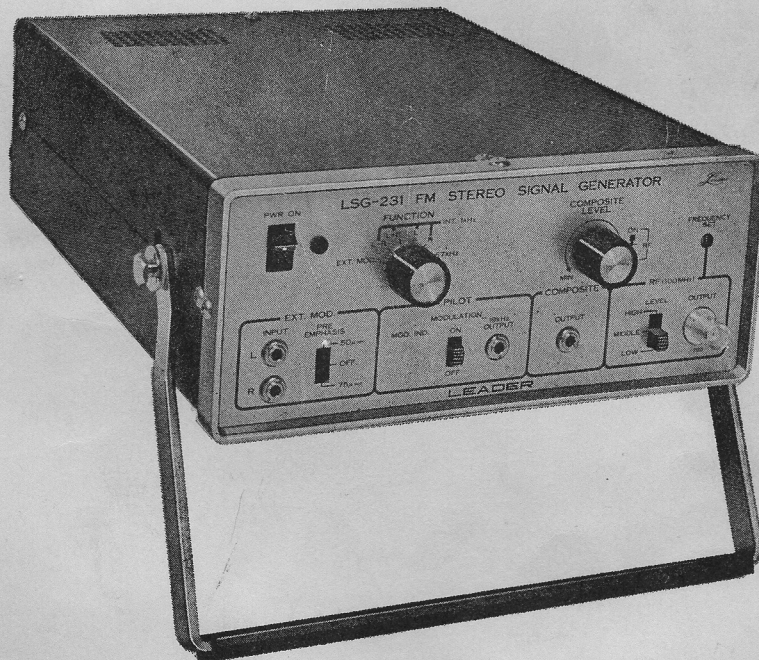


LEADER TEST INSTRUMENTS

LSG-231

FM STEREO SIGNAL GENERATOR

INSTRUCTION MANUAL



LEADER ELECTRONICS CORPORATION

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SECTION 1 DESCRIPTION

1.1 General

LSG-231 is specially designed for use in testing FM stereo and monaural receivers and stereo multiplex circuits.

The composite signals for the subchannel, main channel, left and right channels at 1kHz are generated in the stereo modulation section. The 38kHz subcarrier and 19kHz pilot signal are produced by stepping down the frequencies from a 228kHz crystal-controlled oscillator. The composite signal is generated by switching two balanced diode modulators with the subcarrier signal. A lowpass filter is used to suppress undesirable spurious components. The pilot signal is added to the stereo signal in the composite amplifier. The composite signal is available directly for stereo MPX testing or for frequency modulation of the RF oscillator.

Inputs are provided for external stereo modulation with preemphasis at 75 μ s or 50 μ s.

Testing is possible for the SCA circuit with use of the internal 67kHz signal or external input.

FEATURES:

1. Over 50dB left-right channel separation at 1kHz for critical separation tests.
2. Phased condition of the pilot and subcarrier signals is of the highest degree.
3. Modulated RF output for simulation of FM broadcasts signals used in overall receiver testing.
4. Pilot signal level can be adjusted in the range, 0 to over 10%, independently of the composite signal.
5. Composite signal can be adjusted in the range, 0 to 100%, independently of the pilot signal level.
6. High reliability components, including integrated circuits are used for stable operation.

1.2 Specifications

RF Signal Section

Carrier Frequency:	100MHz, adjustable range, ± 1 MHz.
Output Voltage:	3 steps at approximately 10mV, 1mV and 0.1mV, into 75 Ω .
Output Impedance:	75 Ω ; 300 Ω , with dummy antenna.
Modulation Signals:	
Composite:	L-R, L+R, L, and R (internal 1kHz).
SCA:	67kHz $\pm 5\%$ (internal), or external.
External:	L and R, 50Hz-15kHz.
Frequency Modulation:	
Composite:	0-100% (0-75kHz deviation), adjustable.
Pilot:	10% (7.5kHz deviation), adjustable.
SCA:	0-20%, adjustable.
Modulation Distortion:	Less than 0.5% at 100% modulation.

Composite Signal Section

1. At Composite Signal Output jack

Output Signal	Output Voltage
L-R, L+R, L, and (internal 1kHz)	0-1Vrms, continuously adjustable
Pilot (19kHz)	100mVrms, adjustable
67kHz (internal)	0-200mVrms, continuously adjustable

Output Impedance: Less than 600 Ω ; unbalanced.
 Subcarrier Leakage: Less than -40dB at 100% modulation condition.
 L-R Separation: Over 50dB with internal 1kHz; over 45dB, 100Hz-3kHz,
 and over 35dB, 50Hz-15kHz, with external input signals.

2. At Pilot Signal Output jack -

Pilot Frequency: 19kHz \pm 2Hz; Output voltage, approximately 0.8Vrms, adjustable;
 Output impedance, approximately 150 Ω , unbalanced.

3. At 1kHz Output jack -

Frequency: 1kHz \pm 1%; Output voltage, approximately 1Vrms at open circuit; Output
 impedance, approximately 1k Ω ; Distortion, less than 0.5%.

