OPERATION MANUAL

FM/AM SIGNAL GENERATOR

KSG4500A

Second Edition

KIKUSUI ELECTRONICS CORPORATION

(KIKUSUI PART NO. Z1-000-032)

M-94071

Power Requirements of this Product

Power requirements of this product have been changed and the relevant sections of the Operation Manual should be revised accordingly.
(Revision should be applied to items indicated by a check mark ☑.)

☐ Input voltage

The input voltage of this product is _____ VAC,
and the voltage range is _____ to _____ VAC. Use the product within this range only.

☐ Input fuse

The rating of this product's input fuse is _____A, _____VAC, and _____.

WARNING

- To avoid electrical shock, always disconnect the AC power cable or turn off the switch on the switchboard before attempting to check or replace the fuse.
- Use a fuse element having a shape, rating, and characteristics suitable for this product. The use of a fuse with a different rating or one that short circuits the fuse holder may result in fire, electric shock, or irreparable damage.

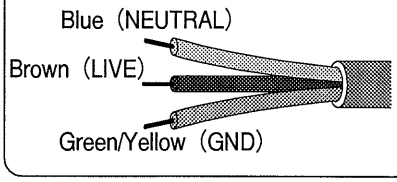
☐ AC power cable

The product is porvided with AC power cables described below. If the cable has no power plug, attach a power plug or crimp-style terminals to the cable in accordance with the wire colors specified in the drawing.

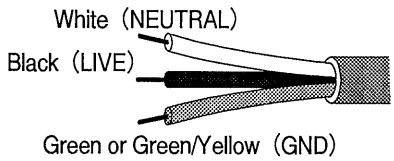
WARNING

- The attachment of a power plug or crimp-style terminals must be carried out by qualified personnel.

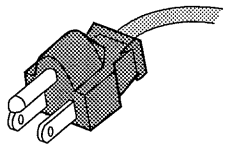
☐ Without a power plug



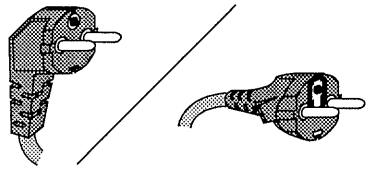
☐ Without a power plug



☐ Plugs for USA



☐ Plugs for Europe



☐ Provided by Kikusui agents

Kikusui agents can provide you with suitable AC power cable.
For further information, contact your Kikusui agent.

☐ Another Cable _____

 Kikusui Part No. Z9-000-027 IB001681

KIKUSUI

CONTENTS

1. INTRODUCTION

1.1 General Description

The KSG4500A is an FM/AM standard signal generator of synthesizer method that uses a reference crystal oscillator for Phase Lock Loop (PLL).

The Signal Generator covers the frequency of 100 kHz to 1040 MHz, and the frequency can be set with the resolution of 10 Hz. The instrument is useful in measuring the characteristics of the audio/visual signals of UHF/VHF TVs and those of various receivers of FM and AM bands.

For the frequency range of 100 kHz to 127.5 MHz, the output level at open circuit ranges from -20.0 dBμ to 132.0 dBμ (0.1 μV to 4 V rms), and for the remaining frequency range, the output level ranges from -20.0 dBμ to 126.0 dBμ. The resolution of the output level is 0.1 dB. As to the unit of the output signal level, EMF dBμ at open circuit, dBμ at loaded, or dBm can be selected by a unit key. Further, the loss caused by an additional item, such as a dummy antenna or transmission line, can be offset.

Three modulation modes, namely, FM, AM, and FM-AM modes, are available, and the modulation can be done with the signal sources of external DC · FM and VIDEO. The FM peak frequency deviation is 500 kHz (the guaranteed deviation is 400 kHz), and the maximum AM depth is 99.9% (the guaranteed depth is 80%). Both internal and external modulation is possible.

Since the KSG4500A gives a very low FM distortion rate of 0.02% or less (for 1 kHz modulation frequency, 75 kHz deviation, and 75 to 110 MHz RF), it is suitable for the adjustment of FM tuners and it can be used for the development and production of audio/video circuits of UHF/VHF sets.

Also, the frequency modulation by external DC coupling is possible.

The AM external modulation range is from 50 Hz to 10 kHz with very little incidental FM; so the AM suppression ratio of an FM tuner can be measured accurately.

The VIDEO modulation is a wide-band amplitude modulation with both side band, and the signals equivalent to TV broadcast radiowaves can be obtained by the input of video signal to VIDEO input terminal and that of audio IF signal to SIF input terminal. The obtained signals can be used for the adjustment and inspection of TV sets and VTRs. The VIDEO modulation rate can be modified around the set value.

The recall method (100 memory points) and numeric data entry method are used for operation, and increment key, rotary knob, and △ key increase operationality.

Simple pressing of numeric data entry keys can store any frequencies, output levels, and modulation rates in memory, the rotary knob makes the operator feel no difference from the same type of dial on conventional signal generator, and the △ display for frequency and output level is very useful for difference measurement.

A remote control function is enabled by supplying the codes that correspond to the panel key and rotary knob operations through the 14-pin connector on rear panel. Also, the extended functions, such as memory copy and memory linkage functions, can be used between the instruments of the same type. Since the standard model of KSG4500A supports GP-IB control, it reduces labor on production lines.

1.2 Features

(1) For the frequency range of 100 kHz to 127.5 MHz, the output level can be selected from a wide range of -20.0 dBμ to 132.0 dBμ (open circuit). The output level can be specified with a 4-digit number by the step of 0.1 dB. Also, a high-frequency output on/off function is provided.

(2) The frequency can be specified by a 9-digit number, and the value of a desired digit (designated by cursor) can be changed continuously by a rotary knob. Also, the KSG4500A has the △FREQ (frequency difference) display function and the +/- function to check selectivity.

(3) The carrier frequency, output level, and modulation rate can be incremented/decremented by the unit of a specified value.

(4) Modulation preset keys are provided for AM 30%, FM 3.5 kHz, 22.5 kHz, and 75 kHz to facilitate operation. ON/OFF of modulation can be specified for AM and FM independently of each other.
In the video modulation mode, a wide-band amplitude modulation with both side bands can be done. The video modulation rate can be modified around the set value.
In the external DC·FM mode, the DC-coupled frequency modulation can be done.

(5) The KSG4500A gives small modulation distortion, high S/N ratio, and good stereo characteristic.

(6) All the data displayed on panel can be memorized; the data can be stored into and recalled from the memory of 100 points. The memory can be used either as a continuous space of 100 points or as a space divided into 10 blocks each having 10 points.

(7) The KSG4500A can be operated easily because all the operations area controlled by a microprocessor and specified values are displayed in digital mode.

(8) Input data can be corrected immediately by the use of back space (⇐) key.

(9) Data can be copied from the memory of one KSG4500A to that of another KSG4500A by simply pressing the DUMP key.

(10) All the panel operations, including memory store/recall, setting of frequency, output level, and modulation rate, and rotary knob operation, can be controlled in remote mode.

(11) The standard model of KSG4500A has a GP-IB interface for controlling frequency, output level, modulation rate, and memory.

(12) Since the KSG4500As can be connected to one another in chain mode by the reference frequency input and output connectors (10 MHz) provided on them, the relative error of the measured frequency can be reduced to zero.

2. SPECIFICATIONS

- Frequency (RF)

Range:	100 kHz to 1040 MHz
Resolution:	10 Hz
Accuracy:	Same as reference oscillator
Display:	9-digit readout, △FREQ display, and ± frequency inversion function

- Reference oscillator

Frequency:	50 MHz
Stability:	Temperature ±5 × 10^{-6} Aging rate ±2 × 10^{-6}/week For the high-stability crystal reference oscillator, see the section of "Special order".

Internal reference signal output

Output frequency:	10 MHz
Output level:	≧ 0.15 Vrms 50Ω loaded

External reference signal input

Input frequency:	10 MHz ±200 Hz (±0.002%)
Input level:	≧ 0.15 Vrms 50Ω

- Output level

Range: Maximum output

(Frequency = 100 kHz to 127.5 MHz)

Unit	For FM	For AM
EMF dBμ	132 dBμ	126 dBμ
dBμ	126 dBμ	120 dBμ
dBm	+19 dBm	+13 dBm

(Frequency = 127.5 MHz to 1040 MHz)

Unit	For FM	For AM
EMF dBμ	126 dBμ	120 dBμ
dBμ	120 dBμ	114 dBμ
dBm	+13 dBm	+7 dBm

Minimum output (Guaranteed ranges)

Unit	≦127.5 MHz	≧127.5 MHz
EMF dBμ	-20 dBμ	-10 dBμ
dBμ	-26 dBμ	-16 dBμ
dBm	-133 dBm	-123 dBm

Unit:	Three types of units, namely, EMF dBμ for open-circuit at 0dB = 1μV, dBμ for loaded-terminal voltage, and dBm for 50Ω output impedance.
Resolution:	0.1 dB
Display:	4-digit display that can be read directly for each one of the three unit types, △dB display, and the display of any desired offset value

In the following description, EMF dBμ, abbreviated as dB, is used as the unit of output level:

Standard level accuracy:	1) ±1 dB (RF ≧ 130 MHz) 2) ±2 dB (RF < 130 MHz) Output = 120 dB
Attenuator accuracy:	1) ±1 dB (Output ≧ 20 dB) 2) ±1.5 dB (Output ≧ 0 dB) 3) ±2 dB (Output < 0 dB)
RF ON/OFF:	RF output can be turned on/off by RF OFF key.
Output impedance:	50Ω N type connector
VSWR:	≦ 1.5 (Output ≦ 100 dB)
Reverse power protection:	Maximum 25W, 25V DC
Spurious signals:	Output level ≦ 120 dB for fundamental wave (= 0 dBc)
Harmonics:	≦ -25 dBc Except in Modulation Mode 2 (VIDEO modulation)
Non-harmonics:	≦ -60 dBc in CW mode and at offset carrier of ±5 kHz
SSB phase noise:	≦ -110 dBc/Hz in CW mode and at offset carrier of 20 kHz

Residual modulation (S/N)

FM components:

Frequency	Demodulation band width		
	0.3 - 3 kHz	50Hz - 15kHz	0.3 - 15 kHz De-emphasis=50us
	3.5kHz deviation	Ratio to 75kHz deviation	
10.7, 75 - 110 MHz		≦ 7.5Hz (80 dB)	≦ 3.8Hz(86 dB)
127.5 - 255 MHz	≦ 3 Hz (61 dB)	≦ 4 Hz (85 dB)	
255 - 520 MHz	≦ 6 Hz (55 dB)	≦ 8 Hz (79 dB)	
0.1 - 1040 MHz	≦ 12 Hz (50 dB)	≦ 16 Hz (73 dB)	

AM component: ≦ -76 dBc CW mode
Demodulation band width = 50 Hz to 15 kHz
(≧ 60 dB for 30% depth)

- Modulation

Modulation mode 1: FM, AM, FM-AM simultaneous modes, and DC·FM
Any of the following signal sources may be selected for each mode:
1) External
2) Internal 400 Hz
3) Internal 1 kHz
4) External DC·FM

Note: For the simultaneous modulation, only one external modulation source can be used.

Internal modulation frequency: 400 Hz and 1 kHz; ±3%
(Two frequencies are available.)

External modulation
1) Input impedance: 10 kΩ approx. (unbalanced)
2) Input voltage: 3 Vp-p approx.

Note: For the above input voltage, an error of ±2% is allowed by HI-LO monitor.

Modulation mode 2: VIDEO modulation

1) VIDEO and SIF input impedance: 75Ω approx. (unbalanced)
2) VIDEO input level: 1 Vp-p approx.
3) SIF input level: 0.5 Vp-p approx.
4) Output level accuracy: 3 dB (for VIDEO modulation)
5) VIDEO modulation
   Modulation method: DSB method (Wide-band amplitude modulation with both side bands)
   Modulation range: ±10.0% of 87.5% (standard, white level)
   Display: 2-digit readout
   Frequency characteristic: -3 dB band width (10 Hz to 6 MHz)
6) SIF modulation
   FM signal is input (Carrier frequency = 4.5 MHz to 6.5 MHz)

[FM]

Frequency deviation range and resolution
(The guaranteed value of deviation is less than 400 kHz.)

Frequency	5 MHz - 127.5 MHz		127.5 MHz - 255 MHz	
Frequency deviation	0 - 99.9kHz	100 - 500kHz	0 - 25.0kHz	26 - 125kHz
Resolution	100 Hz	1 kHz	100 Hz	1 kHz

Frequency	255 MHz - 510 MHz		510 - 1040 MHz	
Frequency deviation	0 - 50.0kHz	51 - 250kHz	0 - 99.9kHz	100 - 500kHz
Resolution	100 Hz	1 kHz	100 Hz	1 kHz

Note: When the value of RF is smaller than or equal to 5 MHz, the maximum frequency deviation is 10% of the RF value.

Display: 3-digit readout
Accuracy: ±5% of maximum frequency deviation (range)
External modulation frequency characteristic: ±1 dB, 20 Hz to 70 kHz, 1 kHz reference
Distortion of modulation: ≦ 0.02% (RF 10.7 ± 1 MHz, 75 to 110 MHz)
≦ 0.1% (Other RF values)

For Demodulation band width = 0.3 to 15 kHz, De-emphasis = 50 μs, Modulation frequency = 1 kHz, and Deviation = 75 kHz

Distortion of external modulation:
≦ 0.05% (RF 10.7 ±1 MHz, 75 to 110 MHz)
≦ 0.1% (Other RF values)
For Demodulation band width = 50 Hz to 15 kHz, and Deviation = 75 kHz

Incidental AM:
≦ 0.5%
For Demodulation band width = 0.3 to 15 kHz, Modulation frequency = 1 kHz, Deviation = 75 kHz, and RF > 5 MHz

DC·FM mode (closed loop system)

Frequency accuracy: ±(Reference frequency + 2 kHz)

Stability: ≦ 2 kHz/10 minutes 2 hours after power on

External modulation frequency characteristic: ±1 dB DC to 100 kHz, 1 kHz reference

[AM]

Setting range: 0 to 99.9%

Depth: 0 to 80% Output ≦ 126 dB (RF < 127.5 MHz)
Output ≦ 120 dB (RF ≧ 127.5 MHz)

Resolution: 0.1%

Display: 3-digit readout

Accuracy: (Indicated value ± 5)% Depth ≦ 80%

External modulation frequency characteristic: ±1 dB 50Hz to 10 kHz, 1 kHz reference

Distortion of internal and external modulation:

	Output ≦ 120 dBμ	Output ≦ 126 dBμ
RF 400kHz - 1.7MHz	≦ 0.5%	≦ 1%
RF 0.1 - 127.5MHz	≦ 1.5%	≦ 3%
Other RF values	≦ 1.5%	

For Demodulation band width = 50 Hz to 15 kHz, Modulation frequency = 1 kHz, and Depth = 30%

Incidental FM: ≦ 200 Hz peak
For Demodulation band width = 0.3 to 3 kHz,
Modulation frequency = 1 kHz, Depth = 30%,
and Output ≦ 120 dB

- Setting functions
  1) Numeric keys and rotary knob (with cursors) for setting carrier frequency, output level, modulation level, and memory address
  2) Step keys for carrier frequency, output level, and modulation level
  3) Preset keys for 3.5 kHz and 22.5 kHz (for FM) and 30% (for AM)

- Memory function
  1) 100 points for carrier frequency, output level, modulation level, modulation mode, etc.
  2) The memory can be used as 10 blocks of 10 points each or as a continuous space of 100 points.

- Dump function
  The contents of the 100-point memory can be transferred to the memory of the same model signal generator by DUMP key.

- Remote control
  The carrier frequency, output level, modula-tion level can be stored/ recalled, they can be incremented/ decremened by steps or continuous by rotary knob, modulation can be turned on/off,etc.

- GB-IB interface
  SHO, AHI, TO, LI, SRO, RLI, PPO, DCI, DTO, CO

- Range Out (dummy antenna switching Output):
  "1" (4V MAX 50 mA) for RF ≧ 35 MHz
  "0" (0V)for RF ≧ 35 MHz

- Leakage field strength

  1 μV or less at 50Ω termination voltage when the leakage field strength is measured by a two-turn loop antenna of 25 mm diameter placed 25 mm apart from the front panel.

- Backup battery is provided.

- Power source

  100, 115, 215, or 230V AC ± 10%
  (Selected by a plug on rear panel)

  Frequency: 50 Hz/60 Hz

  Power dissipation: 70 VA approx.

- Size and weight

  Dimensions: 430(W) × 99(H) × 400(D) mm
  (16.93(W) × 3.90(H) × 15.75(D) in.)
  445(W) × 119(H) × 455(D) mm (Full envelope)
  (17.52(W) x 4.69(H) x 17.91(D) in.)

  Weight: 13 kg (29 lbs) approx.

- Environmental conditions (temperature and humidity)

  Range to satisfy specifications: 5 to 35°C (41 to 95°F)
  85% or less

  Allowable range for operation: 0 to 40°C (32 to 104°F)
  90% or less

- Accessories:

Output cable (SA556)	1	N type 5D-2W
Power supply cord	1	
Fuse (2.0A)	1	
Fuse (1.0A)	1	
Operation manual	1	

- Factory-installed options

1) External reference frequency modification

The standard model of KSG4500A supports the reference signal input frequency of 10 MHz, but it can be changed to the following 5 MHz or 1 MHz:

a) 5 MHz ± 100 Hz (± 0.002%)

b) 1 MHz ± 20 Hz (± 0.002%)

2) Accessories: See Section 9.

- Special order (Please consult our Sales Office)

1) High stability reference crystal oscillator

Frequency:	10 MHz
Temperature stability:	$\pm 5 \times 10^{-8}$
Aging rage:	$\pm 2 \times 10^{-8}$/day 24 hours after power on

2) High stability reference crystal oscillator

Frequency:	10 MHz
Temperature stability:	$\pm 1 \times 10^{-7}$
Aging rate:	$\pm 5 \times 10^{-8}$/day 24 hours after power on

3) Output impedance of RF output terminal

Output impedance:	75Ω
Connector:	BNC type
VSWR:	≦ 1.5

3. PREPARATION FOR USE

3.1 Unpacking and Inspection

Before being shipped from the factory, the KSG4500A goes through thorough mechanical and electrical examinations and inspections, and its correct operation is confirmed and guaranteed.

On receiving the instrument, inspect it for any damage that may have been caused during transportation. Should a damage be found, notify the Sales Office immediately.

3.2 Line Voltage and Fuse Selection

Select a voltage range from the table below by the voltage selection plug on the rear panel of KSG4500A, and the instrument can be used in the selected voltage range.

Before connecting the power supply cord to the instrument, confirm that the voltage selection matches the actual line voltage.

When the voltage range is changed, change the fuse also according to the table below.

Application of a voltage out of the selected range will cause incomplete operation or failure of the instrument.

