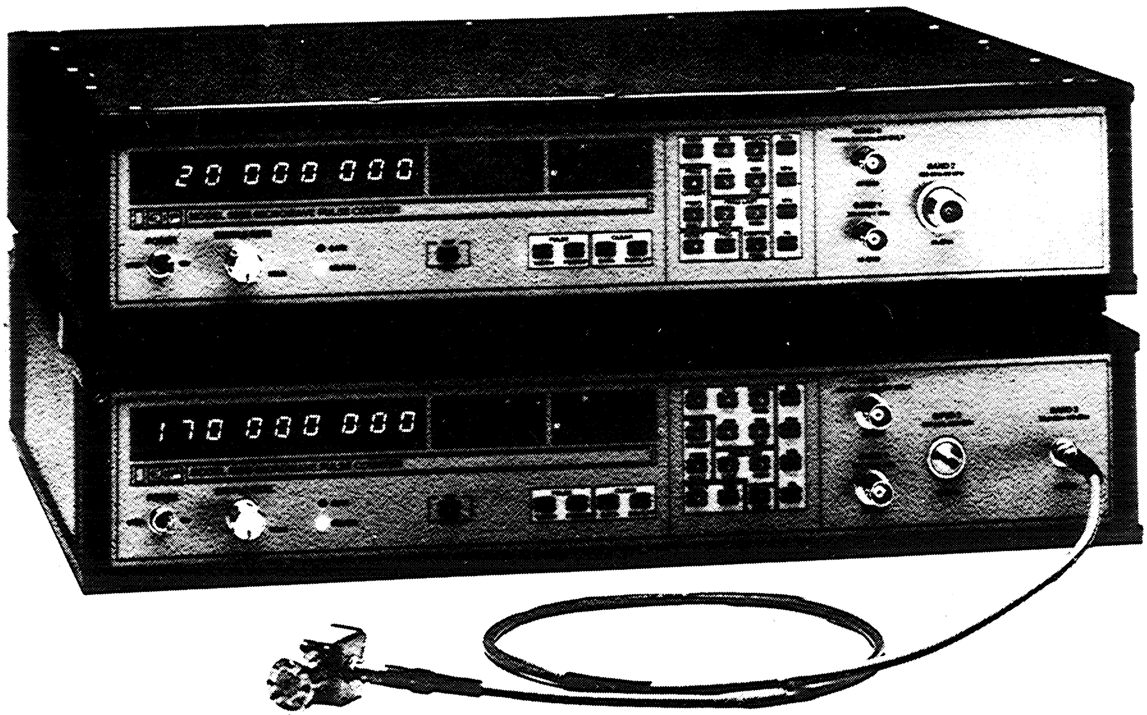

Models 585B & 588B
Pulsed Microwave Frequency Counters

Operation Manual

EIP

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Models 585B and 588B Pulsed Microwave Frequency Counters

Operation Manual

Manual Assembly Part Number: 5585105-02
Manual Text Part Number: 5580105-02

585B: CCN 6803 thru 6809
588B: CCN 6903 thru 6911

Printed in U.S.A., August 1994

Warranty

EIP Microwave warrants this product to be free from defects in material and workmanship for three years* from the date of delivery. Damage due to accident, abuse, or improper signal level is not covered by the warranty. Removal, defacement, or alteration of any serial or inspection label, marking, or seal may void the warranty. EIP Microwave will repair or replace, at its option, any components of this product which prove to be defective during the warranty period, provided the entire unit is returned to EIP or an authorized service facility. In-warranty units will be returned freight prepaid; out-of-warranty units will be returned freight COLLECT. No warranty other than the above is expressed or implied.

Certification

EIP Microwave certifies this instrument to be in conformance with the specifications noted herein at time of shipment from the factory. EIP Microwave further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology.

Instruments Covered by This Manual

The information in this manual applies to EIP Models 585B and 588B with the CCN number(s) listed on the cover. The CCN is the configuration control number. It is a four digit number which is either shown separately as the "CCN" on the serial number tag of the instrument, or as the first four digits of the serial number. The serial number tag is located on the rear panel. Please inspect the serial number tag of the instrument and verify the CCN is listed among the CCN numbers covered by this manual.

Manual Updates

The CCN of the instrument will change any time a part or assembly of the instrument is changed to the extent that it is no longer interchangeable with the earlier part or assembly. When changes occur, either a new manual is printed incorporating the changes or the manual is shipped with a Manual Update. To ensure the technical accuracy of the manual, please be sure to incorporate new information as instructed in the Manual Update.

Supplied Accessories

The EIP Models 585B and 588B are supplied with an operations manual and an ac line cord. Other available options and accessories are listed in Section 1.

Customer Suggestion Form

A mail-in form at the end of this manual provides an easy way for you to tell us about any additions, corrections, or changes that would improve this publication. Your suggestions are a valuable part of the input used in revising our manuals and developing the structure and format for new manuals.

* Products shipped prior to October 1992 had a standard one year warranty.

SAFETY

The EIP Models 585B and 588B have been designed and tested according to international safety requirements, but as with all electronic equipment, certain precautions must be observed. This manual contains information, cautions, and warnings that must be followed to prevent the possibility of personal injury and/or damage to the instrument.

SAFETY SYMBOLS

WARNING The WARNING sign denotes a hazard. It calls attention to a procedure or practice, which, if not correctly performed or adhered to, could result in personal injury.

CAUTION The CAUTION sign denotes a hazard. It calls attention to an operating procedure or practice, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

OVERALL SAFETY CONSIDERATIONS

WARNING

Before this instrument is switched on, the protective earth terminals of this instrument MUST be connected to the protective conductor of the ac power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective earth (grounding) conductor.

WARNING

Only fuses with the required rated current, voltage and specified type should be used. DO NOT use repaired fuses or short-circuited fuseholders. To do so could cause a shock or fire hazard.

WARNING

Whenever it is likely that the protection has been impaired, the instrument MUST BE made inoperative and be secured against any unintended operation.

WARNING

All protective earth terminals, extension cords, autotransformers, and devices connected to this instrument should be connected to a socket outlet provided with a protective earth contact. Any interruption of the protection will cause a potential shock hazard that could result in personal injury.

WARNING

Whenever ac power is connected to this instrument, the power supply is energized. Therefore, exercise caution whenever covers are removed.

CAUTION

Before connecting power to the instrument, check to insure that the correct fuse is installed and the voltage select switch on the rear panel of the instrument is set properly. Refer to Section 2, Installation.

CAUTION

Excessive signals can damage these instruments. To prevent damage, do not exceed specified damage level. Refer to specifications listed in Section 1.

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GENERAL INFORMATION

INTRODUCTION

The EIP Models 585B and 588B Pulsed Microwave Frequency Counters are microprocessor-based multifunction instruments used for both CW and pulsed microwave measurements. They can automatically measure the frequency of repetitive pulse signals as narrow as 50 ns. Both models can also automatically measure pulse widths from 50 ns to 1 second and pulse periods from 250 ns to 1 second, to a 10 ns resolution. Additionally, through the INHIBIT IN connector, the 585B and 588B can profile pulsed or chirped signals with measurement windows as narrow as 15 ns. No manual switching is required to measure CW or pulsed signals.

The frequency range of the 585B is 100 Hz to 20 GHz. The frequency range of the 588B is 100 Hz to 26.5 GHz, and is extendible, by option, up to 170 GHz. Band 0, 100 Hz to 250 MHz, is for CW measurements only.

All major functions are controlled through the 21-button, functionally grouped keyboard. Information is presented for viewing on a nine-digit sectionalized frequency display, a three-digit floating point pulse parameter display, and a 20-message annunciator bank.

Microprocessor control and the unique architecture employed offer all the major counter functions, such as frequency offsets, frequency range limits, and averaging capabilities, plus a variety of special functions including internal diagnostics, calibration and test aids, and sophisticated operational enhancements.

All front panel controls (except the POWER switch) and all background functions are externally programmable via the IEEE 488 - 1978 standard GPIB (General Purpose Interface Bus) port. The instrument output status and all displayed information are accessible via the GPIB.

OPERATING CONDITIONS

This instrument is designed to be operated at temperatures not exceeding 0 to 50 °C at relative humidity not to exceed 95% (75% over 25 °C; 45% over 40 °C). This instrument will perform to specifications at altitudes not exceeding 10,000 ft (3050 m) and will tolerate vibration not exceeding 2 g. It is fungus resistant. The chassis is not designed to provide protection from mechanical shock or falling water particles and is intended for normal bench use in an environmentally uncontaminated area.

VENTILATION

Air circulates through the vents in the rear panel of the counter. These vents must not be obstructed or the temperature inside the counter may increase enough to reduce counter stability and shorten component life.

STORAGE

Store the instrument in an environment that is protected from moisture, dust, and other contaminants. Do not expose the instrument to temperatures below -55 °C or above 75 °C, nor to altitudes above 40,000 ft (12,000 m).

SPECIFICATIONS

GENERAL	
SIZE	3.5 in H x 16.75 in. W x 14 in. D (8.9 cm H x 42.6 cm W x 35.6 cm D)
WEIGHT	35 lb (15.9 kg)
SHIPPING WEIGHT	41 lb (18.6 kg)
OPERATING TEMPERATURE	32 to 122 °F (0 to 50 °C)
POWER	100/120/140/200/220/240 Vac ±10% 50-400 Hz, 100 VA, typical
MINIMUM PULSE WIDTH	50 ns
MAXIMUM PULSE WIDTH	CW
MINIMUM PULSE PROFILE	15 ns
MINIMUM PRF	1 Hz
MINIMUM OFF TIME	200 ns (will count CW)
MINIMUM ON/OFF RATIO	15 dB
RESOLUTION	1 kHz to 1 GHz (100 Hz to 100 MHz in Band 0)
GATE TIME	10 ms to 1 μs (dependent upon resolution)

BAND 0	
FREQUENCY RANGE	100 Hz to 250 MHz (CW only)
CONNECTOR	BNC
IMPEDANCE	50 Ω nominal
SENSITIVITY	-15 dBm
MAXIMUM INPUT	+7 dBm
MAXIMUM VIDEO1	N/A
MAXIMUM FM	Carrier frequency must remain within band
AVERAGING ERROR IN Hz	N/A
GATE ERROR IN Hz	N/A
DISTORTION ERROR	N/A
TOTAL ERROR	TE = time base error ±1 count (excluding noise effects)
ACQUISITION TIME	N/A
MEASUREMENT TIME	
100 Hz RESOLUTION	200 ms
1 kHz RES AND ABOVE	(1/RES) + 85 ms

(See notes on page 1-7)

SPECIFICATIONS (Continued)

BAND 1	
FREQUENCY RANGE	250 MHz to 1 GHz
CONNECTOR	BNC
IMPEDANCE	50 Ω nominal
SENSITIVITY	-15 dBm
MAXIMUM INPUT	+7 dBm peak
DAMAGE LEVEL	+24 dBm peak
AMPLITUDE DISCRIMINATION	10 dB for signals separated by <100 MHz
MAXIMUM VIDEO[1]	
VIDEO FREQUENCY <250 MHZ	MV = SL - [10 log (250 MHz/FV)^4] - 20 dB
VIDEO FREQUENCY >250 MHz	MV = SL - 20 dB
(SL FREQUENCY MUST BE >250 MHZ)	
MAXIMUM FM/CHIRP[2]	Carrier frequency must remain within band
AVERAGING ERROR IN Hz[1]	AE = ±2 x $\sqrt{RES/[(GW)(AVG)]}$
GATE ERROR IN Hz[1]	GE= ±0.07/GW
DISTORTION ERROR IN Hz[1]	DE = ±0.03/(PW - 3 x 10^{-8})
TOTAL ERROR (PULSE)[1]	TEp = ±AE ±GE ±DE ±Time Base Error
TOTAL ERROR (CW)	TEcw = Time Base Error ±1 count (Based on averaging 10 measurements.)
ACQUISITION TIME[1]	AQ = (1/MINPRF) + 55 ms
MEASUREMENT TIME (PULSE)[1]	MT = [((4) (PP)) / ((GW) (RES))] + 0.1
MEASUREMENT TIME (CW)[1]	MT = [4 / ((GW) (RES))] + 0.1

(See notes on page 1-7.)

SPECIFICATIONS (Continued)

BAND 2	
FREQUENCY RANGE	950 MHz to 20 GHz (585B), 26.5 GHz (588B)
CONNECTOR	Precision N (585B), APC 3.5 (588B)
IMPEDANCE	50 Ω nominal
SENSITIVITY	-20 dBm (950 MHz to 20 GHz) -10 dBm (20 to 26.5 GHz, 588B Only)
MAXIMUM INPUT	+7 dBm peak
DAMAGE LEVEL	+45 dBm CW, +53 dBm peak (≤1 µsec pulse width, 0.1% duty cycle)
AMPLITUDE DISCRIMINATION	15 dB. If <15 dB, will count one signal accurately if separated by >200 MHz.
MAXIMUM VIDEO[1]	MV = SL - 20 dB
MAXIMUM FM/CHIRP[2]	20 MHz peak-to-peak
AVERAGING ERROR IN Hz[1]	$AE = \sqrt{RES/[(GW)(AVG)]}$
GATE ERROR IN Hz[1]	GE = +0.01/GW
DISTORTION ERROR IN Hz[1]	$DE = \pm 0.03/(PW - 3 \times 10^{-8})$
TOTAL ERROR (PULSE)	TEp = ±AE ±GE ±DE ±Time Base Error
TOTAL ERROR (CW)	TEcw = Time Base Error ±1 count (Based on averaging 10 measurements)
ACQUISITION TIME (PULSE)	
FREQ. LIMITS	$AQ = 2(FH)[(4 \times 10^{-12}) + (4 \times 10^{-8}/MINPRF)] + 60/MINPRF + [(2 \times 10^{-5})(PP)]/GW + 0.35$
CENTER FREQ	$AQ = 72/MINPRF + [(2 \times 10^{-5})(PP)]/GW + 0.2$
ACQUISITION TIME (CW)	
FREQ. LIMITS	$AQ = 2(FH)[(4 \times 10^{-12}) + (4 \times 10^{-8}/MINPRF)] + 60/MINPRF + 0.25$
CENTER FREQ	AQ = 72/MINPRF + 0.1
MEASUREMENT TIME (PULSE)	MT = [(PP) / ((GW) (RES))] + 0.2
MEASUREMENT TIME (CW)	MT = (1/MINPRF) + 0.2
FREQUENCY LIMITS	Instrument will ignore signals outside of limits. 10 MHz resolution, ±50 MHz accuracy. Unwanted signals must be greater than 100 MHz from either limit.
CENTER FREQUENCY	Will lock on signals ≤50 MHz from the entered frequency at sensitivity. 10 MHz resolution.

(See notes on page 1-7.)

SPECIFICATIONS (Continued)

	BAND 3 (Option 5804)
FREQUENCY RANGE	26.5 to 170 GHz, see Table 1-1
CONNECTOR	Depends on remote sensor, see Table 1-1
SENSITIVITY	-20 dBm (-25 dBm Typ)
MAXIMUM INPUT (TYP)	+5 dBm peak
DAMAGE LEVEL	+10 dBm peak
AMPLITUDE DISCRIMINATION	20 dB
MAXIMUM VIDEO[1]	MV = 15 mv peak-to-peak
MAXIMUM FM/CHIRP[2]	
AUTOMATIC	20 MHz peak-to-peak
CENTER FREQ	150 MHz peak-to-peak
AVERAGING ERROR IN Hz[1]	$AE = \pm 2 \times \sqrt{RES/[(GW)(AVG)]}$
GATE ERROR IN Hz[1]	$GE = \pm 0.03/GW$
DISTORTION ERROR IN Hz[1]	$DE = \pm 0.02/(PW - 3 \times 10^{-8})$
TOTAL ERROR (PULSE)	TEp = ±AE ±GE ±DE ±Time Base Error
TOTAL ERROR (CW)	TEcw = Time Base Error $\pm N^2$ counts N = freq/20 GHz
ACQUISITION TIME (PULSE)[1]	
AUTOMATIC	$AQ = 70/MINPRF + [[(6 \times 10^{-3})(PP)]/GW] + 0.25$
CENTER FREQ	$AQ = 70/MINPRF + [[(8 \times 10^{-4})(PP)]/GW] + 0.25$
ACQUISITION TIME (CW)	AQ = 70/MINPRF + 0.25
MEASUREMENT TIME (PULSE)	MT = [(4) (PP)]/[(GW) (RES)] + 0.15
MEASUREMENT TIME (CW)	(4 / MINPRF) + 0.15
CENTER FREQUENCY	Instrument assumes any signal present to be in the range of ±2 GHz from the specified center frequency and calculates the harmonic number based on this assumption.

(See notes on page 1-7.)

SPECIFICATIONS (Continued)

PULSE PERIOD	
ACCURACY[1]	±(20 ns + time base error x PP)
DISPLAY RESOLUTION	3 digits, floating point, 10 ns maximum (Special function available for 10 ns)
RESOLUTION TO GPIB	10 ns
MIN/MAX PULSE PERIOD	250 ns/1 s
MEASUREMENT POINTS	6 dB ±1.5 dBc

PULSE WIDTH	
ACCURACY[1]	±(20 ns + time base error x PW)
DISPLAY RESOLUTION	3 digits, floating point. 10 ns maximum (Special function available for 10 ns on all measurements)
RESOLUTION TO GPIB	10 ns
MIN/MAX PULSE PERIOD	50 ns/1 s
MEASUREMENT POINTS	6 dB ±1.5 dBc

TCXO TIME BASE (STANDARD)	
FREQUENCY	10 MHz
AGING RATE	<1 x 10^{-7}/ mo
SHORT TERM STABILITY	<1 x 10^{-9} RMS for one second averaging time
TEMPERATURE STABILITY	<1 x 10^{-6} over the range 0 to 50 °C
LINE VARIATION	<1 x 10^{-7} (±10% line voltage change)
WARM-UP TIME	30 minutes
OUTPUT FREQUENCY	10 MHz, square wave, 1 V peak-to-peak minimum into 50 Ω
EXTERNAL TIME BASE	Requires 10 MHz, 1 V peak-to-peak minimum into 300 Ω
PHASE NOISE	-95 dBc/Hz at 10 Hz from carrier

(See notes on page 1-7.)

Note 1: MV is the maximum video amplitude in dBm.
SL is the input signal level in dBm.
FV is the frequency component of the video in Hz.
GW is the logical "AND"of pulse width and inhibit signal minus 30 ns.
PW is pulse width of the incoming signal in seconds.
PP is the period of the input signal in seconds.
RES is the resolution in Hz up to 1 MHz. Above 1 MHz, resolution is 1 MHz.
AVG is the number of measurements averaged.
FH is the difference between Frequency Limit High and Frequency Limit Low in Hz.
MINPRF is the specified instrument MINPRF in Hz up to 1 kHz. Above 1 kHz MINPRF 1 kHz.

Note 2: If FM/Chirp is >150 MHz and non symmetrical, the measured frequency is a function of average frequency and geometric center frequency.

OPTIONS AND ACCESSORIES

OPTIONS	DESCRIPTION
5803	Rear Panel Input Connectors
5804	Band 3 Frequency Extension Module. Available on Model 588B only. Required for frequencies between 26.5 GHz and 170 GHz. Frequency Extension Cable Kit 890 and appropriate remote sensors are also required.
5806	2-Year Extended Warranty①
5807	Ovenized High Stability Time Base (Aging Rate: 5 x 10^{-9}/day)②
5808	Ovenized High Stability Time Base (Aging Rate: 1 x 10^{-9}/day)②
5809	AT-cut Ovenized High Stability Time Base (Aging Rate: 5 x 10^{-10}/day)②
5809	SC-cut Ovenized High Stability Time Base (Aging Rate: 5 x 10^{-10}/day)

ACCESSORIES	DESCRIPTION
890	Frequency Extension Cable Kit
091	Remote Sensor 26.5 - 40 GHz (WR-28)
092	Remote Sensor 40 - 60 GHz (WR-19)
093	Remote Sensor 60 - 90 GHz (WR-120
094	Remote Sensor 90 - 110 GHz (WR-10)
095	Remote Sensor 50 - 75 GHz (WR-150
096	Remote Sensor 33 - 50 GHz (WR-22)
097	Remote Sensor 26.5 - 50 GHz (Coaxial K-Connector③)
098	Remote Sensor 110 - 170 GHz (WR-6)
010	Transit Case
021	Rack Mount Kit with Handles
022	Rack Mount Kit without Handles
031	Operation Manual (one supplied with each instrument)
032	Service Manual (includes Operation Manual)
041	Service Kit
050	Sof-Pac Carrying Case
101	Chassis Slide Kit with Handles (includes rack mount kit)
102	Chassis Slide Kit without Handles (includes rack mount kit)

① A three year warranty became standard as of October 1, 1992.

② Options 5807, 5808, and 5809 were discontinued as of December 1992. These discontinued high stability ovenized oscillators incorporated an AT-cut crystal. They were replaced by a new Option 5809 incorporating a SC-cut crystal. The new Option 5809 has virtually identical specifications as the old Option 5809, but requires less warm-up time.

③ K-Connector is a registered trademark of the Wiltron Company.

Table 1-1. Band 3 Remote Sensors.

REMOTE SENSOR	BAND	FREQUENCY RANGE (GHz)	WAVEGUIDE SIZE	WAVEGUIDE FLANGE	POWER RANGE (dBm)	DAMAGE LEVEL (dBm)
91	3-1	26.5 - 40	WR-28	UG-599/U	-20 to +5	+10
92	3-3	40 - 60	WR-19	UG-383/U	-20 to +5	+10
93	3-5	60 - 90	WR-12	UG-387/U	-15 to +5	+10
94	3-6	90 - 110	WR-10	UG-387/U	-15 to +5	+10
95	3-4	50 - 75	WR-15	UG-385/U	-20/-15 to +5	+10
96	3-2	33 - 50	WR-22	UG-383/U	-20 to 5	+10
97	3-1 or 3-2	26.5 - 50	K-Connector*	N/A	-20 to +5	+10
98	3-8	110 - 170	WR-6	UG-387/U	-15 to +5	+10

* K-Connector is a registered trademark of the Wiltron Corporation.

Table 1-2. Options 5807, 5808, and 5809 - Ovenized High Stability Time Bases (AT-Cut).

	5807	5808	5809
AGING RATE/24 HOURS (After 72 hour warm-up)	<5 x 10^{-9}	<1 x 10^{-9}	<5 x 10^{-10}
SHORT TERM STABILITY (1 second average)	<1 x 10^{-10} rms	<1 x 10^{-10} rms	<1 x 10^{-10} rms
0 to +50 °C TEMPERATURE STABILITY	<6 x 10^{-8}	<3 x 10^{-8}	<3 x 10^{-8}
±10% LINE VOLTAGE CHANGE	<5 x 10^{-10}	<2 x 10^{-10}	<2 x 10^{-10}

Table 1-3. Option 5809 - Ovenized High Stability Time Base (SC-Cut).

FREQUENCY	10 MHz
AGING RATE	<5 x 10^{-10}/24 hours (after one hour warm-up), 1 x 10^{-7}/year
SHORT TERM STABILITY (1 second average)	<1 x 10^{-10} rms
0 to +50 °C TEMPERATURE STABILITY	<3 x 10^{-8}
±10% LINE VOLTAGE CHANGE	<2 x 10^{-10}
WARM-UP TIME	Within ≤5 x 10^{-9} of final value 10 minutes after turn-on at 25 °C Within 1 x 10^{-9} of final value 30 minutes after turn-on at 25 °C
PHASE NOISE	-120 dBc/Hz at 10 Hz from carrier

Note: Options 5807, 5808, and 5809 were discontinued as of December 1992. These discontinued high stability ovenized oscillators incorporated an AT-cut crystal. They were replaced by a new Option 5809 incorporating a SC-cut crystal. The new Option 5809 has virtually identical specifications as the old Option 5809, but requires less warm-up time.