4. At L and R Input jacks -

Input voltage: less than 1Vrms; Input impedance: approximately 100k Ω direct and
 approximately 10k Ω with pre-emphasis, 50 μ s or 75 μ s, at on; Frequency range:
 50Hz-15kHz.

5. At SCA Input jack -

Input voltage: approximately 150mVrms for 10% modulation (7.5kHz deviation); maxi-
 mum input, 1Vrms; Input impedance, over 100k Ω ; Frequency range, 10 to 100kHz.

Power Supply

100, 115, 200 or 230V as specified, 50/60Hz; 10VA, approx.

Size and Weight

3-1/8"(H) \times 8"(W) \times 10"(D); 5 lbs, approx.

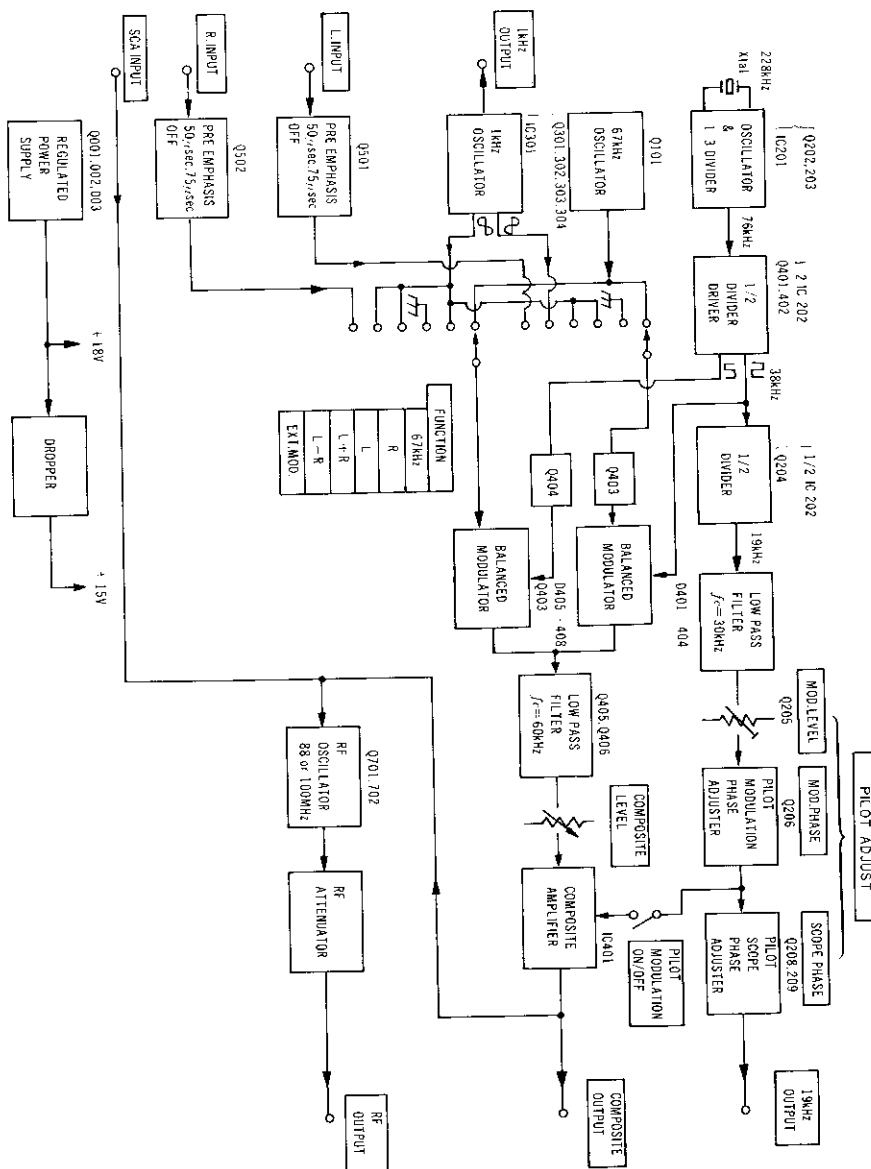
Accessories, supplied -

Dummy antenna, with BNC connector: LBN-06	1 ea.
Cable with miniplug and clips	2 ea.
Miniplug	2 ea.

1.3 Controls and Connectors

Before operation, it is advisable that the user become familiar with the function of the
 different controls and connectors on the LSG-231. The number in the circles refer to the con-
 trols, switches, etc., designated in Fig. 1-1 and Fig. 1-2.

