



TrueWave AC Power Source

TW SERIES

SCPI Programming Manual

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SECTION 1 SCPI CONFORMANCE INFORMATION

The Elgar TW Series conforms to all specifications for devices as defined in IEEE 488.2, and complies with SCPI command syntax version 1995.0.

1.1 PARAMETER DEFINITIONS

Type	Valid arguments
<boolean>	ON, OFF, 0, or 1
<value>	Integer or Floating point number
<name>	String enclosed by single or double quotes

1.2 UNITS

The TW Series accepts the following units as suffixes to numeric values:

Type of Unit	Valid suffix
Voltage	"Volts" or "V"
Current	"Amps" or "A"
Frequency	"Hz"
Time	"ms" (milliseconds), "s" (seconds), or "min" (minutes).

1.3 CONVENTIONS

Commands enclosed by "[]" are optional.

For example, **SOURce:VOLTage:LEVel:IMMediate:AMPLitude 120.0** can be written as, **SOURce:VOLTage 120.0**.

1.4 QUERIES

The query syntax is identical to the command syntax, with a "?" appended.

For example, to query the programmed voltage on phase A, send the string:

SOURce:VOLTage?. A subsequent device read will return a value such as "120.00".

All queries are terminated with a carriage return and line feed (0x0D 0x0A) for those GPIB controllers that require termination characters. When the TW Series has nothing to report, its output buffer will contain three ASCII characters: space, carriage return, and linefeed (in decimal these values are <32><13><10>).

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SECTION 2 POWER-ON AND RESET CONDITIONS

The following sections define the factory and reset power-on conditions of the unit.

2.1 FACTORY DEFAULTS

When the TW is first powered up, the following factory defaults will be in place:

- GPIB Address: 25
- RS-232 Baud Rate: 9600
- RS-232 Data Bits: 8
- RS-232 Stop Bits: 1
- RS-232 Parity: N
- Number of phases (amplifiers in chassis): TW1750 – 1
TW3500 – 2
TW3700 – 2
TW5250 – 3

2.2 POWER-ON CONDITIONS

When the TW is first powered up, the system reads in the configuration that was last saved to memory position 0. The specific system items are:

- VoltsA, VoltsB, VoltsC
- Voltage Range, either High or Low
- OffsetVoltsA, OffsetVoltsB, OffsetVoltsC (for DC and AC-DC)
- Current Protection Type, either Fold or Shut
- Current Shutdown Time
- Current LimitA, Current LimitB, Current LimitC
- Frequency
- Phase AngleAB
- Phase AngleAC
- External Input Assignment, either Ext Gain Control or Off
- External Trigger Assignment, either Trig In, Trig Out, Phase A In, or Phase A Out
- Coupling State, either AC, DC, or AC-DC
- Parallel State, all amps in parallel, or not
- Sense State, either Local or Remote
- Output Impedance Setting, (IEC) either On or Off.

In addition, unique system settings are read in from the non-volatile EEROM memory:

- Output Relay State, either Auto Start or Standby
- Keyboard Lock State, either Front Panel Program Enabled or Disabled
- Passcode Protection State, and the Passcode (if enabled)
- Quantity of Installed Amplifiers
- Quantity of Chassis Installed

2.3 RESET CONDITIONS

When the *RST command is sent via SCPI, the following conditions apply:

- Faults are cleared
- The error queue is cleared
- The output relay is opened
- VoltsA, VoltsB, VoltsC are set to 0
- OffsetVoltsA, OffsetVoltsB, OffsetVoltsC (for DC and AC-DC) are set to 0
- TW is moved to Low Range (0–156V, 5 Amps current limit)
- External Input Assignment is turned Off
- A locked keyboard remains locked.

SECTION 3 SCPI COMMANDS

3.1 MEASURE COMMANDS

```

MEASure[phase]
  :CURR-ent?
    :PEAK?
    :INRUSH?
  :FREQuency?
  :PEAKCURRent?
  :PHASe?
  :POWER?
    :TOTal?
  :POWERFACTOR?
    :TOTal?
  :CRESTFACTOR?
  :VA?
    :TOTal?
  :VOLTage?
    :VAB?
    :VBC?
    :VCA?

```

Phase shall be 1, 2 or 3.

