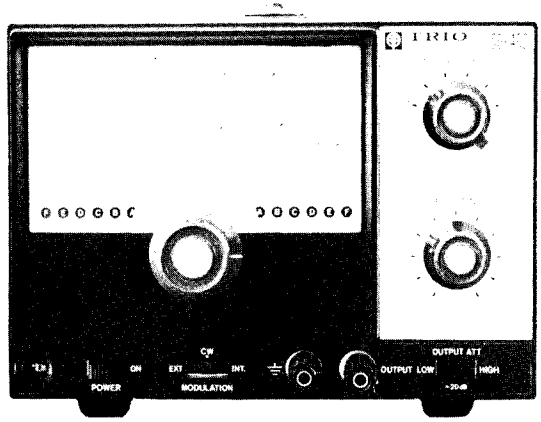
TRIO

RF SIGNAL GENERATOR

SOLID-STATE
WIDEBAND

SG-402

INSTRUCTION MANUAL



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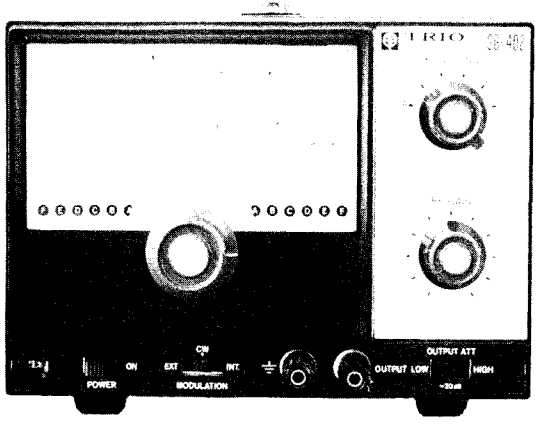


Thank you very much for purchasing the TRIO SG-402.

The TRIO SG-402 is a radio frequency signal generator employing a Hartley circuit and covers a frequency range of from 100kHz to 30MHz in six ranges.

The output voltage available is more than 0.1V rms and continuously adjustable through combined use of the RF GAIN control and HIGH-LOW attenuator, the latter giving a fixed attenuation of approximately 20dB.

The output can be AM-modulated, either internally (approximately 40% at 400Hz) or externally (1.5V rms for 40% modulation or more between 50Hz and 10kHz), when switched.

- All solid-state construction.
- Compact, easy-to-look-at frequency scale with smooth mechanism.
- 100kHz to 30MHz frequency coverage in six ranges, each in different color on scale plate for easy, quick reading.
- Output voltage of more than 0.1V rms, continuously adjustable to any desired magnitude through combined use of 20dB (approximately 1/10) attenuator and RF OUTPUT control.
- Modulation possible either internally approximately 40% at 400Hz or externally (50Hz to 10kHz) when selected by means of MODULATION switch.
- High stability against power voltage fluctuations.
- Markings on scale plate for convenience in amateur band, and TV and AM receiver IF adjustments.

SPECIFICATIONS

Oscillating frequency:	A band	100kHz to 250kHz
	B band	250kHz to 650kHz
	C band	550kHz to 1.5MHz
	D band	1.5MHz to 4MHz
	E band	4MHz to 11MHz
	F band	10MHz to 30MHz
Frequency accuracy:	±1.5%	
Output voltage:	More than 0.1V rms (20°C)	
Attenuator:	HIGH-LOW, (Provide approximately 20dB change)	
Internal modulation frequency:	Approximately 400Hz	
Internal modulation degree:	40% ± 5%	
External modulation frequency:	50Hz to 10kHz	
External modulation voltage:	1.5V rms for 40% modulation or more	
Operating temperature:	0 to 50°C	
Power requirements:	100V, 117V or 230V AC ±10%, 50 or 60Hz	
Power consumption:	2.8W	
Dimensions:	186(W) x 220(D) x 131(H) mm or 190(W) x 245(D) x 154(H) mm when all protrusions are included.	
Weight:	2.2kg	

Accessories

(1) Shielded lead with clothed clip and banana plug 1
(2) Fuse (0.1A) 2
Fuse (0.2A) 2
(3) Instruction manual ..... 1 copy

CIRCUIT DESCRIPTION

1. OUTLINE

Please refer to the block diagram of Fig. 1 (P. 15) and circuit diagram (P. 17).

