UPC1T

PROGRAMMABLE CONTROLLER

OPERATION MANUAL

UPC1T

OPERATION MANUAL

PPSC PART NO. 141021

THIS MANUAL ASSIGNED TO:

CONTROLLER MODEL _____ S/N _____

POWER SOURCE MODEL _____ S/N _____

PACIFIC POWER SOURCE CORPORATION
15122 BOLSA CHICA STREET
HUNTINGTON BEACH, CALIF. 92649

FIRST EDITION

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HOW TO... FRONT PANEL REFERENCE

This is a quick reference to commonly used **FRONT PANEL** functions and will aid the user in quickly learning **how to** use functions of interest.

REMOTE INTERFACE FUNCTION REFERENCE

This is a quick reference to commonly used **REMOTE INTERFACE** functions and will aid the user in quickly finding the functions of interest.

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SECTION 1

GENERAL

1 GENERAL

This manual is written to provide the information required to use the Universal Programmer / Controller (UPC1T). This manual is an Operation Manual. Installation, operation, and calibration are the subjects covered by this manual.

This manual is to be used with the UPC1T. The UPC1T is an unique programmable controller designed to operate in an IEC TEST SYSTEM. When used in the IEC TEST SYSTEM, the UPC1T is under REMOTE CONTROL via the GPIB. For control of the IEC TEST SYSTEM refer to PACIFIC POWER SOURCE CORPORATION's TMX SERIES AC TEST SYSTEMS OPERATION MANUAL.

1.1 USING THIS MANUAL

It is very important that the user reads Section 4 (Front Panel Operation) prior to using this equipment. A thorough understanding of this section is required to properly operate this equipment. If the user intends on using the UPC1T under REMOTE CONTROL via the GPIB, without the VIRTUAL INSTRUMENTATION provided by PACIFIC POWER SOURCE CORPORATION, then the user should also read Section 5 (GPIB Operation).

Be aware of the "**HOW TO**" section following the Table of Contents as it may be helpful for the first time user as well as the experienced user. Also very helpful is the "**QUICK OVERVIEW,**" Section 4.0.1, and "**QUICKLY PUTTING THE UNIT TO USE,**" Section 4.0.2. REMOTE INTERFACE users will find the "**REMOTE INTERFACE FUNCTION REFERENCE**" to be helpful also.

Conventions used in this manual include references to specific key sequences which are denoted within parenthesis and in boldface type. For example, the key sequence required to display the Function Generator screen is (**fn**,**6**). Two keys are pressed, the key labeled "**fn**" is pressed and released and then the key labeled "**6**" is pressed and released. The parenthesis and comma(s) are not entered. References to a single key operation will simply be shown in boldface type, for example, **EXECUTE**.

1.2 SAFETY NOTICES

The UPC1T controls the TMX Series of equipment which is capable of transferring very large amounts of electrical energy quickly. This basic quality is fundamental to a high-performance power source. The warnings and cautions listed below should be observed at all times.

WARNINGS are conditions which are hazardous to user personnel. All warnings throughout this manual will be formatted as shown below. A condition which is hazardous to both personnel and equipment will be issued as a warning.

CAUTION statements indicate a dangerous situation which may damage the equipment but is not a threat to life or limb. Cautions will assume the format shown opposite. All cautions should be rigorously observed

* * * **WARNING** * * *

- THIS EQUIPMENT CONTAINS HIGH-ENERGY, LOW-IMPEDANCE CIRCUITS !!
LETHAL POTENTIALS ARE CONTAINED WITHIN THE SYSTEM.

- CARE MUST BE EXERCISED WHEN INSTALLING OR CALIBRATING THIS EQUIPMENT IN ORDER TO PREVENT SERIOUS OPERATOR INJURY OR EQUIPMENT DAMAGE.

- OUTPUT VOLTAGE RESPONDS ***INSTANTLY*** WHEN THE POSITION OF THE OUTPUT POWER SWITCH IS CHANGED.

LOAD MAY BE DAMAGED DUE TO EXCESSIVE OUTPUT VOLTAGE.

- ALWAYS MAKE SURE THAT THE OUTPUT ON/OFF SWITCH IS IN THE **OFF** POSITION BEFORE CHANGING THE OUTPUT COUPLING MODE.

* * * **WARNING** * * *

1.2 SAFETY NOTICES (cont)

* * * **WARNING** * * *

• OBSERVE THE FOLLOWING WHEN INSTALLATION OR CALIBRATION IS REQUIRED:

1) REMOVE ALL JEWELRY FROM HANDS, ARMS AND NECK WHEN SERVICING THIS EQUIPMENT. THIS PREVENTS THE POSSIBILITY OF SHORTING THROUGH THE JEWELRY AND CAUSING BURNS TO OR ELECTROCUTION OF THE OPERATOR.

2) **WEAR SAFETY GLASSES** WHEN SERVICING THIS EQUIPMENT TO PREVENT EYE INJURY DUE TO FLYING PARTICLES CAUSED BY ACCIDENTAL SHORT CIRCUIT CONDITIONS.

3) DO NOT REMOVE ANY PANELS OR COVERS WITHOUT FIRST OPENING **ALL** CIRCUIT BREAKERS AND THEN REMOVING THE INPUT SERVICE.

4) SERVICING SHOULD BE REFERRED TO PERSONNEL AUTHORIZED BY THE FACTORY TO SERVICE THIS EQUIPMENT.

* * * **WARNING** * * *

--- **CAUTION** ---

READ SECTIONS 3, 4 AND 8 OF THIS MANUAL BEFORE INSTALLING, CALIBRATING OR OPERATING THIS EQUIPMENT.

--- **CAUTION** ---

1.3 GENERAL PRODUCT DESCRIPTION

1.3.1 UPC1T DESCRIPTION

The UPC1T is a highly versatile single phase signal generator. It is designed to directly plug into Pacific Power Source Corporation's TMX Series Power Source. It is NOT interchangeable with other UPC/UMC Series controllers.

The signal generation section produces one output signal for the 1ϕ output of the power source. The signal can be any of the 22 waveforms stored in memory. 20 waveforms can be altered by the user to produce any arbitrary function of time. Some pre-stored waveforms are: waveform number 1, a sine wave; waveform number 2, a triangle wave; waveform number 3, a square wave; and waveform number 4, a pulse wave. These can be altered using waveform editing (**fn,2,1**), waveform synthesis (**fn,2,3**), or copied (**fn,2,2**) either from the front panel of the UPC1T or remotely via the GPIB using SCPI commands.

The voltage amplitude may be varied by direct numeric entry, slew keys, or SCPI commands..

The frequency of the output is controllable from 20.00 to 1200 Hz, under normal operation. (The Function Generator is capable of producing frequencies from 0.005Hz to 2.4KHz).

The signal generation section produces either steady-state signals--a base set of volts, frequency, waveforms and phase angle--or dynamic signals in which parameters change with time. The signal generator can dynamically produce transient events lasting from microseconds to many hours.

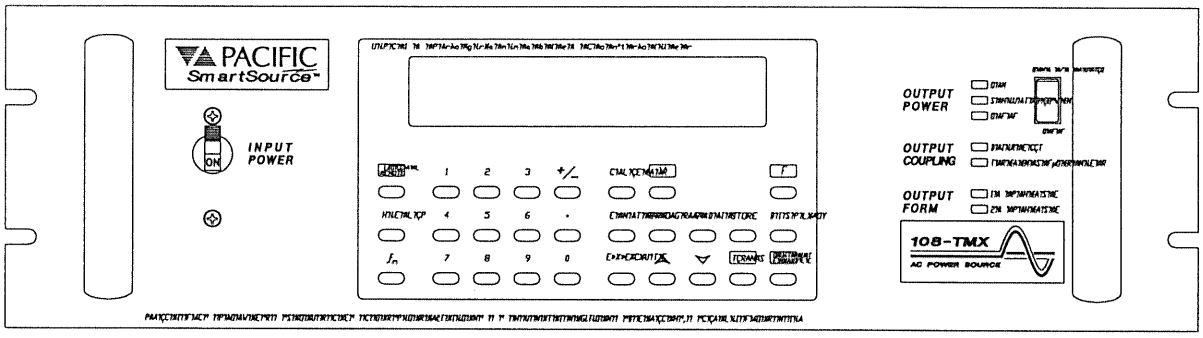
The display section of the UPC1T utilizes a 160 character backlit LCD. The LCD alternately meters operating parameters or displays alphanumeric text interactively with the operator to prompt and assist in loading programs or editing. The display automatically reverts to the metering display currently selected on completion of any programming or editing function.

Metering is provided by the UPC1T for all relevant parameters including: output volts (true RMS), current (true RMS, peak and crest factor), kVA, kW and Power Factor. Frequency is indicated. Internal or External voltage metering is user selectable. Internal metering causes the output voltage to be metered at a point prior to the Output Contactor. This allows the output voltage to be checked prior to applying power to the load. External metering allows the output voltage to monitored at a remote point outside of the power source. With CSC enabled (see below), external sense can be used to maintain an accurate voltage at a remote point, compensating for line voltage drops.

Externally referenced calibration is simplified by the aid of internal software that allows external measurements to be directly entered by way of the front panel or the Remote Interface. Correction values are then automatically calculated and stored in the UPC1T's memory. Refer to Section 8, EXTERNALLY REFERENCED CALIBRATION for explicit details.

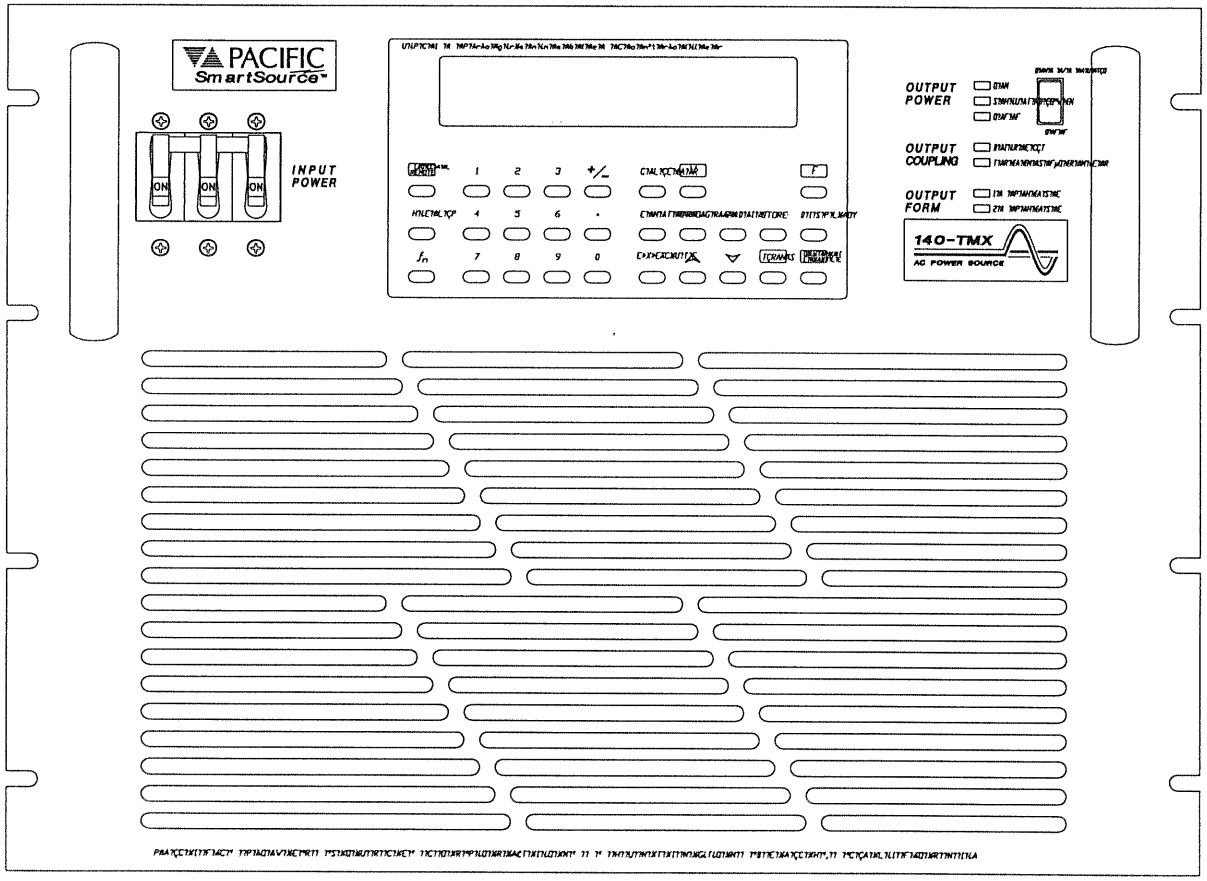
CSC (Continuous Self Calibration) is also provided. This feature allows the user to compensate for real losses due to output transformers and distribution lines by maintaining an accurate COMMAND (program) voltage at the metered sense point.

FIGURE 1.3 UPC1T



MODEL 108-TMX

W/ UPCIT CONTROLLER



MODEL 140-TMX

W/ UPCIT CONTROLLER

1.3.1 UPC1T DESCRIPTION (cont)

Programmable Current limit is provided.

Auxiliary and Amplitude Modulation inputs are provided.

The user may store 99 editable programs in battery backed up RAM. Each program may contain steady-state and transient parameters. There are also pre-stored programs that allow the user to generate MIL-STD 704D transients.

A unique feature available within the UPC1T is TRANSITION TIME. If a transition time is set to a non-zero value and a new program is executed, or changes are made in MANUAL MODE, or changes are made via REMOTE CONTROL, it will take this long for the UPC1T to perform the transition from the present voltage and frequency to the new voltage and frequency. This feature may be used when it is undesirable to cause abrupt changes to the output power signal. This feature does not affect transient operation. Transition time may be set from 0 to 300 seconds in 200 microsecond steps.

Waveform analysis functions are provided to report both magnitude and phase angle of each harmonic for metered voltage and current waveforms. THD, ODD and EVEN harmonic distortion measurement data is also reported.

Programmable Output Impedance allows the user to compensate for dynamic losses due to output transformers and distribution lines by effectively controlling the output impedance of the power source. This feature, also known as *current compensation*, is especially useful in reducing output distortion at the load when non-linear pulse currents are present.

The UPC1T may be used in Local (front panel) or Remote (GPIB) control.

The GPIB interface is IEEE-488.1, IEEE-488.2 and SCPI compatible.

Metered voltage and current waveform data (digitized waveforms) can be retrieved via the Remote Interface.

A Function Generator is built into the UPC1T and is capable of producing low amplitude signals at either low frequency or high frequency. This output features programmable routing to either the AM or AUX oscillator inputs.

Synthetic Impedance provides a mechanism to easily vary low levels of resistance and inductance. This feature is a powerful tool for developmental and troubleshooting tasks.

An IEC 725 Reference Impedance network may be activated or bypassed using front panel control.

Auxiliary Metering is provided to monitor IEC related data channels from the UPC1T front panel.

1.3.2 CONTROLLER MODELS

The term 'UPC' is derived from Universal Programmer / Controller. The UPC1T is a 1ϕ signal generator designed to plug in to any PACIFIC TMX Series chassis.

The UPC1T is a special UPC which is designed for use in a TMX Test System.

The assembly number for the UPC1T is 141101.

1.3.3 IEC TEST SYSTEM

The UPC1T, TMX SERIES AC POWER SOURCE, and special software running on an IBM compatible Personal Computer under Microsoft Windows forms PPSC's TMX SERIES AC TEST SYSTEMS.

The PPSC TMX SERIES AC TEST SYSTEM is a fully integrated test solution designed to meet the need to test and evaluate products for compliance to the IEC 1000-3-2 and -3 (IEC 555-2,3) international standards. The requirements for an IEC testing system are specified as an international standard for electromagnetic compatibility (EMC) in the CEI IEC 1000-3-2 (Limits for harmonic current emissions with equipment input current < = 16A per phase) and CEI IEC 1000-3-3 (Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current < = 16A).

The system will operate either as a stock Power Source or fully compliant IEC test system, refer to PACIFIC POWER SOURCE CORPORATION's TMX SERIES AC TEST SYSTEMS OPERATION MANUAL for information about IEC testing.

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SECTION 2

SPECIFICATIONS

2 SPECIFICATIONS

This section states the specifications of both Output Control and Metering capabilities of the UPC1T.

Ambient conditions are as follows.

Temperature	0-50° C.
Humidity	0-95% R.H Non-Condensing.

2.1 CONTROL SPECIFICATIONS

2.1.1 FREQUENCY

The UPC1T output frequency is variable from 20.00 to 1200 Hz. There are 4 frequency spans, each with a different number of steps in the output waveform.

FREQUENCY SPAN	WAVEFORM STEPS	METERING SAMPLES
20.00 - 150 Hz	1024	512
20.00 - 300 Hz	512	256
20.00 - 600 Hz	256	128
20.00 -1200 Hz	128	64

Accuracy: ± 0.01 % of full scale over the full range of ambient conditions.

To change FREQUENCY SPAN refer to Section 4.5.3.2.

2.1.2 VOLTAGE

There is one coupling mode within the UPC1T and that is DIRECT COUPLED MODE. All voltages referred to are Alternating Current, unless specifically referred to otherwise. The following voltages are power source output voltages. The UPC1T actually produces an RMS voltage equal to Power source output V_{RMS} / 25.

Range: 0 to 150 VAC RMS for single phase operation,
0 to 300 VAC RMS for two phase (i.e. split-phase) operation.

Accuracy: ± 0.5% of full scale over the full range of ambient conditions with CSC off,
± 0.05% of the program voltage, referenced to the internal voltmeter, with CSC on.

2.1.2.1 CSC (CONTINUOUS SELF CALIBRATION)

The UPC1T includes a Continuous Self Calibration function that can be turned on and off by the user from the front panel of the UPC1T. When ON this function maintains a constant output voltage at the metered point. Accurate calibration of metering is essential for CSC to operate accurately. When SENSE=INT is set, CSC maintains accurate COMMAND voltage ($V_{PROGRAM}$) at the line side (internal) of the Output Contactor. When the load voltage drops due to distribution losses, CSC can be used to maintain precise COMMAND voltage ($V_{PROGRAM}$) at the load side (external) of the Output Contactor by setting SENSE=EXT with CSC enabled. Refer to Section 4.5.3.1 for details on front panel control of CSC.

Basic properties of the CSC function (**fn,3,1**) are:

1. Voltage level held to ± 0.05% of the program voltage referenced to the internal voltmeter with CSC enabled.

2. Response time varies anywhere from 100 ms to 200 ms and only responds while the UPC1T is metering. CSC is inactive while in Program Edit or Setup mode.

3. CSC operates independent of the selected waveform, it does not increase distortion and is stable into any PF load.

4. Automatically switches between internal and remote voltage control as the metering function is switched between INT and EXT.

5. CSC does NOT function during transients, inrush metering, or IEC testing.

6. CSC will only correct the Output Voltage by ± 10%. If the sense voltage is beyond ± 10% of the COMMAND voltage, then CSC will be disabled until the Output Voltage is back to a level within ± 10% of the COMMAND voltage.

2.1.2.2 TRANSITION TIME

The UPC1T includes a feature called TRANSITION TIME. If transition time (**fn,3,1**) is set to a non-zero value and:

1) a new program is executed, or
2) changes are made in MANUAL MODE, or
3) changes are made via REMOTE CONTROL,

It will take this programmed period of time for the UPC1T to perform the transition from the present voltage and frequency to the new voltage and frequency. This feature may be used when it is undesirable to cause abrupt changes to the output power signal. This feature does not effect transient operation.

Range: Transition time may be set from 0 to 300 seconds.
Resolution: 200 microsecond steps.

Refer to Section 4.5.3.1.

2.1.3 PROGRAMMABLE CURRENT LIMIT

Current limit is provided as an RMS current value. The range of this value is proportional to the ammeter range set by the AMPS TO VOLTS RATIO. This is an average responding, RMS programmed function, with a response time of approximately 50 ms. Refer to the TMX SERIES AC POWER SOURCE OPERATION MANUAL that came with the unit to find the Amps to Volts ratio required for a particular Power Source.

Range: (Amps to Volts ratio) x 6.67.

Resolution: Range/2000 (.05%).

Accuracy: ± 3% of full scale over the full range of ambient conditions.

Refer to Section 2.2.2.

2.1.4 WAVEFORM

The output voltage is generated by one of 21 waveforms stored in RAM. Each of the 99 user programs may specify any one of 21 waveforms for use with that program. Each Transient Segment may specify any one of 21 waveforms for use during that Transient Segment.

The Function Generator may specify any one of 21 waveforms and may specify a different waveform than the currently executing program. The waveform produced by the currently executing Program and the waveform produced by the Function Generator will be either algebraically summed (ROUTE=AUX), amplitude modulated (ROUTE=AM), or neither (ROUTE=OFF) to produce the output signal. In the case of ROUTE=OFF the output signal is produced solely by the currently executing Program.

Waveform 1 is always a sine wave. Waveforms 2-21 may be edited. Note that this gives the user the ability to create almost any waveform with the UPC1T such as sub-cycle transients and harmonics. See Section 4.4.2.2 for creating a cycle-based transient that performs waveform substitution for a single cycle.

Be aware that when the ERASE ALL RAM AND RESET CPU function (**fn,1,3,EXECUTE**) is selected--all edited waveforms are erased and reset to sine waves with the exceptions of waveforms number 2, 3, 4, and 22, which are set to a triangle wave, a square wave, a pulse, and a sixteen-cycle sine wave (Function Generator access only), respectively.

Waveform manipulation is provided for in various ways. Waveforms may be created by entering harmonic content using the waveform synthesis function (**fn,2,3**), edited using the waveform edit function (**fn,2,1**), copied using the waveform copy function (**fn,2,2**) and uploaded or downloaded remotely via the GPIB using SCPI commands.

Refer to Section 4.5.2 for waveform utility functions, Section 4.4 for specifying an output waveform to be used by Programs and Transients, Section 4.5.6 for specifying a waveform to be used by the Function Generator, and Section 5 for REMOTE OPERATION.

2.1.5 WAVEFORM SYNTHESIS

WAVEFORM SYNTHESIS provides waveform creation by entering magnitude and phase angle of harmonics.

HARMONIC RANGE is 2 through 51.

MAGNITUDE

Each magnitude percentage is referenced to the fundamental which is always defined as having a magnitude of 100%.

Range is 0% to 99.9%
Resolution is .1%
Accuracy is ± 1% referenced to the fundamental

PHASE ANGLE

Phase angles based on a Sine series are accepted.

Range is 0° to 359.9°
Resolution is .1°
Accuracy is ± 2% F.S.

Refer to Section 4.5.2.3.

2.1.6 OUTPUT POWER FORM

The UPC1T generates one output vector. The UPC1T must be configured for either one- or two- phase output. The factory default is a two-phase configuration. A two-phase Output Power Form configuration is also referred to as "split-phase" output. The Output Power Form is a user Program parameter and as such may be edited and displayed, by pressing the **PROGRAM** key. The Output Power Form of the last program to be executed determines the system's present configuration.

FORM = 1

One-phase output form is selected, the hardware in the TMX Series AC Power Source causes a potential difference between ϕA and Neutral. If the user programs 120 V_{RMS} the result is 120 V_{RMS} from terminal block HI (L1) to terminal block LO (L2).

FORM = 2

Two phase output form is selected, the hardware in the TMX Series AC Power Source causes the ϕB signal to be 180° out of phase with the ϕA signal. If the user programs 240 V_{RMS} the result is 240 V_{RMS} from ϕA to ϕB, terminal block HI (L1) to terminal block LO (L2).

Refer to Section 4.4.1.

2.1.7 FUNCTION GENERATOR

The UPC1T has a separate oscillator that can generate user programmable waveforms asynchronous to the power source output frequency. The Function Generator (**fn,6**) may be used for:

Flicker Meter verification by amplitude modulating the UPC's output.

Frequency range of 0.005-150Hz in 1% steps with a 1024 step waveform.
Amplitude Modulation programmable from 0 - 10% of 230 VAC output.

Harmonics immunity testing (IEC 1000-4-13) by summing harmonics with the UPC's output.

Frequency range of 150-2400Hz in 1% steps with a 64 step sine wave.
Harmonic Voltage programmable from 0 - 27% of 230 VAC output.

Refer to Section 4.5.6.

2.1.8 IMPEDANCE NETWORKS

2.1.8.1 IEC 725 EXTERNAL REFERENCE IMPEDANCE NETWORK

A lumped R+jX impedance network in series with the output, as per IEC 725, is provided by the TMX Power Source and may be selected or bypassed by the UPC1T, refer to Section 4.5.5.2. Refer to the TMX Series AC Power Source Operation Manual for specifications.

2.1.8.2 SYNTHETIC IMPEDANCE NETWORK

Programmable electronic simulation of the R+jX impedance network.

Resistance is programmable from 0.1 - 1Ω in .001Ω steps, accuracy is ±1%.

Inductance is programmable from 10 - 1000μH in 1μH steps, accuracy is ±1%.

Refer to Section 4.5.5.2.

2.1.8.3 PROGRAMMABLE OUTPUT IMPEDANCE

Programmable Output Impedance (Prog. Zo) is used to control the Output Impedance of the power source. Refer to Section 4.5.3.1.1.

Range: Varies with Power Source.
Resolution: ± 0.1% $Z_{O\,MAX}$ steps.
Accuracy: 1%.

2.2 METERING SPECIFICATIONS

Refer to Section 4.2.1, METERING DISPLAYS, for a description of metering operation and display.

2.2.1 VOLTMETER

One voltmeter input is provided. Range, resolution, and accuracy of the voltage metering **circuit** is as follows:

Meter range is 354 VAC RMS 1ϕ and 708 VAC RMS 2ϕ.

DISPLAY resolution is 0.1 VAC RMS. The Remote Interface may provide up to 3 digits of precision (number of digits to the right of the decimal point).

Accuracy is ± 0.2% of full scale ± calibration reference.

NOTE: Some load voltage may be displayed with NO OUTPUT due to the sensitivity of the metering circuits.

NOTE: Power source voltmeter scaling is internally fixed at 50:1, e.g.;

50 VAC at load = 1 VAC input to UPC1T = 50 VAC displayed.

2.2.2 AMMETER

2.2.2.1 STEADY-STATE AMPS

One ammeter input is provided. Both Peak and RMS values are displayed. Current Crest Factor is also displayed which is the ratio of Peak current to RMS current. Refer to the TMX SERIES AC POWER SOURCE OPERATION MANUAL that came with the unit to find the Amps to Volts ratio required for a particular Power Source.

Range, resolution, and accuracy of the current metering **circuit** is as follows.

I Meter range = (Amps to Volts ratio) x 6.67

DISPLAY range and resolution is .01 Amps RMS or Peak. The Remote interface may provide 3 digits of precision to the right of the decimal point.

Accuracy is ± 0.2% of full scale ± calibration reference.

Current crest factor is I_{PEAK} / I_{RMS}. Display range and resolution is XX.XX.

The AMPS TO VOLTS RATIO is set and displayed using the UPC STATUS function (***fn***,**3**,**3**).

NOTE: Some load current may be displayed with NO LOAD attached due to the sensitivity of the metering circuits.

2.2.2.2 INRUSH METER

Inrush metering is fast current metering used to capture and display peak surge currents. The peak inrush meter provides users with a method to display power source current peak measurements for single-phase and split-phase configurations. An arm/disarm mechanism is either controlled by the user from the UPC1T's front panel or by a remotely located program using SCPI commands. One UPC1T front panel screen handles the peak value display and the arm/disarm functionality. The UPC1T continues to operate the power source and normal UPC1T operations may be conducted while peak current surge inrush measurement is armed with the exclusion of other metering operations (this includes V/I METER, POWER METER, AMPS METER, CSC, and AUXILIARY METERING).

Range, resolution, and accuracy are the same as for AMPS METER, described above.

Sampling frequency is approximately 44.2KHz, providing for the capture of surge currents with a duration of 22.6 mircoseconds or greater.

2.2.3 POWER METER

2.2.3.1 kVA METER

kVA metering is provided using the metered volts and amps values multiplied by each other.

Display range and resolution is XXX.XXX kVA.
Accuracy is ± 1% of full scale over the full range of ambient conditions.

2.2.3.2 kW METER

True kilowatt metering is provided using the voltmeter and ammeter inputs.

Display range and resolution is XXX.XXX kW. The Remote interface may provide 3 digits of precision to the right of the decimal point.

Accuracy is ± 1% of full scale over the full range of ambient conditions.

2.2.3.3 POWER FACTOR METER

Power Factor is kW / kVA.

Display range and resolution is X.XXX. The Remote interface may provide 3 digits of precision to the right of the decimal point.

Accuracy is ± 1% of full scale over the full range of ambient conditions.

2.2.4 FREQUENCY DISPLAY

The programmed frequency is displayed as an indicator only.

Range 20.00 - 1200 Hz.

