## SECTION 2: HARDWARE DESCRIPTION

### 2-1 General

The purpose of this section is to familiarize the reader with IQ Analyzer hardware, its nomenclature, and to list the unit's specifications. The information presented is divided into the following four parts:

- Operator Panel
- Rear Access Area
- External Hardware
- Specification Summary

### 2-2 Operator Panel

The operator panel, which is normally accessible from the outside of a panel or door, provides a means for:

- Being alerted to specific conditions
- Receiving functional help
- Programming
- Parameter Monitoring/Selection

LEDs, a display window, and pushbuttons make up the front accessible operator panel (Figure **2-1**).

Except for the Normal LED, which blinks green, LEDs are red and can be blinking or lit continuously, depending upon their specific function. For detailed information on individual LEDs refer to Paragraph 3-2.

The display window is used to display all IQ Analyzer metered parameters, setpoints and messages in a number of different formats. The information is presented in the form of display screens for a variety of categories. The LED backlit LCD display is approximately 1.5 by 3.0 inches and is able to display up to eight lines of information at a time.

*1* Status LEDs
*2* Reset Pushbutton
*3* Display Window
*4* Previous Level Pushbutton
*5* Function Pushbuttons
*6* Home Pushbutton
*7* Display Information LEDs
*8* Up and Down Pushbuttons
*9* Program Pushbuttons
*10* Help Pushbutton

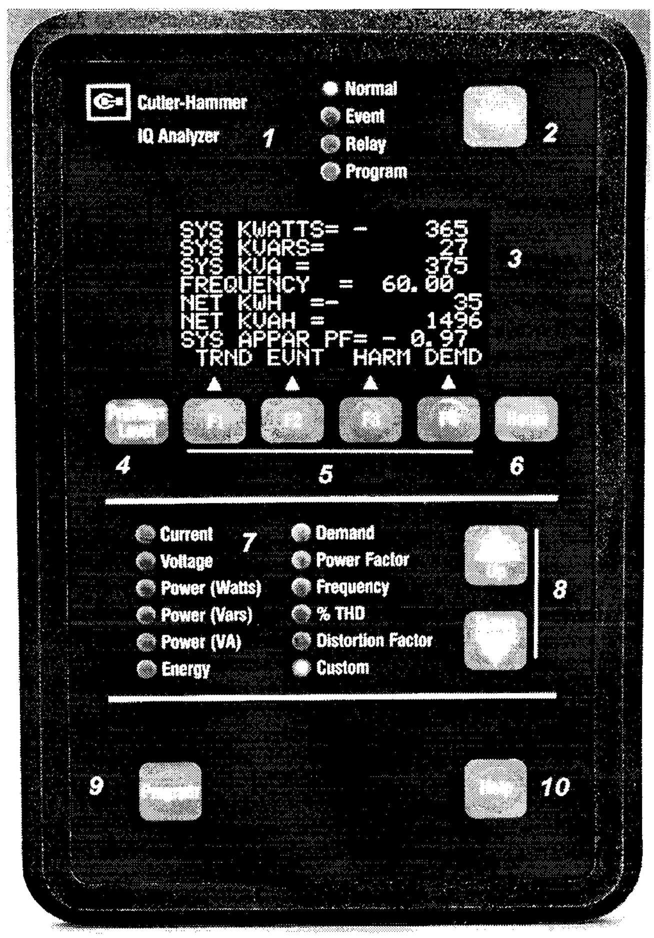


*Figure 2-1. IQ Analyzer Operator Panel*

For information that is frequently accessed, four custom screens will cycle through 28 Meter Menu parameters of the user’s choosing (5 seconds/screen). For details concerning the kind of information and the types of screens that can be viewed in the display window refer to Paragraph 3-3.

The front operator panel supports eleven long-life membrane pushbuttons. Pushbuttons accomplish their function when pressed and released. Certain pushbuttons will, however, continue to scroll if they are pressed and not released. Refer to Paragraph 3-4 for information concerning the function of specific pushbuttons.

## 2-3 Rear Access Area

The rear access area of the IQ Analyzer is normally accessible from the rear of an open panel door (Figure **2-2**).

All wiring connections to the IQ Analyzer are made at the rear of the chassis. For the sake of uniform identification, the frame of reference when discussing the rear access area is facing the back of the IQ Analyzer with the panel door open. The power module port, for example, is located on the upper left rear of the IQ Analyzer. The communication module port is located on the lower right rear of the unit. Detailed information relative to any connection made to the rear access area is presented in Section 4 entitled “Installation, Startup and Testing.”

### 2-3.1 Back of Chassis

The back of the chassis provides terminal blocks for 3-phase ac line connections and connections for the three required external current transformers plus neutral and ground (Figure **4-7** and **4-8**). The ac line connections are identified on the terminal block “Phases A, B, C and Neutral.” The current transformer connections are identified “Phases A, B, C, Neutral and Ground.”

