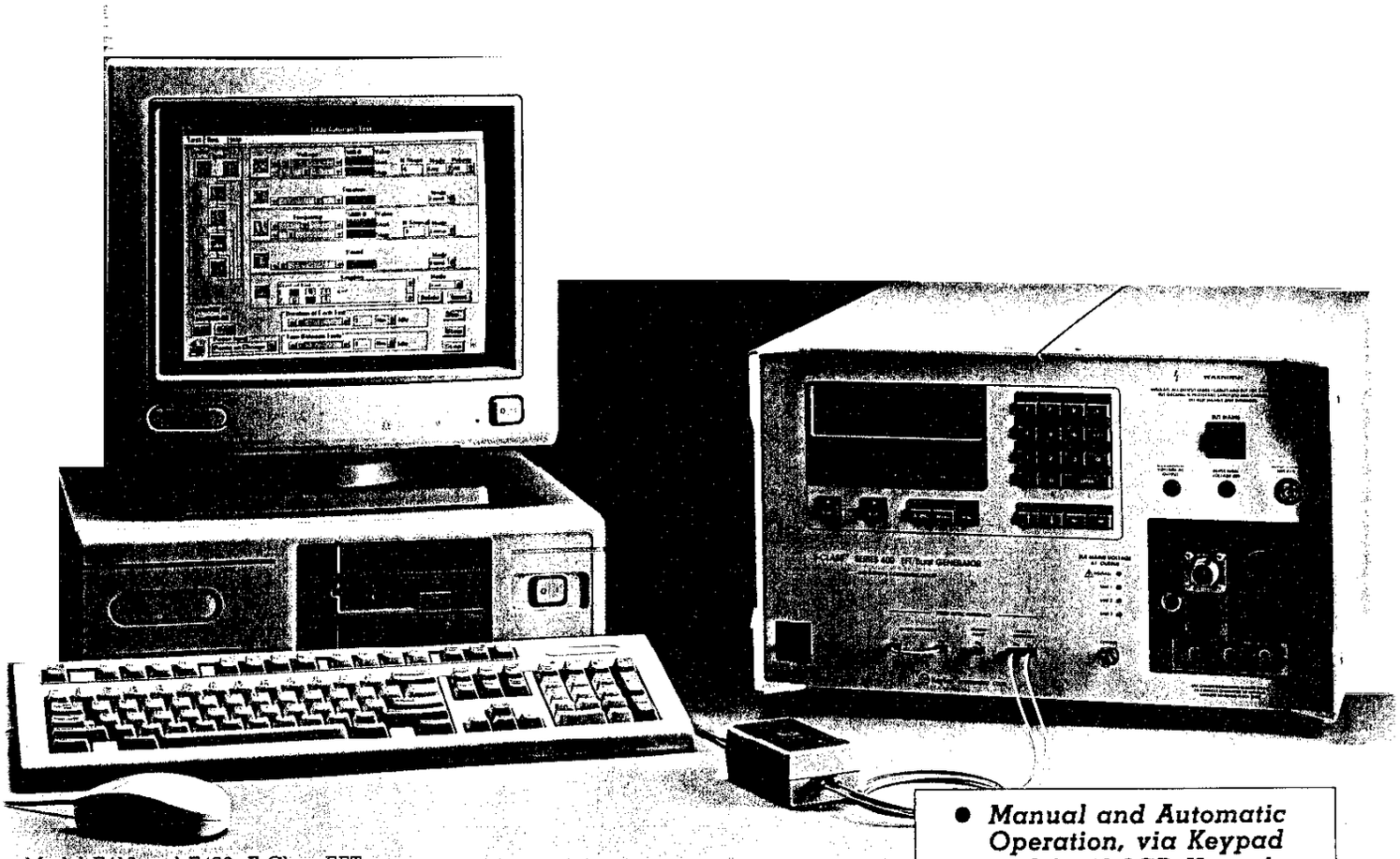
All New — E-Class Pulsed EMI Simulators!

E-CLASS™ SERIES 400 EFT/BURST SIMULATORS

MLLP: $24,000. STAND-ALONE SYSTEM



Model E410 and E420, E-Class EFT simulators generate *correct-duration* test pulses, with peaks to 8 kV (Model E420) for limit testing and for remote termination.

