OPERATION MANUAL

FM/AM SIGNAL GENERATOR

KSG4700T

First Edition

KIKUSUI ELECTRONICS CORPORATION

(KIKUSUI PART NO. Z1-000-050)

M-91060

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.

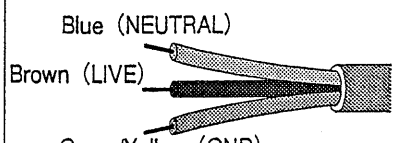
☐ AC power cable

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.

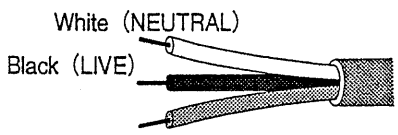
WARNING

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

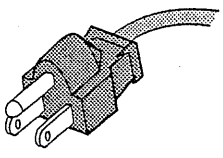
☐ Without a power plug



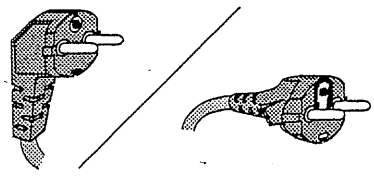
☐ Without a power plug



☐ 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

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1. INTRODUCTION

1.1 General Description

The KSG4700T is an FM/AM standard signal generator of synthesizer method for communication instruments, using a reference crystal oscillator for Phase Lock Loop (PLL). It covers the frequency of 100 kHz to 2 GHz, and the resolution of the frequency lower than 1 GHz is 10 Hz and that of the frequency higher than 1 GHz is 20 Hz (a doubler is used for the frequency higher than 1 GHz).

The instrument is useful in measuring the characteristics of pagers, cordless telephones, MCAs, cellular telephones, personal radios, and various receivers for professional use. It can be operated easily as it adopts recall and numeric data entry methods.

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

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

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

Since the KSG4700T 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, cellular telephones, personal radios, etc.

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. Therefore, 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 50 Hz to 10 kHz 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 enabled by supplying the codes that correspond to the panel key and rotary knob operations through the 14-pin connector on rear panel.

Also, extended functions, such as memory copy and memory linkage functions, can be used between the instruments of the same type.

Since the standard model of KSG4700T supports GP-IB control, it reduces labor on production lines.
Since the KSG4700T has a GP-IB local controller function (download program), it can be used as a controller. The KSG4700T has a text area for memory steps, and when it is used as local controller, it reads the listener addresses and commands for them from the text area and executes the commands one by one.
The program in the text area can be edited by the host computer, and after the program is downloaded to the KSG4700T, the instrument can execute the program by its local controller function without the host computer.

1.2 Features

(1) Since the KSG4700T covers a wide frequency band of 100 kHz to 2 GHz, it can be used for testing various types of radios and communication instruments.

(2) The frequency can be specified by a 9-digit number, and the value of a desired digit (designated by cursor) can be changed continuously by a rotary knob. Also, the KSG4700T has the △FREQ (frequency difference) display function and the +/- function to check selectivity.

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

(4) The output level can be selected from a wide range of -20.0 dBμ to 126.0 dBμ (open circuit), and it can be specified with a 4-digit number by the step of 0.1 dB. Also, a high-frequency output on/off function is provided. As to the unit of output level, either dBm, dBμ, or EMF dBμ can be selected directly.

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

(6) Since the KSG4700T 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 50 ms approximately.

(8) Modulation preset keys are provided for FM 1.75 kHz and 3.5 kHz and AM 30% 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) The KSG4700T can control its peripheral equipments by a down-load program.

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

(12) Data can be copied from the memory of one KSG4700T to that of another KSG4700T by simply pressing the DUMP key.

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

(14) The standard model of KSG4700T has a GP-IB interface for controlling frequency, output level, modulation rate, and memory.

(15) Since the KSG4700Ts can be connected to one another in chain mode by the reference frequency input and output connectors (10 MHz) provided on them, the relative error of the measured frequency can be reduced to zero.

