

SG-1501B

FM / AM Stereo Signal Generator

SG-1501B

OPERATING

Read First

In order for a long period of trouble-free service of the instrument, please pay special attention to the following precautions:

1. Protect the instrument from excessive impact during transportation and installation.
2. Be sure to verify whether the line voltage setting matches the line voltage used.
3. Use a fuse with correct ratings only.
4. Do not apply excessive AC or DC voltage to the signal output connector beyond the maximum voltage allowed.
5. Use the instrument within operating temperature range, which is from 15 deg C to 35 deg C.
6. For an accurate measurement, allow approximately 30 minutes of instrument warm-up time.
7. Avoid operating the instrument under the following conditions; direct sun light, rapid temperature variation, high humidity, or strong magnetic field.
8. Do not alter or change the parts or their locations inside the instrument. please contact Jung Jin Electronics company for service and calibration.

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<http://www.credix.co.kr>

This Information contained in this document is subject to change without Notice

Safety Symbols

The following symbols on instrument and in the documentation indicate precautions which must be taken to maintain safe operation of the instrument.

Warning 

: A warning calls attention to a procedure, practice or the like which, correctly performed or adhered to, could result in injury or loss of life.

Caution 

: A Caution calls attention to a procedure, practice or the like which, if not correctly performed or adhered to, could result in damage to or the destruction of part or all of the equipment.



: Earth Ground to chassis



: Protective Conductor Terminal



: Frame or chassis Terminal



: Caution, risk of danger



: Out / In position

Clearing and Maintenance

1. In order for a long period of trouble-free use of the instrument, please read this manual carefully.

2. Be sure to verify whether the line voltage setting matches the line voltage used. Use a fuse with the correct rating only.

3. **Caution** ⚠

Use 3 pin power cable to avoid any damage caused by floating voltage.
(but, Telephone analyzer (DD-5601 ...) use 2 pin power cable

4. Precaution

👉 Note :

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

- Avoid placing this instrument in an extremely hot or cold place.
- Do not use this instrument after bring it in from the cold.
- Do not expose the instrument to wet or dusty environment.
- Do not place liquid-filled container, such as coffee cups on top of this instrument
- Do not use this instrument where it is subject to serve vibration.
- Do not use this instrument in strong magnetic fields, such as near motors.
- Do not place heavy objects on the case or block the ventilation holes.
- Do not leave a hot soldering iron near the instrument.
- Cleaning :
To clean stained case, lightly rub the stained area with a soft cloth dipped in a neutral detergent.

Never use highly volatile material such as benzene or paint thinner.

CONTENTS

Chapter 1

GENERAL INFORMATION

1.1 Introduction	-----	1
1.1.1 Carrier Frequency	-----	1
1.1.2 RF Output	-----	1
1.1.3 Modulation	-----	1
1.1.4 Memory Function (Store / Recall)	-----	1
1.1.5 Remote Control	-----	1
1.1.6 Dummy Antenna	-----	2
1.1.7 GPIB	-----	2
1.2 Specification	-----	2
1.2.1 Carrier Frequency	-----	2
1.2.2 RF Output	-----	2
1.2.3 Modulation	-----	2
1.2.4 Others	-----	4
1.2.5 Options	-----	4

Chapter 2

INSTALLATION INSTRUCTIONS

2.1 Introduction	-----	5
2.2 Initial Inspection	-----	5
2.3 Electrical Installation	-----	5
2.4 Installation Check	-----	5
2.4.1 Required Equipments	-----	5
2.4.2 Initial Turn On	-----	5
2.4.3 Test Procedure	-----	5

Chapter 3

OPERATING INSTRUCTIONS

3.1 Front Panel Description	-----	6
3.2 Rear Panel Description	-----	11
3.3 Operation	-----	12
3.3.1 Frequency Setting	-----	12
3.3.2 Level Setting	-----	14
3.3.3 Modulation Setting	-----	15
3.3.4 Address Setting	-----	21
3.3.5 Use OF Memory Function (Store / Recall Mode)	-----	22
3.3.6 Special Maintenance Function Using KEY	-----	23

Chapter 4

GPIB

4.1 Introduction	-----	25
4.2 Installation Introduction	-----	25
4.3 Operating Instruction	-----	25
4.3.1 Local / Remote Mode Selection	-----	25
4.3.2 Address Setting	-----	25
4.3.3 GPIB Input Command Definition	-----	25
4.3.4 GPIB Input Command Type	-----	25
4.3.5 Examples	-----	31

Chapter 5

MANUAL CHANGES AND UPDATES

Chapter 1 GENERAL INFORMATION

1.1 Introduction

SG-1501B is a high accuracy micro-processor controlled RF Signal generator covering frequency range of 100kHz ~ 150MHz.

In addition to an excellent AM/FM modulation capability, the output level can vary from -20dB μ to 126dB μ in 0.1dB step.

This signal generator is designed specifically to test AM/FM radio, CB, and cordless phones under product development and production environment.

1.1.1 Carrier Frequency

The operating frequency range of SG-1501B is 100kHz to 150MHz with PLL accuracy.

The 7 digit LED displays the frequency.

The desired carrier frequency is entered directly by key pad or rotary knob. The frequency can also be stepped.

Besides, the delta F capability is very convenient for setting frequency offset from a reference frequency.

1.1.2 RF Output

Level can vary from -20dB μ to 126dB μ in 10dB, 1dB and 0.1dB steps using key pad or rotary knob.

Also an output level value can be entered directly from key pad or stepped in desired increment or decrement using step keys.

Independent A, B, C, and D level memory keys can store 4 most often used levels.

1.1.3 Modulation

AM and FM can be generated either by internal 400Hz/1kHz oscillator or by external modulation signals.

Using 'SHIFT' key, single key stroke can set AM 30%, FM 3.5kHz / 22.5kHz / 75kHz, and stereo 100% / 30%.

1.1.4 Memory Function (Store/Recall)

Up to 100 different combinations of frequency (F), output level (L), and modulation (M) can be stored and recalled. By defining BEGIN and END addresses, the stored settings in between can be sequenced for repeated measurements. There are also 4 additional memories to store the output levels which can be recalled by single key stroke. Back-up battery keeps the data stored in the internal RAM memory for unto a year without requiring AC power.

1.1.5 Remote Control

Using the remote control device which is purchased separately, instrument setting can be done at a convenient operator position.

MODEL SG-1501B

1.1.6 Dummy Antenna

Optional dummy antenna is a convenient way to adjust for car radio receivers.

1.1.7 GPIB

Optional IEEE-488 bus and a computer allows programmable control of the instrument.

