  
Rise and fall time < 10 ns.

-Matching amplifier output is calibrated into  
a specified length of cable and a 50 ohm or  
greater load as specified by the customer.

### Power Requirements

105 V to 125 VAC, 50/60 Hz.  
Power Consumption-5W.

### Environmental

Indoor.  
0 °C to +50 °C.

### Dimensions

3 1/2" high X 7" wide X 8 3/8" deep.

### Miscellaneous

Red LED indicates power on. Model  
VDE-Matching Amplifier includes cabinet,  
amplifier, 115 volt 50-400 Hz power supply,  
cable and terminations as specified by the  
customer.

Power supply input isolated for 2000  
volts.

Matching amplifier may also be used with  
other test equipment such as voltmeters,  
signal generators, recorders, etc.

### WARNING

MATCHING AMPLIFIER OUTPUT  
COAXIAL CABLE SHIELD IS NOT  
GROUNDED. FOR SAFETY, OUTPUT  
COAXIAL CABLE SHIELD SHOULD BE  
GROUNDED AT COAXIAL CABLE  
TERMINATING RESISTOR. If output  
coaxial cable is connected to matching  
amplifier input ground or matching amplifier  
115 volt ground, there may be excessive  
ground currents causing electrical noise in  
matching amplifier output.

### CAUTION

Do not subject output to reverse voltage.  
External pickup from coaxial cables can  
easily exceed safe values if the cables are  
run near high pulse current conductors.

The matching amplifier, coaxial cable and  
coaxial cable terminating resistor are  
calibrated as a system. If any of these are  
changed, the calibration, the high frequency  
response and the pulse response may  
change.

### Options On Request

Signal Input Variations Available:

Any maximum input voltage from  
+- 0.5 to over +- 250 volt with  
proper input range selected, to over  
900KV when using  
Ross Engineering Corp.  
voltage dividers.



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## Options continued

### Signal Output Variations Available:

Coaxial cable lengths from  
0 to 500 feet

### Power Options Available:

Battery or DC operated.  
115V, 208V, 240V 50-400Hz.

### Environment Additional Requirements Available:

Outdoor  
Transformer Oil

### Miscellaneous Available:

Power on/off switch

Typical Response vs. frequency

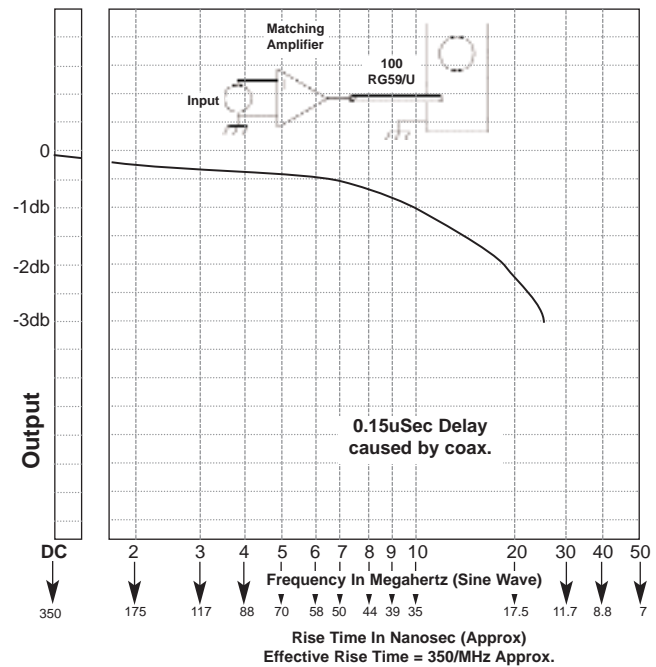


Figure 1

Maximum undistorted output voltage swing (into 50 ohm or greater load)

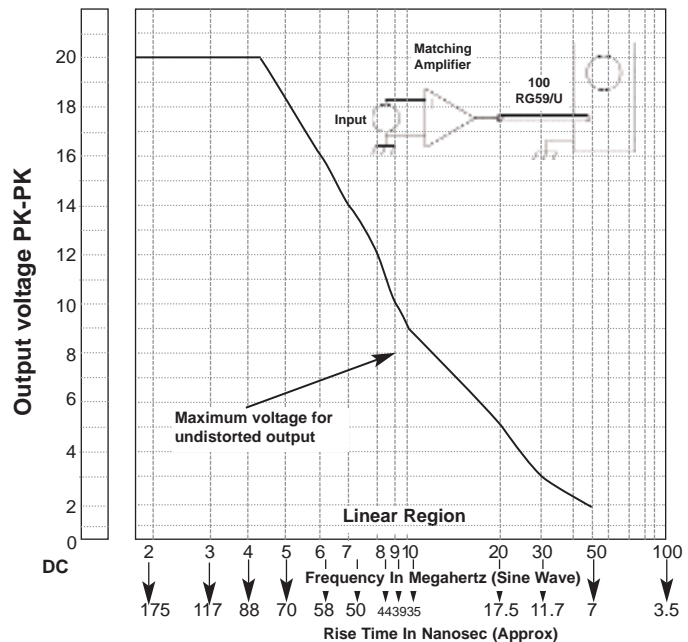


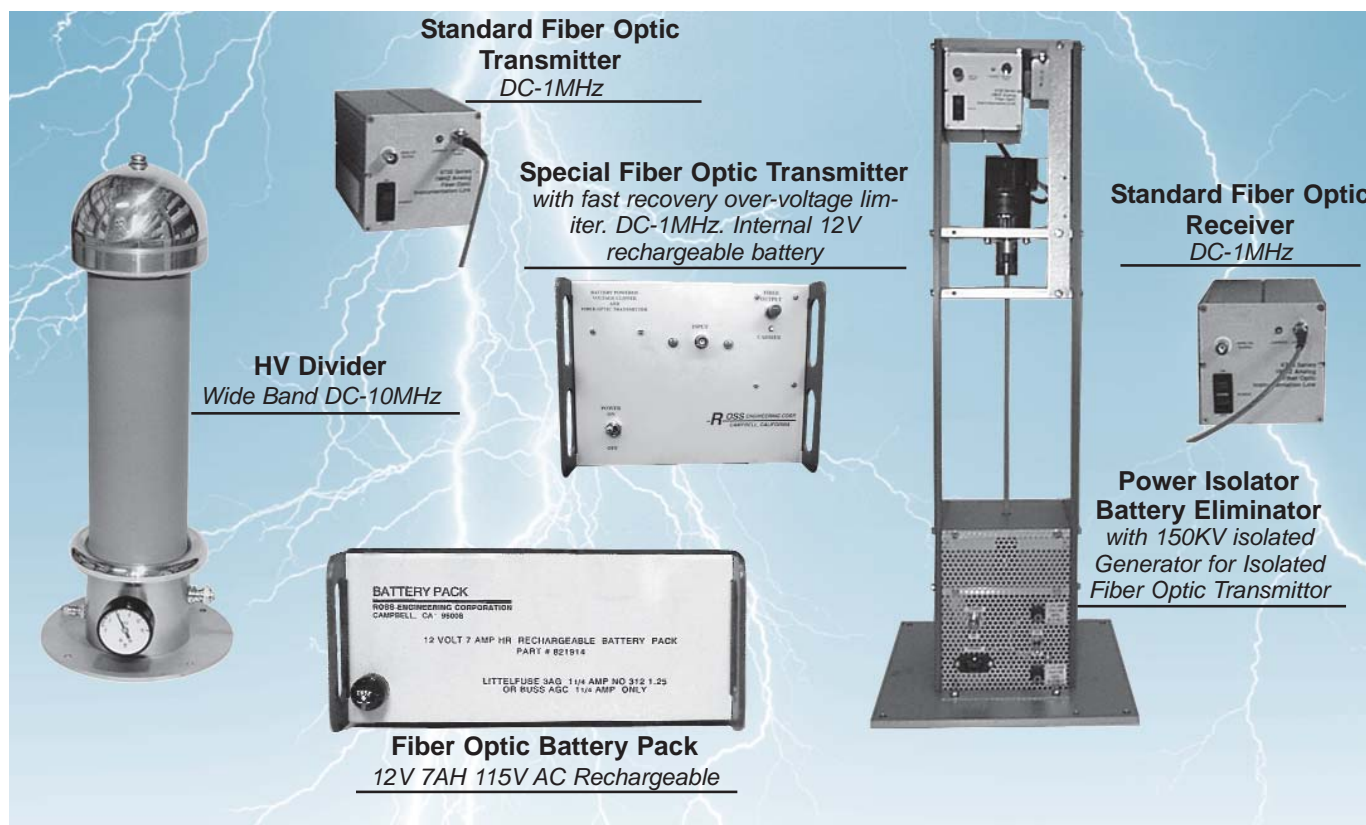
Figure 2



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# Fiber Optic Transmission Systems

## Analog Wideband DC-1MHz



Ross Engineering corporation has developed a HV compact analog fiber optic transmitting and receiving system, with optional over-voltage limiting designed to drive instrumentation from a DC to 1MHz signal source. The system is available with optional multiple input and output ranges of  $\pm 0-1V$  PK,  $0-5V$  PK to  $0-10V$  PK. It will also operate in conjunction with Ross Engineering Corporation's high accuracy high voltage wideband voltage dividers, which are useful from DC to over 10MHz up to 1,000,000V PK at 0.01% to 3% accuracy. Transmitters and receivers can be powered by either AC or DC.

Ross HV probes can be combined with the Ross fiber optic transmission system to provide isolated, safe instrumentation for accurate high voltage measurement and transient wave shape viewing and recording. The use of fiber optics eliminates conductive cable pick-up and ground current effects as well as isolating high voltage. When a battery or low capacitance isolated power source is used at the transmitter, the system can isolate the transmitter from possible power source interference, ground currents, and if necessary allows it to be at high voltage above ground. The optical and FM mode of transmission will completely isolate instrumentation and will provide stable measurement or display in the presence of shock & vibration on the fiber optic cable and is immune to changes in light intensity.

An optional battery charge level indicator with low battery shut-off is available to eliminate low battery error. An optional fiber optic remote controlled on/off switch which can control the battery operated transmitter from the receiver or other isolated remote source can save battery power when the transmitter is in an inaccessible location and is not required to be operative. The user can also connect an external 12V battery to the external power socket to allow for longer operating time between battery charge cycles. Self-aligning fiber optic connectors allow for quick set-up and easy disassembly for test facility reconfiguration.

