FLUKE®

5520A

Multi-Product Calibrator

Programmers Guide

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Warning

The 5520A Calibrator (hereafter referred to as “The Calibrator”) can produce voltages up to 1000 V rms and must be programmed with caution to prevent hazardous voltages from being produced without sufficient warning to the operator.

Write programs carefully and test them extensively to ensure safe operation of the Calibrator. Fluke suggests that you include error-catching routines in your programs. These error-catching routines will help you identify programming errors that may cause the calibrator to behave other than intended. You can program the Calibrator to cause an SRQ when an error is detected by setting the Service Request Enable (SRQ) register. The following skeleton program includes error-catching code:

```
10   PRINT @4, "*CLS"    ! Clear status
20   PRINT @4, "*SRE 8" ! Set SRE Error Avail.
30   ON SRQ GOTO 1000    ! Enable SRQ Function

100                      ! Body of program here

900  STOP                ! End of program

1000 REM Start of SRQ Handler     ! Start routine
1010 PRINT @4, "FAULT?" ! Request fault code
1020 INPUT @4, A%        ! Input fault code
1030 PRINT @4, "EXPLAIN? ";A%! Request fault text
1040 INPUT @4, A$        ! Input fault text
1050 PRINT "Fault ";A$" detected" ! Print message
1060 PRINT @4, "STBY"    ! Place 5520A in standby
1070 STOP
```

Types of Commands

Device-Dependent Commands

Commands unique to 5520A.

Common Commands

Commands defined by the IEEE 488.2 standard.

Query Commands

Commands ending with a ?.

Compound Commands

Two or more commands in a single command line.

Coupled Commands

Commands that could interfere with each other.

Overlapped Commands

Commands requiring more time to execute.

Sequential Commands

Commands that execute immediately.

Commands for RS-232 Only

IEEE-488	RS-232 Equivalent
GTL	LOCAL command
GTR	REMOTE command
LLO	LOCKOUT command
SRQ	SRQSTR command
SDC, DCL	^C (<Ctrl> C) character [clear the device]
GET	^T (<Ctrl> T) character [execute a group trigger]
SPE, SPD	^P (<Ctrl> P) character [print the serial poll string]

Also: SP_SET SPLSTR SRQSTR
SP_SET? SPLSTR? SRQSTR?

Command Syntax

General Syntax Rules

1. Separate parameters with commas.
2. Numeric parameters up to 15 significant digits and exponents in the range ±1.0E ± 20.
3. Null parameters cause an error, e.g., the adjacent commas in OUT 1V, ,2A.
4. Expressions, for example 4 + 2 * 13, are not allowed as parameters.
5. Binary Block Data can be in one of two IEEE 488.2 formats:

   Indefinite Length Format Accepts data bytes after #0 until the ASCII Line Feed character is received with an EOI signal (for RS-232, a line feed or carriage return will terminate the block).

   Definite Length Format The data bytes are preceded by #n and an n-digit number, which identifies how many data bytes follow.

6. One space after a command is required. You can insert extra spaces or tabs between commands and arguments.

Command Syntax (cont)

Units Accepted in Parameters and Responses

Units	Meaning
HZ	Frequency in hertz
KHZ	Frequency in kilohertz
MHZ	Frequency in megahertz
UV	Volts in microvolts
MV	Volts in millivolts
V	Volts in volts
KV	Volts in kilovolts
UA	Current in microamperes
MA	Current in milliamps
A	Current in amps
PCT	Percent
PPM	Parts-per-million
DBM	Volts in decibels referenced to 1 milliwatt into 600Ω load
OHM	Resistance in ohms
KOHM	Resistance in kilohms
MOHM	Resistance in megohms
NF	Capacitance in nanofarads
PF	Capacitance in picofarads
UF	Capacitance in microfarads
MF	Capacitance in millifarads
F	Capacitance in farads
CEL	Temperature in degrees Celsius
FAR	Temperature in degrees Fahrenheit

Command Syntax *(cont)*

Units Accepted in Parameters and Responses *(cont)*

Units	Meaning
NS	Period in nanoseconds
US	Period in microseconds
MS	Period in milliseconds
S	Period in seconds
PSI	Pressure in pound-force per square inch
MHG	Pressure in meters of mercury
INHG	Pressure in inches of mercury
INH2O	Pressure in inches of water
FTH2O	Pressure in feet of water
MH2O	Pressure in meters of water
BAR	Pressure in bar
PAL	Pressure in pascal
G/CM2	Pressure in grams per centimeter squared
INH2O60F	Pressure in inches of water at 60 degrees Fahrenheit

Incoming Character Processing

1. The most significant data bit (DIO8) is ignored.
2. All data is taken as 7-bit ASCII.
3. Lower-or upper-case characters.
4. ASCII characters less than 32 (Space) are discarded, except for characters 10 (LF) and 13 (CR), and in the *PUD command argument.

