



General System Specifications

Parameter	Description
Network Voltage	210V through 690V Other voltages available upon request.
Operational Frequency	45-55Hz for 50Hz Network 55-65Hz for 60Hz Network
Switching	<u>Transient free operation:</u> <ul style="list-style-type: none">• Electronic switching element designed to switch power capacitor groups into the network without switching transients.• Connection to the network is performed during capacitors current zero-crossings, providing smooth connection and disconnection of the capacitor groups.
Capacitor group configurations	<u>Number of groups:</u> Up to 12 groups per one controller. <u>Switching Sequence:</u> <ul style="list-style-type: none">• 1:1:1:1 (all equal)• 1:2:2:2 (half group)• 1:2:4:4 (quarter, half groups)
Acquisition time	<u>A. Equalizer</u> <u>Full compensation within one network cycle:</u> <ul style="list-style-type: none">• 5-20ms for 50Hz network• 4-16ms for 60Hz network <u>B. Activar</u> <u>Full compensation within 3-4 Seconds</u>

Parameter	Description
Control Mode	<p><u>Main CT Location options:</u></p> <ul style="list-style-type: none"> • Load only (open loop) • Load + Capacitors (close loop) <p><u>Network configuration:</u></p> <ul style="list-style-type: none"> • Single phase • Three phases WYE/DELTA balanced • Three phases WYE/DELTA unbalanced <p><u>Capacitor configuration options:</u></p> <ul style="list-style-type: none"> • Delta • Unbalance/Single Phase - Line to Neutral • Single Phase - Line to Line <p><u>Power Factor Control Options:</u></p> <ul style="list-style-type: none"> • Open loop or close loop • Single phase Line-Neutral • Single Phase Line-Line • Three phase average • Load sharing between two or more compensation system • Full support for unbalanced DELTA networks <p><u>Power Factor Range:</u></p> <ul style="list-style-type: none"> • Set between 0.75 Inductive to 0.7 Capacitive • Power flow direction: Four-quadrant power flow direction support
Operational Mode	<ul style="list-style-type: none"> • Manual • Automatic • Test <p><u>Scan option:</u> Can be used in Manual or Automatic modes. This option provides uniform occupation of the capacitor groups, which is carried out by transient free exchange between engaged and not engaged capacitor groups every few seconds in FIFO rotating sequence (first in First out). Prevents overloading and overheating of the capacitors and inductors.</p>

Parameter	Description
Troubleshooting	<ul style="list-style-type: none"> • Self explained, automatic capacitor group self test procedure • Blown fuse error • Shorted SCR error • Over temperature alarm • Parallel resonance detection mechanism The system identifies the resonance frequency (5th, 7th etc.) and disables the connection of the Capacitors groups as soon as resonance occurs. • Phase sequence error detection • Frequency margins error detection • Spikes detection • Automatic recording of all troubleshooting related events including time (year, month, day, hour, minute, second, cycle number), up to 16,000 events, stored in FIFO configurations • Voltage free contact (N.O./N.C.) alarm relay
Display	<p><u>Structure:</u></p> <ul style="list-style-type: none"> • Graphic, high contrast FSTN LCD • 4.7", Black/White • Long life LED backlight • Antiglare coated polycarbonate window <p><u>Functions:</u></p> <ul style="list-style-type: none"> • Menu driven operation • Self explained windows • User friendly • Easy installation using wizard <p><u>Display Modes:</u></p> <ul style="list-style-type: none"> • Large Digit Screen – displays 9 numerical values • Waveform Screen – displays wave shape together with wave form detailed information • Harmonics Screen – displays complete harmonic spectrum, including each harmonic details (amplitude, percentage and phase shift).

