The user should follow the instructions in the "Quick Start" section of the Users' Manual (TD17530); however, the IQ Analyzer has additional undocumented features. The following is a summary of these features.

IQA-6000 Series (2d82302G01 & G02)

Additional Settings

In the programming mode under EVENT TRIGGERS are several additions. The number of PRE-TRIGGER CYCLES can now range from 0 to 6 (previously 2 to 6). Also, the present trigger setting is displayed for each of the seven triggers (previously, one had to select a particular trigger to determine its setting).

Also, under EVENT TRIGGERS are more options. **MAGNITUDE THD** and **PERCENT THD** each have three more selections: **"IA,IB,IC"**, **"VAN,VBN,VCN"**, and **"VAB,VBC,VCA"**. These selections allow a single trigger to capture events based upon the worst of the three phases (previously, separate triggers were required per phase).

The IQ Analyzer has a new class of EVENT TRIGGER, **MIN/MAX UPDATE.** This added trigger captures events at the worst-case conditions by triggering when the present extremes of min/max values are exceeded. While the other previously existing triggers are appropriate for alarms or load shedding purposes, min/max triggering is best at determining the worst-case conditions. Underneath MIN/MAX UPDATE are five optional masks: MIN/MAX CURRENT, MIN/MAX VOLTAGE, MIN/MAX POWER FACTOR, MIN/MAX POWER (or frequency), or MIN/MAX THD. Any combination of the five can be selected. For example, to trigger events upon extreme voltage or THD conditions, select MIN/MAX VOLTAGE and MIN/MAX THD using the soft-keys then ENTER as shown. Upon the reset of min/max values, the Analyzer will record an event and several more events in the first few minutes. As new extremes are detected, new events are captured with decreasing frequency. Normal extremes are likely to be captured after a day or week of operation. Any further recorded events are the extremes of interest.

```
PGM/EVT/1/MINMAX
 SELECT PARAMETER:
  MIN/MAX CURRENT
 *MIN/MAX VOLTAGE
  MIN/MAX PWR FACTOR
  MIN/MAX POWER
 *MIN/MAX THD
 SEL    UP   DOWN ENTER
```

Another new class of EVENT TRIGGER is under **VOLTAGE DISTURBANCE.** SAG and SWELL triggers continue, based upon 2-cycle RMS values; however, the trigger **DELAY TIME** is now **0 to 3600 cycles** (previously 2 to 3600 cycles). Also, the newly added **INTERRUPTION** and **EXCESS dV/dt** triggers check voltages 32 times each cycle. For all disturbance triggers, the Assuming a sinusoidal voltage, no consecutive samples should be too close to zero (an INTERRUPTION) or too far appart (EXCESS dV/dt). In this way, the worst of voltage transient are captured as well as momentary interruptions due to poor connections. While the IQ Analyzer is not a transient analyzer, these added triggers allow the capture of sub-cycle events that do not

```
PGM/EVT/2/VDI
 SELECT PARAMETER:
 SAG
 SWELL
 INTERRUPTION
*EXCESS dV/dt

 SEL    UP   DOWN
```

greatly affect the rms values. Since the new triggers are dependent only upon consecutive samples, some "non-interesting" events are likely; however, this sensitivity adds the ability to capture sub-cycle disturbances that might otherwise go unnoticed until physical damage results.

In the programming mode under GENERAL SETUP is an added item, **ENERGY / POWER OPTIONS.** The first added option in the **ENERGY RANGE,** which allows the user to choose either KILO or MEGA energy units (e.g., kilowatt-hr or megawatt-hr). The second addition is the **POWER CONVENTION,** which allows the user to choose between the mathematical power convention and the power engineering convention. As a factory default, the Analyzer uses the mathematical convention in which lagging vars and power factor are represented as negative values for a load (positive for a generator). This is consistent with P=VI. The alternative is a power engineering convention, which uses P=VI* such that consumption of power is positive (i.e., a motor conveniently consumes positive watts and positive vars). Changing this setting has no effect upon the unsigned "LEADING KVAR-HR" and "LAGGING KVAR-HR" energy readings; however, the signed "NET KVAR-HR" energy will begin counting in the opposite direction. This setting is also programmable as part of the display options settings.

In the programming mode under RELAY OUTPUTS / PULSE INITIATOR is an added item, **PULSE INITIATOR SCALE.** Without adjustment the Pulse Initiator (PI) changes state each 0.6wh (varh, vah) times current rating/5 times the voltage rating/120. So in a system rated at 500 amperes and 480 volts, the PI would toggle each 240wh (0.6*500/5*480/120wh). Without a scale factor, however, running at rated current could quickly wear out the PI relay (rated for 5 million operations) by cycling each 1.2 seconds. The scale can vary between 1 and 255. For example, setting the scale to 100 would extend relay life by a factor of 100 (a worst case of roughly 20 years, cycling once each 2 minutes). The scale applies to all of the 4 relay outputs.

In the programming mode under RELAY OUTPUTS is an added item, **RELAY MODE OPTIONS.** Then, each relay has a setting that allows the user to choose between MODE1 (energize relay upon event/alarm) and MODE2 (release relay upon event/alarm). Neither mode is ideal for all situations. Mode2 is ideal as an under-voltage relay, but Mode1 is ideal as an over-current relay. The Analyzer had only operated in Mode2 such that the relays are normally energized but are de-energized upon an event or when the Analyzer loses power.

Communications via **IMPACC can directly control the state of the relay outputs.** Their activation is grouped with events/alarms and discrete inputs. That is, a relay can be activated by several selected event triggers, discrete inputs, or IMPACC command. With this scenario the relay would remain active until all selected triggers, inputs, and IMPACC command have cleared. **Note, when selecting IMPACC control, we recommend AUTO reset with 0000 release time.**

There have been display options to: select either a blanking or dimming screen saver; choose a time-out period; and program custom screens. In the programming mode under DISPLAY MANAGER there is an additional item, **DISPLAY OPTIONS.** Presently, there are three options as shown in the following table.