FUNCTIONAL BLOCK DIAGRAM



A. Front Panel, Fig. 1-1

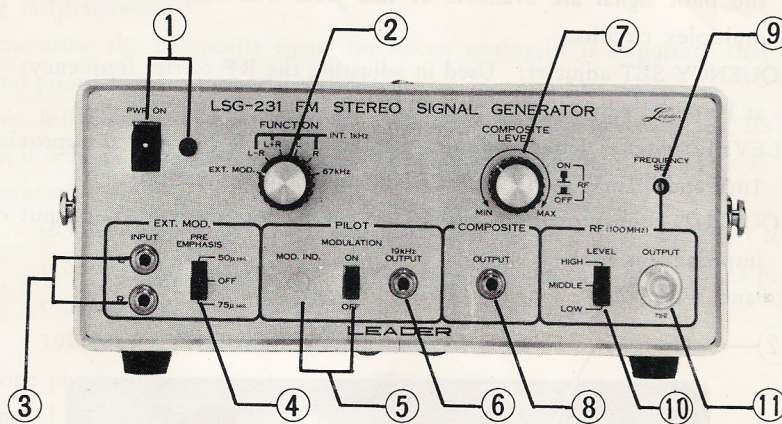
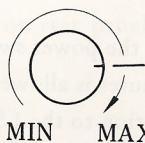


Fig. 1-1 Front panel controls.

- ① PWR ON switch: For turning on the AC power; pilot lamp glows at on.
- ② FUNCTION switch: With six positions for selecting the different signals at the COMPOSITE OUTPUT jack and the modulation signal for the RF oscillator.
 - a. EXT MOD: For the composite signal with external Left and Right inputs.
 - b. L-R: Subchannel signal
 - c. L+R: Main channel signal
 - d. L : Left channel only
 - e. R : Right channel only
 - f. 67kHz: Use of internal SCA signal.
- ③ INPUT L and R jacks: For connection to the external Left and Right channel inputs. The composite signal is produced when the FUNCTION switch is at EXT MOD.
- ④ PRE-EMPHASIS switch: With three positions, 50μsec, OFF, and 75μsec for selecting the pre-emphasis applied to the external modulation input.
- ⑤ PILOT MODULATION switch and indicator: The MOD IND lamp (blue) will glow when the switch is set at on. The pilot signal is at the 10% level (adjustable) at all settings of the COMPOSITE LEVEL control.
- ⑥ 19kHz OUTPUT jack: The pilot signal is available directly from this jack; main purpose is for use in phasing with the 38kHz subcarrier.
- ⑦ COMPOSITE LEVEL control and RF ON-OFF switch: At the maximum setting of the control, the RF modulation is 100% (75kHz deviation) with the L-R, L+R, L and R, and EXT MOD (2.83Vp-p at COMPOSITE OUTPUT jack). At the marking, or "3-o'clock" setting, the composite signal is 90% and with addition of the pilot signal at 10%, the total becomes 100%.



Setting for 90% composite signal. The RF oscillator is switched on when the knob is at the in position and is cut off at the out position, see markings on the panel.

- ⑧ COMPOSITE OUTPUT jack: All signals as selected with the FUNCTION switch and the pilot signal are available at this jack. The output is used in checking stereo multiplex circuits.
- ⑨ FREQUENCY SET adjuster: Used in adjusting the RF carrier frequency; nominally set at 100MHz, adjustable range is $\pm 1\text{MHz}$.
- ⑩ RF LEVEL switch: Three positions for setting the RF output at approximately 10mV, 1mV and 0.1mV, at HIGH, MEDIUM and LOW respectively.
- ⑪ RF OUTPUT connector: BNC type for connection to the RF output cable; output impedance is 75Ω .

B. Rear Panel, Fig. 1-2

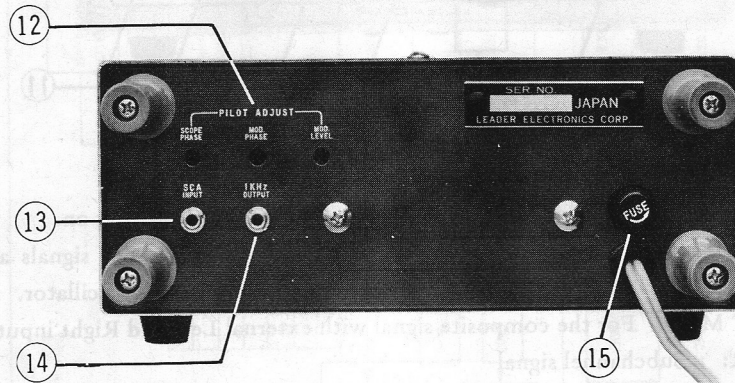


Fig. 1-2 Rear panel controls.

- ⑫ PILOT adjusters -
 1. MOD LEVEL: Normally set at 10%; adjustable range, 0 to over 10%.
 2. MOD PHASE: For phasing the pilot signal with the 38kHz subcarrier signal.
 3. SCOPE PHASE: For phasing the scope circuitry prior to pilot-subcarrier phasing.
- ⑬ SCA INPUT jack: For connection to an external SCA signal for direct modulation of the RF carrier.
- ⑭ 1kHz OUTPUT jack: Signal is available for use in audio tests. Output, approximately 1Vrms with distortion less than 0.5%; output impedance, $1k\Omega$.
- ⑮ FUSE holder: For insertion of the AC line fuse.