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Built in Power Quality measurement system	<p><u>Simultaneous measurement of the following sections:</u></p> <ul style="list-style-type: none"> • Mains (total of load and capacitor) • Load • Capacitor (system) • Combination of Mains, Load and Capacitors. <p>For example, if reactive energy parameter is selected, the user can see the kVAR consumption by the Load, the connected kVAR by the Capacitor System and the result on the Mains.</p> <p><u>Calculation Method</u></p> <ul style="list-style-type: none"> • True RMS measurements (up to 63rd harmonics) • Based on FFT algorithm which is carried out cycle by cycle (128 samples per cycle) <p><u>Measured Parameters:</u></p> <table border="0"> <tr> <td>• Frequency</td> <td>Common</td> </tr> <tr> <td>• Phase Current</td> <td>N, L1, L2, L3</td> </tr> <tr> <td>• Phase to phase Current*</td> <td>L1-2, L2-3, L3-1</td> </tr> <tr> <td>• Phase Voltage</td> <td>N, L1, L2, L3</td> </tr> <tr> <td>• Phase to Phase Voltage</td> <td>L1-2, L2-3, L3-1</td> </tr> <tr> <td>• Active Power (kW)</td> <td>L1, L2, L3, Total</td> </tr> <tr> <td>• Reactive Power (kVAR)</td> <td>L1, L2, L3, Total</td> </tr> <tr> <td>• Apparent Power (kVA)</td> <td>L1, L2, L3, Total</td> </tr> <tr> <td>• Power Factor</td> <td>L1, L2, L3, Total</td> </tr> </table> <p>*<u>Note:</u> Unique feature: internal current of feeder transformer(delta secondary)</p> <p><u>THD, Harmonic Spectrum, and Waveform Analysis for:</u></p> <table border="0"> <tr> <td>• 3 line current of Mains</td> <td>DELTA, WYE</td> </tr> <tr> <td>• 3 line-line current of Mains</td> <td>DELTA</td> </tr> <tr> <td>• 3 line current of Load</td> <td>DELTA, WYE</td> </tr> <tr> <td>• 3 line-line current of Load</td> <td>DELTA</td> </tr> <tr> <td>• 3 line current of Capacitors</td> <td>DELTA, WYE</td> </tr> <tr> <td>• 3 Phase to Neutral voltage</td> <td>DELTA, WYE</td> </tr> <tr> <td>• 3 line Phase to Phase voltages</td> <td>WYE</td> </tr> <tr> <td>• Neutral current</td> <td>WYE</td> </tr> <tr> <td>• Neutral voltage</td> <td>WYE</td> </tr> </table> <p><u>Energy:</u></p> <ul style="list-style-type: none"> • Active Energy (kWh) • Reactive Energy (kVARh) • Stores energy every 15 minutes for two month backwards 	• Frequency	Common	• Phase Current	N, L1, L2, L3	• Phase to phase Current*	L1-2, L2-3, L3-1	• Phase Voltage	N, L1, L2, L3	• Phase to Phase Voltage	L1-2, L2-3, L3-1	• Active Power (kW)	L1, L2, L3, Total	• Reactive Power (kVAR)	L1, L2, L3, Total	• Apparent Power (kVA)	L1, L2, L3, Total	• Power Factor	L1, L2, L3, Total	• 3 line current of Mains	DELTA, WYE	• 3 line-line current of Mains	DELTA	• 3 line current of Load	DELTA, WYE	• 3 line-line current of Load	DELTA	• 3 line current of Capacitors	DELTA, WYE	• 3 Phase to Neutral voltage	DELTA, WYE	• 3 line Phase to Phase voltages	WYE	• Neutral current	WYE	• Neutral voltage	WYE
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Communication	<ul style="list-style-type: none">• Isolated RS485• Up to 115k Baud Rate• Protocols options: ELCOM-(Elspec High-Speed communication protocol) ModBus/RTU (IEEE 754 Floating Point)• Full remote control
PC Software	<p><u>PowerIQ Software:</u></p> <ul style="list-style-type: none">• Provides complete System Remote Control• Real Time measurements• Time-Of-Use and Cost Allocation• Harmonic & Waveform graphic and tabular display• Comprehensive Data Logging, including triggers and set points• Automatic comparing to international Power Quality standards, such as IEEE 519 (Harmonics standard)• Easy Report Generation• Exporting to word processor (such as Microsoft Word) and spreadsheets (such as Microsoft Excel)• User Friendly on-line help, toolbars and hints• Internet and Intranet operation• Stand-alone or network versions, allowing intra-net and internet connectivity
Software Upgrading methods	<ul style="list-style-type: none">• No Jumpers or switches• Firmware can be upgraded by communication• All parameters are software selectable, and stored in onboard Flash memory• Easy, user-friendly firmware upgrade process• Optional features can be enabled just by communication
Controller Specifications	<p><u>Power supply:</u> 115/230V, 50/60Hz</p> <p><u>LCD Display:</u></p> <ul style="list-style-type: none">• Size: 94x76mm• Resolution: Graphic 160x128 pixels• Type: FSTN, LED backlight <p><u>Frequency:</u> 30 to 70 Hz</p> <p><u>Power consumption:</u> 10VA</p>

Operating temperature:

-20 to +55°C

Communications:

RS-485 communication port

Protocol:

ELCOM (Elspec's protocol), Modbus/RTU

Alarm:

Voltage free N.O. / N.C., relay, max 250 VAC / 2A

Protection class:

IP 40

Dimensions:

144x144x138mm

Weight:

1.4 kg

Storage temperature:

-25 to +70°C

Sensors:

- Three 5A current sensors for Mains/Load currents
- Two 5A current sensors for Capacitor current
- Four voltage sensors (up to 500V phase to ground)

Keys:

Five soft touch button

Controller Box Standard:

- Electromagnetic compatibility:
EN50081-2, EN50082-2, EN55011,
EN61000-4-2/3/4/5, ENV50204, ENV50141.
- Safety standards: EN61010-1, EN50439-1

Switching Module

Electronic switches:

- Rated voltage: 2400V/Peack
- Rated Current: 200Amp

Cooling:

- Temperature controlled, forced air cooling system.

Panel mounted

- Easy for Maintenance
- External air circulation (air does not pass through the cabinet)
- Long life, Ball bearings fan

Low losses:

- 400V: 0.35% (3.5W/kVAr)
- 480V: 0.3% (3W/kVAr)

REACTORS

Iron Core Reactors Options:

Tuned reactor 5th, 7th or both.
Detuned reactor 7% and 14%

Maximum Increase in temperature (ΔT):

60°C above ambient.

Core:

Electrical steel laminations

Fixing Parts:

Cold Rolled steel.

Windings:

Enamelled Copper wire, temperature class H/180°C.
(E101843M).

Insulation material- Winding/core:

Glass fiber polyester profile
Temp. class H/180°C (Tested UL-94 V-0).

Insulation Voltage:

6000V.

Varnish :

Sterling Cover 2 (002-1010) polyester varnish.
Temp. class H/180°C.(E75165, E123536).

Terminals:

Flat copper connection.

Tolerance:

- 0 /+2%.

Impregnation:

Oven Impregnation

CAPACITORS

Dry Low loss, self healing, MKP-type

Voltage Range: 690V

Rated Frequency:
50/60Hz.

Capacitance Tolerance:
-5 / +10%.

Case:
Aluminum.

Fixing Stud:
M12 x 16mm.

Dielectric:
Polypropylene Film.

Impregnant:
Dry Polyurethanic Resin/non PCB/non Toxic/Non polluting.

Safety Device:
Over-pressure switch.

Temperature Range:
-25°C / +55 °C.

Storage Temperature:
-40°C / +85 °C.

Individual Test Voltages:

- Between Terminals: 2.15 x Un for 2 seconds.
- Between Terminals & Case:
3kV for 10 seconds For Un < 660V
6kV for 10 seconds For Un > 660V

Losses:
0.3 watts per kVAr under working conditions.

Overloads:

- Maximum permissible Voltage:
+10% for 8 hours in 24.
+15% for 30 minutes / day.
+20% for 5 minutes / 200 times.
+30% for 1 minute / 200 times.

Maximum over-current:
1.3 X In.



	<p><u>Maximum permissible Switching Current:</u> 100 X In max.</p> <p><u>Insulation:</u> 3kV for Un < 660V. 6kV for Un > 660V</p> <p><u>Discharge time:</u> 50 volts after 1 minute.</p> <p><u>Standards:</u> EN60831 / 1 / 2</p>
Cabinet	<p><u>Design:</u> Sheet steel cabinet</p> <p><u>Finish:</u> Epoxy powder coated, inside/out in gray (RAL 7032)</p> <p><u>Enclosure:</u> IP 20</p> <p><u>Maximum ambient temperature:</u> 40°C</p>
System 's Standards	<p><u>Electromagnetic compatibility:</u> EN50081-2, EN50082-2, EN55011, EN61000-4-2/3/4/5, ENV50204, ENV50141.</p> <p><u>Safety standards:</u> EN61010-1, EN50439-1</p>