1.2 Specification

1.2.1 Carrier Frequency

- Range : 100kHz ~ 150MHz
- Resolution : 100Hz
- Accuracy : $\pm 5 \times 10^{-6}$ (5ppm)

1.2.2 RF Output

- Range : -20dB μ ~ 126dB μ , open circuit
(-133 ~ +13dBm into 50 Ω termination)
- Resolution : 0.1dB
- Attenuator accuracy : ± 1.5 dB (@ 100dB μ to 126dB μ)
 ± 1.0 dB (@ 20dB μ to 100dB μ)
 ± 2.0 dB (@ -20dB μ to 20 dB μ)
- Source impedance : 50 Ω , VSWR < 1.2
- Frequency Flatness : ± 1 dB (@ 100dB μ)
- Harmonics : less than -30dBc
- Non-harmonics : less than -40dBc
- Residual modulation (S/N)
 - : FM component > 70dB
 - @Referenced to 75kHz Deviation, AF=1 kHz
 - CF= 10.7, 76 ~ 150MHz
 - : AM component > 50dB
 - @Referenced to 30% AM, AF=1 kHz
 - except at CF= 80 MHz / N, where N =3,4,5...

1.2.3 Modulation

- Type : FM, AM
- Int. mod. frequencies : 400Hz and 1kHz, $\pm 2\%$
- Ext. mod. input impedance : 10K Ω unbalanced $\pm 10\%$
- Ext. mod. input voltage : 3Vpp $\pm 2\%$
- Ext. H/L LED indicator : When LED is off,
3Vpp $\pm 3\%$ (for AF \leq 20kHz)
3Vpp $\pm 5\%$ (for 20kHz < AF \leq 100kHz)

MODEL SG-1501B

- FM

Max. deviation	: 100kHz (@ CF \geq 1MHz) CF \times 10% (@ CF < 1MHz)
Resolution	: 0.1 kHz
Accuracy	: \pm 10% of max. dev. (@CF>1MHz, AF=1KHz)
Distortion	: < 0.06% (@ CF : 10.7MHz, 76 ~ 110MHz) < 0.11% (@ CF : other range) with Dev=75kHz, AF=1kH, Demod.BW = 50Hz to 15kHz De-emp.= 50 μ sec

- FM STEREO

Separation	: > 50dB (@ AF= 400Hz to 1kHz) > 35dB (@ AF= 100Hz to 10kHz) > 30dB (@ AF= 50Hz to 15kHz) @ CF= 10.7, 76 ~ 110MHz, EXT. Stereo Main 90%, Pilot OFF
Pilot	: 19kHz \pm 2Hz
Distortion	: Less than 0.07% for modulation @ CF= 10.7, 76 ~ 110MHz AF= INT 1kHz Stereo Main 90%, Pilot OFF
External modulation	
Frequency flatness	: 50Hz ~ 15kHz (\pm 1dB) @ CF = 10.7, 76 ~ 110MHz Stereo 90% main, pilot OFF

- AM

Range	: 0 to 60%
Resolution	: 0.1%
Accuracy	: \pm (indicated value \times 5%), 100kHz ~ 110MHz \pm (indicated value \times 10%), 110MHz~150MHz @ AF = INT 1kHz
Distortion(\leq -13dBm)	: < 0.65% (@ CF : 400kHz to 30MHz except at CF = 80MHz/N, N=3,4,5...) < 1.5% (@ CF : other range) with AM=30%, AF=1kHz, Demod.BW =50Hz ~ 15kHz

MODEL SG-1501B

Distortion(\geq -13dBm) : < 1.5 % (200 kHz \square 30 MHz)
except at CF = 80MHz/N N= 3, 4, 5
< 2 % elsewhere
AM=30%, AF=1kHz, Demod. BW=50Hz to 15kHz

1.2.4 Others

- Preset Keys : Modulation ... AM (30%)
FM (3.5kHz, 22.5kHz, 75kHz)
Stereo (30%, 100%)
Output 4 RF levels
- Memories : 100 points (non-volatile RAM)
- Power requirement : 115/230VAC (\pm 10%)
(50/60Hz, 42VA maximum)
- Dimension : 115(H) \times 430(W) \times 310(D)mm
- Weight : 8.5kg
- Standard accessories : Power Cable, BNC Cable, Operating Manual, Fuse
- Temperature : 10 $^{\circ}$ C \sim 35 $^{\circ}$ C specification
0 $^{\circ}$ C \sim 40 $^{\circ}$ C operation
- Others : Indoor use
Amplitude up to 2000 m
Pollution degree IP20

1.2.5 Options

- GPIB (Option 001) : SG-1501B can be controlled with the
IEEE - 488 Interface BUS with GPIB option installed.
- Pre-Emphasis (Option 002)
- RF output adaptor : This option is provided for special applications
and used with SG models.
JO-1102 (Dummy Antenna for Car Radio receiver)
- Remote controller : The SG - 1501B can be controlled
by remote controller(OP-302)

Chapter 2 INSTALLATION INSTRUCTIONS

2.1 Introduction

This chapter provides complete installation instruction for SG-1501B RF signal generator. The instruction includes the initial inspection, the precautions for AC line connection, and the equipment turn-on procedures.

2.2 Initial Inspection

Open the package, inspect for any mechanical damage to the product; e.g., instrument exterior, connectors, and so on.

2.3 Electrical Installation

The equipment operates on 50/60Hz, 115/230 VAC line voltages.

Fuse setting : 630mA (1ea) T type -- 115 VAC
 400mA (1ea) T type -- 230 VAC

2.4 Installation Check

Although every SG-1501B is checked carefully before each customer shipment, some chance still exists for the equipment damage during transportation.

Therefore, the operator should verify the received equipment whether it is functioning correctly. The following installation instruction provides the procedure.

2.4.1 Required Equipments

In order to test the operation of SG-1501B, one needs to verify the output frequency, modulation, and power level requiring spectrum analyzer, modulation analyzer, oscilloscope, and power meter.

2.4.2 Initial Turn – ON

When the power switch is pushed on, the front panel display will indicate the operation of the instrument.

2.4.3 Test Procedure

The following paragraphs describe the general operational test procedures for SG-1501B. Please verify with test equipments that have proper specification.

2.4.3.1 Frequency

- 1) Set Modulation=OFF, Power Level = -13dBm, Frequency = 50MHz.
- 2) Then measure the output frequency
- 3) and change the frequency to 150MHz and repeat.
- 4) Use the rotary knob to change the frequency to 70MHz and repeat the measurement.
- 5) Use the key pad to enter 50MHz and change the frequency to 40MHz using the rotary knob, while verifying for the correct frequencies.

MODEL SG-1501B

2.4.3.2 Output Level

- 1) Set Modulation=OFF, Frequency = 400kHz, and Level = 100dB μ .
- 2) Measure the output level using a power meter.
- 3) Then change the frequency to 50MHz and the level to 96dB μ
- 4) Verify the level. Set the frequency to 150MH and the level to 92dB μ and check the level.
- 5) Change the level to 84dB μ and do the same.