Resolution is .01 Hz from 20.00 to 99.99 Hz.
Resolution is 0.1 Hz from 100.0 to 999.9 Hz.
Resolution is 1.0 Hz from 1000 to 1200 Hz.

Accuracy is ± 0.01% of full scale over the full range of ambient conditions.

2.2.5 WAVEFORM ANALYSIS

WAVEFORM ANALYSIS derives harmonic components for any of the output voltage or current waveforms. Harmonics are displayed in tabular form on the front panel LCD display or may be queried via the Remote Interface. Harmonics are shown as a sine series with phase angle. Also displayed is Total Harmonic content (THD) and individual sums of even and odd harmonics (EHD & OHD). THD is the RMS of EHD and OHD.

These Harmonic analysis functions report both magnitude and phase angle (relative to 0° of voltage) of each harmonic for metered voltage or current waveforms.

HARMONIC RANGE:	2nd - 51st Harmonic.
HARMONIC CONTENT (Magnitude)	
Accuracy:	± 1% of Fundamental (see NOTE 1)
Resolution:	0.1 %
HARMONIC PHASE ANGLE (see NOTE 2)	
Accuracy:	F_{out} < 100 Hz. - 2nd-20th: ± 1° 21st-51st: ± 2° F_{out} >= 100 Hz. ± 8°
Resolution:	1° with a range of 0° to 359°.

NOTES:

1. When analyzing load current or voltage, always use as much of the meter range as possible. The specifications given apply to measured waveforms in which the peak values are at least 20% of the meter range. Valid results can be obtained from lower magnitudes, but accuracy of the higher order harmonics will deteriorate rapidly.

2. Phase angle accuracy is a guideline value only. It cannot be precisely stated because it varies greatly with waveform type and magnitude. In general, it is most accurate with quasi-sinusoidal waveforms - and poorest with pulse type waveforms and those containing many discontinuities, when resolving high order harmonics.

2.2.6 AUXILIARY METER

The UPC1T provides an auxiliary digital meter. Eight channels are multiplexed to this meter which operates in either single channel mode or dual channel mode. Auxiliary metering primarily to supports IEC testing. **The UPC1T should be configured for two phase operation (FORM = 2) when using the AUXILIARY METER** (single-phase voltage metering will be accurate, but single-phase current will not always be metered correctly; therefore, the METERING DISPLAYS, described in Section 4.2.1, should be used for single-phase metering operations).

IEC tests utilizes three voltage channels and two current channels sensed by the AUXILIARY METER:

V_EXT — This channel meters the EXT SENSE voltage (i.e. load voltage) from the terminal block found on the back of the TMX power source. The UUT undergoing IEC testing would be connected to this terminal to be metered. External calibration is also done from this sensing location (Refer to the following UPC1T OPERATIONS MANUAL Sections: Section 8, CALIBRATION; Section 8.2, EXTERNALLY REFERENCED UPC1T CALIBRATION; Section 8.3.1, EXTERNALLY REFERENCED AUXILIARY METERING CALIBRATION; and the TMX SERIES AC POWER SOURCE OPERATION MANUAL for more detail).

V_RELAY — This channel meters voltages before the output contactor and after the IEC 725 REFERENCE IMPEDANCE NETWORK.

V_PA — This channel meters Power Amp volts.

I_AFE — This channel meters unfiltered load current.

IAAAF — This channel meters load current after anti-alias filtering.

Display resolution is 0.001 VAC RMS, 3 digits of precision to the right of the decimal point.

Voltage metering:

Meter RANGE for voltage is 354 VAC RMS 1ϕ and 708 VAC RMS 2ϕ.

Meter ACCURACY is $\pm$ 0.05% of full scale $\pm$ calibration reference.

Current metering:

Meter RANGE for current = (Amps to Volts ratio) x 3.33 , for 2ϕ.
= (Amps to Volts ratio) x 10 , for 1ϕ.

Meter ACCURACY is $\pm$ 0.2% of full scale $\pm$ calibration reference.

NOTE: Some load current may be displayed with NO LOAD attached due to the sensitivity of the metering circuits.

2.3 ELECTRICAL INTERFACE

2.3.1 ISOLATION

The UPC1T contains one isolated power supply for all circuits. The Remote Interface is **NOT** isolated from the CPU or oscillator sections. The UPC1T's circuits may float with respect to GND but this is not recommended. In the Power Source, provision is made at one location to tie power supply common to GND. The user may establish their own local ground by removing the link from power supply common and GND.

2.3.2 INPUT POWER

The UPC1T requires that +10 VDC and ± 20 VDC is received from the power source on J6.

2.3.3 ANALOG INPUT

An **Auxiliary Input, AUX,** is provided on J5. The Auxiliary Input is algebraically summed to the Oscillator signal produced by the UPC1T. It should be noted that the Auxiliary Input can be used as external inputs simply by programming the UPC1T for 0 VAC output.

Auxiliary Input voltage range (V_{AUX}) is ± $10V_{PEAK}$ ($20V_{PEAK\text{-}TO\text{-}PEAK}$).

Power source OUTPUT VOLTAGE = $V_{PROGRAM}$ + (V_{AUX} x 25).

Input impedance is 600 ohms.

Full scale Gain Bandwidth from the auxiliary inputs to UPC1T outputs is > 100 kHz.

An **AM Input, AM,** is provided on J5. A varying DC voltage may be used to Amplitude Modulate the output.

AM Input voltage range (V_{AM}) is ± 10Vdc ($20V_{PEAK\text{-}TO\text{-}PEAK}$).

Power source OUTPUT VOLTAGE RMS = $V_{PROGRAM}$ + (V_{AM}/10 x 204.5)

Limited by the output voltage range of the power source.

Input impedance is 600 ohms.

Caution: Attempting to drive the OUTPUT VOLTAGE beyond the voltage range of the power source will result in a clipped (distorted) output waveform.

2.3.4 DIGITAL OUTPUTS

Digital outputs on J5 are 0 to 5 VDC, TTL level positive logic.

Logic outputs are:

AUX I/O pin# 5:
EVENT TRIGGER, true when a transient is in progress (previously called Transient Pedestal).
EVENT TRIGGER, true for 1ms when a program is first executed.

AUX I/O pin# 7:
DRM, 128, 256, 512 or 1024 times output frequency, dependent on the UPC1T frequency span set-up.

AUX I/O pin#9:
SYNC OUT, Positive Zero Crossing (0°) of Phase A analog output.

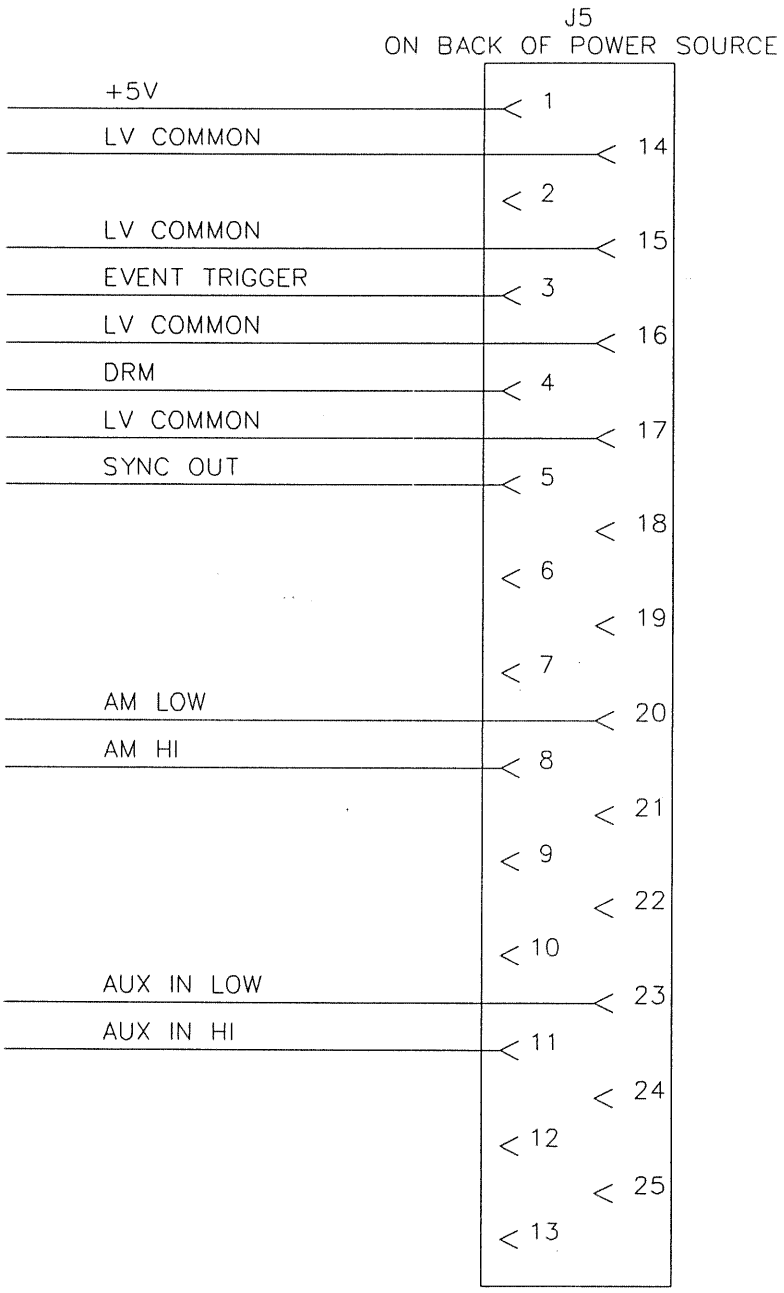

FIGURE 2.3.6 J5 AUXILIARY INPUTS AND OUTPUTS

2.4 GPIB REMOTE INTERFACE

The GPIB Remote Interface is provided on J4. It has listener and talker capabilities.

The GPIB device address is set via the UPC1T STATUS display screen. Default address is 1. See Section 4.5.3.3 for configuration and Section 5 for programming information.

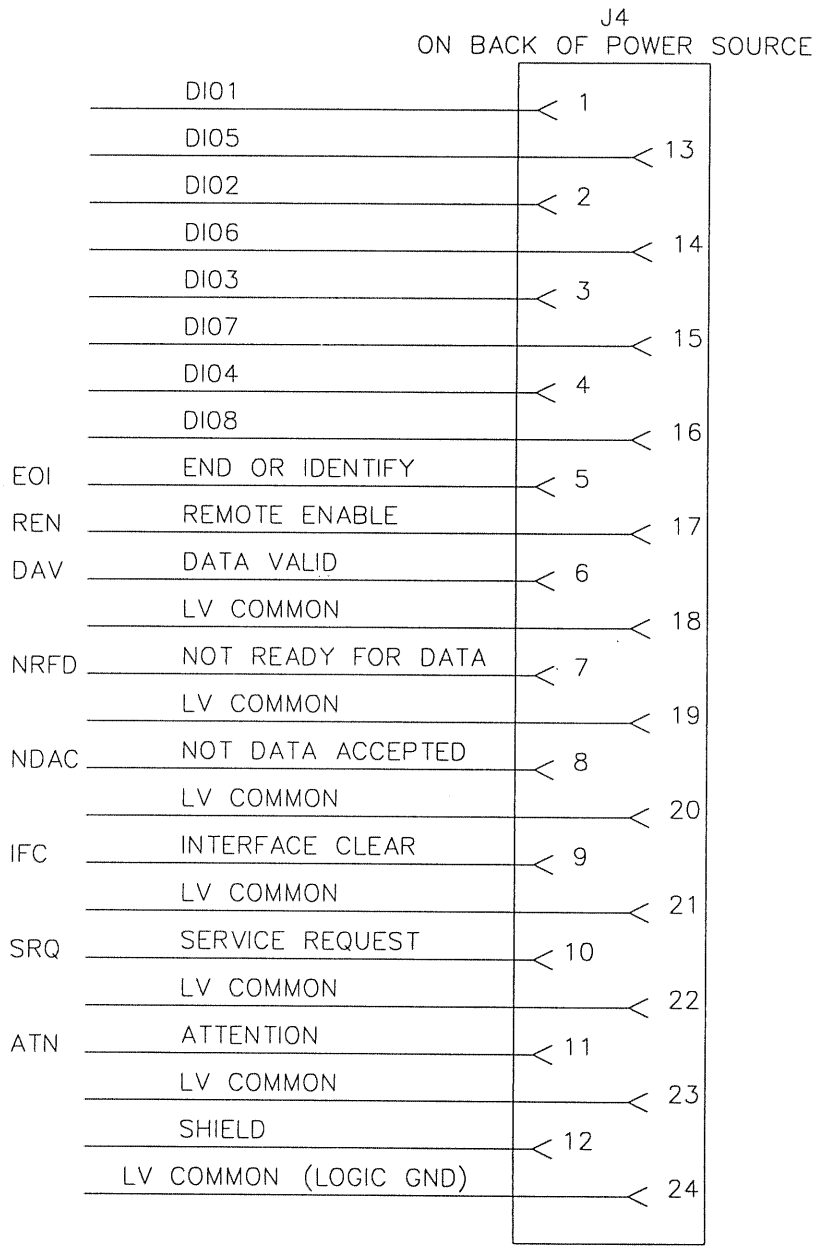

FIGURE 2.4 J4 GPIB INTERFACE

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SECTION 3

INSTALLATION

3 INSTALLATION

This section describes installation of a UPC1T into an TMX Power Source.

NOTE: It is recommended that the user return the product to the factory should a controller or power source upgrade be desired, however, the following information is provided for reference. Should a question arise, call Pacific Power Source, toll free, at 1-800-854-2433 (USA) or (outside USA) 1-714-898-2691.

*** * * WARNING * * ***

LETHAL POTENTIALS ARE CONTAINED WITHIN THE SYSTEM.

DO NOT REMOVE ANY PANELS OR COVERS WITHOUT FIRST OPENING **ALL** CIRCUIT BREAKERS AND THEN REMOVING THE INPUT SERVICE.

*** * * WARNING * * ***

- - - CAUTION - - -

READ SECTION 3 OF THIS MANUAL
BEFORE INSTALLING A UPC1T INTO
A POWER SOURCE.

- - - CAUTION - - -

NOTE: Normally the UPC1T is supplied in a TMX Series Power Source and is properly configured for operation. **Refer to Section 3.0 of the TMX Series AC Power Source Operation Manual** for TMX Series AC Power Source installation specifics. Also, refer to the TMX Series AC Test Systems Operation Manual for software installation requirements.

3 INSTALLATION (cont)

The installation of a UPC1T into a TMX Power Source consists of the following steps:

1) Open all Circuit Breakers and remove Input Service.
(Refer to paragraph 3.1)

2) Remove cover and cabling.
(Refer to paragraph 3.2)

3) Remove existing controller.
(Refer to paragraph 3.3)

4) Install UPC1T.
(Refer to paragraph 3.4)

5) Install cabling and cover.
(Refer to paragraph 3.5)

6) Connect Input Service and turn on.
(Refer to paragraph 3.6)

7) Configure UPC1T.
(Refer to paragraph 3.7)

3.1 REMOVE INPUT SERVICE

Turn the Input Power Circuit Breaker on the front panel OFF.
Remove Input Power from the Power Source.

3.2 REMOVE COVER AND CABLING

Remove screws from the top cover then remove the top cover.
Remove J2A from P2A.
Remove J3A of the existing controller from P3A the LED PCB.
Reattach mounting hardware to J5.
Remove J6A of the Power Source from P6A of the UPC1T.
Remove J3B of the Power Source from P3B of the LED PCB.
Remove J9 of the Power Source from P9 of the UPC1T.

3.3 REMOVE EXISTING CONTROLLER

Remove the existing controller by removing the two nuts holding the UPC1T front panel to the Power Source front panel.

3.4 INSTALL UPC1T

NOTE: Most users will not need to concern themselves with the following installation issue if the UPC1T is packaged with the Power Source.

Install the UPC1T with two nuts, attaching the UPC1T front panel to the Power Source front panel. See figure 3.5.

3.5 INSTALL CABLING AND COVER

NOTE: Most users will not need to concern themselves with the following installation issue if the UPC1T is packaged with a Power Source.

Connect J2A of the UPC1T to P2A of the Power Source.
Connect J3A of the UPC1T to P3A the LED PCB.
Connect J6A of the Power Source to P6A of the UPC1T.
Connect J9 of the Power Source to P9 of the UPC1T.
Place the top cover on top and install screws.

3.6 CONNECT INPUT SERVICE

Verify the Input Power Circuit Breaker on the front panel is off.
Connect Input Power to the Power Source chassis.

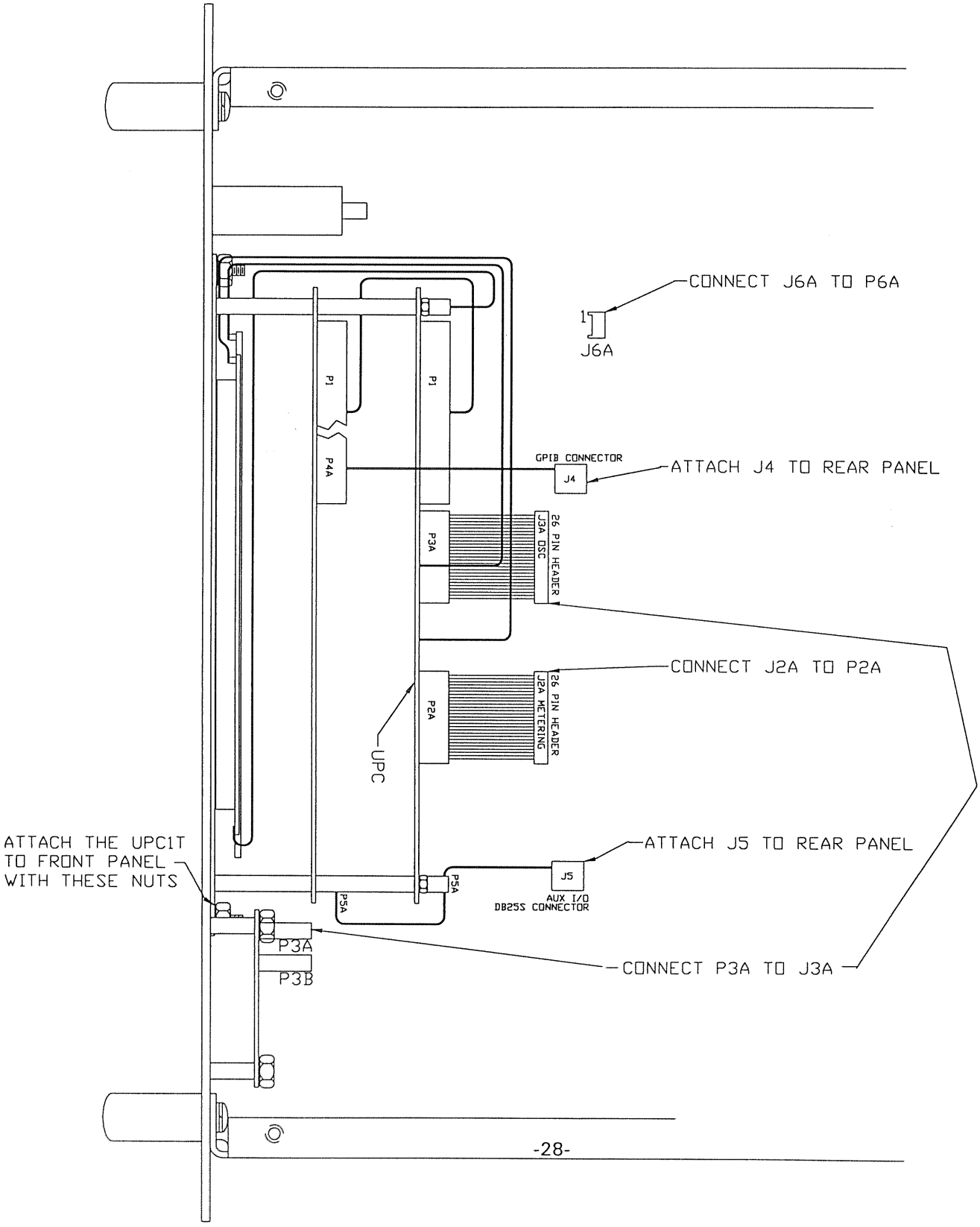
--- **C A U T I O N** ---

USE OF EQUIPMENT CONNECTED
TO IMPROPER VOLTAGE
MAY CAUSE PERMANENT DAMAGE
AND VOID WARRANTY.

--- **C A U T I O N** ---

Turn the Input Circuit Breaker ON.

FIGURE 3.5 INSTALLATION



3.7 CONFIGURE UPC1T

The UPC1T AMPS TO VOLTS RATIO must be configured to operate with the Power Source. Setting the GPIB device address is optional depending on whether the user intends to use the REMOTE interface.

3.7.1 GPIB DEVICE ADDRESS

The GPIB DEVICE ADDRESS is set by pressing (**fn,3,3,EDIT,1,STORE**). The default address is 1.

NOTE: IEEE-488 type cables with 90° "cable to connector" bends may interfere with other interface connectors on the Power Source and some power source model's rear panels. It is recommended that a straight "cable to connector" IEEE-488 cable be used (NATIONAL INSTRUMENTS type X5) or a 90° adapter be used.

Refer to Section 4.5.3.3.

3.7.2 AMPS TO VOLTS RATIO

Most users will not need to concern themselves with the following configuration issue as it is set at the factory if the UPC1T is packaged with a TMX Series Power Source.

The ammeter scale is calculated by the UPC1T based on the AMPS TO VOLTS RATIO. The AMPS TO VOLTS RATIO is used to interpret the voltage fed into the ammeter circuit input. This voltage represents a given amount of current, once scaled with the proper AMPS TO VOLTS RATIO.

The AMPS TO VOLTS RATIO of the UPC1T *must* be matched to the Power Source for accurate current metering by the UPC1T.

The AMPS TO VOLTS RATIO is set via the UPC STATUS display. Refer to Section 4.5.3.3 for operation of the UPC STATUS display. To set the AMPS TO VOLTS RATIO:

press> (**fn,3,3,EDIT,ENTER,**<amps_to_volts_ratio>,**STORE**).

Enter the appropriate value in place of <amps_to_volts_ratio> when the cursor is positioned on the AMPS TO VOLTS RATIO parameter.

NOTE: At the time of this writting, the AMPS TO VOLTS RATIO settings were as follows:

Power Source Model	AMPS-TO-VOLTS RATIO
108-TMX	6.0
125-TMX	9.0
140-TMX	15.0

NOTE: Refer to the TMX SERIES AC POWER SOURCE OPERATION MANUAL to determine the appropriate AMPS TO VOLTS RATIO of the Power Source.

3.7.3 AUXILIARY AMPS TO VOLTS RATIO

Most users will not need to concern themselves with the following configuration issue as it is set at the factory if the UPC1T is packaged with a TMX Series Power Source.

The 2ϕ Power Form ammeter scale is calculated by the UPC1T based on the AUXILIARY METERING AMPS TO VOLTS RATIO. The AUXILIARY METERING AMPS TO VOLTS RATIO is used to interpret the voltage fed into the ammeter circuit input. This voltage represents a given amount of current, once scaled with the proper AMPS TO VOLTS RATIO.

The AUX. METER AMPS TO VOLTS RATIO of the UPC1T *must* be matched to the Z-PCB settings, a sub-assembly of the TMX Series AC Power Source, for accurate current metering and accurate synthetic impedance control by the UPC1T. The Z-PCB setting will vary with power source model.

The AMPS TO VOLTS RATIO (AUX. METER) is set using the display with this same name.

To set the AUX. METER AMPS TO VOLTS RATIO:

press> (**fn**,**4**,**1**,**1**,**3**,**EDIT**,<aux_amps_to_volts_ratio>,**STORE**).
Enter the appropriate value in place of <aux_amps_to_volts_ratio> when the cursor is positioned on the AMPS TO VOLTS RATIO parameter.

Refer to Section 4.5.4.1.1.3 for operation of the AMPS TO VOLTS RATIO (AUX. METER) display.

NOTE: At the time of this writting, the AUX. METER AMPS TO VOLTS RATIO settings for the various models of TMX SERIES AC POWER SOURCE were as follows:

Power Source Model	AMPS-TO-VOLTS RATIO (AUX. METER ONLY)
108-TMX	1.0
125-TMX	2.0
140-TMX	4.0

NOTE: Refer to the TMX SERIES AC POWER SOURCE OPERATION MANUAL to determine the appropriate AMPS TO VOLTS RATIO of the Z-PCB.

SECTION 4

FRONT PANEL OPERATION

4 FRONT PANEL OPERATION

This section describes the front panel operation of a UPC1T Controller installed in a TMX Series Power Source.

The UPC1T Controller allows the user to control all output parameters of the TMX Series power source via the front panel keyboard as well as through the REMOTE interface (see Section 5 for REMOTE operation).

4.0 USERS GUIDE TO QUICK OPERATION

The purpose of this sub-section is two-fold:

1. to give the user a **QUICK OVERVIEW** of UPC1T operation (para. 4.0.1),

2. to help the user in **QUICKLY PUTTING THE UNIT TO USE** without having to master all of its complexities (para. 4.0.2).

4.0.1 QUICK OVERVIEW

The study of this section is a must. In addition to quick usage, this section gives the user a level of familiarity which is quite essential later when studying UPC1T operation in depth.

The UPC1T is operable either from its front panel (LOCAL CONTROL operation) or remotely over a GPIB communications link (REMOTE CONTROL operation). A host computer can force REMOTE CONTROL when it is displaying a Metering display. LOCAL CONTROL can be resumed either by a bus command (GO TO Local (GTL)) or by the operator pressing the **LOCAL** key. The host computer can force retention of REMOTE CONTROL by issuing a lockout command (Local LockOut (LLO) see Section 5.6.1).

In order to gain quick familiarity and usage of the UPC1T, it is useful to think of its being in one of 4 operating "modes" when in LOCAL CONTROL.

1. MANUAL OPERATE
2. PROGRAM OPERATE
3. PROGRAM EDIT
4. SETUP

MANUAL MODE is assumed when Voltage and/or Frequency parameters are manually entered from the front panel. Voltage and Frequency may be directly entered through the numeric keyboard. Alternatively they may be smoothly varied by use of the "slew" controls (up and down arrows). The V/I METER display (default display) tells the operator both command values and metered values. Stored transients may not be executed in the MANUAL MODE.

4.0.1 QUICK OVERVIEW (cont)

The PROGRAM OPERATE mode simplifies certain test operations by allowing the operator to execute pre-stored programs (certain combinations of Volts, Frequency, Output Form, Phase angle, Waveform, and Current limit.) A stored program can be executed simply by pressing **PROGRAM**, entering a program number and then pressing **EXECUTE**. Up to 99 programs can be stored--each with or without associated transients, as desired. After a program is called up by number **EXECUTE** causes the "Steady-state" program to be executed. Execution of the transient portion is separately controlled by pressing the **TRANS** key.

The PROGRAM EDIT mode allows the operator to create new programs, or change existing programs. It is noteworthy that programs can be edited without disrupting power source output. That is, if the operator is executing program number 5, then program number 2 (or any other program including program number 5) can be edited without interrupting execution of program 5.

The SETUP MODE is one in which the operator can make certain semi-permanent changes in system configuration. Examples are:

Set Min. and Max. Voltage Limits
Set Min. and Max. Frequency Limits
Set Programmable Output Impedance
Set Transition Time
Set Slew Rates
Calibrate Meters
Calibrate Output
Calibrate Synthetic Impedance Network
Calibrate Function Generator Output
Set Range Control (if supported by Power Source)
Create new Waveforms
Copy Waveforms
Modifying existing Waveforms
Copy Programs
Delete Programs
Erase Memory
Local/Remote meter source
Turn CSC On/Off
Program Output Impedance
Change Frequency Span
Monitor UPC1T and Power Source Status
Synthesize Waveforms from Harmonic values
View Auxiliary Metering Channels
Control Synthetic Impedance
Control IEC 725 Reference Impedance Network Bypass Relay
Control Function Generator

4.0.1 QUICK OVERVIEW (cont)

CHANGING MODES

Changing from one mode to another is simple and occurs as a result of invoking a specific function of a mode. All modes can be accessed from the V/I METER display. On first turn-on the system will operate using the default parameters set by the factory. A sign on screen displays for a few seconds then the V/I METER, which is the default display, will appear. The V/I METER shows basic operating parameters, and in the lower left portion shows the operating mode.

Once the V/I METER display is on, the UPC1T will accept a mode selection entry.

i.	(**fn**)	for SETUP mode menus
ii.	(**PROGRAM, EXECUTE**)	for PROGRAM OPERATE mode
iii.	(**PROGRAM, EDIT**)	for PROGRAM EDIT mode
iv.	(**V**) or (**F**)	for MANUAL MODE

A manual operation aid is the panel LEDs. When the **V** or **F** LED is on, that means that the unit is in MANUAL MODE and the illuminated parameter is ready for a new value to be entered--either by numeric entry or slew control (UP and DOWN arrows). In PROGRAM OPERATE mode these two LEDs are off.