Units are available in single or multiple channel sets. The multiple channel sets are rack mountable and will accommodate up to four independent and removable channels. Ross also offers AC/battery operated 50-75 ohm coaxial cable drivers. (See brochures B-1011, voltage dividers; B-1020 and B-1020-A, matching amplifiers and fiber optic systems for more information on these Ross products.)



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# Fiber Optic Amplifiers and Transmission Systems, Analog Wideband **DC-1MHz**

## Specifications

### Input Voltage Ranges:

Switch selectable with over 1000 megohm, 30pF input. 0 to  $\pm 1V$  PK, 0 to  $\pm 5V$  PK,  $\pm 10V$  PK. Other ranges available. To 1,000,000V PK with matched Ross wideband voltage divider.

### Output Voltage Ranges:

Independent of transmitter setting. 0 to  $\pm 1V$  PK. 0 to  $\pm 5V$  PK, 0 to  $\pm 10V$  PK. Max output current 10MA. to  $\pm 0.5V$  PK into 50 ohms. To  $\pm 10V$  PK into 1,000 ohms or higher such as 1 to 10 Megohms, with up to 15ft. coax to 1MHz.

### Basic Accuracy

0.3% DC, 0.5% 1Hz-400Hz, 3% 400Hz-100KHz, 10% 100KHz-1MHz

### Transmission Distance:

1 Kilometer

Signal transmission not affected by shock, vibration or change in light intensity.

### Power Requirements:

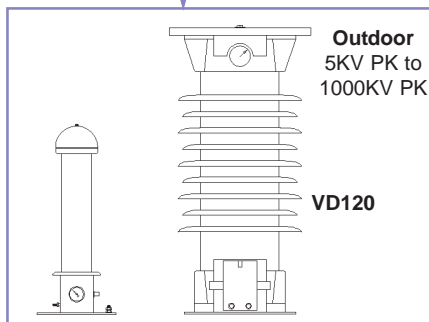
#### Transmitter

115V or 230V 50/60Hz and/or 12V DC powered, with integral charger or  $\pm 15V$  DC + 5V DC external DC source. Optional remote on/off controlled by fiber optic cable from receiver. Standard 7AH 12V battery provides 8-15 hours of operation between charges, longer available. (Additional 12V battery can be added for longer operation). Also isolated at 115V or 230V 50/60Hz generator with 150KV PK isolation or more to power source available for continuous operation without need for battery, 5V. Or + 15V 65MA, -15V 40MA, +5V 130MA, 3.5w DC.

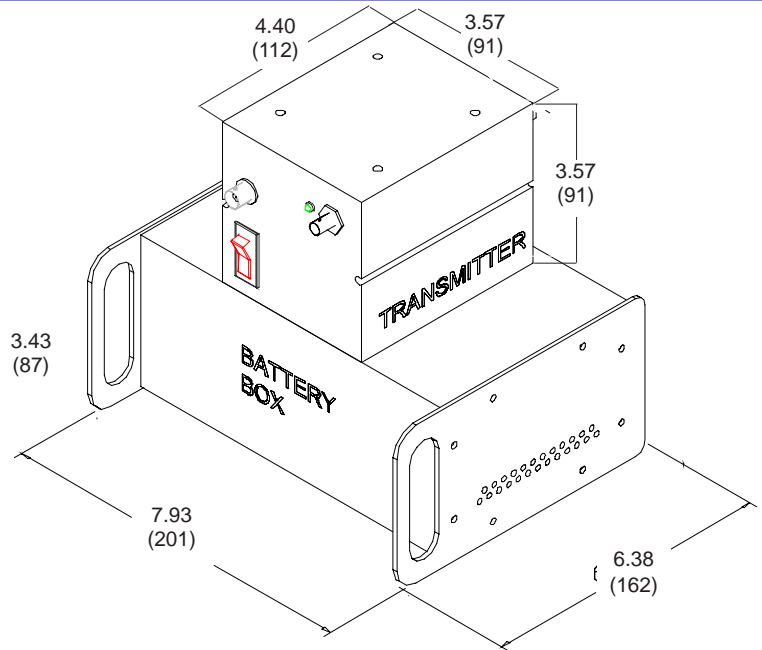
#### Receiver

115V or 230V 50/60Hz, 5VA, AC Powered and/or 12V DC battery powered or +15V, 65MA, -15V 40MA, + 5V 130MA DC Powered. 3.5 Watts.

Voltage input range can be extended in 15KV increments to 1000KV PK by Ross Engineering Corporation's wideband voltage dividers.

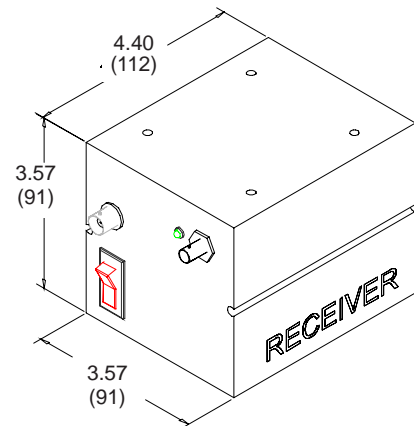


Specifications subject to change without notice

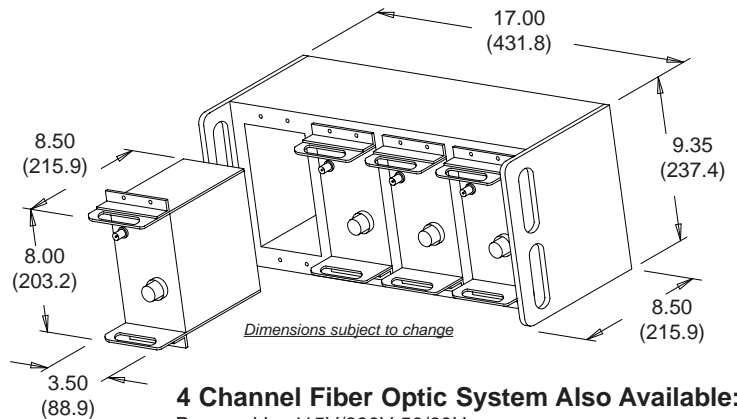


AC/DC Powered Transmitter with 12V DC 8-15Hr. Battery Pack

Dimensions in inches (metric)

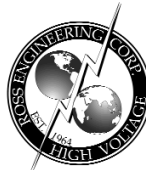


AC Powered Receiver



4 Channel Fiber Optic System Also Available:

Powered by 115V/230V 50/60Hz or  $\pm 15V$ , + 5V DC.



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# HIGH VOLTAGE POWER ISOLATORS FOR SENSITIVE EQUIPMENT

## TRANSFORMER TYPE:

These supply 115V or 230V AC power for long periods of time for electronic equipment that must operate while at a high voltage to ground. For example, a fiber optic transmitter at the HV level for waveforms to be received and measured or recorded by grounded instrumentation might be powered by an isolation transformer. The low dielectric constant air insulation provides lower capacitive coupling between the secondary and the primary or ground than would solid or oil insulation. The lower capacitance provides better isolation both at line frequency and especially at high frequency voltages such as lightning or switching transients.



Capacitance values as low as 20 Picofarads and withstand voltages of 60KV or more are available. Ratings may be 50VA to 2KVA or more. Isolation ratings between secondary and primary or grounded transformer core of 5KV up to 50KV RMS. 60KV or 110KV 1.2x50 microsecond impulse withstands are available. The most popular models for low power instrumentation are 50 volt amps or 500 volt amps with 115V/230V primary to 115V/230V secondary and withstand isolation of 25KV RMS 1 minute and 60KV impulse. Approximate size: 12" x 14" x 20", approximate weight: 50 lbs.



*60KV Impulse Isolation Transformer.  
Less than 20PF primary to  
secondary or to ground.  
115/230V to 115/230V, 50 volt amps.*

## MOTOR GENERATOR TYPE:

By use of a high voltage insulated coupling to isolate a motor at ground potential and a generator at high voltage, very low capacitance and very high voltage withstand isolation can be obtained. A range of continuous AC or DC power output of 12V to 115V, 5 to 100 volt amps or more is available. Light weight and practically unlimited high voltage isolation withstand levels are possible with motor input voltage of 12V to 230V, 50 or 60Hz.



*Isolated  
Instrumentation*

*5-50VA  
Motor / Generator  
Type  
> 150KV PK  
Isolation  
< 1 Picofarad*

*115V, 230V AC Motor*

## BATTERY TYPE:

12 volt DC output or other isolated supply can be recharged by removable 115V AC charger and supply 3 to 50 ampere hours or more depending on allowable size and weight. Remote On-Off control by fiber optics is available.



*Battery Supply*

*12V DC Output  
12 ampere hours  
Less than 10 Picofarads*

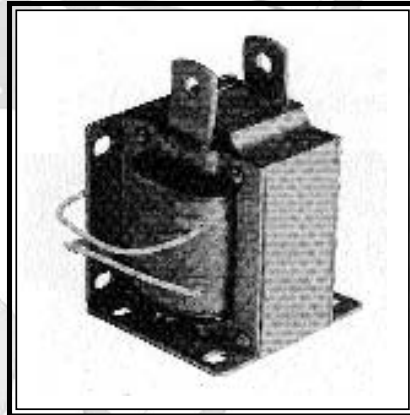
*Any HV Isolation required must be  
provided by an insulating support platform.*



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# SOLENOIDS



- AC QUIET

- DC TO 800Hz

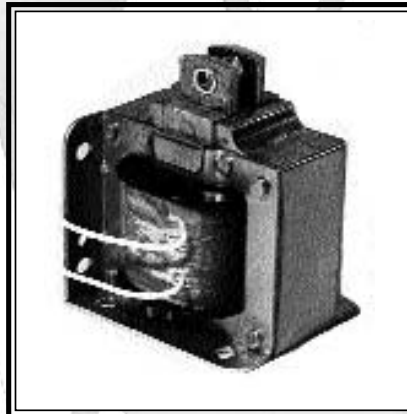
- CLASS B AND H INSULATION

- EXTENDABLE STROKE

- UNIVERSAL MOUNTING

- HIGHER HOLDING FORCE

- ENVIRONMENT RESISTANT



- OPTIONAL ELECTRONIC CONTROLLER \*

- ALLOWS VIBRATION FREE OPERATION

- PREVENTS COIL BURNOUT

- PROVIDES DC-800Hz CAPABILITY WITHOUT HEAT PRODUCING DROPPING RESISTORS

- OPTIONAL COMPUTER CONTROLLED WITH 4 - 10V 5mA SIGNAL



**SOLENOID-SAVER®  
CONTROLLER**

\* ELECTRONIC CONTROLLER TO ALLOW VIBRATION FREE AC SOLENOID OPERATION 25Hz TO 800Hz, 24V TO 240V AND DC 12V TO 250V. FOR COILS OF 1.5 OHMS TO OVER 1000 OHMS REQUIRING UP TO 50 AMPS DURING PULL-IN AND OVER 2 AMPS CONTINUOUS HOLDING. CAN BE ADDED TO EXISTING ACTUATOR. SEE B1022-A BROCHURE (SOLENOID-SAVER®)



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## LONG LIFE

Stainless steel plunger guides that eliminate jamming, lightweight plungers that reduce impact forces, and high temperature Class H 180°C coil insulation along with reduced temperature rise contribute to the solenoid's longevity and reliability. An optional plating gives high corrosion resistance.

