3.3.3 8540C Emulation Command Code Set

Table 3-8 lists the 8540C IEEE 488.2 emulation commands that are implemented in the 8650A. Most of these codes do not stand alone; commands; prefixes, variables and suffixes must be combined with them. For further information refer to the manual sections cited in Table 3-8.

Table 3-8: 8540C Emulation Command Set

Command	Description	Section
Required Commands		
*CLS	Clear status byte	3.19.13
*ESE	Set Event Status Enable Register	3.19.13
*ESE?	Ask for current status of Event Status Enable Register	3.19.13
*ESR?	Ask for and clear Event Status Register bits	3.19.13
*OPC	Operation complete command	3.2.13 3.2.24
*OPC?	Operation complete query	3.2.13 3.2.24
*RST	Software reset	3.19.9
*STB?	Ask for status byte	3.19.13
*SRE	Set the service request mask	3.19.13
*SRE?	Ask for service request mask	3.19.13
*IDN?	Ask for instrument ID	3.13
Function Commands		
@1	Set service request mask	3.19.13
@2	Set learn mode 2 data	3.14.3
?ID	Ask for instrument ID	3.13
AD	Measure A-B	3.19.2
AE	Specifies the A sensor	3.3.1
ANALOG	Configure analog output	3.4
AP	Measure sensor A	3.19.12
AR	Measure A/B	3.19.12
BAP	BAP mode	3.18.4
BD	Measure B-A	3.19.12
BE	Specifies the B sensor	3.3.1
BP	Measure sensor B	3.19.12
BR	Measure B/A	3.19.12
BSPE	Burst end exclude	3.19
BSTE	Burst start exclude	3.19
BTDP	Burst dropout	3.19.3
BURST	Fast buffered mode	3.17.3
CL	Calibrate sensor	3.7

Table 3-8: 8540C Emulation Command Set (Continued)

Command	Description	Section
CRF	Ask for crest factor value	3.8
CR	Crest factor	3.8
CS	Clear status byte	3.19.13
CW	CW mode	3.18
DA	Test LCD display	3.9
DC0	Duty cycle disable	3.10
DC1	Duty cycle enable	3.10
DD	Display disable	3.9
DE	Display enable	3.9
DU	Display user message	3.9
DY	Set duty cycle	3.10
EEPROM	Sensor EEPROM query	3.12
FA	Auto averaging	3.5
FBUF	Fast buffered mode	3.17.3
FH	Hold current averaging number	3.5.1
FM	Set averaging number	3.5.2
FMOD	Fast modulated mode	3.17.5
FR	Frequency	3.12.2
GATE	Time gating function	3.11
GT0	Cancel GET	3.16.2
GT1	GET single measurement	3.16.2
GT2	GET full measurement with settling	3.16.2
ID	Ask for instrument ID	3.13
KB	Enter cal factor	3.6
LG	Log units (dB or dBm)	3.19.6
LH	Set high limit	3.15
LL	Set low limit	3.15
LM0	Disable limit checking	3.15
LM1	Enable limit checking	3.15
LN	Linear units (Watts or %)	3.19.16
LP1	Ask for learn mode #1 string	3.14.1
LP2	Ask for learn mode #2 output	3.14.3
MAP	MAP mode	3.18
MAX	Ask for max value	3.19.4
MEAS	Ask for measurement mode	3.18.6
MIN	Ask for minimum value	3.19.4

Table 3-8: 8540C Emulation Command Set (Continued)

Command	Description	Section
MN0	Min/max disable	3.19.4
MN1	Min/max enable	3.19.4
OC0	Disable calibrator source	3.7.2
OC1	Enable calibrator source	3.7.2
OF0	Offset disable	3.19.5
OF1	Offset enable	3.19.5
OS	Set offset value	3.19.5
PAP	PAP mode	3.18
PEAK	Peak sensor settings	3.19.8
PH0	Peak hold Off	3.19.7
PH1	Peak Hold On	3.19.7
PKH	Ask for peak hold value	3.19.7
PR	Preset the 8650A	3.19.9
PULSE	Peak sensor settings	3.19.8
RC	Recall a saved instrument state	3.19.14.2 3.19.15
RE	Display resolution	3.19.11
RL0	Disable relative measurement	2.3.3
RL1	Enable relative measurement	2.3.3
RL2	Use old reference for relative measurement	2.3.3
RV	Ask for service request mask	3.19.13
SCPI	Switches to SCPI command mode	3.19.22
SM	Ask for status message	3.19.13
ST	Store instrument state	3.19.15
SWIFT	Swift mode	3.17.4
TR0	Trigger hold mode	3.16
TR1	Trigger single measurement	3.16
TR2	Trigger full measure with settling	3.16
TR3	Free run trigger mode	3.16
$V_{PROP}F$	Configure $V_{PROP}F$ feature (See Figure 3-6)	3.19.17
ZE	Sensor zeroing	3.19.18

3.3.4 HP436 Emulation Command Code Set

Table 3-9 lists the GPIB commands that are available when the instrument is placed in the HP436 emulation mode:

Table 3-9: HP436 Emulation Command Set

Command	Description
5[1]	Set range 5
4[1]	Set range 4
3[1]	Set range 3
2[1]	Set range 2
1[1]	Set range 1
9[1]	Set auto range
A	Set linear units (Watts)
B	Set relative mode
C	Set relative value
D	Set Log units (dBm)
Z	Zero sensor
+ +	Enable cal factors
-	Disable cal factors (ignored)
H	Set TR0 mode
T	Set TR2 mode
I	Set TR1 mode
R	Set TR3 mode
V	Set TR3 mode

1. The 8650A is always able to measure over its entire dynamic range; there is no need to specify the range. Therefore, range-related commands have no effect on the measurement capability of the 8650A. The auto range, range hold, and set range commands only offset the analog output voltage, and only in HP436, HP437 or HP438 GPIB emulation modes. In these emulation modes (when using a single sensor, and not measuring in a relative mode), the power will be scaled to a range of 0 to 1 volts, representing the relative power within the current 10 dB range of the 8650A. The range hold and set range commands will simulate locking the range of power represented by the output voltage.

   In HP436 emulation, the specified range is also indicated in the power data strings returned to the host.

3.3.5 HP437 Emulation Command Code Set

These are the GPIB commands that are available when the instrument is placed in the HP437 emulation mode. Footnotes appear at the end of Table 3-10.

Table 3-10: HP437 Emulation Command Set

Command	Description
Required Commands	
*CLS	Clear all Status Registers[2]
*ESE	set the event status enable mask[3]
*ESE?	event status register enable mask query[3]
*ESR?	event status register query[3]
*IDN?	GPIB identification query[2]
*RST	Software reset
*SRE	Set the Service Request Mask value[2]
*SRE?	Service Request Mask query
*STB?	Read the Status Byte
Function Commands	
@1	Prefix for Status Mask
@2	Learn mode prefix
CL	CAL[1]
CS	Clear the Status Byte
CT0 - CT9	clear sensor data tables 0 thru 9 [ignored]
DA	Test LCD display
DC0	Duty Cycle on
DC1	Duty Cycle off
DD	Display disable
DE	Display enable
DN	down arrow emulation [ignored]
DU	Display user message
DY	Duty Cycle (enter duty cycle value)
ERR?	device error query
ET0 - ET9	edit sensor cal factor table 0 thru 9 [ignored]
EX	exit [ignored]
FA	automatic filter selection
FM	manual filter selection[1]
FR	frequency entry
GT0	ignore Group Execute Trigger (GET) bus command
GT1	trigger immediate response to GET command
GT2	trigger with Delay response to GET command
ID	GPIB identification query
KB	Cal Factor[1]
LG	Log display
LH	High limit[1]
LL	Low limit[1]

Table 3-10: HP437 Emulation Command Set (Continued)

Command	Description
LM0	Disable limits checking function
LM1	Enable limits checking function
LN	Linear display
LP2	HP437 learn mode
LT	Left arrow [ignored]
OC0	Reference oscillator off
OC1	Reference oscillator on
OD	Output display text [ignored]
OF0	Offset off - Local
OF1	Offset on - Local
OS	Offset (enter offset value)
PR	Preset
RA	Auto range[4]
RC	Recall[1]
RE	Resolution[1]
RF0 - RF9	Enter sensor ref cal factor [ignored]
RH	Range hold[4]
RL0	Exit REL mode
RL1	Enter REL mode using REL value
RL2	Use old ref number
RM	Set range[1, 4]
RT	Right arrow [ignored]
RV	Read Service Request Mask value
SE	Sensor [ignored]
SM	Status Message
SN0 - SN9	enter sensor serial number [ignored]
ST	Store instrument state
TR0	Trigger hold
TR1	Trigger immediate
TR2	Trigger with delay
TR3	Trigger - free run
UP	Up arrow [up arrow]
ZE	Zero

Notes:

1. A numeric entry is required by these GPIB codes, followed by the code EN (ENTER).
2. This GPIB code uses the next 6 characters (0-9, A-Z, or an underscore) as input data.
3. The asterisk (*) must be included as part of the GPIB command string.
4. The 8650A can always measure over its entire dynamic range; there is no need to specify the range. Therefore, range-related commands have no effect on the measurement capability of the 8650A. The auto range, range hold, and set range commands only offset the analog output voltage, and only in HP436, HP437, or HP438 GPIB emulation modes. In these emulation modes (when using a single sensor, and not measuring in a relative mode), the power will be scaled to a range of 0 to 1 volts, representing the relative power within the current 10 dB range of the 8650A. The range hold and set range commands will simulate locking the range of power represented by the output voltage.

3.3.6 HP438 Emulation Command Code Set

These are the GPIB commands that are available when the instrument is placed in the HP438 emulation mode. Footnotes appear at the end of Table 3-11.

Table 3-11: HP438 Emulation Command Set

Command	Description
IEEE 488.2 Function Commands	
?ID	Ask for ID
@1	Prefix for Service Request Mask
@1;CHR$(4)	Set Service Request Mask to 4
AD	Measure A-B
AE	Specifies the A sensor
AP	Measure sensor A
AR	Measure A/B
BD	Measure B-A
BE	Specifies the B sensor
BP	Measure sensor B
BR	Measure B/A
CL[1]	Calibrate sensor (precede with AE or BE)
CS	Clear status byte
DA	Test LCD display
DD	Display disable
DE	Display enable
FA	Set auto average filtering (precede with AE or BE)
FM	Set averaging number
GT0	Group execute trigger cancel
GT1	Group execute trigger single measurement
GT2	Group execute trigger full measurement with settling
KB	Cal Factor
LG	Set Log units (dB or dBm)
LH	High limit
LL	Low limit
LM0	Disable limit checking
LM1	Enable limit checking
LN	Set linear units (Watts or %)
LP1	Set learn mode #1
LP2	Set learn mode #2

Table 3-11: HP438 Emulation Command Set (Continued)

Command	Description
OC0	Turn off calibrator source
OC1	Turn on calibrator source
OS	Offset
PR	Preset the instrument to a known state
RA[2]	Resume autorange [not supported]
RC	Recall previous instrument state
RH[2]	Do a range hold
RL0	Turn off rel mode
RL1	Turn on rel mode
RM[2]	Set manual range
RV	Ask for status request mask
SM	Ask for status message
ST	Store instrument state
TR0	Trigger hold mode
TR1	Trigger single measurement
TR2	Trigger full measurement with settling
TR3	Free run trigger mode
ZE	Zero sensor (precede with AE or BE)

Notes:

1. A numeric entry is required by these GPIB codes, followed by the EN suffix.
2. The 8650A is always able to measure over its entire dynamic range; there is no need to specify the range. Therefore, range-related commands have no effect on the measurement capability of the 8650A. The auto range, range hold, and set range commands only offset the analog output voltage, and only in HP436, HP437, or HP438 GPIB emulation modes. In these emulation modes (when using a single sensor, and not measuring in a relative mode), the power will be scaled to a range of 0 to 1 volts, representing the relative power within the current 10 dB range of the 8650A. The range hold and set range commands will simulate locking the range of power represented by the output voltage.