The older Options 5807, 5808, and 5809 (AT-cut) are adjusted using a rear panel adjustment. The adjustment for the new Option 5809 (SC-cut) is inside the counter beneath a screw on top of the oscillator.

SECTION 2
INSTALLATION

UNPACKING

The EIP Models 585B and 588B series Pulsed Microwave Frequency Counters arrive ready for operation. Carefully inspect the shipping carton for any sign of damage. If the carton is damaged, immediately notify shipper's agent.

Remove the packing carton and supports, being careful not to scar or damage the instrument. Make a complete visual inspection of the counter, checking for any damage or missing components. Check that all switches and controls operate mechanically. Report any damage to EIP immediately.

INSTALLATION

There are no special installation instructions for these units. The units are self-contained bench or rack mounted instruments, which only require connection to a standard, single-phase power line for operation.

CAUTION

Always be sure that the fuse is the type and value specified, and that the voltage select switch (Figure 2-1) is set to correspond to the AC power input voltage; otherwise, the counter may be damaged.

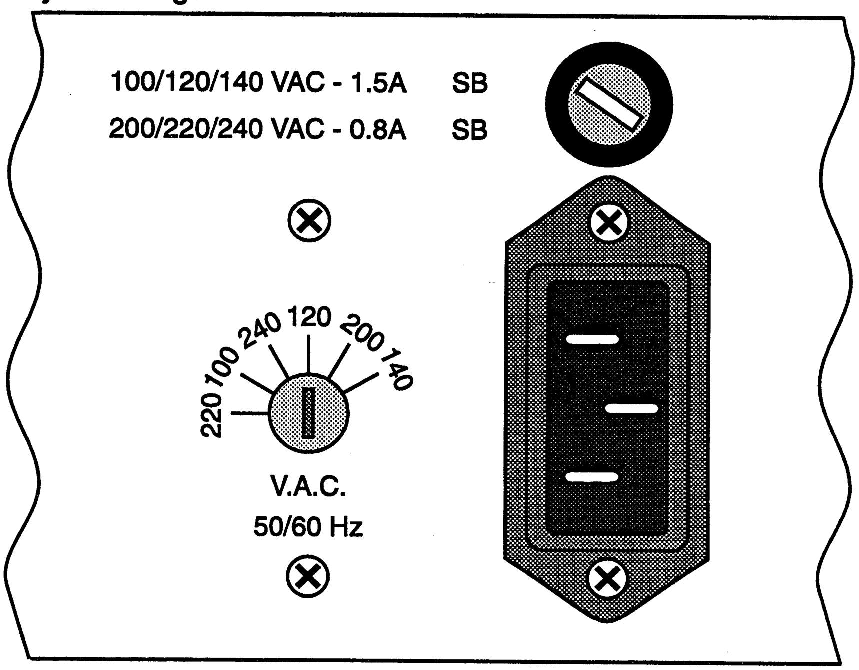

Figure 2-1. Rear Panel Fuse and Voltage Select Switch Locations.

VOLTAGE SELECTION

The voltage select switch (V.A.C.) must be set to the proper line voltage. To change the line voltage, disconnect the counter from the power line and, using a screwdriver, set the V.A.C. switch to the desired position.

FUSE REPLACEMENT

The fuse for the counter is located on the rear panel above the line voltage socket (Figure 2-1). The following fuse types must be used:

Line Voltage	Fuse Type
100/120/140 Vac	1.5 A Slow-blow MDL
200/220/240 Vac	0.8 A Slow-blow FST

To release the fuse, use a screwdriver to rotate the slotted cap counterclockwise. To reinstall the fuse, press the fuse and slotted cap assembly into the fuse cavity and turn it clockwise until it locks into place.

INCOMING OPERATIONAL CHECKOUT

The following procedure can be performed without special tools or equipment.

1. Before connecting power to the instrument, check to make sure the correct fuse is installed and the V.A.C. switch is set properly.
2. Connect the power cord to the appropriate single-phase power source. The ground terminal on the power cord plug must be properly grounded.
3. Turn the POWER switch on. All LEDs and annunciators should light for about two seconds The model number should be displayed for about one second. The counter should then display all zeros indicating that the automatic self-check has been successfully completed
4. PRESS: [SPECIAL 9 FUNC] [0] [1] Display should read 100 000 ±1 (100 MHz)
5. PRESS: [SPECIAL 9 FUNC] [0] [2] Display should read all 8's and all annunciators should be lit.
6. PRESS: [SPECIAL 9 FUNC] [0] [3] Each display segment should light in turn (adjustable by the front panel SAMPLE RATE control).
7. PRESS: [SPECIAL 9 FUNC] [0] [4] Each digit should light in turn (adjustable by the front panel SAMPLE RATE control).

This completes the incoming operational checkout procedure.

SERVICE INFORMATION

PERIODIC MAINTENANCE

No periodic maintenance is required. However, to maintain accuracy, it is recommended that the counter be recalibrated every 12 months. The specific calibration interval depends upon the measurement accuracy required. For sample measurement error calculations for both 6 and 12-month calibration intervals, see "Time Base Error" in Section 3.

CAUTION

Do not attempt repair or disassembly of the microwave converter, millimeter wave converter, or time base oscillator assemblies. Such action will void the warranty of the counter. Contact EIP or your sales representative.

COUNTER IDENTIFICATION

This counter is identified by three sets of numbers the model number (585B or 588B), serial number, and a configuration control number (CCN). These numbers, located on a label affixed to the frame at the rear of the counter, must be included in any correspondence regarding your counter.

FACTORY SERVICE

If the counter is being returned to EIP for service or repair, be sure to include the following information with the shipment.

- Name and address of owner.
- Model, complete serial number, and CCN of the counter.
- A complete description of the problem. (Under what conditions did the problem occur? What was the signal level? What equipment was attached or connected to the counter? Did that equipment experience failure symptoms?)
- Name and telephone number of someone familiar with the problem that may be contacted by EIP for any further information if necessary.
- Shipping address to which the counter is to be returned. Include any special shipping instructions.

Pack the counter for shipping as detailed below.

SHIPPING INSTRUCTIONS

Wrap the counter in heavy plastic or kraft paper, and repack in original container if available. If the original container cannot be used, use a heavy (275 pound test) double-walled carton with approximately four inches of packing material between the counter and the inner carton. Seal carton with strong filament tape or strapping. Mark the carton to indicate that it contains a fragile electronic instrument. Ship to the EIP address on the cover of this manual.

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SECTION 3 OPERATION

INTRODUCTION

This section lists the counter controls, connectors, and indicators, explains how each counter function operates, and provides some general measurement considerations.

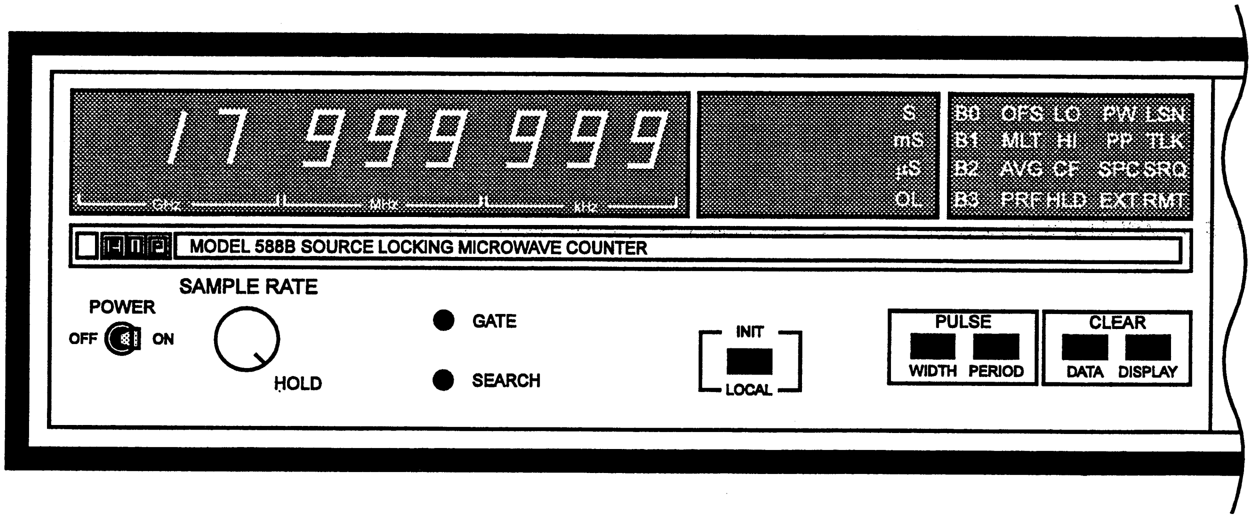

Figure 3-1. Front Panel Controls and Indicators (Model 588B Shown).

FRONT PANEL CONTROLS, INDICATORS AND CONNECTORS

- POWER switch - selects ON or STBY. In the standby position power is applied to the oven oscillator, if installed, and to the primary side of the power transformer.
- SAMPLE RATE/HOLD control - varies time between measurements from 0.1 to 10 seconds (nominal). The last reading is retained indefinitely in HOLD.
- GATE indicator - lights when the signal gate is open and a measurement is being made.
- SEARCH indicator - lights when the counter is not locked to an input signal.
- Data display - 12-digit LED display provides a direct numerical readout of a measurement. The frequency information is displayed on the nine left-most digits in a fixed position format that is sectionalized in GHz, MHz, kHz. Pulse parameters (pulse width and pulse period) are displayed in a three-digit floating point format to the right of the frequency display.
- Status display - A series of annunciators provided to indicate current operating status of the counter.
- Keyboard - Both data entry and function selection are controlled through the keyboard (see Keyboard Operation on page 3-5).

Figure 3-2. Status Display.

STATUS DISPLAY

- S - indicates pulse parameters are being displayed in seconds.
- mS - indicates pulse parameters are being displayed in milliseconds.
- µS - indicates pulse parameters are being displayed in microseconds.
- OL (overload) - indicates that the input signal level is in excess of the optimum counting range. (Overload does not indicate improper operation, only that the input amplitude is greater than optimum.)
- B0 - lights when Band 0 is selected.
- B1 - lights when Band 1 is selected.
- B2 - lights when Band 2 is selected.
- B3 - lights when Band 3 is selected.
- OFS (frequency offset) - lights when a frequency offset is being used.
- MLT (frequency multiplier) - lights when a frequency multiplier other than 1 is being used.
- AVG (average) - lights when measurement averaging is enabled.
- PRF (minimum pulse repetition frequency) - lights when a MINPRF other than the factory default is being used.
- LO (frequency limit low) - lights when a low limit other than the factory default is being used.
- HI (frequency limit high) - lights when a high limit other than the factory default is being used.
- CF (center frequency) - lights when the center frequency mode of operation is enabled.
- HLD (hold) - lights when measurement updating is disabled.
- PW (pulse width) - lights when the counter is in the pulse width measurement mode.
- PP (pulse period) - lights when the counter is in the pulse period measurement mode.
- SPC (special function) - lights when a special function is enabled.
- EXT (external reference) - lights when the counter is set to an external timebase reference.

NOTE

For proper counter operation: when the EXT function is selected, a 10 MHz external reference MUST be applied to the rear panel input connector.

GPIB STATUS INDICATORS

- LSN (listen) - lights when the counter is addressed as a listener by the GPIB.
- TLK (talk) - lights when the counter is addressed as a talker by the GPIB.
- SRQ (service request) - lights when the counter is sending a service request.
- RMT (remote) - lights to indicate that the front panel controls are disabled and the counter is being controlled by the GPIB.

SIGNAL INPUT CONNECTORS

- BAND 0 (BNC female) - has a nominal input impedance of 50 Ω and is used for CW measurements in the range of 100 Hz to 250 MHz.
- BAND 1 (BNC female) - has a nominal input impedance of 50 Ω and is used for measurements in the range of 250 MHz to 1 GHz.
- BAND 2 (precision N for Model 585B, APC 3.5 female for Model 588B) - has a nominal input impedance of 50 Ω and is used for measurements in the range of 950 MHz to 20 GHz (26.5 GHz for 588B).
- BAND 3 (Optional - for Model 588B only, Selectro "quick connect") - has a nominal input impedance of 50 Ω and is used for measurements in the range of 26.5 to 170 GHz. This input is used in conjunction with the Model 890 Frequency Extension Cable Kit and a remote sensor.

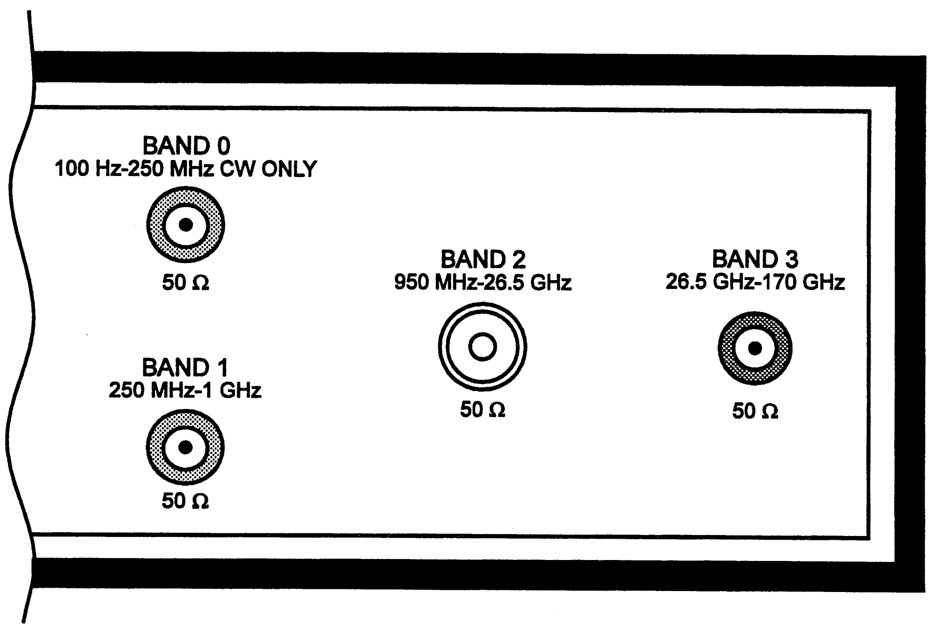

Figure 3-3. signal Input Connectors (Model 588B Shown).

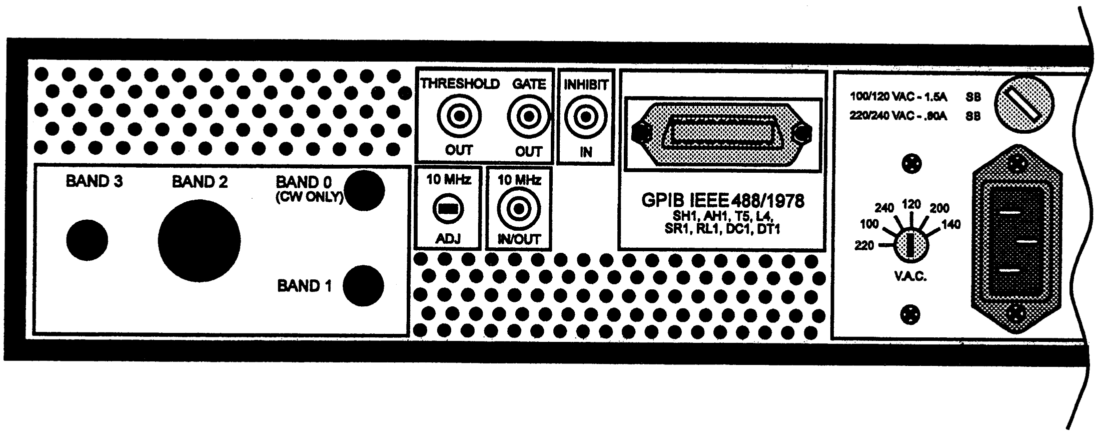

Figure 3-4. Rear Panel Control and Connectors.

REAR PANEL CONTROL AND CONNECTORS

- BAND 0, BAND 1, BAND 2, and BAND 3 - are provided on instruments with optional rear panel inputs (Option 5803).
- THRESHOLD OUT - is the digitized pulse envelope. When the counter has a converter lock and a signal is present, the output is -0.75 volts into 50 Ω. Without a converter lock, the output is 0 volts.
- GATE OUT - represents the gate to the Count Chain board. The gate output follows the actual gate, not the gate enable. When the gate is active, the output is -0.75 volts into 50 Ω; otherwise, the output is 0 volts.
- 10 MHz IN/OUT - provides a 10 MHz square wave output at 1 volt peak-to-peak, AC coupled into 50 Ω, when the counter's internal timebase is enabled. Accepts a 10 MHz 1 volt peak-to-peak signal into 300 Ω for external timebase operation. Special Functions 08 and 09 are used to select either the external or internal timebase.
- INHIBIT IN - causes the counter to perform as if the input signal were turned off. The counter ignores any signal that is present while inhibit is true during all phases of operation. An input of -1 volt inhibits the counter. An input of -2 volts enables the counter. The inhibit input impedance is 50 Ω to -2 volts so that the counter can be driven by either an ECL signal or a 0 to -1 volt, 50 Ω source.

NOTE

The INHIBIT IN is designed to be compatible with either a 50 Ω impedance pulse generator, or emitter-coupled-logic (ECL) devices. An internal termination of 50 Ω returned to -2 volts makes this dual compatibility possible. An ECL high level signal (-0.8 to -1.1 volts) will inhibit measurement. ECL devices are designed to drive 50 Ω lines without reflections when the lines are terminated with 50 Ω returned to -2 volts. The direct compatibility with a 50 Ω pulse generator results from the fact that 0 volts from a 50 Ω source will produce -1 volts at the INHIBIT IN (inhibiting the counter) while a -1 volt signal into 50 Ω will produce 1.5 volts at the INHIBIT IN, thus enabling the counter.

- GPIB - connects the instrument to the IEEE 488 - 1978 bus.
- Fuse - provides current overload protection.
- V.A.C. switch - sets operating voltage of counter to match power line voltage.

CAUTION

Switch setting and fuse rating must match power line voltage.

- AC power connector - accepts the power cord supplied with the counter.

INSTRUMENT DEFAULT SETTINGS

When the counter is initially turned on the state of the counter is determined by a set of default values which are stored in memory. The factory-set values are listed below.

Parameter	Default Value
Band	2 (microwave band)
Subband	1
Resolution	3 (1 kHz)
Special Function	00 (all cleared)
Average	01
Frequency Multiplier	01
Frequency Offset	0 kHz
Minimum PRF	2 kHz
Frequency Limit Low	900 MHz
Frequency Limit High	20.5 GHz (Model 585B) 26.7 GHz (Model 588B)
Center Frequency	0 kHz (not active)
Frequency Display	On
Pulse Width Measurements	Off
Pulse Period Measurements	Off

Models 585B and 588B both offer a feature that enables the user to customize the state of the instrument at turn-on. For more information on this feature, see Special Function 72.

KEYBOARD OPERATION

The keyboard consists of 21 push-button keys that control the major functions of the counter. Twelve keys are used for numerical data entry - the digits 0 through 9, the decimal point, and the change sign (±). Four keys (GHz, MHz, kHz, and Hz) act as terminators for the input of frequency parameters. The CLEAR DISPLAY and CLEAR DATA keys are also considered terminator keys.

Ten of the keys, called parameter call keys, are also used to select the measurement parameters. Five of these, BAND (which also calls subband), SPECIAL FUNC, FREQ MULT, RES, and AVG, are used without terminators, while the other five, MIN PRF, FREQ LIMIT LOW, FREQ LIMIT HIGH, CENTER FREQ, and FREQ OFFSET, are used with the terminator keys. The parameter call keys are dual function keys since they are also used for numeric data entry.

The remaining keys are called one-shot action keys; they include INIT/LOCAL, PULSE PERIOD, PULSE WIDTH, RESET, and TRIG.

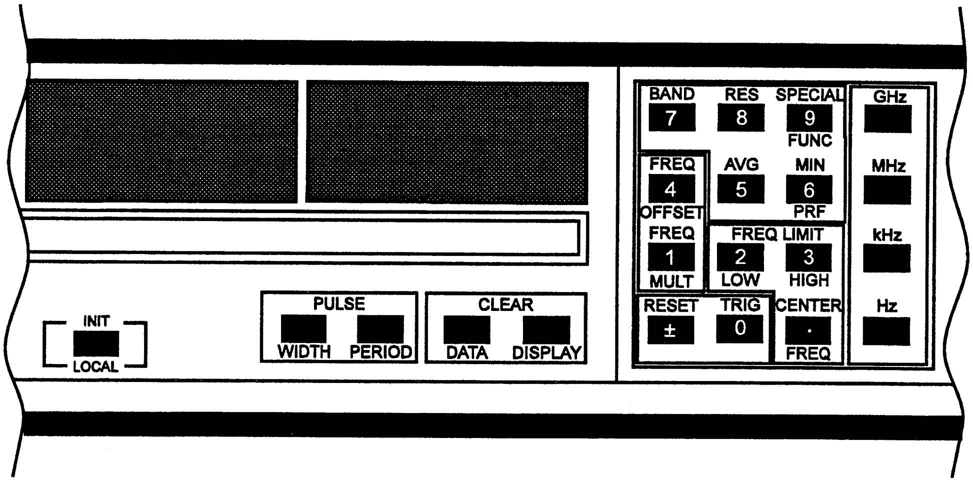

Figure 3-5. Keyboard.

NUMERIC ENTRY KEYS

The numeric entry keys are:

- Digits 0 through 9
- (±) change sign key
- (.) decimal point key

TERMINATOR KEYS

The terminator keys are:

- GHz
- MHz
- kHz
- Hz

CLEAR DISPLAY AND CLEAR DATA

These are also considered terminator keys. At any point during a key sequence, the user has the option either to:

- Press CLEAR DISPLAY to abort the sequence and return to normal operation without changing the value of the called parameter
- Press CLEAR DATA to abort the sequence and assign the default value to the called parameter.

ONE-SHOT ACTION KEYS

- INIT/LOCAL - when the counter is in local mode, this key causes the counter to be initialized to the power-on state. When the counter is in remote mode, the INIT/LOCAL key causes a return to local mode (unless a GPIB local lockout is active).

- PULSE WIDTH - turns the pulse width measurement on or off. The result is displayed in the pulse parameter display.
- PULSE PERIOD - turns the pulse period measurement on or off. The result is displayed in the pulse parameter display.

NOTE

When the counter is in local mode, it cannot display both pulse width and pulse period simultaneously; in remote operation, however, both parameters can be output to the controller.

- RESET - resets the converter and restarts the signal acquisition process. If a signal is found, a measurement will be taken, even if the counter is in HOLD.
- TRIG - begins a new measurement cycle. If a measurement cycle is in progress, it will be aborted.

PARAMETER CALL KEYS

The operation of the counter is controlled by the values of the measurement parameters. These parameters can be changed by the user through the keyboard or via the GPIB.

