OPERATION MANUAL

FM/AM SIGNAL GENERATOR

KSG 4500T

Third Edition

KIKUSUI ELECTRONICS CORPORATION

(KIKUSUI PART NO. Z1-478-320)

M-94072

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.

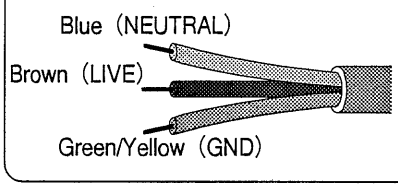
☐ AC power cable

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.

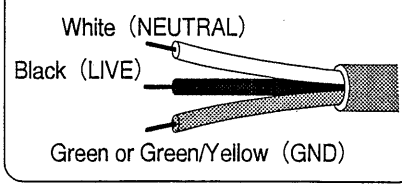
WARNING

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

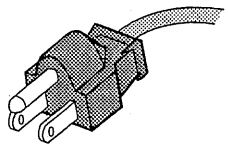
☐ Without a power plug



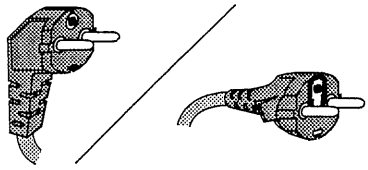
☐ Without a power plug



☐ 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

CONTENTS

(Cont'd)

CONTENTS

(Cont'd)

CONTENTS

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1. INTRODUCTION

1.1 General Description

The KSG4500T is an FM/AM signal generator that covers the frequency of 100kHz to 1040MHz. Since it generates highly stable signals with the resolution of 10 Hz by the use of Phase Lock Loop (PLL), it is suitable for measuring the characteristics of pagers, cordless telephones, MCAs, celuller telephone, personal radios, and various receivers of FM and AM band. 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, such as a dummy antenna, can be offset. The output level can be changed continuously.

Since the time required for switching between program and command and that required for settling frequency and amplitude is approximately 50ms (150ms at maximum), the instrument can be incorporated into a system.

Three modulation modes, namely, FM, AM, and FM-AM modes, are available. The modulation can be done by external DC·FM. The FM peak frequency deviation is 250kHz, and the maximum AM depth is 99.9% (guaranteed range 80% max.). Both internal and external modulation is possible.

Since the KSG4500T gives a very low FM distortion rate of 0.5% or less, it can be used for the development and production of pagers, cordless telephones, MCAs, celuller telephones, personal radios.
In the DC·FM mode, highly stable and accurate output frequency can be obtained because a closed loop DC·FM method is adopted instead of the conventional free run method. The DC·FM mode is suitable for the low rate frequency modulation on such an item as a pager.

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.

A special function allows a two-tone modulation of internal FM and external FM.

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 KSG4500T supports the GP-IB control, it reduces labor on production lines.

1.2 Features

1) Since the KSG4500T covers a wide band range of 100kHz to 1040MHz, it can be used for testing various radios and communication instruments.

2) The carrier frequency can be specified with a 9-digit number, and the value of a desired digit (designated by cursor) can be changed continuously by a rotary knob.
Also, the KSG4500T has the △FREQ (frequency difference) display function and the [illegible] 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) The output level can be selected from a wide range of −20.0dBμ to 126.0dBμ (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.

5) The Δ dB key can change the output level continuously within the range of ±5dB from any point by the unit of 0.1dB.

6) Since the KSG4500T can generate highly pure signals, it can be used for testing not only FM/AM but also SSB receivers.

7) The settling time is only 50ms approximately.

8) Modulation preset keys are provided for AM 30%, FM 1.75kHz, 3.5kHz and 22.5kHz to facilitate operation. ON/OFF of modulation can be specified for AM and FM independently of each other. Also, in the external DC·FM mode, the DC-coupled frequency modulation can be done.

9) Special functions allow the FM two-tone modulation and many other additional operations.

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

11) Data can be copied from the memory of one KSG4500T to that of another KSG4500T by the pressing of DUMP key.

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

13) The KSG4500T has a GP-IB interface.

14) Since the KSG4500Ts 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

  Resolution : 10Hz

  Accuracy : Same as reference oscillator

  Display : 9-digit readout, ΔFREQ display, and ± frequency inversion function

- Reference oscillator

  Frequency : 50MHz

  Stability : Temperature stability $\pm 5 \times 10^{-6}$
  : Aging rate $\pm 2 \times 10^{-6}$/Week
  : Refer to the High stability crystal oscillator (Options, on page 11)

  Internal 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

o 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 - 130MHz	130MHz - 1040MHz
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
Δ 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 : ±1dB Output = 113dB (0dBm)

Output level accuracy : ±1dB Output ≧ 103dB (−10dBm)
±1.5dB Output ≧ −7dB (−120dBm)
±2dB Output < −7dB (−120dBm)

Output level changing : The output level can be changed continuously within the range of ±5dB from any point by the unit of 0.1 dB. (This function cannot be used for amplitude modulation.)

RF.ON/OFF : RF output can be turned ON/OFF by RF.OFF key.

Output impedance : 50Ω N type connector

VSWR : ≦ 1.5 Output ≦ 100dB (−13dBm)

Reverse power protection: Maximum 25W, 25V DC

Spurious signals (Fundamental wave = 0dBc)

Harmonics : ≦ −25dBc Output ≦ 120dB (+7dBm)
Non-harmonics : At Modulation OFF, offset carrier ±5kHz
≦ −60dBc

SSB phase noise : At CW mode, offset carrier 20kHz
≦ −127dBc/Hz 127.5MHz to 260MHz
≦ −121dBc/Hz 260 to 520MHz
≦ −115dBc/Hz 0.1 to 130MHz, 520 to 1040MHz

Residual modulation (S/N)
FM component :

Frequency	Demodulation band width	
	0.3 to 3kHz 3.5kHz deviation	50Hz to 15kHz 75kHz deviation
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 : Selection can be made from the following signal sources for FM, AM, FM-AM simultaneously, external DC·FM:

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: 400Hz and 1kHz; ±3%
frequency

External modulation

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

2) Input voltage : 1V peak approx.
requirement *Note: For the above input voltage, an error of*
for external *±2% is allowed by HI-LO moniter.*
modulation

[FM]

Maximum frequency deviation range and resolution

Frequency		Range		
127.5 to 260MHz	Freq. deviation	0 to 9.99kHz	10 to 60kHz	
	Resolution	10Hz	100Hz	
260 to 520MHz	Freq. deviation	0 to 9.99kHz	10 to 99.9kHz	100 to 125kHz
	Resolution	10Hz	100Hz	1kHz
2.5 to 127.5MHz	Freq. deviation	0 to 9.99kHz	10 to 99.9kHz	100 to 250kHz
520 to 1040MHz	Resolution	10Hz	100Hz	1kHz

Note: When the value of RF is smaller than or equal to 2.5MHz, the maximum frequency deviation is 10% of the RF value.

Display : 3-digit readout

Accuracy : ±5% of maximum frequency deviation (Range)
(Except residual FM)

External modulation frequency characteristics : ±1dB 20Hz to 70kHz, 1kHz reference

Distortion of modulation : For Demodulation band width = 50 Hzto 15kHz,
and Deviation = 75kHz
≦ 0.5%

Incidental AM : For Demodulation band width = 50Hz to 15kHz,
Modulation frequency = 1kHz, Deviation = 60kHz
and RF > 2.5MHz
≦ 0.5%

DC·FM mode (Closed loop system)

Frequency accuracy	±(Reference frequency +125Hz)	127.5 to 255MHz
	±(Reference frequency +250Hz)	255 to 510MHz
	±(Reference frequency +500Hz)	0.1 to 127.5MHz, 510 to 1040MHz

Stability ≦ 100Hz/60 minutes
(Except drift of reference oscillator)

External modulation frequency characteristics : ±1dB DC to 70kHz, 1kHz reference

[AM]

Settable : 0 to 99.9%

Depth : 0 to 80% Output ≦ 120dB (+7dBm)

Resolution : 0.1%

Display : 3-digit readout

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

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

Distortion of modulation : For Demodulation band width = 50Hz to 15kHz, and
Depth = 30%
≦ 1.5%

Incidental FM : For Demodulation band width = 0.3 to 3kHz
Modulation frequency = 1kHz, Depth = 30%
Output ≦ 120dB (+7dBm)
≦ 200Hz peak

○ Special functions (additional function) :

1) Memory protection

2) FM two-tone modulation
(FM-FM simultaneous modulation)
a) Internal 400Hz and external signal source
b) Internal 1kHz and external signal source
The DC·FM mode is allowed to the external signal source.
Modulation factor can be set for the internal and external signals individually.
For the two-tone modulation, AM·FM simultaneous modulation is not allowed.

3) FM polarity switching

4) Frequency offset display function

5) Range out switching frequency setting function

6) Output level continuous changing function

7) Initialization of the above functions

○ 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 1.75kHz, 3.5kHz and 22.5kHz (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

- 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 : 100, 115, 215, 230V AC ±10% (selectable by voltage selector plug)

  Frequency : 50Hz/60Hz

  Power dissipation : Approx. 69VA

- 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% RH or less

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

a) Temperature stability: $\pm 5 \times 10^{-8}$
Aging rate : $\pm 2 \times 10^{-8}$/day 24 hours after power on

b) Temperature stability: $\pm 1 \times 10^{-7}$
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 KSG4500T 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 KSG4500T, 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.

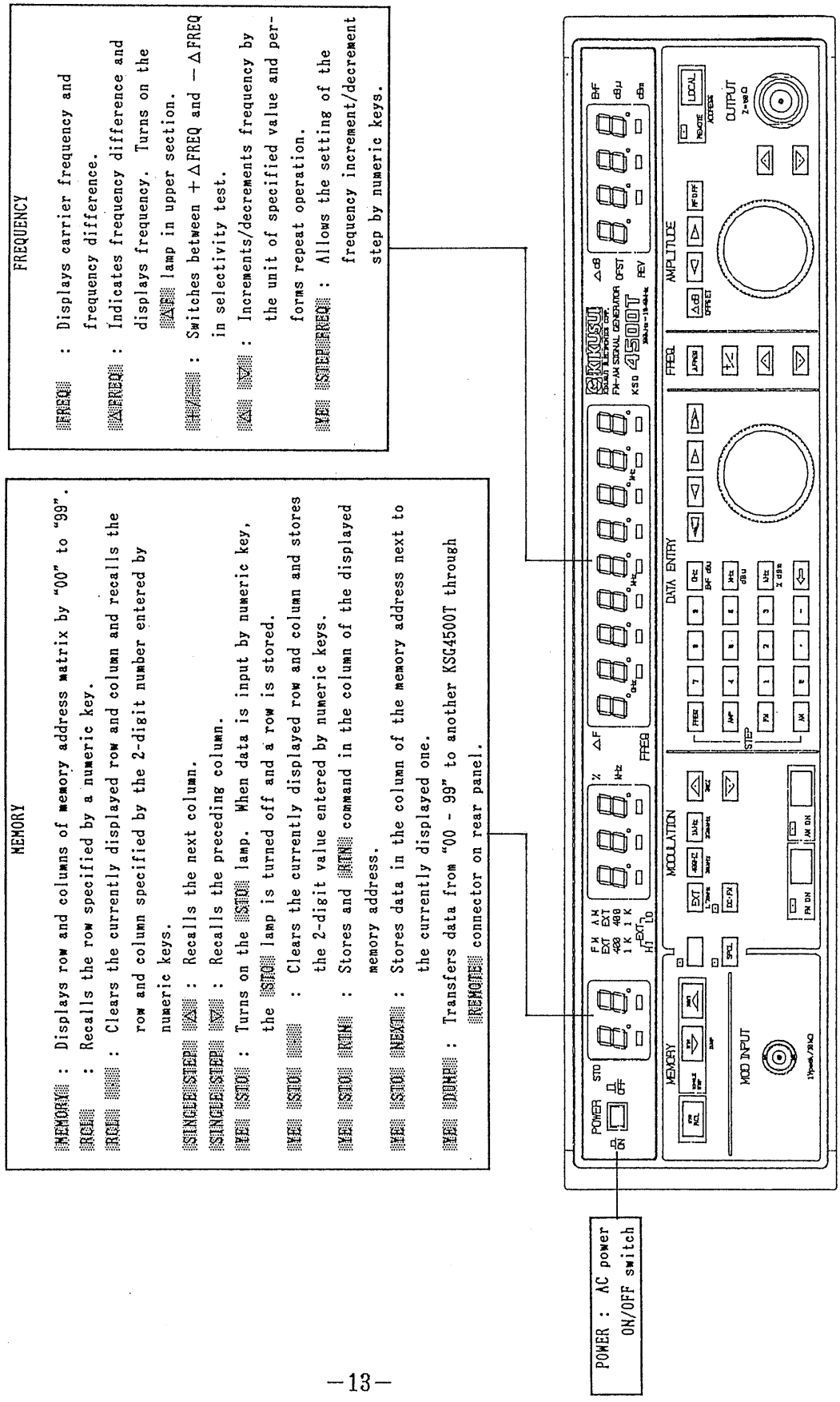
Setting Position	Center Voltage	Line Voltage Range	Fuse
A	100V	90 - 110V	3.0A
B	115V	104 - 126V	
C	215V	194 - 236V	1.5A
D	230V	207 - 253V	