- *Manual and Automatic Operation, via Keypad and 8 x 40 LCD Virtual Front Panel™*
- *Computer Control, via Windows 3 Based Application Package and Fiber-Optic Link*

KeyTek®

SPECIFICATIONS

E-Class Simulators Cover EFT/Burst			
EFT/Burst SIMULATED FOR EQUIPMENT LOCATED ON	**EQUIPMENT REQUIRED**	**VOLTAGE AND CURRENT RANGES**	**STANDARDS MET OR EXCEEDED**
I. Power Lines	Model E410	To 4 kV, with Z_0†† = 50Ω	IEC 1000-4-4 (IEC 801-4)
	Model E420	To 8 kV, with Z_0 = 50Ω	ANSI/IEEE C62.41†
II. I/O (data and signal) Lines	Model E410 with Clamp CCL-801 or CCL-801/S	To 4 kV, with Z_0 = 50Ω	IEC 1000-4-4 (IEC 801-4)
	Model E420 with Clamp CCL-801 or CCL-801/s	To 8 kV, with Z_0 = 50Ω	

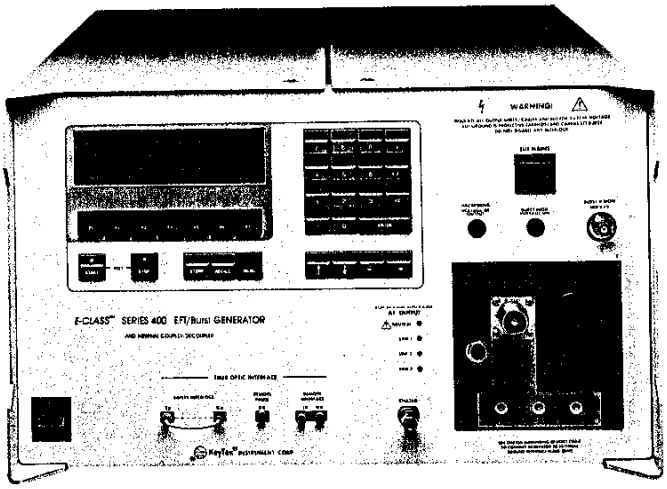
† "ANSI/IEEE C62.41" refers to the 1991 revision. It was originally IEEE Std 587.
†† Z_0 is simulator source impedance.

PARAMETERS	DOMINANT TEST STANDARDS * means same as previous column		TEST EQUIPMENT PERFORMANCE * means same as previous column	
	IEC 1000-4-4 (IEC 801-4)	**ANSI/IEEE C62.41 (revised)**	***Model E410***	***Model E420***
Wave	Unidirectional Impulse	*	*	*
Character	5 ns/50 ns	*	*	*
Individual or Burst	Burst	*	*	*
Amplitude	±0.25 to ±4 kV	*	±0.25 to ±4.4 kV	±0.25 to ±8kV
Output Z_0	50 ohms	*	*	*
Wave Repetition Frequency	5 kHz to 2 kV 2.5 kHz to 4 kV	* *	Selectable, to 5 kHz to 2.2 kV; 2.5 kHz to 4.4 KV	Selectable, to 10 kHz to 4.4 kV; 2.5 kHz to 8 kV
Random	Not required	*	Included	*
Chirp	Not required	*	Included	*
Burst Duration	15 ms	*	1 ms to 20 ms	*
Burst Repetition Period	0.3 s	*	0.3s to 5s	*
Synch with Power Line	Not required	*	Included	*
Adjustable Line Phasing	Not required	*	Included	*
Coupler/Decoupler	Required	*	Internal	*
Capacitor Clamp	Required	Not required	Models CCL-801 and CCL-801/S Optional	*
Fiber-optic RS-232 Control	Not required	*	Included	*
488-Bus Control	Not required	*	Optional	*

* *Means same as previous column.*

Specifications subject to change without notice.

NEW E-Class EFT simulators make testing for fast-transient noise immunity accurate, safe, and easier than ever before with Manual, Automatic and Computer Control capabilities.