Setting position	Center voltage	Line voltage range	Fuse
A	100 V	90 - 110 V	2.0 A
B	115 V	104 - 126 V	
C	215 V	194 - 236 V	1.0 A
D	230 V	207 - 253 V	

3.3 Surrounding Temperature/Humidity, Warm-up Time, and Installation Place

The KSG4500A operates correctly in temperatures from 0 to 40°C (32 to 104°F).

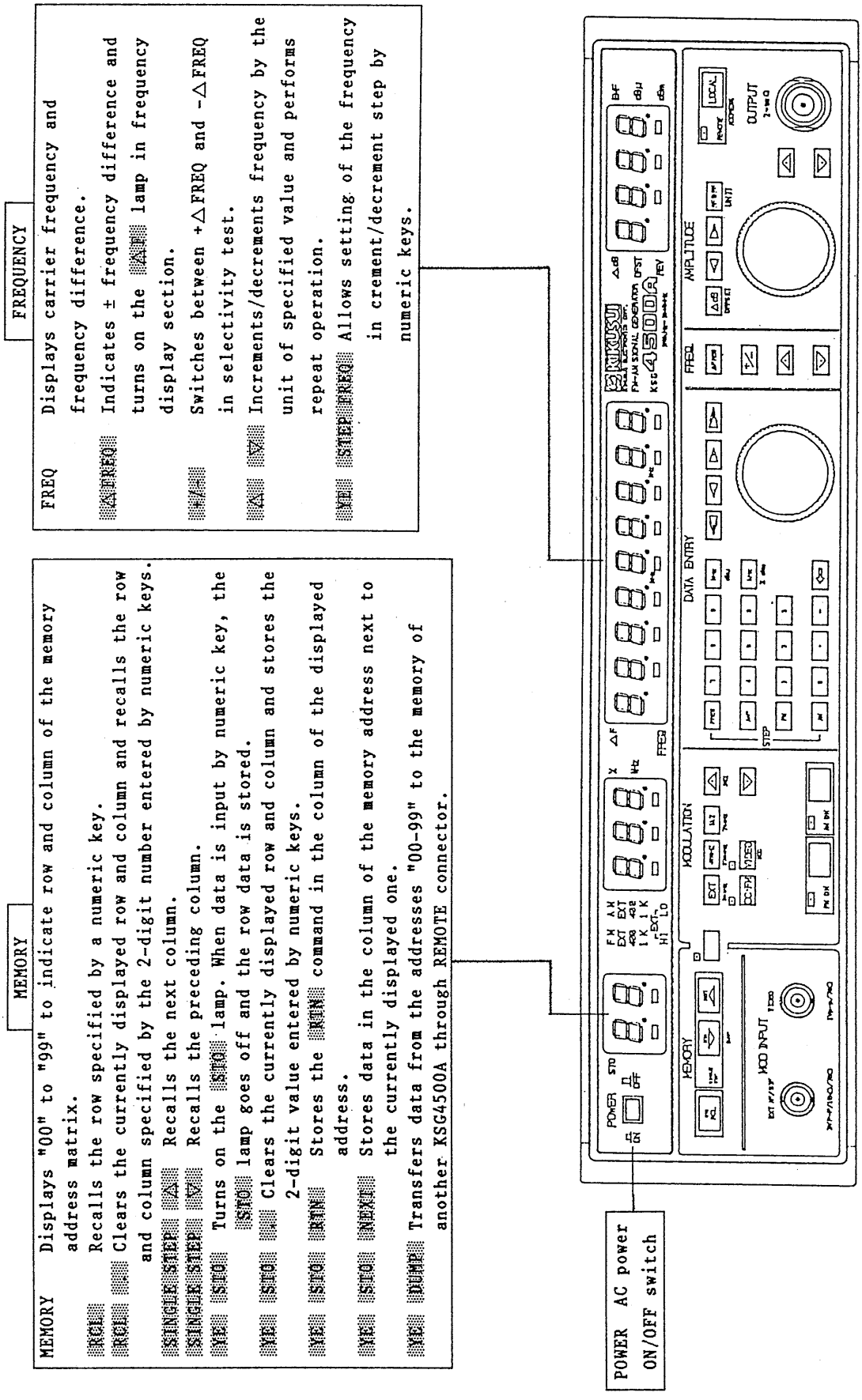
If the instrument is used or placed under high temperature or humidity for a long time, failures may occur and the life of the instrument will be shortened.

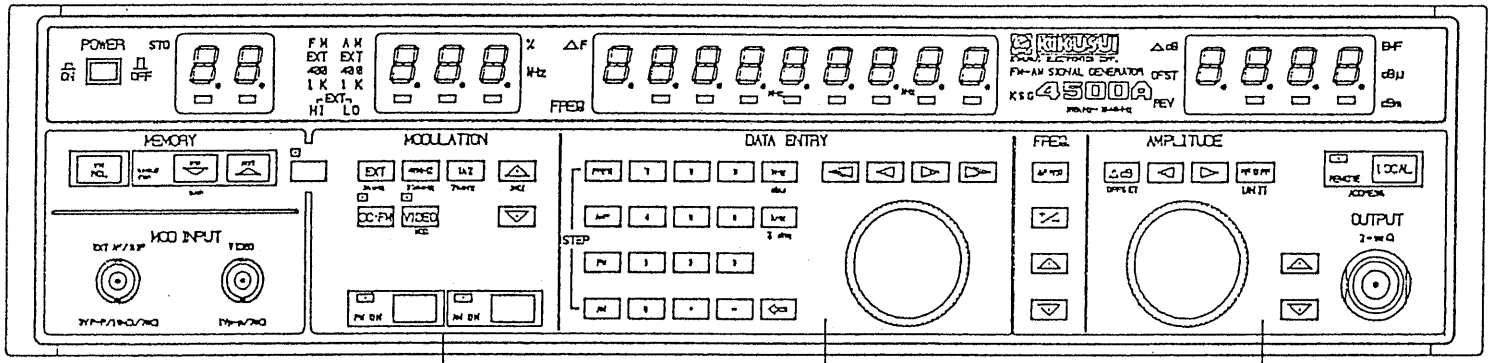
The instrument requires the warm-up time of 30 minutes.

Do not use the instrument near a strong magnetic field or electromagnetic waves.

4. OPERATION

4.1 Front Panel Features





MODULATION

MODULATION Displays FM/AM modulation rate by three digits.

MOD INPUT, EXT AC External modulation input connector for FM or AM single signal

FM EXT, 400, 1K Indicates FM source.

AM EXT, 400, 1K Indicates AM source.

EXT HI/LO Indicates external modulation input level range. The range is correct when HI and LO are off.

% Indicates AM depth by the unit of 0.1%.

kHz Indicates FM frequency deviation by the unit of 100 Hz.

EXT 400Hz 1kHz Switches between external modulation and internal modulation for FM and AM.

DC·FM Sets the instrument in DC·FM mode after approximately 2 s.

VIDEO Sets the instrument in VIDEO modulation mode.

VF MODE Allows the VIDEO modulation rate to be changed. It can be changed within the range of ±10.0% (the corresponding value is displayed within the range from "-10.0" to "10.0"). The displayed value "0.0" means the standard modulation rate.

△ ▽ Increments/decrements modulation rate by the unit of specified value and performs repeat operation.

FM ON Turns on/off FM modulation.

AM ON Turns on/off AM modulation.

VF 3.5kHz, 22.5kHz, 75kHz Presets FM deviation at 3.5 kHz, 22.5 kHz, or 75 kHz.

VF 30% Presets AM depth at 30%.

DATA ENTRY

DATA ENTRY Keys to input numeric values directly and to move cursor, and rotary knob to modify displayed value

FREQ Allows the setting of frequency by numeric keys.

AMP Allows the setting of output level by numeric keys.

FM Selects FM mode and allows the setting of FM deviation by numeric keys.

AM Selects AM mode and allows the setting of AM depth by numeric keys.

Numeric keys (0-9, ., -) Keys for entering numeric values

MHz, kHz, %, dB Keys for selecting unit

← Back space (BS) key. Used for correcting error during numeric data entry or for displaying center frequency when ΔFREQ function is used.

◁◁ ▷▷ Moves cursor to a different block.

◁ ▷ Moves cursor within a block.

Rotary knob Displays the RF output level by four digits.

AMPLITUDE

AMPLITUDE Displays RF output level by four digits

△dB Displays difference of output level.

◁ ▷ Moves cursor.

RF OFF Turns on/off RF output.

LOCAL Release the instrument from remote control by GP-IB.

Rotary knob Modifies the value at cursor position

△ ▽ Increments/decrements amplitude by the unit of specified value and performs repeat operation.

OUTPUT RF output connector. -20.0 dBμ to 132.0 dBμ at open circuit. The signal source impedance is 50Ω.

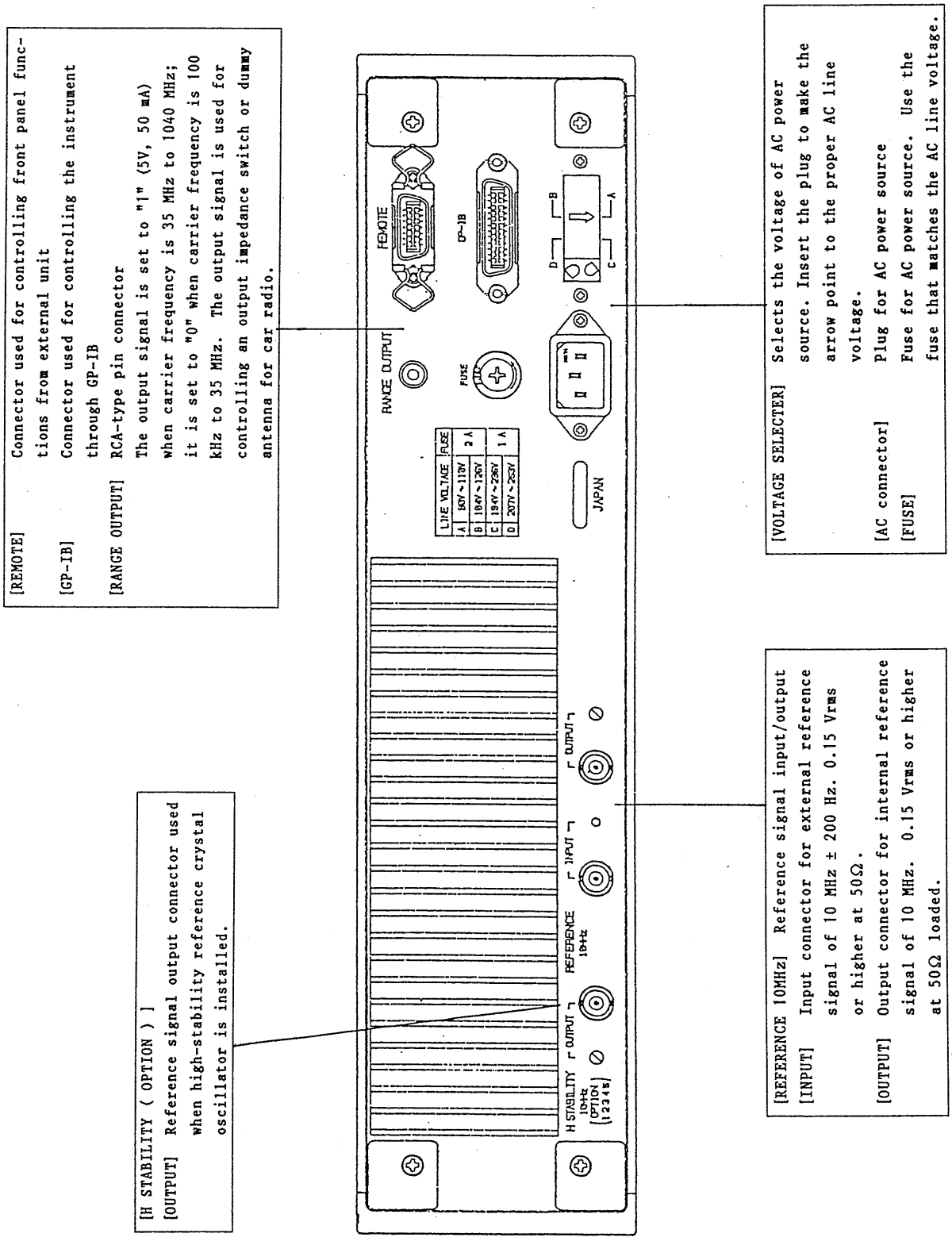
VF STEP AMP Allows the setting of increment/decrement step of output level by numeric keys.

VF OFFSET Displays the offset value for dummy antenna, etc.

VF UNIT Sets a unit.

VF ADDRESS Displays GP-IB address.

4.2 Rear Panel Features

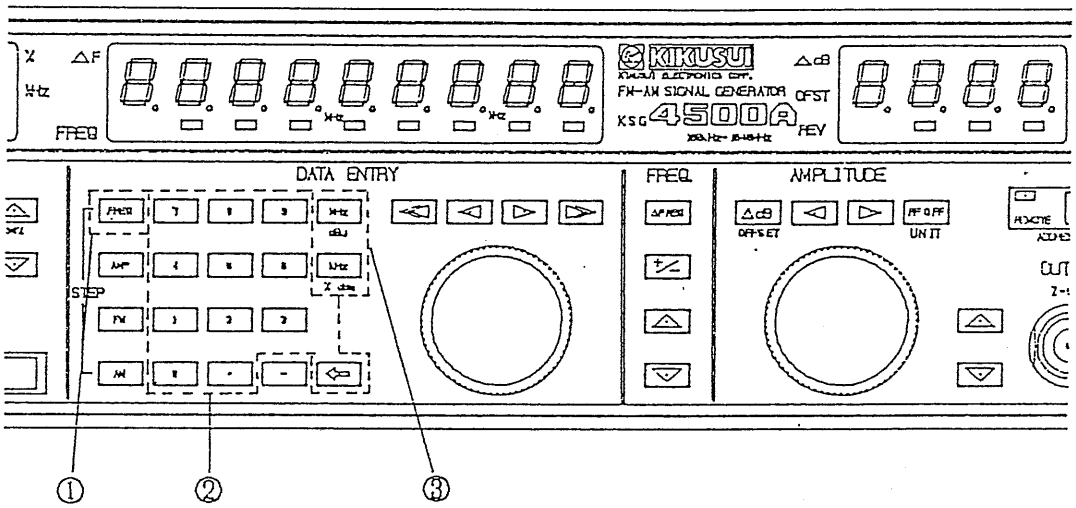


4.3 Initial Operation

Connect the power supply cord to the power source of the selected voltage and press the POWER switch. All the LEDs on front panel (except HI, LO, and REV LEDs) come on and then the status found immediately before the power was turned off is displayed.

4.4 Setting Frequency

4.4.1 Setting frequency by numeric keys



Press the FREQ key, enter a desired value by numeric keys (0-9, .), and press the desired unit key. That is, press keys in the order of ①, ②, and ③ in the above chart. If a key outside of the frame [ ] is pressed, the value that was effective before the FREQ key was pressed is displayed again.

When the MHz, or kHz key is pressed on completion of the entry of a value by numeric keys, the entered value is displayed in the FREQUENCY section correctly. The maximum number of digits for the entered value is nine; a value of more than nine digits is not accepted.

The range of the frequency that can be specified is 0 to 1060 MHz. Since the frequency resolution of the instrument is 10 Hz, a fraction smaller than 10 Hz is ignored when the unit key is pressed.

When pressing a numeric key by mistake, press the FREQ key again and enter the desired value by numeric keys or correct the value of the particular digit by the ⇦ (back space) key.

If AMP, FM, or AM key is not pressed after the unit key MHz or kHz, a different frequency can be set only by numeric keys and unit key without pressing the FREQ key.

a) Example: To input 123.45678 MHz

× ..... Undefined

␣ ..... Turned off

Key operation	[FREQUENCY] display	
FREQ	××××.×××.××	Previous value
1	1␣␣␣ ␣␣␣ ␣␣	
2	12␣␣ ␣␣␣ ␣␣	
3	123␣ ␣␣␣ ␣␣	
.	123. ␣␣␣ ␣␣	
4	123.4␣␣␣ ␣␣	
5	123.45␣␣ ␣␣	
6	123.456␣ ␣␣	
7	123.4567 ␣␣	
8	123.4567 8␣	
MHz	␣123.456.78	

b) Example: To input 455 kHz

Key operation	[FREQUENCY] display
FREQ	␣123.456.78
4	4␣␣␣ ␣␣␣ ␣␣
5	45␣␣ ␣␣␣ ␣␣
5	455␣ ␣␣␣ ␣␣
kHz	␣␣␣␣ 455.00

c) Example: 11 MHz was to be input, but 12 MHz was input by mistake.

Key operation	[FREQUENCY] display
FREQ	␣␣␣␣ 4 5 5.0 0
1	1␣␣␣ ␣␣␣ ␣␣
2 "2" was pressed for "1" by mistake	1 2␣␣ ␣␣␣ ␣␣
⇦	1␣␣␣ ␣␣␣ ␣␣
1	1 1␣␣ ␣␣␣ ␣␣
MHz	␣␣1 1.0 0 0.0 0

If an incorrect numeric key is pressed by mistake as in Example (c), the character of the pressed key can be deleted by the pressing of ⇦ key. If the ⇦ key is pressed continuously, all the displayed characters are deleted and the previous value is displayed.

d) Example: 85.7 MHz was to be input, but an error was made during the input.

Key operation	[FREQUENCY] display
FREQ	␣␣1 1.0 0 0.0 0
8	8␣␣␣ ␣␣␣ ␣␣
6 "6" was pressed for "5" by mistake	8 6␣␣ ␣␣␣ ␣␣
.	8 6.␣ ␣␣␣ ␣␣
7	8 6. 7 ␣␣␣ ␣␣
⇦ Press twice.	8 6␣␣ ␣␣␣ ␣␣
⇦ Press twice.	␣␣1 1.0 0 0.0 0

Since a unit key MHz, or kHz is not pressed before the ⇦ key, the previous value of frequency is displayed.

8	8␣␣␣ ␣␣␣ ␣␣
5	8 5␣␣ ␣␣␣ ␣␣
.	8 5.␣ ␣␣␣ ␣␣
7	8 5. 7 ␣␣␣ ␣␣
MHz	␣␣8 5.7 0 0.0 0

e) Example: 11 MHz was input for 1 MHz by mistake.

Key operation	[FREQUENCY] display
FREQ	␣␣85.700.00
1	1␣␣␣ ␣␣␣ ␣␣
1	11␣␣ ␣␣␣ ␣␣
MHz	␣␣11.000.00
1	1␣␣␣ ␣␣␣ ␣␣
MHz	␣␣␣1.000.00

If an error is found after the unit key is pressed as in Example (e), the correct frequency can be input without pressing the FREQ key again.

4.4.2 Rotary knob

The rotary knob increases or decreases the values of the digits at and above the cursor position in FREQUENCY display section.
If the cursor is not found in the FREQUENCY display section, bring it into the section by the ◁◁ or ▷▷ key; to move the cursor within the section, use the ◁ or ▷ key.