Command Syntax (cont)

Terminator Characters

Function	ASCII #	ASCII Code	Control	C Code
Carriage Return	13	Chr(13)	<Ctrl> M	\n
Line Feed	10	Chr(10)	<Ctrl> J	\r
Backspace	8	Chr(8)	<Ctrl> H	\b
Form Feed	12	Chr(12)	<Ctrl> L	\f

EEE-488 Interface The Calibrator sends the ASCII character Line Feed with the EOI control line held high as the terminator for response messages.

RS-232 Interface The Calibrator returns an EOL (End of Line) character with each response, selectable as CR, LF or both CRLF.

Response Message Data Types

Data Type	Description
Integer	Decimal numbers to 32768.
Floating	Numbers plus an exponent.
String	ASCII characters within double or single quotes (“string” or ‘string’).
Binary Block Data	Defined by the IEEE-488.2.

Checking 5520A Status

Status Register Summary

Status Register	Read	Write
Serial Poll Status Byte (STB)	*STB?	—
Service Request Enable Register (SRE)	*SRE?	*SRE
Event Status Register (ESR)	*ESR?	—
Event Status Enable Register (ESE)	*ESE?	*ESE
Instrument Status Register (ISR)	ISR?	—
Instrument Status Change Register (ISCR)	ISCR?	—
ISCR 1 to 0 transition	ISCR0?	—
ISCR 0 to 1 transition	ISCR1?	—
Instrument Status Change Enable Register (ISCE)	ISCE?	ISCE
ISCE 1 to 0 transition	ISCE0?	ISCE0
ISCE 0 to 1 transition	ISCE1?	ISCE1

Checking 5520A Status (cont)

STB and SRE

7	6	5	4	3	2	1	0
0	**RQS MSS**	**ESB**	**MAV**	**EAV**	**ISCB**	**0**	**0**

RQS	Requesting service. The RQS bit is set to 1 whenever bits ESB, MAV, EAV, or ISCB change from 0 to 1 and are enabled (1) in the SRE. When RQS is 1, the 5520A asserts the SRQ control line on the IEEE-488 interface. You can do a serial poll to read this bit to see if the 5520A is the source of an SRQ.
MSS	Master summary status. Set to 1 whenever bits ESB, MAV, EAV, or ISCB are 1 and enabled (1) in the SRE. This bit can be read using the *STB? command in serial remote control in place of doing a serial poll.
ESB	Set to 1 when one or more enabled ESR bits are 1.
MAV	Message available. The MAV bit is set to 1 whenever data is available in the 5520A's IEEE-488 interface output buffer.
EAV	Error available. An error has occurred and an error is available to be read from the error queue by using the ERR? query.
ISCB	One or more enabled ISCR bits are 1.

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For RS-232, transmitting the ^P character (hold down the <Ctrl> key and press P) returns the SPLSTR (Serial Poll String) and the status byte.

Checking 5520A Status (cont)

ESR and ESE

15	14	13	12	11	10	9	8
0	0	0	0	0	0	0	0
7	6	5	4	3	2	1	0
PON	**0**	**CME**	**EXE**	**DDE**	**QYE**	**0**	**OPC**

PON Power on. This bit is set to 1 if line power has been turned off and on since the last time the ESR was read.

CME Command error. The 5520A's IEEE-488 interface encountered an incorrectly formed command. (The command ERR? fetches the earliest error code in the error queue, which contains error codes for the first 15 errors that have occurred.)

EXE Execution error. An error occurred while the 5520A tried to execute the last command. This could be caused, for example, by a parameter being out of range. (The command ERR? fetches the earliest error in the error queue, which contains error codes for the first 15 errors that have occurred.)

DDE Device-dependent error. An error related to a device-dependent command has occurred.

QYE Query error. The 5520A was addressed to talk when no response data was available or appropriate, or when the controller failed to retrieve data on the output queue.

OPC Operation complete. All commands previous to reception of a *OPC command have been executed, and the interface is ready to accept another message.

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Checking 5520A Status (cont)

ISR, ISCE, and ISCR

15	14	13	12	11	10	9	8
0	**0**	**RPTBUSY**	**SETTLED**	**REMOTE**	**0**	**UUTBFUL**	**UUTDATA**
7	6	5	4	3	2	1	0
HIVOLT	**MAGCHG**	**TMPCAL**	**0**	**0**	**0**	**0**	**OPER**

RPTBUSY	Set to 1 when a calibration report is being printed to the serial port.
SETTLED	Set to 1 when the output has stabilized to within speclfication or the TC measurement has settled and is available.
REMOTE	Set to 1 when the 5520A is under remote control.
UUTBFUL	Set to 1 when data from the UUT port has filled up the UUT buffer.
UUTDATA	Set to 1 when there ia data available from the UUT port.
HIVOLT	Set to 1 when the 5520A is programmed to a voltage above 33 Volts.
MAGCHG	Set to 1 when the output magnitude has changed as a result of another change (e.g. RTD_TYPE). This bit is always 0 in the ISR. It changes to 1 only in the ISCR0 and ISCR1 registers.
TMPCAL	Set to 1 when the 5520A is using temporary (non-stored) calibration data.
OPER	Set to 1 when the 5520A is in operate, 0 when it is in standby.