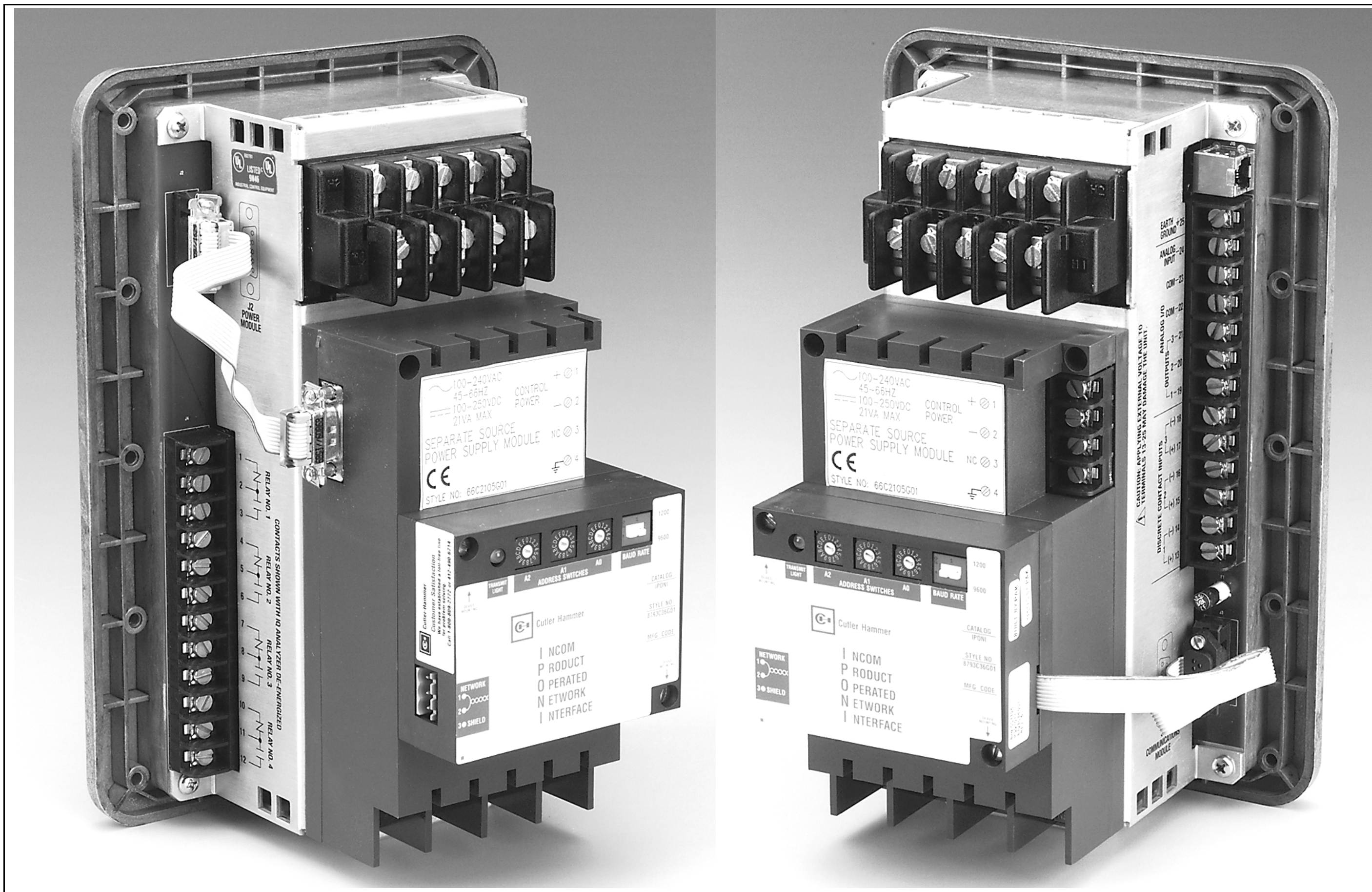


*Figure 2-2. IQ Analyzer (Rear Views). See Figures 4-7 and 4-8 for detailed identifications.*

In addition, the rear of the chassis, through the use of two stacking screws, provides a means for mounting the standard 3-phase self-powered power module, 100-240V separate source power module, or 24-48Vdc source power module. (Figures **2-3** and **2-4**). An optional communication module (IPONI - INCOM Product Operated Network Interface) is mounted to the power module using the same stacking screws (Figure **2-5**). When a power module is remotely mounted, the IPONI mounts directly to the back of the chassis. Alternatively, Ethernet comminications is available through the same port via an EPONI (Ethernet PONI).

### 2-3.2 Left Rear of Chassis

The left rear of the chassis provides a port that will accept the D-sub female connector of either the self-powered or separate source power module (Figure **2-2**). Four sets of Form C Relay Output Contacts are also provided for control relay connections.