Exclusive Series 400 Features

The features listed below represent operating capabilities that are unique to KeyTek Series 400 systems, specifically including the Model E410 and E420 EFT/Burst Simulators. They take EFT testing to an entirely new level of operating ease, accuracy and safety.

- Three levels of test control provide total operating flexibility — *Manual and Automatic* via built-in microprocessor, keypad and LCD display; *plus* operation via external *Computer.*
- *Built-in, typical default test programs* available for instant use.
- *Take-Charge™* option permits program changes, single-stepping and manual tests during an automatic run.
- *Virtual Front Panel™* retains key operating parameters on-screen during both setup and test.
- KeyTek *BurstWare™* computer applications software, a turn-key, Windows-based package, offers unprecedented ease of use with external computers.
- *Multi-level interlock architecture* for maximum safety.

Full control of pulse frequency within each burst and of burst repetition rate timing provides Total Test Capability.

Model E410 and E420 simulators furnish the following selections for pulse frequency within each burst:

- constant,
- chirp, (i.e., varies during the burst), or
- random.

The Models E410 and E420 provide variable-duration bursts, at a repetition rate that is selectably:

- random versus the power mains, or
- synched with the mains.

KeyTek's E-Class EFT simulators can be provided to supply peak pulse voltages to 8 kV.

The Model E420 EFT simulator is designed to furnish peak voltages to 8 kV, twice the IEC 801-4 standard's maximum level.

Because of its 8 kV capability, the Model E420 is fitted to perform not just production-related testing, but also engineering and QA limit testing. At issue is the importance of knowing not just whether a product design can withstand a given level of power mains or I/O line transients, but also knowing what additional margin it has for continuing to perform properly in spite of incident EFT.

Designers and Quality Assurance personnel need to know that there is in fact enough margin. They can then be comfortable that ordinary manufacturing variations won't degrade a product's EFT immunity enough to cause later batches to fail a retest, or still worse, to fail in actual service. *The E420 lets you determine margin.*

8 kV peak capability means that even when terminated in 50 ohms, the Model E420 can still supply 4 kV.

The E420's 8 kV output not only facilitates limit testing, it also provides the capability for delivery of undistorted waves to locations remote from the simulator's output.

Single-phase power mains EFT coupler AND optional three-phase coupler — available in the same instrument.

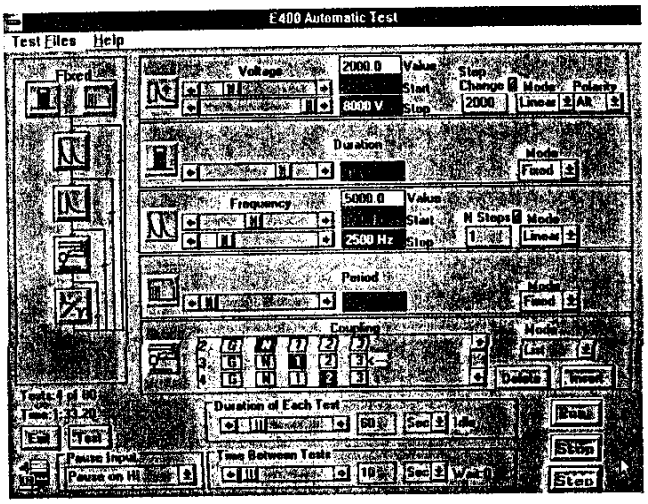
No need for an auxiliary package for three-phase work; just order or retrofit the three-phase capability into the same versatile unit.

Optional Interface for Remote Sensors and Controls

The optional capability is available for interfacing any KeyTek E-Class EFT/Burst simulator to remote sensors and controls, for monitoring various aspects of the test program including various safety-related issues.

This optional capability provides for maximizing the usefulness of automatic testing when EUT failure can in fact be user-detected. Using the optional interface for inputting such information, the failure and test conditions may be recorded, failure statistics can be assembled, and the test may or may not be stopped as appropriate.

Example of an automatic EFT test run using a typical, user-defined automatic PC test screen, running as part of KeyTek's Windows 3 based BurstWare.



