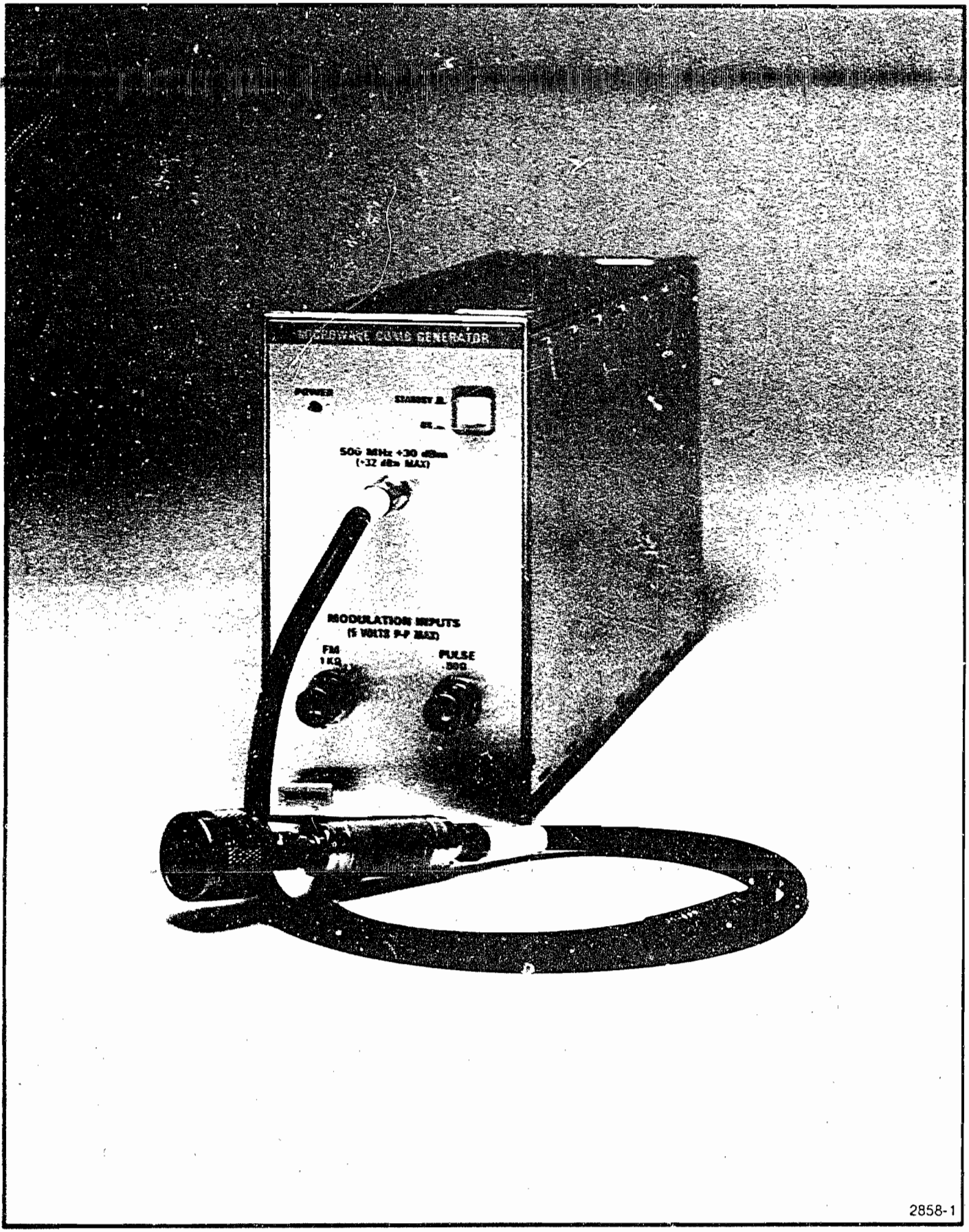

Microwave Comb Generator.

