

LEADER TEST INSTRUMENTS

MODEL LSG-215A

STANDARD SIGNAL GENERATOR

INSTRUCTION MANUAL



LEADER ELECTRONICS CORP.

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1. GENERAL

The LSG-215A is Standard Signal Generators using the synthesizer system for generating CW and FM/AM modulation signals of (A) 30 to 120 MHz and (B) 100 kHz to 30 MHz.

2. FEATURES

- (1) Highly stable signals are available as the oscillation signal is locked to the reference crystal oscillator.
- (2) Output level can be set in a range of -10 to 120 dB μ (0 dB= 1μ V) in 1-dB step.
- (3) Using an internal memory, which is battery backed up, 100 points of selections combining frequency, modulation type, and output level can be stored.
- (4) Frequency and output level settings are available by ten-key operations.
- (5) The peak indication system is used for the meter circuit, and thus the composite signal can also be accurately indicated.
- (6) Using a separately available memory, EPROM (2716 type), settings of predetermined frequencies for a service station or production line can be conveniently made.
- (7) Remote control is available for the operations such as the memory call, using the 36-p connector on the rear panel.

3. SPECIFICATIONS

- | | |
|--------------------------|--|
| (1) Frequency | |
| Range | 2 ranges: 0.1 to 30 MHz and 30 to 120MHz |
| Indication | 6-digit digital indication |
| | Resolution: 0.1 to 30 MHz; 100 Hz |
| | 30 to 120 MHz; 1 kHz |
| Accuracy | within $\pm 5 \times 10^{-5}$ |
| Drifting | within $\pm 5 \times 10^{-5}$ |
| (2) RF Output | |
| Range | -10 to 120 dB μ (0 dB= 1μ V, open terminal) |
| Indication | 3-digit digital indication |
| Reference level accuracy | within ± 1 dB at 120 dB μ |
| Attenuator accuracy | within ± 1.5 dB (more than 0 dB) |
| | within ± 2 dB (less than 0 dB μ) |
| Output impedance | 50Ω , VSWR less than 1.2 |
| Spurious output | less than -30 dB |

(3) Modulation

Internal modulation frequency 400 Hz, 1 kHz within $\pm 1\%$

External modulation input impedance approx. 10 k Ω

FM

Frequency deviation 0 to 100 kHz (carrier of more than 1 MHz)
Deviation indicator 5, 10, 50 & 100 kHz full scale
Indicator error 1 to 120 MHz; $\pm 10\%$ of full scale
Distortion rate 1 to 120 MHz; less than 0.2% for 75-kHz deviation (demodulation band 80 Hz to 100 kHz)

External modulation frequency range 20 Hz to 100 kHz
External modulation frequency response ± 1 dB (reference 1 kHz)

AM

Modulation rate 0 to 50%
Modulation meter 5, 10, 50 & 100% full scale
Meter error $\pm 10\%$ of full scale
Distortion rate 0.1 to 30 MHz, less than 1% at 30% modulation
30 to 120 MHz, less than 3% at 30% modulation

External modulation frequency range 20 Hz to 10 kHz
External modulation frequency response ± 1 dB (reference 1 kHz)

Residual Modulation (S/N)

FM component more than 70 dB in S/N for 75-kHz deviation
(FM linear detector: demodulation band, 80 Hz to 20 kHz)

AM component more than 50 dB in S/N for 30% modulation rate

(4) Preset

- Using the internal memory, 100 points of presettings can be stored for combinations of frequency, modulation type, and output level.
- Separately available memory unit, EPROM, can be ordered.

(5) Miscellaneous

Power voltage 100, 120, 220, and 240 V
Power consumption approx. 30 VA
Size and weight 400(W) x 100(H) x 300(D) mm
7 kg
Accessory output cable 1 (50 Ω BNC 3D-2V)

4. NOTES ON USE

(1) Power voltage

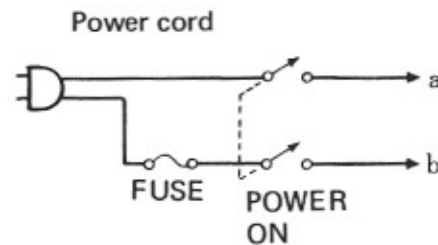
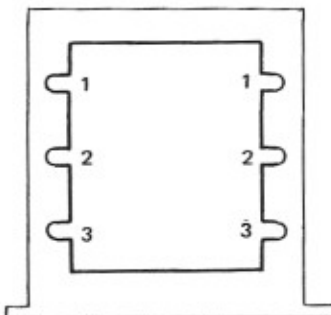
The power supply voltage should be in a range of $\pm 10\%$ of the specified rating voltage. When the power voltage is below -10% , the instrument may not properly operate. On the other hand, when the power voltage is more than $+10\%$, the power unit of the instrument may be damaged. Before using the instrument, ensure the correct voltage is applied and a fuse of appropriate rating is used referring to the indication on the rear panel.

The power transformer is provided with the 100-V and 120-V taps of serial/parallel windings, and therefore 4 different types of voltage ratings are available by rewiring the taps. Note the fuse rating when the voltage specification is change. (Refer to Fig. 4-1 and Table 4-1.)

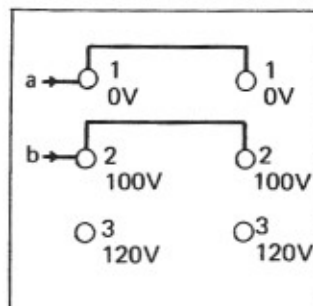
Table 4-1 Power voltage ranges

Voltage rating	Operating voltage range ($\pm 10\%$)	Fuse rating
100 V	90 ~ 110 V	0.63 A, time lag
120 V	108 ~ 132 V	
220 V	198 ~ 242 V	0.315A, time lag
240 V	216 ~ 264 V	

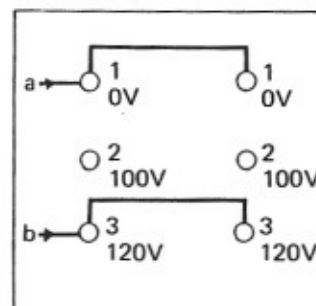
Terminal arrangement



100V



120V



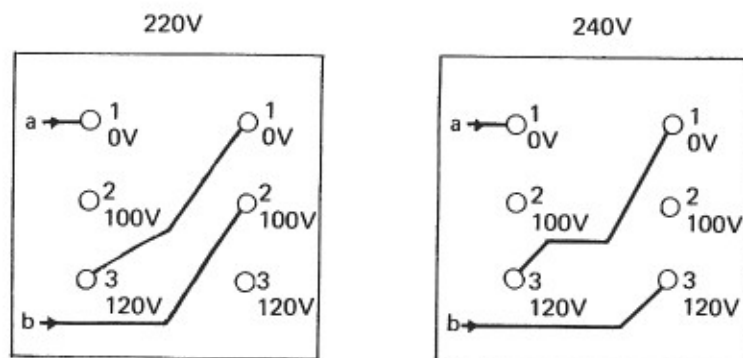


Fig. 4-1 Power transformer wirings

(2) Battery back up of the memory

When the instrument is to be kept unused for a long period of time, the battery must be charged. The stored information in the memory of the LSG-215A can be maintained for more than a month by the battery back up (with the battery full-charged) even though the instrument is not supplied with the power. But, when the instrument is kept unused more than a month, the memory contents may be erased. In such a case, supply the power to the instrument for more than 8 hours, before writing the memory.