The icon array at the left defines the test sequence. Icons (and therefore the test sequence) are interchangeable just by picking one up via the mouse, and dropping it onto another's location. Starting from the bottom the first change during a test sequence is polarity, the next is coupling mode, then voltage amplitude and finally frequency. The two parameters that are fixed in this example, burst duration and burst period, are shown at the top.

The uppermost slidebar along with its associated icon and other selections show linear (as opposed to log or doubling) voltage selection, in 2 kV steps from 2 to 8 kV with alternating polarity. (The value at the point reached in the run is still the initial 2 kV.) The second slidebar shows a duration fixed at 15 mS. The third shows frequency selected via the IEC 801-4 method, i.e. 5 kHz to 2 kV, 2.5 kHz above 2 kV. The fourth slidebar shows fixed selection of burst period at the IEC 801-4 standard's value of 300 mS.

Additional selections include coupling mode, which has reached the third mode selection, line 1 to GRP (Ground Reference Plane) *in the three-phase, four-wire example* displayed. When there are more than three selections, the modes scroll within the overall coupling mode selection box.

Still further selections include test duration, time between test and various pause alternatives, while administrative annunciations include real time, present test number and so on.

EFT means Electrical Fast Transients, — and it comes in bursts.

EFT is a burst or series of bursts of very-fast-risetime voltage (electrical noise) pulses. It is often associated with the opening of a switch. The resulting so-called showering arc phenomenon has finally been tied down with a realistic yet repeatable test by the IEC 801-4 (1988) standard, and by ANSI/IEEE C62.41-1991 which follows it.

The EC Directive makes EFT immunity mandatory because it is crucial to equipment performance.

EFT occurs whenever switching is carried out on the ac power mains. Sources range from simple light switches to the relays used to operate heavy loads like compressors, oil burners, machine tools and other power and industrial equipment.

EFT can cause equipment malfunction and damage. It reaches equipment primarily via cables, both ac mains and I/O (data, signal and control). It reaches the cables by both conduction and radiation.

There is only one way to determine whether the equipment you are shipping is really immune to normal, high-frequency EMI threats to its input/output cables . . . *subject it to appropriate, properly-executed EFT tests.*

KeyTek simulators generate EFT pulse bursts with the correct exponential waveforms and with the correct test pulse durations.

The IEC 801-4 EFT test standard calls for a test pulse with a 5 ns risetime and exponential decay of 50-ns duration, when measured with a 50-ohm termination across the simulator's output.

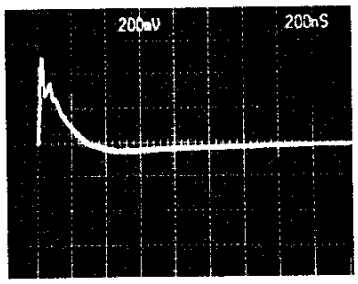


Figure 1a. An exponential-decay simulator test pulse on an actual AC power line, that satisfactorily approximates the calibration wave specified by the standards, and provides a suitable, repeatable EFT test.

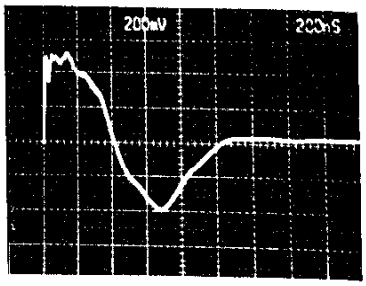


Figure 2a. The extremely long, almost sinusoidal test pulse (which can severely overtest a device or instrument) produced by another simulator whose calibration pulse, nevertheless, conforms reasonably to the standards.

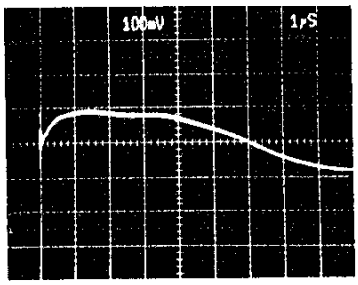


Figure 1b.

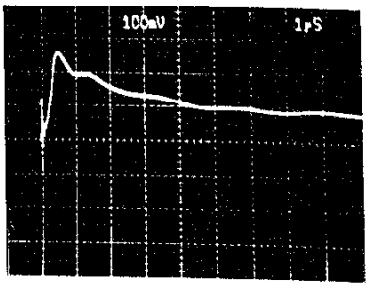


Figure 2b.