Parameter Call Keys Used Without Terminator

BAND

This key controls the frequency measurement range. Select the appropriate band according to the following:

Band	Range
0	100 Hz to 250 MHz
1	250 MHz to 1 GHz
2	950 MHz to 20 GHz (Model 585B) 950 MHz to 26.5 GHz (Model 588B)
3	26.5 to 170 GHz (Optional - Model 588B only)

Keyboard Example:

PRESS: [BAND] [CLEAR / DATA] **to select default band.**

PRESS: [BAND] [2] **to select Band 2.**

GPIB Example:

Enter: OUTPUT 718;"**BA**ND 2" to select Band 2.

Subband (Called using BAND key)

This parameter controls the frequency measurement range of Band 3. It is set according to the remote sensor being used. Select the appropriate subband as follows:

Subband	Range (GHz)
1	26.5 to 40
2	33 to 50
3	40 to 60
4	50 to 75
5	60 to 90
6	75 to 110
7	90 to 140
8	110 to 170

Keyboard Examples:

PRESS: [BAND] [3] [CLEAR/DATA] **to select default subband.**

PRESS: [BAND] [3] [4] **to select Band 3, subband 4.**

PRESS: [BAND] [CLEAR/DISPLAY] **to display the band without changing it.**

PRESS: [BAND] [3] [CLEAR/DISPLAY] **to display the subband without changing it.**

GPIB Examples:

Enter: OUTPUT 718;"**BA**ND 3, **SU**BBAND 4" to select Band 3, subband 4.

Enter: OUTPUT 718;"**SU**BBAND 4" to select subband 4 (if counter is already in Band 3.)This command does not automatically set counter to Band 3.

RES

This key controls the frequency measurement resolution. Select the desired resolution according to the table below.

Resolution	Frequency	Gate Time
2	100 Hz	10 ms (Band 0 only)
3	1 kHz	1 ms
4	10 kHz	100 µs
5	100 kHz	10 µs
6	1 MHz	1 µs
7	10 MHz	1 µs
8	100 MHz	1 µs
9	1 GHz	1 µs

Keyboard Examples:

PRESS: [RES] [CLEAR DATA] **to select default resolution.**

PRESS: [RES] [2] **to select resolution 2 (100 Hz).**

PRESS: [RES] [9] **to select resolution 9 (1 GHz).**

GPIB Examples:

Enter: OUTPUT 718; "**RE**SOLUTION 2" to select resolution 2 (100 Hz).

SPECIAL FUNC

This key is used to call any of the various special functions listed in the Special Functions section of this manual.

PRESS: [SPECIAL FUNC] [CLEAR DATA] **to clear all activated special functions.**

PRESS: [SPECIAL FUNC] [0] [1] **to activate Special Function 01, 100 MHz self-test.**

PRESS: [SPECIAL FUNC] [0] [4] **to activate Special Function 04, scan digits test.**

Keyboard Examples:

GPIB Example:

Enter: OUTPUT 718; "**SP**ECIAL 01" to activate Special Function 01, 100 MHz self-test.

AVG

This key controls the number of measurements to be averaged on frequency and pulse parameters.

PRESS: [AVG] [CLEAR DATA] **to select default average factor.**

PRESS: [AVG] [0] [2] **to average 2 readings before displaying result.**

PRESS: [AVG] [2] [7] **to average 27 readings before displaying result.**

Select average in the range of 01 to 99.

Keyboard Examples:

GPIB Example:

Enter: OUTPUT 718; "**AV**ERAGE 27" to average 27 readings before displaying the result.

FREQ MULT

This key controls the value of the constant M in the formula:

Display frequency = (M x measured frequency) ±B

where M is the frequency multiplier and B is the frequency offset. The frequency multiplier must be an integer in the range of 01 to 99.

Keyboard Examples:

PRESS: [FREQ MULT] [CLEAR DATA] **to select the default multiplier value.**

PRESS: [FREQ MULT] [0] [7] **to select a multiplier value of 7.**

PRESS: [FREQ MULT] [3] [1] **to select a multiplier value of 31.**

GPIB Example:

Enter: OUTPUT 718;"**MU**LTIPLIER 31" to select a multiplier value of 31.

Parameter Call Keys Used With Terminator

FREQ OFFSET

Frequency offset allows the entry of a negative or positive frequency to 1 kHz resolution into the offset frequency register. This parameter controls the constant B in the formula:

Displayed frequency = (M x measured frequency) ±B

where M is the frequency multiplier and B is the frequency offset. Select frequency offset in the range of -99.999 999 GHz to +99.999 999 GHz. The number can be entered in any fixed-point format. The units terminator determines the scale of the input number.

Keyboard Examples:

PRESS: [FREQ OFFSET] [CLEAR DATA] **to select the default value.**

PRESS: [FREQ OFFSET] [1] [2] [.] [3] [4] [MHz] **to select a 12.34 MHz value.**

PRESS: [FREQ OFFSET] [±] [0] [.] [1] [2] [GHz] **to select a -0.12 GHz value.**

GPIB Example:

Enter: OUTPUT 718;"**OF**FSET 12.34 MHZ" to select a 12.34 MHz value.

MIN PRF

This key controls the minimum pulse repetition frequency of the pulsed signals that can be acquired and measured by the counter. For example, if a MIN PRF of 500 Hz is selected, the counter will only measure signals with a minimum pulse repetition frequency of 500 Hz or greater. This parameter affects the acquisition speed indirectly by affecting two internal processes: the time of waiting for a pulse at each frequency step in the frequency range search, and the time of waiting for a pulse when taking measurements before declaring a "signal lost" condition.

Select MIN PRF in the range of 1 Hz to 100 kHz, depending on the minimum pulse repetition frequency of the signal being measured. The number can be entered in any fixed-point format; the units terminator determines the scale of the input number.

Keyboard Examples:

PRESS: [MIN PRF] [CLEAR DATA] **to select the default value.**

PRESS: [MIN PRF] [5] [0] [0] [Hz] **to select a 500 Hz value.**

GPIB Example:

Enter: OUTPUT 718;"**MIN**PRF 500 HZ" to select a minimum pulse repetition frequency value of 500 Hz.

FREQ LIMIT LOW

This key controls the low end of the frequency window that is searched for a signal in Band 2. Select frequency limit low in the range of 900 MHz to 20.4 GHz for Model 585B, and in the range of 900 MHz to 26.6 GHz for Model 588B. The value entered by the user is truncated to 10 MHz resolution. This function is only available in Band 2. The frequency limit low must always be less than the frequency limit high. The number can be entered in any fixed-point format; the units terminator determines the scale of the input number.

PRESS: [FREQ LIMIT LOW] [CLEAR DATA] **to select the default value.**

PRESS: [FREQ LIMIT LOW] [2] [.] [3] [5] [GHz] **to select a 2.35 GHz value.**

PRESS: [FREQ LIMIT LOW] [3] [1] [3] [6] [.] [3] [MHz] **to select a 3130.0 MHz (3.13 GHz) value (truncated to 10 MHz resolution).**

Keyboard Examples:

GPIB Example:

Enter: OUTPUT 718;"**LO**WLIMIT 2.35 GHZ" to select a 2.35 GHz value.

FREQ LIMIT HIGH

This key controls the high end of the frequency window that is searched for a signal in Band 2. Select the high frequency limit in the range of 900 MHz to 20.5 GHz for Model 585B, and in the range of 900 MHz to 26.7 GHz for Model 588B.

The value entered by the user is truncated to 10 MHz resolution. This function is only available in Band 2. Frequency limit low must always be less than frequency limit high.

The number can be entered in any fixed-point format; the units terminator determines the scale of the input number.

Keyboard Examples:

PRESS: [FREQ LIMIT HIGH] [CLEAR DATA] to select the default value.

PRESS: [FREQ LIMIT HIGH] [3] [.] [2] [GHz] to select a 3.2 GHz value.

PRESS: [FREQ LIMIT LOW] [2] [1] [0] [9] [0] [MHz] to select a 21,090 MHz (21.09 GHz) value (truncated to 10 MHz resolution).

GPIB Example:

Enter: OUTPUT 718;"**HI**GHLIMIT 3.2 GHZ" to select a 3.2 GHz value.

CENTER FREQ

This key controls the center frequency mode of operation in which the counter looks for a signal in the vicinity of the CENTER FREQ value. This mode can be used to reduce the acquisition time or when measuring a particular signal in a multiple signal environment. This mode is available in Band 2 and Band 3.

Select Band 2 CENTER FREQ in the range of 950 MHz to 20 GHz for Model 585B, and in the range of 950 MHz to 26.5 GHz for Model 588B. The counter will lock onto signals within ±50 MHz from the entered value, depending on its power and frequency. The locking frequency is determined by the bandpass width of the YIG filter located at the input to Band 2.

Select Band 3 CENTER FREQ in the range of the subband currently selected. The counter will lock on signals ±1 GHz from the entered frequency. The counter will NOT reject signals outside this range. If a signal more than 1 GHz from the entered frequency is applied, an erroneous reading may result.

The value entered by the user is truncated to 10 MHz resolution. The number can be entered in any fixed-point format; the units terminator determines the scale of the input number.

Keyboard Examples:

PRESS: [CENTER FREQ] [CLEAR DATA] to select the default value.

PRESS: [CENTER FREQ] [1] [4] [.] [8] [GHz] to select a center frequency value of 14.8 GHz.

PRESS: [CENTER FREQ] [2] [1] [7] [0] [MHz] to select a center frequency value of 2170 MHz (2.17 GHz, truncated to 10 MHz resolution).

GPIB Example:

Enter: OUTPUT 718;"**CE**NTERFREQ 14.8 GHZ" to select a center frequency of 14.8 GHz.

SIGNAL MEASUREMENTS

AUTOMATIC FREQUENCY MEASUREMENTS

The EIP Models 585B and 588B Pulsed Microwave Frequency Counters can automatically measure the frequency of CW and repetitive pulse signals having pulse widths as narrow as 50 ns.

To measure the frequency of a CW signal, apply the signal to the input connector that corresponds to the frequency being measured and select the appropriate band. The counter then automatically finds the signal, measures it, and displays the measured frequency.

The average frequency of repetitive pulse signals is measured in much the same way as CW signals. The only difference is that for pulse signals with pulse recurrence frequencies of less than 2 kHz, the minimum pulse recurrence frequency must be entered into the counter using the MINPRF key on the front panel. If the MINPRF is not set at or below the minimum pulse repetition frequency of the signal to be measured, the counter will be unable to lock on the signal .

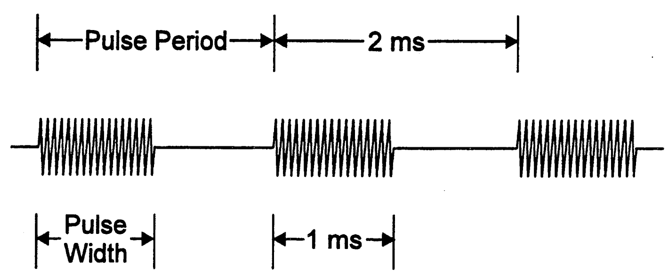

Figure 3-6. Pulsed Signal.

As an example, consider the signal shown in Figure 3-6. The signal is a 2 GHz signal with a pulse width of 1 ms and a pulse period of 2 ms. Since the pulse recurrence frequency is the reciprocal of pulse period, the minimum pulse repetition frequency of the signal shown is 500 Hz. Since this is less than 2 kHz, it must be entered into the counter. To enter a minimum pulse repetition frequency of 500 Hz into the counter, press the MINPRF key followed by the 5 key, the 0 key, and the 0 key; then terminate the sequence with the Hz terminator key. If the signal at this point is applied to the Band 2 input connector and Band 2 is selected, the counter would automatically find the signal and display the frequency on the front panel.

These counters can also automatically measure both the pulse width and the pulse period of the incoming signal to a resolution of 10 ns. This is accomplished by pressing either the PULSE WIDTH key to measure the pulse width or the PULSE PERIOD key to measure the pulse period.

MULTIPLE SIGNAL MEASUREMENTS

In actual microwave environments, there are often multiple signals present. In a multisignal environment, the counter automatically finds and measures the largest signal (as specified by amplitude discrimination).

In Band 2, the counter can also measure signals other than the largest signal present. This is accomplished by setting frequency limits around the desired signal. Figure 3-7 shows an example of the frequency limits feature.

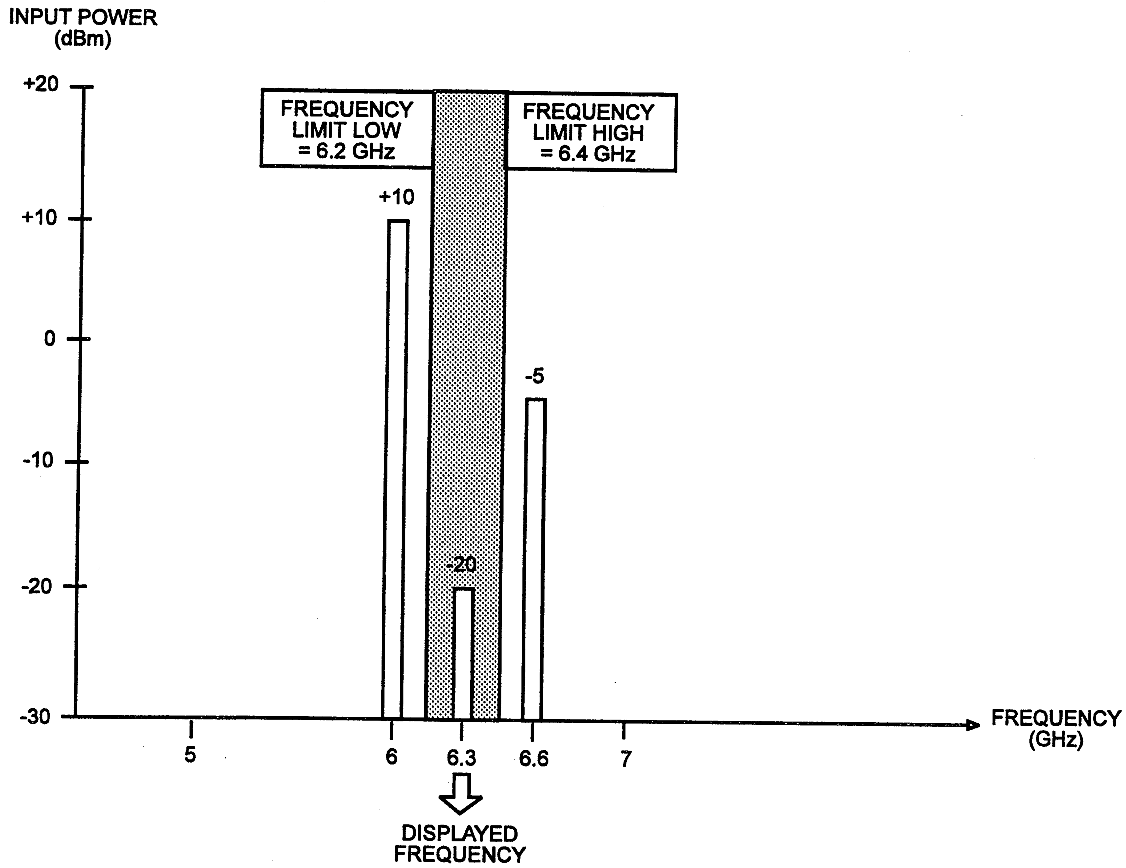

Figure 3-7. Frequency Limits.

If the signals shown in Figure 3-7 are applied to Band 2, the counter will automatically find the signal at 6 GHz since it is the largest signal. If it is desired to measure the signal at 6.3 GHz, set the frequency limit low to 6.2 GHz and the frequency limit high to 6.4 GHz. This will prevent the counter from seeing either the signal at 6 GHz or the signal 6.6 GHz.

The counter also provides a center frequency mode. In this mode, the counter automatically sets frequency limits around the specified center frequency. Referring back to Figure 3-7, the signal at 6.3 GHz could also be measured by entering a center frequency of 6.3 GHz. In the center frequency mode, the counter will lock on signals within 50 MHz of the specified center frequency.

PULSE PROFILING

Automatic pulse measurements determine the average frequency across a pulse. In some cases, however, additional information may be required. For example, a pulsed magnetron may exhibit substantial frequency shift near the leading and trailing edges of the pulse, or a pulsed Gunn diode oscillator may exhibit frequency shift during a pulse due to peak power thermal effects. Measurements of these characteristics are easily made using only the counter and a delaying pulse generator (See Figure 3-8).

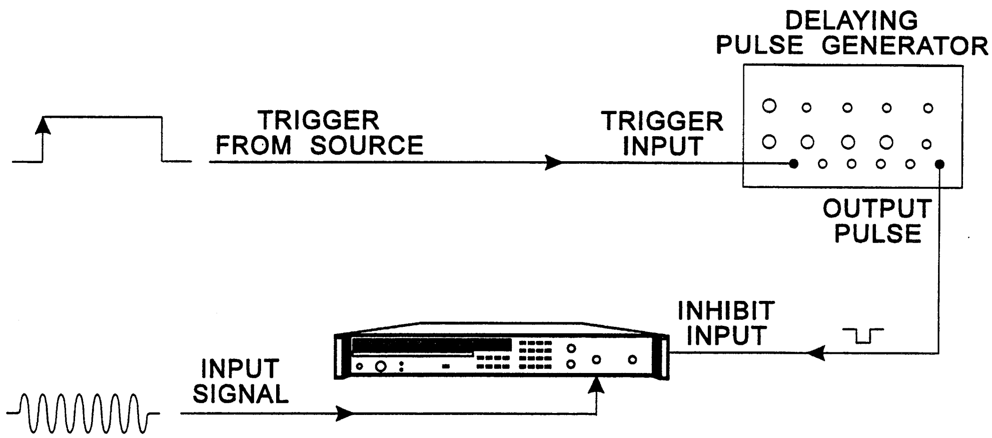

Figure 3-8. Pulse Profile Measurement Test Setup.

The output pulse of the signal generator is used as an enable input to the counter. As the pulse delay is varied, the measurement window can be "walked" through the pulse. A plot of frequency-versus-delay gives the frequency-versus-time profile of the pulse directly, as shown in Figure 3-9. The width of the measurement window is determined by the width of the pulse generator output. Measurement windows as narrow as 15 ns can be used, although wider windows yield higher accuracy.

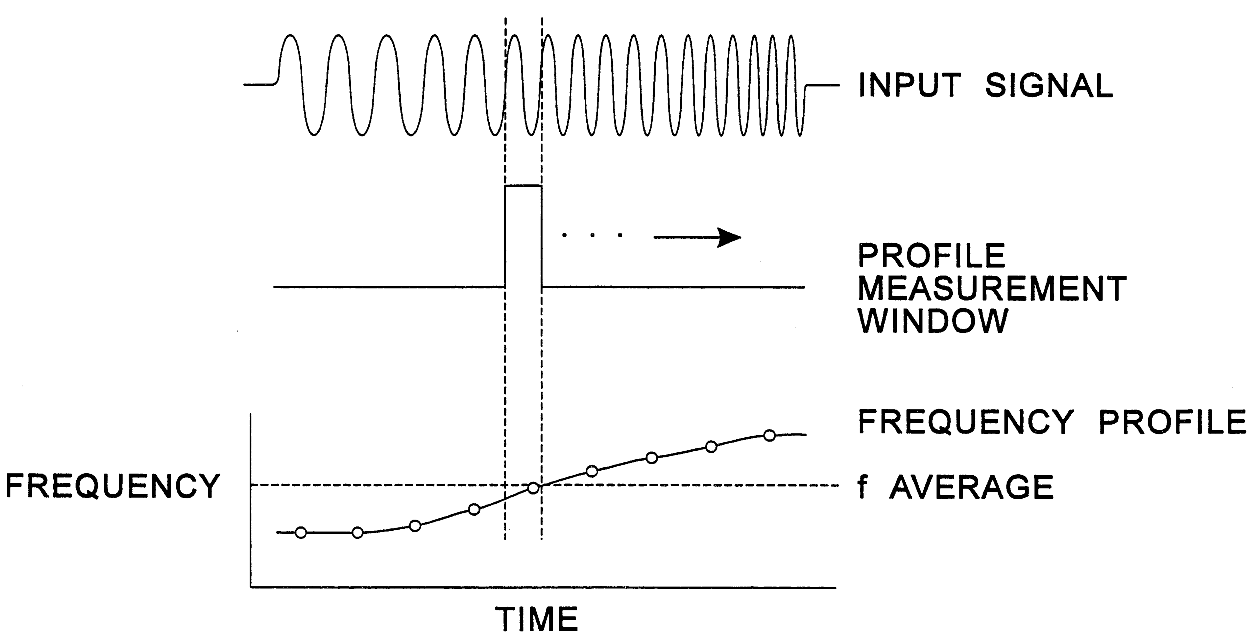

Figure 3-9. Pulse Profile Measurement.

VCO SETTLING TIME MEASUREMENTS

Many complex signals are not pulsed at all, but are continuous signals with frequencies that vary repetitively over time. One example is a settling time measurement of a voltage controlled oscillator (VCO). When a voltage step is applied to the tuning voltage input on a VCO its output frequency will change to reflect the voltage change on the tuning input. However, as shown in Figure 3-10, it takes the VCO a finite amount of time to settle in at the new frequency. The amount of time it takes for the VCO to settle in at the new frequency within some predetermined limits is specified as its settling time. A typical VCO settling time specification would require that the frequency output be within ±10 MHz of the settled frequency within 1 µs after the voltage step is applied to the tuning input on the VCO.

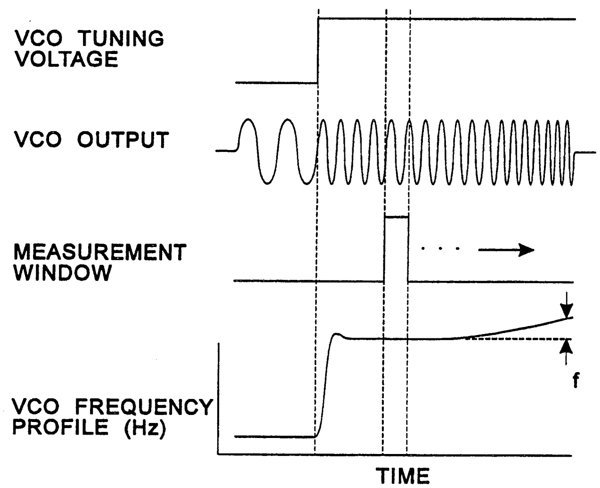

Figure 3-10. VCO Settling Time Measurements.

VCO settling time measurements can easily be made using the counter and a delaying pulse generator as shown in Figure 3-11.

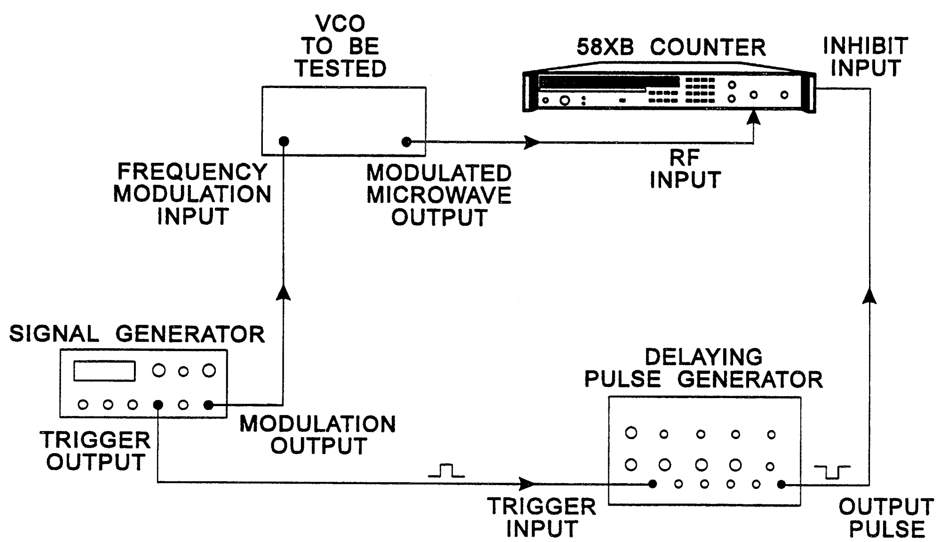

Figure 3-11. Time Varying Signal Measurement Test Setup.