(3) Input/output cable connection

Care must be taken not to apply voltage externally to the output terminal of the instrument. When the output signal cable touches to a DC power source, the internal attenuator circuit may be damaged.

Further, the external modulation input terminal should not be applied with an excess voltage of more than 5 Vp-p. When the DC component of the applied signal is more than ± 2 V, the DC component must be eliminated using a condenser.

5. DESCRIPTION OF OPERATING KEYS AND SWITCHES

In this instruction manual, circled numbers indicate operating keys and switches. Referring to Figs. 5-1 and 5-2, operating sections will be described.

5.1 Display Section

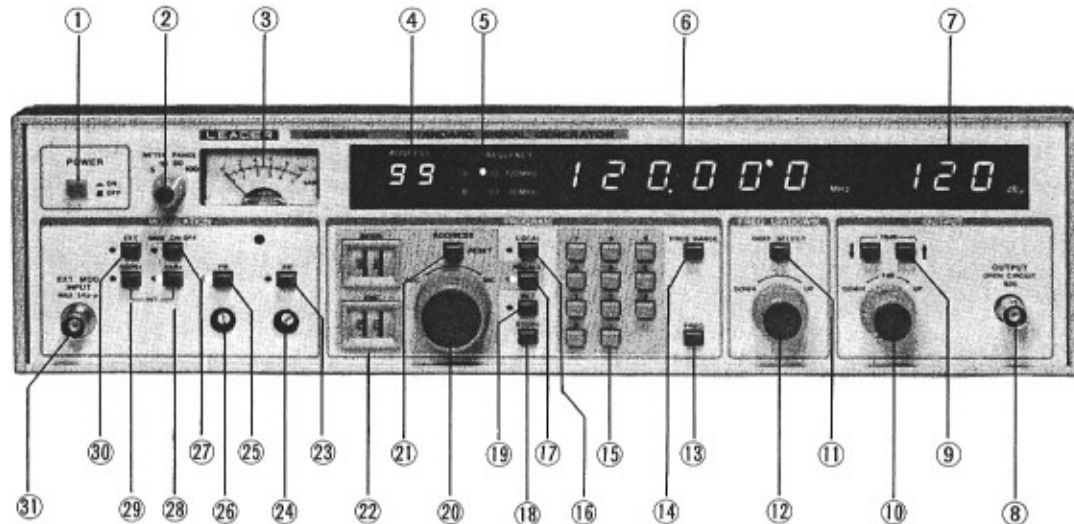


Fig. 5-1 Front panel of LSG-215A

- ① **POWER switch:**
Goes ON when pushed in "■". When pushed out "■", the power goes OFF. When the power is turned on, the RECALL mode is activated and the BEGIN address data is accessed.
- ② **METER RANGE switch:**
Switches the range of the ③ modulation rate meter, 4 ranges of 5, 10, 50 & 100% (kHz).
- ③ **Modulation rate meter:**
Indicates a modulation rate (%) of AM and deviation (kHz) of FM. The inner graticule is the 5 & 50% (kHz) range, and the outer graticule is the 10 & 100% (kHz) range. The maximum modulation rate for AM is 50%.
- ④ **ADDRESS indication:**
Indicates address (0 to 99) of the internal memory when the instrument is in other than LOCAL mode.
- ⑤ **FREQ range indication:**
Automatically indicates a range based on the selected frequency. As it also serves as an indicator of the synthesizer's lock signal, it blinks when out of the lock range.

A range:	30 to 120 MHz
B range:	0.1 to 30 MHz

- ⑥ **FREQUENCY display section:**
Displays a frequency (MHz) in 6 digits.

10.0000 MHz
↑
Decimal point

- ⑦ **OUTPUT display:**
Indicates output level (dBμ) in 3 digits.

5.2 Output Level Variable Section

- ⑧ **OUTPUT terminal:**
Is the RF output terminal which is a BNC connector.
- ⑨ **10-dB output level keys:**
Change the output level in 10-dB step. Key  is for increase, and key  is for decrease.
- ⑩ **1-dB output level switch:**
Changes the output level in 1-dB step. Clockwise turn to UP increases the level, and counterclockwise turn to DOWN decreases the level. The switch has no stopper and turns endless.

5.3 Frequency Variable Section

- ⑪ **DIGIT SELECT key:**
Specifies a digit of frequency to be variably changed. Variable digit is indicated by a LED.
- ⑫ **FREQ UP/DOWN switch:**
Changes a digit specified by the ⑪ DIGIT SELECT key. Clockwise turn to UP increases the frequency, and counterclockwise turn to DOWN decreases the frequency. It is convenient for partial modification of frequency. The switch has no stopper and turns endless.

5.4 Program Section

- ⑬ **FREQ key:**
Be sure to push this key before setting frequency data using the ten-key. This is used as the entry key of frequency data.
- ⑭ **FREQ RANGE key:**
Switches frequency range and selects the indication of the ⑤ FREQUENCY range between (A) 30 to 120 MHz and (B) 0.1 to 30 MHz. Selection of (A) and (B) is alternative, and the floating point indication is switched accordingly.