Outputs from a typical equipment RF power line input filter, tested with simulators producing the output waves of Figures 1a and 2a. The ratio of peak voltages passed on into the EUT is about 3:1 for Figure 2b vs Figure 1b.

Unfortunately, a poorly-designed simulator can meet this calibration requirement, but still supply excessive pulse energies when used to test an EUT. In actual test applications, waveforms of 200 to 400 ns duration, almost sinusoidal in shape, can be produced by such simulators at the output of their coupler/decouplers.

When driven by such waves, a typical ac-mains RFI filter may transmit pulse peaks into the EUT that are *3x higher* than with 50-ns, exponential EFT test pulses.

This is serious overtesting . . . and can falsely indicate the need for a much higher level of EFT immunity than is really required. *Result:* Significant potential expenses, not only in re-engineering cost and delay, but also in the manufacturing cost of every unit produced.

KeyTek's Model E410 and E420 EFT simulators, unlike some others, tell you exactly what you need to know. They comply fully with IEC 801-4 pulse shape requirements during calibration. *AND* . . . they also meet essentially the *same* duration specification when driving real-world loads — which include typical EUTs.

Test sequences can include programmatic changes of all generator functions including peak output voltage, polarity, pulse frequency, burst length, burst duration, power line coupling mode, and so on.

For example, test sequences can include automatic advance in peak voltage after a specific duration of sequential or interleaved positive and negative bursts. As another example, the voltage step is fully programmable — as the same step after each burst group or in different steps after each burst group, as a function of the most recent test voltage or based on a stored or operator-determined program.

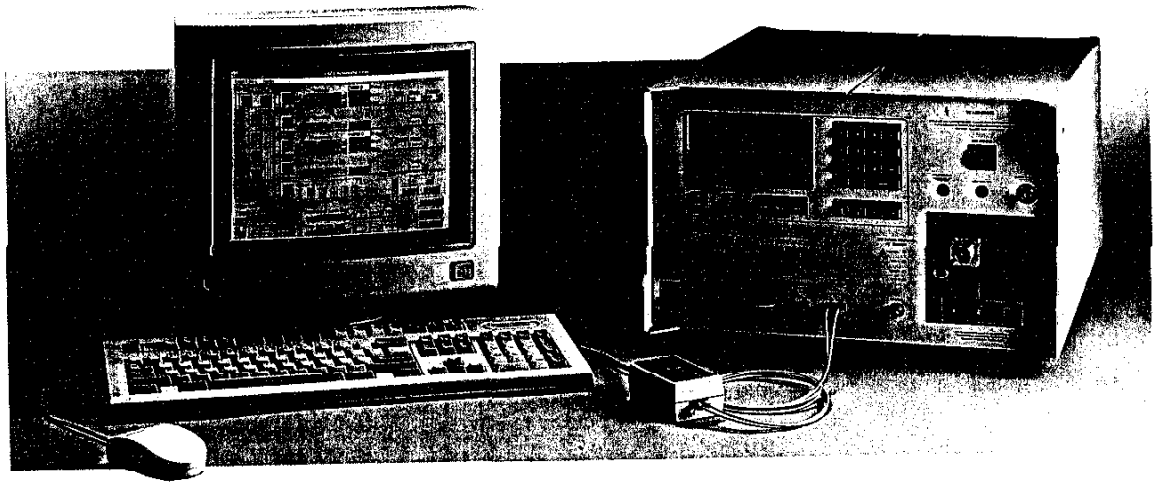
In addition to default test sequences supplied with E-Class EFT/B simulators, both modified and altogether new test sequences may be stored and recalled for future use.

- **Computer-Controlled,** using a turn-key, Windows 3 based applications software package included with each E-Class simulator, operating on any IBM-compatible PC.