When setting a frequency by the rotary knob, the unit key MHz, or kHz need not be pressed.

a) Example: To change frequency from 100 MHz to 100.02 MHz
The mark "_" denotes the cursor position.

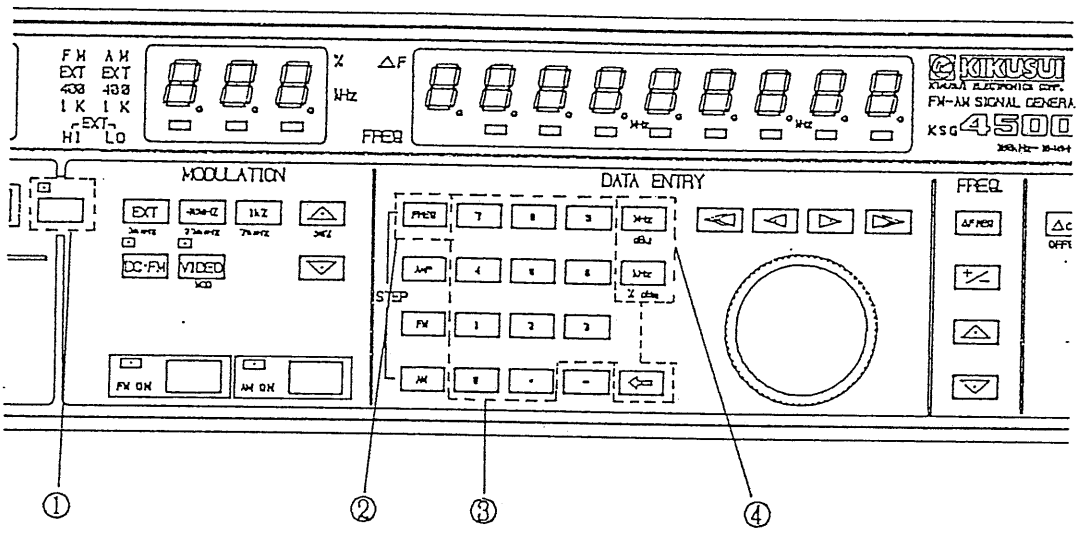
Key operation		[FREQUENCY] display
		␣100.000.00
◁	Press once.	␣100.000.00
	Turn the rotary knob clockwise by two steps.	␣100.020.00

b) Example: To change frequency from 100.02 MHz to 98.02 MHz

Key operation		[FREQUENCY] display
		␣100.020.00
◁	Press twice.	␣100.020.00
	Turn the rotary knob counterclockwise by two steps	␣␣98.020.00

4.4.3 Setting frequency step for △ and ▽ keys

Set a desired step value for the FREQUENCY △ and ▽ keys, and the frequency can be incremented or decremented by the unit of that value. When changing the frequency by the △ or ▽ key, the cursor position in the FREQUENCY display section is ignored.



Set the step value in the order of ①, ②, ③, and ④ shown in the above chart.

The YE key in the explanation below means the yellow key of number ①.

The YE key functions as a shift key, and when this key is pressed, the YE indicator is turned on. If one of the yellow keys on the panel is pressed while the YE indicator is on, the corresponding function is executed.

a) Example: To set 9 kHz for △ and ▽ keys when carrier frequency is 1 MHz.

Key operation		[FREQUENCY] display	
YE		␣␣␣1.000.00	YE indicator is turned on.
STEP FREQ		␣␣␣␣ ␣␣␣ ␣␣	YE indicator is turned off.
9		9␣␣␣ ␣␣␣ ␣␣	
kHz		␣␣␣1.000.00	
△	Press once.	␣␣␣1.009.00	

Keep pressing the △ or ▽ key in the FREQUENCY section, and the repeat function will be applied; that is, the frequency will keep increasing or decreasing by the unit of 9 kHz.

4.4.4 Frequency difference △FREQ and +/− keys

The △FREQ function, to check the value of change in frequency, is useful for measuring the band width of a receiver.

When the △FREQ key is pressed, the △F indicator in the FREQUENCY display section is turned on and the frequency difference (△FREQ) is displayed.

a) Example: Using △FREQ when 100 MHz is set

Key operation	[FREQUENCY] display	
YE	×××× ××× ××	YE indicator is turned on.
STEP FREQ	×××× ××× ××	YE indicator is turned off.
1	1␣␣␣ ␣␣␣ ␣␣	
0	10␣␣ ␣␣␣ ␣␣	
0	100␣ ␣␣␣ ␣␣	
kHz	×××× ××× ××	
FREQ	×××× ××× ××	
1	1␣␣␣ ␣␣␣ ␣␣	
0	10␣␣ ␣␣␣ ␣␣	
0	100␣ ␣␣␣ ␣␣	
MHz	␣100.000.00	
△FREQ	␣␣␣␣ ␣␣0.00	△F indicator is turned on.
[FREQUENCY] ▽	−␣␣␣ 100.00	Output frequency 99.9 MHz
⊖	␣␣␣␣ ␣␣0.00	

If the operator keeps pressing the △ or ▽ key in the FREQUENCY section, the repeat function is applied and the frequency keeps increasing or decreasing by the unit of 100 kHz. If the ⊖ key is pressed in the above example, the frequency returns to the center value ("0").

b) Example: 100 MHz is set currently.

Key operation	[FREQUENCY] display	
	␣100.000.00	
△FREQ	␣␣␣␣ ␣␣0.00	indicator is
◁ Press three times	␣␣␣␣ ␣␣0.00	turned on.
Turn the rotary knob counter-clockwise by five steps.	−␣␣5.000.00	Output frequency 95 MHz
△FREQ	␣␣95.000.00	

To release the △FREQ function, press the △FREQ or FREQ key again. In the above example, the frequency effective after the release is 95 MHz.

c) Example: Using +/− key after modifying 100 MHz by △FREQ

Key operation	[FREQUENCY] display	
	␣100.000.00	
△FREQ	␣␣␣␣ ␣␣0.00	△F indicator is
2	2␣␣␣ ␣␣␣ ␣␣	turned on.
0	20␣␣ ␣␣␣ ␣␣	
0	200␣ ␣␣␣ ␣␣	
kHz	␣␣␣␣ 200.00	Output frequency 100.2MHz
+/−	−␣␣␣ 200.00	Output frequency 99.8MHz
△FREQ or FREQ	␣␣99.800.00	

4.4.5 Reference signal input/output terminals

(1) Reference signal output (REFERENCE OUTPUT)

The REFERENCE OUTPUT terminal outputs the reference signal of 10 MHz and 0.15 Vrms or higher.

When this signal is applied to the reference signal input terminals of other instruments, the relative difference in the frequency of the reference signal for the instruments can be reduced.

The half-fixed resistor on the right side of the output connector is to be used for fine adjustment of the output frequency.

The fine adjustment, however, cannot be done while the LED of REFERENCE INPUT is on to indicate that the reference signal is being input.

The half-fixed resistor is adjusted properly before the instrument is shipped from the factory.

(2) Reference signal input (REFERENCE INPUT)

The reference signal of 10 MHz and 0.15 Vrms or higher can be applied to this terminal from an external instrument or from the optional high stability reference crystal oscillator (ordered specially).

When this reference signal is applied, the LED indicator on the right side of the input connector goes on and the frequency of the internal reference signal is locked to that of the external reference signal or optional high stability crystal oscillator signal. Thus, the relative difference between these signals is reduced.

By applying an external highly stable reference signal to the REFERENCE INPUT terminal and connecting the REFERENCE OUTPUT terminal to external instruments, highly accurate frequency can be obtained and the relative difference in frequency among the connected instruments can be reduced.

The reference input frequency can be changed to 5 MHz or 1 MHz by option.

(3) High stability reference crystal oscillator output (H STABILITY OUTPUT) - special order

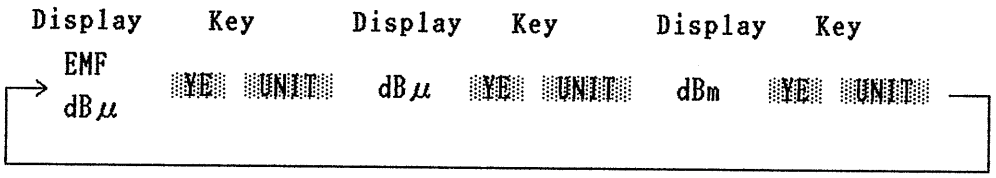
If the optional high stability reference crystal oscillator is installed, the signal whose frequency is 10 MHz and whose voltage is 0.15 Vrms or higher is output from the H STABILITY OUTPUT terminal.

If the H STABILITY OUTPUT terminal is connected to the REFERENCE INPUT terminal by the BNC cable provided with the instrument, the accuracy of the frequency used in the instrument can be made the same as the accuracy of the frequency output from the high stability reference crystal oscillator.

See the section of "Special order" in Chapter 2 for details.

4.5 Setting Output Level

4.5.1 Setting unit



Each time the YE and UNIT keys are pressed, the unit of output level changes cyclically as above. In the RF.OFF state, however, the unit and other modes cannot be set.

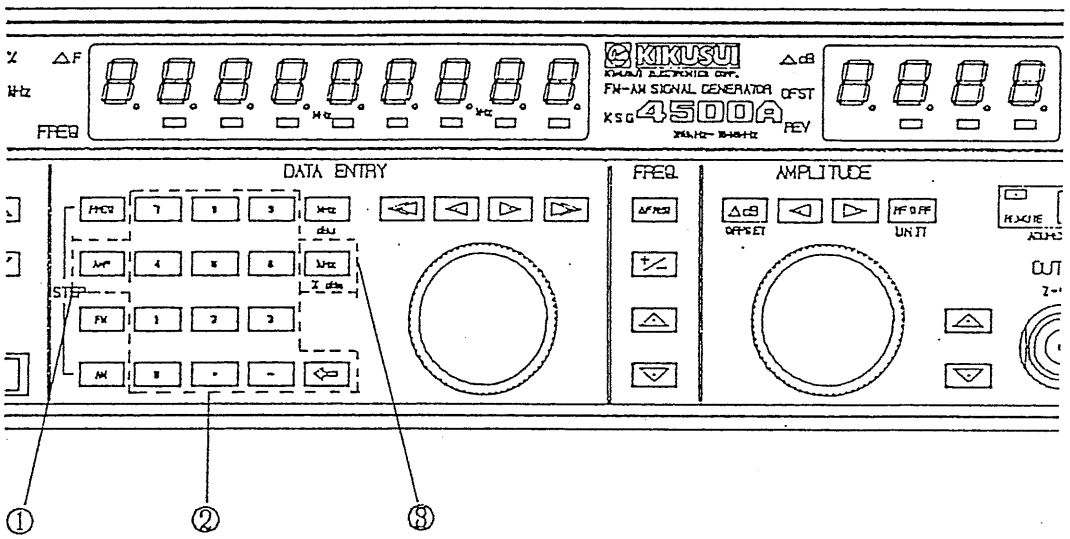
(a) EMF dBμ: Voltage indication -20.0 dBμ to 126.0 dBμ at open circuit
The EMF dBμ indicator in the AMPLITUDE section is turned on.

(b) dBμ: Voltage indication -26.0 dBμ to 114.0 dBμ at loaded
The dBμ indicator in the AMPLITUDE section is turned on.

(c) dBm: Power indication -133.0 dBm to 13.0 dBm
The dBm indicator in the AMPLITUDE section is turned on.

In the frequency band of 0.1 MHz to 127.5 MHz, the maximum output levels are 6 dB higher than those described in (a) to (c).

4.5.2 Setting output level by numeric keys



Press the AMP key and enter a desired value by numeric keys 0-9, ., -. That is, press keys in the order of ①, ②, and ③ in the above chart.

If a key outside of the frame [ ] is pressed, the value displayed before the AMP key was pressed is displayed again.

After entering a value by numeric keys, press the required unit key.

Then, the value is displayed in the AMPLITUDE section correctly.

a) Example: To set 10 dBμ

Key operation	[AMPLITUDE] display
AMP	×××.× ..... Previous value
1	1␣␣␣
0	10␣␣
dBμ	␣10.0

b) Example: To set -5 dBm

Key operation	[AMPLITUDE] display
AMP	␣10.0
(-)	−␣␣␣
5	−5␣␣
dBμ	−␣5.0

The AMP key need not be pressed if an output level is to be set immediately after another output level.

c) Example: 120 dBμ was to be set, but an error was made during the setting (Unit = EMF dBμ)

Key operation	[AMPLITUDE] display
AMP	−␣5.0
1	1␣␣␣
3 "3" was pressed for "2" by mistake	13␣␣
⇦	1␣␣␣
2	12␣␣
0	120␣
dBμ	120.0

If an error is made during the entry of a value by numeric keys, correct the error by the ⇦ key. If an error is found after the unit key is pressed, enter the correct value by using numeric keys again.

If a value smaller than or greater than the range allowed to the selected unit is specified, the previously set value is displayed. See Section 4.5.1 for the range allowed to each unit.

4.5.3 Rotary knob

The rotary knob increases or decreases the values of the digits at and above the cursor position in the AMPLITUDE display section. Use the ◁| and |▷ keys for moving the cursor.

To increase the output level, turn the rotary knob clockwise, and to decrease it, turn the rotary knob counterclockwise.

a) Example: To change output level from 46 dB to 66 dB
(Unit = EMF dBμ)

The mark "_" denotes the cursor position.

Key operation	[AMPLITUDE] display
	␣46.0
◁| Press once.	␣46.0
Turn the rotary knob clockwise by two steps.	␣66.0

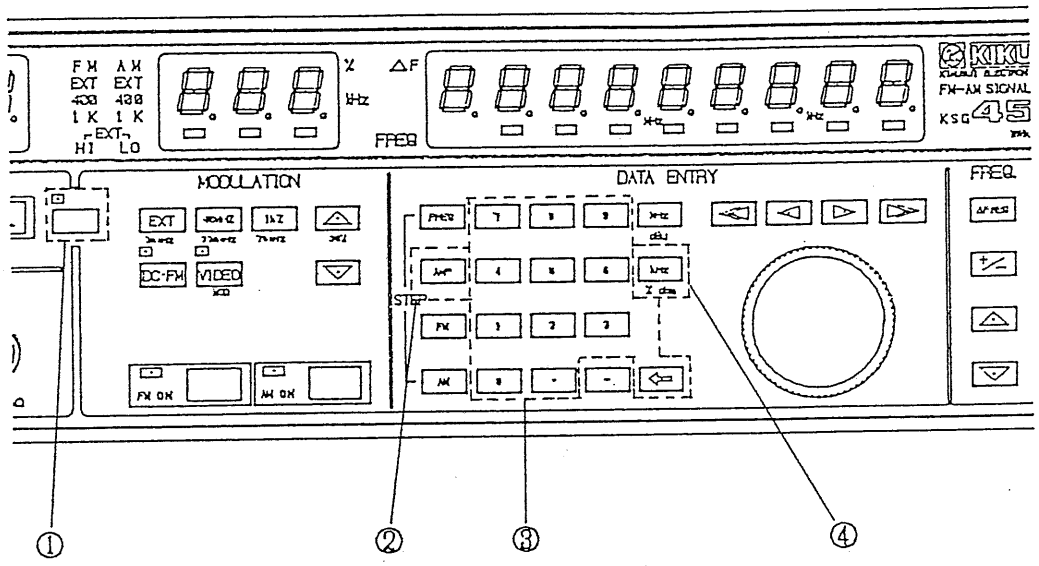
b) Example: To change output level from 66 dB to 60 dB

Key operation	[AMPLITUDE] display
	␣66.0
|▷ Press once.	␣66.0
Turn the rotary knob counter-clockwise by six steps.	␣60.0

When setting the output level by rotary knob, the unit key dB (1kHz) need not be pressed.

4.5.4 Setting output-level step for △ and ▽ keys

Set a desired step value (minimum 0.1 dB) for the AMPLITUDE △ and ▽ keys, and the output level can be incremented or decremented by the unit of that value.



Press keys in the order of ①, ②, ③, and ④ in the above chart.

a) Example: To set 2 dB for △ and ▽ keys when the output level is 60 EMF dBμ.

Key operation		[AMPLITUDE] display	
YE		␣60.0	YE indicator is turned on.
STEP AMP		␣60.0␣	YE indicator is turned off.
2		2␣␣␣	
dB		␣60.0	
△	Press once.	␣62.0	

To change the output level continuously by the step of 2 dB, keep pressing the AMPLITUDE △ or ▽ key (the key has a repeat function).

4.5.5 Setting offset value

The offset function is used for compensating the gain in amplifier and loss in dummy antenna and cable.

To set an offset value for the output level, press AMP, 0-9, ., - (numeric keys), and YE OFFSET in this order. When YE OFFSET is pressed again, the offset output level is displayed.
The offset value can be set within the range of ±50 dB.

a) Example: To give -6 dB offset to 100 EMF dBμ

Key operation	[AMPLITUDE] display	
AMP	100.0	
-	−␣␣␣	
6	−6␣␣	
YE OFFSET	100.0	
YE OFFSET	␣94.0	OFST indicator is turned on.
To release offset		
YE OFFSET	100.0	OFST indicator is turned off.

4.5.6 Output level difference △dB key

The △dB function is used for checking the value of change in output level, and it is useful in measuring the band width of a receiver and attenuation characteristic of a filter.

When the △dB key is pressed, the △dB indicator in the AMPLITUDE section is turned on. To release the △dB function, press the △dB key again.

The output level can be changed within the range from the minimum value to its maximum value.

a) Example: The current output level is 54 EMF dBμ

Key operation	[AMPLITUDE] display	
	␣54.0	
△dB	␣␣0.0	△dB indicator is turned on.
Turn the rotary knob counter-clockwise by 16 steps.	−16.0	
△dB	␣38.0	△dB function is released.

4.5.7 RF.OFF key

When the RF.OFF keys is pressed, the RF output signal is turned off and "OFF" is displayed in the AMPLITUDE section.

In the RF.OFF state, the output level and unit cannot be set.

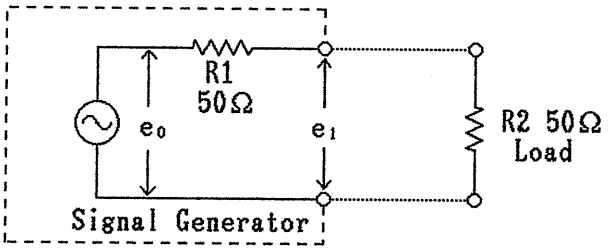
4.5.8 Reverse power protector

When a high frequency power is applied to the OUTPUT terminal from an external unit, an internal protector operates and stops signal output. Then, the REV indicator in the AMPLITUDE section is turned on.

To reset the protector function, that is, to return to the normal state, press the RF.OFF key twice.

