OPERATION MANUAL

FM/AM SIGNAL GENERATOR

KSG4500

Fourth Edition

KIKUSUI ELECTRONICS CORPORATION

(KIKUSUI PART NO. Z1-477-920)

M-94073

For the power supply source, it is requested that the related sections in the operation manual be replaced with the following items:
(Please apply those items indicated with checks)

☐ Power Supply Voltage: to _____ V AC

☐ Line Fuse: to _____ A

☐ Powre Cable: to 3-core cable (See Fig.1 for the colors.)

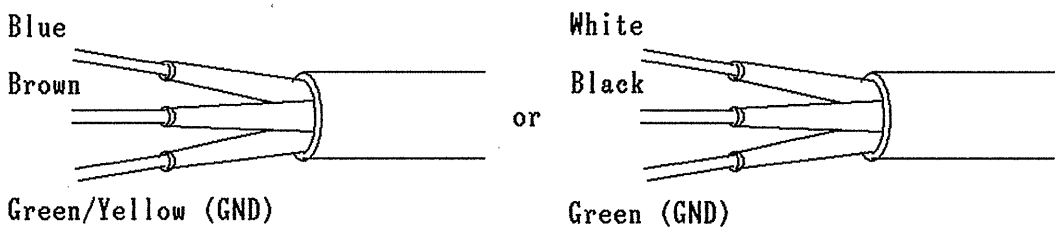

Fig. 1

Please be advised that the above changes may result in some discrepancies with the explanations or circuit diagrams in the operation manual.

*AC Plug: In the case of a line voltage of 125V AC or more, in principal, the AC plug is delivered removed from the cable for safety reasons.
(AC plugs used on 3-core cables are removed regardless of the input voltage.)

Before using the instrument, it is requested that a plug be attached that is suitable for the voltage used.

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1. INTRODUCTION

1.1 General Description

The KSG4500 is an FM/AM signal generator that covers the frequency of 100kHz to 1040MHz (RF output 1060MHz). Since it generates highly stable signals with the resolution of 100Hz by the use of Phase Lock Loop (PLL), it is suitable for measuring the characteristics of MCAs, personal radios, car telephones, UHF/VHF TV, TV video, TV sounds, and various receivers of FM and AM bands. It can be operated easily as it adopts recall and numeric data entry methods.

The output level at open circuit ranges from −20.0dBμ to 126.0dBμ (0.1μV to 2V rms), and the resolution of output signal is 0.1dB. As to the unit of output signal level, dBμ at loaded, EMF dBμ at open circuit, or dBm can be selected by a unit key. Further, the loss caused by an additional item, suchas a dummy antenna or a transmission line, can be offset.

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

Since the KSG4500 gives a very low FM distortion rate of 0.02% or less (for 1kHz modulation frequency, 75kHz deviation and 75 to 110MHz RF), it is suitable for the adjustment of FM tuners and it can be used for the development and production of MCAs, personal radios, car telephones, and audio/video circuits of UHF/VHF TV sets.
Also, the frequency modulation by external DC coupling is possible.

The AM external modulation range is from 50Hz to 10kHz 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 double side band, and the signals equivalent to TV broadcast radio waves 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.

A recall method (100 memory points) is used for operation, and numeric data entry, 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 also provided for control of all operations possible from the panel. Since the standard model of KSG4500 supports the GP-IB control, it reduces labor on production lines.

1.2 Features

1) The carrier frequency can be specified with a 8-digit number, and the value of a desired digit (designated by cursor) can be changed continuously by a rotary knob. Also, the KSG4500 has the △FREQ (frequency difference) display function and the [illegible] function to check selectivity.

2) The output level can be selected from a wide range of −20dBμ to 126dBμ (open circuit), and it can be specified with a 4-digit number in units of 0.1dB. Also, an output level ON/OFF function is provided.

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 3.5kHz, 22.5kHz, and 75kHz 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 double side bands can be done, and high frequency signals equivalent to TV broadcast radio waves can be obtained simply by the input of video signal and audio IF signal. Also, in the external DC · FM mode, the DC-coupled frequency modulation can be done.

5) The KSG4500 gives small modulation distortion, high S/N ratio, and good stereo characteristic.

6) All the information displayed on panel can be memorized; The memory can be used in units of 10-point blocks or as a continuous space of 100 points.

7) The KSG4500 can be operated easily because all the operations are controlledby 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 KSG4500 to that of another KSG4500 by the pressing of DUMP key.

10) The panel operation can be done in remote control mode.

11) The KSG4500 has a GP-IB interface.

12) Since the KSG4500s can be connected to one another in chain mode by the refernce frequency input and output connectors (10MHz) provided on them, the relative error of the measured frequency can be reduced to zero.

2. SPECIFICATIONS

○ Frequency (RF)

Range : 100kHz to 1040MHz (Setable 0 to 1060MHz)

Resolution : 100Hz

Accuracy : Same as reference oscillator

Display : 8-digit readout, ΔFREQ display, and
± frequency inversion function

○ Reference oscillator

Frequency : 50MHz

Stability : Temperature $\pm 5 \times 10^{-6}$
: Aging rate $\pm 2 \times 10^{-6}$/Week
: Refer to the High stability crystal oscilloator
(Options, on page 12)

Reference signal output
Output frequency : 10MHz
Output level : ≧0.15Vrms 50Ω termination

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

○ RF Output

Range :Maximum output

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

:Minimum output

Unit	100kHz to 130MHz	130 to 1040 MHz
EMF dBμ	−20dBμ	−10dBμ
dBμ	−26dBμ	−16dBμ
dBm	−133dBm	−123dBm

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 : 0.1dB

Display : 4-digit readout that can be read directly in each one of the three unit types
△ dB display and any desired offset value display

The unit of EMF dBμ, abbreviated as dB, is applied to all the following description:

Standard level accuracy : At the output level of 120dB (7dBm)
1) ±1dB RF ≧ 130MHz
2) ±2dB RF < 130MHz

Attenuator accuracy : 1) ±1dB Output ≧ 20dB (−93dBm)
2) ±1.5dB Output ≧ 0dB (−113dBm)
3) ±2dB Output < 0dB (−113dBm)

RF.ON/OFF : Output level can be turned ON/OFF by RF.OFF key.

Output impedance : 50Ω N type connector

VSWR : ≦ 1.5 Output level ≦ 100dB (−13dBm)

Reverse power protection: Maximum 25W, 25V DC

Spurious signals (Fundamental wave = 0dBc)

Harmonics : ≦ −25dBc Output ≦ 120dB (7dBm)
Except Modulation mode 2 (VIDEO modulation)

Non-harmonics : At Modulation OFF, offset carrier ±5kHz
: ≦ −60dBc
Except 516.6, 525, 533.3±5MHz, 597±15MHz,
750±2MHz, frequency 1/2 and 1/4
: ≦ −55dBc
550, 850±2MHz

SSB phase noise : ≦ −110dBc/Hz
At CW mode, offset carrier 20kHz

Residual modulation (S/N)

FM component :

Frequency	Demodulation band width		
	0.3 to 3kHz	50Hz to 15kHz	0.3 to 15kHz Deemphasis=50μs
	3.5kHz deviation	Ratio to 75kHz deviation	
10.7,75 to 110MHz		≦7.5Hz (80dB)	≦3.8Hz (86dB)
127.5 to 260MHz	≦ 3Hz (61dB)	≦ 4Hz (85dB)	
260 to 520MHz	≦ 6Hz (55dB)	≦ 8Hz (79dB)	
0.1 to 1040MHz	≦12Hz (50dB)	≦16Hz (73dB)	

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

○ Modulation

Modulation mode 1 : Selection can be made from the following signal sources for FM, AM and FM-AM simultaneously:

1) External
2) Internal 400Hz
3) Internal 1kHz
4) External DC・FM

Note: For the simultaneous modulation, only one external modulation source is allowed to be used.

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

External modulation

1) Input impedance : 10kΩ approx. (unbalanced)

2) Input voltage requirement for external modulation : 3Vp-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 modulation input impedance : 75Ω approx. (unbalanced)

2) Input voltage requirement for VIDEO modulation : 1Vp-p approx.

3) Input voltage requirement for SIF modulation : 0.5Vp-p approx.

4) VIDEO modulation characteristics : ±3dB 10Hz to 15MHz (double side-band AM modulation)

5) SIF modulation signal requirement : Frequency modulation signal (4.5 to 6.5MHz frequency bandwidth)

6) Output level accuracy : ±3dB (at VIDEO modulation)

[FM]

Maximum frequency deviation range and resolution

(Guaranteed ranges ≦ 400kHz)

Frequency	5 to 127.5MHz		127.5 to 260MHz	
Freq. deviation	0 to 99.9kHz	100 to 500kHz	0 to 25.0kHz	26 to 125kHz
Resolution	100Hz	1kHz	100Hz	1kHz

Frequency	260 to 510MHz		520 to 1040MHz	
Freq. deviation	0 to 50.0kHz	51 to 250kHz	0 to 99.9kHz	100to 500kHz
Resolution	100Hz	1kHz	100Hz	1kHz

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

Display : 3-digit readout

Accuracy : ±5% of maximum frequency deviation

External modulation frequency characteristics : ±1dB 20Hz to 100kHz, 1kHz reference

Distortion of internal modulation : For Demodulation band width = 300Hz to 15kHz, Deemphasis = 50μs, Modulation frequency = 1kHz, and Deviation = 75kHz
≦ 0.02% (RF 10.7 ±1MHz, 75 to 110MHz)
≦ 0.1% (Other RF values)

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

Incidental AM : For Demodulation band width = 300Hz to 15kHz, Modulation frequency = 1kHz, Deviation = 75kHz and RF > 5MHz
≦ 0.5%

DC · FM mode
Frequency accuracy : ±(Reference frequency+2kHz)

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

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

[AM]
Settable : 0 to 99.9%
Depth : 0 to 80% Output ≦ 120dB (7dBm)

Resolution : 0.1%

Display : 3-digit readout

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

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

Distortion of internal and external modulation : For Demodulation band width = 50Hz to 15kHz, and Depth = 30%
≦ 0.5% (RF = 400kHz to 1.7MHz)
≦ 1.5% (Other RF values)

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

○ Setting Functions : 1) The numeric keys and rotary knob (with cursor designation) for specifying carrier frequency, output level, modulation level, and memory.
2) Step keys for specifying carrier frequency, output level, and modulation level.
3) Preset keys for specifying 3.5kHz, 22.5kHz, and 75kHz (for FM) and 30% (for AM).

○ Memory Function : 1) 100 point for carrier frequency, output level, modulation level, modulation mode, etc.
2) The memory can be used in blocks of 10 points 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, and modulation level can be stored/recalled, the carrier frequency and output level can be incremented/decremented by steps or continuously by rotary knob, modulation can be turned ON/OFF, etc.

- GP-IB Interface : SH0, AH1, T0, L1, SR0, RL1, PP0, DC1, DT0, C0

- Range Out (dummy antenna switching output):

  "1" (5V MAX 50mA) for RF $\geqq$ 35MHz
  "0" (0V) for RF $<$ 35MHz

- Leakage Field Strength : The measurement of 0dB (1μV) is not affected. Or 1μV or less at 50Ω termination voltage when the leakage field strength is measured by a two-turn loop antenna of 25mm diameter placed 25mm apart from the front panel.

- Backup Battery is provided.

Power Source : AC 100, 115, 215, 230V ±10%
(selected by a switch on rear panel)

Frequency : 50Hz/60Hz

Power dissipation : Approx. 70VA

- 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) × 4.69(H) × 17.91(D) in.)

Weight : Approx. 13kg (29 lbs)

○ 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	: Ouptut cable (SA556)	1	N type 5D-2W
	: Power supply cord	1	
	: Fuse (3.0A)	1	
	: Fuse (1.5A)	1	
	: Operation manual	1	

○ Options

1) High stability reference crystal oscillator (Factory-installed option)

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

2) External reference frequency modification (Factory-installed option)
The standard model of KSG4500T supports the reference signal input frequency of 10MHz, but it can be changed to the following 5MHz or 1MHz

a) 5MHz±100Hz (±0.002%)

b) 1MHz±20Hz (±0.002%)

3. PREPARATION FOR USE

3.1 Unpacking and Inspection

Before being shipped from the factory, the KSG4500 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 pulg on the rear panel of KSG4500, and the instrument can be used in the selected voltage range.

Before connecting the power supply cord to the instrument, verify that the voltage selection is matched to the power source. When the voltage range is changed, change the fuse also according to the table below.

Application of a voltage beyond the selected range will cause in complete operation or failure.

Setting Position	Center Voltage	Line Voltage Range	Fuse
A	100V	90 - 110V	3.0A
B	115V	104 - 126V	
C	215V	194 - 236V	1.5A
D	230V	207 - 253V	

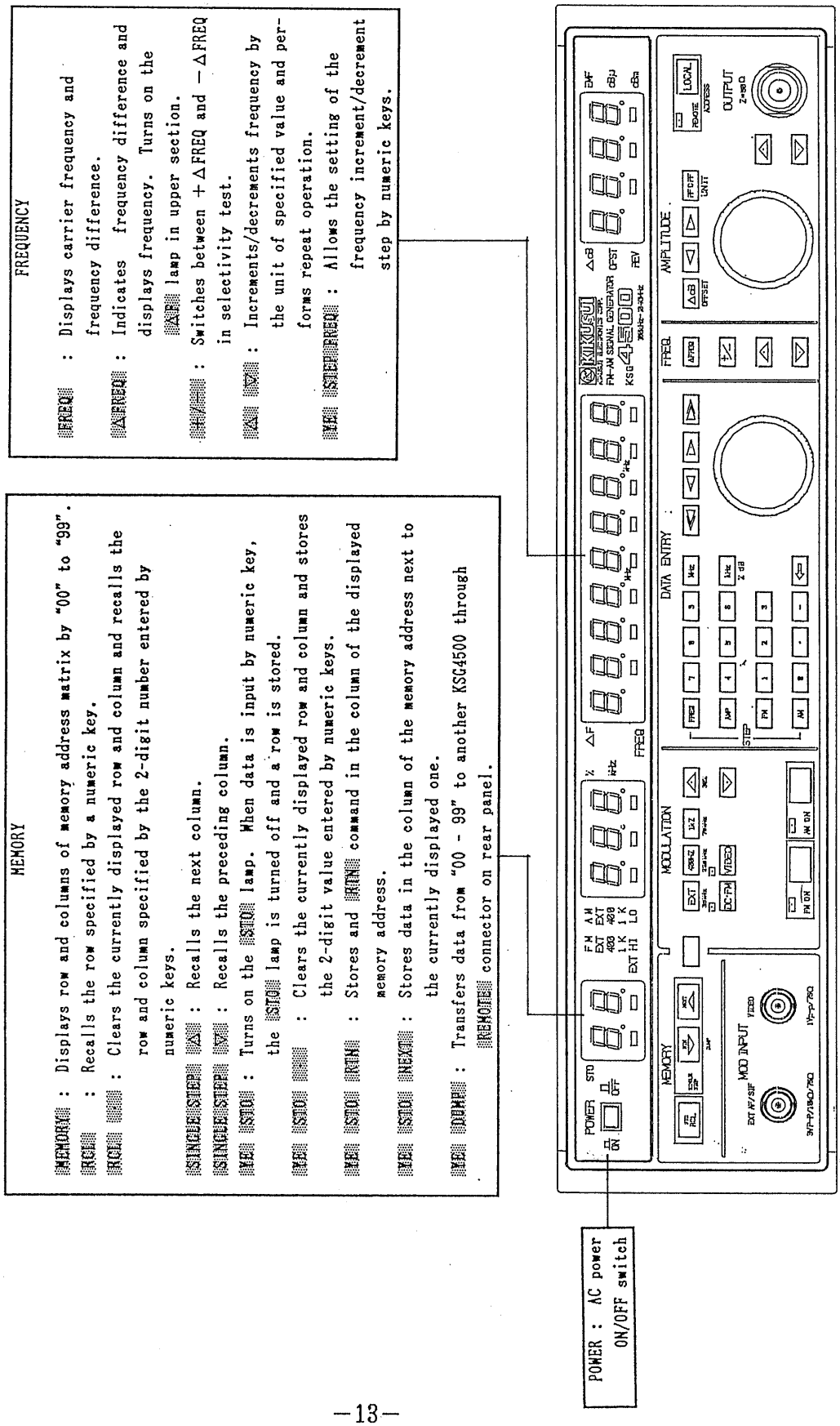
3.3 Surrounding Temperature/Humidity, Warm-up Time, and Installation Place