The sine wave signal produced in the RF oscillator circuit is directly amplified by the modulated amplifier when the MODULATION switch is at CW, then passes the output attenuator, and appears at the output terminal. When the MODULATION switch is set to INT, the output can be internally modulated to approximately 40% at 400Hz by sine wave signal from the AF oscillator circuit, or externally modulated when the switch is shifted to EXT. Required level of the modulating signal is more than 1.5V rms for 40% modulation at frequencies between 50Hz and 10kHz.

2. RF OSCILLATOR CIRCUIT

The RF oscillator circuit employs a Hartley circuit, the oscillating elements consisting of coils (FREQ. RANGE), which are switched in six ranges, and a variable capacitor (FREQUENCY dial), covering 2.5 times the lower edge of each range or a total of from 100kHz and 30MHz.

The amplifier circuit for the oscillator is a high input impedance circuit employing an FET (2SK55-E), and includes a feedback resistor for each range so that output may be equal in all ranges.

3. MODULATED AMPLIFIER

The signal from the RF oscillator circuit is amplified by Q2 (2SC535-B), and passes the modulated amplifier (a gate modulated type built around Q3, 2SK55-E), and then an RLC type low-pass filter before taken out through an emitter follower, Q4 (2SC458-C).

4. AF OSCILLATOR CIRCUIT

Transistor Q5 (2SC458-C) forms an RC oscillator circuit, and its output is coupled to the modulated amplifier adjusting by VR1.

5. POWER SUPPLY

Input AC voltage (100V, 117V or 230V AC) is stepped down to a required voltage by the power transformer, rectified in full-wave rectification by rectifier D1, and passed through a smoothing circuit to obtain the DC voltage. This power supply section feeds 15V DC to all signal generator circuits as "B" voltage.

OPERATING INSTRUCTIONS

FRONT PANEL

The controls and their function are listed below.
Refer to EXTERNAL VIEW (P. 16)

Ref. No.	Controls, Connectors, etc.	Description
(1)	(Neon lamp)	Lights up when POWER switch (2) is turned to ON.
(2)	POWER	Slide switch for power switching and turns on power when set to right-hand position.
(3)	MODULATION	Selector switch for modulating signal.
	EXT	In this mode, output signal can be AM-modulated at any frequency between 50 Hz and 10kHz when a modulating signal is fed to EXT MOD INPUT terminals (12) and (13).
	CW	This is the central position of the MODULATION switch, and produces un modulated output.
	INT	Output is AM-modulated by the built-in AF oscillator to approximately 40% at 400Hz.
(4)	⏚ (GND)	Grounding terminal.
(5)	OUTPUT	Any output can be obtained from this output terminal.
(6)	OUTPUT ATT, 20dB	Output attenuator
	HIGH	In this position, output is passed directly to the output terminal without attenuation.
	LOW	Gives an attenuation of approximately 20dB.
(7)	RF OUTPUT	Permits changing output voltage continuously between 0 and 0.1V rms (sine wave).
(8)	FREQ RANGE	Used to select frequency ranges indicated on scale (10) and pointer (11) as follows.
	A:	100kHz to 250kHz
	B:	250kHz to 650kHz
	C:	550kHz to 1.5MHz
	D:	1.5MHz to 4MHz
	E:	4MHz to 11MHz
	F:	10MHz to 30MHz
(9)	(Frequency dial)	Used to set for a desired output frequency. Mechanically ganged with the variable capacitor and pointer (11).

Ref. No.	Controls, Connectors, etc.	Description
(10)	(Scale plate)	Graduated in six ranges to read output frequencies between 100kHz and 30MHz.
(11)	(Pointer)	Indicates scale settings.

REAR PANEL

(12)	EXT MOD INPUT	Input terminal for external modulation signals. To modulate the SG-402 with an external modulation signal, feed a signal to this terminal and set MODULATION switch (3) to EXT. Usable modulating frequencies are between 50Hz and 10kHz.
(13)	GND	Grounding terminal for external modulation.
(14)	(Power cord)	Power supply cord.