:MEASure[phase]	Measurement (readbacks) tree, Phase = 1,2,or 3 indicating phase to read. Phase = 0 is illegal here.
:CURRent ?	Return current of a phase.
:PEAK?	Return the peak current reading of a phase.
:INRUSH?	Return the inrush current reading of a phase.
:FREQuency?	Return the frequency of the TW system. The phase is not applicable in this query.
:PEAKCURRent?	Return the peak current of a phase.
:PHASe?	Return the phase angle of a phase in relation to phase 1 (A).
:POWER ?	Return presently calculated power in Watts of a phase.
:TOTal?	Return presently calculated power of all three phases.
:POWERFACTOR ?	Return the power factor of a phase.
:TOTal?	Return the total powerfactor of all phases.
:CRESTFACTOR?	Return the crestfactor of a phase.
:VA?	Return the Volt/Amps of a phase.
:TOTal?	Return the total VA of all three phases.
:VOLTage ?	Return the RMS voltage of a phase.
:VAB?	Return the RMS voltage difference between phases 1(A) and 2(B).
:VBC?	Return the RMS voltage difference between phases 2(B) and 3(C).
:VCA?	Return the RMS voltage difference between phases 3(C) and 1(A).

3.2 MISCELLANEOUS COMMANDS

```

ASSYno                <string>
ASSYno?
OUTPut?
OUTPut                <boolean>
OUTPut
    :COUPling?
    :COUPling          <AC,DC,AC+DC>
    :STATe?
    :STATe              <boolean>
    
```

:ASSYno ?	Returns the assembly number.
:OUTPut?	Return the state of the output relay.
:OUTPut <boolean>	Set the output relay to open (OFF) or closed (ON).
:OUTPut	
:COUPling?	Return the present state of the output coupling electronics AC, DC, or ACDC.
:COUPling <value>	Set output electronics coupling state "AC", "DC", or "ACDC". To source DC with the TW it is necessary to set coupling to DC. To apply a DC offset to an AC output use ACDC. The AC value is entered into Volts, the DC offset is entered into Volts:Offset.
:STATe?	Return the state of the output relay 1 or 0.
[:STATe] <boolean>	Set the output relay to open (0,OFF) or closed (1,ON).

3.3 SOURCE COMMANDS

```

SOURCE[phase]
    :CURRent?
    :CURRent          <value>
        [:LEVel?]
        [:LEVel]      <value>
            :IMMediate?
            [:IMMediate] <value>
                [:AMPLitude] <value>
                :AMPLitude?
    :LOCK?
    :LOCK              <boolean>
    :PROTection?
    :PROTection        <value>
        :CLEar
        :CURTimeout?
        :CURTimeout    <value>
            :STATe?
            :STATe      <boolean>
            [:TIME]     <value>
            :TIME?
    
```

```

        [:LEVel]                <value>
        :LEVel?
        :STATE                  <boolean>
        :STATE?
        :TRIPped?
:FREquency                    <value>
:FREquency?
:DISTurbanCe
    :STATE                    <boolean>
    :STATE ?
    :STARTPHASE               <value>
    :STARTPHASE ?
    :STOPPHASE                <value>
    :STOPPHASE ?
    :CYCLES                   <value>
    :CYCLES ?
    :VOLTage                  <value>
    :VOLTage ?
    :TRIGger                  <GPIBGET,EXTERNAL,
                              IMMEDIATE,DISABLE>
    :TRIGger ?
:PHASe?
:PHASe                        <value>
    [:ADJust]                 <value>
    :ADJust?
    :LOCK                     <boolean>
    :LOCK?
:Sense?
:Sense                        <LOCAL, REMOTE>
:VOLTage?
:VOLTage
    :LEVel?
    [:LEVel]
        :IMMediate?
        [:IMMediate]
        [:AMPLitude]         <value>
        :AMPLitude?
        :OFFSet              <+-value>
        :OFFSet?
    :LOCK                     <boolean>
    :LOCK?
    :PROTection?
    :PROTection               <value>
        [:LEVel]             <value>
        :LEVel?
        :STATE               <boolean>
        :STATE?
        :TRIPped?
:RANGe                        <value>
:RANGe?

```

If the phase is set to 0 at query time, the phase A value will be returned.