FREQUENCY AGILE PULSE MEASUREMENTS

Another type of measurement is that of a repetitive sequence of pulses that differ in frequency. In this case, it is desirable to measure the frequency of each pulse in the sequence separately. The same test setup as shown in Figure 3-11 is required, with the trigger pulse synchronous with the sequence. In this measurement, the input inhibit is used to discriminate between pulses. The enabling pulse can be slightly wider than the pulse to be measured. By shifting the delay time of the enabling pulse, the user can measure each input pulse of the sequence separately.

TIMING CONSIDERATIONS

The internal timing usually should be of no concern to the user. However, in applications where a few nanoseconds are significant, two factors of internal operation must be considered. These involve two areas. One factor is the measurement window width, and the other is the internal timing delays.

Measurement Window Width

The measurement window width is the period during which the gate is actually open to enable the counting of a signal. This gate width will typically be 30 ns narrower than the pulse applied to the INHIBIT IN connector. The width of the gate is always an integral number of clock periods (12.5 ns). For applications where the measurement window must be known to an accuracy better than 20 ns, it is recommended that the gate output on the rear panel be observed on a high speed oscilloscope. The desired gate width may be set by varying the input inhibit pulse width. For accurate pulse representation, the oscilloscope input should be terminated in a 50 Ω load.

Internal Timing Delays

When it is necessary to measure the signal frequency at a precise point in time, the internal delays of the measuring instrument can be significant. In the EIP 585B and 588B counters, the total delay between the time a signal is applied to an input connector and the time it is available to be counted is nominally 60 ns. The signal threshold output on the rear panel typically occurs 20 ns after the signal is applied. The gate signal at the rear panel occurs at the measurement time with virtually no delay. In other words, when absolute time positioning of a signal is required, it is necessary to consider that the gate signal (representing the measurement period) is actually making a measurement of the signal which appeared at the input connector 60 ns earlier. If the signal threshold output is used as an indication of input signal, then it occurs 40 ns prior to measurement. Figure 3-12 shows the relative timing of these signals for a pulsed input signal. Timing, however, is not a function of input signal characteristics.

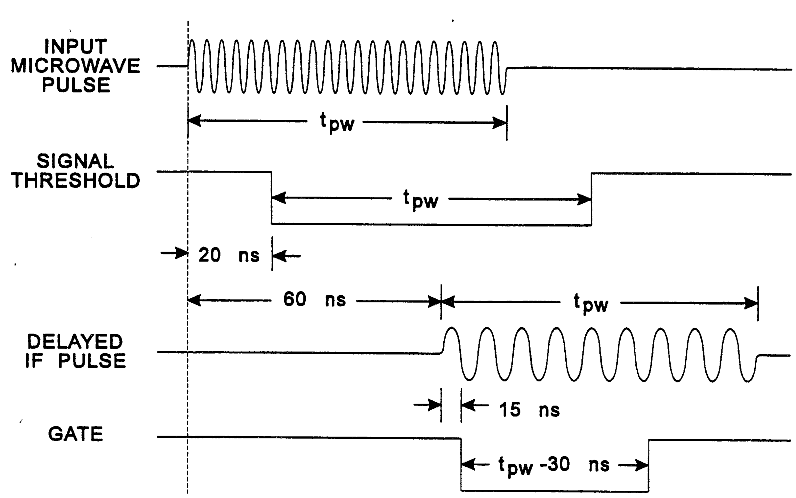

Figure 3-12. Internal Timing Delays.

ACCURACY

When making any type of measurement, some degree of measurement error exists. In EIP's CW type frequency counters, as with most other CW counters, these errors are limited to a combination of timebase error, gate phasing error (±1 count), and gate width error. In making frequency measurements on pulsed RF signals, the preceding errors, along with one additional error due to distortion of the pulsed RF signal, affect measurement accuracy. To minimize these errors and to properly interpret the results of the measurements, the magnitude of these errors must be known.

CW MEASUREMENT ACCURACY

When measuring CW signals the measurement accuracy is specified as:

Total error = timebase error ±1 count
(Based on measurement averaging)

Timebase error causes an error in the measured frequency proportional to the error in the timebase oscillator. For example, if the 10 MHz oscillator is off frequency by 3 Hz, the corresponding measurement error on a 1 GHz signal would be 300 Hz. For an 18 GHz signal, the same 3 Hz error in the timebase would cause a measurement error of 5.4 kHz. The maximum error in the timebase is the sum of the various possible errors, such as aging rate and temperature stability.

The second type of error, ±1 count, is due to the lack of phase coherence between the gate and the signal. Simply stated, if an event occurs every 400 ms (F = 2.5 Hz), a counter could measure either 2 or 3 events in a one second interval.

The above note "based on measurement averaging" is included due to a random instrumentation error in the counter. This error can be virtually eliminated by averaging measurements.

PULSE MEASUREMENT ACCURACY

Each of the sources of CW measurement error contribute to the overall error in pulsed frequency measurements, along with gate error and distortion error. For narrow pulses, the averaging error and gate error can become the dominant sources of error for pulse measurements. The following list describes the source of potential measurement errors when using the EIP 585B and 588B counters.

Timebase Error

A frequency error in the timebase reference oscillator results in a proportional frequency measurement error. Two main sources of timebase error are aging rate and temperature stability. Aging rates of less than 1×10^{-7} parts per month, and temperature stability of 1×10^{-6} over the range of 0 to 50 °C, are standard on the 585B and 588B counters.

Following are sample calculations for determining the measurement error of the counter, based on the timebase aging rate.

Given: Aging rate: 1×10^{-7}/month
Calibration interval: 6 months
Frequency: 20 GHz

Calculation: Error = ± (aging rate x cal. interval x frequency)

$$= \pm \left(\frac{1 \times 10^{-7}}{\text{mo.}} \times 6\text{ mo.} \times 2 \times 10^{10}\text{ Hz}\right)$$
$$= \pm (6 \times 10^{-7} \times 2 \times 10^{10}\text{ Hz})$$
$$= \pm (12 \times 10^{3}\text{ Hz})$$
$$= \pm 12\text{ kHz}$$

Counter measurement, after a six-month calibration interval, could have an error of ±12 kHz in measuring a 20 GHz signal.

Given: Aging rate: 1×10^{-7}/month
Calibration interval: 12 months
Frequency: 20 GHz

Calculation: Error = ± (aging rate x cal. interval x frequency)

$$= \pm \left(\frac{1 \times 10^{-7}}{\text{mo.}} \, 6 \text{ mo.} \times 2 \times 10^{10} \text{ Hz}\right)$$
$$= \pm (12 \times 10^{-7} \times 2 \times 10^{10} \text{ Hz})$$
$$= \pm (24 \times 10^{3} \text{ Hz})$$
$$= \pm 24 \text{ kHz}$$

Counter measurement after the recommended 12-month calibration interval could have an error of ±24 kHz in measuring a 20 GHz signal just due to timebase aging.

These examples are to illustrate error due to the timebase aging rate only. Actual calculations of measurement error must include the other sources of error discussed in the following text.

Averaging Error

This error is caused by the relative timing between the gate and the incoming signal and results in an uncertainty of ±1 count in the least significant digit of each measurement. If the counter resolution is set to 10 kHz, then the potential error is ±10 kHz. On signals having pulse widths less than the required gate time (determined by the resolution), the counter will generate more than one gate per measurement cycle. If the counter generates N number of gates, then an uncertainty of ±N counts is possible though very unlikely. The resultant averaged measurement follows the rules of statistics in that, on successive gates, the ±1 count error will vary randomly to a certain degree. In fact, most of the readings (63%) will fall between ± the square root of N, where N is the number of gates required to accumulate the required gate time. This is called the RMS averaging error. In the following formulas, N=RES/GW. It should be noted that the total gate time is typically 30 ns narrower than the input pulse. The RMS averaging error, in Hz, can be calculated by using the following formulas:

Bands 1 and 3: averaging error (RMS) = $\pm 2\sqrt{RES/GW}$

Band 2: averaging error (RMS) = $\pm\sqrt{RES/GW}$

Where: RES is the specified instrument resolution in Hz, up to 1 MHz. Above 1 MHz, RES is always 1 MHz. GW is the logical AND of the pulse width and the inhibit signal minus 30 ns. See Figure 3-13 for a graphical description of the logical AND function.

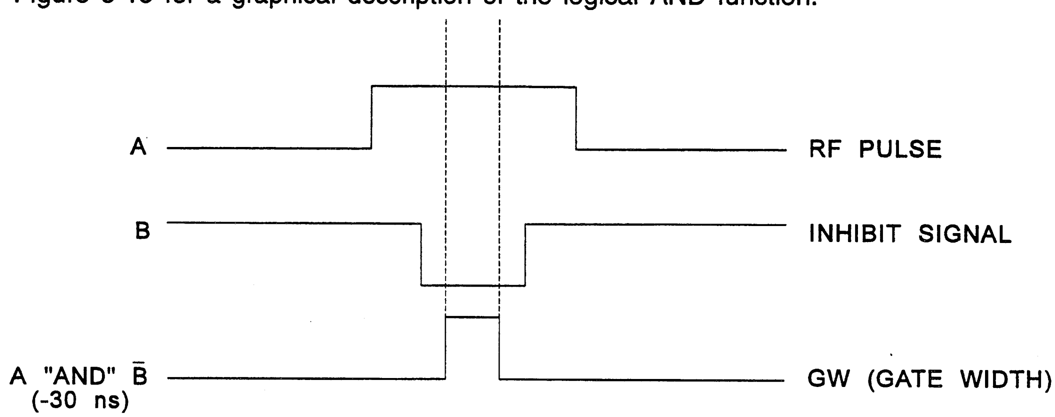

Figure 3-13. Logical "AND" Function.

Gate Error

When narrow pulses are counted, the gate is opened and closed many times in order to accumulate enough gate time to provide the required resolution. Each time the gate opens and closes, there will be a small but finite error. The total error is proportional to the number of times the gate is cycled during a measurement, and is inversely proportional to the gate width. This error is also related to both temperature and input frequency. In the 585B and 588B counters, the worst case gate error, including all variables, is specified as:

Band 1: gate error = ±0.07/GW

Band 2: gate error = ±0.01/GW

Band 3: gate error = ±0.03/GW

Where: GW, in seconds, is the logical AND of the pulse width and the inhibit signal minus 30 ns. Unlike averaging error, which is random, gate error is systematic, and is not reduced by averaging.

Distortion Error

During the first and last few nanoseconds of a pulse, phase distortion caused by impedance mismatches or video effects can occur, resulting in shifts in time of the zero crossing. On wide pulses, distortion error is insignificant; however, on narrow pulses it may become the dominant source of error. To reduce the effect of distortion error on count accuracy, the 585B and 588B counters automatically adjust the gate to start 15 ns after the pulse begins, and to end 15 ns before the end of the pulse. The specified maximum distortion error for all three bands can be calculated from the following formula:

Maximum Distortion Error = ±0.03/(PW - 30 ns)

Where: PW = pulse width (minimum pulse width is 50 ns).

TECHNIQUES FOR IMPROVING ACCURACY

In most cases, the specified counter accuracy will be more than sufficient to meet measurement requirements. If greater accuracy is required, all four sources of error can be minimized by a combination of calibration, long term averaging, added correction factors, and signal conditioning.

TIMEBASE CALIBRATION

A frequency error in the internal timebase oscillator results in a proportional error in the frequency reading for either CW or pulsed signals. The aging rate of the internal timebase is specified to be less than 1 X 10^{-7} parts per month. This means that if the oscillator were set precisely on frequency at the beginning of the month, it could be 1 Hz off frequency at the end of the month. On a frequency measurement of 18 GHz, a 1 Hz error in the 10 MHz timebase would cause a measurement error of 1.8 kHz. Other errors can result from changes in ambient temperature. Measurement errors caused by the timebase can be reduced by adjusting the timebase at the temperature it will be used using a standard of known accuracy. Another error reduction method is to use an external 10 MHz timebase with a known degree of accuracy, such as an oven oscillator, or a 10 MHz frequency standard.

REDUCING AVERAGING ERROR

Averaging error is reduced to ±1 count whenever the gate width (GW) is greater than 1/RES where RES is the counter resolution in Hz. Since the averaging error is random in nature, it can also be reduced by increasing the number of individual gates. This can be accomplished by increasing the resolution of the counter and/or averaging a number of individual measurements. The counter allows 1 kHz maximum resolution and can automatically average up to 99 individual measurements internally. With the GPIB and a controller, the user can average a larger number of individual measurements, which will virtually eliminate averaging error. The following formulas can be used to determine the averaging error (RMS) when averaging a number of individual measurements.

Bands 1 and 3: averaging error (RMS) = $\pm 2 \sqrt{RES/[(GW)(AVG)]}$

Band 2: averaging error (RMS) = $\pm \sqrt{RES/[(GW)(AVG)]}$

Where: RES is the specified instrument resolution in Hz, up to 1 MHz. Above 1 MHz, RES is always 1 MHz. GW is the logical AND of the pulse width and the inhibit signal minus 30 ns. AVG is the number of individual measurements to be averaged.

REDUCING GATE ERROR

Gate error at any given frequency and pulse width can also be virtually eliminated by comparing a CW frequency measurement to a simulated pulsed frequency measurement and computing a correction factor due to gate error. This correction factor can then be added to, or subtracted from, the indicated pulsed measurement to obtain the corrected frequency. The CW signal should be the same frequency (within 25 MHz) as that of the actual pulsed signal to be measured. To simulate a pulsed signal, apply an enable signal (of the same width as the pulse to be measured) to the INHIBIT IN connector on the rear panel. a single measurement will contain both averaging error and gate error. Averaging measurements will reduce averaging error by the square root of the number of measurements averaged. If 100 measurements are averaged, the averaging error will be reduced by a factor of 10. Gate error, and any residual averaging error, is the difference in reading between the pulsed and nonpulsed measurement of the same CW signal.

Example: Pulse frequency = 2 GHz
Pulse width = 2 µs

1. Apply a CW signal to the counter at 2 GHz ±25 MHz and record the displayed frequency. This frequency will be called F1.

2. Apply an ECL signal with a pulse width of 2 µs at the INHIBIT IN connector on the rear panel. Set the counter to average 99 readings. The frequency displayed on the counter will be called F2.

3. Gate Error = F2 - F1

NOTE

This procedure avoids errors associated with pulsed signal distortion and any possible pulling of the signal source. It should be noted that by using Special Function 92, gate error can also be automatically calibrated out of the system for a given pulse width and frequency. However, the calibration procedure may result in additional errors for other pulse widths or frequencies. For additional information on Special Function 92, see the service manual.

REDUCING DISTORTION ERROR

Since distortion error is most significant on the edges of the pulse, it may be reduced by using the counter inhibit feature to measure only in the middle of the pulse; however, measuring only the middle of the pulse narrows the gate, and gate error will increase. For pulses less than 70 to 80 ns, this may add more error than it removes. The performance test section of the service manual describes a method of determining the magnitude of this error that can be used to determine the improvement in accuracy achieved by using the inhibit function.

CALCULATING MEASUREMENT ACCURACY

Following is a sample calculation for determining the maximum specified measurement error for a typical pulse frequency measurement.

Given:	Frequency:	18 GHz
	Pulse Width:	530 ns
	Resolution:	100 kHz

- TIMEBASE ERROR (TBE) (Based on 6 Hz error from 10 MHz timebase) _ _ _ _ _ ±10.8 kHz

  TBE = (6 Hz/10 MHz) (18 GHz) = 10.8 kHz

NOTE

The direction of the timebase error is not specified, so it is not known whether the timebase error caused the indicated reading to be higher or lower. If the actual frequency of the timebase was 6 Hz high, then its period would be reduced and the counter would indicate a lower frequency.

- RMS AVERAGING ERROR (AE) _ ±45 kHz

  $AE\ (RMS) = \pm\sqrt{RES/[(GW)\ (AVG)]}$

  Where: RES = specified counter resolution
  GW = (pulse width AND inhibit signal) - 30 ns
  AVG = number of measurements averaged

  $AE\ (RMS) = \pm\sqrt{(100E3)/[(500E{-}9)\ (99)]} = \pm 45$ kHz

NOTE

To reduce the averaging error for this example, the measurement averaging feature of the counter was used. If it had not been used, the averaging error would have been ±450 kHz.

- GATE ERROR (GE) (Worst Case) _ ±20 kHz

  GE = ±0.01/GW

  Where: GW = (pulse width AND inhibit signal) - 30 ns

  GE = ±0.01/(500E-9) = ±20kHz

- DISTORTION ERROR (DE) (Worst Case) _ ±60 kHz

  DE = ±0.03/(PW - 30 ns)

  Where: PW = pulse width

  DE = ±0.03/(530 ns - 30 ns) = ±60 kHz

- TOTAL ERROR = SUM OF INDIVIDUAL ERRORS _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ ±136 kHz

NOTE

The total measurement error, as calculated above, is the worst case error. The errors that make up the total error would not under normal circumstances be additive. Errors in opposite directions would offset one another, with the effect of reducing the total error.

MEASUREMENT ACCURACY WORKSHEET

The following worksheet can be used to determine the maximum specified measurement error for a particular application. To determine the specified maximum error, select the desired operating parameters and use the formulas given to determine the magnitude of each type of error.

VARIABLES: Frequency (F): ______________
Pulse width (PW): ______________
Counter resolution (RES): ______________

SUM INDIVIDUAL ERRORS

- TIMEBASE ERROR

This error can be determined by accurately measuring the frequency at the rear panel 10 MHz IN/OUT connector. The frequency measured (F mea) is then used in the following formula to determine measurement error.

TBE = ((10 MHz - F mea)/10 MHz)(F) ______________

Where: F mea = measured timebase frequency
F = input frequency

- RMS AVERAGING ERROR

Bands 1 and 3: AE (RMS) = $\pm 2\sqrt{RES/[(GW)(AVG)]}$ ______________

Band 2: AE (RMS) = $\pm\sqrt{RES/[(GW)(AVG)]}$ ______________

Where: RES = specified counter resolution in Hz up to 1 MHz. Above 1 MHz resolution, the counter's internal resolution remains at 1 MHz.
GW = (pulse width AND inhibit signal) - 30 ns
AVG = number of measurements averaged

NOTE

If GW is > 1/RES then AE = ±1 count

- GATE ERROR (Worst Case)

Band 1: GE = ±0.07/GW ______________

Band 2: GE = ±0.01/GW ______________

Band 3: GE = ±0.03/GW ______________

Where: GW = (pulse width AND inhibit signal) - 30 ns

- DISTORTION ERROR (Worst Case)

DE = ±0.03/(PW - 30 ns) ______________

Where: PW = pulse width

TOTAL ERROR = sum of individual errors ______________

SPECIAL FUNCTION DIRECTORY

Counter special functions can be divided into three categories:

1. Counter operation verification
2. Calibration/troubleshooting aids
3. Counter capability enhancements

The special functions are grouped according to the above categories. Further information about how each one works is summarized at the end of each discussion. The summary covers the following features:

- ONE-SHOT OR CONTINUOUS ACTION

  One-shot action functions - automatically revert the counter to its normal operation after a specific action has been taken. These special functions are designated ONE-SHOT.

  Continuous action functions - supersede all normal operations of the counter and cause it to stay in the special function mode until the user terminates the function. Most continuous action functions can be terminated by pressing any key on the keyboard or entering any function command through the GPIB interface. After the special function is terminated, the function corresponding to the key pressed or the command entered will be serviced and a reset will be generated. Exceptions to the above termination sequence will be stated in the individual special function descriptions. These functions are designated STOP/RESET or STOP/NO RESET as applicable.

- SPECIAL FUNCTION (SPC) INDICATOR ON OR OFF: at the end of a special function description, this indicates whether the SPC status indicator on the front panel is on or off upon exiting the special function.

- SPECIAL STATUS BIT (SB) ON OR OFF: indicates whether the special on/off bit in the status byte is on or off during the special function.

ACTIVATION OF SPECIAL FUNCTIONS

CAUTION

Executing Special Function 46, 76, 91, or 92 can cause a loss of calibration data. To prevent this from occurring, access to these functions is blocked by an internal memory protect feature. Attempting to access these functions with the memory protected will cause the counter to display "ERROR 53".

Special functions can be activated through both the front panel keyboard and the GPIB interface. To activate a special function through the keyboard, press the SPECIAL key followed by two digit keys. To activate a special function through the GPIB interface, enter the word SPECIAL followed by a two-digit number. Activating special functions will not alter any previously entered parameters unless specifically stated. To terminate all previously activated special functions: press the SPECIAL key and the the 0 key followed by the 0 key again; or, press the SPECIAL key followed by the CLEAR DATA key. To terminate all special functions using GPIB, issue the command SPECIAL 00.

OPERATION VERIFICATION FUNCTIONS

Special Functions numbered 01 through 09 provide the user with a means of verifying that the counter is operational.

SPECIAL FUNCTION 01 --- 100 MHz Self Test

This function verifies that the count chain, gate generator, and VCO are operational.

When this function is entered, the counter:

1. Exits the current band
2. Sets the hardware to the self-test mode
3. Sets the VCO to 400 MHz
4. Sets the counter to take frequency measurements only
5. Starts measurement cycles

The display shows the frequency measurement results. These results are output to the GPIB interface when frequency readings are requested. The measurement result should be 100 MHz ±1 count.

STOP/RESET SPC INDICATOR: ON SPECIAL SB: ON

SPECIAL FUNCTION 02 --- Light Display Segments Test

This function verifies that all the digit segments and annunciator LEDs are operational. When this function is activated, all digit segments and all annunciators will be turned on. The GATE and the SEARCH annunciators will both be on for the duration of the special function.

STOP/RESET SPC INDICATOR: ON SPECIAL SB: ON

SPECIAL FUNCTION 03 --- Scan Display Segments Test

Each segment in all the digits and banks of annunciators is turned on sequentially by this function to test the display segment drivers. The scan rate is determined by the setting of the SAMPLE RATE control.

STOP/RESET SPC INDICATOR: ON SPECIAL SB: ON

SPECIAL FUNCTION 04 --- Scan Display Digits Test

Each digit and each bank of annunciators is turned on sequentially by this function to check the display digit driver. The scan rate is determined by the setting of the SAMPLE RATE control.

STOP/RESET SPC INDICATOR: ON SPECIAL SB: ON

SPECIAL FUNCTION 05 --- Keyboard Test

This function verifies the operation of the keyboard.

After this function is activated the counter stops normal operations and the display shows the key code of the last key pressed. When a new key is pressed, the display is updated to show the code of the new key. When the GPIB controller requests a key code, the code of the last key pressed is output. (If the controller requests a key code, the counter outputs to the GPIB interface the code of the last key pressed even if Special Function 05 is not activated). If the counter is in LOCAL, this function must be terminated by the CLEAR DISPLAY key. If it is in remote, this function can be terminated by any device-dependent command.