(1) Starting

With power cord (14) connected to a power source, turn power switch (2) to ON. This turns neon lamp (1) on and places the signal generator in the running condition. Allow 2 or 3 minutes for the set to warm up in order to stabilize the operation.

(2) Setting to a desired frequency

To set to a desired frequency, select a proper range with FREQ. RANGE switch (8) and operate FREQUENCY dial (9) until its pointer (11) indicates the desired frequency on scale (10). The frequency dial is ganged with the variable capacitor.

For example, to set to 1MHz:

Set FREQ. RANGE switch (8) to C, and pointer (11) to 1MHz on scale (10).

(3) Adjusting output voltage

Output voltage taken out from output terminal (5) can be continuously adjusted from 0 to 0.1V rms by means of RF GAIN control (7). The RF GAIN control increases the output voltage when turned clockwise, up to 0.1V rms at the fully clockwise position if output attenuator (6) is at HIGH. When the attenuator is set to LOW, the output voltage is reduced to approximately 1/10 (−20dB). When obtaining a small voltage, set the attenuator to LOW, since this makes adjustments easier at such small voltages.

(4) Use of EXT MOD INPUT terminal

When connected to an external sine wave signal, this terminal enables the output voltage to be AM-modulated at a desired frequency between 50Hz and 10kHz, when the MODULATION switch (3) is at EXT. Required modulating voltage is more than 1.5Vrms for 40% modulation.

APPLICATIONS

In this description, it is assumed that radio receiver intermediate frequency and TV intermediate frequency are 445kHz and 10.7MHz respectively.

The followings are the examples of the uses of this RF signal generator operated for measurements of the RF amplifier and IF amplifier of AM radio receivers.

(1) Aligning IF transformers

Set the SG-402 to 455kHz, an intermediate frequency of the radio receiver to be aligned, and connect the signal generator to the base of transistor Tr2, a mixer, in Fig. 2. The local oscillator must be kept inoperative during this adjustment. To make it inoperative shunt the base of the local oscillator transistor or the tank circuit to ground.

Connect an output meter (or a VOM set to 2.5 to 10V DC range) to the emitter of Tr3, and measure the emitter voltage. The emitter voltage, which is high when detuned, will drop as tuned to 455kHz. This measurement refers to intermediate transformer IFT1. From this point, at which the IF transformer is accurately