3.4 Analog Output

These commands control the A and B analog outputs.

3.4.1 Enabling & Disabling the Output

The ANALOG function can enable or disable the analog outputs. The command format for this purpose is:

Syntax:	ANALOG [STD or OPT] STATE [ON | OFF] [STD or OPT] specifies analog output A or B respectively STATE indicates that the analog output ON/OFF status is being configured The variables ON and OFF indicate whether the analog output is to be enabled or disabled	
Example:	OUTPUT 713;ANALOG STD STATE ON	! ENABLES ANALOG A OUTPUT
Example 2:	OUTPUT 713;ANALOG OPT STATE OFF	! DISABLES ANALOG B OUTPUT

3.4.2 Setting Options for the Output

The ANALOG function can also configure various aspects of the analog output. The command format is:

Syntax:	ANALOG [STD or OPT] [TOP or BOT] [LG or LN] [a b c d] [STD or OPT] specifies the analog output A or B respectively [LG or LN] specifies logarithmic (dBm) or linear (Watts) measurement The command string ends with four numeric variables (with at least one separator character between each pair of them), which define the relationship between the input power range and the output voltage range: a: power level represented by the minimum output voltage, b: power level represented by the maximum output voltage, c: minimum output voltage, d: maximum output voltage Valid power range numbers are -100 to +100 [dBm] for LOG, or 0 to 15 [Watts] for LIN. Valid voltage range numbers are 0.00 to +10.00 [VDC]	
Example:	OUTPUT 713;ANALOG STD LOG -80.0, 20.0, 0.0, 10.0	! CONFIGURES THE ANALOG A OUTPUT CHANNEL AS FOLLOWS: ! LOGARITHMIC UNITS, -80 TO +20 DBM INPUT, 0 TO 10 VOLT OUTPUT
Example 2:	OUTPUT 713;ANALOG OPT LIN 0.00, 1.00E-3, 0.0, 1.0	! CONFIGURES THE ANALOG B OUTPUT CHANNEL AS FOLLOWS: ! LINEAR UNITS, 0 TO 1.00 MW, 0 TO 1 VOLT OUTPUT

3.5 Averaging

3.5.1 Auto Averaging

The 8650A is normally used in the auto averaging mode. The power meter chooses an averaging factor that is appropriate for the ambient noise level.

3.5.1.1 Activating the Auto Filter Mode

The command which activates auto averaging for a sensor is based on the FA function. The command format is:

Syntax:	[AE or BE] FA	
	[AE or BE] prefix specifies Sensor A or Sensor B. FA activates the auto filter mode for the selected sensor	
Example:	OUTPUT 713;AE FA	! ACTIVATES AUTO AVERAGING FILTERING FOR SENSOR A

3.5.1.2 Setting the Measurement Settling Target

In the auto averaging mode, the 8650A chooses the lowest averaging factor that will yield a stable measurement at the present resolution setting. Stability is defined in terms of peak to peak variation in the measurement; the variation target value is expressed as a percentage of average power. Default values for this Measurement Settling Target are:

Table 3-12: Measurement Setting Target Default Values

Resolution	Peak to Peak Variation
xx.	25% (~1 dB)
xx.x	4.7% (~.2 dB)
xx.xx	0.46% (~.02 dB)
xx.xxx	0.10% (~.004 dB)

Because the target value affects the speed of measurement, it is possible to increase measurement speed by increasing the target value (a small increase in the target value can result in a large increase in speed). If the auto averaging mode is selected using the front panel menus, or the AE FA or BE FA commands as described above, the default target values shown in the table are used. However, it is possible to add a numeric variable after FA in order to specify a different target value:

Syntax:	[AE or BE] FA [t] [EN % or PCT]	
	[t] represents the measurement settling target value in percent, and has a valid range of 0.10 to 100.00	
Example:	OUTPUT 713;BE FA .8 %	! ACTIVATES AUTO AVERAGING FILTERING FOR SENSOR B, WITH ! A MEASUREMENT SETTLING TARGET OF .8%

3.5.1.3 Freezing the Present Averaging Number

The command which causes auto filtering to hold its present averaging number is based on the FH function. The command format is:

Syntax:	[AE or BE] FH	
	[AE or BE] prefix specifies sensor A or Sensor B FH causes the 8650A to hold its present averaging number; auto averaging is deactivated	
Example:	OUTPUT 713;BE FH	! HOLDS PRESENT AVERAGE NUMBER FOR SENSOR B

3.5.2 Manual Averaging

The averaging number can be specified directly. The commands for this purpose are based on the FM function. The command format is:

Syntax:	[AE or BE] FM [v] EN	
	[AE or BE] prefix specifies Sensor A or Sensor B FM specifies manual averaging [v] has allowable values of 0 through 10. Each value represents a particular averaging number. The numbers are shown in Table 3-13 A terminating suffix is required (EN)	
Example:	OUTPUT 713;AE FM 2 EN	! SETS AVERAGING NUMBER TO 4

Table 3-13: Numbering Averaging

Value of *v*	Averaging Number	Value of *v*	Averaging Number
0	1	5	32
1	2	6	64
2	4	7	128
3	8	8	256
4	16	9	512
		10	1024

Example 2:	OUTPUT 713;AE FM 8 EN	! SETS AVERAGING NUMBER TO 256

3.6 Cal Factors

The commands described below do not need to be employed with the 8650A; it is included here for the sake of compatibility with remote programs written for older power meters.

When a sensor is attached to the 8650A, the power meter automatically loads calibration factors from an EEPROM in the sensor. This data is frequency related, and in order for the 8650A to make use of it, the user must supply frequency information to the power meter, either by means of the front panel FREQ key, by means of the GPIB FR command (See FREQUENCY, Section 3.12.2), or by means of the $V_{PROP}F$ input. Once the frequency has been specified, the 8650A automatically applies the appropriate cal factor to each reading.

The KB function code specifies a cal factor which is to be used in place of the cal factors stored in the sensor EEPROM. The command format is:

Syntax:	[AE or BE] KB [*n*] EN	
	[AE or BE] prefix specifies Sensor A or Sensor B [*n*] specifies a cal factor, expressed as a percentage with a valid range of 1.0 to 150.0 A terminating suffix is required (EN)	
Example:	OUTPUT 713;AE KB 96 EN	! ENTERS A 96% CAL FACTOR FOR SENSOR A
Example 2:	OUTPUT 713;BE KB 102 EN	! ENTERS 102% CAL FACTOR FOR SENSOR B

3.7 Calibration

Commands which cause the 8650A to calibrate a sensor are based on the CL function code. The command format is:

Syntax:	[AE or BE] CL [*n*] [EN or PCT or %] [AE or BE] prefix specifies Sensor A or Sensor B [*n*] represents a reference calibration factor of *n*%. The 8650A makes no use of this variable; instead it reads cal factors from the sensor EEPROM. The variable is included in the command format only for compatibility with power meters which require it. Any value between 50 and 120 can be entered for *n* A terminating suffix is required (EN, PCT or %)	
Example:	OUTPUT 713;AE CL 100 EN	! CALIBRATE SENSOR A
Example 2:	OUTPUT 713;BE CL 100 EN	! CALIBRATE SENSOR B

The appropriate sensor must be attached to the calibrator output for the calibration process to function. If the sensor is not attached, the calibration will fail, and operation will continue as before.

3.7.1 Calibration Routine

The following is an example of a GPIB program to calibrate a sensor. It is strongly recommended that this format be followed for remote calibration. Note that the service request feature is used to determine when the calibration has completed; this will result in the fastest calibration routine.

```
Calibrate:                              ! calibration routine
ON INTR 7 GOSUB Srq_interrupt           ! setup serial poll interrupt jump location
ENABLE INTR 7;2                         ! enable SRQ interrupts3;*SRE010
! set service request mask to 23;CS     ! clear status byte
OUTPUT 713;CL100EN                      ! start calibration
Flag=0                                   reset control flag
WHILE Flag=0                            ! wait while calibrating
END WHILE
RETURN
Srq_interrupt:                          ! SRQ interrupts jump here
13;*STB?
ENTER 713;State
IF BIT(State, 1) THEN
      PRINT GOOD CAL
      ELSE
          IF BIT(State, 3) THEN
          PRINT BAD CAL
          ENDIF
ENDIF
OUTPUT 713;CS                           ! clear status byte
Flag=1                                  ! set control flag true
RETURN
```

3.7.2 Calibrator Source

The 8650A Calibrator output (a fixed signal at 0 dBm) is activated and deactivated by means of two simple commands:

Syntax:	[OC1 or OC0]	
Example:	OUTPUT 713;OC	! TURNS ON CALIBRATOR SOURCE
Example 2:	OUTPUT 713;OC0	! TURNS OFF CALIBRATOR SOURCE

☛ ***NOTE:*** *This command is needed for test purposes only. The calibrator source is enabled automatically during calibration of a sensor.*

The following command sets the calibrator frequency for Option 12:

Syntax:	[OC1] *d* (where *d* = HZ, KZ, MZ, GZ)	
Example:	OUTPUT 713;OC1 1.000 GZ	! SETS THE CALIBRATOR FREQUENCY TO 1.000 GHZ

☛ ***NOTE:*** *This command resets calibration output to 0.00 dBm.*

3.7.3 Calibrator Test

These commands set and query the calibrator output power level:

Syntax:	TEST CALIB POWER *d*, where *d* is the dBm power level	
Example:	OUTPUT 713;TEST CALIB POWER 10	! SETS THE CALIBRATOR OUTPUT POWER AT 10 DBM

Syntax:	TEST CALIB POWER?	
Example:	OUTPUT 713;TEST CALIB POWER?	! QUERIES THE CALIBRATOR OUTPUT POWER LEVEL

These commands set and query the calibrator frequency for Option 12:

Syntax:	TEST CALIB FREQ *d*, (HZ, KZ, MZ, GZ)	
Example:	OUTPUT 713;TEST CALIB FREQ 800.0 MZ	! SETS THE CALIBRATOR FREQUENCY TO 800 MHZ

Syntax:	TEST CALIB FREQ?	
Example:	OUTPUT 713;TEST CALIB FREQ?	! QUERIES THE CALIBRATOR FREQUENCY

☛ ***NOTE:*** *During power sensor calibration, the calibrator frequency is automatically set to 50 MHz for all sensors except 807XXA which are calibrated at 1 GHz.*

3.7.4 Channel Designation

The command is required to specify which channel (display line) will be assigned to all subsequent commands that are affected.