2.4.3.3 AM

- 1) Set Frequency = 50MHz and Level = -3dBm. Select INT AM, 1kH
- 2) Using modulation analyzer, verify AM at AM = 60%.
- 3) Change the output frequency to 100MHz and repeat.
- 4) Change the internal source frequency to 400Hz(INT 400 Hz) and verify the same.

2.4.3.4 FM

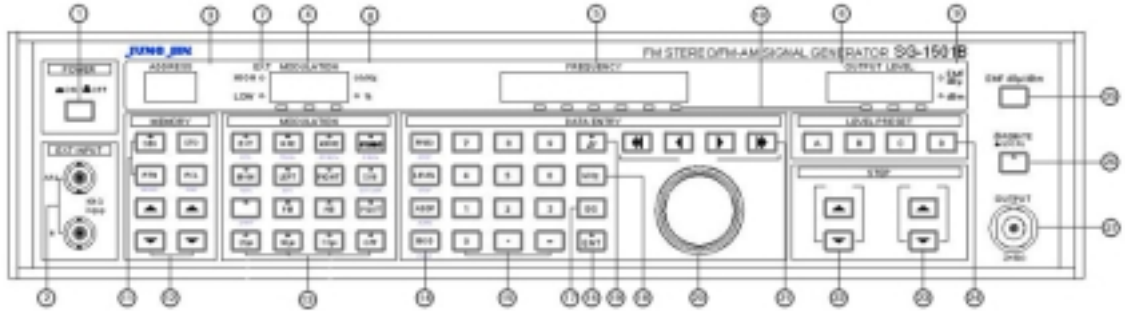
- 1) Set Level = 100dB μ , Frequency = 50MHz, INT FM (1 kHz).
- 2) Set FM deviation to 100kHz and verify the deviation value with modulation analyzer.
- 3) Change the output frequency to 150MHz and select internal 400Hz(INT 400 Hz) source.
- 4) Verify the deviation value.

2.4.3.5 EXTERNAL AM/FM

- 1) Using the front panel External Modulation connector,
- 2) Apply the external modulation source to test EXT AM and EXT FM.
- 3) Repeat (2.4.3.3) and (2.4.3.4).

Chapter 3 OPERATING INSTRUCTIONS

3.1 Front Panel Description



1. Power ON/OFF switch.

2. External Input Connector

- AF/L Connector : at FM, AM mode -- External modulation signal input
at STEREO mode -- This connector is used for LEFT signal input.
- R Connector : at STEREO mode -- This connector is used for Right signal input.

3. Address Display

Displays MEMORY address and GPIB address.

4. Modulation Display

Displays FM or AM modulation level.

5. Frequency Display

Displays present output frequency.

6. Level Display

Indicates the present output level.

7. EXT High/Low Indicator LED

Used to set external modulation signal level to 3Vpp.
When both LEDs are off, the input signal level is 3Vpp.

8. Unit Indicator LED (FM/AM)

FM : kHz (deviation)
AM, Stereo : % (depth).

MODEL SG-1501B

9. LEVEL UNIT LED

Displays the current unit of the output level.

10. Cursor LED

key moves the cursor to the desired digit location and its value can be adjusted by using Rotary knob.

11. Memory Setting

- Sequential Recall

Pressing this key turns on the key-top LED showing that the key is activated.

Only then, the data (Frequency-Level-Modulation) stored in the memory can be recalled.

When key-top LED is OFF, an address must be established before recalling the data store in that address.

- STO (Store)

Used to store current state (Frequency-Level-Modulation) into an address.

Set an address and the data (Frequency-Level-Modulation), then press the key followed by key.

- RTN (return)/BEGIN

Returns to BEGIN address during address rotation operation.

BEGIN address is entered by pressing and 'RTN(BEGIN)' keys in sequence after an address is established.

- RCL (Recall)/END

Data stored in the current address is recalled.

To enter END address for address rotation operation, press and 'RCL(END)' keys in sequence after an address is established.

12. Address Up/Down key

Increase or decrease the address by unit of 10 or 1.

13. Modulation Setting key

- EXT key : Turn ON/OFF external modulation input.

- 1kHz key : Select the internal 1kHz.

- 400Hz key : Select the internal 400Hz.

- Stereo Key : Turn ON/OFF Stereo mode during FM Stereo.

- Main Key : Activate MAIN modulation during FM Stereo.

- Left Key : Activate LEFT modulation during FM Stereo.

- Right Key : Activate RIGHT modulation during FM Stereo.

- SUB Key : Activate SUB modulation during FM Stereo.

- Shift key (2nd function Key) : let you do blue letters function.

- FM key : Turn on /off FM.

- AM key : Turn on /off AM.

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- Pilot ON/OFF : Turns ON/OFF the pilot tone during FM Stereo.
- Pre_Emphasis (25 usec) : Activate during External FM. -- Option 002
- Pre_Emphasis (50 usec) : Activate during External FM. -- Option 002
- Pre_Emphasis (75 usec) : Activate during External FM. -- Option 002
- Pre_Emphasis (off) : Don't activate Pre-Emphasis. -- Option 002

14. Setting Menu (frequency, Level, level ,Modulation)

- FREQ key
 - Allows direct entry of frequencies from the key pad.
 - When pressed, Frequency display becomes blank and 'ENT' LED is blinking.
 - Then enter the frequency value followed by 'ENT' key.
 - To cancel during the operation before 'ENT' key, depress 'FREQ' key again.

- LEVEL key
 - Allows direct entry of output level from the key pad.

- ADDR(ADRS)key
 - Allows direct entry of ADDRESS value from the key pad.
 - If a numeric value is entered from the key pad without first selecting a function, the instrument assumes it is the last digit of an address value.

- MOD key
 - Allows direct entry of Modulation level from the key pad.
 - When depressed, MOD DISP goes to blank and 'ENT'key LED starts Blinking.

15. Numeric Keypad

The numeric keypad consists of the digit keys (0 ~9) , (-), a decimal point

16. ENT key

Completes numeric entry sequence.
If 'ENT' key is not depressed for a period of time (15 LED blinking),
the entry sequence is cancelled.

17. BS (Back Space)key

Erase the last entered numeric value.

18. kHz key

Enters kHz unit during key pad entry of FREQ.

19. Δ F (Offset Frequency)

Toggles between FREQ display mode and Offset FREQ display mode.
When the key is depressed while FREQ display mode,
the display changes to OFFSET frequency display referenced to the present frequency.

MODEL SG-1501B

20. Rotary knob

Increment or decrement numeric value of MOD, FREQ, or LEVEL display at the current cursor position.

21. Cursor key

'<', '>' move the cursor one digit to left, right direction.

