2.1 UNPACKING AND INSPECTION

2.2 The Series 8000B Counter is packed in a molded plastic-foam form within a cardboard carton for shipment. The plastic form holds the Counter securely in the carton and absorbs any reasonable external shock normally encountered in transit. Prior to unpacking, examine the exterior of the shipping carton for any signs of damage. Carefully remove the Counter from the carton and inspect the exterior of the instrument for any signs of damage. If damage is found, notify the carrier immediately.

2.3 Included with the Counter packed in the container are the instruction manual, Dana Part Number 980448, and power cord 403530. Counters which are equipped with remote programming and BCD output (Option 008 systems interface) are shipped with three mating connectors, 600698, and keys included.

2.4 BENCH OPERATION.

2.5 Each Counter is equipped with a tilt bail or "kickstand" to enable the front of the instrument to be elevated for convenient bench use. The tilt bail is attached to the two front supporting "feet" at the bottom of the instrument. For use, the bail is pulled down to its supporting position.

2.6 RACK MOUNTING.

2.7 The instrument can be mounted in a standard 19-inch rack with the optional rack-mounting flanges (403402, includes attaching hardware). To install the flanges, proceed as follows:

a. With instrument on its side, remove four Phillips-head screws holding bottom cover. Remove cover. Remove screws holding feet (and bail) in place. Replace bottom cover.

b. Place one of the supplied screws through each of the two holes in the mounting flange (figure 2.1). Thread a securing nut onto each screw just enough to attach it to the screw (approximately one turn).

c. Place the mounting flange onto the mounting slot in the instrument side panel so that the securing nuts fit entirely into the slot. Be sure the rack-mount slots on the flange are toward the front of the instrument.

d. Tighten screws. The securing nuts will rotate and hold the flange securely in place.

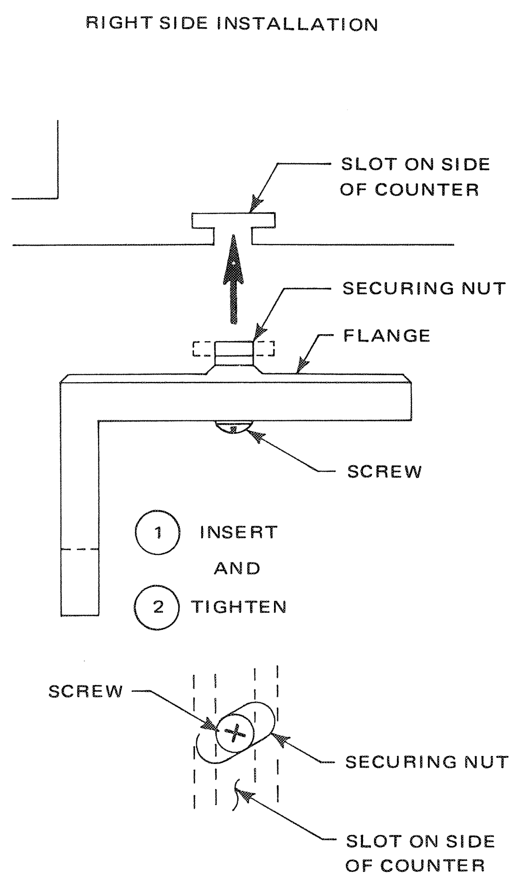


Figure 2.1 - Rack Mount Installation

2.8 POWER CONNECTIONS.

WARNING

Disconnect the instrument from the AC Power source before attempting to change power connections. Potentially lethal voltages are exposed when covers are removed.

2.9 Power requirements for domestic units are 115V ± 10%, 50 to 400 Hz. Power consumption is 60 watts maximum. All 8000B series counters are adaptable for 230V operation. Figure 2.2 shows input wiring for 230V ± 10% line voltage.

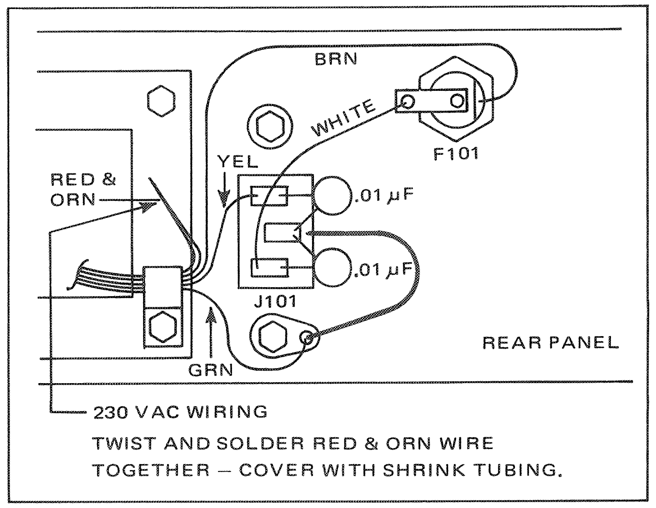


Figure 2.2 - 230V Operation

2.10 Power Cable.

2.11 A standard power cable having a three-pin plug is supplied with the counter. The cord connects to the power connector J101. The ground pin (round) is attached to the main frame of the counter. It is important that this pin be connected to a good quality earth ground.

2.12 Fuse.

2.13 The power fuse holder is located on the rear panel of the counter. A .75 amp 3AG fuse is used.

2.14 REMOTE PROGRAMMING AND BCD OUTPUT.

2.15 Information on the programming and output options available for the 8000B series Counters is provided in Manual No. 980469, Systems Interface for the 8000B series Counter.

2.16 OPERATING PROCEDURES.

2.17 Table 2.1 describes the function of each operating control and each connector on the instrument. Tables 2.2 through 2.9 describe procedures for operating the instrument in each of the measurement modes.

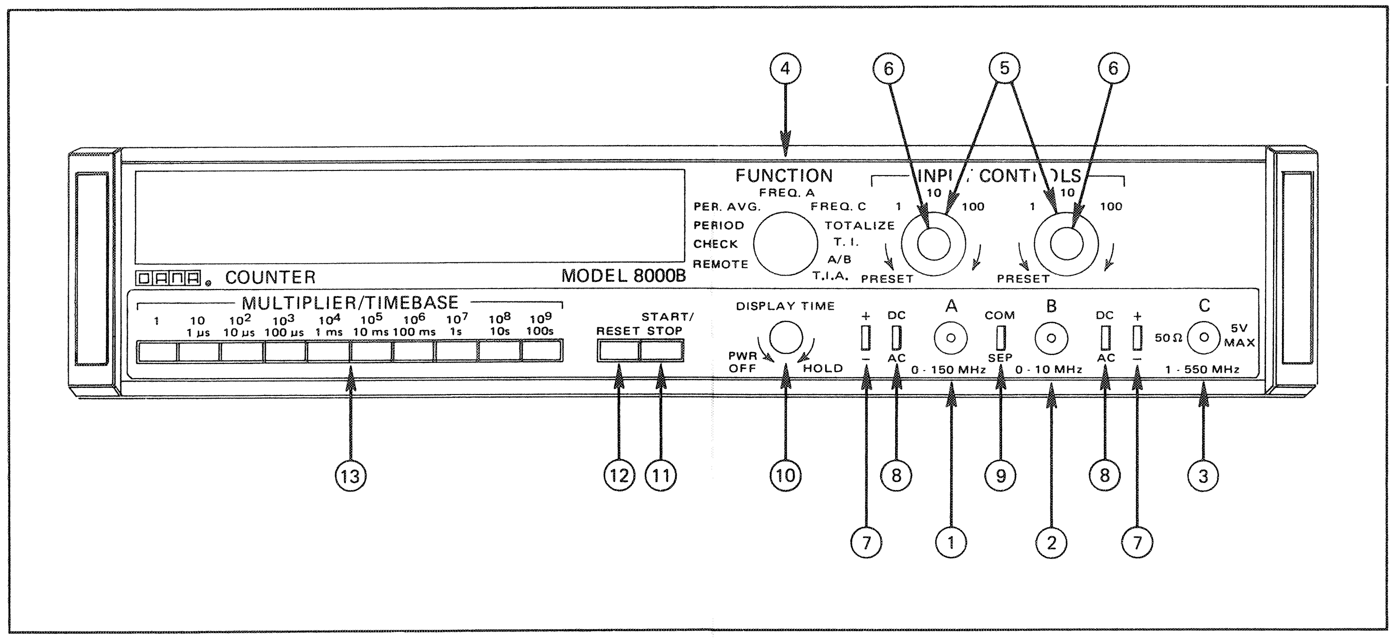


Figure 2.3 - Front Panel

Table 2.1 - Controls and Connectors (see figure 2.3)

input connectors (BNC type)	(1) A INPUT	Used for each function except FREQ C (500 MHz). It accepts up to 250V RMS or 300V peak on all ranges except 150V RMS or 200V peak to 1 MHz on 1V range without damage.
	(2) B INPUT	Always used in conjunction with Channel "A" for making ratio and time interval measurements. It accepts up to 250V RMS or 300V peak on all ranges except 150V RMS or 200V peak to 1 MHz on 1V range without damage.
	(3) C INPUT*	Used in the FREQ C mode only. It accepts frequencies from 1 MHz to 550 MHz and amplitudes from 50 mV to 1V. It accepts a maximum of 5V without damage. This input has no trigger controls because the slope is always set for +; the coupling is always AC; the level is set at the 0 crossing; and the attenuator is automatic.

Control	Position	Action
(4) FUNCTION (rotary switch)	REMOTE	This puts the FUNCTION switch, MULTIPLIER/TIME BASE controls, RESET and START/STOP switches, and the +/– slope switches under remote digital programming control, regardless of what position they are in at the time. The trigger level may be remotely programmed using an analog voltage. To do this, it is necessary for the trigger level control to be set at zero or for the attenuator to be in PRESET. The AC/DC coupling switch, the SEP/COM switch and the attenuator cannot be programmed.
	CHECK	In this mode, the counter measures its internal 10 MHz reference. The rear panel scaled output provides a TTL squarewave with a frequency equal to 10 MHz divided by the multiplier setting.
	PERIOD	In this mode, the amount of time for one period of the input waveform is measured.
	PER. AVG.	In this mode, a number of input waveform periods are averaged and measured. The number of periods is determined by the multiplier control.
	FREQ A	In this mode, the frequency on the A channel input is measured.
	FREQ C*	In this mode, the frequency on the C channel input is measured.
	TOTALIZE	In this mode, the number of events occurring between the start and stop command is totaled.
	T.I.	In this mode, the time interval between two electrical events is measured. The start point is determined by the A trigger controls and the stop point by the B trigger controls.
	A/B	In this mode, the ratio of the frequency applied at the A input to the frequency applied at the B input is measured.
	T.I. AVG.	In this mode, the time interval between two repetitive electrical events can be averaged and measured. The number of time intervals measured is determined by the multiplier control.
INPUT CONTROLS		The purpose of the controls is to set the point on the incoming waveform that causes a trigger pulse to be sent to the counting logic. In the frequency mode, it is necessary to send one trigger pulse during each cycle of the input signal; the number of such trigger pulses received during a gate time determines the frequency measured.