:SOURce[phase]	Source words: Phase = 0,1,2,or 3 indicating phase(s) to control. Phase = 0 will apply the specified value to all three phases for set operations.
:CURRent?	Return the present current limit setpoint of a phase.
:CURRent [<value>]	Set foldback over-current mode and optionally specify the over-current value.
:LEVel?	Return the present current limit setpoint of a phase.
:LEVel [<value>]	Set over-current limit setpoint.
:IMMEDIATE ?	Return the present over-current setpoint of a phase.
:IMMEDIATE	Process new amplitude without waiting for more commands. Must be followed by :AMPLitude command.
:AMPLitude <value>	Set over-current limit setpoint.
:AMPLitude?	Return the present current limit setpoint of a phase.
:LOCK?	Returns the present SCPI over-current register lock state.
:LOCK <boolean>	Locks all phase over-current registers at the SCPI command level. Phase 0,1,2, or 3 may be programmed; any value programmed will affect all 3 phases immediately.
:PROTECTION?	Returns the present current limit value.
:PROTECTION [<value>]	Specifies the over current shutdown mode and optionally can specify the over current value.
:CLEAR	Clears the over-current protection circuit. Places the over current system into foldback mode.
:CURTimeout?	Returns the present over-current timeout value.
:CURTimeout [<value>]	Programs the current level in current shutdown mode and optionally sets the timeout value in milliseconds.
:STATE?	Return the present enabled/disabled state of the over-current timeout circuit 0 = tripped, 1 = not tripped.
:STATE <boolean>	Set over-current timeout system to 1 = not tripped, 0 = tripped.
:TIME <value>	Program the over-current timeout setpoint.
:TIME?	Return the over-current timeout setpoint.
:LEVel <value>	Sets the over-current setpoint and sets the shutdown mode.
:LEVel?	Returns the over-current setpoint.
:STATE <boolean>	Set protection mode to 1 = shutdown, 0 = foldback.
:STATE?	Return present protection mode 0 = foldback, 1 = shutdown.
:TRIPped?	Return 1 if the over-current circuit has tripped, 0 if not.
:FREQuency <value>	Set the frequency of the unit. Since there is only one frequency for the unit, the frequency applies to all phases.

:DISTurbance	This set of words allows the operator to generate a change to the output waveforms of the TW. A number of cycles can be raised or lowered in voltage at any point in the rising or falling portion of a cycle.
:STATE ?	Returns the present state of the disturbance software. 0 = off, 1 = on.
:STATE <boolean>	Set the Disturbance software to the on state. This command shall precede all other disturbance commands.
:STARTPHASE ?	Returns the present degrees that the disturbance begins.
:STARTPHASE <value>	Sets the point on a cycle that the disturbance will begin. 0-360.
:STOPPHASE ?	Returns the present degrees on a cycle that the disturbance will end.
:STOPPHASE <value>	Set the point on a cycle that the disturbance will end.
:CYCLES ?	Returns the present quantity of cycles that will exhibit the disturbance voltage after the start point and before the end point.
:CYCLES <value>	Set the quantity of cycles that will exhibit the disturbance voltage.
:VOLTage ?	Returns the present disturbance voltage.
:VOLTage <value>	Set the voltage of the disturbance cycles.
:TRIGger ?	Returns the present set trigger type that kicks off the disturbance.
:TRIGger GPIBGET	Specify that a GPIB trigger will kick off the disturbance. Any number of disturbances can Be specified at GPIB trigger time.
:TRIGger EXTERNAL	Specify that a rising TTL signal on the Sync Input will kick off the disturbance.
:TRIGger IMMEDIATE	Specify that the reception of this command will kick off the disturbance.
:TRIGger DISABLE	Specify none of the above; there will be no disturbance.
:PHASe?	Return the phase angle of the specified phase (in relation to phase A).
:PHASe [<value>]	Set the phase angle of the specified phase in relation to phase A.
:ADJust <value>	Set the phase angle of the specified phase in relation to phase A.
:ADJust?	Return the phase angle of the specified phase in relation to phase A.
:LOCK <boolean>	Lock the specified phase angle at the SCPI level to phase A. Any phase can be programmed, but phases B & C will move together in relation to Phase A.
:LOCK?	Return the SCPI level lock state of the phase angle registers.