SECTION 2 OPERATION

2.1 General

In this section, the general procedures will be given for testing FM receiver circuits. There are many variations in these circuits and reference should be made to the service manual for the particular type under test.

The generator is ready for use when the power switch is set at on. However, it is recommended that a warmup period of about ten minutes is allowed for internal circuit stabilization.

The test equipment required in addition to the LSG-231 is as follows:

1. Wideband scope, DC-5MHz, equipped with a frequency-compensated 10:1 probe.
2. AC millivoltmeter, with decibel calibration.

2.2 Phasing Adjustments

In generating the composite signal for stereo testing, it is important that the 38kHz sub-carrier and pilot signal are properly phased.

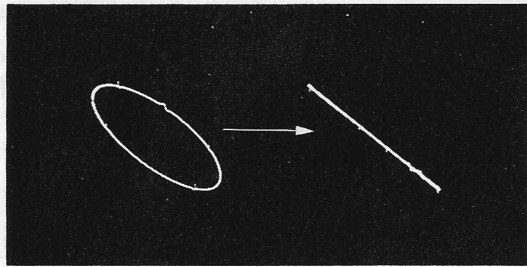
In this instrument, special attention has been paid to maintain the stable relationship. However, it is advised, before use, to check the phased condition as given below.

1. Connections:
 - a. COMPOSITE OUTPUT to vertical input of the scope; use short leads. If an input probe is used, remove the barrel on the miniplug and connect the probe to the inner terminal.
 - b. 19kHz OUTPUT to horizontal input of scope.
2. Scope phasing:

Control settings -

 - a. FUNCTION switch at EXT MOD.
 - b. PILOT MODULATION switch at ON.
 - c. Scope controls -
 1. For horizontal input.
 2. Vertical and horizontal gain for suitable trace display.

The trace should be a single slanted line, or 0° phase difference condition, as shown in Fig. 2-1.



If the trace is a loop type, set the SCOPE PHASE adjuster, on rear panel, for the proper condition.

Fig. 2-1 Scope phasing.

3. Subcarrier-Pilot phasing:

Control settings -

 - a. PILOT MODULATION switch at off.
 - b. FUNCTION switch at L-R.
 - c. COMPOSITE LEVEL control at MAXIMUM; control knob at RF OFF, or pushed in.
 - d. Scope vertical gain for suitable amplitude.

When the signals are properly phased, the trace will be as shown in Fig. 2-2 where two loops meet at the "base" line. If the trace is not clearly defined, set the MOD PHASE adjuster, on rear panel, for the proper condition.

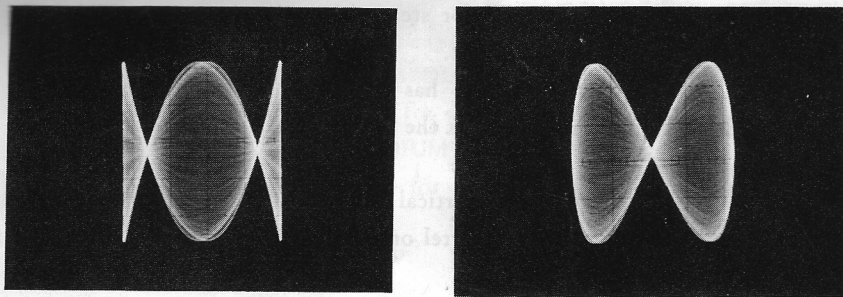


Fig. 2-2 Subcarrier and pilot signal phasing.

2.3 Demodulated Stereo Output Checking

1. Connections:
 - a. RF output cable, LBN-06, to OUTPUT connector.
 - b. Dummy antenna to tuner input -

300 Ω	Yellow and white clips.
75 Ω	Black clip to ground terminal and red clip to "hot" terminal.
 - c. Demodulator output test point to vertical scope input.
2. Control settings:
 - a. FUNCTION switch at L, or R.
 - b. PILOT MODULATION switch at ON.
 - c. COMPOSITE LEVEL control at reference marking (90%).
 - d. COMPOSITE LEVEL control-knob at RF ON, or pulled out.
 - e. RF LEVEL switch as required.
3. Waveform display:

The scope controls should be adjusted to obtain a trace similar to that shown in Fig. 2-3.

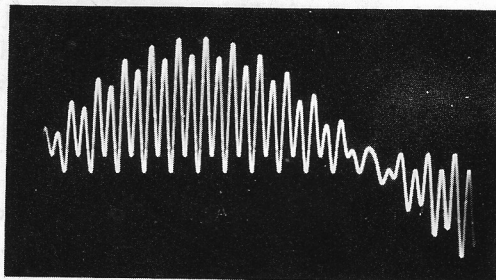


Fig. 2-3 Demodulated stereo output.

Rotate the COMPOSITE LEVEL control to vary the trace amplitude; there should be no change in the wave form.

Set the FUNCTION switch at R, or L, and repeat the operation.