The affected commands are: LG, LN, RE, RL(0/1/2), LH, LL, LM(0/1), MAX, MIN, MIN(0/1) and STAT.

Syntax:	[AE or BE] CH *n* EN (where *n* = 1,2,3 or 4 line number)	
Example:	OUTPUT 713;BE CH 3 EN	! THE COMMANDS TO FOLLOW APPLY TO SENSOR B AND DISPLAY LINE #3

3.8 Crest Factor

The Crest Factor feature holds on to the highest instantaneous power measured from the time the feature is enabled until it is reset; it is similar to the Peak Hold feature, except that the measurement is expressed as a ratio in relation to average power.

Like the Peak Hold feature, the Crest Factor feature also has the same minimum average power level restriction of -20 dBm. Beginning in firmware version 1.51, this has been implemented to increase accuracy and maintain wide bandwidth of Crest Factor measurement over the peak power range of -20 dBm to +20 dBm. The Crest Factor selection will also affect Histogram measurement if there is power below -20 dBm. To obtain accurate average power measurements below -20 dBm, the Crest Factor feature should be disabled.

☛ ***NOTE:*** *The Crest Factor feature can only be used in the standard measurement collections modes (not in the fast modes), and only in a modulated measurement mode (MAP, PAP or BAP). Crest Factor is not recommended for use in combination with the $V_{PROP}F$ function.*

3.8.1 Enabling the Crest Factor Feature

The Crest Factor feature is enabled or disabled by one of two function codes:

Syntax:	[AE or BE] [CR0 or CR1]	
Example:	OUTPUT 713;AE CR1	! ENABLES THE CREST FACTOR FEATURE FOR SENSOR A
Example 2:	OUTPUT 713;BE CR0	! DISABLES THE CREST FACTOR FEATURE FOR SENSOR B
Description:	Like the PH0 and MN0 commands, the CR0 command will disable Peak Hold and Min/Max measurements. Sending a CR1 command after the Crest Factor is enabled will reset both the Crest Factor and Peak Hold (See Section 3.19.7).	

3.8.2 Reading the Crest Factor Value

The Crest Factor value is read over the bus using a simple command:

Syntax:	[AE or BE] CRF	
Example:	OUTPUT 713;AE CRF	! SENDS THE CREST FACTOR VALUE FOR SENSOR A

The Crest Factor feature monitors the maximum power as it is measured, but does not provide any feedback to the controller until a CRF command is received. To monitor for a limit violation, the Limits feature may be more useful (See Section 3.15).

The Crest Factor feature returns the current ratio between held power and average power, as displayed on the front panel. A CRF command does not initiate data collection in same manner as a trigger command, such as TR1. To get a good reading of the Peak Hold value, the procedure is:

1. Set up the signal being measured, and send CR1 to reset the Crest Factor measurement.
2. Send TR2.
3. Read the TR2 data, or wait for the data ready service request (this allows for settling).
4. Send CRF.
5. Read the Crest Factor value.

3.9 Display Control

3.9.1 Display Testing

The LCD display window and can be tested remotely, by means of three simple commands:

Syntax:	DE (Enable the display) DA (Test the display) DD (Disable the display)	
Example:	OUTPUT 713;DE	! ACTIVATES THE LCD DISPLAY ! (THIS HAS THE EFFECT OF CANCELING A DA OR DD COMMAND)
Example 2:	OUTPUT 713:DA	! PERFORMS A TEST OF THE DISPLAY
Example 3:	OUTPUT713;DD	! DISABLES THE DISPLAY

3.9.2 Displaying Messages

The DU function can show a test message in the LCD display window. The command format for this purpose is:

Syntax:	DU [string]	
	The test message string can contain up to 32 characters.	
Example:	OUTPUT 713;DU THIS IS A TEST	! SHOWS THE MESSAGE THIS IS A TEST ON THE ! LCD DISPLAY WINDOW

3.10 Duty Cycle Commands

3.10.1 Activating or Deactivating a Duty Cycle

The commands which activate or deactivate a duty cycle are based on the DC0 and DC1 functions. The command format is:

Syntax:	[AE or BE] [DC0 or DC1]	
	[AE or BE] prefix specifies Sensor A or Sensor B [DC0] turns the duty cycle off (for the specified sensor); if the sensor is in Pulse Average Power measurement mode, this command will change the sensor measurement mode to Modulated Average Power. If the sensor is not measuring Pulse Average Power at the time this command is received, then this command will have no effect [DC1] turns the duty cycle on. This is equivalent to the PAP command (See Measurement Mode Commands in Section 3.18)	
Example:	OUTPUT 713;AE DC0	! TURNS OFF THE DUTY CYCLE FOR SENSOR A
Example 2:	OUTPUT 713;BE DC1	! TURNS ON THE DUTY CYCLE FOR SENSOR B

3.10.2 Specifying a Duty Cycle

The commands which specify a duty cycle are based on the DY function. The command format is:

Syntax:	[AE or BE] DY [*n*] [EN or PCT or %]	
	[AE or BE] prefix specifies Sensor A or Sensor B DY specifies a duty cycle value; it also configures the sensor to Pulse Average Power mode. Therefore, this function includes the capabilities (and entry error reporting) of the PAP function (See Measurement Mode Commands in Section 3.18) [*n*] species the duty cycle value in percent with a valid range of .001 to 99.999) A terminating suffix is required (EN, PCT or %)	
Example:	OUTPUT 713;AE DY 50 %	! SETS 50% DUTY CYCLE FOR SENSOR A
Example 2:	OUTPUT 713;BE DY 25.000 EN	! SETS 25% DUTY CYCLE FOR SENSOR B
Example 3:	OUTPUT 713;BE DY 40.412 PCT	! SETS 40.412% DUTY CYCLE FOR SENSOR B

3.10.3 Reading Duty Cycle Status

The status message bit O indicates whether the duty cycle function is active for the selected sensor. 0 indicates OFF; 1 indicates ON.

3.11 Time Gating Measurement

The structure of the Time Gating GPIB commands for the Series 8650A Universal Power Meters has been modified from the format used in the Series 8540C Universal Power Meters. The timing parameters cannot be concatenated into a single command string. Each parameter must be specified in an individual string.

☛ ***NOTE:*** *For the Series 8650A in 8540C Emulation, the 8540C Time Gating commands must be modified to meet the 8650A Time Gating GPIB command structure.*

3.11.1 Description

The time gating measurement option limits a power measurement to a defined interval that is controlled by a start time and a duration. The start time begins after a programmable delay following a hardware trigger applied to the Trigger Input connector on the instrument's rear panel.

Off/Gated/Trigger	This selects between two modes of specifying the measurement period.
Off	Cancels the time gating function.
Gated	Selects the External Gating Mode in which measurements are taken while the trigger input signal is true.
Trigger	Selects the External Trigger Mode and initiates a sequence of timers for defining the measurement duration.

3.11.1.1 External Gating Mode

Gate Polarity	This specifies the external signal TTL high or low level as true for defining the gated time.

3.11.1.2 External Trigger Mode

Trigger Polarity	This specifies the rising or falling edge of the trigger signal as the time reference point.
Trigger Delay	This is the delay time from receipt of an externally gated trigger edge input to the start of the gated measurement period.
Gate Time	This specifies of the length of the gated measurement period.
Holdoff Time	This is the timeout period between the end of the measurement period and the time another trigger will be accepted.

3.11.2 Time Gating Mode

The Time Gating mode is fully defined and illustrated in Section 2.3.1 of this publication. The following are the commands for using this feature over the GPIB.

3.11.2.1 Gate A or B

All time gating commands begin with GATE. Only one setup data structure is stored by the meter, so the parameters specified apply to the one channel that has time gating enabled. For example, the command GATEA enables the time gating on channel A with previously specified parameters, and GATEB switches time gating to channel B with the same parameters.

3.11.2.2 OFF or GATE or TRIGGER or EDGE

OFF turns off the time gating on either channel regardless of the channel specified. If GATE is sent, the time gating board is set up in the External Gating Mode. If TRIGGER is sent, the External Trigger Mode will be enabled. Although it is legal to send any of the indicated parameters in one command, only the last specified parameter is relevant. For example, if the command GATEA OFF TRIGGER GATE is sent, the time gating option will be set up in the External Gating Mode.

Example:	OUTPUT 713;GATEA EDGE

3.11.2.3 INVERT or NONINVERT

INVERT and NONINVERT specify the polarity of the trigger input signal. In the External Gating Mode, INVERT specifies that measurements can be taken when the trigger input is low, and NONINVERT specifies the measurements can be taken when the trigger input is high. In the External Trigger Mode, INVERT specifies that a falling edge on the trigger input triggers the gating, and NONINVERT specifies that a rising edge triggers the gating. Although it is legal to send both of the parameters in one command, only the last specified parameter is relevant.

Example:	OUTPUT 713;GATEA NONINVERT

3.11.2.4 DELAY d

DELAY *d* specifies the delay time from the trigger input edge to the start of the gating period. The *d* must be time specified in seconds in the range of 0 to 327.675 μs in 5 μs steps, where 0 represents some minimum non-zero delay time. This parameter is relevant only in the External Trigger Mode. For example, if the command

Example:	OUTPUT 713;GATEA DELAY 20E-3

is sent, the External Trigger Mode will be enabled on channel A with a trigger delay of 20 ms. Since the previous set up may be unknown, the DELAY, DURATION and HOLDOFF should be sent in the same command.

3.11.2.5 DURATION g

DURATION *g* specifies the duration of the gating period. The *g* must be a time specified in seconds in the range of 5 μs to 327.675 μs, with a resolution of 5 μs. This parameter is relevant only in the External Trigger Mode. For example, if the command

Example:	OUTPUT 713;GATEA DURATION 250E-3

is sent, the External Trigger Mode will be enabled on channel A with a gate duration of 250 ms.

3.11.2.6 HOLDOFF h

HOLDOFF *h* specifies the holdoff time from the end of the gating period to the time when the circuit will accept another trigger input edge. The *h* must be a time specified in seconds in the range of 0 to 327.675 μs, with a resolution of 5 μs. This parameter is relevant only in the External Trigger Mode. For example, if the command

Example:	OUTPUT 713;GATEA HOLDOFF 0

is sent, the External Trigger Mode will be enabled on channel A with no holdoff delay.

3.11.2.7 Error Codes

Specifying a channel where no sensor is connected, or it is a peak sensor not in CW mode, then the Entry Error bit of the Status byte is set, as well as the Execution Error bit of the Event Status register. If requesting the Status Message, the code in the Entry Error portion of the message will be 64.

If specifying an out of range value for the delay, gate duration, or holdoff values, the Entry Error bit of the Status byte is also set as well as the Execution Error bit of the Event Status register. If requesting the Status Message, the code in the Entry Error portion will be 65 for a delay range, 66 for a gate duration range error and 67 for a holdoff range error.

3.12 EEPROM

3.12.1 EEPROM Cal Factors

The EEPROM command is used to query the cal factor data in the sensor EEPROM. The cal factor data is typically stored in the EEPROM at 1 GHz steps over the frequency range of the sensor. Additional cal factors may also be stored at additional special frequencies. When a measurement frequency is specified which does not exactly match the frequencies at which cal factors have been stored, the power meter determines the appropriate cal factor via interpolation.