Acquisition time – definition

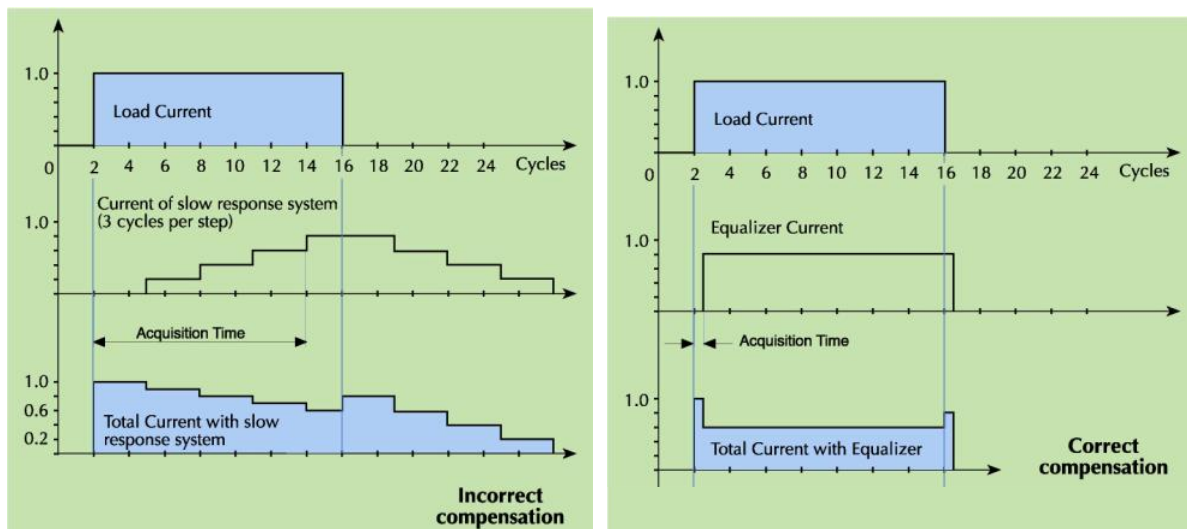
The Equalizer is a fast response system that is used to compensate any variation in reactive power within one cycle of the network.

Correct compensation using the Equalizer:

The top graph demonstrates how the Equalizer compensates the reactive current of the loads with a duration of 14 cycles. Typical acquisition time (full compensation of reactive current) is less than one cycle and the total current is substantially reduced.

Adverse effects of slower response systems:

The bottom graph demonstrates incorrect compensation where the response time is 3 cycles for the connection of a single group and the acquisition time required to connect a total of 4 groups is 12 cycles. Due to the delay in compensation the current is partially reduced and due to the corresponding delay in disconnection of the capacitor groups there is residual current. The total effect of the compensation system on the current is negative since the average current of the load is increased instead of being reduced. This increases voltage flickering due to overcompensation.



