Test&Measurement

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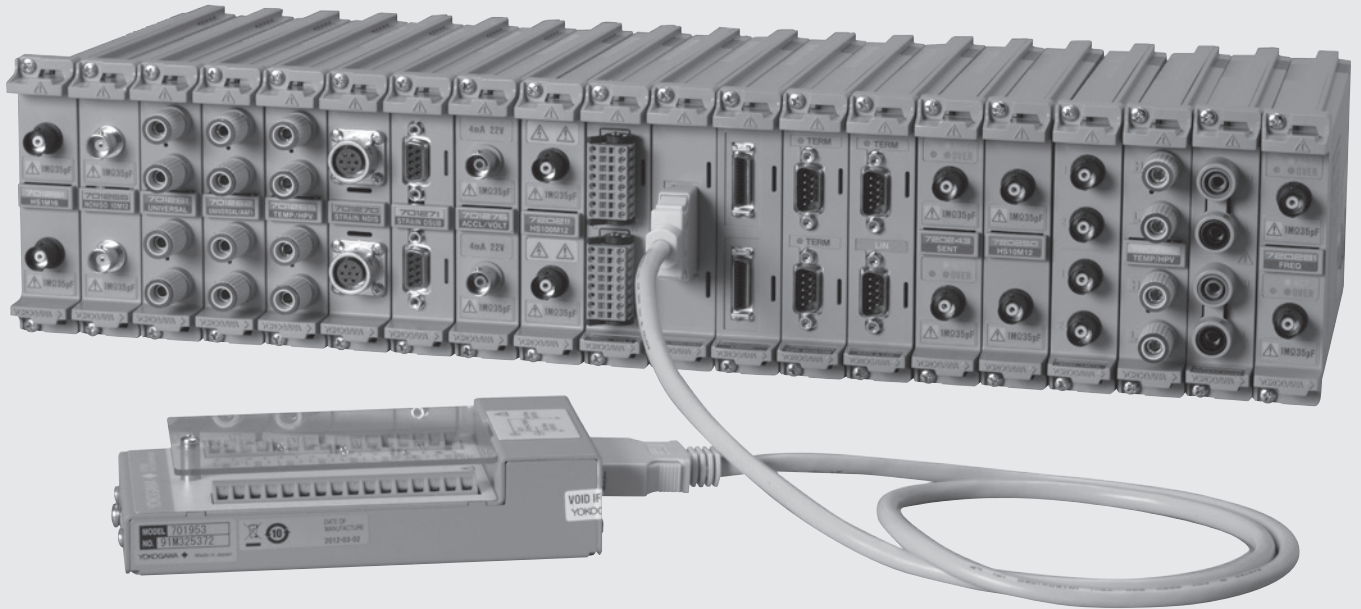
Plug-in modules specifications

ScopeCorder series
DL850E/DL850EV/DL350/SL1000

Bulletin DL850E-01EN

Module Selection

Input	Model No.	Sample rate	Resolution	Bandwidth	Number of channels	Isolation	Maximum measurement voltage[*10] (DC+ACpeak)	DC accuracy	Note
Analog Voltage	720211[*8]	100 MS/s	12 bit	20 MHz	2	Isolated	1000 V[*2], 200 V[*3]	±0.5%	High speed · High voltage · Isolated
	720250	10 MS/s	12 bit	3 MHz	2	Isolated	800 V[*2], 200 V[*3]	±0.5%	high noise immunity
	701251	1 MS/s	16 bit	300 kHz	2	Isolated	600 V[*2], 140 V[*3]	±0.25%	High sensitivity range (1 mV/div), low noise (±100 µVtyp.), and high noise immunity
	720254	1 MS/s	16 bit	300 kHz	4	Isolated	600 V[*2], 200 V[*3]	±0.25%	4 CH BNC inputlow noise, high noise immunity
	701255	10 MS/s	12 bit	3 MHz	2	Non-Isolated	600 V[*4], 200 V[*3]	±0.5%	High speed · Non isolated
	720268	1 MS/s	16 bit	300 kHz	2	Isolated	1000 V[*9 *11]	±0.25%	With AAF, RMS, and high noise immunity
	720220	200 kS/s	16 bit	5 kHz	16	Isolated (GND-terminal) non-isolated (CH-CH)	20 V[*3]	±0.3%	16 CH voltage measurement (Scan-type)
Analog Voltage & Temperature	701261	100 kS/s (Voltage), 500 S/s (Temperature)	16 bit (Voltage), 0.1°C (Temperature)	40 kHz (Voltage), 100 Hz (Temperature)	2	Isolated	42 V	±0.25% (Voltage)	Thermocouple (K, E, J, T, L, U, N, R, S, B, W, KP/AuFe)
	701262	100 kS/s (Voltage), 500 S/s (Temperature)	16 bit (Voltage), 0.1°C (Temperature)	40 kHz (Voltage), 100 Hz (Temperature)	2	Isolated	42 V	±0.25% (Voltage)	Thermocouple (K, E, J, T, L, U, N, R, S, B, W, KP/AuFe), with AAF
	701265	500 S/s (Voltage), 500 S/s (Temperature)	16 bit (Voltage), 0.1°C (Temperature)	100 Hz	2	Isolated	42 V	±0.08 (Voltage)	Thermocouple (K, E, J, T, L, U, N, R, S, B, W, KP/AuFe), high sensitivity range (0.1 mV/div)
	720266	125 S/s (Voltage), 125 S/s (Temperature)	16 bit (Voltage), 0.1°C (Temperature)	15 Hz	2	Isolated	42 V	±0.08 (Voltage)	Thermocouple (K, E, J, T, L, U, N, R, S, B, W, KP/AuFe), high sensitivity range (0.1 mV/div), Low noise
	720221[*7]	10 S/s	16 bit	600 Hz	16	Isolated	20 V	±0.15% (Voltage)	16 CH voltage or temperature measurement (scan method) Thermocouple (K, E, J, T, L, U, N, R, S, B, W, KP/AuFe)
Strain	701270	100 kS/s	16 bit	20 kHz	2	Isolated	10 V	±0.5% (Strain)	Supports strain NDIS, 2, 5, 10 V built-in bridge power supply
	701271	100 kS/s	16 bit	20 kHz	2	Isolated	10 V	±0.5% (Strain)	Supports strain DSUB, 2, 5, 10 V built-in bridge power supply, and shunt CAL
Analog Voltage, Acceleration	701275	100 kS/s	16 bit	40 kHz	2	Isolated	42 V	±0.25% (Voltage) ±0.5% (Acceleration)	Built-in anti-aliasing filter, Supports built-in amp type acceleration sensors (4 mA/22 V)
Frequency	720281	1 MS/s	16 bit	resolution 625 ps	2	Isolated	420 V[*2], 42 V[*3]	±0.1% (Frequency)	Measurement frequency of 0.01 Hz to 500 kHz, Measured parameters (frequency, RPMs, RPSs, period, duty cycle, power supply frequency, pulse width, pulse integration, and velocity)
Logic	720230	10 MS/s	—	—	8 bit × 2 ports	non-isolated	depend on logic probe used.	—	(8 bit/port) × 2, compatible with four-type of logic probe (sold separately)
CAN/CAN FD	720242	100 kS/s	—	—	(60 signals × 2) port	Isolated	10 V	—	CAN/CAN FD port × 2, CAN/CAN FD Data of maximum 32 bit allowable[*5 *6]
CAN, LIN	720241	100 kS/s	—	—	(60 signals × 2) port	Isolated	10 V (CAN port) 18 V (LIN port)	—	CAN port × 1 (CAN FD is not supported), LIN port × 1[*5 *6]
SENT	720243	100 kS/s	—	—	11 data × 2 ports	Isolated	42 V	—	Supported protocol: SAE J2716.[*5 *6]

*1: Probes are not included with any modules.   *2: In combination with 700929, 702902 or 701947 probe.   *3: Direct input   *4: In combination with 10:1 probe model 701940
*5: Any other modules can be installed in the remaining slots.   *6: When using these modules with DL850EV, up to four CAN Bus Monitor Modules (720240), CAN & LIN Bus Monitor Modules (720241), CAN/CAN FD monitor modules (720242) or SENT Monitor Module (720243) in total can be used on a single main unit. For the CAN Bus Monitor Modules (720240) and CAN & LIN Bus Monitor Modules (720241), CAN/CAN FD monitor modules (720242), up to two in total can be used on a single main unit.   *7: The 16 CH Scanner Box (701953) is required for measurement.   *8: Class 1 Laser Product, IEC/EN60825-1:2007, GB7247.1-2012 *9: In combination with 758933 and 701954.   *10: See the main specifications for voltage-axis sensitivity setting and measurement range.   *11: 1000 Vrms (1000 VDC or 1414 Vpeak maximum) when using with DL350. 850V (DC + ACpeak) when using with DL850/DL850V/DL850E/DL850EV or SL1000

Refer to the following table to confirm the compatibility of plug-in modules with main units.

Compatibility of the plug-in modules with the main units

Plug-in Module			Main Unit			
Model	Name	Remark	DL350	DL850E	DL850EV	SL1000
720210	High-speed 100 MS/s 12 Bit Isolation Module	Discontinued	No	Yes	Yes	Yes
720211	High-speed 100 MS/s 12 Bit Isolation Module		Yes	Yes	Yes	Yes
701250	High-speed 10 MS/s 12 Bit Isolation Module	Discontinued	No	Yes	Yes	Yes
720250	High-speed 10 MS/s 12 Bit Isolation Module		Yes	Yes	Yes	Yes
701251	High-speed 1 MS/s 16 Bit Isolation Module		No	Yes	Yes	Yes
720254	4 CH 1 MS/s 16 Bit Isolation Module		Yes	Yes	Yes	No
701255	High-speed 10 MS/s 12 Bit non-Isolation Module		No	Yes	Yes	Yes
701267	High-voltage 100 kS/s 16 Bit Isolation Module (with RMS)	Discontinued	No	Yes	Yes	Yes
720268	High-voltage 1 MS/s 16 Bit Isolation Module (with AAF, RMS)		Yes	Yes	Yes	Yes
720220	16 CH Voltage Input Module		Yes	Yes	Yes	No
701261	Universal Module		Yes	Yes	Yes	Yes
701262	Universal Module (with AAF)		Yes	Yes	Yes	Yes
701265	Temperature/High-Precision Voltage Module		Yes	Yes	Yes	Yes
720266	Temperature/High-Precision Voltage Isolation Module (Low Noise)		Yes	Yes	Yes	Yes
720221	16 CH Temperature/Voltage Input Module		Yes	Yes	Yes	No
701270	Strain Module (NDIS)		Yes	Yes	Yes	Yes
701271	Strain Module (DSUB, Shunt-CAL)		Yes	Yes	Yes	Yes
701275	Acceleration/Voltage Module (with AAF)		Yes	Yes	Yes	Yes
701281	Frequency Module	Discontinued	No	Yes	Yes	Yes
720281	Frequency Module		Yes	Yes	Yes	Yes
720230	Logic Input Module		Yes	Yes	Yes	Yes
720240	CAN Bus Monitor Module	To Be Discontinued	Yes	No	Yes	No
720242	CAN/CAN FD Monitor Module		Yes	No	Yes	No
720241	CAN & LIN Bus Monitor Module		Yes	No	Yes	No
720243	SENT Monitor Module		Yes	No	Yes	No

* Probes are not included with any modules.
* The use of a 720221 module always requires the External Scanner Box (model 701953).
* Firmware update may be required depending the module used.
* /VE option is required when using 720240, 720241, 720242 or 720243 module with DL350.
* Refer to the note described in page 18 when using 720254 module with DL850E and DL850EV.
* 720240 CAN Bus Monitor Module will be discontinued in September 2018.

Main Specifications (plug-in modules)

*1: Under standard operating conditions (temperature of 23°C ±5°C, 20 to 80% RH, warm-up of 30 minutes or more), after calibration. Recommended calibration period: 1 year.
Note that the strain modules (701270/71) must be balanced.
*2 to *11: See the figure on page 7 for notes on the maximum input voltage and maximum rated voltage to earth.
*12: See the figure on page 7 for the voltage-axis sensitivity setting.