'<<', '>>' move the active function cursor between MOD, FREQ, and LEVEL display.

22. FREQ step key

Increment or decrement FREQ by a preset FREQ STEP value.

23. Level step key

Increment or decrement LEVEL by a preset LEVEL STEP value.

24. Level Preset (A,B,C,D) key

Frequently used output levels are stored in these keys and recalled by a single key stroke.

25. dBu EMF / dBm SW key and LED indicator

Toggles the output level units between dBu EMF and dBm.

dBu EMF : Open circuit voltage in dB referenced to 1uV RMS.

dBm : Power delivered to 50Ω load in dB referenced to 1mW.

26. Remote/Local Key

Press this key to return the signal generator to LOCAL (front panel) control from remote operation.

27. RF Output Connector

MODEL SG-1501B

3.2 Rear Panel Description

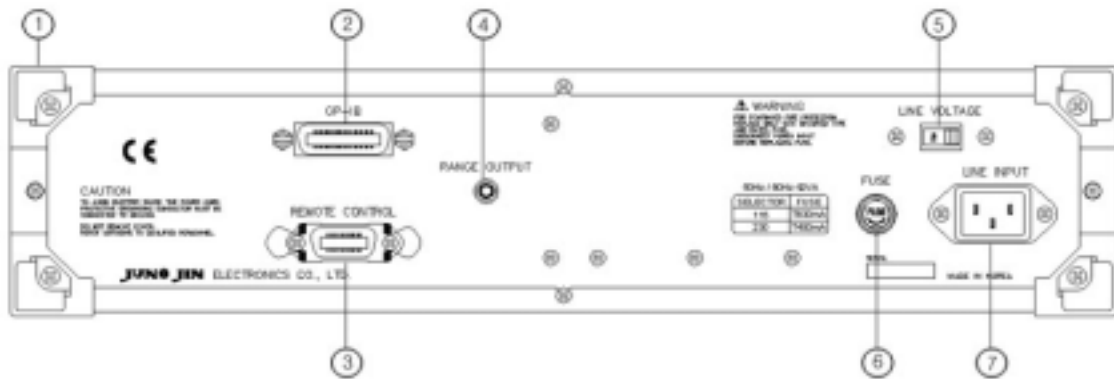


Fig 3.5 REAR PANEL

1. Cord Winder

2. GPIB Connector (OPTION)

3. Remote Control Connector

4. Range Output Jack

Outputs TTL compatible signal indicating whether the output frequency is greater than 35 MHz or not.
There are two versions.

Press ' STO', '3' ;

Then if 'Frequency Display ' indicates 35...1, then the range signal is +5V for (above 35 MHz).

35...0, indicates that the range output is 0V for (above 35 MHz).

5. Line Voltage Selector

☞ Refer to chapter 2. (electrical installation)

6. Fuse

7. AC Inlet

3.3 Operation

SG-1501B has 3 numeric entry modes

1) Normal mode

Increase or decrease the current data value (above cursor position).

2) Direct numeric entry,


After selecting menu , use numeric keys to enter the desired data followed by 'ENT' key.

Menu : **FREQ,LEVEL,ADDR,MOD**

Numeric Keys : **1,2,3,4,5,6,7,8,9,0,.(decimal point),- (minus)**

3) Memory Store/Recall mode.

After store the current instrument setting to a specific address and recall later.

Unique SEQUENTIAL RECALL mode available in this instrument can greatly simplify routine measurement. ( 3.3.5.5)

3.3.1 Frequency Setting

3.3.1.1 Normal Mode

[How to use]

- 1) Move the cursor ' Freq display ' position with '<<', '>>' keys
- 2) Move the cursor to the desired digit with '<', '>' keys.
- 3) Increase or decrease the value using Rotary knob.
- 4) Increase or decrease Freq Step (\uparrow , \downarrow) key

3.3.1.2 Direct Numeric Entry

[How to use]

- 1) Press 'FREQ' key.

Then, FREQ DISP goes blank and the LED of 'ENT' key starts blinking.

If no action is taken during 15 LED blinking periods,

the new data entry mode is canceled and the display goes back to original state.

- 2) Enter data with numeric keys.

The last entered number can be erased one at a time using 'BS'(Back Space) key for correction.

- 3) Complete the data entry with 'ENT' key. The default unit is MHz.

For data entry in kHz, use kHz key instead of 'ENT'key.



- Before completion of data entry mode with an 'ENT' key
- the process can be canceled at any time using 'FREQ' key.



- When data is entered from the key pad, the keys except numeric keys(including ., - keys), BS key, and ENT key are disabled.



- If an invalid FREQ value is entered, the FREQ returns to the original value (valid range : 100KHz ~ 150MHz)

Ex1) frequency setting 100.0000 MHz → 123.0000 MHz
Press 'FREQ', '1','2','3','ENT'

3.3.1.3 ΔF (Offset Frequency)

It is convenient to use ΔF (Offset Frequency) function if one wants to make measurement in terms of offset frequencies from a given reference frequency.

[How to use]

- 1) Establish the reference frequency.
- 2) Press the ΔF Key.
Then ΔF Key LED is turned on and the FREQ display changes to offset frequency mode.
But the actual frequency is not changed yet.
- 3) Either using direct numeric entry or normal mode, enter an offset frequency.
- 4) An offset frequency higher than the reference frequency is entered without sign while an offset frequency below the reference frequency is entered as a negative number using '-' sign.
The maximum offset frequency is $\pm 10\text{MHz}$.

3.3.1.4 Step Frequency

FREQ stepping function is very useful when the output frequency must be incremented or decremented in a preset step.

After FREQ step value is entered, FREQ can be stepped up or down using the Up/Down (\uparrow, \downarrow) keys.

- 1) Press 'SHIFT', 'FREQ' key, then the current FREQ STEP value is displayed.
Enter new data with numeric keys followed by 'ENT' key.
To cancel and return to old value, press 'FREQ' keys,
- 2) FREQ STEP value is stored in the battery backed internal memory, the last value reappears when AC power is turned off and on.

3.3.2 Level Setting

3.3.2.1 Normal Mode

[How to use]

- 1) Move the cursor ' Level display ' position with <<, >> keys
- 2) Move the cursor to the desired digit with <, > keys.
- 3) Increase or decrease the value using Rotary knob.
- 4) Increase or decrease Level Step (↑, ↓) key .

3.3.2.2 Direct Numeric Entry

[How to use]

- 1) Press 'LEV' key.
Then, Level DISP goes blank and the LED of 'ENT' key starts blinking.
If no action is taken during 4 LED blinking periods,
the new data entry mode is canceled and the display goes back to original state.
- 2) Enter data with numeric keys.
The last entered number can be erased one at a time using 'BS'(Back Space) key for correction.
- 3) Complete the data entry with 'ENT' key. It means dBm or dBuEMF.