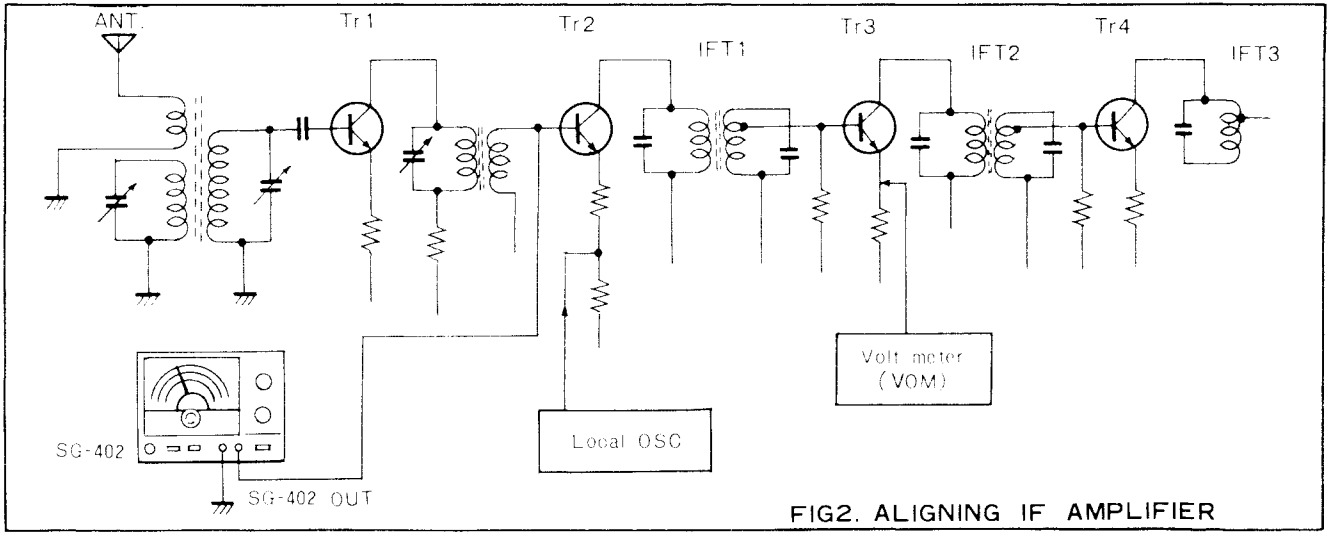


FIG2. ALIGNING IF AMPLIFIER

tuned, gradually change the oscillator frequency of the SG-402 to both sides of the point to obtain a curve, which should be as shown in Fig. 3. A detuning width between points that give 3dB difference of output as compared to that of the center frequency (a point which showed the maximum output drop) is referred to as the passband of the IF transformer, and an attenuation obtained when the IF transformer is detuned ±10kHz from the center frequency is called rated selectivity.

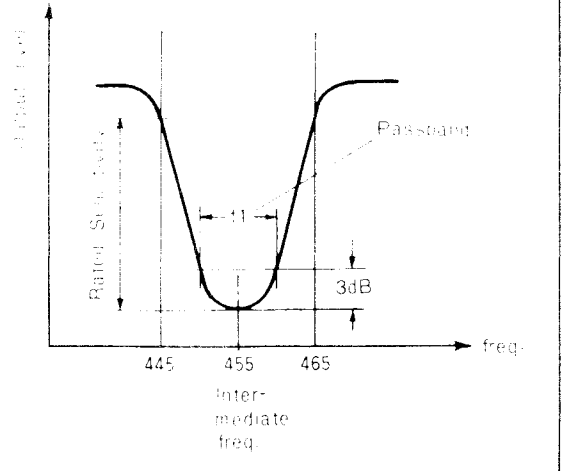


FIG3. SELECTIVITY

The frequency scale of the SG-402 is marked 455kHz IF (10.7MHz for FM receiver) for convenience in use.

In this way, the overall selectivity characteristic and gain of the IF amplifier can be known by measuring IF transformers one by one.

When finding a maximum point on the AF output meter, set MODULATION switch (3) to INT and use a modulating output, or to EXT when modulating externally. When utilizing the tuning meter or emitter voltage, the SG-402 may be either modulated or non-modulated (CW). When measuring the bandwidth of IFTs, however, non modulated signal will be better since it indicates their characteristics more faithfully.

(2) Tracking

A test circuit for tracking is shown in Fig. 4. Tune the SG-402 to the receiver frequency to be tested, and feed its output to the antenna circuit.

Three different frequencies are generally specified for this test:

Three frequencies for standard tracking

LW	MW	SW
180kHz	600kHz	4.0MHz
240kHz	1,000kHz	7.0MHz
320kHz	1,400kHz	10.0MHz

Measure and adjust the RF tuner and local oscillator frequencies using these three testing frequencies. Connect a 100pF capacitor to the antenna. This capacitor serves as a dummy antenna and without this capacitor, a point tuned during tracking will appear in a different place in normal reception.

Adjust all controls of the receiver so that its output becomes maximum when a 400Hz, 40% internally modulated signal is received from the signal generator. Practical receiver sensitivity is expressed in terms of a minimum input signal voltage measured at the AF output for 20dB of signal-to-noise ratio. This sensitivity can be checked by measuring and adjusting the RF amplifier section.

Note that this receiver will produce an image signal in addition to its true signal because of its superheterodyne action. Such an image will be 910kHz different from its true signal when the intermediate frequency is 455kHz, and may appear nearly as strong as the true signal in short wave bands. However, it can readily be identified from the fact that the image is always above its true signal as checked by shifting the signal generator frequency back and forth, or below the true signal on the receiver dial.