High-Speed 100 MS/s, 12 Bit Isolation Module (720211)

Input channels	2
Input type	Isolated unbalanced
Input coupling	AC, DC and GND
Input connector	BNC connector (isolated type)
Input impedance	1 MΩ ±1%, approx. 35 pF
Maximum sample rate	100 MS/s
Frequency range (–3 dB)[*1]	DC to 20 MHz
A/D conversion resolution	12 bit (150 LSB/div)
Voltage-axis sensitivity setting[*12]	Direct input: 10 mV/div to 20 V/div (1-2-5 steps)

Maximum input voltage (1 kHz or less)

In combination with 700929 (10:1)/702902 (10:1)/701947 (100:1)[*2]	1000 V (DC + ACpeak)
In combination with 701901 + 701954 (1:1)[*6]	200 V (DC + ACpeak)
Direct input[*10]	42 V (DC + ACpeak)

Maximum rated voltage to earth (1 kHz or less)

In combination with 700929 (10:1)/702902 (10:1)/701947 (100:1)[*3]	1000 Vrms (CAT Ⅱ)
In combination with 701901 + 701954 (1:1)[*9]	1000 Vrms (CAT Ⅱ)
Direct input[*11]	42 V (DC + ACpeak) (CAT Ⅱ, 30 Vrms)

–3 dB point when AC coupled low frequency attenuation point	10 Hz or less (1 Hz or less when using the 700929, 702902, 0.1 Hz or less when using the 701947)
Vertical (voltage) axis accuracy[*1]	DC accuracy: ±(0.5% of 10 div)
Common mode rejection ratio	80 dB (50/60 Hz) or more (Typ.)
Temperature coefficient	Zero point: ±(0.1% of 10 div)/°C (Typ.) Gain: ±(0.05% of 10 div)/°C (Typ.)
Bandwidth limit	Full/2 MHz/1.28 MHz/640 kHz/320 kHz/160 kHz/80 kHz/ 40 kHz/20 kHz/10 kHz
Probe attenuation setting	Voltage Probe 1:1, 10:1, 100:1, 1000:1
	Current Probe 1 A:1 V, 10 A: 1 V (for the 701932/701933) 100 A: 1 V (for the 701930/701931)
Weight	Approx. 290 g

High-Speed 10 MS/s, 12 Bit Isolation Module (720250)

Input channels	2
Input type	Isolated unbalanced
Input coupling	AC, DC, and GND
Input connector	BNC connector (isolated type)
Input impedance	1 MΩ ±1%, approx. 35 pF
Common mode rejection ratio	80 dB (50/60 Hz) or more (Typ.)
Maximum sample rate	10 MS/s
Frequency range (–3 dB)[*1]	DC to 3 MHz
A/D conversion resolution	12 bit (150 LSB/div)
Voltage-axis sensitivity setting[*12]	Direct input: 5 mV/div to 20 V/div (1-2-5 steps)

Maximum input voltage (1 kHz or less)

In combination with 700929 (10:1)/702902 (10:1)/701947 (100:1)[*2]	800 V (DC + ACpeak)
In combination with 701901 + 701954 (1:1)[*6]	200 V (DC + ACpeak) (as a value that meets the safety standard) 250 V (DC + ACpeak) (Maximum allowable voltage, as a value that does not damage the instrument when applied.)
Direct input[*10]	42 V (DC + ACpeak)

Maximum rated voltage to earth (1 kHz or less)

In combination with 700929 (10:1)/702902 (10:1)/701947 (100:1)[*3]	400 Vrms (CAT Ⅱ)
In combination with 701901 + 701954 (1:1)[*9]	400 Vrms (CAT Ⅱ)
Direct input[*11]	42 V (DC + ACpeak) (CAT Ⅱ, 30 Vrms)

–3 dB point when AC coupled low frequency attenuation point	10 Hz or less (1 Hz or less when using the 700929/702902, 0.1 Hz or less when using the 701947)
Vertical (voltage) axis accuracy[*1]	DC accuracy: ±(0.5% of 10 div)
Temperature coefficient	Zero point: ±(0.05% of 10 div)/°C (Typ.) Gain: ±(0.02% of 10 div)/°C (Typ.)
Bandwidth limit	Full/500 Hz/5 kHz/50 kHz/500 kHz
Weight	Approx. 280 g

High-Speed 1 MS/s, 16 Bit Isolation Module (701251)

Input channels	2
Input type	Isolated unbalanced
Input coupling	AC, DC, and GND
Input connector	BNC connector (isolated type)
Input impedance	1 MΩ ±1%, approx. 35 pF
Common mode rejection ratio	80 dB (50/60 Hz) or more (Typ.)
Maximum sample rate	1 MS/s

Frequency range (–3 dB)[*1]	DC to 300 kHz (5 m V/div to 20 V/div) DC to 200 kHz (1 m V/div, 2 m V/div)
A/D conversion resolution	16 bit (2400 LSB/div)
Voltage-axis sensitivity setting[*12]	Direct input: 1 m V/div to 20 V/div (1-2-5 steps)

Maximum input voltage (1 kHz or less)

In combination with 700929 (10:1)/702902 (10:1)/701947 (100:1)[*2]	600 V (DC + ACpeak)
In combination with 701901 + 701954 (1:1)[*6]	140 V (DC + ACpeak)
Direct input[*10]	42 V (DC + ACpeak)

Maximum rated voltage to earth (1 kHz or less)

In combination with 700929 (10:1)/702902 (10:1)/701947 (100:1)	400 Vrms (O), 300 Vrms (CAT Ⅱ)
In combination with 701901 + 701954 (1:1)[*9]	400 Vrms (O), 300 Vrms (CAT Ⅱ)
Direct input[*11]	42 V (DC + ACpeak) (CAT Ⅱ, 30 Vrms)

–3 dB point when AC coupled low frequency attenuation point	1 Hz or less (0.1 Hz or less when using the 700929/702902, 0.01 Hz or less when using the 701947)
Vertical (voltage) axis accuracy[*1]	DC accuracy 5 mV/div to 20 V/div: ±(0.25% of 10 div) 2 mV/div: ±(0.3% of 10 div) 1 mV/div: ±(0.5% of 10 div)
Temperature coefficient	Zero point 5 mV/div to 20 V/div: ±(0.02% of 10 div)/°C (Typ.) 2 mV/div: ±(0.05% of 10 div)/°C (Typ.) 1 mV/div: ±(0.10% of 10 div)/°C (Typ.)
	Gain 1 mV/div to 20 V/div: ±(0.02% of 10 div)/°C (Typ.)
Bandwidth limit	Full/400 Hz/4 kHz/40 kHz
Weight	Approx. 270 g

4 CH 1 MS/s 16 Bit Isolation Module (720254)

Input channels	4
Input type	Isolated unbalanced
Input coupling	AC, DC, GND
Input connector	BNC connector (isolated type)
Input impedance	1 MΩ ±1%, approx. 35 pF
Common mode rejection ratio	80 dB (50/60 Hz) or more (Typ.)
Maximum sample rate	1 MS/s
Frequency range (–3 dB)[*1]	DC to 300 kHz
A/D conversion resolution	16 bit (2400 LSB/div)
Voltage-axis sensitivity setting[*12]	Direct input: 10 mV/div to 50 V/div (1-2-5 steps)

Maximum input voltage (1 kHz or less)

In combination with 700929 (10:1)/702902 (10:1)/701947 (100:1)[*2]	600 V (DC + ACpeak)
In combination with 701901 + 701954 (1:1)[*6]	200 V (DC + ACpeak), 400 V (DC + ACpeak) (Maximum allowable voltage, as a value that does not damage the instrument when applied.)
Direct input[*10]	42 V (DC + ACpeak)

Maximum rated voltage to earth (1 kHz or less)

In combination with 700929 (10:1)/702902 (10:1)/701947 (100:1)[*3]	400 Vrms (O), 300 Vrms (CAT Ⅱ)
In combination with 701901 + 701954 (1:1)[*9]	400 Vrms (O), 300 Vrms (CAT Ⅱ)
Direct input[*11]	42 V (DC + ACpeak) (CAT Ⅱ, 30 Vrms)

–3 dB point when AC coupled low frequency attenuation point	1 Hz or less (0.1 Hz or less when using the 700929, 702902, 0.01 Hz or less when using the 701947)
Vertical (voltage) axis accuracy[*1]	DC accuracy: ±(0.25% of 10 div)
Temperature coeffi cient	Zero point: ±(0.02% of 10 div)/°C (Typ.) Gain: ±(0.02% of 10 div)/°C (Typ.)
Bandwidth limit	Full/6.25 Hz/12.5 Hz/25 Hz/50 Hz/100 Hz/200 Hz/400 Hz/ 800 Hz/1.6 kHz/3.2 kHz/6.4 kHz/12.8 kHz/40 kHz
Weight	Approx. 310 g

High-Speed 10 MS/s, 12 Bit Non-Isolation Module (701255)

Input channels	2
Input type	Non-isolated, unbalanced
Input coupling	AC, DC, and GND
Input connector	BNC connector (metallic type)
Input impedance	1 MΩ ±1%, approx. 35 pF
Maximum sample rate	10 MS/s
Frequency range (–3 dB)[*1]	DC to 3 MHz
A/D conversion resolution	12 bit (150 LSB/div)
Voltage-axis sensitivity setting[*12]	Direct input: 5 mV/div to 20 V/div (1-2-5 steps)

Maximum input voltage (1 kHz or less)

In combination with 701940 (10:1)	600 V (DC + ACpeak)
Direct input	200 V (DC + ACpeak) (as a value that meets the safety standard) 250 V (DC + ACpeak) (Maximum allowable voltage, as a value that does not damage the instrument when applied.)

–3 dB point when AC coupled low frequency attenuation point	10 Hz or less (1 Hz or less when using the 701940)
Vertical (voltage) axis accuracy[*1]	DC accuracy: ±(0.5% of 10 div)
Temperature coefficient	Zero point: ±(0.05% of 10 div)/°C (Typ.) Gain: ±(0.02% of 10 div)/°C (Typ.)

Bandwidth limit	Full/500 Hz/5 kHz/50 kHz/500 kHz
Weight	Approx. 270 g

High-Voltage 1 MS/s, 16 Bit Isolation Module (with AAF, RMS) (720268)

Input channels	2
Input type	Isolated unbalanced
Input coupling	AC, DC, GND, AC-RMS, and DC-RMS
Input connector	Plug-in terminal (safety terminal)
Input impedance	2 MΩ ±1%, Approx. 12 pF
Common mode rejection ratio	80 dB (50/60 Hz) or more (Typ.)
Maximum sample rate	1 MS/s
Frequency range (−3 dB)[1]	Waveform observation mode DC to 300 kHz
	RMS observation mode DC, 40 Hz to 100 kHz
A/D conversion resolution	16 bit (2400 LSB/div)
Voltage-axis sensitivity setting[12]	20 mV/div to 200 V/div (1-2-5 steps)
Maximum input voltage (1 kHz or less) In combination with (758933 or 701904) + 701954 (1:1)[6]	 1000 Vrms (1000 VDC or 1414 Vpeak maximum)[13]
Direct input[10]	42 V (DC + ACpeak)
Maximum rated voltage to earth (1 kHz or less) In combination with (758933 or 701904) + 701954 (1:1)[9]	 1000 Vrms (CAT II), 600 Vrms (CAT III)
Direct input	42 V (DC + ACpeak) (CAT II, 30 Vrms)[11]
−3 dB point when AC coupled low frequency attenuation point 1 Hz or less	

Vertical (voltage) axis accuracy[1]
  Waveform observation mode
    DC accuracy: ±(0.25% of 10 div)
 	
  RMS observation mode
    DC accuracy: ±(1.0% of 10 div)
 	
  AC accuracy
    Sinewave input: ±(1.5% of 10 div) At frequency of 40 Hz to 10 kHz
    Crest factor 2 or less: ±(2.0% of 10 div) At frequency of 40 Hz to 10 kHz
    Crest factor 3 or less: ±(3.0% of 10 div) At frequency of 40 Hz to 10 kHz
    1 kHz to 10 kHz: Add 1.0% on the above AC accuracy.	

Temperature coefficient (Waveform observation mode)	Zero point: ±(0.02% of 10 div)/°C (Typ.) Gain: ±(0.02% of 10 div)/°C (Typ.)
Bandwidth limit	Full/400 Hz/4 kHz/40 kHz/AAF
Response time (RMS observation mode)	Rising (0 to 90% of 10 div) 120 ms (Typ.) Falling (100 to 10% of 10 div) 280 ms (Typ.)
Weight	Approx. 280 g

*13: 850 V (DC + ACpeak) when using with DL850/DL850V/DL850E/DL850EV or SL1000

16 CH Voltage Input Module (720220)

Input channels	16
Input type	Isolated unbalanced
Input coupling	DC, GND (Selectable for each sub-CH)
Maximum sample rate	200 kS/s (single CH) [10 kS/s when using 16 CH]
Frequency range (−3 dB)[1]	DC to 5 kHz
A/D conversion resolution	16 bit (2400 LSB/div)
Voltage-axis sensitivity setting	200 mV/div to 2 V/div (1-2-5 steps)
Maximum input voltage (1kHz or less) Direct input: 42 V (DC + ACpeak)	
Maximum rated voltage to earth (1 kHz or less) Direct input: 42 V (DC + ACpeak) (CAT II, 30 Vrms)	
Vertical (voltage) axis accuracy	DC accuracy: ±(0.3% of 10 div)
Input connector	Spring-type terminal (removable per 8 CH)
Input impedance	1 MΩ ±1%
Common mode rejection ratio	80 dB (50/60 Hz) or more (Typ.)
Temperature coefficient	Zero point: ±(0.02% of 10 div)/°C (Typ.) Gain: ±(0.02% of 10 div)/°C (Typ.)
Bandwidth limit	Full/500 Hz (Selectable for each sub-CH)
Weight	Approx. 230 g

Universal (Voltage/Temp.) Module (701261) / with AAF (701262)

Function	Temperature (thermocouple) or voltage measurement (switchable)
Input channels	2
Input type	Isolated unbalanced
Input coupling	TC (thermocouple), DC, AC, and GND
Input connector	Binding post
Input impedance	Approx. 1 MΩ
Maximum sample rate	Voltage: 100 kS/s
Data update rate	Temperature: 500 Hz
Frequency range (−3 dB)[1]	Voltage: DC to 40 kHz Temperature: DC to 100 Hz
A/D conversion resolution	Voltage: 16 bit (2400 LSB/div) Temperature: 0.1°C

−3 dB point when AC coupled low frequency attenuation point	Voltage measurement: 0.5 Hz or less
Measurement range/accuracy[1]	Voltage measurement: Voltage-axis sensitivity setting[12]
	5 mV/div to 20 V/div (1-2-5 steps)
	Vertical (voltage) axis accuracy ±(0.25% of 10 div)

Temperature measurement
(Does not include the reference junction temperature compensation accuracy.)