:SENSe?	Returns the present sense points LOCAL or REMOTE.
:SENSe LOCAL	Specify that the amplifier(s) control circuit will use internal voltage readback points.
:SENSe REMote	Specify that the amplifier(s) control circuit will use external voltage readback points.
:VOLTage?	Return the present voltage of the specified phase. If the phase is 0 then Phase A will be returned.
:VOLTage [<value>]	Set the voltage setpoint of the specified phase.
:LEVel?	Return the present voltage setpoint of the specified phase.
:LEVel [<value>]	Set the voltage setpoint of the specified phase.
:IMMediate?	Return the present voltage of the specified phase.
:IMMediate [<value>]	Set the voltage setpoint of the specified phase immediately without waiting for any other commands.
:AMPLitude <value>	Set the voltage setpoint of the specified phase.
:AMPLitude?	Return the voltage setpoint of the specified phase.
:OFFSet ?	Returns the DC (offset) voltage setpoint of the specified phase.
:OFFSet [<value>]	Set the offset voltage setpoint of the specified phase. Coupling state must be set to DC or ACDC or an execution error will be returned. In ACDC mode the value may appear too high to the TW if the AC signal + the offset = MAXV.
:LOCK <boolean>	Lock the phase voltage registers at the SCPI level together. When locked, any change to any phase will affect all phases.
:LOCK?	Return the specified phase SCPI register lock state.
:PROTection?	Return the present overvolt protection level .
:PROTection [<value>]	Set the overvolt protection setpoint value of the specified phase.
:LEVel <value>	Set the overvolt protection setpoint value of the specified phase.
:LEVel?	Return the overvolt protection value of the specified phase.
:STATe <boolean>	Specify the overvolt protection state. 1 = protection turned on. 0 will be ignored.
:STATe?	Return the present overvolt state of the TW. Always will return 1.
:TRIPped?	Return the present state of the overvolt protection circuit. 0 = there has been no overvolt condition. 1 = the TW has shut down based on an overvolt condition.
:RANGe <value>	Set the voltage range to (HIGH,1) range or (LOW,0) range.
:RANGe?	Returns the present set voltage range of the TW. Return values will be either "1" for HIGH or "0" for LOW.

3.4 STATUS COMMANDS

```

:STATus
  :OPERation?
  :OPERation
    [:EVENT]?
    :CONDition?
    :ENABLE <value>
    :ENABLE?
  :PRESet
  :QUEStionable?
  :QUEStionable
    :CONDition?
    [:EVENT]?
    :ENABLE <value>
    :ENABLE?

```

:STATus	The status commands tree.
:OPERation?	SCPI commands returns '0' always.
:OPERation	The SCPI Operation sub-tree.
:[EVENT?]	Returns '0'.
:CONDition?	Returns '0'.
:ENABLE <value>	Sets the enable mask of the Operation Enable register. This allows true conditions to be reported in the summary bit of the Operation Condition register. Values may be written and queried, but have no effect on the Operation Condition register.
:ENABLE?	Returns the value in the Operations Enable register.
:PRESet	Preset the value of the Operations Enable register and the Status Questionable registers = 0x7fff.
:QUEStionable?	Returns '0' always.
:QUEStionable	
:CONDition?	Returns '0'.
:[EVENT?]	Returns '0'.
:ENABLE <value>	Sets the enable mask of the Questionable Event register. This allows true conditions to be reported in the summary bit of the Questionable Conditions register.
:ENABLE?	Returns the value of the Questionable Conditions register.

3.5 SYSTEM COMMANDS

```

:SYSTem
  :AMPLIFier?
  :AMPLIFier <value>
  :CHASSIS?
  :CHASSIS <value>
  :CHAIN?
  :CHAIN <value>
  :CHECKSUM?
  :CHECKSUM
  :COMMunicate
    :GPIB
      [ :SELF]
        :ADDRESS <value> [,<value>]
        :ADDRESS?
  [ :CONFIg]
    :STORE <value>
    :STORE ?
    :RECall <value>
:ERRor?
  :EXTernal
    :CLOCK?
    :CLOCK <REFOUT,REFIN,TRIGIN,SYNCOUT>
    :LOCK?
  :DIRect <boolean>
  :DIRect ?
  :GAIN ?
  :GAIN <boolean>
  :IECLoad <boolean>
  :IECLoad?
  :MODulation <boolean>
  :MODulation?
  :KLOCK <boolean>
  :KLOCK?
  :AUTORUN <boolean>
  :AUTORUN?
  :PARAllel?
  :PARAllel <boolean>
  :PASSword
    :CDISable <password>
    [ :CENable] <password>
    :STATE?
    :NEW <curr password>,<new password>
  :SERIALNO %s
  :SERIALNO?
  :SYNC?
  :SYNC <boolean>
  :UPGRade
  :VER[S][ion]?