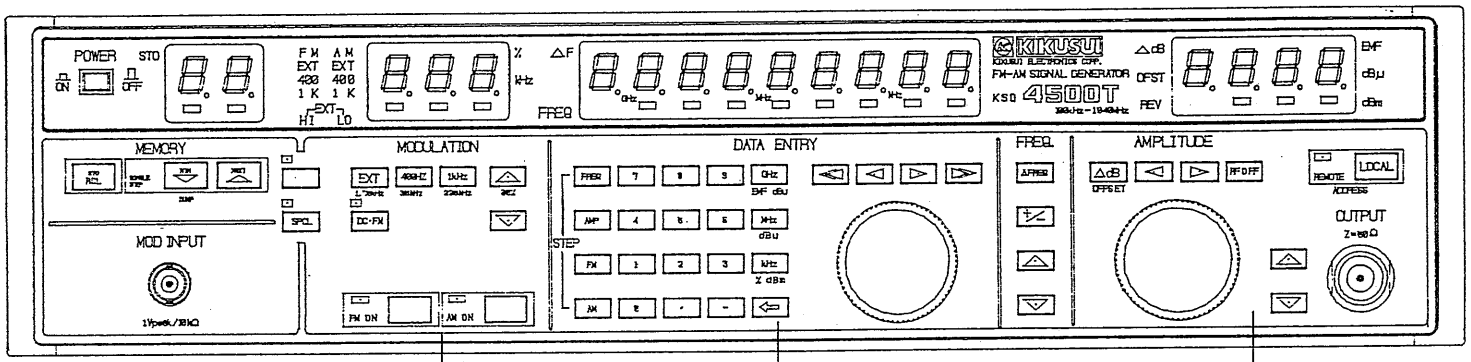
3.3 Surrounding Temperature/Humidity, Warm-up Time, and Installation Place

The KSG4500T 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.

F1 1.75kHz 3.5kHz 22.5kHz : Presets FM deviation at 1.75kHz, 3.5kHz or 22.5kHz.

F2 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.

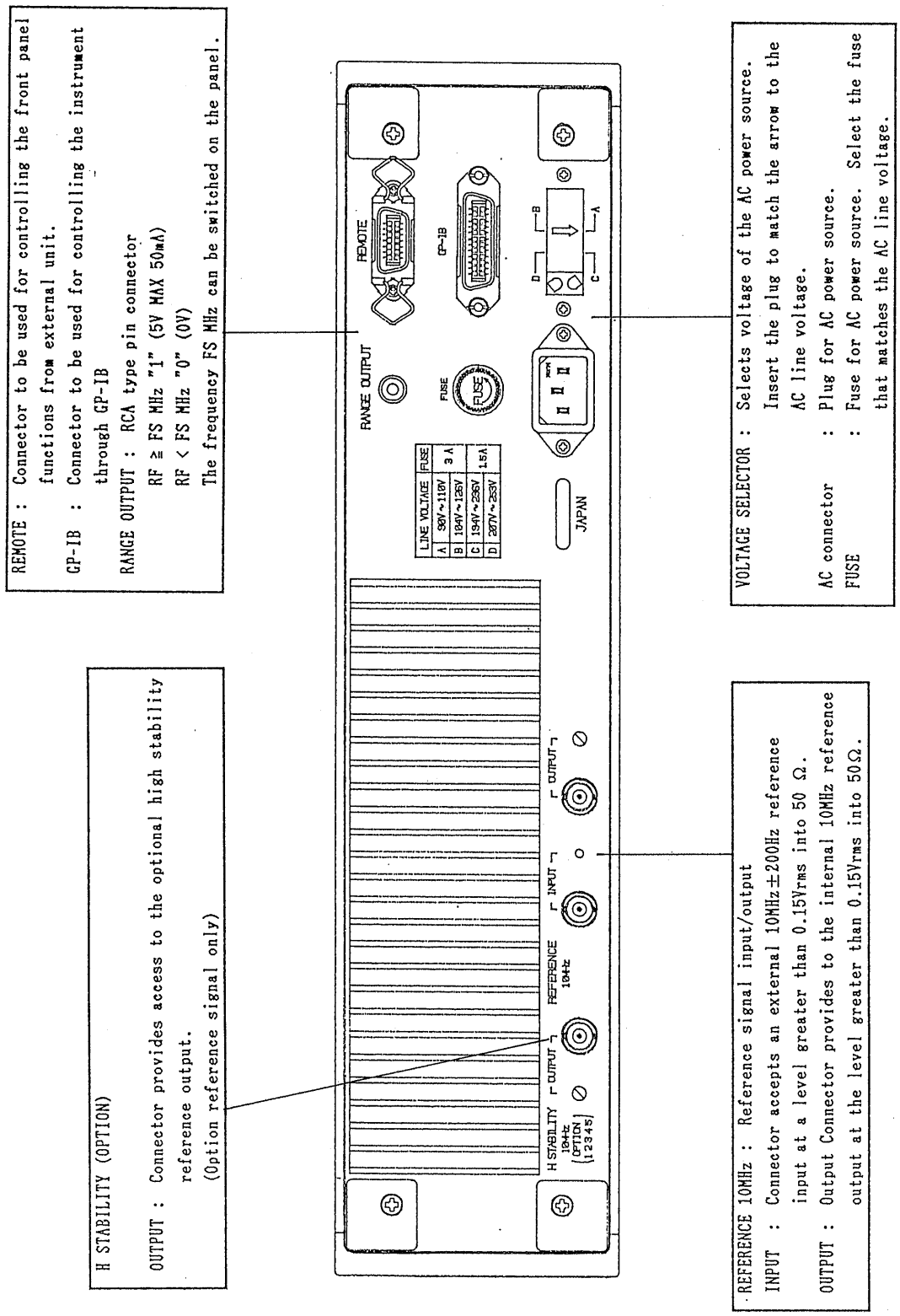
OUTPUT : N type connector for RF output.
−20.0dBμ to 126.0dBμ at open circuit.
The signal source impedance is 50Ω.

F1 STEP AMP : Allows the setting of the output level increment/decrement step by numeric keys.

F2 OFFSET : Displays the offset for dummy antenna, etc.

F1 ADDRESS : Displays GP-IB address.

4.2 Rear Panel Features

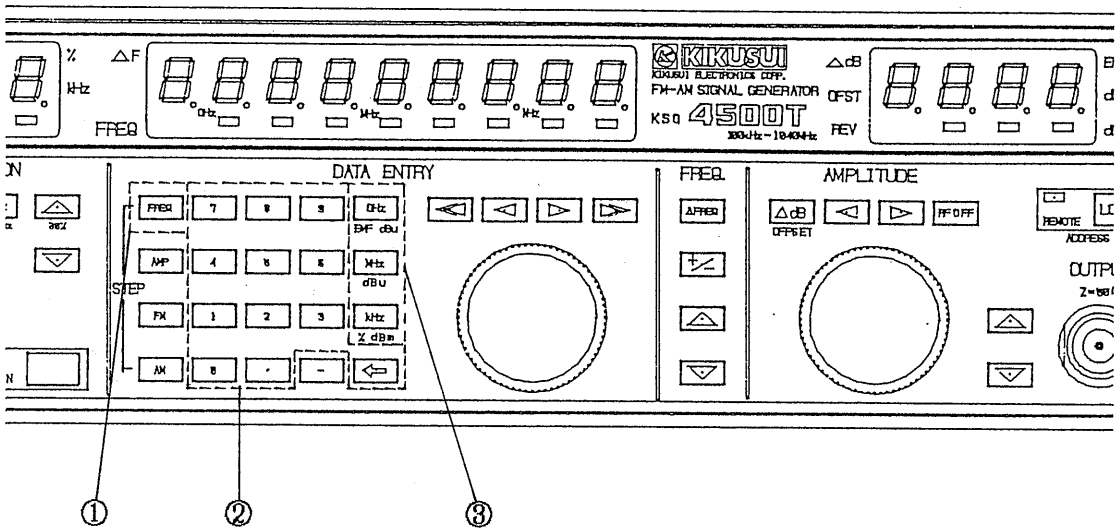


4.3 Turning on the Power Supply

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. (Except HI·LO and REV indicators.)

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 GHz, 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 9; a value of more than nine digits is not accepted. The range of the frequency that can be specified is 0 to 1040MHz. Since the frequency resolution of the instrument is 10Hz, a value less than 10Hz 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 (GHz, 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: 123.45678MHz 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 ␣␣	
8	123.4567 8␣	
MHz	␣123.456.78	

(b) Example: 455kHz is input.

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

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

Key operation	FREQUENCY display
FREQ	␣␣␣␣ 455.00
1	1␣␣␣ ␣␣␣ ␣␣
2 "2" was pressed for "1" by mistake	12␣␣ ␣␣␣ ␣␣
C	1␣␣␣ ␣␣␣ ␣␣
1	11␣␣ ␣␣␣ ␣␣
MHz	␣␣11.000.00

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		␣␣11.000.00
8		8␣␣␣ ␣␣␣ ␣␣
6	"6" was pressed for "5" by mistake	86␣␣ ␣␣␣ ␣␣
.		86.␣ ␣␣␣ ␣␣
7		86.7 ␣␣␣ ␣␣
⇦	Press twice	86␣␣ ␣␣␣ ␣␣
⇦	Press twice	␣␣11.000.00

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

8	8␣␣␣ ␣␣␣ ␣␣
5	85␣␣ ␣␣␣ ␣␣
.	85.␣ ␣␣␣ ␣␣
7	85.7 ␣␣␣ ␣␣
MHz	␣␣85.700.00

(e) Example: 11MHz was input for 1MHz 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 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 GHz, 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
		␣100.000.00
◁	Press once	␣100.000.00
	Turn the rotary knob clockwise by two steps	␣100.020.00

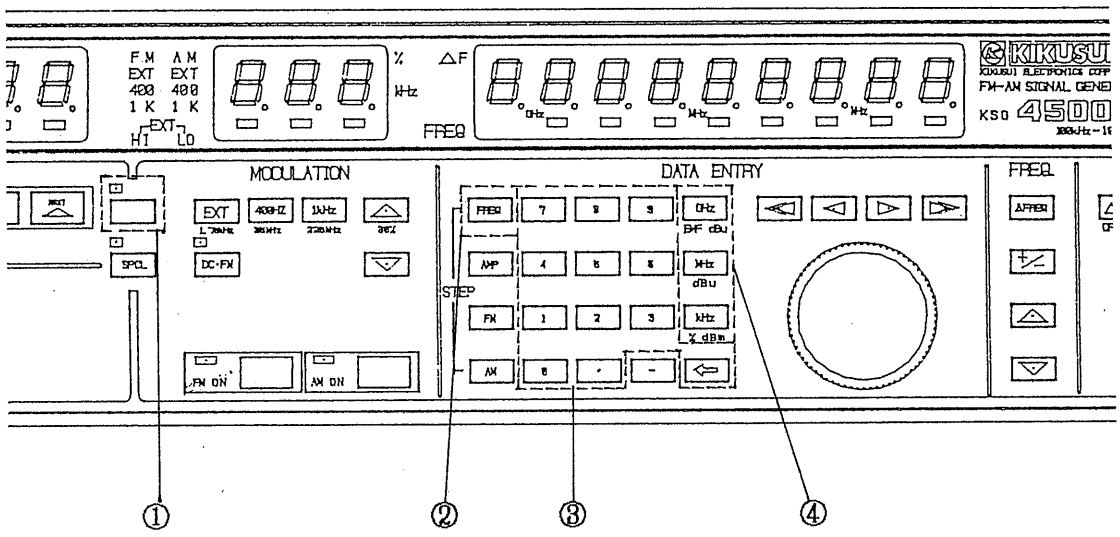
(b) Example: To change frequency from 100.02MHz to 98.02MHz

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 (minimum 10Hz) 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. The [YE] key is function 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 9kHz for [△] and [▽] keys when carrier frequency is 1MHz.