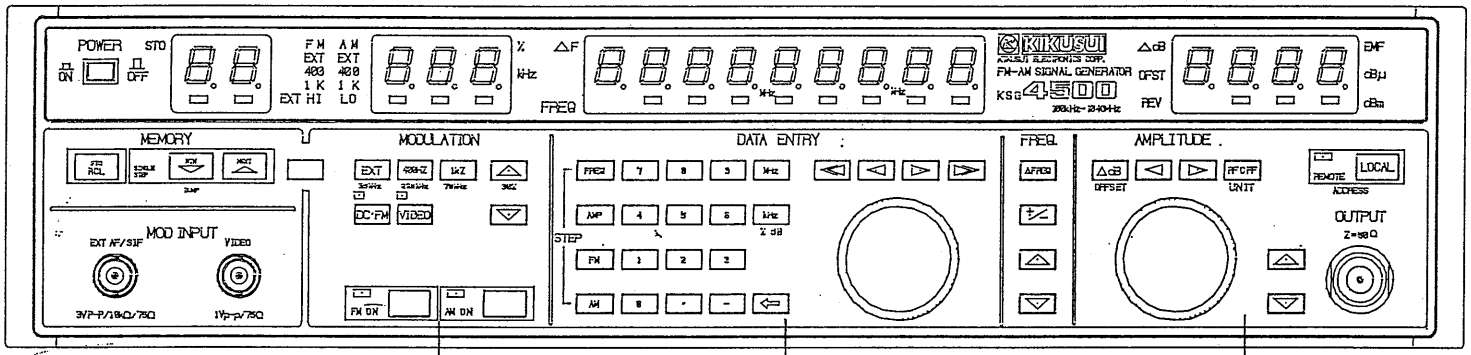
The KSG4500 operates correctly in temperatures from 0 to 40°C (32 to 104°F). If the instrument is used or placed under high temperature and humidity for a long time, failures will occur and the life of the instrument will be shortened.

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

SPCL : Sets additional function mode. The lamp goes on, and the MODULATION display enters the SPCL display mode.

MODULATION : Displays FM/AM modulation rate by three digits

MOD INPUT : External modulation input connector for FM or AM single signal.

FM EXT 400 1K : Display FM mode

AM EXT 400 1K : Display AM mode

EXT HI LO : Indicates external modulation input level range. The range is normal when HI LO is off.

% : Indicates AM depth by the unit of 0.1%.

kHz : Indicates FM frequency deviation by the unit of 10Hz.

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

DC FM : Sets DC · FM modulation mode.

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

FM ON : Turns ON/OFF FM modulation.

AM ON : Turns ON/OFF AM modulation.

YE 1.75kHz 3.5kHz 22.5kHz : Presets FM deviation at 1.75kHz, 3.5kHz or 22.5kHz.

YE 30% : Presets AM depth at 30%.

DATA ENTRY

DATA ENTRY : Keys to input numeric values directly and 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 : Allows the setting of FM deviation by numeric keys.

AM : Allows the setting of AM depth by numeric keys.

Numeric keys (0～9, · , −) : Enter numeric values.

GHz MHz kHz : Enter units.

⇦ : Back space (BS) key. Correct data input error or displays center frequency when △FREQ function is used.

◁◁ ▷▷ : Move cursor into block.

◁ ▷ : Move cursor within block.

Rotary knob : Modifies the value at cursor position.

AMPLITUDE

AMPLITUDE : Displays RF output level by four digits.

△dB : Displays difference of output level.

◁ ▷ : Moves cursor.

RF OFF : Turns ON/OFF output level.

LOCAL : Releases 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.

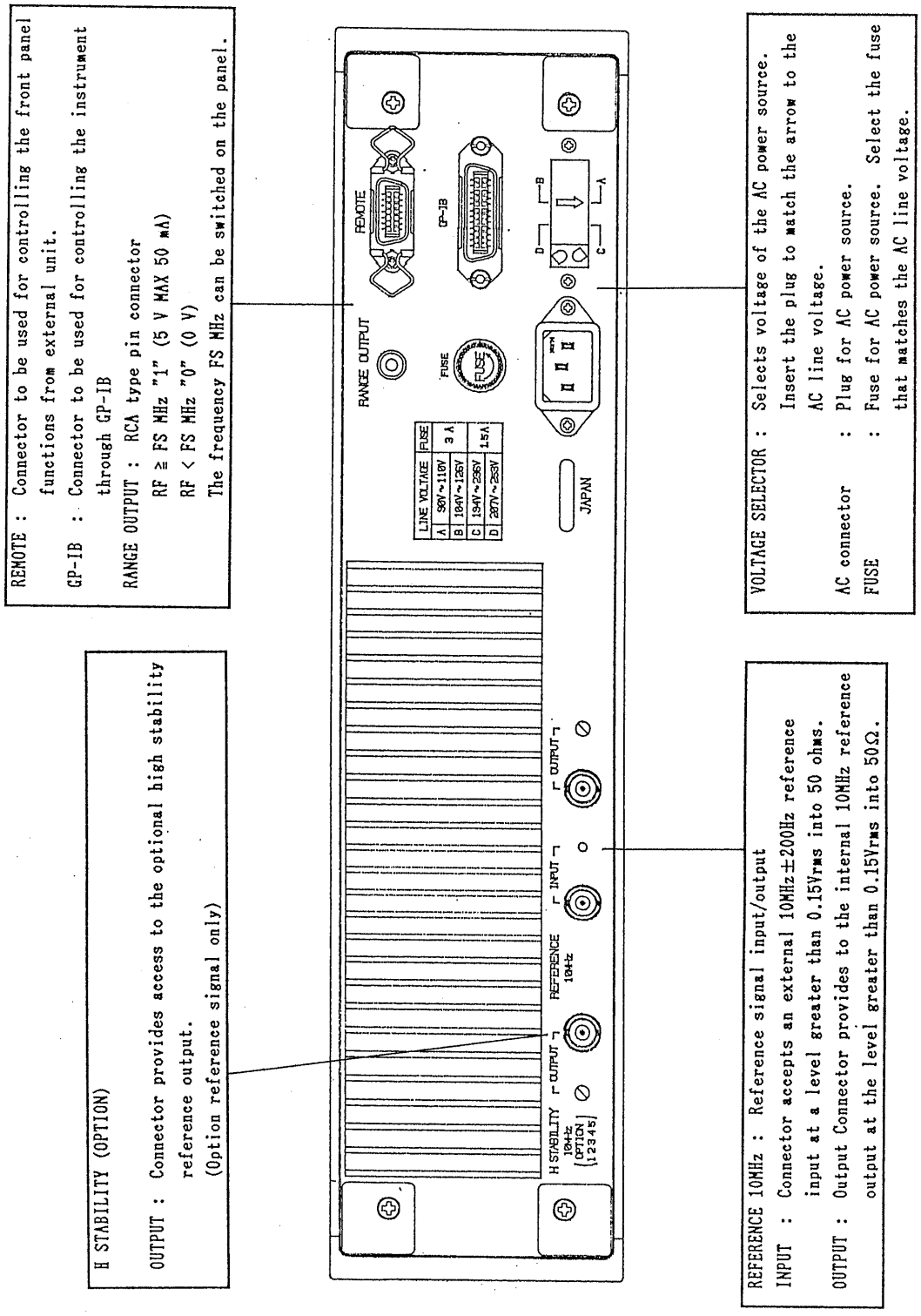
OUTPUT : N type connector for RF output.
−20.0dBu to 126.0dBu at open circuit.
The signal source impedance is 50Ω.

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

YE OFFSET : Displays the offset for dummy antenna, etc.

YE ADDRESS : Displays GP-IB address.

4.2 Rear Panel Features

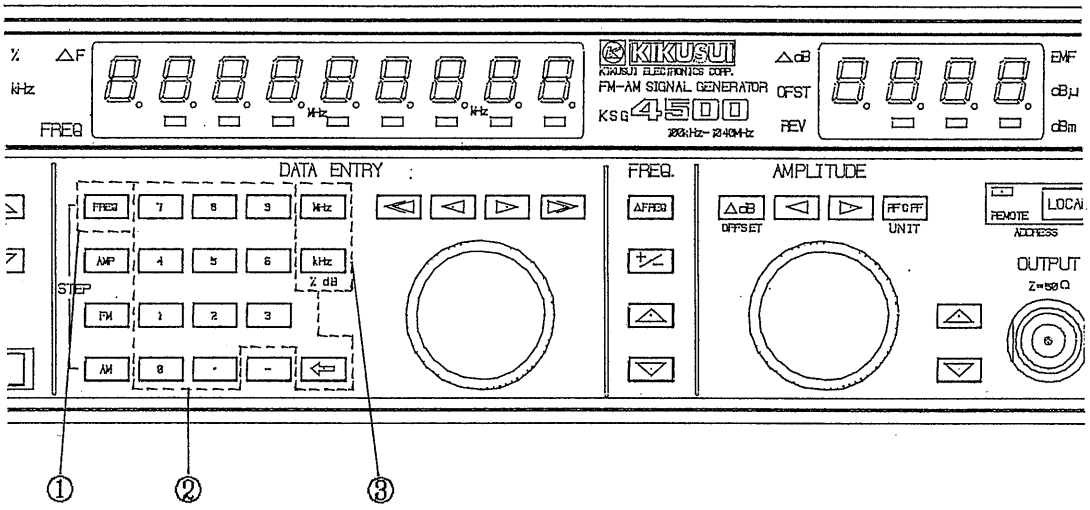


4.3 Turning on the power supply

Connect the power supply cord to the power source of the selected voltage and press the POWER switch. All the LEDs on front panel come on and then the status found before the power was turned off is displayed.

4.4 Setting Frequency

4.4.1 Setting frequency by numeric keys



Press the FREQ key and enter a desired value by numeric keys (0～9, ·). 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 found before the FREQ key was pressed is displayed.

Press the MHz or kHz key on completion of the numeric key entry, and the specified value is displayed in the [FREQUENCY] section correctly. The maximum number of digits for the input value is 8; a value of more than eight digits is not accepted. The range of the frequency that can be specified is 0 to 1060MHz. Since the frequency resolution of the instrument is 100Hz, a value less than 100Hz 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 the AMP, FM, or AM key has not been pressed after the unit key (MHz or kHz) is pressed, a different frequency can be set only by the numeric keys and unit key without the necessity of pressing the FREQ key.

(a) Example: 123.4567MHz is input.

× ..... 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 ␣	
MHz	␣123.456.7	

(b) Example: 455kHz is input.

Key operation	FREQUENCY display
FREQ	␣123.456.7
4	4␣␣␣ ␣␣␣ ␣
5	45␣␣ ␣␣␣ ␣
5	455␣ ␣␣␣ ␣
kHz	␣␣␣␣ 455.0

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

Key operation		FREQUENCY display
FREQ		␣␣␣␣ 455.0
1		1␣␣␣ ␣␣␣ ␣
2	"2" was pressed for "1" by mistake	12␣␣ ␣␣␣ ␣
⇦		1␣␣␣ ␣␣␣ ␣
1		11␣␣ ␣␣␣ ␣
MHz		␣␣11.000.0

If a numeric key is pressed by mistake as in the above example, the character of the pressed key can be deleted by the pressing of ⇦ key. If the ⇦ is pressed continuously, all the displayed characters are deleted and the previous value is displayed.

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

Key operation		FREQUENCY display
FREQ		␣␣11.000.␣
8		8␣␣␣ ␣␣␣ ␣
6	"6" was pressed for "5" by mistake	86␣␣ ␣␣␣ ␣
.		86.␣ ␣␣␣ ␣
7		86.7 ␣␣␣ ␣
⇦	Press twice	86␣␣ ␣␣␣ ␣
⇦	Press twice	␣␣11.000.0

If the ⇦ key is pressed before the key (MHz or kHz), the previous frequency is displayed.

8	8␣␣␣ ␣␣␣ ␣
5	85␣␣ ␣␣␣ ␣
.	85.␣ ␣␣␣ ␣
7	85.7 ␣␣␣ ␣
MHz	␣␣85.700.0

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

Key operation	FREQUENCY display
FREQ	␣␣85.700.0
1	1␣␣␣ ␣␣␣ ␣
1	11␣␣ ␣␣␣ ␣
MHz	␣␣11.000.0
1	1␣␣␣ ␣␣␣ ␣
MHz	␣␣␣1.000.0

If an error is found after the unit key is pressed as in the above example, the correct frequency can be input without pressing the FREQ key again.

4.4.2 Rotary knob

The rotary knob increases or decreases the value of the digits at and above the cursor position in the [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.
There is no need to set the MHz or kHz unit keys when making setting with the Rotary knob.

(a) Example: To change frequency from 100MHz to 100.02MHz

The mark "_" denotes the cursor position

Key operation		FREQUENCY display
		␣100.000.0
<<	Press once	␣100.00_0.0
	Turn the rotary knob clockwise by two steps	␣100.02_0.0

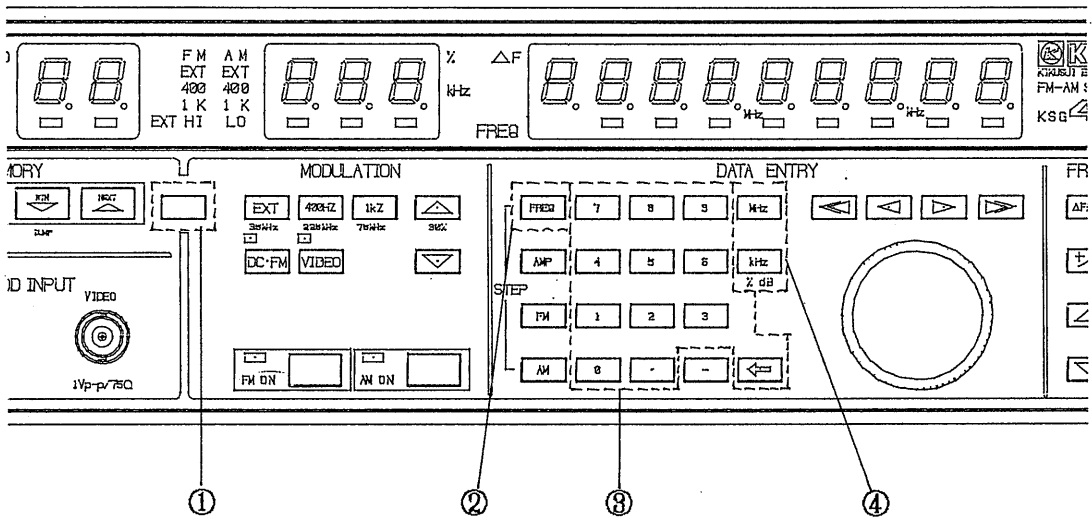
(b) Example: To change frequency from 100.02MHz to 98.02MHz

Key operation		FREQUENCY display
		␣100.02_0.0
<<	Press twice	␣10_0.020.0
	Turn the rotary knob counterclockwise by two steps	␣␣98_.020.0

4.4.3 Setting frequency step for △ and ▽ keys

Set a desired step value (minimum 100Hz) for the [FREQUENCY] △ and ▽ keys, and the frequency can be incremented or decremented by the unit of that value.