*Not in 8010B

Table 2.1 - Controls and Connectors (Continued)

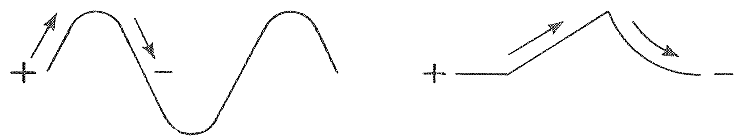
Control	Position	Action
(5) Trigger Range (outer switch)	1	Couples the input signal conditioner directly. Maximum usable signal is ±3 volts peak.
	10	Attenuates the input voltage by ten or 20 dB. Maximum usable signal is ±30 volts peak.
	100	Attenuates the input signal by one hundred or 40 dB. Maximum usable signal is ±300 volts peak.
		The trigger range also adjusts a special circuit that is designed to prevent false counts due to noise superimposed on the waveform being measured. This special circuit is called the trigger hysteresis. When the trigger range is in the 100V range it prevents all false counts due to superimposed noise of amplitude up to 2.5 volts peak to peak. In the 10V range, the protection is 250 mV; in the 1V range, it is 25 mV. It is therefore most desirable to have the range control set to the highest range possible for any given measurement – the higher the range, the greater the hysteresis protection.
(6) Trigger Level (inner control)	– +	The level control provides continuous adjustment of the trigger amplitude from –300% of the trigger range setting to +300%. (If the trigger range control is set on the 10V range, for example, the trigger level control can be adjusted to cause triggering between –30V and +30V.)
	PRESET	When making frequency measurements, the waveform being measured is usually a low amplitude sinewave. Because this waveform is so widely encountered, a PRESET position has been included at which the counter triggers at a point ≤ ±5% of range.
(7) +/– Slope (slide switch)		Selects which slope of the incoming waveform is to trigger the counter (positive or negative). 
	"+"	Causes triggering on the positive-going slope.
	"–"	Causes triggering on the negative-going slope.
(8) AC/DC Coupling (slide switch)	DC	Couples the input signal directly to the signal conditioner. Signal conditioner responds to dc signal changes. Used for time interval measurements.
	AC	Couples the input signal via a capacitor. Signal conditioner responds to periodic AC waveforms. Used for Frequency, Period, and Period AC measurements.
(9) COM/SEP	COM	(Common.) Directs the input signal from input A to channel A and channel B. Used for time interval and multiple time interval average measurements.
	SEP	(Separate.) Connects channel A to channel A input and connects channel B to channel B input.

Table 2.1 - Controls and Connectors (Continued)

Control	Position	Action
(10) DISPLAY TIME (rotary control with switch)	PWR OFF	(Power off.) Turns off the output of the +5 volt, and ±18 volt regulators. Turns off the +150 volts to the display tubes.
	DISPLAY TIME	Applies power to all circuits. Provides a 30 ms (CCW) to 5 second (CW) display time interval between measurements.
	HOLD	Programs the counter to take one measurement. Displays and stores that measurement until RESET is depressed or the position of the DISPLAY TIME control is changed.
(11) START/STOP (momentary pushbutton switch)	Depressed momentarily	This switch is used in the totalize mode. When pushed the first time, the counter starts counting; pushed the second time, the counter stops counting and holds the reading.
(12) RESET	Depressed momentarily	Resets the digital counter to all zeros, arms the counter for a new reading. Commands a new reading anytime.
(13) MULTIPLIER/TIME-BASE Switches (pushbutton switches)	Top row of numbers: 1 10 10^2 10^3 10^4 10^5 10^6 10^7 10^8 10^9	In Period Average and Time Interval Average modes, the numbers represent the multiplier. This indicates the number of periods or time intervals over which the measurement will be averaged. The higher the multiple, the greater the resolution and the slower the measurement time. In Frequency Ratio mode (A/B), the numbers indicate the number of cycles of the channel B (denominator) signals used to make the ratio measurement. The greater the number of cycles, the greater the resolution and the slower the measurement time.
	Lower row of numbers: 1 μs 10 μs 100 μs 1 ms 10 ms 100 ms 1s 10s 100s	In Frequency mode, the numbers select the time base control. This controls the time the internal gate is open. The longer the gate is open, the greater the resolution, and the slower the measurement time. In Period and Time Interval modes, the numbers indicate the reference frequency to be counted during the gate time. The shorter the time base selected, the greater the resolution; therefore, the left most button is usually selected for these operating modes.

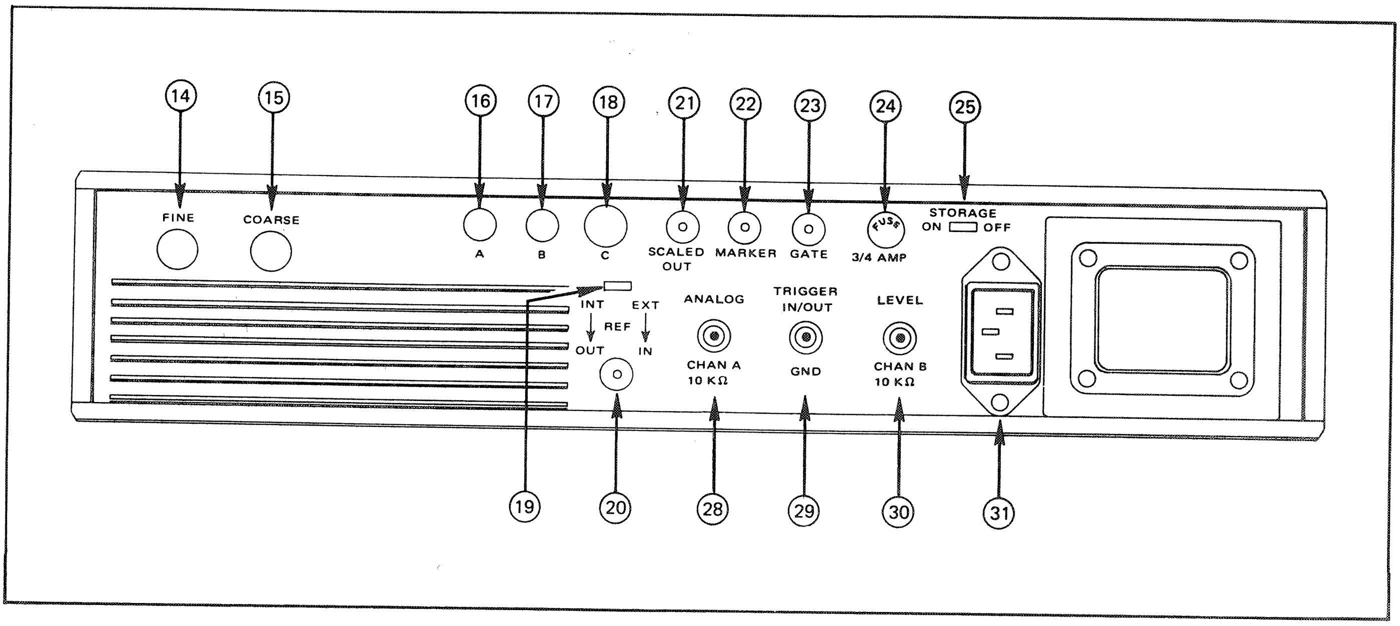


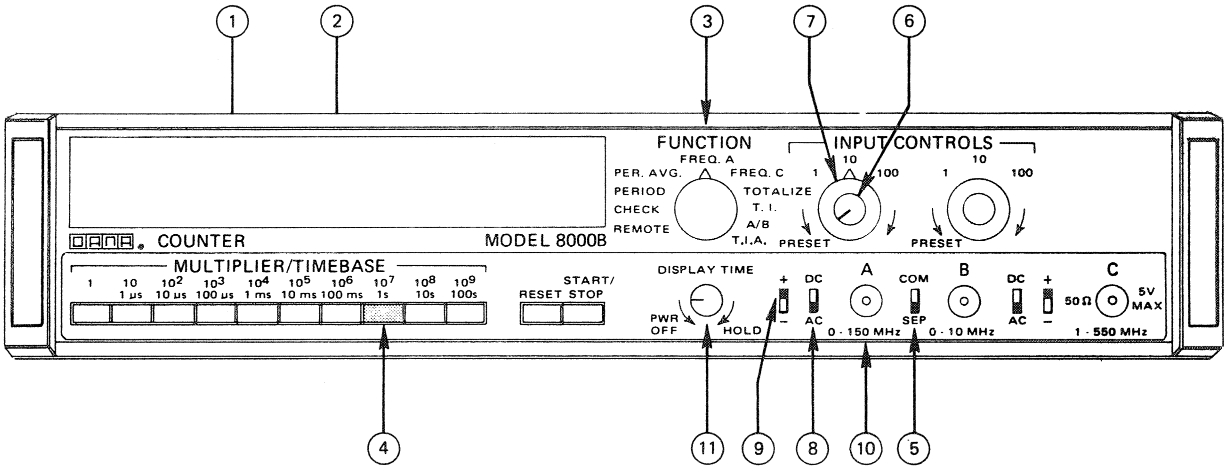
Figure 2.4 - Rear Panel

Table 2.1 - Controls and Connectors (Continued)
REAR PANEL (see figure 2.4)

(14) FINE		Access hole used in the FINE adjustment of the ovenized oscillator Option 200. See Calibration.
(15) COARSE		Access hole used in the COARSE adjustment of the ovenized oscillator Option 200. See Calibration.
(16) "A" (BNC connector)		Provides rear input for channel A. Used in Option 010 rear input. Degrades sensitivity by 10 dB above 50 MHz.
(17) "B" (BNC connector)		Provides rear input for channel B. Used in Option 010 rear input.
(18) "C"* (BNC connector)		Provides rear input for channel C. Used with Option 010 rear input.
(19) INT/EXT REF. (slide switch)	INT (Internal)	Routes the internal reference oscillator to the reference filter and to the reference BNC connector.
	EXT (External)	Routes the external reference oscillator from the reference BNC connector to the reference filter circuit.
(20) REF (BNC connector)		Used as internal reference oscillator output when the REF switch is in INT position. Used as external input to reference filter when switch is in EXT position. The counter will accept 1, 5, and 10 MHz external reference.
(21) SCALED OUT (BNC connector)		Provides a SCALED OUTput of the input in Totalize mode.
(22) MARKER OUT (BNC connector)		Provides a negative 18 volt output starting with trigger A and ending with trigger B. Used to modulate the Z axis of an oscilloscope.
(23) GATE (BNC connector)		Provides a positive true GATE output capable of driving five TTL loads.
(24) FUSE		Provided for the protection of internal circuits in the counter. Located on the rear panel. 3 AG, 3/4 AMP.
(25) STORAGE (slide switch)	OFF	Allows the counter to continuously update the display. Automatically off in the Totalize mode.
	ON	Allows the counter to store information and periodically updates the display.
(28) ANALOG, CHAN A		Used to measure or program a trigger level to channel A.
(29) TRIGGER IN/OUT GND		Used as a ground return for channel A and B trigger level input and output.
(30) ANALOG, CHAN B		Used to measure or program a trigger level to channel B.
(31) Power Connector		A three pin connector used for power input. Third pin is power ground.