If distortion, such as flattening of the peaks or other effects, is present, check the tuner and IF circuits for alignment and bandwidth.

Disconnect the RF cable and set the COMPOSITE LEVEL control knob at RF OFF.

2.4 MPX Circuit Testing

The use of signals from the LSG-231 in general testing of the MPX circuit will be given. For test methods, input voltages, and connections, please refer to the information in the manufacturer's service notes.

Connections:

- a. COMPOSITE OUTPUT to MPX circuit input.
- b. Scope probe to the test points designated in the service notes.

2.4.1 19kHz and Subcarrier Circuits

For 19kHz peaking and 38kHz circuit adjustments.

(NOTE: For the 38kHz signal, the doubled 19kHz signal is used.)

Control settings:

- a. FUNCTION switch at EXT MOD.
- b. COMPOSITE LEVEL control at MIN; control knob at RF OFF.
- c. PILOT MODULATION switch at ON.

2.4.2 SCA Trap

For nulling check and adjustment.

Control settings:

- a. FUNCTION switch at 67kHz.
- b. PILOT MODULATION switch at OFF.
- c. COMPOSITE LEVEL control at MAX; control knob at RF OFF.

For check, rotate the COMPOSITE LEVEL control, MAX to MIN; there should be no change in the amplitude. If there is any change, adjust the trap circuit for a minimum.

2.4.3 Channel Separation at 1kHz

- A. L to R separation.

Control settings:

- a. FUNCTION switch at "L".
- b. PILOT MODULATION switch at ON.
- c. COMPOSITE LEVEL control at the reference mark; control knob at RF OFF.

Connect the AC millivoltmeter to the LEFT output.

Note signal amplitude in dB.

Set the FUNCTION switch at "R" and note the amplitude.

The L to R channel separation is the difference between the two dB readings.

Examples:	L reading	0dB	+2dB
	R reading	-30dB	-25dB
	L to R separation	30dB	27dB

If necessary, adjust the separation control for maximum separation, or minimum R reading.

- B. R to L separation.

Set the FUNCTION switch at "R".

Connect the AC millivoltmeter to the RIGHT output.

Note the signal amplitude in dB.

Set the FUNCTION switch at "L" and note the amplitude to determine the R to L separation.

If necessary, adjust the separation control for maximum separation. For check repeat the L to R separation test as given in "A". above.

2.5 Stereo Indicator Checking

The indication for stereo operation is checked as follows:

Control settings:

- a. FUNCTION switch at L-R.
- b. COMPOSITE LEVEL adjusted at the manufacturer's specified voltage at the input test point; set the control knob at RF OFF.
- c. PILOT MODULATION switch at ON.

Under this condition, the indicator lamp should glow, automatically, or with the manual switch if used.

Next set the PILOT MODULATION switch at OFF, the light should go out.

If the lamp does not glow with the input signal, check the indicator circuit, or lamp, for defect.

2.6 External Stereo Modulation

For overall receiver checking or demonstration.

2.6.1 Conventional Stereo Signal

Connections:

- a. From external audio source, 50Hz-15kHz, to L and R INPUT jacks.
Input voltage approximately 1Vrms at 400Hz.
- b. To tuner input from RF OUTPUT connector, or to MPX input from COMPOSITE OUTPUT jack.

Control settings:

- a. FUNCTION switch at EXT MOD.
- b. PILOT MODULATION switch at ON.
- c. COMPOSITE LEVEL control at reference mark; control knob at RF ON or RF OFF, depending on the output signal.
- d. PRE EMPHASIS switch at 75 μ sec.

2.6.2 Stereo with SCA Signal

Only the stereo modulated RF output is used.

For the standard condition with the internal 1kHz for L-R, L+R, L or R, and external audio input, the COMPOSITE LEVEL control must be set for 80% modulation.

Initial control settings:

- a. PILOT MODULATION switch at OFF.
- b. COMPOSITE LEVEL control knob at RF ON.
- c. FUNCTION switch at L + R.

Connections and adjustments:

- a. Composite signal.
- b. Connect the scope probe, or AC millivoltmeter, at the COMPOSITE OUTPUT jack.
Set the COMPOSITE LEVEL control for the signal voltage of 2.26Vp-p, or 800mVrms for sine wave. Disconnect the scope, or AC millivoltmeter.
- b. Connect the SCA signal to the SCA INPUT jack on the rear panel.
Adjust the SCA input voltage to 150mVrms as measured across the SCA source.
- c. Set the PILOT MODULATION switch at ON.
- d. Connect the RF OUTPUT to the tuner input.
Set the RF LEVEL switch as required.

2.7 Monaural Operation

Only the modulated RF signal is used.

2.7.1 Internal Modulation

Control Settings:

- a. FUNCTION switch at L + R.
- b. PILOT MODULATION switch at OFF.
- c. COMPOSITE LEVEL control knob at RF ON.
- d. COMPOSITE ELVEL control at MAX for 100% modulation.