## QUIETER

The reduced shock and vibration noise (AC hum) of the solenoid is attributed to low inertia and precision ground plungers with high seated holding force.

## COMPACT

The Ross Engineering Corporation's Precision AC Solenoid is structured compactly and is lighter in weight than many types with equal force. It is also useful with DC, using proper pull-in/hold switching as required.

## FORCES AND STROKES

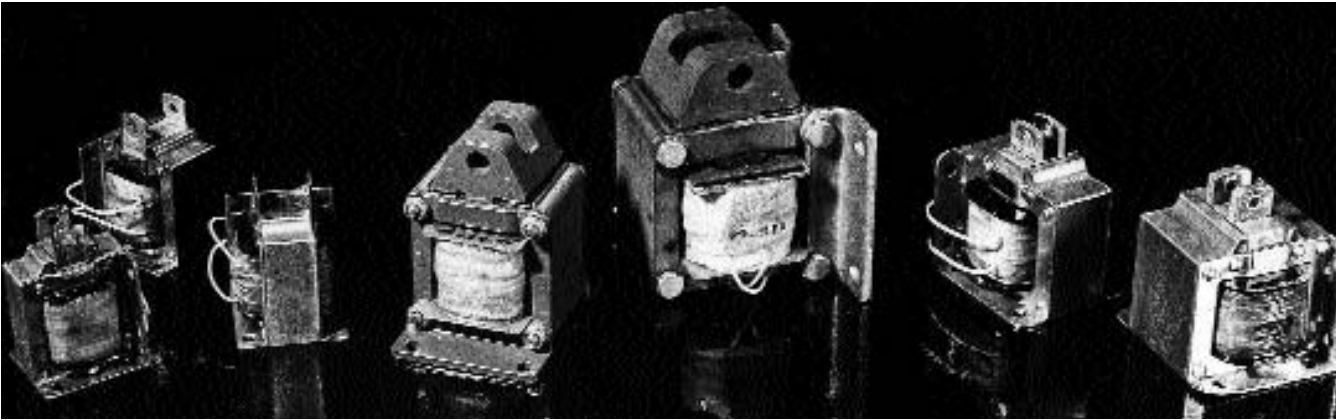
Coils and plungers are interchangeable. The stroke, which is normally 0.875 to 1.25 inches, can be lengthened to several inches on some models. Forces are from 6 to 150lbs, from continuous to intermittent duty.

## UNIVERSAL MOUNTING AND PARTS

Made for use in various applications, the mounting brackets may be fastened in five different positions. Coils, plungers, and guides are easily interchangeable.

## MANY OPTIONS

120V, 208V, 240V, 480V, 60Hz coil voltages are standard. Other voltages and frequencies (including DC) are also available.



## SPECIFICATIONS

MODEL	Force at 100% V (Multiply x 0.7 at 85% V)				Max Normal Stroke Inches	Size Inches H x W x D	Weight of Plunger Lbs	① Nominal AC Pull-in Current with Max Stroke **AMPS RMS	② Approximate Momentary Pull-in Current for 25 x 1 stroke Lbs at 1"		**Continuous Holding Current with 230V 60 Hz Coil **AMPS RMS	Part Number 60 Hz	
	Seated Lbs		At 1/4" Lbs AC	At Max Stroke Lbs AC					Lbs at 1"	Lbs at 1"		115V	250V
	AC Coil Hold	DC Coil Hold											
SOL 38	16	100	41	10	1	4.3 x 3.1 x 4.0	1.5	17	68	1.9%	1.0	0860	0862
	*40	210	30	25	1			12					
SOL 12	26	150	18	12	1	3.5 x 2.4 x 3.4	0.7	7	28	12	0.5	0530	0532
	*18	105	13	8	1			8					
SOL 13	24	100	17	13	1	2.9 x 2.4 x 2.8	0.6	13	52	15	0.7	1911	1912
	*21	70	12	9	1			11					
SOL 9	17	80	10	9	1	2.9 x 2.4 x 2.2	0.4	11	32	31	0.4	1811	1812
	*13	58	8	7	1			7					
SOL 6	13	40	7	8	0.88	2.5 x 1.7 x 1.8	0.3	5	20	21	0.4	1411	1412
	*9	28	5	4	0.88			4					
SOL 5	10	35	6	5	0.88	2.5 x 1.7 x 1.7	0.2	5	16	17	0.3	1314	1316
	*6	25	4	3	0.88			4					
SOL 2	8	30	4.5	2	0.88	2.5 x 1.7 x 1.6	0.2	3	12	7	0.2	1111	1115
	*4	21	2.5	1.2	0.88			2					

50Hz and other voltages and frequencies available. 60Hz coils can be used on 50Hz at 100% of rated intermittent and at a max of 85% of 60Hz rated continuous voltage. Stroke can be extended if loss of pull force at the extended length, and higher inrush current is not critical. 60Hz coils voltage derated 20% and force derated.

\*Force is approximately proportional to V<sup>2</sup>. Over 8 times rated continuous voltage can be applied momentarily to 115V AC rated coil within I<sup>2</sup>T rating for increased pull-in force to obtain as much as 10 times rated force at the stroke length.

\*\*Inrush and hold current inversely proportional to voltage at various continuous ratings, but not at intermittent ratings.

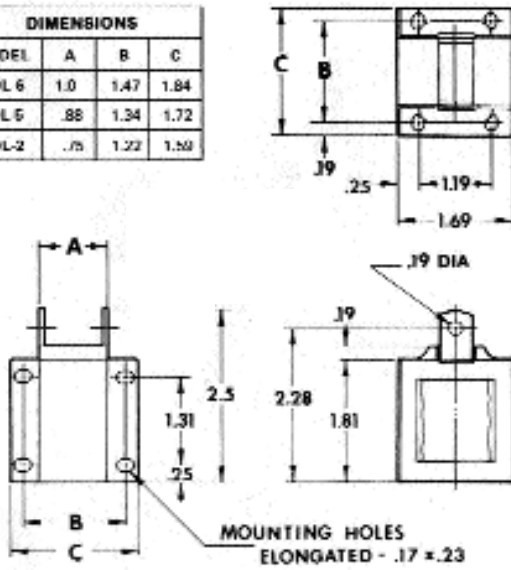
① At 230V 60Hz and 230V coil

② 230V AC or 125V DC on 115V AC coil. Max 0.060 second pulse, 30 operations per minute.