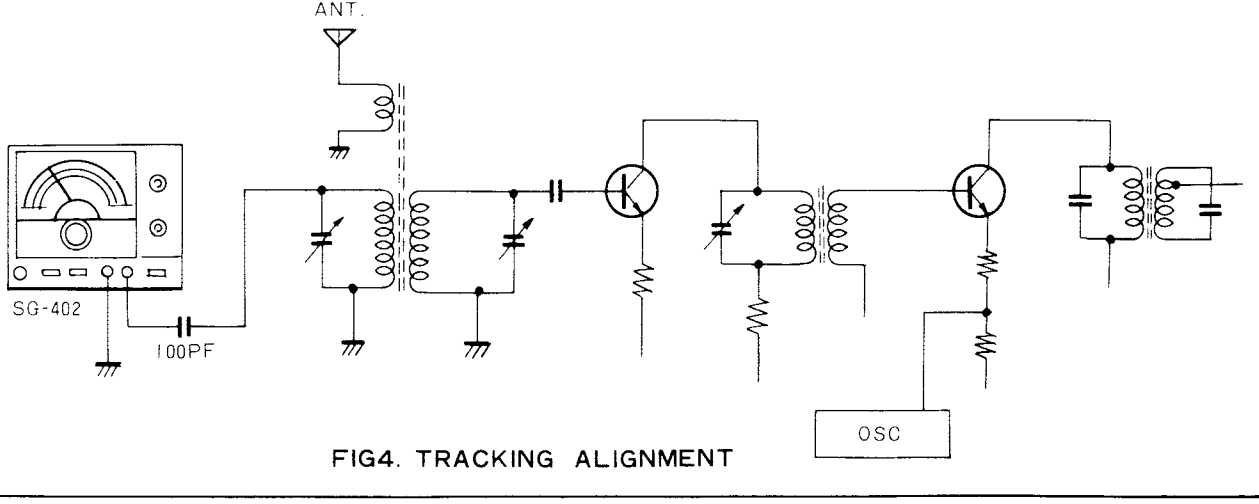


FIG4. TRACKING ALIGNMENT

(3) Suggestions on short wave band adjustment

To adjust a short wave receiver operating at frequencies above 10MHz, connect an actual antenna to the receiver as normally used, and twine the hot lead of the signal generator to this antenna in two or three turns, to form a capacitive coupling for adjustment. This small coupling permits effective adjustment without affecting the actual conditions of the receiver.

An excessively large input will impair adjustment. Reduce the attenuator setting as much as possible and fully raise receiver sensitivity. The AVC (automatic volume control) may be left operating.

MAINTENANCE

1. REMOVING THE CASE

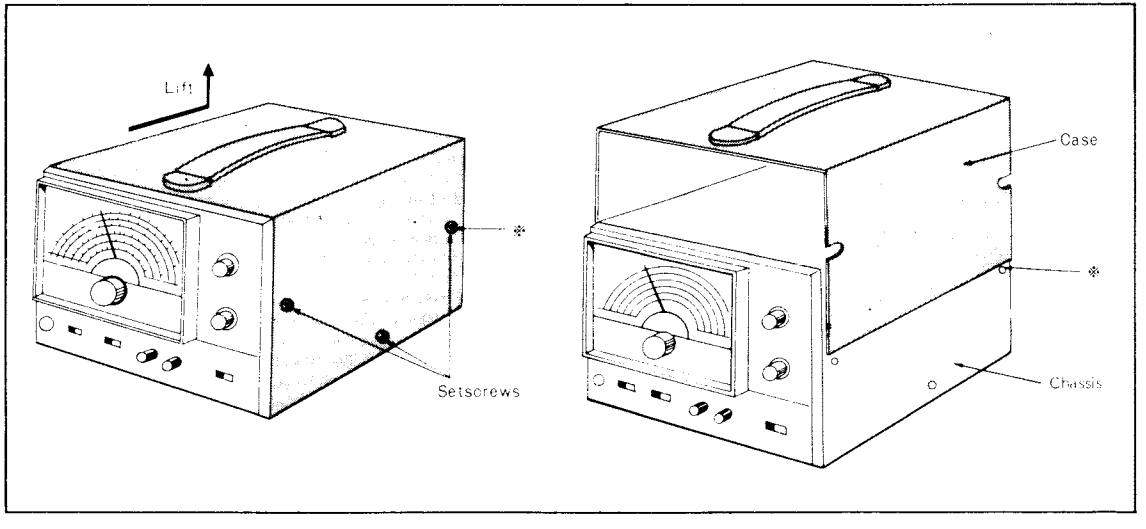
Remove 3 setscrews each on the left and right side plates with a Phillips screwdriver. The case can then be readily removed by lifting it up by the grip on top, since the case does not have a bottom.