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Checking 5520A Status (cont)

Service Request (SRQ) Line

IEEE-488 Bus control line that asserts to notify the controller that it requires some type of service.

RS-232 Sends the SRQSTR string over the serial interface when service is required.

Service Request Enable Register (SRE)

The SRE enables or masks the bits of the Serial Poll Status Byte. The SRE is cleared at power up.

Output Queue

Whenever a query is processed, the output queue is loaded. If the queue is empty, the Calibrator does not respond to the INPUT statement. The Message Available (MAV) bit in the Serial Poll Status Byte is 1 if there is something in the output queue and 0 if the output queue is empty. The output queue contains a maximum of 800 characters.

Error Queue

Whenever a command error, execution error, or device-dependent error occurs, its error code is placed in the error queue where it can be read by the ERR? command. The error queue contains a maximum of 16 entries.

Command Summary

Common Commands

*CLS	Clears ESR, ISCR0, ISCR1, error queue, RQS, and terminates pending *OPC or *OPC?
*ESE	Loads ESE register.
*ESE?	Returns ESE contents.
*ESR?	Returns ESR contents.
*IDN?	Returns instrument identification.
*OPC	Sets OPC bit in ESR to 1 when device operations are complete.
*OPC?	Returns 1 after operations are done.
*OPT?	Returns hardware/software options.
*PUD	Stores a string in nonvolatile memory.
*PUD?	Returns contents of *PUD memory.
*RST	Resets to power-up state.
*SRE	Loads SRE register.
*SRE?	Returns SRE contents.
*STB?	Returns the status byte.
*TRG	Triggers a measurement return value.
*TST?	Initiates self test; return 0 for pass.
*WAI	Waits until commands are executed.

Command Summary (cont)

Error Mode Commands

EDIT	Sets edit field.
EDIT?	Returns edit field setting.
ERR_UNIT	Sets the UUT error display unit or ppm/% change threshold.
ERR_UNIT?	Returns the selected UUT error display unit or change threshold.
INCR	Increments or decrements output.
MULT	Multiplies reference magnitude.
NEWREF	Sets reference to output value.
OLDREF	Sets output to previous reference.
OUT_ERR?	Returns UUT computed error.
REFOUT?	Returns reference value.

Command Summary (cont)

External Connection Commands

CUR_POST	Selects terminals for current output.
CUR_POST?	Returns terminals for current output.
EARTH	Selects earth ground is isolated or tied.
EARTH?	Returns earth ground isolated or tied.
EXTGUARD	Connects or disconnects the internal guard shield from the LO binding post.
EXTGUARD?	Returns whether the internal guard shields are connected or disconnected from earth (chasis) ground.
LOWS	Selects low terminals open or tied.
LOWS?	Returns low terminals open or tied.
RTD_TYPE	Sets RTD sensor type.
RTD_TYPE?	Returns RTD sensor type.
TC_REF	Sets internal/external reference value.
TC_REF?	Returns TC reference value.
TC_TYPE	Sets TC sensor type.
TC_TYPE?	Returns TC sensor type.
TSENS_TYPE	Sets temperature sensor type.
TSENS_TYPE?	Returns temperature sensor type.

Command Summary (cont)

Oscilloscope Commands

See Chapter 8 of the *5520A Operators Manual* for usage information.

OL_TRIP?	Returns the detected state of scope overload protection.
OUT_IMP	Sets the output impedance of the SCOPE BNC.
OUT_IMP?	Returns the output impedance of the SCOPE BNC.
RANGE	Sets the 5520A range when in OVERLD, PULSE, or MEASZ scope modes.
SCOPE	Sets the calibrator output to an oscilloscope mode.
SCOPE?	Returns the present oscilloscope mode.
TDPULSE	Activates or deacvitates the tunnel diode pulser drive for the -SC600 EDGE mode.
TDPULSE?	Returns whether the tunnel diode pulser drive for the -SC600 EDGE mode is active.
TLIMIT	Sets the time limit for -SC600 OVERLD mode to stay in operate.
TLIMIT?	Returns the time limit for -SC600 OVERLD mode to stay in operate.
TLIMIT_D	Sets the power-up and reset default for the time limit for -SC600 OVERLD mode to stay in operate.

Command Summary (cont)

Oscilloscope Commands (cont)

TLIMIT_D?	Returns the power-up and reset default for the time limit for -SC600 OVERLD mode to stay in operate.
TMWAVE	Selects the waveform for MARKER mode.
TMWAVE?	Returns the timemark waveform setting for MARKER mode.
TRIG	Sets the frequency of the signal at the TRIG OUT BNC.
TRIG?	Returns the frequency of the signal at the TRIG OUT BNC.
VAL?	Returns the last thermocouple, pressure, or, for the -SC600, impedance measurement value.
VIDEOFMT	Selects the format for VIDEO mode.
VIDEOFMT?	Returns the VIDEO mode format.
VIDEOMARK	Sets the VIDEO mode line marker location.
VIDEOMARK?	Returns the VIDEO mode line marker location.
ZERO_MEAS	Zeros the pressure module or sets the zero offset for capacitance measurement using the -SC600.
ZERO_MEAS?	Returns the zero offset for the pressure module or capacitance measurement using the -SC600.