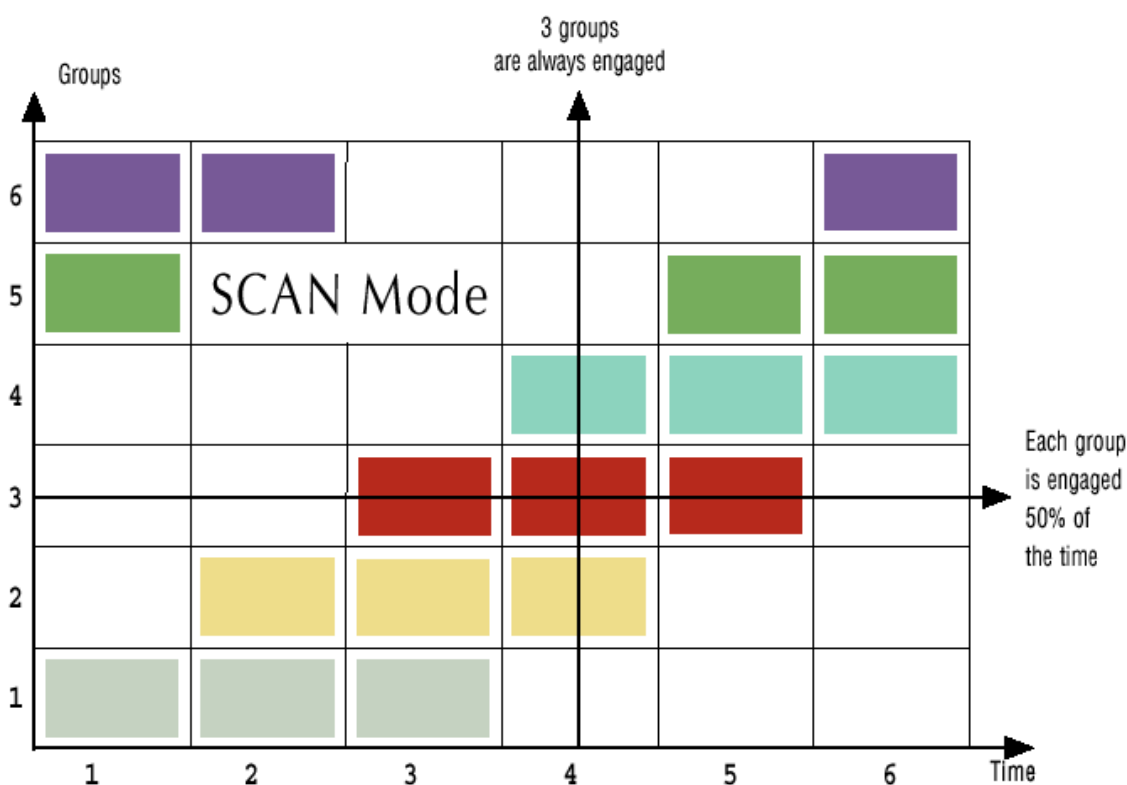
Scan Mode – definition

In scan mode the Equalizer/Activar systems provide uniform engagement to all capacitor groups.

When there is a certain demand for capacitor groups the system provides uniform occupation to all groups. Each group is connected and disconnected. The connection of one group occurs simultaneously with the disconnection of another group. This operation is performed every few seconds and engages all capacitor groups intern, resulting in a reduction of mean current due to the lower ratio of engagement time to cycle time (duty cycle).

The scan feature reduces the average current in the capacitors and the reactors and therefore providing the following advantages:

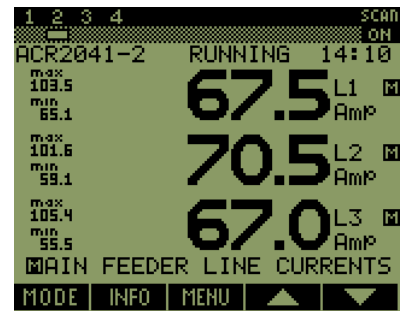
1. Reduces substantially the increase of temperature in these elements resulting in longer life expectancy of the inductors and capacitors.
2. Reduces the effect of over-current and over-voltage caused by the harmonics on the capacitors and inductors.
3. The tuning frequency of the de-tuned filter or tuned filter is stable due to the fact that the capacitor value (μF) doesn't change due to the low temperature achieved by the scan mode.



LCD Display

Numeric Screen

Permits simultaneous display of 9 parameters: 3 measured values plus 3 minimum and 3 maximum. Parameters can be mixed, such as average voltage, current and power factor. This unique feature allows of the foremost parameters analysis at a glance, without touching the unit. The readings are on the network (including the system), the load (without the system) and the system itself.



Harmonics Screen

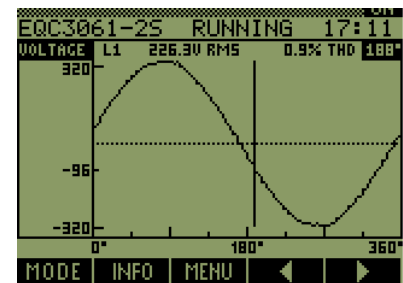
The graphic display enables inspection of the harmonics pollution at a glance. The display includes detailed information for each harmonic: type, phase, number of the harmonic, the value in amperes/ volts and in percent, the angle and the frequency. The readings are on the network (including the system), the load (without the system) and the system itself.



Waveform Screen

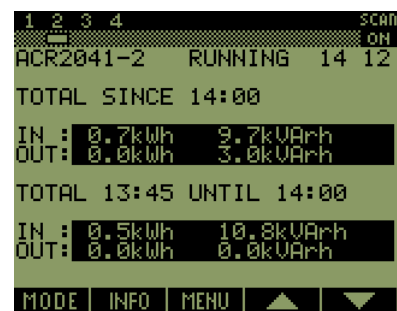
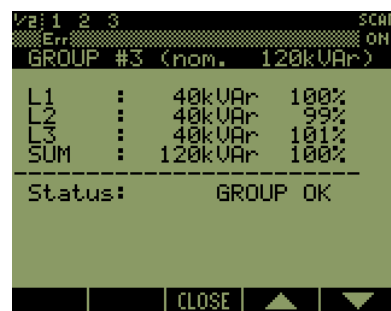
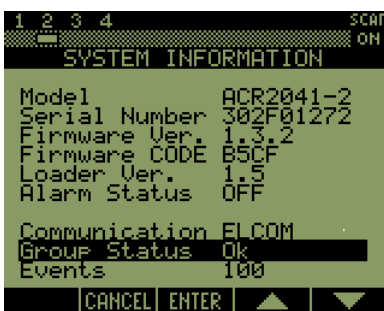
This large graphic display allows easy monitoring of transients of 130/156μS (at 60/50 Hz). The display includes detailed information for each wave: the type and phase, THD, RMS, peak & bottom values value at cursor position.