Type	Measurement Range	Accuracy
K E J T L U N	−200°C to 1300°C −200°C to 800°C −200°C to 1100°C −200°C to 400°C −200°C to 900°C −200°C to 400°C 0°C to 1300°C	±(0.1% of reading + 1.5°C) Except ±(0.2% of reading + 1.5°C) for −200°C to 0°C
R S	0°C to 1700°C	±(0.1% of reading + 3°C) Except, 0 to 200°C: ±8°C 200°C to 800°C: ±5°C
B	0°C to 1800°C	±(0.1% of reading + 2°C) Except, 400°C to 700°C: ±8°C Effective range is 400°C to 1800°C
W	0°C to 2300°C	±(0.1% of reading + 3°C)
KP/AuFe	0 K to 300 K	0 K to 50 K: ±4 K 50 K to 300 K: ±2.5 K

Thermocouple standard JIS C1602 (K, E, J, T, N, R, S, B)

Maximum input voltage (1 kHz or less)	42 V (DC + ACpeak) (as a value that meets the safety standard) 150 V (DC + ACpeak) (maximum allowable voltage, as a value that does not damage the instrument when applied)
Maximum rated voltage to earth (1 kHz or less)	42 V (DC + ACpeak) (CAT II, 30 Vrms)
Temperature coefficient (Voltage)	Zero point: ±(0.01% of 10 div)/°C (Typ.) Gain: ±(0.02% of 10 div)/°C (Typ.)

Reference junction comp. accuracy (at input terminal temp. balancing)
    K, E, J, T, L, U, N: ±1°C   R, S, B, W: ±1.5°C
    KP/AuFe: ±1 K	

Bandwidth limit	Voltage: Full/AUTO (AAF)/40 Hz/400 Hz/4 kHz Temperature: Full/2 Hz/8 Hz/30 Hz

Anti-aliasing filter (AAF)
(701262 only)
	Cutoff frequency (fc)
	Automatically linked with the sampling frequency (fs)
	    fs ≥ 100 Hz : fc = fs × 40%
	    fs ≥ 50 Hz : fc = 20 Hz

Weight	Approx. 280 g

Temperature, High Precision Voltage Isolation Module (701265)

Function	Temperature (thermocouple) or voltage measurement (switchable)
Input channels	2
Input type	Isolated unbalanced
Input coupling	TC (thermocouple), DC, and GND
Input connector	Binding post
Input impedance	Approx. 1 MΩ
Data update rate	Temperature: 500 Hz
Frequency range (−3 dB)[1]	DC to 100 Hz
A/D conversion resolution	Voltage: 16 bit (2400 LSB/div) Temperature: 0.1°C

−3 dB point when AC coupled low frequency attenuation point	Voltage measurement: 0.5 Hz or less
Measurement range/accuracy[1]	Voltage measurement: Voltage-axis sensitivity setting[12]
	100 µV/div to 10 V/div (1-2-5 steps)
	Vertical (voltage) axis accuracy ±(0.08% of 10 div + 2 µV)

Temperature measurement
(Does not include the reference junction temperature compensation accuracy.)

Type	Measurement Range	Accuracy
K E J T L U N	−200°C to 1300°C −200°C to 800°C −200°C to 1100°C −200°C to 400°C −200°C to 900°C −200°C to 400°C 0°C to 1300°C	±(0.1% of reading + 1.5°C) Except ±(0.2% of reading + 1.5°C) for −200°C to 0°C
R S	0°C to 1700°C	±(0.1% of reading + 3°C) Except, 0 to 200°C: ±8°C 200°C to 800°C: ±5°C
B	0°C to 1800°C	±(0.1% of reading + 2°C) Except, 400°C to 700°C: ±8°C Effective range is 400°C to 1800°C
W	0°C to 2300°C	±(0.1% of reading + 3°C)
KP/AuFe	0 K to 300 K	0 K to 50 K: ±4 K, 50 K to 300 K: ±2.5 K

Thermocouple standard JIS C1602 (K, E, J, T, N, R, S, B)

Maximum input voltage (1 kHz or less) 42 V (DC + ACpeak)	
Maximum rated voltage to earth (1 kHz or less) 42 V (DC + ACpeak) (CAT II, 30 Vrms)	

Temperature coefficient (Voltage)	Zero point: ±((0.01% of 10 div)/°C + 0.05 µV)/°C (Typ.) Gain: ±(0.02% of 10 div)/°C (Typ.)
Reference junction comp. accuracy (at input terminal temp. balancing)	K, E, J, T, L, U, N: ±1°C R, S, B, W: ±1.5°C KP/AuFe: ±1 K
Bandwidth limit	Full/2 Hz/8 Hz/30 Hz
Weight	Approx. 270 g

Temperature/High-Precision Voltage Isolation Module (Low noise) (720266)

Function	Temperature (thermocouple) or voltage measurement (switchable)
Input channels	2
Input type	Isolated unbalanced
Input coupling	TC (thermocouple), DC, and GND
Input connector	Binding post
Input impedance	Approx. 1 MΩ
Data update rate	125 Hz
Frequency range (–3 dB)[1]	DC to 15 Hz
A/D conversion resolution	Voltage: 16 bit (2400 LSB/div) Temperature: 0.1°C
–3 dB point when AC coupled low frequency attenuation point	Voltage measurement: 0.5 Hz or less
Measurement range/accuracy[1]	Voltage measurement: Voltage-axis sensitivity setting[12] 100 µV/div to 10 V/div (1-2-5 steps)
	Vertical (voltage) axis accuracy ±(0.08% of 10 div + 2 µV)

Temperature measurement
(Does not include the reference junction temperature compensation accuracy.)

Type	Measurement Range	Accuracy
K E J T L U N	–200°C to 1300°C –200°C to 800°C –200°C to 1100°C –200°C to 400°C –200°C to 900°C –200°C to 400°C 0°C to 1300°C	±(0.1% of reading + 1.5°C) Except ±(0.2% of reading + 1.5°C) for –200°C to 0°C
R S	0°C to 1700°C	±(0.1% of reading + 3°C) Except, 0 to 200°C: ±8°C 200°C to 800°C: ±5°C
B	0°C to 1800°C	±(0.1% of reading + 2°C) Except, 400°C to 700°C: ±8°C Effective range is 400°C to 1800°C
W	0°C to 2300°C	±(0.1% of reading + 3°C)
KP/AuFe	0 K to 300 K	0 K to 50 K: ±4 K, 50 K to 300 K: ±2.5 K

Thermocouple standard JIS C1602 (K, E, J, T, N, R, S, B)

Maximum input voltage (1 kHz or less)	42 V (DC + ACpeak)
Maximum rated voltage to earth (1 kHz or less)	42 V (DC + ACpeak) (CAT Ⅱ, 30 Vrms)
Temperature coefficient (Voltage)	Zero point: ±((0.01% of 10 div)/°C + 0.05 µV)/°C (Typ.) Gain: ±(0.02% of 10 div)/°C (Typ.)
Reference junction comp. accuracy (at input terminal temp. balancing)	K, E, J, T, L, U, N: ±1°C R, S, B, W: ±1.5°C KP/AuFe: ±1 K
Bandwidth limit	Full/0.1 Hz/1 Hz/8 Hz
Weight	Approx. 270 g

16 CH Temperature/Voltage Input Module (720221)

Input channels	16
Input type	Isolated unbalanced
Input coupling	TC (thermocouple), DC, GND
Data updating period	Switching among 100 ms, 300 ms, 1 s, and 3 s
Measurement range/accuracy	Voltage measurement: Voltage axis sensitivity 1 mV/div to 2 V/div (1-2-5 steps)
	Voltage accuracy ±(0.15% of 10 div)

Temperature measurement
(Does not include the reference junction temperature compensation accuracy.)

Type	Measurement Range	Accuracy
K E J T L U N	–200°C to 1300°C –200°C to 800°C –200°C to 1100°C –200°C to 400°C –200°C to 900°C –200°C to 400°C 0°C to 1300°C	±(0.1% of reading + 1.5°C) Except ±(0.2% of reading + 1.5°C) for –200°C to 0°C
R S	0°C to 1700°C	±(0.1% of reading + 3°C) Except, 0 to 200°C: ±8°C 200°C to 800°C: ±5°C
B	0°C to 1800°C	±(0.1% of reading + 2°C) Except, 400°C to 700°C: ±8°C Effective range is 400°C to 1800°C
W	0°C to 2300°C	±(0.1% of reading + 3°C)
KP/AuFe	0 K to 300 K	0 K to 50 K: ±4 K, 50 K to 300 K: ±2.5 K

Thermocouple standard JIS C1602 (K, E, J, T, N, R, S, B)

Maximum input voltage (1 kHz or less)	
	Both voltage & temp. 42 V (DC + ACpeak)
Maximum rated voltage to earth (1 kHz or less)	
	Both voltage & temp. 42 V (DC + ACpeak) (CAT Ⅱ, 30 Vrms)
Vertical resolution	At voltage input: 2400 LSB/div At temp. measurement: 0.1°C
Common mode rejection ratio	At voltage measurement: 100 dB or more (50/60 Hz) (Typ.) At temp. measurement: 140 dB or more (at data updating rate of 3 s) (50/60 Hz) (Typ.)
Residual noise level	±0.01 div (Typ.)
A/D conversion resolution	At voltage measurement: 16 bit (2400 LSB/range)
Temperature coefficient	Zero point: ±(0.025% of 10 div)/°C (Typ.) Gain: ±(0.01% of 10 div)/°C (Typ.)
Reference junction comp. accuracy (at input terminal temp. balancing)	K, E, J, T, L, U, N: ±1°C R, S, B, W: ±1.5°C KP/AuFe: ±1 K
Bandwidth limit (Typ.) (–3 dB point)	At data updating period of 100 ms 600 Hz At data updating period of 300 ms 200 Hz At data updating period of 1 s 50 Hz At data updating period of 3 s 10 Hz
Input connector	Screwed type, External terminal mounting
Input impedance	Approx. 1 MΩ
Burnout detection function	ON/OFF available on channel basis
Channel-to-channel interference	100 dB or more (50/60 Hz) (Typ.)
Internal reference junction compensation	
	ON or OFF (Switchable)
External scanner box	Model: 701953 Supplied cable length: 1 m, 3 m (selectable)
Weight	Approx. 220 g

Strain Module (NDIS) (701270) / Strain Module (DSUB, Shunt-Cal) (701271)

Input channels	2
Input type	DC bridge (auto balancing), balanced differential input, and isolated
Auto balance type	Electronic auto balance
Auto balance range	±10000 µSTR (1 gauge method)
Bridge voltage	Select from 2 V, 5 V, and 10 V.
Gauge resistance	120 Ω to 1000 Ω (bridge voltage: 2 V) 350 Ω to 1000 Ω (bridge voltage: 2 V, 5 V, and 10 V)
Gauge factor	1.90 to 2.20 (set in 0.01 steps)
Maximum sample rate	100 kS/s
Frequency range (–3 dB)[1]	DC to 20 kHz
A/D conversion resolution	16 bit (4800 LSB/div: Upper = +FS, Lower = –FS)
mV/V range support	mV/V range = 0.5 × (µSTR range/1000)

Measurement range/ measurable range	Measurement range (FS)	Measurable range (–FS to +FS)
	500 µSTR	–500 µSTR to +500 µSTR
	1000 µSTR	–1000 µSTR to +1000 µSTR
	2000 µSTR	–2000 µSTR to +2000 µSTR
	5000 µSTR	–5000 µSTR to +5000 µSTR
	10000 µSTR	–10000 µSTR to +10000 µSTR
	20000 µSTR	–20000 µSTR to +20000 µSTR

Maximum input voltage (1 kHz or less)	10 V (DC + ACpeak)
Maximum rated voltage to earth (1 kHz or less)	
	42 V (DC + ACpeak) (CAT Ⅱ, 30 Vrms)
DC accuracy[1]	±(0.5% of FS + 5 µSTR)
Temperature coefficient	Zero point: ±5 µSTR/°C (Typ.) Gain: ±(0.02% of FS)/°C (Typ.)
Bandwidth limit	Full/10 Hz/100 Hz/1 kHz

• NDIS (701270)

Function	mV/V support. Supports the strain gauge transducer unit system.
Input connector	NDIS connector (Recommended by JSNDI (The Japanese Society for Non-destructive Inspection)
Standard accessories	NDIS connector : 2 pieces
Recommended bridge head (sold separately)	701955 (NDIS 120 Ω, comes with a 5-m cable) 701956 (NDIS 350 Ω, comes with a 5-m cable)

• DSUB, Shunt-Cal (701271)

Function	mV/V support.
Supports	the strain gauge transducer unit system. Shunt calibration support. Built-in shunt calibration relay (1 gauge method).
Input connector	9-pin D-Sub connector (female)
Standard accessories	Connector shell set for soldering: 2 sets
Recommended bridge head (supports DSUB shunt-Cal) (sold separately)	701957 (D-Sub 120 Ω, comes with a 5-m cable) 701958 (D-Sub 350 Ω, comes with a 5-m cable)
Weight	Approx. 260 g

Acceleration/Voltage Module (with AAF) (701275)