In setting the value, the cursor position in the [FREQUENCY] display section may be ignored.



Input 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. This key functions as a shift key; the function of a yellow key on the panel pressed after the [YE] key is different from that of the same key pressed without [YE] key.

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

Key operation		FREQUENCY display
[YE]		␣␣␣1.000.0
[STEP FREQ]		␣␣␣1.000.0
[9]		9␣␣␣ ␣␣␣ ␣
[kHz]		␣␣␣1.000.0
[△]	Press once	␣␣␣1.009.0

Keep pressing the [△] or [▽] key in the [FREQUENCY] section, and the repeat function is applied to keep increasing or decreasing the frequency by the unit of 9kHz.

4.4.4 Frequency difference [ΔFREQ] and [+/−] keys

The [ΔFREQ] function, to check the value of change in frequency, is useful for measuring the band width of a receiver.
When the [ΔFREQ] key is pressed, the [ΔF] indicator in the [FREQUENCY] display section is turned on and the frequency difference (ΔFREQ) is displayed.

(a) Example: 100MHz is set currently.

Key operation	FREQUENCY display	
[YE]	×××× ××× ×	
[STEP FREQ]	×××× ××× ×	
[1]	1␣␣␣ ␣␣␣ ␣	
[0]	10␣␣ ␣␣␣ ␣	
[0]	100␣ ␣␣␣ ␣	
[kHz]	×××× ××× ×	
[FREQ]	×××× ××× ×	
[1]	1␣␣␣ ␣␣␣ ␣	
[0]	10␣␣ ␣␣␣ ␣	
[0]	100␣ ␣␣␣ ␣	
[MHz]	␣100.000.0	
[ΔFREQ]	␣␣␣␣ 100.0	ΔF indicator comes on
[FREQUENCY] [▽]	−␣␣␣ 100.0	Carrier frequency 99.9MHz
[⇦]	␣␣␣␣ ␣␣0.0	

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 100kHz.
If the [⇦] key is pressed in the above example, the carrier frequency returns to the initial value (center value).

(b) Example: 100MHz is set currently.

Key operation		FREQUENCY display	
		␣100.000.0	
ΔFREQ		␣␣␣␣ ␣␣0.0	ΔT indicator comes on.
◁	Press three times	␣␣␣␣ ␣␣0.0	
	Turn the rotary knob counter-clockwise by five steps	−␣␣5.000.0	Carrier frequecy 95MHz
ΔFREQ		␣␣95.000.0	

To release the ΔFREQ function, press the ΔFREQ key again.
In the above example, the carrier frequency effective after the release is 95MHz.

(c) Example: Using +/− key after modification of 100MHz by ΔFREQ

Key operation	FREQUENCY display	
	␣100.000.0	
ΔFREQ	␣␣␣␣ ␣␣0.0	ΔT indicator comes on.
2	2␣␣␣ ␣␣␣ ␣	
0	20␣␣ ␣␣␣ ␣	
0	200␣ ␣␣␣ ␣	
kHz	␣␣␣␣ 200.0	Carrier frequency 100.2MHz
+/−	−␣␣␣ 200.0	Carrier frequency 99.8MHz
ΔFREQ or FREQ	␣␣99.800.0	ΔF indicator in turned off.

4.4.5 Reference signal input/output terminals

(1) Referece signal output (REFERENCE OUTPUT)

The REFERENCE OUTPUT terminal outputs a reference signal (Frequency = 10MHz; Voltage = 0.15Vrms or higher).

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

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 indicator is on after a signal is input to the reference signal input terminal (REFERENCE INPUT).
The half-fixed resistor is set to the standard value before the instrument is shipped from the factory. Do not change value.

(2) Reference signal input (REFERENCE INPUT)

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

When this reference signal is applied, the LED indicator on the right side of the input connector is turned on and the frequency of the internal reference signal is locked to the frequency 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, high accuracy can be obtained and the relative difference in frequency among the connected instruments can be reduced. The reference input frequency can be changed to 5MHz or 1MHz by option.

(3) High stability standard crystal oscillator output (H STABILITY OUTPUT) - option

If the optional high stability crystal oscillator is installed, the signal whose frequency is 10MHz and whose voltage is 0.15Vrms 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 standard crystal oscillator.

See the section explaining the optional items for details.

4.5 Setting Output Level

4.5.1 Setting unit key

Display	Key	Display	Key	Display	Key
EMF dB	YE UNIT	dB	YE UNIT	dBm	YE UNIT

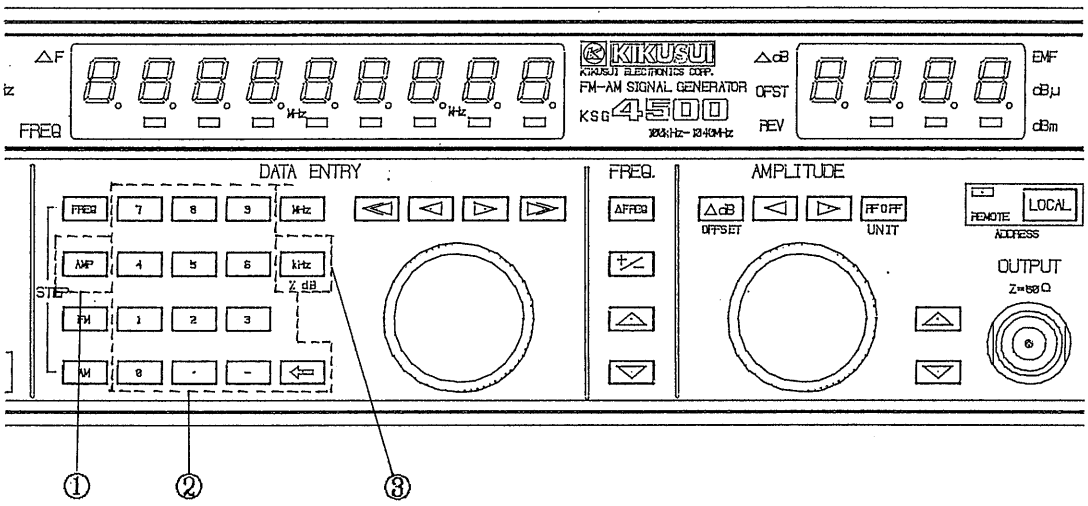
Each time the YE and UNIT keye are pressed, the unit of output level changes cyclically as above. In the RF・OFF state, however, the unit and other modes cannot be set.

(a) EMF dBμ: Open circuit voltage −20.0dBμ to 126.0dBμ
The EMF dBμ indicator in the [AMPLITUDE] section is turned on.

(b) dBμ: Loaded voltage −26dBμ to 120dBμ
The dBμ indicator in the [AMPLITUDE] section is turned on.

(c) dBm: Power indication −133dBm to 13dBm
The dBm indicator in the [AMPLITUDE] section is turned on.

4.5.2 Setting output level by numeric keys



Press the AMP key and enter a desired value by numeric keys (0～9, ・, −). 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 dB (kHz) key. Then, the value is displayed in the [AMPLITUDE] section correctly.

(a) Example: To set 10dB

Key operation	AMPLITUDE display
AMP	×××.× .... Previous value
1	1␣␣␣
0	10␣␣
dB	␣10.0

(b) Example: To set −5dB

Key operation	AMPLITUDE display
AMP	␣10.0
←	−␣␣␣
5	−5␣␣
dB	−␣5.0

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

(c) Example: 120dB 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␣
dB		120.0

If an error is made during the setting by numeric keys, correct the error by the ← key. If an error is found after the dB key is pressed, enter the correct value by numeric keys again.
If an output level higher or lower than the maximum or minimum value allowed for the specified unit is set, the [AMPLITUDE] section displays the previous value. See Article 4.5.1 for the range allowed to each unit.

4.5.3 Rotary knob

The rotary knob increases or decreases the value of the digits at and above the cursor position in the [AMPLITUDE] section. Use the ◁ or ▷ key for moving the cursor. Turn the rotary knob clockwise, and the output level will increase; turn it counterclockwise, and the output level will decrease.

(a) Example: To change output level from 46dB to 66dB
(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

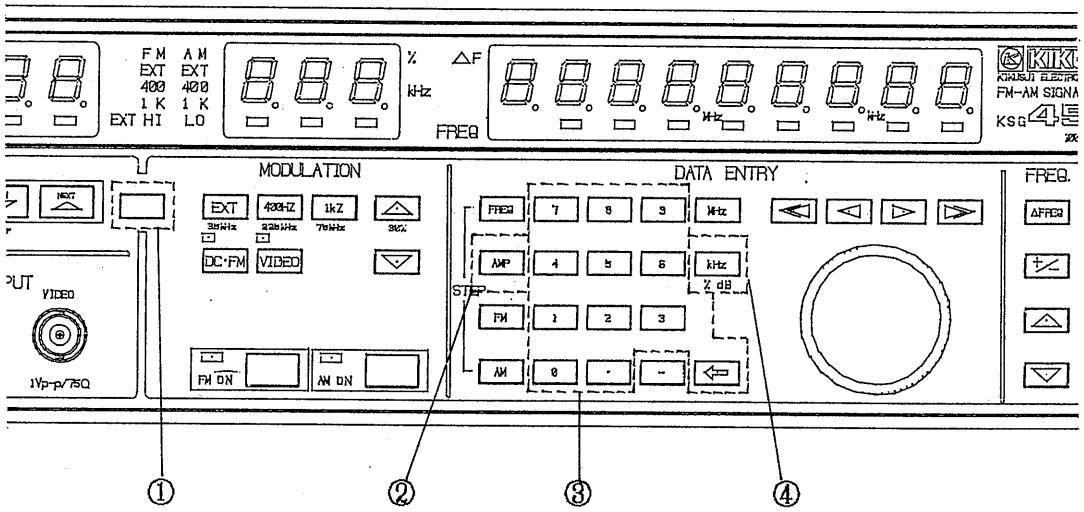
(b) Example: To change output level from 66dB to 60dB

Key operation		AMPLITUDE display
		␣66.0
▷	Press once	␣66.0
↺	Turn the rotary knob counterclockwise by six steps	␣60.0

There is no need to press the dB (kHz) key when making setting with the Rotary knob.

4.5.4 Setting output level step for [△] and [▽] keys

Set a desired step value (minimum 0.1dB) 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 2dB for [△] and [▽] keys when the output level is 60dB

Key operation		AMPLITUDE display
[YE] [STEP] [AMP]		␣60.0
[2]		2␣␣␣
[dB]		␣60.0
[△]	Press once	␣62.0

To change the output level continuously by the step of 2dB, keep pressing the [AMPLITUDE] [△] or [▽] key.
When the key remains pressed, a repeat function is applied.

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 the AMP key, numeric keys (0~9, ., -) and YE OFFSET.
When YE OFFSET is pressed, the offset output level is displayed.
The offset value can be adjusted within the range of ±50dB.

(a) Example: To give −6dB 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 Δ dB key

The Δ dB function, to check the value of change in output level, is useful for measuring the band width of a receiver and attenuation characteristic of a filter.
Note that the Δ dB indicator in the [AMPLITUDE] section is turned on when the Δ dB key is pressed.
When to release the Δ dB function, press Δ dB key again.
The output level can be changed only within the range from its minimum value to its maximum value.

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

Key operation		AMPLITUDE display	
		␣54.0	
ΔdB		␣␣0.0	ΔdB indicator is turned on
	Turn the rotary knob counterclockwise by 16 steps	−16.0	
ΔdB		␣38.0	To release the ΔdB function

4.5.7 RF.OFF key

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

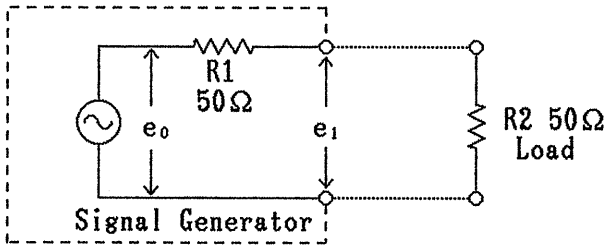
In the RF.OFF state, the output level and unit cannot be set.

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, press the RF.OFF key twice.

4.5.9 Unit of output level

The units of output level used for the KSG4500 are as follows:



(a) EMF dBμ (open circuit voltage)

The voltage e_0 in the above chart is normalized by "0dBμ = 1μVrms".

(b) dBμ (loaded voltage)

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

(c) dBm (power indication)

The power consumed by R2 in the above chart is normalized by

"0dBm = $\sqrt{1\text{mW} \times 50\Omega}$ = 0.2236Vrms".

4.6 Setting the Modulation

4.6.1 [YE] key

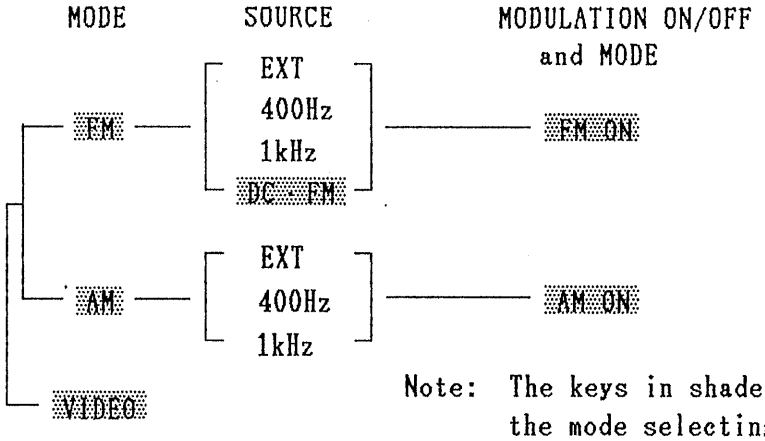
a) Press [YE] [3.5kHz], and the FM deviation is set to 3.5kHz.

b) Press [YE] [22.5kHz], and the FM deviation is set to 22.5kHz.

c) Press [YE] [75kHz], and the FM deviation is set to 75kHz.

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

4.6.2 Setting modulation mode and source



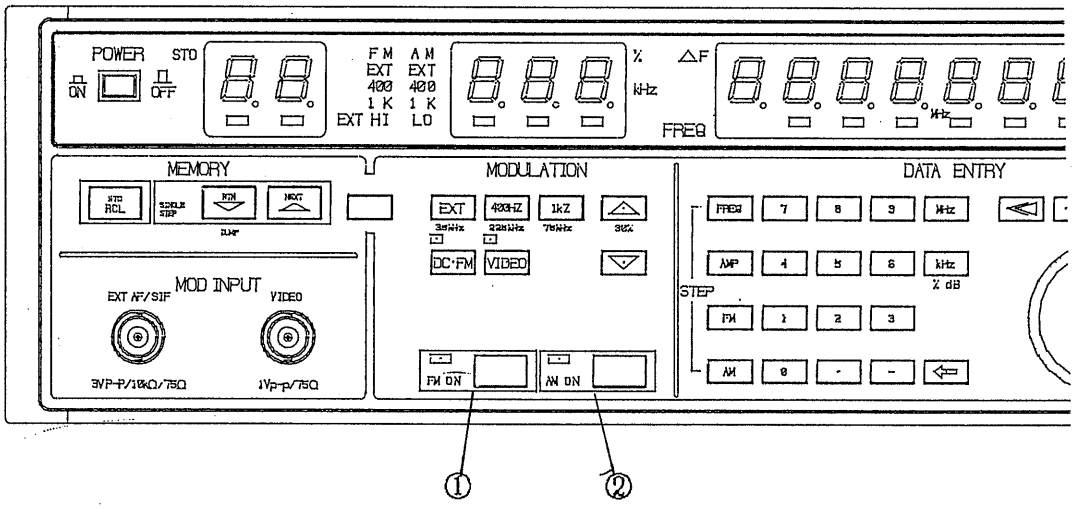
Note: The keys in shaded boxs ([ ]) have the mode selecting function.