INTRODUCTION

General Information

The Microwave Comb Generator is a calibration fixture for microwave spectrum analyzers. It consists of a signal source, a coaxial cable, and a comb generator module. The signal source plugs into a TM 500 Power Module; its output is applied to the comb generator module via the coaxial cable. The 500 MHz source can be frequency- or pulse-modulated externally. When the output of the signal source is applied to the comb generator module, a comb line (spectrum) of markers is generated, which are harmonics of the fundamental 500 MHz.

Standard Accessories

1 Cable
1 Comb Generator Module
Instructions

Table 1-1

ELECTRICAL CHARACTERISTICS

Characteristics	Performance Requirements	Supplemental Information
	SIGNAL SOURCE	
-33 V Source		
ON		13.2 W (400 mA).
STANDBY		3.6 W (110 mA).
Frequency	500 MHz, ±0.01%.	
Power Out	-30 dBm, ±2 dB.	
Output Impedance		50 Ω.
Spurious Responses		40 dB below carrier for a 6 dB or greater return loss load.
Modulation, External		
Pulse		
On off ratio		>20 dB.
Polarity		0 V on, -5 V off.
Input Impedance		50 Ω.
3 dB Bandwidth, -10 dBm sinewave input		>1 MHz.
Frequency Modulation	~~1.4 V provides 1 kHz or more frequency deviation.~~	±1.4 V provides approximately ±1 kHz frequency deviation at the 500 MHz fundamental.
Output amplitude variation due to any amplitude modulation component	2 dB or less	

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Table 1-1 (cont)

Characteristics	Performance Requirements	Supplemental Information
COMB GENERATOR MODULE		
Comb Line Amplitude		See Figure 1-1.
Pulse Width		50—70 ps.