- ⑮ **Ten keys:**
Is used to enter frequency data. Before operating the ten-key, select the ⑯ LOCAL mode and push the ⑬ FREQ key.
- ⑯ **LOCAL key:**
Regardless of stored contents of the internal memory, the instrument can be controlled by operations on the front panel when this key is pushed. The condition while the LOCAL key is pushed in is called "LOCAL mode" and indicated by the LED. In this condition, the RECALL mode is released.
- ⑰ **RECALL key:**
Recalls stored contents in the internal memory for controlling operations of the instrument when this key is pushed in. The RECALL mode is indicated by the LED. The present address being accessed is displayed on the ADDRESS display. In this mode, the LOCAL mode is released and ten-key input is inactive.
- ⑱ **STORE key:**
Writes the data which is set by the ⑲ SET mode into the memory when this key is pushed. Upon completing a writing, the address is automatically incremented by 1.
- ⑲ **SET key:**
When the key is pushed, the instrument becomes ready to write data such as of frequency, output level, and modulation type in the memory. In this condition, the LOCAL mode is released.
- ⑳ **ADDRESS variable switch:**
Clockwise turn to INC of the switch increments the address by 1 and counter-clockwise turn to DEC decrements the address by 1. Address area is defined by the ㉒ BEGIN/END address switches.
- ㉑ **ADDRESS RESET key:**
Restores address of the memory used in the RECALL mode to the initial position (address position set by the ㉒ BEGIN ADDRESS switch). Be sure to push the switch whenever the ㉒ BEGIN/END ADDRESS switches are operated.
- ㉒ **BEGIN/END ADDRESS switches:**
The memory of the instrument has 100 points of addresses numbered 0 through 99. The digital switches are used to define an address area to be used. Strictly observe the relationship "BEGIN < END".

5.5 Modulation Section

- ㉓ **AM key:**
Specifies the operating condition for **AM** when the key is pushed, indicating the condition by the LED. The AM condition is released when the ㉔ FM key is pushed.

- ②4 **AM MOD level:**
Adjusts modulation rate in AM, for internal and external modulation modes. The maximum modulation rate is 50%.
- ②5 **FM key:**
Specifies the operation condition for **FM** when the key is pushed, indicating the condition by the LED. The FM condition is released when the ②3 AM key is pushed.
- ②6 **FM MOD level:**
Adjusts modulation rate in FM, for internal and external modulation modes. The maximum modulation rate (diviation) is 100 kHz.
- ②7 **MOD ON/OFF key:**
This key operates alternatively; i.e., ON/OFF of the operation is linked to the indication of the LED, on and off.
- ②8 **1 kHz (INT) key:**
Specifies the internal modulation frequency to 1 kHz when the key is pushed, indicating by the LED. The function is released when the ③0 EXT key is pushed.
- ②9 **400 Hz (INT) key:**
Specifies the internal modulation frequency to 400 Hz when the key is pushed, indicating by the LED. The function is released when the ③0 EXT key is pushed.
- ③0 **EXT key:**
Specifies the modulation mode to external, indicating the mode by the LED. In this condition, the input to the ③1 EXT MOD terminal is active. In this condition, the functions of the ②8 1 kHz key and the ②9 400 Hz key for internal modulation are released.
- ③1 **EXT MOD terminal:**
Is the input terminal for the external modulation, which is a BNC connector.

5.6 Rear Panel

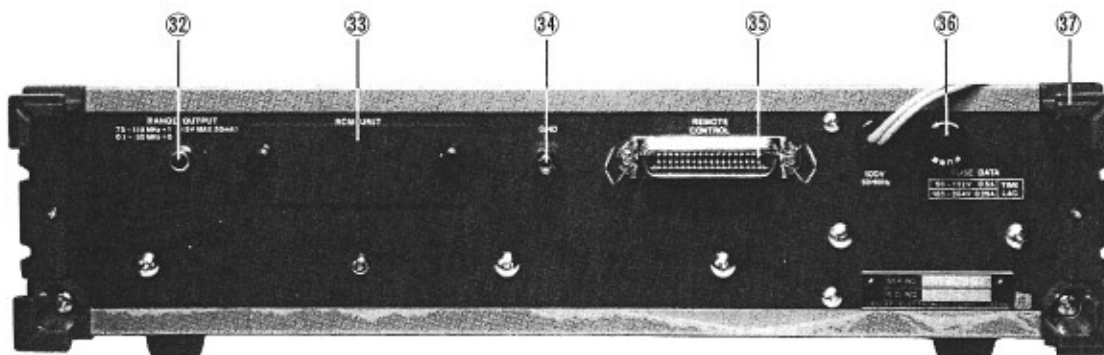


Fig. 5-2 Rear panel of LSG-215A

③② RANGE OUTPUT:

Is the control terminal for the LSS-5011 Output Selector. When the output signal is to be used for other purpose, note the rating which is 5 V, 50 mA (source) for (A) 30 to 120 MHz.

③③ ROM UNIT:

Normally, a cover is attached. When an optional ROM UNIT, 217-U01, is to be used, insert the unit to this position.

③④ GND:

Is the ground terminal which is connected to the frame chassis.

③⑤ REMOTE CONTROL:

The connector is connected to the LSG-215-01 Remote Controller. (For the details, refer to Section 7. REMOTE CONTROLLER.)

③⑥ Fuse:

As to the fuse data, refer the seal attached below the fuse holder. For fuse replacement, turn the holder cap to the counterclockwise direction using a screwdriver.

③⑦ Cord winder:

The power cord can be wound around the cord winder legs.

6. BASIC OPERATION

6.1 Operation of Frequency Setting

Sections related to frequency setting operation are shown in Fig. 6-1. The frequency range, display, and resolution are shown in Table 6-1.