STOP/RESET SPC INDICATOR: ON SPECIAL SB: ON

SPECIAL FUNCTION 06 --- PROM Check Sum Test

This function generates the check sum for each PROM in the counter and compares it with the check sum table stored in the firmware. If all the check sums generated are correct, the counter displays the word "PASSEd" on the front panel. If any one of the check sums is incorrect, an error message corresponding to that particular check sum is output to the display. At the same time, the error condition status bit in the GPIB serial poll status byte will be set. During check sum generation, "SPECIAL 06" is displayed.

ONE-SHOT   SPC INDICATOR: ON   SPECIAL SB: ON

SPECIAL FUNCTION 07 --- Display Counter Model Number

This function enables the user to find out whether the counter is configured as a 585B or 588B counter. After the appropriate model number is displayed on the front panel, the counter returns to the measurement mode. No reset is generated.

ONE-SHOT   SPC INDICATOR: ON   SPECIAL SB: ON

SPECIAL FUNCTION 08 --- External Timebase Select

Selecting this function configures the counter to external timebase input mode.

ONE-SHOT   SPC INDICATOR: OFF   SPECIAL SB: ON

SPECIAL FUNCTION 09 --- Internal Timebase Select

Selecting this function configures the counter to internal timebase mode.

ONE-SHOT   SPC INDICATOR: OFF   SPECIAL SB: ON

CALIBRATION AND TROUBLESHOOTING FUNCTIONS

Special Function numbers 20, 40-42, 44-47, 91, and 92 aid the user in calibrating and/or troubleshooting the counter.

SPECIAL FUNCTION 20 --- Band 2 Detected RF Level

This function verifies coarse calibration of the Band 2 YIG DAC offset and YIG DAC slope adjustments.

When this function is activated, the counter waits for the user to enter the new YIG calibration frequency. The previously entered frequency number and "Fr" are displayed in the frequency section and the pulse parameter section of the display, respectively. The special function stops in this state until the user enters a new frequency number; or, if the previously entered frequency number is the required frequency, the kHz key can be pushed to tell the special function to continue.

After the number has been entered, the YIG DAC is set to the entered frequency number. The display shows "CAL DAC" plus a number from 1 to 8 that corresponds to the information on the Band 2 power discrimination circuitry. The counter will output the power discrimination circuitry information when requested by the GPIB to output LEVEL. (For more calibration information, see the service manual.)

STOP/RESET   SPC INDICATOR: ON   SPECIAL SB: ON

SPECIAL FUNCTION 40 --- Sweep YIG DAC

When this function is activated, the counter waits for the user to enter the start frequency of the YIG sweep. The previously entered start frequency and "F1" are displayed in the frequency section and the pulse parameter section of the display, respectively. The special function stops in this state until the user enters a new start frequency or, if the previously entered frequency is the required start frequency, the user presses the kHz key to tell the special function to continue.

After the start frequency is entered, the counter waits for the user to enter the stop frequency of the YIG sweep. The previously entered stop frequency and "F2" are displayed in the frequency section and the pulse parameter section of the display, respectively. The special function will stop in this state until the user enters a new stop frequency or, if the previously entered frequency is the required stop frequency, the user presses the kHz key to tell the special function to continue.

When both the start and stop frequencies have been entered, the display reverts to displaying "SPECIAL 40." The YIG DAC sweeps continuously from F1 to F2 in steps determined by the difference between the low and high sweep limit (Step Size = [High - Low]/512) until the function is terminated. The minimum step size is 2 MHz. The sweep rate is controlled by the setting of the SAMPLE RATE control. Maximum sweep rate may be obtained by disabling the sample rate (Special Function 63) before calling this function. If F1 and F2 are equal, the YIG DAC will be set to the frequency corresponding to F1 and F2.

To activate this function in remote, the user programs the controller to output SPECIAL 40. The start and stop frequencies used will be the frequencies specified in the GPIB commands Y1FREQ and Y2FREQ (where Y1FREQ and Y2FREQ correspond to F1 and F2 respectively). If the start or stop frequency required is different from that specified in Y1FREQ or Y2FREQ respectively, the number in that frequency register must be updated before Special Function 40 is activated.

STOP/RESET SPC INDICATOR: ON SPECIAL SB: ON

SPECIAL FUNCTION 41 --- Sweep VCO with VCO Power Amplifier On

After this function is activated, the counter waits for the user to enter the start frequency of the VCO sweep. The previously entered start frequency and "F1" are displayed in the frequency section and the pulse parameter section of the display, respectively. The special function will stop in this state until the user enters a new start frequency or, if the previously entered frequency is the required start frequency, the user presses the kHz key to tell the special function to continue.

After the start frequency is entered, the counter waits for the user to enter the stop frequency of the VCO sweep. The previously entered stop frequency and "F2" will be displayed in the frequency section and the pulse parameter section of the display, respectively. The special function will stop in this state until the user enters a new stop frequency or, if the previously entered frequency is the required stop frequency, the user presses the kHz key to tell the special function to continue.

When both the start and stop frequencies have been entered, the display will revert to displaying "SPECIAL 41". The VCO sweeps continuously from F1 to F2 in 50 kHz steps until the function is terminated. The sweep rate is controlled by the sample rate. Maximum sweep rate may be obtained by disabling the sample rate (Special Function 63) before calling this function. If F1 and F2 are equal, the VCO will be set to that particular frequency. The VCO power amplifier is turned on during this function.

To activate this function in remote, the user instructs the controller to output SPECIAL 41. The start and stop frequencies used will be the frequencies specified in the GPIB commands V1FREQ and V2FREQ (where V1FREQ and V2FREQ correspond to F1 and F2 respectively). If the start or stop frequency required is different from that specified in V1FREQ or V2FREQ, the number in that frequency register must be updated before SPECIAL 41 is activated.

STOP/RESET SPC INDICATOR: ON SPECIAL SB: ON

SPECIAL FUNCTION 42 --- Sweep VCO with VCO Power Amplifier Off

After this function is activated, the counter waits for the user to enter the start frequency of the VCO sweep. The previously entered start frequency and "F1" will be displayed in the frequency section and the pulse parameter section of the display, respectively. The special function will stop in this state until the user enters a new start frequency or, if the previously entered frequency is the required start frequency, the user presses the kHz key to tell the special function to continue.

After the start frequency is entered, the counter waits for the user to enter the stop frequency of the VCO sweep. The previously entered stop frequency and "F2" will be displayed in the frequency section and the pulse parameter section of the display, respectively. The special function will stop in this state until the user enters a new stop frequency or, if the previously entered frequency is the required stop frequency, the user presses the kHz key to tell the special function to continue.

When both the start and stop frequencies have been entered, the display will revert to displaying "SPECIAL 42". The VCO sweeps continuously from F1 to F2 in 100 kHz steps until the function is terminated. The sweep rate is controlled by the sample rate. Maximum sweep rate may be obtained by disabling the sample rate (Special Function 63) before calling this function. If F1 and F2 are equal, the VCO will be set to that particular frequency. The VCO power amplifier is turned off during this function.

To activate this function in remote, the user instructs the controller to output SPECIAL 42. The start and stop frequencies used will be the frequencies specified in the GPIB commands V1FREQ and V2FREQ (where V1FREQ and V2FREQ correspond to F1 and F2, respectively). If the start or stop frequency required is different from that specified in V1FREQ or V2FREQ, the number in that frequency register must be updated before SPECIAL 42 is activated.

STOP/RESET SPC INDICATOR: ON SPECIAL SB: ON

SPECIAL FUNCTION 44 --- Disable Normal Operations

This function prevents the counter from performing the normal converter lock and measurement cycles. It freezes the counter in the state it was in at the moment the function was activated. The display will show "PAUSE" and the STOP ON/OFF status bit will be set when this function is active. Special Function 44 remains activated until terminated through Special Function 45 or by pressing the SPECIAL key followed by the CLEAR DATA key, or by pressing the SPECIAL key followed by the 0 key and then the 0 key again.

STOP/RESET SPC INDICATOR: ON SPECIAL SB: ON

SPECIAL FUNCTION 45 --- Enable Normal Operations

This function reverses the action taken when Special Function 44 is activated. The function returns the counter to normal operation. A reset is generated and the STOP ON/OFF status bit is cleared when this function is activated.

STOP/RESET SPC INDICATOR: OFF SPECIAL SB: ON

SPECIAL FUNCTION 46 --- Display and/or Alter Memory

CAUTION

Care must be used when operating Special Function 46. Although the counter cannot be damage by this function, stored calibration data can be changed. For this reason, access to this function is blocked by an internal memory protect feature. Attempting to access this function with the memory protected will cause the counter to display "ERROR 53".

This function allows the user to display and/or alter any memory location. The counter continues its normal operations when performing this function unless Special Function 44 has previously been activated.

In the local mode, the keys on the keyboard take on different meanings after Special Function 46 is activated. Following are the definitions of the keys when the counter is in this function.

- All number keys remain number keys.
- GHz key = hexadecimal digit A.
- MHz key = hexadecimal digit B.
- kHz key = hexadecimal digit C.
- Hz key = hexadecimal digit D.
- . key = hexadecimal digit E.
- ± key = hexadecimal digit F.
- PULSE WIDTH key = INCREMENT command.
- PULSE PERIOD key = DECREMENT command.
- CLEAR DATA key = ADDRESS command.
- CLEAR DISPLAY and INIT keys remain the same.

After activating Special Function 46, the user can do one of the following:

- Exit the function by issuing a CLEAR DISPLAY command (pressing the CLEAR DISPLAY key).
- Alter the content of the memory location by entering an INCREMENT command (pressing the PULSE WIDTH key).
- Display the previous memory location by issuing a DECREMENT command (pressing the PULSE PERIOD key).
- Enter another memory address by first issuing an ADDRESS command (pressing the CLEAR DATA key).

If the content of a memory location is altered, the new content of that memory location is displayed in the pulse parameter section of the display. If the ADDRESS command is issued, the display will change to show "Addr_ _ _ _". While the address is being entered, the hexadecimal digits keyed in replace each blank sequentially. After the memory address is entered, the content of that memory location is displayed in the pulse parameter section of the display. This function must be terminated by the CLEAR DISPLAY command.

In the remote mode, a memory content can be interrogated by using the OUTPUT MEMORY command. When the counter is addressed to talk, the last memory address accessed will be output. A memory location can be accessed using the MEMORY 0HHHH command (where H is a hexadecimal digit). The content of a memory location can be altered using the MEMORY 0HHHH 0HH command. In the remote mode, Special Function 46 need not be activated when accessing and altering memory locations. Those operations can be done by the controller in the background.

STOP/RESET SPC INDICATOR: ON SPECIAL SB: ON

SPECIAL FUNCTION 47 --- Measure IF Only

This function provides the user with the means to measure the frequency of the IF signal, present at the input of the count chain assembly, without having the counter converter locked on the signal. The counter will not measure pulse parameters when this function is activated.

When Special Function 47 is activated, the counter stops the normal converter lock and measurement cycles. The VCO, YIG, and all microprocessor-controlled hardware switches are left at the state they were in when the function was activated. The counter then starts measuring the frequency of the IF signal present at the input to the count chain assembly. The measurement results are displayed on the front panel and are also output via the GPIB interface if frequency readings are requested. Note: this function does not check periodically for the presence of a signal as in the normal operation of the counter.

STOP/RESET SPC INDICATOR: ON SPECIAL SB: ON

CAPABILITY ENHANCEMENT FUNCTIONS

Special function numbers 61-70, 72-76, and 90 provide, to sophisticated users, those functions that are not required in the normal use of the counter.

SPECIAL FUNCTION 61 --- Disable Input Signal Tracking

This function configures the counter to skip the execution of the input signal tracking function that normally occurs after every measurement cycle. This function shortens the measurement cycle time, but prohibits the counter from tracking a moving signal.

The action taken with this function can be reversed by activating Special Function 62.

ONE-SHOT SPC INDICATOR: ON SPECIAL SB: ON

SPECIAL FUNCTION 62 --- Enable Input Signal Tracking

This function allows the user to reverse the action taken with Special Function 61.

ONE-SHOT SPC INDICATOR: OFF SPECIAL SB: OFF

SPECIAL FUNCTION 63 --- Disable Sample Rate Control

This function configures the counter to ignore the local and the remote sample rate controls. The counter measurement cycle rate is maximized, which shortens the measurement cycle time.

The action taken with this function can be reversed by activating Special Function 64.

ONE-SHOT SPC INDICATOR: ON SPECIAL SB: ON

SPECIAL FUNCTION 64 --- Enable Sample Rate Control

This function allows the user to reverse the action taken with Special Function 63.

ONE-SHOT SPC INDICATOR: OFF SPECIAL SB: OFF

SPECIAL FUNCTION 65 --- Disable Results Display

This function prohibits the output of measurement results to the front panel display. When Special Function 65 is activated, the front panel displays only a row of dots. When the user enters parameters through the keyboard, the display responds normally. This function shortens the measurement cycle time and provides security in systems used with classified frequencies.

The action taken with this function can be reversed by activating Special Function 66.

ONE-SHOT SPC INDICATOR: ON SPECIAL SB: ON

SPECIAL FUNCTION 66 --- Enable Results Display

This function is used to reverse the action taken by Special Function 65. When this function is activated, the display is immediately updated with the last measurement results.

ONE-SHOT SPC INDICATOR: OFF SPECIAL SB: OFF

SPECIAL FUNCTION 67 --- Display Pulse Repetition Frequency (PRF)

This function configures the counter to display the pulse period measurements as a frequency. It has no effect on pulse width measurements.

After this function is turned on, frequency measurements will NOT be displayed on the front panel. The pulse period will be displayed to the maximum available resolution, using the pulse parameter display as the 100 Hz, 10 Hz and 1 Hz digits. Since the PRF is derived mathematically from the period, the resolution will be a function of the period measurement resolution per the formula:

$$\text{Resolution (Hz)} = \frac{1}{\text{Period} \pm 10\text{ ns}} - \frac{1}{\text{Period}}$$

When requested by the GPIB bus controller to output a period measurement, the counter will output the period measurement instead of the PRF of the input signal.

If pulse period measurements are enabled, Special Function 67 has a higher priority than Special Function 69. That is, the front panel will be configured according to Special Function 67 if both Special Function 67 and Special Function 69 are activated.

This function is terminated when Special Function 68 is activated.

ONE-SHOT SPC INDICATOR: ON SPECIAL SB: ON

SPECIAL FUNCTION 68 --- Display Pulse Period

This function allows the user to reverse the action taken with Special Function 67.

ONE-SHOT SPC INDICATOR: OFF SPECIAL SB: OFF

SPECIAL FUNCTION 69 --- Display Pulse Parameter Measurements Only

When this function is activated, frequency measurements are not displayed on the front panel. Instead, the 12 digits on the front panel are devoted exclusively to displaying pulse parameter measurements to 10 ns resolution.

If the pulse period function is on, this special function has a lower priority than Special Function 67. That is, the front panel is configured according to Special Function 67 if both Special Function 67 and Special Function 69 are activated.

This function is terminated when Special Function 70 is activated.

ONE-SHOT SPC INDICATOR: ON SPECIAL SB: ON

SPECIAL FUNCTION 70 --- Display Frequency and Pulse Parameter Measurement

This function returns the counter to the normal mode of displaying measurement results, reversing the action taken by Special Function 69.

ONE-SHOT SPC INDICATOR: OFF SPECIAL SB: OFF

SPECIAL FUNCTION 72 --- Store Counter Setup and/or Default Values

This function serves two purposes. Its primary use is to store the present counter setup in the storage register specified. When this function is activated, the counter requests the user to enter the register number by displaying "REG _" on the front panel. The counter remains in this state until the user enters a number between 0 and 9. After the register number is entered, the function stores the current counter setup in the register specified. During this time, "REG N" is displayed on the front panel (where N is the register number entered).

This function also can be used to customize the default values used by the counter. The default values determine the state of the instrument at turn-on. This is accomplished by setting the instrument up in the desired turn-on condition and storing it in register 0. The information stored in register 0 is used to determine the power-on state of the counter. To clear the instrument back to the factory-set default values, select Special Function 72 and press the CLEAR DATA key.

ONE-SHOT SPC INDICATOR: OFF SPECIAL SB: OFF

SPECIAL FUNCTION 73 --- Recall Counter Setup

This function recalls the counter setup stored in the storage register specified.

When this function is activated, the counter requests the user to enter the register number by displaying "REG _" on the front panel. The counter remains in this state until the user enters a number between 0 and 9. After the register number is entered, the function proceeds to set up the counter according to the information stored in the register specified. During this time, "REG N" will be displayed on the front panel (where N is the register number entered).

When the counter finishes setting the counter up, a reset will be generated.

ONE-SHOT/RESET SPC INDICATOR: OFF SPECIAL SB: OFF

SPECIAL FUNCTION 74 --- Relative Frequency Readings

When this function is activated, the counter assigns a negative value to the last input frequency reading and enters it into the frequency offset register (overwriting any previously entered frequency offset). The last input frequency in this case means the actual frequency of the input signal, not the frequency displayed on the front panel, which may be affected by a frequency multiplier or another special function. The counter displays the difference between the last input frequency and the current one, subject to any other functions activated. It will continue to do so until the FREQ OFFSET and CLEAR DATA keys are pressed. The OFS annunciator is turned on when this function is activated.

ONE-SHOT SPC INDICATOR: OFF SPECIAL SB: ON

SPECIAL FUNCTION 75 --- Display IF Frequency Readings

When this function is activated, the counter assigns a negative value to the local oscillator (LO) frequency and enters it into the frequency offset register (overwriting any previously entered frequency offset). The counter then subtracts the LO frequency from the input frequency and displays the resulting IF frequency. It continues to do so until the FREQ OFFSET and CLEAR DATA keys are pressed. The OFS annunciator is turned on.

ONE-SHOT SPC INDICATOR: OFF SPECIAL SB: ON

SPECIAL FUNCTION 76 --- EEPROM Test

CAUTION

Care must be used when operating Special Function 76. Although the counter cannot be damaged by this function, if execution of this function is interrupted prior to completion a loss of the data contained in the EEPROM will occur. For this reason, access to this function is blocked by an internal memory protect feature. Attempting to access this function with the memory protected will cause the counter to display "ERROR 53".

This function provides the means for the user to test the EEPROM.

This function performs write and read tests on each location in the EEPROM. If any one location in the EEPROM fails the write and read tests, "ERROR 94" will be displayed. If all memory locations pass the tests, "PASSEd" will be displayed.

This function requires approximately eight minutes to complete. During those eight minutes, the counter will not respond to any entry from the keyboard.

ONE-SHOT SPC INDICATOR: ON SPECIAL SB: ON

SPECIAL FUNCTION 90 --- Display and/or Alter GPIB Address

When this function is activated, the counter displays the current address of the GPIB interface. If the address need not be changed, the function may be terminated by pressing the CLEAR DISPLAY or CLEAR DATA keys.

After this function has been activated, the GPIB address can be changed by entering a two-digit number between 01 and 99. The function is terminated and the display returned to displaying measurement results after the second digit key is released.

(Refer to the GPIB interface section, page 4-16, for meanings of GPIB addresses above 31.)

ONE-SHOT SPC INDICATOR: ON SPECIAL SB: ON

SPECIAL FUNCTION 91 --- YIG DAC Automatic Calibration

CAUTION

Care must be used when operating Special Function 91. Although the counter cannot be damaged by this function, improper operation of it can affect the counter calibration. For this reason, access to this function is blocked by an internal memory protect feature. Attempting to access this function with the memory protected will cause the counter to display "ERROR 53".

This function is used to calibrate the Band 2 input filter. Refer to the service manual for more information.

SPECIAL FUNCTION 92 --- Gate Accuracy Calibration

CAUTION

Care must be used when operating Special Function 92. Although the counter cannot be damaged by this function, improper operation of it can affect the counter calibration. For this reason, access to this function is blocked by an internal memory protect feature. Attempting to access this function with the memory protected will cause the counter to display "ERROR 53".

This function is used for calibration of the counter. Refer to the service manual for more information.

ERROR MESSAGES

When an error occurs, an error number will be displayed. The probable cause of each error is listed below.

01 KEY PUSHED NOT FUNCTION KEY
02 LOWER LIMIT HIGHER THAN HIGH LIMIT
03 LIMITS ENTRY ONLY IN BAND 2
04 CENTER FREQUENCY ENTRY ONLY IN BAND 2 OR BAND 3
05 CENTER FREQUENCY ENTRY OUTSIDE CURRENT BAND RANGE
06 NO VALID DATA IN STORAGE REGISTERS FOR RECALL FEATURE
07 CONVERTER UNABLE TO LOCK ON SIGNAL DURING SPECIAL
09 ILLEGAL REGISTER ENTRY
10 ILLEGAL BAND ENTRY
11 ILLEGAL SUBBAND ENTRY
12 ILLEGAL RESOLUTION ENTRY
13 ILLEGAL SPECIAL FUNCTION ENTRY
14 ILLEGAL AVERAGE ENTRY
15 ILLEGAL MULTIPLIER ENTRY
16 ILLEGAL FREQUENCY OFFSET ENTRY
17 ILLEGAL CENTER FREQUENCY ENTRY
18 ILLEGAL MINPRF ENTRY
19 ILLEGAL LOW LIMIT ENTRY
20 ILLEGAL HIGH LIMIT ENTRY
21 ILLEGAL SAMPLE RATE ENTRY
22 ILLEGAL SRQ NUMBER ENTRY
23 ILLEGAL GPIB ADDRESS
24 ILLEGAL VCO FREQUENCY 1 ENTRY
25 ILLEGAL VCO FREQUENCY 2 ENTRY
26 ILLEGAL YIG FREQUENCY 1 ENTRY
27 ILLEGAL YIG FREQUENCY 2 ENTRY
28 ILLEGAL YIG DAC FREQUENCY ENTRY
29 FREQUENCY OVERFLOW DUE TO MULTIPLIER
30 PULSE PARAMETERS MEASUREMENTS GREATER THAN SPECIFIED MINPRF
31 GPIB INPUT MESSAGE TOO LONG
32 GPIB MESSAGE STARTS WITH A NUMBER
33 GPIB MESSAGE STARTS WITH A WRONG NUMBER
34 UNIDENTIFIED WORD FOUND
35 WORD MISSPELLED
36 MISSING SPACE
37 WRONG MODE ARGUMENT
40 NON-NUMERIC PARAMETER VALUE
41 WRONG FREQUENCY TERMINATOR
42 WRONG TIME TERMINATOR
43 WRONG OUTPUT ARGUMENT

ERROR MESSAGES (Continued)

44 NUMERIC ARGUMENT SYNTAX ERROR
45 NUMERIC MANTISSA HAS TOO MANY DIGITS
46 NUMERIC EXPONENT HAS TOO MANY DIGITS
47 HEX DATA SHOULD PRECEDE WITH A ZERO
48 NO HEX MEMORY ADDRESS SPECIFIED
49 ILLEGAL HEX DATA ENTRY
50 ILLEGAL HEX ADDRESS ENTRY
51 ACTIVATE SPC 72 AND 73 through STORE AND FETCH
52 ILLEGAL ENTRY
53 ACCESS TO THIS FUNCTION BLOCKED BY MEMORY PROTECT SWITCH
60 RAM FAULT
61 ROM CHECK SUM ERROR: ADDR 4000 TO 7FFF
62 ROM CHECK SUM ERROR: ADDR 8000 TO BFFF
71 COUNT CHAIN BOARD MISSING
72 GATE GENERATOR BOARD MISSING
90 NO KEY RELEASE DETECTED
91 OPTION NOT INSTALLED
92 BAND 3 OPTION IN A 585B UNIT
93 BAND 3 WITH NO BAND 1 BOARD
94 NONVOLATILE MEMORY FAILURE
99 NO IF DETECTED

SECTION 4
PROGRAMMING

REMOTE PROGRAMMING

GENERAL PURPOSE INTERFACE BUS

The GPIB interface of the 585B/588B counters conforms to the IEEE Code and Format conventions and the IEEE 488-1978 Standards. With the GPIB interface, the counter can respond to remote control instructions and can output measurement results via the IEEE 488-1978 bus interface. At the simplest level, the counter can output data to other devices, such as a thermal printer. In more sophisticated systems, an instrument controller or computer can program the counter remotely, trigger measurements, and read results. A quick reference list of GPIB commands is located in Appendix A at the end of this manual.