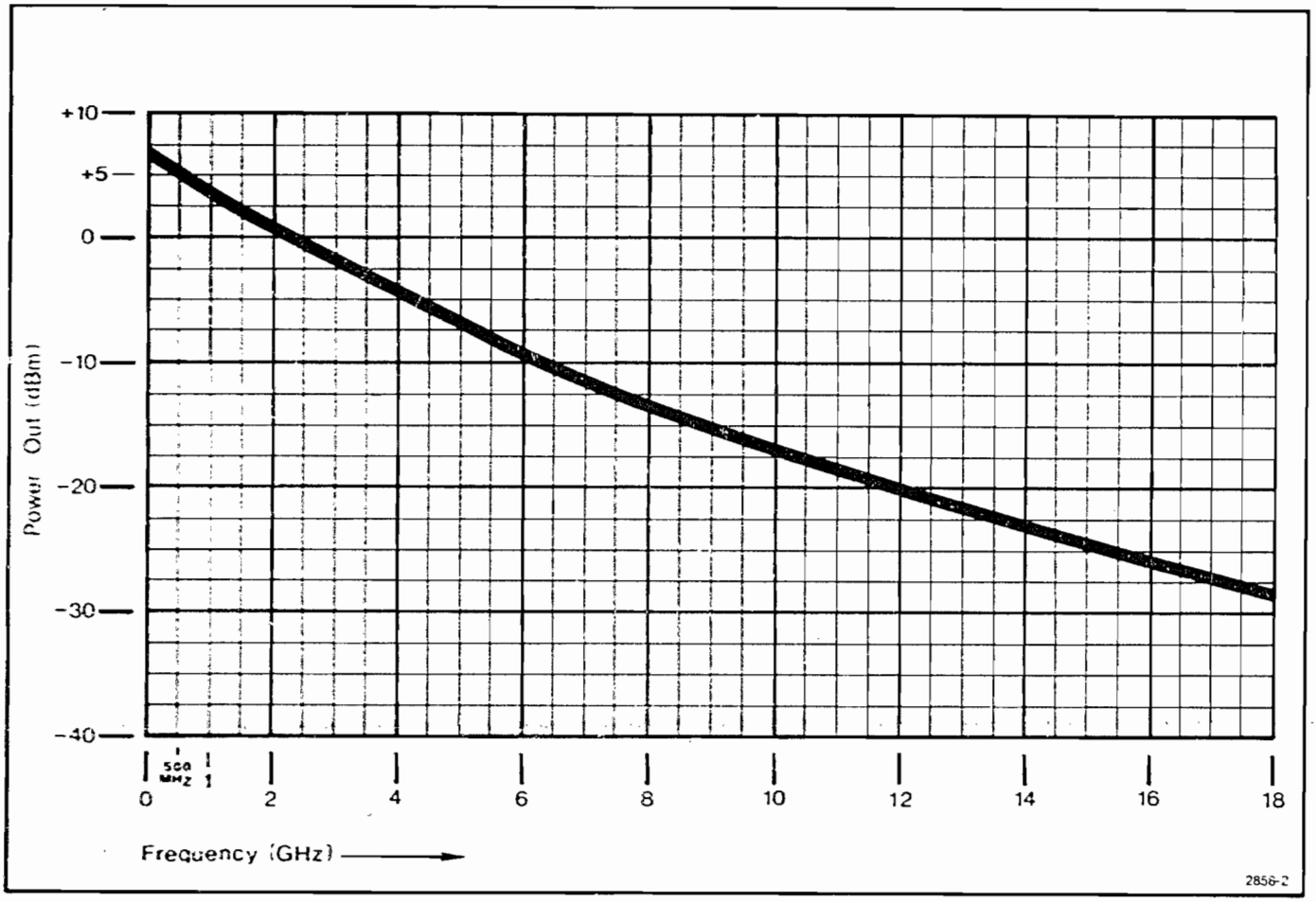

Fig. 1-1. Typical output characteristics of the Microwave Comb Generator.

Table 1-2

ENVIRONMENTAL CHARACTERISTICS

Characteristics	Performance Requirements	Supplemental Information
Temperature		
Operating	0°C to 55°C.	
Humidity	To 95%, −5, −0% RH.	
Vibration	.025" p-p, 10-55-10 Hz, 15 minutes dwell @ 55 Hz 10 minutes.	
Transit Drop	30 cm (12 inches) drop.	

Table 1-3

PHYSICAL CHARACTERISTICS

Characteristics	Performance Requirements	Supplemental Information
Weight		1 lb. 14 oz.
Domestic Shipping		
Weight		3 lbs. 6 oz.
Length		17 inches.
Width		9 1/2 inches.
Depth		7 inches.

OPERATING INSTRUCTIONS

Installation

1. Connect the Microwave Comb Generator signal source and the comb generator module with the coaxial cable.

2. Plug the signal source into a TM 500 Power Module.

CAUTION

Applying the 500 MHz +30 dBm (1 watt) source directly to the spectrum analyzer RF input connector may damage some mixers.

3. Connect the comb generator module to the spectrum analyzer RF input connector.

4. Turn on the power on the TM 500 Power Module.

Front Panel Controls

The purpose of each front panel connector, indicator, and control is described below.

POWER

This indicator lights when the instrument is in the operating mode.

ON/STANDBY

ON—the instrument is in the operating mode.

STANDBY—power is applied only to certain parts of the circuitry for stability purposes.

500 MHz, 30 dBm (+32 dBm max)

This output is the signal source for the comb generator module.

MODULATION INPUTS (5 VOLTS P-P MAX)

FM—Provides a means of pulling the 500 MHz signal source frequency by approximately ±1 kHz, depending on the polarity and magnitude of the dc voltage applied.

PULSE—Provides a means of adding sidebands to the 500 MHz carrier by switching the carrier on (+30 dBm) and off (<10 dBm). For best side lobe symmetry apply 2 V peak-to-peak to the pulse input. Optimum duty cycle of the modulated input is 50%.

Applications

The following are some typical applications for the Microwave Comb Generator.