# DRAWINGS AND DIMENSIONS

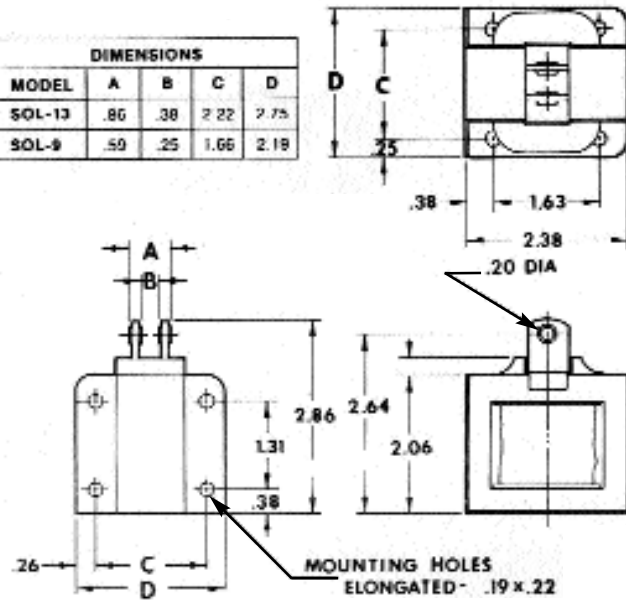
## MODELS SOL-6, SOL-5, SOL-2

DIMENSIONS			
MODEL	A	B	C
SOL-6	1.0	1.47	1.84
SOL-5	.88	1.34	1.72
SOL-2	.75	1.22	1.59

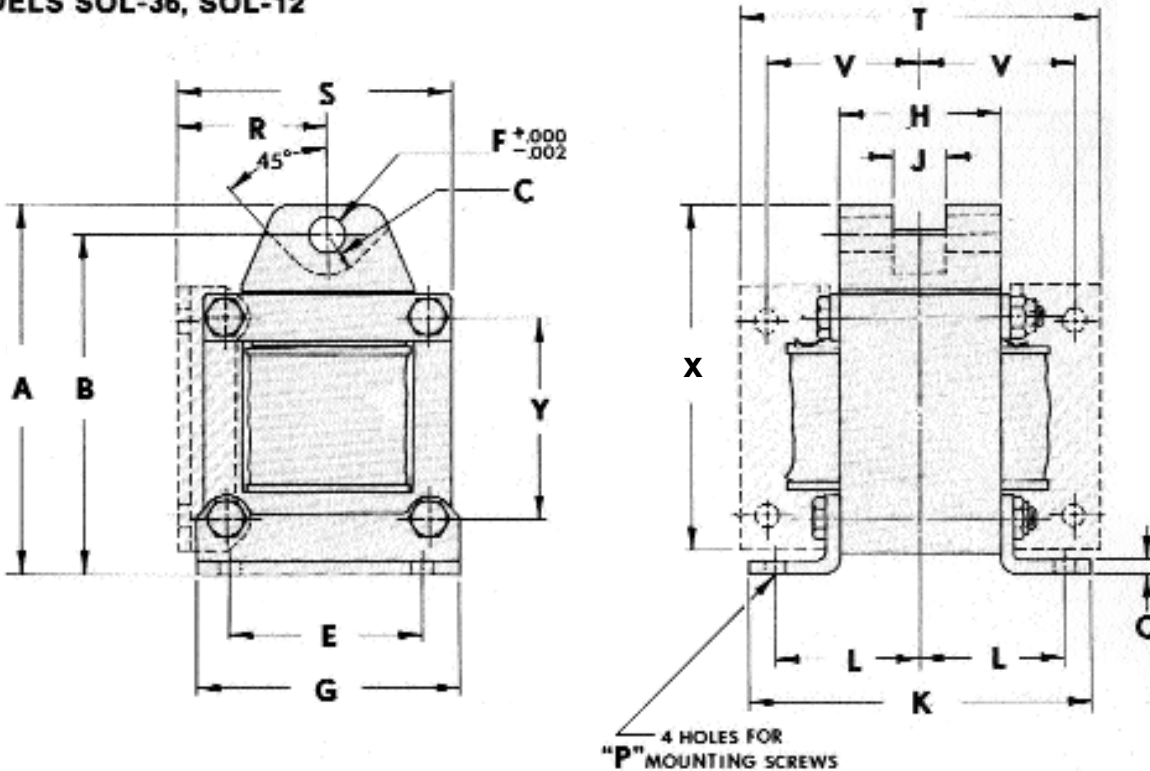


## MODELS SOL-13, SOL-9

DIMENSIONS				
MODEL	A	B	C	D
SOL-13	.86	.38	2.22	2.75
SOL-9	.50	.25	1.66	2.19



## MODELS SOL-36, SOL-12



DIMENSIONS													
MODEL	A	B	C	e	F	G	H	J	K	L	U	P	Y
SOL-36	4.32	3.98	.40	2.25	.44	3.08	1.88	.85	4.0	1.67	.16	.25	2.38
SOL-12	3.44	3.13	.40	1.81	.38	2.38	1.6	.62	3.19	1.38	.13	#10	1.88

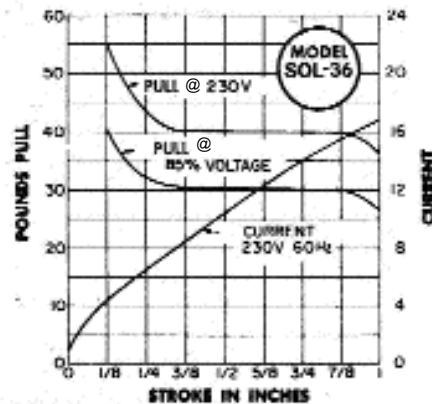
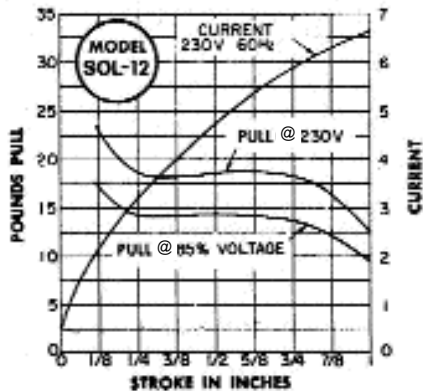
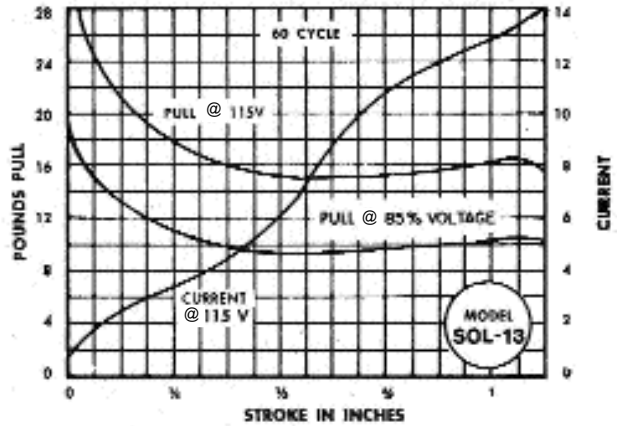
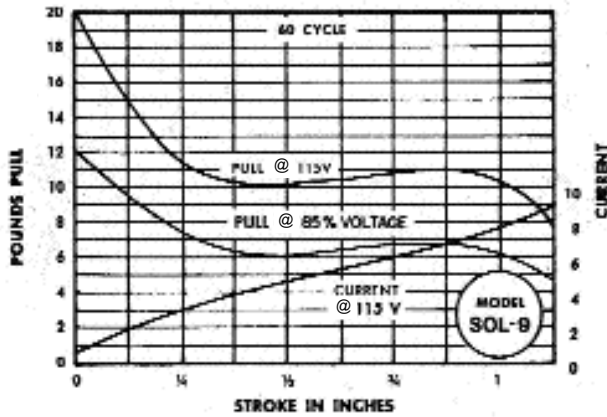
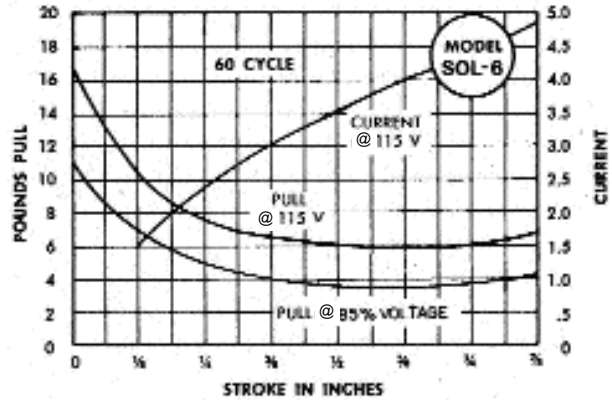
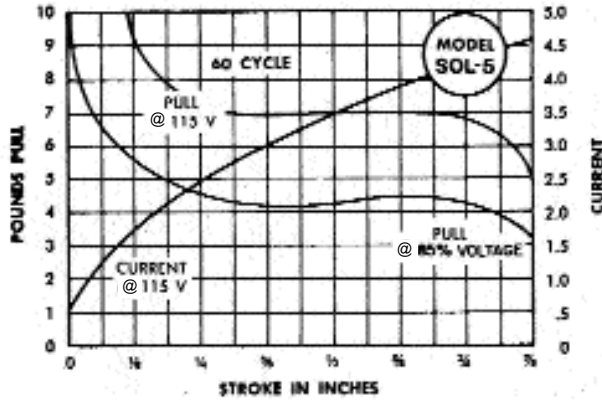
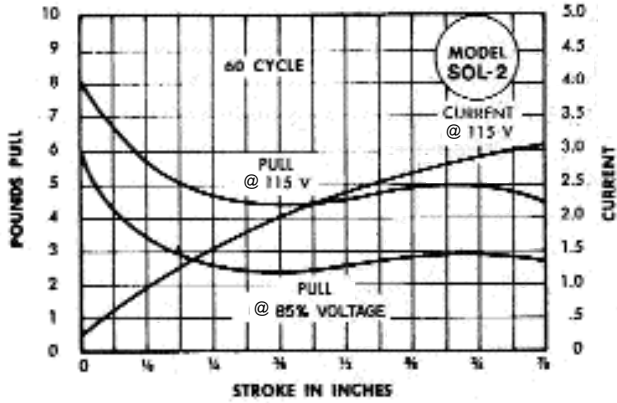
DIMENSIONS - Side Mounted					
MODEL	R	S	T	V	X
SOL-36	1.77	3.20	4.25	1.80	4.09
SOL-12	1.94	2.47	3.38	1.47	3.28

Ross Engineering Corporation

PRECISION  
HIGH-FORCE  
AC&DC

# Solenoids

Force & Current Curves



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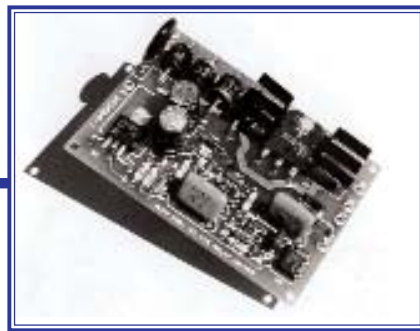
3/00-2500

# SOLENOID-SAVER®

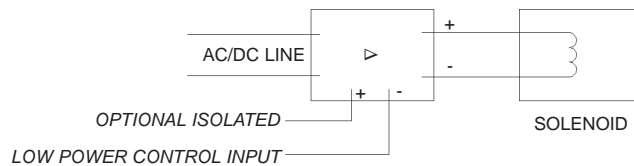
**50 TO 400Hz AC/DC SOLENOID CONTROLLER WITH OPTIONAL LOW VOLTAGE LOW POWER ISOLATED CONTROL SIGNAL INPUT AND/OR STORED ENERGY FOR DELAY TO RELEASE ON LOSS OF POWER OR HIGH SPEED ACTUATION WITH OR WITHOUT LOSS OF POWER**



FOR SMALL SOLENOIDS

SOLENOID-SAVER® CONTROLLER  
FOR A WIDE RANGE OF SOLENOID SIZES

FOR LARGE SOLENOIDS



- ✦ SOLENOID-SAVER® eliminates AC hum and reduces heat generation for many types of solenoids.
- ✦ Controlled application of current prevents coil burnout if high pull-in/low holding current AC or DC solenoids fail to pull-in completely.
- ✦ Can adapt high pull-in low holding current solenoids to special voltages & frequencies 12V to 250V DC or 12V to 240V AC wideband 25-800Hz.
- ✦ Optional optical isolated control input 4 to 10V, 5MA, 20 usec or more (or other control voltages) to actuate any high current solenoid directly by computer or other low power signal source.
- ✦ For coils of 1 ohm to 3,500 ohms DC resistance requiring up to 70 amps during pull-in up to 120 milliseconds. Basic solenoid coil voltage and resistance must be specified.
- ✦ Eliminates heat producing dropping resistors, bypass switch, dual coils, laminations, & shading coils.
- ✦ Can increase pull-in and holding force of many types of solenoids.
- ✦ Optional stored energy to delay solenoid release on loss of power.
- ✦ Can be used as an added accessory to existing solenoid installation to eliminate AC hum, lower coil temperature and prevent coil burnout.
- ✦ Optional high speed, 1 microsecond sensing, 1-10 millisecond actuation with stored energy Solenoid-Saver®.