*Figure 2-3. Separate Source Power Module (Shown Mounted)*

### 2-3.3 Right Rear of Chassis

**CAUTION**

**ANALOG I/O IS NOT ISOLATED. EQUIPMENT DAMAGE COULD RESULT IF EXTERNAL VOLTAGE IS APPLIED TO TERMINALS 19-25. WIRE GROUND TERMINALS 22-23 BEFORE THE 3 ANALOG OUTPUT TERMINALS, 19-21.**

**NOTICE**

**THE IQ ANALYZER CASE MUST BE GROUNDED FOR PROPER MEASUREMENT. CONNECT A GROUNDING WIRE TO EITHER THE POWER MODULE OR ANALYZER GROUND TERMINAL. FAILURE TO GROUND THE CASE RESULTS IN INCORRECT AND UNSTABLE VOLTAGE AND CURRENT READINGS.**


*Figure 2-4. Self-Powered Three-Phase Power Module (Unmounted)*

The right rear of the chassis provides a port that will accept the D-sub male connector of the optional Communication Module (IPONI, EPONI, or EPONIF) (Figure 2-2).

Three sets of dry contacts for discrete remote inputs are provided. An open contact registers as INACTIVE in the display while a closed contact registers as ACTIVE. Just above the discrete input contacts are Analog I/O terminals.

Output terminals #19-21 are programmable. Terminals #22-23 are ground and internally connected to the chassis ground terminal #25. In the wiring of analog outputs, be sure to connect the ground and load before connecting to terminals #19-#21.

Terminal #24 is the analog input and can sense 0-20 mA from a transducer

## 2-4 External Hardware

External hardware is defined as any required potential transformers, current transformers, power supply module or communication module. Power supply modules and communication modules are defined as external devices, even though they are usually directly mounted on the back of the IQ Analyzer.

### 2-4.1 Current Transformers

Each IQ Analyzer requires that at least two external current transformers be wired into the CT input terminal block (Paragraph 2-3.1, Figures **4-7** and **4-8**). Inputs are 5 amperes nominal or up to 40 amperes continuous. Current transformers are supplied by the user and should be selected for appropriate accuracy.

### 2-4.2 Potential Transformers

Potential transformers are required when the line voltage is above 600 volts line-to-line. They are wired directly to the ac line connection terminals (Figures **4-7** and **4-8**). Potential transformers are also the user’s responsibility. Refer to potential transformers in the Glossary before programming, even if potential transformers are not used in the system.

### 2-4.3 Power Supply Modules

**WARNING**

**NEVER WORK WITH POWER SUPPLY MODULES WHEN AC LINE POWER IS APPLIED TO THE IQ ANALYZER. PERSONAL INJURY OR DEATH COULD RESULT.**

A standard 3-phase power module, separate source power module, or dc source power module is shipped from the factory mounted to the back of the IQ Analyzer.

Two stacking screws secure the power module in position (Figure **2-3**). Power modules can be detached and mounted remotely up to 36 inches from the IQ Analyzer through the use of an optional extension cable (IQACABLE). This may be required if local codes prohibit ac power devices from being located on a panel door. Power modules utilize a D-sub female connector to plug into a power port located on the left rear side of the chassis (Figure **2-2**). The cable also unplugs from the power module to permit the installation of an extension cable.

Each 3-phase power module is supplied with 3 line fuses internal to the power module (Figure **2-6**). The fuses are accessed by removing the screws holding the cover in place. Fuse replacement should only be done with all voltages removed from the IQ Analyzer.

Terminals, located on the lower rear portion of each power module, provide sensing inputs for the 3-phase voltage being monitored. The inputs are identified from left to right as A, B, C and NEU (Figures **4-7** and **4-8**). On up to 600 volt systems, direct input can be applied. For systems greater than 600 volts, potential transformers are required.

The separate source power module is supplied with a power input terminal block located in the upper right portion of the power module (Figure 2-3). Standard 3-phase (self-powered) power modules do not require this terminal block input.

### 2-4.4 Optional Communication Module

The IQ Analyzer is a PowerNet compatible device. PowerNet can remotely monitor, upload waveforms, control, and program the IQ Analyzer.

Communications is made possible by attaching a communications module (IPONI, EPONI, or EPONIF). Since the IQ Analyzer is always supplied with a communications port, any PONI (Product Operated Network Interface) can be easily retrofitted at any time. The PONI modules **may be connected to or disconnected** from the IQ Analyzer under power **without risk of damage** to either product.

### 2-4.4.1 IPONI

The IPONI (INCOM Product Operated Network Interface) is a small, addressable communication module that attaches to the back of the IQ Analyzer (Figure 2-5). The Communication Module can be mounted directly to the back of the IQ Analyzer or to a Power Module already mounted on the IQ Analyzer. Addresses and BAUD Rates are established on the IPONI itself. Refer to the instruction details supplied with the IPONI for details.

### 2-4.4.2 EPONI and EPONIF

The EPONI is an Ethernet Product Operated Network interface that attaches directly to the back of the IQ Analyzer. The power module can then be mounted to the PONI or mounted remotely (36 inches away). The EPONIF is an Ethernet PONI with a 10Base-FL (fiber optic) interface. Refer to the instruction details supplied with the EPONI or EPONIF for details.