Command Summary (cont)

Output Commands

CFREQ?	Returns the frequency for capacitance modes.
DBMZ	Sets the impedance used for dBm outputs (ac volts).
DBMZ?	Returns the impedance used for dBm outputs (ac volts).
DC_OFFSET	Applies dc offset to ac output.
DC_OFFSET?	Returns the dc offset voltage.
DPF	Sets displacement power factor.
DPF?	Returns displacement power factor.
DUTY	Sets squarewave duty cycle.
DUTY?	Returns duty cycle.
FUNC?	Returns output function.
HARMONIC	Sets harmonic output.
HARMONIC?	Returns harmonic location.
LCOMP	Activates or deactivates inductive load compensation for ac current output.
LCOMP?	Returns whether inductive load compensation for ac current output is active.
OPER	Activates 5520A output.
OPER?	Returns operate/standby setting.
OUT	Sets output and reference point.
OUT?	Returns output.

Command Summary (cont)

Output Commands (cont)

PHASE	Sets phase for dual outputs.
PHASE?	Returns phase output.
POWER?	Returns power for power outputs.
RANGE?	Returns output ranges.
RANGELCK	Locks range or set autorange.
RANGELCK?	Returns locked or autorange.
REFCLOCK	Sets the reference clock source (internal or through the 10 MHz IN BNC connector).
REFCLOCK?	Returns the reference clock source (internal or through the 10 MHz IN BNC connector).
REFPHASE	If two 5520As are synchronized using 10 MHz IN/OUT, sets the phase difference between the NORMAL terminals on the slave 5520A and the NORMAL terminals on the master 5520A.
REFPHASE?	If two 5520As are synchronized using 10 MHz IN/OUT, returns the default phase difference between the NORMAL terminals on the slave 5520A and the NORMAL terminals on the master 5520A.
STBY	Puts 5520A in standby.
SYNCOUT	Sends a synchronization pulse out to a slave 5520A through the 10 MHz OUT BNC connector.

Command Summary (cont)

Output Commands (cont)

WAVE	Sets waveforms for ac outputs.
WAVE?	Returns output waveform.
ZCOMP	Activates or deactivates impedance compensation.
ZCOMP?	Returns status of impedance compensation.

Pressure Measurement Commands

DAMPEN	Activates or deactivates dampening (averaging) of pressure readings.
DAMPEN?	Returns whether dampening (averaging) of pressure readings is active.
PRES?	Queries the attached pressure module for its model and serial number.
PRES_MEAS	Changes the operating mode to pressure measurement.
PRES_UNIT	Sets the pressure display units.
PRES_UNIT?	Returns the pressure display units.
VAL?	Returns last pressure measurement.
ZERO_MEAS	Zeros the pressure module or sets the zero offset for capacitance measurement using the -SC600.
ZERO_MEAS?	Returns the zero offset for the pressure module or capacitance measurement using the -SC600.

Command Summary (cont)

RS-232 Host Port Commands

LOCAL	Puts 5520A into local.
LOCKOUT	Puts 5520A into lockout state
REMOTE	Puts 5520A into remote.
SPLSTR	Sets Serial Poll response string.
SPLSTR?	Returns Serial Poll response.
SRQSTR	Sets serial mode SRQ response.
SRQSTR?	Returns serial mode SRQ response.
^P (<Ctrl>p)	Prints serial poll string.
^C (<Ctrl>c)	Clears device.
^T (<Ctrl>t)	Executes group trigger.

RS-232 UUT Port Commands

UUT_FLUSH	Flush UUT receive buffer.
UUT_RECV?	Returns data from UUT serial port.
UUT_RECVB?	Returns binary data from the UUT serial port as integers.
UUT_SENDB	Sends binary data to the UUT serial port as integers.
UUT_SEND	Sends string to UUT serial port.
UUT_SET	Sets the UUT serial port settings.
UUT_SET?	Returns the UUT serial port settings.

Command Summary (cont)

Setup and Utility Commands

CLOCK	Sets the real-time clock.
CLOCK?	Queries the real-time clock.
DBMZ_D	Sets the power-up and reset default impedance used for dBm outputs (ac volts).
DBMZ_D?	Returns the power-up and reset default impedance used for dBm outputs (ac volts).
ERR_UNIT	Sets the UUT error display unit or ppm/% change threshold.
ERR_UNIT?	Returns the selected UUT error display unit or change threshold.
FORMAT	**Use with extreme care.** Restores the contents of the nonvolatile memory device to factory defaults.
LIMIT	Sets maximum output magnitudes.
LIMIT?	Returns maximum output magnitudes.
ONTIME?	Returns time since last powered up.
PRES_UNIT_D	Sets power-up and reset default pressure display units.
PRES_UNIT_D?	Returns power-up and reset default pressure display units.
REFCLOCK_D	Sets the power-up and reset default for the reference clock source (internal or through the 10 MHz IN BNC connector).