The readings are on the network (including the system), the load (without the system) and the system itself.

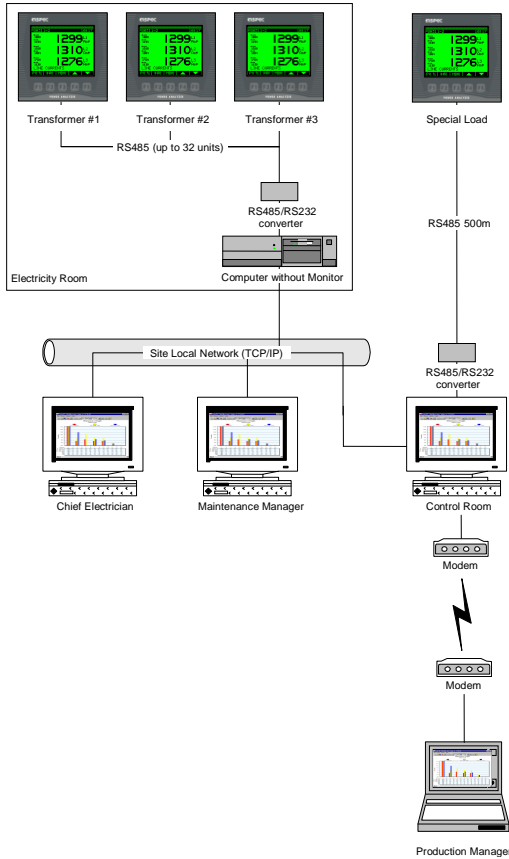


Text Screen

Comprise menus, system information, energy and events.

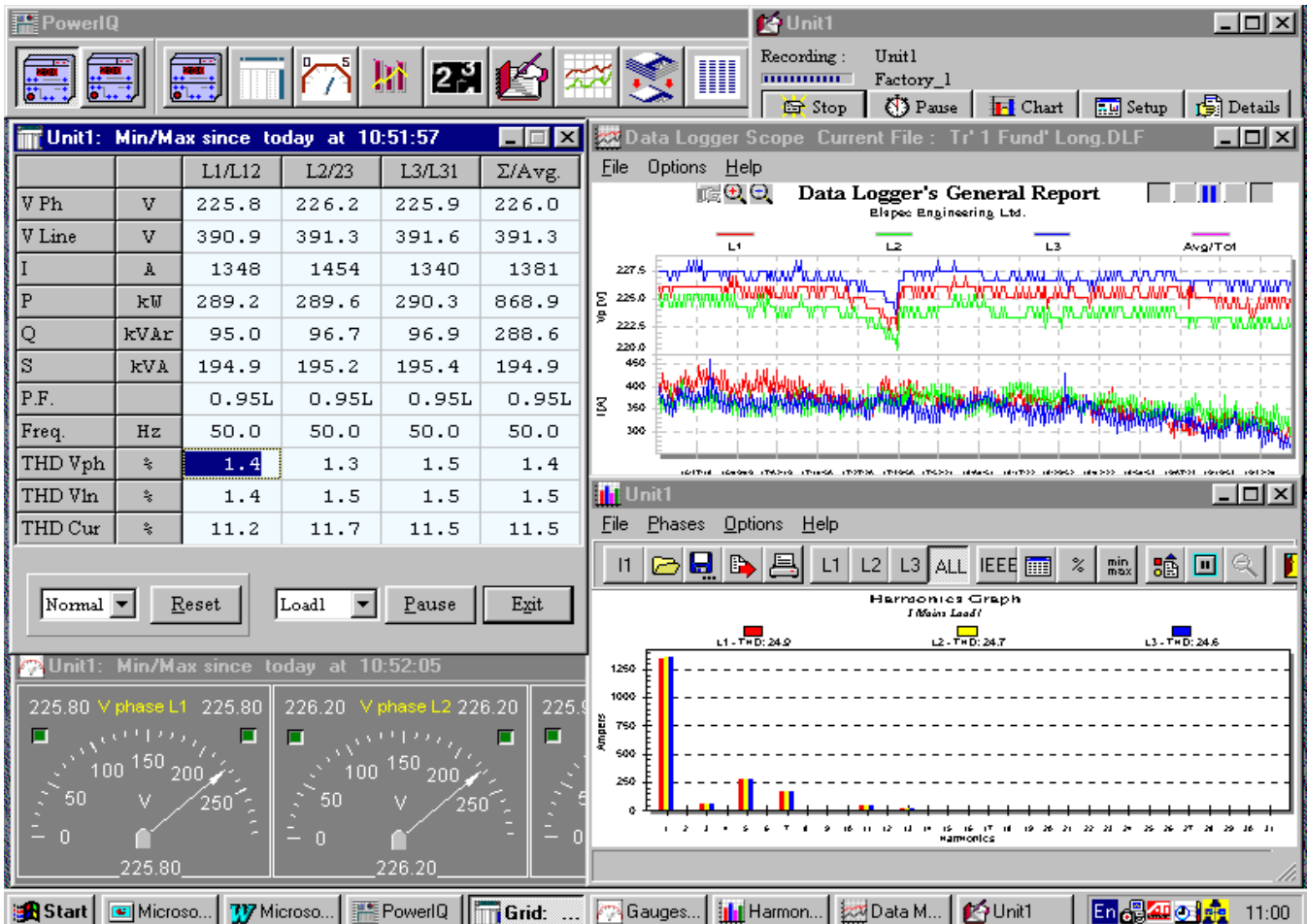
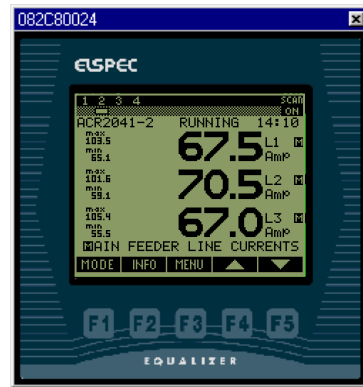