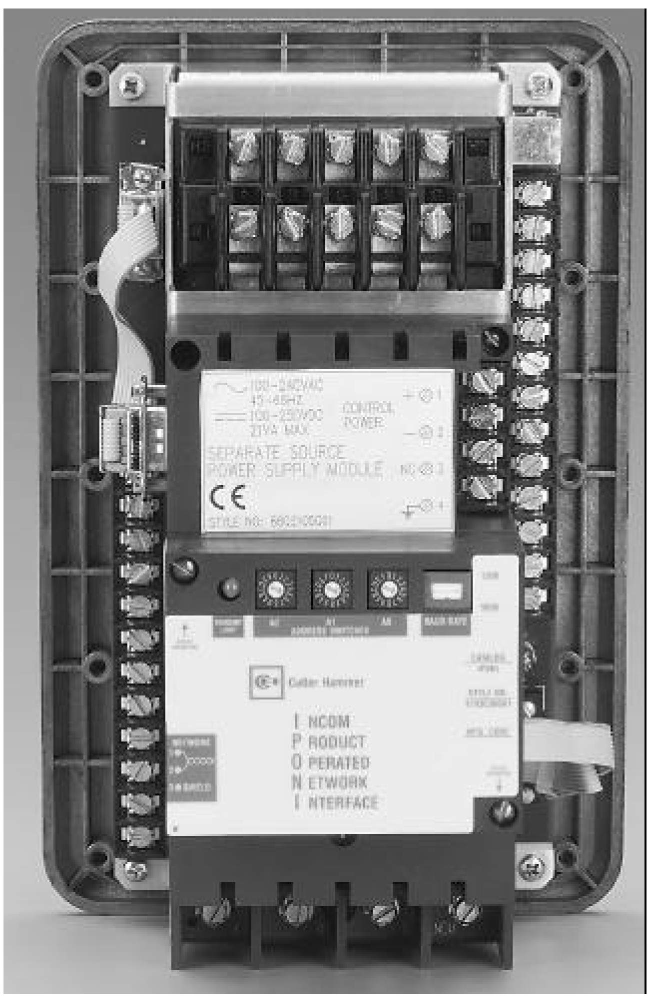


*Figure 2-5. Communications Module – IPONI – (Mounted)*

### 2-4.4.3 PowerNet Software Suite

Regardless of the type of PONI chosen, PowerNet offers a two-tied communication system that is based on an Ethernet backbone and an INCOM frequency carrier signal running through equipment rooms. The Ethernet backbone follows standard Ethernet wiring rules, allowing a mix of CAT5 cable and Fiber networks. The INCOM signal may extend up to 10,000 feet and connect 200 devices through a NetLink to the Ethernet backbone.

The PowerNet Software Suite provides the ability to monitor and record power distribution system data as it occurs. PowerNet is a Microsoft™ Windows95/98/NT compatible application that features user-friendly, menu-driven screens.

### 2-4.4.4 PowerNet Graphics

PowerNet Graphics software provides the capability to generate custom animated color graphics. For example, animated one-line drawings of electrical power distribution systems, flow diagrams of processes, equipment elevation views, and other graphical representations can be developed.

### 2-4.4.5 Connectivity

A computer running the PowerNet Software Suite can interface with other networks. Example of connectivity interfaces include:

- PLCs (Programmable Logic Controllers)
- DCSs (Distributed control Systems)
- BMSs (Building Management Systems)
- PC-based graphical operator interface programs

## 2-5 Specification Summary

The IQ Analyzer is intended for indoor use only, and meets the specifications in Table **2.1**.

*Table 2-1 IQ Analyzer Specifications and Details Summary (continued on next page)*