*Not in 8010B

Table 2.2 - Frequency Measurement 0 - 150 MHz



(1) Connect AC power.

(2) Set STORAGE switch to the ON position.

(3) Set the FUNCTION switch to FREQUENCY A.

(4) Set the TIMEBASE switch to desired gate time.

(5) Set the SEP/COM to SEP.

(6) Set channel A level control to desired trigger level or to PRESET to trigger at ≅(0) zero volts.

(7) Set INPUT CONTROL range switch to be compatible with the input signal amplitude (1, 10 or 100 volt range).

(8) Set AC/DC coupling to AC or DC.

(9) Set the A slope to (+) plus.

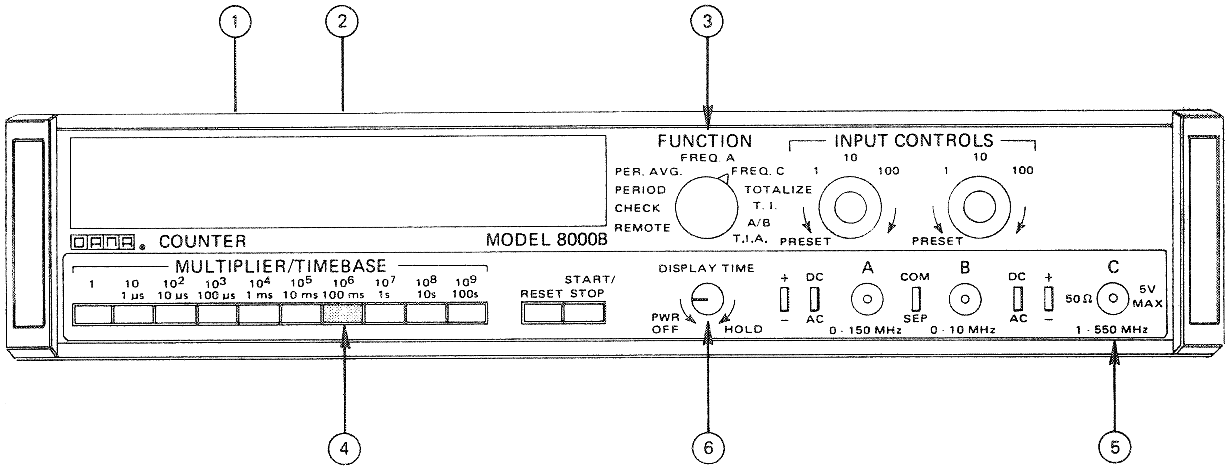
(10) Connect input signal (0 to 150 MHz) to channel A input jack. Note: Max. input 250V RMS or 300V peak.

(11) Set DISPLAY TIME to a convenient display interval.

Example: Input frequency to be measured is 600 hertz at 8 volts peak to peak. The TIMEBASE is set to 1 second. Input voltage range is set to 10 volts, trigger level to PRESET, slope to plus and AC/DC to AC. Display will be .000600 MHz with 1 hertz resolution. Change the TIMEBASE to 10 second, the display will be .6000 kHz with 0.1 hertz resolution. Change the TIMEBASE to 100 sec and the display will be .60000 kHz with 0.01 hertz resoltuion.

NOTE: A much faster reading would be to use the PERIOD mode and measure the period of the frequency.

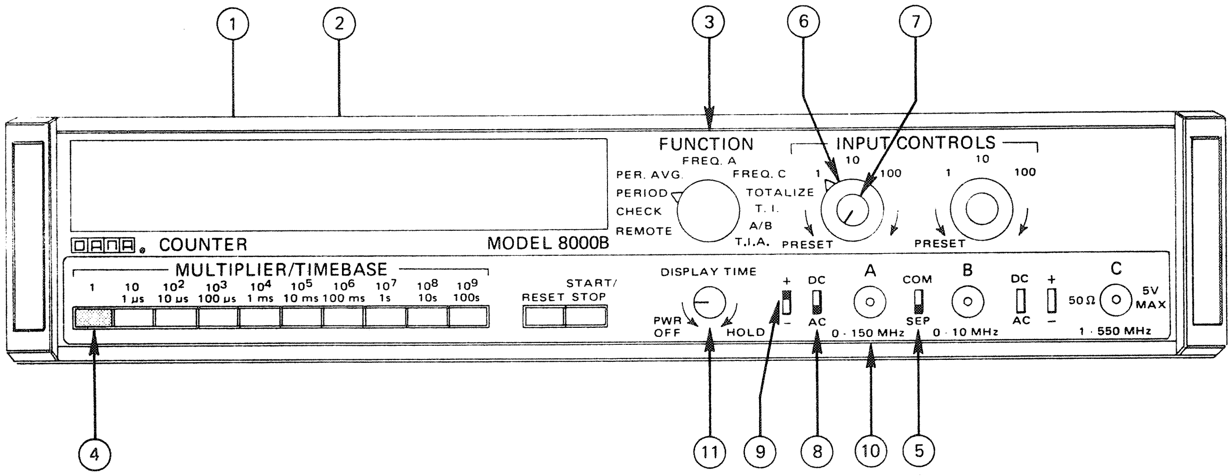
Table 2.3 - Frequency Measurement 1 - 550 MHz (Not in 8010B)



1. Connect AC power.
2. Set STORAGE switch to the ON position.
3. Set the FUNCTION switch to FREQUENCY C.
4. Set the TIMEBASE switch to the desired gate time.
5. Connect the input signal from 1 to 550 MHz (10 to 500 MHz with Option 030) in frequency to channel C input. Note: Max. input operating input is 1V RMS. Max. input without damage is 5V RMS.
6. Set DISPLAY TIME to a convenient display interval.

Example: Input frequency to be measured is 200 MHz at .5V rms. The TIMEBASE is set to 100 milliseconds. The trigger level setting is automatic in the FREQUENCY C function. The display will be 200.00000 MHz with 10 hertz resolution. Gate time is expanded by 4 in this mode of operation (i.e., a 100 ms gate selected on front panel will actually be 400 milliseconds).

Table 2.4 - Period Measurements



(1) Connect AC power.

(2) Set STORAGE switch to the ON position.

(3) Set the FUNCTION switch to PERIOD.

(4) Set the TIMEBASE switch to the desired time units to be counted.

(5) Set the SEP/COM to SEP.

(6) Set the channel A INPUT CONTROL range switch to be compatible with the input signal amplitude.

(7) Set the channel A trigger level control to the desired trigger level or to PRESET to trigger at ≅(0) zero volts.

(8) Set the AC/DC coupling to AC or DC on channel A.

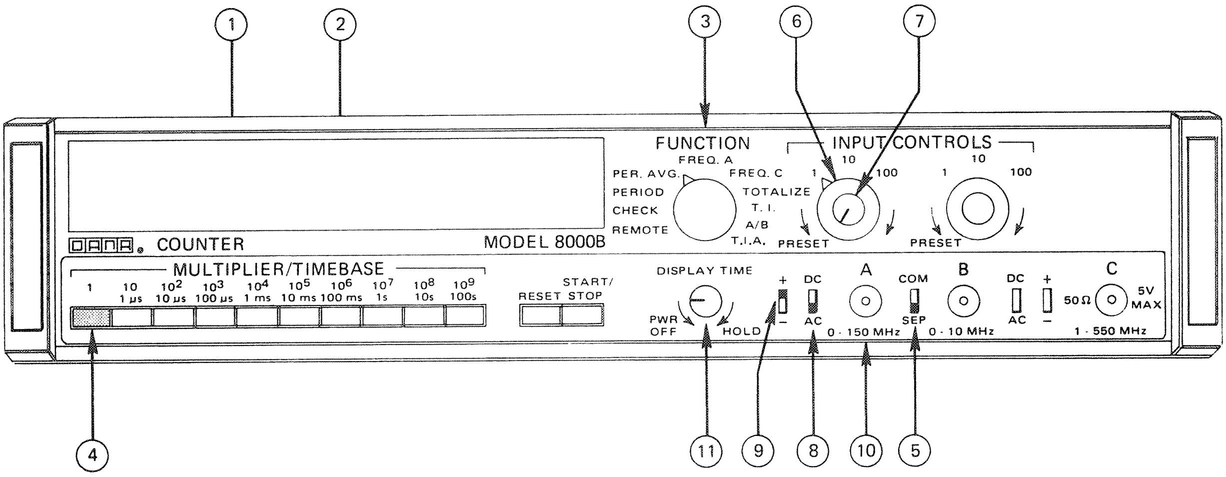
(9) Set the A slope to (+) plus or (−) minus.

(10) Connect the input signal (0 to 10 MHz) to channel A input jack.

(11) Set DISPLAY TIME to a convenient display interval.

Example: Input PERIOD to be measured is 1 millisecond at 1V peak. The TIMEBASE is set to 1. The channel A INPUT CONTROL switch is set to the 1-volt range, trigger level is set to the PRESET position and AC/DC is set to AC. The display will be 0001000.0 microseconds with 100 nanoseconds resolution.

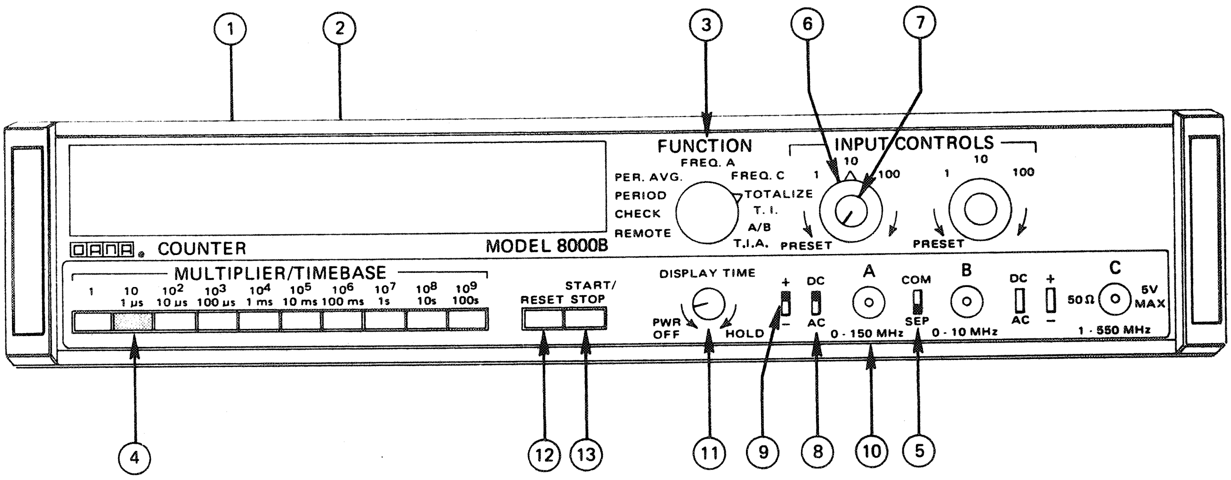
Table 2.5 - Period Average Measurements



1. Connect the AC power.
2. Set the STORAGE switch to the ON position.
3. Set the FUNCTION switch to PERIOD AVERAGE.
4. Set the MULTIPLIER switch to the desired time multiplier position.
5. Set the SEP/COM switch to SEP.
6. Set the channel A INPUT CONTROL range switch to match the input signal amplitude.
7. Set the channel A level control to the desired trigger level or to PRESET to trigger at ≅(0) zero volts.
8. Set the AC/DC coupling to AC or DC on channel A.
9. Set the channel A slope to (+) or (–) minus.
10. Connect the input signal (0 to 10 MHz) to channel A input jack.
11. Set DISPLAY TIME to a convenient display interval.