GPIB FUNCTIONS IMPLEMENTED

The following GPIB interface function subsets are implemented:

Interface Function	Subset	Description
SOURCE HANDSHAKE	SH1	Complete capability
ACCEPTOR HANDSHAKE	AH1	Complete capability
TALKER	T5	Basic talker, serial poll, talk only mode, unaddress if MLA
LISTENER	L4	Basic listener, unaddress if MTA
SERVICE REQUEST	SR1	Complete capability
REMOTE/LOCAL	RL1	Complete capability
DEVICE CLEAR	DC1	Complete capability
DEVICE TRIGGER	DT1	Complete capability

The 585B/588B counters thus have the capacity to provide the following capabilities in remote operation to the user:

- Acceptance of device-dependent messages to set the instrument measurement mode and parameters. The input buffer can store up to 256 characters accepted from the bus. Execution of the device-dependent messages starts after the first message separator is accepted. Input of more characters will interrupt the execution so that the additional characters are accepted and stored for fast bus response (unless buffer is full).
- Output of measurement results or any parameter value or instrument mode on demand from the system controller.
- Configuration of the output format in several ways to accommodate different system controllers and speed requirements.
- Implementation of device clear and selected device clear function to configure the instrument to the power-on state. See page 4-14 for the counter's power-on configuration.
- Implementation of group execute trigger (GET) message to start a new measurement cycle.
- Implementation of serial poll functions to allow the system controller to get a status byte from the instrument that gives status information for various functions. The instrument can also be instructed to interrupt (SRQ) the controller on any ORed combination of the status events.

- Implementation of remote/local transitions. When the counter is in remote, all front and rear panel keys and switches are disabled (except the POWER switch). Remote/local transitions will not change any instrument configuration (except the sample rate settings, which will override in a remote-to-local transition). When the counter changes from local to remote functioning, or vice-versa, all stored information is retained. The counter will operate in the same state as it was in before the change. The only exception is when the counter is performing a special function, the special function will be terminated.
- Implementation of local lockout, with the INIT/LOCAL key disabled accordingly. When the counter is in remote, and local lockout is not active, the INIT/LOCAL key on the front panel acts as the return-to-local key.
- Availability of counter configuration information, in addition to the status events available in the status byte, by means of a special OUTPUT CONFIGURATION command. When the counter is configured as a talker, it will output five bytes that contain the current configuration.
- Recognition of all three bus terminators: CR LF (carriage return line feed), NL (null), and EOI (end or identify).
- Availability of front panel annunciators for remote (RMT), talker (TLK), listener (LSN), and (SRQ) that continuously show the interface state.
- Implementation of talk-only modes for no-controller applications.

DEVICE-DEPENDENT MESSAGES (LISTENER FEATURES)

A device-dependent message generally consists of reserved words and numbers. The message structure depends on the type of message, and can be:

- Header only
- Header and argument
- Header and argument and terminator

Where the header is a reserved word, the argument is a number or a reserved word, and the terminator is a reserved word.

Messages can be concatenated with a comma (,) or semicolon (;) as separators. A message chain can be terminated with CR LF or NL or EOI. Any device-reserved word will be recognized by at least two first characters, with the exception of RESET which requires the first four letters to be entered. These first two characters are printed in **large boldface** type in the following command lists and in program examples to promote user familiarity with the shortened form of the command. Spelling of more characters (up to the full word) is optional for user program readability.

Example: INITIALIZE
INITIAL — are all recognized equivalently.
INIT
IN

A <number> can be sent in any of the defined IEEE formats (NR1, NR2, NR3).

Example: 12000
12000.00 — are all recognized equivalently.
001.2e4
.12000E+5

The reserved word DEFAULT can replace a numeric argument for default value assignment.

The terminator in the parameter messages group is optional, and defaults to Hz or seconds.

A command message having more than one word (e.g., PERIOD ON) should have a space between words. However, this is optional if the second word is a number (OFFSET4.3e9 and OFFSET 4.3e9 are recognized equivalently). Additional spaces in front of words, between words, or after a message are optional, and will be ignored. Nulls and CRs are ignored anywhere. Both upper case and lower case characters are equally acceptable.

Following are the possible GPIB command messages for the 585B/588B series of counters.

Control Messages

Control, mode, and parameter messages are all used with the controller in the listener mode to enter instructions and data.

Header	Argument	Terminator	Description
CLEARDISPLAY	None	None	Returns the display to normal measurement results display, clear error. (Equivalent to front panel CLEAR DISPLAY key.)
INITIALIZE	"	"	Reconfigures the instrument to power-on state. (Equivalent to front panel INIT/LOCAL key.)
RESET	"	"	Resets counter to restart a new signal measurement cycle. (Equivalent to front panel RESET key.)
TRIGGER	"	"	Triggers a new measurement cycle. (Equivalent to front panel TRIG key.)

Mode Messages

Header	Argument	Terminator	Description
DYNAMIC	ON or OFF	None	Suppresses blanks when counter is configured in talker mode for faster free-field data transfer.
EXTERNAL	"	"	Selects the INT/EXT timebase reference. (Special Function 08 can also be used to select the external timebase.)
HEADER	"	"	Adds an alpha header and terminator for talker.
HOLD	"	"	Holds the last result if on. (Equivalent to front panel HOLD.)
PERIOD	"	"	Turns pulse period measurement on or off or DEFAULT. (Equivalent to front panel PULSE PERIOD key.)
SCIENTIFIC	"	"	Selects scientific notation for talker.
SEPARATE	"	"	Replaces the commas with CR LF between multinumber results.
WIDTH	"	"	Turns pulse width measurement on or off. (Equivalent to front panel PULSE WIDTH key.)

NOTE

In the local mode, SAMPLE RATE and HOLD are controlled via the front panel control, but in remote the front panel control has no effect. In the remote mode, both SAMPLE RATE and HOLD are under software control. Refer to GPIB SAMPLE RATE and HOLD commands.

Parameter Messages

Header	Argument	Terminator	Description
AVERAGE	<number>	None	Inputs an averaging value (01 to 99).
BAND	"	"	Selects a specific band (0 to 3) or DEFAULT.
CENTERFREQ	"	(Hz/kHz/MHz/GHz)	Sets a center frequency value and mode.
FETCH	"	None	Recalls counter setup stored in specified storage register (0 to 9). (Special Function 73.)
HIGHLIMIT	"	(Hz/kHz/MHz/GHz)	Sets a frequency limit high value.
LOWLIMIT	"	"	Sets a frequency limit low value.
MEMORY	<hex_adrs>	<hex_data>	Accesses a memory location and alters it (altering is optional). (Special Function 46.)
MEMORY	INCREMENT	"	Accesses the next memory location. (Special Function 46.)
MEMORY	DECREMENT	"	Accesses the previous memory location. (Special Function 46.)
MINPRF	<number>	(Hz/kHz/MHz/GHz)	Sets a minimum PRF value.
MULTIPLIER	"	None	Inputs a multiplier value.
OFFSETFREQ	"	(Hz/kHz/MHz/GHz)	Sets a frequency offset value.
RESOLUTION	"	None	Sets the frequency measurement resolution (0 to 9).
SAMPLERATE	"	(s/ms)	Sets a delay between measurement values (0 to 100 sec, 10 ms resolution).
SPECIAL	"	None	Activates a specific special function (00 to 99).
SRQMASK	"	"	Selects the ORed combination of status events to cause a service request.
STORE	"	"	Stores current counter setup in specified storage register (0 to 9). (Special Function 72.)
SUBBAND	"	"	Selects a specific Band 3 subband (1 to 6).
V1FREQ	"	(Hz/kHz/MHz/GHz)	Sets a start frequency for VCO sweep (Special Functions 41, 42).
V2FREQ	"	"	Sets a stop frequency for VCO sweep (Special Functions 41, 42).
Y1FREQ	"	"	Sets a start frequency for YIG sweep (Special Function 40).
Y2FREQ	"	"	Sets a stop frequency for YIG sweep (Special Function 40).

Output Control Messages

These commands are used with the controller in the talker mode to request the output of data.

Command	Description
OUTPUT **AV**ERAGE	Outputs the last specified averaging value.
OUTPUT **BA**ND	Outputs the number of the last specified band.
OUTPUT **CE**NTERFREQ	Outputs the center frequency last specified.
OUTPUT **CO**NFIGURATION	Outputs current configuration of instrument. See page 4-13.
OUTPUT **DA**TE	Outputs a 25-character string that contains part number, revision level, and date code of the software. The format is as follows: "#######-## REV.X MM-DD-YY"
OUTPUT **DE**FAULT	Outputs displayed data.
OUTPUT **ER**RORNUMBER	Outputs the number of the last error. See listing of error numbers on page 3-35.
OUTPUT **FR**EQUENCY (AND **WI**DTH) (AND **PE**RIOD)	Controls which measurement results to output. (Note: More than one measurement result is optional. The order of the results is preserved in the output. Output frequency, width and period can be used in any combination.)
OUTPUT **HI**GHLIMIT	Outputs the high frequency limit last specified.
OUTPUT **ID**ENTIFICATION	Outputs "EIP58nB GPIB dd", where n is 5 or 8 and dd is the GPIB address.
OUTPUT **KE**YCODE	Outputs the code of the last key pressed.
OUTPUT **LE**VEL	Outputs the rough amplitude measurement result (Special Function 20).
OUTPUT **LO**WLIMIT	Outputs the low frequency limit last specified.
OUTPUT **ME**MORY	Outputs the content of the memory in the last accessed location (Special Function 46).
OUTPUT **MI**NPRF	Outputs the minimum PRF last specified.
OUTPUT **MU**LTIPLIER	Outputs the last specified multiplier value.
OUTPUT **OF**FSETFREQ	Outputs the offset frequency last specified.
OUTPUT **RE**SOLUTION	Outputs the last specified frequency measurement resolution.
OUTPUT **SA**MPLERATE	Outputs the last specified delay time between measurement values.
OUTPUT **SE**TUP	Outputs a 142-character string that describes the current setup. See page 4-6.
OUTPUT **SR**QMASK	Outputs the combination of status events required to cause a service request. See page 4-11.
OUTPUT **SU**BBAND	Outputs the number of the last specified subband.
OUTPUT **V1**FREQ	Outputs the last specified start frequency for VCO sweep. (Special Functions 41 and 42).
OUTPUT **V2**FREQ	Outputs the last specified stop frequency for VCO sweep.
OUTPUT **Y1**FREQ	Outputs the last specified start frequency for YIG sweep. (Special Function 40.)
OUTPUT **Y2**FREQ	Outputs the last specified stop frequency for YIG sweep.

Output Setup Command

The output setup command causes the counter to output a 142-character string that corresponds to the current setup of the instrument. The following sample program, for the HP 85, can be used to obtain the setup string:

```
10  DIM A$[150]                 !Dimension a variable to hold the string
20  OUTPUT 718;"OUTPUT SETUP'   !Send command to counter
30  ENTER 718;A$                !Get output from computer
40  DISP A$                     !Display output on HP-85
```

Setup string: BA2,SU1,RE3,AV01,MU01,OF+000000000KH,LO000900MH,HI018500MH, CE000000MH,MI2000E00,SA000040MS,SR000,SP62,SP64,SP66,SP68, SP70,SP45,PE0,WI0,HO0,EX0

The following list can be used to decode the returned setup string. The information contained in the parentheses will change depending on the current setup of the instrument.

BA2:	BAND (2)
SU1:	SUBBAND (1)
RE3:	RESOLUTION (3)
AV01:	AVERAGE (1) READING
MU01:	MULTIPLY X (1)
OF+000000000KH:	FREQUENCY OFFSET = (0)
LO000900MH:	LOW LIMIT = (900) MHz
HI018500MH:	HIGH LIMIT = (18.5) GHz
CE000000MH:	CENTER FREQUENCY = (0) NOT ACTIVE
MI0002000:	MINIMUM PRF = (2) kHz
SA000040MS:	SAMPLE RATE = (40) MILLISECONDS
SR000:	SERVICE REQUEST MASK
SP62:	SPECIAL FUNCTION (62) ACTIVE
SP64:	SPECIAL FUNCTION (64) ACTIVE
SP66:	SPECIAL FUNCTION (66) ACTIVE
SP68:	SPECIAL FUNCTION (68) ACTIVE
SP70:	SPECIAL FUNCTION (70) ACTIVE
SP45:	SPECIAL FUNCTION (45) ACTIVE
PE0:	PULSE PERIOD = (0) OFF
WI0:	PULSE WIDTH = (0) OFF
HO0:	HOLD = (0) OFF
EX0:	TIMEBASE = (0) INTERNAL

Syntax Definition

In the instructions that follow, | means "or" and N|S means "null or space." The format used for the examples is that used for the HP 85 controller. Sample formats for other controllers are also shown.

DEVICE-DEPENDENT MESSAGE:	<message><N|S><message terminator>|<message> <message separator><message><message terminator>
Message	<control message>|<mode message>|<parameter message>|<output control message>
Message separator	,|;
Message terminator	CR LF|NL|EOI

1. CONTROL MESSAGE: INITIALIZE | RESET | TRIGGER | CLEAR DISPLAY

   Example: To instruct the instrument to begin a new signal acquisition process, the operator enters: OUTPUT 718;"RESET"

2. MODE MESSAGE: <mode name><space><mode position>

   Mode name: WIDTH | PERIOD | HOLD | EXTERNAL | SCIENTIFIC | SEPARATE | HEADER | DYNAMIC

   Mode position: ON | OFF | 1 | 0 | DEFAULT

   Example: To instruct the instrument to an external reference, the operator enters: OUTPUT 718;"EXTERNAL ON"

3. PARAMETER MESSAGE: <parameter message 1> | <parameter message 2> | <parameter message 3> | <parameter message 4> | <parameter message 5>

   - PARAMETER MESSAGE 1: <parameter 1><N | S><argument>

     Parameter 1: BAND | SUBBAND | RESOLUTION | SPECIAL | AVERAGE | MULTIPLIER | SRQMASK | GPIBADDRESS

     Argument: DEFAULT | <number>

     Number: <NULL | + | ><mantissa><exponent>

     Mantissa: <digit> | <digit string> | <digit | digit string,digit | digit string>

     Exponent: NULL | E<NULL | + | ><digit | digit string>

     Example: To instruct the instrument to accept an averaging value, the operator enters: OUTPUT 718;"AVERAGE 70"

   - PARAMETER MESSAGE 2: <parameter 2><N | S><argument>N | S<frequency terminator>

     Parameter 2: OFFSETFREQ | HIGHLIMIT | LOWLIMIT | MINPRF | CENTER FREQ | Y1FREQ | Y2FREQ | Y3FREQ | V1FREQ | V2FREQ

     Frequency terminator: NULL | Hz | kHz | MHz | GHz

     Example: To instruct the instrument to accept a frequency high limit value, the operator enters: OUTPUT 718;"HIGHLIMIT 12.3 GHz" or "HIGHLIMIT 12.3E6 kHz"

   - PARAMETER MESSAGE 3: SAMPLERATE<N | S><argument><N | S><time terminator>

     Time terminator: NULL | SEC | MSEC

     Example: To instruct the instrument to accept a sample rate value, the operator enters: OUTPUT 718;"SAMPLERATE 100 MSEC"

- PARAMETER MESSAGE 4: MEMORY<N|S><memory instruction><N|S> <memory data>

  Memory instruction: INCREMENT|DECREMENT|<memory location>

  Memory location: 0<hex digit><hex digit><hex digit><hex digit>

  Hex digit: <digit>|A|B|C|D|E|F

  Memory data: NULL|0<hex digit><hex digit>

  Example: To instruct the instrument to change memory location 99AF to 3B, the operator enters: OUTPUT 718;"MEMORY 099AF 03B."

- PARAMETER MESSAGE 5: STORE|FETCH|<N|S><number>

  Example: To instruct the instrument to store or recall a counter setup in a specified storage register, the operator enters: OUTPUT 718; "STORE 03" or OUTPUT 718;"FETCH 03."

4. OUTPUT CONTROL MESSAGE: OUTPUT<SPACE><output parameter>

   Output parameter: <single parameter>|<result parameter>

   Single parameter: RESOLUTION|BAND|SUBBAND|AVERAGE|MULTIPLIER|ERRORNUMBER|SRQMASK|CONFIGURATION|LEVEL|MEMORY|IDENTIFICATION|LOWLIMIT|HIGHLIMIT|OFFSETFREQ|CENTERFREQ|MINPRF|SAMPLERATE|KEYCODE|SETUP

   Result parameter: DEFAULT|<result list>

   Result list: <result name>|<result name><SPACE>AND<SPACE><result name>|<result name><SPACE>AND<SPACE><result name><SPACE>AND<SPACE><result name>

   Result name: FREQUENCY|WIDTH|PERIOD

   Example: To request the controller to display the width and frequency, in that order, the operator enters:

   ```
   OUTPUT 718;"OUTPUT WIDTH AND FREQUENCY"
   ENTER 718;A$
   DISP A$
   ```

Output and Format Examples

The following programs illustrate how controllers function with the counter and how different kinds of controllers give instructions. These programs set the counter up in a sample configuration and program it to make a series of measurements of a 12.5 GHz pulsed signal with 13.258 μs period. The talk and listen address of the counter is assumed to be 18.

- Hewlett Packard 85

```
10  DIM A$[36]
20  OUTPUT 718;"IN"
30  WAIT 4000
40  OUTPUT 718;"PE ON,RE 4"
50  OUTPUT 718;"HI 17.5 GHZ,LO 1.1 GHZ"
60  WAIT 1000
70  OUTPUT 718;"OUTPUT WI AND FR"
80  WAIT 1000
90  ENTER 718;A$
100 DISP A$
110 END
```

This program initializes the counter, provides a resolution value and a high and low frequency limit, and instructs it to output pulse width to the counter display and pulse width and frequency to the controller display. The controller display would appear something like this:

0.0000132580 12500000000

- Hewlett Packard 9825A

```
0:  dim A(10)
1:  rem 7
2:  wrt 718,"BA 2,RE 4,OF - 4.55 MHZ"
3:  wait 300
4:  For I = 1 to 10
5:  red 718, A(1)
6:  prt A(1)
7:  next I
8:  end
```

The HP 9825A program will cause the counter to take a series of ten readings, print them on the HP 9825A paper tape, and stop. Notice that an offset of 4.55 MHz is subtracted from each reading.

- Hewlett Packard 9845A

```
10: OUTPUT 718,"BA 3, RE 4, OF -4.55 MHZ"
15: WAIT 300
20: INPUT 718, A
30: PRINT "Frequency minus offset equals," A
40: GO TO 20
```

- Tektronix 4051

```
10: PRINT @ 18:"BA 3,RE 4, OF -4.55 MHZ"
20: INPUT @ 18:A
30: PRINT "Frequency minus offset equals,"A
40: GO TO 20
```

The programs shown for the HP 9845A and Tektronix 4051 cause the counter to make a frequency measurement and print that measurement. To end the program, initiate a STOP command. This is accomplished on the HP 9845A with the key labeled STOP, and on the Tektronix 4051 with the key labeled BREAK. To restart the program, enter the RUN statement followed by the line number that is printed in the INTERRUPT message.

OUTPUT MESSAGES (TALKER FEATURES)

After receiving a talk address, the GPIB will output the current configuration, or any parameter value or measurement result, in response to the appropriate output control message. After power-on or device-clear, the controller outputs the displayed measurement results (as it does after the OUTPUT DEFAULT command).

The controller can be instructed to output any ordered combination of the three possible measurements, no matter what is displayed on the front panel.

Examples: OUTPUT FREQ AND WIDTH
OUTPUT WIDTH AND PERIOD
OUTPUT WIDTH AND FREQUENCY AND PERIOD

The format of each output message can be controlled using the following:

- SCIENTIFIC - provides exponential notation with engineering exponents when SCIENTIFIC is ON. Default is OFF.
- DYNAMIC - suppresses blanks and trailing zeros for faster data transfers when DYNAMIC is ON. Default is OFF.
- HEADER - provides an alpha header and terminator around each numeric data item for clarity, (useful for printers) when HEADER is ON. Default is OFF.

NOTE

Terminator takes over the exponential role if both SCIENTIFIC and HEADER are ON.

- SEPARATE - Substitutes CR LF for the comma between results of one measurement (freq,period) when SEPARATE is ON. Default is OFF.
- DEFAULT - Outputs data in default format. The fixed fields are 16 characters long for the header and argument, and 5 long for the terminator. When none of the output formatting features above are turned on, numbers are right justified, letters are left justified, blanks are filled.

Example: The counter is measuring a 12.34 GHz pulsed signal with 98 ns width and 14.567 μs period. The operator enters the following messages through the controller:
RESOLUTION 6
OUTPUT FREQ AND WIDTH AND PERIOD

The output for each message format will be as follows (b is for blank):

Parameter	Output
Default:	bbbbb12340000000,bbbbb0.000000100,bbbbb0.000014570 CR LF
SCIENTIFIC on:	bbbbbbbb12.340E+9,bbbbbbbbbb100E-9,bbbbbbbb14.57E-6 CR LF
DYNAMIC on:	12.34E9, 100E-9, 14.57E-6 CR LF
SEPARATE on:	12.34E9 CR LF 100E-9 CR LF 14.57E-6 CR LF
HEADER on:	FREQUENCY 12.34 GHz CR LF WIDTH 100 NSEC CR LF PERIOD 14.57 USEC CR LF

If the counter is searching, zero data will be output to the controller on all results once every search loop. If the counter has found a signal, a measurement result will be output only once.

When the instrument is in HOLD, therefore, the user must trigger the counter before sending another talk address. Otherwise, since it has no data to output, the counter will hold indefinitely.