4.5.9 Unit of output level

The equivalent circuit of the output block and the units of output level for the KSG4500A are as follows:



a) EMF dBμ: Open circuit voltage
The voltage e_0 in the above chart is normalized by "0 dBμ = 1 μVrms".

b) dBμ: Loaded voltage
The voltage e_1 in the above chart is normalized by "0 dBμ = 1 μVrms".

c) dBm: Power indication
The power consumed by R_2 in the above chart is normalized by "0 dBm = $\sqrt{1\ \text{mW} \times 50\Omega}$ = 0.2236 Vrms".

4.6 Setting Modulation

4.6.1 YE key

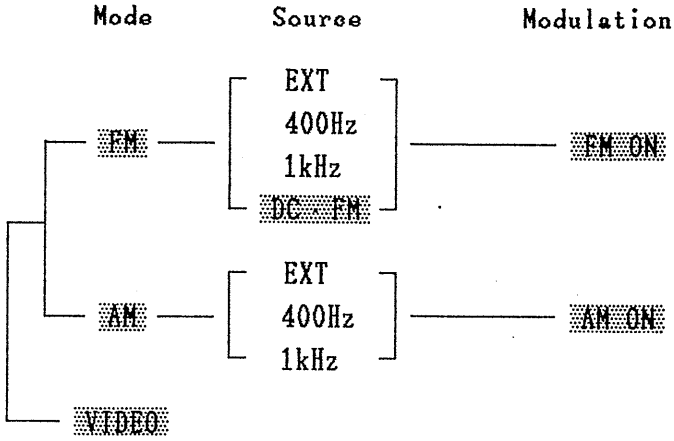
a) Press YE 3.5 kHz, and the FM peak frequency deviation is set to 3.5 kHz.

b) Press YE 22.5 kHz, and the FM peak frequency deviation is set to 22.5 kHz.

c) Press YE 75 kHz, and the FM peak frequency deviation is set to 75 kHz.

d) Press YE 30%, and the AM depth is set to 30%.

4.6.2 Setting modulation mode and source

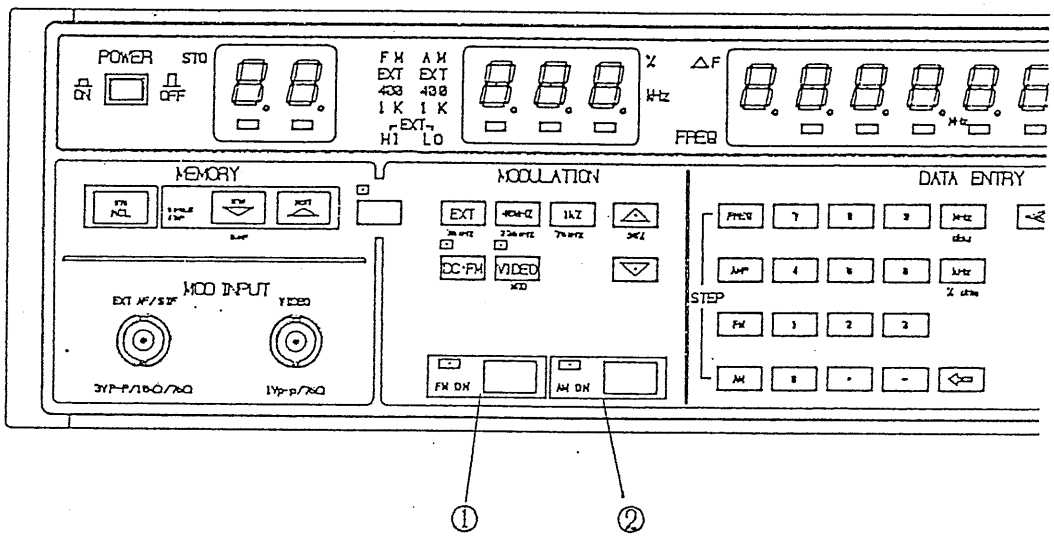


Note: The keys in shaded boxes (▒▒) have the mode selecting function.

When a modulation mode switching key is pressed, the modulation mode of the displayed symbol is selected (%=AM and kHz=FM) and the corresponding indicator is turned on.

For switching the source, use the EXT, 400Hz, or 1kHz key.

Keys ① and ② turn on/off FM and AM respectively. Each time ① or ② is pressed, the relevant modulation is turned on and off alternately. The keys have the function to select the modulation mode also.



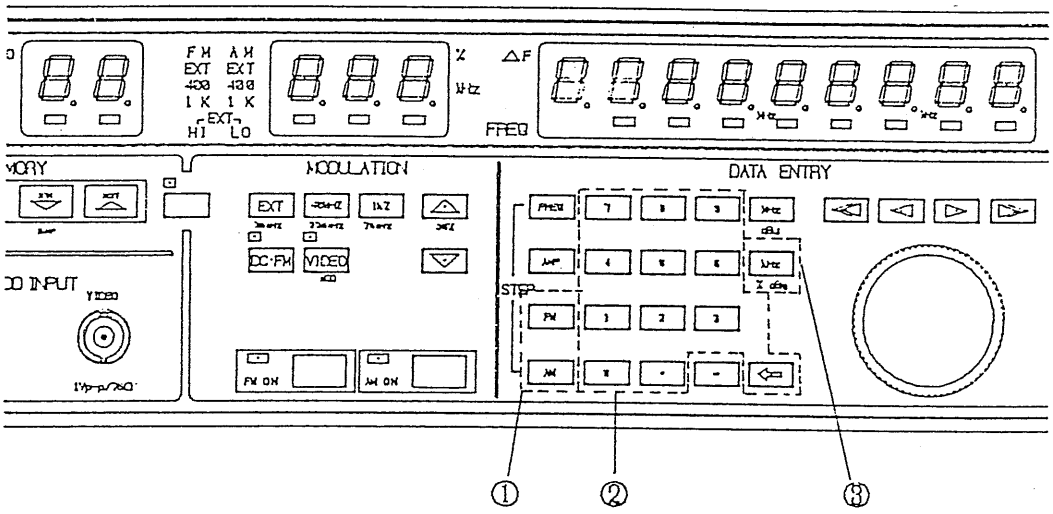
a) Example: To set 75 kHz deviation for 400 Hz internal FM source

Key operation	[MODULATION] display
FM	××.× ..... Previously set value
	kHz indicator is turned on.
400Hz	FM 400Hz indicator is turned on.
7	7␣␣
5	75␣
kHz	75.0

b) Example: To turn off the modulation

Press key ①, and the FM ON indicator goes off, which means that the frequency modulation is terminated.
At this time, the MODULATION display shows AM depth.

4.6.3 Setting modulation by numeric keys



Press keys in the order of ①, ②, and ③ in the above chart.

First, press the FM or AM key in DATA ENTRY section, and the previously set modulation factor is displayed in MODULATION section with its unit.

Next, enter a desired value by numeric keys [0-9], [.].

After entering the value, press [kHz] for FM and [%] ([kHz]) for AM. Then, the value is displayed in MODULATION section with the specified unit.

Any desired value can be entered by the numeric keys [0-9], [.], but if the entered value is not within the allowable range, the previous value is displayed.

The relationships between the carrier frequency and maximum/minimum deviation are as follows:

Carrier frequency	Maximum deviation	Minimum deviation
100kHz - 127.5MHz	500 kHz	100Hz, or 1kHz
127.5MHz - 255MHz	125 kHz	100Hz, or 1kHz
255 MHz - 510MHz	250 kHz	100Hz, or 1kHz
510 MHz - 1040MHz	500 kHz	100Hz, or 1kHz

Note: See Chapter 2 "SPECIFICATIONS" for the guaranteed ranges.

In the AM mode, the maximum depth that is displayed is 99.9% and the resolution for display is 0.1%.

a) Example: To set FM 25 kHz

Key operation	[MODULATION] display
[FM]	××.× ..... Previously set value
	[kHz] is displayed as unit.
[2]	2␣␣
[5]	25␣
[kHz]	25.0

b) Example: To set AM 30% after the above operation

Key operation	[MODULATION] display
AM	××.× ..... Previously set value % is displayed as unit.
3	3␣␣
0	30␣
%	30.0

4.6.4 Flashing in MODULATION section

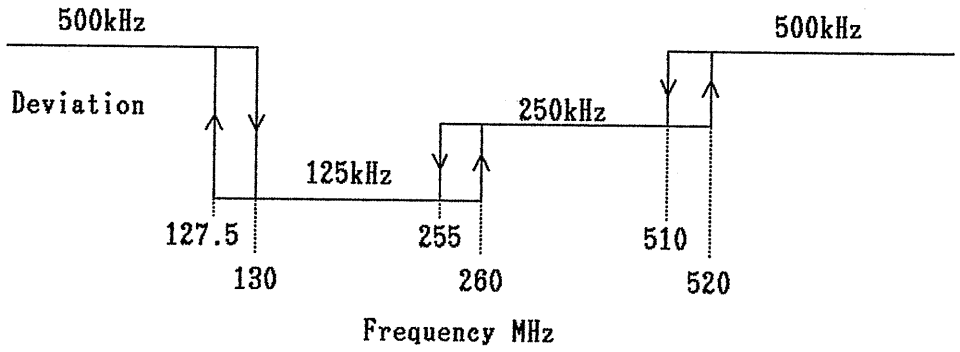
If the FM deviation specified by the user is not within the range determined by carrier frequency, an error is reported as below and the modulation is not executed. When this happens, set the deviation again within the allowable range.

(1) The value displayed in MODULATION section flashes when it is out of the allowable range as a result of change in carrier frequency.

(2) The kHz unit indicator flashes when the AM indicator in MODULATION section is on.

For the actual frequency modulation, the frequency is divided into several bands and the adjacent bands overlap each other.

The following chart shows the overlapping ranges of frequency bands:



For example, specify the deviation of 250 kHz for the frequency of 300 MHz and reduce the frequency. When the frequency is reduced to 255 MHz or lower, the value "250" in the MODULATION display flashes. At this time, the frequency deviation is zero.

4.6.5 Rotary knob

The rotary knob can modify the FM deviation and AM depth by increasing or decreasing the value of the digit at the cursor position in MODULATION display. When the cursor is not found in the MODULATION display, bring it into the display by ◁◁ or ▷▷ key; when it is in the display, move it by ◁ or ▷ key.

a) Example: To change FM deviation from 25 kHz to 35 kHz (when carrier frequency is 350 kHz or higher)
The mark "_" denotes the cursor position.

Key operation	[MODULATION] display
FM	2<u>5</u>.0
◁ Press once.	<u>2</u>5.0
 Turn the rotary knob clockwise by one step.	<u>3</u>5.0

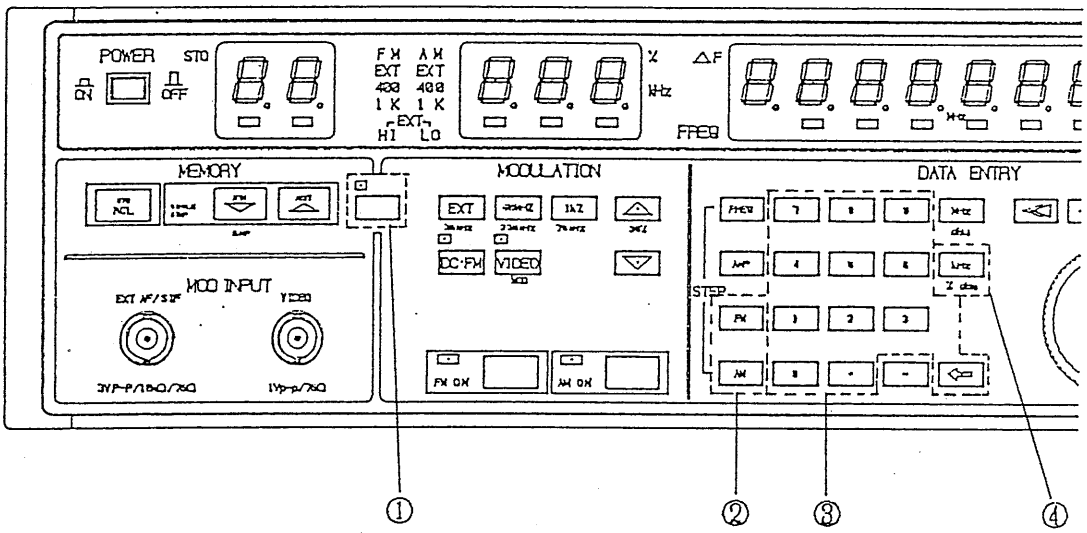
b) Example: To change AM depth from 30% to 25%

Key operation	[MODULATION] display
AM	<u>3</u>0.0
▷ Press once.	3<u>0</u>.0
 Turn the rotary knob counterclockwise by five steps.	2<u>5</u>.0

After changing the modulation factor by the rotary knob, the unit key kHz or % need not be pressed.

4.6.6 Setting modulation rate step for △ and ▽ keys

Set a desired step value (minimum 100 Hz or 1 kHz for FM according to frequency range and minimum 0.1% for AM) for the MODULATION △ and ▽ keys, and the modulation rate can be incremented or decremented by the unit of that value.



Press keys in the order of ①, ②, ③, and ④ in the above chart.

a) Example: To set 2.5 kHz as FM deviation step

Key operation		[MODULATION] display		
YE		75.0	kHz	YE indicator is turned on.
STEP FM		75.0		YE indicator is turned off.
2		2␣␣		
.		2.␣␣		
5		2.5␣		
kHz		75.0		
△	Press once.	77.5		

To increment or decrement the FM deviation continuously by the unit of the specified value, keep pressing the MODULATION △ or ▽ key for the repeat operation. The AM depth can be incremented/decremented in the same way as FM deviation.

4.6.7 Connecting and setting external modulation signal

(1) Connecting and setting method

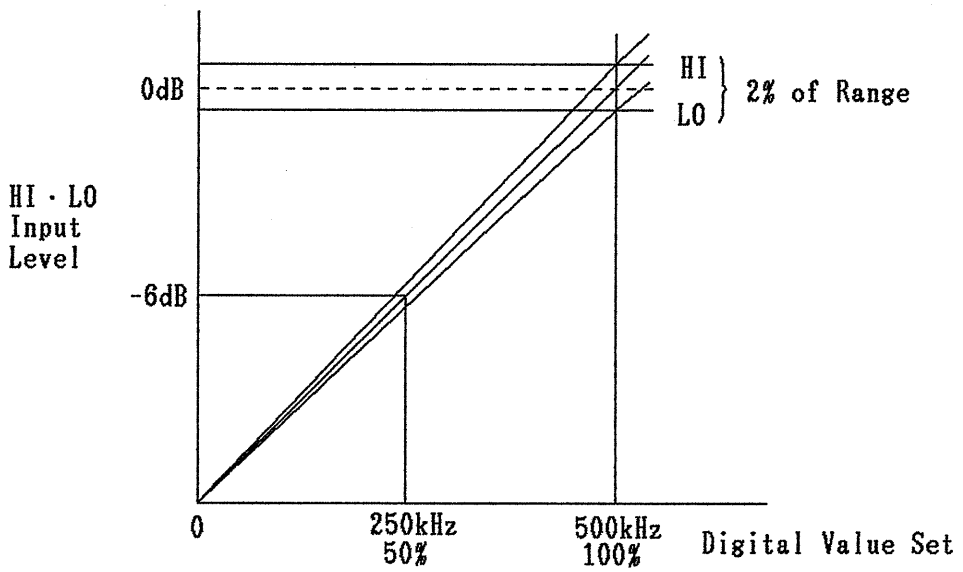
Connect an external modulation signal source to MOD INPUT (EXT AF) on the front panel. The input impedance is approximately 10 kΩ, and the proper input level is about 3 Vp-p.

The input level is in proper range when both HI and LO of EXT in MODULATION section are turned off. Therefore, adjust the level of the external modulation signal source to the range that turns off both HI and LO.

When the level of the external modulation signal source is too low, LO is turned on; when it is too high, HI is turned on.

The level of the external modulation signal source need not be adjusted each time the modulation rate is modified.

(2) Setting range



The above chart shows the relationship between modulation rate and input level.

When the input level is adjusted to the range of HI and LO, it is set within the error range of ±2%. The modulation rate is converted into a digital value internally on the basis of this input level.

Whether the input level is a composite wave signal or single wave signal, the instrument checks if the peak of the signal is within the range of HI and LO and the modulation rate is proportioned to the input level as shown in the above chart.

For example, after setting the input level within the range of HI and LO and the FM peak frequency deviation to 500 kHz, attenuate the input level by 6 dB. Then, 500 kHz (= 100%) remains displayed but the actual peak frequency deviation is reduced to 250 kHz (= 50%).

At this time, the LO lamp is turned on, but modulation is done correctly at the peak frequency deviation of 250 kHz.

When the input level is set within the range of HI and LO, the HI and LO lamps are turned off, but when the MAIN, LEFT, RIGHT, and SUB switches on the stereo signal generator are manipulated, the HI and LO lamps may be turned on alternately.

Since the range of HI and LO is very narrow, the HI and LO lamps may be turned on alternately, but that does not mean a serious error and does not affect the operation.

4.6.8 DC·FM mode

In the [DC·FM] mode, external modulation signal is input through DC coupling.
The frequency of FM VCO enters a free run state, and in this state, the frequency can be shifted by the DC signal.
The displayed modulation is accomplished by 1.5V DC.
Note: After the modulation source is changed from DC·FM to EXT, 400Hz, or 1kHz, it takes approximately 5 seconds for the signal to become stable.

4.6.9 VIDEO modulation mode

The VIDEO modulation is a wide-band amplitude modulation with both side bands, and the high frequency output level accuracy for the VIDEO modulation is within 3 dB.

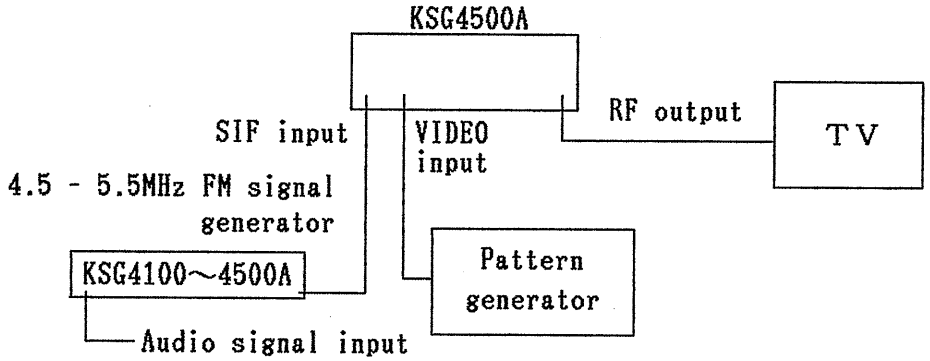
Pressing of the VIDEO key sets the instrument in the VIDEO modulation mode, turns on the VIDEO indicator, and turns off the FM/AM source indicators, MODULATION display, and unit indicator.

Press MOD and MOD (VIDEO) in this order, and the MODULATION display and % indicator are turned on. When these keys are pressed again, the MODULATION display and % indicator are turned off (toggle operation).

When a value within the range from -10.0 to 10.0 is displayed in the MODULATION section, the VIDEO modulation rate can be modified.
Bring the cursor into MODULATION section and turn the rotary knob to modify the VIDEO modulation rate.