Example: Input period to be measured is 1 millisecond at 1V peak. The TIME BASE is set to 1. The channel A input voltage range switch is set to the 1 volt range, the trigger level is set to the PRESET position and AC/DC is set to AC. The display is 0001.0000 milliseconds with 100 nanoseconds resolution. Depress the 10 multiplier switch. The display will be 001.00000 ms with 10 nanosecond resolution.

Table 2.6 - Totalize



(1) Connect the AC power.

(2) Set the STORAGE switch to the ON position. Note: storage automatically disabled.

(3) Set the FUNCTION switch to the TOTALIZE position.

(4) Set the MULTIPLIER switch for the scaled output desired.

(5) Set the SEP/COM switch to the SEP position.

(6) Set the channel A INPUT CONTROL range switch to match the input signal amplitude.

(7) Set the channel A level control to the desired trigger level or to PRESET to trigger at ≅ (0) zero volts.

(8) Set the AC/DC coupling to AC or DC on channel A.

(9) Set the channel A slope to (+) plus or (–) minus.

(10) Connect the input signal (0 to 150 MHz) to channel A input jack.

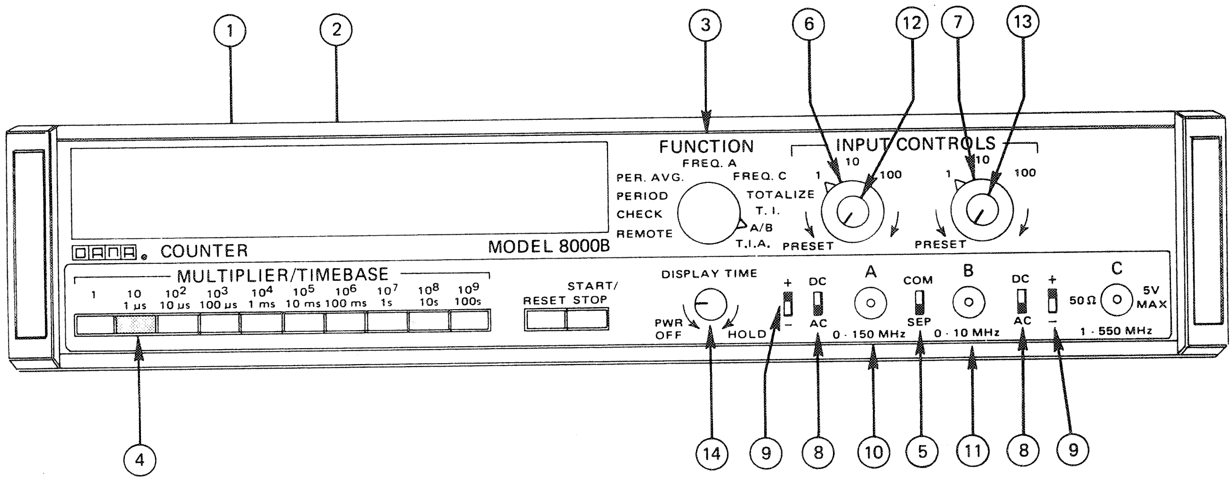
(11) Turn DISPLAY TIME clockwise to any position. It is not operative in this mode.

(12) Depress the RESET switch.

(13) To start the count, depress the START/STOP momentary switch. To stop the count, depress the START/STOP switch again.

Example: A series of electrical events is to be counted. They are 10V peak in amplitude and have a rate of 10 kHz. A scaled output is needed at 10 Hz. Set the channel A input voltage range switch to the 10V range, the trigger level to PRESET position, and the AC/DC to AC. The MULTIPLIER switch is set to 10. The count is initiated by depressing the START button. The SCALED OUT will be 10 Hz.

Table 2.7 - A/B Ratio



(1) Connect the AC power at the rear panel.

(2) Set the STORAGE switch to the ON position.

(3) Set the FUNCTION switch to the A/B position.

(4) Set the MULTIPLIER switch for the multiplier desired.

(5) Set the SEP/COM switch to the SEP position.

(6) Set the channel A INPUT CONTROL range switch to match the input signal amplitude.

(7) Set the channel B INPUT CONTROL range switch to match the input signal amplitude.

(8) Set channel A and B coupling to AC or DC.

(9) Set channel A and B slope to (+) plus or (–) minus.

(10) Connect the higher frequency input (0 - 150 MHz) to channel A.

(11) Connect the lower frequency input (0 - 10 MHz) to channel B.

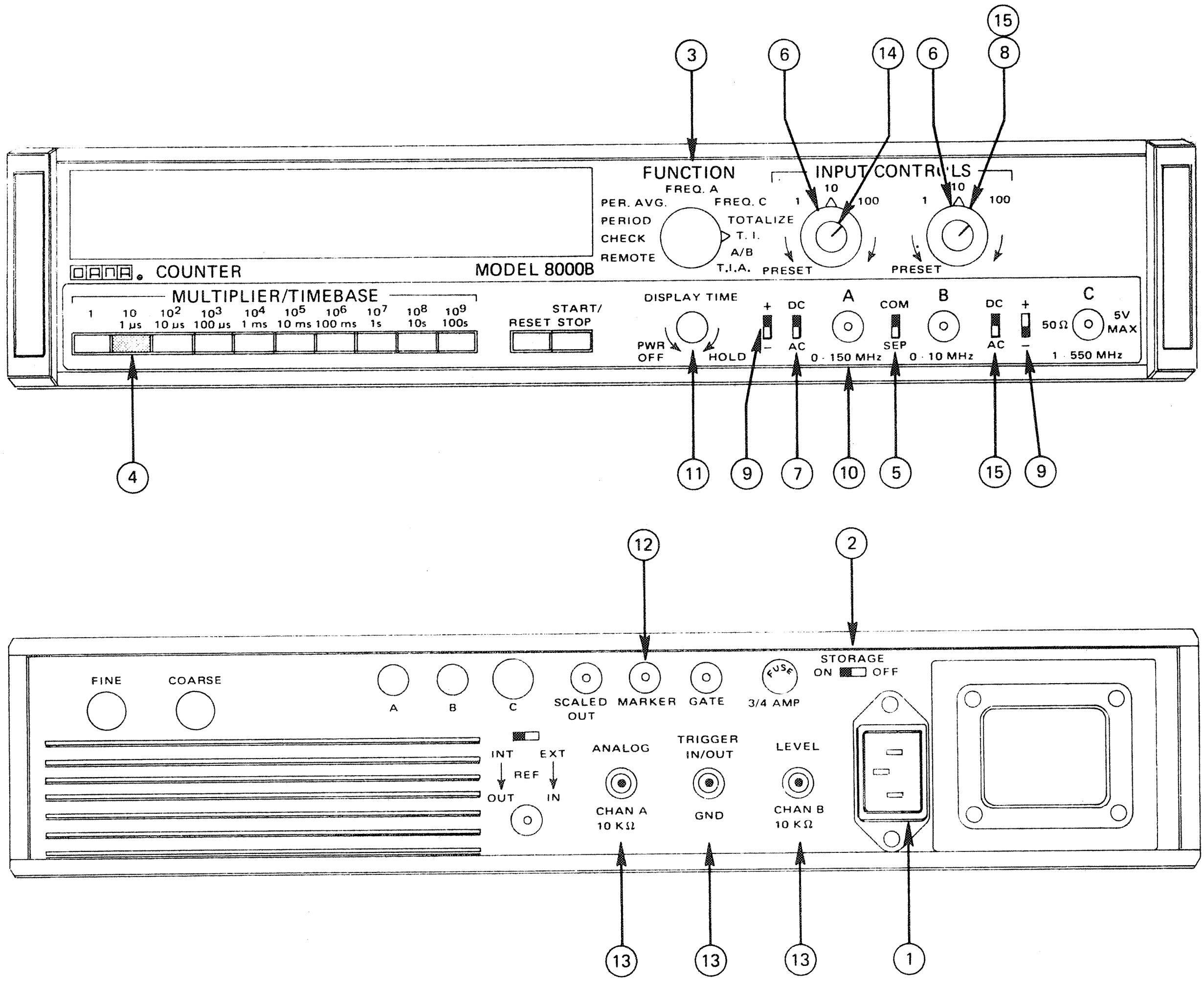
(12) Set the channel A trigger level control to the desired trigger level or to the PRESET to trigger at ≅(0) zero volts.

(13) Set the channel B trigger level control to the desired trigger level or to PRESET to trigger at ≈(0) zero volts.

(14) Set DISPLAY TIME to a convenient display interval.

Example: The ratio of two frequencies, 100 kHz and 1 kHz, are to be measured. The 100 kHz signal is applied to channel A. The 1 kHz signal is applied to channel B. The 1 MULTIPLIER is depressed. The SEP/COM is set to the SEP position. Both A and B trigger levels are set to PRESET position. The display indicates ratio directly. Ratio equals frequency A divided by frequency B times the multiplier. The display is 00000100. Depress the 10 multiplier. The display is 00001000. Depress the 10^2 multiplier. The display is 00010000.

Table 2.8 - Time Interval



(1) Connect the AC power.

(2) Set the STORAGE switch to the ON position.

(3) Set the FUNCTION switch to the TIME INTERVAL position.

(4) Set the TIMEBASE switch to the desired TIME BASE position.

(5) Set the SEP/COM switch to the COM position.

(6) Set the channel A and B INPUT CONTROL range switch to be compatible with the input signal amplitude.

(7) Set channel A AC/DC coupling switch to desired setting.

(8) Set channel B AC/DC coupling switch to AC and trigger level to PRESET.

(9) Set +/– slope switches to desired setting.

(10) Connect input signal (0 to 10 MHz) to channel A input.