| | | | |
|---|---|---|---|
| **IQ ANALYZER Dimensions:** | | | |
| Overall Depth: | 4.7 inches (12 cm) | | |
| Overall Height: | 10.25 inches (26 cm) | | |
| Overall Width: | 6.72 inches (17 cm) | | |
| **IQ ANALYZER weight:** | 6 pounds (2.7 kg) | | |
| **Terminals:** | | | |
| Wire Size: | # 12 - 22 AWG | | |
| Screw Size: | # 6-32 | | |
| Torque: | 8 - 10 in-lbs | | |
| **Certification;** | | | |
| ISO: | Manufactured in an ISO9001 certified facility | | |
| UL/cUL: | Listed UL-508, File E62791, NKCR Auxiliary Devices (with IQM3PPM)<br>Listed UL-3111, File E185559, Metering (with IQMSSPM, IQMDCPM) | | |
| NEMA: | 3R and 12 (with supplied gasket) | | |
| FCC: | Part 15, Class A | | |
| CISPR-11: | Class A | | |
| CE: | Units marked with CE comply with IEC1010-1 (1990) incl. Amend 1 & 2 (1995)<br>EN61010-1 (1993), CSA C22.2 #1010.1 (1992) and EN50082-2 (1994) | | |
| Measurement Canada: | Electricity Meter, Approval # AE-0782 | | |
| **Current Inputs (Each Channel):** | | | |
| Conversion: | True rms, 32 sample/cycle (all samples used in all rms calculations) | | |
| CT Input: | 5 Amp secondary (any integer 5:5 to 10,000:5) | | |
| Burden: | 0.05 VA | | |
| Overload Withstand: | 40 Amps ac continuous, 300 Amps ac 1 second | | |
| Range: | 8 x CT Continuous | | |
| Accuracy: | 0.1% of CT primary rating, 0.2% of reading above 150% of rating, sinusoidal<br>(see accuracy below for non-sinusoidal specifications) | | |
| Input Impedance: | 0.002 ohm | | |
| Wiring: | 14 AWG (larger wire requires appropriate terminals) | | |
| **Voltage Inputs (Each Channel):** | | | |
| Conversion: | True rms, 32 samples/cycle (all samples used in all rms calculations) | | |
| PT Input: | Direct or any integer 120:120 to 500,000:120 | | |
| Range: | 30 to 635 (separate source only) Vac | | |
| Nominal Full Scale Voltage: | 120 - 600 Vac (120 - 440 Vac IQA6020/IQA6220) | | |
| Burden: | 21 VA (self-powered only) | | |
| Overload Withstand: | 635 Vac continuous, 700 Vac 1 second | | |
| Input Impedance: | 1 megohm | | |
| Wiring: | 12 AWG to 22 AWG ② | | |
| Transient Overvoltage: | Category-III | | |
| **Control Power Input (Separate Source and Self Powered):** | | | |
| | **3-Phase Powered** ①<br>**(IQM3PPM)** | **Separate Source**<br>**(IQMSSPM)** | **DC Source**<br>**(IQMDCPM)** |
| Input Range: | 100-220 Vac +/- 10%<br>100-600 Vac +/- 10% | 24-48 Vdc +/- 20%<br>45 - 66 Hz<br>110 - 250 Vdc +/- 10% | N.A. |
| Burden: | 20 VA | 20 VA | 20 VA |
| Wiring: | 12 AWG to 22 AWG ② | 12 AWG to 22 AWG ② | 12 AWG to 22 AWG ② |
| Transient Overvoltage: | Category-III | Category-II | Category-I |

① When directly wired to 480 Vac, IQ Analyzer can ride through a continuous sag that is 20% of rated voltage.
② Wire insulation must support line-to-line voltage per local codes.

*Table 2-1 IQ Analyzer Specifications and Details Summary (continued on next page)*

**Frequency Range:** 20 - 66Hz fundamental (up to 50th harmonic)

**Harmonic Response (Voltages, Currents):** 50th harmonic (3kHz)

**Accuracy (in percent full scale unless specified otherwise):**

The IQ Analyzer is a revenue-accurate energy meter that complies with numerous accuracy standards, including: ANSI C12.20(0.5%), ANSI C12.16(1%), IEC687(0.5%), and Canada(0.5%).

*(Accuracy is from 5 - 300% of Full Scale and from -0.5 to 1.00 to 0.5 power factor)*

| | |
|---|---|
| Current and Voltage: | ±0.20% |
| Power, Energy, and Demand: | ±0.5% of reading |
| Frequency: | ±0.04% |
| Power Factor: | ±1% |
| THD: | ±1% (with continuous current) |

*Current Accuracies at specific peak current limits:*

±0.20% of Full Scale to 200% of Full Scale and 150% Crest Factor
±0.20% of Full Scale to 150% of Full Scale and 200% Crest Factor
±0.20% of Full Scale to 100% of Full Scale and 300% Crest Factor
±0.40% of Reading for Currents to 800% of Full Scale
Power and Energy: Starts recording with an average of 3 mA secondary current
Current: Starts recording at 0.55% of full scale (27 mA of secondary current)

**Environmental Conditions:**

| | |
|---|---|
| Operating Temperature: | -20° to 70° C |
| Storage Temperature: | -30° to 85° C |
| Operating Humidity: | 5 to 95% Relative Humidity (Non-condensing) |
| Altitude: | 5000 m |
| Pollution Degree: | 2 (IEC 664) |

**Discrete Inputs (Dry Contact):**

+30 Vdc differential across each discrete input pair of terminals.
Minimum Pulse Width: 34ms on a 60Hz system, 40ms on a 50Hz system
Optically isolated inputs to protect IQ Analyzer circuitry.
Withstand Rating: 120 Vac

**Analog Outputs: (CAUTION: Wire to ground before wiring to output terminals; otherwise, damage may result)**

0 to 20m A / 4 to 20 mA into max. 750 ohm load

| | |
|---|---|
| Accuracy: | 1% |
| Resolution: | 0.25% |
| Withstand Rating: | 60Vdc |
| Wiring: | Shielded twisted pair cable, Belden 9486 or equiv. |

**Analog Input:**

0 to 20 mA / 4 to 20 mA into 200 ohm load (0 to 5 V with external 50 ohm series resistance)

| | |
|---|---|
| Accuracy: | 1% |
| Resolution: | 1% |
| Withstand Rating: | 5 Vdc |
| Wiring | Shielded twisted pair cable, Belden 9486 or equiv. |