PowerIQ Software

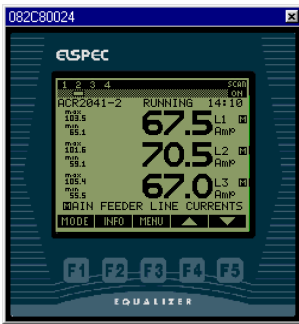


General

This easy-to-use software displays the system's status, as well as the measurement results on numerous screens running under Windows (95, 98, me, NT and 2000). PowerIQ integrates all Elspec systems, allowing power quality analysis, cost allocation, circuit optimization, demand & power factor monitoring. PowerIQ includes real-time measurements, as well as comprehensive data logging and power quality analysis features. All screens allow customization, printing and exporting of data. The network version enables complete and Internet operation, as well intra-net as modem access.

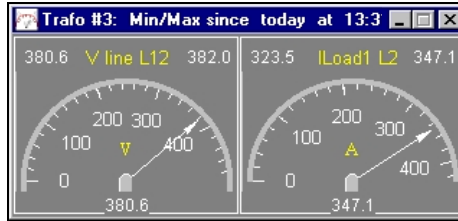


Remote Control



Real-Time Measurements

Provides clearly visible real time values and minimum and maximum readings.



Trafo #3: Min/Max since today at 13:30:30					
		L1/L12	L2/23	L3/L31	Σ/Avg.
V Ph	V	220.6	221.1	219.7	220.5
V Line	V	382.5	382.0	380.6	381.7
I	A	325.2	323.5	288.1	312.3
P	kW	69.6	69.9	62.9	202.4
Q	kVAr	15.8	7.4	1.5	24.7
S	kVA	71.7	71.5	63.3	206.5
P.F.		0.98L	0.99L	1.00L	0.99L
Freq.	Hz	50.0	50.0	50.0	50.0
THD Vph	%	1.3	1.5	1.5	1.4
THD Vln	%	1.1	1.0	1.0	1.0
THD Cur	%	8.9	19.6	14.7	14.4