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# SOLENOID - SAVER®

The AC/DC Solenoid-Saver® allows most high force solenoids to operate on DC to 800HZ or more. It controls coil current for high pull-in current, low holding current solenoids. The AC current is rectified to DC which eliminates AC vibration, increases pull-in force, significantly increases holding force which stops chattering and reduces holding current and coil heating. Also rectification allows almost any solenoid with suitable coil DC resistance to be used at any frequency to 800HZ or more.

The timing portion applies high DC or rectified AC pull-in current for a limited time usually in the order of 100 milliseconds, then reduces it automatically to a low holding current. This automatic timed reduction of pull-in current eliminates coil overheating and burnout if an AC solenoid fails to pull-in and reduce coil current by the increased inductance of a fully seated plunger. Burnout can also occur if high pull-in low holding current DC solenoid fails to pull-in completely to actuate an associated contact which will insert an additional coil or a current limiting but heat producing resistor to drop the current to a safe holding level.

The Solenoid-Saver® eliminates the need for the lamination and shading coil required for AC solenoids and the switch and the dual coil or heat producing dropping resistor for the DC solenoid. The Solenoid-Saver® also eliminates the need for a coil burnout protective fuse since only low holding current is present after a short time. To renew a failed pull-in attempt the solenoid saver input power or control signal is merely removed and then reapplied for another try to pull-in.

The timer section also has an inherent ability to act as an optional delay to pull-in or drop-out with application or loss of power. Delays of up to several seconds can be obtained.

In addition, as an option, the Solenoid-Saver® with optically isolated control input can be used with a very low signal power input in order of 4 to 10 volts, 5 milliamps, or other control voltage from a computer or other signal source to control the much higher current required to power the solenoid.

Even most presently installed AC or DC high pull-in, low holding current solenoids can benefit by merely inserting the Solenoid-Saver® unit between the coil and the power source. Some solenoids may require a modified coil or an additional pull-in current limiting resistance to be inserted between the Solenoid Saver® to prevent excessive pull-in current or to prevent the plunger from hitting its seat with excessive force even if the power source can stand the extra current. It also may be necessary to bypass the switch and heat producing holding current dropping resistor used on many high force DC solenoids.

Solenoid-Savers® are available from 10V to 250V AC or DC for coils in the order of 1 OHM to 3,500 OHMs, with pull-in as high as 70 amps for 0.1 seconds, and with optional low current control voltage inputs from 4V to 125V, 5 milliamps, AC or DC.

## DELAYED ACTION OR HIGH SPEED ACTUATION STORED ENERGY SOLENOID-SAVER® FOR HIGH VOLTAGE RELAYS OR OTHER SOLENOID ACTUATED DEVICES WITH ADJUSTABLE DEACTIVATION TIME DELAY OR STORED ENERGY ACTUATION ON LOSS OF POWER

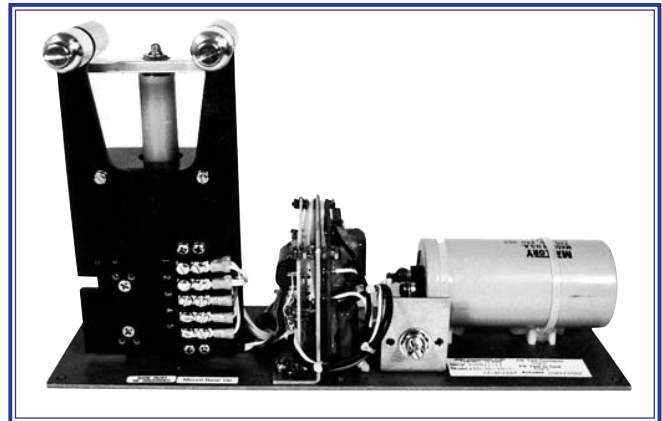
Upon loss of power provides stored energy for delay to close for a normally closed or delay to open for a normally open relay or contactor, or delay loss of holding force in any solenoid actuator upon loss of actuator power.

Also with stored energy, high speed actuation is available with or without loss of power with 1-20 microseconds trigger pulse and actuator time as fast as 1-4 milliseconds.

Available for standard 115V, 208V, or 240V 50/400 Hz actuation (other AC & DC voltages available):

Provides same AC hum elimination, reduced coil temperature and coil burnout prevention as standard Solenoid-Saver®. Solenoid can not be energized at below 60% of line voltage. Other minimum actuation settings available.

Standard delay to close or open on loss of AC line below minimum voltage is obtainable from 1 to 3 or 4 to 9 seconds for specific HV relay for standard unit. Other delays available.



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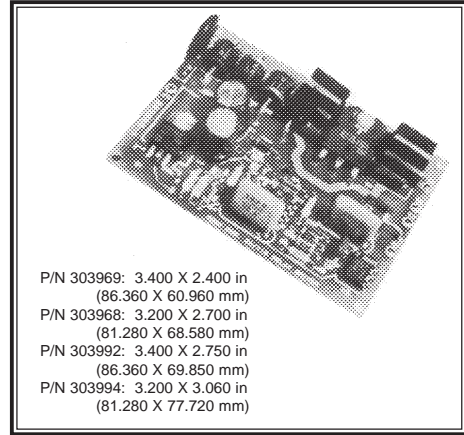
e-mail: [info@rossengineeringcorp.com](mailto:info@rossengineeringcorp.com)



# SOLENOID-SAVERS® / ADAPTERS

**FOR AC OR DC SOLENOID TYPE ACTUATORS DC-400Hz  
WITH HIGH PULL IN CURRENT & LOW HOLDING CURRENT  
FEATURES:**

1. Protects high current pull-in coil from burnout due to pull-in failure.
  2. Eliminates AC hum.
  3. Makes basic DC or 50/60Hz solenoid usable over wide frequency range, DC-400Hz.
  4. Reduces holding current and coil temperature. Increases AC Force.
  5. Holding current can be as low as 10% of basic AC solenoid's holding current when used direct without solenoid saver, resulting in major reduction of coil temperature.
  6. Can be modified to add time delay for pull-in or drop-out.
  7. Types with low power control capability can be used as optically isolated controller/driver with low current control voltages as low as 4 to 10 volts 5MA DC for computerized control.
  8. Energy Storage for High Speed closing or tripping available.
- In many cases a solenoid saver can simply be inserted between the present solenoid coil and power source. However, the resistance of some coils may need to be changed or an external resistor added between solenoid and driver to adjust pull-in current.



P/N 303969: 3.400 X 2.400 in  
(86.360 X 60.960 mm)  
P/N 303968: 3.200 X 2.700 in  
(81.280 X 68.580 mm)  
P/N 303992: 3.400 X 2.750 in  
(86.360 X 69.850 mm)  
P/N 303994: 3.200 X 3.060 in  
(81.280 X 77.720 mm)

VOLTAGE CLASS	PART NUMBERS		*OPERATING VOLTAGE VOLTS RMS/DC		ALLOWABLE SOLENOID RESIST OHMS		*ALLOWABLE SOURCE PULL-IN CURRENT AMPS RMS/DC		*SOURCE HOLDING CURRENT AMPS		**TYPICAL ACTIVATION MILLISECONDS NOMINAL 120 MILLISEC PULL IN CURRENT	
	WITHOUT ISOLATED CONTROL	***WITH LOW POWER OPTICALLY ISOLATED CONTROL 4-10V DC-5MA	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	ACT	DE-ACT
<b>FOR AC 50-400Hz APPLICATION</b>												
1. 100/115V AC	303969-700	303992-725	77	130	4.8	760	0.01	27	0.005	0.11	34	118
2. DELAY DE-ACT. 115V AC NOTE	303969-701/2	303992-726-2	77	130	4.8	760	0.01	27	0.005	0.11	34	2SEC
3. DELAY DE-ACT. 115V AC NOTE	303969-701/3 303969-702/3	303992-727-3	77	130	4.8	760	0.01	27	0.005	0.11	34	3SEC
4. DELAY DE-ACT. 115V AC	303969-702/7	303992-727-7	77	130	4.8	760	0.01	27	0.005	0.11	34	7SEC
5. DELAY ACT. 115V AC	303969-703	303992-728-2	77	130	4.8	760	0.01	27	0.005	0.11	2SEC	118
6. HIGH CURRENT 115V AC	303969-704	303992-729	77	130	1.4	760	0.1	93	0.01	0.3	34	118
7. HIGH CURRENT 200-208V AC	303968-706	303994-731	140	260	1.4	760	0.01	172	0.01	0.2	34	118
8. 200/240V AC 8a. 200/240V AC, 2-1 sec. delay off	303968-707 303968-707/0.2	303994-732 303994-732	175 175	260 260	10 10	3500 3500	0.005 0.005	20 20	0.005 0.005	0.10 0.10	34 34	118 200
9. HIGH CURRENT 220-240V AC	303968-708	303992-733	175	260	1.4	760	0.01	172	0.01	0.2	34	118
10. 24V AC	303968-709	303992-734	17	30	0.9	350	0.004	27	0.005	0.53	34	118
11. 200-240V AC	303968-711	303992-736	140	275	5.5	760	0.004	50	0.005	0.2	34	118
12. 200-240V AC/24V DC CONTROL	-	303992-732/24	140	275	5.5	760	0.004	50	0.005	0.02	34	118
13. 100-130V AC ENERGY STORAGE DUMP +24V TRIGGER 325V 100MFD	-	303992-736/24-5	77	141	0.8	10	-	400PK	N/A	N/A	1-3	5SEC
14. 115-240V AC	303968-712	303992-737	77	275	5.5	3500	0.005	50	0.005	0.10	34	118
<b>FOR DC APPLICATION</b>												
1. 24/28V DC 1a. 24/28V DC	303969-750 303969-750a	303992-775 303992-775	15 15	38 38	0.9 0.9	350 350	0.004 0.004	42 35	0.005 0.005	0.53 0.53	34 34	118 118
2. DELAY DE-ACT 24V DC NOTE	303969-751	303992-776/24	15	38	0.9	350	0.004	42	0.005	0.53	34	3SEC
3. 100/110V DC	303969-752	303992-777	67	140	6.3	760	0.009	27	0.005	0.12	34	118
4. 125V DC	303969-753	303992-778	76	140	6.3	760	0.01	27	0.005	0.12	34	118
5. HIGH CURRENT 125 VDC	303969-754	303992-779	76	140	1.7	760	0.1	100	0.01	0.31	34	118
6. 48V DC	303969-755	303992-780	30	72	1.7	350	0.004	42	0.005	0.28	34	118
7. 12V DC	303969-756	303992-781	7	18	0.4	350	0.004	42	0.005	1.11	34	118
8. 250V DC	303969-757	303992-782	190	275	6.3	1000	0.009	29	0.005	0.06	34	118

\* Actual solenoid min. pull-in, drop-out, timing and continuous voltage or current may vary, & depends on specific solenoid.