Commands to read EEPROM cal factor data are based on the EEPROM function code. The command format is:

Syntax:	EEPROM [A or B] [CALF? or FREQ?]	
	[A or B] specifies Sensor A or Sensor B [CALF?] queries the cal factors. The cal factor data is output as a table of cal factors expressed in dB, separated by commas [FREQ?] queries the frequencies which correspond to the cal factors. The frequency data is output as a table of frequencies expressed in Hz, separated by commas	
Example:	OUTPUT 713;EEPROM A CALF?	! QUERIES SENSOR A EEPROM WHOLE CAL FACTOR ! TABLE ! (THIS EXAMPLE IS FROM AN 80301A SENSOR)
Response:	0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00	

Example:	OUTPUT 713;EEPROM A FREQ?	! QUERIES SENSOR A EEPROM WHOLE ! FREQUENCY TABLE ! (THIS EXAMPLE IS FROM AN 80301A SENSOR)
Response:	5.000e7, 2.000e9, 3.000e9, 4.000e9, 5.000e9, 6.000e9, 7.000e9, 8.000e9, 9.000e9, 1.000e10, 1.100e10, 1.200e10, 1.300e10, 1.400e10, 1.500e10, 1.600e10, 1.700e10, 1.800e10	

3.12.2 Frequency

Cal factors are stored in the sensor's EEPROM by frequency. Specifying a frequency causes the 8650A to apply the cal factor appropriate to that frequency. To cancel the use of cal factors, specify a frequency of 50 MHz (this is the frequency of the front panel Calibrator reference output, and has a cal factor of zero).

Commands which specify a frequency are based on the FR function. The command format is:

Syntax:	[AE or BE] FR [n] [HZ or KZ or MZ or GZ]	
	[AE or BE] prefix specifies Sensor A or Sensor B FR specifies a frequency value [*n*] specifies the frequency value (the units are Hz, kHz, MHz, or GHz, depending on the terminating suffix used). A terminating suffix is required (HZ, KZ, MZ, or GZ)	
Example:	OUTPUT 713;AE FR 5.67 GZ	! FREQUENCY FOR SENSOR A IS 5.7 GHZ
Example 2:	OUTPUT 713;AE FR 1.0E9 HZ	! FREQUENCY FOR SENSOR A IS 1E9 HZ (1 GHZ)
Example 3:	OUTPUT 713;BE FR 84.6 MZ	! FREQUENCY FOR SENSOR B IS 84.6 MHZ

3.13 Instrument Identification

The 8650A can be queried over the GPIB for purposes of identification; user application programs make use of such queries in order to verify that the appropriate equipment is connected. The 8650A will reply to an ID query by sending back an identification string.

The simple commands which query the instrument ID consist of any of three function codes:

Syntax:	[ID or ?ID or *IDN?]	
Example:	OUTPUT 713;*IDN?	! ASKS FOR ID STRING
Example 2:	ENTER 713; NAME	! READS ID INTO STRING VARIABLE NAME

3.13.1 Identification Strings

The ID string is determined by the configuration choices that were made (from the front panel) under the Config/GPIB menu. In the 8651A modes, the ID string consists of four fields separated by commas:

- Field 1 is the manufacturer (GIGA-TRONICS)
- Field 2 is the model (8651A, 8652A, 8541C or 8542C)
- Field 3 is the serial number field (it displays the serial number of the calibrator EEPROM)
- Field 4 is the software version number

Example strings:

8652A mode	Name = GIGA-TRONICS,8652A,9548024,3.00
8451C mode	Name = GIGA-TRONICS,8451C,9548024,3.00
8452C mode	Name = GIGA-TRONICS,8452C,9548024,3.00

However, the ID strings for the following emulation modes are fixed, as follows:

HP437B mode	Name = HEWLETT-PACKARD,437B,1.8
HP438A mode	Name = HP438A,VER1.10
HP436A mode	Not Applicable

3.14 Learn Modes

The 8650A has the ability to send information regarding its current configuration to the controller. The controller requests this information by sending a learn mode command. At a later time, the controller can send the configuration information back to the power meter in order to reconfigure the 8650A to the same state it was in when it received the learn mode command.

Conceptually this feature is similar to the store and recall capability of the 8650A but with several important differences:

- The configuration information is stored in the controller's memory and not in the 8650A memory
- Learn Mode #1 returns information regarding the current GPIB operational configuration (such as the trigger mode) which would not be covered by the store/recall function
- The learn modes do not support many of the advanced features of the 8650A
- The learn modes involve transmission of long strings of data between the controller and the 8650A These strings must be transmitted without interruption; transmissions cannot be considered complete until EOI is read

The two learn modes are discussed under separate headings on the following pages.

The learn modes are provided for the sake of compatibility with remote programs written for older power meters. The configuration information returned to the host is not as complete as the information that would be stored in the 8650A memory using the store/recall function; the configuration data for many features of the 8650A are not included in the learn mode data.

3.14.1 Learn Mode #1

Learn Mode #1 is used to return the configuration of the 8650A to the controller in the form of a sequence of GPIB commands.

3.14.2 Requesting the String

The simple command which requests the Learn Mode #1 string has the following format:

Syntax:	LP1	
Example:	OUTPUT 713;LP1	! REQUESTS LEARN MODE #1 STRING

After receiving the LP1 command, the 8650A will return the Learn Mode #1 string the next time it is addressed to talk. The string will consist of up to 128 ASCII characters. The last character is sent with EOI true. Table 3-14 shows the information contained in the Learn Mode #1 string and the order in which it is sent.

Table 3-14: Learn Mode #1 Output Format

Parameter	Output from the Power Meter[1]
Trigger Mode	TRd
Measurement Mode	AP, BP, AR, BR, AD, or BD
SENSOR A PARAMETERS Cal Factor Offset Range Filter Low Limit High Limit	AE KB ddd.d EN OS ±dd.dd EN RA d EN FA or FM d EN LL ±ddd.ddd EN LH ±ddd.ddd EN
SENSOR B PARAMETERS Cal Factor Offset Range Filter Low Limit High Limit	BE KB ddd.d EN OS ±dd.dd EN RA d EN FA or FM d EN LL ±ddd.ddd EN LH ±ddd.ddd EN
Active Entry Channel	AE or BE
Measurement Units	LG or LN
Reference Oscillator Status	OC0 or OC1
Group Trigger Mode	GTd
Limits Checking Status	LM0 or LM1
Carriage Return Line Feed	EOI
1 ± indicates sign; d indicates a single digit.	

3.14.2.1 Sending the String

The power meter can be restored to the configuration described in the Learn Mode #1 string, by sending the string to the 8650A.

3.14.3 Learn Mode #2

Learn Mode #2 is used to return the 8650A configuration information to the controller in the form of a series of binary values.

3.14.3.1 Requesting the String

The simple command which requests the Learn Mode #2 string has the following format:

Syntax:	LP2	
Example:	OUTPUT 713;LP2	! REQUESTS LEARN MODE #2 STRING

After receiving the LP2 command, the 8650A will return the Learn Mode #2 string the next time it is addressed to talk. The string starts with two ASCII characters, @ and 2, followed by a string of 28 (58 for the 437 emulation mode) 8-bit binary bytes. The last byte is sent with EOI true. Learn Mode #2 requires a controller that can receive and send information in binary form.

The Learn Mode #2 string contains the following information:

- Measurement mode
- REL mode status (ON | OFF)
- Reference oscillator status (ON | OFF)
- Current reference value if in REL mode
- Measurement units (Log or Lin)
- Cal Factor for each sensor
- Offset for each sensor
- Range for each sensor
- Filter for each sensor

3.14.3.2 Sending the String

The command that sends the Learn Mode #2 data to the 8650A is based on the @2 function. The command format is:

binary bytes

The 8650A will change its configuration to match the configuration defined by the Learn Mode #2 string.

3.15 Limits

> ☛ ***NOTE:*** *Both limits need to be set and LL must always be lower than LH. The reason is that the default settings are 0 dBm for LL and LH.*

3.15.1 Setting Limits

Commands which set limits are based on the LH and LL function codes. The command format is:

Syntax:	[LH or LL] [*n*] EN	
	[LH] specifies the high limit; LL specifies the low limit [*n*] is a limit value, expressed in dBm or dB as appropriate A terminating suffix is required (EN)	
Example:	OUTPUT 713;LH 12.34 EN	! SETS HIGH LIMIT TO +12.34 DB
Example 2:	OUTPUT 713;LL -2.58 EN	! SETS LOW LIMIT TO -2.58 DB

> ☛ ***NOTE:*** *These commands must be preceded by CH [n] EN command.*

3.15.2 Activating Limits

Limit-checking is activated or deactivated by simple commands consisting of one of two function codes:

Syntax:	[LM0 or LM1]	
	[LM0] disables limit checking [LM1] enables limit checking	
Example:	OUTPUT 713;LM0	! DISABLES LIMIT CHECKING
Example 2:	OUTPUT 713;LM1	! ENABLES LIMIT CHECKING

Before enabling limit checking (LM1), set the high and low limits (LH and LL). Once enabled, the Status Byte (Bit 4) will signal a too high or too low condition. The status message AA bytes will indicate a too high condition (Error code 21), or a too low condition (Error code 23). Status Message byte L contains the limit status. 0 indicates within limits, 1 indicates too high, and 2 indicates too low.

The LCD display will indicate a too high condition with Over Limit displayed to the right of the reading, and Under Limit displayed to the right of the reading for a too low condition.

> ☛ ***NOTE:*** *These commands must be preceded by CH [n] EN command.*

3.15.3 Measuring with Limits

For Sensor A or B measurements with limits are enabled by the command

Syntax:	LM1.	
Example:	OUTPUT 713; AP LM1	! MEASURES SENSOR A AND ENABLE LIMIT CHECKING

This measures Sensor A with the previously set LL and LH limits.

Example:	OUTPUT 713; BP LM1	! MEASURES SENSOR B AND ENABLE LIMIT CHECKING

This measures Sensor B with previously set LL and LH limits.

3.16 Measurement Collection Modes (Standard)

3.16.1 Measurement Triggering

Trigger modes determine when a measurement will be made. Four simple commands consisting of one of four function codes select the desired mode:

Syntax:	[TR0 or TR1 or TR2 or TR3]

All four modes discussed here are standard measurement collection modes (as opposed to the fast modes described in Section 3.17), and use the standard data output format.

3.16.1.1 Trigger Hold (TR0)

This command places the instrument in standby mode. The LCD display is frozen at the current values. The display will be updated when the instrument receives a TR1 or TR2 command. To resume the normal free run mode of the instrument and display, use the TR3 command. During the standby mode, the instrument continues to make measurements and update the internal digital filter, but does not update the display or the GPIB buffer.

Example:	OUTPUT 713;TR0	! SELECTS THE TRIGGER HOLD MODE

3.16.1.2 Trigger Immediate (TR1)

This command triggers a single reading; the reading is added to the internal digital filter. An ENTER statement will return the updated filter power level. After a TR1 command, the instrument returns to the standby mode.

Example:	OUTPUT 713;TR1	! TRIGGER A SINGLE MEASUREMENT

3.16.1.3 Trigger Immediate with Full Averaging (TR2)

This mode triggers a new series of readings; enough to update the digital filter for a noise free reading at the current power level. An ENTER statement will return the fully updated filter power level. After a TR2 command, the instrument returns to the standby mode.