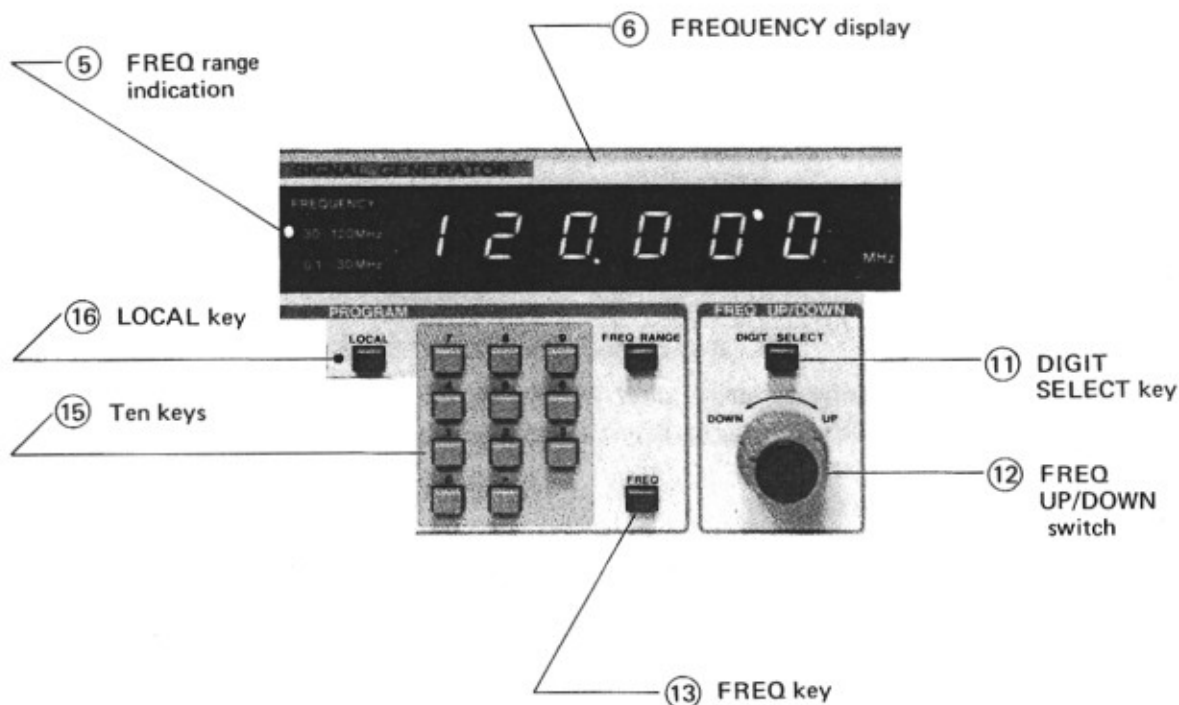


Fig. 6-1 Operating sections related to frequency setting

Table 6-1 The frequency range, display and resolution

Range	Display	Resolution
(A) 30 to 120 MHz	30.000 to 120.000 ↑ ↑ MHz 1 kHz	1 kHz
(B) 0.1 to 30 MHz	0.1000 to 29.0000 ↑ ↑ MHz 100 Hz	100 Hz

WARNING: Flashing of LED in upper 2 digits of frequency indication indicates that a frequency is set out of range. Make sure a frequency is set in right range.

Frequency setting methods are described below.

A. Use of ten keys

Assuming the frequency to be set is 98.0 MHz, the order of key operations is shown in Fig. 6-1 by numbers with diamond mark "◇".

- (1) Push the (16) LOCAL key.
- (2) Push the (13) FREQ key.
- (3) Push the (14) RANGE key, and ensure the range (A) 30 to 120 MHz is selected. Neglect blinking of the LED if it happens.
- (4) Key enter in sequence; [0], [9], [8], [.] , [0], [0], and [0]. FREQUENCY display will become as follows:

0 98.000 MHz

The highest position "0" is a blank.

When the highest order digit is "0" (less than 100 MHz for range A, and less than 10 MHz for range B), it is displayed as a blank, but be sure to enter "0" in such a case.

B. Use of FREQ UP/DOWN switch

This switch is operative regardless of the LOCAL or RECALL mode.

- (1) Specify a digit to be changed by the (11) DIGIT SELECT key. Variable digit position is indicated by the corresponding LED located at the right upper of a digit display. The highest digit position is not specifiable. By the abovementioned key operation, specified position moves ① through ⑤ as shown below.

1 0 0 . 0 0 0 MHz

The highest order position is not specifiable.

- (2) Set the required frequency using the (12) FREQ UP/DOWN switches. Digit position selection can be made automatically.

6.2 Operation of Output Level Setting

Sections related to output level setting are shown in Fig. 6-2.

Output level is shown in 2 digits. Display is based on the relationship $0 \text{ dB} = 1 \mu\text{V}$ and indicates the open termination voltage. Output level setting is available in a range of $-10 \text{ dB}\mu$ ($0.316\mu\text{V}$) to $120 \text{ dB}\mu$ (1V) in 1-dB step.

For the operation method, refer to items ⑨ and ⑩ in section "5.2 Output Variable Section."

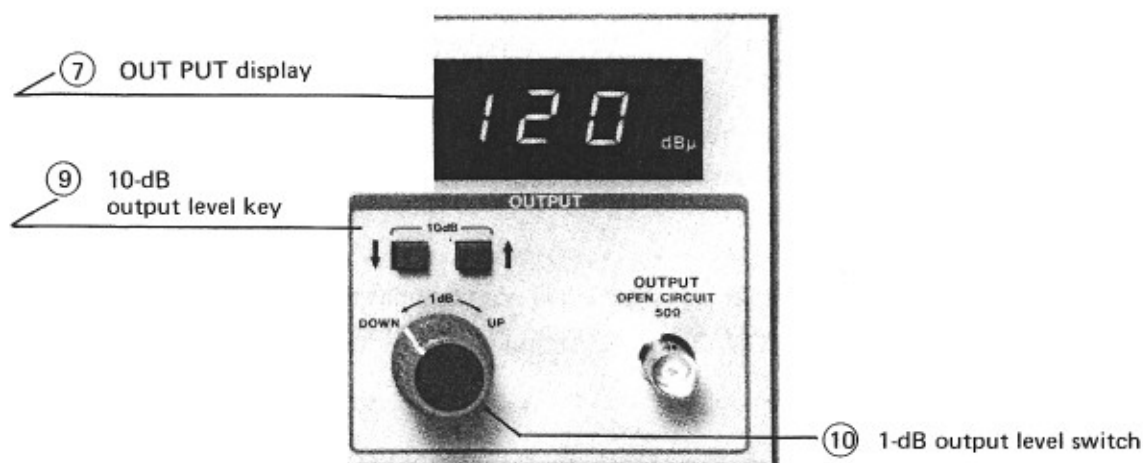


Fig. 6-2 Operating sections related to output level setting

6.3 Operation of Modulation Setting

Sections related to modulation setting are shown in Fig. 6-3.