STATUS BYTE

Both the 585B and 588B counters maintain a one byte register that contains current information on the status of the instrument. This register, called the status byte, can be accessed through the GPIB using the serial poll command. When serial polled, the counter responds by returning a numeric value between 0 and 256. This value is the weighted sum of the status bits which are set. The status byte is structured as follows:

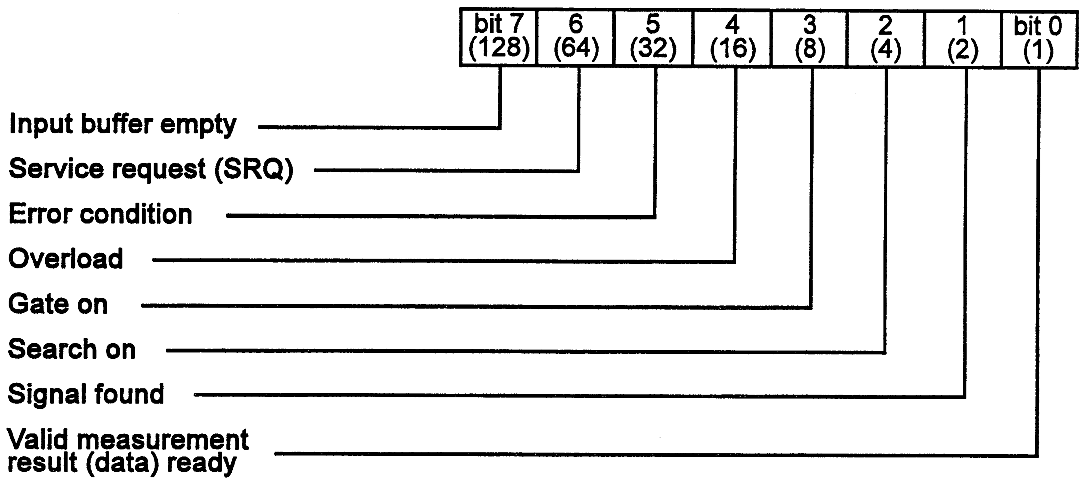

Figure 4-1. Status Byte Structure.

For example, execute the following commands using an HP 85.

```
10   A=SPOLL(718)
20   DISP A
30   END
```

With no signal applied to the counter, the value displayed on the HP 85 controller should be 132. Since the value is the weighted sum of all the bits set in the status byte, a value of 132 indicates that the GPIB input buffer is empty and the counter is in the search mode.

SERVICE REQUEST MASK

The counter can be instructed to send an interrupt, by setting the SRQ line on the GPIB, when any ORed combination of the bits in the status byte are set. This is done by sending the counter a service request mask.

For example, to instruct the counter to generate an SRQ whenever it has valid data available or an error condition exists, send the following service request mask:

```
OUTPUT 718;"SRQMASK 33"
```

This would tell the counter to generate an SRQ whenever bit 0 and bit 5 of the status byte are set. Since bit 0 corresponds to valid measurement result ready and bit 5 corresponds to an error condition, the counter would generate an SRQ whenever either an error condition exists or a valid measurement is available.

The following items should be included in any program using the SRQ feature:

1. Tell the counter when to generate an SRQ. That is, tell the counter which events should generate an SRQ. This is done using the SRQMASK command.

2. Tell the controller to monitor the SRQ line on the GPIB. The SRQ is a maskable interrupt and the controller needs to know if it should respond to the interrupt.

3. Tell the controller what to do when it receives an SRQ interrupt.

4. Serial poll the counter after an SRQ is generated to clear the interrupt. When the counter generates an SRQ it sets bit 6 in the status byte. Serial polling the instrument clears the SRQ bit and allows the instrument to generate a new SRQ upon the next occurrence of the conditions specified in the SRQ Mask.

5. It may also be necessary to clear the SRQ register in the controller. Consult your manual on the controller for more information on clearing the SRQ register in the controller.

The following program, written on an HP 9826, demonstrates how to use the SRQ feature to obtain a valid measurement from the counter.

```
10   ASSIGN @COUNTER TO 718             ! Assigns 718 to address variable
                                        ! The number 7 is the GPIB interface
                                        ! and 18 is the counter's GPIB address
20   REMOTE @COUNTER                    ! Place counter in remote
30   OUTPUT @COUNTER;"SRQMASK 1"        ! Send SRQ mask to counter
40   ENABLE INTR 7;2                    ! Enable interrupt in controller
50   ON INTR 7 GOTO FLAG                ! Tell controller how to handle interrupt
60   WAITING                            ! Label
70   PRINT "WAITING FOR VALID MEASUREMENT"
80   GOTO WAITING
90   FLAG:  PRINT "* * * * * SRQ RECEIVED * * * * *"
100  ENTER @COUNTER;FREQ                ! Input frequency from counter
110  PRINT "FREQ = ";FREQ               ! Print frequency
120  S2 = SPOLL(@COUNTER)               ! Clear SRQ bit in counter
130  STATUS                             ! Clear SRQ bit in controller
140  OUTPUT @COUNTER;"SRQMASK 00"       ! Turn off SRQ mask in counter
150  OFF INTR 7                         ! Turn off interrupt in controller
160  END                                ! Program end
```

To demonstrate this program, set up counter with no signal applied and start the program running. The controller should continually print out "Waiting for valid measurement." Then apply a signal. As soon as the counter finds the signal and counts it, the controller will print out the frequency of the signal.

CONFIGURATION INFORMATION

Counter configuration information is accessible via five configuration bytes. After receiving the OUTPUT CONFIGURATION message and then being addressed to talk, the controller will output five ASCII characters, the symbols for the decimal equivalents of the setting of the status bytes. The bytes are structured as follows:

	bit 7	6	5	4	3	2	1	bit 0
Byte 1 Options and Measurement Mode	PERIOD on/ off	WIDTH on/ off	UDF	UDF	UDF	BAND 3 Opt.	BAND 1	585B or 588B

	bit 7	6	5	4	3	2	1	bit 0
Byte 2 Parameters Condition	UDF	UDF	AVG	FREQ MULT	FREQ OFFSET	CENTER FREQ	HIGH LIMIT	LOW LIMIT

	bit 7	6	5	4	3	2	1	bit 0
Byte 3 Specials State	UDF	PP ONLY on/ off	PRF on/ off	STOP on/ off	SAMPL on/ off	TRACK on/ off	DISP on/ off	SPECIAL on/ off

	bit 7	6	5	4	3	2	1	bit 0
Byte 4 Interface and Switch State	UDF	UDF	UDF	UDF	EXT	HOLD	SRQ	REMOTE

	bit 7	6	5	4	3	2	1	bit 0
Byte 5 Format Configuration	UDF	UDF	UDF	UDF	DYNAM on/ OFF	SEPAR on/ off	HEADR on/ off	SCIEN on/ off

The program below is an example of how to query the status bytes for configuration information. The counter model number is determined by checking byte 1, bit 0.

```
10   OUTPUT 718; "OUTPUT CONFIGURATION"
20   ENTER 718; A$
30   PRINT "CONFIGURATION STRING = ";A$
40   B$=A$[1,1]
50   PRINT "FIRST BYTE = "B$
60   Y=NUM(A$)
70   IF BIT (Y,0) THEN C=588B ELSE C=585B
80   PRINT "COUNTER IS EIP"; C
90   END
```

The controller would output:

CONFIGURATION STRING = +%X-[
FIRST BYTE = *@+//
COUNTER IS EIP 588B

DEFAULT STATE (DEVICE CLEAR FEATURES)

The default state of the instrument occurs after power-on, hardware initialization, or a device clear command. The default state can be customized using Special Function 72. For additional information on this feature, see page 3-32. The following table lists the factory-set default state values of the counter.

Parameter	Default State
Average	01
Band	2
Center Frequency	0 (off)
Clear Display	Activated
Converter	Reset
Display	Enabled
Dynamic	Off
External Reference	Off
Frequency limit high	20.5 GHz (585B) or 26.5 GHz (588B)
Frequency limit low	900 MHz
Header	Off
Hold	Off
Minimum pulse repetition frequency	2 kHz
Multiply frequency	01
Offset frequency	00
Output	Frequency measurement data
Resolution	3 (1 kHz)
Sample rate	Maximum
Scientific	Off
Separate	Off
Special Functions	Off
SRQmask	Off

GPIB ADDRESS SELECTION

This counter employs a software selectable GPIB address which is stored in nonvolatile memory. To verify the GPIB address, enter Special Function 90: the counter will display the current GPIB address. Press the CLEAR DISPLAY key to exit Special Function 90 without changing the GPIB address.

To change the GPIB address, enter Special Function 90 followed by the desired GPIB address (see Figure 4-2).

PRESS: [SPECIAL FUNC] [9] [0] [2] [0]

Since the GPIB address is stored in nonvolatile memory, the counter will always default to the last GPIB address selected.

** ADDRESS CHARACTERS		ADDRESS CODES					
Listen	Talk	binary					decimal
		5	4	3	2	1	*
SP	@	0	0	0	0	0	00
!	A	0	0	0	0	1	01
"	B	0	0	0	1	0	02
#	C	0	0	0	1	1	03
$	D	0	0	1	0	0	04
%	E	0	0	1	0	1	05
&	F	0	0	1	1	0	06
'	G	0	0	1	1	1	07
(	H	0	1	0	0	0	08
)	I	0	1	0	0	1	09
*	J	0	1	0	1	0	10
+	K	0	1	0	1	1	11
,	L	0	1	1	0	0	12
-	M	0	1	1	0	1	13
.	N	0	1	1	1	0	14
/	O	0	1	1	1	1	15
0	P	1	0	0	0	0	16
1	Q	1	0	0	0	1	17
2	R	1	0	0	1	0	18
3	S	1	0	0	1	1	19
4	T	1	0	1	0	0	20
5	U	1	0	1	0	1	21
6	V	1	0	1	1	0	22
7	W	1	0	1	1	1	23
8	X	1	1	0	0	0	24
9	Y	1	1	0	0	1	25
:	Z	1	1	0	1	0	26
;	[	1	1	0	1	1	27
<	/	1	1	1	0	0	28
=	]	1	1	1	0	1	29
>	^	1	1	1	1	0	30

* Decimal Talk/Listen Address is provided as a cross reference for those controllers which use decimal address.

** Address characters in ASCII code.

Figure 4-2. Allowable Address Codes.

TALK ONLY MODES

The talk only modes enable the counter to continuously output data to other devices on the bus, such as a printer, without the need of an instrument controller. To use the counter in a talk only mode, enter the GPIB address corresponding to the desired data output format. The receiver must be configured to the listen only mode to enable data to transfer across the bus.

NOTE

Address is composed of the binary value of the choices +32.

Scientific	Separate	Header	Dynamic	Address
off	off	off	off	32
off	off	off	on	33
off	off	on	off	34
off	off	on	on	35
off	on	off	off	36
off	on	off	on	37
off	on	on	off	38
off	on	on	on	39
on	off	off	off	40
on	off	off	on	41
on	off	on	off	42
on	off	on	on	43
on	on	off	off	44
on	on	off	on	45
on	on	on	off	46
on	on	on	on	47

DATA INPUT AND OUTPUT SPEED

Input Speed

It takes a specific amount of time for the counter to process input data (error checking, formatting, changing the mode of operation, etc.). To prevent the data rate of the bus from slowing down while the counter is processing input data, the data is accepted as soon as it is available on the bus and is temporarily stored in a 256-character storage memory.

It is necessary to be aware of the difference between accepting data and complying with it. If the counter is asked to output a reading before it is finished processing the input data, the output will not reflect the newly entered data. To prevent this, sufficient programmed delays must be provided (see the sample program formats on page 4-9). Bit 7 in the status byte can be used to determine if the counter has completed the processing of the GPIB command messages. Refer to the section on the status byte.

Output Speed

Several options have been provided in the GPIB interface for the user who wants to increase the output speed of the counter. Each of the following conditions increases the measurement cycle rate. The fastest measurement cycle time is achieved with all of the following conditions set:

HEADER OFF: Outputs the numeric results without header or terminator (default).

SCIENTIFIC OFF: Outputs fixed point results which are shorter than exponential notations (default).

DYNAMIC ON: Suppresses leading blanks. NOTE: The controller has to have free field capability.

SPECIAL 61: Disables the tracking feature, thus saving the time required for YIG and VCO corrections.

SPECIAL 63: Disables sample rate control, thus deleting any delay between gates. (For counter in local mode.)

SPECIAL 65: Disables the LED results display thus saving the time required for display, formatting and output.

SAMPLERATE 0: Same as SPECIAL 63 for counter in remote mode.

READING MEASUREMENTS

To read a measurement from the counter to a controller, the user must first address the counter to talk and the controller to listen. The examples below indicate how a controller may read a measurement from the counter.

- Hewlett Packard 9825A

```
10   red 718,A
20   prt A
```

- Hewlett Packard 9845A

```
10   ENTER 718,A
20   PRINT A
```

- Tektronix 4051A

```
10   INPUT @ 18:A
20   PRINT A
```

The EIP counter provides a choice of method for taking readings. When the command HOLD is ON, the counter takes one reading then waits for a RESET command or a device trigger GPIB command. In this condition, the counter is sent a RESET command or a device trigger and (when addressed to talk) outputs a new reading to the bus. The counter will hold that particular reading on the display until another RESET command or device trigger is received.

When the HOLD command is off, data is read out to the bus in the normal way. The display is automatically updated at the specified sample rate, and the counter outputs successive measurement readings without requiring a RESET command or device trigger each time.

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SECTION 5
OPERATIONAL VERIFICATION TESTS

INTRODUCTION

This section contains information for verifying proper operation of the counter. Although these tests are not comprehensive, they do insure, to a high degree of confidence, that the instrument is operating properly. The tests can be useful for incoming inspection and should be performed after any servicing to insure proper operation of the counter. All tests can be performed without removing the instrument covers. A test report form is included at the end of this section that can be used to provide a test record. If the application is especially critical in nature, more extensive testing may be required and is covered in the performance verification test section of the service manual.

Because of the high cost and specialized nature of frequency sources above 40 GHz, testing above this frequency is not covered. Also, for the purpose of operational verification tests, simulated pulsed signals are used in Bands 1 and 3.

EQUIPMENT REQUIREMENTS

Equipment required for the operational verification tests on the EIP 585B or 588B counter is listed in Table 5-1. The critical parameters are the minimum use specifications required for the performance of the procedures, and are included to assist in the selection of alternative equipment. Satisfactory performance of alternative items should be verified prior to use. All applicable equipment must bear evidence of current calibration. For many of the following test, an EIP 578B counter is used to source lock the microwave sweeper, thus providing a stable source for testing. This combination may be replaced by a frequency synthesizer.

Table 5-1. Equipment Requirements.

Description	Critical Parameters	Recommended Manufacturer	Model
Frequency Synthesizer	100 Hz to 10 MHz	Hewlett Packard	3325A
Sweep Generator	10 MHz to 40 GHz	Wiltron	6668B
Sweep Generator	3 GHz to 18 GHz	Wiltron	6635B
Source Locking Counter	10 MHz to 26.5 GHz	EIP	578B
Spectrum Analyzer	3 GHz to 18 GHz	Hewlett Packard	8566B
Power Meter	10 MHz to 60 GHz	Hewlett Packard	437B
Power Sensor	10 MHz to 18 GHz (-20 to +10 dBm)	Hewlett Packard	8481B
Power Sensor	950 MHz to 26.5 GHz (-20 to +10 dBm)	Hewlett Packard	8485A
Power Sensor	26.5 GHz to 40 GHz (-20 to +10 dBm)	Hewlett Packard	R8486A
Oscilloscope	100 Hz to 10 MHz	Tektronix	475
Power Splitter	10 MHz to 26.5 GHz	Hewlett Packard	11667B
Directional Coupler	950 MHz to 18 GHz	Narda	4226-10
Directional Coupler	18 GHz to 26.5 GHz	Narda	4017C-10
Pulse Generator	1 MHz	Wavetek	801
Pulse Modulator	1 GHz to 2 GHz	Hewlett Packard	8731B
Pulse Modulator	2 GHz to 18 GHz	Hewlett Packard	11720A
Pulse Modulator	18 GHz to 26.5 GHz	Narda	S214DS
3 dB Attenuator	950 MHz to 26.5 GHz	Weinschel	9-3
Cable Kit	--	EIP	590
Remote Sensor	26.5 to 40 GHz	EIP	091

SOURCE LOCKING SETUP

In some of the following tests, the EIP 578B counter is used to source lock the sweep generator to provide a stable frequency source for testing the 585B/588B counters.

The source locking setup, described below, is not limited to locking the Wiltron sweeper. It can be used to source lock almost any electronically tunable signal source over a frequency range of 10 MHz to 110 GHz. For more information on source locking the Wiltron 6600 series of sweep generators, request Application Bulletin 10 from our sales representative in your area or directly from EIP.

Regardless of the particular sweeper, the procedure for source locking is basically the same. A sample of the output from the sweeper is applied to the appropriate band on the EIP 578B counter. For the setup shown in Figure 5-1, a power splitter provides the sample. The COARSE TUNE OUT connector from the 578B counter is connected to the external sweep input on the sweeper. The Ø LOCK OUT connector on the 578B counter is connected to the FM input on the sweeper. The FM modulation on the sweeper is enabled and the sweeper is set to the external sweep mode.

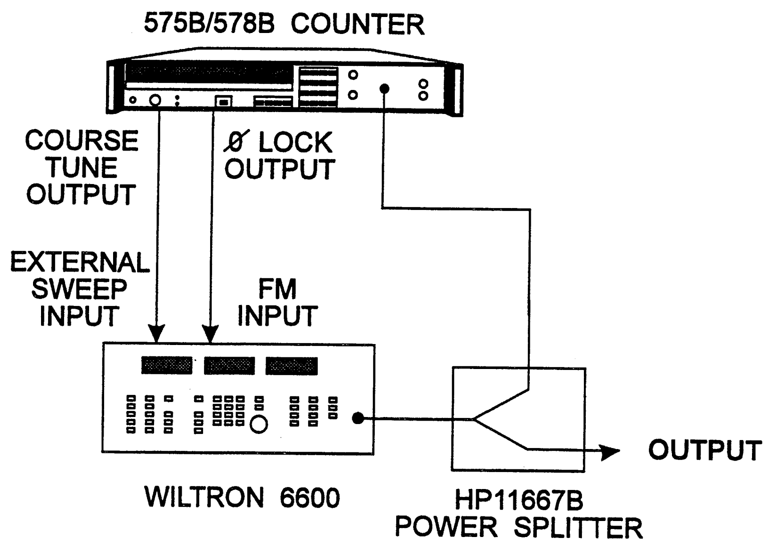

Figure 5-1. Source Locking Setup.

With the equipment set up as described above, source locking over the entire range of the sweeper can be achieved by entering the desired frequency.

For example, to lock the sweeper at 10 GHz:

PRESS: [LOCK/FREQ] [1] [0] [GHz]

At this point, the sweeper should be locked to 10 GHz, the LCK annunciator on the counter should be lit, and 10 GHz should be the displayed frequency. In the following tests, the output frequency from the sweeper is controlled directly by the EIP 578B counter, while the power is controlled at the sweeper.

OPERATIONAL VERIFICATION TEST PROCEDURES

BAND 0 RANGE AND SENSITIVITY TEST (CW ONLY)

Description

This test verifies counter operation from 100 Hz to 250 MHz at -15 dBm (0.1125 V p-p into 50 Ω). The oscilloscope is used to set signal levels below 10 MHz, and the power meter is used to set signal levels at 10 MHz and above. Test setup 1 covers the frequency range from 100 Hz to 10 MHz and test setup 2 covers the range from 10 MHz to 250 MHz.

Equipment

Frequency synthesizer (Hewlett Packard 3325A)
Sweep generator (Wiltron 6668B)
Source locking counter (EIP 578B)
Power meter (Hewlett Packard 437B)
Power sensor (Hewlett Packard 8481A)
Power splitter (Hewlett Packard 11687B)
Oscilloscope (Tektronix 475)

Test Setup 1

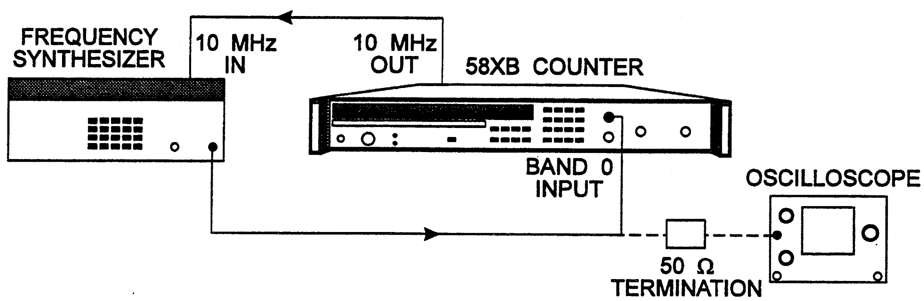

Figure 5-2. Band 0 Range and Sensitivity Test Setup (100 Hz to 10 MHz).

Procedure

1. Connect equipment as shown in Figure 5-2.
2. Set the counter to Band 0 and select resolution 2.
3. Set the output frequency from the synthesizer to 100 Hz.
4. Using the oscilloscope, set the output signal level from the synthesizer to -15 dBm (0.11 V p-p into 50 Ω).
5. Apply the 100 Hz signal to the counter, verify proper reading, and record the results.
6. Repeat steps 3, 4, and 5 at 1 kHz, 10 kHz, 100 kHz, 1 MHz and 10 MHz.

Test Setup 2

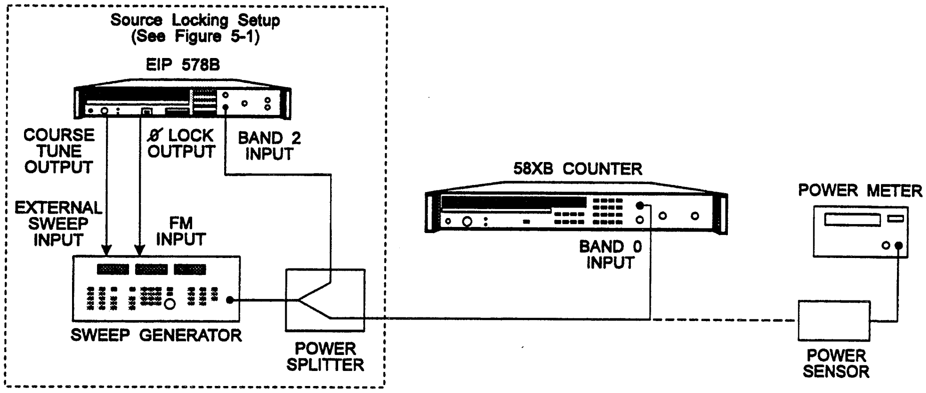

Figure 5-3. Band 0 Range and Sensitivity Test Setup (100 MHz to 250 MHz).

Procedure

1. Connect equipment as shown in Figure 5-3.
2. Set the 585B/588B counter to Band 0 and select resolution 3.
3. Using the EIP 578B counter, source lock the sweeper at 100 MHz.
4. Using the power meter, set the output signal level from the sweeper to -15 dBm.
5. Apply the 100 MHz signal to the 585B/588B counter, verify proper reading, and record the results.
6. Repeat steps 3, 4, and 5 at 200 MHz and 250 MHz.

BAND 1 RANGE AND SENSITIVITY TEST

Description

This test verifies counter operation from 250 MHz to 1 GHz at -15 dBm for both CW and simulated pulsed signals. The pulse generator is used to simulate a pulsed signal by applying a 50 ns ECL low with a 1 MHz repetition rate to the INHIBIT IN connector on the rear panel of the 585B/588B counter. The power meter is used to set signal levels.

Equipment

Sweep generator (Wiltron 6668B)
Source locking counter (EIP 578B)
Power meter (Hewlett Packard 437B)
Power sensor (Hewlett Packard 8481B)
Pulse generator (Wavetek 801)
Power splitter (Hewlett Packard 11667B)
Oscilloscope (Tektronix 475)

Procedure

1. Connect equipment as shown in Figure 5-4.
2. Set the 585B/588B counter to Band 1 and select resolution 3.
3. Using the EIP 578B counter, source lock the sweeper at 250 MHz.
4. Using the power meter, set the output signal level from the sweeper to -15 dBm.