Example:	OUTPUT 713;TR2	! TRIGGER A FULL MEASUREMENT, WITH SETTLING

3.16.1.4 Free Run (TR3)

This free run trigger mode (which is the default mode) allows the user to read the power at any time with an ENTER statement. There is no need to send the TR3 command again. Multiple ENTER statements can be executed. The power meter will return the present power level just as if looking at the LCD display.

Example:	OUTPUT 713;TR3	! FREE RUN TRIGGER MODE

3.16.2 Group Execute Trigger

The GPIB GET command (group execute trigger) causes all the devices on the interface which are currently addressed to listen to start a device dependent operation (usually a measurement). Three simple commands (consisting of one of three function codes) regulate the 8650A response to a GET command:

Syntax:	[GT0 or GT1 or GT2]

This command disables the response of the 8650A to a GPIB GET command.

Example:	OUTPUT 713;GT0	! GROUP EXECUTE TRIGGER CANCEL

3.16.2.1 Group Trigger Immediate (GT1)

This mode is similar to the mode specified by the TR1 command (trigger immediate), except that the GT1 command causes the 8650A to wait for a GPIB GET command. When the GET command is received, it triggers a single reading which is added to the internal digital filter. An ENTER statement will return the updated filter power level. After a GT1 command, the instrument is placed in the standby mode.

Example:	OUTPUT 713;GT1	! GROUP EXECUTE TRIGGER SINGLE MEASUREMENT

This mode is similar to the mode specified by the TR2 command (trigger immediate with full averaging), except that the GT2 command causes the 8650A to wait for a GPIB GET command. When the GET command is received, it triggers a new series of readings; enough to update the digital filter for a noise free reading at the current power level. An ENTER statement will return the fully updated filter power level. After a GT2 command, the instrument is placed in the standby mode.

Example:	OUTPUT 713;GT2	! GROUP EXECUTE TRIGGER FULL MEASUREMENT WITH SETTLING

3.17 Measurement Collection Modes (Fast)

3.17.1 General

The 8650A offers three special fast measurement collection modes which are available only during remote operation over the GPIB. These fast modes make it possible to take more measurements per second, but at the cost of limited functionality compared to the standard measurement collection mode. The fast modes operate differently from the standard measurement collection mode in several important ways. The three fast modes are called Swift, Fast Buffered and Fast Modulated.

3.17.1.1 Sensor Measurements Supported

One restriction on the 8650A functionality in the fast modes is that it cannot perform comparative measurements (that is, measurements consisting of a comparison between the two sensors, such as A/B or A-B). However, when the 8650A operates in the Swift and Fast Buffered modes, it does have an added capability which is not otherwise available: measurements from both sensors can be returned to the host. In the Fast Modulated mode, only one sensor measurement can be performed and returned to the host.

3.17.1.2 Averaging

The averaging feature has a unique implementation in the Swift and Fast Buffered modes. Note that in standard measurement collection modes, and in the Fast Modulated modes, the averaging factor is taken to indicate the amount of filtering desired. Each measurement which is returned to the host is a true running average for a period of time which is derived from the averaging factor.

In the Swift and Fast Buffered modes, the averaging indicates the exact number of samples to be taken for each returned measurement, with the proviso that a minimum of four samples are taken (even if a number below four is requested).

☛ ***NOTE:*** *Four samples are also taken if auto averaging is selected. Each measurement returned to the host reflects all new data. Therefore, operation will be much faster with an averaging number of four than with a higher number.*

3.17.1.3 Disabled Features

The following features are disabled during operation in any of the three fast modes: over-range alert, limit checking, min/max power, relative measurements, peaking meter, analog output and $V_{PROP}F$ (voltage proportional to frequency) correction.

3.17.1.4 Measurement Changes

Other changes to the operation of the instrument during fast operation include the following: the temperature of the sensors is not read and updated, so the temperature correction will become inaccurate over time if the temperature of the sensor changes.

3.17.1.5 Warning Regarding Interruption & Reconfiguration

Another important consideration is that, while any of the three fast measurement modes is running, it should not be interrupted, and the measurement setup should not be changed. The measurement setup must be thoroughly configured before the command is sent to start the fast measurement mode. To reconfigure the instrument, or to zero a sensor, it is necessary to exit the fast mode and then restart it. If a measurement setup command is sent after a fast mode command, the results are undefined.

3.17.1.6 Fast Mode Setup

Prior to initiating a fast measurement collection mode, the host should select the measurement (i.e., AP or BP), select the measurement mode (i.e., CW, MAP, PAP, PEAK or BAP), define the frequency correction (via the FR or KB command, but not via the $V_{PROP}F$ function), define the offset (if any), define the averaging (via the FA or FM command), and define the duty cycle (if applicable). When a fast mode is initiated, the display will blank and a message will display indicating the fast mode selected.

3.17.2 Data Output Formats for Fast Modes

The data output formats for fast measurement collection are illustrated below. Fast mode data is always returned in units of dBm. Each A or B represents a single digit (0 to 9).

3.17.2.1 For the Swift Free-Run Mode

If one sensor is used, the format is:

±AAA.AA CR LF
±AAA.AA CR LF etc.
or:
±BBB.BB CR LF
±BBB.BB CR LF etc.

If two sensors are used, the format is:

±AAA.AA,±BBB.BB CR LF
±AAA.AA,±BBB.BB CR LF etc.

3.17.2.2 For The Swift Triggered & Fast Buffered Modes

If one sensor is used, the format is :

±AAA.AA, ±AAA.AA, etc. CR LF
or:
±BBB.BB, ±BBB.BB, etc. CR LF

If two sensors are used, the format is:

±AAA.AA, ±AAA.AA, etc. [until the specified number of readings has been sent]
±BBB.BB, ±BBB.BB, etc. [until the specified number of readings has been sent],
CR LF

3.17.2.3 For the Fast Modulated Mode

In this mode, only one sensor can be used; the format is:

±AAA.AA CR LF
±AAA.AA CR LF etc.
or:
±BBB.BB CR LF
±BBB.BB CR LF, etc.

☛ ***NOTE:*** *If BAP is unable to sync, 200.00 is added to the actual value in order to flag this error condition.*

3.17.3 Fast Buffered Mode

Fast Buffered Mode is a fast measurement collection mode, which makes it possible for a series of measurements to be taken and buffered rapidly, without external triggering of each measurement. The measurement collection can consist of a buffer-load of measurements taken after a trigger, or a buffer-load of measurements taken prior to a trigger (that is, the trigger marks the beginning or the end of the measurement period, depending on the option selected). This mode also makes it possible to buffer a very large number of data points. For the sake of speed, no chopped measurements are taken in the fast buffered mode.

The fast buffered mode cannot be entered if a modulated measurement (MAP, PAP or BAP) is being performed.

Commands related to the fast buffered mode are based on the FBUF command. (For the sake of backward compatibility with earlier Giga-tronics power meter designs, the command BURST is accepted as a substitute for FBUF. However, this command has nothing to do with the burst average power measurement mode; it is a vestige of the terminology applicable to previous models). For the FBUF commands, the command format is:

Syntax:	FBUF [PRE or POST] [GET or TTL] BUFFER [b] TIME [t]
	[PRE or POST] define the relationship between the measurement period and the trigger: [PRE] the trigger marks the end of the measurement period. The 8650A will continuously take measurements and buffer them until a trigger is received. At that point, it will stop collecting data and output all of the previously collected data in a continuous data stream the next time it is addressed to talk [POST] the trigger marks the beginning of the measurement period. The 8650A will wait for a trigger before taking and buffering the measurements. After the requested number of measurement have been taken and buffered, it will be ready to output all of the data in a continuous stream the next time it is addressed to talk. If the GPIB GET command is specified as the trigger, the 8650A will assert a service request at this time [GET or TTL] define the trigger [GET] the expected trigger is a GPIB GET command [TTL] the expected trigger is a TTL high at the rear panel trigger input The buffer value (numeric variable [b]) specifies the number of measurements to be taken and stored in the buffer. The minimum value is one. The maximum value is 5,000 The time value (numeric variable [t]) is an optional variable which specifies a fixed delay between measurements. The time value specifies the time (in ms) to wait between measurements; the minimum value is zero. The maximum value is 5000 ms (five seconds)

NOTE: *This delay is in addition to the relatively short time it takes to perform each measurement. If no time value is specified, [t] is assumed to be zero, and the measurements are taken as fast as possible.*

Example:	OUTPUT 713;FBUF PRE GET BUFFER 200	! TAKE MEASUREMENTS (AS FAST AS POSSIBLE) ! UNTIL GET IS RECEIVED ! THEN OUTPUT THE LAST 200 MEASUREMENTS ! TAKEN
Example 2:	OUTPUT 713;FBUF POST TTL BUFFER 100 TIME 2	! WAIT FOR A TTL TRIGGER, THEN TAKE READINGS ! AT INTERVALS OF 2 MS ! UNTIL A TOTAL OF 100 MEASUREMENTS HAVE ! BEEN TAKEN

Two simpler commands are also based on the FBUF function code:

Syntax:	FBUF [DUMP or OFF]	
	[DUMP] stops the data measurement and buffering, and prepares to return the data taken so far to the host, even if fewer than the requested number of measurements have been taken. The requested number of measurements are still returned to the host (the extra measurements beyond those actually taken are represented by the number -300.00) [OFF] causes the 8650A to exit the fast buffered mode. All unread data is lost	
Example:	OUTPUT 713;FBUF DUMP	! STOP MEASUREMENT AND BUFFERING
Example 2:	OUTPUT 713;FBUF OFF	! EXIT THE FAST BUFFERED MODE

3.17.3.1 Fast Buffered Mode Speed Notes

The fast buffered mode is the fastest method of collecting measurement data. Top speed in the fast buffered mode is achieved by using a low averaging number (≤4), the POST trigger mode, and no time delay between measurements.

The POST trigger mode is faster than the PRE trigger mode because in the latter mode the 8650A must check for a trigger between each measurement. In the POST mode, the 8650A is in freerun operation after the trigger is received.

After issuing the Fast Buffered command, allow for the 8650A to set up in Fast Buffered mode before issuing a TTL or GET (Group Executable Trigger). Typical delay may vary from 200 msec to 500 msec based on the number of samples to be collected.

3.17.4 Swift Mode

Swift mode is a fast mode which allows for fast continuous data taking and return of each measurement to the host as it is taken (the freerun mode). Swift mode also allows for triggered buffered measurements, in which a host or external trigger indicates when to take each measurement.

The swift mode cannot be entered if a modulated measurement (MAP, PAP or BAP) is being performed.