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 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]	×××× ××× ××	[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	
[ΔFREQ]	␣␣␣␣ 100.00	[ΔF] indicator is turned on.
[FREQUENCY] [▽]	−␣␣␣ 100.00	Frequency 99.9MHz
[⇦]	␣␣␣␣ ␣␣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 100kHz.
If the [⇦] key is pressed in the above example, the frequency returns to the initial value (center value).

(b) Example: 100MHz is set currently.

Key operation		FREQUENCY display	
		␣100.000.00	
ΔFREQ		␣␣␣␣ ␣␣0.00	ΔF indicator is turned on.
◁	Press three times	␣␣␣␣ ␣␣0.00	
◯	Turn the rotary knob counter-clockwise by five steps	−␣␣5.000.00	Frequecy 95MHz
ΔFREQ		␣␣95.000.00	ΔF indicator is turned off.

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

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

Key operation	FREQUENCY display	
	␣100.000.00	
ΔFREQ	␣␣␣␣ ␣␣0.00	ΔF indicator is turned on.
2	2␣␣␣ ␣␣␣ ␣␣	
0	20␣␣ ␣␣␣ ␣␣	
0	200␣ ␣␣␣ ␣␣	
kHz	␣␣␣␣ 200.00	Frequency 100.2MHz
+/−	−␣␣␣ 200.00	Frequency 99.8MHz
ΔFREQ or FREQ	␣␣99.800.00	ΔF indicator is 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

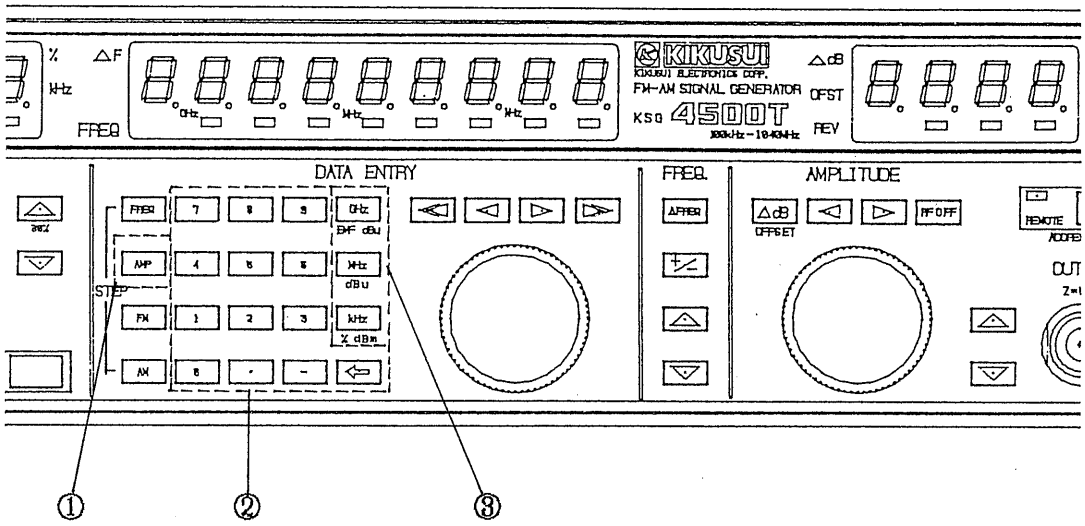
If the optional high stability crystal oscillator is installed, the signal whose frequency is 10MHz and whose voltage is 0.15Vrms or higher is output from the H STABILITY OUTPUT terminal.

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 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 a required unit key.
Then, the value is displayed in the [AMPLITUDE] section correctly.
To select the unit of output level, press the EMF dB (GHz), dB (MHz), or dBm (kHz) key after pressing the AMP key.

(a) Example: To set 10dBμ

Key operation	AMPLITUDE display	
AMP	×××.×	..... Previous value
1	1␣␣␣	
0	10␣␣	
dBμ (MHz)	␣10.0	dBμ indicator is turned on.

(b) Example: To set −5dBm

Key operation	AMPLITUDE display	
AMP	␣10.0	
←	−␣␣␣	
5	−5␣␣	
dBm (kHz)	−␣5.0	dBm indicator is turned on.

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

(c) Example: 120 EMF 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␣	
EMF dBμ (GHz)	120.0	EMF dBμ indicator is turned on.

If an error is made during the setting by numeric keys, correct the error by the ← key. If an error is found after the unit key (EMF dBμ, dBμ or dBm) is pressed, enter the correct value by 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 Article 4.5.8 for the range allowed to each unit.

4.5.2 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

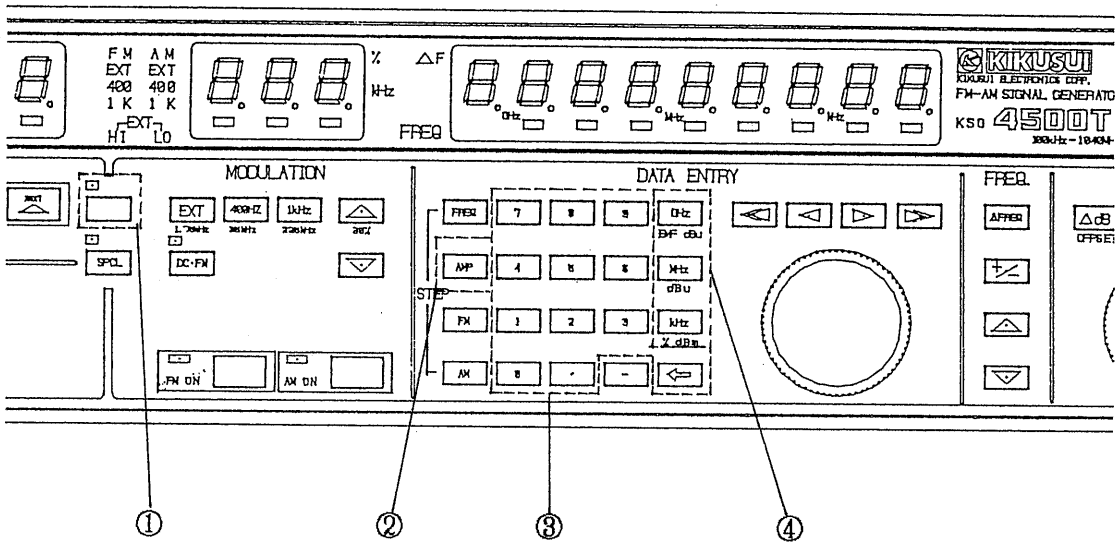
(b) Example: To change output level from 66dB to 60dB

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 unit key (EMF dBμ , dBμ , dBm , etc.) when making setting with the Rotary knob.

4.5.3 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 60dBμ

Key operation	AMPLITUDE display	
YE	␣60.0	YE indicator is turned on.
STEP AMP	␣␣␣␣	YE indicator is turned off.
2	2␣␣␣	
EMF dBμ (GHz)	␣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.

Note: In addition to the EMF dBμ (GHz) key, the dBμ (MHz) and dBm (KHz) keys can also be used.

4.5.4 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 indicator is turned on and then off.
YE OFFSET	␣94.0	OFST indicator is turned on.
To release offset		
YE OFFSET	100.0	OFST indicator is turned off.

4.5.5 Output level difference ΔdB key

The ΔdB 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 ΔdB indicator in the [AMPLITUDE] section is turned on when the ΔdB key is pressed.
When to release the ΔdB function, press ΔdB key again.
The output level can be changed only within the range from its minimum value to its maximum value.
When the ΔdB key is pressed, the output level can be changed within the range of ±5dB from the current value without using the main attenuator. See Article 4.7.7 for the operation method.

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

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

4.5.6 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.

4.5.7 Reverse power protector

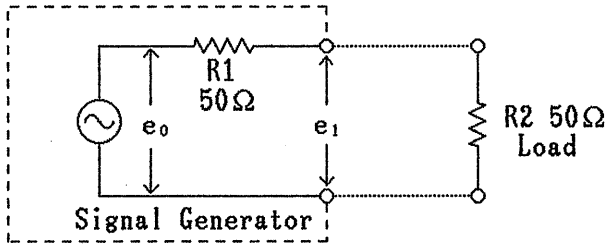
When a high frequency power is applied to the OUTPUT terminal from an external unit, an internal protector operates and stops signal output. Then, the REV indicator in the [AMPLITUDE] section is turned on.
To reset the protector function, press the RF.OFF key twice.

4.5.8 Unit of output level

Setting unit key

Key operation	Display
AMP EMF dBμ	EMF dBμ
AMP dBμ	dBμ
AMP dBm	dBm

The equivalent circuit of the output block used in the KSG4500T is as follows:



The output level can be set in ranges below.

(a) EMF dBμ: Open circuit voltage −20.0dBμ to 126.0dBμ

The voltage e_0 in the above chart is normalized by "0dBμ = 1μVrms".
The EMF dBμ indicator in the [AMPLITUDE] section is turned on.

(b) dBμ: Loaded voltage −26.0dBμ to 120dBμ

The voltage e_1 in the above chart is normalized by "0dBμ = 1μVrms".
The dBμ indicator in the [AMPLITUDE] section is turned on.

(c) dBm: Power indication −133.0dBm to +13.0dBm

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

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

The dBm indicator in the [AMPLITUDE] section is turned on.

4.6 Setting the Modulation

4.6.1 [YE] key

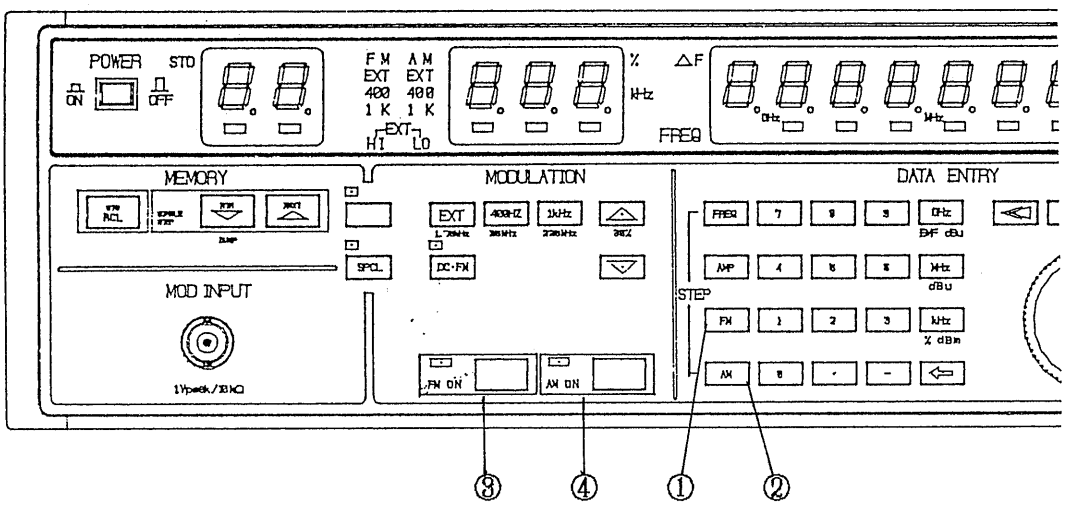
a) Press [YE] [1.75kHz], and the FM peak frequency deviation is set to 1.75kHz.
b) Press [YE] [3.5kHz], and the FM peak frequency deviation is set to 3.5kHz.
c) Press [YE] [22.5kHz], and the FM peak frequency deviation is set to 22.5kHz.
d) Press [YE] [30%], and the AM depth is set to 30%.