Program / Display Mgr. / Options		
Bit0 (rightmost)	0= Kilo units (e.g., Kilowatt-Hr)	1=Mega units (e.g., Megawatt-Hr)
Bit1	0=Normal Operation	1=Disable event/alarm screens This is useful when discrete inputs trigger an event either manually or periodically.
Bit2	0=Normal blanking of line-to-neutral parameters in a 3-wire delta configuration. (otherwise, readings for Van, Vbn, and Vcn might be confusing to a user without a neutral)	1=Show all parameters
Bit3	0=Mathematical power convention in which Power = VI. Lagging vars and power factor are negative for a load (positive for a generator).	1=Power Engineering convention in which Power = VI*. Lagging vars and power factor are positive for a load (positive for a generator).
Bit4-7	Undefined	

For example, to disable the local alarm displays, use the "-->" and "SET" soft-keys to move to and set bit1 as shown.

```
PGM/DISPMGR/OPTS
DISPLAY OPTIONS:
PRESS HELP FOR A LIST
OF CODES. BIT0 IS THE
RIGHTMOST -- BIT7 THE
LEFTMOST.  00000010
 (ENTER BINARY CODE)
-->   SET   CLR ENTER
```

Additional Features

Under TRND (softkey F1) we have recorded the minimum and maximum currents, voltages, powers, power factors, %THD, and frequency. Added is **min/max MAGNITUDE THD**, which is more informative than %THD. While a 10% harmonic current is 10 amps when drawing 100 amps, the percentage often rises when the current draw falls. For example, at night linear loads may be shut down, leaving only harmonic-generating loads (the %THD rises). Conversely, the maximum magnitude THD occurs during high demand periods. In summary, the maximum %THD and Magnitude THD occur at different times.

The K-factor is updated whenever there is an event and had been displayed only as the largest of the per-phase K-factors. Now, the meter menu displays **three K-factors, one for each current**, and the largest is recorded in the event metered data. For those unfamiliar with the K-factor, it is a transformer derating factor that relates the sum of heat that harmonic eddy currents generate in a transformer's core. Without harmonics the K-factor is 1.00, but as harmonics increase so does the K-factor. The following equation is

the mathematical description of the K-factor, where i_k is the current of the kth harmonic. It is the normalized sum of the harmonic currents squared, weighted by the square of the harmonic number. That is, higher harmonics have a larger heating effect than do lower harmonics.

The formula for K-factor is as follows:

$$Kfactor = \frac{\sum_{k=1}^{k=50} k^2 * \frac{i_k^2}{i_1^2}}{\sum_{k=1}^{k=50} \frac{i_k^2}{i_1^2}}$$

For energy monitoring via IMPACC, **Snapshot Energy Buffers** have been added. Either a broadcast or direct command causes the Analyzer to capture the system energies (forward kwh, reverse kwh, forward kvarh, reverse kvarh, and kvah). IMPACC commands (30B and 30C) access the results. In this way all IMPACC devices can be synchronized to the utility via the IMPACC software.

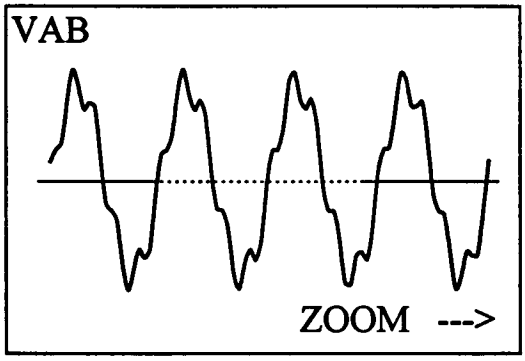
IQA-6200 Series (2d82302G03 & G04)

Additional Features

In addition to all the features of the IQA-6000, the IQA-6200 includes **graphic displays of event waveforms and harmonic spectrums.**

Under EVNT (softkey F2) the Analyzer displays the ten most recent events (or older events that are locked and require a manual reset). For a particular event there have been two items, METERED VALUES and HARMONIC VALUES. With the IQA-6200 series two new items exist, GRAPHIC WAVEFORM and HARMONIC SPECTRUM.

GRAPHIC WAVEFORM displays the waveform captured as a result of an event. There is a menu of the11 currents and voltages that were simultaneously sampled and saved at the time of the event. Upon the selection of an item, the Analyzer displays the first cycle of high-speed sampled data captured as a result of the trigger event. Pressing "-->" (F4) pans to the second cycle, and "ZOOM" (F3) displays the first four saved cycles (shown in the figure on the right). While in zoom, pressing "-->" (F4) pans to the second set of four cycles. In either case, pressing "<--" (F1) returns to the first cycle or first four cycles. The high-speed sampled data is indicated with the dotted portion of the display axis. An experienced user can often determine the source of an electrical problem from the shape of the captured waveform. Pressing the PREVIOUS LEVEL key or HOME key exits the graphic waveform display.



HARMONIC SPECTRUM displays a graphic representation of HARMONIC values. An experienced user who quickly finds the largest harmonic can often identify electrical problems from the harmonic signature. The primary display shows the fundamental as 100% along with harmonics through the 21st (shown in the figure on the right). Pressing "--->" (F4) advances the display to show harmonics 22nd through 42nd. One more press advanced to show harmonics 43rd through 50th. Finally, one more press of "--->" displays the first 21 harmonics again. Pressing the PREVIOUS LEVEL key or HOME key exits the graphic waveform display.