The five keys in the lower right portion of the keyboard (colored black) are executive keys:

- In order to change power applied to the load *usually* one of these keys must be pressed.

- Whenever one of these keys is pressed, power to the load may be changed.

This operational feature has been programmed in to help keep the user from accidentally pressing the wrong key and unintentionally changing power to the load.

Remember! When you press a BLACK key the OUTPUT POWER will probably CHANGE.

4.0.1 QUICK OVERVIEW (cont)

QUICK OVERVIEW SUMMARY.

The system has four basic modes of controlling output parameters when it is operated from the front panel under LOCAL control:

1) MANUAL MODE allows direct modification of output parameters.
(Refer to paragraph 4.2)

2) PROGRAM OPERATE MODE allows pre-stored program execution including transients.
(Refer to paragraph 4.3)

3) PROGRAM EDIT MODE allows editing of stored programs including transients.
(Refer to paragraph 4.4)

4) SETUP MODE is used to copy and delete programs, erase memory, copy, edit, and create waveforms. You may set the meter sense point, turn CSC on or off, program Output Impedance, set transition time, set minimum and maximum voltages and frequencies, and set the Frequency Span. Calibration for metering and Programmable Output Impedance may also be performed. Status is given for firmware version, GPIB device address, amps to volts ratio and the Power Source.
(Refer to paragraph 4.5)

NOTE: The above does not apply to REMOTE operation (see Section 5), only LOCAL operation.

4.0.2 QUICKLY PUTTING THE UNIT TO USE

The following steps provide a quick method (using MANUAL MODE) for setting Voltage and Frequency and applying power to a load. In addition to programming voltage and frequency, PROGRAM EDIT MODE allows you to set-up phase angle, waveform, current limit, and power form. PROGRAM EDIT MODE also allows you to set-up transient events. Programming and executing a stored program are described in Sections 4.4 and 4.3 respectively, or see the **HOW TO** reference for a list of individual functions.

QUICK MANUAL MODE OPERATION

1. **DO NOT CONNECT A LOAD** to the power source until you are satisfied that the Power Source Output is appropriate for the load.

2. TURN the **OUTPUT POWER SWITCH OFF**. Then apply input power to the Power Source using its INPUT POWER SWITCH. Allow a few seconds for the UPC1T to initialize itself.

3. The V/I METER will appear. This is the default display. It shows metered Volts and Amps (AC RMS). It also shows the Voltage and Frequency entries in the upper right of the display if the user is entering or changing them.

4. TO CHANGE VOLTAGE: Light the **V** LED by pressing the **V** key. Now perform one of the following steps:
   A. Enter a numeric value on the keypad and press **EXECUTE**, or
   B. Press the UP or DOWN arrows to *slew* the voltage.
   The output will be changed to the voltage entered.

5. TO CHANGE FREQUENCY: Light the **F** LED by pressing the **F** key. Now perform one of the following steps:
   A. Enter a numeric value on the keypad and press **EXECUTE**, or
   B. Press the UP or DOWN arrows to *slew* the frequency.
   The output will be changed to the frequency entered.

NOTE: You cannot change Voltage and Frequency simultaneously using MANUAL MODE.

NOTE: OBSERVE ALL SAFETY WARNINGS AND CAUTIONS LISTED IN SECTION 1.2 !

6. TO CLOSE THE OUTPUT CONTACTOR: Switch the **OUTPUT POWER** switch on the power source front panel to **ON/AUTO**. Then press the **OUTPUT ENABLE** key on the UPC1T controller. Verify that the Power Source output (rear panel output terminals) is generating the desired voltage and frequency using an oscilloscope.

7. TO APPLY POWER TO THE LOAD: **TURN OFF** the **INPUT POWER** switch, then **TURN OFF** the **OUTPUT POWER** switch. Connect the load to the rear panel output terminals (Refer to the TMX SERIES AC POWER SOURCE OPERATION MANUAL). Switch ON the INPUT POWER switch, switch the OUTPUT POWER switch to the ON/AUTO position. Then press the **OUTPUT ENABLE** key on the UPC1T controller. Power is now being applied to the load.

4.1 FRONT PANEL CONTROLS AND INDICATORS

This section shows the locations and defines the functions of the front panel controls and indicators of the UPC1T as installed in a TMX Series Power Source. See figure 4.1.

4.1.1 POWER SOURCE FRONT PANEL

1) **INPUT POWER** (Circuit Breaker) - Used as the main input power ON/OFF control and protects the power source from drawing excessive input current from the input A.C. line.

2) **OUTPUT POWER** (Rocker Switch) - Controls the Output Contactor between the power source and the load.

This switch must be in ON/AUTO to allow the UPC1T to control the Output Contactor. In the OFF position the UPC1T cannot close the Output Contactor.

3) **OUTPUT POWER** (LEDs) - ON is illuminated when the Output Contactor is closed.

OFF is illuminated when the Output Contactor is open.

SHUTDOWN indicates the Power Source is in an error condition.

4) **OUTPUT COUPLING** (LEDs) - DIRECT is illuminated when the Power Amplifier is directly connected to the Output Contactor. This will always be the case for a TMX SERIES AC POWER SOURCE.

NOTE: TMX SERIES AC POWER SOURCE products use DIRECT COUPLING only.

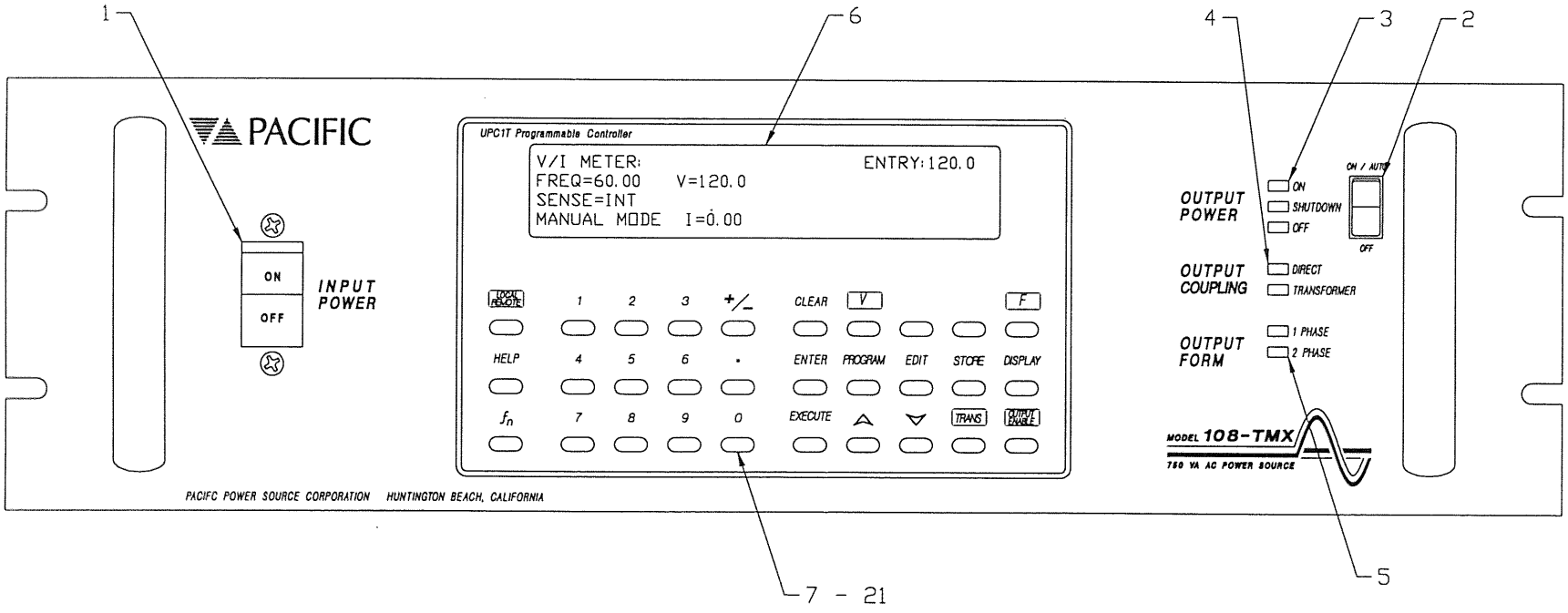


FIGURE 4.1 FRONT PANEL

4.1.1 POWER SOURCE FRONT PANEL (cont)

5) **OUTPUT FORM** (LEDs) -

1 PHASE is illuminated when the Power Source is configured for two-phase operation. The two Power Amplifiers are in parallel.

2 PHASE is illuminated when the Power Source is configured for two-phase operation. The two Power Amplifiers are in series.

4.1.2 UPC1T FRONT PANEL

6) **LIQUID CRYSTAL DISPLAY** (LCD) - Gives pertinent information to the user relating to front panel operation.

7) **LOCAL / REMOTE** (KEY and LED) - When the REMOTE INTERFACE is in control of the UPC1T and has not issued a local lockout command, this key will return control to the keyboard.

The LOCAL LED is lit when in LOCAL CONTROL.

The REMOTE LED is lit when in REMOTE CONTROL.

8) **HELP** (KEY) - From any METER display, this key provides help on how to operate the UPC1T.

9) **fn** (KEY) - When pressed from any meter display causes the UPC1T to enter SETUP MODE.

10) **NUMERIC KEYPAD** - Is used to enter numeric values. The +/- key toggles the sign of a numeric entry or toggles other two state parameters.

4.1.2 UPC1T FRONT PANEL (cont)

11) **CLEAR** (KEY) -

The first key press shall clear an entry and allow new values to be entered. The second key press shall back-up the cursor one field. If several key presses backup to the first field in a display, the next key press shall abort edit functions and return to the V/I METER display.

12) **V and F** (keys and LEDs) -

From the V/I METER display, pressing either of these keys causes MANUAL MODE to be active. When an LED is lit, this parameter is selected.

From the V/I METER display, if the **V** key is pressed, that LED toggles on or off and forces the F led off.

From the V/I METER display, if the **F** key is pressed that LED toggles on or off and forces V LED off.

When in the V/I METER display and either the **V** or **F** LED is lit, pressing an **UP ARROW** or **DOWN ARROW** key causes selected parameters to slew.

When in the V/I METER display and either the **V** or **F** LED is lit, entering a number then pressing **EXECUTE** causes the selected parameters to change to the newly entered value.

13) **ENTER** (KEY) -

Is used to enter numeric values then go to the next field. This key is *not* used in MANUAL MODE.

14) **PROGRAM** (KEY) -

When pressed from any meter display causes PROGRAM OPERATE MODE to be active.

15) **EDIT** (KEY) -

When pressed from the PROGRAM display causes PROGRAM EDIT MODE to be active. Pressing the **EDIT** key again causes the TRANSIENT display to be active.

4.1.2 UPC1T FRONT PANEL (cont)

16) **STORE** (KEY) - After editing, the STORE key is used to save new values.

17) **DISPLAY** (KEY) - Is used to cycle through the meter displays and the waveform analysis displays. Refer to Section 4.2.1

18) **EXECUTE** (KEY) - In MANUAL MODE, causes the output to change to new values.

In PROGRAM OPERATE MODE, causes a new program to be executed.

In PROGRAM EDIT MODE and in the PROGRAM display, causes the program to be saved and executed.

In SETUP MODE is used to change the set-up of the UPC1T.

19) **ARROW** (keys) When in MANUAL MODE, pressing an **ARROW** key causes the selected parameters to slew up or down.

20) **TRANS** (KEY) When in PROGRAM OPERATE MODE and a transient is stored, pressing this key causes the transient to start or stop. When the **TRANS** LED is lit this indicates a transient is in progress.

21) **OUTPUT ENABLE** (KEY) Causes the output contactor enable to toggle on and off. When the **OUTPUT ENABLE** LED is lit this indicates output enable is active.

4.2 METERING DISPLAYS

This section describes the operation of the METERING displays. These displays may be operated in either MANUAL MODE (refer to Section 4.2.6) or PROGRAM OPERATE MODE (refer to Section 4.3). A general description follows that applies to all METERING displays in either mode of operation.

There are four primary metering displays plus a set of Harmonic Analysis displays. Pressing the **DISPLAY** key will cycle through these metering displays. If a display other than a metering display is active, pressing the **DISPLAY** key will abort common edit functions and return to a metering display.

UPC1T METERING displays are ordered as follows:

i. V/I METER
ii. POWER METER
iii. AMPS METER
iv. INRUSH METER
v. HARMONIC ANALYSIS

Options available to the user from a meter display are:

Pressing the **PROGRAM** key will display the PROGRAM EDIT/EXECUTE screen. From here users may edit and execute programs as well as edit transient events associated with programs. Upon execution of a program, storing of an edited program and/or transient, or pressing CLEAR the user will return to the previous METER display. Refer to Sections 4.3 and 4.4.

or

Pressing the **fn** key will display the SETUP MENU. From here users may invoke any set-up functions described under Section 4.5. (Some restrictions may apply).

or

Pressing the **CLEAR** key will return to the V/I METER where normal metering will resume.

or

Pressing the **DISPLAY** key will advance to the next METER display and eventually cycle back to the V/I METER where normal metering will resume.

or

Pressing the **TRANS** key will execute any transient associated with an executing Program.

4.2.1 V/I METER

The V/I METER is the default display. Other meters are invoked by pressing the **DISPLAY** key until the desired meter is displayed.

The V/I METER display indicates FREQuency, metering SENSE point (INTernal or EXTernal), and either the executing PROGRAM #nn or MANUAL MODE. This display meters true RMS Voltage and true RMS Current.

Single-phase configuration display of the V/I METER.

```
V/I METER:
FREQ=60.00    V=120.0
SENSE=INT
PROGRAM #1    I=0.00
```

Split-phase configuration display of the V/I METER.

```
V/I METER:
FREQ=50.00
SENSE=INT   V=230.0
PROGRAM #1    I=0.00
```

4.2.1 V/I METER

The V/I METER is the default display. Other meters are invoked by pressing the **DISPLAY** key until the desired meter is displayed.

The V/I METER display indicates FREQuency, metering SENSE point (INTernal or EXTernal), and either the executing PROGRAM #nn or MANUAL MODE. This display meters true RMS Voltage and true RMS Current.

Single-phase configuration display of the V/I METER.

```
V/I METER:
FREQ=60.00    V=120.0
SENSE=INT
PROGRAM #1    I=0.00
```

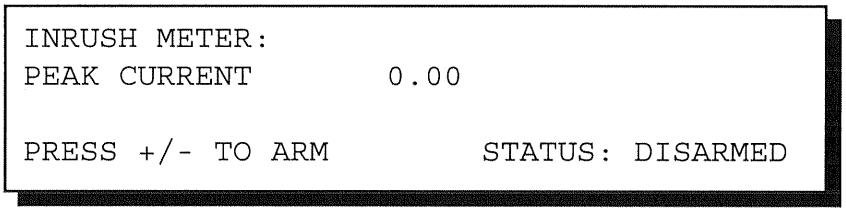
Split-phase configuration display of the V/I METER.

```
V/I METER:
FREQ=50.00
SENSE=INT   Vab=230.0
PROGRAM #1    I=0.00
```

4.2.4 INRUSH METER

The INRUSH METER display meters PEAK amps. It performs fast current metering used to capture and display peak surge currents. The peak inrush meter provides a method to display Power Source current peak measurements for single-phase and split-phase configurations. An arm/disarm mechanism is either controlled by the user from the UPC1T's front panel or by a remotely located program using SCPI commands. One UPC1T front panel screen handles the peak value display and the arm/disarm functionality. The UPC1T continues to operate the power source and normal UPC1T operations may be conducted while peak current surge inrush measurement is armed with the exclusion of other metering operations (includes: V/I METER, POWER METER, AMPS METER, CSC, and AUXILIARY METERING).

Sampling frequency is approximately 44.2KHz, providing for the capture of surge currents with a duration of 22.6 micro-seconds or greater.



Pressing the "+/-" key will "ARM" the INRUSH METER. This action will initiate a continuous sample-and-hold process and display peak currents captured for each phase.

Maximum current values are sampled and displayed in real-time as scaled AMPS. Only peak "absolute" values will be displayed. Values displayed will be zero when the meter is DISARMED. The capture process will begin *immediately* when ARMED.

The following example provides a description of how peak current capture can be used along with execution phase control to conduct surge inrush analysis.

4.2.4.1 INRUSH METERING EXAMPLE

Beginning from the V/I METER:

```
V/I METER:
FREQ=60.00    V=120.0
SENSE=INT
MANUAL MODE   I=30.00
```

Create a program and set the programmed voltage amplitude to zero:

press> **PROGRAM, 9, ENTER, EDIT, ENTER, ENTER, ENTER, 0**

```
PROGRAM: #9   FORM=1   COUPLING=DIRECT
FREQ=60.00    V=0.0
EXEC ϕ=90     WF=1
#SEGS=0    Ilim=30
```

Execute the newly created program number 9 which will store the program for future usage and produce an output voltage of zero volts to simulate an *off* state:

press> **EXECUTE**

```
V/I METER:
FREQ=60.00    V=   0.0
SENSE=INT
PROGRAM #9    I= 0.00
```

Note: Programs (and transients) can be created, viewed, stored, and/or executed from any of the METER displays; hence, we could have first went to the INRUSH METER and manipulated our programs from that meter. This would return us to the INRUSH METER each time a program action was completed, instead of the V/I METER.

Next, create a program and store it in memory. This program will be used to generate a surge current. In this example, voltage will instantaneously go from $0V_{RMS}$ to peak of $120V_{RMS}$ when program number 10 is executed since we specify an EXECution phase of 90 degrees.

press> **PROGRAM, 10, EDIT, EDIT,** {set program values for test, including EXEC ϕ}

```
PROGRAM: #10 FORM=1   COUPLING=DIRECT
FREQ=60.00    V=120
EXEC ϕ=90    WF=1
#SEGS=0    Ilim=30
```

press> **STORE**

```
V/I METER:
FREQ=60.00    V=   0.0
SENSE=INT
PROGRAM #9    I= 0.00
```

The power source continues to operate at zero volts and a program has been created to produce a surge inrush scenario. Now go to the INRUSH METER:

press> **DISPLAY, DISPLAY, DISPLAY**

```
INRUSH METER:
PEAK CURRENT     000.00

PRESS +/- TO ARM          STATUS: DISARMED
```

Arm the INRUSH METER:

press> +/-

```
INRUSH METER:
PEAK CURRENT       0.01

PRESS +/- TO DISARM          STATUS: ARMED
```

At this point we have initiated the sample-and-hold process. Program number 9 is still executing at zero volts simulating an *off* state. A trace current may possibly be detected and displayed. We are now ready to simulate a turn-on by executing program number 10 while the INRUSH METER remains armed.

press> **PROGRAM, 10, ENTER**

```
PROGRAM: #10 FORM=1  COUPLING=DIRECT
FREQ=60.00   V=120
EXEC ϕ=90   WF=1
#SEGS=0   Ilim=30
```

And execute program 10:

press> **EXECUTE**

```
INRUSH METER:
PEAK CURRENT      29.32

PRESS +/- TO DISARM          STATUS: ARMED
```

Peak current caused from turn-on at a voltage A phase angle of 90 degrees will now be captured and displayed in real-time.

Consecutive tests can be ran to determine exact peak surge current inrush for different execution phase angles using a simple, iterative process such as the following:

i. Disarm the INRUSH METER
ii. Execute program number 9
iii. Arm the INRUSH METER
iv. Edit the EXEC ϕ for program number 10
v. Execute program number 10

The exact key sequence to perform one iteration from the INRUSH METER display, with STATUS: ARMED (i.e. the last state from the example above), is:

press> +/-, **PROGRAM, 9, ENTER, EXECUTE**, +/-, **PROGRAM, 10, ENTER, EDIT, ENTER, ENTER, ENTER, ENTER**, <*exec_phase*>, **EXECUTE**

Where <*exec_phase*> is iterated. The operator may simply repeat this key sequence for each execution phase angle of interest and log the results.

4.2.5 WAVEFORM ANALYSIS

The Waveform Analysis functions are provided to report both magnitude and phase angle (relative to 0° of °A voltage) of each harmonic for metered voltage and current waveforms.

THD, ODD, and EVEN harmonic distortion measurement data are also available. They are calculated from the 2nd to the 51st harmonic.

Pressing the **DISPLAY** key four times will display the following screen.

```
 Press DISPLAY to view Harmonic Data.
Then use ENTER to UPDATE, CLEAR to EXIT.
       +/- selects VOLTS or CURRENT,
```

Pressing the **DISPLAY** key at this point will page to display the HARMONIC DATA in memory with screens similar to the following.

```
ϕA CURRENT  THD=0.1 % OHD=0% EHD=0.1%
HARMONIC: 2nd  3rd  4th  5th  6th
CONTENT:  .1%  0%   0%   0%   0%
ϕANGLE:   0°   0°   0°   0°   0°
```

Pressing the +/- key will toggle between current and voltage analysis.

The **CLEAR** key will return the display back to the V/I meter.

The **ENTER** key causes the UPC1T to measure a signal, and calculate and update the harmonic data in memory. This may take a few seconds. A beep is heard when the update is complete. Only the parameter selected, as described above, is updated. All parameters are retained until the power is turned off or the memory is cleared.

THD is TOTAL HARMONIC DISTORTION for all harmonics of the selected parameter and phase.

OHDis ODD HARMONIC DISTORTION for all harmonics of the selected parameter and phase.

EHDis EVEN HARMONIC DISTORTION for all harmonics of the selected parameter and phase.

4.2.6 MANUAL MODE

This section describes operation in Manual Mode.

In Manual Mode you may slew or directly enter Voltage or Frequency. Parameters other than Voltage or Frequency can only be changed by editing and executing a Steady-State Program.

The V/I METER display will indicate MANUAL MODE in the lower left of the display.

4.2.6.1 VOLTAGE ENTRY

To enter Manual Mode and change the Voltage: from any meter display light the **V** LED by pressing the **V** key.

Pressing an **ARROW** key causes the selected voltage to slew up or down. Entering a number and then pressing **EXECUTE** causes the selected voltage to change to the new value. The upper right of the display will show the last valid voltage entered.

For example, to change the output amplitude to 125 volts light the **V** LED by pressing the **V** key. Enter **125** and press **EXECUTE**. The Power Source should now be generating 125 volts, assuming that 125 is within the dynamic range previously set-up for the voltage.

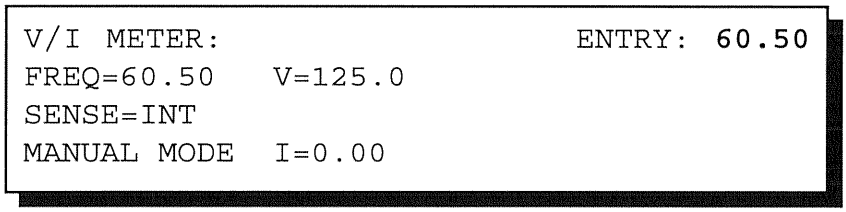
```
V/I METER:                          ENTRY: 125.0
FREQ=60.00    V=125.0
SENSE=INT
MANUAL MODE   I=0.00
```

4.2.6.2 FREQUENCY ENTRY

To enter Manual Mode and change the Frequency: from any meter display, light the **F** LED by pressing the **F** key. Entering a number then pressing **EXECUTE** causes the Frequency to change to the new value. The upper right of the display shows the last entered voltage.

Pressing an **ARROW** key causes the frequency to slew up or down. Entering a number then pressing **EXECUTE** causes the frequency to change to the new value. The upper right of the display will show the last valid frequency entered.

For example to change to 60.50 hertz light the **F** LED by pressing the **F** key Enter **60.50** and press **EXECUTE**. The Power Source should now be generating 60.50 hertz, assuming that 60.5 is within the dynamic range previously set-up for the frequency.



4.3 PROGRAM OPERATE MODE

This section describes Program Operate Mode.

Program Operate Mode allows pre-stored program execution including transients.

When the V/I METER display is active the lower left corner of the LCD will indicate that PROGRAM #nn is currently being executed or that MANUAL MODE is active.

4.3.1 PROGRAM EXECUTION

To enter Program Operate Mode: from any meter display press the **PROGRAM** key. This will cause the PROGRAM display to become active. The last program executed (possibly the program currently executing) will be displayed. You may enter a new program number and then press **ENTER** to view any of the 99 user programs that have previously been created.

```
PROGRAM:   #1      FORM=1   COUPLING=DIRECT
FREQ=60.00    V=120.0
EXEC ϕ=0     WF=1
#SEGS=0    Ilim=50.0
```

Pressing **EXECUTE** now will cause that program to be executed and the V/I METER display to be active. The display will show that Program #1 is now the active program.

```
V/I METER:
FREQ=60.00    V=120.0
SENSE=INT
PROGRAM #1    I=0.00
```

4.3.2 TRANSIENT EXECUTION

The UPC1T must be in Program Operate Mode to execute a transient and the executing program must have a transient stored. This is indicated by #SEGS = 1, or more, in the lower left hand corner of PROGRAM display. From any metering display, pressing the **TRANS** key will start a transient at positive zero crossing of phase A. Pressing the **TRANS** key again will stop the transient, if the transient is still active.

General steps to create a new transient program are as follows:

1. **Create or edit a program** using the method described in Section 4.4.1. Executing the program at this point is optional.

2. **Create or edit the transient** portion of the program using the method described in Section 4.4.2.

3. **Execute the program** using the method described in Section 4.3.1.

4. **Execute the transient** by pressing the TRANS key. Pressing the **TRANS** key again will stop the transient if still active.

The minimum number of keystrokes to create a transient program is as follows:

1. From the V/I meter, press **PROGRAM**, enter the program number, and press **ENTER**.

2. Press **EDIT**. Change steady-state values, if desired, pressing **ENTER** after each value is entered.

3. Press **EDIT**. Change segment values, if desired, pressing **ENTER** after each value is entered.
   Setting T to 0 in the first segment makes the transient a cycle based transient.
   Continue pressing **ENTER** to create new segments.

4. Press **STORE**. Enter the number of desired events and then press **STORE** again.

5. Execute the programs steady-state values by pressing **PROGRAM, EXECUTE.**

6. Execute the programs transient values by pressing **TRANS**. Pressing the **TRANS** key again will stop the transient, if the transient is still active.

4.3.2.1 MIL-STD-704D TRANSIENT PROGRAMS

The UPC1T is capable of producing the Voltage and Frequency excursions required by MIL-STD-704D.

Programs 100-103 are permanent, pre-stored, non-executable transient programs. These permanent programs may be copied to any of programs 1 - 99 for execution. To copy programs see Section 4.5.1.1.

Program 100 is a MIL-STD-704D over voltage transient.

Program 101 is a MIL-STD-704D UNDER VOLTAGE transient.

Program 102 is a MIL-STD-704D over-frequency transient.

Program 103 is a MIL-STD-704D under-frequency transient.

The four voltage and frequency programs are for equipment which is nominally powered by 115/200 volts and a nominal Frequency of 400 Hz. Transient program data is stated for over/under voltage and over/under frequency tests, as specified by paragraph 5.2.3 of MIL-STD-704D, and is provided in the following paragraphs.

The data presented in this section is based on MIL-STD-704D dated 30 SEP 1980.

NOTE: All four transients described are single event transients.

4.3.2.1 MIL-STD-704D TRANSIENT PROGRAMS (cont)

OVER-VOLTAGE TRANSIENT (Program #100)

The power source will produce the over-voltage transient excursion as defined by MIL-STD-704D (Paragraph 5.2.3.2.1). The power source **must** be configured for a voltage range of at least 180Vrms to perform this test.

INITIAL CONDITIONS:

f_o	400 Hz.
V	124 VAC (Max High-Line Steady-State Limit)
WF = 1	
DIRECT COUPLED	
2 PHASE	

TRANSIENT COMMAND SEQUENCE:

Segment 1:
F = 400, V = 180, T = 0.0002

Segment 2:
F = 400, V = 180, T = 0.01

Segment 3:
F = 400, V = 124, T = 0.07

4.3.2.1 MIL-STD-704D TRANSIENT PROGRAMS (cont)

UNDER-VOLTAGE TRANSIENT (Program #101)

The power source will produce the under-voltage transient excursion as defined by MIL-STD-704D (Paragraph 5.2.3.2.1). The power source **must** be configured for a voltage range of at least 108Vrms to perform this test.

INITIAL CONDITIONS:

f_o	400 Hz.
V	108 VAC (Min High-Line Steady-State Limit)
WF = 1	

TRANSIENT COMMAND SEQUENCE:

Segment 1:
F = 400, V = 80, T = 0.0002

Segment 2:
F = 400, V = 80, T = 0.01

Segment 3:
F = 400, V = 108, T = 0.07

4.3.2.1 MIL-STD-704D TRANSIENT PROGRAMS (cont)

OVER-FREQUENCY TRANSIENT (Program #102)

The power source will produce the over-frequency transient excursion as defined by MIL-STD-704D (Paragraph 5.2.3.2.1). The power source **must** be configured for a voltage range of at least 115Vrms to perform this test.