For lower modulation levels, adjust this control as required. The level can be determined by measurement of the voltage at the COMPOSITE OUTPUT jack where it is in the proportion, 0.283Vp-p or 0.10Vrms per 10%.

Example: For 30% modulation, the voltage is 0.85Vp-p or 0.3Vrms.

2.7.2 External Modulation

Control settings:

- a. FUNCTION switch at EXT MOD.
- b. PILOT MODULATION switch at OFF.
- c. COMPOSITE LEVEL control knob at RF ON.
- d. COMPOSITE LEVEL control at MAX for 100% modulation.
- e. PRE EMPHASIS switch at 75 μ sec.

Connections:

- a. External audio source, 50Hz-15kHz, to L and R INPUTS in parallel.
When making a frequency run, adjust the input voltage to approximately 1Vrms at 400Hz.
- b. RF OUTPUT to the tuner input.

2.8 Use of 1kHz Output

The internal 1kHz signal is available for test purposes at the 1kHz OUTPUT jack on the rear Panel.

The output voltage is approximately 1Vrms on open circuit and for low distortion, the load should be over 10k Ω .

SECTION 3 MAINTENANCE

3.1 General

Procedures are given in this section for checking and circuit adjustments.

3.1.1 Exposing the Chassis

When adjustment of an internal adjuster is necessary, the chassis can be exposed for tests and inspection as follows:

- a. Remove the two cover fastening screws at the rear.
- b. The bottom and top covers are taken off by removing two screws each at the sides.

3.1.2 Location of Adjusters

Circuit adjusters on the PCB are shown in the drawing which follows this section.

3.2 Subcarrier and Pilot Signal Phasing

The phasing adjustments are described in Section 2.2.

3.3 Pilot Level Check and Adjustment

The pilot level in the composite output signal is initially set at 10%: for other levels, see "3" below.

1. Control settings for checking:

- a. FUNCTION switch at EXT MOD; no connections to L and R Input jacks.
- b. PILOT MODULATION switch at ON.
- c. COMPOSITE LEVEL control at MIN; control knob at RF OFF.

2. Connections:

AC millivoltmeter to the COMPOSITE OUTPUT jack, using the miniplug.

3. Adjustments:

The output voltage should be 100mVrms for the 10% level. If not, adjust the MOD LEVEL adjuster of PILOT ADJUST on the rear panel.

For other levels in the 0 to over 10% range, adjust the MOD LEVEL adjuster as required in the proportion 10mVrms per 1% level, for example, at 8%, the voltage is 80mVrms.

3.4 Composite Output Check and Adjustment

1. Control settings:

- a. FUNCTION switch at L + R.
- b. COMPOSITE LEVEL control at MAX; control knob at RF OFF.
- c. PILOT MODULATION switch at OFF.

2. Connections:

AC millivoltmeter to the COMPOSITE OUTPUT jack, using the miniplug.

3. Adjustments:

The output voltage should be 1Vrms at maximum. If not, adjust VR407, on the PCB.

3.5 Left and Right Channel Separation

The channel separation at 1kHz in the LSG-231 is over 50dB.

For checking, a high-gain wideband scope with probe and the miniplug are required.

1. Control settings:

- a. FUNCTION switch at "L" (or "R").
- b. PILOT MODULATION switch at OFF.
- c. COMPOSITE LEVEL control at MAX; control knob at RF OFF.
- d. Scope controls for waveform display.

2. Connections:

Scope probe to the COMPOSITE OUTPUT jack, using the miniplug.

3. Adjustments:

Scope controls to display two cycles.

The channel separation is determined by noting of the waveform from the base line, see Fig. 3-1.

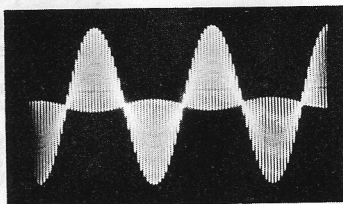


Fig. 3-1 Channel separation waveform.

The ratio of the amplitudes, upper peak for "L" (or "R") and the lower "peak" for "R" (or "L") gives the separation. Since this ratio is high, over 50dB or over about 320, the vertical gain of the scope must be increased to "open up" the lower peak (the upper peak will go off the screen).

If the lower peak amplitude is high, adjust VR404 on the PCB, to obtain the minimum condition, see Fig. 3-2. In the ideal case, there should be no deviation from the base line.

Set the FUNCTION switch at "R" (or "L") and repeat the above check. Adjust VR404 if necessary.

Recheck by setting the FUNCTION switch at "L" (or "R").

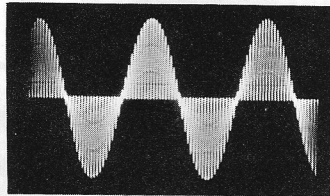


Fig. 3-2 Ideal separation condition.

3.6 1kHz Output Check and Adjustment

At the 1kHz OUTPUT jack, the voltage should be 1Vrms. If not, adjust VR302 on the PCB.