*Table 2-1 IQ Analyzer Specifications and Details Summary (continued on next page)*

**Relay Output Contacts:**
- General Purpose: 100,000 operation under load, 10 million operations as a pulse initiator.
- CAUTION! For pulse-initiator operation, set the pulse rate so that 10 million operations is within the desired lifetime. For example, one pulse/sec accumulates to 10 million in less than 4 months.
- Load shed on any system demand
- Event trigger
- Discrete input
- Remote PowerNet / IMPACC control

Minimum Pulse Width: 4 cycles (68 ms)
Withstand Rating: 1000 Vac (across contacts, 1 minute)
5000 Vac (contacts to coil, 1 minute)
10,000 Vac (contacts to coil, surge voltage)

**RELAY Make, Break, and Carry CHARACTERISTICS**

| Loading | Voltage | Carry (constant load) | Make (50ms) | Break |
|---|---|---|---|---|
| Resistive (PF=1.0 | 120 Vac | 10 A | 50 A | 10 A |
| | 250 Vac | 10 A | 30 A | 10 A |
| | 30 Vdc | 10 A | 30 A | 10 A |
| | 60 Vdc | 10 A | 30 A | 1 A |
| | 110 Vdc | 10 A | 30 A | 0.5 A |
| | 250 Vdc | 10 A | 30 A | 0 A |
| Inductive (PF=0.4) | 120 Vac | 10 A | 43 A | 7 A |
| | 240 Vac | 10 A | 21 A | 7 A |

**Memory Capacity:**
Program Memory: 512KB (EPROM or Flash)
Total Data Memory: 256KB (Non-Volatile RAM)
Program Settings: 2KB (EEPROM)

**Event Storage:**
The IQ Analyzer stores the waveforms and metered data for 10 events. Each set of waveforms includes 8 cycles of VAN, VBN, VCN, VAB, VBC, VCA, VNG, IA, IB, IC, IN, and IG (2 cycles at 128/cycle & 6 cycles at 32/cycle).

**Event Logs:**
The IQ Analyzer stores the timestamp and cause of the most recent 504 events. These non only include events that trigger waveform captures but also relevant status changes: Power Up, Relay On, Relay Off, Reset (demand, energy, min/max, relays, events, and trends), Settings, Calibration, Network Connection Established, and Network Disconnected (20sec timeout).

**Trend Data:**
The IQ Analyzer includes a powerful trending engine that can be applied to 4 indepentent applications. For example, one trend can record energies every few minutes for months while a second trend captures the first seconds or minutes of a motor start.
Independent Trends: 4
Trend Buffers: 100 (900 bytes each)
Items Per Trend: 6
Trend Intervals: 8cycles, 1-5040 minutes
Max Memory Allocation: 1-100 buffers each
Trend1: 8-cycle sampling triggered by Discrete Input#1
Trend2: 8-cycle sampling triggered by Discrete Input#2
Trend3: 8-cycle sampling triggered by Discrete Input#3
Trend4: 8-cycle sampling triggered by waveform capture event (ideal for sag/swell details)

*Table 2-1 IQ Analyzer Specifications and Details Summary (continued on next page)*

**MEASURED VALUES** [1]

| Parameter | Accuracy | Range | Time & Date Stamped |
|---|---|---|---|
| Current | 0.2% | 0 to 800% of CT | Per phase min/max |
| Voltage | 0.2% | 0 to 150% of PT | Per phase min/max |
| watts | 0.4%<br>0.5% of reading<br>1 % of reading | 0-80000MW<br>(PF = 1; 5%-300% of full scale)<br>(PF > ±0.5; 5%-300% of full scale) | Per phase and system min/max |
| vars | 0.4%<br>1% of reading | 0-80000Mvar<br>(PF < ±0.5; 3%-300% of full scale) | Per phase and system min/max |
| VA | 0.4%<br>0.5% of reading | 0-80000MVA<br>( 5%-300% of full scale) | Per phase and system min/max |
| kWh | | 999,999,999 kWh | |
| MWh | | 999,999,999 Mwh | |
| kvarh | | 999,999,999 kvarh | |
| Mvarh | | 999,999,999 Mvarh | |
| kVAh | | 999,999,999 kVAh | |
| MVAh | | 999,999,999 MVAh | |
| amp demand | 0.2% | 0 to 800% of CT | Per phase system maximum demand |
| watt demand | 0.4% | 0-80000MW | Maximum demand |
| var demand | 0.4% | 0-80000Mvar | Maximum demand |
| VA demand | 0.4 | 0-80000MVA | Maximum demand |
| Displacement Power Factor<br>(isolates fundamental components) | 1% | -.01 to 1 to +.01 and 0 | Per phase and system min/max |
| Apparent Power Factor<br>(includes harmonic components) | 1% | -.01 to 1 to +.01 and 0 | Per phase and system min/max |
| Frequency | 0.01Hz | 20.00 to 70.00Hz | min/max |
| % amps THD | 1.5% | 0-9999% | Per phase min/max |
| Magnitude amps THD | 1.5% | 0-80000A | Per phase min/max |
| % volts THD | 1.5% | 0-600% | Per phase min/max |
| Magnitude volts THD | 1.5% | 0-500000V | Per phase min/max |
| K-factor (during event) | 0.5% | 0-1.000 | Event only |
| Crest Factor<br>(largest of per-phase values) | 0.2% | 1.000-3.000 | |
| THDF (CBEMA)<br>(smallest of per-phase values) | 0.2% | 0-1.414 | |
| Time | 10ms resolution | (synchronized via IMPACC with entire system) | |
| Phase Angle | 0.5 degrees | 0-360 degrees | Event Only |