The value in the range from -10.0 to 10.0 is simply an indicator. When it is 0.0, the VIDEO modulation rate is set to 87.5%, which is the standard rate. When the value changes from -10.0 to 10.0, the VIDEO modulation rate changes by the ratio of +10.0% of the standard rate.
The modulation sources may be input from external units only. The EXT HI LO lamps operate (provide the guideline of input level) for the combination of VIDEO level and SIF level.
The EXT AF/SIF terminal is used as audio IF input terminal, and the input impedance is switched to 75Ω. Normally, an SIF signal of approximately 0.5 Vp-p is applied (the center frequency is 4.5 MHz and FM deviation frequency is 25 kHz by M Method).
A video signal is applied to the VIDEO input terminal (normally 1 Vp-p).

Note: The modulation rate is adjusted by a digital process internally. The input VIDEO and SIF signals are combined by a resistor block (by Pad of 75n system) immediately after they are input, and the combined signal is input to an AGC circuit. Therefore, the VIDEO modulation rate cannot be changed even if the levels of the input signals are changed.



4.7 Memory

4.7.1 Memory recall method

The memory addresses are allocated in a matrix of 10 rows and 10 columns (100 points in total).

The following is the memory address allocation diagram:

MEMORY address (2-digit 7-segment display)

00	01	02	03	04	05	06	07	08	09
10									.
20									.
30									.
40									.
50									.
60									.
70									.
80									.
90	.	.	.	.	.	.	.	.	.	.99

The basic recall operation is to call the row number by RCL key and numeric key 0-9 and to call the column number by the MEMORY △ key.

Also, a memory address (row and column) can be called directly by the entry of a 2-digit number by numeric keys 0-9 after clearing the MEMORY display by the RCL and . keys.

In the following examples, it is assumed that the carrier frequency, output level, modulation mode, etc. that are set according to the explanations in Section 4.4 to 4.6 are stored in the memory by the operation explained in Section 4.7.2.

a) Example: Method of recalling memory by rotary knob

When the cursor is not found in the MEMORY display, bring it into the display by ◁◁ or ▷▷ key; when it is in the MEMORY display, move it by ◁ or ▷ key.

By turning the rotary knob, the addresses "00" to "99" can be recalled continuously.

b) Example: To recall memory address "10"

	MEMORY display
RCL, 1	"10"

c) Example: To recall memory address "43"

RCL, 4	
Press MEMORY △ three times.	"43"

d) Example: To recall memory address "85"

RCL, 8	
Press MEMORY △ five times.	"85"

e) Example: To recall memory address "56" directly

Press RCL and ., and the MEMORY display is cleared.
Press the numeric keys 5 and 6, and "56" is displayed.

To recall the address "78" subsequently, clear the MEMORY display by pressing [.] (pressing of [RCL] may be omitted). Then, press the numeric keys [7] and [8], and "78" is displayed.

4.7.2 Memory store method

Most of the functions specified on front panel can be stored in the memory addresses allocated in the form of a matrix as described in Section 4.7.1, but the step values of frequency, output level, and modulation factor and the △FREQ, △dB, and RF OFF functions cannot be stored.

The basic store operation is to set data such as frequency, output level, modulation level, and modulation type and to press [YE], [STO], numeric key, and MEMORY [△] in this order. Also, the address (row and column) can be specified directly by clearing the MEMORY display by [YE] and [.] and entering a 2-digit number by numeric keys.

a) Example: To store 1 MHz frequency, 76 EMF dBμ output level, 1 kHz internal modulation source, and 30% AM depth into memory address "10"

①	[FREQ]	×××.×××.××
	[1]	1␣␣ ␣␣␣ ␣␣
	[MHz]	␣␣1.000.00

Besides the above method, the frequency can be set by the rotary knob or FREQUENCY [△] or [▽] key.

②	[AMP]	××× ×
	[7]	7␣␣ ␣
	[6]	76␣ ␣
	[dBμ]	␣76.0

Besides the above method, the output level can be set by the rotary knob or AMPLITUDE [△] or [▽] key.

③ AM 1kHz ××.×
YE 30% 30.0 %

Besides the above method, the modulation level and source can be set by numeric keys 0-9, . and modulation mode key.

After setting the above data, press YE, STO (STO green indictor is turned on), and 1. Then, the data is stored into memory address "10".

b) Example: To store different data into memory address "13"

		MEMORY display
①	RCL, 1 △ (Press △ twice.)	"12" is displayed.
②	Set frequency, output level, modulation mode, etc.	
③	YE STO △	"13" is displayed.

The data set by step 2 is stored into memory address "13".

c) Example: To store data into memory address "45"

① Set frequency, output level, modulation mode, etc.

② Press YE, STO, and ., and MEMORY display is cleared.

③ Press numeric keys 4 and 5, and the data set by step 1 is stored.

Note 1: When data is to be stored consecutively, pressing of YE, STO, and . cannot be omitted.

Note 2: When the RTN key explained in Section 4.7.3 is used, the memory address (row and column) cannot be specified directly.

4.7.3 Storing data into a part of memory block
(Setting RTN function)

a) Example: To shift memory addresses as "10" → "11" → "12" → "13" → "10" → "11"

Key operation	[MEMORY] display	
RCL, 1, △ (Press △ three times.)	"13"	
YE, STO, RTN	"14"	RTN command is stored.

[How to use the function]

RCL 1	"10"	(First memory address)
△	"11"	(Second memory address)
△	"12"	(Third memory address)
△	"13"	(Fourth memory address)
△	"10"	(Returns to first memory address)

4.7.4 How to reset RTN function

The following two methods are available:

(1) Press RCL, ., 1, 9 "19" is displayed.
Press YE, STO, ▽ "19"

By the above operation, the memory addresses are used in units of 10 columns per block as before.

(2) Press RCL, 1, △ "13" is displayed.
Press YE, STO, △ RTN is stored in "14"
" "
" "
" "
" "
Press YE, STO, and △ five times. "19"

Each time the △ key is pressed, the RTN command is sent to the next column, and finally, all the ten columns become available as they were before the RTN function was set.

4.7.5 Recalling more than ten columns continuously (Setting NEXT function)

Normally, memory addresses are recalled by the unit of ten columns at a time (00-09, 10-19, ..., 90-99), but more than ten columns can be recalled continuously by the following operation:

Display the column number, "9" in MEMORY section and press YE, STO, and NEXT; then, the next ten columns can be recalled continuously.

a) Example: To recall memory addresses 30 - 49 continuously

Key operation	[MEMORY] display	
×	"39"	Previous value
YE	"39"	
STO	"39"	STO indicator is turned on.
NEXT	"40"	STO indicator is turned off.

The memory addresses are recalled as follows:

→ "30" → "31" → . . . → "39" → "40" → "41" → . . . → "49" →

4.7.6 How to reset NEXT function

Display the memory address ("09", "19", ..., or "89") at which the function is to be reset, and press the YE, STO, and RTN keys in this order.

a) Example: To terminate the continuous recall of memory addresses 30 - 49 (i.e. to recall 30 - 39 and 40 - 49 separately)

Key operation	[MEMORY] display	
×	"39"	Previous value
YE	"39"	
STO	"39"	STO indicator is turned on.
RTN	"39"	STO indicator is turned off.

4.7.7 Copying memory data to another KSG4500A

(1) The data stored in the 100-point memory data can be copied to another unit of KSG4500A.

(2) Memory data copying procedure

① Power on the local and remote signal generators.

② Connect the remote control terminals of local signal generator to those of remote signal generator by DUMP cable.

③ Press YES, RTN and DUMP (▽) of the local signal generator, and the copy operation is started.

Note: The DUMP cable uses the amphenol-type 14-pin connectors. Among the 14 pins, pins 8 - 10 need not be connected, but all the remaining pins should be connected.

Optional DUMP cable (SA510) is recommended.

5. REMOTE CONTROL

5.1 General Description

5.1.1 Outline

The KSG4500A has a 14-pin connector for remote control. The control through this connector is equivalent to the control on the front panel.

5.2 How to Use Remote Control Function

5.2.1 Explanation of remote control connector

Figure 5-1 shows the connector pin allocation on the rear panel.

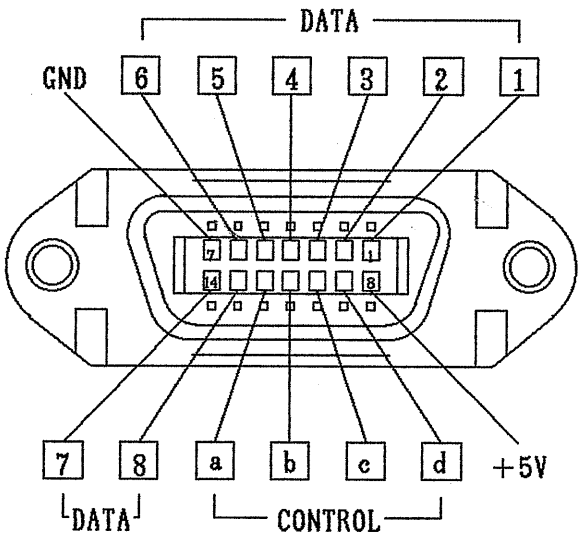


Fig. 5-1

[Explanation of terminals]

In the following explanation, "1" and "0" correspond to high level and low level of TTL respectively.

1) DATA terminals [redacted] - [redacted] (Pins 1 - 6, 13, and 14)
The DATA terminals are used as a bidirectional bus for both input and output, and they are connected to the internal bus for the front panel features.

Note: Since the DATA bus is a bidirectional bus, the signal generator does not work if data "0" or "1" is applied to DATA terminals [illegible] - [illegible] directly.

2) CONTROL terminals (Pins 11 and 12)

[illegible] DATA STROBE output terminal (Pin 12)
Normally, "1" is output from this terminal, and when data is read, "0" is output from it.

[illegible] REQUEST TO READ input terminal (Pin 11)
Normally, "1" is input to this terminal, and when data read is requested, "0" is input to it.

3) CONTROL terminals (Pins 9 and 10)

[illegible] and [illegible] are display control output terminals.
When "1" is output from [illegible] or [illegible], data is being processed.
That is, the logical sum of [illegible] and [illegible] is used as the BUSY signal for external instrument.

4) +5V terminal (Pin 8)

Power source for remote control (max. 100 mA; equivalent to the power for turning on 2-digit LED)

5) GND terminal (Pin 7)

5.2.2 Input data timing

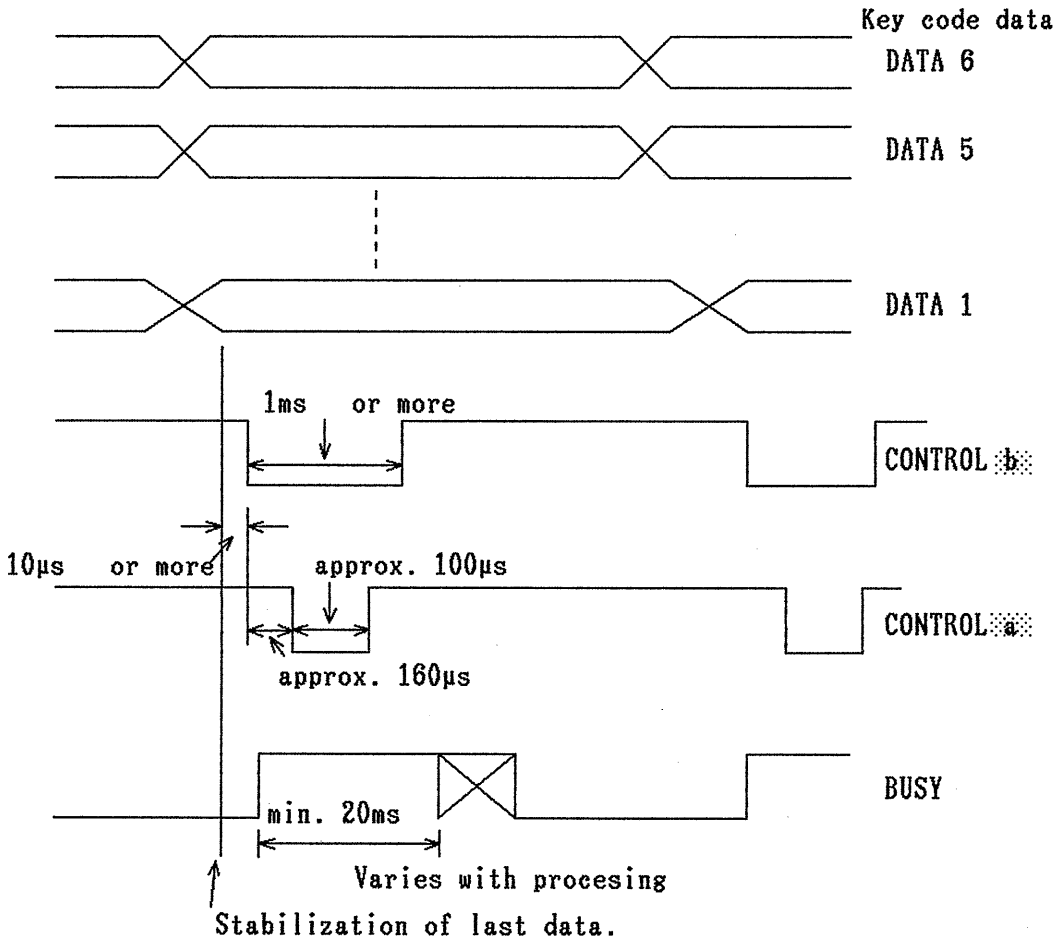


Fig. 5-2

Set the key code data DATA 1 - 6 while the BUSY signal is off ("0"), give 10 µs or more time after the last data of DATA 1 - 6 is stabilized, and set CONTROL b to "0" for 1 ms or longer as shown in Figure 5-2.

Approximately 160 µs after the falling of CONTROL b, CONTROL a which is output from the KSG4500A is set to "0" for approximately 100 µs.

During this approximate 100 μs, the key code data set above is read and processed.

After CONTROL [b] falls and before CONTROL [a] falls, (during the period of approximately 160 μs), the BUSY signal rises to "1" to indicates that the key code data is being processed.

The next key code data should be input after the BUSY signal is set to "0".

5.2.3 Panel key code table

All the panel keys are expressed in codes. So, sending one of the key codes listed in Table 5-1 by setting CONTROL [b] to "0" is equivalent to pressing the panel key corresponding to the code.

Table 5-1

	DATA input pin number					
	6	5	4	3	2	1
Key name	MSB ← Key Code → LSB					
[MEMORY] [RCL] / [STO]	0	0	0	1	0	0
" [▽] / [RTN] (DUMP)	0	0	0	1	1	1
" [△] / [NEXT]	0	0	0	1	1	0
[YE] (Yellow Key)	0	1	1	0	1	1
[EXT]	0	0	1	0	0	1
[400Hz]	0	0	1	0	1	1
[1kHz]	0	0	1	1	0	0
[DC-FM]	0	1	1	1	0	0
[VIDEO]	0	1	1	1	0	1
[MODULATION] [△]	1	0	1	0	1	0
" [▽]	0	1	1	1	1	1
[FM ON]	0	0	1	1	1	0
[AM ON]	0	0	1	1	1	1
[DATA ENTRY] [FREQ] / [STEP FREQ]	0	1	0	0	1	0
" [AMP] / [STEP AMP]	0	1	0	0	1	1
" [FM] / [STEP FM]	0	1	0	1	0	0
" [AM] / [STEP AM]	0	1	0	1	0	1
" [0]	1	1	0	0	0	0

Key name		MSB ← Key Code → LSB					
DATA ENTRY	1	1	1	0	0	0	1
"	2	1	1	0	0	1	0
"	3	1	1	0	0	1	1
"	4	1	1	0	1	0	0
"	5	1	1	0	1	0	1
"	6	1	1	0	1	1	0
"	7	1	1	0	1	1	1
"	8	1	1	1	0	0	0
"	9	1	1	1	0	0	1
"	.	1	0	1	1	1	0
"	-	1	0	1	1	0	1
"	⇦	0	0	1	0	0	0
"	MHz	0	1	0	1	1	0
"	kHz, %, dBm	1	0	0	1	0	1
"	⧏⧏	0	1	0	1	1	1
"	⧏	1	1	1	1	0	0
"	⧐	1	1	1	1	1	0
"	⧐⧐	0	1	1	0	0	0
"	Rotary knob UP	0	0	0	0	0	0
"	" DOWN	0	0	0	0	0	1
FREQUENCY	△FREQ	1	1	1	1	0	1
"	+/-	1	0	1	0	0	1
"	△	0	1	1	0	0	1
"	▽	0	1	1	0	1	0
AMPLITUDE	△dB	1	0	0	0	0	1
"	◁	1	0	0	0	1	0
"	▷	1	0	0	0	1	1
"	RF.OFF	1	0	0	1	0	0
"	△	1	0	0	1	1	0
"	▽	1	0	0	1	1	1
"	Rotary knob UP	0	0	0	1	0	0
"	" DOWN	0	0	0	0	1	1
LOCAL		1	0	1	1	1	1

5.2.4 Setting frequency by remote control (example)

In this example, the frequency is to be set to 82.5 MHz.

(1) Set the DATA ENTRY FREQ code "010010" according to the panel key code table (Table 5-1).

(2) Set CONTROL [illegible] to "0" for 1 ms or longer as shown in the input data timing chart (Figure 5-2).

(3) Set the data for "82." according to the key code table, and send it by setting CONTROL [illegible] to "0" for 1 ms or longer as shown in Figure 5-3.