Command Summary (cont)

Setup and Utility Commands (cont)

REFCLOCK_D?	Returns the power-up and reset default for the reference clock source (internal or through the 10 MHz IN BNC connector).
REPHASE_D	If two 5520As are synchronized using 10 MHz IN/OUT, sets the power-up and reset default phase difference between the NORMAL terminals on the slave 5520A and the NORMAL terminals of the master 5520A.
REPHASE_D?	If two 5520As are synchronized using 10 MHz IN/OUT, returns the power-up and reset default phase difference between the NORMAL terminals on the slave 5520A and the NORMAL terminals of the master 5520A.
RTD_TYPE_D	Set the default RTD sensor.
RTD_TYPE_D?	Returns default RTD sensor.
SP_SET	Sets serial HOST port settings.
SP_SET?	Returns serial HOST port settings.
TC_TYPE_D	Sets default TC sensor.
TC_TYPE_D?	Returns default TC sensor.

Command Summary (cont)

Setup and Utility Commands (cont)

TEMP_STD	Sets temperature standard.
TEMP_STD?	Returns temperature standard.
UNCERT?	Retums specified uncertainties for the present output. If there are no specifications for an output, returns zero.

Status Commands

ERR?	Returns first error code and explanation in queue and removes it from the queue.
EXPLAIN?	Explains an error code.
FAULT?	Returns first error code in queue and removes it from the queue.
ISCE	Loads bytes into ISCE0 and ISCE1.
ISCE?	Returns ISCE0 and ISCE1 contents.
ISCE0	Loads two bytes into ISCE0.
ISCE0?	Returns contents of ISCE0.
ISCE1	Loads two bytes into ISCE1.
ISCE1?	Returns contents of ISCE1.
ISCR?	Returns contents of ISCR0/ISCR1.
ISCR0?	Returns and clears ISCR0.
ISCR1?	Returns and clears ISCR1.
ISR?	Returns contents of ISR register.

Command Summary (cont)

Thermocouple (TC) Measurement Commands

TC_MEAS	Changes mode to TC measurement.
TC_OFFSET	Sets a TC temperature offset.
TC_OFFSET?	Returns TC temperature offset.
TC_OTCD	Activates or deactivates open thermocouple circuit.
TC_OTCD?	Returns status of open thermocouple circuit.
VAL?	Returns last thermocouple measurement.
VVAL?	Returns last TC measurement as a voltage. If a measurement is not valid, returns zero.

Command List

CFREQ?	
Response:	(Float) Optimal frequency
CLOCK	
Parameters:	1. (Optional) Year as YYYY 2. (Optional) Month as MM 3. (Optional) Day as DD 4. Hour as HH 5. Minute as MM 6. Second as SS
CLOCK?	
Responses:	1. (Character) Date as YYYY-MM-DD 2. (Character) Time as HH:MM:SS
***CLS**	
Parameter:	None
CUR_POST	
Parameter:	AUX or A20
CUR_POST?	
Response:	(Character) AUX or A20
DAMPEN	
Parameter:	ON or OFF
DAMPEN?	
Response:	(Character) ON or OFF
DBMZ	
Parameter:	Z50, Z75, Z90, Z100, Z135, Z150, Z300, Z600, Z900, Z1000, or Z1200
DBMZ?	
Response:	(Character) Z50, Z75, Z90, Z100, Z135, Z150, Z300, Z600, Z900, Z1000, or Z1200
DBMZ_D	
Parameter:	Z50, Z75, Z90, Z100, Z135, Z150, Z300, Z600, Z900, Z1000, or Z1200

Command List (cont)

DBMZ_D?	
Response:	(Character) Z50, Z75, Z90, Z100, Z135, Z150, Z300, Z600, Z900, Z1000, or Z1200
DC_OFFSET	
Parameters:	Offset amplitude with optional multiplier and voltage unit
DC_OFFSET?	
Response:	(Float) Signed offset amplitude
DPF	
Parameters:	1. Cosine of phase offset (0.0 to 1.0) 2. (Optional) LEAD (default) or LAG
DPF?	
Responses:	1. (Float) Cosine of phase offset 2. (Character) LEAD or LAG
DUTY	
Parameter:	Duty cycle percentage (.1 to 99.9)
DUTY?	
Response:	(Float) Duty cycle
EARTH	
Parameter:	OPEN or TIED
EARTH?	
Response:	(Character) OPEN or TIED
EDIT	
Parameter:	PRI, SEC. FREQ, or OFF
EDIT?	
Response:	(Character) PRI, SEC. FREQ, or OFF
ERR?	
Responses:	1. (Integer) Error code 2. (String) Error message string, formatted for display
ERR_UNIT	
Parameter:	GT1000, GT100, GT10, PPM, or PCT

Command List (cont)