When a modulation mode switching key is pressed, the modulation mode of the displayed symbol (%=AM and kHz=FM) is selected 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 key has the function to select the mode also.

When VIDEO modulation is selected, the indicators in [MODULATION] section are turned off.

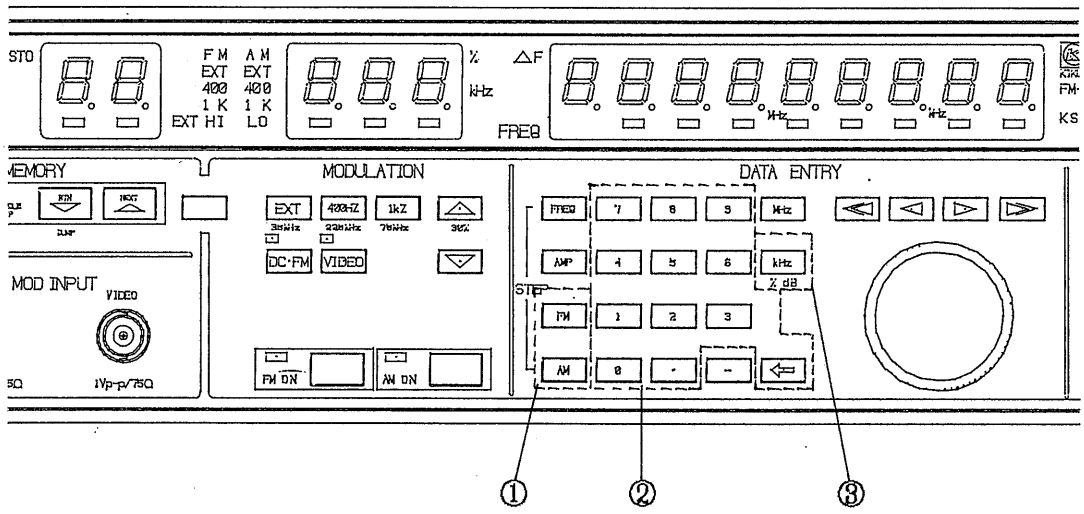


(a) Example: 75kHz deviation is to be set for 400Hz internal FM source

Key operation	MODULATION display
FM	××.× ... Previously set value kHz indicator is on
400Hz	FM 400Hz indicator is on
7	7 ␣ ␣
5	7 5 ␣
kHz	7 5.0

(b) Example: The modulation is to be turned off
The modulation is terminated when key ① is pressed and the FM ON indicator is turned off.

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 with unit in the [MODULATION] section.
Enter a desired value with numeric keys (0~9, ·).
After entering the value, press kHz for FM and % (kHz) for AM. Then, the value is displayed in the [MODULATION] section with the specified unit.

Any value may be input by the numeric keys, but the following relationship between carrier frequency and FM deviation range and resolution must be observed:

Carrier frequency	Maximum deviation	Resolution
100kHz to 127.5MHz	500kHz	0.1kHz or 1kHz
127.5MHz to 255MHz	125kHz	0.1kHz or 1kHz
255MHz to 510MHz	250kHz	0.1kHz or 1kHz
510MHz to 1040MHz	500kHz	0.1kHz or 1kHz

The maximum AM depth is 99.9% and minimum depth is 0.1%.

(a) Example: To set FM 25kHz

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

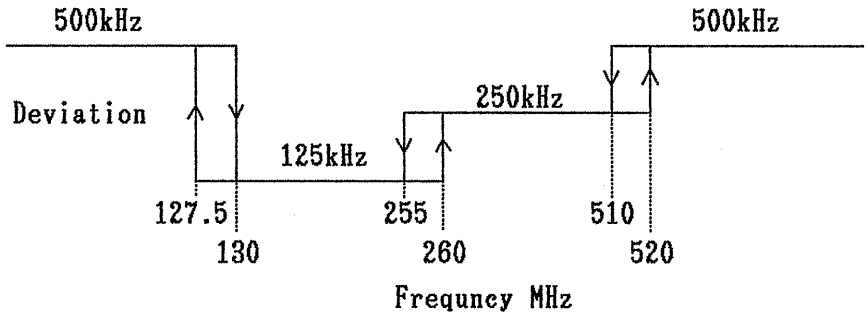
Key operation	MODULATION display
AM	××.×.... Previously set value
	% is displayed as unit
3	3␣␣
0	30␣
%	30.0

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 in one of the three ways described below and the modulation cannot be executed. When this happens, set the deviation again within the allowable range.

(1) The value displayed in the [MODULATION] section flashes when it is not within the allowable range because the carrier frequency has been changed.

(2) The kHz unit indicator flashes when the AM indicator in the [MODULATION] section is on for (1).
The overlapping ranges of frequency are as follows:
The border values of the overlapping ranges are rough values.



For example, when the carrier frequency is 300MHz and FM deviation is 250kHz, the value "250" is displayed in the [MODULATION] section.
If the carrier frequency is reduced to range 127.5 - 255MHz, the value "250" flashes in the [MODULATION] section and the output signal is not modulated.

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] section. When the cursor is not found in the [MODULATION] section, bring it into the section by the ◁ or ▷ key; when it is found in the section, move it by the ◁◁ or ▷▷ key.
After changing the modulation factor by the rotary knob, the unit key (kHz or %) need not be pressed.

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

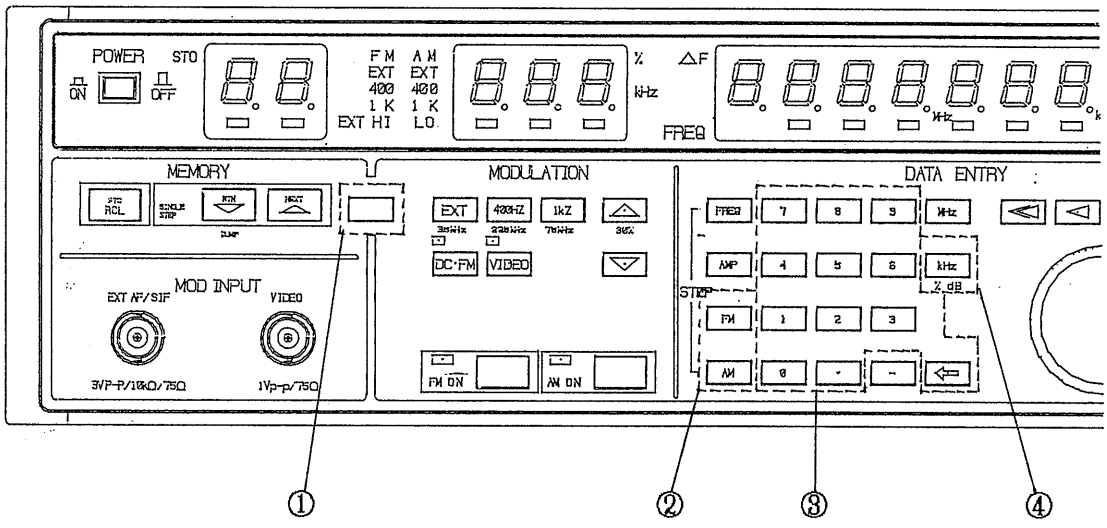
Key operation		MODULATION display
FM		25.0
◁	Press once	25.0
↻	Turn the rotary knob clockwise by one step	35.0

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

Key operation		MODULATION display
AM		30.0
▷	Press once	30.0
↺	Turn the rotary knob counter-clockwise by five step	25.0

4.6.6 Setting Modulation Step for △ and ▽ Keys

Set a desired step value (minimum 0.1kHz or 0.1%) for the [MODULATION] △ and ▽ keys, and the modulation 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 2.5kHz as FM step

Key operation	MODULATION display
YE STEP FM	75.0 kHz
2	2␣␣
.	2.␣␣
5	2.5␣
kHz	75.0
△	Press once 77.5

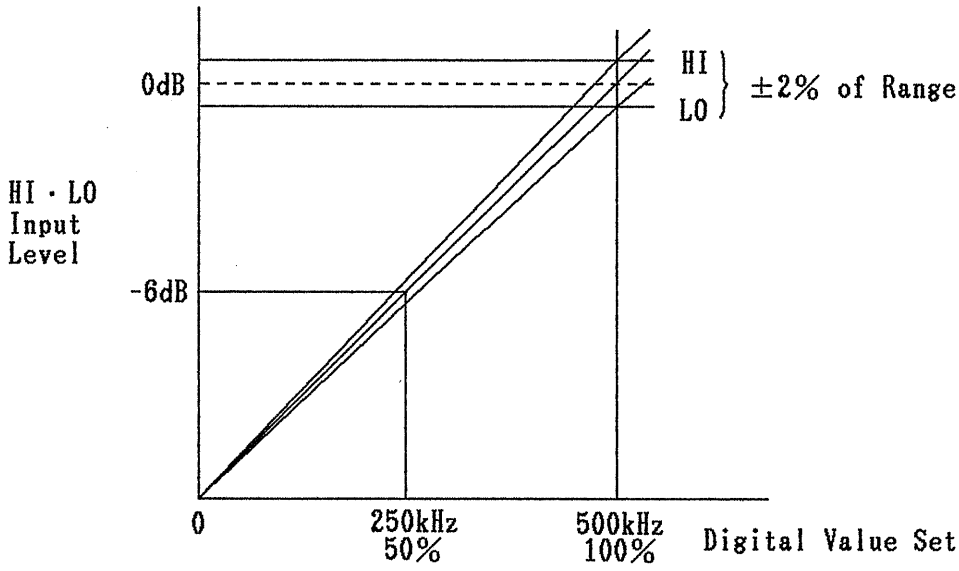
To increment or decrement the FM deviation continuously by the unit of the specified value, keep pressing the [MODULATION] △ or ▽ key. When the key remains pressed, a repeat function is applied.
The AM depth can be incremented/decremented in the sameway as FM deviation.

4.6.7 External modulation signal connection and setting

(1) Connection and setting method

Connect the external modulation signal source to MOD INPUT (EXT AF) on the front panel. The input impedance is approximately 10kΩ, and appropriate input level is about 3Vp-p.
The appropriate input level range is obtained when both HI and LO of EXT LEVEL are turned off. Adjust the level of external modulation signal source to the range that turns off both HI and LO.
When the level of external modulation signal source is too low, LO is turned on; when it is too high, HI is turned on.
The external modulation signal source level need not be adjusted each time the modulation is modified.

(2) Setting range



The above chart shows the relationship between modulation 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 modulaion is converted into a digital value internally on the basis of this input level.

Whether the input signal 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 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 500kHz, attenuate the input level by -6dB.

Then, 500kHz (=100%) remains displayed but the actual peak freauency deviation is reduced to 250kHz (=50%). At this time, the LO lamp is turned on, but modulation is done correctly at the peak freauency deviation of 250kHz.

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 of 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.

4.6.8 DC·FM modulation mode

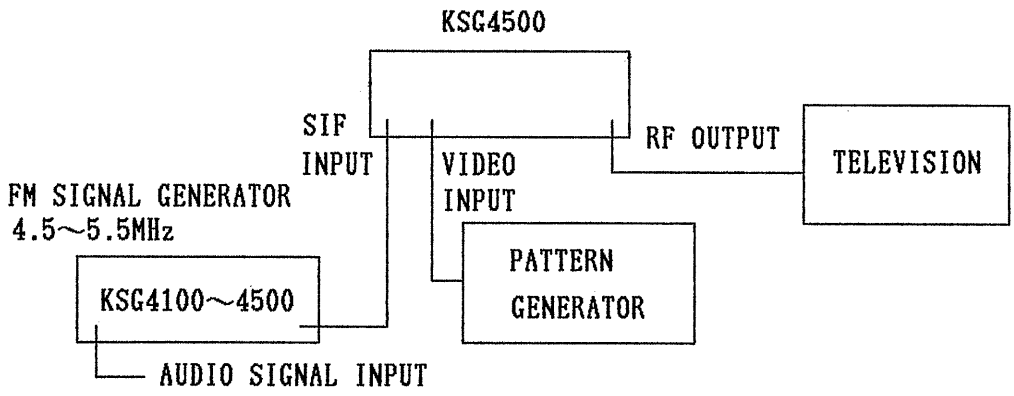
When the DC·FM key is selected, external modulation is done by DC coupling and the frequency of FM VCO enters a free run state.
In this state, the frequency can be shifted by the DC signal.
The displayed modulation is accomplished by 1.5V DC.

Note: After the modulation mode is changed from the DC·FM source 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 ±3dB.
Pressing of the VIDEO key sets the instrument in the VIDEO modulation mode, turns on the VIDEO indicator, and turns off the FM/AM mode, MODULATION, and unit indicators.
The modulation mode may be input from external units only.
The EXT HI LO lamps operate accroding to the combination of VIDEO level and SIF level. These lamps, when turned off, indicates the optimum input level.
The EXT AF/SIF terminal is used as sound IF input terminal, and the input impedance is switched to 75Ω. Normally, an SIF signal of approximately 0.5Vp-p is applied (the center frequency is 4.5MHz and FM deviation frequency is 25kHz by M Method).

A video signal is applied to the VIDEO input terminal (normally 1Vp-p).



4.7 Memory

4.7.1 Memory recall method

Memory addresses are allocated in a matrix of 10 raws 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

Basically, the recall operation means to call the row number by the RCL key and numeric key (0~9) and to call the column number by the [MEMORY] △ key.
Also, a memory 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 ▽ kyes.
When repeating the recall operation continuously, it is only necessary to press the RCL key the first time.
In the following examples, it is assumed that the carrier frequency, output level, modulation mode, etc. are set as explained in Section 4.4 to 4.6 and that they are stored in 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, move it by the ◁◁ key; when it is found in the [MEMORY] display, move it by the ◁ or ▷ key.
By turning the rotary knob, the data of addresses 00 to 99 can be recalled continuously.

(b) Example: To recall memory address "10"

	MEMORY display
RCL key, 1 key	"10"

(c) Example: To recall memory address "43"

RCL key, 4 key	
Press [MEMORY] △ key three times	"43"

(d) Example: To recall memory address "85"

RCL key, 8 key	
Press [MEMORY] △ key five times	"85"

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

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

When the address "78" is to be called subsequently, omit pressing the RCL key and simply press the . key. When the [MEMORY] display is cleared by the . key, press the numeric keys 7 and 8. Then, "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 carrier frequency, output level, and modulation factor, ΔFREQ function, ΔdB, and RF ON/OFF function cannot be stored.

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

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

①	FREQ	×××.××××.×
	1	1␣␣ ␣␣␣␣ ␣
	MHz	␣␣1.000.0

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

②	AMP	××× ×
	7	7␣␣ ␣
	6	76␣ ␣
	dB	␣76.0

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

③	AM, 1kHz	××.×
	%, 30%	30.0 %

Besides the above method, the modulation level and mode may be set by numeric keys (0~9) and modulation mode key.
Aftere setting the above data, press %, STO, (STO green indicator 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 carrier frequency, output level, modulation mode, etc.	
③	Press % 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 carrier frequency, output level, modulation mode, etc.
② Clear [MEMORY] display by %, STO, and ·.
③ Press numeric keys 4 and 5, and the data set by step ① is stored.