4.6.2 Setting modulation mode and source

Switching between FM and AM modes is done by the [FM] ① and [AM] ② keys in the DATA ENTRY section or by the [FM ON] ③ and [AM ON] ④ keys in the MODULATION section.

The same display is used for the modulation factor of both FM and AM. In the FM mode, "kHz" is selected as the unit, and in the AM mode, "%" is selected as the unit. The value of the modulation factor is displayed in the MODULATION section.
For switching the source, use the [EXT], [400Hz], or [1kHz] key.

The [FM ON], [AM ON], and [DC·FM] keys are toggle switches, and when one of them is selected, the relevant LED is turned on.
See Article 4.6.8 for the DC·FM mode.



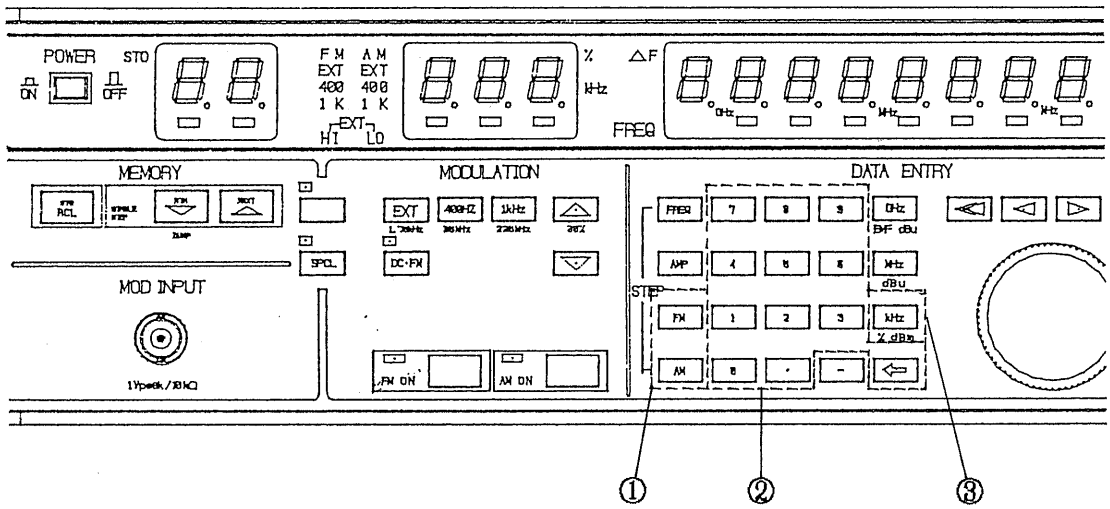
(a) Example: 50kHz deviation is to be set for 400Hz internal FM source

Key operation	MODULATION display	
FM	××.×	Previously set value
		kHz indicator is turned on.
400Hz		FM 400Hz indicator is turned on.
5	5␣␣	
0	50␣	
kHz	50.0	

(b) Example: The modulation is to be turned off

The modulation is terminated when key ③ is pressed and the FM ON indicator is turned off.
At this time, the MODULATION display indicates AM depth if AM is on (lamp ④ is on), and it indicates 0kHz if AM is 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 desired value can be input by the numeric keys (0 - 9 and .), but if the input value is not within the allowable range, the previous value is displayed.

The relationships between the carrier frequency and maximum/minimum deviation are listed below. See Chapter 2 "SPECIFICATIONS" for the guaranteed ranges of the specifications.
See Article 4.6.4 for the overlapping ranges of frequency.

Carrier frequency	Maximum deviation	Resolution
0 to 130MHz	250kHz	10Hz, 100Hz or 1kHz
127.5MHz to 260MHz	60kHz	10Hz or 100Hz
255MHz to 520MHz	125kHz	10Hz, 100Hz or 1kHz
510MHz to 1040MHz	250kHz	10Hz, 100Hz 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 (%, dBm)	25.0

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

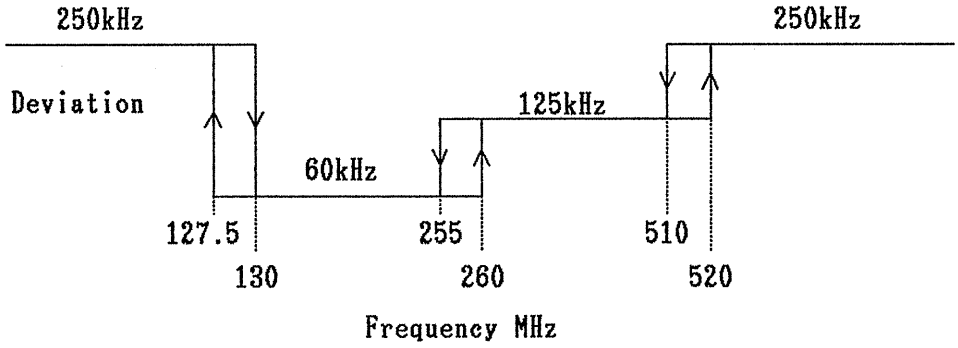
Key operation	MODULATION display
AM	××.×.... Previously set value % is displayed as unit.
3	3␣␣
0	30␣
%, dBm (kHz)	30.0

4.6.4 [MODULATION] section

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

When the frequency is changed from band A to band B and if the deviation specified for Band A is greater than the maximum deviation of band B, the maximum deviation of band B is displayed.

The overlapping ranges of frequency are as follows:
The border values of the overlapping ranges are rough values.



For example, specify the deviation of 125kHz for the frequency of 300MHz and reduce the frequency. When the frequency is reduced to 255MHz or lower, the MODULATION indicator displays 60kHz as the value of deviation. After that, even if the frequency is increased to the band of 300MHz, the displayed value of deviation (60kHz) remains unchanged. To get the deviation of 125kHz again, specify the deviation again.

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 frequency is 350kHz or higher)
The mark "_" denotes cursor position

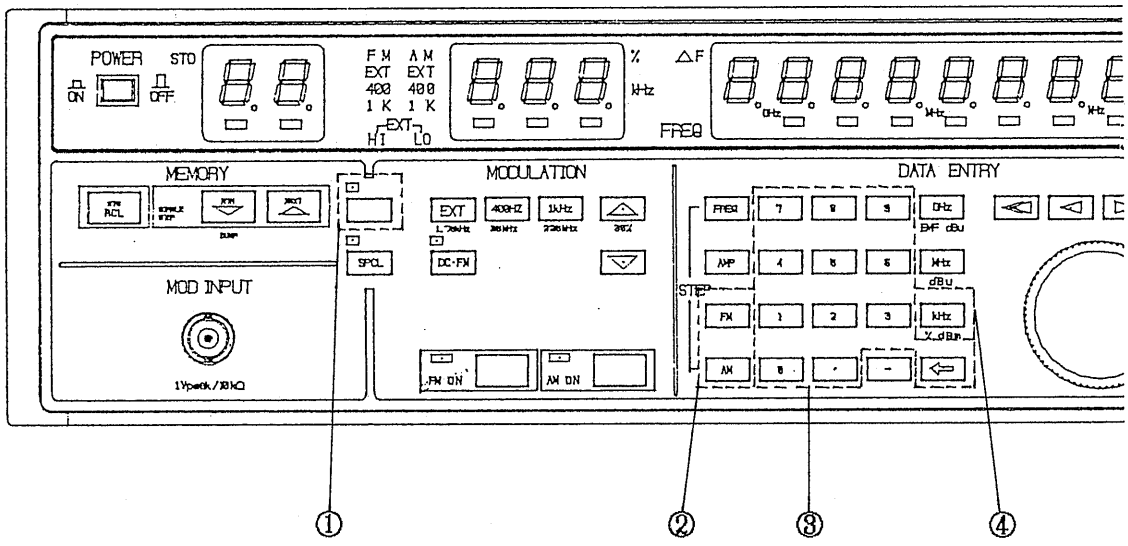
Key operation		MODULATION display
FM		25.0
◁	Press once.	25.0
↻	Turn the rotary knob clockwise by one step.	35.0

(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 10Hz, 100Hz or 1kHz for FM, or 0.1% for AM) 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	75.0 kHz	YE indicator is turned on.
STEP FM	␣␣ ␣	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. 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

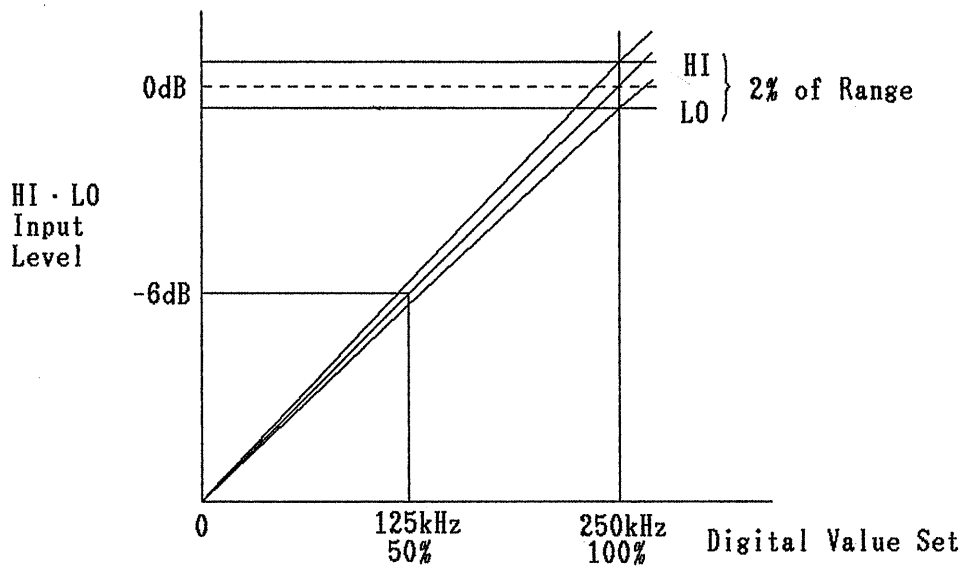
(1) Connection and setting method

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 1Vpeak.

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 250kHz, attenuate the input level by −6dB.
Then, 250kHz (= 100%) remains displayed but the actual peak freauency deviation is reduced to 125kHz (= 50%). At this time, the LO lamp is turned on, but modulation is done correctly at the peak freauency deviation of 125kHz.

4.6.8 DC·FM modulation mode

When the DC·FM key is selected, external modulation is done by DC coupling.

In the DC·FM mode, a closed loop DC·FM method is used, and compared with the conventional open loop method, this method enables highly stable DC·FM modulation.
By this method, the frequency lock circuit is always active; that is, it is active even when the modulation is done by a DC signal.
The DC·FM mode is set when the DC·FM key is pressed and DC·FM indicator is turned on.