2. ATTACHING THE CASE

To replace the case onto the chassis, loosely thread 2 setscrews (marked *) before mounting the case.

Place the case onto the chassis starting with the rear side and fit cuts provided at the middle rear edges of left and right side plates onto the setscrews attached beforehand (marked *). Press down the case over the chassis while thrusting it rearward by the case until the case is placed on the case properly. In doing this operation, be careful not to allow the front ends of the case to strike the panel and damage.

Then, fix the left and right side plates of the case to the chassis by screwing 2 setscrews into the holes



provided on the front and bottom edges of the side plates. The case itself has no face or back.

CAUTION:

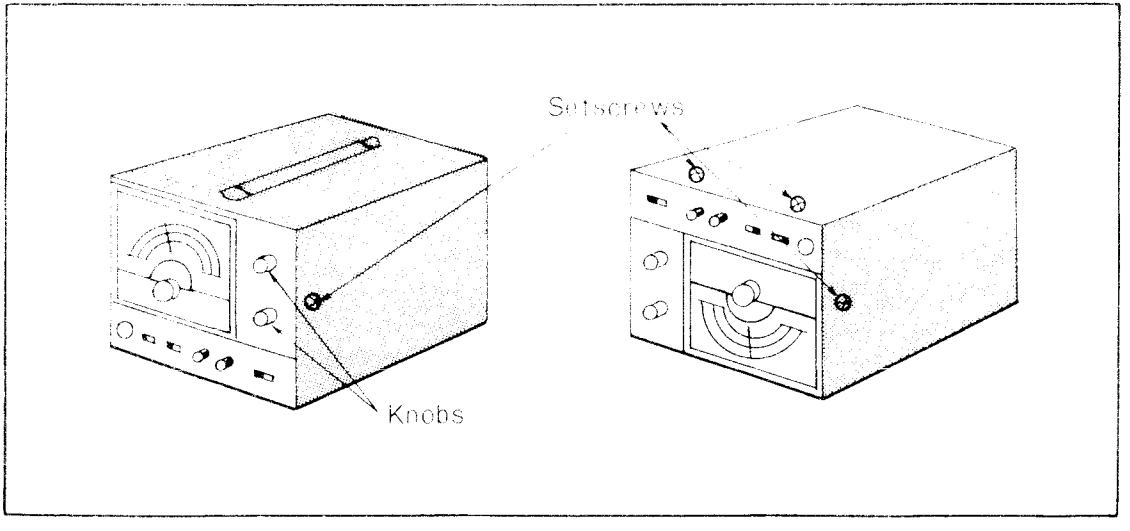
When removing the case, pay attention not to touch the internal printed circuit board and other parts. Also, never fail to disconnect the power cord because 100VAC (117V or 230VAC) is at the printed circuit boards.

3. REMOVING THE FRONT PANEL

To remove the front panel, loosen the setscrews for 3 knobs on the panel and remove the knobs. Then, remove 2 setscrews each from left and right sides. These screws are used also to fix the case. Further remove 2 setscrews from the bottom of the panel.

Then hold the panel with both hands and pull it toward you. The panel will then come off the chassis.

When removing the panel, pull it gently while taking care not to allow the panel to be caught by the terminals, slide switches, front face etc.



ADJUSTMENT

Model SG-402 is shipped after factory adjusted about the following items. When it is to be readjusted, however, calibrate the power source voltage before adjustment.

The test equipment to be used for calibration should also be calibrated ones.

Prior to adjustment, set the controls as follows unless otherwise noted.

(1) MODULATION (3) at CW
(2) OUTPUT ATT (6) at HIGH
(3) FREQ. RANGE (8) at C
(4) RF GAIN (7) at maximum output (fully clockwise position)
(5) FREQUENCY dial (9) at 1MHz

Prior to proceed in the adjustment, make DC voltage checks to all circuits of this signal generator to make sure that all circuits are operating normally. For proper checking, refer to the circuit diagram on page 17.