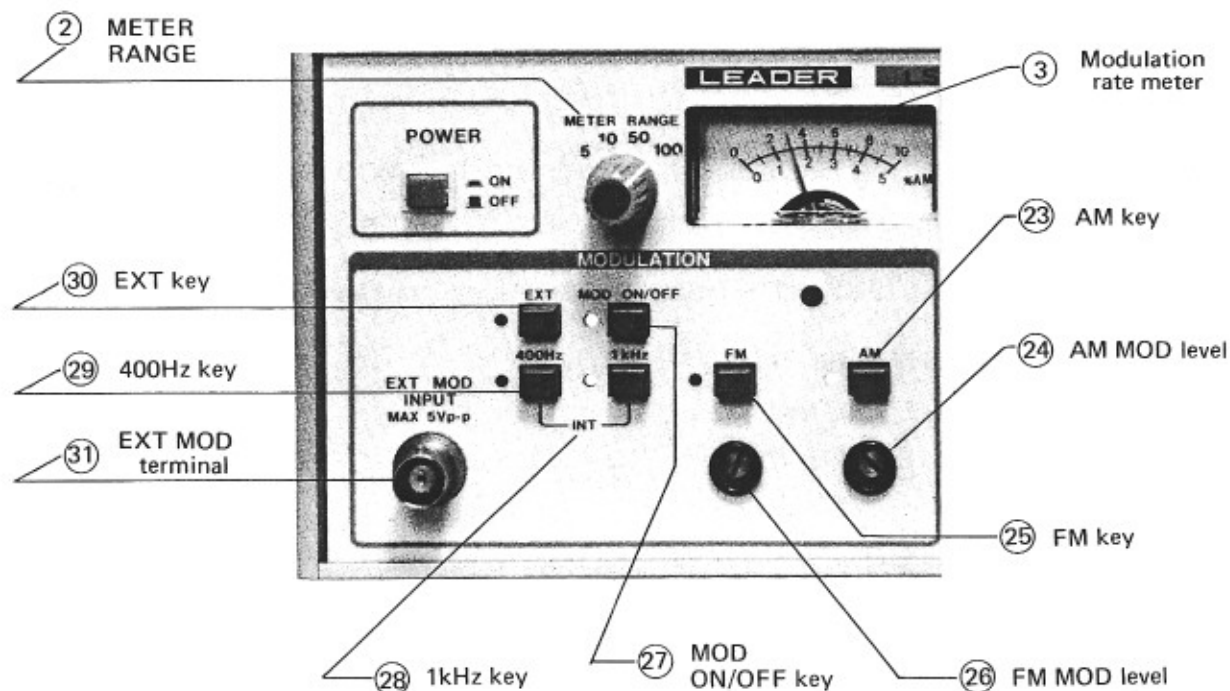
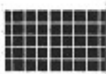


Fig. 6-3 Operating sections related to modulation setting



Operations of this part select a type of output signal. There are 5 types of output signals selectable.

- (1) CW (carrier wave)
- (2) Internal modulation FM
- (3) External modulation FM
- (4) Internal modulation AM
- (5) External modulation AM

Setting methods of 5 different signals are described below.

6.3.1 CW (carrier wave)

The output signal is a carrier signal which is not modulated.

- (1) Turn off the (27) MOD ON/OFF key; no indication by the LED.

6.3.2 Internal modulation FM

- (1) Turn on the (25) FM key.
- (2) Turn on the (28) 1 kHz key or the (29) 400 Hz key.
- (3) Turn on the (27) MOD ON/OFF key.
- (4) Adjust the modulation level to a required shift using the (26) FM MOD level. Note the (2) METER RANGE selection.

6.3.3 External modulation FM

- (1) Turn on the (25) FM key.
- (2) Turn on the (30) EXT key.
- (3) Turn on the (27) MOD ON/OFF key.
- (4) Apply the external modulation signal to the (31) EXT MOD terminal.
- (5) Adjust the modulation level to a required shift using the (26) FM MOD level. Level of the composite signal can be directly read by the (3) modulation rate meter. About 75 kHz of deviation is available with input level of 3 Vp-p.

6.3.4 Internal modulation AM

- (1) Turn on the (23) AM key.
- (2) Turn on the (28) 1 kHz key or the (29) 400 Hz key.
- (3) Turn on the (27) MOD ON/OFF key.
- (4) Adjust the modulation level to a required rate using the (24) AM MOD level. The maximum modulation rate of AM is 50%.

6.3.5 External modulation AM

- (1) Turn on the (23) AM key.
- (2) Turn on the (31) EXT key.
- (3) Turn on the (27) MOD ON/OFF key.
- (4) Apply the external modulation signal to the (31) EXT MOD terminal.
- (5) Adjust the modulation level to a required rate using the (24) AM MOD level.
About 30% of modulation rate is available with input level of 1.7 Vp-p.

6.4 Preset Operation

Presetting means to store (write) data of required frequency, output level, and modulation type in the memory.

Sections related to the preset operations are shown in Fig. 6-5. The memory of the instrument has 100 points of memory area, numbered 0 to 99. A single address can store 3 kinds of data as follows:

- (1) Frequency data (including range)
- (2) Output level data
- (3) Modulation data

The modulation rate and the METER RANGE can not be stored.

6.4.1 Preset procedure

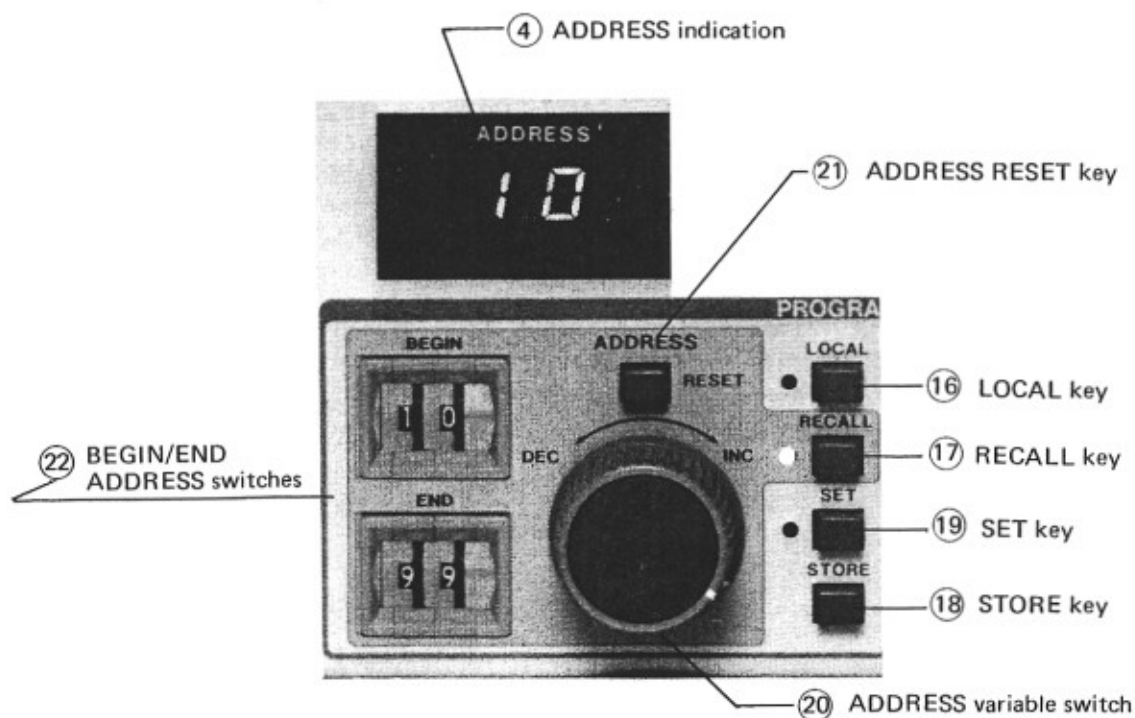
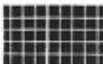