(11) Set DISPLAY TIME to a convenient display interval.

(*12) To use the MARKER of the counter, tee-off the input signal of channel A input and connect to vertical input of oscilloscope. Connect MARKER output of counter to Z axis of oscilloscope.

continued

Table 2.8 - Time Interval (continued)

(*13) Connect two DC voltmeters capable of reading ±30 VDC to the ANALOG TRIGGER LEVEL outputs. Use the following formula to determine the trigger level voltage.

$$TL = \frac{VR}{10}$$

Where: TL = trigger level
V = voltmeter reading
R = Input control range

Example: The meter reading is 5 volts on the Input Control range 1.

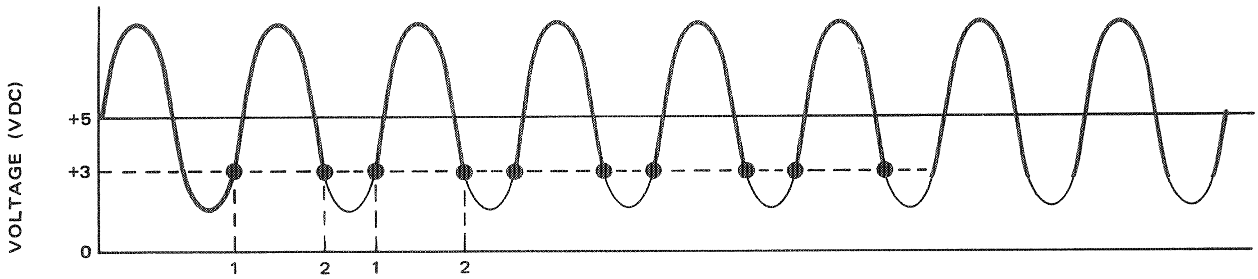
$$TL = \frac{5\,(1)}{10} = .5 \text{ volts}$$

(14) Adjust channel A trigger level control to desired "start" trigger voltage.

(15) Set channel B AC/DC to desired setting and adjust trigger level to desired "stop" trigger voltage.

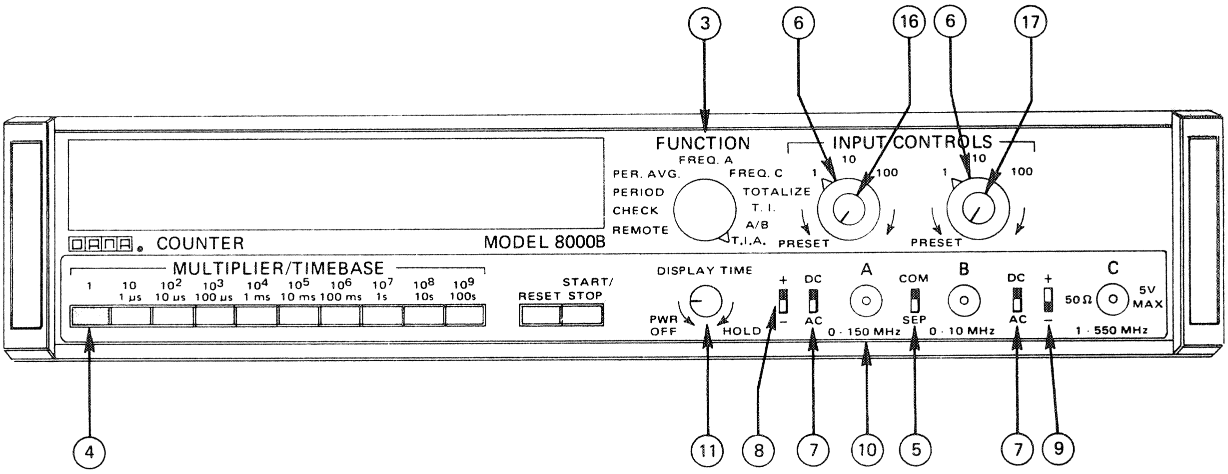
*Two features are provided in the 8000B counters to aid in setting the front panel controls. These features are the MARKER and the trigger level voltage connectors located on the rear panel. The use of these features is optional.

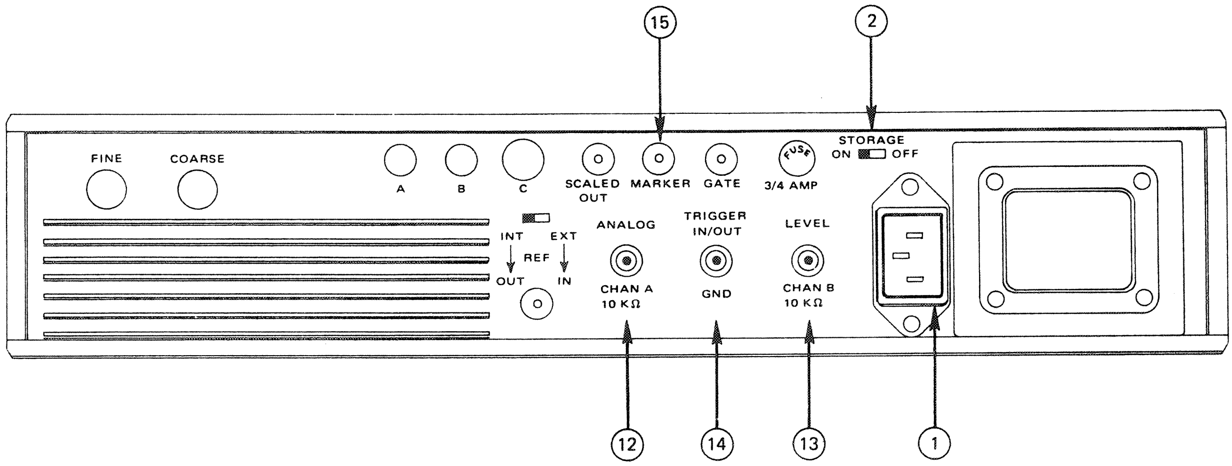
Example: The input waveform is a 1 kHz 5V peak to peak waveform riding on a 5 volt DC voltage. It is desired to measure the portion of the PERIOD which exist above 3 volts. See figure. Set the TIMEBASE to 1 µsec. Set the SEP/COM to COM. Set the channel A and B input voltage range to 10 volts. Set the A and B coupling to DC. Set the channel A slope to plus and channel B slope to (–) minus. Connect the voltmeters and oscilloscope to the counter as before. Adjust the A trigger level to trigger at 3 VDC on the plus slope. Adjust the B trigger level to trigger at 3 VDC on the minus slope. The period that is measured is intensified on the oscilloscope. The display is 0000746.0 µsec.



1. A TRIGGER LEVEL + SLOPE
2. B TRIGGER LEVEL – SLOPE

Table 2.9 - Time Interval Average





(1) Connect the AC power.

(2) Set the STORAGE switch to the ON position.

(3) Set the FUNCTION switch to the TIME INTERVAL AVERAGE position.

(4) Set the MULTIPLIER switch to the desired multiplier position.

(5) Set the SEP/COM switch to the COM position.

(6) Set the channel A and B INPUT CONTROL range switch to be compatible with the input signal amplitude.

(7) Set channel A AC/DC coupling switch to desired setting.

(8) Set channel B AC/DC coupling switch to AC and trigger level to PRESET.

(9) Set +/– slope switches to desired setting.

(10) Connect the input signal (0 to 2.5 MHz) to channel A input.

(11) Set DISPLAY TIME to a convenient display interval.

(*12) To use the MARKER of the counter, tee-off the input signal of channel A input and connect to vertical input of oscilloscope. Connect MARKER output of counter to Z axis of oscilloscope.

continued

Table 2.9 - Time Interval Average (continued)

(*13) Connect two DC voltmeters capable of reading ±30 VDC to the ANALOG TRIGGER LEVEL outputs. Use the following formula to determine the trigger level voltage.

$$TL = \frac{VR}{10}$$

Where: TL = trigger level
V = voltmeter reading
R = Input control range

Example: The meter reading is 5 volts on the Input Control range 1.

$$TL = \frac{5\,(1)}{10} = .5 \text{ volts}$$

(14) Adjust channel A trigger level control to desired "start" trigger voltage.

(15) Set channel B AC/DC to desired setting and adjust trigger level to desired "stop" trigger voltage.

*Two features are provided in the 8000B counters to aid in setting the front panel controls. These features are the MARKER and the trigger level voltage connectors located on the rear panel. The use of these features is optional.

Example: It is desired to measure the positive pulse width of a 5 kHz square wave. Set the MULTIPLIER to 1. Set the SEP/COM to COM. Set the A and B coupling to DC. Set the A slope to (+) plus and the B slope to (–) minus. Set the A and B trigger levels to PRESET. The display is 0000100.0 μsec. The resolution is 100 ns. Depress the MULTIPLIER 10 and the display is 000100.00 μsec. The resolution is 10 ns.

NOTE: In time interval average mode, the input signals must be repetitive and asynchronous with the counter's reference oscillator (10 MHz). If the input signal approaches a sub-harmonic of the reference frequency, a greater number of time intervals will have to be averaged to achieve good accuracy. The accuracy is found by the following formula.

$$\pm\text{reference error} \pm 2 \text{ nsec} \pm \frac{(\text{trigger error} \pm 100 \text{ nsec})}{\sqrt{\text{Number of Intervals Averaged}}}$$

where: $\text{trigger error} = \frac{.0025\ \mu\text{sec}}{\text{signal slope } (V/\mu\text{sec})}$

3.1 INTRODUCTION.

3.2 This procedure is designed to insure that the instrument is operating properly and within its specifications. If any of the readings are not within tolerance, refer to the calibration procedure. If the instrument fails to operate properly, refer to the troubleshooting procedure.

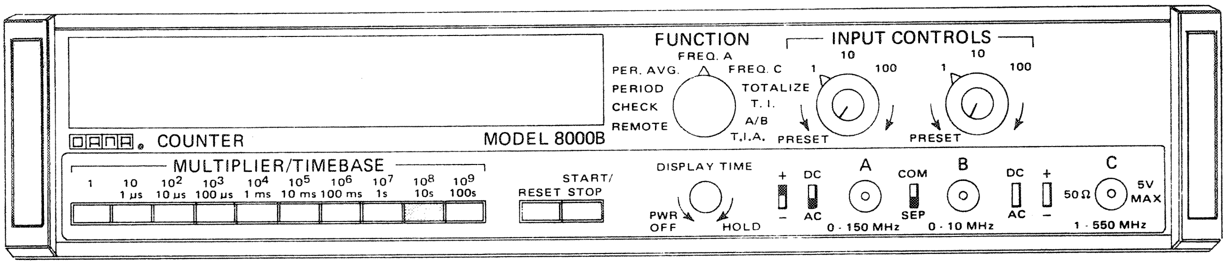
3.3 RECOMMENDED TEST EQUIPMENT.