Commands related to the swift mode are based on the SWIFT function code:

Syntax:	SWIFT [FREERUN or OFF]	
	[FREERUN] initiates the freerun mode (continuous taking and returning of measurements) [OFF] causes the 8650A to exit the swift mode; all unread data is lost	
Example:	OUTPUT 713;SWIFT FREERUN	! INITIATE SWIFT FREERUN MODE
Example 2:	OUTPUT 713;SWIFT OFF	! EXIT THE SWIFT MODE

For commands which set up triggered measurements, the command format is:

Syntax:	SWIFT [GET or TTL] BUFFER [b]	
	[GET or TTL] define the trigger: [GET] the expected trigger is a GPIB GET command. The 8650A signals the host by asserting SRQ every time it is ready to take a measurement [TTL] the expected trigger is a TTL high at the rear panel trigger input BUFFER (followed by the numeric variable [b]) specifies the number of measurements to be taken and stored in the buffer. The minimum value is one. The maximum value is 5000	
Example:	OUTPUT 713;SWIFT GET BUFFER 200	! TAKE MEASUREMENTS UNTIL GET IS RECEIVED ! THEN OUTPUT THE LAST 200 MEASUREMENTS ! TAKEN
Example 2:	OUTPUT 713;SWIFT TTL BUFFER 200	! WAIT FOR A TTL TRIGGER, THEN TAKE 100 ! MEASUREMENTS

3.17.4.1 Example Programs

The following program can measure, buffer and print 30 readings on one sensor:

```
REAL Data(30)7
Example:  OUTPUT 713;SWIFT GET BUFFER 30WAIT 0.5
                                                    ! wait for instrument configuration

FOR I=1 to 30
      Srq_flag=0
! wait for ready condition
      TRIGGER 713
! trigger measurement
WHILE Srq_flag=0
      Srq_flag=SPOLL(713)
      END WHILE
NEXT I
      ENTER 713;Data(*)
      FOR I=1 TO 30
      PRINT I,Data(I)
NEXT I
```

☛ ***NOTE:*** *For a computer that does not support matrix reads, read the entire buffer into a string and parse the data. Multiple ENTER commands will not work.*

The following program can be used to perform 20 measurements on two sensors in swift freerun mode:

```
OUTPUT 713;APBP
OUTPUT 713;SWIFT FREERUN
WAIT 0.5
FOR I=1 to 20
      ENTER 713;ReadA,ReadB
      PRINT ReadA,ReadB
NEXT I
OUTPUT 713;SWIFT OFF
```

The following program can be used to measure, buffer, and print 30 readings on each of two sensors:

```
REAL DataA(30),DataB(30)
OUTPUT 713;SWIFT GET BUFFER 30
WAIT 0.5
FOR I=1 to 30
      srq_flag=0
      TRIGGER 713                          ! send group execute trigger
WHILE srq_flag=0
      srq_flag=SPOLL (713)
      END WHILE
NEXT I
ENTER 713;DataA(*),DataB(*)                ! read the buffer
FOR I=1 to 30
      PRINT I,DataA(I),DataB(I)
NEXT I
```

3.17.5 Fast Modulated Mode

This is a fast mode which permits more frequent return of measurement data to the host, during operation in the modulated measurement modes (MAP, PAP or BAP). The commands which activate or deactivate this mode are based on the FMOD function code:

Syntax:	FMOD [ON | OFF]	
	[ON | OFF] enables or disables the fast modulated mode When the fast modulated mode is enabled, data will be taken and returned continuously. This is analogous to the swift freerun mode The fast modulated mode cannot be initiated unless a modulated measurement (MAP, PAP or BAP) is being performed	
Example:	OUTPUT 713;FMOD ON	! ENABLES FAST MODULATED MODE
Example 2:	OUTPUT 713;FMOD OFF	! DISABLES FAST MODULATED MODE

3.18 Measurement Mode Commands

3.18.1 CW Mode

Commands which specify the CW measurement mode are based on the CW function code:

Syntax:	CW [A or B]
	[AE or BE] specifies Sensor A or Sensor B

These commands can be used with any sensor (although it is superfluous in the case of a CW sensor). Possible GPIB entry errors: 60 (uncalibrated sensor), 61 (missing sensor). Refer to Table 3-18 for error numbers.

Example:	OUTPUT 713;CW A	! SELECTS CW MODE FOR SENSOR A
Example 2:	OUTPUT 713;CW B	! SELECTS CW MODE FOR SENSOR B

3.18.2 MAP Mode

Commands which specify the modulated average power measurement mode are based on the MAP function code:

Syntax:	MAP [A or B]
	[AE or BE] specifies Sensor A or Sensor B

These commands will work only with a modulated sensor. Possible GPIB entry errors: 60/61 (uncalibrated or missing sensor A/B), 62/63 (not a modulated sensor, or two sensor operation active, A/B). Refer to Table 3-18 for error numbers.

Example:	OUTPUT 713;MAP A	! SELECTS MAP MODE FOR SENSOR A
Example 2:	OUTPUT 713;MAP B	! SELECTS MAP MODE FOR SENSOR B

If an irregularly modulated signal is measured in MAP mode, measurement settling time will vary as the power meter attempts to synchronize to the modulation. In such a situation, it may be desirable to disable synchronization for faster measurement. The commands which disable synchronization are based on the MAP function code.

Syntax:	MAP [A or B] 0
	[AE or BE] specifies Sensor A or Sensor B 0 specifies that synchronization is to be disabled

Example:	OUTPUT 713;MAP A 0	! DISABLES MAP MODE SYNCHRONIZATION FOR SENSOR A
Example 2:	OUTPUT 713;MAP B 0	! DISABLES MAP MODE SYNCHRONIZATION FOR SENSOR B

☛ ***NOTE:*** *To reactivate synchronization, send the MAP A or MAP B command again.*

3.18.3 PAP Mode

Commands which specify the pulse average power measurement mode are based on the PAP function code:

Syntax:	PAP [A or B]
	[A or B] specifies Sensor A or Sensor B

These commands will work only with a modulated sensor. Possible GPIB entry errors: 60/61 (uncalibrated or missing sensor A/B), 62/63 (not a modulated sensor, or two sensor operation active, A/B). Refer to Table 3-18 for error numbers.

Example:	OUTPUT 713;PAP A	! SELECTS PAP MODE FOR SENSOR A
Example 2:	OUTPUT 713;PAP B	! SELECTS PAP MODE FOR SENSOR B

3.18.4 BAP Mode

Commands which specify the burst average power measurement mode are based on the BAP function code:

Syntax:	BAP [A or B]
	[A or BE] specifies Sensor A or Sensor B

These commands will work only with a modulated sensor. Possible GPIB entry errors: 60/61 (uncalibrated or missing sensor A/B), 62/63 (not a modulated sensor, or two sensor operation active, A/B). Refer to Table 3-18 for error numbers.

Example:	OUTPUT 713;BAP A	! SELECTS BAP MODE FOR SENSOR A
Example 2:	OUTPUT 713;BAP B	! SELECTS BAP MODE FOR SENSORB

3.18.5 Peak Mode

The commands for Peak mode are discussed under separate headings for the 80350A sensors (See Section 3.19.8).

3.18.6 Measurement Mode Query

It is possible to query the 8650A over the bus to determine what measurement mode has been selected for a particular sensor. The 8650A will respond to a measurement mode query by returning one of the following strings to the controller:

NO SENSOR
UNCAL
CW
MAP (or MAP SYNC OFF)[1]
PAP
PEAK
BAP (or BAP *a b c*)[2]

Measurement mode query commands are based on the MEAS function code.

Notes:

1. MAP SYNC OFF will be returned if MAP mode synchronization has been disabled.
2. BAP *a b c* will be returned if any of the advanced features have been enabled. In this message, *a* represents the burst start exclude time in ms, *b* represents the burst end exclude time in ms, and *c* represents burst dropout time in ms. The value ranges are 0.000 ≤ a ≤ 45.548; 0.000 ≤ b ≤ 31.949;0.000 ≤ c ≤ 3.747.

Syntax:	MEAS [A? or B?]	
	[A? or B?] specifies Sensor A or Sensor B	
Example:	OUTPUT 713;MEAS A?	! QUERIES THE MEASUREMENT MODE SETTING FOR SENSOR A
Example 2:	OUTPUT 713;MEAS B?	! QUERIES THE MEASUREMENT MODE SETTING FOR SENSOR B

3.19 Advanced Features

3.19.1 Burst Start Exclude

Commands which cause the beginning of a burst to be excluded from measurement are based on the BSTE function code (this feature is available only in the BAP mode):

Syntax:	[AE or BE] BSTE [a] EN	
	[AE or BE] prefix specifies Sensor A or Sensor B [a] specifies the number of 0.027 ms samples to be excluded; it has an integer value in the range of 0 to 1686 with 1686 samples corresponding to 45.519 ms. The command is ignored for [a] values that are out of acceptable range	
Example:	OUTPUT 713;AE BSTE 1 EN	! EXCLUDES ONE SAMPLE = 0.027 MS FROM START OF BURST, FOR BAP ! MEASUREMENTS ON SENSOR A
Example 2:	OUTPUT 713;BE BSTE 3 EN	! EXCLUDES THREE SAMPLES = 0.081 MS FROM START OF BURST, FOR BAP ! MEASUREMENTS ON SENSOR B

3.19.2 Burst End Exclude

Commands which cause the end of a burst to be excluded from measurement are based on the BSPE function code (this feature is available only in BAP mode):

Syntax:	[AE or BE] BSPE [a] EN	
	[AE or BE] prefix specifies Sensor A or Sensor B [a] specifies the number of 0.027 ms samples to be excluded; it has an integer value in the range of 0 to 1183 (1183 samples correspond to 31.936 ms) when burst dropout time is 0.000 ms. For non-zero values of burst dropout time, the maximum value of end exclude time is limited to 3.396 ms minus the burst dropout time setting. The command is ignored for [a] values that are out of acceptable range	
Example:	OUTPUT 713;AE BSPE 1 EN	! EXCLUDES ONE SAMPLE = 0.027 MS FROM END OF BURST, FOR BAP ! MEASUREMENTS ON SENSOR A
Example 2:	OUTPUT 713;BE BSPE 3 EN	! EXCLUDES THREE SAMPLES = 0.081 MS FROM END OF BURST, FOR BAP ! MEASUREMENTS ON SENSOR B

3.19.3 Burst Dropout Tolerance

Commands which define a tolerated burst dropout time are based on the BTDP function code (this feature is available only in BAP mode):

Syntax:	[AE or BE] BTDP [a] EN	
	[AE or BE] prefix specifies Sensor A or Sensor B [a] specifies the dropout time in milliseconds with a range of 0 to 3.346 when the burst end exclude time is 0.000 ms. The value entered will be rounded to the nearest multiple of 0.027 ms. For non-zero values of end exclude time, the maximum value of burst dropout time is limited to 3.396 ms minus the end exclude time. The command is ignored for [a] values that are out of acceptable range. The actual value can be checked by means of a MEAS query. The dropout time represents a guaranteed minimum time; the time actually tolerated will usually be greater, and can be up to 2.125 times greater. (Note: Selecting a value of zero effectively disables this function)	
Example:	OUTPUT 713;AE BTDP .02 EN	! SETS DROPOUT TIME TO 0.02 MS OR NEAREST (=0.027 MS) DISCRETE ! VALUE, FOR BAP MEASUREMENTS ON SENSOR A
Example 2:	OUTPUT 713;BE BTDP .06 EN	! SETS DROPOUT TIME TO 0.06 MS OR NEAREST (=0.054 MS) DISCRETE ! DISCRETE VALUE, FOR BAP MEASUREMENTS ON SENSOR B

3.19.4 Min/Max Power Value

The Min/Max feature monitors the measurements being taken, and maintains a continuously updated record of the highest and lowest values measured so far.