1. Frequency Response. Figure 1-1 is a graph illustrating the typical output versus frequency characteristics of the Comb Generator. Since the output lines decrease at a 1 ÷ N rate, a displayed spectrum on the analyzer should show the same characteristics. Any radical (10 dB or more) change of adjacent lines, or a flat display, are indications that the frequency response of the instrument is probably out of specifications.

2. Frequency Accuracy. Since the comb lines are multiples of a crystal controlled 500 MHz source, these comb lines provide an accurate reference to check frequency readout accuracies up to 20 GHz.

3. Measuring Frequency Drift, Residual FM, and Sideband (Phase) Noise. Since the 500 MHz source is very stable, the comb lines provide a good reference for spectrum analyzer drift and incidental FM. Figure 2-1 shows a typical spectrum analyzer display with sideband noise.

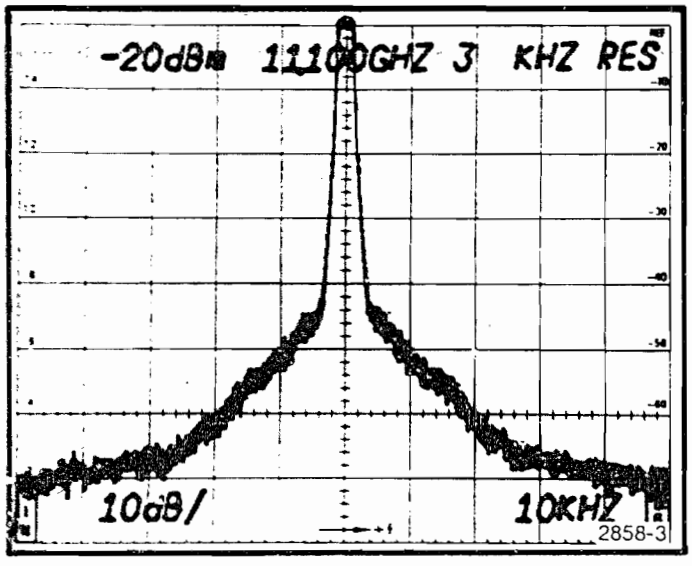

Fig. 2-1. Typical spectrum analyzer display of sideband noise.

4. **Frequency Span Accuracy.** Provisions to externally modulate the 500 MHz source permit modulating the comb markers with frequency pulses, sinewaves, or time marks. When modulated, these envelopes can be used to accurately check the Span/Div settings of spectrum analyzers. Span/Div accuracy can easily be checked at frequencies in the GHz range.

5. **Providing Simulated Pulse and Frequency Modulated Displays.** Figure 2-2 and Figure 2-3 illustrate examples of simulated pulse and frequency modulated displays. These displays provide a good indication of the analyzer's resolution and bandpass characteristics at the higher frequencies (into the GHz range).

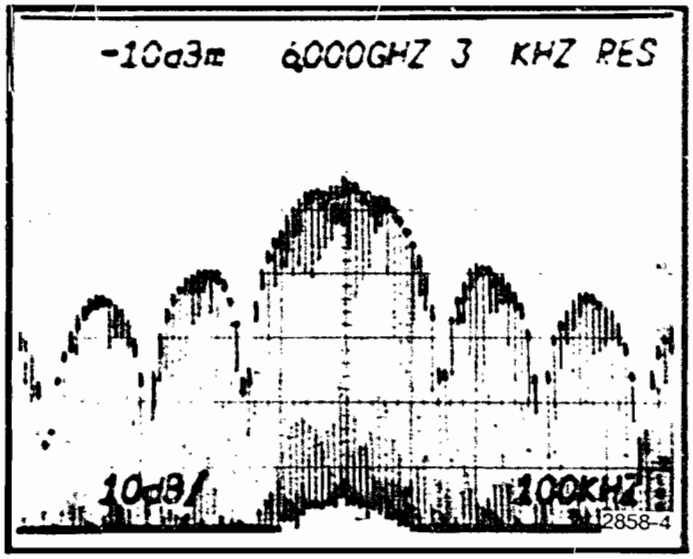

Fig. 2-2. Typical pulse response display with a pulse width of 6.6 μs. For best results, use a pulse width ≥5 μs.