3.4 Test equipment recommended for the Performance check is listed in table 3.1. Procedures are described in tables 3.2 through 3.11.

Table 3.1 - Required Equipment

Instrument Type	Required Specification	Recommended Instruments
Frequency Standard	1 MHz, 5 MHz, or 10 MHz	
Oscilloscope	150 MHz Bandwidth	TEK 454
Voltmeter	10 mVDC to 200 VDC	Dana 4300
Sine Wave Generator	2 Hz – 10 MHz	Dana 7010
VHF Signal Generator	10 – 150 MHz	HP8654A
VHF Signal Generator	1 – 550 MHz (Not required for 8010B)	HP8654A
Alignment Tool	.075" Hex (nonmetallic)	General Cement 9300
Alignment Tool	Blade (nonmetallic)	
Sampling Voltmeter	0 – 600 MHz	HP3406
50Ω Feedthru		TEK 011-049
BNC "T" Connectors		
50Ω Tee Connector		HP1022A
2 – BNC to GR Adapters		

Table 3.2 - Reference Oscillator Stability



DISPLAY TIME: Power on/CCW position
FUNCTION Switch: FREQ A
TIME BASE: 10 sec
SLOPE A: (+) Plus
A COUPLING: AC

INPUT VOLTAGE RANGE: 1 Volt
TRIGGER LEVEL A: PRESET
SEP/COM Switch: SEP
STORAGE Switch: ON
REFERENCE Switch: INT

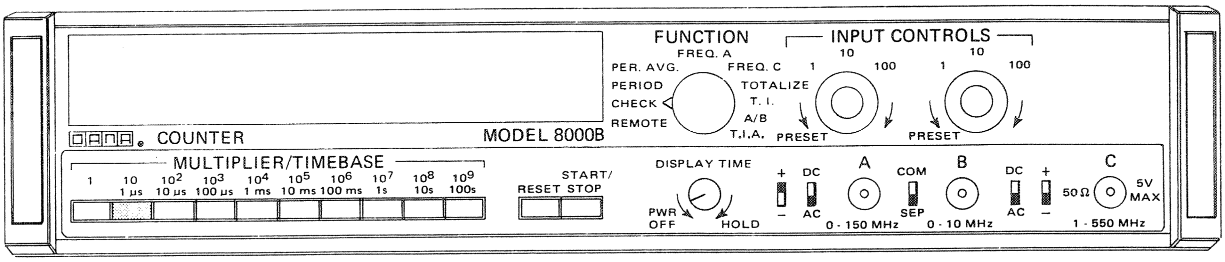
1. Set the controls as shown above.
2. Allow the counter to warmup for 1 hour, except with Option 200, which is 72 hours. Do not remove covers.
3. Connect a 1 MHz at 1V RMS Frequency Standard to Frequency Input A.
4. The difference between the Internal Counter Reference oscillator and the 1 MHz Frequency Standard can be determined by the following formula (20 000 000, – Reading in counts) = the Internal oscillator frequency in hertz.

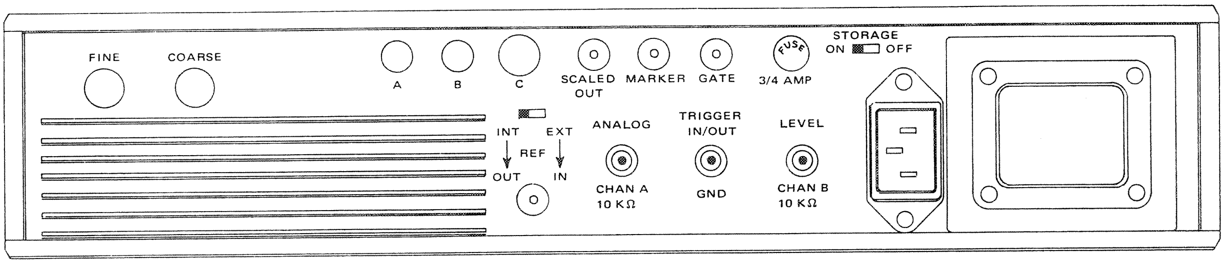
Typical Counter Reference Oscillator Difference for Standard Oscillator

Display	Internal Reference Oscillator
999.9950 kHz	10000.050 kHz
999.9975	10000. 025
1000.0000	10000.000
1000.0025	9999.975
1000.0050	9999.950

5. To calibrate the counter to a Frequency Standard, refer to the Calibration section.
6. To determine long term stability, operate the counter continuously for at least 1 month. The stability is as follows: Standard Oscillator, $<3 \times 10^{-7}$ per month, Option 050 1×10^{-7} per month, Option 200 1×10^{-9} per day.
7. To measure line voltage stability, use a Variac to vary the line voltage $\pm 10\%$ and measure the frequency difference. The line stability is as follows: Standard Oscillator $\pm 1 \times 10^{-7}$, Option 050 $\pm 5 \times 10^{-8}$, Option 200 $\pm 2 \times 10^{-9}$.
8. To measure temperature stability, vary the temperature from 25°C to 0°. Allow the reading to stabilize and note the reading. Increase the temperature to 50°C and allow the reading to stabilize. The temperature stability 0° to 50°C is as follows: Standard Oscillator $\pm 2.5 \times 10^{-6}$, Option 050 $\pm 5 \times 10^{-7}$, and Option 200 $\pm 5 \times 10^{-9}$.
9. Check the Reference Oscillator output by connecting an oscilloscope to the REF. OUT jack on the rear of the counter. An output of >2.0V peak to peak at 10 MHz is normal.

Table 3.3 - Counting Decades and Multiplier/Timebase Decades





DISPLAY TIME: Power on/CCW position

FUNCTION Switch: CHECK

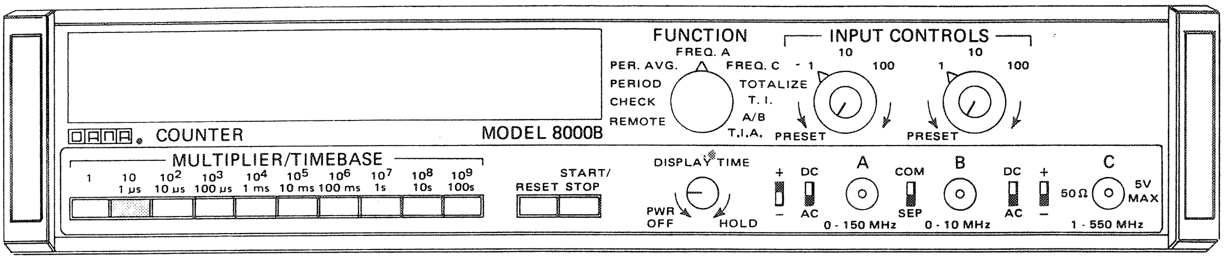
TIME BASE: See chart

STORAGE Switch: ON

REFERENCE Switch: INT

Timebase	Display	Tolerance
1 µs	000000010	± 1 count
10	000000100	± 1 count
100	000001000	± 1 count
1 ms	000010000	± 1 count
10	000100000	± 1 count
100	001000000	± 1 count
1 sec	010000000	± 1 count
10	100000000	± 1 count
100	000000000	± 1 count
9th digit option ⟶ (first digit)		

Table 3.4 - Decimal Point and Units



DISPLAY TIME: Power on/CCW position

FUNCTION Switch: Set for each check

TIME BASE: See table below

STORAGE Switch: ON

REFERENCE Switch: INT

Timebase	DISPLAY			
	FREQ A	Units	FREQ C (Not in 8010B)	Units
1 μsec	000000000	MHz	000000000	MHz
10	00000000.0	MHz	00000000.0	MHz
100	0000000.00	MHz	0000000.00	MHz
1 ms	000000.000	MHz	000000.000	MHz
10	00000.0000	MHz	00000.0000	MHz
100	0000.00000	MHz	0000.00000	MHz
1s	000.000000	MHz	000.000000	MHz
10	00000.0000	kHz	00.0000000	MHz
100	0000.00000	kHz	0.00000000	MHz
9th digit option	↑		↑	

PERIOD
TIME INTERVAL

Multiplier Selected	Display	Units
1	00000000.0	μsec
10	000000000	μsec
10^2	0000000.00	msec
10^3	00000000.0	msec
10^4	000000000	msec
10^5	0000000.00	sec
10^6	00000000.0	sec
10^7	000000000	sec
10^8	000000000	–
10^9	000000000	–
9th digit option	↑	

continued

Table 3.4 - Decimal Point and Units (continued)

PERIOD AVERAGE

Multiplier Selected	Display	Units
1	00000.0000	msec
10	0000.00000	msec
10^2	000.000000	msec
10^3	00000.0000	μsec
10^4	0000.00000	μsec
10^5	000.000000	μsec
10^6	00000.0000	nsec
10^7	0000.00000	nsec
10^8	000.000000	nsec
10^9	000000000	–
9th digit option → (first display digit)		

TIME INTERVAL AVERAGE

Multiplier Selected	Display	Units
1	00000000.0	μsec
10	0000000.00	μsec
10^2	000000000	nsec
10^3	00000000.0	nsec
10^4	0000000.00	nsec
10^5	000000.000	nsec
10^6	00000.0000	nsec
10^7	0000.00000	nsec
10^8	000.000000	nsec
10^9	00.0000000	nsec
9th digit option → (first display digit)		

TOTALIZE
A/B RATIO

Verify that no annunciators except the gate are lit when any multiplier button is depressed.