Input channels	2
Input type	Isolated unbalanced
Input coupling	AC, DC, ACCL (acceleration), and GND
Input connector	BNC connector (metallic type)
Input impedance	1 MΩ ±1%, approx. 35 pF
Common mode rejection ratio	80 dB (50/60 Hz) or more (Typ.)
Maximum sample rate	100 kS/s
Frequency range (−3 dB)[1]	Acceleration: 0.4 Hz to 40 kHz Voltage: DC to 40 kHz
A/D conversion resolution	16 bit (2400 LSB/div)
Voltage-axis sensitivity setting[12]	Acceleration (±5 V = ×1 range) X0.1 to ×1 to X100 (1-2-5 steps) Voltage: 5 mV/div to 10 V/div (1-2-5 steps)
Maximum input voltage (1 kHz or less)[10]	42 V (DC + ACpeak)
Maximum rated voltage to earth (1 kHz or less)[11]	42 V (DC + ACpeak) (CAT II, 30 Vrms)
−3 dB point when AC coupled low frequency attenuation point	0.4 Hz or less (0.04 Hz or less when using the 701940) (Typ.)
Vertical (voltage) axis accuracy[1]	Voltage (DC accuracy): ±(0.25% of 10 div) Acceleration: ±(0.5% of range) at 1 kHz
Temperature coefficient (voltage) (excluding AUTO filter)	Zero point: ±(0.02% of 10 div)/°C (Typ.) Gain: ±(0.02% of 10 div)/°C (Typ.)
Bandwidth limit	Full/Auto (AAF)/40 Hz/400 Hz/4 kHz
Anti-aliasing filter (AAF)	Cutoff frequency (fc): automatically linked with the sampling frequency (fs) fs ≥ 100 Hz : fc = fs × 40% fs ≤ 50 Hz : fc = 20 Hz
	Cutoff characteristics: −65 dB at 2 × fc (Typ.)
Sensor supply current (voltage)	OFF/4 mA ±10% (approx. 22 VDC)
Applicable acceleration sensor	Built-in amplifier type Kistler Instruments Corp. : Piezotron, PCB Piezotronics Inc. : ICP, Endevco Corp : Isotron, etc.
Weight	Approx. 280 g

Frequency Module (720281)

Measurement function	Frequency (Hz), RPMs, RPSs, period (s), duty cycle (%), power supply frequency (Hz), pulse width (s), pulse integration, and velocity
Input channels	2
Input type	Isolated unbalanced
Input coupling	AC and DC
Input connector	BNC connector (isolated type)
Input impedance	1 MΩ ±1%, approx. 35 pF Pull-up function: 10 kΩ, approx. 5 V (pull-up can be turned ON only when the input is set to Pull-Up 5 V)
Data update rate	1 MHz (1 µs)
Minimum measurement resolution	625 ps
Measured data resolution	16 bit (2400 LSB/div)
Input voltage range (±FS)	(1:1) ±1 V to ±50 V (1-2-5 steps)
Maximum input voltage	In combination with 700929 (10:1)[2] 420 V (DC + ACpeak)
	Direct input[10] 42 V (DC + ACpeak)
Maximum rated voltage to earth	In combination with 700929 (10:1)/702902 (10:1)/701947 (100:1)[3] 400 Vrms (CAT II)
	Direct input[11] 42 V (DC + ACpeak) (CAT II, 30 Vrms)
Bandwidth limit	Full/100 Hz/1 kHz/10 kHz/100 kHz
Comparator section	Preset function Logic (5 V/3 V/12 V/24 V), electromagnetic pickup, zero crossing, pull-up (5 V), AC100 V, AC 200 V, and user-defined
	Threshold range ±FS range, resolution 1% units
	Hysteresis ±1%, ±2.5%, ±5% of FS
Chatter elimination function	OFF or 1 ms to 1000 ms (1 ms resolution)
LED display (per CH)	ACT (green): Operating status (lights during pulse input) OVER (red): Overdrive status (lights when input exceeds range)

Measured parameters and measuring range

Measured parameter	Measuring Range	Vertical axis sensitivity setting
Frequency (Hz)	0.01 Hz to 500 kHz	0.1 Hz/div to 100 kHz/div
RPMs	0.01 rpm to 100000 rpm	0.1 rpm/div to 10 krpm/div
RPSs	0.001 rps to 2000 rps	0.01 rps/div to 200 rps/div
Period (s)	2 µs to 50 s	10 µs/div to 5 s/div
Duty cycle (%)	0% to 100%	1%/div to 20%/div
Power supply frequency (Hz)	(50 Hz, 60 Hz, 400 Hz) ±20 Hz	0.1 Hz/div to 2 Hz/div
Pulse width (s)	1 µs to 50 s	10 µs/div to 5 s/div
Pulse integration	Up to 2×10^9 pulses	10×10^{-21} value/div to 0.5×10^{21} value/div
Velocity	Measuring range same as frequency (units can be converted to km/h, etc.)	

Measurement accuracy[1]

- When in frequency, RPM, RPS, or velocity measurement mode
  Measurement accuracy
  ±(0.05% of 10 div + accuracy dependent on the input frequency)

Accuracy dependent on the input frequency	
2 kHz or less	0.05% of the input frequency + 1 mHz
2 kHz to 50 kHz	0.05% of the input frequency
50 kHz to 100 kHz	0.1% of the input frequency
100 kHz to 200 kHz	0.2% of input frequency
200 kHz or higher	0.5% of the input frequency

- When in period measurement mode
  Measurement accuracy
  ±(0.05% of 10 div + accuracy dependent on the input frequency)

Accuracy dependent on the input period	
500 µs or greater	0.05% of the input period
20 µs to 500 µs	0.1% of the input period + 0.1 µs
10 µs to 20 µs	0.2% of the input period + 0.1 µs
10 µs or less	0.5% of the input period + 0.1 µs

- When in duty cycle measurement mode
Accuracy dependent on the input frequency	
50 kHz or less	±0.1%
50 kHz to 100 kHz	±0.2%
100 kHz to 200 kHz	±0.5%
200 kHz to 500 kHz	±1.0%

- When in pulse width measurement mode
  Measurement accuracy
  ±(0.05% of 10 div + accuracy dependent on the input pulse width)

Accuracy dependent on the input pulse width	
500 µs or greater	0.05% of the input pulse width
20 µs to 500 µs	0.1% of the input pulse width + 0.1 µs
10 µs to 20 µs	0.2% of the input pulse width + 0.1 µs
10 µs or less	0.5% of the input pulse width + 0.1 µs

- When in power supply frequency mode
  Measurement accuracy
  When the center frequency is 50/60 Hz: ±0.03 Hz (0.01 Hz resolution)
  When the center frequency is 400 Hz: ±0.3 Hz (0.01 Hz resolution)

Auxiliary measurement functions

Deceleration prediction	Computes the deceleration condition in realtime when the pulse input is cut off. Can be specified when measuring the frequency, RPMs, RPSs, period, and velocity.
Stop prediction	Sets the frequency to 0 after a certain time elapses after the pulse input is cut off. Stop interval setting: Set in the range of 1.5 to 10 times (10 settings) the period of the pulse measured last. Can be specified when measuring the frequency, RPMs, RPSs, period, and velocity.
Smoothing	Computes the moving average of the measured data using the specified time. Specified time: 0.1 to 1000 ms (0.1 ms resolution). Can be specified on all measurement parameters.
Pulse average	Performs frequency measurement per specified number of pulses. When fluctuation exists periodically in the pulse interval, the fluctuation can be eliminated. Specified number of pulses: 1 to 4096. Can be specified when measuring the frequency, RPMs, RPSs, power supply frequency, period, pulse integration, and velocity.
Offset function	Observe fluctuation with respect to the offset frequency. Offset range: Can be set up to 100 times the maximum range value.

Weight	Approx. 270 g

Logic Input Module (720230)

Input ports	2
Input type	non-isolated
Input bits	8 bit/Port
Maximum sample rate	10 MS/s
Compatible probes	Model: 700986 (8 bit, non isolated input) Model: 700987 (8 bit, isolated input) Model: 702911 (8 bit, non-isolated input, support contact input) Model: 702912 (8 bit, non-isolated input, support contact input)
Weight	Approx. 250 g

CAN/CAN FD Monitor Module (720242)

Input ports	2
Input type	Isolated (across port and main unit, across each port)
Input connector	D-Sub 9-pin (male)
Input channels	60 signals/port
Maximum sample rate	100 kS/s (60 CH × 1 kS/s per port)
Bit rate	10 k, 20 k, 33.3 k, 50 k, 62.5 k, 66.7 k, 83.3 k, 100 k, 125 k, 200 k, 250 k, 400 k, 500 k, 800 k, 1 Mbps
Flexible data rate	1 M, 2 M, 3 M, 4 M, 5 Mbps
Supported protocol	CAN, CAN FD (ISO 11898-1: 2015 or non-ISO) Physical layer: ISO-11898 (High Speed Communication)
Terminator	Built-in, it is switchable On and Off per port.
Endian	Little or Big selectable
LED display	Indicates on/off status of built-in terminator in each port
Channel setting	Message ID (Standard or Extended) Extraction Position Bit Length (Maximum 32 bit) Select the Endian (little or big) Convert physical value

Output function	Single shot Specified ID (Data) can be outputted manually. (Up to 64 bytes of CAN FD data frame is supported.)	
Allowable voltage range	-3 V to +10 V (CAN_H,CAN_L input to GND)	
Maximum rated voltage to earth (1 kHz or less)	42 V (DC + ACpeak) (CAT II, 30 Vrms)	
Weight	Approx. 240 g	

CAN & LIN Bus Monitor Module (720241)

|		
Input ports	CAN port: 1, LIN port: 1	
Input type	Isolated (across port and main unit, across each port)	
Maximum sampling rate	100 kS/s (60 CH × 1 kS/s per port)	
LIN port specifications	Maximum input voltage	−1 V to +18 V (LIN input to GND)
	LIN supply voltage input range	7 V to 18 V
	Maximum allowable common mode voltage 30 Vrms (CAT II)	
	Input connector	D-sub 9-pin (male)
	Supported protocol	Physical layer: ISO-9141
	Supported bit rate	2400, 9600, 19200 bps
	Supported data length	32 bits
	Input channels	60-signal/port
	Supported data field checksum	Standard and extended checksums
CAN port specifications	Maximum input voltage	-3 V to +10 V (CAN_H,CAN_L input to GND)
	Maximum allowable common mode voltage	30 Vrms (CAT II)
	Input connector	D-sub 9-pin (male)
	Terminator	Built-in, it is switchable On and Off
	Endian	Little or Big selectable
	LED display	Indicates on/off status of built-in terminator
	Supported protocol	Physical layer: ISO-11898 (High Speed Communication)
	Bit rate	10 k, 20 k, 33.3 k, 50 k, 62.5 k, 66.7 k, 83.3 k, 100 k, 125 k, 200 k, 250 k, 400 k, 500 k, 800 k, 1 Mbps
	Supported data length	32 bits
	Input channels	60-signal/port
	Output function	Single shot Specified ID (Data) can be outputted manually.
Weight	Approx. 240 g	

SENT Monitor Module (720243)

Input ports	2
Input type	Isolated
Maximum sampling rate	100 kS/s (10 µs)
Input connector	BNC connector (isolated type)
Input impedance	1 MΩ ±1%, approx. 35 pF
Supported protocol	SAE J2716
Clock Tick	1 µs to 100 µs (set in 0.01 steps)
Nibble	1 to 6
Channel setting	FAST CHANNEL 8 CH maximum SLOW CHANNEL 5 CH maximum (Up to 8 CH in total by FAST CHANNEL and SLOW CHANNEL) STATUS & COMMUNICATION 1 CH (4 bit) Error 1 CH Error count 1 CH
FAST CHANNEL analysis	FAST CHANNEL MULTIPLEXING support
L input voltage	1.5 V (Typ.)
H input voltage	3.5 V (Typ.)
Input status indication	Status indication through LED In operation: Illuminates in green when input is detected. Overdriven: Illuminates in red when the input voltage exceeds 20 V.
Maximum input voltage	42 V (DC + ACpeak) (CAT II, 30 Vrms)
Maximum rated voltage to earth	42 V (DC + ACpeak) (CAT II, 30 Vrms)
Weight	Approx. 260 g

Measurement Range and Display Range

The measurement range of the ScopeCorder is ±10 divisions (20 divisions of absolute width (span)) around 0 V. The display range of the screen is ±5 divisions (10 divisions of span). The following functions can be used to move the displayed waveform and display the waveform outside the display range by expanding/reducing the displayed waveform.
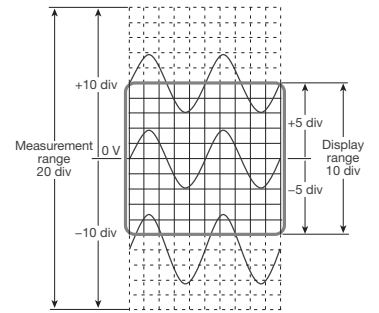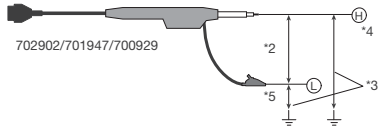
• Move the vertical position.
• Set the offset voltage.
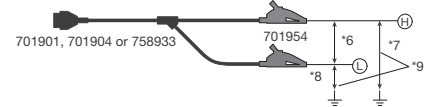• Zoom in or out of the vertical axis (expand/reduce).

Maximum Input Voltage and Maximum rated voltage to earth
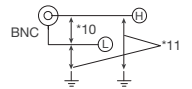
See Specifications of Plug-in Modules

In combination with 702902/701947/700929

702902/701947/700929

In combination with (701901+701954), (701904+701954) or (758933+701954)

701901, 701904 or 758933   701954

Direct input
(with a cable which doesn't comply with the safety standard)

BNC

WARNING
Do not apply input voltage exceeding the maximum input voltage, Maximum rated voltage to earth. To prevent the possibility of electric shock, be sure to furnish protective earth grounding of the main unit. To prevent the possibility of electric shock, be sure to fasten the module screws.