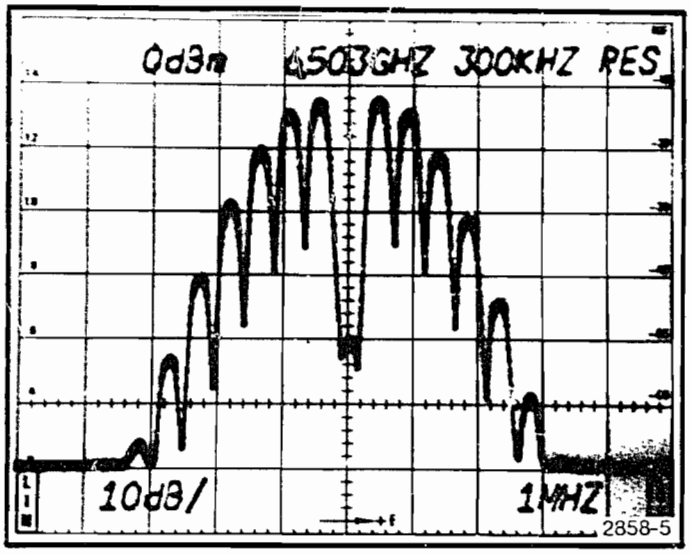

Fig. 2-3. Typical display of a frequency modulation envelope.

SERVICING INSTRUCTIONS

CIRCUIT DESCRIPTION

Signal Source

Oscillator. Q2026 forms a common base oscillator with crystal Y3025.

The 125 MHz output of the oscillator is coupled to the bases of Q2034 and Q3032 via T2029. T3031 holds the signal to these transistors' bases centered around 0 V. Q2034 and Q3032 conduct during the positive portion of their respective input waveforms. The signals on their bases are 180° out of phase. these transistors are connected as a push-push doubler. L2036 and C2036 are tuned to resonate at 250 MHz.

T2038, T3038, Q3041 and Q3039 form another push-push doubler, with L3042 and C3042 resonating at 500 MHz. The output of this tank circuit is coupled through C3044 to the base of Q3047.

Q3047 is used as a class A amplifier. Q2046 stabilizes the collector current of Q3047. The output of the amplifier is fed to the base of Q3052, which is also used as an amplifier. Q2055 sets the collector current of Q3052. The output signal from this amplifier is tapped from L3057 and fed to the base of Q3062. The output of this power output stage is coupled to the output tank L2067-C1066 from L2065.

FM. The basic 125 MHz frequency can be modulated by changing the voltage at P3015, the FM input. (1.4 V changes the 500 MHz ±1 kHz.)

Pulse. Pulses applied to P1061 will switch Q1058 on or off. Q1058 turns Q1054 on or off, which removes or applies the 18 V collector supply for the output power switch transistor, Q3062. This provides a means for pulse modulation of the 500 MHz signal.

PERFORMANCE CHECK

1. Using a spectrum analyzer, verify that the output of the signal source at the comb generator module is 500 MHz, −30 dBm ±2 dB.

2. Measure the 500 MHz (±0.01%) output frequency of the signal source with a frequency counter (TEKTRONIX DC 508 or Hewlett-Packard 5340-A) and a 20 dB attenuator.

3. Apply +10 dBm (50 Ω) to the PULSE input of the signal source, using a Hewlett-Packard ~~654~~ 651A Test Oscillator. Verify that the first sideband (f0±m) 3 dB point is >1 MHz, with a spectrum analyzer. See Fig. 3-1.

4. Apply ±1.4 V to the FM input of the signal source and verify with a spectrum analyzer that the carrier shift is ±1 kHz. Also verify that the amplitude variation is less than 2 dB. See. Fig. 3-2.