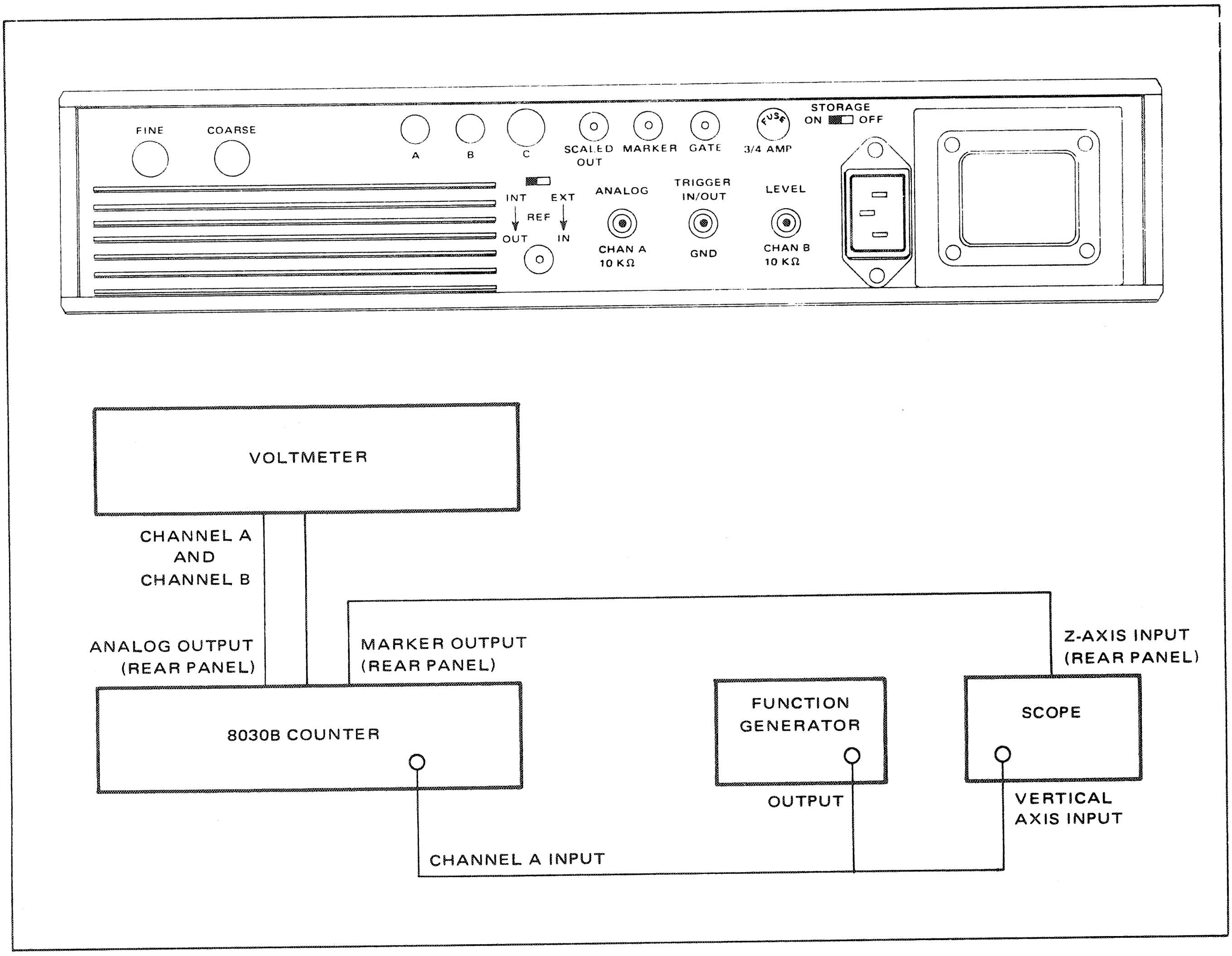
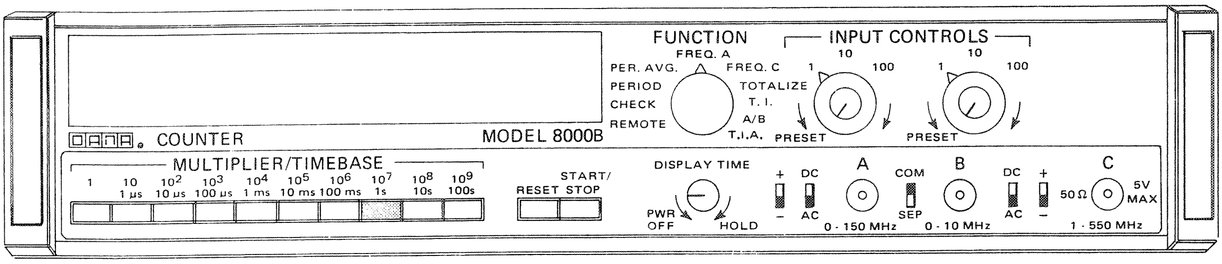


Figure 3.1 - Input Control and Marker Check Connections

Table 3.5 - Input Controls and Marker



DISPLAY TIME: Power on/CCW position
FUNCTION: FREQ A
TIME BASE: 1 second
SLOPE A: Minus (–)
SLOPE B: Minus (–)
COUPLING A: AC
STORAGE: ON (rear panel)

COUPLING B: AC
INPUT RANGE CONTROL A: 1
INPUT RANGE CONTROL B: 1
TRIGGER LEVEL A: PRESET
TRIGGER LEVEL B: PRESET
SEP/COM: COM

1. Set counter controls as shown above.
2. Connect Function Generator output to Input A on the counter. Also connect the Function Generator to the vertical input on an oscilloscope. Refer to figure 3.1 for all connections.
3. Adjust the Function Generator to 100 Hz at 4V peak to peak sine wave. Adjust the oscilloscope for a trace.
4. Connect voltmeter to the channel A Analog Output on the rear panel of the counter. For counters with Option 008, Systems Interface, connect to J110-S and J110-15.
5. Verify that the marker initiation is ±50 mVDC on the negative slope. Vary the channel A trigger level control and verify the marker initiation is variable over +3 volts to –3 volts on the negative slope of the sine wave.
6. Return channel A trigger level to the Preset position. Change channel A slope to (+) plus. Verify that the marker initiation is ±50 mVDC on the positive slope. Vary channel A trigger level control and verify the marker initiation is variable over +3 volts to –3 volts on the positive slope of the sine wave on the oscilloscope.
7. Return the channel A trigger level to Preset and the channel A slope to (–) minus.
8. Connect a voltmeter to the channel B Analog Output on the rear panel of the counter. For counters with Systems Interface, connect to J110-N and J110-15.
9. Verify that the marker termination is ±50 mVDC on the negative slope. Vary the channel B trigger level control and verify that the marker termination is variable over +3 volts to –3 volts on the negative slope of the sine wave.
10. Return channel B trigger level to Preset position. Change channel B slope to (+) plus. Verify that the marker termination is ±50 mVDC on the positive slope. Vary channel B trigger level control and verify the marker initiation is variable over +3 volts to –3 volts on the positive slope of the sine wave on the oscilloscope.

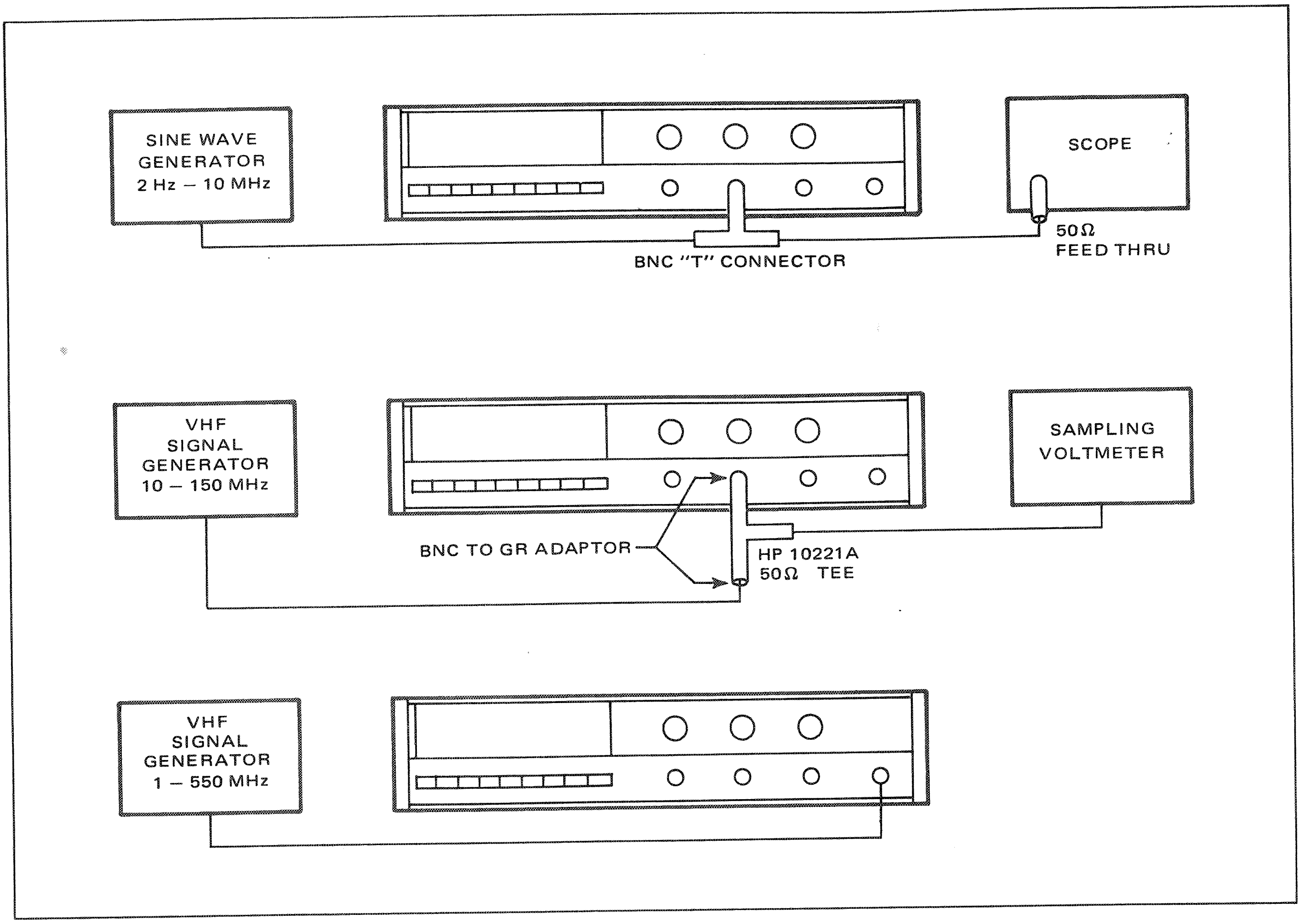
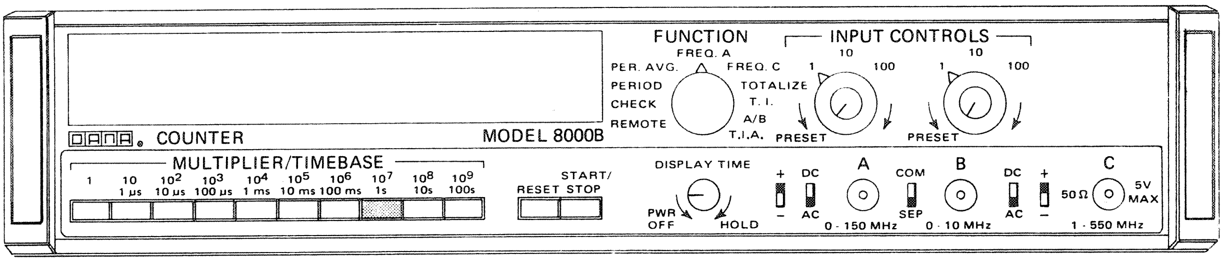


Figure 3.2 - Frequency Response Check Connections

Table 3.6 - Frequency Response and Sensitivity



DISPLAY TIME: Power on/CCW position
FUNCTION: FREQ A
TIME BASE: 1 second
SLOPE A: (+) Plus
SLOPE B: (+) Plus
COUPLING A: AC
STORAGE: ON

COUPLING B: AC
INPUT RANGE CONTROL A: 1
TRIGGER LEVEL CONTROL A: PRESET
INPUT RANGE CONTROL B: 1
TRIGGER LEVEL CONTROL B: PRESET
SEP/COM: SEP

1. Set controls as shown above.

2. Connect a BNC "T" connector to channel A input. Connect a sine wave generator (2 Hz – 10 MHz) and an oscilloscope to the "T" connector. Use a 50 ohm termination at the vertical input to the oscilloscope. Refer to figure 3.2 for hookup.