Main Specifications (probes and accessories)

100:1 Probe (for Isolated BNC Input) (701947)

Frequency range (–3 dB)	DC to 200 MHz
Attenuation ratio	100:1
Input impedance/capacitance	100 MΩ ±1%[*1] /7 pF
Maximum input voltage[*2]	Space between shield and earth. ±1000 V (DC + ACpeak) CAT II ±1000 V (DC + ACpeak) CAT I Space between tip and shield, tip and earth. ±1000 V (DC + ACpeak) CAT II ±3540 V (DC + ACpeak) CAT I
Total length	1.5 m

*1: When the input impedance of the measuring instrument is 1 MΩ ±1%.
*2: When the input voltage is AC, the maximum allowable input decreases depending on the frequency.

10:1 Passive Probe (Wide operating temperature range) (702902)

Frequency range (–3 dB)	DC to 60 MHz
Attenuation ratio[*]	10:1 (Fixed) ±2% (5 to 40℃) ±3% (–40 to 5℃, 40 to 85℃)
Input resistance/capacitance[*]	10 MΩ ±2%/17.0 pF (Typ.)
Maximum input voltage	Between the pincher tip and safety ground lead ±1000 V (DC + ACpeak) CAT II Between safety ground lead and ground ±1000 V (DC + ACpeak) CAT II
Total length	2.5 m
Operating temperature range	–40 to +85℃

* In conjunction with a measuring instrument with an input impedance of 1 MΩ±1%.

10:1 Probe (for Isolated BNC Input) (700929)

Frequency range (–3 dB)	DC to 100 MHz
Attenuation ratio	10:1
Input impedance/capacitance	10 MΩ/approx. 18 pF
Maximum input voltage (probe alone)	1000 V (DC + AC peak) Space between clip and lead, lead and earth. When the input voltage is AC, the maximum allowable input decreases depending on the frequency.
Total length	1.5 m

Current Probe (701917)

Frequency range (–3 dB)	DC to 50 MHz
Maximum continuous input range	5 Arms (The maximum allowable input decreases depending on the frequency.)
Maximum peak current	7.5 Apeak, non-continuous
Output voltage rate	1 V/A
Amplitude accuracy	±1% of reading ±1 mV typical, ±3.0% of reading ±1 mV (DC, and 45 to 66 Hz)

Current Probe (701918)

Frequency range (–3 dB)	DC to 120 MHz
Maximum continuous input range	5 Arms (The maximum allowable input decreases depending on the frequency.)
Maximum peak current	7.5 Apeak, non-continuous
Output voltage rate	1 V/A
Amplitude accuracy	±1% of reading ±1 mV typical, ±3.0% of reading ±1 mV (DC, and 45 to 66 Hz)

Current Probe (701932)

Frequency range (–3 dB)	DC to 100 MHz
Maximum continuous input range	30 Arms (The maximum allowable input decreases depending on the frequency.)
Maximum peak current	50 Apeak, non-continuous
Output voltage rate	0.1 V/A
Amplitude accuracy	To 30 Arms: ±1% of reading ±1 mV 30 Arms to 50 Apeak: ±2% of reading (DC, and 45 to 66 Hz)

Current Probe (701933)

Frequency range (–3 dB)	DC to 50 MHz
Maximum continuous input range	30 Arms (AC and DC components) (The maximum allowable input decreases depending on the frequency.)
Maximum peak current	50 Apeak, non-continuous
Output voltage rate	0.1 V/A
Amplitude accuracy	To 30 Arms: ±1% of reading ±1 mV 30 Arms to 50 Apeak: ±2% of reading (DC, and 45 to 66 Hz)

Current Probe (701930)

Frequency range (–3 dB)	DC to 10 MHz
Maximum continuous input range	150 A (The maximum allowable input decreases depending on the frequency.)
Maximum peak current	300 Apeak, non-continuous
Output voltage rate	0.01 V/A
Amplitude accuracy	To 150 A: ±1% of reading ±1 mV 150 A to 300 A: ±2% of reading (DC, and 45 to 66 Hz)

Current Probe (701931)

Frequency range (–3 dB)	DC to 2 MHz
Maximum continuous input range	500 A (The maximum allowable input decreases depending on the frequency.)
Maximum peak current	700 Apeak, non-continuous
Output voltage rate	0.01 V/A
Amplitude accuracy	To 500 A: ±1% of reading ±5 mV 500 A to 700 A: ±2% of reading (DC, and 45 to 66 Hz)

Clamp-on Probe (720930)

Measuring range	AC 0 to 50 Arms
Measurable conductor size	Maximum 18 mm diameter
Output voltage	AC 0 to 500 mVrms (10 mV/A)
Accuracy (sine wave input)	Bandwidth ±0.5% of reading ±0.1 mV (50/60 Hz) ±0.8% of reading ±0.2 mV (40 Hz to 1 kHz) ±1.0% of reading ±0.4 mV (1 kHz to 3.5 kHz)
	Phase Within ±2.0 deg (0.5 to 50 A, 40 Hz to 3.5 kHz)
Maximum allowable input	AC 130 Arms continuous (50/60 Hz)
Output impedance	Approx. 18 Ω
Output terminal	BNC connector (isolated)
External dimensions	52 (W) × 106 (H) × 25 (D) mm (excluding protrusions)
Cable length	Approx. 3 m
Weight	Approx. 210 g

Clamp-on Probe (720931)

Measuring range	AC 0 to 200 Arms (300 Apeak)
Measurable conductor size	Maximum 30 mm diameter
Output voltage	AC 0 to 500 mVrms (2.5 mV/A)
Accuracy (sine wave input)	Bandwidth ±0.5% of reading ±0.1 mV (50/60 Hz) ±0.8% of reading ±0.2 mV (40 Hz to 1 kHz) ±1.0% of reading ±0.4 mV (1 kHz to 3.5 kHz)
	Phase Within ±1.0 deg (2 to 200 A, 40 Hz to 3.5 kHz)
Maximum allowable input	AC 250 Arms continuous (50/60 Hz)
Output impedance	Approx. 6 Ω
Output terminal	BNC connector (isolated)
External dimensions	73 (W) × 130 (H) × 30 (D) mm (excluding protrusions)
Cable length	Approx. 3 m
Weight	Approx. 280 g

Differential Probe (700924)

Frequency range (–3 dB)	DC to 100 MHz
Attenuation ratio	Switched ratios of 100:1 and 1000:1
Input impedance/capacitance	4 MΩ/approx. 10 pF
Differential allowable voltage	±1400 V (DC + ACpeak) or 1000 Vrms at 1000:1 attenuation ±350 V (DC + ACpeak) or 250 Vrms at 100:1 attenuation
Max common mode voltage	±1400 V (DC + ACpeak) or 1000 Vrms
Max input voltage (to ground)[*]	±1400 V (DC + ACpeak) or 1000 Vrms

*Derating is applied towards frequencies.

High Voltage Differential Probe (701926)

Frequency range (–3 dB)[*]	DC to 50 MHz
Attenuation	1000:1 or 100:1, switchable
Input resistance and capacitance (Typ.)	50 MΩ + approx. 17 pF (parallel with respect to ground)
Allowable differential voltage (between + and – terminals)	
	5000 V rms or less and 7000 Vpeak or less at 1000:1 attenuation 500 V rms or less and 700 Vpeak or less at 100:1 attenuation
Allowable common mode voltage	5000 Vrms or less and 7000 Vpeak or less
Maximum input voltage (to ground)[*]	1000 Vrms CAT III 5000 Vrms and 7000 Vpeak CAT I
Operating conditions	5 to 40℃, 25 to 85%RH (no condensation)
Power requirements	• Internal battery: Four AA dry cells • External power supply: 6 VDC/200 mA or more or 9 VDC/ 150 mA or more • From the probe power supply terminal of the DL Series, the 701934 using the probe power cable
External dimensions	202 mm × 83 mm × 38 mm (excluding connector and cable)
Weight	Approx. 500 g (excluding batteries)

*Derating is applied towards frequencies.

Passive Probe (701940)

Frequency range (–3 dB)	DC to 10 MHz at 10:1 attenuation DC to 6 MHz at 1:1 attenuation
Attenuation ratio	Switched ratios of 10:1 and 1:1
Input impedance/capacitance	10 MΩ/approx. 22 pF (10:1), 200 pF maximum (1:1)
Maximum input voltage (probe alone)	600 V (DC + AC peak)

Logic Probe (702911: 1 m and 702912: 3 m)

Number of inputs	8
Input type	Non-isolated (earth of all bits is common, main unit earth and earth of all bits are common)
Maximum input voltage	±35 V
Response time	3 μs (Typ.)
Input impedance	10 kΩ or greater
Threshold level	Approx. 1.4 V
Input level	TTL level or contact input (switching type)

High-Speed Logic Probe (700986)

Number of inputs	8
Input type	Non-isolated (earth of all bits is common, Main unit earth and earth of all bits are common)
Maximum input voltage (1 kHz or less)(across probe tip and earth) 42 V (DC + ACpeak)	
Response time	1 μs (Typ.)
Input impedance	Approx. 100 kΩ
Threshold level	Approx. 1.4 V

Isolation Logic Probe (700987)

Number of inputs	8	
Input type	Isolated (all bits are isolated)	
Input connector	Safety terminal type (for banana plug) × 8	
Input switching	Can switch between AC/DC input for each bit	
Applicable input range	DC input	H/L detection of 10 VDC to 250 VDC
	AC input	H/L detection of AC type of 80 VAC to 250 VAC 50/60 Hz
Threshold level	DC input	6 VDC ±50%
	AC input	50 VAC ±50%
Response time	DC input	within 1 ms (Typ.)
	AC input	within 20 ms (Typ.)
Maximum input voltage (1 kHz or less) (across H and L of each bit) 250 Vrms (CAT Ⅱ)		
Maximum rated voltage to earth (1 kHz or less) 250 Vrms (CAT Ⅱ)		
Maximum allowable voltage between bits 250 Vrms (CAT Ⅱ)		
Input impedance	Approx. 100 kΩ	

Bridge Head (701955, 701956, 701957, 701958)

Bridge resistance	Model 701955, 701957 : 120 Ω Model 701956, 701958 : 350 Ω
Applicable gauge methods	Single-gauge, Single-gauge three-wire, Adjacent-side two-gauge, Opposed-side two-gauge, Opposed-side two-gauge three-wire, Four-gauge
Operating conditions	Temperature: 5 to 40°C Humidity: 20 to 85% RH
External dimensions	701955, 701956: Approx. 37 (W) × 97 (H) × 30 (D) mm 701957, 701958: Approx. 50 (W) × 101 (H) × 29 (D) mm
Weight	701955, 701956: Approx. 85 g (Bridge head only) 701957, 701958: Approx. 100 g (Bridge head only)

Power Supply (701934)

Compatible Probes	Current probe: 701930, 701931, 701932, 701933, 701917, 701918 Differential probe: 701920, 701921, 701922, 700924, 701926
No. of Power Receptacles	4
Output Voltage	±(12 ±0.5) V
Rated Output Current	±2.5 A (total value for each output)
Rated Supply Voltage	100 to 240 VAC (actual power supply voltage may fluctuate within ±10% of the rating)
Ripple Voltage	50 mVp-p
Rated Power	190 VA maximum (at the rated output current)
External Dimensions	80 (W) × 119 (H) × 200 (D) mm
Weight	Approx. 1.2 kg

Module and accessory combinations

High-speed 100 MS/s 12 Bit Isolation Module 720211

High-speed 10 MS/s 12 Bit Isolation Module 720250

High-speed 1 MS/s 16 Bit Isolation Module 701251

High-Voltage 1 MS/s 16 Bit Isolation Module (with AAF, RMS) 720268

Frequency Module 720281

4 CH 1 MS/s 16 Bit Isolation Module 720254

10:1 Probe (for isolated BNC input) 702902

100:1 Probe (for isolated BNC input) 701947

10:1 Probe (for isolated BNC input) 702902

1:1 Safety BNC adapter lead 701901

Measurement lead set 758933

Safety BNC cable 1 m: 701902 3 m: 701903

Current probe 30 Arms, DC to 50 MHz 701933

Current probe 150 Arms, DC to 10 MHz 701930

Current probe 500 Arms, DC to 2 MHz 701931

Current probe 5 Arms, DC to 50 MHz 701917

Current probe 5 Arms, DC to 120 MHz 701918

Current probe 30 Arms, DC to 100 MHz 701932

Clamp-on Probe 50 Arms, 40 Hz to 3.5 kHz 720930

Clamp-on Probe 500 Arms, 40 Hz to 3.5 kHz 720931

4 mm Conversion adapter B8099NL/B8099NM

1:1 Safety adapter lead 701904

Plug on clip 701948

Long test clip 701906

Large alligator clips (dolphin type) 701954

Pinchers tip (hook type) B9852MM/B9852MN

Alligator adapters 758922

Alligator adapters 758929

Fork terminal adapters 758921

/P4, Probe power 4-output (option for DL850E/DL850EV/SL1000)

Probe power 4-output 701934

Acceleration/Voltage Module (with AAF) 701275

High-speed 10 MS/s 12 Bit Non-isolation Module 701255

Passive probe 701940

BNC cable 1 m: 366924 2 m: 366925

BNC-alligator cable 366926

±500 V, 15 MHz Differential probe 700925

±1400 V, 100 MHz Differential probe 700924

7000 Vpk, 50 MHz Differential probe 701926

Warning:
Connect the probe earth cable to ground (grounding potential) when using these differential probes with isolation modules.