Fig. 6-4 Operating sections related to the presetting

- 
- (1) Select the LOCAL mode by the (16) LOCAL key.
 - (2) Set the frequency data, output level data, and modulation data. (For setting method, refer to Sections 6.1 to 6.4.)
 - (3) Push the (19) SET key to prepare to store the data. The (4) ADDRESS display section will display the present address.
 - (4) Set the starting and end addresses of the memory using the (22) BEGIN/END ADDRESS switches.
(Observe the relationship "BEGIN < END ADDRESS".)
 - (5) Push the (21) ADDRESS RESET key. The (4) ADDRESS display section will display the starting address.
 - (6) By operating the (18) STORE key, the display data is stored in the memory, and then, the address is automatically incremented by (+1).
 - (7) To successively make presetting, repeat the above-described procedures of items (1), (2), (3) and (6).

6.5 Recall Operation

Recall means to read out the stored contents in the memory in contrast to preset operation. Operating procedure for recall operation is described below. (Refer to Fig. 6-4.)

- (1) Push the (17) RECALL key.
- (2) Select the desired address using the (20) ADDRESS variable switch. By turning the switch clockwise, the address is incremented by 1; and by turning it counterclockwise, the address is decremented by 1. To access the starting address (BEGIN), the address can be reached faster by using the (21) ADDRESS RESET key.

In the RECALL mode, the present address is displayed on the (4) ADDRESS display section. In this case, all the functions except ten keys are active.

6.6 ROM Unit

The ROM unit (215A-U01) is available as an option for the instrument. A multiple of the ROM units having the same program contents are useful to operate a multiple of signal generators. Description of the ROM unit and programming method are described in the instruction manual of the 215A-U01.

7. REMOTE CONTROL

For remote control operation, the instrument is used in the RECALL mode, and random access of memory address is possible. The connector type used is AMPHENOL (plug 57-30360).

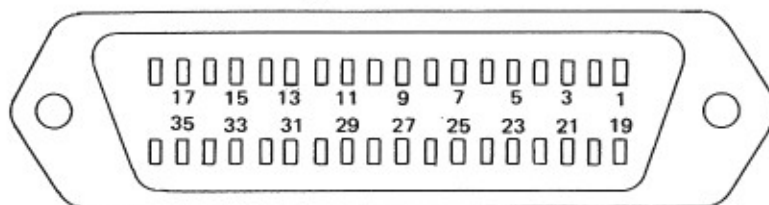
7.1 Functions

- (1) Direct random access of memory address is possible. But the BEGIN/END address restriction is applied to defined memory area. Address increment by 1 and address decrement by 1 are also possible.
- (2) Turning on and off of modulation is available.
- (3) UP/DOWN control of output level in 10-dB and 1-dB steps.
- (4) UP/DOWN control of frequency by the DIGIT SELECT.

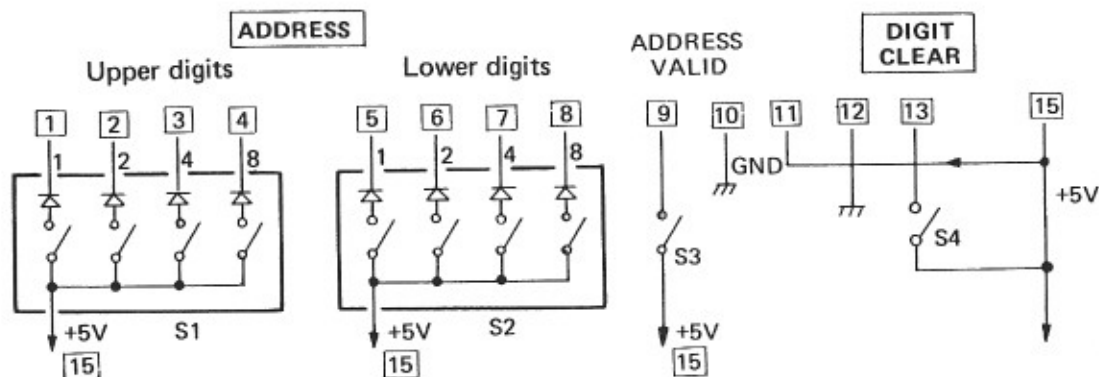
7.2 Pin Connection of Remote Connector

Pin connection of the remote connector is shown in Fig. 7-1.

Pin arrangement of the connector



- (a) Numbers in square mark "□" indicate pin numbers.
- (b) For switches S1 and S2, digital switches with diodes are used. (positive logic in BCD code)
- (c) For switches S3, S4, S5, S6, S7, and S10, snap-switches of momentary-on type (normal off and pushing on) are used.
- (d) For switches S8, S9, and S11, pulse switches are used which are special type (SBU102C) available by an order.
- (e) Signal level of +5 V should be only used for the remote control. The pin number 6, 14, 16, 17 and 28 to 36 are unused.



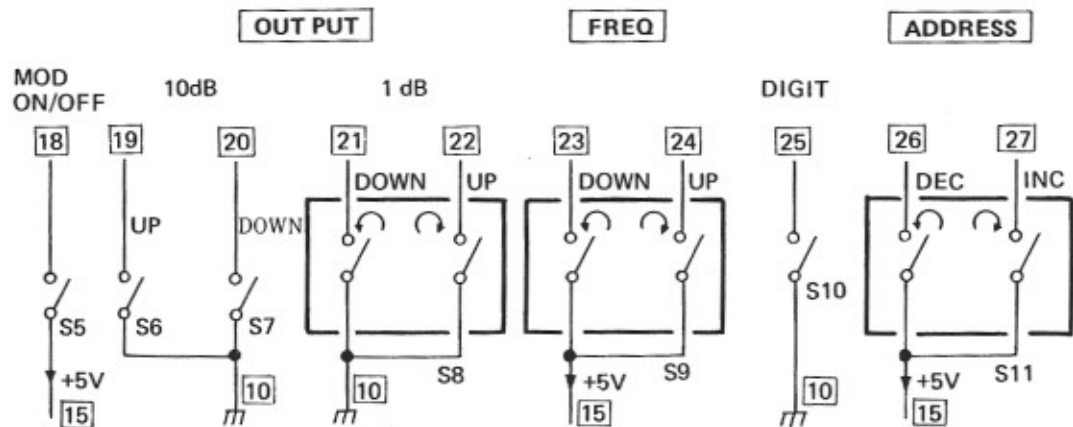
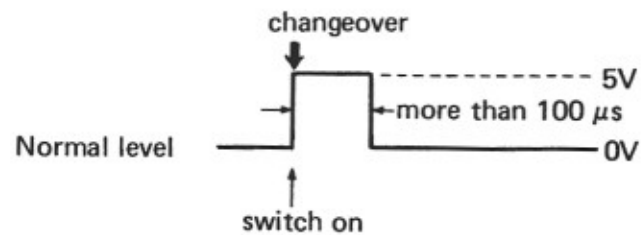