\*\* Timing may vary depending on coil resistance, inductance, and voltage. Faster DE-ACT operation to less than half of standard deactivation available with additional circuitry.

\*\*\* For lower power optically isolated 4-10V 5MA DC control option add \$50.00 to price, and for lower power optically isolated control other than 4-10V DC Add \$50.00 additional to 4-10V price in small quantities.

For special base & assembly when included with Ross Engineering Corporation may add \$75.00 to Solenoid Saver® base price.

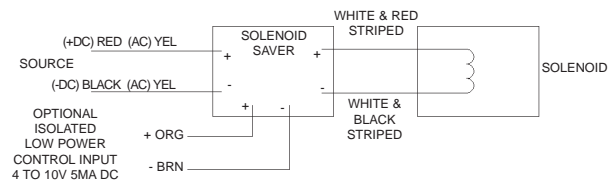
♦ Pull in currents 40 millisecond on instead of normal 120 millisecond on.

NOTE: For delay units add number for seconds delay

SPECIFY IF USE IN OIL

Add "x" if PCBID is furnished separately, Add

"xa" if PCBID is supplied in separate enclosure.



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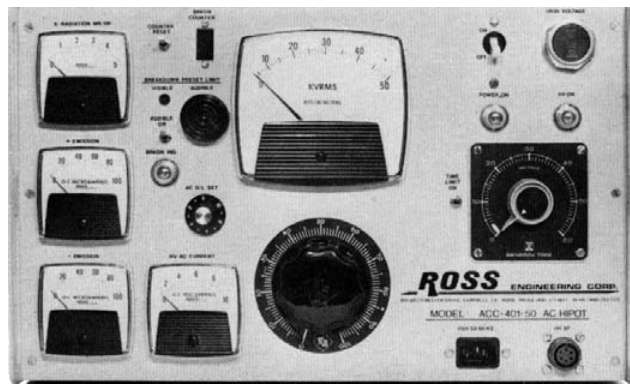
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e-mail: info@rossengineeringcorp.com

# AC-AC/DC HI-POT 0-50 KV RMS

Specifically designed for testing  
HV Vacuum Devices  
HV Equipment and Insulation.  
*0-50 KV DC Adaptor Optional*

**Features include:**  
**X-Radiation and Emission Monitor**  
**Visible and Audible Breakdown Indicator**  
**Digital Breakdown Counter**



**Model ACC-401-50**  
0-50 KV RMS

**Model ACC-401-50-AC/DC**  
0-50 KV RMS, 0-50 KV DC

Included is an accurate built-in X-Radiation Monitor especially calibrated for this energy level, making it ideal for safely testing withstand levels of High Vacuum High Voltage devices such as HV Vacuum Contactors, HV Vacuum Relays, and HV Vacuum Circuit Breakers. Also included is an Audible and Visible intermittent Breakdown Counter and warning system, and 0-1 minute timer.

Ross Engineering's Hi-Pot Control Unit features Variable Voltage Control with safety return to zero and safety return switch. It provides adjustable current overload trip, a large scale 0-50 KV RMS analog meter for easy viewing, and a 0-50 MA AC Milliammeter. Its simplified design is excellent for testing and accurately measuring AC leakage current, AC and rectified DC emission current in high vacuum devices, and breakdown or withstand voltage for any type of device where AC Hi-Pot testing is appropriate.

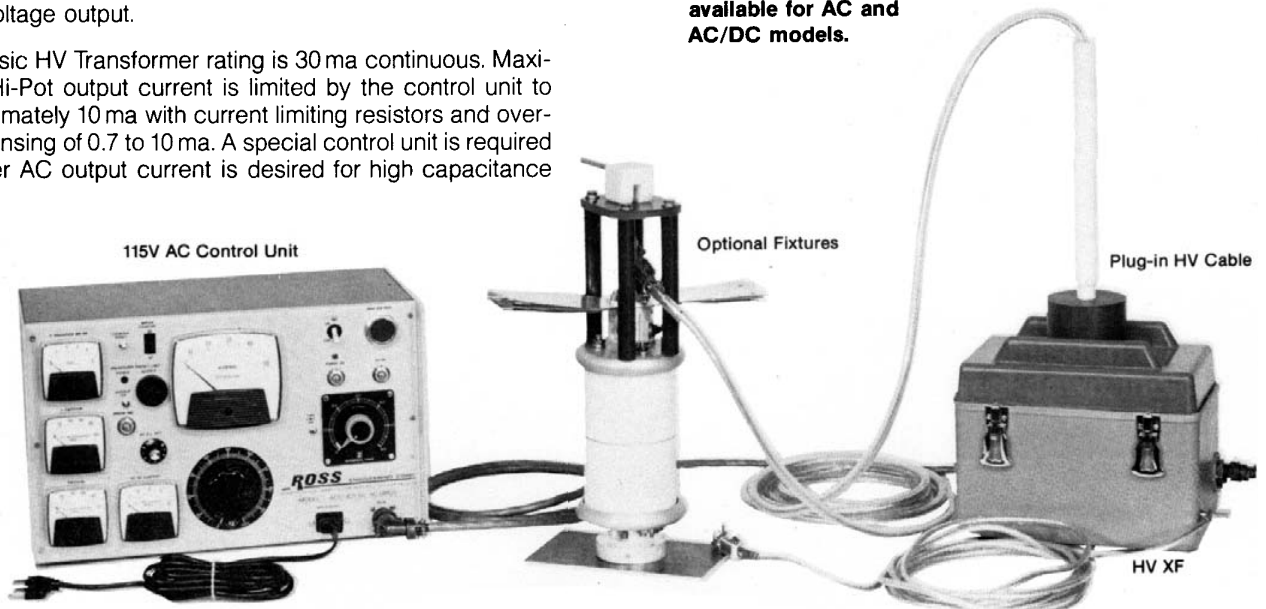
**Note: With the addition of external HV rectifiers, the system is also suitable for DC Hi-Pot testing of vacuum devices and insulation of  $\pm 50$  KV DC. Adjustable voltage limit available for AC and AC/DC models.**

## HV Transformer included with the Hi-Pot System

The Hi-Pot's 50 KV RMS Transformer is one of the smallest and lightest of portable High Voltage test transformers. It is solid epoxy encapsulated, measures 9" x 12½" x 5", and weighs only 43 pounds. Total system weight is 76 lbs. for AC, 88 lbs. for AC/DC. Shipping/carrying case adds approximately 80 lbs. Total shipping weight is in the order of 215-230 lbs.

The secondary of the transformer is provided with a special 500 to 1 control winding which permits easy monitoring of High Voltage output.

The basic HV Transformer rating is 30 ma continuous. Maximum Hi-Pot output current is limited by the control unit to approximately 10 ma with current limiting resistors and overload sensing of 0.7 to 10 ma. A special control unit is required if higher AC output current is desired for high capacitance loads.





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**Ross Engineering Corporation**


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*High Voltage / High Power*

# Test Load Systems & Special Devices

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Design and manufacture of electronic and electromechanical devices and systems for our customers' special applications has been Ross Engineering Corporation's specialty for over 17 years . Among these devices are our High Voltage Test Loads and Resistance/Capacitance Networks designed to simulate radar, communication, and television transmitter loads for testing.

For example, one Test Load System required 4 separate simulated load networks to complete an 8KV, 14KV, 24/6KV, and 34KV high voltage testing system. Each unit in the system required different features to meet our customers' needs. For example: the 34KV Pulse Load required the ability to measure the current and pulse voltage from the power supply between two points, both 34KV above ground, with differential wide-band voltage dividers. The 14KV unit required switching from 10% to 50% to 100% of load. Both of these features (and others) could be designed into any type of Test Load for more control and versatility.