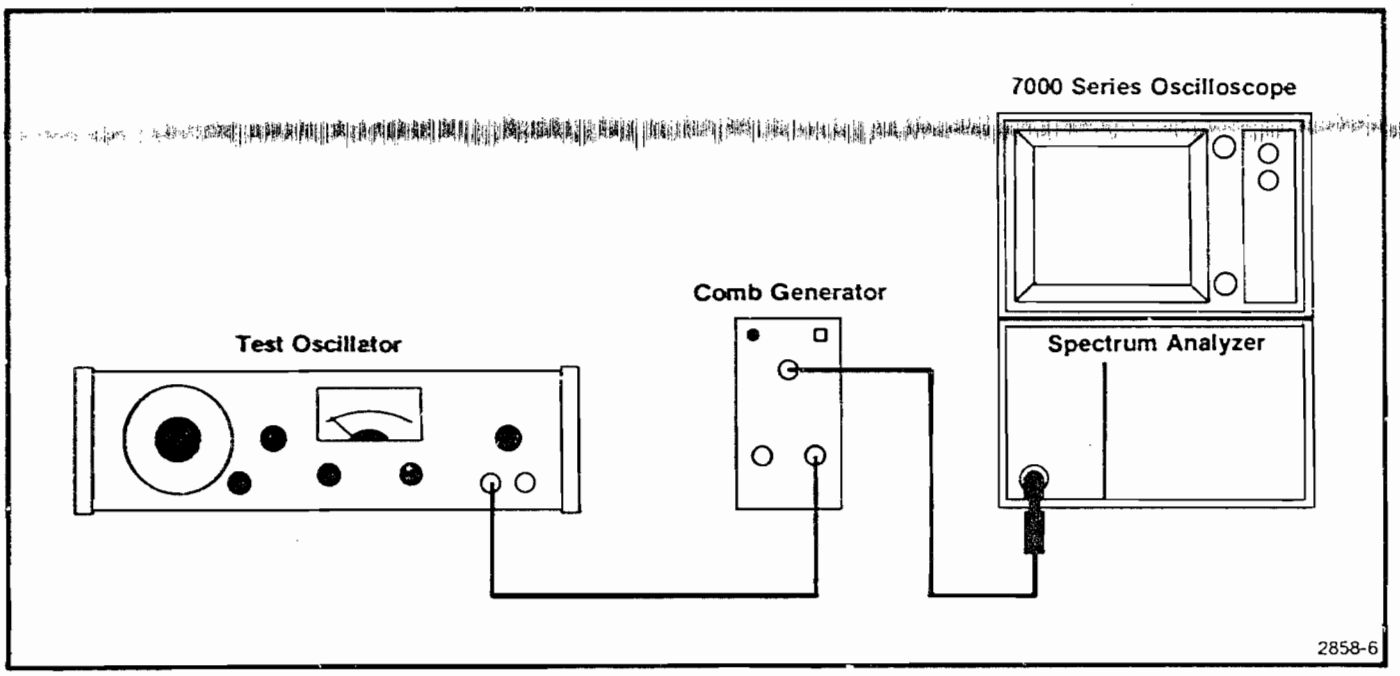

Fig. 3-1. Setup to check the first sideband 3 dB point.