[Note on DC·FM mode]

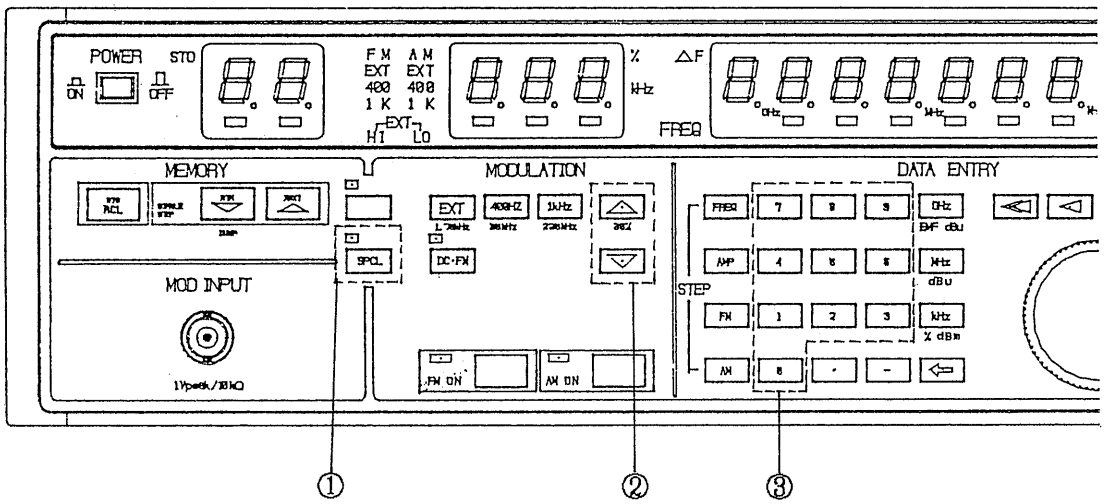
For frequency modulation, either normal FM mode or DC·FM mode can be selected. In the normal FM mode, frequency is stabilized by PLL, and in the DC·FM mode, it is stabilized by a closed loop.
The stabilization by PLL gives accurate output frequency, but it reduces deviation and distorts waveform in the case of modulation by a low frequency signal because the PLL follows the low frequency signal.
The stabilization by closed loop DC·FM enables modulation by DC signal, and it can give a modulated waveform without sag even if a signal of square waveform of less than 1Hz is used for the modulation, but it cannot reduce the frequency error to zero.
Switching between these modes requires a transient time of approximately 5 seconds for the stabilization of frequency.
Therefore, the DC·FM mode must be set in advance of the modulation that uses the EXT DC·FM mode.

To obtain accurate frequency, use the normal mode.

4.7 How To Use Special Functions

In addition to the basic functions described in the preceding sections, special functions are provided to increase the usefulness of the KSG4500T.

Combined with the basic functions and used effectively, the special functions can contribute to the wider application of the KSG4500T.



Press the SPCL key ①, and the KSG4500T enters the special function mode. At this time, the FREQUENCY and MODULATION displays are turned off as they are set in the special function display mode.

Press ▽ or △ key ② in MODULATION section, and the currently active special functions except those in the initial state are displayed.
In other words, if all the special functions are in the initial state, the SPCL key indicator ① remains off and no information appears on the FREQUENCY and MODULATION displays.
To activate a new special function, press the SPCL key ① and input its 2-digit code by numeric keys ③. The value of the input code appears on the FREQUENCY display.

After that, press the SPCL key ① again, and the SPCL key indicator ① goes on and the code of the activated function appears on the MODULATION display and flickers once. Then, the displays return to their normal mode.

The SPCL key indicator ① is turned on when any one of the special functions that are not in the initial state is active (see Table 1).

Note that the special functions cannot be stored in MEMORY (address 00 -99). The special functions are listed in Table 1.

Table 1 Special functions and their codes

Code	GP-IB code	Description
00	SP00	Instrument preset
* 10	SP10	Memory protect mode off
11	SP11	Memory protect mode on
* 20	SP20	FM two-tone modulation mode off
21	SP21	FM two-tone modulation mode on
* 30	SP30	FM modulation polarity positive
31	SP31	FM modulation polarity negative
* 40	SP40	Frequency offset mode off
41	SP41	Frequency offset mode on
* 50	SP50	RANGE OUTPUT switching frequency: Standard state
51	SP51	RANGE OUTPUT switching frequency: Positive logic setting mode
52	SP52	RANGE OUTPUT switching frequency: Negative logic setting mode
* 60	SP60	Output level continuous changing mode: Δ dB indication
61	SP61	Output level continuous changing mode: Level indication
80	SP80	Set all special functions in initial state

The mark "*" indicates the initial state. The SPCL key indicator ① is not turned on for the special functions marked with "*".

4.7.1 Instrument preset (SPCL00)

The panel gives the following preset values:

Frequency:	1040MHz
Output level:	−20 EMF dBμ
Frequency modulation:	On, 1kHz
FM deviation:	3.5kHz
Amplitude modulation:	Off
Cursor position:	Digit of 1kHz for frequency
	Digit of 0.1dB for output level
Memory address:	00

Key operation	MODULATION display	FREQUNCY display	
	× ××	× ××× ××× ××	Previous value
SPCL	␣ ␣␣	␣ ␣␣␣ ␣␣␣ ␣␣	SPCL indicator is turned on.
0	␣ ␣␣	0 ␣␣␣ ␣␣␣ ␣␣	
0	␣ ␣␣	0 0␣␣ ␣␣␣ ␣␣	
SPCL	3.50	1.040.000.00	SPCL indicator is turned off.

The value "00" is displayed and it flickers once. Then, the vlaus "3.50" is displayed.

4.7.2 Memory protect mode (SPCL10, 11)

This function enables (SPCL10) or disables (SPCL11) rewriting of the 100 point memory.

Key operation	MODULATION indicator	FREQUNCY indicator	
	×× ×	×××××××××	Previous value
SPCL	␣␣ ␣	␣␣␣␣␣␣␣␣␣	SPCL indicator is turned on.
1	␣␣ ␣	1␣␣␣␣␣␣␣␣	
* 1	␣␣ ␣	1 1␣␣␣␣␣␣␣	
SPCL	××.×	×××××××××	SPCL indicator is turned on.

The value "11" is displayed and flickers once. Then, the previous value is displayed.

The above key operation disables rewriting of the 100 point memory and keeps the contents of the memory unchanged.

The key operation to enable rewriting is the same as above except for the part marked with "*" ; that is, the letter "1" marked with "*" must be replaced with the letter "0". For this operation, the SPCL indicator is turned off.

4.7.3 FM two-tone (tone squelch) modulation mode (SPCL20, 21)

In the FM two-tone (continuous tone-controlled squelch) modulation mode, an internal modulation signal is combined with an external modulation signal and the sum of these two signals is used for modulating the carrier frequency. The minimum displayed resolution of the FM deviation is 10Hz. This mode is mainly used for adjusting and inspecting the narrow band receivers having the tone squelch function.

(1) Specifications

- Frequency modulation signal source indication:
  ① EXT (External)
  ② 400Hz (Internal 400Hz)
  ③ 1kHz (Internal 1kHz)
  ④ EXT and 400Hz
  ⑤ EXT and 1kHz
  For ④ and ⑤, the combined frequency deviation is displayed.

- Frequency deviation indication:
  External modulation. Sum of the deviation of internal modulation and that of external modulation

- Frequency deviation range:
  The sum of the deviations must not exceed the maximum deviation allowed on specification.

- Resolution of frequency deviation: 10Hz minimum

- External modulation input voltage: 1Vpeak ±2% (HI-LO indicator off)

- External modulation frequency characteristic: ±1dB 20Hz to 70kHz

- System standard preset valuse (The values conform to the EIAJ TR-027 ±2.5kHz modulation)

External tone signal	External modulation	FM deviation = 0.35kHz
Internal tone signal	Internal modulation 1kHz	FM deviation = 1.4kHz
Combined deviation	1.75kHz	

(2) Operation

(a)

Key operation	MODULATION indicator	FREQUNCY indicator	
	× ××	×××××××××	Previous value
SPCL	␣ ␣␣	␣␣␣␣␣␣␣␣␣	SPCL indicator is turned on.
2	␣ ␣␣	2␣␣␣␣␣␣␣␣	
1	␣ ␣␣	21␣␣␣␣␣␣␣	
SPCL	1.75	×××××××××	SPCL indicator is turned on.

The value "21" is displayed and flickers once. Then, the system standard preset value explained in Item (1) is set.

(b) Supply the input voltage (approx. 1Vpeak) to MOD INPUT. Keep supplying it till the EXT HI LO indicator in MODULATION section is turned off.

(c) The table below lists the keys to be pressed, data to be displayed in [MODULATION] section, and states of the FM signal source indicators. The keys must be pressed in the order listed.

Key operation	MODULATION display	State of FM signal source indicator
1kHz	"0.35" kHz External modulation deviation is displayed.	EXT is selected and indicator remains on. 1kHz is unselected and 1kHz indicator is turned off.
1kHz	"1.75" kHz Combined deviation is displayed.	EXT is selected and indicator remains on. 1kHz is selected and 1kHz indicator is turned on.
EXT	"1.40" kHz Deviation of internal 1kHz is displayed.	EXT is unselected and indicator is turned off. 1kHz is selected and 1kHz indicator remains on.
EXT	"0.35" kHz External modulation deviation is displayed.	EXT is selected and indicator is turned on. 1kHz is selected and 1kHz indicator remains on.
1kHz Press twice	"1.75" kHz Combined deviation is displayed.	EXT is selected and indicator remains on. 1kHz is selected and 1kHz indicator is turned on.

(d) Method of setting frequency deviation without using system standard preset values

In this section, as an example, 0.4kHz deviation is to be set for external tone and 1.55kHz deviation is to be set for internal 1kHz tone. The table below lists the keys to be pressed, data to be displayed in [MODULATION] section, and states of the FM signal source indicators for this example. As explained in the above section (c), the keys must be pressed in the order listed.

Key operation	MODULATION display	State of FM signal source indicator
1kHz	"0.35" kHz External modulation deviation is displayed.	EXT is selected and indicator remains on. 1kHz is unselected and 1kHz indicator is turned off.
FM, 0, ., 4, kHz	"0.40" kHz External modulation deviation is displayed.	EXT is selected and indicator remains on. 1kHz is unselected and 1kHz indicator remains off.
1kHz	"1.80" kHz Combined deviation is displayed.	EXT is selected and indicator remains on. 1kHz is selected and 1kHz indicator is turned on.
FM, 1, ., 9, 5, kHz	"1.95" kHz Combined deviation is displayed.	EXT is selected and indicator remains on. 1kHz is selected and 1kHz indicator remains on.
EXT	"1.55" kHz Deviation of internal 1kHz is displayed.	EXT is unselected and indicator is turned off. 1kHz is selected and 1kHz indicator remains on.
EXT	"0.40" kHz External modulation deviation is displayed.	EXT is selected and indicator is turned on. 1kHz is selected and 1kHz indicator remains on.
1kHz	"0.40" kHz External modulation deviation is displayed.	EXT is selected and indicator remains on. 1kHz is unselected and 1kHz indicator is turned off.
1kHz	"1.95" kHz Combined deviation is displayed.	EXT is selected and indicator remains on. 1kHz is selected and 1kHz indicator is turned on.

The data vlaues can be input by numeric keys as above, but they can also be input by rotary knob. In the latter case, move the cursor by ◁◁ and ▷▷ keys if the cursor is not found in [MODULATION] display, and move it by ◁ and ▷ keys if it is found in the [MODULATION] display.

Note 1: When the FM signal source indicator "EXT" is on and either the "400Hz" or "1kHz" indicator is on:

(a) Press the key of eiter the "400Hz" or "1kHz" indicator that is on, and both the "400Hz" and "1kHz" indicators are turned off.

(b) Press the key of the indicator that is off, and the indicator of the pressed key is turned on.

Note 2: During the FM two-tone modulation, amplitude modulation cannot be done. The AM signal source indicator is off.

Note 3: In the combined frequency deviation display mode, the displayed value does not go lower than the external modulation frequency deviation value. A value lower than that cannot be input by numeric keys, either.