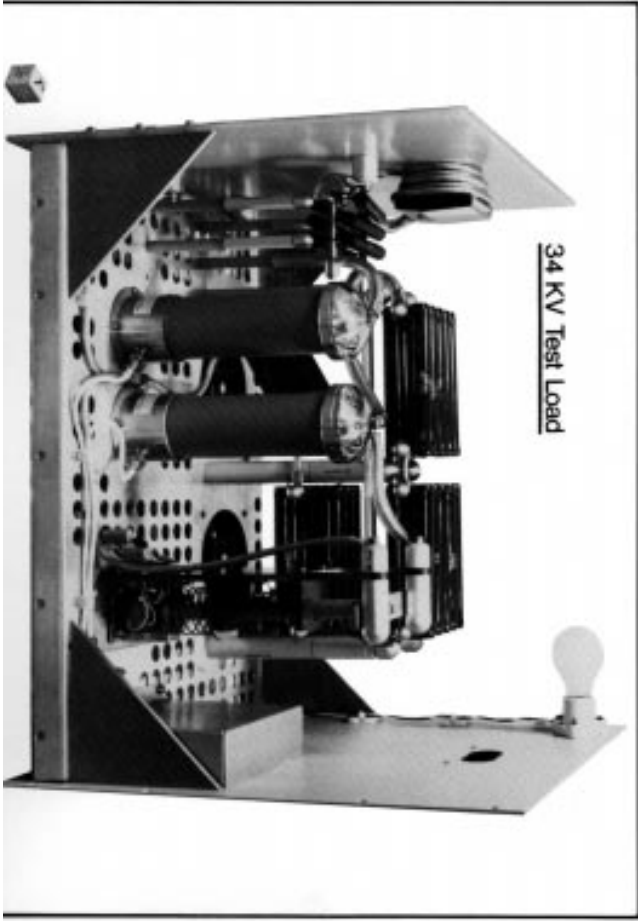
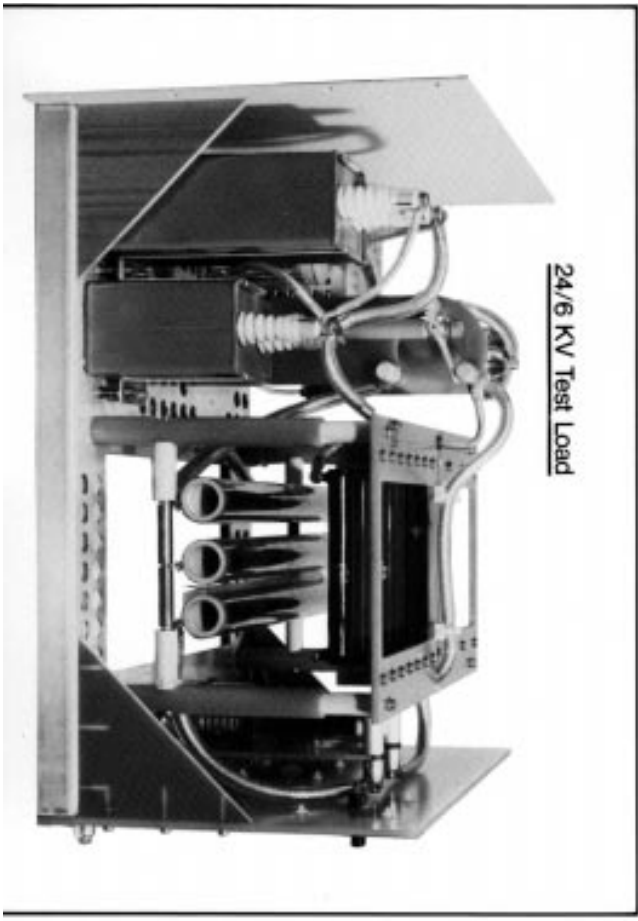
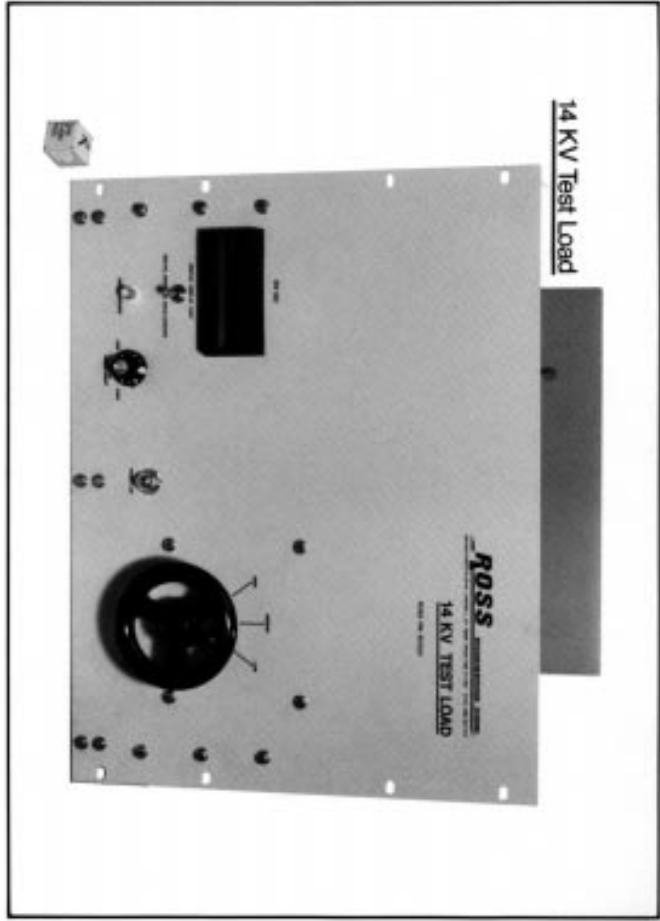
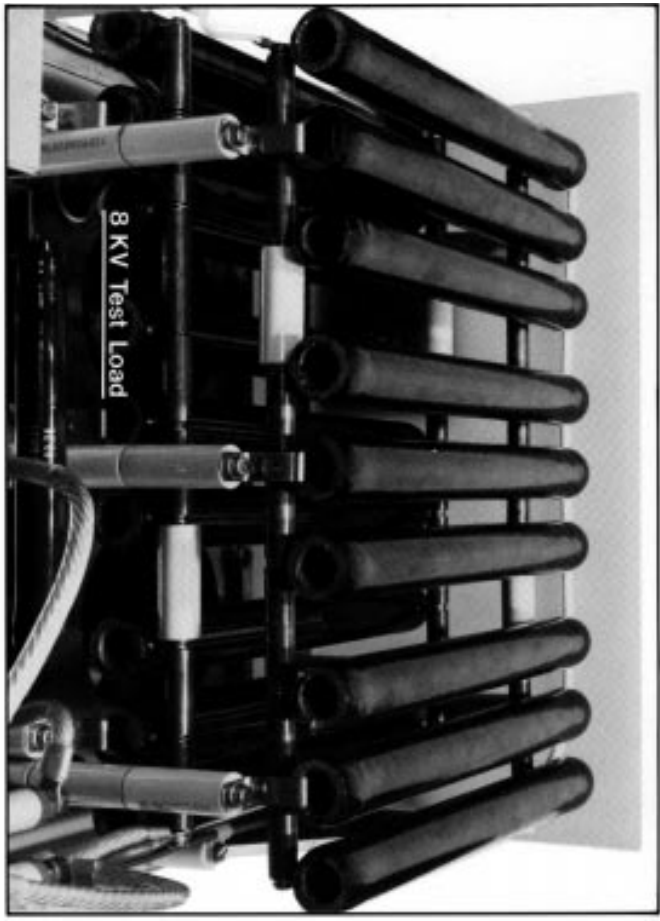
These Ross High Voltage Test Loads were also designed with non-inductive resistors and were equipped with current and voltage meters. Also incorporated into the systems were Ross Engineering Wide Band Voltage Dividers for accurate measurement and wave shape display. And for safe, easy switching of high voltage, Ross High Voltage Relays and Ross High Voltage Rotary Switches were incorporated to provide completely automatic, safely grounded systems.

Other special units, besides our High Voltage Test Loads, can be designed, manufactured, and tested within our own facilities to meet your specifications. Also, high and low voltage design and testing services are available if assistance is needed with your high voltage or high power projects.



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## ESD Tester



B-1026-A

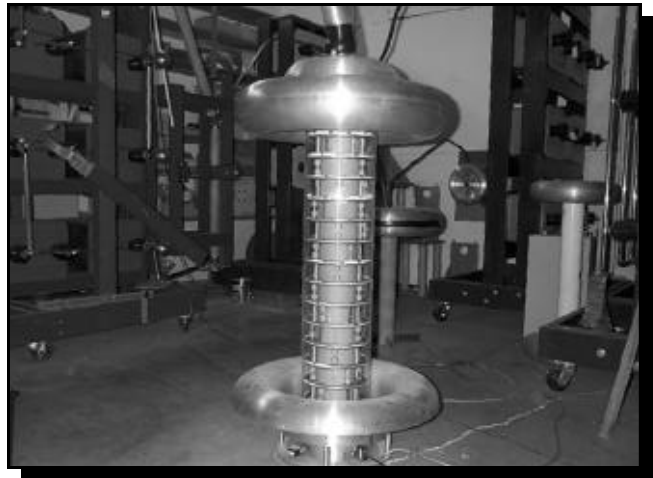
### ESD TESTER *for Electrostatic Discharge Certification*



- Up to 30KV or more
- Up to 500pF or more
- Automatic push button operation
- Safety grounded when test is complete so operator can remove device under test safely
- Contact Ross Engineering for you specific requirements

Ross Engineering Corporation has developed and manufactures a line of Electrostatic Discharge (ESD) testers. One model is designed for explosive proof testing per MIL-I-23659C, Paragraph 4.4.3.2 static discharge test. It incorporates high voltage electro magnetic or air pressure operated relays to safety ground, charge, and dump a 500PF, 25KV capacitor into the appropriate device under test. This ESD tester is a portable system utilizing 120V AC power and requires 50 PSI air pressure or 115V AC to operate. It is a high reliability device capable of many thousands of cycles. Contact Ross Engineering for details.

# High Voltage Calibration & Test Lab to 450KV



Ross Engineering's high voltage calibration and test lab provides high accuracy capability for conducting tough reliability tests on all our high voltage devices. In this facility we test and calibrate High voltage Relays, HV Dividers, HV Probes, Spark Gaps, our Fiber Optic Systems, and High Voltage Digital Voltmeters up to 450KV. We provide our own in house test lab to ensure Ross products meet or exceed required safety standards as well as our own high standards of dependability, long life, and quality. Our technicians use the most advanced test equipment calibrated to (NIST) National Institute of Standards and Technology to provide the highest in testing accuracy.

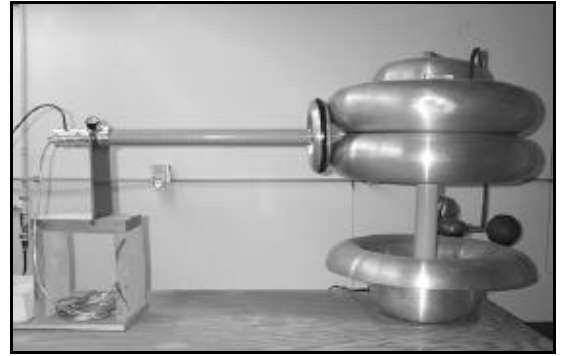
With steadily increasing worldwide high voltage calibration needs, Ross Engineering Corporation now maintains two separate, N.I.S.T. traceable high voltage calibration laboratories. Calibration capabilities are up to 450KV PK 60Hz, 400KV DC and 400KV 1.2x50uS lightning impulse and other waveforms. Our engineers can perform a wide variety of testing on high voltage devices, instruments and materials. The lab also has a large capacitor bank from 50KV to 400KV in 50KV, 0.5uF 625J steps, series or parallel.

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# High Voltage Calibration & Test Lab

## Ross Voltage Divider Standards

The standards used to calibrate and test were designed and built by Ross Engineering in 1982 and given transfer status by the National Bureau of Standards (NBS), now called the National Institute of Standards and Technology (NIST). Since then the devices have not shown any appreciable drift or non-linearity after thousands of hours of operation. The standards are routinely sent to the NIST and compared to the national standard to insure accurate and repeatable calibrations and high voltage testing from the Ross calibration lab.