```

:SYSTem	The system command tree.
:AMPLIFier?	Returns the quantity of amplifiers that are installed in the TW.
:AMPLIFier <value>	Set installed quantity amps (1..3).
:CHASSIS?	Returns the number of parallel connected chassis.
:CHASSIS <value>	Set the quantity of parallel connected chassis. If the number is 1, this TW is either an individual power supply or a chained slave. If the number is 2–8, this TW will attempt to connect to slave chassis at power-up.
:CHAIN?	Returns the units chain address
:CHAIN <value>	Set the Slave address of this box. If the address is set to 0, this TW is either an individual power source or a master. If this value is 1–7, this TW is chain (slave) address 1–7.
:CHECKSUM?	Return the results of the checksum test. 1 == the checksum passed. 0 === failed.
:CHECKSUM	Specify that the TW shall re-check its flash checksum.
:COMMunicate	The communications sub-tree.
:GPIB	The GPIB communications channel.
[:SELF]	SCPI sub-command.
:ADDRess <value> [<value>]	Set the GPIB address The address must be 1..31.
:ADDRess?	Returns the GPIB address presently set.
[:CONFig]	The SYSTem:CONFig sub-tree.
:STORE <value>	Specify that the present system setpoint/register set shall be saved to EEPROM at the <value> address. <value> shall be 0..98.
:STORE?	Return the present EEPROM register address that was read from to set the present setpoint/register values. TW shall read in EEPROM address 0 at power-up.
:RECall <value>	Specify that TW shall read in the EEPROM setpoint/registers from EEPROM location <value>.
:ERRor?	Return the last Error logged by the GPIB/RS-232 command processor. If there are no errors, TW shall return as SPACE.
:EXTernal	External connectors sub-tree.
:CLOCK?	Return the present state of the Clock/Lock connector interface circuit Returns.

:CLOCK <value>	Set the Clock/Lock connector interface settings to: <ul style="list-style-type: none"> - REFOUT : sends a TTL pulse out at each zero crossing of Phase A. - REFIN : is used with the PLL and the TW will attempt to sync the outputs to the input TTL signal. - TRIGIN : configures the clock/lock BNC as an input allowing the TW to use a supplied signal to kick off events (such as the disturbance). - SYNCOUT : specifies that changes to the operations will generate a sync signal.
:LOCK ?	Returns 1 if the PLL phase lock is in control, and 0 if the PLL is not locked to the frequency source.
:DIRect <boolean>	Set the EXT INPUT connector to control the amplifiers directly. GAIN and MOD must be off, or an execution error will occur.
:DIRect?	Return the state of the EXT INPUT connector.
:GAIN?	Return the state of the EXT INPUT connector.
:GAIN <boolean>	Set the EXT INPUT connector to control the gain of the amplifiers. MOD and DIRECT must be off, or an execution error will occur.
:IECLoad <boolean>	Set the output impedance of the TW to support the IEC European standard.
:IECLoad?	Return the present state of the IEC load output circuitry.
:MODulation <boolean>	Set the EXT connector to modulate the amplifiers. GAIN and DIRECT must be Off, or an execution error will occur.
:MODulation?	Return the state of the EXT INPUT connector.
:KLOCK ?	Returns 1 if front panel program keys are locked.
:KLOCK <boolean>	Send 1 or 'ON' to lock out front panel program keys and output key. Send 0 or 'OFF' to make these keys available again.
:AUTORUN ?	Returns 1 if TW is setup to automatically close its output relay after powering up, or else returns 0.
:AUTORUN <boolean>	Send 1 or 'ON' to specify that the TW will automatically close its output relay at power up.
:PARAllel?	Returns 1 if the TW amplifiers are paralleled. Returns 0 if parallel mode is not set.
:PARAllel <boolean>	Set the TW amplifiers to operate in parallel mode: 1(ON). 0(OFF) specifies that the TW amplifiers are operating independently.

:PASSword	Password operations. The TW menu system is protected by a password or “passcode” that is actually an integer in the range of 0-9999.
:CDISable <password>	Disable password protection of menu system if supplied password is the correct password.
[:CENable] <password>	Enable password menu protection if supplied password is correct.
:STATe ?	Get the present state of the menu password protection.
:NEW <old pword> <new pword>	Rename password to the new value if the supplied old password matches the stored value.
:VER[S][ion]?	Return the code version of the FLASH application presently active in the TW.

3.6 COMMON COMMANDS

The following commands are common to all SCPI instruments and declared mandatory by IEEE 488.2. In the table below, the TW Series will be defined as the “device” on the GPIB bus. These commands are further supported on the RS-232 command interface.

*CLS
 *ESE
 *ESE?
 *ESR?
 *IDN?
 *OPC
 *OPC?
 *RST
 *SRE
 *SRE?
 *STB?
 *TST?
 *WAI

*CLS	Clear Status Command. Clears all status reporting data structures, including the Status Byte, Standard Event Status Register, and Error Queue. Enable Masks are not cleared.
*ESE	Standard Event Status Enable Command. Sets the Standard Event Status Enable Register, which determines which bits can be set in the Standard Event Status Register.
*ESE?	Standard Event Status Enable Query. Returns value of Standard Event Status Enable register.
*ESR?	Standard Event Status Register Query. Returns value of Standard Event Status Register. The ESR and the Status Byte ESR are cleared.