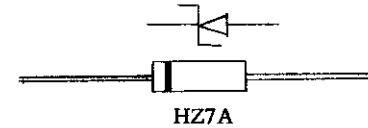
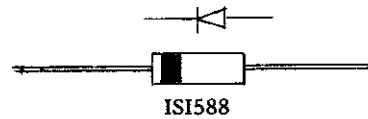
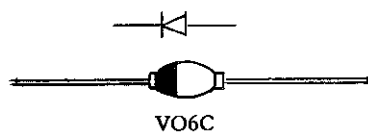
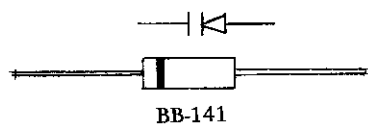
3.7 67kHz Frequency Check and Adjustment

Set the FUNCTION switch at 67kHz.

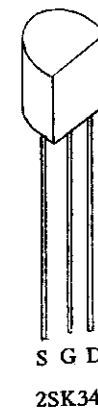
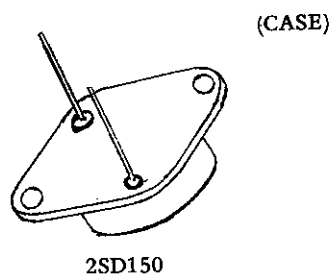
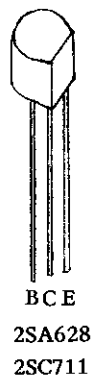
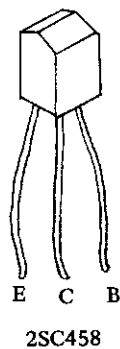
Connect an electronic frequency counter to the COMPOSITE OUTPUT jack, using the miniplug.

The frequency should be 67kHz \pm 5%. If not, adjust L101 on the PCB. (NOTE: In place of the frequency counter, the lissajous pattern method can be used. A scope and an accurate audio generator are required.)