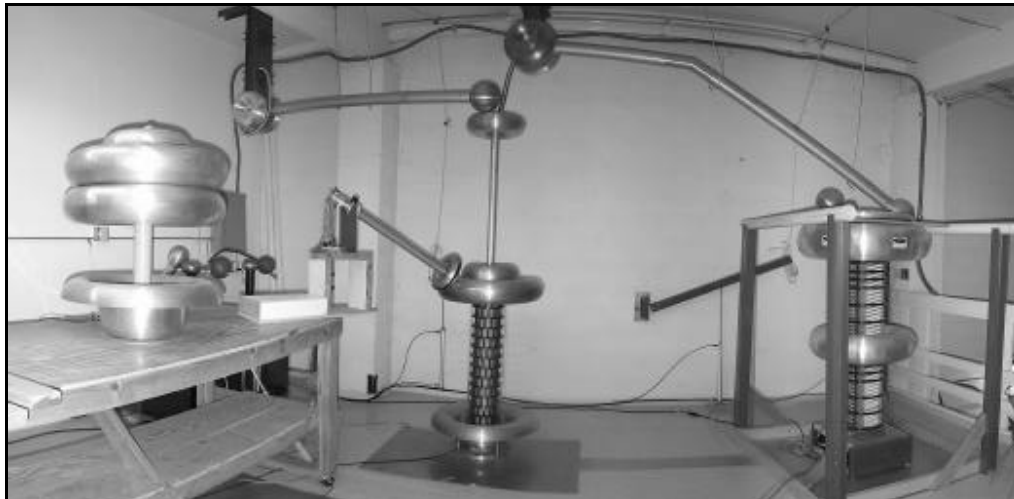
## High Frequency RF & Pulse Testing

Ross Engineering voltage dividers are designed for use up to 30MHz, 10 nanosecond rise time pulses. Since no national standard exists for wideband high voltage, it was necessary for Ross Engineering to develop its own RF standard and test facility. This allows us to make accurate and repeatable measurements at high frequency, high voltage. Devices calibrated in this facility have been compared to other laboratories standards and have proven to be an accurate and useful measurement tool.



Other test capabilities include:

- DC to 10MHz CW and pulse frequency response calibration
- HV resistor and capacitor testing and evaluation
- High current low voltage temperature rise testing up to 4,000 Amp 60Hz continuous
- Thermal hipot and leakage current testing from -75 to +370°C (24 cu ft)
- HV Vacuum interrupter, contactor and circuit breaker testing
- Insulation testing and evaluation



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# WORKSHEET

## H.V. DIVIDERS

### PROBES/METERS

Please fill in as much as possible so Ross Engineering Corp. can recommend the best device for the application!

What is the actual working voltage range? DC \_\_\_ KV to \_\_\_ KV. AC RMS \_\_\_ KV to \_\_\_ KV.  
AC Peak \_\_\_ KV to \_\_\_ KV. Pulse, peak \_\_\_ KV to \_\_\_ KV. Pulse, peak to peak \_\_\_ KV to \_\_\_ KV.

What is the desired ratio? 1000/1 \_\_\_ 10,000/1 \_\_\_ Other? \_\_\_

Note: Multiple ratios and multiple matching are also available.

What is the desired HV input resistance and capacitance? \_\_\_ Megohms, \_\_\_ Picofarads \_\_\_.

Note: Certain resistance & capacitance may be best for optimum performance.

Desired features – check all that apply:

- |   |  |
|---|--|
| <input type="checkbox"/> Base mounted voltage divider             | <input type="checkbox"/> Portable laboratory use.                |
| <input type="checkbox"/> Hand held probe type.                    | <input type="checkbox"/> Fixed in equipment.                     |
| <input type="checkbox"/> (___ with handle. ___ with ground lead). | <input type="checkbox"/> Voltage will be applied continuously.   |
| <input type="checkbox"/> DC, ___ 50/60Hz ___ 400 Hz, ___ other.   | <input type="checkbox"/> Voltage will be applied short time      |
| <input type="checkbox"/> Wide band or ___ fast rise time pulse.   | <input type="checkbox"/> (___ sec or less or ___ single pulse?). |
| <input type="checkbox"/> High voltage power line use.             | <input type="checkbox"/> Pulse train (repetitive short pulses).  |
| <input type="checkbox"/> Differential (2 matched dividers).       | <input type="checkbox"/> Match more than one instrument.         |

If for power line use, what is line-to-ground voltage? \_\_\_ KV RMS. \_\_\_ 3 phase - \_\_\_ WYE or \_\_\_ Delta.  
\_\_\_ single phase. AC. \_\_\_ DC. Subject to lightning or switching transients? \_\_\_.

Basic Impulse Level Test Rating (single pulse 1x 50uSEC wave 3+ & 3-) \_\_\_\_\_ KV PK.  
(BIL, Switching Transient Level)

What is the maximum frequency response to -3Db? \_\_\_ MHz, \_\_\_ KHz, \_\_\_ Hz,  
or rise time? \_\_\_ uSEC, pulse width \_\_\_ uSEC, duty cycle \_\_\_ PPS or \_\_\_ %.

What are the required accuracies?  $\pm$  \_\_\_ % DC,  $\pm$  \_\_\_ % \_\_\_ Hz,  $\pm$  \_\_\_ % \_\_\_ MHz. Available are:  
 $\pm 0.1\%$  DC or  $\pm 0.01\%$  DC and  $\pm 0.2\%$   $\pm 5\%$  or  $\pm 1\%$  50-60Hz and  $\pm 3\%$  to  $10\%$  DC-1MHz to 10MHz.  
Correction chart for 10% or 20% steps included. Steps at particular voltages available - \_\_\_\_\_ KV.

At what frequency or rise time is best accuracy desired? Primarily \_\_\_ DC, \_\_\_ 50/60Hz, \_\_\_ KHz,  
\_\_\_ MHz. \_\_\_ uSEC rise time. At what voltage(s) \_\_\_\_\_ KV PK.

What is the instrumentation type load impedance, (resistance and capacitance). That the divider or probe must match?  
\_\_\_ Oscilloscope, \_\_\_ DVM, \_\_\_ other. \_\_\_ megohms, \_\_\_ picofarads.

What is (RG59 U-9259) coaxial output cable length required: 15' is standard, (2', 3', 6', 20' are available).  
\_\_\_\_\_ Ft. For max frequency response cable should be as short as possible.

What is output end of output cable connector required? \_\_\_ BNC, \_\_\_ Banana, \_\_\_ other.  
Max. allowable dimension: height \_\_\_\_\_ inches, diameter \_\_\_\_\_ inches.  
Proximity of nearest large conductive object or wall: \_\_\_ Ft.

Power source voltage for meter or charger if required. \_\_\_ VDC, \_\_\_ VAC 50/60Hz, \_\_\_ 400Hz.

Environment: For use in \_\_\_ air, \_\_\_ oil. To \_\_\_ Ft. max altitude. \_\_\_ Indoor, \_\_\_ Outdoor.

Ambient temperature range during operation \_\_\_ °C to \_\_\_ °C.

Insulated handle (hotstick) length desired: \_\_\_\_\_

Other requirements:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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# WORK SHEET H.V. RELAYS/SWITCHES



Please fill in as much as possible so Ross Engineering Corp. can recommend the best device for the application!

Ross relays are rated with 60Hz PK test voltage, 1 minute hold without breakdown.

What is the actual continuous working high voltage? \_\_\_\_\_KV DC. \_\_\_\_\_KV AC RMS. \_\_\_\_\_KV PK.  
\_\_\_\_\_KV PK pulse. Pulse width \_\_\_\_\_uSEC. Pulse Duty Cycle \_\_\_\_\_% \_\_\_\_\_PPS. \_\_\_\_\_ Rise time.

What is the frequency? \_\_\_\_\_Hz. Used in \_\_\_\_\_ air \_\_\_\_\_ oil \_\_\_\_\_SF6. Used at \_\_\_\_\_ Ft. \_\_\_\_\_ Meters max. altitude.

Is there a test voltage (one minute hold) required? \_\_\_\_\_KV DC \_\_\_\_\_KV RMS 50/60Hz \_\_\_\_\_KV PK.  
Is there a basic impulse level required (BIL, 1 uSEC X uSEC wave: \_\_\_\_\_KV PK.

Contact configuration required: \_\_\_\_\_NC. \_\_\_\_\_NO. \_\_\_\_\_DT. \_\_\_\_\_ latching. No. of poles: \_\_\_\_\_.

How many amps must it carry? \_\_\_\_\_ Amps RMS. \_\_\_\_\_ Amps PK.

How long must it carry current? \_\_\_\_\_.

Does it have to close on current? \_\_\_\_\_. \_\_\_\_\_ Amps \_\_\_\_\_ continuous \_\_\_\_\_ momentary.

Does it have to carry current after making or breaking current & reclosing? \_\_\_\_\_ Amps.

Capacitor Discharge \_\_\_\_\_ MFD \_\_\_\_\_ Amps PK \_\_\_\_\_ RC time constant to 37%.

Does it have to break load current? \_\_\_\_\_ . \_\_\_\_\_ Amps.

Does it have to interrupt a short circuit? \_\_\_\_\_. \_\_\_\_\_ Amps RMS.

Required speed: open \_\_\_\_\_ millisecc, close \_\_\_\_\_ millisecc. Delay required: \_\_\_\_\_ sec. to close. \_\_\_\_\_ sec. to open

### ACTUATOR:

What is the actuator voltage and frequency? \_\_\_\_\_ V, \_\_\_\_\_. 50Hz, 60Hz, 400Hz, DC & special available.

Momentary pull-in current for 10-100 Millisecc can be 5 to 20 times continuous holding current:

Are enough amps available from power supply to maintain at least 90% voltage during pull-in? \_\_\_\_\_ Amps.

How many sets of SPDT auxiliary contacts needed? \_\_\_\_\_.

Auxiliary contacts requirements: \_\_\_\_\_V AC \_\_\_\_\_V DC \_\_\_\_\_ Amps. For 60KV PK and under units Standard is SPDT 11A 250V AC, 5A 30V DC. Over 60KV units have 15 amp 450V AC. Higher voltage and/or current available.

Ambient temperature range during operation: \_\_\_\_\_ °C to \_\_\_\_\_ °C.

Operational life: \_\_\_\_\_ No. of operations per week for \_\_\_\_\_ years.

Notes or special requirements:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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