☛ ***NOTE:*** *The Min/Max feature can only be used in the standard measurement collections modes (not in the fast modes).*

3.19.4.1 Enabling the Min/Max Feature

☛ ***NOTE:*** *These commands must be preceded by CH [n] EN command.*

The Min/Max feature is enabled or disabled by simple commands consisting of one of two function codes:

Syntax:	[MN0 or MN1]	
	[AE or BE] prefix specifies Sensor A or Sensor B	
Example:	OUTPUT 713;MN	! ENABLES THE MIN/MAX FEATURE
Example 2:	OUTPUT 713;MN0	! DISABLES THE MIN/MAX FEATURE

The MN1 command, like the LG command, has the effect of specifying logarithmic measurement units (dB or dBm). Like the PH0 and CR0 commands, this command will disable crest factor and peak hold measurements.

3.19.4.2 Reading the Min/Max Values

Min/Max values are read over the bus using simple commands consisting of one of two function codes:

Syntax:	[MIN or MAX]	
	MIN specifies that the current minimum measured value should be sent MAX specifies that the current maximum value should be sent	
Example:	OUTPUT 713;MIN	! SENDS THE MINIMUM MEASURED VALUE
Example 2:	OUTPUT 713;MAX	! SENDS THE MAXIMUM MEASURED VALUE

The Min/Max feature monitors the minimum and maximum powers as they are measured and displayed on the front panel. Transient drop-outs or spikes in the power may not be captured by this feature. If it is necessary to examine transient or unusual events, the triggering capability of the peak power sensor, the fast measurement modes, or the Peak Hold feature may provide a better way to characterize the signal in question. The Min/Max feature monitors for the minimum and maximum power, but does not provide any feedback to the controller until a MIN or MAX command is received. To monitor for a limit violation, the Limits feature may be more useful (See Section 3.15).

The Min/Max feature returns the current Min/Max values as displayed on the front panel. A Min or Max commands does not initiate data collection in same manner as a trigger command, such as TR1. To get a good reading of Min/Max values, the procedure is:

1. Set up the signal being measured, and send MN1 to reset the Min/Max measurements.
2. Send TR2.
3. Read the TR2 data, or wait for the data ready service request (this allows for settling).
4. Send MIN or MAX.
5. Read the Min or Max value.

3.19.5 Offset Commands

Power offsets (in dB) can be specified, in order to provide a fixed correction for loss or gain in the test setup. The offset is added to, not a replacement of, the sensor's cal factors. All measurement data returned by the 8650A over the bus is corrected for the offset that has been specified (even in the fast measurement collection modes).

Be careful with offsets when using the analog outputs. The offset value is reflected in the analog output voltage. A change in the offset value may result in a measurement which is outside of the power range represented by the voltage range of the analog output.

3.19.5.1 Enabling/Disabling an Offset

The commands which enable and disable the offset function are based on the function codes OF0 and OF1:

Syntax:	[AE or BE] [OF0 or OF1]	
	[AE or BE] prefix specifies Sensor A or Sensor B [OF0] deactivates the offset; [OF1] activates the offset	
Example:	OUTPUT 713;AE OF0	! DISABLES OFFSET FOR SENSOR A
Example 2:	OUTPUT 713;BE OF1	! ENABLES OFFSET FOR SENSOR B

3.19.5.2 Setting an Offset Value

The commands which specify the offset value are based on the OS function code:

Syntax:	[AE or BE] OS [*n*] EN	
	[AE or BE] specifies Sensor A or Sensor B [OS] indicates that an offset is being specified for the sensor [*n*] specifies the offset in dB. The value of *n* can range from -99.999 dB to +99.999. A terminating suffix (EN) is required	
Example:	OUTPUT 713;AE OS 20.00 EN	! SETS +20 DB OFFSET FOR SENSOR A
Example 2:	OUTPUT 713;BE OS -15.12 EN	! SETS -15.12 DB OFFSET FOR SENSOR B

☛ ***NOTE:*** *A change to the offset of a sensor will reset any Peak Hold or Crest Factor measurement involving that sensor.*

3.19.6 Measured Offset Entry

A measurement can be saved and used as an offset. The command format for this purpose is:

Syntax:	[AP, BP, AR, BR, AD, or BD] OS DO EN	
	The command begins with a function code which describes the measurement that is to be stored as an offset value. There are six possible function codes; they are interpreted as follows: AP:A BP:B AR:A/B BR:B/A AD:A-B BD:B-A OS followed by DO indicates that the difference between the current offset and the current value of the measurement described in the prefix, is to be saved as an offset value A terminating suffix (EN) is required	
Example:	OUTPUT 713;AP OS DO EN	! SAVES MEASUREMENT A AS AN OFFSET
Example 2:	OUTPUT 713;BP OS DO EN	! SAVES MEASUREMENT B AS AN OFFSET
Example 3:	OUTPUT 713;AR OS DO EN	! SAVES MEASUREMENT A/B AS AN OFFSET
Example 4:	OUTPUT 713;BR OS DO EN	! SAVES MEASUREMENT B/A AS AN OFFSET
Example 5:	OUTPUT 713;AD OS DO EN	! SAVES MEASUREMENT A-B AS AN OFFSET
Example 6:	OUTPUT 713;BD OS DO EN	! SAVES MEASUREMENT B-A AS AN OFFSET

3.19.7 Peak Hold

The Peak Hold feature causes the measured value to hold at the highest instantaneous power measured from the time the feature is enabled until it is reset (the measured value changes only when it is rising to a new maximum, or when it is reset).

When the Peak Hold feature is selected, the minimum average power level that can be accurately measured is -20 dBm. Beginning in firmware version 1.51, this has been implemented to increase accuracy and maintain wide bandwidth of Peak Hold measurement over the peak power range of -20 dBm to +20 dBm. The Peak Hold selection will also affect Histogram measurement if there is power below -20 dBm. To obtain accurate average power measurements below -20 dBm, the Peak Hold feature should be disabled.

The Peak Hold feature can only be used in the standard measurement collections modes (not in the fast modes), and only in a modulated measurement mode (MAP, PAP or BAP). *Peak Hold is not recommended for use in combination with the $V_{PROP}F$ function.*

3.19.7.1 Enabling the Peak Hold Feature

The Peak Hold feature is enabled or disabled by simple commands consisting of one of two function codes:

Syntax:	[AE or BE] [PH0 or PH1]	
	[AE or BE] prefix specifies Sensor A or Sensor B [OF0] deactivates the offset; [OF1] activates the offset	
Example:	OUTPUT 713;AE PH1	! ENABLES THE PEAK HOLD FEATURE FOR SENSOR A
Example 2:	OUTPUT 713;BE PH0	! DISABLES THE PEAK HOLD FEATURE FOR SENSOR B
Description:	Like the MN0 and CR0 commands, The PH0 command will disable Crest Factor and Min/Max measurements. Sending the PH1 command after Peak Hold is enabled will reset it. Peak Hold will also reset when sending a CR1 command (See Section 3.8).	

3.19.7.2 Reading the Peak Hold Value

The Peak Hold value is read over the bus using a simple command:

Syntax:	[AE or BE] PKH	
Example:	OUTPUT 713;AE PKH	! SENDS THE PEAK HOLD VALUE FOR SENSOR A
Description:	The Peak Hold feature monitors the maximum power as it is measured, but does not provide any feedback to the controller until a PKH command is received. To monitor for a limit violation, the Limits feature may be more useful (See Section 3.15).	

The Peak Hold feature returns the current held value as displayed on the front panel. A PKH command does not initiate data collection in same manner as a trigger command, such as TR1. To get a good reading of the Peak Hold value, the procedure is:

1. Set up the signal being measured, and send PH1 to reset the Peak Hold measurement.
2. Send TR2.
3. Read the TR2 data, or wait for the data ready service request (this allows for settling).
4. Send PKH.
5. Read the Peak Hold value.

3.19.8 Peak Power Sensor Commands

Commands related to the peak power sensor are based on the function code PEAK (for the sake of backward compatibility with earlier Giga-tronics power meter designs, the command PULSE is accepted as a substitute for PEAK).

3.19.8.1 Series 80350A Sensors SENS

The command format for setting trigger modes and levels is:

Syntax:	PEAK [A or B] [INT or EXT] TRIG [*n*]	
	A or B specifies Sensor A or Sensor B [INT or EXT] specifies internal or external triggering TRIG indicates that a trigger level is being set [*n*] specifies the trigger level in units of dBm in the case of internal triggering, or volts in the case of external triggering	
Example:	OUTPUT 713:PEAK A INT TRIG -10.00	! CONFIGURES SENSOR A FOR INTERNAL TRIGGERING AT ! A TRIGGER LEVEL OF -10.00 DBM
Example 2:	OUTPUT 713:PEAK B EXT TRIG 1.50	! CONFIGURES SENSOR B FOR EXTERNAL TRIGGERING ! AT A TRIGGER LEVEL OF 1.50 VDC

The command format for selecting the CW mode is:

Syntax:	PEAK [A or B] CW	
	[A or B] specifies Sensor A or Sensor B CW specifies the CW mode	
Example:	OUTPUT 713:PEAK A CW	! CONFIGURES SENSOR A FOR CW MEASUREMENTS

A delay between the trigger and the actual measurement can be specified (in the CW mode, delay settings have no effect). The command format for setting the delay is:

Syntax:	PEAK [A or B] DELAY [*n*]	
	[A or B] specifies Sensor A or Sensor B DELAY indicates that a delay value is being set [*n*] is a numerical variable which specifies the delay in seconds. It has a range of -20E-9 (-20 ns) to 104E-3 (104 ms)	
Example:	OUTPUT 713;PEAK A DELAY 1.20E-6	! CONFIGURES SENSOR A FOR A DELAY OF 120 MS
Example 2:	OUTPUT 713;PEAK B DELAY 33.5E-9	! CONFIGURES SENSOR B FOR A DELAY OF 33.5 NS

☛ ***NOTE:*** *The actual duration of the delay is the sum of this setting and the delay offset setting.*

An offset to the trigger delay can be specified (in the CW mode, delay settings have no effect). The command format for setting the delay offset is:

Syntax:	PEAK [A or B] OFFSET [*n*]	
	[A or B] specifies Sensor A or Sensor B OFFSET indicates that a delay offset value is being set [*n*] is a numerical variable which specifies the offset in seconds. It has a range of -20E-9 (-20 ns) to 104E-3 (104 ms). The default value of the offset is 0	
Example:	OUTPUT 713;PEAK A OFFSET 1.20E-6	! CONFIGURES SENSOR A FOR A DELAY OFFSET OF ! 120 μs

3.19.8.2 Reading Values

Trigger

The query format for trigger settings is:

Syntax:	PEAK [A or B]	
	[A or B] Sensor A or Sensor B	
Example:	OUTPUT 713;PEAK A	! QUERIES THE CURRENT SENSOR A TRIGGER SETTING
Example 2:	OUTPUT 713;TRIG$	! ENTERS THE RETURNED STRING INTO THE STRING VARIABLE TRIG

The possible replies to the query are CW, INT_TRIG and EXT_TRIG.