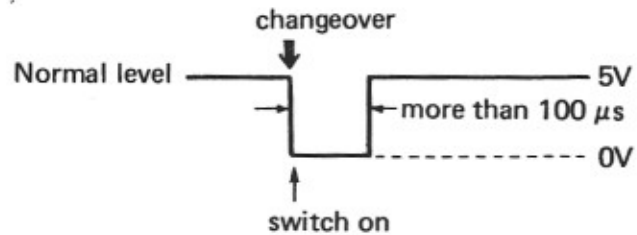
Fig. 7-1 Pin connection of remote connector

7.3 Operation of Each Terminal and Switch

(1) S4, S5

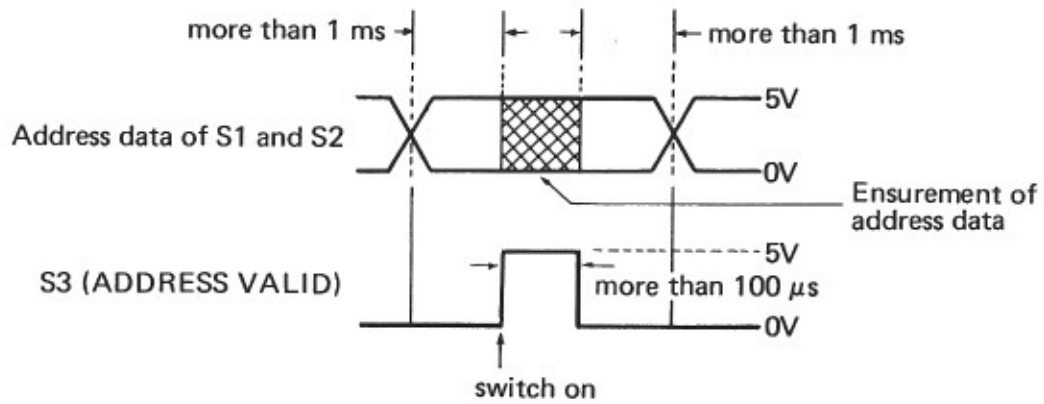


(2) S6, S7, S10

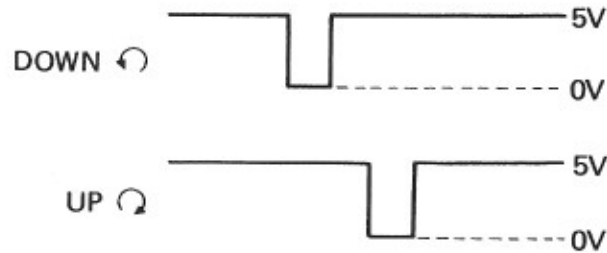


Avoid simultaneous operations of the switches S6 and S7.

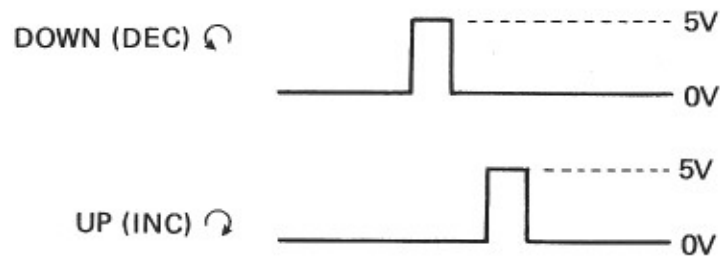
(3) Relationship between S1, S2, and S3



(4) S8 (single-pulse generation by single click)



(5) S9, S11 (single-pulse generation by single click)



8. METHOD OF USE

8.1 Accessories for Measurement

For the instrument, the remote control box (LSG-215-01) and other various accessories are separately available. Productive measurement works can be made using the accessory devices.

(1) Remote control box (LSG-215-01)

An external appearance of the box is shown in Fig. 8-1. It is a compact size box which includes all the functions described in Section 7.1. Direct setting of memory addresses is possible up to 12 points. The settings are made by using the internal BCD switches. Use of the remote control box will contribute to a productivity increase of the production line.

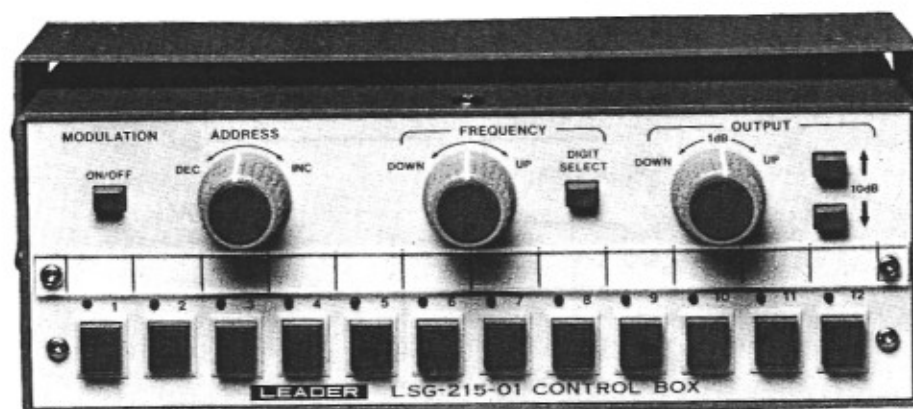


Fig. 8-1 Remote control box LSG-215-01

(2) Test loop (LPA-070)

An external appearance of the test loop is shown in Fig. 8-2.



Fig. 8-2 Test loop

(3) Dummy antenna (LDA-1554-50)

An external appearance of the dummy antenna is shown in Fig. 8-3. The input impedance is $50\ \Omega$ unbalanced, and the output impedance is $300\ \Omega$ balanced.