(3) MODULATION display in FM two-tone modulation mode

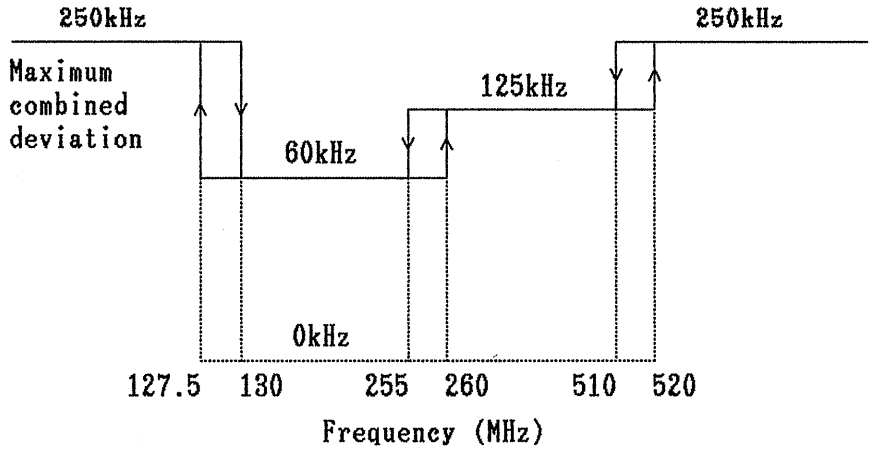
For the FM two-tone modulation, the adjacent standard frequency deviation bands overlap each other as in the case of single tone modulation (see Article 4.6.4, page 34).

When the sum of the external modulation deviation and internal modulation deviation (combined deviation) is less than 60kHz, the displayed value of displayed can be used for any values of frequency.

If the frequency is changed from band A to band B when the combined deviation specified for band A is greater than the maximum combined deviation of band B, "0" is displayed. In this case, specify the combined deviation again.

For single tone modulation, "0" is not displayed even under the above condition.

The chart below shows the overlapping ranges of frequency.
The border values of the overlapping ranges are rough values.

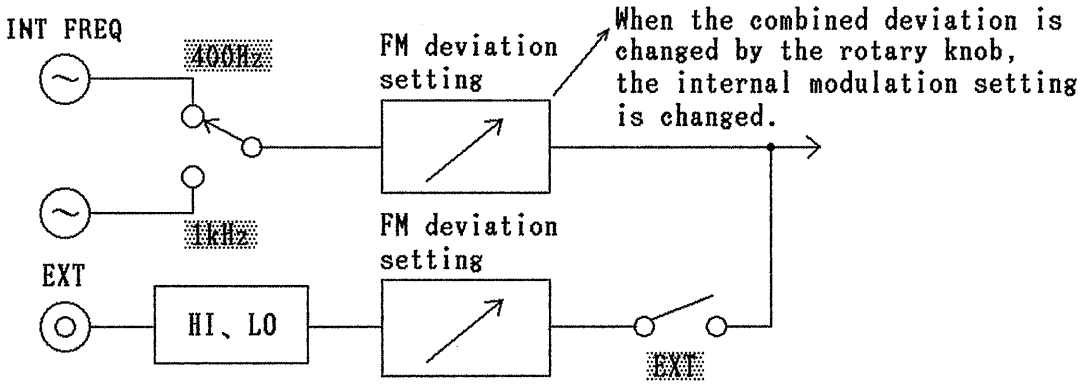


For example, specify the combined deviation of 125kHz for the frequency of 300MHz and reduce the frequency. When the frequency is reduced to 255MHz or lower, the [MODULATION] display shows "0".

To perform the FM two-tone modulation in the frequency range of 130MHz to 255MHz, specify the combined deviation again with a value less than 60kHz.

If the combined deviation is set lower than 60kHz for all the frequency bands, the displayed value of deviation remains unchanged.

(4) Block diagram of FM two-tone modulation section



The shaded box ( ) denotes a key.

(5) Example setting by GP-IB

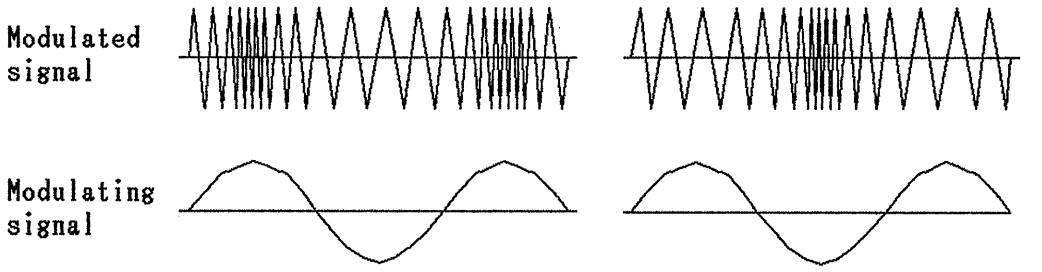
"SP21" Sets two-tone mode.
"FE0.35KZ" Sets external modulation deviation to 0.35kHz.
"FMS21" Sets internal frequency to 400Hz (for 1kHz, specify S31).
"FM1.75KZ" Sets combined deviation to 1.75kHz.

By the above procedure, the FM two-tone modulation mode is set with the external frequency deviation of 0.35kHz, internal frequency of 400Hz, and combined frequency deviation of 1.75kHz (internal frequency deviation of 1.4kHz).

4.7.4 FM modulation polarity switching (SPCL30, 31)

This function switches the polarity of frequency modulation.

The following chart shows the relationship between the modulating and modulated signals for the positive and negative modulation:



Positive modulation (SPCL30) Negative modulation (SPCL31)

When SPCL30 is specified, the positive modulation is performed; when SPCL31 is specified, the negative modulation is performed.

For this function, press keys as follows:

SPCL → 3 → 1 (or 0) → SPCL

4.7.5 Frequency offset mode (SPCL40, 41)

Press the SPCL, numeric 0–9, ., -, GHz (or MHz or kHz), 4, 1, SPCL, ΔFREQ keys in this order, and the offset frequency is obtained.

(a) Example: To offset 5MHz for 100MHz

Key operation	MODULATION indicator	FREQUNCY indicator	
	×××	×××× ××× ××	Previous value
FREQ	×××	×××× ××× ××	
1	×××	1␣␣␣ ␣␣␣ ␣␣	
0	×××	10␣␣ ␣␣␣ ␣␣	
0	×××	100␣ ␣␣␣ ␣␣	
MHz	×××	␣100.000.00	
SPCL	␣␣␣	␣␣␣␣ ␣␣␣ ␣␣	SPCL indicator is turned on.
5	␣␣␣	5␣␣␣ ␣␣␣ ␣␣	
MHz	␣␣␣	␣␣␣␣ ␣␣␣ ␣␣	
4	␣␣␣	4␣␣␣ ␣␣␣ ␣␣	
1	␣␣␣	41␣␣ ␣␣␣ ␣␣	
SPCL	×××	␣100.000.00	SPCL indicator is turned on.

After this value flickers once, the previous value is displayed.

ΔFREQ	×××	␣100.000.00 is turned on.	ΔF indicator

In this stage, a signal of 105MHz is output.

ΔFREQ	×××	␣100.000.00	ΔF indicator is turned off.

In this stage, a signal of 100MHz is output.
To terminate this mode, press keys as follows:

SPCL → 4 → 0 → SPCL

To check the offset value, press the SPCL key and let the [MODULATION] display show the value "41" by using the using the △ and ▽ keys in [MODULATION] section. The offset value appears on the [FREQUENCY] display.
Note, however, that the offset value is not displayed when the frequency offset mode is off (SPCL40).

4.7.6 RANGE OUTPUT (SPCL50, 51, 52)

The user can specify the frequency to switch the logic signal output from RANGE OUTPUT on the rear panel.

For the standard state, see Chapter 6 "OUTPUT IMPEDANCE AND DUMMY ANTENNA SWITCHING SIGNAL" (page 67).

(a) Example: To set the switching frequency to 100MHz

Key operation	MODULATION indicator	FREQUNCY indicator	
SPCL	␣␣␣	␣␣␣␣ ␣␣␣ ␣␣	SPCL indicator is turned on.
1	␣␣␣	␣␣␣ ␣␣␣ ␣␣	
0	␣␣␣	1 0␣␣ ␣␣␣ ␣␣	
0	␣␣␣	1 0 0␣ ␣␣␣ ␣␣	
MHz	␣␣␣	␣␣␣␣ ␣␣␣ ␣␣	
5	␣␣␣	5␣␣␣ ␣␣␣ ␣␣	
* 1	␣␣␣	5 1␣␣ ␣␣␣ ␣␣	
SPCL	×××	×××× ××× ××	SPCL indicator is turned on.

After this value flickers once, the previous value is displayed.

In the above example, when the frequency is within the range from 100.00000MHz to 1040MHz, the RANGE OUTPUT terminal outputs "1", and when the frequency is within the range from 100kHz to 99.99999MHz, it outputs "0".

In the above key operation, replace the value "1" marked with "*" by the value "2", and the polarity is changed; that is, when the frequency is within the range from 100.00000MHz to 1040MHz, the RANGE OUTPUT terminal outputs "0", and whenthe frequency is within the range from 100kHz to 99.99999MHz, it outputs "1".

To set the switching frequency in the standard state, press keys as follows:

SPCL → 5 → 0 → SPCL

To check the switching frequency, press the SPCL key and let the MODULATION display show the valus "51" or "52" by using the △ and ▽ keys in [MODULATION] section. The switching frequency appears on the [FREQUENCY] display.
Note, however, that the switching frequency is not displayed when it is set in the standard state (SPCL50).

4.7.7 Output level continuous changing mode (SPCL60, 61)

In the standard state, that is, when this mode is off, the output signal is cut momentarily during increase or decrease of the output level because the main attenuator is switched at every 4dB normally.

This mode can change the output level continuously within the range of ±5dB from the currently set level without switching the main attenuator.

To use this mode, press keys as follows:

SPCL → 6 → 1 → SPCL → Δ dB

In this mode, the [AMPLITUDE] display does not show the offset value even when the Δ dB key is pressed.

Therefore, for SPCL61, the Δ dB key simply turns on or off the output level continuous changing mode.

4.7.8 Initial setting (SPCL80)

To set all the currently specified special functions in the initial state (see Table 1), press keys as follows:

SPCL → 8 → 0 → SPCL

4.8 Memory

4.8.1 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 Airticle 4.8.2:

(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.

4.8.2 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 Article 4.8.1, but the step values of frequency, output level, and modulation factor, ΔFREQ function, ΔdB, RF ON/OFF function, and special function can not be stored.

The basic store operation is to set data such as frequency, output level, modulation level, and modulation type and press YE, STO and numeric key or [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 YE, STO and ·.

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

①	FREQ	×××.×××.××
	1	1␣␣ ␣␣␣ ␣␣
	MHz	␣␣1.000.00

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

②	AMP	××× ×
	7	7␣␣ ␣
	6	76␣ ␣
	EMF dBμ (GHz)	␣76.0

Besides the above method, the output level may 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 may be set by numeric keys (0~9) and modulation source key.
After setting the above data, press YE, 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 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 Clear [MEMORY] display by YE, STO, and ·.
③ Press numeric keys 4 and 5, and the data set by step ① is stored.

Note 1: If the store operation is performed in the memory protect mode (SPCL11), STO LED is turned on and turned off immediately.
This indicates that the memory protect function is active.

Note 2: When data is to be stored continuously, the YE, STO, and · key must not be omitted.

Note 3: The RTN key explained in Article 4.8.3 cannot be used in the direct store method.

4.8.3 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)

4.8.4 How to release RTN key

The following two methods are available:

(1) Display "19" by RCL, ., 1, 9

Press YE, STO, RTN (▽) "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, 1, and △ keys (Press three times)

Press YE, STO, NEXT (△) "14" RTN command is stored at "14"

..

..

YE, STO, NEXT (△) (Press 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 key was pressed.

4.8.5 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" →

4.8.6 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.

4.8.7 Copying memory data to another KSG4500T

1) The 100-point memory data can be copied to another unit of KSG4500T.

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 KSG4500T 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.