- Before completion of data entry mode with an 'ENT' key,
- the process can be canceled at any time using 'LEV' key.



- When data is entered from the key pad, the keys except numeric keys(including ., - keys), BS key, and ENT key are disabled.



- If an invalid Level value is entered, the Level returns to the original value
(valid range : -20 dBuEMF ~ 126 dBuEMF (-133 dBm ~ +13 dBm)

Ex1) Level setting 100.0 dBu EMF → 99.9 dBu
Press 'LEVEL'. '9', '9'. '.', '9', 'ENT'

3.3.2.3 Step Level

Level stepping function is very useful when the output frequency must be incremented or decremented in a preset step.

After Level step value is entered, Level can be stepped up or down using the Level Step (↑, ↓) keys.

- 1) Press ' SHIFT ', 'LEVEL' key, then the current Level STEP value is displayed.
Enter new data with numeric keys followed by 'ENT' key.

MODEL SG-1501B

To cancel and return to old value, press 'LEV' keys,

2) Level STEP value is stored in the battery backed internal memory.

3.3.2.4 Preset key

Frequently used levels can be stored in 'A', 'B', 'C', 'D' keys and recalled by a single key stroke.

- 1) first set a desired level on DISP,
- 2) then press 'STO', 'A' (or 'A', 'B', 'C', 'D')keys.
- 3) Press 'A' (or 'A', 'B', 'C', 'D')keys to recall.

[Changing Units of Level Display]



Press dBu EMF /dBm key to toggle between dBu EMF and dBm

- dBu EMF (Open Circuit Voltage)
- dBm (power measured across 50 Ohm load in dB referenced to 1 mW)
- Formula

$$X [\text{dBu EMF}] = X[\text{dBm}] + 113\text{dB} (\dots\text{for } 50 \text{ Ohm source})$$

Example 1) -20 dBm → x dBu EMF

$$\begin{aligned} x[\text{dBu EMF}] &= -20 \text{ dBm} + 113 \text{ dB} \\ &= 93 \text{ dBu} \end{aligned}$$

Example 2) 0 dBu EMF → x dBm

$$\begin{aligned} x[\text{dBm}] &= 0 \text{ dBu EMF} - 113 \text{ dB} \\ &= -113\text{dBm} \end{aligned}$$

3.3.3 Modulation Setting

[How to use]

Modulation is set as follows

- 1) Set Modulation Type (FM, AM or FM STEREO)
- 2) Set Modulation Source (INT 1kHz, INT 400Hz, External Source)
- 3) Set Modulation Value
 - FM : 0 ~ 100 kHz
 - AM : 0 ~ 60 %
 - FM stereo : 0 ~ 100%

3.3.3.1 FM (Frequency Modulation)Setting

3.3.3.1.1 Normal Mode

- 1) Press 'FM' Key ; It is toggle function FM on/off
 - FM on : LED on
 - FM off : LED off
- 2) Press 'INT 1kHz' (or EXT , INT 400Hz.)
- 3) Move the cursor to Modulation Display using '<<','>>' keys
- 4) Enter data with Rotary knob and '<' , '>' keys.



- To Turn off modulation , Press 'FM' key again



- Press 'SHIFT' , 'Stereo' : FM 3.5 kHz
- Press 'SHIFT' , '400Hz' : FM 22.5 kHz
- Press 'SHIFT' , '1kHz' : FM 75 kHz

3.3.3.1.2 Direct Entry Mode

- 1) Press 'FM' Key ; It is toggle function FM on/off
 - FM on : LED on
 - FM off : LED off
- 2) Press 'INT 1kHz' (or EXT , INT 400Hz.)
- 3) Press 'MOD' key
- 4) Enter data with Numeric Key Pads.
- 5) Press 'ENT' key

3.3.3.2 AM (Amplitude Modulation)Setting

3.3.3.2.1 Normal Mode

- 1) Press 'AM' Key ; It is toggle function AM on/off
 - AM on : LED on
 - AM off : LED off
- 2) Press 'INT 1kHz' (or EXT , INT 400Hz.)
- 3) Move the cursor to Modulation Display using '<<','>>' keys
- 4) Enter data with Rotary knob and '<' , '>' keys.



- To Turn off modulation , Press 'AM' key again



- Press 'SHIFT' , 'EXT' : AM 30 %

3.3.3.2.2 Direct Entry Mode

- 1) Press 'AM' Key ; It is toggle function AM on/off
 - A. AM on : LED on
 - B. AM off : LED off
- 2) Press 'INT 1kHz' (or EXT , INT 400Hz.)
- 3) Press 'MOD' key
- 4) Enter data with Numeric Key Pads.
- 5) Press 'ENT' key

3.3.3.4 FM + AM Modulation Setting

- 1) FM (Internal 1kHz or 400 Hz) +AM (External)
 - A. Press 'FM' Key. (then FM Key LED on)
 - B. Press ' INT 1kHz (or INT 400Hz).
 - C. Press 'AM' key.(then AM key LED on).
 - D. Press 'EXT'(then EXT key LED on).
- 2) AM (Internal 1kHz or 400 Hz) +FM (External)
 - A. Press 'AM' Key. (then AM Key LED on)
 - B. Press ' INT 1kHz (or INT 400Hz).
 - C. Press 'FM' key.(then FM key LED on).
 - D. Press 'EXT'(then EXT key LED on).



- It is impossible
 - INT AM + INT FM
 - EXT AM + EXT FM

3.3.3.5 Setting FM STEREO Modulation

3.3.3.5.1 Normal Mode

- 1) Press 'Stereo Key ; It is toggle function Stereo on/off
 - Stereo on : LED on (also, FM on)
 - Stereo off : LED off
- 2) Press 'INT 1kHz' ('EXT 'or ' INT 400Hz').
- 3) Select ' Stereo Mode'
- 4) Press 'MAIN' key ('Left', 'RIGHT', or 'SUB')
- 5) Move the cursor to Modulation Display using '<<','>>'' keys
- 6) Enter data with Rotary knob and '<' , '>' keys.



- In STEREO mode, 100% modulation corresponds to 75kHz peak deviation.

- **Main Mode**

This Mode is used to test the main (or (L+R)) channel of a stereo receiver.

When this mode is selected the same audio tone is applied to both L and R channels.

; therefore, the stereo signal has only (L+R) component with pilot tone but no (L-R), or sub, channel component.

In this case, main channel modulation component is 90% and the 19kHz pilot tone Component is 10%.

- **Left Mode**

L signal only modulation.

This generates 45% main channel and 45% sub-channel component.

Pilot tone takes up 10%.

When this signal is received by a perfect STEREO receiver, demodulated signal will appear only on left channel speaker.

- **Right Mode**

R signal only modulation.

The rest is the same as Left Mode case.