3. Adjust the sine wave generator between 10 Hz to 10 MHz maintaining 50 mV RMS output. Verify that the counter displays the frequency through this range. Change the A slope to (–) minus. Verify that the counter displays the frequency through this range.

4. Replace the sine wave generator with a VHF signal generator. Connect generator as shown in figure 3.2 and adjust for a 50 mV RMS output.

5. Set the Time Base to 1 second and the A slope to (+) plus.

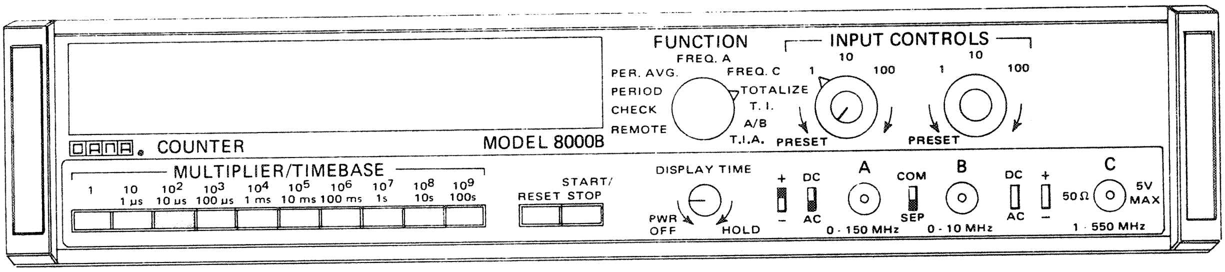
6. Vary the signal generator from 10 MHz to 100 MHz. Verify that the counter displays the frequency.

7. Set the output of the VHF signal generator to 100 mV RMS. Vary the signal generator from 100 MHz to 150 MHz. Verify that the counter displays the frequency.

8. Frequency C Models 8020B, 8030B. Change the function to Frequency C. Connect the VHF signal generator as shown in figure 3.2 and set the output to 50 mV RMS (for Option 030, set the output to 1 mV RMS). Vary the VHF signal generator between 1 MHz and 550 MHz (for Option 030, 10 MHz to 500 MHz).

9. The counter should display all frequencies in this range.

Table 3.7 - Totalize



DISPLAY TIME: Power on/CCW

FUNCTION: TOTALIZE

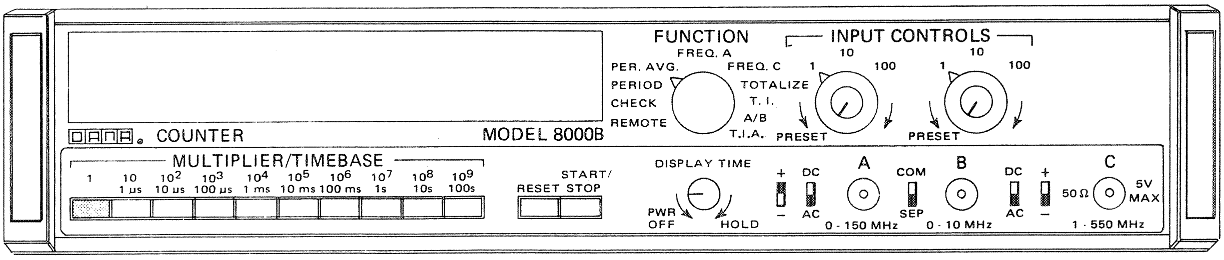
MULTIPLIER: 10^2

INPUT VOLTAGE RANGE A: 1

TRIGGER LEVEL A: PRESET

1. Set the counter controls as shown above.
2. Connect test oscillator to the counter at Input A. Set the oscillator output to .5V RMS at a frequency of 1 MHz.
3. Connect an oscilloscope to the scaled output jack on the counter rear panel.
4. Push the Reset on the counter. The display should read all zeros. Push the Start/Stop button. The display should totalize.
5. The scaled out should be a series of pulses with an amplitude of greater than 2V P.P. The scaled out repetition rate will be 1 kHz.
6. Depress the Start/Stop again. Totalizing should stop and the accumulated count should be displayed.
7. Push the Reset button and the display should be all zeros.

Table 3.8 - Period and Period Average



DISPLAY TIME: Power on/CCW
FUNCTION: PERIOD
MULTIPLIER: 1

INPUT VOLTAGE RANGE: 1
INPUT TRIGGER LEVEL A: PRESET

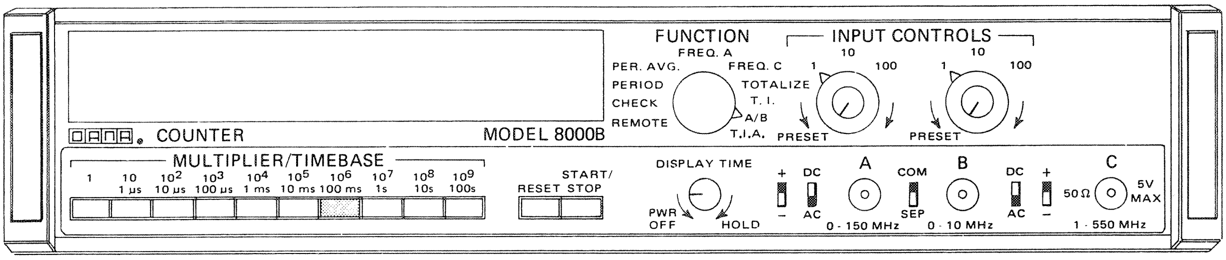
PERIOD

1. Set the counter controls as shown above.
2. Connect a test oscillator to Input A. Adjust the output of the oscillator to .5V RMS.
3. Vary the test oscillator frequency between 10 Hz and 10 MHz. The counter will display the period of the frequency.

PERIOD AVERAGE.

1. Set the Function switch to Period Average. Set the multiplier to 10.
2. Vary the test oscillator frequency between 10 Hz and 10 MHz.
3. The counter will display the period by taking the average period of the periods averaged.

Table 3.9 - A/B Ratio



DISPLAY TIME: Power on/CCW

FUNCTION: A/B

MULTIPLIER: 10^6

SLOPE (A and B): (+) Plus

COUPLING (A and B): AC

INPUT VOLTAGE RANGE (A and B): 1

SEP/COM: COM

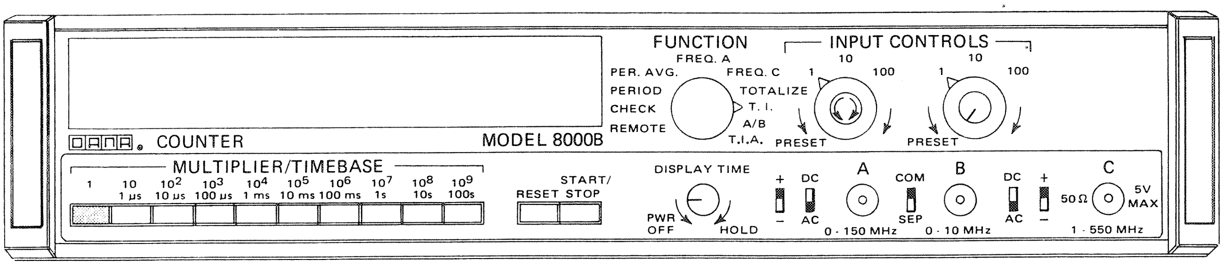
STORAGE: ON

TRIGGER LEVEL (A and B): PRESET

A/B RATIO

1. Set controls as shown above.
2. Adjust test oscillator output to 10 MHz at 100 mV RMS.
3. Connect test oscillator to Input A.
4. Counter should display 1000000 counts.

Table 3.10 - Time Interval and Time Interval Average



DISPLAY TIME: Power on/CCW
FUNCTION: T. I.
MULTIPLIER: 1
SLOPE A: (+) Plus
SLOPE B: (+) Plus
COUPLING A: AC
COUPLING B: AC

INPUT VOLTAGE RANGE A: 1
INPUT VOLTAGE RANGE B: 1
SEP/COM: COM
STORAGE: ON
TRIGGER LEVEL A: Adjust
TRIGGER LEVEL B: PRESET

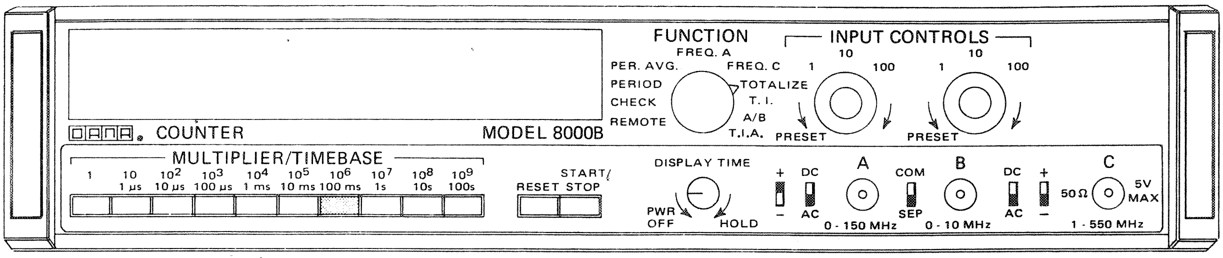
TIME INTERVAL

1. Set controls as shown above.
2. Connect pulse generator output and oscilloscope to a "T" connector. Connect the "T" connector to the input "A" on the counter. Use a 50 ohm feed through on the input to the oscilloscope.
3. Adjust the pulse generator output to 900 kHz repetition rate, with a 200 nanosecond pulse width at 1V peak to peak.
4. The counter will display the period of the waveform.
5. Set slope B to (–) minus. The counter will display pulse width.

TIME INTERVAL AVERAGE

6. Set the function to T.I. AVG., and the multiplier to 10^3.
7. The counter will display the pulse width of the input waveform.
8. Set the slope B to (+) plus. The counter will display the period of the input waveform.

Table 3.11 - Display Time and Gate Output



DISPLAY: Power on/CCW

FUNCTION: TOTALIZE

1. Set controls as shown above.
2. Connect the vertical input of an oscilloscope to the gate output on the counter rear panel.
3. Press Reset and check that the gate output is low.
4. Press Start/Stop and check that the gate output is greater than 2V.
5. Press Start/Stop again and check that the gate output is low.
6. Set the Function switch to Frequency A and the Time Base to 100 msec.
7. Vary the Display Time and check that the repetition rate changes from approximately 30 milliseconds to 5 seconds.