Normal Reset Load1 Pause Exit

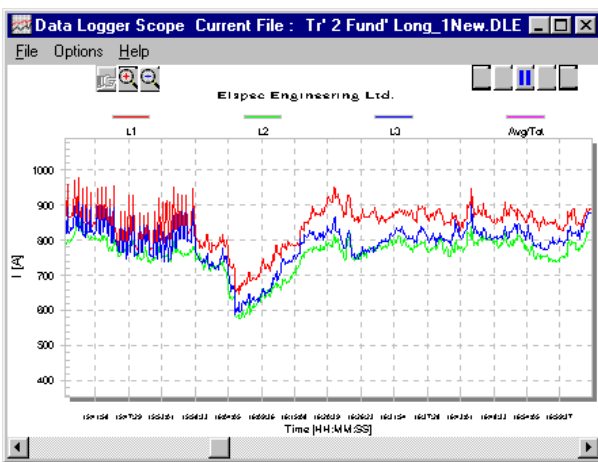
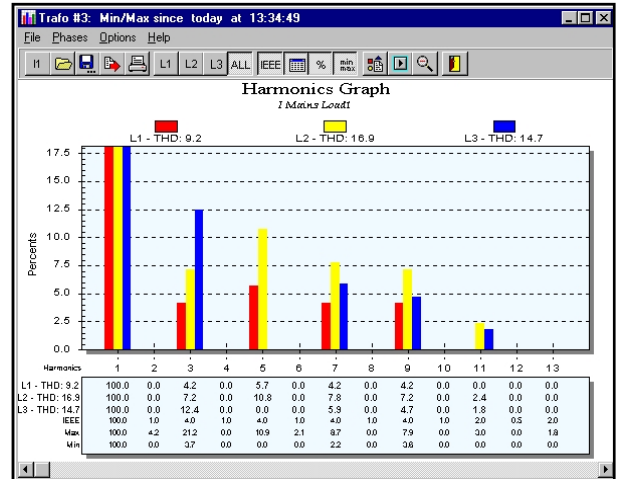
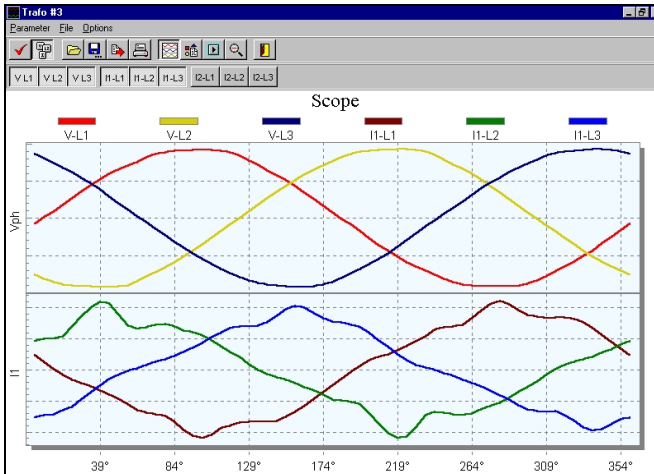
Harmonics Analysis

Displays the harmonics spectrum, both as a graph and as a table, in addition to harmonics analysis parameters (THD, K-Factor and Crest-Factor).

Compliance monitoring of international power quality standards, such as IEEE-519, allows easy network analysis.

Scope

Displays waves and their phase shifting, and enables detection of existing or potential power quality problems.

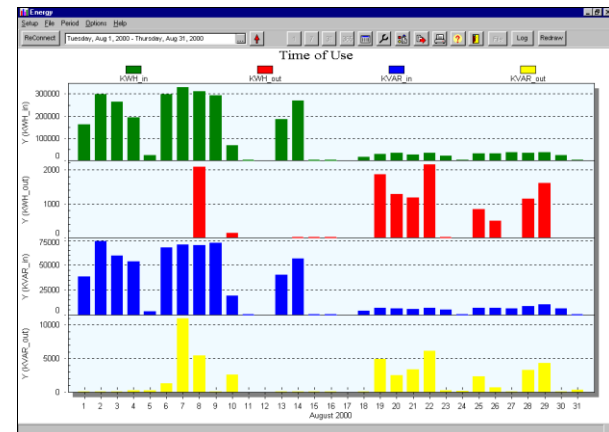


Data Logging

Enables comprehensive network analysis, by logging over 2000 parameters per record. It can be set to record data either on pre-defined intervals (from 1 cycle to 99 hours) or according to network events. The recording volume and time is limited only by the size of the computer's hard disk.

Data Monitoring

Displays the recorded data in either on-line, or off-line mode. The on-line mode displays the data while simultaneously recording it for maximum power analysis control.



Report Generator

Creates user-defined or preset reports (such as load profile and power quality) reports. The reports are easily defined using a word processor (such as Microsoft Word).

Time-of-Use (TOU)

Displays the Time-of-Use information stored in the analyzer, in addition to calculation of energy costs, according to virtually any utility tariff structure.

Events

The event screen is used for retrieving, monitoring and analyzing the events information from the analyzer.