Strain Module (NDIS)
701270

Bridge head (NDIS)
120 Ω: 701955
350 Ω: 701956

Strain Module
(DSUB Shunt-CAL)
701271

Bridge head
(DSUB, Shunt-CAL)
120 Ω: 701957
350 Ω: 701958

Logic input
Module
720230

High-speed logic probe
700986

Isolated logic probe
700987

Logic Probe
(TTL level/contact input)
1 m: 702911
3 m: 702912

These logic probes can be connected to DL350 logic input terminal as well.

16 CH Temp./Voltage
Input Module
720221

Scanner box
701953
(provided with a connecting cable)
Note:
This unit is always required for
measurement.

Universal Module
701261

1:1 Banana-alligator cable
366961

Universal Module
(with AAF)
701262

Shunt resister for 4-20 mA measurement
250 Ω ± 0.1% : 438920
100 Ω ± 0.1% : 438921
 10 Ω ± 0.1% : 438922

Temperature/High-precision
Voltage Module
701265

Temperature/High-precision
Voltage Isolation Module
(Low noise)
720266

Strain Module (NDIS)
(Model: 701270)

Strain Module (DSUB, Shunt-CAL)
(Model: 701271)

Two types of modules are available depending on differences in the input connectors and support for shunt calibration. These support not only strain gauges, but also strain gauge type sensors.

Strain gauge

A strain gauge is a sensor that detects mechanical stress (strain). It works on the principle that the resistance value of a metal foil changes as it expands and contracts. The strain gauge uses a specialized sensor that is affixed in the direction of expansion and contraction with an instant adhesive.

$+\Delta R$ Expansion: Resistance value increases

$-\Delta R$ Contraction: Resistance value decreases
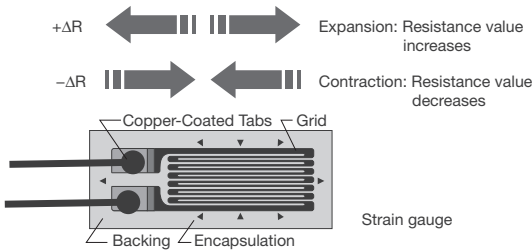
Strain gauge

The strain gauge's rate of change in resistance is very small. For instance, when using a 120 Ω strain gauge, the change in resistance corresponding to a strain of 1000 µSTR is 0.24 Ω. Relative to a strain of 1 µSTR, the resistance change is only 0.00024 Ω. Converting such minute resistance changes to voltage requires a Wheatstone bridge.
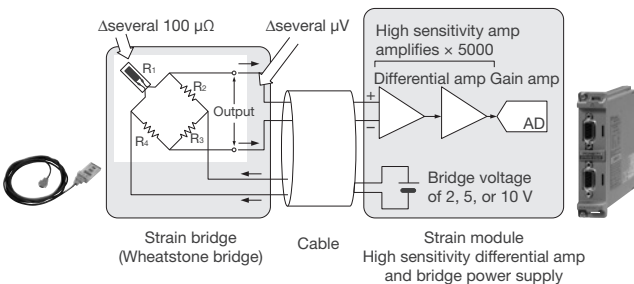
Strain gauge and measurement circuit

Furthermore, because the bridge output is as small as a few micro volts, the input must be amplified inside the strain module using a differential and high gain amp.

You can select a bridge voltage (DC) of 2, 5, or 10 V. The higher the input voltage the higher the output voltage. Therefore, low noise measurements are possible, but only a bridge resistance of 350 ohm is supported at 5/10 V.

Measuring with a strain module

You can determine structural durability (elasticity) by measuring the strain.

$$\sigma = \varepsilon E$$ σ: stress ε: strain   E: elasticity (Young's modulus)
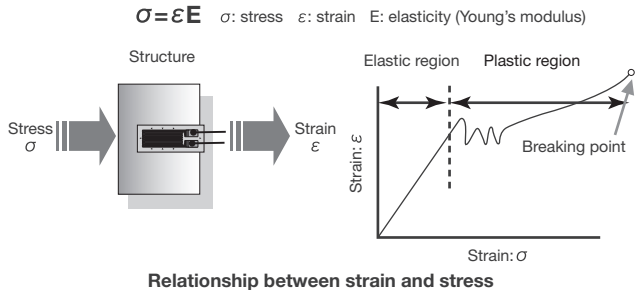
Relationship between strain and stress

Stress is calculated using the relationship of elasticity (Young's modulus), which depends on structure's material, and the durability of the structure.

A strain gauge type sensor uses built-in strain gauge to measure stresses that occur with changes in various physical quantities (load, pressure, displacement, vibration, torque, etc.) based on the above principle. It then converts those to the original physical quantities and outputs them.

Connecting to a strain module
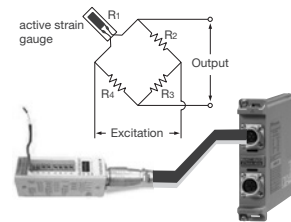
For strain measurements with a strain gauge, use the accessory bridge head.
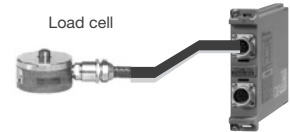
Strain gauge type sensors are connected directly.

Shunt calibration

Shunt calibration (shunt CAL) means correcting the gain in strain measurements by inserting a known resistance (shunt resistance) in parallel with the strain gauge. Correction can be made without introducing a load, and while not perfectly accurate the correction can include the gauge wiring cables.
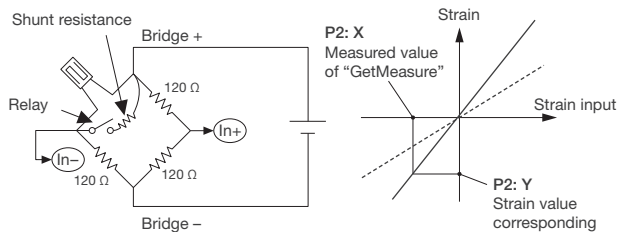
Gain correction using shunt CAL
(gain correction on the negative (–) side)

The model 701271 Strain Module (DSUB, shunt CAL) supports shunt calibration. A bridge head that supports shunt CAL (model 701957 or 701958) is required to execute shunt CAL.

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Acceleration/Voltage Module
(with Anti-Aliasing Filter) (Model: 701275)

This module will accept direct input from a built-in amp type acceleration sensor to measure acceleration. You can also connect a charge output type acceleration sensor via a commercially available charge converter. Additionally, the module doubles as a voltage module to support common voltage measurements, and an effective anti-aliasing filter is built in for FFT analysis.

Built-in amp type acceleration sensors

Built-in amp type acceleration sensors use a voltage (piezoelectric) method, and have a built in piezoelectric element that emits a charge from the area of distortion when it encounters mechanical stress. When vibration occurs, a charge is generated on both ends of the element. Vibration is measured by measuring the voltage proportional to the generated charge.

DC power (4 mA/22 V) is supplied from the module to the sensor, and the vibration detected by the sensor is fed back to the module as AC output. The DC component is cut from the vibration output to isolate the AC component which is then amplified.

The model 701275 Acceleration/Voltage Module supports built-in amp type acceleration sensors. No charge amp is required, allowing sensors to be connected directly. It has low impedance, thus offering anti-noise characteristics.

Charge output type acceleration sensors

When you need to perform measurements by connecting a charge output type acceleration sensor, you can input to the 701275 Acceleration/Voltage module through a commercially available charge converter or charge amp.
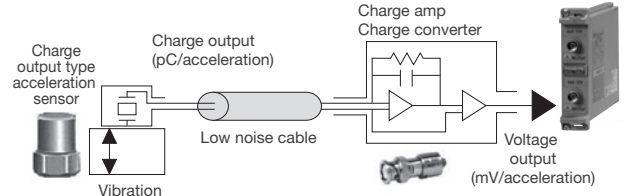
Connecting a charge output type acceleration sensor

The electric charge proportional to acceleration (pC/acceleration) is conveyed to the charge amp via a low noise cable. The charge amp converts charge to voltage (mV/acceleration). Because impedance is high and charge is small, the signal is susceptible to noise and caution should be exercised. The drive current/voltage needed for connecting a built-in amp type acceleration sensor is not required with charge output type acceleration sensors.

When using the model 701275 Acceleration/Voltage Module to measure acceleration, enter output units (sensitivity, mV/unit) that are appropriate for the acceleration sensor being used. The output units are included on the sensor's spec sheet.

When connecting a built-in amp type acceleration sensor or charge output type acceleration sensor via charge converter, turn ON the bias output (constant drive current).

Connecting a built-in amp type acceleration sensor

The 701275 Acceleration/Voltage Module can connect to any built-in amp type acceleration sensor that supports a constant drive current of 4 mA and drive voltage of 22 V. Please check the sensor's spec sheet to ensure you are using one that meets the constant drive current and voltage (range) requirement of 4 mA and 22 V. They are available from the following manufacturers.
Kistler: Piezotron   PCB: ICP   Endevco: isotron2

Frequency Module (Model: 720281)

This module incorporates all the functions and performance required for measuring rotating bodies (pulses). It performs measurement of 9 different items, and reads in measured values directly.

With isolated input, its measurement range is 0.01 Hz to 500 kHz. Measured values are updated at high speed (1 µs/1 MHz) for real time confirmation.

DUTs of the Frequency module

Unlike general FV converters, the model 720281 Frequency Module does not require scale conversion when acquiring measurement items such as the ones in figure 1 because it can read in values directly. It not only displays data as waveforms, but enables cursor and waveform parameter measurement of those waveforms.

Input signals
A variety of signal types can be input, such as encoder pulse input of up to ±42 V, powered electromagnetic pickup direct input (1:1), and AC power of up to 300 V (when using a 10:1 probe). The isolation function, amplifier, and filters are all equivalent to those in a normal voltage module, therefore it supports a broad range of voltage (6 ranges) and input formats. Precise chattering elimination from 1 ms to 1 s is supported. The unit comes configured with menu presets for logic input (3 V to 24 V), electromagnetic pickup, AC power, and other inputs.
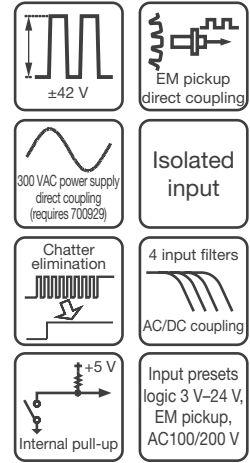
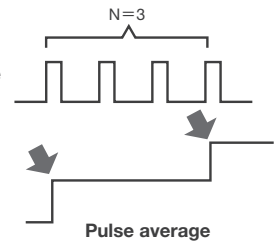## Real-time digital filtering
Smoothing filter (Moving average)
Smooth stair-step shaped waveforms. Updating occurs every 1 µs, giving a high speed averaging effect. Filters are set at 0.1 ms to 1 s (up to the 25000th order). Filters reduce jitter in observed waveforms, and increases resolution.

Smoothing (moving average)
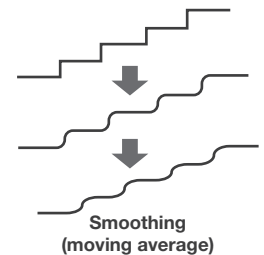
Pulse average
Useful for determining the average value per rotation, or determining the number of rotations when a gear is missing teeth. Output is averaged every specified number of pulses (between 1 and 4096 pulses).

Pulse average

Frequency module test items

Test item	Real-time calculation	Measurement range[1]	Measurement
Frequency (Hz)	$\text{Frequency (Hz)} = \dfrac{1}{Tw \ (s)}$	0.01 Hz to 500 KHz	
Period (s)	$\text{Period (s)} = Tw \ (s)$	2 µs to 50 s	
Rpm	$Rpm = \dfrac{\text{freq. (Hz)}}{\text{pulses per revolution (Nr)}} \times 60$	0.01 rpm to 100000 rpm	
Rps	$Rps = \dfrac{\text{freq (Hz)}}{\text{pulses per revolution (Nr)}}$	0.001 rps to 2000 rps	
Duty (%)	$\text{Duty (\%)} = \dfrac{Thigh \ (s)}{Tw \ (s)}$ or $\dfrac{Tlow \ (s)}{Tw \ (s)}$	0% to 100%	
Pulse width	$\text{Pulse width (s)} = Thigh \ (s)$ or $Tlow \ (s)$	1 µs to 50 s	
Power Supply Freq. (Hz)	$\text{Power supply freq. (Hz)} = \dfrac{1}{Tw \ (s)}$ at the 50/60 Hz setting, 0.01 Hz resolution	(50 Hz, 60 Hz, 400 Hz) ±20 Hz	
Pulse Integration (Distance/ Quantity of flow)	Distance $= N \ (count) \times \text{distance per pulse } \ell$ *Distance ℓ and units are user-definable.	up to 2×10^9 count	
Velocity (km/h, mph)	Velocity (km/h) $= \dfrac{\text{distance per pulse } \ell \ (km)}{Tw \ (s)} \times 3600$ Velocity (m/s) $= \dfrac{\text{distance per pulse } \ell \ (m)}{Tw \ (s)}$ *Units are user-definable (angular velocity and other units)	$F = \left(\dfrac{1}{Tw}\right)$ = 0.01 Hz to 200 kHz	

1 Allowable input frequency range: 0.01 Hz to 200 kHz

Supports braking applications
By predicting the deceleration curve and stop point, the module automatically compensates for the lack of information on encoder pulses which occur during deceleration.