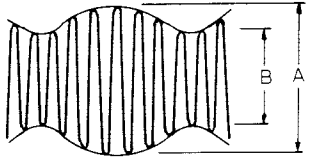
1. ADJUSTING THE OUTPUT VOLTAGE

(1) Connect an RF voltmeter to output terminals (4) and (5).
(2) Adjust semi-fixed resistor VR2 until the RF voltmeter reads more than 0.1V rms. (If an ordinary AC voltmeter is used as an alternative, use range A allowing its narrower frequency response.)

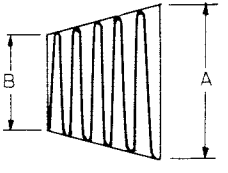
2. ADJUSTING INTERNAL MODULATION DEGREE

If an oscilloscope is used, adjustment may be accomplished either in a wave-envelope pattern or trapezoidal pattern method. In either case, adjust at a frequency within range A of the signal generator.

(1) Set the MODULATION switch to INT.
(2) Connect an oscilloscope to output terminals (4) and (5).
(3) Adjust the semi-fixed resistor VR1 until approximately 40% of modulation is obtained.



Wave envelope pattern method



Trapezoidal pattern method

3. ADJUSTING THE POINTER

(1) Fix the variable capacitor to provide a maximum value.
(2) Adjust the pointer to a proper position. If the pointer alone cannot give a proper setting, adjust

the scale plate after loosening its setscrew.

4. ADJUSTING THE OSCILLATION FREQUENCY

(1) Connect a frequency counter to output terminals (4) and (5).

(2) Set the FREQUENCY RANGE to C and the pointer to 550kHz. Confirm that the oscillation frequency is accurate to ±1.5% of 550kHz. If not, adjust L3.

(3) Then, shift the pointer to 1.5MHz, and confirm that the oscillation frequency is 1.5MHz ±1.5%. If not, adjust trimmer TC1, located on the variable capacitor.

(4) Return the pointer to 550kHz and reconfirm that the signal generator is oscillating at 550kHz ±1.5%. If there is a greater deviation, repeat adjustments (2) and (3) until a correct frequency is obtained.

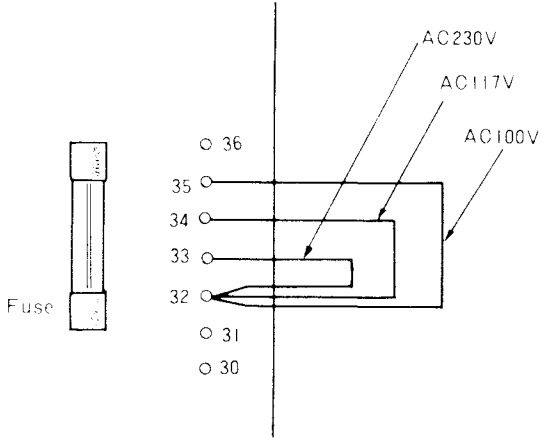
(5) Calibrate other ranges than C with the pointer being set to the lowest frequency of the range. And, adjust coil L1 for range A, coil L2 for range B, coil L4 for range D, coil L5 for range E and coil L6 for range F. Trimmer TC1, which has been finished in adjustments (2) and (3), should not be touched.

(6) Other intermediate scale graduations are automatically calibrated by the above adjustments.

CAUTIONS

CAUTIONS

(1) The primary voltage of the power transformer can be altered as follows.
Connections at printed circuit board terminals:
100V AC: Connect to No. 35 and 32
117V AC: Connect to No. 34 and 32
230V AC: Connect to No. 33 and 32
Fuse for 230VAC operation is 0.1A.