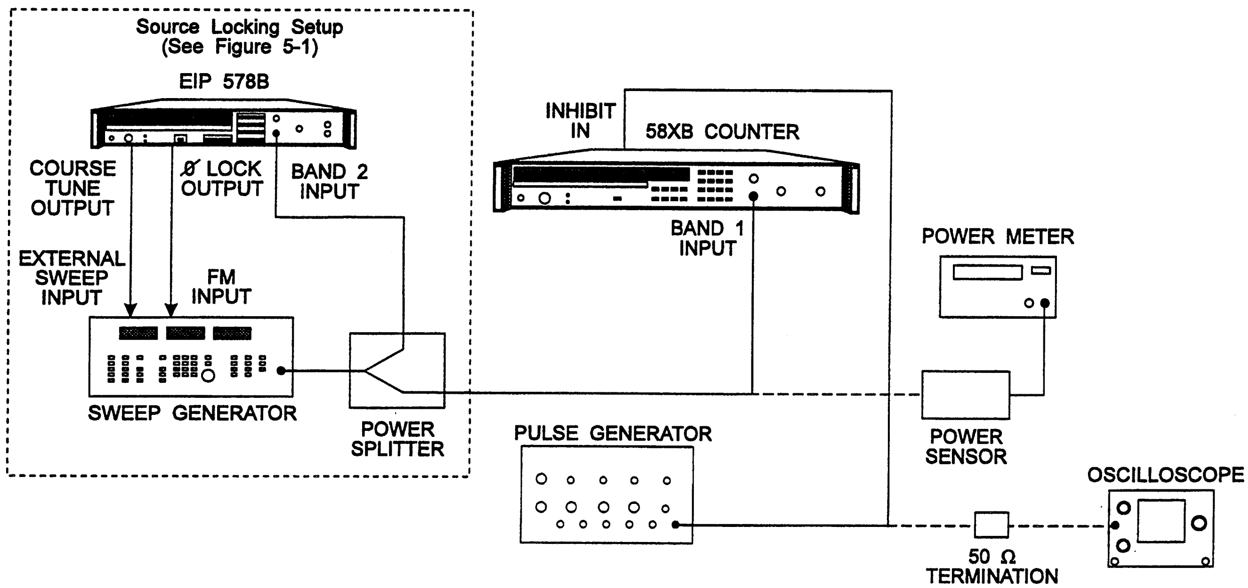

Figure 5-4. Band 1 Range and Sensitivity Test Setup.

5. Apply the 250 MHz signal to the counter, verify proper reading, and record the results.

6. Repeat steps 3, 4, and 5 at 300 MHz, 400 MHz, 500 MHz, 600 MHz, 700 MHz, 800 MHz, 900 MHz, and 1 GHz.

7. Using the oscilloscope, set up the pulse generator to output a 50 ns wide ECL low signal with a 1 MHz pulse repetition rate. Apply the signal to the INHIBIT IN connector on the rear panel of the 585B/588B counter. This signal gates signal threshold inside the counter and is used to simulate a pulsed signal.

8. Repeat steps 3, 4, 5, and 6 for the simulated pulsed signal and record the results.

BAND 2 RANGE AND SENSITIVITY TEST

Description

This test verifies counter operation from 950 MHz to 20 GHz (26.5 GHz for the 588B counter). The first part of the test verifies operation in the CW mode. Next, the counter is tested in the pulse mode using the pulse modulators to modulate the microwave source. Attenuators are necessary on the input and output of the pulse modulators to reduce frequency pulling of the microwave source. To be able to accurately set the power level of the pulsed signal, it is necessary to compensate for the insertion loss of the pulse modulators by applying a constant enable signal to the pulse modulator and adjusting the sweeper at each test frequency until the output power from the modulator is at the required level.

Equipment

Sweep generator (Wiltron 6668B)
Source locking counter (EIP 578B)
Power meter (Hewlett Packard 437B)
Power sensor (Hewlett Packard 8485A)
Pulse generator (Wavetek 801)
Pulse modulator (Hewlett Packard 8731B)
Pulse modulator (Hewlett Packard 11720A)
Pulse modulator (Narda S214DS)
Power splitter (Hewlett Packard 11667B)
Directional coupler (Narda 4226-10)
Directional coupler (Narda 4017C-10)
3 dB attenuator (2) (Weinschel 9-3)

Test Setup 1

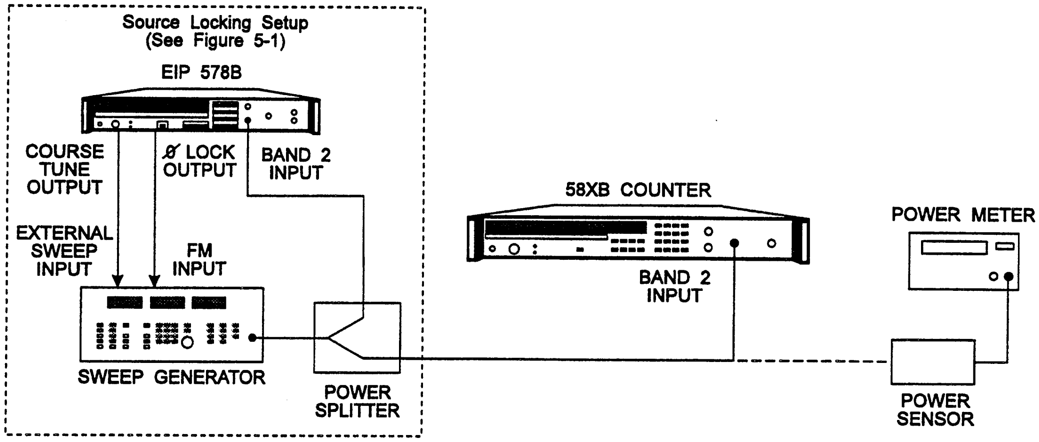

Figure 5-5. Band 2 CW Signal Range and Sensitivity Test Setup.

Procedure

1. Connect equipment as shown in Figure 5-5.
2. Set the counter to Band 2 and select resolution 3.
3. Using the EIP 578B counter, source lock the sweeper at 950 MHz.
4. Using the power meter, set the output signal level from the sweeper to -20 dBm.
5. Apply the 950 MHz signal to the 585B/588B counter, verify proper reading, and record the results.
6. Repeat steps 3, 4, and 5 at 1 GHz, 3 GHz, 6 GHz, 10 GHz, 12.4 GHz, 15 GHz, 18 GHz, and 20 GHz. For Model 588B counters, also test at 22 GHz, 24 GHz, and 26.5 GHz.

Test Setup 2

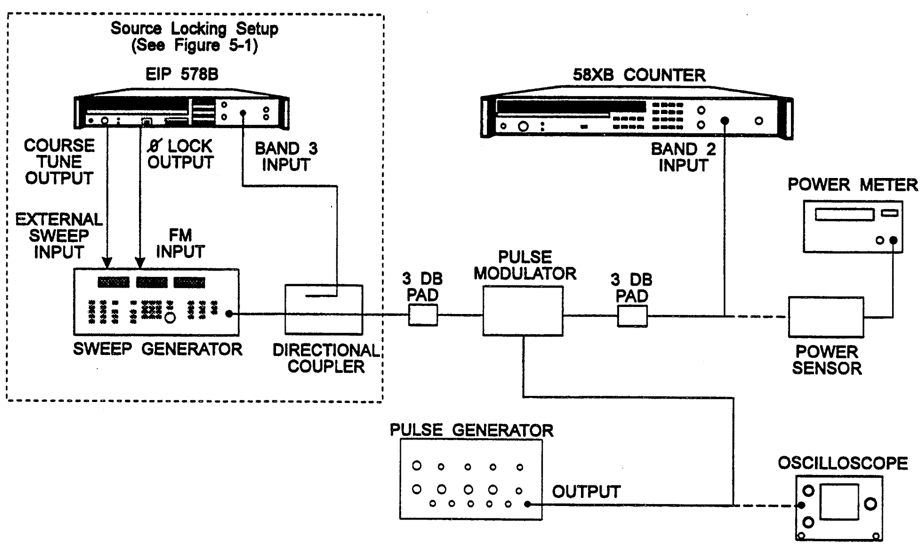

Figure 5-6. Band 2 Pulsed Signal Range and Sensitivity Test Setup.

Procedure

For this test, three pulse modulators and two directional couplers are used. Use the devices that correspond to the frequency under test. See Table 5-1 for a listing of frequency ranges of the pulse modulators and directional couplers.

1. Connect equipment as shown in Figure 5-6.
2. Set the counter to Band 2 and select resolution 3.
3. Using the oscilloscope, set the pulse generator to output a 100 ns wide TTL signal with a 1 MHz repetition rate. This signal will be used to drive the pulse modulators.
4. Using the EIP 578B counter, source lock the sweeper at 950 MHz.
5. Apply a constant enable signal from the pulse generator to the pulse modulator. Adjust the output power on the sweep generator until the power meter indicates the specified sensitivity level for the counter.
6. Apply the modulation drive from the sweep generator to the appropriate pulse modulator and connect the pulse modulated signal to the counter.
7. Verify that the counter counts the pulsed signal properly and record the results.
8. Repeat steps 4, 5, 6, and 7 at 1 GHz, 3 GHz, 6 GHz, 10 GHz, 12.4 GHz, 15 GHz, 18 GHz, and 20 GHz. For Model 588B counters, change the pulse width from the modulator to 500 ns and test at 22 GHz, 24 GHz, and 26.5 GHz.

BAND 2 AMPLITUDE DISCRIMINATION TEST

Description

This test verifies that the counter will measure accurately the larger of two signals differing in amplitude by 15 dB or more.

Equipment

Sweep generator (Wiltron 6668B)
Sweep generator (Wiltron 6635B)
Spectrum analyzer (Hewlett Packard 8566B)
Power splitter (Hewlett Packard 11667B)

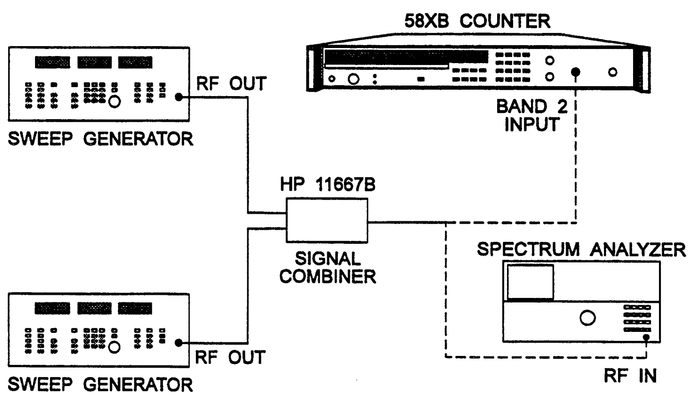

Figure 5-7. Band 2 Amplitude Discrimination Test Setup.

Procedure

1. Connect equipment as shown in Figure 5-7.
2. Set signal generator 1 to 3.0 GHz at 0 dBm and set signal generator 2 to 3.2 GHz at +6 dBm.
3. Using the spectrum analyzer, adjust the generator power levels so that the signal amplitude difference is 15 dB.
4. Verify that the counter correctly measures the frequency of the higher power signal source.
5. Repeat steps 2, 3, and 4 at 6 and 6.2 GHz, at 12 and 12.2 GHz, and at 17.8 and 18 GHz.

BAND 3 SUBBAND 1 RANGE AND SENSITIVITY TEST (588B Option 5804 Only)

Description

This test verifies counter operation from 26.5 GHz to 40 GHz at -20 dBm for both CW and simulated pulsed signals. The pulse generator is used to simulate a pulsed signal by applying a 50 ns ECL low with a 1 MHz repetition rate to the INHIBIT IN connector on the rear panel of the counter. The power meter is used to set signal levels.

Equipment

Sweep generator (Wiltron 6668B)
Power meter (Hewlett Packard 437B)
Power sensor (Hewlett Packard R8486A)
Pulse generator (Wavetek 801)
Oscilloscope (Tektronix 475)
Remote sensor (EIP 091)
Cable kit (EIP 590)

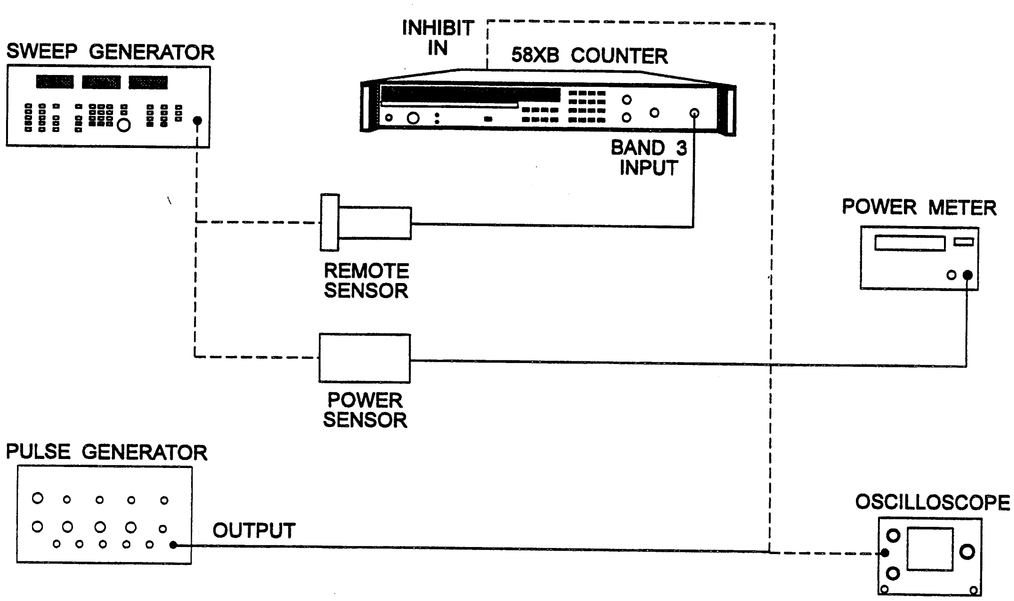

Figure 5-8. Band 3 Range and Sensitivity Test Setup (Model 588B Option 5804 Only).

Procedure

1. Connect equipment as shown in Figure 5-8.
2. Set the counter to Band 3 and select resolution 3.
3. Set the output frequency from the sweeper to 26.5 GHz.
4. Using the power meter, set the output signal level from the sweeper to -20 dBm.
5. Apply the 26.5 GHz signal to the remote sensor, verify proper reading, and record the results.
6. Repeat steps 3, 4, and 5 at 30 GHz, 35 GHz, and 40 GHz.
7. Set up the pulse generator to output a 50 ns wide ECL low signal with a 1 MHz repetition rate and apply the signal to the INHIBIT IN connector on the rear panel of the counter. This signal gates signal threshold inside the counter and is used to simulate a pulsed signal.
8. Repeat steps 3, 4, 5, and 6 for the simulated pulsed signal and record the results.

OPERATIONAL TEST RECORD

MODEL________________ SERIAL NO. ________________ DATE________________

TEST			ACTUAL		SPECIFICATIONS
INPUT 0	RANGE AND SENSITIVITY TEST				100 Hz TO 250 MHz (CW ONLY)
	INPUT SENSITIVITY	100 Hz	________		-15 dBm
		1 kHz	________		
		10 kHz	________		
		100 kHz	________		
		1 MHz	________		
		10 MHz	________		
		100 MHz	________		
		200 MHz	________		
		250 MHz	________		
INPUT 1	RANGE AND SENSITIVITY TEST				250 MHz TO 1 GHz
			CW	PULSE	
	INPUT SENSITIVITY	250 MHz	________	________	-15 dBm
		300 MHz	________	________	
		400 MHz	________	________	
		500 MHz	________	________	
		600 MHz	________	________	
		700 MHz	________	________	
		800 MHz	________	________	
		900 MHz	________	________	
		1 GHz	________	________	
INPUT 2	RANGE AND SENSITIVITY TEST				250 MHz TO 1 GHz
			CW	PULSE	
	INPUT SENSITIVITY	950 MHz	________	________	-20 dBm
		1 GHz	________	________	
		3 GHz	________	________	
		6 GHz	________	________	
		10 GHz	________	________	
		12.4 GHz	________	________	
		15 GHz	________	________	
		18 GHz	________	________	
		20 GHz	________	________	
	588B ONLY	22 GHz	________	________	-10 dBm
		24 GHz	________	________	
		26.5 GHz	________	________	

OPERATIONAL TEST RECORD (Continued)

TEST			ACTUAL		SPECIFICATIONS
INPUT 2	AMPLITUDE DISCRIMINATION TEST				
	CONDITIONS: F1 > F2 BY 15 dB OR MORE				
	F1	F2	PASS	FAIL	
	3 GHz	3.2 GHz	________	________	15 dB
	6 GHz	6.2 GHz	________	________	
	12 GHz	12.2 GHz	________	________	
	17.8 GHz	18 GHz	________	________	
BAND 3-1	RANGE AND SENSITIVITY TEST (588B Option 5804 Only)				26.5 GHz TO 40 GHz
			CW	PULSE	
	INPUT SENSITIVITY:	26.5 GHz	________	________	-20 dBm
		30 GHz	________	________	
		35 GHz	________	________	
		40 GHz	________	________	

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QUICK REFERENCE LIST OF GPIB COMMAND MESSAGES

CONTROL MESSAGES

Header	Argument	Terminator	Description
CLEARDISPLAY	None	None	Returns the display to normal measurement results display, clear error. (Equivalent to front panel CLEAR DISPLAY key.)
INITIALIZE	"	"	Reconfigures the instrument to the power-on state. (Equivalent to front panel INIT/LOCAL key.)
RESET	"	"	Resets counter to restart a new signal measurement cycle. (Equivalent to front panel RESET key.)
TRIGGER	"	"	Triggers a new measurement cycle. (Equivalent to front panel TRIG key.)

MODE MESSAGES

Header	Argument	Terminator	Description
DYNAMIC	ON or OFF	None	Suppresses blanks and trailing zeros when counter is configured in talker mode for faster free-field data transfer.
EXTERNAL	"	"	Controls the INT/EXT timebase reference. (Special Function 08 can also be used to select the external timebase.)
HEADER	"	"	Adds an alpha header and terminator for talker.
HOLD	"	"	Holds the last result if on. (Equivalent to front panel HOLD.)
PERIOD	"	"	Turns pulse period measurement on or off or DEFAULT. (Equivalent to front panel PULSE PERIOD key.)
SCIENTIFIC	"	"	Selects scientific notation for talker.
SEPARATE	"	"	Replaces the commas with CR LF between multinumber results.
WIDTH	"	"	Turns pulse width measurement on or off. (Equivalent to front panel PULSE WIDTH key.)

PARAMETER MESSAGES

Header	Argument	Terminator	Description
AVERAGE	<number>	None	Inputs an averaging value (01 to 99).
BAND	"	"	Selects a specific band (0 to 3) or DEFAULT.
CENTERFREQ	"	(Hz/kHz/MHz/GHz)	Sets a center frequency value and mode.
FETCH	"	None	Recalls counter setup stored in specified storage register (0 to 9). (Special Function 73.)
HIGHLIMIT	"	(Hz/kHz/MHz/GHz)	Sets a frequency limit high value.
LOWLIMIT	"	"	Sets a frequency limit low value.
MEMORY	hex_adrs	hex_data	Accesses a memory location and alters it (altering is optional). (Special Function 46.)
MEMORY	INCREMENT	"	Accesses the next memory location. (Special Function 46.)
MEMORY	DECREMENT	"	Accesses the previous location. (Special Function 46.)
MINPRF	<number>	(Hz/kHz/MHz/GHz)	Sets a minimum PRF value.
MULTIPLIER	"	None	Inputs a multiplier value (01 to 99).
OFFSETFREQ	"	(Hz/kHz/MHz/GHz)	Sets a frequency offset value.
RESOLUTION	"	None	Sets the frequency measurement resolution (0 to 9).
SAMPLERATE	"	(s/ms)	Sets a delay between measurement values (0 to 100 sec, 10 ms resolution).
SPECIAL	"	None	Activates a specific special function (00 to 99).

QUICK REFERENCE LIST OF GPIB COMMAND MESSAGES (Continued)

PARAMETER MESSAGES (Continued)

Header	Argument	Terminator	Description
SRQMASK	<number>	None	Selects the ORed combination of status events to cause a service request.
STORE	"	"	Stores the current counter setup in specified storage register (0 to 9). (Special Function 72.)
SUBBAND	"	"	Selects a specific Band 3 subband (1 to 6).
V1FREQ	"	(Hz/kHz/MHz/GHz)	Sets a start frequency for VCO sweep. (Special Functions 41, 42.)
V2FREQ	"	"	Sets a stop frequency for VCO sweep. (Special Functions 41, 42.)
Y1FREQ	"	"	Sets a start frequency for YIG sweep. (Special Function 40.)
Y2FREQ	"	"	Sets a stop frequency for YIG sweep. (Special Function 40.)

Output Control Messages

Command	Description
OUTPUT AVERAGE	Outputs the last specified averaging value.
OUTPUT BAND	Outputs the number of the last specified band.
OUTPUT CENTERFREQ	Outputs the center frequency last specified.
OUTPUT CONFIGURATION	Outputs current configuration of instrument. See page 4-13.
OUTPUT DATE	Outputs a 25-character string that contains part number, revision level, and date code of the software. The format is as follows: "#######-## REV.X MM-DD-YY".
OUTPUT DEFAULT	Outputs displayed data.
OUTPUT ERRORNUMBER	Outputs the number of the last error. See listing of error numbers on page 3-35.
OUTPUT FREQUENCY (AND WIDTH) (AND PERIOD)	Controls which measurement results to output. (Note: More than one measurement result is optional. The order of the results is preserved in the output. Output frequency, width and period can be in any combination.)
OUTPUT HIGHLIMIT	Outputs the high frequency limit last specified.
OUTPUT IDENTIFICATION	Outputs "EIP58nB GPIB dd", where n is 5 or 8 and dd is the GPIB address.
OUTPUT KEYCODE	Outputs the code of the last key pressed.
OUTPUT LEVEL	Outputs the rough amplitude measurement result. (Special Function 20.)
OUTPUT LOWLIMIT	Outputs the low frequency limit last specified.
OUTPUT MEMORY	Outputs the content of the memory in the last accessed location. (Special Function 46.)
OUTPUT MINPRF	Outputs the minimum PRF last specified.
OUTPUT MULTIPLIER	Outputs the last specified multiplier value.
OUTPUT OFFSETFREQ	Outputs the offset frequency last specified.
OUTPUT RESOLUTION	Outputs the last specified frequency measurement resolution.
OUTPUT SAMPLERATE	Outputs the last specified delay time between measurement values.
OUTPUT SETUP	Outputs a 142-character string that describes the current setup. See page 4-6.
OUTPUT SRQMASK	Outputs the combination of status events required to cause a service request. See page 4-11.
OUTPUT SUBBAND	Outputs the number of the last specified subband.
OUTPUT V1FREQ	Outputs the last specified start frequency for VCO sweep. (Special Function 41, 42.)
OUTPUT V2FREQ	Outputs the last specified stop frequency for VCO sweep (Special Function 41, 42.)
OUTPUT Y1FREQ	Outputs the last specified start frequency for YIG sweep (Special Function 40.)
OUTPUT Y2FREQ	Outputs the last specified stop frequency for YIG sweep (Special Function 40.)

Dear Customer,

EIP welcomes any suggestions you may have for changes, additions, or corrections that would improve the usefulness of this manual. Your suggestions are a valuable part of the input used in revising our manuals and developing the structure and format of new ones.

Please send us your comments. Your contributions will help us attain our goal of providing you with the best possible service for your instrument.

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