Deceleration Prediction (1)
Automatically calculates and outputs a deceleration curve based on the interval of the last input pulse.
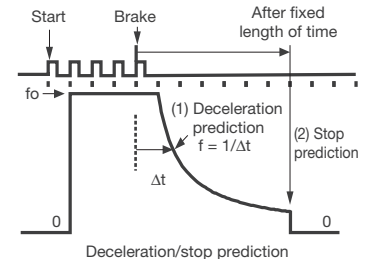
Stop Prediction (2)
If no pulses are inputted for a period of time, a stop is inferred, and output is set to 0. Up to 10 steps can be specified.

Deceleration/stop prediction

You can detect actions from pulse output stop (break, etc.) to the actual stop, therefore it is effective for applications involving pulse measurement associated with deceleration and stopping.

16 CH Voltage Input Module (Model: 720220)

This is a multichannel voltage module capable of measuring 16 channels (subchannels) of DC voltage on a single unit. Scan method measurements are possible by using a removable spring-type terminal block (removable in 8 channel sections) at the input. The input section uses Weidmueller B2L 3.5/16LH clamp connectors.

The maximum sampling rates are 200 kS/s (for 1 CH) and 10 kS/s (for 16 CH simultaneously). The minimum voltage input range is 200 mV/div, and the maximum input voltage is 42 V (direct input, 1 kHz or less).

You can build a 128 CH measuring system by installing up to eight modules in a single DL850E/DL850EV.

Input terminal blocks are isolated from ground. There is no isolation between channels within the input terminal block.

Setting subchannels

On each of the 16 channels (subchannels) in the module, you can individually set the range and other input conditions, position, zoom, and other display conditions.

Channel setting screen (DL850E)

Connecting wires to terminal block

The following electrical wire is recommended.
0.20 mm^2 to 1.00 mm^2 (two solid wires or thin stranded wire).
AWG size: 24-18

Strip approx. 7 mm of the insulation from the end of the wire and insert the end into a wire inlet of a terminal block.
A terminal block can be detached from the module as shown right; wires can be easily installed.
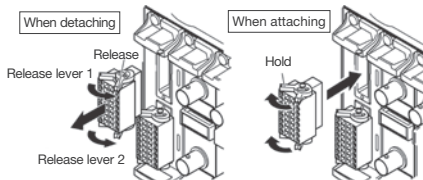
Number of subchannels to be used, sampling rate, and record length

Subchannels under measurement (those set to ON) are sampled in turn. As noted above, the subchannel sampling rate changes depending on the main channel's sampling rate and the number of subchannels to be used. The figure below shows the difference in sampling rate when all subchannels (16 CH) are set to ON and when only two subchannels (subchannels 1 and 16) are set to ON.

Main channel's sampling rate: 200 kS/s

When the number of subchannels to be measured is 16 (all subchannels set to ON)

Subchannels' sampling rate: 10 kS/s
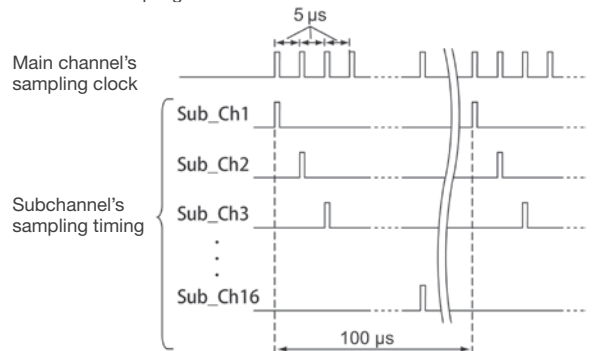
When the number of subchannels to be measured is 2 (subchannels 1 and 16 set to ON)

Subchannels' sampling rate: 100 kS/s
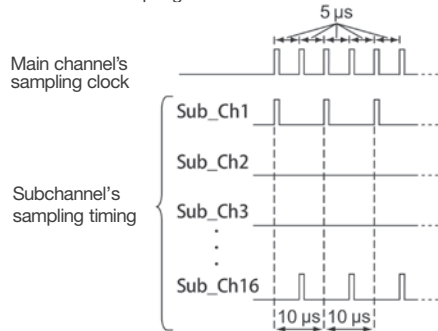
For example, if the main channel's sampling rate is 200 kS/s, the sampling clock is 5 μs period. The subchannels are sampled at this sampling clock in turn. Therefore, the subchannel's sampling timing is as shown in the figure above. Because scanning all required channel's takes time in proportion to the number of subchannels to be used (set to ON), the greater the number of subchannels to be used, the lower the sampling rate for one subchannel.

In the example shown above, the sampling rate is 10 kS/s (5 μs × 16 CH + 20 μs) when using 16 CH, while it is 100 kS/s (5 μs × 2) when using 2 CH.

The sampling rate that is displayed on the main unit screen is the main channel's sampling rate.

The record length of each subchannel changes depending on the set record length and the number of subchannels to be used and there is a relationship between them as follows:

$$\text{Record length of each subchannel} \leq \frac{\text{set record length}}{\text{number of subchannels to be used}}$$
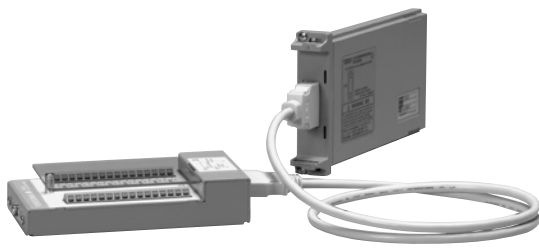
External Scanner Box
(Model: 701953)

16 CH Temperature/Voltage
Input Module (Model: 720221)

This is a multichannel input module capable of measuring up to 16 channels (subchannel's DC voltage or temperature measured by TC) on a single unit. It consists of the module body (model: 720221) and external scanner box (model: 701953) and both units are always required to make measurement. Wires for voltage measurement or a thermocouple for temperature measurement are connected to terminal blocks (screwed type) of the external scanner box.

The input section is isolated between ground and terminal blocks and between subchannels. For the voltage measurement range and temperature measurement range (available thermocouple types and accuracy), see the module specifications described on page 5 of this manual.

Both the maximum input voltage and maximum rated voltage to earth are 42 V (AC + DCpeak, 1 kHz or less).

Scanning method, Data updating period, and Bandwidth limit

Alternatives	Setting ①	Setting ②	Setting ③	Setting ④
Data updating period (selectable)	100 ms	300 ms	1 s	3 s
Bandwidth limit (–3 dB) (unselectable, automatic setting)	600 Hz	200 Hz	50 Hz	10 Hz

The data updating period can be selected from among the following settings ① to ④. According to the selected data updating period, the predetermined bandwidth limit is imposed as per the following combinations.

The scan data updating period for one scan (maximum 16 CH) can be selected from among four types of alternatives (① to ④) shown in the table above. The selected updating period is independent of the number of subchannels to be used and is consistent. Thus, if setting ① is selected, a maximum of 16 points (CH) can be measured every 100 ms. The updating rate is also independent of the measurement object and is common to both voltage and temperature. The predetermined bandwidth limit is automatically enabled according to the selected scan data updating period. The combinations of the updating period and bandwidth limit are as shown in the table above (① to ④). If a signal to be measured contains significant noise, lower the data updating period. This allows the bandwidth limit to be enabled at a lower cut-off frequency, improving the noise reduction effect.

Reference junction compensation (RJC)

The RJC circuit is built into the external scanner box. The RJC allows switching between internal and external equipment. For details of the RJC compensation accuracy, see the module specifications described on page 5 of this bulletin.

Moreover, the external scanner box also incorporates
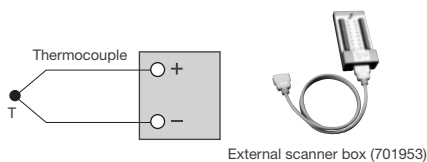
Reference junction compensation

a burnout circuit for detecting a wire break and this burnout detection is always available even during measurement. The burnout detection can be set to ON/OFF for each subchannel.

Noise reduction performance

This module adopts the ΔΣ-type A/D conversion method. Using the digital filtering function based on oversampling, it reduces the noise effect and ensures accurate measurement.

The oversampling performs sampling (A/D conversion) at a higher frequency by comparison with input signal frequency. Since the module performs a larger number of samplings at a faster period to take the average of them, the resolution of measured values is improved, enabling a measured value closer to the true value to be obtained. At the same time, it provides a noise component reduction (averaging) effect if a signal contains noise. Moreover, because the sampling resolution is high, input signal waveforms can be reproduced more faithfully.

ΔΣ-type A/D conversion block diagram

In general temperature scanner modules, the filtering performance tends to be sacrificed (weakened) to improve the data updating period, and therefore high-frequency noise cannot be reduced sufficiently in some cases. The module also offers excellent common mode reduction performance as well as the ability to scan 16 points (CH) of data at an updating period as high as 100 ms.

Channel setting screen (DL850E)

Comparison with the 16 CH Voltage Input Module (720220)

The features of the two types of 16 CH input modules (models: 720220 and 720221) are compared in the table below. The hatched areas show the features of the respective modules. You can select an appropriate module according to the measurement application.

	16 CH Voltage Module (720220)	16 CH Voltage/Temp. Module (720221)
Channels	16	16
Input	DC V	DC V, temperature
Voltage measurement range	200 mV/div to 2 V/div (1-2-5 steps)	1 mV/div to 2 V/div (1-2-5 steps)
Voltage accuracy	±(0.3% of 10 div)	±(0.15% of 10 div)
Updating period	5 µs maximum (when only one subchannel is used)	100 ms, 300 ms, 1 s, or 3 s (user selectable) (Independent of the number of subchannels to be used)
Maximum rated voltage to earth	42 V (DC + ACpeak) (CAT II, 30 Vrms)	42 V (DC + ACpeak) (CAT II, 30 Vrms)
Isolation between channels	No	Yes
A/D conversion resolution	16 bit (2400 LSB/div)	16 bit (2400 LSB/div)

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Logic Input Module (Model: 720230)

Probe model	Number of inputs	Isolated/ non-isolated	Maximum input voltage	Threshold level	Response time
702911/702912	8	Non-isolated	±35 V	Approx. 1.4 V	3 µs or less
700986	8	Non-isolated	30 Vrms	Approx. 1.4 V	1 µs or less
700987	8	Isolated	250 Vrms	6 VDC or 50 VAC	1 ms or less (DC), 20 ms or less (AC)

Input logic signals can also be displayed for numeric monitoring in either binary or hexadecimal format.
Moreover, you can put the cursor on the measured logic waveform to read bit data.

Input logic signals can be displayed as waveforms at a sampling resolution of up to 10 MS/s. Each port can measure 8 bit, and 2 ports of input are available on each module. Thus, a single module can observe 16 bit logic signals. You can turn the display
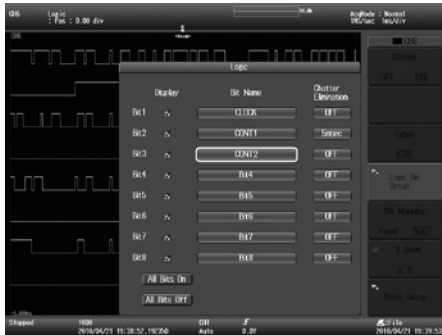
Logic display setting screen (DL850E)

of individual bits ON/OFF, and assign each bit its own unique label.
In all, you can input and display up to 128 bit of logic signals by installing up to eight modules in a single DL850E/DL850EV for example.

You can select from four different types of logic probe to best fit the input signal. (For details on logic probes, see page 9 of this bulletin.)
The input format, maximum input voltage, threshold level, and other settings depend on the logic probe being used; please refer to the specifications of your logic probe. The following logic probes can be used.

Logic probe
(TTL level/contact input)
1 m: 702911/3 m: 702912
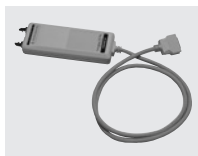
High-speed logic probe
700986

Isolation logic probe
700987

4 CH 1 MS/s 16 Bit Isolation Module (Model: 720254)

This module has 4 CH isolated BNC inputs. By installing 8 pieces of this module in a DL850E/EV for example, it makes total 32 channels stand-alone measurement system. This module meets your applications widely as isolated high-voltage and multi-channel (up to 32) measurements and recording.
The A/D conversion resolution is 16 bit (2400 LSB/div) and maximum input voltage is 600 V (DC + ACpeak, when using 700929 or 701947 probe). Maximum rated voltage to earth is 300 Vrms (CAT II).

Another feature for this module is excellent noise immunity. The common mode rejection ratio (CMRR) is more than 80 dB (50/60 Hz) (Typical).
The following graph shows typical data for the CMRR performance.
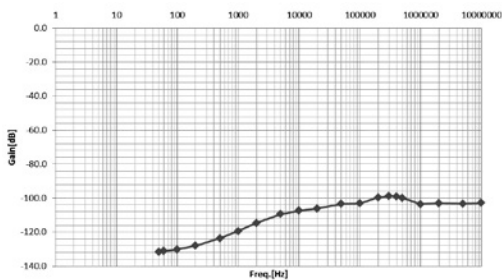
In general, a high number of isolated CHs and high resolution are required to record inverter signals typically 300 Vrms or greater for long periods of time. In transportation applications, a high number of isolated CHs are also essential to measure the advanced control signals and sensor output signals controlled by the ECU (Electronic Control Unit). An increase in the number of measurement systems in power plants also requires more channels in one instrument. troubleshooting can be done efficiently by measuring multiple signals simultaneously in one measuring instrument.
This module supports these applications.