LDA-1554-50 $50\ \Omega : 300\ \Omega$

Fig. 8-3 Dummy antenna

(4) ROM unit (215A-U01)

An appearance of the ROM unit is shown in Fig. 8-4. For the details of the function and its use, refer to the instruction manual of the 215A-U01.



Fig. 8-4 ROM unit 215A-U01

8.2 Use Examples

The LSG-215A is used in connection as shown in Fig. 8-5. Measurement examples of AM/FM receivers are described as practical cases. The measurement methods are based on the JIS specifications.

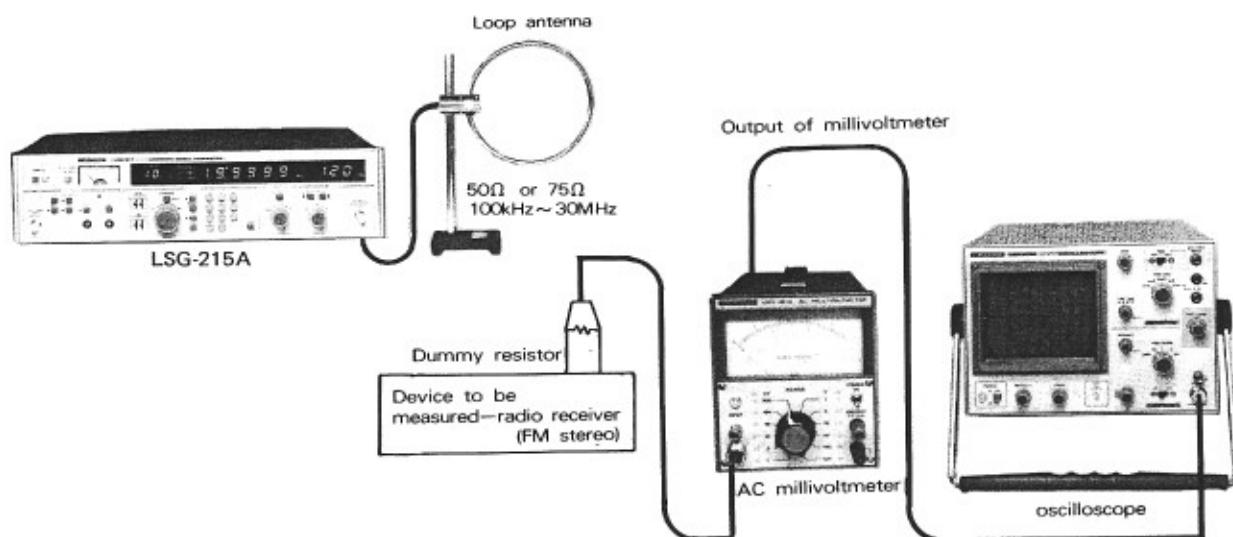


Fig. 8-5 Connection diagram of radio receiver for measurement

8.2.1 Measurement example of practical AM sensitivity

- (1) Connect as shown in Fig. 8-5. Set the radio receiver to AM mode.
- (2) Set the instrument to LOCAL by the (16) LOCAL mode.
- (3) Set the output level to 35 dB using the (9) 10 dB output level key and the (10) 1 dB level switch.
- (4) Set the RF frequency to 1.0 MHz using the (15) ten keys or (12) FREQ UP/DOWN switches.
- (5) Select AM modulation by the (23) AM key.

- (6) Turn on the modulation by the (27) MOD ON/OFF key.
- (7) Set the internal modulation to 400 Hz by the (29) 400 Hz key.
- (8) With the above described procedure, the initial setting is completed. The front panel, at this time, looks as shown in Fig. 8-6.



Fig. 8-6 Setting of the LSG-215A for measurement of AM practical sensitivity

- (9) Make a tuning by turning the receiver dial. Adjust the receiver's output level to get a rating output (for example, 1 W).
- (10) The output level of the receiver at this time is regarded as S. Read indication of a millivoltmeter in dB which is convenient for S/N ratio calculation.
- (11) Turn off the (27) MOD ON/OFF key. The noise level at this time is regarded as N.
- (12) From the above measurement results of items (10) and (11), calculate the S/N ratio.
- (13) With the abovedescribed procedure for calculating the S/N ratio, measure the output level while decreasing the output level of the instrument; the **output level when the S/N ratio is 20 dB is referred to as the practical sensitivity.**

9. MAINTENANCE

This instrument is designed and built to function stably in long period. In case, however, it becomes defective, please contact to the "LEADER" authorized service center/agent for proper repair and calibration. Cabinet cover can be removed by removing 4 screws and 2 cord winders as illustrated in Fig. 9-1.

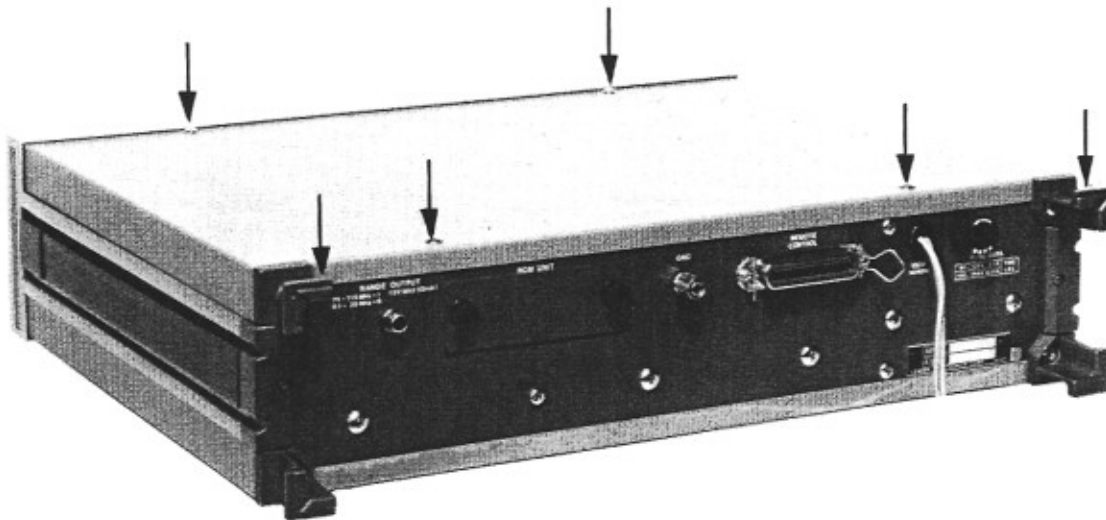


Fig. 9-1 How to remove upper lid