*IDN?	Identification Query. Returns the device identity as an ASCII string: <manufacturer>, <model>, <serial number>, <firmware level>. Example: Elgar, TW Series 5256, 1234, 1.0.
*OPC	Operation Complete Command. Causes the Operation Complete bit to be set in the Standard Events Status Register when all pending operations are complete.
*OPC?	Operation Complete Query. Causes an ASCII "1" to be placed in the output queue when all pending operations are complete.
*RST	Reset Command. Resets the device to the state defined in section 2 of this manual. Clears all status reporting data structures, including the Status Byte, Standard Event Status Register, and Error Queue. Enable Masks are not cleared.
*SRE	Service Request Enable Command. Sets the Service Request Enable Register, which determines which bits in the Standard Event Status Register will cause a service request from the device.
*SRE?	Service Request Enable Query. Returns contents of Service Request Enable Register. Values range from 0 to 63 or 128 to 191.
*STB?	Read Status Byte Query. Returns the Status Byte with bit 6 representing the Master Summary Status (MSS) instead of RQS. The MSS bit acts as a summary bit for the Status Byte, and indicates whether or not the device has at least one reason to request service, based on the MAV and SESR bits. The return value is in the range of 0-255. The Status Byte is cleared after the read.
*TST?	Self Test Query. Causes the device to execute an internal self-test and report whether or not it detected any errors. A value of "0" indicates the test completed without detecting any errors.
*WAI	Wait to Continue command. Makes the device wait until all previous commands and queries are completed before executing commands following the *WAI command.

APPENDIX A STATUS REGISTER DEFINITIONS

The TW Series supports the IEEE 488.2 and SCPI 1993.0 status reporting data structures. These structures are comprised of status registers and status register enable mask pairs. These pairs are described below:

A.1 STATUS BYTE

The Status Byte status register can be read by the *STB? command or by issuing a GPIB serial poll. Either operation clears the contents of the Status Byte. The *CLS command clears the Status Byte.

The TW Series unit can be configured to request service from the GPIB controller by setting the appropriate bits in the Service Request Enable register. The SRE register has the same bit pattern as the Status Byte. The SRE register is modified using the *SRE command, and can be read with the *SRE? command. For example, if the SRE register is set to 0x10 (MAV), when the TW Series unit has a message available, the Status Byte register will contain 0x50 (RQS and MAV) and the SRQ line of the GPIB bus will be pulled low indicating a request for service.

Bit	Hex Value	Description
0	01	Not used.
1	02	Not used.
2	04	Error/event queue message available.
3	08	Questionable Status flag. Indicates quality of current data being acquired. This bit is not used.
4	10	Message available (MAV).
5	20	Standard Event Status Register (ESR).
6	40	Request Service flag (RQS) for serial polling, or Master Summary Status (MSS) in response to *STB?
7	80	Operation Status flag. Indicates the current operational state of the unit. This bit is not used.

Bit 2, Error/Event Queue Information Available

This bit is set when any error/event is entered in the System Error queue. It is read using the SYSTem:ERRor? query.

Bit 4, Message Available

Indicates a message is available in the GPIB output queue. This bit is cleared after the GPIB output buffer is read.

Bit 5, Standard Event Status Register

This is a summary bit for the ESR. It is set when any of the ESR bits are set, and cleared when the ESR is read.

Bit 6, Request Service/Master Summary Status

If service requests are enabled (with the *SRE command), this bit represents the RQS and will be sent in response to a serial poll, then cleared. If RQS is not enabled, the bit represents the MSS bit and indicates the device has at least one reason to request service. Although the device sends the MSS bit in response to a status query (*STB?), it is not sent in response to a serial poll. It is not considered part of the IEEE 488.1 Status Byte.

A.2 STANDARD EVENT STATUS REGISTER

The ESR can be read by the *ESR? command. Reading this register, or using the *CLS command will clear the ESR.

Bits in the ESR will be set only when the corresponding bit in the Standard Events Status Enable register is set. Use the *ESE to set bits, and the *ESE? to read this register. To configure the TW Series to generate SRQ's based on the ESR, both the Standard Event Status Enable register and the Service Request Enable registers must be programmed.

Bit	Hex Value	Description
0	01	Operation Complete.
1	02	Request Control - Not used.
2	04	Query Error.
3	08	Device-Dependent Error.
4	10	Execution Error (e.g., range error).
5	20	Command Error (e.g., syntax error).
6	40	User Request - Not used.
7	80	Power On.

Operation Complete

Set whenever the last command is completed and the TW is ready to accept another command, or when query results are available.