INITIAL CONDITIONS:

f_o	407 Hz. (Max Steady-State Limit)
V,	115 VAC
WF = 1	

TRANSIENT COMMAND SEQUENCE:

Segment 1:
F = 425, V = 115, T = 0.0002

Segment 2:
F = 425, V = 115, T = 1

Segment 3:
F = 420, V = 115, T = 0.0002

Segment 4:
F = 420, V = 115, T = 4

Segment 5:
F = 410, V = 115, T = 0.0002

Segment 6:
F = 410, V = 115, T = 5

4.3.2.1 MIL-STD-704D TRANSIENT PROGRAMS (cont)

UNDER-FREQUENCY TRANSIENT (Program #103)

The power source will produce the under-frequency transient excursion as defined by MIL-STD-704D (Paragraph 5.2.3.2.1). The power source **must** be configured for a voltage range of at least 115Vrms to perform this test.

INITIAL CONDITIONS:

f_o	393 Hz. (Min Steady-State Limit)
V	115 VAC
WF = 1	

TRANSIENT COMMAND SEQUENCE:

Segment 1:
F = 375, V = 115, T = 0.0002

Segment 2:
F = 375, V = 115, T = 1

Segment 3:
F = 380, V = 115, T = 0.0002

Segment 4:
F = 380, V = 115, T = 4

Segment 5:
F = 390, V = 115, T = 0.0002

Segment 6:
F = 390, V = 115, T = 5

4.4 PROGRAM EDIT MODE

This section describes Program Edit Mode.

Program Edit Mode allows program and transient editing.

4.4.1 PROGRAM EDITING

To enter Program Edit Mode: from any meter display press (**PROGRAM**, <program_number>, **ENTER**, **EDIT**), where <program_number> is any number from 1 to 99. The cursor will move to FORM. Edited program parameters will not become active until the **EXECUTE** key is pressed.

```
PROGRAM: #1  FORM=1 COUPLING=DIRECT
FREQ=50.00   V=120.0
EXEC ϕ=0     WF=1
#SEGS=0    Ilim=50.0
```

The following may be programmed:

FORM — Enter 1 or 2 Phase output FORM.

1 PHASE is when the Power Source is connected as a Single-Phase Power Source. The two power amplifiers are in parallel.

2 PHASE is when the Power Source is connected as a Split-Phase Power Source. The two power amplifiers are in series. This may be called two phase.

Refer to Section 2.1.6.

COUPLING — DIRECT is when the Power Amplifier is directly connected to the Output Contactor. This is the only mode allowed for TMX SERIES AC POWER SOURCE products.

FREQ — Enter any desired output frequency from 20.00 to 1200 hertz. The UPC1T must be in the frequency span desired for execution. See Section 4.5.3.2.

V — Programmed output voltage is entered.

EXEC ϕ — Execution phase angle. Range is inclusive for 0 to 359 integral degrees. Specifies the angle during the phase A voltage cycle to begin execution of a new program.

4.4.1 PROGRAM EDITING (cont)

WF

Select the desired output waveform. Waveform 1 is always a sine wave. Waveform 2-21 may be copied and/or edited as desired using the SETUP (**fn**) functions. Any waveform numbered from 1 to 21 may be selected.

The UPC1T will attempt to generate the selected waveform at the RMS voltage programmed. Because of the difference in the RMS voltage content of various waveforms the UPC1T may not be able to reproduce the waveform at the voltage desired. Selecting 2 phase output may solve this problem.

Ilim

Programmable current limit can be set as desired. This function is average responding, RMS programmed.

Pressing **STORE** at any time during editing will cause the program to be stored. The V/I METER display will become active.

Pressing **EXECUTE** at any time during editing will cause the program to be stored and executed. The V/I METER display will become active.

Pressing **EDIT** at any time during editing allows transients to be created and edited. The TRANSIENT edit display will become active.

4.4.1.1 PROGRAM EXAMPLE

The following is an example of how to create and execute a 1 phase, 108 volt, 400 Hz program. To execute a 400 Hz program you must be in frequency span 3 or 4 (refer to Section 4.5.3.2).

From any metering display (see Section 4.2.1) press the **PROGRAM** key.

```
PROGRAM: #1  FORM=2 COUPLING=DIRECT
FREQ=50.00   V=230.0
EXEC ϕ=0     WF=1
#SEGS=0    Ilim=30.0
```

Press **4, ENTER, EDIT** to edit program #4. Press EDIT once more if program #4 does not exist.

```
PROGRAM: #4  FORM=1 COUPLING=DIRECT
FREQ=50.00   V=230.0
EXEC ϕ=0     WF=1
#SEGS=0    Ilim=30.0
```

Press **1, ENTER** to select 1 phase form.

```
PROGRAM: #4  FORM=1 COUPLING=DIRECT
FREQ=50.00   V=230.0
EXEC ϕ=0     WF=1
#SEGS=0    Ilim=30.0
```

Press **400, ENTER** to select 400 hertz.

```
PROGRAM: #1  FORM=1 COUPLING=DIRECT
FREQ=400.00  V=230.0
EXEC ϕ=0     WF=1
#SEGS=0    Ilim=30.0
```

4.4.1.1 PROGRAM EXAMPLE (cont)

Press **108, ENTER** to select 108 volts.

```
PROGRAM: #4  FORM=1 COUPLING=DIRECT
FREQ=400.00  V=108.0
EXEC ϕ=0     WF=1
#SEGS=0    Ilim=30.0
```

Press **0, ENTER** to select an Execution angle of 0 degrees.

```
PROGRAM: #4  FORM=1 COUPLING=DIRECT
FREQ=400.00  V=108.0
EXEC ϕ=0     WF=1
#SEGS=0    Ilim=30.0
```

Press **1, ENTER** to select waveform 1.

```
PROGRAM: #4  FORM=1 COUPLING=DIRECT
FREQ=400.00  V=108.0
EXEC ϕ=0     WF=1
#SEGS=0    Ilim=50.0
```

Press **60,ENTER** to select default maximum Ilim (current limit) for this Power Source.

```
PROGRAM: #4  FORM=1 COUPLING=DIRECT
FREQ=400.00  V=108.0
EXEC ϕ=0     WF=1
#SEGS=0    Ilim=60.0
```

Press **EXECUTE** to execute this new program #4. The V/I METER display will become active.

```
V/I METER:
FREQ=60.00    V=120.0
SENSE=INT
PROGRAM #4    I=0.00
```

4.4.2 TRANSIENT EDITING

To edit transients: from any meter display press (**PROGRAM**, <program_number, **ENTER**, **EDIT**), where <program_number> is any number from 1 to 99. The cursor will move to FORM. This example presumes the user has loaded the program #4 information as described in the previous example.

```
PROGRAM: #4   FORM=1 COUPLING=DIRECT
FREQ=400.0    V=108.0
EXEC ϕ=0      WF=1
#SEGS=0    Ilim=60
```

From the PROGRAM edit display pressing **EDIT** again allows transients to be created and edited. The TRANSIENT edit display will become active.

```
TRANSIENT: PRGM #4    SEGMENT #1    OF 1
T=0.0002       V=120.0
F=400.0        WF=1
```

The following may be programmed:

SEGMENT # — Segments are small portions of a transient. Each segment provides a linear transition in volts and/or frequency in the time indicated. Different waveforms may be switched in during each segment.

Normally don't enter a number here. It will automatically increment as required. Up to 100 segments may be used to generate a transient. If you want to go to a previously edited segment, you may enter that segment number.

In the upper right hand corner the total number of segments are displayed. If you wish to reduce the number of segments in this transient you may enter the last segment number here and then press **STORE** to save the transient.

4.4.2 TRANSIENT EDITING (cont)

T (Transition time) — Enter a time from 0.0002 to 300 seconds for a time based transient.

If a cycle based transient is desired, then enter **0** in the first segment to make the transient a cycle based transient. The display will then show "1 CYCLE." The time for each segment will be 1 period of the output waveform. This is useful for switching in different waveforms on a cycle by cycle basis for sub-cycle transients.

V — Output voltage is entered.

FREQ — Any desired output frequency from 20.00 to 1200 hertz may be entered. The UPC1T must be in the frequency span desired for execution. See Section 4.5.3.2.

WF — Select the desired output waveform. Waveform 1 is always a sine wave. Waveform 2-21 may be copied and/or edited as desired using the SETUP (**fn**) functions.

The UPC1T will attempt to generate the selected waveform at the RMS voltage programmed at the *beginning* of each segment. Because of the difference in the RMS voltage content of various waveforms, the UPC1T may not be able to reproduce the waveform at the voltage desired. Selecting two-phase mode (FORM = 2 from the program edit display) may solve this problem.

TRANSIENT EVENTS — Enter the number of times you wish the transient to repeat. 0 causes the transient to repeat until the **TRANS** key is pressed.

4.4.2.1 TIME BASED TRANSIENT EXAMPLE

The following is an example of how to *create* a MIL-STD-704D time based transient. (Refer to the beginning of Section 4.3.2 regarding pre-stored transients).

Start with the previous program #4 example as shown in Section 4.4.1. From any metering display press (**PROGRAM, 4, ENTER, EDIT, EDIT**) and you will see the following display:

```
TRANSIENT: PRGM #4   SEGMENT #1   OF 1
T=0.0002     V=108.0
F=400.0     WF=1
```

Press **1, ENTER, ENTER** to select segment 1 of 1.

```
TRANSIENT: PRGM #4   SEGMENT #1   OF 1
T=0.0002     V=108.0
F=400.0     WF=1
```

Press **.0002, ENTER** to select a time of .0002 seconds. This is the smallest time allowed for a time based transient.

```
TRANSIENT: PRGM #4   SEGMENT #1   OF 1
T=0.0002     V=108.0
F=400.0     WF=1
```

Press **80, ENTER** to select 80 volts.

```
TRANSIENT: PRGM #4   SEGMENT #1   OF 1
T=0.0002     V=80.0
F=400.0     WF=1
```

4.4.2.1 TIME BASED TRANSIENT EXAMPLE (cont)

Press **400, ENTER** to select 400 hertz output frequency.

```
TRANSIENT: PRGM #4   SEGMENT #1   OF 1
T=0.0002     V=80.0
F=400.0     WF=1
```

Press **1** to select Waveform number 1.

```
TRANSIENT: PRGM #4   SEGMENT #1   OF 1
T=0.0002     V=80.0
F=400.0     WF=1
```

Press **ENTER**, now we are starting segment 2 of 2.

```
TRANSIENT: PRGM #4   SEGMENT #2   OF 2
T=0.0002     V=80.0
F=400.0     WF=1
```

Press **ENTER, ENTER, .01, ENTER** to select default segment 2 of 2 and a time of 10 milliseconds.

```
TRANSIENT: PRGM #4   SEGMENT #2   OF 2
T=0.0100     V=80.0
F=400.0     WF=1
```

4.4.2.1 TIME BASED TRANSIENT EXAMPLE (cont)

Press **80, ENTER** to select 80 volts.

```
TRANSIENT: PRGM #4   SEGMENT #2   OF 2
T=0.0100     V=80.0
F=400.0      WF=1
```

Press **400, ENTER** to select 400 hertz.

```
TRANSIENT: PRGM #4   SEGMENT #2   OF 2
T=0.0100     V=80.0
F=400.0      WF=1
```

Press **1** to select Waveform number 1.

```
TRANSIENT: PRGM #4   SEGMENT #2   OF 2
T=0.0100     V=80.0
F=400.0      WF=1
```

Press **ENTER**, now we are starting segment 3 of 3.

```
TRANSIENT: PRGM #4   SEGMENT #3   OF 3
T=0.0100     V=80.0
F=400.0      WF=1
```

4.4.2.1 TIME BASED TRANSIENT EXAMPLE (cont)

Press **ENTER, ENTER, .07, ENTER** to select default segment 3 of 3 and a time 70 milliseconds.

```
TRANSIENT: PRGM #4   SEGMENT #3   OF 3
T=0.0704     V=80.0
F=400.0      WF=1
```

Press 108, ENTER to select 108 volts.

```
TRANSIENT: PRGM #4   SEGMENT #3   OF 3
T=0.0704     V=108.0
F=400.0      WF=1
```

Press **400, ENTER** to select 400 hertz.

```
TRANSIENT: PRGM #4   SEGMENT #3   OF 3
T=0.0704     V=108.0
F=400.0      WF=1
```

Press **1** to select Waveform 1.

```
TRANSIENT: PRGM #4   SEGMENT #3   OF 3
T=0.0704     V=108.0
F=400.0      WF=1
```

4.4.2.1 TIME BASED TRANSIENT EXAMPLE (cont)

Press **STORE** to save the transient.

```
TRANSIENT EVENTS:
ENTER # OF TRANSIENT EVENTS 1
0 FOR INFINITE OR 1-65535.
```

Press **1, STORE** to cause only one transient event.

```
V/I METER:
FREQ=400.0    V=108.0
SENSE=INT
MANUAL MODE   I=00.0
```

If the UPC1T was previously executing program #4, it will now be in MANUAL MODE. This is because program #4 has changed. To execute the transient you must first execute program #4. Press **PROGRAM, 4, ENTER, EXECUTE** to execute the program.

```
V/I METER:
FREQ=400.0    V=108.0
SENSE=INT
PROGRAM #4    I=0.00
```

Press **TRANS** to execute the transient.

This is a MIL-STD-704D under voltage time based transient. See figure 4.4.2.1.

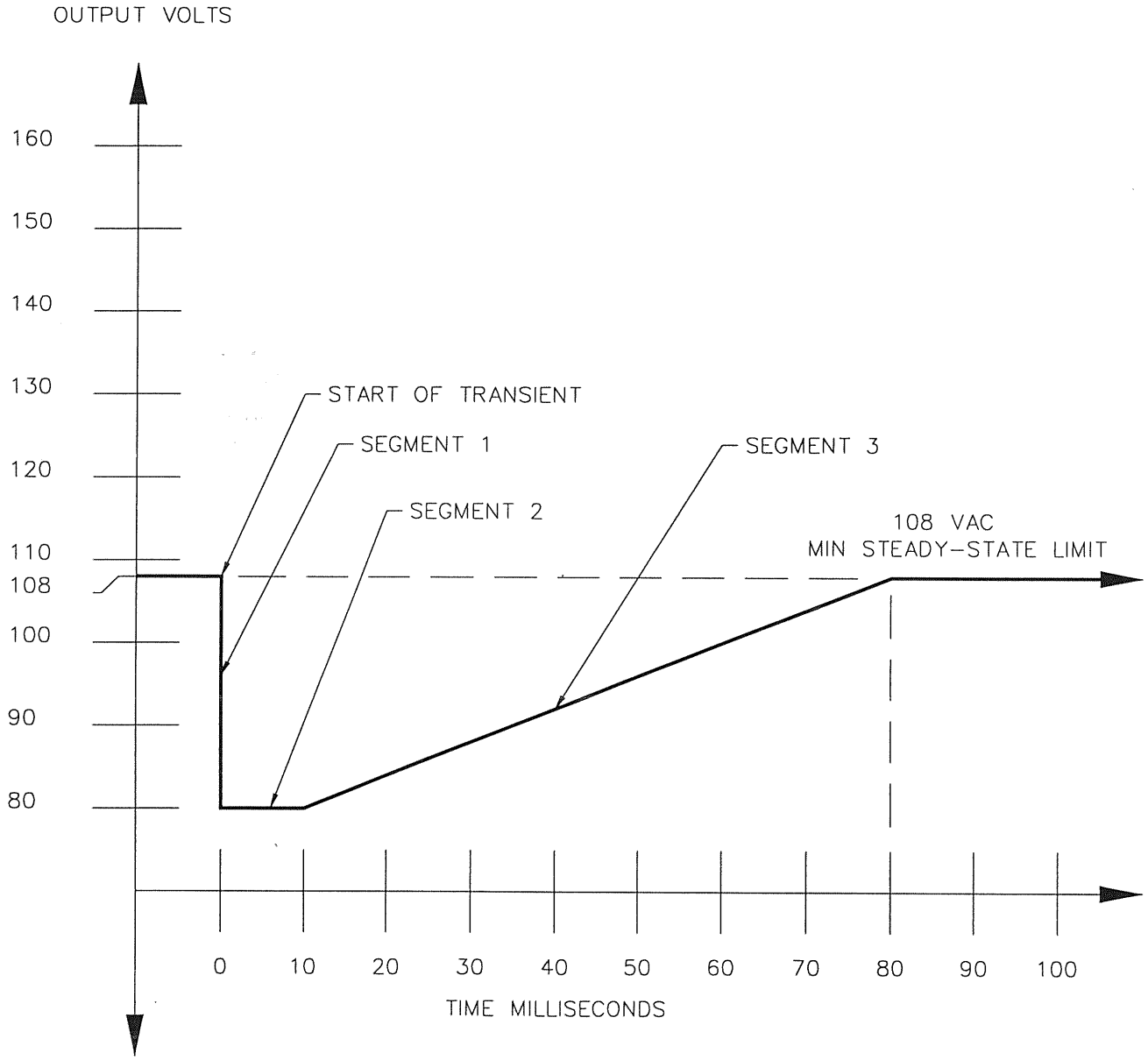


FIGURE 4.4.2.1 MIL-STD-704D UNDERVOLTAGE TRANSIENT

4.4.2.2 CYCLE BASED TRANSIENT EXAMPLE

The following is an example of how to create a cycle based transient. This example presumes the user has loaded the program information as described in the previous examples.

Start with program #4 example as shown in Section 4.4.1.1. From any metering display press **PROGRAM, 4, ENTER, EDIT, EDIT** and you should see the following display:

```
TRANSIENT: PRGM #4    SEGMENT #1    OF 1
T=0.0002      V=108.0
F=400.0       WF=1
```

Press **1, ENTER, ENTER** to select segment 1 of 1.

```
TRANSIENT: PRGM #4    SEGMENT #1    OF 1
T=.0002       V=108.0
F=400.0       WF=1
```

Press **0, ENTER** to select a cycle based transient.

```
TRANSIENT: PRGM #4    SEGMENT #1    OF 1
T=1 CYCLE     V=108.0
F=400.0       WF=1
```

Press **122, ENTER** to enter 122 volts. Note 122 volts is higher than the 108 volts of the steady-state program. This will cause the base sine wave to remain at a constant amplitude while adding extra voltage for the spikes.

```
TRANSIENT: PRGM #4    SEGMENT #1    OF 1
T=1 CYCLE     V=122.0
F=400.0       WF=1
```

4.4.2.2 CYCLE BASED TRANSIENT EXAMPLE (cont)

Press **400, ENTER** to select 400 hertz.

```
TRANSIENT: PRGM #4   SEGMENT #1   OF 1
T=1 CYCLE    V=122.0
F=400.0     WF=1
```

Press **15** to select waveform #15.

```
TRANSIENT: PRGM #4   SEGMENT #1   OF 1
T=1 CYCLE    V=122.0
F=400.0     WF=15
```

Press **STORE** to save the transient.

```
TRANSIENT EVENTS:
ENTER # OF TRANSIENT EVENTS 1
0 FOR INFINITE OR 1-65535.
```

Press **1, STORE** to cause only one transient event.

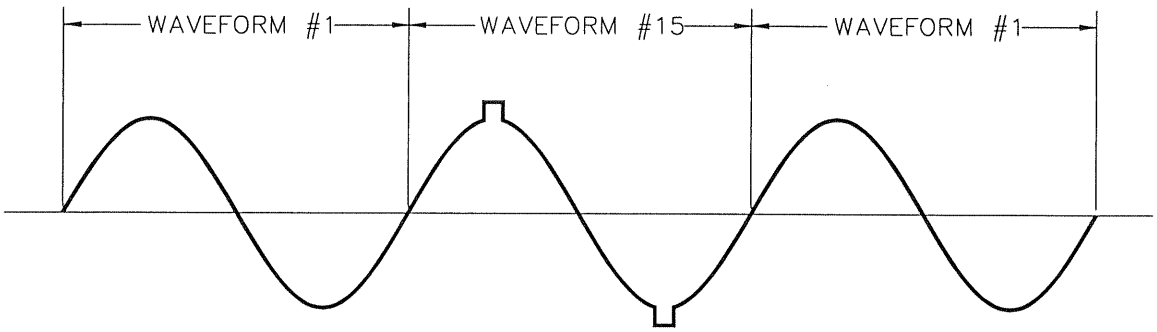
```
V/I METER:
FREQ=400.0   V=108.0
SENSE=INT
MANUAL MODE  I=0.00
```

If the UPC1T was previously executing program #4, it will now be in MANUAL MODE. This is because program #4 has changed. To execute the transient you must first execute program #4. Press **PROGRAM, 4, ENTER, EXECUTE** to execute the program.

```
V/I METER:
FREQ=400.0    V=108.0
SENSE=INT
PROGRAM #4    I=0.00
```

Press **TRANS** to execute the transient.

This cycle based transient will switch waveform #15 in for one cycle. This will cause a spike on the positive and negative half of the sine wave for one cycle. See figure 4.4.2.2.



SEGMENT 1 SWITCHES
IN WAVEFORM #15

FIGURE 4.4.2.2 SPIKE TRANSIENT

4.5 SETUP MODE

SETUP MODE is used to copy and delete programs, erase memory, copy and edit waveforms. You may set meter sense point, set CSC on or off, set Output Impedance, set Output range, transition time, min and max frequency, and frequency span. Status is given for firmware version, GPIB device address, amps to volts ratio, and the Power Source.

CALIBRATION functions for metering, IEC TEST SYSTEM CALIBRATION including: AUXILIARY METERING CALIBRATION, SYNTHETIC IMPEDANCE NETWORK CALIBRATION, and FUNCTION GENERATOR CALIBRATION are accessed from SETUP MODE.

Additionally, the IEC TEST SYSTEM CONTROL PANEL for local control of AUXILIARY METERING, IMPEDANCE NETWORKS, and the FUNCTION GENERATOR are reached using SETUP MODE.

From any meter display, press the ***fn*** key to enter SETUP MODE.

```
SETUP: PRESS
1 PROGRAM              4 UPC1T CALIBRATION
2 WAVEFORM             5 IEC TEST SYSTEM
3 GENERAL              6 FUNCTION GENERATOR
```

4.5.1 PROGRAM SETUP

PROGRAM SETUP is used to copy and delete programs, erase memory, copy and edit waveforms.

From any METER display (V/I, AMPS, POWER, or INRUSH):
press the ***fn*** key to enter SETUP MODE.
From the SETUP display, press **1** to enter PROGRAM SETUP.

```
PROGRAM SETUP: PRESS
1 TO COPY A PROGRAM,
2 TO DELETE A PROGRAM,
3 TO ERASE ALL MEMORY AND RESET CPU.
```

4.5.1.1 COPY PROGRAM

COPY PROGRAM is used to copy programs.

From any METER display (V/I, AMPS, POWER, or INRUSH):
press> (**fn**,**1**,**1**)

```
COPY PROGRAM:                          RANGE
SOURCE PROGRAM NUMBER=1                0-103
DESTINATION PROGRAM NUMBER=2           1-99
PRESS STORE TO COPY.
```

SOURCE PROGRAM NUMBER — **0**will copy the MANUAL MODE operating parameters.

1-99 are user created programs that may be edited or copied to and from.

NOTE: Program **100** is a MIL-STD-704D over voltage transient.
Program **101** is a MIL-STD-704D UNDER VOLTAGE transient.
Program **102** is a MIL-STD-704D over-frequency transient.
Program **103** is a MIL-STD-704D under-frequency transient.
These programs may be copied to any of programs **1 - 99** and executed.

DESTINATION PROGRAM NUMBER — **1-99** are user created programs that may be edited or copied to and from.

4.5.1.2 DELETE PROGRAM

DELETE PROGRAM is used to delete programs. This is useful to free up memory.

From any METER display (V/I, AMPS, POWER, or INRUSH):
press> (**fn**,**1**,**2**)

```
DELETE PROGRAM:                        RANGE
PROGRAM TO DELETE=1                    1-99
PRESS STORE TO ERASE
```

Enter the program number to delete and press **STORE** to erase that program.

4.5.1.3 ERASE ALL RAM AND RESET CPU

ERASE ALL RAM AND RESET CPU is used to erase edited programs 1-99 and edited waveforms 2-21. This will reset everything in the UPC1T. Only do this if the UPC1T is acting abnormally or if it is desired to restore all factory default settings. This must also be performed if the UPC1T firmware (EPROMs) have been changed.

From any METER display (V/I, AMPS, POWER, or INRUSH):
press> (**fn**,**1**,**3**)

```
ERASE ALL RAM AND RESET CPU:
WARNING-THIS WILL ERASE ALL PROGRAMS AND
EDITED WAVEFORMS. PRESS EXECUTE TO
ERASE RAM AND RESET CPU.
```

Press **EXECUTE** to perform this action.

NOTE: Pressing **9** instead of **EXECUTE** will cause the UPC1T to reset without clearing RAM.

4.5.2 WAVEFORM SETUP

WAVEFORM SETUP is used to copy and edit waveforms.

From any METER display (V/I, AMPS, POWER, or INRUSH):
press> (**fn**,**2**) to enter WAVEFORM SETUP.

```
WAVEFORM SETUP: PRESS
1 TO EDIT A WAVEFORM,
2 TO COPY A WAVEFORM.
3 FOR WAVEFORM SYNTHESIS
```

4.5.2.1 EDIT WAVEFORM

EDIT WAVEFORM is used to change or modify waveforms.

From any METER display (V/I, AMPS, POWER, or INRUSH):
press> **(fn,2,1)**

```
EDIT WAVEFORM: NUMBER=16        RANGE=2-21
STARTING PHASE ANGLE=0          0-359.5°
ENDING PHASE ANGLE  =0          0-359.5°
VOLTAGE IN PERCENT =0          (+/-)0-100%
```

Press **EXECUTE** to save the new waveform.

NUMBER — **2-21** may be edited.

PHASE ANGLE — The STARTING AND ENDING PHASE ANGLE determine what portion of the waveform is being edited.

VOLTAGE IN PERCENT — All points on the waveform from the starting to ending phase angle will change to this new voltage. This voltage is entered in percent, relative to the peak of the waveform, and may be positive or negative.

NOTE: On WAVEFORM RMS CONTENT: The UPC1T will attempt to generate the selected waveform at the RMS voltage programmed. Because of the difference in the RMS voltage content of various waveforms the UPC1T may not be able to reproduce the waveform at the voltage desired.

Basic sinusoidal waveforms with large dropouts or spikes will change the RMS content of the waveform. The UPC1T will cause the basic sine wave to change in amplitude in order to keep the correct RMS voltage. If you wish to keep the basic sine wave at the same amplitude and add a large dropout, you must also program a lower RMS voltage. If you wish to keep the basic sine wave at the same amplitude and add a large spike, you must also program a larger RMS voltage.

4.5.2.1 EDIT WAVEFORM (cont)

For example if you wanted to put a 10% spike on top of a sine wave, first copy waveform 1 to waveform 2 at a 90% amplitude scale factor. See the example in Section 4.5.2.2 copy waveform. This will give you 10% more voltage at the peak of the sine wave to work with. Then you may edit waveform 2 and add a 10% spike.

From the WAVEFORM SETUP display, press **1** to enter EDIT WAVEFORM.

```
EDIT WAVEFORM: NUMBER=2          RANGE=2-21
STARTING PHASE ANGLE=0           0-359.5°
ENDING PHASE ANGLE  =0           0-359.5°
VOLTAGE IN PERCENT =0           (+/-)0-100%
```

Press **2, ENTER** to select waveform 2.

```
EDIT WAVEFORM: NUMBER=2          RANGE=2-21
STARTING PHASE ANGLE=0           0-359.5°
ENDING PHASE ANGLE  =0           0-359.5°
VOLTAGE IN PERCENT =0           (+/-)0-100%
```

Press **85, ENTER** to select the start angle.

```
EDIT WAVEFORM: NUMBER=2          RANGE=2-21
STARTING PHASE ANGLE=85.0        0-359.5°
ENDING PHASE ANGLE  =0           0-359.5°
VOLTAGE IN PERCENT =0           (+/-)0-100%
```

Press **95, ENTER** to select the end angle.

```
EDIT WAVEFORM: NUMBER=2          RANGE=2-21
STARTING PHASE ANGLE=85.0         0-359.5°
ENDING PHASE ANGLE  =95.0         0-359.5°
VOLTAGE IN PERCENT =0           (+/-)0-100%
```

4.5.2.1 EDIT WAVEFORM (cont)

Press **100** to select the peak voltage in percent of full scale from the starting to ending phase angles.

```
EDIT WAVEFORM: NUMBER=2          RANGE=2-21
STARTING PHASE ANGLE=95.5         0-359.5°
ENDING PHASE ANGLE  =95.0         0-359.5°
VOLTAGE IN PERCENT =100          (+/-)0-100%
```

Press **EXECUTE,** to save the new waveform.