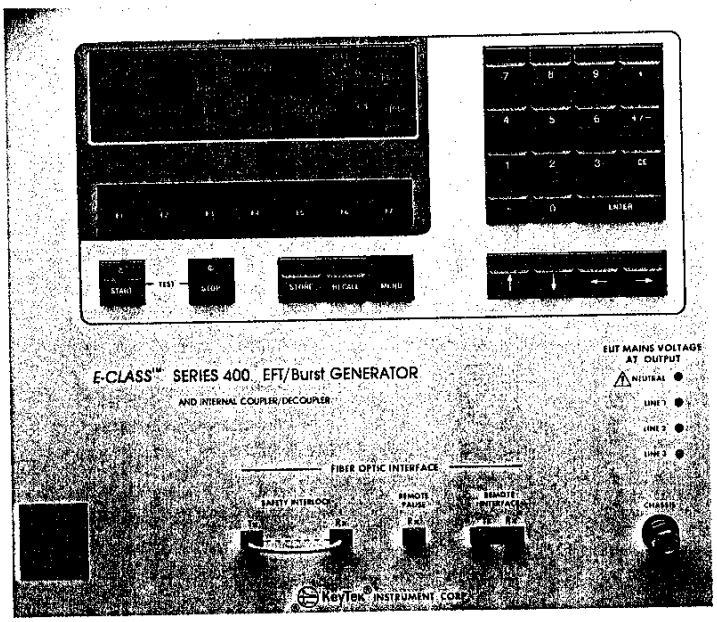
  For both manual and automatic operation via remote computer, control is accomplished via an RS-232 fiber-optic link, with an isolated 488-bus as an available option. The fiber-optic link is specifically designed to minimize the influence of nearby operators on EFT/B test results, a potential known issue with burst testing. The use of fiber optics also fully meets the requirements of screen-room and safety-enclosure usage. *Note:* remote operation via fiber-optic link is particularly convenient for EFT/B testing, in view of the IEC 801-4 standard's requirement that the EFT simulator's coupler/decoupler be situated on a floor-mounted ground plane.

The KeyTek turn-key BurstWare™ EFT/B computer applications program is based on Windows 3, for maximum ease of use. Computer control is provided for all EFT simulator functions. Once again, the operator may use the built-in default programs, may modify them, or may set wholly new automatic test sequences. All meter, indicator and interlock conditions are annunciated by the computer, to ensure proper operation of the computer/simulator combination as an *integrated* Test System.

Printed reports at various levels of detail are routinely available.



Windows™ is a trademark of Microsoft Corporation.



VIRTUAL FRONT PANEL LCD SCREEN OPERATION

Any parameter may be changed while leaving all others resident on the 8 x 40 character LCD screen, simply by using a cursor to identify the one being altered and then entering its new value. This can even be done during a run via the Take-Charge mode, i.e. while pausing in the middle of the run. (The STOP key is used to pause, the START key to restart from the point at which the run was paused. To totally stop the test in order to restart from the beginning, the STOP key is pressed twice.)

When the run is either started or re-started, the word STANDBY changes to RUNNING and actual % run completion is continually updated and displayed as the run progresses.

A run may be paused at any time, a manual test screen entered, and one or more tests may be run manually, independent of the in-process automatic program. The automatic run may then be re-started where it left off.

Additional built-in capabilities not shown in the example include both KeyTek default screen and user screen IDs for ready test program retrieval, and continuous display of total run time and remaining run time in both STANDBY and RUN modes.

Fiber-Optic Interface and Mains Voltage Warning Lights

Under the screen, note the inputs and outputs of the fiber-optic interface; beside it are individual warning lights for mains voltage at each output of the optional, built-in three-phase power mains coupler/decoupler, including Neutral — to warn of a facility miswire. (A built-in single-phase mains coupler/decoupler is standard with every E400 series EFT/B simulator.)