Note 1: When data is to be stored continuously, the YE, STO, and . key must not be omitted.

Note 2: The RTN key explained in Section 4.7.3 cannot be used in the direct store method.

4.7.3 Storing data into a part of memory column (Setting RTN key)

(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 release RTN key

The following two methods are available:

(1) Display "19" by RCL "19"
RCL . 1 9
Press YE STO ▽ "19"
By the above operation, all the ten columns become available as they were before the RTN key was pressed.

(2) Display "13" by RCL, "13"
RCL 1 , and △ keys (Press three times)
Press YE STO △ "14" RTN command is stored at
.. "14"
..
YE STO △ (Press "19"
five times)

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 key was pressed.

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

Normally, up to ten memory columns (00 - 09, 10 - 19, ..., 90 - 99) can be recalled at a time, but more than ten columns can be recalled continuously by the following operation:
Display column number "9" in [MEMORY] section and press YE, STO, and NEXT keys; then, another ten columns can be recalled without specifying the next row number.

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

Key operation	MEMORY display	
×	"39"	Previous value
YE	"39"	
STO	"39"	STO LED comes on
NEXT	"40"	STO LED comes off

The memory addresses are recalled as follows:

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

4.7.6 How to release NEXT key

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

(a) Example: To reset the continous recall of memory addresses 30 - 49 (to recall 30 - 39 and 40 - 49 separately)

Key operation	MEMORY display	
×	"39"	Previous value
YE	"39"	
STO	"39"	STO LED comes on
RTN	"39"	STO LED comes off

4.7.7 Copying memory data to another KSG4500

1) The 100-point memory data can be copied to another unit of KSG4500.

2) Memory data copying method

① Turn on the power for the local and remote signal generators.

② Connect the remote control terminals on rear panel of the local signal generator to those of remote signal generator, using DUMP cable.

③ Press YE, DUMP (▽), and the copying is started.

Note: The DUMP cable uses an amphenol-type 14-pin connector. Among the 14 pins, numbers 8 - 10 are unconnected, but all other are connected.

Optional DUMP cable Model SA510

5. REMOTE CONTROL

5.1 General Discription

5.1.1 Outline

The KSG4500 has a 14-pin connector for remote control.

5.2 Operation Procedure

5.2.1 Explanation of Remote Control Connector

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

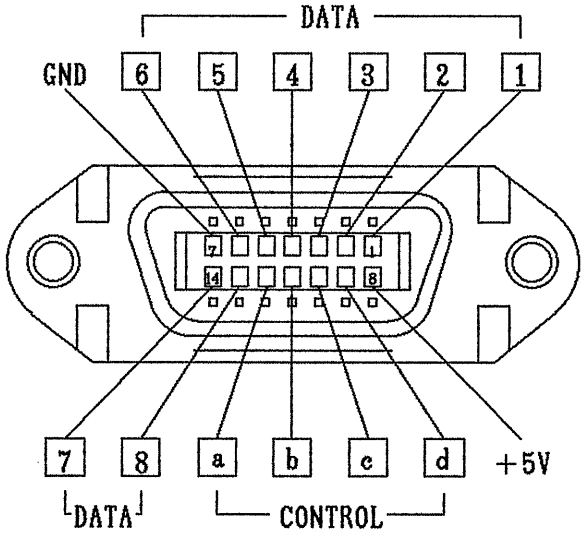


Figure 5-1

[Explanation of terminals]

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

1) DATA terminals 1 - 8 (Pins 1 - 6, 13, and 14)

The DATA terminals are used for connecting a bus to the rear panel of the KSG4500. Since the bus is bidirectional, it can be used for both input and output.

Note: Since the DATA terminals are bidirectional bus, the signal generator does not function if data "0" or "1" is applied to the lines of DATA 1 - 8 directly.

2) CONTROL terminals [a] and [b] (Pins 11 and 12)

[a] DATA STROBE output terminals (Pin 12)
Normally, "1" is output from this terminal. When data is read, "0" is output from it.

[b] REQUEST TO READ input terminals (Pin 11)
Normally, "1" is input to this terminals. When data read is requested, "0" is input to it.

3) CONTROL terminals [c] and [d] (Pins 9 and 10)

[c] and [d] Display control output terminals
When "1" is output from either of these terminals ([c] or [d]), data is being processed.

That is, the logical sum of the signals output from [c] and [d] is the BUSY signal to external instrument.

4) +5V (Pin 8)

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

5) GND (Pin 7)

5.2.2 Input data timing

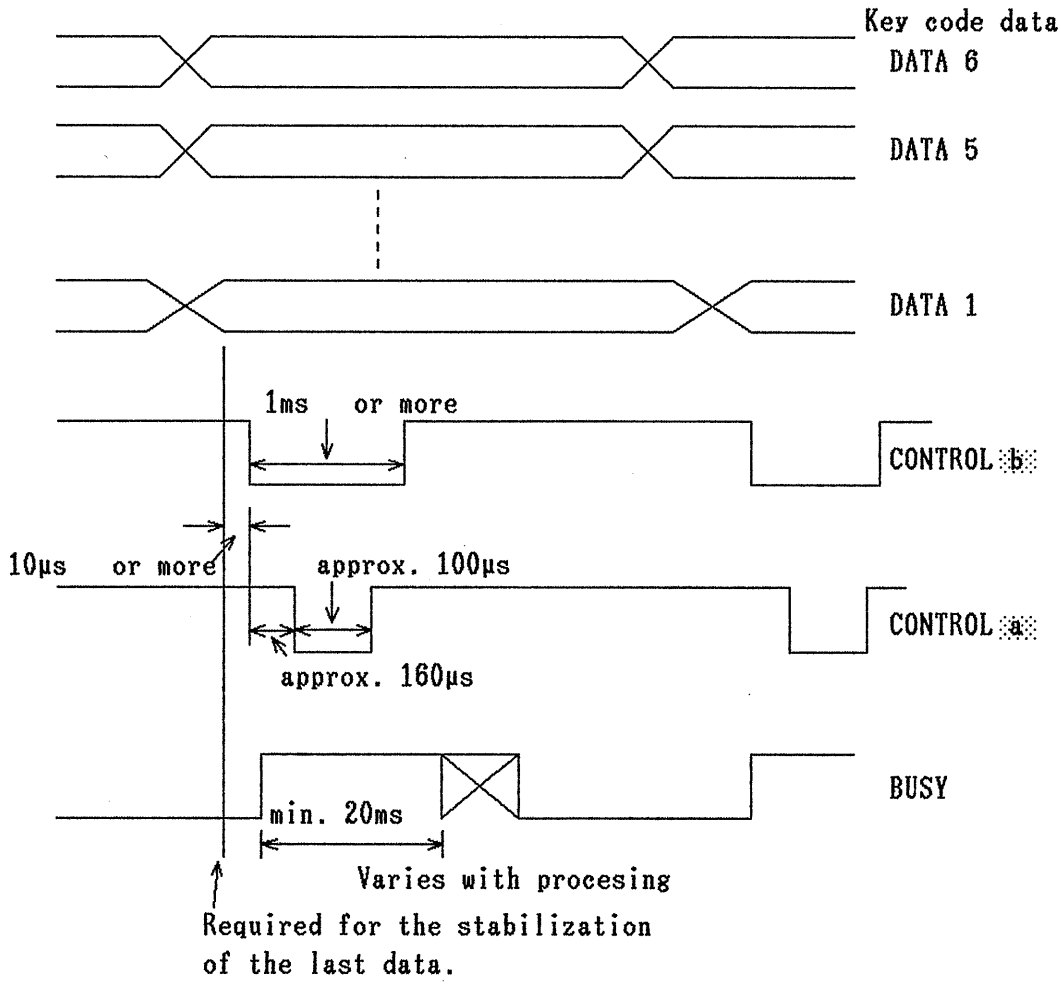


Figure 5-2

When the BUSY signal is "0", set the key code data (DATA1-6), and after the last data of DATA1-6 is established, wait for 10μs or longer. Then, set CONTROL b to "0" for 1ms or longer as shown in Figure 5-2.
Approximately 160μs after CONTROL b falls, CONTROL a is set to "0" for approximately 100μs.
During this period of approximately 100μs , the key code data that have been set are read processed.

After CONTROL b falls and before CONTROL a falls (that is, during the period of approximately 160μs), the BUSY signal rises to "1" to indicate that the key code data are being processed.
Enter the next key code data after the BUSY signal is set to "0".

5.2.3 Panel key code table

All the panel keys are expressed in codes. So, setting one of the key codes listed below (table 5-1) and sending it with CONTROL 1 isequivalent to pressing the panel key corresponding to the code.

Table 5-1

Key name	DATA input pin number					
	6	5	4	3	2	1
	MSB	← Key Code →				LSB
MEMORY RCL / STO	0	0	0	1	0	0
MEMORY ▽ / RTN (DUMP)	0	0	0	1	1	1
MEMORY △ / 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
MODULATION ▽	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
DATA ENTRY AMP / STEP AMP	0	1	0	0	1	1
DATA ENTRY FM / STEP FM	0	1	0	1	0	0
DATA ENTRY AM / STEP AM	0	1	0	1	0	1
DATA ENTRY 0	1	1	0	0	0	0
DATA ENTRY 1	1	1	0	0	0	1
DATA ENTRY 2	1	1	0	0	1	0
DATA ENTRY 3	1	1	0	0	1	1

(Cont'd)

Table 5-1

Key name	MSB		← Key Code →			LSB
DATA ENTRY 4	1	1	0	1	0	0
DATA ENTRY 5	1	1	0	1	0	1
DATA ENTRY 6	1	1	0	1	1	0
DATA ENTRY 7	1	1	0	1	1	1
DATA ENTRY 8	1	1	1	0	0	0
DATA ENTRY 9	1	1	1	0	0	1
DATA ENTRY .	1	0	1	1	1	0
DATA ENTRY +/−	1	0	1	1	0	1
DATA ENTRY ⇦	0	0	1	0	0	0
DATA ENTRY MHz	0	1	0	1	1	0
DATA ENTRY kHz , % , dB	1	0	0	1	0	1
DATA ENTRY ⇦|	0	1	0	1	1	1
DATA ENTRY <	1	1	1	1	0	0
DATA ENTRY >	1	1	1	1	1	0
DATA ENTRY |>	0	1	1	0	0	0
DATA ENTRY Rotary knob UP	0	0	0	0	0	0
DATA ENTRY Rotary knob DOWN	0	0	0	0	0	1
FREQUENCY ΔFREQ	1	1	1	1	0	1
FREQUENCY +/−	1	0	1	0	0	1
FREQUENCY △	0	1	1	0	0	1
FREQUENCY ▽	0	1	1	0	1	0
AMPLITUDE Δ dB	1	0	0	0	0	1
AMPLITUDE |<	1	0	0	0	1	0
AMPLITUDE |>	1	0	0	0	1	1
AMPLITUDE RF ON/OFF	1	0	0	1	0	0
AMPLITUDE △	1	0	0	1	1	0
AMPLITUDE ▽	1	0	0	1	1	1
AMPLITUDE Rotary knob UP	0	0	0	0	1	0
AMPLITUDE Rotary knob DOWN	0	0	0	0	1	1
LOCAL	1	0	1	1	1	1

5.2.4 Setting frequency by remote control (example)

The frequency of 82.5MHz is to be set.

1) Set the FREQ code "010010" according to the panel key code table (Table 5-1).
2) Send CONTROL ▒b▒ which is set to "0" for 1ms or longer as shown in Figure 5-2 (input data timing).
3) Set the data "82.5" according to the code table and send CONTROL ▒b▒ signal as shown in Figure 5-3.

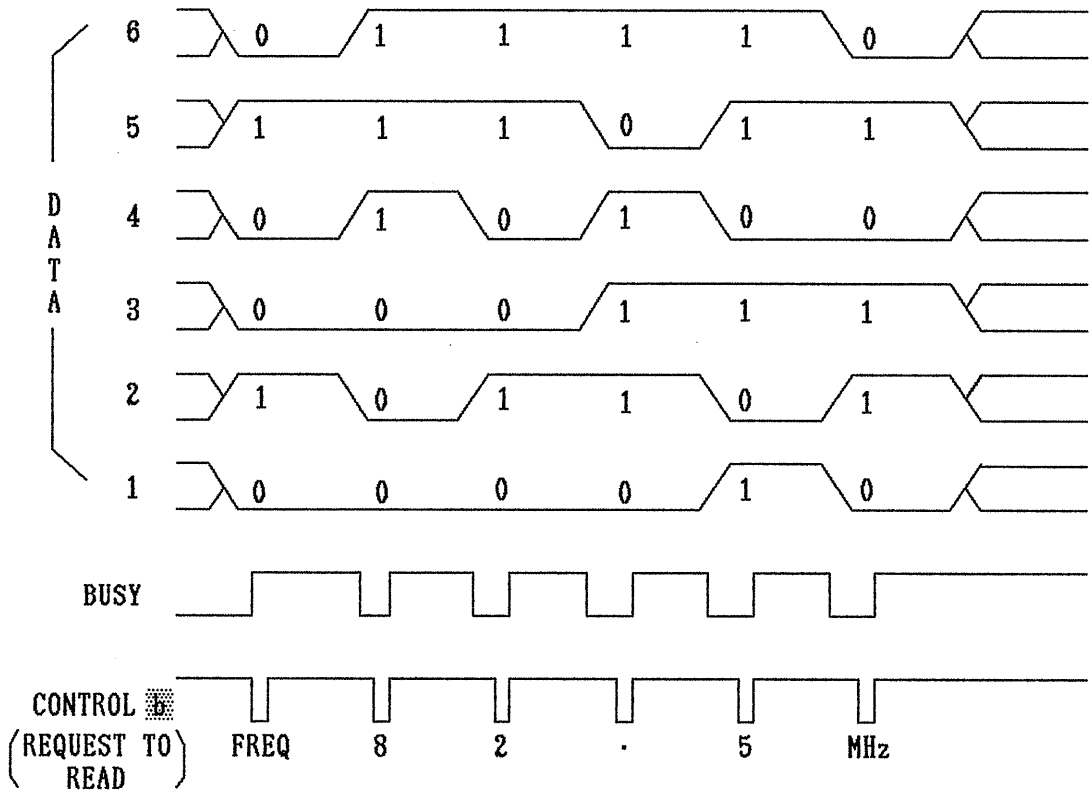


Figure 5-3

4) In the same way, set "110101" as the data of "5" and send CONTROL ▒b▒.
5) Finally, send "010110" for "MHz" with CONTROL ▒b▒ signal, and the data transmission is completed.
6) When the signal generator receives the last data, namely, "010110" for "MHz" and CONTROL ▒b▒, it starts processing the specified frequency.

5.2.5 Remote Control circuit diagram example and operation.

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

Figure 5-4 shows the remote control circuit that increments the memory address by one each time the switch is pressed.