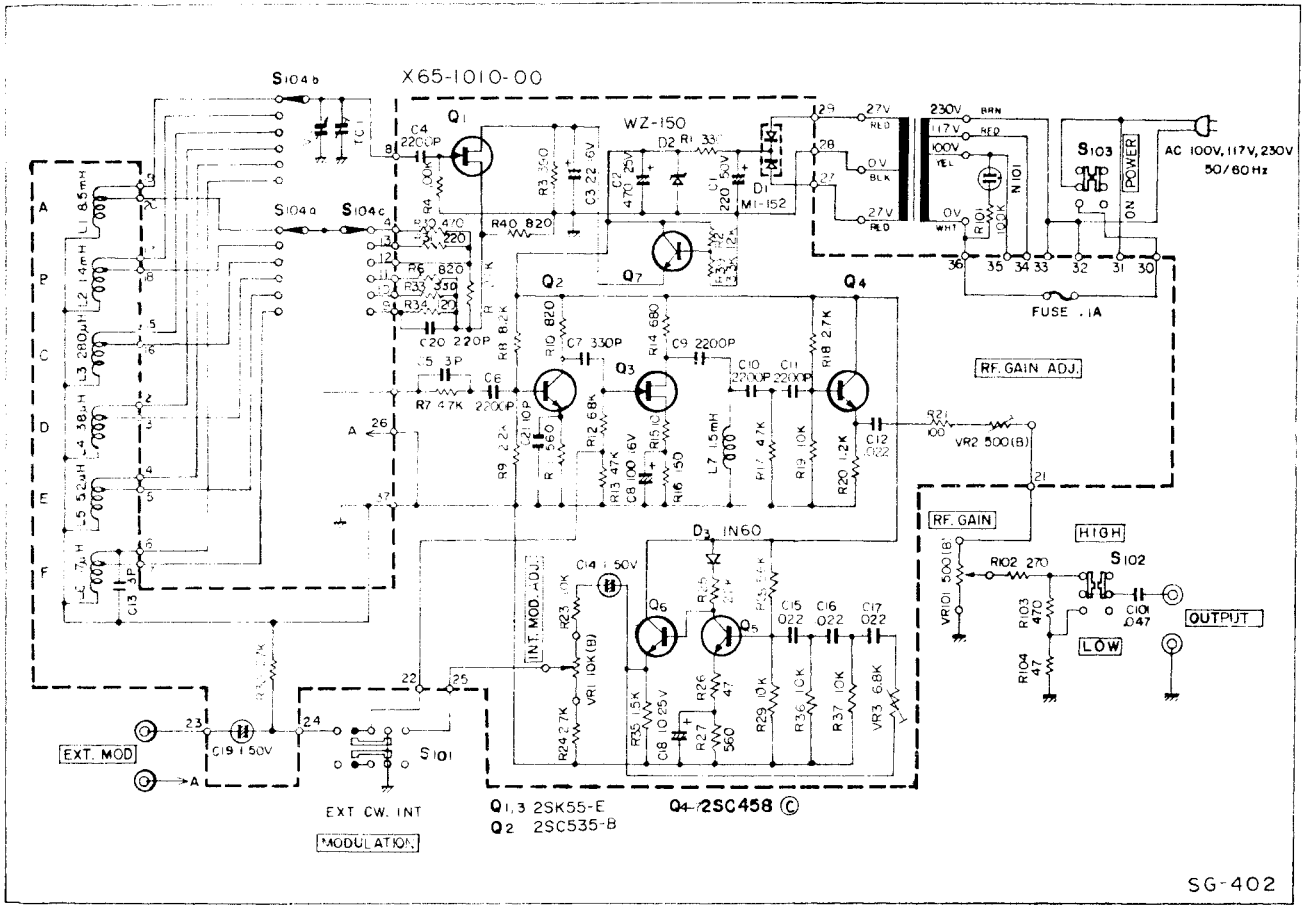


(2) Although this signal generator will start operating as soon as power is supplied, however, allow approximately 3 minutes for the set to warm up when making an accurate measurement.

(3) Since the attached shielded lead has capacitance of approx. 100pF (between a conductor and shield) per 1m length, output voltage will be affected largely. For instance, attenuation by it is 6dB at 30MHz. If the above attenuation is seriously considered, use a single lead shorten.
In this case, the lead will be affective inductively.

(4) Avoid to install this set in a place which contains a strong magnetic or electrostatic field as well as high temperature or humidity.

NOTE: The circuit elements may be changed without notice owing to a technical innovation.



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