Query Error

Set when a query is made for which no response is available.

Device-Dependent Error

Set for device-specific errors. These errors are entered in the System Error Queue and have error codes greater than 0. See Appendix B for error descriptions.

Execution Error

Set when a parameter exceeds its allowed range.

Command Error

Set for a syntax error.

Power On

Set once at power-up. The Status Byte ESR bit is not set.

A.3 OPERATION STATUS/QUESTIONABLE STATUS REGISTERS

The Operation Status and Questionable Status registers always return 0 when queried. The Operation Status Enable and Questionable Status Enable registers can be programmed and queried to allow SCPI compatibility, but have no effect on the Operation Status and Questionable Status registers.

A.4 ERROR/EVENT QUEUE

The TW Series maintains an Error/Event Queue as defined by SCPI. The queue holds up to 10 errors and events. It is queried using the `SYSTEM:ERRor?` command, which reads in a first in, first out manner. The read operation removes the entry from the queue. The `*CLS` command clears all entries from the queue.

A.5 SERIAL POLL OPERATION

Performing a serial poll will not modify the Status Byte other than to clear the RQS (bit 6) for a TW requesting service. Queries affecting the status registers and subsequent serial polls are described below:

- `*STB?` clears the Status Byte
- `*ESR?` clears the ESR and bit 5 of the Status Register
- `SYSTEM:ERRor?` clears bit 2 of the Status Register if the queue is empty.

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APPENDIX B ERROR CODES

B.1 ERROR CODES RETURNED BY SYSTEM:ERROR? QUERY

The following error codes are defined in the SCPI 1993.0 specification, and are supported by the TW Series. Error codes are in the range of [-32768, 32767]. SCPI reserves the negative error codes and 0, while error codes greater than 0 are device-specific errors.

B.2 SCPI ERROR CODES

0, No error

The error queue is empty.

-102, Syntax error

An unrecognized command or data type was encountered.

-200, Execution error

An error/event number in the range [-299, -200] indicates that an error has been detected by the instrument's execution control block. The occurrence of any error in this class shall cause the execution error bit (bit 4) in the event status register to be set.

An execution error can be the result of:

- A <program data> element out of range, such as programming 200 volts in low (156 volt) range.
- A command could not be executed due to the current condition of the device, such as attempting to change ranges while the output relay is closed. The output relay must be opened first.

-292, Referenced name does not exist

-292, Referenced name already exists

-330, Self-test failed

-350, Queue overflow

The error queue can contain up to 10 entries. If more than 10 error/event conditions are logged before the SYSTem:ERRor? query, an overflow will occur; the last queue entry will be overwritten with error -350. When the queue overflows, the least recent error/events remain in the queue and the most recent errors/events are discarded.

B.3 DEVICE SPECIFIC ERROR CODES

The TW power supply may experience various fault states during operation. The possible fault states can be generated by accidental overloading of the TW supply, or system failures within the TW.

DSP Fault 0

DSP Initialization Error

This error is reported when the DSP sub-processing system does not boot up. This error is not a recoverable error. The TW power should be cycled. If this error appears excessively, consult the Elgar technical support staff.

DSP Fault 1

DSP Timeout Error

This error is reported when the DSP sub-processing system ceases to communicate with the main processor in the TW. This error is not a run-time recoverable error. The TW power should be cycled. If this error appears excessively, consult the Elgar technical support staff.

PS A Fault 0

Phase Over Voltage Error

This error is reported when a given Phase experiences an over voltage condition. This error is a run-time recoverable error. From the front panel, press the ENTER key. Through SCPI, send the *RST command.

PS A Fault 1

Phase Over Current Trip Error

This error is reported when a given Phase experiences an over current condition. This error is a run-time recoverable error. From the front panel, press the ENTER key. Through SCPI, send the *RST command.

PS A Fault 2

Phase Over Temperature Error

This error is reported when a given Phase experiences an over temperature condition. This error is a run-time recoverable error. From the front panel, press the ENTER key. Through SCPI, send the *RST command.

PS A Fault 3

Phase 350 V DC Bus Overvolt Error

This error is reported when a given Phase DC internal bus experiences a 350V threshold voltage condition. This error is a run-time recoverable error. From the front panel, press the ENTER key. Through SCPI, send the *RST command.

PS A Fault 4

Phase 380 V DC Bus Overvolt Error

This error is reported when a given Phase DC internal bus experiences a 380V threshold over voltage condition. This error is not a run-time recoverable error. The TW power should be cycled. If this error appears excessively, consult the Elgar technical support staff.