[1] *All accuracies as % full scale unless noted otherwise*

*Table 2-1 IQ Analyzer Specifications and Details Summary (continued on next page)*

**EVENT TRIGGERS** [1]

| # of Selections | Trigger | Description |
|---|---|---|
| 2 | 2 | Undervoltage - any VLL, VLN (40-100% of PT primary line-to-line) |
| 2 | 4 | Overvoltage - any VLL, VLN (100-750% of PT primary line-to-line) |
| 1 | 5 | Interruption - any VLN (transient trigger only available in the IQA-6200 series) |
| 1 | 6 | Excess dV/dt - any VLN (transient trigger only available in the IQA-6200 series) |
| 26 | 7-32 | Maximum %THD or magnitude THD - any current, any VLL, any VLN, Ia, Ib, Ic, In, Van, Vbn, Vcn, Vab, Vbc, Vca |
| 7 | 33-39 | Maximum Demand - Ia, Ib, Ic, In, system watts, system vars, system VA |
| 5 | 40-44 | Maximum Current - Ia, Ib, Ic, In, Ig |
| 7 | 45-51 | Maximum Voltage - Van, Vbn, Vcn, Vab, Vbc, Vca, Vng |
| 3 | 52-54 | Maximum Power - system watts, system vars, system VA |
| 2 | 55-56 | Maximum Power Factor - (smallest ‘+’ or largest ‘-’) - system displacement, system apparent |
| 3 | 57-59 | Minimum Current - Ia, Ib, Ic |
| 6 | 60-65 | Minimum Voltage - Van, Vbn, Vcn, Vab, Vbc, Vca |
| 3 | 66-68 | Minimum Power - system watts, system vars, system VA |
| 2 | 69-70 | Minimum Power Factor (smallest ‘-’ or largest ‘+’) - system displacement, system apparent |
| 3 | 71-73 | Frequency - high, low, high/low |
| 2 | 74-75 | Voltage Unbalance - VLL, VLN (as % of average) |
| 1 | 76 | Current Unbalance (as % of average) |
| 3 | 77-79 | Discrete Inputs - Input 1, Input 2, Input 3 |
| 5 | 80-84 | Min/Max Update - any combination of min/max current, min/max voltage, min/max power factor, min/max power/freq., or min/max THD |
| 2 | 85-86 | Manual - local or via IMPACC |

[1] *Each of the 7 triggers may be programmed to any of 86 selections*

**EVENT STORAGE** [1]

| Type | # of records | Description |
|---|---|---|
| Event Waveforms and Data | 10 | Upon event, meter-menu capture, 8-cycle capture, and harmonics 1-50 of Van, Vbn, Vcn, Vab, Vbc, Vca, Vng, Ia, Ib, Ic, In Ig (2-cycles at 128 samples/cycle 6 cycles at 32 samples/cycle), |
| Event Log (NEW!) | 504 | Each record includes the time and reason for the event. Also included are records for Powerup time, resets, communications, relay, and setting changes. |

*Table 2-1 IQ Analyzer Specifications and Details Summary (continued on next page)*

**UPDATE TIMES**

| Parameter | Time | Comments |
|---|---|---|
| Voltage | 2 cycles | |
| Current | 8 cycles | |
| Power | 8 cycles | |
| Energy | 8 cycles | |
| Demand | 1-60 min | Programmed or Sync Demand Windows |
| Power factor | 8 cycles | Currents less than 0.05% are ignored |
| Frequency | 8 cycles | Measured each cycle digital filtered with 1s time-constant |
| THD | 8 cycles/ parameter | Parameters: Ia, Ib, Ic, In, Van, Vbn, Vcn, Vab, Vbc, Vca |
| K-Factor | Of Event | Ka, Kb, Kc K-factor in IMPACC and event data it is the largest of Ka, Kb, Kc |
| Crest Factor and CBEMA THDF | 8 cycles | Largest of Ia, Ib, and Ic crest factors. Currents less than 0.05% are ignored |
| Discrete Inputs | 2 cycles | Dry Contact |
| Relay Outputs | 2 cycles | Plus 15ms (energize), 5ms (de-energize) |
| Analog Input | 8 cycles | |
| Analog Outputs | 8 cycles | |
| Display Large Text | 1 second/screen | e.g., a screen with IA, IB, IC updates in 1 second |
| Display Small Text | 0.5s per screen | e.g., each 7 parameter custom screen updates in 0.5 seconds |
| Event Trigger Checks | 2 cycles | Note that while triggers are checked every 2 cycles, the actual time depends upon the specified trigger. Those triggers based upon voltage, discrete inputs, or manual/IMPACC update in 2 cycles while others update in 8 or more cycles. |
| Fast Trends (NEW!) | 8 cycles (setting=0min) | Trends1-3 triggered by Discrete Input contacts 1-3. Trend4 triggered by waveform event. Each can be programmed to 6 items. Data is continually collected until the programmed memory allocation is full. |
| Event Driven Trends (NEW!) | Triggered (setting=5040 minutes) | Trends1-3 triggered by Discrete Input contacts 1-3. Trend4 triggered by waveform event. Each can be programmed to 6 items, which is sampled only once per trigger. |
| Periodic Trends (NEW!) | 1-5039 minutes | Periodic Data: Each of 4 trends can be programmed for 6 items and independet update time. |