Delay & Delay Offset

The query format for delay and delay offset settings is:

Syntax:	PEAK [A or B] [DELAY? or OFFSET?]	
	[A or B] specifies Sensor A or sensor B [DELAY?] indicates that delay is being queried [OFFSET?] indicates that delay offset is being queried	
Example:	OUTPUT 713;PEAK A DELAY?	! QUERIES THE CURRENT DELAY SETTING FOR SENSOR A
Example 2:	ENTER 713;DELAY	! ENTERS THE RETURNED NUMBER INTO THE VARIABLE DELAY
Example 3:	OUTPUT 713;PEAK B OFFSET?	! QUERIES THE CURRENT DELAY OFFSET SETTING FOR SENSOR B
Example 4:	ENTER 713;OFFSET	! ENTERS THE RETURNED NUMBER INTO THE VARIABLE OFFSET

3.19.9 Preset

The PR command resets the 8650A to its default settings, leaving the user settings intact as *Previous Settings* if they were different from the default settings. This command does not function while in the SWIFT, FMOD or CM modes.

Alternatively, the IEEE 488.2 command *RST also resets the 8650A to its default settings, and functions in the SWIFT, FMOD and CM modes. These modes must be re-entered either over the GPIB or from the front panel.

The preset conditions of the instrument are outlined in Table 3-15.

Table 3-15: Preset (Default) Conditions

Sensors (All parameters apply to sensor A & sensor B)		**General**	
Parameter	**Condition**	**Parameter**	**Condition**
Cal Factor	100.0%	Sensor Selection	Sensor A
Offset	0.00 dB	Calibrator	Off
Filter	AUTO	Default Sensor Prefix	Sensor A
Range	AUTO	Resolution	2 (0.01 dB)
Low Limit	0.000 dBm	Limits Checking	Off
High Limit	0.000 dBm	Max/Min	Off
Frequency	50 MHz	REL	Off
Duty Cycle	OFF, 1.000%	Trigger Mode	TR3
Measurement Mode	See Note 1	Group Execute Trigger Mode	GT2
		Display Function	Display Enable
		Peaking Meter Mode	Status
		Pulse Sensor Mode	Internal Trigger
		Measurement Units	See Note 2
		Sound	On
		Analog Output	Off

Notes:

1. The default measurement mode depends on the sensor type. For a CW sensor, the default is CW. For a modulation sensor, the default is MAP. For a peak sensor, the default is INT TRIG. Regardless of the sensor type, all advanced features are turned off.
2. There is a slight difference between the preset conditions as set by a remote command, and as set from the front panel menus. This difference has to do with measurement units. If the 8650A is preset from the front panel, this sets the measurement units to dBm in all cases. If the 8650A is preset over the bus, this sets the measurement units to Watts in the case of HP438 emulation, and has no effect at all in the case of HP436 emulation; otherwise, it sets the measurement units to dBm.

   This distinction is made to accommodate differences between emulations for remote programming purposes without affecting the benchtop user.

3.19.10 Relative Measurements

In the relative measurement mode, the 8650A saves the current measured power level as a reference. Subsequent measurements will be expressed relative to this reference level; the measurement units become dBr (for logarithmic measurement) or % (for linear measurement).

☛ ***NOTE:*** *These commands must be preceded by the CH [n] EN command.*

The simple commands associated with relative measurement modes consist of one of three function codes:

Syntax:	[AE or BE] RL0 or RL1 or RL2	
	[RL0] deactivates the relative measurement mode [RL1] activates the relative mode, and causes the current measured level to be recorded as the reference level [RL2] activates the relative mode and causes the reference level that was saved under a prior RL1 command to be used as the reference level. That is, if the relative mode is activated by an RL1 command, and then deactivated by an RL0 command, the effect of RL2 is to restore the reference level that was saved in response to the RL1 command	
Example:	OUTPUT 713;AE RL0	! DISABLES THE RELATIVE MODE FOR SENSOR A
Example 2:	OUTPUT 713;BE RL1	! ENABLES THE RELATIVE MODE FOR SENSOR B ! SAVES THE CURRENT LEVEL AS A REFERENCE
Example 3:	OUTPUT 713; BE RL2	! REPLACE THE CURRENT REFERENCE LEVEL FOR SENSOR B ! WITH THE PREVIOUS LEVEL

3.19.11 Resolution

☛ ***NOTE:*** *These commands must be preceded by CH [n] EN command.*

Commands which specify measurement resolution are based on the function code RE. The command format is:

Syntax:	RE [a] EN	
	RE indicates that resolution is being set [a] indicates the resolution with four values allowed (0, 1, 2 and 3). These specify the number of digits to the right of the decimal point A terminating suffix (EN) is required	
Example:	OUTPUT 713;RE 0 EN	! SETS THE DISPLAY RESOLUTION TO XX.
Example 2:	OUTPUT 713;RE 1 EN	! SETS THE DISPLAY RESOLUTION TO XX.X
Example 3:	OUTPUT 713;RE 2 EN	! SETS THE DISPLAY RESOLUTION TO XX.XX
Example 4:	OUTPUT 713;RE 3 EN	! SETS THE DISPLAY RESOLUTION TO XX.XXX

3.19.12 Sensor Selection

Six simple commands (consisting of one of six function codes) specify how the sensors are used:

Syntax:	[AP BP AR BR AD BD]	
Example:	OUTPUT 713;AP	! MEASURES SENSOR A
Example 2:	OUTPUT 713;BP	! MEASURES SENSOR B
Example 3:	OUTPUT 713;AR	! MEASURES A DIVIDED BY B
Example 4:	OUTPUT 713;BR	! MEASURES B DIVIDED BY A
Example 5:	OUTPUT 713;AD	! MEASURES A LESS B
Example 6:	OUTPUT 713;BD	! MEASURES B LESS A

These commands, like the prefixes AE and BE, are sensor-specific, and cause the 8650A to assume that subsequent commands are intended for the same sensor unless they specify otherwise. Also, these commands (like the MN0, CR0 and PH0 command) have the effect of disabling Min/Max monitoring, Crest Factor and Peak Hold.

3.19.13 Status

3.19.13.1 Status Byte Message

The power meter responds to a Serial Poll Enable (SPE) bus command by sending an 8-bit byte when addressed to talk. If the instrument is holding the SRQ bus control line true (issuing the Require Service message), bit position 6 in the Status Byte and the bit representing the condition causing the Require Service message to be issued will both be true. The bits in the Status Byte are latched, but can be cleared by sending the Clear Status (CS) program code.

Table 3-16: Status Byte & Service Request Mark

Bit	Weight	Service Request Condition
7	128	Over/Under Limit
6	64	RQS bit Require Service
5	32	Event Status
4	16	MAV
3	8	Measurement or Cal Zero Error
2	4	Entry Error
1	2	Cal/Zero Complete
0	1	Data Ready

The condition indicated in Bits 1-5 must be enabled by the Service Request Mask to cause a Service Request Condition. The mask is set with the @1 program code followed by an 8-bit byte, or the *SRE program code followed by three ASCII characters. The value of the byte is determined by summing the weight of each bit to be checked (the three ASCII characters are the value of the byte in decimal). The RQS (bit 6) is true when any of the conditions of bits 1-5 are enabled and occur. Bits remain set until the Status Byte is cleared.

OUTPUT 713;CS	! CLEARS SRQ AND STATUS BYTE
or	
OUTPUT 713;*CLS	! CLEARS SRQ AND STATUS BYTE (488.2)
STATE = SPOLL(713)	! READS STATUS BYTE
or	
OUTPUT 713;*STB?	! ASKS FOR STATUS BYTE (488.2)
ENTER 713;STATE	! READS STATUS BYTE WITH 3 ASCII DIGIT NUMBERS
OUTPUT 713;@1;CHR$(4)	! SETS SERVICE REQUEST MASK TO 4
or	
OUTPUT 713;*SRE004	! SETS SERVICE REQUEST MASK TO 4
OUTPUT 713;RV	! ASKS FOR SERVICE REQUEST MASK
or	
OUTPUT 713;*SRE?	! ASKS FOR SERVICE REQUEST MASK (488.2)

3.19.13.2 Event Status Register

The Event Status Register (ESR) is essentially a second status byte; it is an 8-bit byte, described in the table below. When a specified event occurs, the ESR bits are set true; they can be read by sending an *ESR? command. When the command is received, the 8650A responds by sending an ASCII 3 digit value (from 0 to 255) that describes the present state of the register. This ASCII value is arrived at by summing the weighted values of the transmitted bits.

The ESR bits consist of the following:

Power On	This bit will always be set.
Command Error	This bit is set when an improper GPIB code is sent to the instrument. The command WT would be considered a command error, for example.
Execution Error	When incorrect data is sent to the instrument, this bit will be set. For example, the command FR-1.0MZ would be considered an execution error.
Device Dependent Error	Errors 1 through 49 are measurement errors, and will set this bit true whenever they occur.

If an ESR bit is set true, this causes bit 5 of the Status Byte to be set only when a corresponding bit in the Event Status Enable Register is enabled. This register is similar to the Service Request Mask, in that it can be used to specify which bits in the ESR register will set bit 5 of the Status Byte.

The Event Status Enable Register is set by sending the program code *ESE, followed by an ASCII 3 digit value (the value is determined by summing the weights of the bits to be checked). To read the current setting of the Event Status Register, send the command *ESE?. The 8650A sends an ASCII 3 digit value that describes the current state of the register (the value is determined by summing the weights of the bits that are set).

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Power On	0	Command Error	Execution Error	Device Dependent Error	0	0	0

3.19.13.3 Status Message

Example:	OUTPUT 713;SM	! ASKS FOR STATUS MESSAGE
Example 2:	ENTER 713;STATUSMESS$	! READS STATUS MESSAGE

3.19.13.4 Status Message Output Format

The output format is as follows:

AAaaBBCCccDDddEFGHIJKLMNOP<CR><LF>

AA	Measurement Error Code
aa	Entry Error Code
BB	Operating Mode
CC	Sensor A Range
cc	Sensor B Range
DD	Sensor A Filter
dd	Sensor B Filter
E	Measurement Units
F	Active Entry Channel
G	Oscillator Status
H	REL Mode Status
I	Trigger Mode
J	Group Trigger Mode
K	Limits Checking Status
L	Limits Status
M	NA
N	Offset Status
O	Duty Cycle Units/Status
P	Measurement Units
<CR>	Carriage Return
<LF>	Line Feed

Each letter in the Status Message Output Format denotes a single ASCII character. See the list of codes in Tables 3-17 through 3-19 on the following pages for expanded definitions of the individual elements in this format.

Table 3-17: Error Code Returned in Position AA

Error Code	Message	Notes
00	All OK	
01	Cannot zero sensor A	Ensure no RF power to sensor A
02	Cannot zero sensor B	Ensure no RF power to sensor B
03	Sensor A not connected to Calibrator	Connect sensor A to Calibrator
04	Sensor B not connected to Calibrator	Connect sensor B to Calibrator
05	Cannot Cal Sensor A	Check sensor A connection to Calibrator; reference must be 1.00 mW
06	Cannot Cal sensor B	Check sensor B connection to Calibrator; reference must be 1.00 mW
21	Over limit	An over-limit condition has occurred
23	Under limit	An under-limit condition has occurred
26	Sensor A unable to synchronize burst average power measurements to a pulse stream	Check measurement setup and RF signal
27	Sensor B unable to synchronize burst average power measurements to a pulse stream	Check measurement setup and RF signal
31	No sensor on Channel A	Connect sensor A, or change channels if B is connected
32	No sensor on Channel B	Connect sensor B, or change channels if A is connected