- **Sub Mode**

This mode is used to test the sub (or (L-R)) channel of a stereo receiver.

When this mode is selected, the same magnitude but of opposite polarity audio tone is applied to L and R channel input.

Thereby, there is only Sub_channel or (L-R) channel component and pilot component on the STEREO signal.

No main channel component.

The test of FM Stereo receiver is usually done by the above 4 modes.

STEREO receiver L or R mode is used to test STEREO separation,

while L+R and L-R modes are used for other STEREO tests.

3.3.3.5.2 Direct Entry Mode

1) Press 'STEREO' Key ; It is toggle function AM on/off

- Stereo on : LED on (also, FM on)
- Stereo off : LED off
-

2) Press 'INT 1kHz' (or EXT , INT 400Hz.)

3) Press 'MOD' key

4) Enter data with Numeric Key Pads.

5) Press 'ENT' key

MODEL SG-1501B



- Press 'SHIFT', 'MAIN' : Stereo 100 %
- Press 'SHIFT', 'LEFT' : Stereo 30 %



- Modulation allowed
 - : Main is 0 ~ 90%, pilot is 0~15% with total up to 100%.
 - : Data resolution is 0.1%.

3.3.3.6 Pilot Level Setting

- 1) Press 'PILOT' Key ; It is toggle function Pilot on/off
 - Pilot on : LED on
 - Pilot off : LED off
- 2) Press 'SHIFT', 'MOD'
- 3) Enter data with Numeric Key Pads (Pilot level can be set from 0 to 15%).
- 4) Press 'ENT' key

3.3.3.7 About Standard FM STEREO Modulation

1) FM STEREO Broadcasting Signal.

FM broadcasting signal is based on suppressed carrier AM and FM system.

This system was approved by FCC(USA), EBU (Europe), MPT Radio Council(7Japan).

SCA band shown in Fig 3.6, as dashed line, is include under FCC standard but not in EBU standard.

EBU calls this system as Pilot tone system.

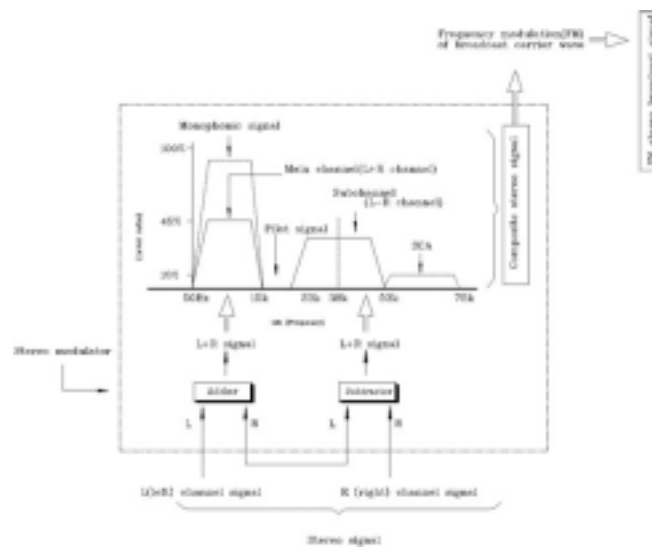


Fig 3.6 Standard FM stereo modulation

MODEL SG-1501B

2) FM STEREO Standard Signal

In FM broadcasting system, 100% modulation (Maximum system deviation) means 75kHz deviation.

For receiver test 100% and 30%(22.5KHz deviation) is most frequently used.

These values can be entered quickly using ‘SHIFT’ keys.

The necessary test conditions for the most commonly used FM receiver test standards, IHF and JIS is provided in Table 3.1.

IHF FM broad- cast receiver test methods	Mono	modulation	100%				
		deviation	75klz				
	stereo		L=R mode including the point	modulation by point signal			
		modulation	100%	9%			
		deviation	75klz	6.75klz			
JIS FM broad- cast receiver test methods	Mono	modulation	30%	The maximum system deviation is 75klz			
		deviation	22.5%				
	Stereo (The maximum system deviation is 67.5klz. equal to 90% of 75klz.)						
	Divide		Modulation by main channel	Modulation by sub channel	Modulation by point signal	Total	
	R=L	Modulation	27%	0	10%	37%	
		Deviation	20.25klz	0	7.5klz	27.75klz	
	L or R	Modulation	13.5%	13.5%	10%	37%	
		Deviation	10,125klz	10.125klz	7.5klz	27.75klz	
	R=L	Modulation	0	27%	10%	37%	
		Deviation	0	20.25klz	7.5klz	27.75klz	

Table 3.1 Standard modulation of SG-1501B

3.3.4 Address Setting

3.3.4.1 Normal Mode

Increment or decrement the current address in steps of 1 or 10 using ↑, ↓ keys.



- When address value is increased or decreased by 1, the address may jump to some other address. This is not due system problem but due to ‘ Address Rotation Function ’ of the instrument. (Refer to 3.3.4.3)
- When new address is entered, the instrument setting may change due to the stored data; this is because the instrument is in ‘ Sequential Recall Mode ’. (Refer to 3.3.5.5)

3.3.4.2 Direct Numeric Entry Mode

1) Press ‘ADDR’ Key.

ADDRESS DISPLAY goes blank and ‘ENT’ Key LED starts blinking.

ADDRESS returns to its original state if no further input is entered during 15 LED blinks.

2) Enter data with numeric keys.

Correct with ‘BS’ key if necessary.

3) Complete with ‘ENT’ Key.

ADDRESS DISPLAY blinks once indicating the value is stored in the memory.

In case the instrument is in ‘Sequential Recall Mode’,

the stored data at the address will appear immediately.(refer to 3.3.5 5)

4) Single digit addresses (0 to 9) can be entered directly from numeric keys if a numeric value is entered without first selecting ADDR key.



- To Cancel the Procedure , Press ‘ADDR’ key before ‘ENT’ key

3.3.4.3 Address Rotation Function

In case a certain sequence of the instrument settings must be repeated,

‘Address rotation function’ is helpful.

In this mode, a sequence of addresses with data is rotated

upon completing ‘END Address’, the control returns to ‘BEGIN Address’ automatically.

1) To Store ‘Begin Address ’ → Press ‘SHIFT’, ‘RTN’

2) To Store ‘ End Address ’ → Press ‘SHIFT’, ‘RCL’

Example 1) Instrument setting data is stored in address 1 to 15 and to be repeated from 1 to 15

- 1) Set desired data (Frequency, Level, Modulation ...) into memory address 1 to 15.
- 2) Set ‘Address’ to 1 (Press ‘1’ key)
- 3) Set ‘ Begin Address ’ = 1 (Press ‘ SHIFT’, ‘RTN’).

- 4) Set 'Address' to 15 (Press 'ADDR', '1', '5', 'ENT' key)
- 5) Set ' End Address ' = 15 (Press ' SHIFT', 'RCL').