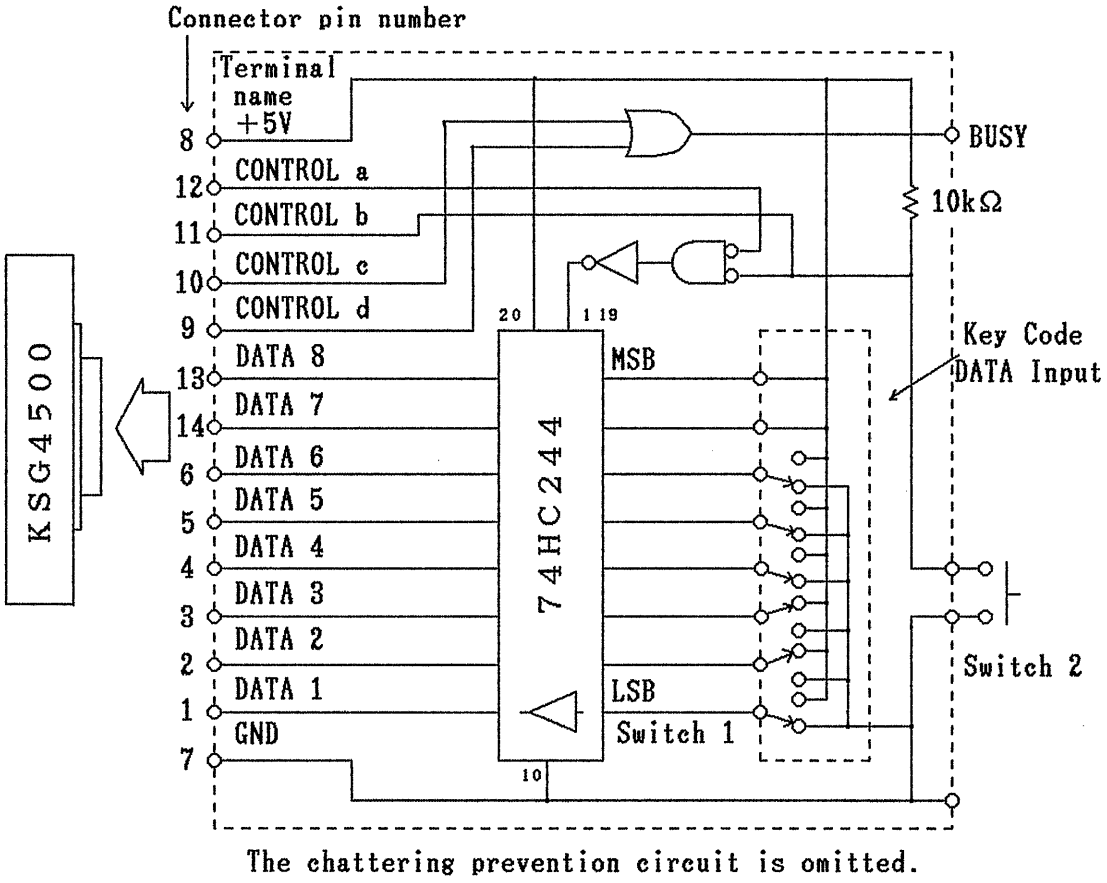


Figure 5-4

Set the data of MEMORY RCL △ on Key Code Data Input Switch 1 according to the key code table (Table 5-1) and set CONTROL [illegible] to "0" (Press Switch 2). Then, approximately 160μs later, CONTROL [illegible] is set to "0" and Enable A and B (pins 1 and 19) of 74HC244 are set to "0". The data is sent to the KSG4500 during the period of approximately 100μs when CONTROL [illegible] is "0"

If other key code data of the key code table is set on Switch 1, the function of the corresponding key on the front panel can be controlled inremote mode.

When using a computer for the external remote control on the basis of function shown in Figure 5-4, be sure to confirm that the BUSY signal is set to "0" before setting CONTROL [redacted] to "0" for more than 1ms.

Note: Since the control terminals (DATA terminals) are assigned to eight bits, the fixed data "1" is sent for the 7th and 8th bits (pins 14 and 13) through 74HC244.

5.2.6 Memory Display output circuit example

Figure 5-5 shows an example circuit.

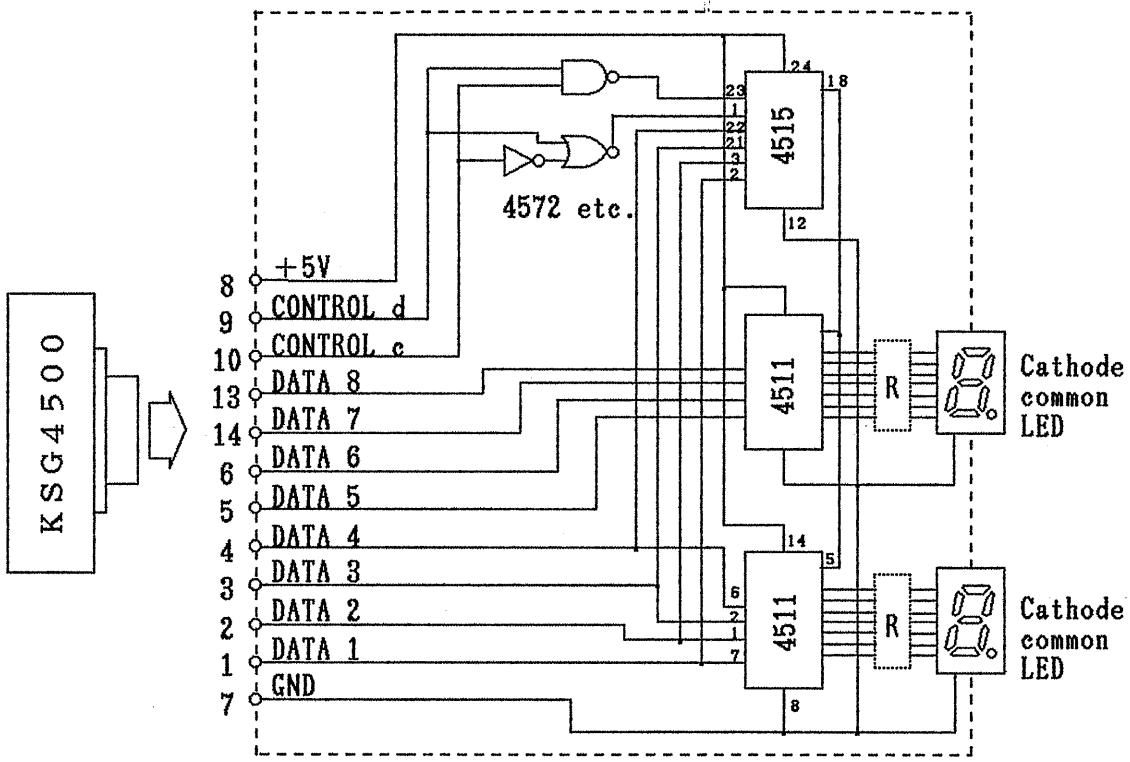


Figure 5-5

Since the remote control terminal has a bidirectional bus structure, it can output the same data displayed in the [MEMORY] section of the signal generator through the circuit shown in Figure 5-5.
In addition to being displayed on a remote device, the data in the [MEMORY] section can be used for a process if the CMOS 4511 is replaced by a latch circuit.

If the circuit in Figure 5-4 is connected to that in Figure 5-5 by the connector section in parallel, the user can not only control the signal generator from a remote unit but also display the data in [MEMORY] section on a remote unit or check the data on the signal generator by a remote unit.

6. OUTPUT IMPEDANCE AND DUMMY ANTENNA SWITCHING SIGNAL

6.1 "RANGE OUTPUT" RCA Pin Connector

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

The output signal can be used as the control signal of an output impedance switch, dummy antenna for car radio, etc.

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

7. BACKUP BATTERY AND INITIALIZING CPU

7.1 Backup Battery

The KSG4500 uses a memory backup battery, and the battery may discharge allits electricity when the signal generator is not used for a long time.

Turn on the power for the signal generator having a charging circuit, and fully charge the battery.

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 approximatly 90% of the initial capability. The battery is 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 the aluminum sash cases attached to the left side of the instrument contains the CPU printed curcuit board, and the battery is mounted on this board.
Remove two screws from the left side, take out the aluminum sash case, pull out the PC board, and 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.

7.2 Initializing CPU

Then, turn on the power switch with pressing [YE] key, the CPU is initialized.

(Note) The stored setting data of memory will be lost.

7.2.1 Hardware reset

Turn on the power, and initialize the CPU by pushing the initial setting button switch S1 by an isolation screwdriver or something inserted from the hole on the side of the aluminum sash case containing the CPU board. At this time, 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; then, the CPU is reset. At this time, the values stored in the memory and the values for steps are not cleared.
The GP-IB address is set in the initial state.

8. GP-IB

(General Purpose Interface Bus)

8.1 Introduction

8.1.1 General description

The KSG4500 has a GP-IB interface, and it can be controlled by the IEEE 488 standard interface bus.

8.1.2 Features

1) The functions of the signal generator can be controlled by the IEEE 488 standard interface bus.
2) The remote mode can be verified 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

Compiles to IEEE Std 488-1975.

8.3 Operation Procedure

8.3.1 Preparation for use

Turn on the power and check the device address of the signal generator on GP-IB.

1) Press the LOCAL key after the YE key, and device address is displayed in the [AMPLITUDE] section.
2) To change the device address, turn off the power and set a new address according to the address setting method explained in Section 8.3.2.
3) After the hardware/software reset of CPU, the specified value "07" is displayed.
4) Connect the GP-IB cable when the power is off.

8.3.2 Address setting method

The address of the KSG4500 is set at "07" when 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 shield board and manipulate the address switch S2 on the PC board 90-SIG-90104 found in the left aluminum sash case viewed from the front panel.
The address "07" can be changed to a desired address.

Remove the two screws on the right side the aluminume sash case.
The aluminum sash case can be taken out. Lift the case, and pull out the case.
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 values of S2 and corresponding addresses.

b) When a switch of S2 is set to ON, the corresponding bit is set to the level of "0".

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

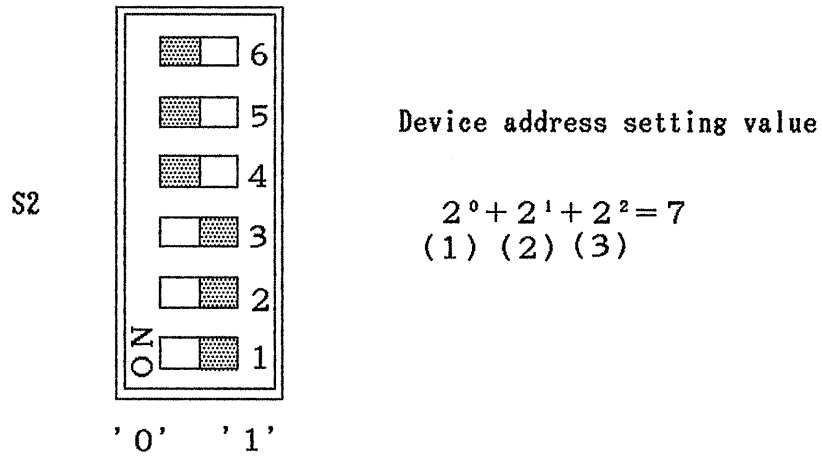


Figure 8-1

Table 8-1

Listener address	Address switch
Device number	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
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

The DIP-SW is set to "07" at the factory

DIP SW

1 = OFF 0 = ON

8.3.3 Available control command 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) and prepares for receiving data when the listener adrress is specified. If the LOCAL key on the front panel is pressed in this state, the REMOTE indicator is turned off and the signal generator is set in local mode to enable manual operation on the front panel.
LOCAL LOCKOUT	Disables manual operation on all the devices on GP-IB. The LOCAL LOCKOUT command is an universal command.
LOCAL	Turns off the REMOTE indicator and sets the signal generator in 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 to be used.

8.3.4 Program code table

Set the measuring conditions for KSG4500 with the codes listed in Table 8-3 GP-IB Function Setting Method. Table 8-4 gives the program codes in alphabetical order, and Table 8-5 list the codes are classifed by function. See these tables also.
When creating a control program, arrange the program codes in the same order as the corresponding functions that would be specified on the panel.

Table 8-3 GP-IB Function Setting Method

Item	Program code	Data	Unit
Carrier frequency			
Carrier frequency	FR	○○.○	HZ, KZ, MZ
Output level unit			
EMF dBμ	EM	---	---
dBμ	DU	---	---
dBm	DM	---	---
Output level	AP	○○.○	DB
Output level OFF	RO	---	---
Output level ON	R1	---	---
Modulation			
AM depth	AM	○○.○	PC
AM depth	AM	○○.○	%
Amplitude modulation OFF	AMS5	---	---
Amplitude modulation OFF	AMOF		
FM peak frequency deviation	FM	○○.○	KZ
Frequency modulation OFF	FMS5	---	---
Frequency modulation OFF	FMOF		
External modulation ON	S1AM, S1FM	---	---
Modulation signal source 400Hz	S2AM, S2FM	---	---
Modulation signal source 1kHz	S3AM, S3FM	---	---
Modulation signal source DC・FM	S6FM	---	---
Modulation signal source VIDEO	S7AM	---	---
Memory control			
Memory recall	RC	○○	---
Memory store	ST	○○	---

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

2: The mark "○○" means than 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.

Table 8-4 GP-IB Program Codes

Alphabetical order

Program code	Explanation	Remarks
AM	Amplitude modulation	Function mode
AMOF	Modulation OFF	Modulation signal source switching
AP	Output level	Function mode
DB	Unit dB	Unit
DU	Output dBμ	Function mode
DM	Output dBm	Function mode
EM	Output EMF dBμ	Function mode
FM	Frequency modulation	Function mode
FMOF	Modulation OFF	Modulation signal source switching
FR	Carrier frequency	Function mode
HZ	Hz	Unit
KZ	kHz	Unit
MZ	MHz	Unit
PC	Modulation in percent	Unit
RC	Memory recall	Function mode
RO	Output level OFF	Function mode
R1	Output level ON	Function mode
S1	External modulation ON	Modulation signal source switching
S2	Internal modulation 400Hz	Modulation signal source switching
S3	Internal modulation 1kHz	Modulation signal source switching
S5	Modulation OFF	Modulation signal source switching
S6	Modulation DC · FM	Modulation signal source switching
S7	Modulation VIDEO (AM)	Modulation signal source switching
ST	Memory store	Function mode
0 - 9	Numeric value	Data
—	Minus sign	Data
·	Decimal point	Data
%	Modulation in percent	Unit

Table 8-5 GP-IB Program Code

Classified by function

Function	Program code
Carrier frequency	FR
Output level	AP
EMF dBμ	EM
dBμ	DU
dBm	DM
Output level OFF	RO
Output level ON	R1
Modulation	
Amplitude modulation	AM
Frequency modulation	FM
External modulation ON	S1
Int. modulation 400Hz	S2
Int. modulation 1kHz	S3
Modulation OFF	S5
	AMOF
	FMOF
Modulation DC · FM	S6
Modulation VIDEO (AM)	S7
Data	
Numeric value	0 - 9
Minus sign	—
Decimal point	.
Unit	
MHz	MZ
kHz	KZ
Hz	HZ
dB	DB
%	PC or %
Memory	
Memory recall	RC
Memory store	ST