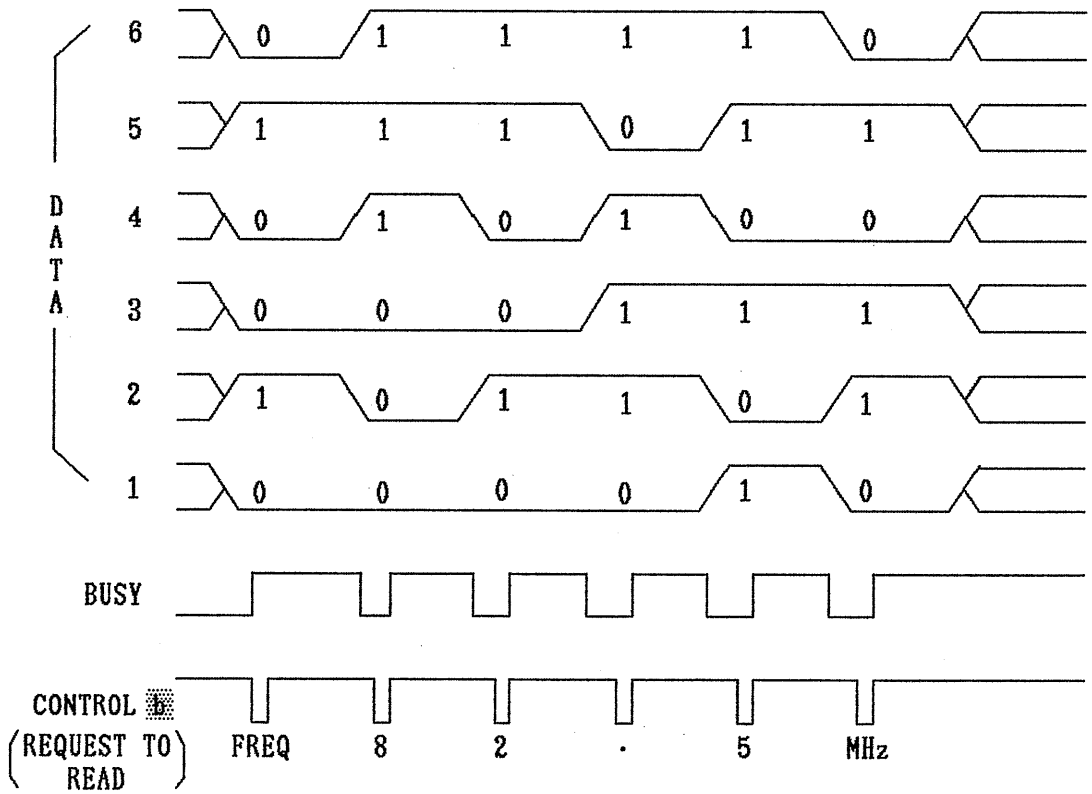


Fig. 5-3

(4) Send the data "110101" for "5" by setting CONTROL [illegible] to "0" in the same way as above.

(5) Finally, send the data "010110" for "MHz" by setting CONTROL [illegible] to "0".

(6) When the signal generator receives the last data, namely, "010110" for "MHz" and CONTROL [illegible], it starts processing the specified frequency.

5.2.5 Remote control circuit and its operation (example)

Since the data lines of the remote control connector are bidirectional bus lines, it is recommended to use a circuit such as the one shown in Figure 5-4 when controlling the signal generator by a remote unit.

The circuit in Figure 5-4 is a remote control circuit that increments the displayed memory address by 1 each time the switch is pressed.

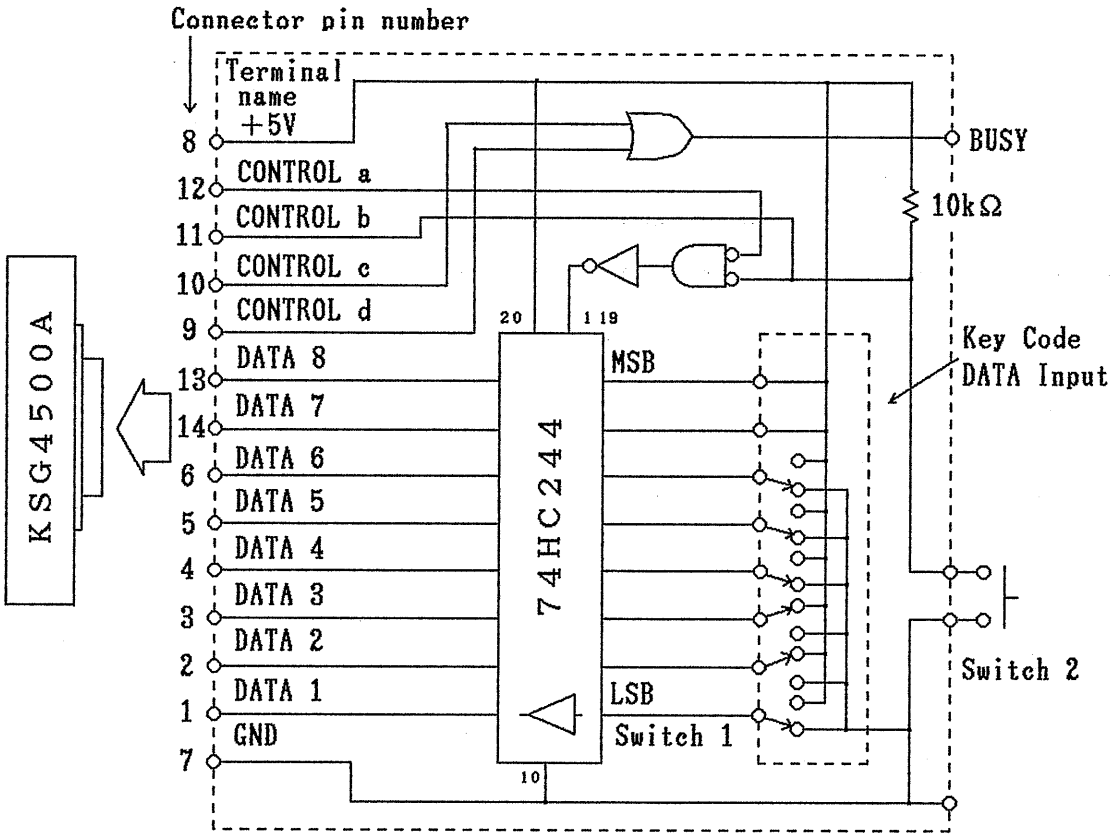


Fig. 5-4

Set the key code data that corresponds to MEMORY △ by Switch 1 according to the key code table (Table 5-1) and set CONTROL ▒b▒ to "0" by pressing Switch 2. Approximately 160 μs after Switch 2 is pressed, CONTROL ▒a▒ falls to "0" and pins 1 and 19 (Enable A and B) of 74HC244 are set to "0". CONTROL ▒a▒ is set to "0" for approximately 100 μs, and during this time, the data of MEMORY △ is read by the Signal Generator.
If other key code data is selected from the key code table and set by Switch 1, the panel key that corresponds to the selected key code can be controlled in remote mode in the same way as above.
When the remote control is managed by a computer on the basis of Figure 5-4, be sure to confirm that the BUSY signal is "0" before setting CONTROL ▒b▒ to "0".

Note: Since the remote control connector has eight DATA terminals, the fixed data "1" is sent to DATA 7 and 8 (pins 14 and 13) through 74HC244.

5.2.6 MEMORY display output circuit (example)

Figure 5-5 shows an example of MEMORY display output circuit.

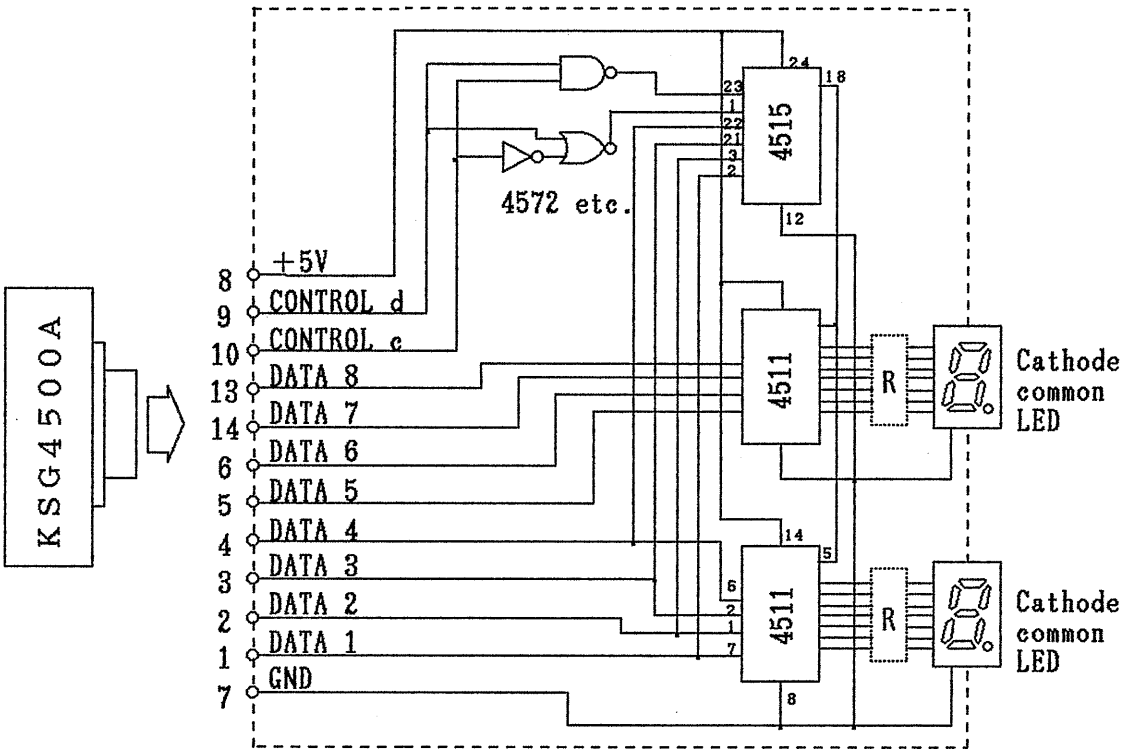


Fig. 5-5

Since the remote control connector has a bidirectional bus structure, it can output the data displayed in the MEMORY section of the Signal Generator through the circuit shown in Figure 5-5.

In addition to being displayed on an external unit, the data in the MEMORY section can be used by the external unit if the CMOS 4511 is replaced by a latch circuit.

If the circuit in Figure 5-4 and that in Figure 5-5 are connected to the Signal Generator in parallel by the connector section, the external unit can not only control the Signal Generator but also display and check the data in MEMORY section.

6. OUTPUT IMPEDANCE AND DUMMY ANTENNA SWITCHING SIGNAL

6.1 "RANGE OUTPUT" RCA Pin Connector

When the frequency is within the range from 35.0000 MHz to 1040 MHz, the output signal is set to "1" (5V, 50 mA), and when it is within the range from 100 kHz to 34.9999 MHz, the output signal is set to "0".

The output signal can be used as the control signal for a device such as an output impedance switch or a dummy antenna for car radio.

The current of 50 mA is used for driving two reed relays.

7. BACKUP BATTERY AND CPU RESET

7.1 Backup Battery

The KSG4500A uses a memory backup battery, and the battery may discharge its electricity when the Signal Generator is not used for a long time. Since the Signal Generator has a charging circuit, the battery will be charged when the Signal Generator is powered on.

The memory backup battery is greatly affected by the surrounding temperature, humidity, and storage conditions. After about five years, the discharge capability of the battery is reduced to approximately 90% of the initial capability. The battery is still fully usable in this state, but when it becomes unusable, replace it with GB 50H-3X of Japan Storage Battery Co., Ltd.

[Battery position and replacement method]

Remove the top panel of the instrument, and an aluminum sash case is found on the left side viewed from the front panel. This case contains the CPU printed circuit board, and the battery is mounted on this board.

See Section 8.3.2 for the method of removing the top panel and aluminum sash case.

To replace the battery, take out the aluminum sash case by removing two screws from its left side and pull out the PC board from the case. Then replace the battery with a new one.

After replacing the battery, insert the PC board into the aluminum sash case and fasten the two screws. Then, be sure to execute the CPU hardware reset.

7.2 CPU Reset

7.2.1 Hardware reset

Turn on the power, and initialize the CPU by pushing the initial setting button (S1) by an insulated screwdriver or something inserted from the hole on the side of the aluminum sash case containing the CPU board. By this operation, all the data in memory, values for steps, and GP-IB address are set to their initial values.

7.2.2 Software reset

Turn on the power switch while pressing the [YE] key on the panel, and the CPU is reset. By this operation, the values stored in memory and the step values are not cleared.

Note: After the hardware or software reset, the instrument is in a key entry wait status. Therefore, press a key such as [GP-IB] before using the instrument; otherwise, the instrument may not perform GP-IB operation.

8. GP-IB

8.1 General Description

8.1.1 Outline

The KSG4500A has a GP-IB interface, and it can be controlled through the IEEE488 standard interface bus.

8.1.2 Features

(1) The listen function of the Signal Generator can be controlled through the IEEE488 standard interface bus.

(2) The remote control mode can be checked by the REMOTE indicator.

(3) The Signal Generator can be set in local mode at any time by the pressing of LOCAL key. In the local mode, manual operation on the front panel is allowed. (In local lockout mode, however, the manual operation is not allowed.)

(4) The device address assigned to the Signal Generator can be displayed in the AMPLITUDE section.

8.2 Performance

8.2.1 Electrical specifications related to interface system

Conforms to IEEE Std 488-1975.

8.3 Operation Procedure

8.3.1 Preparation for use

Turn on the power and check the GP-IB device address of the Signal Generator.

(1) Press YB and LOCAL, and the GP-IB device address is displayed in the AMPLITUDE section while these keys are being pressed.

(2) To change the device address, set a new address according to the address setting method explained in Section 8.3.2.

(3) After the hardware reset of CPU, "07" is displayed; after the software reset of CPU, the specified value is displayed. After the CPU reset, press a key such a ⇐.

(4) Turn off the power and connect the GP-IB cable.

8.3.2 Address setting method

(1) Address setting by software

The current address is displayed while YES and LOCAL keys are being pressed.

Enter a new address by numeric keys within approximately 2 seconds after releasing the LOCAL key, and then press the LOCAL key again.

(2) Address setting by hardware

The address of the KSG4500A is set to "07" before the instrument is delivered from the factory.

The address switch is mounted on the CPU board in the Signal Generator. To set a new address, remove the top panel and manipulate the address switch S2 on the PC board 90-SIG-90104 found in an aluminum sash case located in the left part viewed from the front panel. The address "07" can be changed to a desired value.

To remove the top panel, remove six screws in total; that is, two screws from top surface, two from upper right side, and two from upper left side (the screws on the upper left side are fastened with rubber feet). Lift up the top panel after removing the screws.

To take out the aluminum sash case, remove two screws from its upper left side and lift it up. Then, pull out the PC board backward.

After setting the address, put the board back to its original position. Then, execute the software or hardware reset of CPU (see Section 7.2).

a) Table 8-1 lists the DIP-SW positions and the addresses determined by them.

b) ON position of DIP-SW means the level of "0".

c) Figure 8-1 shows how S2 is set for address "07".

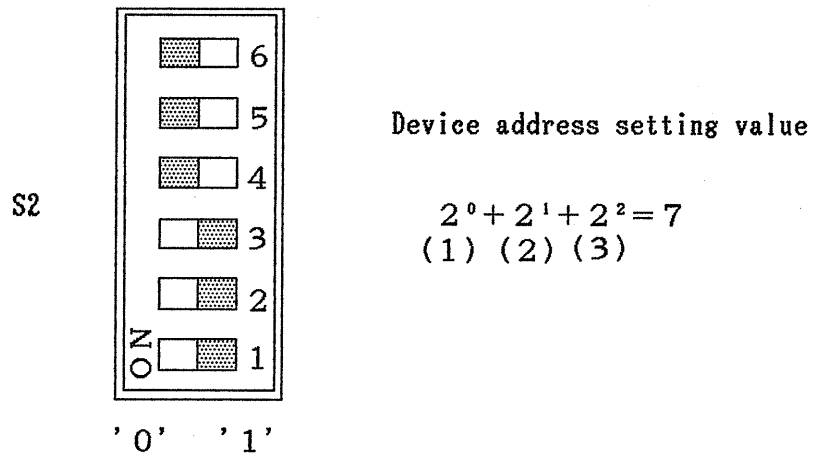


Fig. 8-1

Table 8-1

Listener address Device number	Address switch 1 2 3 4 5 6	
00	0 0 0 0 0 0	
01	1 0 0 0 0 0	
02	0 1 0 0 0 0	
03	1 1 0 0 0 0	
04	0 0 1 0 0 0	
05	1 0 1 0 0 0	
06	0 1 1 0 0 0	
07	1 1 1 0 0 0	Set to "07" before shipment.
08	0 0 0 1 0 0	
09	1 0 0 1 0 0	
10	0 1 0 1 0 0	
11	1 1 0 1 0 0	
12	0 0 1 1 0 0	
13	1 0 1 1 0 0	
14	0 1 1 1 0 0	
15	1 1 1 1 0 0	
16	0 0 0 0 1 0	
17	1 0 0 0 1 0	
18	0 1 0 0 1 0	
19	1 1 0 0 1 0	
20	0 0 1 0 1 0	
21	1 0 1 0 1 0	
22	0 1 1 0 1 0	
23	1 1 1 0 1 0	
24	0 0 0 1 1 0	
25	1 0 0 1 1 0	
26	0 1 0 1 1 0	
27	1 1 0 1 1 0	
28	0 0 1 1 1 0	
29	1 0 1 1 1 0	
30	0 1 1 1 1 0	
Listen only	* * * * * 1	

DIP SW

1 = OFF 0 = ON

8.3.3 Available control and bus line commands

Table 8-2

Control command and bus line command (for HP BASIC)	Explanation
OUTPUT	Specifies the listener address and sends program data
REMOTE	Turns on the REMOTE indicator (red) when the listener address is specified. When the REMOTE indicator is on, the instrument is ready to receive data. If the LOCAL key is on the front panel is pressed in this state, the REMOTE indicator goes off and the Signal Generator is set in the local mode which enables manual operation on the front panel.
LOCAL LOCKOUT	This is a universal command, and when it is sent to all the devices on GP-IB, it disables all the manual operations for them through the front panel of KSG4500A.
LOCAL	Turns off the REMOTE indicator and sets the Signal Generator in the local mode to allow manual operation on the front panel.
CLEAR	Sets the Signal Generator in the same state as the initial power-on state.

Note: Since the bus line commands vary with the computer to be used, refer to the instruction manual of the specific computer.

8.3.4 Program code table

The programs for the KSG4500A should be described with the codes listed in Table 8-3 "GP-IB function setting method".

The program codes are listed in alphabetical order in Table 8-4, and they are classified by function in Table 8-5. See these tables also.

When creating a control program, arrange the program codes in the same order as their corresponding functions would be specified on the panel.

Table 8-3 GP-IB function setting method

Item	Program code	Data	Unit
Frequency	FR	oo.o	HZ, KZ, MZ
Output level unit			
" EMF dBμ	EM	---	---
" dBμ	DU	---	---
" dBm	DM	---	---
Output level	AP	oo.o	DB
" OFF	RO, ROF	---	---
" ON	R1, RON	---	---
Modulation			
AM depth	AM	oo.o	PC
"	AM	oo.o	%
Amplitude modulation OFF	AMS5, AMOF	---	---
FM peak frequency deviation	FM	oo.o	KZ
Frequency modulation OFF	FMS5, FMOF	---	---
DC·FM	S6FM	---	---
External modulation	S1AM, S1FM	---	---
Internal modulation 400Hz	S2AM, S2FM	---	---
Internal modulation 1kHz	S3AM, S3FM	---	---
VIDEO modulation signal	VI	oo.o	---
Memory control			
Memory recall	RC	oo	---
Memory store	ST	oo	---

Note: 1. The mark "---" means an optional item.