- IF it is desired to return to 'Begin address' before finishing 'End address' while performing 'Address Rotation function ', Press 'RTN' key.



- To go outside of 'Begin Address' and 'End address', use direct numeric entry mode to set new memory address.



- Address Rotation Function can be cancelled by setting Address
 - Begin Address = 00
 - End Address =99
- Then, all 100 addresses can be accessed and sequenced.

3.3.5 Use of Memory Function (Store / Recall Mode)

While performing a complicated test where instrument setting needs be changed frequently, 100 instrument settings of Freq(F)+Level(L)+Mod(M) combinations can be stored at 100 internal memory addresses and 4 frequently used levels at A, B, C, D keys.

3.3.5.1 Storing Address

- 1) Set an 'Address' to store data.
- 2) Set ' Frequency', ' Level', 'Modulation' data.
- 3) Press ' STO', 'ENT' key
- 4) Front panel display will blink once indicating acceptance.



- In case 'Sequential Recall Mode 'is on, data may change whenever a new address is entered and this may be annoying.
- Then, just turn off 'Sequential Recall Mode ' by pressing 'SEQ' key (Refer to 3.3.5.5)

3.3.5.2 Recalling Address

- 1) Set an 'Address' to recall .
- 2) Press ' RCL' key



- Be sure that ' Sequential Recall Mode' is turned off.

MODEL SG-1501B

3.3.5.3 Storing Preset Levels at A-B-C-D keys

- 1) Enter a desired level.
- 2) Press 'STO' Key. Now it is ready to store.
- 3) Press 'A', (or 'B','C','D') key.
'Level Display' blinks once indicating the operation is completed.

3.3.5.4 Recalling Preset Levels from A-B-C-D keys

- Simply 'A', (or 'B','C','D') key.
The preset level output to the RF output connector.

3.3.5.5 Sequential Recall

- 1) 'Sequential Recall Mode' is active when the 'SEQ' key LED is on.
- 2) By increasing and decreasing ADDRESS using ↑, ↓ keys,
the desired memory address can be accessed and the data stored at the address is output.
Direct entry of the address value with numeric key will do the same.

3.3.6 Special Maintenance Functions using 'STO' key

3.3.6.1 'STO', '0' (DISPLAY test)

- 1) Press 'STO', '0' key turns on all the display.
The purpose of this function is to test DISPLAY.
First check in all the display segments are on.
- 2) Press any key of 'Front Panel' keys
Then turn off the segments one by one.

3.3.6.2 'STO', '1', 'STO' (Default settings)

- 1) Press 2 'STO', '1', 'STO' key
Performing this keying sequence sets the default values and displays "InItIAL" on FREQ window.
The factory default values are shown in Table 3-1.
This function is intended for factory use only.



- Be careful since all the memory contents will be lost.

Table 3-1 DEFAULT SETTING

MOD	: OFF
FREQ	: 100MHz
LEVEL	: 126dBu
ADDRESS	: 00
FREQ STEP	: 10MHz
LEVEL STEP	: 10dB
CURSOR POSITION	: FREQ 1kHz

MODEL SG-1501B

GPIB ADDRESS	: 02
BEGIN ADDRESS	: 00
END ADDRESS	: 99
LEVEL A	: 100dBu
LEVEL B	: 100dBu
LEVEL C	: 100dBu
LEVEL D	: 100dBu
SEQ	: ON

3.3.6.3 'STO', '2' (Program Version Number)

FREQUENCY DISPLAY : "VER-1.0" (The Latest version is displayed)

3.3.6.4 'STO', '3' (Range Logic Toggle)

- 1) Press ' STO', '3' key, then change ' Range output' for Dummy Control at Rear Panel.
- 2) then, displays the current logic state on ' Frequency Display ' window.

- 35...1 → the ' Range logic output' is +5V for (≥ 35 MHz).
- 35...1 → the ' Range logic output' is +0V for (< 35 MHz).

- 35...0 → the ' Range logic output' is +0V for (≥ 35 MHz).
- 35...0 → the ' Range logic output' is +5V for (< 35 MHz).

- 3) This Function is toggle function,
So, when press above keys then the 'Range Output ' is reversed

3.3.6.5 'STO', '5' (FM Calibration Mode)

- 1) This function is to Enter 'FM calibration Mode'.
- 2) Press 'STO', '5', then , 'JPr oPn' appears on display window.

Caution

- A. It means Protect to user (so, Please user do not this function)

Chapter 4

GPIB

4.1 INTRODUCTION

General Purpose Interface Bus (GPIB) is another important option in SG-1501B for test automation. SG-1501B GPIB is fully compatible with IEEE 488-1978 standard and the following set of commands are available.

SHO	Source handshake disabled
AH1	Complete acceptor handshake capability
TO	Talker disabled
TEO	Extended talker mode disabled
L2	Basic listener
LEO	Extended listener mode disabled
RL1	Complete Remote/Local capability
PPO	Parallel poll capability disabled
DC2	Complete Device clear capability
DTO	Device trigger disabled
CO	Controller capability disabled
SRO	Service request disabled

All of the instrument functions except Power ON/OFF can be accessed through GPIB. The GPIB Command format in SG-1501B uses small set of unique commands which are flexible for general purpose programming from GPIB controller (Computer).

4.2 INSTALLATION INSTRUCTIONS

The default address of SG-1501B GPIB (My listen Address : MLA) set at the factory is "02", but it can easily changed from the front panel. GPIB Controller is made up of a computer with GPIB I/O interface hardware and an operating system which is compatible with IEEE-488 standard. The GPIB controller sends ASCII command strings on GPIB to control GPIB instrument on GPIB bus.

For Example,
a simple carrier frequency command "FR 100MZ" can be sent to the GPIB Bus by the controller. If the installation is done correctly, the frequency display will change to 100MHz.

4.3 OPERATING INSTRUCTIONS

4.3.1 Local / Remote Mode Selection

When Power is turned ON, SG-1501B is in LOCAL mode and front panel is active.

MODEL SG-1501B

If a valid GPIB command is sent to GPIB bus, the instrument enters Remote mode.

During Remote mode, only LOCAL key is active on the front panel.

Unless Local Lockout bus command is sent previously, pressing Local key returns the full control to the front panel.

To return to LOCAL mode from Local Lockout condition, a GPIB command, RTL (Return to Local), is sent from the controller.

Otherwise, the instrument could be hard reset turning Power SW off and on.

4.3.2 Address Setting

MLA (my listen address), the GPIB address of SG-1501B, can be set as follows.