Make a new program with Waveform 2 and execute the new program. You should see the waveform as shown in figure 4.5.2.1.

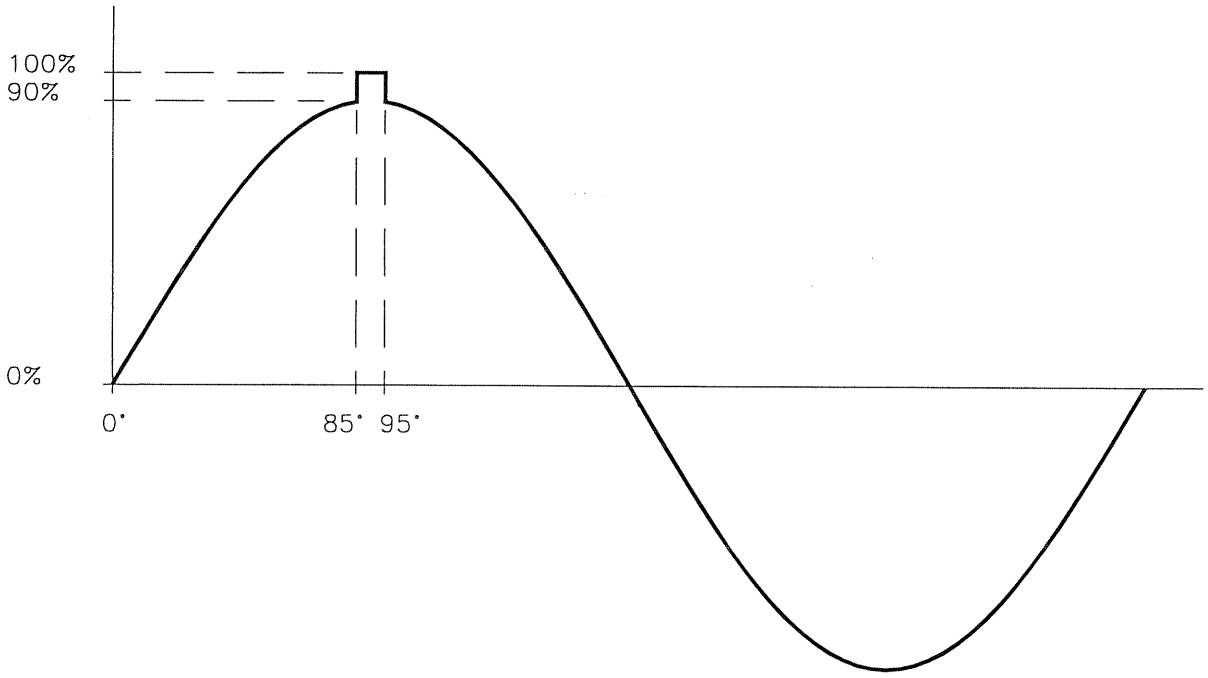


FIGURE 4.5.2.1 EDITED WAVEFORM

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4.5.2.2 COPY WAVEFORM

COPY WAVEFORM is used to copy waveforms.

From any METER display (V/I, AMPS, POWER, or INRUSH):
press > (**fn**,**2**,**2**)

```
COPY WAVEFORM:                          RANGE
AMPLITUDE SCALE FACTOR=100              0-100%
SOURCE WAVEFORM          =1             1-21
DESTINATION WAVEFORM     =2             2-21
```

Press **EXECUTE** to copy the waveform.

AMPLITUDE SCALE FACTOR — Sets the amplitude of the destination waveform relative to the source waveform.

SOURCE WAVEFORM — **1-21**may be copied from. **1** is always a sine wave. **2-21** may be edited.

DESTINATION WAVEFORM — **2-21** may be copied to.

4.5.2.2 COPY WAVEFORM (cont)

For example if you wanted to put a 10% spike on top of a sine wave, first copy waveform 1 to waveform 2 at a 90% amplitude scale factor. This will give you 10% more voltage at the peak of the sine wave to work with. Then you may edit waveform 2 and add a 10% spike.

From the WAVEFORM SETUP display, press **2** to enter COPY WAVEFORM.

```
COPY WAVEFORM:                          RANGE
AMPLITUDE SCALE FACTOR=100              0-100%
SOURCE WAVEFORM          =1             1-21
DESTINATION WAVEFORM     =2             2-21
```

Press **90, ENTER, 1, ENTER, 2** to select amplitude scale factor, source and destination waveforms.

```
COPY WAVEFORM:                          RANGE
AMPLITUDE SCALE FACTOR=90               0-100%
SOURCE WAVEFORM          =1             1-21
DESTINATION WAVEFORM     =2             2-21
```

Press **EXECUTE** to copy the waveform. Waveform 2 is now a sine wave but at 90% of the amplitude of waveform 1.

4.5.2.3 WAVEFORM SYNTHESIS

WAVEFORM SYNTHESIS is used to create waveforms from Harmonic magnitude and phase angle information.

From any METER display (V/I, AMPS, POWER, or INRUSH):
press> (**fn**,**2**,**3**)

The following is displayed.

```
WAVEFORM SYNTHESIS: WAVEFORM #2
HARMONIC: 2nd  3rd  4th  5th  6th
CONTENT:  .1%  0%   0%   0%   0%
ϕANGLE:   0°   0°   0°   0°   0°
```

Note: The CONTENT fields hold the Magnitude expressed as a percentage of the fundamental.

Press **EDIT** to advance a screen ahead.

The first step in creating a waveform from Harmonic data is to specify the Waveform number that will hold the newly created waveform. After entering the waveform number, enter each harmonic magnitude and its phase angle. Harmonics up to the 51st may be entered.

The waveform is synthesized using a sine series with coefficients expressed in polar format, i.e. that is magnitude and phase angle.

Each CONTENT is referenced to the fundamental which is always defined as having a magnitude of 100%.

When all desired harmonic data has been entered, press the **EXECUTE** key. The waveform previously stored in the specified Waveform location # is overwritten. Programs referring to this waveform # are affected.

The **STORE** key may be used to store the data entered so far, without calculating and producing the new waveform.

4.5.3 GENERAL SETUP

GENERAL SETUP is used for UPC SETUP, FREQUENCY SPAN, UPC STATUS, POWER SOURCE STATUS, RANGE CONTROL, and SLEW RATE SETUP.

From any METER display (V/I, AMPS, POWER, or INRUSH):
press> (**fn**,**3**) to enter GENERAL SETUP.

```
GENERAL SETUP: PRESS
1 UPC SETUP            4 POWER SOURCE STATUS
2 FREQUENCY SPAN       5 RANGE CTRL
3 UPC STATUS           6 SLEW RATE SETUP
```

The following pages describe each menu item shown above.

4.5.3.1 UPC SETUP

UPC SETUP is used to select meter sense point, enable or disable Continuous Self Calibration, set transition time, voltage limits, frequency limits and Programmable Output Impedance.

From any METER display (V/I, AMPS, POWER, or INRUSH):
press> (**fn**,**3**,**1**)

```
UPC SETUP: SENSE=INT, CSC=OFF
PROG.Zo-Hit EDIT. TRANSITION TIME=0
FREQ.    LIMITS MIN=45     MAX=1200
VOLTAGE LIMITS MIN=0       MAX=600
```

SENSE	May be **INT**ernal or **EXT**ernal. This is the sense point for metering and CSC. **EXT**ernal uses the remote sense terminals on the rear panel of the Power Source.
CSC	Continuous Self Calibration. If EXTernal SENSE is selected, CSC may be used to compensate for output wiring losses and maintain accurate program output voltage at the sense point which may be the load.
PROG. Zo	(Programmable Output Impedance) is used to compensate for regulation loss due to transformer outputs or to control the Output Impedance of the power source. Press **EDIT** to access the PROG. Zo menu, as shown below.
TRANSITION TIME	If a new program is executed, or changes are made in MANUAL MODE (or in REMOTE CONTROL), it will take this long for the UPC1T to transition from the current voltages and frequency to the new voltages and frequency. This feature may be used when it is undesirable to cause abrupt changes to the output power signal. This feature does not affect transient operation. This parameter may be set from 0 to 300 seconds in 200 uS steps. Waveforms are switched at the *end* of the Transition. This feature does not apply to Function Generator operations.
FREQ LIMITS	Sets the MINimum and MAXimum programmable frequency limits of the UPC1T.
VOLTAGE LIMITS	Sets the MINimum and MAXimum programmable voltage limits of the UPC1T.

4.5.3.1.1 PROGRAMMABLE OUTPUT IMPEDANCE (PROG. Z-OUT)

Programmable Output Impedance (Prog. Zo) is used to compensate for regulation loss due to transformer outputs or to control the Output Impedance of the power source. Press **EDIT** while the display cursor is located in the PROG. Zo field in the UPC1T SETUP menu to access the PROG. Zo menu, as shown below.

```
PROG. Zo SETUP: PRESS EXECUTE TO SAVE.
PROG. Zo = OFF: PROG. Zo OHMS = 0.000
                MAX=2.516   MIN=-2.484
(PRESS EDIT TO CALIBRATE, THEN EXECUTE)
```

Pressing the +/- key while the cursor is in the ON/OFF field will enable/disable the Prog. Zo function. When disabled, no output compensation occurs and the inherent output impedance of the power source and wiring will remain uncompensated. When enabled, the UPC1T will attempt to provide an output impedance at the load equal to the value set in the PROG. Zo OHMS field.

Min and max impedance values are shown on the display as this range dynamically changes based upon current operating parameters such as Form. Press **EXECUTE** to exit the screen.

--- CAUTION ---

CARELESS OR IMPROPER USE
OF THE
PROGRAMMABLE OUTPUT IMPEDANCE FUNCTION
MAY RESULT IN OVER-VOLTAGE OR UNDER-VOLTAGE BEING PRESENTED
TO THE LOAD, AND CAUSE DAMAGE TO THE LOAD.

REACTIVE LOADS MAY CAUSE THE OUTPUT POWER TO BECOME UNSTABLE (OSCILLATE)
AND CAUSE DAMAGE TO THE LOAD
IF EXCESSIVE NEGATIVE IMPEDANCE IS USED!

USE THIS FUNCTION WITH CARE

--- CAUTION ---

4.5.3.1.1 PROGRAMMABLE IMPEDANCE OUTPUT (PROG. Z-OUT) (cont)

Press **EDIT** again to access the following screen.

```
PRESS ENTER TO LOAD PROG. Zo CALIBRATION.
            VALUES
PRESS 0  TO RESET CALIBRATION VALUES TO
            FACTORY DEFAULTS.
```

Press **ENTER** to access the following screen to enter special calibration values for the Prog. Zo function.

Single-Phase Display (Form = 1).

```
ϕ  Z direct
1   0.006
```

Split-Phase Display (Form = 2).

```
ϕ  Z direct

2   0.012
```

NOTE: The unit is pre-calibrated at the factory, but if re-calibration of this function is desired, or if the RAM (memory) in the UPC1T has been lost or erased, use this screen to enter new calibration values. A calibration procedure is provided below.

The Z direct column accepts the Direct coupled impedance of the power source for the given Power Form listed on the far left. During DIRECT coupled operation, the proper Z direct value is used to calibrate the PROG. Zo function based upon the Power Form selected in the Program being executed.

4.5.3.1.1 PROGRAMMABLE IMPEDANCE OUTPUT (PROG. Z-OUT) (cont)

Calibration values for Direct coupled operation may be established via the following procedure.

Turn CSC OFF. Disable PROG. Zo. Execute a program.

A. Establish the difference in output voltage between no-load and full-load voltage.

B. Divide the Voltage difference by the full-load current. The net result is the inherent direct coupled impedance of the power source.

$$Z = \frac{V\_no\_load - V\_full\_load}{I\_full\_load}$$

Use the result to enter in as Z-Direct for the power Form used to perform this test.

4.5.3.2 FREQUENCY SPAN

FREQUENCY SPAN sets available frequency range and resolution of the output waveform. It also sets the number of samples used during metering, except for AUXILIARY METERING.

From any METER display (V/I, AMPS, POWER, or INRUSH):
press> (**fn**,**3**,**2**) to enter FREQUENCY SPAN.

```
FREQUENCY SPAN:          PRESS 1 FOR  150Hz
SPAN = 150Hz                   2 FOR  300Hz
                               3 FOR  600Hz
                               4 FOR 1200Hz
```

Usage:
i. Press number key associated with a FREQUENCY SPAN ["**1**" or "**2**" or "**3**" or "**4**"],
ii. Press "**EXECUTE**"

PRESS	FREQUENCY SPAN	WAVEFORM STEPS	METERING SAMPLES
1 default	20.00 - 150 Hz	1024	512
2	20.00 - 300 Hz	512	256
3	20.00 - 600 Hz	256	128
4	20.00 - 1200 Hz	128	64

4.5.3.3 UPC STATUS

UPC STATUS indicates firmware version and GPIB interface status. It also allows the user to set the GPIB device address and AMPS TO VOLTS RATIO. The UPC SETUP menu is accessed from the General Setup menu (***fn***,**3**,**1**).

From any METER display (V/I, AMPS, POWER, or INRUSH):
press> (**fn**,**3**,**3**) to enter UPC STATUS.

GPIB interface:

```
UPC STATUS: FIRMWARE 141298 v2.10
GPIB ADDRESS 1  IFC   LAST DATA BYTE=00h

AMPS TO VOLTS RATIO 6.00A=1 V
```

GPIB ADDRESS — This is the IEEE-488 device address for the UPC1T. To change the address, press **EDIT**, enter a number from 0 to 30 then press **ENTER** or **STORE**. The factory default address is 1.

AMPS TO VOLTS RATIO — This sets the ratio of current to voltage which the UPC1T meters. This **MUST** be the TMX SERIES AC POWER SOURCE output AMPS TO VOLTS RATIO. Refer to PACIFIC POWER SOURCE CORPORATION's TMX SERIES AC POWER SOURCE OPERATION MANUAL for the appropriate value to enter. To change the ratio, press **EDIT**, **ENTER**, **ENTER**, **ENTER**, enter a number from 1 to 500. Then press **ENTER** or **STORE**.

IFC — This is displayed only if an IEEE-488 Interface Clear message is received while this status display is shown. This display latches the IFC message. Press **CLEAR** to clear this display and the IFC field. This is used for troubleshooting the GPIB interface.

LAST DATA BYTE= — This field indicates the last data byte (DAB) received by the devices GPIB interface. The byte is shown in hexadecimal format. Hex 0D (Carriage Return) is displayed as Hex 0A (New Line). This is used for troubleshooting the GPIB interface.

4.5.3.4 POWER SOURCE STATUS

POWER SOURCE STATUS indicates the state of control signals to and from the Power Source that are not indicated by LEDs on the front panel. See Sections 2.3.4 OUTPUT CONTROL and 2.3.5 INPUT CONTROL for a description of these signals. This display is only used for technical diagnostics.

From any METER display (V/I, AMPS, POWER, or INRUSH):
press> (**fn**,**3**,**4**) to enter POWER SOURCE STATUS.

```
POWER SOURCE STATUS:
          3PH     1PH    CONNECTOR     XFMR
CMD     FALSE   FALSE      FALSE       FALSE
CONF    FALSE   FALSE      FALSE       FALSE
```

CMD Are Commands signals sent from the UPC1T to the Power Source.

CONF Are Confirmations signals sent from the Power Source to the UPC1T.

Pressing **EDIT** will enable the +/- key to toggle the Connector CMD signal state.

4.5.3.5 RANGE CONTROL

Some power source models support Range Control. The UPC1T used with TMX SERIES AC POWER SOURCE products does not, so, this menu selection has no effect.

4.5.3.6 SLEW RATE SETUP

Selecting SLEW RATE SETUP from the General Setup menu (***fn***,**3**,**6**) allows the slewing functions to slew at a predetermined rate. Defaults values are 1 volt per second and 1 Hz. per second. Press **EXECUTE** to save the parameter entries.

```
SLEW RATE SETUP:
VOLTS / SEC. = 1
HERTZ / SEC. = 1.00
```

NOTE: Slew rates are approximate.

4.5.4 UPC1T CALIBRATION MENU

Selecting UPC1T CALIBRATION from the General Setup menu (***fn***,**4**) allows the further selection of calibration procedures for IEC TEST SYSTEM related calibration, UPC1T voltage and current EXTERNALLY REFERENCED calibration and Kfactor DISPLAY screens.

```
          UPC1T CALIBRATION MENU
1 IEC TEST SYSTEM CALIBRATION
2 EXTERNALLY REFERENCED CALIBRATION
3 Kfactor DISPLAY
```

Usage:
i. Press selected number key ["**1**" or "**2**" or "**3**"],
ii. Press "**ENTER**"

4.5.4.1 IEC TEST SYSTEM CALIBRATION

Selecting IEC TEST SYSTEM CALIBRATION from the Calibration Menu (**fn**,**4**,**1**) allows the further selection of related calibration procedures, including: AUXILIARY METERING CALIBRATION, SYNTHETIC IMPEDANCE CALIBRATION, and FUNCTION GENERATOR CALIBRATION screens.

```
       IEC TEST SYSTEM CALIBRATION
1 AUXILIARY METERING CALIBRATION
2 SYNTHETIC IMPEDANCE CALIBRATION
3 FUNCTION GENERATOR CALIBRATION
```

Usage:
i. Press selected number key ["**1**" or "**2**" or "**3**"],
ii. Press "**ENTER**"

4.5.4.1.1 AUXILIARY METERING CALIBRATION

Selecting IEC TEST SYSTEM CALIBRATION from the Calibration Menu (**fn,4,1,1**) allows the further selection of the method to calibrate auxiliary metering. Either, EXTERNALLY REFERENCED CALIBRATION or DISPLAY CALIBRATION SCALE FACTORS may be selected.

```
     AUXILIARY METERING CALIBRATION
1 EXTERNALLY REFERENCED CALIBRATION
2 DISPLAY CALIBRATION SCALE FACTORS
```

Usage:

i. Press selected number key ["**1**" or "**2**"],
ii. Press "**ENTER**"

4.5.4.1.1.1 AUX. METER EXT. REF. CALIBRATION

Selecting EXTERNALLY REFERENCED CALIBRATION from the Auxiliary Metering Calibration Menu (**fn,4,1,1,1**) allows the user to enter externally measured RMS values directly. The UPC1T will use the values entered to automatically calibrate an auxiliary metering channel. The procedure is as follows:

```
    AUX. METER EXT. REF. CALIBRATION

PRESS (+/-) <channel><rms_display> UNITS
ENTER EXTERNAL REF.= <rms_entry>   UNITS
```

Usage:

i. Select one of the eight channels to calibrate by pressing the "+/-" key a few times,
ii. Press the "**ENTER**" key to initiate metering for that channel (i.e. a RMS metered value corresponding to the selected channel will be displayed in real-time),
iii. Press the "**ENTER**" key again to advance the cursor position to the "EXTERNAL REFERENCE" entry field, metering will be suspended,
iv. Enter the externally measured RMS reference value,
v. Press the "**EXECUTE**" or "**STORE**" key to automatically calculate and apply the scale factor for this channel, metering automatically resumes to allow verification.
vi. Repeat procedure for each channel to be calibrated.

The "**CLEAR**" key may be used anytime during the procedure to clear an entry, back the cursor to the previous field, or return to the V/I (or other) METER display.
The "**DISPLAY**" key may be used anytime to immediately return to a METER display.

4.5.4.1.1.2 DISPLAY CALIBRATION SCALE FACTORS

Selecting DISPLAY CALIBRATION SCALE FACTORS from the Auxiliary Metering Calibration Menu (**fn,4,1,1,2**) allows the user to enter and/or view the scale factors used for auxiliary metering.

```
V_EXT    <scale> mV  SPARE    <scale> mA
V_RELAY  <scale> mV  I_SPARE  <scale> mA
V_SPARE  <scale> mV  I_AFE    <scale> mA
V_PA     <scale> mV  I_AAAF   <scale> mA
```

Usage:

i. Press "**EDIT**" to allow modification of the scale factors,
ii. Enter "<scale>" as a floating point numeric,
iii. Press "**ENTER**" to accept scale value and advance cursor to next entry,
iv. Repeat for each value to be entered,
v. Press the "**EXECUTE**" or "**STORE**" key to apply the displayed calibration scale factors.

4.5.4.1.2 SYNTHETIC IMPEDANCE CALIBRATION

Selecting SYNTHETIC IMPEDANCE CALIBRATION from the IEC TEST SYSTEM CALIBRATION menu (**fn,4,1,2**) allows the user to calibrate the synthetic impedance network by entering the number of counts per unit appropriate for the desired range. Units are ohms for the resistive network and micro-Henrys for the inductive network; therefore, the R-net scale is in counts-per-ohm and the L-net scale is in counts-per-microHenry. The calibration is based on a full-count of 65535. For example, to calibrate the R-net for a range of 0 to 4 ohms the R-net scale = 65536 total #of counts / (4-0) ohms = 65536 / 4 = 16384 counts-per-ohm. This procedure will get the unit close, further calibration may be required to fully calibrate the unit.

```
 CALIBRATE SYNTHETIC IMPEDANCE NETWORK
Z-COMPONENT     COUNTS-PER-UNIT
R-NET SCALE = <counts>    PER OHM
L-NET SCALE = <counts>    PER uH
```

Usage:

i. Press "**EDIT**" to allow modification of the scale factors,
ii. Enter "<counts>" as an integer numeric,
iii. Press "**ENTER**" to accept R-net scale value and advance cursor to next entry,
iv. Repeat ii and iii for the L-net scale value,
v. Press the "**EXECUTE**" or "**STORE**" key to apply the displayed calibration scale factors.

4.5.4.1.3 FUNCTION GENERATOR CALIBRATION

Selecting FUNCTION GENERATOR CALIBRATION from the IEC TEST SYSTEM CALIBRATION menu (**fn**,**4**,**1**,**3**) allows the user to enter or view the scale factors used for the Function Generator. These calibration constants are used internally by the UPC1T to accommodate (automatically) low-gain voltages and high-gain voltages, as well as user designated routing of the function generator output.

```
AUX LO-GAIN VOLTAGE SCALE:  <scale>
AUX HI-GAIN VOLTAGE SCALE:  <scale>
AM  LO-GAIN VOLTAGE SCALE:  <scale>
AM  HI-GAIN VOLTAGE SCALE:  <scale>
```

Usage:

i. Press "**EDIT**" to allow modification of the scale factors,
ii. Enter "<scale>" as a floating point numeric,
iii. Press "**ENTER**" to accept scale value and advance cursor to next entry,
iv. Repeat for each value to be entered,
v. Press the "**EXECUTE**" or "**STORE**" key to apply the displayed calibration scale factors.

Note: Refer to Section 8 in this Operation Manual for detailed calibration procedures.

4.5.4.2 EXTERNALLY REFERENCED CALIBRATION

Selecting EXTERNALLY REFERENCED CALIBRATION from the CALIBRATION MENU (**fn,4,2**) allows the user to directly enter externally measured RMS voltages and RMS currents to be used by the controller to automatacally calculate Kfactors. The UPC1T should be calibrated for both single-phase and split-phase configurations. **Refer to Section 8 for detailed calibration procedures.**

Split-Phase Display (Form = 2).

```
 ϕ INT.V-SENSE EXT.V-SENSE |
AB <rms_entry> <rms_entry> | Ia <RMS_>
```

Single-Phase Display (Form = 1).

```
 ϕ INT.V-SENSE EXT.V-SENSE | I1 <RMS_>
A  <rms_entry> <rms_entry> |
```

Usage:

i. Press "**EDIT**" to allow modification of the scale factors,
ii. Enter "<scale>" as a floating point numeric,
iii. Press "**ENTER**" to accept scale value and advance cursor to next entry,
iv. Repeat for each value to be entered,
v. Press the "**EXECUTE**" or "**STORE**" key to apply the displayed calibration scale factors.

4.5.4.3 Kfactor DISPLAY

Selecting (**fn,4,3**) from the CALIBRATION MENU allows the user to directly enter or view all oscillator calibration Kfactor constants on a single screen. Only the fields in the first column and the last column apply to the UPC1T controller. These Kfactors are automatically calculated when externally referenced Kfactors for INT.V-SENSE (internal voltage sense) are entered.

```
Kin A:<####> B:<####> C:<####> AB:<####>
Kex A:<####> B:<####> C:<####> AB:<####>
Ki  A:<####> B:<####> C:<####> AB:<####>
Ko  A:<####> B:<####> C:<####> AB:<####>
```

Usage:

i. Press "**EDIT**" to allow modification of the scale factors,
ii. Enter "<scale>" as a floating point numeric,
iii. Press "**ENTER**" to accept scale value and advance cursor to next entry,
iv. Repeat for each value to be entered,
v. Press the "**EXECUTE**" or "**STORE**" key to apply the displayed calibration scale factors.

4.5.5 IEC TEST SYSTEM SETUP

Selecting IEC from the General SETUP menu (**fn,5**) allows the further selection of IEC test system related controls, including: AUXILIARY METERING control, IMPEDANCE NETWORK control, and alternative access to the FUNCTION GENERATOR.

```
    IEC TEST SYSTEM CONTROL PANEL
1 AUXILIARY METERING
2 IMPEDANCE NETWORK
3 FUNCTION GENERATOR
```

Usage:

i. Press selected number key ["**1**" or "**2**" or "**3**"],
ii. Press "**ENTER**"

4.5.5.1 AUXILIARY METERING CONTROL

Selecting AUXILIARY METERING CONTROL from the IEC TEST SYSTEM CONTROL PANEL menu (**fn,5,1**) allows the user to meter any one of eight (single channel ADC mode) or any compatible two of eight (dual channel ADC mode) channel(s) from the UPC1T front panel. Auxiliary metering is used by PPSC Virtual Instruments to accomplish IEC 1000-3-2 and IEC 1000-3-3 testing. This is done via GPIB communication between the UPC1T controller and a PC-HOST system. **During an IEC 1000-3-x test, Auxiliary Metering is controlled exclusively by PPSC Virtual Instrumentation.** UPC1T local control of auxiliary metering is provided for stand-alone calibration and verification of the auxiliary metering operation.

Single Channel Operation Display:

```
            AUXILIARY METERING
ADC MODE = SINGLE
CHANNEL 1 = <name> <rms_display>  UNITS
```

Dual Channel Operation Display:

```
            AUXILIARY METERING
ADC MODE = DUAL
CHANNEL 1 = <name> <rms_display>  UNITS
CHANNEL 2 = <name> <rms_display>  UNITS
```

Usage:

i. Press "**EDIT**" to interrupt RMS metering process, cursor will position on ADC MODE entry,
ii. Press "+/-" key to toggle between "SINGLE" and "DUAL" channel ADC modes,
iii. Press "**ENTER**" to set ADC mode and advance cursor to CHANNEL 1 entry,
iv. Press "+/-" key to step through possible choices for entry,
v. Press "**ENTER**" to select channel entry, if dual mode repeat iii-v to select CHANNEL 2,
vi. Press "**EXECUTE**" to initiate metering <rms_display(s)> for selected channel(s).

4.5.5.2 IMPEDANCE NETWORK CONTROL

Selecting IMPEDANCE NETWORK CONTROL from the IEC TEST SYSTEM CONTROL PANEL menu (**fn,5,2**) allows the user to configure both the IEC 725 reference impedance (lumped parameter) and synthetic impedance networks. Synthetic resistance and synthetic inductance may be entered in ohms and microHenrys, respectively. The synthetic impedance network is activated by setting the SYNTHETIC Z state to "ON." Likewise, the lumped parameter impedance network is active when IEC 725 REF. Z state is set "ON" and the IEC 725 reference impedance network is bypassed when IEC 725 REF. Z is "OFF."

```
            IMPEDANCE NETWORK
SYNTHETIC RESISTANCE = <value>    OHMS
SYNTHETIC INDUCTANCE = <value>    uH
SYNTHETIC Z = ON     IEC 725 REF. Z = OFF
```

Usage:

i. Enter "<value>" as a floating point numeric for the resistive component.
ii. Press **ENTER** to set synthetic resistance.
iii. Enter "<value>" as a floating point numeric for the inductive component.
iv. Press **ENTER** to set synthetic inductance.
v. Press "+/-" to toggle between on/off states for synthetic impedance.
vi. Press **ENTER** to set the state of synthetic impedance.
vii. Press "+/-" to toggle between on/off states for the IEC 725 reference impedance network.
viii. Press **ENTER** to set the state of the analog IEC 725 reference impedance network.
ix. Press **EXECUTE** or **STORE** to implement new impedance settings.