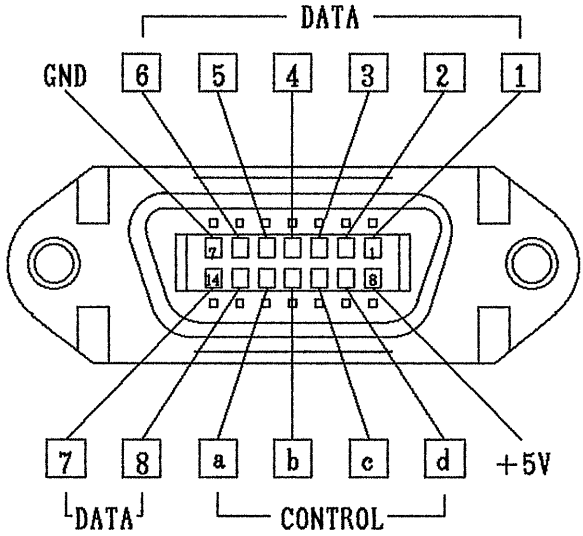


Figure 5-1

[Explanation of terminals]

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

1) DATA terminals [illegible] - [illegible] (Pins 1 - 6, 13, and 14)

The DATA terminals are used for connecting a bus to the rear panel of the KSG4500T. 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 [illegible] - [illegible] 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

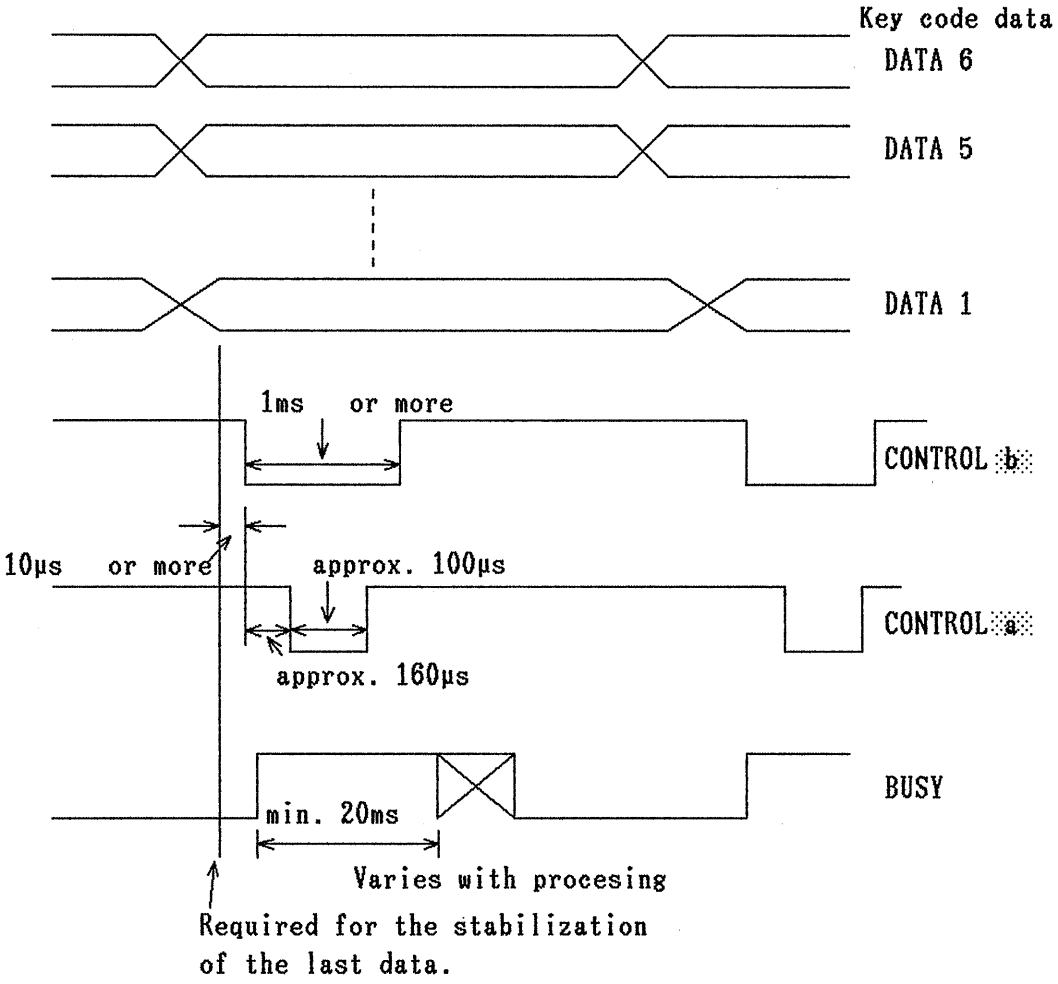


Figure 5-2

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 b 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	0	0	0	1	1	1
MEMORY △ / NEXT	0	0	0	1	1	0
YE (Yellow key)	0	1	1	0	1	1
SPCL	0	1	0	0	0	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
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
DATA ENTRY 4	1	1	0	1	0	0

(Cont'd)

Table 5-1

Key name	MSB		← Key Code →			LSB
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 GHz, EMF dB	1	0	1	0	0	0
DATA ENTRY MHz, dB	0	1	0	1	1	0
DATA ENTRY kHz, %, dBm	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·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.

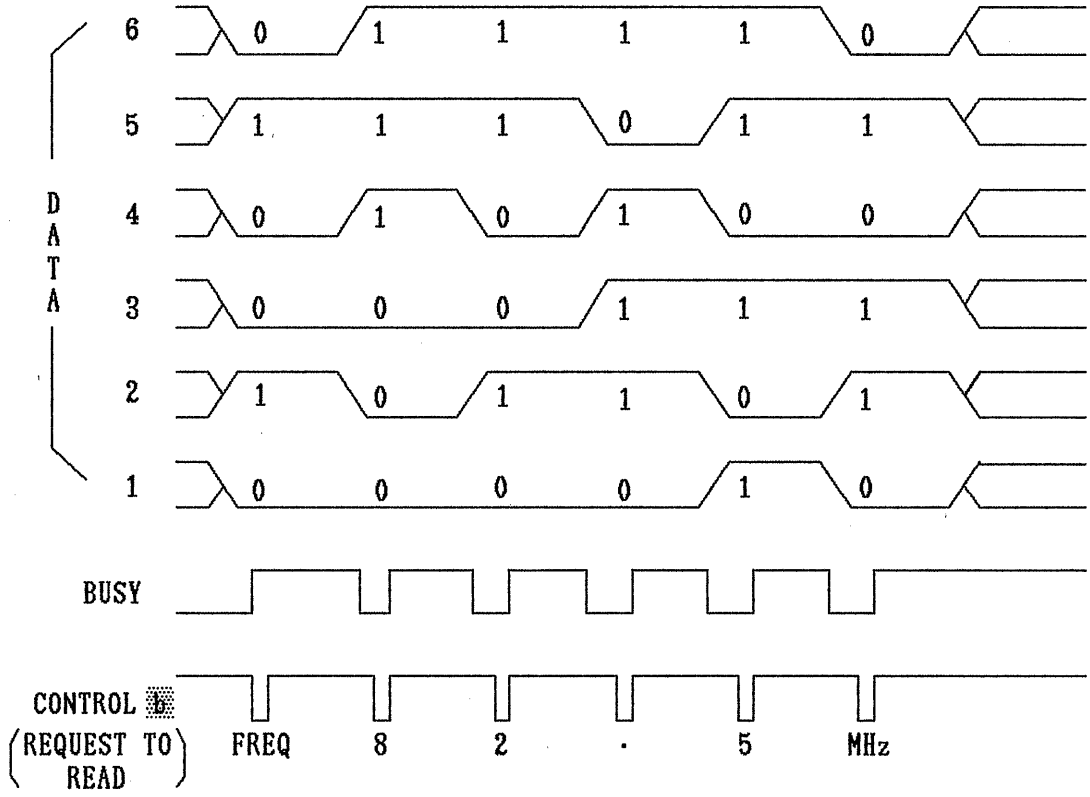


Figure 5-3

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.

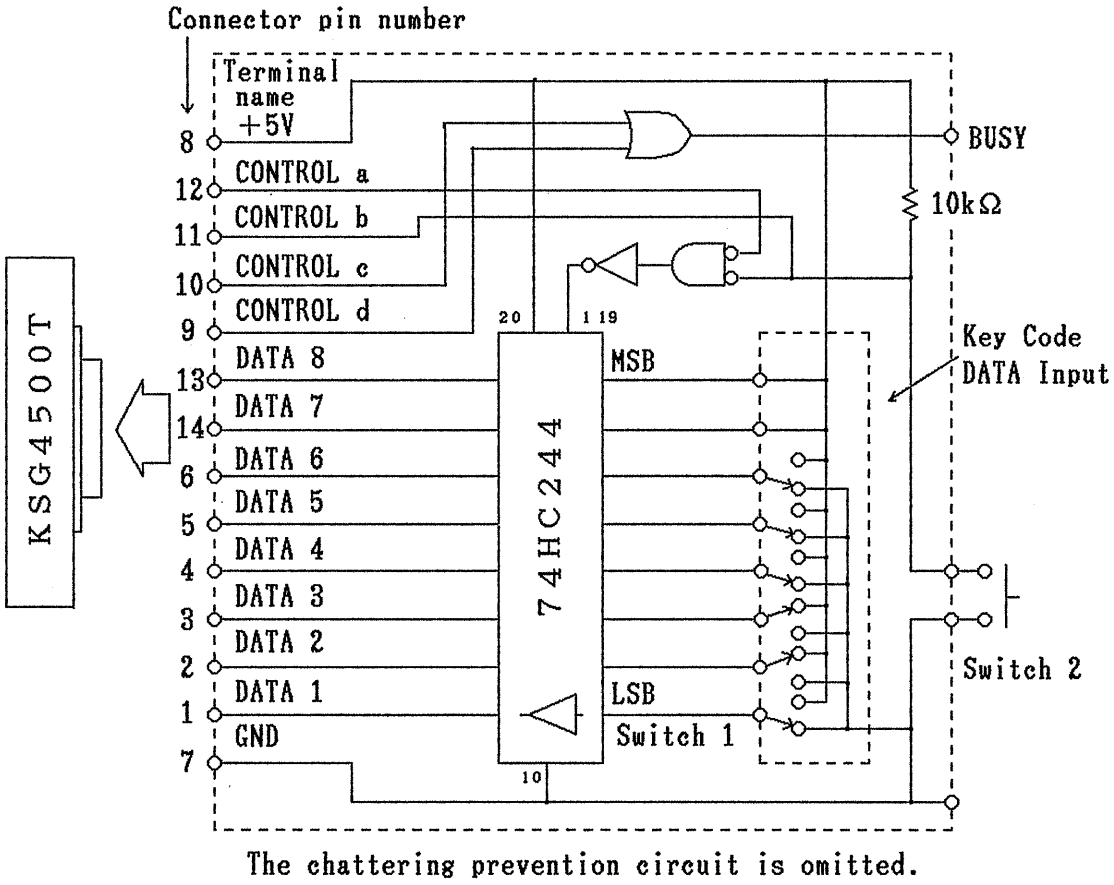


Figure 5-4

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 KSG4500T 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 in remote 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 [illegible] to "0" for more than 1msec.

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.