2. The mark "oo" means that the data may be specified with one digit up to the maximum number of digits.

3. Data must be expressed in integers or real numbers; it must not be expressed in E format.

4. Alphabetic characters may be expressed in small letters.

5. See Item (5) of Section 4.7.3 "FM two-tone modulation mode" for the items marked with "*".

Table 8-4 GP-IB program codes

Alphabetic order

Program code	Explanation	Remarks
AM	Amplitude modulation	Function mode
AMOF	Amplitude modulation OFF	Switches modulation signal source
AP	Output level	Function mode
DB	Output level unit	Unit
DU	" dBμ	Unit
DM	" dBm	Unit
EM	" EMF dBμ	Unit
FM	Frequency modulation	Function mode
FMOF	Frequency modulation OFF	Switches modulation signal source
FR	Frequency	Function mode
HZ	Hz	Unit
KZ	kHz	Unit
MZ	MHz	Unit
PC	Percent for AM depth	Unit
RC	Memory recall	Function mode
R0, ROF	Output level OFF	Function mode
R1, RON	Output level ON	Function mode
S1	External modulation ON	Switches modulation signal source
S2	Internal modulation 400 Hz	Switches modulation signal source
S3	Internal modulation 1 kHz	Switches modulation signal source
S5	Modulation OFF	Switches modulation signal source
S6	DC·FM	Switches modulation signal source
ST	Memory store	Function mode
VI	VIDEO (AM)	Switches modulation signal source
0 - 9	Numeric value	Data
-	Minus sign	Data
.	Decimal point	Data
%	Percent for AM depth	Unit

Table 8-5 GP-IB program codes

Classified by function

Function	Program code
Frequency	FR
Output level	AP
Output level OFF	RO, ROF
Output level ON	R1, RON
Modulation	
Amplitude modulation	AM
Frequency modulation	FM
EXT	S1
400 Hz	S2
1 kHz	S3
Modulation OFF	S5
DC·FM	S6
VIDEO (AM)	VI
Amplitude modulation OFF	AMOF, AMS5
Frequency modulation OFF	FMOF, FMS5
Data	
Numeric value	0 - 9
Minus sign	-
Decimal point	.
Unit	
MHz	MZ
kHz	KZ
Hz	HZ
EMF dBμ	EM
dBμ	DU
dBm	DM
dB	DB
%	PC or %
Memory	
Memory recall	RC
Memory store	ST

8.3.5 Basic data setting method

Examples 1 and 2 show the methods of setting carrier frequency to 100 MHz, output level to 120 EMF dBμ, internal modulation frequency to 1 kHz, and FM peak frequency deviation to 75 kHz.

In all the examples in this section, it is assumed that HP9816 is used.

Example 1 OUTPUT 707 ; "FR100MZ, EMAP120DB, S3FM75KZ"

Output command	Frequency data	Output level data	FM deviation data

Normally, CRLF or EOI is sent.

Example 2 To send the above data items one by one:

```
OUTPUT 707 ; "FR100MZ"
OUTPUT 707 ; "EMAP120DB"
OUTPUT 707 ; "S3FM75KZ"
```

The following are typical examples of the data setting methods for some of the GP-IB functions:

Example 3 To set the carrier frequency to 88.2 MHz:

a) "FR88.2MZ"

Example 4 To set the output level to 120 EMF dBμ:

a) "EM, AP120DB" b) "EM", "AP120DB"

Example 5 To set the output level to 100 dBu:

a) "DU, AP100DB" b) "DU", "AP100DB"

Example 6 To set the output level to -3.5 dBm:

a) "DM, AP-3.5DB" b) "DM", "AP-3.5DB"

Example 7 To set the internal modulation frequency to 400 Hz and AM depth to 30%:

a) "S2AM30%" b) "S2AM30PC"

Example 8 To set external FM deviation to 75 kHz:

a) "S1FM75KZ" b) "S1FM", "FM75KZ"

Note: S1 only is invalid.

Example 9 To turn off modulation:

a) "AMS5" b) "FMS5"

Example 10 Memory recall and store:

To recall/store data from/to the memory address "36"

a) "RC36" b) "ST36"

8.3.6 Connector pin allocation

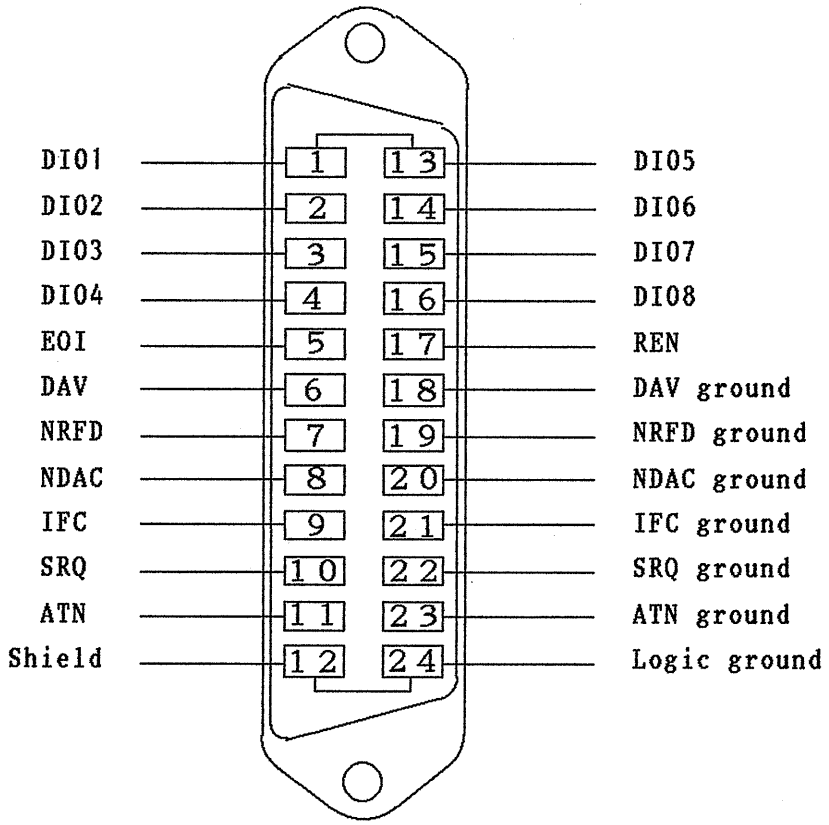


Fig. 8-4

8.3.7 Reference (Program example)

An example of a program for HP9816 is given below. This program is to set the data of frequency, output level, and modulation rate, to store the data into the Signal Generator (memory "00" - "09"), and to recall the data from it.

This program is just for reference, and it may not be the best one. Since the program description method varies with the system to control the Signal Generator, code the program in the most suitable way for the system.

```
 10  Dev=707                          Interface select code * 100 +
                                      Device address
 20  Frequency=100*1.E+6              100 MHz

 30  Freqstep=10*1.E+6                10 MHz

 40  Level=120                        120 dB

 50  Levelstep=-10                    -10dB

 60  Fm=75                            75 kHz

 70  Fmstep=-5                        -5 kHz

 80  CLEAR Dev                        Clear selected device

 90  WAIT 2

100   OUTPUT Dev;"R1"                 Output level ON

110   OUTPUT Vec;"AMS5"               Amplitude modulation OFF

120   FOR N=0 TO 9

130     Freq=Frequency + Freqstep*N

140     Lev=Level+Levelstep*N
```

```
150     Fmlev=Fm+Fmstep*N
160     OUTPUT Dev;"FR";Freq/1.E+6;"MZ" Set frequency.
170     OUTPUT Dev;"EMAP";Lev;"DB"      Set output level.
180     OUTPUT Dev;"S2FM";Fmlev;"kZ"    Set internal 400Hz and FM
                                        deviation
190     OUTPUT Dev;"ST";N               Store data into memory
200   NEXT N
210   FOR N=0 TO 9
220     OUTPUT Dev;"RC";N               Recall data from memory
230     WAIT 2
240   NEXT N
250   END
```

9. ACCESSORIES (OPTIONAL)

9.1 SA100 Test Loop

(1) Performance

Frequency range:	100 kHz to 30 MHz
Movable length:	Approx. 250 mm vertical
	360° horizontal
Input cable:	50Ω coaxial cable
Test loop:	Diameter 250 mm, 0.8ϕ, 1 turn

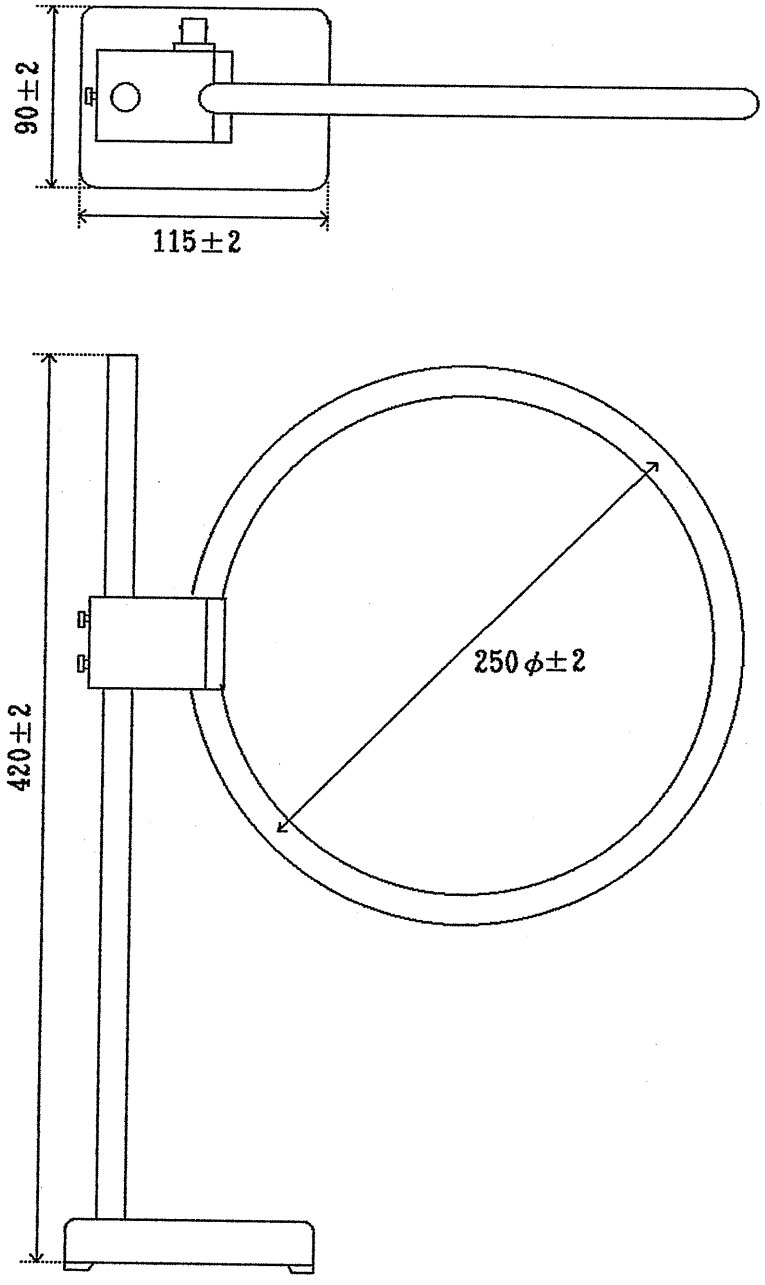


Fig. 9-1

9.2 SA150 Band Splitting Filter

(1) Performance

Input frequency range:	DC to 130 MHz
Input/output impedance:	50Ω (BNC-J type connector)
VSWR input/output:	1.2 or less
Output frequency range:	AM: DC to 30 MHz
	FM: 75 MHz to 130 MHz
Insertion loss:	0.5 dB or less

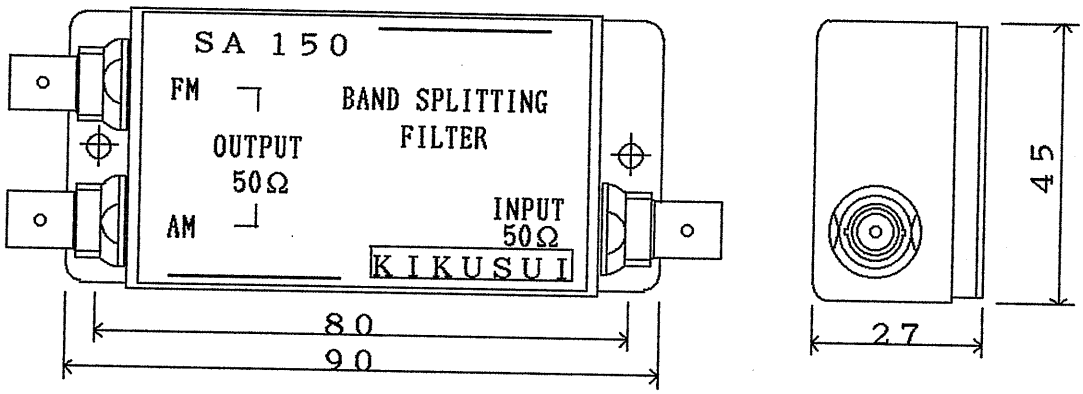
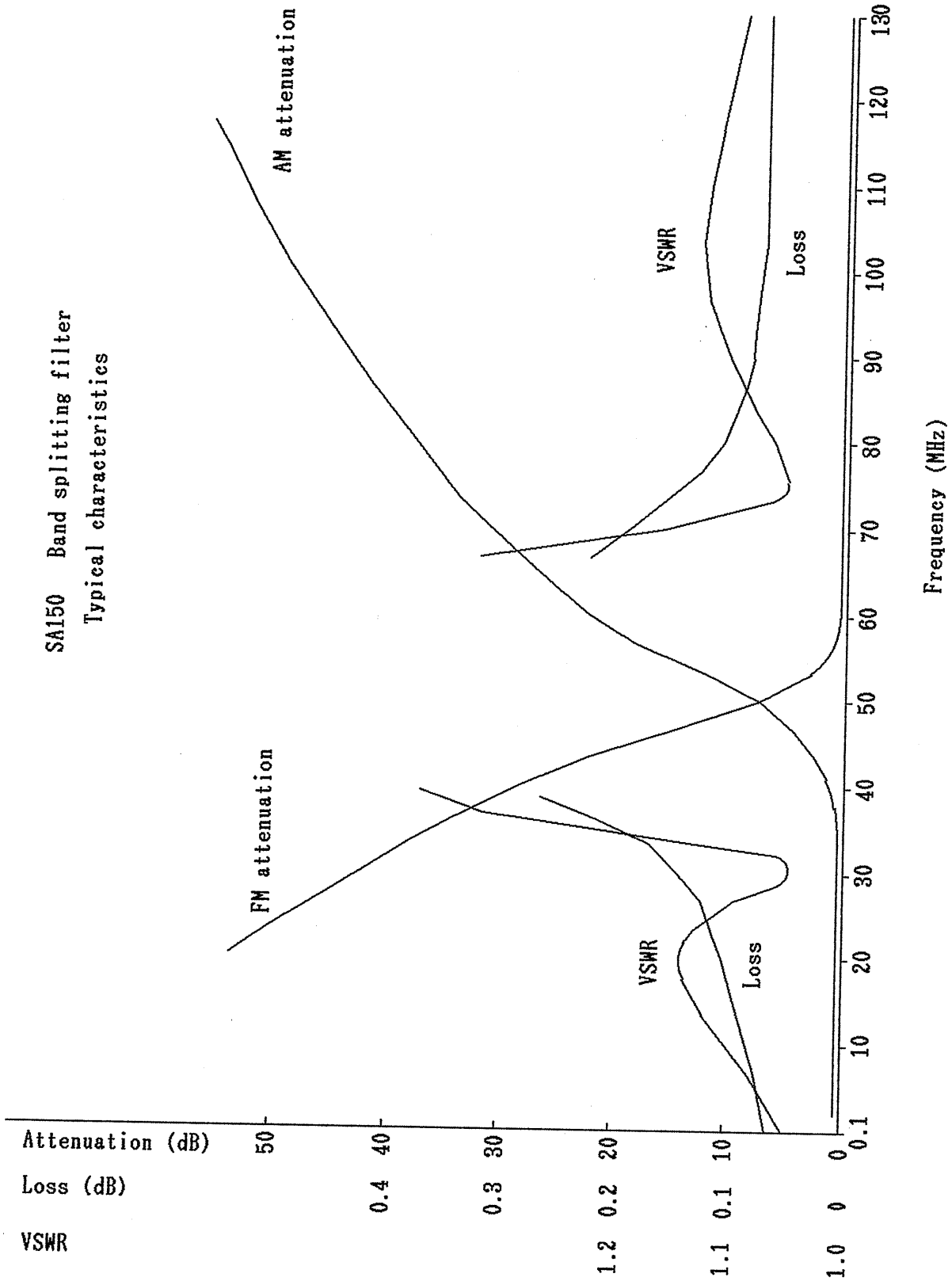


Fig. 9-2

Fig. 9-3


SA150 Band splitting filter
Typical characteristics
AM attenuation
FM attenuation
VSWR
Loss
VSWR
Loss
Attenuation (dB)
Loss (dB)
VSWR
Frequency (MHz)
50
40
30
20
10
0
0.4
0.3
0.2
0.1
0
1.2
1.1
1.0
0.1
10
20
30
40
50
60
70
80
90
100
110
120
130

(2) SA150 application example

The SA150 outputs separate signals by the combination of HPF and LPF. The control signal output from RANGE OUTPUT on the rear panel of KSG4500A need not be used.
Figure 9-4 shows an example application of the SA150.

The SA150 can be used with little error when the input signal frequency is less than 30 MHz or between 75 MHz and 110 MHz; the error increases in other ranges. (See Figure 9-2 for the external appearance and Figure 9-3 for typical characteristics.)

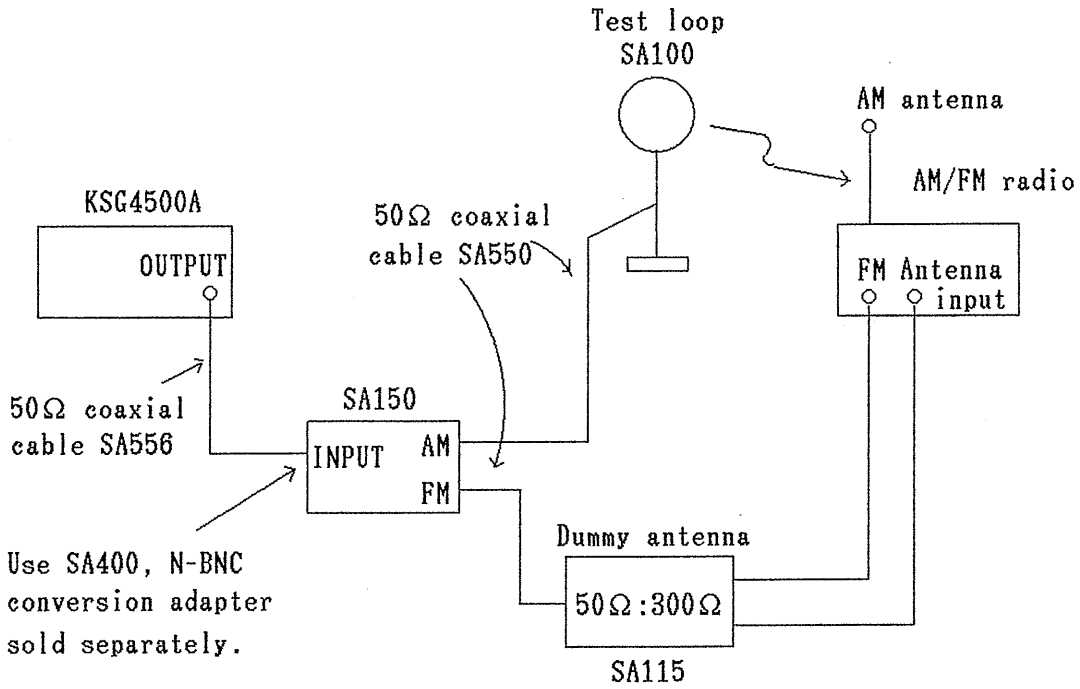


Fig. 9-4

9.3 SA151 and SA152 Dummy Antennas for Car Radios

The SA151 and SA152 dummy antennas comply with JIS C6102-1988, and they are used for testing car radios.