ERR_UNIT?	
Response:	(Character) GT1000, GT100, GT10, PPM, or PCT
***ESE**	
Parameter:	Decimal equivalent of the 8-bit binary number to load into the register
***ESE?**	
Response:	(Integer) Decimal equivalent of the register byte
***ESR?**	
Response:	(Integer) Decimal equivalent of the register byte
EXPLAIN?	
Parameter:	(Integer) Error code
Response:	(String) An explanation of the error code, with the parameter (if there is one) shown as a percent sign followed by d, f, or s
EXTGUARD	
Parameter:	ON or OFF
EXTGUARD?	
Response:	(Character) ON or OFF
FAULT?	
Response:	(Integer) Error code
FORMAT	
Parameter:	ALL (replaces the whole contents with defaults), CAL (replaces all call constants with defaults), or SETUP (replaces setup parameters with defaults)

Command List (cont)

FUNC?	
Response:	(Character) DCV, ACV, DCI, ACI, RES, CAP, RTD, TC_OUT, DC_POWER, AC_POWER, DCV_DCV, ACV_ACV, TC_MEAS, or PRES_MEAS
HARMONIC	
Parameters:	1. Harmonic multiple 2. (Optional) PRI (fundamental is at primary output location) or SEC (fundamental is at secondary output location)
HARMONIC?	
Response:	1. (Integer) Harmonic multiple 2. (Character) PRI or SEC (location of fundamental)
***IDN?**	
Responses:	(Indefinite ASCII) A message containing four fields separated by commas as follows: 1. Manufacturer 2. Model number 3. Serial number 4. Firmware revision levels for the Main CPU, Front Panel CPU, and Inguard PGA
INCR	
Parameters:	1. Positive or negative step size 2. (Optional) Magnitude
ISCE	
Parameter:	Decimal equivalent of the binary number to load into the registers

Command List (cont)

ISCE?	
Response:	(Integer) Decimal equivalent of the OR of the contents of the Instrument Status 1 to 0 Change Enable register and the Instrument Status 0 to 1 Change Enable register
ISCE0	
Parameter:	Decimal equivalent of the binary number to load into the register
ISCE0?	
Response:	(Integer) Decimal equivalent of the binary number in the Instrument Status 1 to 0 Change Enable register
ISCE1	
Parameter:	Decimal equivalent of the binary number to load into the register
ISCE1?	
Response:	(Integer) Decimal equivalent of the binary number in the Instrument Status 0 to 1 Change Enable register
ISCR?	
Response:	(Integer) Decimal equivalent of the OR of the contents of the Instrument Status 1 to 0 Change Register and the Instrument Status 0 to 1 Change Register
ISCR0?	
Response:	(Integer) Decimal equivalent of the binary number in the Instrument Status 1 to Change Register

Command List (cont)

ISCR1?	
Response:	(Integer) Decimal equivalent of the contents of the Instrument Status 0 to 1 Change Register
ISR?	
Response:	(Integer) Decimal equivalent of the OR of the contents of the Instrument Status 1 to 0 Change Register and the Instrument Status 0 to 1 Change Register
LCOMP	
Parameter:	ON or OFF
LCOMP?	
Response:	(Character) ON or OFF
LIMIT	
Parameters:	1. Positive limit value with optional multiplier and optional unit 2. Negative limit value with optional multiplier and optional unit
LIMIT?	
Response:	1. (Float) Positive voltage limit value 2. (Float) Negative voltage limit value 3. (Float) Positive current limit value 4. (Float) Negative current limit value
LOCAL	
Parameter:	None
LOCKOUT	
Parameter:	None
LOWS	
Parameter:	OPEN or TIED
LOWS?	
Response:	(Character) OPEN or TIED

Command List (cont)

MULT	
Parameter:	Multiplier value
NEWREF	
Parameter:	None
OLDREF	
Parameter:	None
ONTIME?	
Response:	(Integer) Number of minutes on time
***OPC**	
Parameter:	None
***OPC?**	
Response:	(Integer) 1 (after all operations are complete)
OPER	
Parameter:	None
OPER?	
Response:	(Integer) 1 (operate) or 0 (standby)
***OPT?**	
Response:	(Indefinite ASCII) A list of option names, separated by commas or 0 (no options)
OUT	
Parameters:	1. (Optional) Output amplitude with optional multiplier and unit 2. (Optional) Output amplitude with optional multiplier and unit 3. (Optional) Output frequency with optional multiplier and unit

Command List (cont)

OUT?	
Parameters:	(Optional) Units of returned amplitudes: ac voltage mode (V or DBM) RTD mode (CEL, FAR, or OHM) TC output mode (CEL, FAR, or V)
Responses:	1. (Float) Output amplitude 2. (Character) Units (V, DBM, A, OHM, F, CEL, or FAR) 3. (Float) Second output amplitude for dual output functions (0 if no second amplitude) 4. (Character) Units of second amplitude (0 if no second amplitude) 5. (Float) Frequency (0 if dc, resistance, capacitance, or temperature)
OUT_ERR?	
Responses:	1. (Float) UUT error magnitude 2. (Character) Units for the above number (PPM, PCT, DB, or 0)
PHASE	
Parameter:	Phase with optional multiplier and DEG unit
PHASE?	
Response:	(Float) Phase in degrees
POWER?	
Response:	(Float) Power in ac or dc power mode