Note

When using this module with the DL850E/DL850EV, the sample rate will be always half or less of the 2 CH voltage input module such as 720250 under the same recording length.

When an external clock signal is applied, the sample rate will also be always half or less of the sample rate of the external clock. Please pay particular attention when using only the 4 CH 1 MS/s, 16 bit isolation module(s) sampled by an external pulse signal such as a rotary encoder.

The sample timing is simultaneous for 4 CH.Refer to the following table for detail.

**Relationship between the main channel
sample rate and the 4 CH 1 MS/s, 16 bit isolation module sample rate.
(DL850E/DL850EV only)**

Main channel sample rate (S/s)	Sample rate of the 4 CH 1 MS/s, 16 bit isolation module (720254) (S/s)
100 M	1 M
50 M	1 M
20 M	1 M
10 M	1 M
5 M	1 M
2 M	1 M
1 M	500 k
500 k	100 k
200 k	100 k
100 k	50 k
50 k	10 k
20 k	10 k
10 k	5 k
5 k	1 k
2 k	1 k
1 k	500
500	100
200	100
100	50
50	10
20	10
10	5
5	1

19

CAN/CAN FD
Monitor Module
(Model: 720242)

CAN & LIN Bus
Monitor Module
(Model: 720241)

SENT Monitor
Module
(Model: 720243)

These modules will interpret the vehicle installed communication protocols, monitor the communication data, and display the time series trend waveform. It is connected as a CAN/CAN FD or LIN bus node and can read data frames of each protocol communicating on the bus, or read transmitting signal values on SENT (Single Edge Nibble Transmission) from a sensor to a controller.

By combining them with other input modules, it can simultaneously measure communication data in a vehicle, voltage and temperature, sensor signals and other changes in analog data over time, as well as ECU (Electronic Control Unit) control logic signals. These data can be displayed as waveforms or saved as files. All related data in the system can be interpreted, thus enabling the evaluation of the overall vehicle installed system.

The CAN/CAN FD Monitor Module (720242) is equipped with two CAN/CAN FD input ports, enabling a single module to be connected to two CAN/CAN FD network systems. The CAN & LIN Bus Monitor Module (720241) is equipped with one CAN and one LIN input port, enabling a single module to be connected to a CAN and a LIN protocol network. This module does not support CAN FD. The SENT Monitor Module (720243) is equipped with two input ports, enabling maximum 11 data trend are monitored simultaneously.

For the supported protocol of each modules, see the description of each specifications in this manual.

CAN data monitoring method (example)
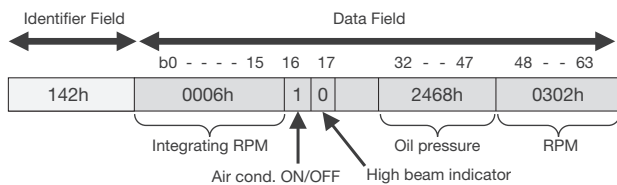

Example of CAN frames and physical data

The following describes the CAN data monitoring method as an example.

With CAN data frames, multiple data (physical data) are carried and received under a single ID. These modules acquire (extract) identifiers for data fields defined as channel settings (for example, "oil pressure" or "RPM"), re-sample the data, and then convert it to time series data.

Data sections can be specified on up to 60 signals per port. That is, a total of up to 120 signals for a single CAN/CAN FD Monitor Module (720242) and that of up to 60 signals for a single CAN & LIN Bus Monitor Module (720241). Both standard (11 bit) and extended (29 bit) message IDs can be specified, and arbitrary locations and bit lengths (up to 32 bits) can also be specified for extraction.

The relationship between sampled data and displayed waveforms is as shown in the figure below (example of CAN).
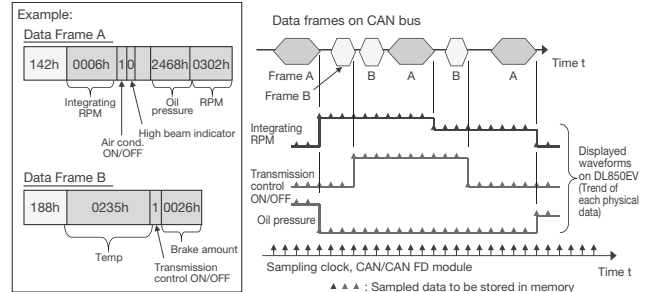
Relationship between sampling data and displayed waveform (s), example

The following shows an example of the monitor screen.

Sampled data (trend waveform data) can be saved to files.
When monitoring LIN bus data using the CAN & LIN Bus Monitor Module (720241) or SENT using 720243 module, the same principle applies.
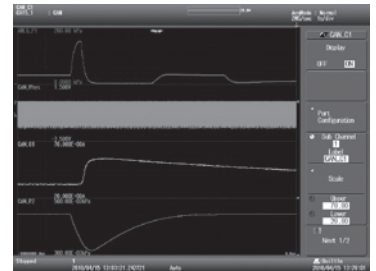

Example monitor screen (DL850EV)

Using vehicle installed network definition files (CAN DBC, LIN LDF)

Data to be monitored (acquired) can not only be specified in digital codes (hexadecimal or numeric), but can also be loaded from each network definition file (CAN DBC or LIN LDF).

CAN DBC: Vector Informatik's CANdb database file (.dbc format)

LIN LDF: LIN Description file, complying with the LIN Configuration Language Specification

Using Yokogawa's free Windows PC software, "Symbol Editor", you can convert these definition files to our proprietary symbol definition file (.sbl format) and import that file to the main unit.
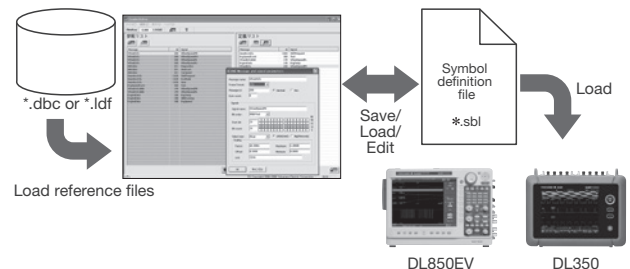
Using a vehicle-installed network definition file

Outputting frame data (only CAN/CAN FD data)

At the CAN/CAN FD port on 720242 and CAN port on 720241, a single specified (defined) data frame or remote frame can be output (manually, at a desired timing).

Plug-in module model numbers

Model	Description
720211	High-speed 100 MS/s 12 Bit Isolation Module
720250	High-speed 10 MS/s 12 Bit Isolation Module
701251	High-speed 1 MS/s 16 Bit Isolation Module
720254	4 CH 1 MS/s 16 Bit Isolation Module
701255	High-speed 10 MS/s 12 Bit non-Isolation Module
720268	High-Voltage 1 MS/s, 16 Bit Isolation Module (with AAF, RMS)
720220	Voltage Input Module (16 CH)
701261	Universal Module
701262	Universal Module (with Anti-Aliasing Filter)
701265	Temperature/High-Precision Voltage Module
720266	Temperature/High-Precision Voltage Isolation Module (Low Noise)
720221	16 CH Temperature/Voltage Input Module
701953-L1	16 CH Scanner Box (provided with 1 m cable)
701953-L3	16 CH Scanner Box (provided with 3 m cable)
701270	Strain Module (NDIS)
701271	Strain Module (DSUB, Shunt-CAL)
701275	Acceleration/Voltage Module (with Anti-Aliasing Filter)
720281	Frequency Module
720230	Logic Input Module
720242	CAN/CAN FD Monitor Module
720241	CAN & LIN Bus Monitor Module
720243	SENT Monitor Module

* Probes are not included with any modules.
* The use of a 720221 module always requires the External Scanner Box (model 701953).
* Firmware update may be required when using these modules.
* Specifications may be changed depending on the main unit.

The High-Speed 100 MS/s, 12-Bit Isolation Module (model: 720211) uses an Internal laser light source.

CLASS 1 LASER PRODUCT
クラス1レーザ製品
1 类激光产品
(IEC/EN60825-1:2007, GB7247.1-2012)

Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No.50, dated June 24, 2007
2-9-32 Nakacho, Musashino-shi, Tokyo 180-8750, Japan

Probes, cables and converters[8]

Model	Product	Description[1]
701947	100:1 Probe (for isolated BNC input)	1000 V (DC+ACpeak) CAT II, 1.5 m
702902	10:1 Probe (for isolated BNC input)	operating temp. range: −40 to 85°C, 2.5 m
700929	10:1 Probe (for isolated BNC input)	1000 V (DC+ACpeak) CAT II, 1.5 m
701901	1:1 Safety BNC adapter lead	1000 Vrms CAT II
701904	1:1 Safety Adapter Lead (in combination with followings)	1000 Vrms CAT II, 600 Vrms CAT III
B9852MM	Pinchers tip (Hook type)	1000 Vrms CAT III black
B9852MN	Pinchers tip (Hook type)	1000 Vrms CAT III red
701954	Large alligator-clip (Dolphin type)	1000 Vrms CAT III, 1 set each of red and black
758929	Alligator clip adaptor set (Rated voltage 1000 V)	1000 Vrms CAT II, 1 set each of red and black
758922	Alligator clip adaptor set (Rated voltage 300 V)	300 Vrms CAT II, 1 set each of red and black
758921	Fork terminal adapter set	1000 Vrms CAT II, 1 set each of red and black
701940	Passive probe[2]	Non-isolated 600 Vpk (701255) (10:1)
366926	1:1 BNC-alligator cable	Non-isolated 42 V or less, 1 m
366961	1:1 Banana-alligator cable	Non-isolated 42 V or less, 1.2 m
701917	Current probe[3, 4]	5 Arms, DC to 50 MHz
701918	Current probe[3, 4]	5 Arms, DC to 120 MHz
701932	Current probe[3, 4]	30 Arms, DC to 100 MHz
701933	Current probe[3, 4]	30 Arms, DC to 50 MHz
701930	Current probe[3, 4]	150 Arms, DC to 10 MHz
701931	Current probe[3, 4]	500 Arms, DC to 2 MHz
720930	Clamp-on probe	AC 50 Arms, 40 Hz to 3.5 kHz
720931	Clamp-on probe	AC 200 Arms, 40 Hz to 3.5 kHz
701934	Probe power supply	Large current output, external probe power supply (4 outputs)
438920	Shunt resistor	250 Ω ±0.1%
438921	Shunt resistor	100 Ω ±0.1%
438922	Shunt resistor	10 Ω ±0.1%
700924	Differential probe	1400 Vpk, 1000 Vrms CAT II
700925	Differential probe	500 Vpk, 350 Vrms (For 701255)
701926	Differential probe	7000 Vpk, 5000 Vrms
701955	Bridge head (NDIS, 120 Ω)	With 5 m cable
701956	Bridge head (NDIS, 350 Ω)	With 5 m cable
701957	Bridge head (DSUB, 120 Ω)	shunt-CAL with 5 m cable
701958	Bridge head (DSUB, 350 Ω)	shunt-CAL with 5 m cable
758924	Safety BNC-banana adapter	500 Vrms CAT II
B9988AE	Printer roll paper	One lot : 10 rolls, 10m each, for DL850E/EV
702911	Logic probe[5]	8 bit, 1 m, non-Isolated, TTL level/Contact Input
702912	Logic probe[5]	8 bit, 3 m, non-Isolated, TTL level/Contact Input
700986	High-speed logic probe[5]	8 bit, non-Isolated, response speed: 1 µs (typ.)
700987	Isolation logic probe[6]	8 bit, each channel isolated
758917	Measurement lead set	0.75 m, Stackable type (2 per set) Alligator-Clip is required separately.
758933	Measurement lead set	1000 V/19 A/1 m length Alligator-Clip is required separately.
701902	Safety BNC-BNC cable (1 m)	1000 Vrms CAT II (BNC-BNC)
701903	Safety BNC-BNC cable (2 m)	1000 Vrms CAT II (BNC-BNC)
701948	Plug-on clip	For 700929 and 701947
701906	Long test clip	For 700924, 701901 and 701926
A1800JD	Terminal	For 720220 input terminal, one (1) piece
705926	Connecting cables	Connecting cable for 701953 (1 m)
705927	Connecting cables	Connecting cable for 701953 (3 m)

*1: Actual allowable voltage is the lower of the voltages specified for the main unit and cable.
*2: 30 Vrms is safe when using the 701940 with an isolated type BNC input.
*3: Either the probe power option of the main unit or the probe power supply (701934) is required.
*4: The number of current probes that can be powered from the main unit's probe power option is limited.
*5: Includes one each of the B9879PX and B9879KX connection leads.
*6: Additionally, 758917 and either the 758922 or 758929 are required for measurement.
*7: Alligator clip is required.
*8: Refer to the bulletin, user's manul of each products to confirm compatibility of each accessory and main unit.

This is a Class A instrument based on Emission standards EN61326-1 and EN55011, and is designed for an industrial environment.
Operation of this equipment in a residential area may cause radio interference, in which case users will be responsible for any interference which they cause.

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Yokogawa's Approach to Preserving the Global Environment
- Yokogawa's electrical products are developed and produced in facilities that have received ISO14001 approval.
- In order to protect the global environment, Yokogawa's electrical products are designed in accordance with Yokogawa's Environmentally Friendly Product Design Guidelines and Product Design Assessment Criteria.

NOTICE
● Before operating the product, read the user's manual thoroughly for proper and safe operation.