4.5.6 FUNCTION GENERATOR

The UPC1T has a separate oscillator that can generate user programmable waveforms asynchronous to the power source output frequency. Waveforms number 1 to 21 may be selected for operation at any selected frequency which is less than the present FREQUENCY SPAN (refer to Section 4.5.3.2). Waveform number 22, a sixteen-cycle sine wave is *automatically* selected if a frequency greater than the present FREQUENCY SPAN is entered, this reduces resolution by a factor of sixteen but allows operation at higher frequencies, all associated frequency calculations are performed automatically and is transparent to the user (with the realization that ***higher frequency waveforms must be a sine wave***).
Refer to Section 2.1.7 for FUNCTION GENERATOR SPECIFICATIONS.

The ROUTE of the FUNCTION GENERATOR's output corresponds to one of the UPC1T's ANALOG INPUTS. For ROUTE = AUX the FUNCTION GENERATOR output is algebraically summed to the oscillator signal output, for ROUTE = AM the FUNCTION GENERATOR output is used to Amplitude Modulate the oscillator signal output, and for ROUTE = OFF no FUNCTION GENERATOR output is produced.

Refer to Section 2.3.6 for AUX and AM ANALOG INPUT SPECIFICATIONS.

Refer to Section 8.4.4 for FUNCTION GENERATOR CALIBRATION procedures.

Selecting FUNCTION GENERATOR (**fn,6**)

```
          FUNCTION GENERATOR
WAVEFORM = <wf#>          ROUTE = <route>
AMPLITUDE = <RMS_volts> VOLTS
FREQUENCY = <frequency>  Hz
```

Usage:

i. Enter "<wf#>" as an integer from 1 to 21.
ii. Press **ENTER** to set selected waveform.
iii. Select OFF, AM, or AUX as the"<route>" of the FUNCTION GENERATOR's output by pressing the "+/-" key until desired route is displayed.
iv. Press **ENTER** to set ROUTE.
v. Enter "<RMS_volts>" as a floating point numeric .
vi. Press **ENTER** to set AMPLITUDE.
vii. Enter "<frequency>" as a floating point numeric, range: 0.0047Hz to 2400 Hz.
viii. Press **ENTER** to set the FREQUENCY.
ix. Press **EXECUTE** or **STORE** to implement new FUNCTION GENERATOR settings.

Waveform	Default
# 1	SINE waveform
# 2	TRIANGLE waveform
# 3	SQUARE waveform
# 4	PULSE waveform

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SECTION 5

GPIB and REMOTE OPERATION

5 GPIB and REMOTE OPERATION

This section describes remote control functions of the UPC1T over the IEEE-488 BUS. It is strongly recommended that the user read Section 4 (Front Panel Operation) to become familiar with the capabilities of the UPC1T. Section 5 expects the user to have already gained an understanding of the UPC1T's capabilities.

5.1 INTRODUCTION

REMOTE CONTROL is established when a controlling or programming command is sent to the UPC1T by the Bus controller with REN (remote enable) set true. The REN line on the bus interface must be kept true to maintain REMOTE CONTROL. REMOTE CONTROL can only be initiated and maintained while the UPC1T is displaying a Metering display (not while editing) or while in the UPC1T STATUS display. All front panel programming and signal controls are disabled while REMOTE CONTROL is active, but metering information is still accessible for viewing through the front panel.

Status and metered data queries do not place the UPC1T into REMOTE CONTROL.

The front panel **LOCAL** key allows the user to restore LOCAL CONTROL unless the Bus controller has sent the IEEE-488 LOCAL LOCKOUT (LLO) message. The Bus controller may restore LOCAL CONTROL by sending the IEEE-488 GO TO LOCAL (GTL) message. Refer to Section 4.5.3.3 for setting the GPIB device address.

NOTE: Contact PPSC for availability of Instrument drivers for use with **National Instruments LabWindows, LabView** and **LabView for Windows**. These software drivers allow graphical programming and control of the UPC1T via the REMOTE interface. These drivers may support the IBM-PC, Macintosh and SUN computers. Software drivers for other programming languages may also be made available.

NOTE: TMX SERIES AC POWER SOURCE/ANALYZER products include Virtual Instrumentation software. Refer to the PPSC TMX SERIES AC TEST SYSTEM (TMXTS) OPERATION MANUAL.

5.2 CONVENTIONS

1. COMMANDS are shown in the left hand column beginning with asterisk (*) or colon (:) in **BOLD** text with NO underline.

2. Command DESCRIPTIONS are shown in the right hand column.

3. Refer to the SCPI 1992 standard for more information. SCPI is "Standard Commands for Programmable Instruments -1992". This standard is available from the SCPI Consortium, 8380 Hercules Dr. Suite P3, La Mesa Ca. 91942.

4. Some SCPI keywords are optional, and are ignored by the device. Optional keywords are enclosed in [] brackets.

5. Lowercase letters of commands shown are optional.

6. SCPI commands (start with :) recognized by the UPC1T, are NOT case sensitive, as opposed to the SCPI 1992 standard requiring uppercase letters in SCPI commands to remain uppercase.

7. IEEE-488.2 commands start with * and are not case sensitive.

8. All SCPI commands have query command counterparts unless noted. A query command consists of the command immediately appended with a question mark (?). No value is to be sent with a query. IEEE-488.2 commands do not have query counterparts unless explicitly shown with a question mark appended.

9. All required Functional Elements for devices are implemented. Refer to IEEE-488.2 Section 4.3.1 for more information.

10. Refer to the ANSI/IEEE-488.1 1987 and ANSI/IEEE-488.2 1987 standards for more information. These standards are available from the IEEE Standards Board, 445 Hoes Ln. PO Box 1331 Piscataway, NJ 08855-1331.

11. Voltage and Waveform parameter names without a channel number suffix (1,2,3) may be used to set all 3 channels (phases) as an alternative to setting each separately to the same value.

12. All numerical values are ASCII encoded decimal strings consisting of 1 or more ASCII digits. 8 and 15 bit register values are binary weighted values represented by an ASCII string of 1 or more decimal digits. One exception, the Serial Poll byte, is an 8 bit hexadecimal byte.

5.2 CONVENTIONS (cont)

13. Multiple Commands and Queries may be sent in one Program Message but each must be separated by a semicolon ;. The term 'Program Message' refers to 1 or more commands and/or queries sent to the UPC1T as one continuous string and is not to be confused with Stored Programs within the UPC1T.

14. Multiple data parameter names and values must be separated by commas.

15. 'Multiple keyword' messages may be sent without duplicating the first level SCPI keyword (i.e.; SOURce).
Eg; **:SOURce:VOLTage1,120; VOLTage2,120; VOLTage3,120.**
A keyword is a single word beginning with a colon (:).

16. Program Messages MUST be terminated with a LINE FEED (0Ahex, 10dec) or END (EOI) signal. This is referred to as an end of string <eos>. A Carriage Return character (0Dhex, 13dec) is converted to a LINE FEED by the UPC1T. Further SCPI commands shall begin with a first level keyword (i.e.; **:SOURce:**).

17. All values shown in angle brackets < > are examples of real values used with commands but labels are sometimes used to indicate a variable which is not known until actual time of use. Eg; <AMPS meter range> might actually be <50>.

    Units such as AAC, Hz or % shown after the angle bracketed value is not to be included inside the value, but is shown as a reference to units. The angle brackets are not part of the value.

18. The UPC1T's input buffer is 8k bytes as is it's output buffer. No program message may exceed this length.

19. **:SOURce:** FORM, COUPling, VOLTage, FREQuency, CURRent:LIMit, PHASe and WAVEFORM values may be read by performing a query of PROGram 0. See examples. PROGram 0 contains the MANUAL MODE parameters. Sending **:SOURce:** commands invokes MANUAL MODE and REMOTE CONTROL.

20. The command strings may contain spaces.

21. The UPC1T interface accepts the IEEE-488.2 NR1, NR2 and NR3 numeric formats. Most query responses are NR1 or NR2 types. i.e.; NR1 = 120, NR2 = 120.0, NR3 = 1.2E+02.

NOTE: The UPC1T only responds to SCPI commands which apply to one or two phase configured systems.

5.3 PROGRAM CONTROL

:PROGram:NAME <nn> selects Program nn for loading. Range of nn is <0> to <99>. No query for this command.

:PROGram[:SELected]:DEFine <program>

defines program nn. Program nn consists of steady-state and optional transient segment parameter names and values. All program parameters are defined in the following sections.

NOTE: Only commas may separate the values, NO Carriage Returns or Line Feeds may separate the values.

Query returns steady-state values of selected program and segment values of most recently selected segment. "LAST" is returned with segment data if the segment is the last segment in the program.

STEADY-STATE OUTPUT PARAMETERS

FORM,<n>,
FREQuency,<n>,
VOLTage,<n>, see Convention #11.
VOLTage1,<n>,
CURRent:LIMit<n>,
PHASe1,<n>,
WAVEFORM,<n>, see Convention #11.
WAVEFORM1,<n>,
EVENTS,<n>,

5.3 PROGRAM CONTROL (cont)

TRANSIENT SEGMENT PARAMETERS (OPTIONAL)

SEGment,<n>,	
FSEG,<n>,	
VSEG,<n>,	see Convention #11.
VSEG1,<n>,	
VSEG2,<n>,	
VSEG3,<n>,	
WFSEG,<n>	see Convention #11.
WFSEG1,<n>,	
WFSEG2,<n>,	
WFSEG3,<n>,	
TSEG,<n>,	
LAST	Sent only if this is the LAST segment.

NOTE: Only 1 segment per Program Message may be sent.

5.3.1 STEADY-STATE OUTPUT PARAMETERS

FORM,<n>	sets Output Power Form of selected program. Values for n are <1>Single ϕ or <2>Split ϕ.
FREQuency,<n>	sets Output Frequency of selected program. Range of n is <FREQ:LIM:MIN> to <FREQ:LIM:MAX> Hz.
VOLTage,<n>	sets Output VOLTAGE of selected program. Range of n is <0> to <150 1ϕ, or 300 2ϕ> Volts.
CURRent:LIMit <n>	sets Output Current Limit of selected program. Range of n is <0> to <AMPS meter range> Amps.
PHASe1, <n>	sets EXECUTION phase angle of selected program. Range of n is <0> to <359> degrees. Resolution is 1 degree, whole degrees only are accepted with truncation occurring if any fractional part is included. Normally zero unless conducting inrush surge analysis.
WAVEFORM,<n>	sets Output Waveform of selected program. Range of n is <1> to <21>.
EVENTS <n>	sets number of times to repeats the transient portion of the selected program when the Transient is executed. Range of n is 0-65535. A value of 0 indicates an infinite number.

5.3.2 TRANSIENT SEGMENT PARAMETERS

SEGment,<n> selects segment n of selected program to be programmed. Range of n is <1> to <100>.

FSEG,<n> sets objective Frequency of selected segment. Range of n is <FREQ:LIM:MIN> to <FREQ:LIM:MAX> Hz.

VSEG,<n> sets objective voltage of selected segment. Range of n is <0> to <150 1ϕ, or 300 2ϕ> Volts.

WFSEG1,<n> sets Waveform of selected segment. Range of n is <1> to <21>.

TSEG,<n> sets execution time (to reach objective Voltage and Frequency) of selected segment. Range of n is <0> or <.0002> to <300> seconds. Setting n to <0> selects cycle-based transient operation, i.e.; each segment time is equal to the period of 1 cycle (1/FREQ).

LAST sets selected segment to be the last segment of selected program.

5.3.3 PROGRAM MEMORY CONTROL

:PROGram[:SELected]:DELete deletes selected program. No query.

:PROGram:DELete:ALL all RAM is erased including all programs, waveforms, calibration and set-up values. Then the UPC1T is reset.

5.4 SIGNAL CONTROL

5.4.1 OUTPUT PARAMETERS

:PROGram:EXECute Executes Program nn steady-state values. Range of nn is <0> to <99>. Program nn becomes selected program.

:PROGram:EXECute:TRANS Executes pre-processed Transient portion of selected Program. Pre-processing is performed by executing a program. Transient terminates upon receipt of any data byte (DAB) from the IEEE-488 Bus, Device Clear, or when the LAST segment of the last EVENT is executed. Steady-state values are then restored. Immediately follow this command (in the same Program Message) with *OPC to detect the termination of the Transient events. An SRQ will occur when the Transient is completed (if the ESB bit is set in the SRE and the opc bit is set in the ESE. *OPC? may also be used in the same manner. No query.

***TRG** Same as **:PROGram:EXECute:TRANS.**

[:SOURce]:VOLTage <n> sets Output VOLTAGE. Range of n is <0> to <150 1ϕ, or 300 2ϕ> Volts. See note 19 for query method.

[:SOURce]:FREQuency <n> sets Output Frequency. Range of n is <FREQ:LIM:MIN> to <FREQ:LIM:MAX> Hz. See note 19 for query method. For convenience, another query for programmed Frequency is available via the **:MEASure:FREQuency?** command. The returned value is an indicator only as the UPC1T does not actually measure Frequency.

[:SOURce]:CURRent:LIMit <n> sets Output Current Limit. Range of n is <0> to <Current meter range> RMS Amps. See note 19 for query method.

[:SOURce]:WAVEFORM <n> sets Output Waveform. Range of n is <1> to <21>. See note 19 for query method.

[:SOURce]:RAMP <t> sets Output TRANSITION TIME of voltage and frequency execution. Range of t is <0> to <300> seconds in 200 uS steps.

5.4.1 OUTPUT PARAMETERS (cont)

[:SOURce]:FREQuency:SPAN <n>
sets Output Frequency span. Values for n are <150>, <300>, <600> and <1200> Hz.

[:SOURce]:FREQuency:LIMit:MAXimum <n>
sets Output Frequency max limit. Range of n is <20.00> to <frequency span> Hz.

[:SOURce]:FREQuency:LIMit:MINimum <n>
sets Output Frequency min limit. Range of n is <20.00> to <frequency span> Hz.

[:SOURce]:VOLTage:LIMit:MAXimum <n>
sets Output Voltage max limit. Range of n is <VOLT:LIM:MIN> to <600> VAC RMS.

[:SOURce]:VOLTage:LIMit:MINimum <n>
sets Output Frequency min limit. Range of n is <0.0> to <VOLT:LIM:MAX> VAC RMS.

[:SOURce]:RANGe <n> sets Output Range Control (for power sources that support Range Control). Range of n is <0> to <4>. A value of 0 sets the Range Control mode to AUTO. See section on GENERAL SETUP for more info.

[:SOURce]:PHASe1 <n> Sets the execution phase angle for phase A voltage of the presently executing program to the specified angle <n> and (re)executes the program using the new execution phase angle. Values for <n> are integral degrees with range: 0 to 359. Non-integral values will be truncated.

[:SOURce]:INRUSH:STATE <b>
Arms/disarms peak current inrush metering. Requires a boolean argument, <b>. Values for b can be either a binary value or plain language state descriptor.
Possible values for <b> are **[OFF | 0 | ON | 1]**.

[:SOURce]:INRUSH:STATE? returns a boolean value indicating the state of inrush metering: 1 = armed, 0 = disarmed.

5.4.1 OUTPUT PARAMETERS (cont)

[:SOURce]:IMPEDance:STATE <b>

Enables or disables the Programmable Output Impedance function. Values for b are <OFF> or <ON> or <0>OFF or <1>ON.

[:SOURce]:IMPEDance <z> Sets the Programmable Output Impedance. Values for z vary based on the present configuration and operational mode of the power source.

[:SOURce]:IMPEDance:CAL <z1,z2,z3, x1,z4, x2,z5, x3,z6>

Calibrates the Programmable Output Impedance function with values for:

Direct Coupled 1ϕ	z1 Ω
Direct Coupled 2ϕ	z2 Ω

See Section 4 for details on this function.

[:SOURce]:RIMPEDance <n>

The :SOURce:RIMPEDance command provides a means to control the synthetic impedance network's resistance.
<n> = resistance in *ohms* (range: 0 ohms - 4 ohms).

[:SOURce]:INDUCTance <n>

The :SOURce:INDUCTance command provides a means to control the synthetic impedance network's inductance.
<n> = inductance in *micro-Henrys*
(range: 0uH - 4000uH).

[:SOURce]:ZELECtronic:STATE <b>

The :SOURce:ZELECtronic:STATE command provides a means to enable and disable the resistive and inductive components of the synthetic impedance network.
<b> 0 = *disables* the synthetic impedance network.
1 = *enables* the synthetic impedance network.

[:SOURce]:ZELECtronic:STATE?

The :SOURce:ZELECtronic:STATE? query returns the state of the synthetic impedance network.
0 = synthetic impedance network is *disabled.*
1 = synthetic impedance network is *enabled..*

5.4.1 OUTPUT PARAMETERS (cont)

[:SOURce]:FGEN:FREQ <n>

The :SOURce:FGEN:FREQ command provides a means to control the frequency of the function generator output.

<n> = frequency in *cycles-per-second* (Hertz) (range: 0.005Hz - 2400Hz).

[:SOURce]:FGEN:VOLTS <n>

The :SOURce:FGEN:VOLTS command provides a means to control the amplitude of the function generator output.

<n> = amplitude in *volts RMS* (range: 0v - 4v).

[:SOURce]:FGEN:WAVEFORM <n>

The :SOURce:FGEN:WAVEFORM command provides a means to select the waveform used by the function generator.

<n> = user waveform number (range: 1 - 21).

[:SOURce]:FGEN:FREQ? Returns function generator frequency as cycles-per-second.

[:SOURce]:FGEN:VOLTS? Returns function generator voltage as RMS volts.

[:SOURce]:FGEN:WAVEFORM?

Returns function generator user waveform number, 1 to 22.

5.4.2 SIGNAL ROUTING

[:SOURce]:FORM <n> Sets Output power form. Values for n are <1>Single ϕ, <2>Split ϕ. See note 19 for query method.

[:SOURce]:VOLTage:ALC[:STATE] <b>
The ALC keyword controls CSC. Values for b are <OFF> or <ON> or <0>OFF or<1>ON.

:SENSe:PATH <s> selects source for metering and CSC. Values for n are <0>Internal or <1>External.

:OUTPut[:STATE] <b> OUTPUT ENABLE command. Values for b are <OFF>, <ON>, <0>OFF or <1>ON. Placing the OUTPUT POWER ON-AUTO/OFF switch in the OFF position overrides the OUTPUT ENABLE command. Query returns actual state of output contactors, <0>OFF or <1>ON, not the OUTPUT ENABLE value.

:ROUTe:IMPEDance:EXTernal <b>
The :ROUTe:IMPEDance:EXTernal command provides a means to control the route of the external impedance by opening/closing the bypass-relay.
<b> 0 = *disables* external impedance (close bypass-relay).
1 = *enables* external impedance (open bypass-relay).

:ROUTe:IMPEDance:EXTernal?
Returns the route/state of the external impedance bypass-relay.
0 = external impedance *disabled* (bypass-relay closed).
1 = external impedance *enabled* (bypass-relay open).

:ROUTe:FGEN <n> The :ROUTe:FGEN command provides a means to control the route of the function generator output.
<n> 0 = *disables* function generator output.
1 = route function generator output to the *AM* input of the UPC1T oscillator.
2 = route function generator output to the *AUX* input of the UPC1T oscillator.

:ROUTe:FGEN? Returns route of the function generator output.
0 = function generator output *disabled*.
1 = *AM* input of the UPC1T oscillator.
2 = *AUX* input of the UPC1T oscillator.

5.4.3 WAVEFORM CONTROL

:PROGRAM:NAME WF<nn> selects waveform n for loading or data query. No query for nn. Range of nn is 1 to 22 for data query or 2 to 21 for data defining (loading).

:PROGram[:SELected]:DEFine <data>
loads selected waveform (1-21) with data from the IEEE-488 Bus. The number of data elements must be 1024, representing 0-359.5 degrees in .351° steps. Each element is a signed percentage of peak full scale voltage. Each element must be separated by a comma. NOTE: Only commas may separate the values, NO Carriage Returns or Line Feeds may separate the values.
Eg; <0,+5,+10,-50,+20,+25,+30> % .

5.5 QUERY FUNCTIONS

The following is a list of 'query only' functions sent by the UPC1T through the IEEE-488 Bus.

5.5.1 CONFIGURATION QUERIES

These query parameters cannot be set via IEEE-488 Bus communications as they are set as required to work with the Power Source. The following does not apply to TMX SERIES AC POWER SOURCE products.

[:SOURce]:XFMRRATIO? Output XFMR ratio query. Returns <0> to <5> to one.

:SENSe:CURRent:RANGe? AMPS meter range query. Returns <0> to <AMPS meter range> RMS Amps.

5.5.2 METERED DATA QUERIES

AC measurements are assumed. The **:AC** keyword following **:MEASure** is optional and is not shown here.
The question mark is optional as the **:MEASure:** command implies a query. Any values following the command are ignored.
'Multiple keyword' queries may be performed to obtain values of simultaneous measurements. Eg; **:MEASure:VOLTage1;VOLTage2;VOLL1?**

:MEASure:VOLTage1? metered voltage ϕA query. Returns <0> to <354> VAC RMS.

:MEASure:VOLTage2? metered voltage ϕB query. Returns <0> to <354> VAC RMS.

:MEASure:VLL1? metered Line to Line voltage ϕA to ϕB query. Returns <0> to <354> VAC RMS.

:MEASure:FREQuency? This is a query for programmed Frequency. The returned value is only an indicator of the programmed Frequency as the UPC1T does not actually measure Frequency. Returns <20.00> to <1200> Hz.

:MEASure:CURRent[:RMS]1? metered RMS current ϕA query. Returns <0> to <current meter range> AAC RMS.

:MEASure:CURRent:PEAK1? metered peak current ϕA query. Returns <0> to <current meter range> AAC Peak. If inrush metering is armed peak current measurement obtained from fast metering will be returned; otherwise, peak current value obtained from normal metering will be returned. PEAK1 specifies Phase A amps

:MEASure:CURRent:CREST1? metered current Crest factor ϕA query. Returns 0 - 1000.

5.5.2 METERED DATA QUERIES (cont)

:MEASure:POWer1? metered Kilowatts ϕA query. Returns <0> to <1000> KW.

:MEASure:KVA1? metered KiloVoltAmps ϕA query. Returns <0> to <1000> KVA.

:MEASure:PF1? metered power factor (KW/KVA) ϕA query. Returns <0> to <1.0>.

:FETCh[:WAVEFORM]:VOLT1?
:FETCh[:WAVEFORM]:CURRent1?

returns a string representing the metered data waveform. Each waveform consists of NR2 type numbers separated by commas. Line to Neutral voltages only are digitized.

:MEASure:SPECTrum:VOLTage1[:MAGnitude]

returns a data set representing the first 51 harmonic magnitudes as a percentage of the PHASE A VOLTAGE fundamental.

This data set consists of 51, NR2 type numbers separated by commas. The first element is the magnitude of the fundamental for reference. The second element is the 2nd harmonic, the third element is the 3rd harmonic, and so on.

:MEASure:SPECTrum:PHASe returns a data set representing the first 51 harmonic phase angles in degrees for the last **:MEASure:SPECTrum:parameter** command. If parameter was PHASE A VOLTS then the phase angles will be for PHASE A VOLTS.

This data set consists of 51, NR2 type numbers separated by commas. The first element is the angle of the fundamental for reference. The second element is the angle of the 2nd harmonic, the third element is the angle of the 3rd harmonic, and so on.

5.5.2 METERED DATA QUERIES (cont)

:MEASure:SPECTrum:THD? returns TOTAL HARMONIC DISTORTION of the last **:MEASure:SPECTrum:parameter** command. If parameter was PHASE A VOLTS then the THD value will be for PHASE A VOLTS.

:MEASure:SPECTrum:OHD? returns ODD HARMONIC DISTORTION of the last **:MEASure:SPECTrum:parameter** command. If parameter was PHASE A VOLTS then the OHD value will be for PHASE A VOLTS.

:MEASure:SPECTrum:EHD? returns EVEN HARMONIC DISTORTION of the last **:MEASure:SPECTrum:parameter** command. If parameter was PHASE A VOLTS then the EHD value will be for PHASE A VOLTS.

5.5.3 EVENT and STATUS REPORTING

Events and device Status may be queried by the Bus controller through the following registers and queues. Query commands are explicitly shown in this section for clarity. NOTE: It is recommended that reading EVENT and STATUS registers and queues occur in the following order. Reading any register or queue is optional. Indents indicate a hierarchy.

1. STB register, read via Serial Poll or ***STB?**.

    2. ESR register, read via ***ESR?**.

        3. **SYSTem:ERRor?** queue.

    4. **STATus:OPERation:EVENt?** register.

    5. **STATus:QUEStionable:EVENt?** register.

NOTE: For most applications, the STB register and SYSTem:ERRor queue will satisfy status and error reporting.

5.5.3.1 IEEE-488.2 STATUS REPORTING

The following lists the IEEE-488.2 Common Commands for **Status Reporting** from the UPC1T. Refer to the ANSI/IEEE-488.2 1987 standard for more information.

Query commands are explicitly shown in this section for clarity. NOTE: <NRf> indicates a Numeric Response format. See Section 5.2 Conventions regarding <NRf>.

STATUS BYTE REGISTER (STB)

STATUS conditions reported by the STATUS BYTE may be queried via the IEEE-488 Bus Serial Poll function, or read directly using *STB?. The SRQ function will be invoked to signal the Bus controller that service is requested, when an unmasked STATUS BYTE bit goes true. Note that no SRQ is generated while in LOCAL CONTROL. *CLS clears the ESR and the STB. Refer to figure 5.1.

BIT	NAME	DEFINITION
7	SOS	:STATus:OPERation register bit summary.
6	MSS/RQS	-MASTER SUMMARY summarizes all STATUS BYTE bits (except bit 6) for *STB?, or, -REQUEST SERVICE indicates this device requested service when a Serial Poll was performed.
5	ESB	STANDARD EVENT STATUS REGISTER bit summary.
4	MAV	MESSAGE AVAILABLE indicates Query response data is available.
3	SQS	:STATus:QUEStionable register bit summary.
2	EEQ	ERROR/EVENT QUEUE indicates an SCPI Error/Event message is available.
1	-----	NOT DEFINED
0	SHUTDOWN	indicates Power Source SHUTDOWN.

Setting a SERVICE REQUEST ENABLE (SRE) bit true unmasks the STATUS bit in the STB. Bit 6 of the SRE is not applicable as the MASTER SUMMARY bit of the STB cannot be masked. The STB, SRE, ESR and ESE registers are 8 bits each.

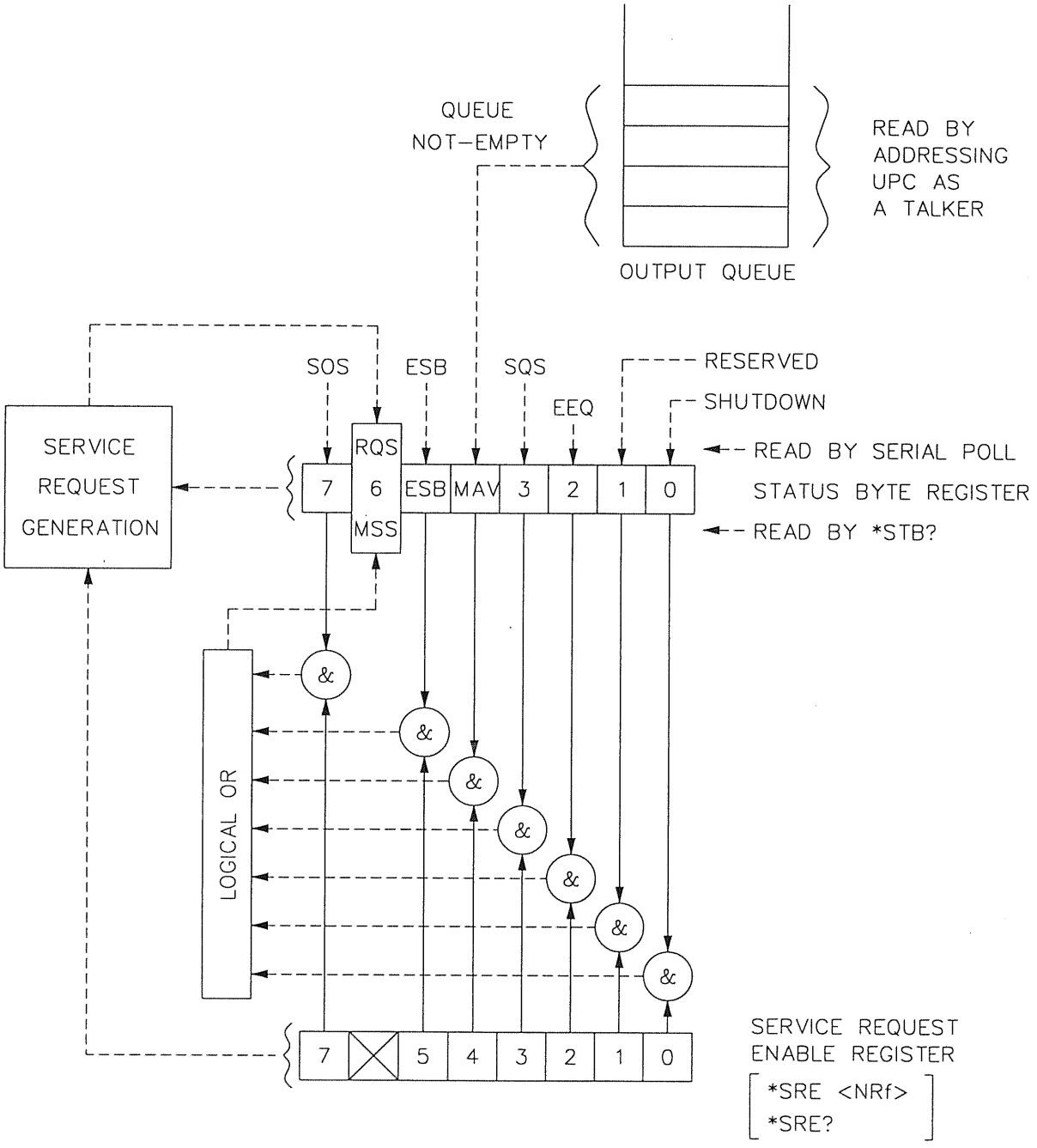


FIGURE 5.1 STATUS BYTE MODEL

5.5.3.1 IEEE-488.2 STATUS REPORTING (cont)

STANDARD EVENT STATUS REGISTER (ESR)

Events reported by the STANDARD EVENT STATUS register may be queried via the ***ESR?** command. Reading the ESR register clears it. The EVENT STATUS summary bit in the STATUS BYTE (STB) will be set when an unmasked EVENT STATUS bit goes true. Refer to figure 5.2.