Example of an IEC 801-4 Screen Including All Lower Test Levels

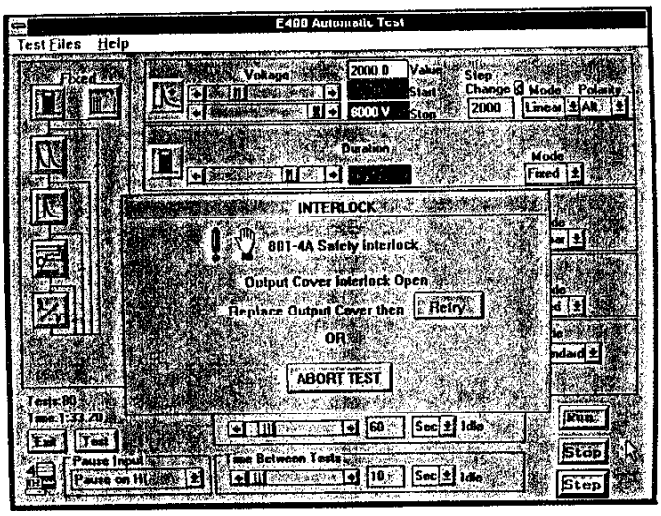
A number of built-in default screens are included with the basic E400 series software, including several for testing the power mains input on a three-phase EUT to the requirements of IEC 801-4.

In the 4 kV (with all lower level) screen shown, peak pulse voltage will be incremented from the standard's lowest level of ±500V through its intermediate levels of ±1 kV and ±2 kV, to its highest level of ±4 kV. Alternately, other built-in default programs permit testing at just each single level.

To maximize information about product vulnerability, however, some users prefer to progressively test at all of the standard's levels lying below the one the EUT is required to pass, 4 kV in the example. When this is the case, it is usual to remain at each voltage level while testing with all other parameter changes before proceeding to the next level.

As shown, burst frequencies have been selected as the standard's 5 kHz to 2 kV and 2.5 kHz to 4 kV. Burst duration and period will be the standard's values of 15 mS and 300 mS, respectively, and tests will be done in all five of the standard's possible coupling modes: to ground, neutral, and lines 1, 2 and 3.

Testing has been selected for the IEC 801-4 minimum of one minute at each combination of parameters, and the EFT is turned off between each of these one-minute tests for an interval selected to be ten seconds.



Multi-Level Interlock Architecture

Two basic levels of interlock operation are identified by every E-Class simulator, each appropriate to the level of interlock or remote sensor that causes the interlock action:

1. *Pause the test.* This is a typical response to the opening of the interlock on the door of a safety chamber or cage.
2. *Stop operation, and shut down power to the EUT.* This is an appropriate response to opening a safety cover on the generator itself. It can also be appropriate for an unusual mains current into the EUT (sensed via an optional remote sensor).

Various levels of alarm including an indication on the LED display and an audible tone are available as required.

All KeyTek EFT/B simulators provide interlock capability for the auxiliary, capacitance-coupling clamp used for EFT testing I/O cables.

Coupling clamps *require* a 1 m x 20-30 cm area of exposed metal to be elevated to the full 4 kV peak output from an IEC 801-4 EFT simulator. KeyTek not only provides a cover for its clamps, we provide interlock circuitry within our EFT simulators to accept a cover-interlock-OK signal from the clamp.

All KeyTek EFT/B simulators are fully interlocked, not just for the burst, but also for the ac mains.

It's important that when any interlock opens, the EUT mains power supplied by the EFT simulator must be shut off. It's even more important that when EFT simulator power is turned off, EUT power from the simulator must *also* be shut down. *All KeyTek EFT simulators perform both of these crucial safety functions.*

Computer, Printer, Other Computer Equipment

The computer and any related equipment are normally user-supplied, to KeyTek specifications; but KeyTek can procure and furnish them with the EFT/Burst test system if desired.

Physical, both Model E410 and Model E420

Size: 17⅛"w x 11¼"h x 22¾"d
43.5 cm w x 28.6 cm h x 58 cm d

Weight: 55 lbs (25 kg)

Power: 95-250V, 50-60 Hz, 150w

Auxiliary Equipment

Model CCL-801 Capacitor Clamp

A *safety-covered, fully-interlocked* capacitor clamp, the Model CCL-801 is optionally available for coupling the EFT/Burst into I/O lines (including data and signal lines). *All metal parts are nickel plated and all clamp hinges use nickel-plated, beryllium copper fingerstock,* to insure excellent continuing RF performance over time.

Model CCL-801/S Capacitor Clamp

Same as CCL-801, but for use in more protected environments. Parts not nickel plated, and no nickel-plated beryllium copper finger stock on hinges.

Specifications subject to change without notice.