- 1) Press 'SHIFT', 'ADDR' keys
- 2) Then Default GPIB address display (= 02)
- 3) Enter new GPIB address data with Numeric Key (Press '0', '3')
- 4) Press 'ENT' key , then Complete GPIB address set is 03

4.3.3 GPIB Input Command Definition

GPIB input commands are ASCII strings used by the GPIB controller for programming GPIB.

When the commands are executed programmatically by the controller,

SG-1501B performs special functions requested by the controller.

4.3.4 GPIB Input Command Types

There are 3 types of GPIB input commands; Parameter, Enumerated, and Direct commands.

These are described in the following sections.

4.3.4.1 Parameter Commands

Parameter commands allow the operational parameter setting of SG-1501B

(e.g., Frequency, Levels, etc.)

Parameter command format:

<header> <numeric argument> <unit> <terminator>

MODEL SG-1501B

A . Header of the parameter command is described in Table 4-1.

Table 4-1. Headers for Parameter Command

HEADER	DESCRIPTION
PI	Pilot
MS	Stereo Modulation
FR	Output Frequency
FS	Frequency Step Interval
LE	Output Level
AM	Internal Amplitude Modulation
FM	Internal Frequency Modulation
ST	Storage of an Instrument Setting
RC	Recall of an Instrument Setting
LS	Level step

B. Numeric argument is made up of maximum of 7 digit numbers including decimal point (.) plus negative sign(-) if necessary.

Table 4-2. Numeric Keys for Parameter Commands Arguments

Numeric data	DESCRIPTION
0 ~ 9	Numbers
.	Decimal Point
-	Minus Sign

Table 4-3. Units for Parameter Command

UNITS	DESCRIPTION
PC	Stereo Modulator, Amplitude Modulation
KZ	Output Frequency
MZ	Output Frequency
DM	Output Level
DU	Output Level
DB	Level step

C. The argument for ST and RC commands is limited to a number between 0 and 99.
It requires no unit.

D. The last input for a parameter command format is made of EOS terminator,

- LF
- CR
- CR+LF
- EOI

E. Each completed command is separated by semicolon (;).

4.3.4.2 Enumerated Commands

These commands are used to change the system state.

Their general format is as follows:

<header> <alphabetic or ASCII symbol argument> <terminator>

A. The arguments related to the enumerated commands are listed in Table 4-4.

B. The last words in a enumerated command is EOS terminator.

- LF
- CR
- CR+LF
- EOI

Table 4-4. Enumerated Command listings

HEADER	ARGUMENT	DESCRIPTION
AM	ON	AM ON
AM	OFF	AM OFF
FM	ON	FM ON
FM	OFF	FM OFF
PI	ON	Pilot ON
PI	OFF	Pilot OFF
MS	ON	Stereo Modulation ON
MS	OFF	Stereo Modulation OFF

4.3.4.3 Direct Commands

Direct Command is another form of system command requiring no argument.

The commands are listed in Table 4-5.

<header> <termination>

Table 4-5. Direct Command Headers

HEADER	DESCRIPTION
M0	Modulation OFF
M1	Stereo Modulation Main
M2	Stereo Modulation Left
M3	Stereo Modulation Right
M4	Stereo Modulation Sub
M5	EXT L&R
FD	Frequency Step Down
FU	Frequency Step Up
LD	Level Step Down
LU	Level Step Up
DM	dBuEMF to dBm Conversion
DU	dBm to dBuEMF Conversion
MR1	Internal Modulation 400Hz
MR2	Internal Modulation 1kHz
MR3	External Modulation

MODEL SG-1501B

Table 4-5. Commands of List

FUNCTION	DATA	UNIT	COMMENTS
AM	0□9,.	PC	Amplitude Modulation
AM	OFF		AM OFF
AM	ON		AM ON
DM			to dBm
DU			to dBμ
FM	OFF		
FM	ON		
FD			Frequency Step Down
FM	0□9,.	KZ	Frequency Modulation
FR	0□9,.	KZ,MZ	Frequency (Carrier)
FS	0□9,.	KZ,MZ	Frequency Step
FU			Frequency Step up
LD			Level Step Down
LE	0□9,.	DU,DM	Level (Carrier)
LS	0□9,.	DB	Level step
LU			Level step up
MR1			Internal Modulation 400Hz
MR2			Internal Modulation 1kHz
MR3			External Modulation
M0			Modulation OFF
M1			Stereo Modulation Main
M2			Stereo Modulation Left
M3			Stereo Modulation Right
M4			Stereo Modulation Sub
M5			Stereo Modulation L&R
MS	0□9,.	PC	Stereo Modulation
MS	OFF		Stereo Modulation OFF
MS	ON		Stereo Modulation ON
PI	0□9	PC	Pilot
PI	OFF		Pilot OFF
PI	ON	PC	Pilot ON
RC	0□9		Recall
ST	0□9		Store

MODEL SG-1501B

4.3.5 Examples

4.3.5.1 Programming ADDRESS Function

Examples 1) Recall stored data from an address between 00□99. (Recall = 10)

"RC 10"

Examples 2) Store current front panel setting to an address between 00□99. (Store = 10)

"ST 10"

4.3.5.2 Programming MODULATION Function

Examples 1) Set AM depth to 60%

"AM 60 PC"

Examples 2) Set FM deviation to 90kHz

"FM 90 KZ"

Examples 3) Select INT Modulation or External Modulation.

"MR1" ; INT 400Hz ON

"MR2" ; INT 1kHz ON

"MR3" ; EXT ON

Examples 4) All Modulation OFF.

"M0" ; MODULATION OFF

4.3.5.3 Programming FREQUENCY Function

Examples 1) Carrier Frequency to 100.123MHz

"FR 100.123 MZ"

Examples 2) Carrier Frequency to 123.4567kHz

"FR 123.4567 KZ"

Examples 3) Set Frequency step value to 1 MHz

"FS 1 MZ"

Examples 4) Up or Down the Carrier Frequency using in freq steps.

"FU" ; Increment one frequency step

"FD" ; Decrement one frequency step

MODEL SG-1501B

Examples 5) Starting at carrier frequency 50MHz, increment the frequency twice and decrement once in 1kHz step.

```
"FR 50 MZ;FS 1 KZ;FU;FU;FD"
```

4.3.5.4 Programming LEVEL Function

Examples 1) Set output level to -13dBm

```
"LE -13 DM"
```

Examples 2) Set output level to 100dBuV

```
"LE 100 DU"
```

Examples 3) Convert units from dBm to dB

```
"DM" ; dB to dBm
```

```
"DU" ; dBm to dB
```

Examples 4) Set step value to 1dB

```
"LS 1 DB"
```

Examples 5) Up and down level steps

```
"LU" ; increase one level step
```

```
"LD" ; decrease one level step
```

Examples 6) Set level to -13dBm, convert units to dBu, set level step value to 2dB, and decrease level by one step.

```
"LE -13 DM;DU;LS 2 DB;LD"
```