8.3.5 Basic data setting method

100MHz carrier frequency, EMF 120dBμ output level, 1kHz internal modulation frequency, and 75kHz FM peak frequency deviation are to be set.
In the following examples, 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"
```

Example 3: To set the carrier frequency at 88.2MHz
a) "FR88.2MZ"

Example 4: To set the output level at 120 EMF dBμ
a) "EM, AP120DB" b) "EM" , "AP120DB"

Example 5: To set the output level at 100dBμ
a) "DU, AP100DB" b) "DU" , "AP100DB"

Example 6: To set the output level at −3.5dBm
a) "DM, AP-3.5DB" b) "DM" , "AP-3.5DB"

Example 7: To set the internal modulation frequency at 400Hz and AM depth at 30%
a) "S2AM30%" b) "S2AM30PC"

Example 8: To set external FM deviation 75kHz
a) "S1FM75KZ" b) "S1FM", "FM75KZ"
Note : S1 only is invalid.

Example 9: To turn off modulation

a) "AMS5" b) "FMS5"

Example 10: To recall memory address "36"

a) "RC36"

Example 11: To store data at memory address "36"

a) "ST36"

8.3.6 Connector pin allocation diagram

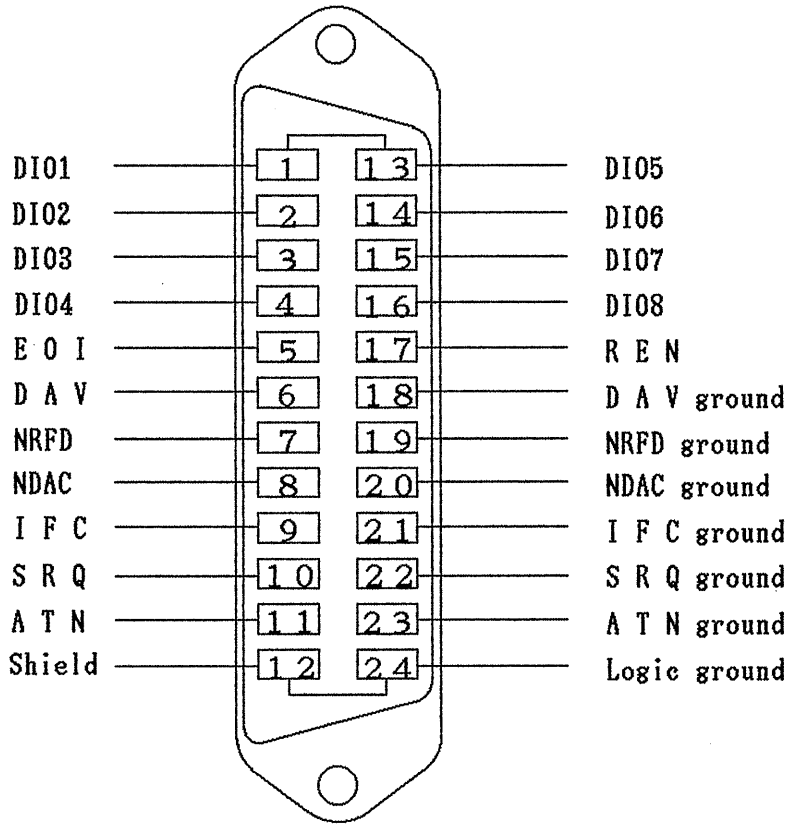


Figure 8-2

8.3.7 Reference (Program example)

An example of a program for HP 9816 is given below. This program is to set the data of frequency, output level, and modulation factor, 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              100000000Hz
30    Freqstep=10*1.E+6                10000000Hz
40    Level=120                        120dB
50    Levelstep=-10                    -10dB
60    Fm=75                            75kHz
70    Fmstep=-5                        -5kHz
80    CLEAR Dev                        Clear selected device
90    WAIT 2
100   OUTPUT Dev;"R1"                  Output ON
110   FOR N=0 TO 9
120     Freq=Frequency+Freqstep*N
130     Lev=Level+Levelstep*N
140     Fmlev=Fm+Fmstep*N
150     OUTPUT Dev;"FR";Freq/1.E+6;"MZ"  Set frequency
160     OUTPUT Dev;"EMAP";Lev;"dB"       Set output level
170     OUTPUT Dev;"AMS5"                Turn off AM modulation
180     OUTPUT Dev;"S2FM";Fmlev;"kZ"     Set 400Hz internal
                                         modulation frequency
                                         and FM deviation
190     OUTPUT Dev;"ST";N                Store data into memory
200   NEXT N
210   FOR N=0 TO 9                       Recall data from memory
220     OUTPUT Dev;"RC";N
230   WAIT 2
240   NEXT N
250   END
```

9. ACCESSORIES

(Optional)

9.1 SA100 Test Loop

1) Performance

Frequency range	100kHz to 30MHz
Migration length	Vertical Approx. 250mm, Horizontal 360°
Input coaxial cable	50Ω
Test Loop	Diameter 250mm, 0.8ϕ 1 Turn

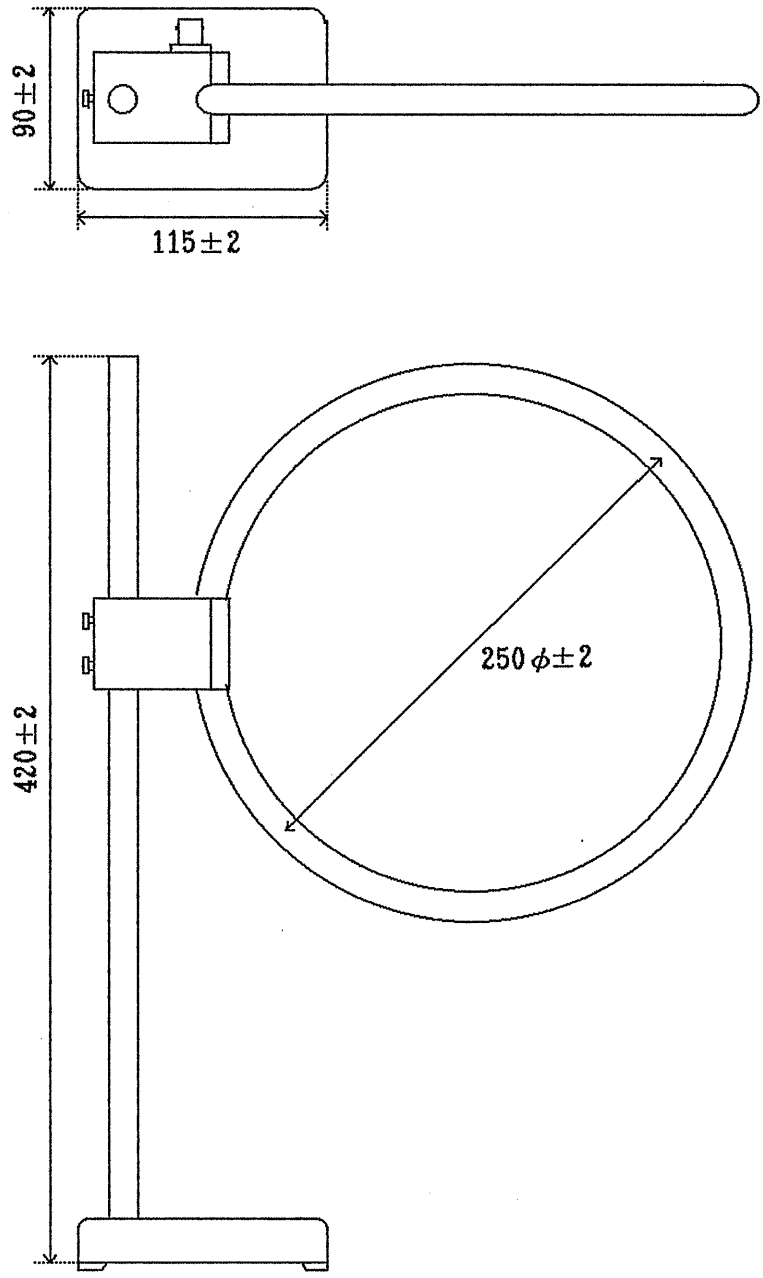


Figure 9-1. Outline drawing

9.2 SA150 Band Splitting Filter

1) Performance

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

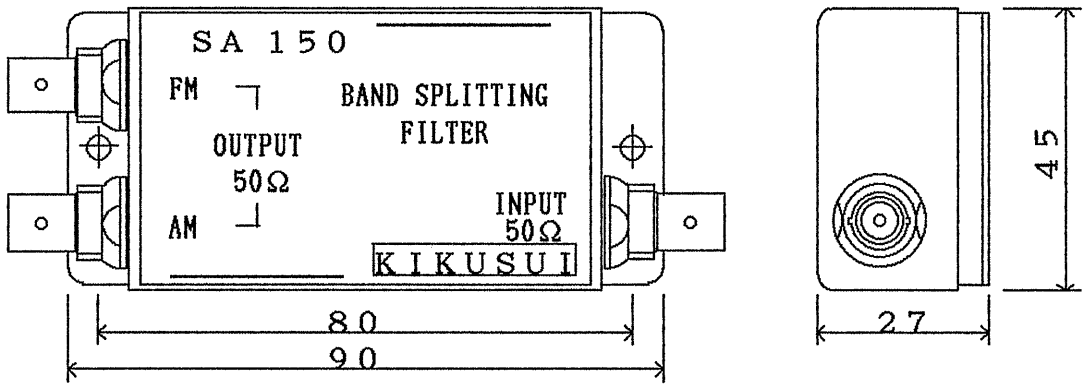
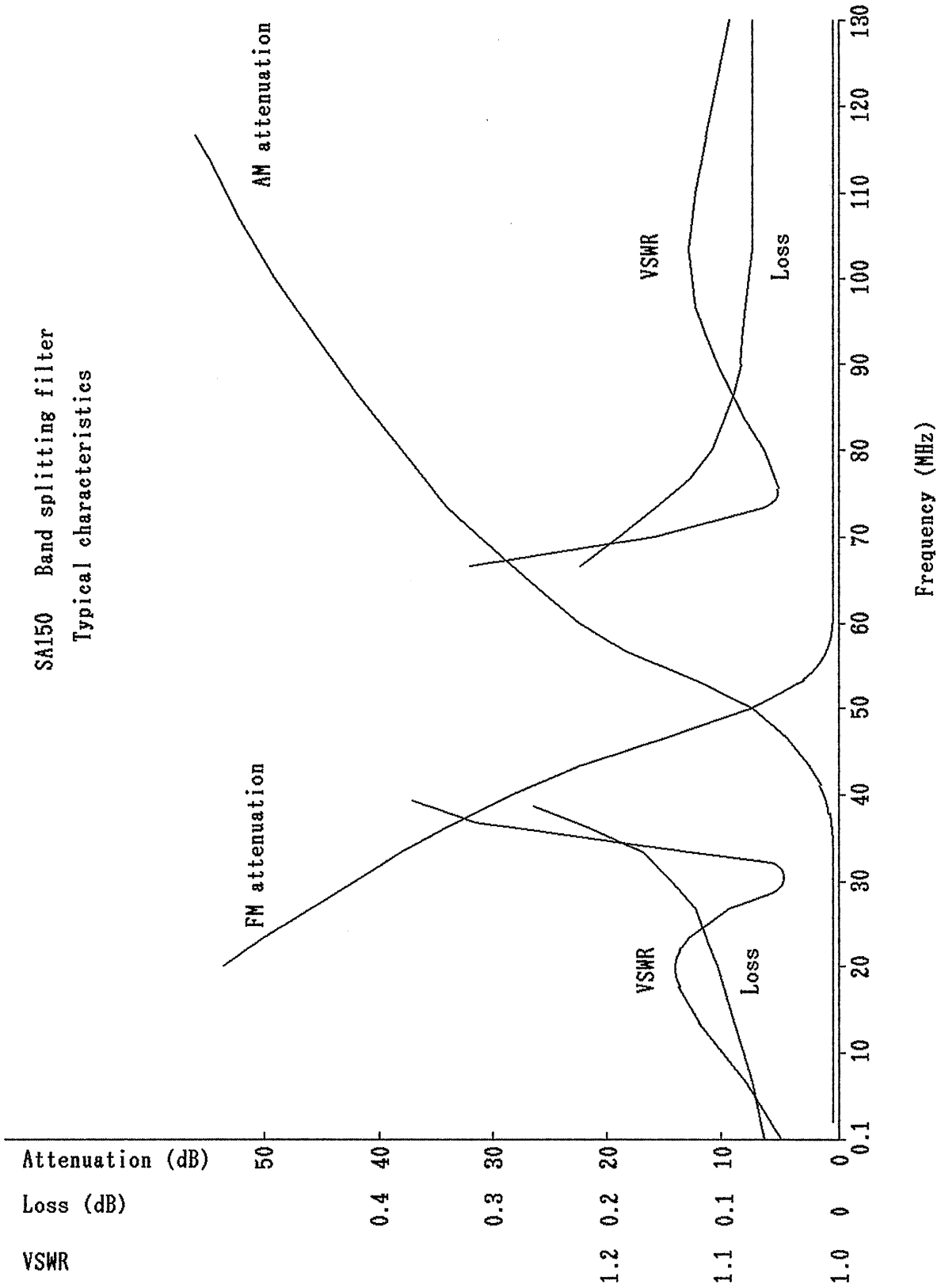


Figure 9-2

Figure 9-3


SA150 Band splitting filter
Typical characteristics
AM attenuation
FM attenuation
VSWR
Loss
VSWR
Loss
Attenuation (dB)
Loss (dB)
VSWR
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
Frequency (MHz)

2) SA150 application example

The SA150 outputs separate signals by the combination of HPF and LPF.

The RANGE OUTPUT control signal output from the rear panel of KGS4500 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 frequencyis less than 30MHz or between 75MHz and 110MHz; the error increases in other ranges. (See Figure 9-2 for the external appearance and Figure 9-3 for typical characteristics.)

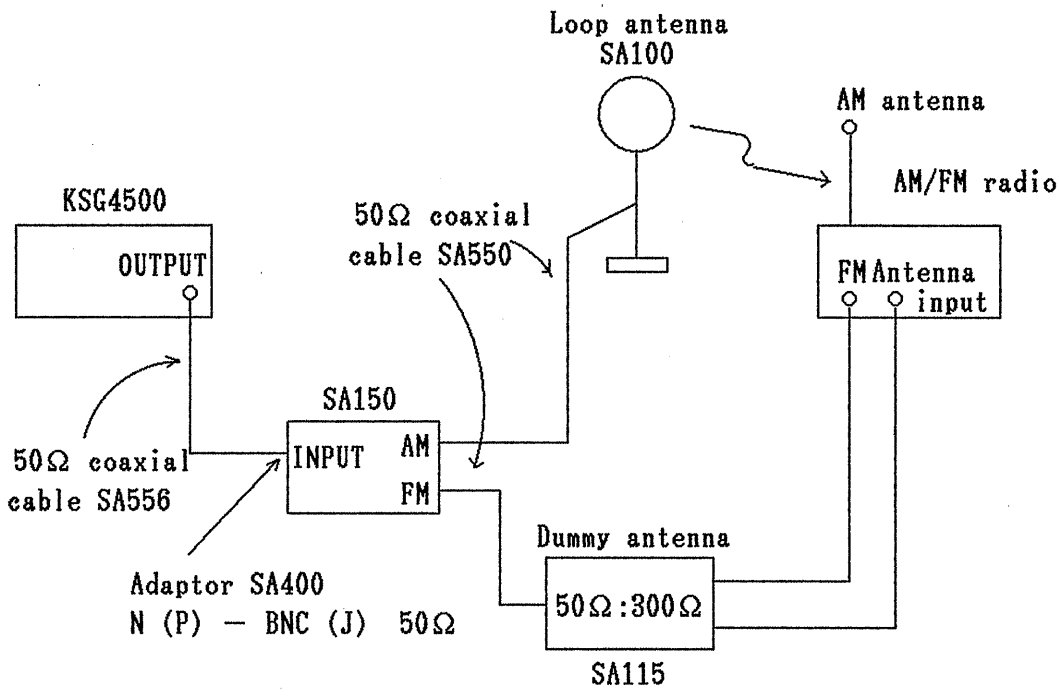


Figure 9-4

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 KSG4500.