BIT	NAME	DEFINITION
7	PON	POWER ON indicates Input power was just applied.
6	URQ	USER REQUEST indicates "LOCAL" key was just pressed.
5	CME	COMMAND ERROR indicates invalid command or query received.
4	EXE	EXECUTION ERROR indicates can't execute command with data received.
3	DDE	DEVICE DEPENDANT ERROR indicates UPC1T not properly configured.
2	QYE	QUERY ERROR indicates cannot respond with data.
1	RQC	REQUEST CONTROL - not used.
0	OPC	OPERATION COMPLETE indicates previous operation complete.

Setting an EVENT STATUS ENABLE (ESE) bit true unmasks the EVENT bit in the ESR. Also see **:SYSTem:ERRor?** query for corresponding information.

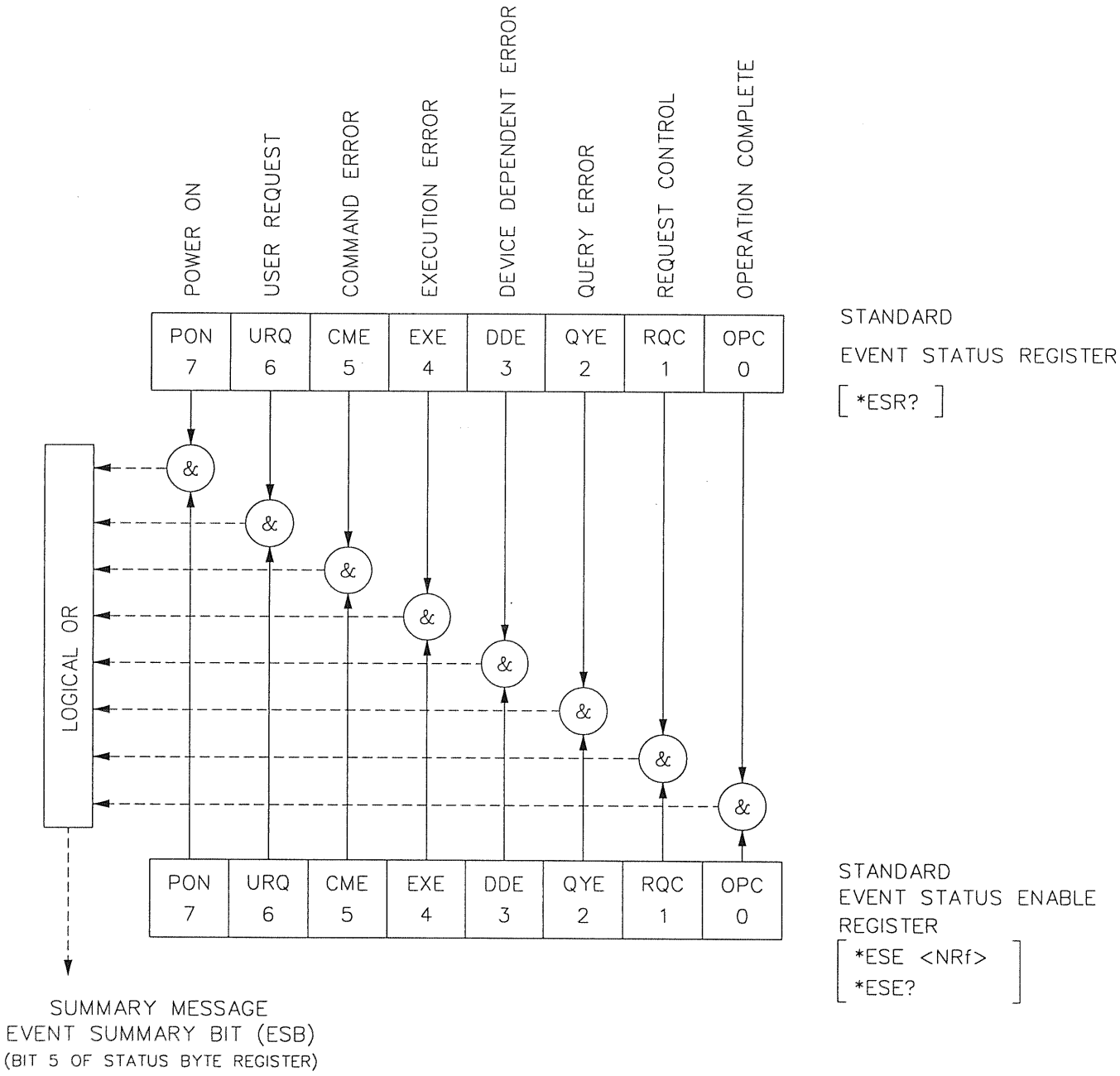


FIGURE 5.2 STANDARD EVENT REGISTER MODEL

5.5.3.1 IEEE-488.2 STATUS REPORTING (cont)

IEEE-488.2 STATUS REPORTING COMMANDS

***IDN?**	Device Identification query. Returns <PPSC UPC1T vN.N> where N.N is the firmware version number.
***CLS**	Clears the ESR and the STB registers as well as the SCPI :EVENt registers and ERROR/EVENT queue.
***STB?**	Read status byte query. Bit 0 is Power Source SHUTDOWN.
***SRE <n>**	Service request enable command.
***SRE?**	Service request enable query.
***ESE <n>**	Standard event status enable.
***ESE?**	Standard event status enable query.
***ESR?**	Standard event status register query.
***OPC**	Operation complete command.
***OPC?**	Operation complete query.

5.5.3.2 SCPI STATUS REPORTING

The following lists the SCPI Commands for **Status Reporting** from the UPC1T. Refer to the SCPI 1992 standard for more information. See Section 5.2 Conventions regarding SCPI.

Query commands are explicitly shown in this section for clarity. Refer to figure 5.3.

:SYSTem:ERRor? system error query. Returns one of the following types of messages, with details appended to it if possible. A maximum of 256 characters may be sent as a response to this query.

-0, "No error"	No error detected.
-100, "Command error"	Indicates invalid command or query received.
-200, "Execution error"	Indicates can't execute command with parameters received.
-300, "Device-specific error"	Without additional text indicates UPC1T is not properly configured or with additional text indicates a specific IEC TEST error, such as:

-300, "Device-specific error, QUEUE OVERFLOW - IEC TEST ABORTED."
-300, "Device-specific error, DATA LINK FAILURE - IEC TEST ABORTED."
-300, "Device-specific error, UNRECOGNIZED IEC CHANNEL PARAMETER. "
-300, "Device-specific error, DEVICE UNRECOGNIZED. "
-300, "Device-specific error, WRITE ATTEMPTED TO A READ-ONLY DEVICE."
-300, "Device-specific error, UNRECOGNIZED EXCEPTION IDENTIFIER."
-300, "Device-specific error, INVALID NUMBER OF SAMPLES REQUESTED."
-300, "Device-specific error, INTERFACE CLEAR RECEIVED - TEST OVER."
-300, "Device-specific error, Z-NETWORK FUNCTIONS REQUIRE FORM=2 "

-400, "Query error"	indicates query aborted.

NOTE: The SYSTem:ERRor query clears the corresponding error bit in the ESR.

5.5.3.2 SCPI STATUS REPORTING (cont)

:SYSTem:VERSion? SCPI version query. Returns <1992.0>.

The STATus:OPERation and STATus:QUEStionable registers provides information about the current mode of operation. Transition of a CONDition bit to the true state causes the EVENt bit to be set true. An unmasked ENABle bits allow an EVENt bit to be reported in the summary bit for that EVENt register in the STATUS BYTE register. Setting an ENABLe bit true unmasks the corresponding EVENt bit. Reading an EVENt register clears it. All :STATUS registers are 15 bits. Refer to figure 5.3.

The STATus:OPERation registers provides information about the current mode of operation. NOTE: Most bits in the following :STATus registers are not applicable to the UPC1T but are shown for reference and may be used for future product enhancements. The PROGram running bit (14) in the :STATus:OPERation registers indicate a stored program (PROGRAM# 1-99) is running.

:STATus:OPERation:CONDition? current condition query.

:STATus:OPERation:ENABle enables events to be reported in the SOS bit in the STB.

:STATus:OPERation:ENABle? STAT:OPER:ENABLE register query.

:STATus:OPERation:EVENt? latched condition query.

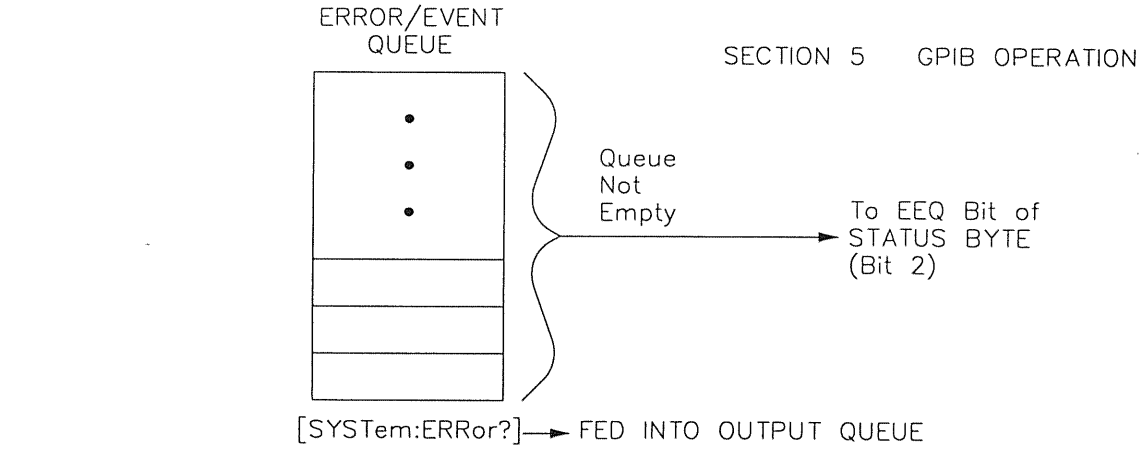
The STATUS:QUESTIONABLE registers provides information about errors and questionable measurements. NOTE: All bits in the following :STATus registers are not applicable to the UPC1T but are shown for reference and may be used for future product enhancements.

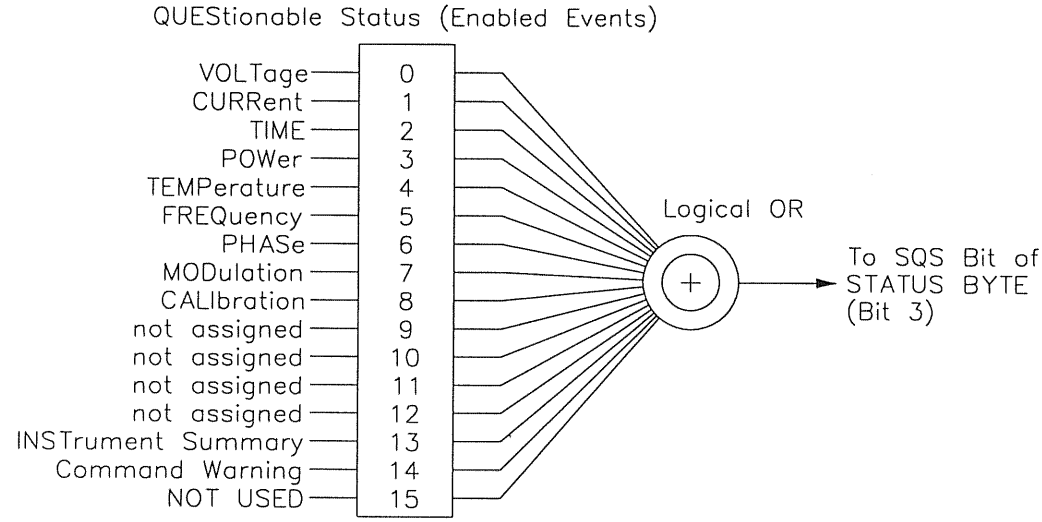
:STATus:QUEStionable:CONDition? current condition query.

:STATus:QUEStionable:ENABle enables events to be reported in the SQS bit in the STB.

:STATus:QUEStionable:ENABle? STAT:OPER:ENABLE register query.

:STATus:QUEStionable:EVENt? latched condition query.





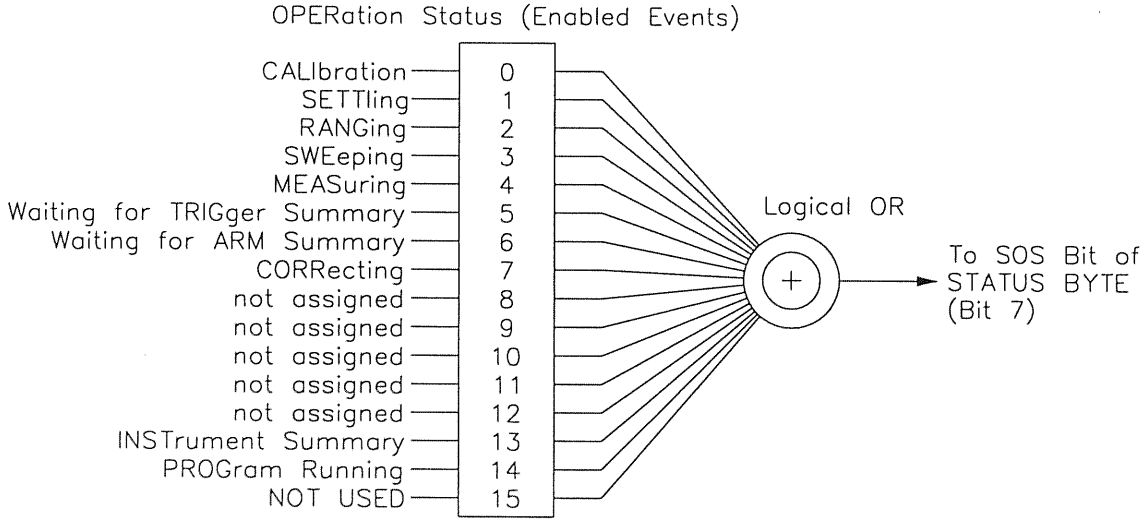


FIGURE 5.3 SCPI STATUS REGISTERS MODEL

5.6 DEVICE CONTROL

:SYSTem:BEEPer beeps the front panel beeper once.

:CALibrate:ZERO Resets all Metering correction factors. The UPC1T meters are then essentially uncalibrated although still functional.
See the Externally Referenced CALIBRATION procedure (Section 8.2) for details.

:CALibrate:DATA <k_int_Va, k_int_Vb, k_int_Vc,
k_ext_Va, k_ext_Vb, k_ext_Vc,
k_Ia, k_Ib, k_Ic >

Loads values measured with an external DVM and Ammeter. These values are used by the UPC1T to calibrate the UPC1T.

The first 3 values are Voltages measured at the **output terminals** of the power source.

The second set of 3 values are Voltages measured at the **EXTernal Sense point** (at the load).

The third set of 3 values are Currents measured to the load.

Loading a value of 0 will cause that metering parameter to be uncalibrated although it will still be functional.

See the Externally Referenced CALIBRATION procedure (Section 8.2) for more details.

:CALIBrate:SCALE? <p1>,<p2>,..,<p#>

The :CALIBrate:SCALE? query specifies auxiliary metering input channels on the IEC PCB and expects floating-point (in ASCII form) scale factors corresponding to each keyword parameter queried. <p1>,<p2>,..,<p#> are channel identifiers for channel-1 and channel-2, respectively. There are eight possible channels to select from and each channel has two ways to be referenced, i.e. either "1" or "V_ext" can be used with equivalent results. The channel identifiers are: "V_ext", "V_relay", "V_spare", "V_pa", "spare", "I_spare", "I_AFE", "I_AAAF"

Example: :CALIB:SCALE? V_ext, V_relay, V_pa, I_filtered;
For this example, four floating-point scale factors would be returned (in standard SCPI format) corresponding to the order and content of the request.

5.6.1 IEEE-488.1 INTERFACE FUNCTIONS

The following lists the IEEE-488.1 capabilities of the UPC1T. Refer to the ANSI/IEEE-488.1 1987 standard for more information.

FUNCTION MNEMONIC	**REMOTE MESSAGE RECEIVED** / Description
SH1	Source handshake functions.
AH1	Acceptor handshake functions.
T6	**MTAnn** - Talker subset 6. nn is GPIB device address 0-30.
L3	**MLAnn** - Listener subset 3. nn is GPIB device address 0-30.
SR1	Service request/Serial Poll functions. **SPE** - Serial Poll Enable **SPD** - Serial Poll Disable
RL1	Local/Remote functions. **GTL** - Go To Local **LLO** - Local Lockout
DC1	Device clear functions. **DCL** - causes a hardware reset of the UPC1T. **SDC** - Same as DCL but device must be addressed.
DT1	Device Trigger function. **GET** - Group Execute Trigger message executes Transient Events (if any), of currently executed program.
PP0	No Parallel Poll functions.
C0	No Controller functions.
E1	Electrical interface Type 1.
IFC	InterFace Clear (**IFC**) sets the UPC1T IEEE-488 bus interface to an idle state. The input and output buffers remain unchanged.

5.6.2 IEEE-488.2 DEVICE CONTROL COMMANDS

The following lists the IEEE-488.2 Common Commands for **Device Control** of the UPC1T. Refer to the ANSI/IEEE-488.2 1987 standard for more information.

***RST** Reset command. Initialize the UPC1T with the following parameters:

OUTPUT DISABLED.

Stored programs are not erased.

***TST?** Self test query. Test validity of non-volatile RAM. Returns 0 if no error.

***WAI** Wait-to-continue command. Only useful following the :PROG:EXEC:TRANS or *TRG commands as all other commands are executed sequentially as the Program Message is parsed.

***TRG** IEEE-488.2 Device trigger function. Executes Transient Events (if any), of currently executed program.

***LLO** causes the UPC1T to enter into the LOCAL LOCKOUT STATE. This state causes the UPC1T to ignore the front panel keyboard and display updates to allow for decreased response time to remote control commands. No query.

***GTL** (Go To Local) causes the UPC1T to exit the LOCAL LOCKOUT STATE. No query.

5.7 REMOTE CONTROL EXAMPLES

The REN (remote enable) line on the bus interface must be kept true to maintain REMOTE CONTROL. REMOTE CONTROL can only be initiated while the UPC1T is displaying a Metering display (not while editing) or while in the UPC1T STATUS display. Be sure that the UPC1T GPIB device address is set to a known unique address within the GPIB system. The factory default device address is 1. See Section 4.5.3.3 for configuration of the GPIB device address.

Optional keywords have been omitted throughout this section for clarity. The command strings may contain spaces.

NOTE: Un-address means to send the UNTALK and UNLISTEN messages. With many programming languages that support GPIB communications, listener and talker addressing and un-addressing is handled automatically and is transparent to the user. Check your programming language or driver documentation for verification of this.

NOTE: <eos> should be a LINE FEED (0Ahex, 10dec). See GPIB convention #16 (Section 5.2) for more details.

5.7.1 EXAMPLE OF STORING A PROGRAM

NOTE: <eos> is a LINE FEED (0Ahex, 10dec).

Step A. Address the UPC1T as a listener.

:PROGram:NAME 1 <eos>

Step B. Select Program 1 for loading.

Step C. Define program 1. Program 1 consists of steady-state and optional transient segment parameter names and values. This is one continuous string of commands and parameters. NOTE: Only commas may separate the values, NO Carriage Returns or Line Feeds may separate the values.

:PROGram:DEFine

FORM,2,
FREQuency,60,
VOLTage1,115,
CURRent:LIMit,10
PHASe1,0,
WAVEFORM1,1,
EVENTS,0,

OPTIONAL TRANSIENT PARAMETERS

SEGment,1,
FSEG,60,
VSEG1,120,
VSEG2,120,
VSEG3,120,
WFSEG1,1,
WFSEG2,1,
WFSEG3,1,
TSEG,.01,
LAST<eos>

Step D. Un-address UPC1T.

5.7.2 EXAMPLE OF PROGRAM QUERY

NOTE: <eos> is a LINE FEED (0Ahex, 10dec).

Step A. Address the UPC1T as a listener.

:PROGram:NAME 1 <eos>

Step B. Select Program 1 for query.

:PROGram:DEFine? <eos>

Step C. Query program 1. Program 1 consists of steady-state and optional transient segment parameter names and values.

This Query returns steady-state values of selected program and segment values of the most recently selected segment (see note 1). "LAST" is returned with segment data if the segment is the last segment in the program.

Step D. Address the UPC1T as a talker to read back the following example query response string. NOTE: Only commas separate the values, NO Carriage Returns or Line Feeds separate the values.

STEADY-STATE OUTPUT PARAMETERS returned

FORM,2,
FREQuency,60,
VOLTage1,115,
CURRent:LIMit,10
PHASe0,0,
WAVEFORM1,1,
EVENTS,0,

5.7.2 EXAMPLE OF PROGRAM QUERY (cont)

To select a segment for query.

Step A. Address the UPC1T as a listener.

:PROGram:NAME 1 <eos>

Step B. Select Program 1 for query by sending the following command.

:PROGram:DEFine SEG,1 <eos>

Step C. Select Segment 1 for query by sending the following command.

:PROGram:DEFine? <eos>

Step D. The steady-state values of the selected program and segment values of the selected segment will be sent by the UPC1T. "LAST" follows segment values if it is the last segment for program 1.

Step E. Address the UPC1T as a talker to read back the following example query response string. NOTE: Only commas separate the values, NO Carriage Returns or Line Feeds separate the values.

OPTIONAL TRANSIENT PARAMETERS returned

SEGment,1,
FSEG,60,
VSEG1,120,
VSEG2,120,
VSEG3,120,
WFSEG1,1,
WFSEG2,1,
WFSEG3,1,
TSEG,.01,
LAST <eos>

Step F. Un-address UPC1T.

5.7.3 EXAMPLE OF EXECUTING A STORED PROGRAM

NOTE: <eos> is a LINE FEED (0Ahex, 10dec).

	Step A. Address the UPC1T as a listener.
:PROGram:NAME 1 <eos>	Step B. Select Program 1 for executing.
:PROGram:EXECute <eos>	Step C. Execute Program.
	Step D. Un-address UPC1T.

5.7.4 EXAMPLE OF EXECUTING A STORED PROGRAM TRANSIENT

NOTE: <eos> is a LINE FEED (0Ahex, 10dec).

	Step A. Address the UPC1T as a listener.
:PROGram:NAME 1 <eos>	Step B. Select Program 1 for executing.
:PROGram:EXECute <eos>	Step C. Execute Program.
:PROGram:EXECute:TRANS <eos>	Step D. Execute Transient.
	Step E. Un-address UPC1T.

5.7.5 EXAMPLE OF DIRECTLY CHANGING THE OUTPUT PARAMETERS

This example changes Frequency and Volts for all phases then ENABLES the OUTPUT.

	Step A. Address the UPC1T as a listener.
:FREQuency 50 <eos>	Step B. Change Frequency to 50 Hz.
:VOLTage 117 <eos>	Step C. Change Volts to 117 VAC RMS for all phases.
:OUTPut ON <eos>	Step D. ENABLES the OUTPUT. The OUTPUT POWER switch must be in the ON/AUTO position to allow power to be applied to the load.
	Step E. Un-address UPC1T.

An alternative to steps B, C and D above is:

:FREQ 50; :VOLT 117; :OUTP ON<eos>	This example uses all shortform keywords in one program message. The OUTPUT POWER switch must be in the ON/AUTO position to allow power to be applied to the load.
- or -	
:OUTPut OFF <eos>	Turns the output OFF.

- - - C A U T I O N - - -

All :SOURce parameters should be set prior to enabling the OUTPUT for the first time after power-on or after resetting the device. An alternative to this is to :DEFine and :EXECute a stored program. See Section 5.7.1 and 5.7.3.

- - - C A U T I O N - - -

5.7.6 EXAMPLE OF VOLTAGE QUERY

This is an example of how to query the UPC1T for RMS metered values. LINE to LINE volts, KVA, KW Power Factor, CURRENT Crest factor, and Peak Current may also be queried in the following fashion. See the **:FETCH** command and example for obtaining metered waveform data.

Phase A RMS volts (Line to Neutral) is queried in this example.

NOTE: <eos> is a LINE FEED (0Ahex, 10dec).

Step A. Address the UPC1T as a listener.

Step B. Select Phase A Voltage for AC-RMS query by sending the following command.

:MEAS:VOLTage1? <eos>

Step C. Address the UPC1T as a talker to read back the following example query response string.

120.02<eos>

Step D. Un-address UPC1T.

5.7.7 EXAMPLES OF VOLTAGE WAVEFORM QUERY

This is an example of how to query the UPC1T for metered waveform data for phase A voltage.

NOTE: <eos> is a LINE FEED (0Ahex, 10dec).

Step A. Address the UPC1T as a listener.

Step B. Select Phase A Voltage for waveform query by sending the following command.

:FETCh? VOLTage1 <eos>

NOTE: The parameter will be measured upon receipt of the :FETCH? command. This may take several hundred milliseconds depending upon Frequency and other factors. The values are not stored in the UPC1T and another :FETCH? command will re-measure the values.

Step C. Address the UPC1T as a talker. The UPC1T returns a string representing the last metered data waveform. The waveform consists of NR2 type numbers separated by commas.

Step D. Un-address UPC1T.

5.7.8 EXAMPLE OF HOW TO CAPTURE A PEAK SURGE CURRENT

This is an example of how the Peak Inrush and Execution Phase features can be used together to analyze surge current inrush.

First we create a program which will be used to simulate the *turn-on* state. This program will be initialized with nominal steady-state power source configuration directives, along with the specification for an execution phase of 90 degrees. It is created and stored for later usage.

:PROGram:NAME 10;
:PROGram[:SELected]:DEFine
FORM,1,COUPLing,1,FREQuency,60,VOLTage,120,CURRent:LIMit,50,PHAse1,90,
WAVEFORM,1,EVENTS,0;

Set the power supply to the simulated *off* state:

[:SOURce]:VOLTage 0;

Arm inrush metering:

[:SOURce]:INRUSH:STATE ON;

Execute program number 10:

:PROGram:NAME 10;:PROGram:EXECute;

Allow some time for the surge inrush and peak current capture to occur by suppling a {programmed delay period}.

Obtain the captured peak current with a query:

:MEASure:CURRent:PEAK1?

The returned value will be the peak current captured during the surge resulting from the simulated *turn-on* at 90 degrees.

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SECTION 6

MAINTENANCE

6 MAINTENANCE

No maintenance is required.

SECTION 7

SERVICE

7 SERVICE

Pacific Power Source maintains a staff of highly trained technicians which are able to assist with diagnosing abnormal operation of the UPC1T. If questions arise, feel free to call the factory at 1-714-898-2691 (8am to 5pm PST (California)).

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SECTION 8

CALIBRATION

8 CALIBRATION

This section describes calibration of an UPC1T. EXTERNALLY REFERENCED calibration achieves calibration of the oscillator output gains (Output voltage), and metering calibration.

This procedure must be performed in order for the CSC (Continuous Self Calibration) function to operate accurately.

NOTE: The UPC1T output voltage and current must be calibrated before AUXILIARY METERING is calibrated. Likewise, AUXILIARY METERING must be recalibrated every time the UPC1T is calibrated.