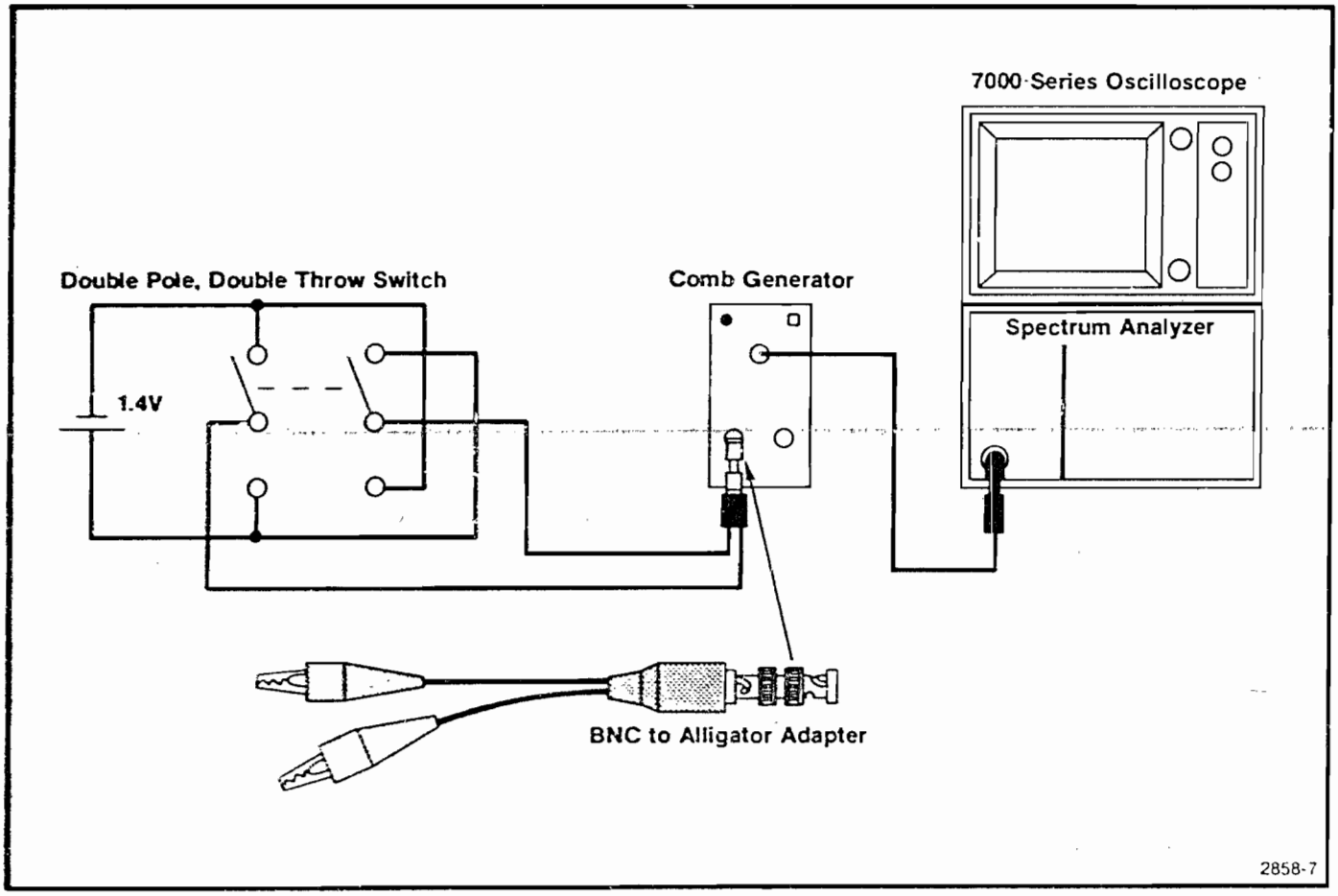

Fig. 3-2. Setup to check carrier shift.

ADJUSTMENT PROCEDURE

Set Spectrum Analyzer To	Observe P=	Adjust*	Maximum Signal Level (Approximately)
3 MHz Bandwidth -10 dBm Reference Level 125 MHz Center Frequency 2 dB 10 MHz Span	P2033	C3029	+10 dBm
250 MHz Center Frequency	P2041	C3035	+10 dBm
500 MHz Center Frequency	P3046	C3042	+ 3 dBm
500 MHz Center Frequency	P3051	C3045	+10 dBm
500 MHz Center Frequency -20 dBm Reference Level	P2062	C3056 C3059 C3060	+10 dBm
500 MHz Center Frequency -30 dBm Reference Level	Signal Source output connector	C1064 C1066	+30 dBm

* Because these adjustments are interdependent, retuning of these capacitors may be necessary until 30 dB or maximum amplitude is attained.