SA151: AM output impedance = 80Ω
FM output impedance = 75Ω
(Loaded type)

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

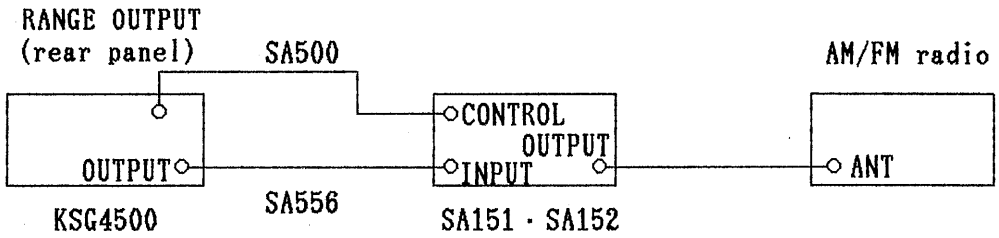


Figure 9-5. Connection Example

9.3.1 SA151 dummy antenna for car radio (loaded type)

1) Performance

Input frequency range	50kHz to 200MHz
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

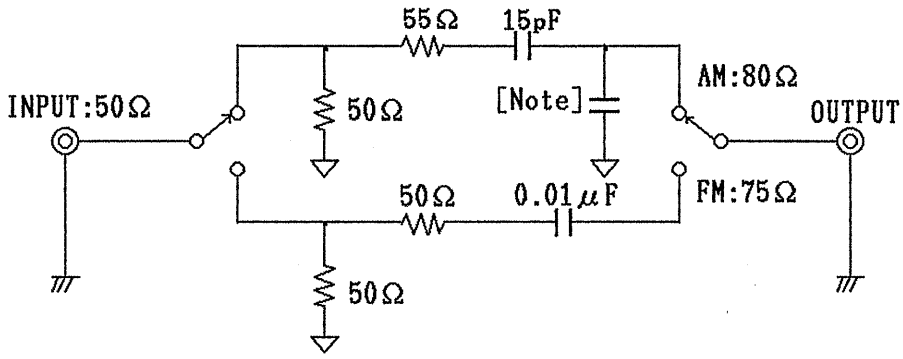


Figure 9-6

Note: Adjust the load capacitance to 60pF including the antenna cable capacitance for car radio. (Actually, a 30pF capacitor is mounted.)

3) Outline drawing

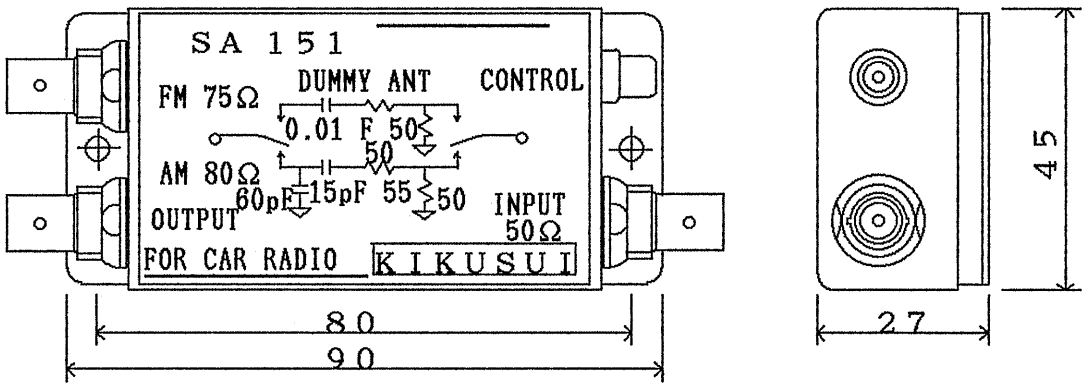


Figure 9-7

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

1) Performance

Input frequency range	50kHz to 200MHz
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 in plugs at both ends. Length = 0.8m)

2) Dummy antenna circuit diagram

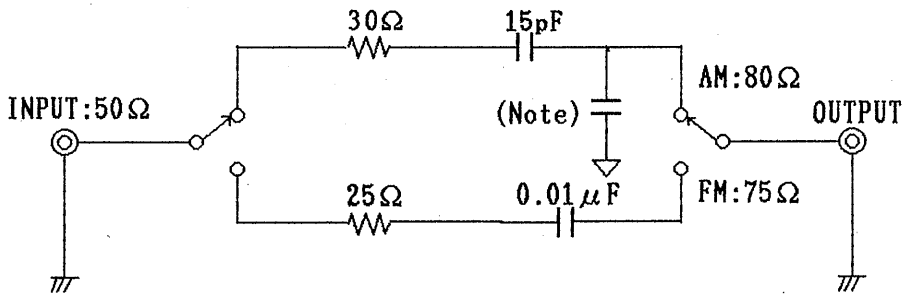


Figure 9-8

Note: Adjust the load capacitance to 60pF including the antenna cable capacitance for car radio. (Actually, a 30pF capacitor is mounted.)

3) Outline drawing

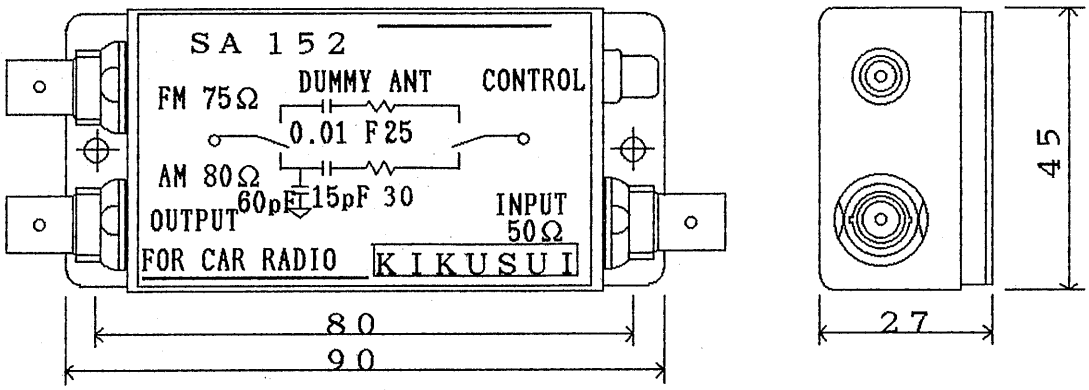


Figure 9-9

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.

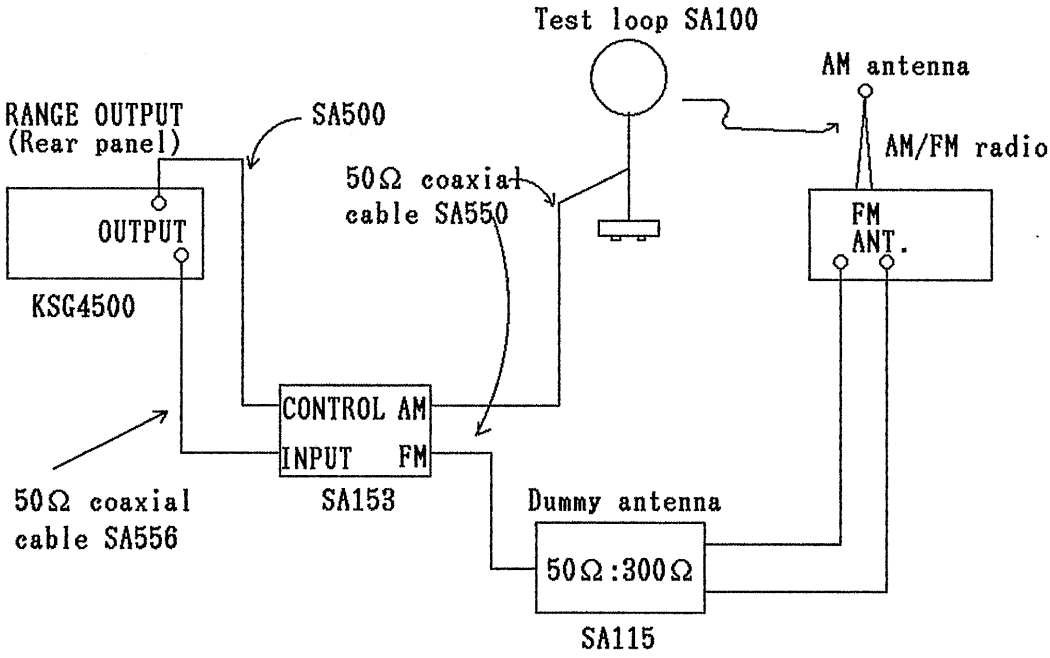


Figure 9-10. SA153 connection diagram

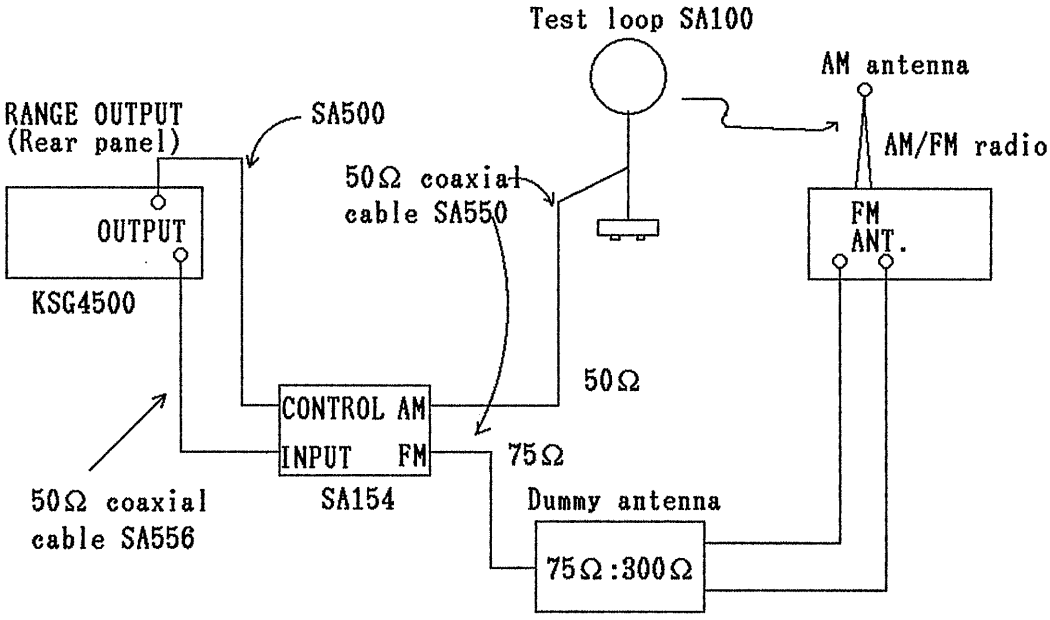


Figure 9-11. SA154 connection diagram

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

Input frequency range	DC to 200MHz
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 in plugs at both ends. Length = 0.8m)

2) Output switch and impedance switch circuit diagrams

SA153

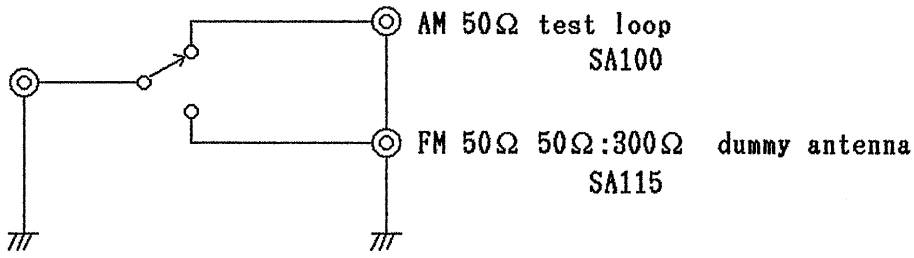


Figure 9-12

SA154

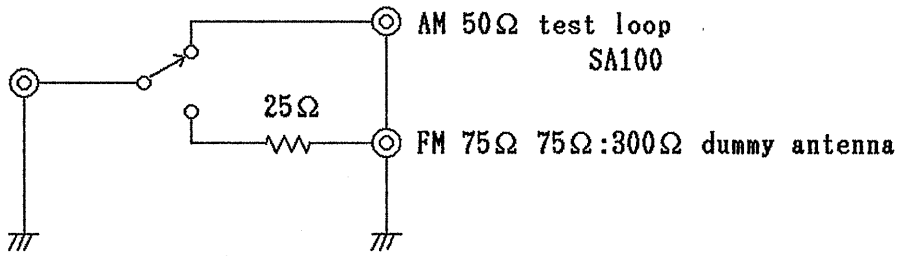


Figure 9-13

3) Outline drawing

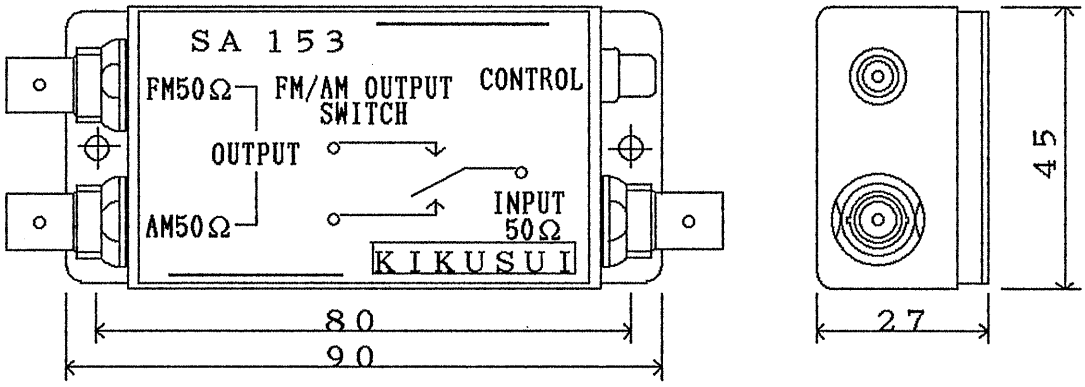


Figure 9-14. Outline drawing

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".

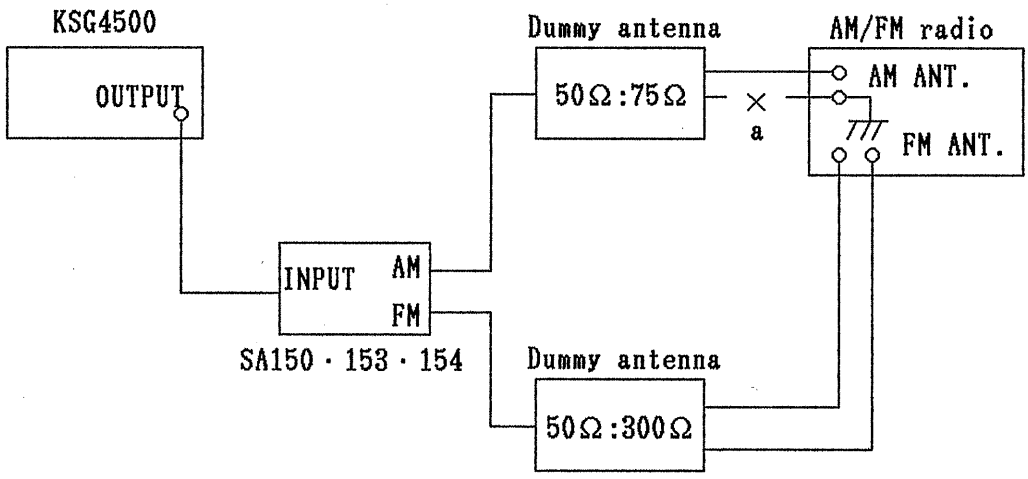


Figure 9-15