8.1 CALIBRATION INTERVAL

The UPC1T requires calibration once every six months or after service has been performed to the system.

8.1.1 TEST EQUIPMENT REQUIREMENTS

The test equipment listed below is required for calibration of the UPC1T installed in a Power Source.

1. Digital Voltmeter: 4½ Digit True-RMS responding
   5000 Hz bandwidth, min.
2. Frequency counter: 5 digit counter, min.
3. Oscilloscope: (Optional)
4. *High current load (capable of 60% Peak rated output current of power source)
5. *Ammeter probe (Shunt type preferred) or ammeter capable of reading RMS amps.

   * = (only needed for calibrating current metering)

8.2 EXTERNALLY REFERENCED CALIBRATION

This section describes the EXTERNALLY REFERENCED CALIBRATION procedure for calibrating the UPC1T which can be performed by the user.

The UPC1T is designed to be calibrated in the field. Calibration may be required in order to ensure that the EXECUTE voltage (the voltage actually produced by the power source) precisely agrees with COMMAND voltage (the desired voltage entered by the operator). Potential sources of error which may cause difference between these two voltages are:

a) Drift in oscillator signal level.
b) Power Amplifier gain drift.
c) Output transformer turns ratio error. i.e. Actual turns ratio different from encoded turns ratio.
d) Difference between INT SENSE metering circuit and EXT SENSE metering circuit.
e) Internal metering inaccuracy.

Since the UPC1T display shows both PROGRAM (Command) and METERED voltages, these errors will reveal themselves - if they occur - as a slight difference between the two voltages. Only basic metering inaccuracy (e) will not reveal itself on the display.

CALIBRATE - EXT REF

In this procedure, the user

1. Sets up the UPC1T to generate output voltage and current.

2. Measures the voltages and currents on all phases using test equipment that has been calibrated to a traceable standard (ie; NBS, NIST).

3. Enters the measured values into the UPC1T keyboard, (fn,4,2) EXTERNALLY REFERENCED CALIBRATION, or using a Remote Interface.

The UPC1T then creates correction factors for it's functions and stores them in RAM. These correction factors (k factors) may be viewed by the user, (fn,4,3) Kfactor DISPLAY.

Normally, calibration is performed with default values of 50 Hz and 230 volts. Because of the precision and stability of the system, the correction factors are the same for all other values of volts and frequency. The user may calibrate the system at any frequency, voltage and current desired. Calibration of current metering is based on the Load Current set by the user. Therefore a nominal Load Current should be chosen for this calibration process.

NOTE: Only RMS voltages and currents are corrected.

8.2 EXTERNALLY REFERENCED CALIBRATION (cont)

CALIBRATION PROCEDURE
Externally Referenced CALIBRATION

* * * WARNING * * *

• OBSERVE THE FOLLOWING WHEN CALIBRATION IS PERFORMED WITH THE OUTPUT CONTACTOR CLOSED:

1) REMOVE ALL JEWELRY FROM ARMS AND NECK WHEN CALIBRATING THIS EQUIPMENT. THIS PREVENTS THE POSSIBILITY OF SHORTING THROUGH THE JEWELRY AND CAUSING BURNS TO OR ELECTROCUTION OF THE OPERATOR.

2) **WEAR SAFETY GLASSES** WHEN CALIBRATING THIS EQUIPMENT TO PREVENT EYE INJURY DUE TO FLYING PARTICLES CAUSED BY ACCIDENTAL SHORT CIRCUIT CONDITIONS.

3) DO NOT REMOVE ANY PANELS OR COVERS WITHOUT FIRST OPENING **ALL** CIRCUIT BREAKERS AND THEN REMOVING THE INPUT SERVICE.

* * * WARNING * * *

8.2 EXTERNALLY REFERENCED CALIBRATION (cont)

1. Apply power to the power source and UPC1T.

2. Press **fn** to invoke the SETUP menu.

3. Select UPC1T CALIBRATION by pressing **4**.

```
          UPC1T CALIBRATION MENU
1 IEC TEST SYSTEM CALIBRATION.
2 EXTERNALLY REFERENCED CALIBRATION
3 Kfactor DISPLAY
```

4. Select EXTERNALLY REFERENCED CALIBRATION by pressing **2**.

5. Enter the measurements taken with external test equipment (voltmeter, ammeter) for each parameter shown on the UPC1T display below. All measurements taken are to be AC RMS. Line to Line, HI (L2) to LO(L1), measurements only are used for split-phase voltage (V_{AB}) measurements and Line to Neutral, HI (L2) to LO(L1), for single-phase voltage (V_A) mesurements.

In order to fully calibrate all current meters for all power forms, this procedure must be performed once for single phase and once for 2 phase operation.

Entering 0 for a parameter causes the correction factor for that parameter to be set to 1.000.

The Form being used by the UPC1T at the time the externally referenced calibration screen is invoked will determine which calibration values are allowable entries.

8.2.1 SPLIT-PHASE

SPLIT-PHASE Display (Form = 2):

```
 ϕ INT.V-SENSE EXT.V-SENSE |
AB <rms_entry> <rms_entry> | Ia <rms_>
```

Only line-to-line V_{AB} voltages are to be entered. Enter either INTernal V_{AB} or EXTernally sensed V_{AB}, according to the location of the sense point. Ia is RMS current for split-phase configuration.

Procedure: Program FREQUENCY SPAN 1, WAVEFORM NUMBER 1, 2ø, 50 Hz, 230 VAC.
Disable Programmable Output Impedance, Real Impedance, Synthetic Impedance and Continuous Self Calibration.
Calibrate 2ø mode INT. V-SENSE, EXT. V-SENSE and Ia.
Verify actual output agrees with programmed and metered values.

8.2.2 SINGLE-PHASE

SINGLE-PHASE Display (Form = 1):

```
 ϕ INT.V-SENSE EXT.V-SENSE | I1 <rms_>
A  <rms_entry> <rms_entry> |
```

Only V_A INTernally sensed or V_A EXTernally sensed, and I1 may be entered.

Procedure: Program FREQUENCY SPAN 1, WAVEFORM NUMBER 1, 1ø, 60 Hz, 120 VAC.
Disable Programmable Output Impedance, Real Impedance, Synthetic Impedance and Continuous Self Calibration.
Calibrate 1ø mode INT. V-SENSE, EXT. V-SENSE and I1.
Verify actual output agrees with programed and metered values.

NOTE: Voltages are to be entered as AC_{RMS}, Currents are to be entered as AC_{RMS}.

8.3 CALIBRATION BY Kfactor DISPLAY

Kfactor DISPLAY (***fn*,4,3**) - Allows viewing and editing of metering multiplication factors. Kfactors may be entered directly without entering the load currents or voltages. Note that calibration currents and voltages in the ***fn*,4,2** display will be set to 0 if Kfactors are entered directly.

Selecting (**fn,4,3**) from the CALIBRATION MENU allows the user to directly enter or view all oscillator calibration Kfactor constants on a single screen. Only the fields in the first column and the last column apply to the UPC1T controller. These Kfactors are automatically calculated for the user when externally referenced calibration for INT.V-SENSE (internal voltage sense) is entered.

```
Kin A:<####> B:<####> C:<####> AB:<####>
Kex A:<####> B:<####> C:<####> AB:<####>
Ki  A:<####> B:<####> C:<####> AB:<####>
Ko  A:<####> B:<####> C:<####> AB:<####>
```

Usage:

i. Press "**EDIT**" to allow modification of the scale factors,
ii. Enter "<scale>" as a floating point numeric,
iii. Press "**ENTER**" to accept scale value and advance cursor to next entry,
iv. Repeat for each value to be entered,
v. Press the "**EXECUTE**" or "**STORE**" key to apply the displayed calibration scale factors.

Each time a non-zero value is entered, the UPC1T measures the output signal for that parameter and compares it against the user entered calibration value. A new Correction factor is then calculated and used to correct that value.

Entering 0 for a parameter causes the correction factor for that parameter to be set to 1.0000. This may be done in order to clear any undesired metering compensation (correction) for that parameter.

If a value for a parameter is not keyed in, its correction factor will remain in memory and will not be re-calculated.

The correction factors are stored in Battery-backed memory (RAM) until the memory is lost or cleared.

8.4 IEC TEST SYSTEM CALIBRATION

Selecting IEC TEST SYSTEM CALIBRATION from the Calibration Menu (**fn,4,1**) allows the the further selection of menus to calibrate AUXILIARY METERING, SYNTHETIC IMPEDANCE, or the FUNCTION GENERATOR.

```
      IEC TEST SYSTEM CALIBRATION
1 AUXILIARY METERING CALIBRATION
2 SYNTHETIC IMPEDANCE CALIBRATION
3 FUNCTION GENERATOR CALIBRATION
```

Selecting AUXILIARY METERING CALIBRATION (fn,4,1,1) allows further selection of the method to calibrate auxiliary metering. Either, EXTERNALLY REFERENCED CALIBRATION or AUXILIARY METER KFACTOR DISPLAY may be selected. Note: AUXILIARY AMPS-TO-VOLTS must be set before calibration of the meter of syhnthetic impedance.

```
     AUXILIARY METERING CALIBRATION
1 EXTERNALLY REFERENCED CALIBRATION
2 AUXILIARY METER KFACTOR DISPLAY
3 AMPS-TO-VOLTS RATIO (AUX. METER)
```

Selecting AMPS-TO-VOLTS RATIO (AUX. METER) (fn,4,1,1,3) allows the amps to volts ratio for the auxiliary meter to be set.

```
 AMPS-TO-VOLTS RATIO  (AUX. METER ONLY)

AMPS-TO-VOLTS = 4.0     amps : 1.0 volt
```

Press
EDIT to allow the amps-to-volts field to be edited, enter to appropriate setting for this system, and press EXECUTE or STORE to make the change. If a non-standard value was entered, then it will be accepted; however, the following notice will be displayed.

```
NOTICE--NON-STANDARD AMPS:VOLTS RATIO.
MODEL 108-TMX use  1.0 amps : 1.0v
MODEL 125-TMX use  2.0 amps : 1.0v
MODEL 140-TMX use  4.0 amps : 1.0v
```

NOTE: After setting the Auxiliary Meter's AMPS-TO-VOLTS RATIO all IEC TEST SYSTEM current metering and synthetic impedance terms must be recalibrated.

8.4.1 EXTERNALLY REFERENCED AUXILIARY METERING CALIBRATION

Selecting EXTERNALLY REFERENCED CALIBRATION from the Auxiliary Metering Calibration Menu (**fn,4,1,1,1**) allows the user to enter externally measured RMS values directly which the UPC1T will use to automatically calibrate auxiliary metering. ***The UPC1T must be calibrated before Auxiliary Metering is calibrated.*** The procedure is as follows:

```
    AUX. METER EXT. REF. CALIBRATION

PRESS (+/-) <channel><rms_display> UNITS
ENTER EXTERNAL REF.= <rms_entry>   UNITS
```

Usage:

i. Select one of the eight channels to calibrate by repeatedly pressing the "+/-" key,

ii. Press the "**ENTER**" key to initiate a single metering cycle for that channel (i.e. a RMS metered value corresponding to the selected channel will be displayed). the cursor will advance to the "EXTERNAL REFERENCE" entry field,

iii. Enter the externally measured RMS reference value,

iv. Press the **EXECUTE** or **STORE** key to automatically calculate and apply the scale factor for this channel.

v. Repeat for each channel to be calibrated.

The "**CLEAR**" key may be used during the procedure to clear an entry, back the cursor to the previous field, or return to the V/I (or other) METER display.

The "**DISPLAY**" key may be used anytime to immediatly return to the last manual mode meter active.

Procedure:
Connect External Sense wires to output terminals.
Program FREQUENCY SPAN 1,WAVEFORM NUMBER 1, 2ø, 50 Hz, 230 VAC.
Disable Programmable Output Impedance, Real Impedance, Synthetic Impedance and Continuous Self Calibration.
Calibrate V_ext, V_relay and V_pa with no load attached.
Verify actual output agrees with metered values.
Attach a 3 amp resistive load.
Calibrate I_AFE and I_AAAF.
Verify actual output agrees with metered values.

8.4.2 DISPLAY CALIBRATION SCALE FACTORS

Selecting DISPLAY CALIBRATION SCALE FACTORS from the Auxiliary Metering Calibration Menu (**fn,4,1,1,2**) allows the user to enter and/or view the scale factors used for auxiliary metering.

```
V_EXT    <scale> mV  SPARE    <scale> mA
V_RELAY  <scale> mV  I_SPARE  <scale> mA
V_SPARE  <scale> mV  I_AFE    <scale> mA
V_PA     <scale> mV  I_AAAF   <scale> mA
```

Usage:

i. Press "**EDIT**" to allow modification of the scale factors,
ii. Enter "<scale>" as a floating point numeric,
iii. Press "**ENTER**" to accept scale value and advance cursor to next entry,
iv. Repeat for each value to be entered,
v. Press the "**EXECUTE**" or "**STORE**" key to apply the displayed calibration scale factors.

These scale factors will be automatically updated when AUXILIARY METERING is calibrated by the EXTERNALLY REFERENCED procedure previously described.

8.4.3 SYNTHETIC IMPEDANCE NETWORK CALIBRATION

Selecting SYNTHETIC IMPEDANCE CALIBRATION from the IEC TEST SYSTEM CALIBRATION menu (**fn,4,1,2**) allows the user to calibrate the synthetic impedance network by entering the number of counts per unit appropriate for the desired range. Units are ohms for the resistive network and micro-Henrys for the inductive network; therefore, the R-net scale is in counts-per-ohm and the L-net scale is in counts-per-microHenry. The calibration is based on a full-count of 65535. For example, to calibrate the R-net for a range of 0 to 4 ohms the R-net scale = 65536 total #of counts / (4-0) ohms = 65536 / 4 = 16384 counts-per-ohm. This will be a good first approximation, further calibration may be required.

```
 CALIBRATE SYNTHETIC IMPEDANCE NETWORK
Z-COMPONENT     COUNTS-PER-UNIT
R-NET SCALE = <counts>    PER OHM
L-NET SCALE = <counts>    PER uH
```

Usage:

i. Press "**EDIT**" to allow modification of the scale factors,
ii. Enter "<counts>" as an integer numeric,
iii. Press "**ENTER**" to accept scale value and advance cursor to next entry,
iv. Repeat for each value to be entered,
v. Press the "**EXECUTE**" or "**STORE**" key to apply the displayed calibration scale factors.

8.4.3.1 R-NET SCALE

Synthetic resistance calibration procedure:

Enter counts per ohm to scale the resistive component of the synthetic impedance network.
Program FREQUENCY SPAN 1, WAVEFORM NUMBER 1, 2ø, 50 Hz, 230 VAC.
Attach a 3 amp resistive load.
Disable Programmable Output Impedance, Real Impedance and Continuous Self Calibration.
Program 1Ω synthetic resistance and 0μH synthetic inductance.
Measure the no load and full load output voltage and verify the Synthetic Resistance is correct.

$\Delta V = V_{no\ load} - V_{full\ load}$
$R = \Delta V \div I$

If not multiply the error by the scale factor and reenter a new scale factor.

8.4.3.2 L-NET SCALE

Synthetic inductive calibration procedure:

Enter counts per microHenry to scale the inductive component of the synthetic impedance network.
Program FREQUENCY SPAN 4, WAVEFORM NUMBER 1, 2⌀, 1200 Hz, 230 VAC.
Attach a 3 amp **RESISTIVE** load.
Disable Programmable Output Impedance, Real Impedance and Continuous Self Calibration.
Program 1000 μH synthetic inductance and 0 Ω synthetic resistance.
Measure the full load output voltage with 0 μH and 1000 μH then verify the Synthetic Inductance is correct. If not multiply the scale factor the by error and reenter a new scale factor.

X_L = synthetic inductive reactance = 2 * π * 1200 Hz * 1000 μH = 7.5398 Ω
R = output load resistance = 230 V ÷ 3 A = 76.667 Ω
Z = total impedance = $\sqrt{(R^2 + X_L^2)}$ = 77.037 Ω
%ΔZ = % change in total impedance = (77.037 Ω - 76.667 Ω) ÷ 76.667 Ω = 0.48243 %
%ΔV = % change in voltage = %ΔI = % change in current = %ΔZ
ΔV = change in output voltage = 230 V - (230 V * %ΔZ) = 1.1096 V

If ΔV is not 1.1096:

R = V ÷ I, with 0 μH programmed
Z = R * (1 + %ΔV) , with 1000 μH programmed
$X_L = \sqrt{(Z^2 - R^2)}$
$L = X_L \div (2 * \pi * F)$

8.4.4 FUNCTION GENERATOR CALIBRATION

Selecting FUNCTION GENERATOR CALIBRATION from the IEC TEST SYSTEM CALIBRATION menu (**fn,4,1,3**) allows the user to enter or view the scale factors used for the Function Generator. These calibration constants are used internally by the UPC1T to accommodate (automatically) low-gain voltages and high-gain voltages, as well as user designated routing of the function generator output.

```
AUX LO-GAIN VOLTAGE SCALE:   <scale>
AUX HI-GAIN VOLTAGE SCALE:   <scale>
AM  LO-GAIN VOLTAGE SCALE:   <scale>
AM  HI-GAIN VOLTAGE SCALE:   <scale>
```

Usage:

i. Press "**EDIT**" to allow modification of the scale factors,
ii. Enter "<scale>" as a floating point numeric,
iii. Press "**ENTER**" to accept scale value and advance cursor to next entry,
iv. Repeat for each value to be entered,
v. Press the "**EXECUTE**" or "**STORE**" key to apply the displayed calibration scale factors.

NOTE: Scale factors are set-up by the manufacturer and stored in non-volatile memory.

8.4.4.1 AUX LO-GAIN VOLTAGE SCALE

Program FREQUENCY SPAN 1, WAVEFORM NUMBER 1, 2ø, 50 Hz, **0** VAC.
Disable Programmable Output Impedance, Real Impedance, Synthetic Impedance and Continuous Self Calibration.
Remove any load.
Program the function generator for waveform 1, route = AUX, amplitude = 100 VAC and frequency = 150 Hz.
Verify actual output agrees with programmed values. If not multiply the error by the scale factor and reenter a new scale factor.

8.4.4.2 AUX HI-GAIN VOLTAGE SCALE

Program FREQUENCY SPAN 1, WAVEFORM NUMBER 1, 2ø, 50 Hz, **0** VAC.
Disable Programmable Output Impedance, Real Impedance, Synthetic Impedance and Continuous Self Calibration.
Remove any load.
Program the function generator for waveform 1, route = AUX, amplitude = 15 VAC and frequency = 50 Hz.
Verify actual output agrees with programmed values. If not multiply the error by the scale factor and reenter a new scale factor.

8.4.4.3 AM LO-GAIN VOLTAGE SCALE

Program FREQUENCY SPAN 3, WAVEFORM NUMBER 1, 1⌀, 400 Hz, 100 VAC.
Disable Programmable Output Impedance, Real Impedance, Synthetic Impedance and Continuous Self Calibration.
Remove any load.
Program the function generator for waveform 3, route = AM, amplitude = 20 VAC and frequency = 0.1 Hz.
Verify actual output agrees with programmed values. If not multiply the error by the scale factor and reenter a new scale factor.

8.4.4.4 AM HI-GAIN VOLTAGE SCALE

Program FREQUENCY SPAN 3, WAVEFORM NUMBER 1, 1⌀, 400 Hz, 100 VAC.
Disable Programmable Output Impedance, Real Impedance, Synthetic Impedance and Continuous Self Calibration.
Remove any load.
Program the function generator for waveform 3, route = AM, amplitude = 3 VAC and frequency = 0.1 Hz.
Verify actual output agrees with programmed values. If not multiply the error by the scale factor and reenter a new scale factor.

NOTE: The above calibration procedures for AM LO-GAIN and AM HI-GAIN require that waveform number 3 is still a SQUARE waveform, as it is when shipped and when memory is cleared using the (**fn**,**1**,**3**) key sequence, as described in Section 4.5.1.3.

8.5 PROGRAMMABLE IMPEDANCE OUTPUT (PROG. Z-OUT) CALIBRATION

Calibration values for Direct coupled operation may be established via the following procedure.

1. Turn CSC OFF. Disable PROG. Zo. Execute a program in Direct coupled mode.

   A. Establish the difference in output voltage between no-load and full-load voltage.
   B. Divide the Voltage difference by the full-load current. The net result is the inherent direct coupled impedance of the power source.

$$Z = \frac{V\_no\_load - V\_full\_load}{I\_full\_load}$$

   Use the result to enter in as Z-Direct for the power form used to perform this test.

1⌀ PROGRAMMABLE IMPEDANCE OUTPUT CALIBRATION PROCEDURE:

Program FREQUENCY SPAN 1, WAVEFORM NUMBER 1, 1⌀, 60 Hz, 120 VAC.
Disable Programmable Output Impedance, Real Impedance, Synthetic Impedance and Continuous Self Calibration.
Apply and remove a 3 amp resistive load.

$\Delta V = V_{no\ load} - V_{full\ load}$
$Z = \Delta V \div I$

Enter as Z-Direct for 1⌀ operation.

2⌀PROGRAMMABLE IMPEDANCE OUTPUT CALIBRATION PROCEDURE:

Program FREQUENCY SPAN 1, WAVEFORM NUMBER 1, 2⌀, 50 Hz, 230 VAC.
Disable Programmable Output Impedance, Real Impedance, Synthetic Impedance and Continuous Self Calibration.
Apply and remove a 3 amp resistive load.

$\Delta V = V_{no\ load} - V_{full\ load}$
$Z = \Delta V \div I$

Enter as Z-Direct for 2⌀ operation.

Refer to Section 4.5.3.1.1 for more detail.

SECTION 9

USER DIAGNOSTICS

9 USER DIAGNOSTICS

This section is intended to aid the user in solving common problems that may occur while using the UPC1T.

PROBLEM

Incorrect or illogical operation, or program values invalid, or "NO PROGRAM RUNNING" is displayed.

PROBABLE CAUSE - Battery backed RAM information corrupt.

SUGGESTED CURE: Clear ALL RAM and RESET CPU. Refer to Section 4.5.1.3 to perform this function.

PROBLEM

LCD Display not readable

PROBABLE CAUSE - Battery backed RAM information corrupt.

SUGGESTED CURE: Clear ALL RAM and RESET CPU. Refer to Section 4.5.1.3 to perform this function

PROBLEM

ERROR Message states

"ERROR - PROGRAMMED OUTPUT VOLTAGE VALUE EXCEEDS OUTPUT VOLTAGE RANGE. CHANGE VOLTAGE, COUPLING or WAVEFORM."

PROBABLE CAUSE - RMS content of selected Waveform is not great enough to produce programmed voltage.

If this type of error occurs when the UPC1T calculates segment step data for a transient program, the just prior to the one indicated as erroneous, may contain a voltage which cannot be achieved by the segment indicated (because the current segment may be ramping from a voltage set in the previous segment).

SUGGESTED CURE: Change programmed Voltage or change the selected waveform (either by editing the Waveform or selecting a Waveform with a greater RMS content). See Section 4.5.2.1 to edit a Waveform.

For this problem with transient segments, you may have to reduce the voltage in the segment prior to the one indicated as having the error as well as the one indicated as having the error.

9 USER DIAGNOSTICS (cont)

PROBLEM

KEYS BEEP when pressed but display does not respond.

PROBABLE CAUSE - UPC1T is in REMOTE CONTROL (check the REMOTE LED on the keyboard).

SUGGESTED CURE: Change to LOCAL CONTROL by pressing the **LOCAL** key. If the REMOTE LED remains ON then the REMOTE INTERFACE controller has put the UPC1T into LOCAL LOCKOUT (LLO). Use the REMOTE INTERFACE controller to send the GOTO LOCAL (GTL) message or clear the REN (REMOTE ENABLE) signal from the GPIB controller. Turning the INPUT POWER to OFF will also restore LOCAL CONTROL.

PROBLEM

UPC1T does not respond to the GPIB.

PROBABLE CAUSE - GPIB device address incorrect or not unique.

SUGGESTED CURE: Verify device address selected within the GPIB controller software matches the GPIB device address within the UPC1T. There may only be a single device at each GPIB address. Refer to Section 4.5.3.3 (UPC1T STATUS display) to verify or set the GPIB device address within the UPC1T.

You may also use the UPC1T STATUS display to verify receipt of an INTERFACE CLEAR (IFC) by the UPC1T from a GPIB controller. Refer to Section 4.5.3.3 (UPC1T STATUS display) for usage of the IFC field.

The "LAST DATA BYTE" field indicates the data byte received by the UPC1T from the GPIB when the UPC1T was addressed as a listener. Normally if a properly terminated command string was received by the UPC1T, the LAST DATA BYTE received should be 0Ah (a Line Feed). The Line Feed character or END signal (EOI) is the proper end of string <eos> terminator. Refer to Section 4.5.3.3 (UPC1T STATUS display) for usage of the LAST DATA BYTE field.

Characters sent one at a time to the UPC1T via the GPIB when the UPC1T is addressed to listen will be displayed in the LAST DATA BYTE field.

PROBLEM

UPC1T displays "TRANSITION IN PROGRESS"
for an extended length of time upon power-up.

PROBABLE CAUSES - A long Transition time was programmed into the UPC1T. The UPC1T is designed to execute the previously executed Program parameters or Manual mode parameters upon power-up.

SUGGESTED CURE: If it is desired to terminate the Transition, press the **TRANS** key.

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CERTIFICATION

Pacific Power Source certifies that this instrument was thoroughly tested and inspected and found to meet or exceed its published specifications when it was shipped from the factory.

LIMITED WARRANTY

Pacific Power Source (PPS) warrants each unit to be free from defects in material and workmanship. For the period of two (2) years from the date of shipment to the purchaser, PPS will either repair or replace, at its sole discretion, any unit returned to its factory in Huntington Beach, California. This warranty does not cover batteries. It does not cover damage arising from mis-use of the unit or attempted field modifications or repairs. This warranty specifically excludes damage to other equipment connected to this unit.

Upon notice from the purchaser within (30) days of shipment of units found to be defective in material or workmanship, PPS will pay all shipping charges for the repair or replacement. If notice is received more than (30) days from shipment, all shipping charges shall be paid by the purchaser. Units returned on debit memos will not be accepted and will be returned without repair.

This warranty is exclusive of all other warranties, express or implied.

The media on which you receive PACIFIC POWER SOURCE software is warranted not to fail to be machine readable, due to defects in materials and workmanship, for a period of 2 years from date of shipment, as evidenced by receipts or other documentation. PACIFIC POWER SOURCE will, at its option, repair or replace software media that is not machine readable if PACIFIC POWER SOURCE receives notice of such defects during the warranty period. PACIFIC POWER SOURCE does not warrant that the operation of the software shall be uninterrupted or error free.

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WARNINGS REGARDING MEDICAL AND CLINICAL USE OF THIS PRODUCT

PACIFIC POWER SOURCE products are not designed with components and testing intended to ensure a level of reliability suitable for use in treatment and diagnosis of humans. Applications of PACIFIC POWER SOURCE products involving medical or clinical treatment can create a potential for accidental injury caused by product failure, or by errors on the part of the user or application designer. Any use or application of PACIFIC POWER SOURCE products for or involving medical or clinical treatment must be performed by properly trained and qualified medical personnel, and all traditional medical safeguards, equipment, and procedures that are appropriate in the particular situation to prevent serious injury or death should always continue to be used when PACIFIC POWER SOURCE products are being used. PACIFIC POWER SOURCE products are NOT intended to be a substitute for any form of established process, procedure, or equipment used to monitor or safeguard human health and safety in medical or clinical treatment.

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NOTES -- INITIAL FACTORY CALIBRATION VALUES

1ϕ (ONE PHASE) Kfactors:

Kin A: _____
Kex A: _____
Ki A: _____
Ko A: _____

2ϕ (TWO PHASE) Kfactors:

Kin AB: _____
Kex AB: _____
Ki AB: _____
Ko AB: _____

AUXILIARY METERING:

V_EXT:	_____mV	SPARE:	_____mA
V_RELAY:	_____mV	I_SPARE:	_____mA
V_SPARE:	_____mV	I_AFE:	_____mA
V_PA:	_____mV	I_AAAF:	_____mA

SYNTHETIC IMPEDANCE NETWORK:

R-NET SCALE: _____PER OHM
L-NET SCALE: _____PER uH

FUNCTION GENERATOR:

AUX LO-GAIN VOLTAGE SCALE: _____
AUX HI-GAIN VOLTAGE SCALE: _____
AM LO-GAIN VOLTAGE SCALE: _____
AM HI-GAIN VOLTAGE SCALE: _____

PROGRAMMABLE OUTPUT IMPEDANCE:

1ϕ Z direct: _____
2ϕ Z direct: _____

MODIFICATIONS

MODIFICATIONS

This section is reserved for any modifications that may be made.

END OF DOCUMENT