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APPENDIX C SAMPLE PROGRAMS

C.1 INTRODUCTION

The following examples illustrate how to perform certain functions on the TW via SCPI, via the GPIB interface, or via the RS-232 channel.

C.2 SOURCE AC FROM POWER UP

- SOUR0:VOLT:RANGE LOW Specify low range 0-156V 13 Amps
- OUTP:COUP AC Specify AC mode (coupling AC)
- SOUR0:CURR 13 Specify 13 Amps current limit; foldback mode
- SOUR0:VOLT 120 Specify 120 VAC setpoint
- SOUR:FREQ 60 Specify 60 Hz frequency
- SOUR:SENSE REMOTE Specify remote sense
- OUTP ON Source power to the output

C.2 SOURCE DC FROM POWER UP

- SOUR0:VOLT:RANGE LOW Specify low range 0-156V 13 Amps
- OUTP:COUP DC Specify DC mode (coupling DC)
- SOUR0:CURR 13 Specify 13 Amps current limit; foldback mode
- SOUR0:VOLT:OFFSET 48 Specify 48 VDC setpoint
- SOUR:SENSE REMOTE Specify remote sense
- OUTP ON Source power to the output

C.3 SOURCE ACDC FROM POWER UP

- SOUR0:VOLT:RANGE LOW Specify low range 0-156V 13 Amps
- OUTP:COUP ACDC Specify ACDC mode (coupling ACDC)
- SOUR0:CURR 13 Specify 13 Amps current limit; foldback mode
- SOUR0:VOLT 40 Specify 40 VAC
- SOUR0:VOLT:OFFSET 48 Specify 48 VDC setpoint
- SOUR:SENSE REMOTE Specify remote sense

C.4 PERFORM AC DISTURBANCE

- SOUR0:VOLT:RANGE HIGH Specify high range 0-312V 6.5 Amps
- OUTP:COUP AC Specify AC mode (coupling AC)
- SOUR0:CURR:PROT 5 Specify 5 Amps current limit; shutdown mode
- SOUR:PROT:CURT 300 Specify 300 milliseconds of overcurrent before shutdown
- SOUR0:VOLT 120 Specify 120 VAC
- OUTP ON Turn on the output
- SOUR1:DIST:STATE 1 Turn on disturbance
- SOUR1:DIST:STARTPHASE 30 Turn on disturbance at 30 degrees
- SOUR1:DIST:STOPPHASE 200 Turn off disturbance at 200 degrees
- SOUR1:DIST:CYCLES 5 Run for 5 cycles

- SOUR1:DIST:VOLT 160 160 volts at disturbance time
- SOUR1:DIST:TRIGGER IMMED Trigger the disturbance immediately
- .
- .
- .
- .
- OUTP OFF Turn off output relay when finished

C.5 PERFORM AC DISTURBANCE WITH EXT TRIGGER

- SOUR0:VOLT:RANGE LOW Specify low range
- OUTP:COUP AC Specify AC mode (coupling AC)
- SOUR0:CURR: 11 Specify 11 Amps current limit; foldback
- SOUR0:VOLT 120 Specify 120 VAC
- OUTP ON Turn on the output
- SOUR1:DIST:STATE 1 Turn on disturbance
- SOUR1:DIST:STARTPHASE 80 Turn on disturbance at 80 degrees
- SOUR1:DIST:STOPPHASE 190 Turn off disturbance at 190 degrees
- SOUR1:DIST:CYCLES 5 Run for 5 cycles
- SOUR1:DIST:VOLT 0 0 volts at disturbance time
- SOUR1:DIST:TRIGGER EXTERNAL Trigger by External Clock BNC
- .
- .
- .
- SOUR1:DIST:TRIGGER DISABLE Turn off trigger
- OUTP OFF Turn off output relay when finished

C.6 TURN OFF FRONT PANEL PROGRAMMABILITY

- SYST:KLOCK ON Lock the program keys out
- .
- .
- .
- SYST:KLOCK OFF Turn the program keys back on

C.7 PASSWORD OPERATIONS

- SYST:PASS:NEW 3333 1234 New password will be 1234 if old password was 3333
- SYST:PASS:CDISABLE 1234 Disable password if present password is 1234
- SYST:PASS:CENABLE 1234 1234 was still in scope and the password protection is back

C.8 PROVIDE ZERO CROSSING PULSES FROM PHASE A

- SYST:EXT:CLOCK REFOUT This is the factory default, as well.

C.9 MASTER/SLAVE OPERATION

For master/slave operation, refer to the TW Operation Manual, Elgar Document No. M161469-01.

NOTES

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