Command List (cont)

PRES?	
Responses:	(Indefinite ASCII) A message containing four fields separated by commas as follows: 1. Manufacturer 2. Model number 3. Serial number 4. Firmware revision (0)
PRES_MEAS	
Parameter:	(Optional) Pressure units
PRES_UNIT	
Parameter:	PSI, MHG, INHG, INH2O, FTH2O, MH2O, BAR, PAL, G/CM2, or INH2O60F
PRES_UNIT?	
Response:	(Character) PSI, MHG, INHG, INH2O, FTH2O, MH2O, BAR, PAL, G/CM2, or INH2O60F
PRES_UNIT_D	
Parameter:	PSI, MHG, INHG, INH2O, FTH2O, MH2O, BAR, PAL, G/CM2, or INH2O60F
PRES_UNIT_D?	
Response:	(Character) PSI, MHG, INHG, INH2O, FTH2O, MH2O, BAR, PAL, G/CM2, or INH2O60F
***PUD**	
Parameter:	#2<nn><nn character string> or #0<character string> or “<character string>“ or ‘<character string>‘
***PUD?**	
Response:	#2nn<nn characters> (64 character maximum)

Command List (cont)

RANGE? Responses: 1. (Character) Symbolic name of the range of the single or first output 2. (Character) Symbolic name of the range of the second output or 0 (no second output)
RANGELCK Parameter: ON or OFF
RANGELCK? Response: (Character) ON or OFF
REFCLOCK Parameter: INT or EXT
REFCLOCK? Response: (Character) INT or EXT
REFCLOCK_D Parameter: INT or EXT
REFCLOCK_D? Response: (Character) INT or EXT
REFOUT? Response: (Float) Reference amplitude
REFPHASE Parameter: Phase with optional multiplier and DEG unit
REFPHASE? Response: (Float) Phase in degrees
REFPHASE_D Parameter: Phase with optional multiplier and DEG unit
REFPHASE_D? Response: (Float) Phase in degrees
REMOTE Parameter: None
***RST** Parameter: None

Command List (cont)

RTD_TYPE Parameter: PT385, PT385_200, PT385_500, PT385_1K, PT3926, PT3916, CU10, or NI120
RTD_TYPE? Responses: (Character) PT385, PT385_200, PT385_500, PT385_1K, PT3926, PT3916, CU10, or NI120
RTD_TYPE_D Parameter: PT385, PT385_200, PT385_500, PT385_1K, PT3926, PT3916, CU10, or NI120
RTD_TYPE_D? Response: (Character) PT385, PT385_200, PT385_500, PT385_1K, PT3926, PT3916, CU10, or NI120
SP_SET Parameters: One or more of the following,: 1. 300, 600, 1200, 2400, 4800, or 6000 (baud rate) 2. TERM or COMP (TERM sets the remote port to expect a human operator using a terminal and COMP sets the report port to expect a computer program controlling the 5520A) 3. XON, RTS, or NOSTALL (stall method) 4. DBIT7 or DBIT8 (number of data bits) 5. SBIT1 or SBIT2 (number of stop bits) 6. PNONE, PEVEN, or PODD (parity) 7. CR, LF, CRLF (end-of-line)

Command List (cont)

SP_SET?	
Response:	1. (Integer) 300, 600, 1200, 2400, 4800, or 6000 (baud rate) 2. (Character) TERM or COMP (TERM for the remote port to expect a human operator using a terminal and COMP for the report port to expect a computer program controlling the 5520A) 3. (Character) XON, RTS, or NOSTALL (stall method) 4. (Character) DBIT7 or DBIT8 (number of data bits) 5. (Character) SBIT1 or SBIT2 (number of stop bits) 6. (Character) PNONE, PEVEN, or PODD (parity) 7. (Character) CR, LF, CRLF (end-of-line)
SPLSTR	
Parameter:	The string to print on receipt of a ^P character (40 characters maximum)
SPLSTR?	
Response:	(String) The string to print on receipt of a ^P character (40 characters maximum)
***SRE**	
Parameter:	Decimal equivalent of the binary number to load into the register
***SRE?**	
Response:	(Integer) Decimal equivalent of the register byte.
SRQSTR	
Parameter:	Serial remote mode SRQ string

Command List (cont)

SRQSTR?	
Response:	(String) Serial remote mode SRQ string
***STB?**	
Response:	(Integer) Decimal equivalent of the status byte
STBY	
Parameter:	None
SYNCOUT	
Parameter:	None
TC_MEAS	
Parameter:	(Optional) CEL or FAR
TC_OFFSET	
Parameter:	Offset amplitude with optional temperature unit
TC_OFFSET?	
Parameter:	(Optional) CEL or FAR units
Responses:	1. (Float) Signed offset amplitude 2. (Character) Units (CEL or FAR)
TC_OTCD	
Parameter:	ON or OFF
TC_OTCD?	
Response:	(Character) ON or OFF
TC_REF	
Parameters:	1. INT (use internal temperature sensor) or EXT (use external reference) 2. (Optional) External reference temperature with optional multiplier and unit.
TC_REF?	
Responses:	1. (Character) INT or EXT 2. (Float) Temperature value 3. (String) Units (CEL or FAR)