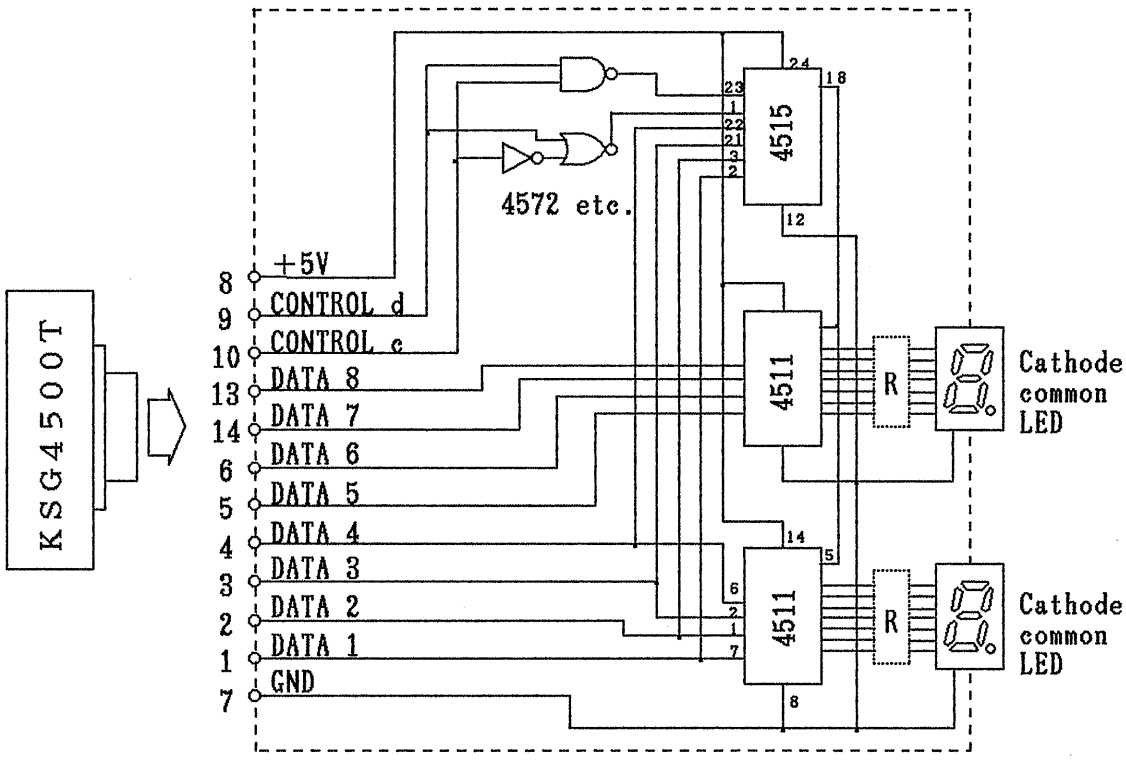


Figure 5-5

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 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 switching frequency can be set to any value by a special function (see Article 4.7.6, page 50).

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

7. BACKUP BATTERY AND INITIALIZING CPU

7.1 Backup Battery

The KSG4500T uses a memory backup battery, and the battery may discharge all its 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.

See Article 8.3.2 (page 70) for the method of removing the top panel and aluminum sash cases.

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.
Then, be sure to execute the CPU hardware reset.

7.2 Initializing CPU

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 [illegible] 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 KSG4500T 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] (ADDRESS) 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 Article 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

(1) Address setting by software

The old address is displayed while the [YE] and [LOCAL] (ADDRESS) keys are pressed.
Input the new address by numeric keys within approximately 2 seconds after releasing the [LOCAL] (ADDRESS) key, and then press the [LOCAL] (ADDRESS) key again.

(2) Address setting by hardware

The address of the KSG4500T 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.

To remove the top panel, lift it up after removing two screws each from the top surface, right side, and left side (six screws in total). The screws on the left side are fastened with rubber feet.

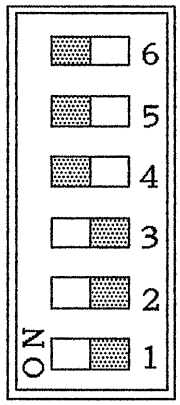
Remove the two screws on the right side the aluminume sash case. The aluminum sash case can be taken out. Lift the case, and pull out the case.

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".



Device address setting value

$2^0+2^1+2^2=7$
(1) (2) (3)

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 control and 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 KSG4500T 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 classified 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
Frequency	FR	○○.○	HZ,KZ,MZ,GZ
Output level unit			
Output level EMF dBμ	EM	– – –	– – –
Output level dBμ	DU	– – –	– – –
Output level dBm	DM	– – –	– – –
Output level	AP	○○.○	DB
Output level OFF	RO, ROF	– – –	– – –
Output level ON	R1, RON	– – –	– – –
Modulation			
AM depth	AM	○○.○	PC
AM depth	AM	○○.○	%
Amplitude modulation OFF	AMS5, AMOF	– – –	– – –
FM peak frequency deviation	FM	○○.○	KZ
* External frequency deviation (for two-tone modulation only)	FE	○○.○	KZ
Frequency modulation OFF	FMS5, FMOF	– – –	– – –
DC·FM (DC coupling)	DC	– – –	– – –
Release of DC·FM	AC	– – –	– – –
External modulation ON	S1AM, S1FM	– – –	– – –
* Simultaneous modulation (for two-tone modulation only)	S21FM, FMS21 S31FM, FMS31	– – –	– – –
Modulation signal source 400Hz	S2AM, S2FM	– – –	– – –
Modulation signal source 1kHz	S3AM, S3FM	– – –	– – –
Special function	SP	○○	– – –
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.

5: See Item (5) of Article 4.7.3 "FM two-tone modulation mode" (page 43) for the items marked with "".*

Table 8-4 GP-IB Program Codes

Alphabetical order

Program code	Explanation	Remarks
AC	Release of modulation DC·FM	Modulation signal source switching
AM	Amplitude modulation	Function mode
AMOF	Amplitude modulation OFF	Modulation signal source switching
AP	Output level	Function mode
DB	Output level Unit	Unit
DC	Modulation DC·FM	Modulation signal source switching
DM	Output level Unit dBm	Unit
DU	Output level Unit dBμ	Unit
EM	Output level Unit EMF dBμ	Unit
* FE	External freq. deviation setting	(Two-tone modulationnly)
FM	Frequency modulation	Function mode
FMOF	Modulation OFF	Modulation signal source switching
FR	Frequency	Function mode
GZ	GHz Frequency	Unit
HZ	Hz Frequency, Modulation	Unit
KZ	kHz Frequency, Modulation	Unit
MZ	MHz Frequency	Unit
PC	Modulation in percent	Unit
RC	Memory recall	Function mode
RO, ROF	Output level OFF	Function mode
R1, RON	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
S4	Internal modulation 3kHz	Modulation signal source switching
S5	Modulation OFF	Modulation signal source switching
* S21	Simultaneous modulation S2 and S1	(Two-tonemodulationonly)
* S31	Simultaneous modulation S3 and S1	(Two-tone modulationnly)
* SP	Special function	Function mode
ST	Memory store	Function mode
0 - 9	Numeric value	Data
-	Minus sign	Data
.	Decimal point	Data
%	Modulation in percent	Unit

Note: See Item (5) of Article 4.7.3 "FM two-tone modulation mode" (page 43) for the items marked with "".*

Table 8-5 GP-IB Program Code

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
Freq deviation setting	FE (Two-tone mod. only)
External modulation ON	S1
Int. modulation 400Hz	S2
Int. modulation 1kHz	S3
Modulation OFF	S5
Ext. modulation 400Hz	S21 (Two-tone mod. only)
Ext. modulation 1kHz	S31 (Two-tone mod. only)
Amplitude modulation OFF	AMOF, AMS5
Frequency modulation OFF	FMOF, FMS5
Modulation DC·FM	DC
Release of DC·FM	AC
Special function	SP
Data	
Numeric value	0 - 9
Minus sign	-
Decimal point	.
Unit	
GHz	GZ
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

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, HP 9816 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"

c) "S2AM", "AM30%"

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) "AMOF"

c) "FMS5" d) "FMOF"

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

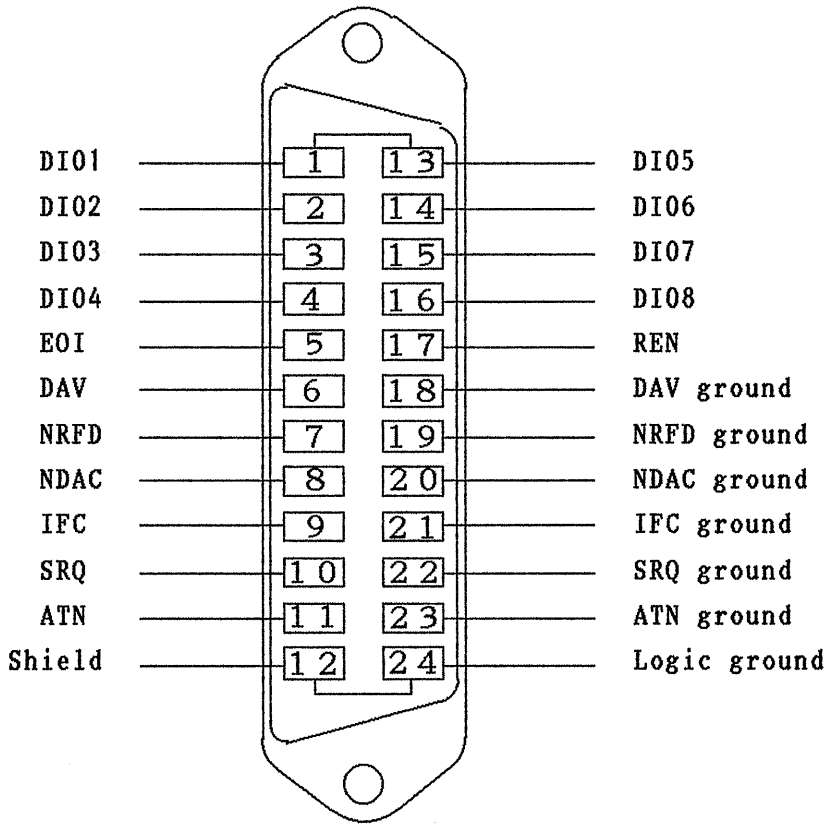


Figure 8-2

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              100Hz
30      Freqstep=10*1.E+6                10Hz
40      Level=120                        120dBμ
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 level ON
110     OUTPUT Dev; Lev; "AMS5"          Turn off AM modulation
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 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)

(1) Dummy antenna

SA 100 Test loop (Loop antenna)
Medium/High frequency band, generate for standard field
Frequency range: 100kHz to 30MHz
BNC type 50Ω Unbalanced type

SA 111 Dummy antenna for single signal, FM receiver
BNC Open type 50Ω:75Ω Unbalanced type

SA 115 Dummy for single signal, FM receiver
BNC Load type 50Ω:300Ω Balanced type

SA 150 Band aplitting filter for AM, FM receiver (selector type)
Frequency range: DC to 130MHz
50Ω:50Ω Load type

SA 151 Dummy antenna for car radio
Frequency range: 50kHz to 200MHz
AM 50Ω:80Ω
FM 50Ω:75Ω Load type

SA 152 Dummy antenna for car radio
Frequency range: 50kHz to 200MHz
AM 50Ω:80Ω
FM 50Ω:75Ω Open type

SA 153 Output adaptor for Test loop/Dummy antenna switch
Frequency range: DC to 200MHz
AM 50Ω:50Ω
FM 50Ω:50Ω

SA 154 Output adaptor for Test loop/Dummy antenna switch
Frequency range: DC to 200MHz
AM 50Ω:50Ω
FM 50Ω:75Ω

SA 234 Impedance transformer
Frequency range: DC to 230MHz
BNC type 50Ω:75Ω Open type

SA 235 Impedance transformer
Frequency range: DC to 1.6GHz
N type 50Ω:75Ω Open type

(2) Coaxial and special cables

SA 500 Shielding cable
RCA-RCA pin plugs Length 0.8m
For RANGE OUTPUT control signal, option

SA 510 Dump cable
14pin-14pin connectors Length 1.5m
For KSG series, option

SA 520 Synchronized timing cable for memory
14pin-14pin connectors Length 0.3m
For KSG3100 to 3210、4100 to 4700, option

SA 550 RF cable
BNC(P)-BNC(P) connectors 50Ω RG-58A/U Length 1m
For KSG4100 to 4300, accessory

SA 556 RF cable
N(P)-N(P) connectors 50Ω 5D-2W Length 1m
For KSG4500 to 4700, accessory

SA 570 RF cable
BNC(P)-BNC(P) connectors 75Ω 3C-2V Length 1m
For KSG3100 to 3210, accessory