**Qualification Tests**

| | |
|---|---|
| Dielectric Strength: | 2.3kV for 1 minute to Relays, CTs, PTs, power supply |
| Transients: | ANSI C37.90 Oscillatory 2.5kV/1MHz, Fast Rise 5kV/10ns |
| | IEC801-4/EN61000-4-4, 2kV, 5ns rise for 50ns, 5kHz repetition |
| Dips and Interruptions: | EN61000-4-11 voltage shift at zero crossing |
| ESD: | IEC801-2/EN61000-4-2, 4kV to terminals, 8kV to faceplate |
| RFI/EMI: | UL991 10V/m |
| | ANSI C37.90.2, 150Mhz and 450Mhz, 10V/m |
| | IEC801-3/EN50140 10V/m, EN50204 10V/m |
| | IEC801-6/EN50141 10V |
| | IEC801-8/EN61000-4-8 30A/m |
| Surge: | IEC801-5/EN61000-4-5, 4kV common mode 1.2 us rise for 50 us |

*Table 2-1 IQ Analyzer Specifications and Details Summary (continued on next page)*

**IQ Analyzer Parameter Equations**

**Basic Metering —**

(The "fundamental period" is the time for a single cycle leg, 1/60 sec.)
(T1 = time between samples [e.g. $\frac{1000}{60 \times 12}$ = .1302 ms])
If "T1" is the time between samples, then j*T1 = "time = t", where j = 0,1,2,…,K.
x(j) is the value of function x(t) at a time = j*T1.
v(j) is the value of voltage v(t) at a time = j*T1.
i(j) is the value of current i(t) at a time = j*T1.

Calculation of RMS current and voltage: X = rms value of x(t) = $\sqrt{1/[K+1] * \sum_{j=0}^{K} \{[x(j)]^2\}}$.

Calculation of watts: WATT = $1/[K+1] * \sum_{j=0}^{K} \{v(j) * i(j)\}$.

Calculation of VARs: VAR = $1/[K+1] * \sum_{j=0}^{K} \{v(j+m) * i(j)\}$,

where m = number of samples in "fundamental period"/4.
This is the fundamental "reactive" power.

Calculation of VA: VA = Vrms * Irms (This includes the effects of harmonics).

Calculation of displacement power factor:

PF displacement = WATT/$\sqrt{[WATT^2 + VAR^2]}$. (60 Hz components for use in power factor correction calculations)

Calculation of apparent power factor: PF apparent = WATT/VA. (includes harmonics)

*Table 2-1 IQ Analyzer Specifications and Details Summary*

**Power Quality —**

Calculation of percent THD:

$$\%THD\ x(t) = 100 * \sqrt{\{x_2^2 + x_3^2 + x_4^2 + \ldots x_n^2\}} / x_1$$

where n is the highest harmonic number used.

Calculation of crest factor: CF = [peak value of x(t)]/[rms value of x(t)].
THDF (Transformer Harmonic Derating Factor) CBEMA = $\sqrt{2}$ / CF

Calculation of "K-factor" (IEEE C57.110-1968):

$$\text{K-factor} = \frac{\sum_{n=1}^{m} h_n^2 (I_n/I_1)^2}{\sum_{n=1}^{m} (I_n/I_1)^2}$$

where: $h_n$ is harmonic number = "n", In is the current of harmonic "n",
$I_1$ is the first harmonic current (n = 1),
m is the highest harmonic number used.

Calculation of Fourier coefficients:

$$F(n) = \sqrt{[Fsine(n)]^2 + [Fcosine(n)]^2}$$

$$Fsine(n) = 2/[K + 1] * \sum_{j=0}^{k}\{sin[n*w*j*T1] * x(j)\}$$

$$Fcosine(n) = 2/[K + 1] * \sum_{j=0}^{k}\{cosine[n*w*j*T1] * x(j)\}$$

where: n = harmonic number, w = 2*PI*(fundamental freq)
and the sampling is done over an integral number of cycles.

**Power Module Fuse:** BUSS KTK-R-3/4 or equivalent (three phase power module)
Littelfuse GDB-250mA, or equivalent, 5 x 20 mm (separate source power module)

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