Command List (cont)

TC_TYPE	
Parameter:	B, C, E, J, K, N, R, S, T, or X (10 mV/°C), Y (% relative humidity), or Z (1 mV/°C)
TC_TYPE?	
Response:	(Character) B, C, E, J, K, N, R, S, T, or X (10 mV/°C), Y (% relative humidity), or Z (1 mV/°C)
TC_TYPE_D	
Parameter:	B, C, E, J, K, N, R, S, T, or X (10 mV/°C), Y (% relative humidity), or Z (1 mV/°C)
TC_TYPE_D?	
Response:	(Character) B, C, E, J, K, N, R, S, T, or X (10 mV/°C), Y (% relative humidity), or Z (1 mV/°C)
TEMP_STD	
Parameter:	IPTS_68 or ITS_90
TEMP_STD?	
Response:	(Character) IPTS_68 or ITS_90
***TRG**	
Responses:	1. (Float) Measured value (temperature, pressure, scope impedance, or scope capacitance) 2. (Character) units
TSENS_TYPE	
Parameter:	TC (thermocouple) or RTD (resistive thermal device)
TSENS_TYPE?	
Response:	(Character) TC or RTD
***TST?**	
Response:	(Integer) 0 (pass) or 1 (fail)

Command List (cont)

UNCERT? Parameter: 1. (Optional) Preferred unit of primary output uncertainty or PCT (default) 2. (Optional) Preferred unit of secondary output uncertainty or PCT (default) Response: 1. (Float) 90-day specified uncertainty of primary unit 2. (Float) 1-year specified uncertainty of primary output 3. (Character) Unit of primary output uncertainty 4. (Float) 90-day specified uncertainty of secondary unit 5. (Float) 1-year specified uncertainty of secondary output 6. (Character) Unit of secondary output uncertainty
UUT_FLUSH Parameter: None
UUT_RECV? Response: (String) Data from the UUT serial port
UUT_RECVB? Parameter: (Optional) Maximum number of integers per line Response: (Indefinite ASCII) Comma separated integers as follows: 1. (Integer) Number of data bytes returned excluding the count 2. (Integer) Data from the UUT serial port as series of comma separated integers

Command List (cont)

UUT_SEND	
Parameter:	1. (Integer) Number of data bytes being returned (excluding the count) 2. (Integer) Data from the UUT serial port as series of comma separated integers
Special Case	Character string sent to a UUT must end in a carriage return (CR) or line feed (LF) command or both
UUT_SENDB	
Parameter:	Data to the UUT serial port as series of comma separated integers
UUT_SET	
Parameters:	One or more of the following, in any order: 1. 300, 600, 1200, 2400, 4800, or 9600 (baud rate) 2. XON, RTS, or NOSTALL (stall method) 4. DBIT7 or DBIT8 (number of data bits) 5. SBIT1 or SBIT2 (number of stop bits) 6. PNONE, PEVEN, or PODD (parity)

Command List (cont)

UUT_SET?	
Responses:	1. (Integer) 300, 600, 1200, 2400, 4800, or 9600 (baud rate) 2. (Character) XON, RTS, or NOSTALL (stall method) 4. (Character) DBIT7 or DBIT8 (number of data bits) 5. (Character) SBIT1 or SBIT2 (number of stop bits) 6. (Character) PNONE, PEVEN, or PODD (parity)
VAL?	
Parameter:	(Optional) Units to return
Response:	1. (Float) Measured temperature or pressure 2. (Character) CEL, FAR, OVER, OPENTC, OHM, F, PSI, MHG, INHG, INH2O, FTH2O, MH2O, BAR, PAL, G/CM2, INH2O60F, or NONE
VVAL?	
Response:	(Float) TC measurement as a voltage
***WAI**	
Parameters:	None
WAVE	
Parameters:	1. SINE, TRI, SQUARE, TRUNCS, or NONE (Waveform) 2. (Optional) SINE, TRI, SQUARE, or TRUNCS (Second waveform for dual outputs)

Command List (cont)

WAVE?	
Responses:	1. (Character) SINE, TRI, SQUARE, TRUNCS, or NONE 2. (Character) SINE, TRI, SQUARE, TRUNCS, or NONE
ZCOMP	
Parameter:	NONE, WIRE2, or WIRE4
ZCOMP?	
Response:	(Character) NONE, WIRE2, or WIRE4
ZERO_MEAS	
Parameters:	1. ON or OFF 2. Reference value for absoluete pressure modules
ZERO_MEAS?	
Parameter:	(Optional) Units of returned value
Responses:	1. (Character) ON or OFF 2. (Float) Offset value 3. (Character) Units (F, PSI, MHG, INHG, INH2O, FTH2O, MH2O, BAR, PAL, G/CM2, INH2O60F)