Switching between AM and FM dummy antennas is done automatically by the RANGE OUTPUT control signal from the rear panel of KSG4500A.

SA151: AM output impedance = 80Ω
FM output impedance = 75Ω
(Loaded type)
SA152: AM output impedance = 80Ω
FM output impedance = 75Ω
(Open-circuit type)

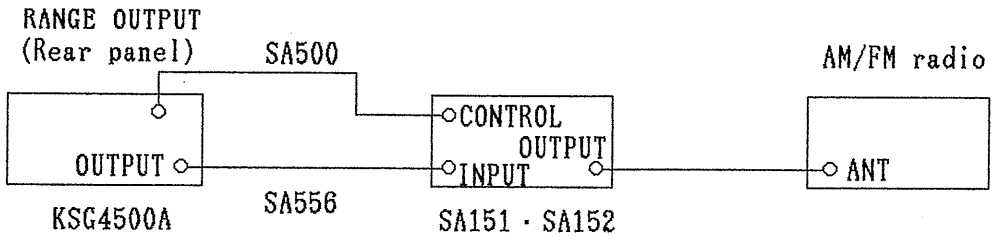


Fig. 9-5 Connection example

9.3.1 SA151 dummy antenna for car radio (loaded type)

(1) Performance

Input frequency range:	50 kHz to 200 MHz
Input impedance:	50Ω (BNC-J type connector)
VSWR:	1.2 or less
Output impedance:	AM: 80Ω
	FM: 75Ω
Control signal:	AM: 0V
	FM: 5V, 50mA or less
Control terminal:	Audio pin connector (RCA type)
Accessory:	SA500 (Single-core shielded cable with RCA-type pin plugs at both ends. Length = 0.8m)

(2) Dummy antenna circuit diagram

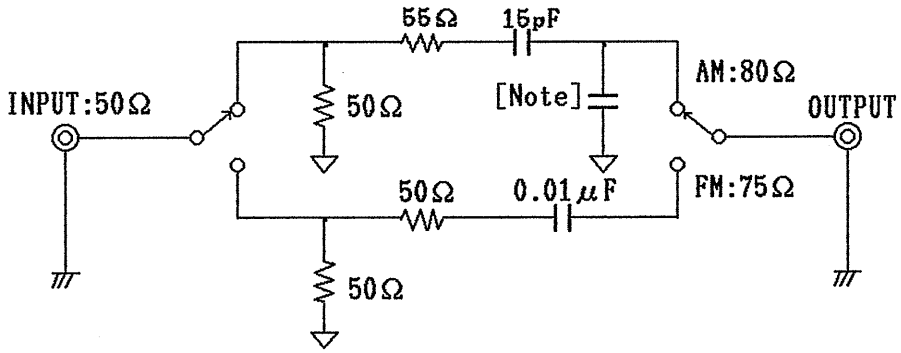


Fig. 9-6

[Note] Adjust the load capacitance to 60pF including the stray capacity of the antenna cable connected to car radio. (Actually, a capacitor of 30pF is mounted.)

(3) Outline drawing

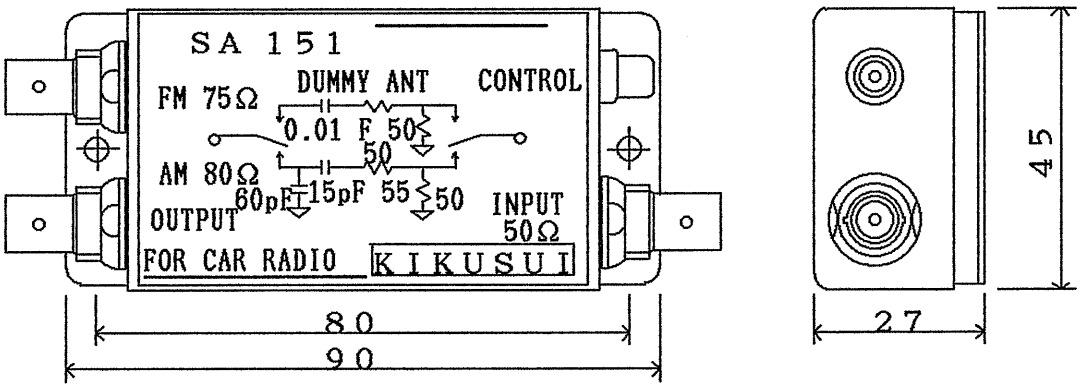


Fig. 9-7

9.3.2 SA152 dummy antenna for car radio (open-circuit type)

(1) Performance

Input frequency range:	50 kHz to 200 MHz
Input impedance:	50Ω (BNC-J type connector)
VSWR:	1.2 or less

Output impedance:	AM: 80Ω
	FM: 75Ω
Control signal:	AM: 0V
	FM: 5V, 50mA or less
Control terminal:	Audio pin connector (RCA type)
Accessory:	SA500 (Single-core shielded cable with RCA-type pin plugs at both ends. Length = 0.8m)

(2) Dummy antenna circuit diagram

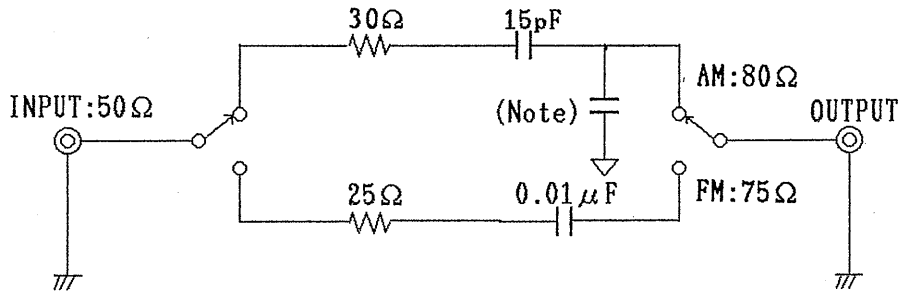


Fig. 9-8

[Note] Adjust the load capacitance to 60pF including the stray capacity of the antenna cable connected to car radio. (Actually, a capacitor of 30pF is mounted.)

(3) Outline drawing

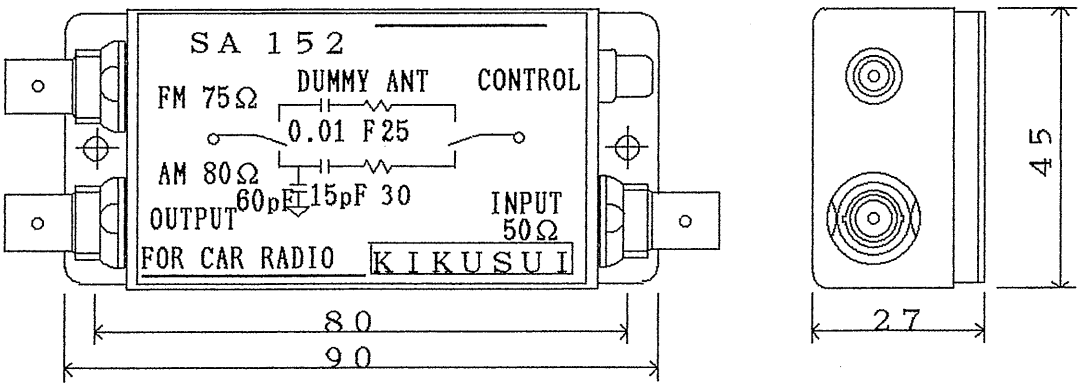


Fig. 9-9

9.4 SA153 Output Switch and SA154 Output Impedance Switch

The SA153 is used for a test loop antenna in AM band and for a 50Ω:300Ω dummy antenna in FM band. The SA154 is used for a test loop antenna in AM band and for a 75Ω:300Ω dummy antenna in FM band.

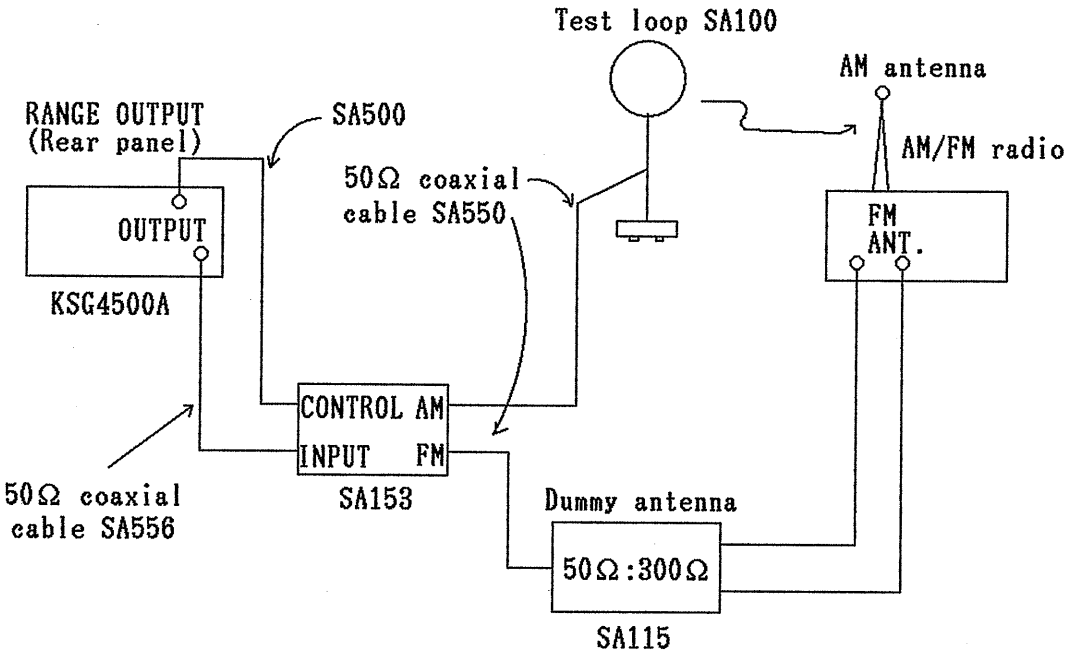


Fig. 9-10 SA153 connection diagram

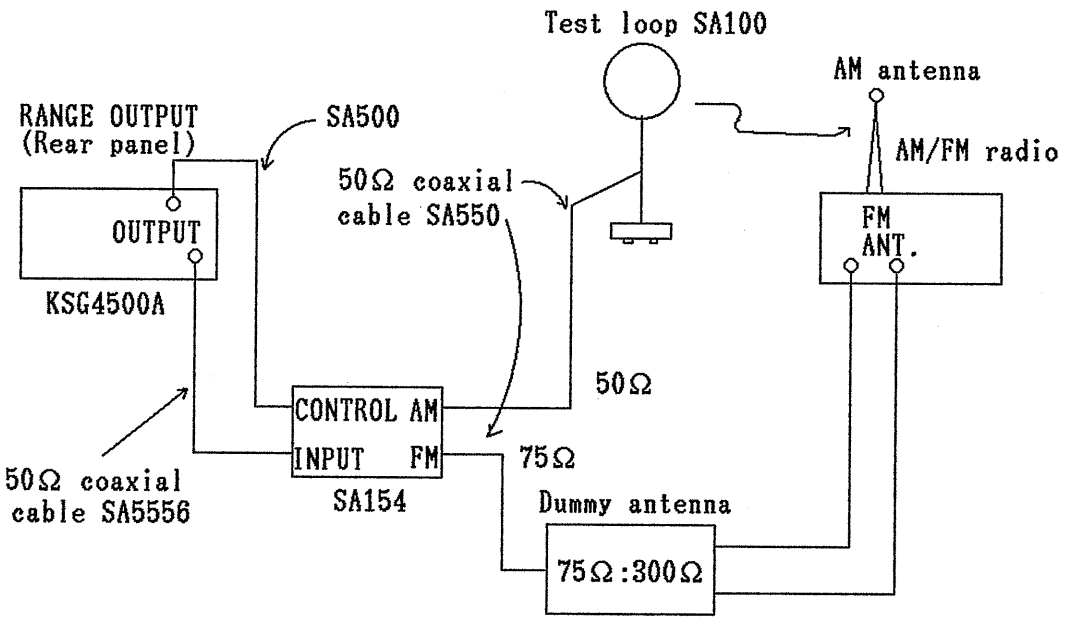


Fig. 9-11 SA154 connection diagram

(1) Performance (SA153 Output Switch and SA154 Output Impedance Switch)

Input frequency range:	DC to 200 MHz
Input impedance:	50Ω (BNC-J type connector)
VSWR:	1.2 or less
Output impedance:	
SA153	AM: 50Ω (for test loop)
	FM: 50Ω (for 50Ω:300Ω dummy antenna)
SA154	AM: 50Ω (for test loop)
	FM: 75Ω (for 75Ω:300Ω dummy antenna)
Control signal:	AM: 0V
	FM: 5V, 50mA or less
Control terminal:	Audio pin connector (RCA type)
Accessory:	SA500 (Single-core shielded cable with RCA-type pin plugs at both ends. Length = 0.8m)

(2) Output switch and impedance switch circuit diagrams

SA153

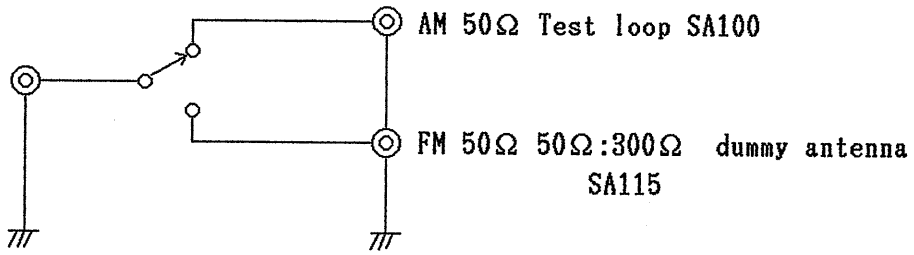


Fig. 9-12

SA154

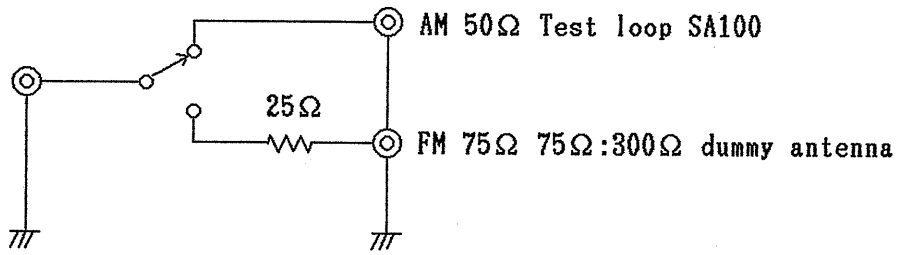


Fig. 9-13

(3) Outline drawing

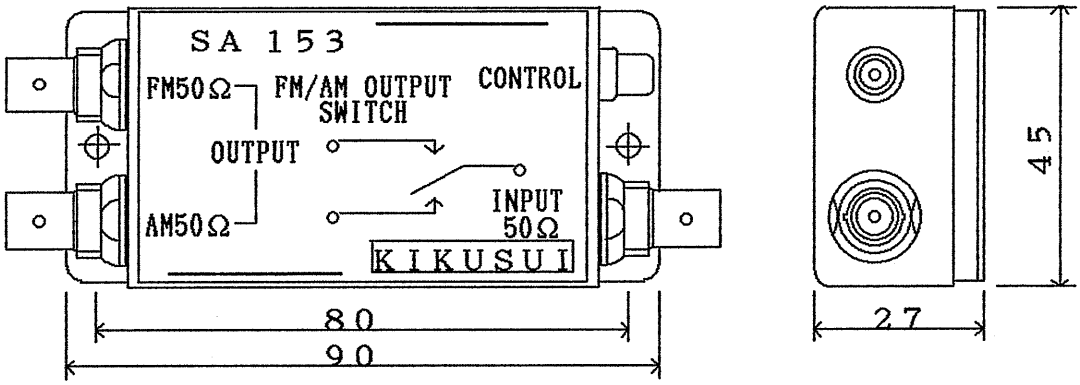


Fig. 9-14 Outline drawing

Note: When using the SA150, SA153, or SA154, do not connect the 50Ω:75Ω dummy antenna for AM band and 50Ω:300Ω balanced dummy antenna for FM band to an AM/FM radio as shown in Figure 9-15 because the balance of the dummy antenna for FM band is lost at point "a".

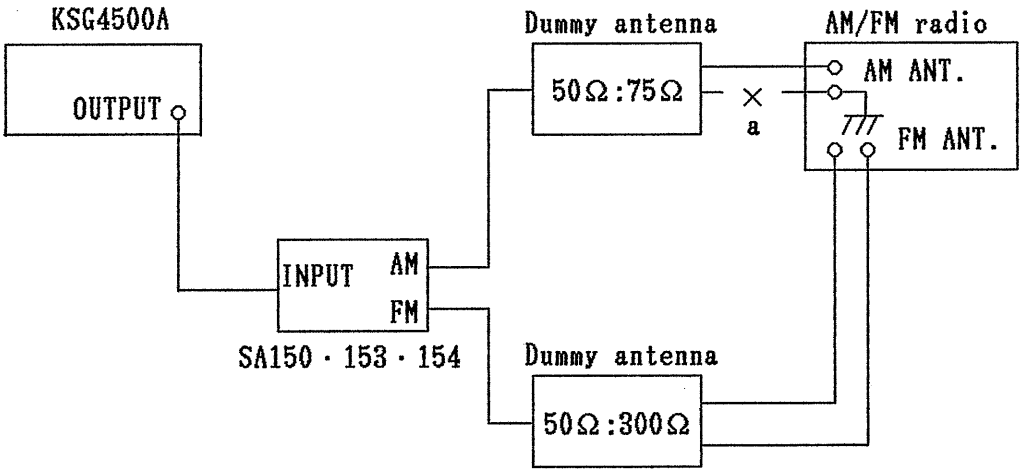


Fig. 9-15