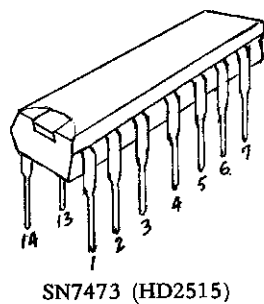
DIODES



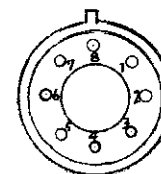
TRANSISTORS



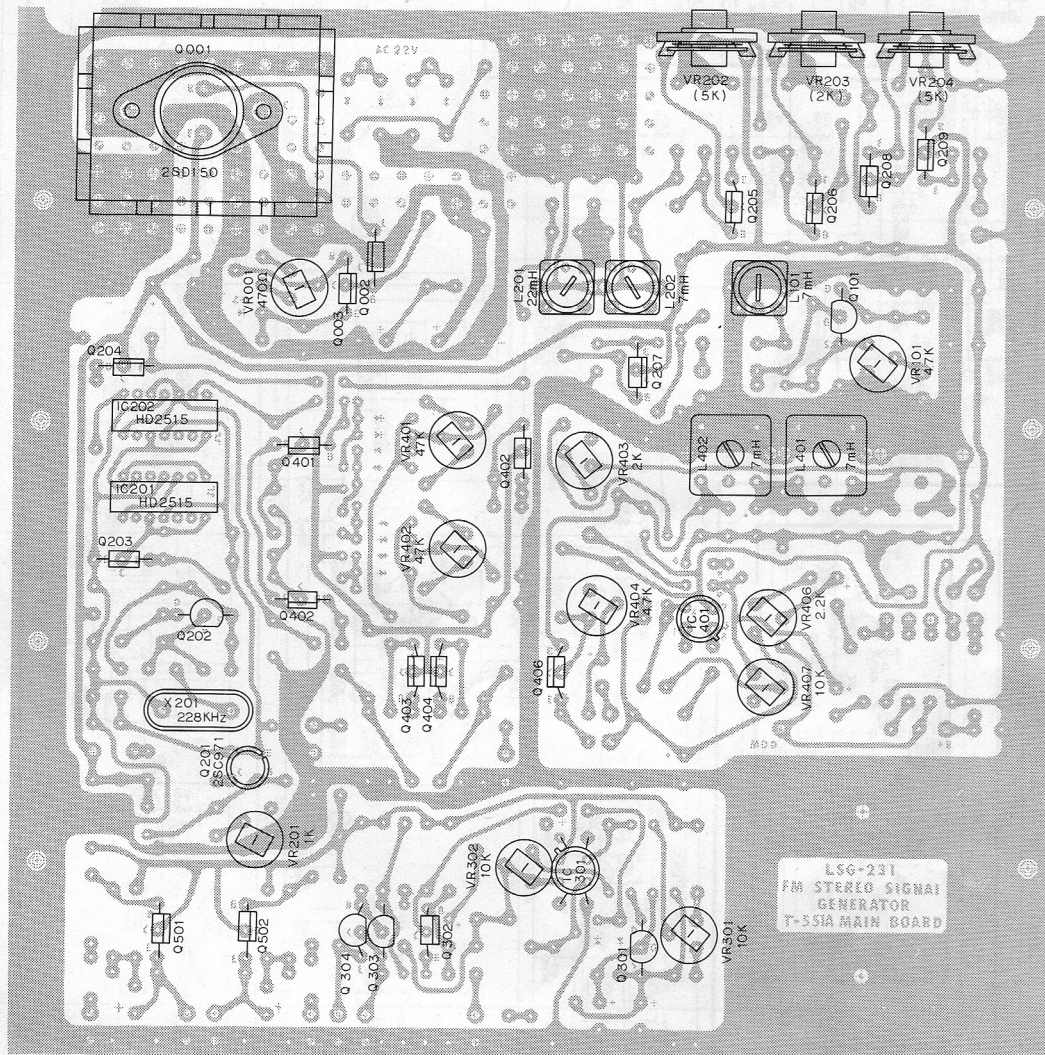
INTEGRATED CIRCUITS

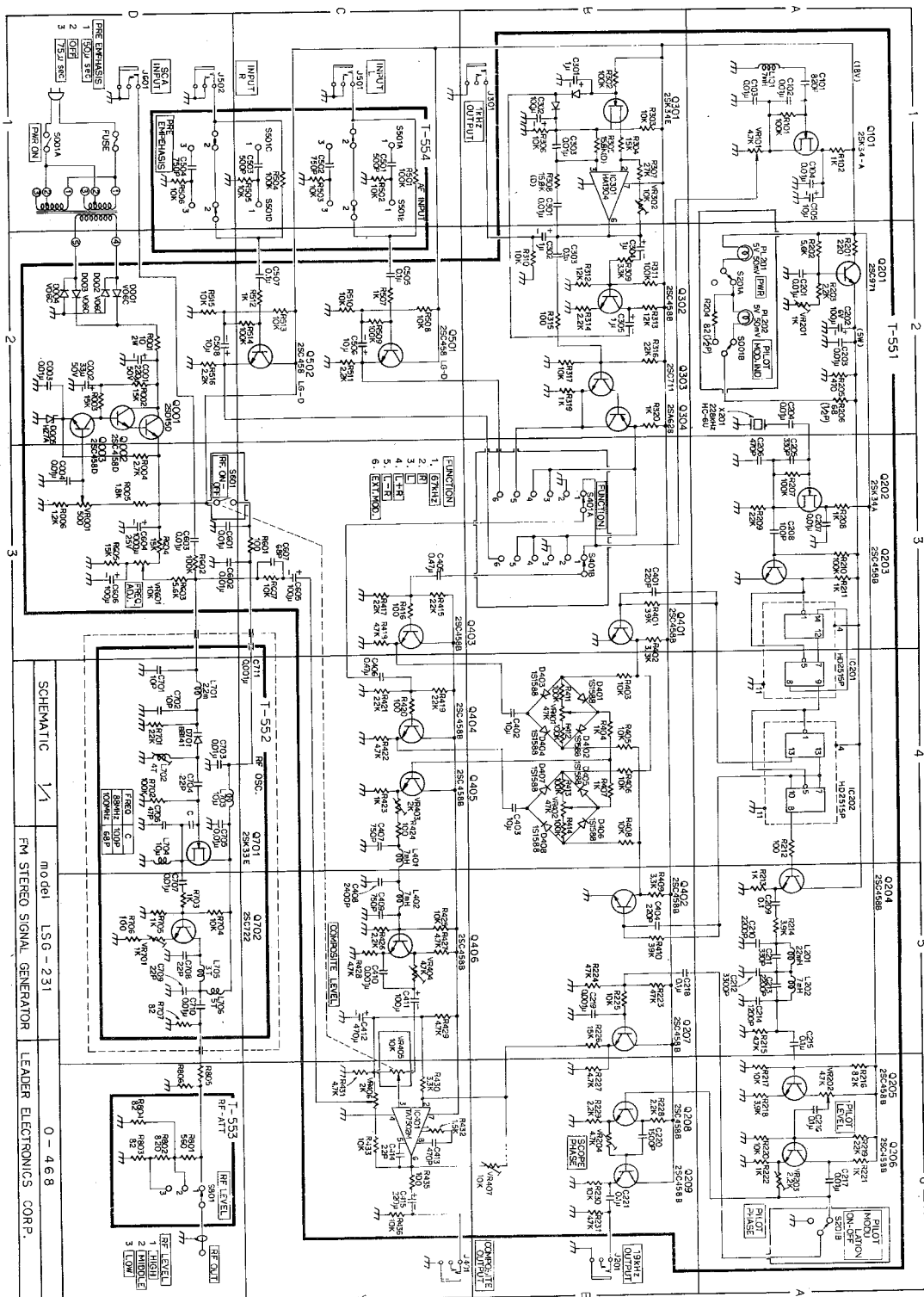


B : BASE
C : COLLECTOR
E : EMITTER
S : SOURCE
G : GATE
D : DRAIN



NA709 (TA7502M)
NA741 (HA1304)





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