2. SPECIFICATIONS

- Frequency (RF)

Range:	100 kHz to 2 GHz
Resolution:	10 Hz (≦ 1.02 GHz)
	20 Hz (> 1.02 GHz)
Accuracy:	Same as reference oscillator
Display:	9-digit readout, △FREQ display, and ± frequency inversion function

- Reference oscillator

Frequency:	50 MHz
Stability:	Temperature ±5 × 10^{-6}
	Aging rate ±2 × 10^{-6}/week
	High stability crystal reference oscillator: See the section of "Special order".
Internal reference signal output	
Output frequency:	10 MHz
Output level:	≧ 0.15 Vrms 50Ω loaded
External reference signal input	
Input frequency:	10 MHz ±200 Hz (±0.002%)
Input level:	≧ 0.15 Vrms 50Ω

- Output level

Range:

Maximum output

	< 1.02 GHz		> 1.02 GHz	
Unit	CW.FM	AM	CW.FM	AM
EMF dBμ	126 dBμ	120 dBμ	120 dBμ	114 dBμ
dBμ	120 dBμ	114 dBμ	114 dBμ	108 dBμ
dBm	+13 dBm	+7 dBm	+7 dBm	+1 dBm

Minimum output (Guaranteed ranges)

Unit	100k - 130 MHz	130 MHz - 1.02 GHz	1.02 - 2 GHz
EMF dBμ	-20 dBμ	-10 dBμ	3 dBμ
dBμ	-26 dBμ	-16 dBμ	-3 dBμ
dBm	-133 dBm	-123 dBm	-110 dBm

Unit: Direct selection from three types of units, namely, EMF dBμ for open-circuit at 0dB = 1μV, dBμ for loaded-terminal voltage, and dBm for 50Ω output impedance.

Resolution: 0.1 dB

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

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

Standard level accuracy: ±1 dB (RF ≦ 1.02 GHz)
±1.5 dB (RF > 1.02 GHz)
At the output level of 113 dB (0 dBm)

Output level accuracy:

	≦ 1.3 GHz	> 1.3 GHz
±1 dB	≧103dB (-10dBm)	
±1.5dB	≧ -7dB (-120dBm)	≧20dB (-93dBm)
±2 dB	< -7dB (-120dBm)	≧10dB (-103dBm)
±3 dB		<10dB (-103dBm)

Output level changing: The output level can be changed continuously within the range of ±5 dB from any point by the step of 0.1 dB. (This function can not 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: ≦1.3 (≦1 GHz)
≦1.8 (>1 GHz)
Output ≦ 100 dB (-13 dBm)

Reverse power protection: Maximum 25W, 25V DC

Spurious signals: Output level ≦ 113 dB (0 dBm) for fundamental wave (= 0 dBc)

Harmonics: ≦ -25 dBc

Sub-harmonics ≦ -25 dBc (> 1.02 GHz)

Non-harmonics ≦ -60 dBc (≦ 1.02 GHz)
≦ -54 dBc (> 1.02 GHz)
at CW mode and offset carrier 5 kHz

SSB phase noise:

Frequency	Offset	
	6.25 kHz	20 kHz
100 kHz - 130 MHz	≦ -116 dBc/Hz	≦ -126 dBc/Hz
127.5 - 260 MHz	≦ -122 dBc/Hz	≦ -132 dBc/Hz
260 - 520 MHz	≦ -119 dBc/Hz	≦ -129 dBc/Hz
520 MHz - 1.04 GHz	≦ -116 dBc/Hz	≦ -126 dBc/Hz
1.02 - 2 GHz	≦ -110 dBc/Hz	≦ -120 dBc/Hz

Residual modulation (S/N)

FM component:

Frequency	Demodulation band width	
	0.3 - 3 kHz 3.5kHz deviation	* 50Hz - 15kHz 75kHz deviation
100kHz - 127.5MHz	≦ 4.4 Hz (55 dB)	≦ 6.6Hz (78 dB)
127.5 - 260 MHz	≦ 1.1 Hz (67 dB)	≦ 1.7Hz (90 dB)
260 - 520 MHz	≦ 2.2 Hz (61 dB)	≦ 3.3Hz (84 dB)
520 MHz - 1.02 GHz	≦ 3.3 Hz (57 dB)	≦ 6.6Hz (78 dB)
1.02 - 2 GHz	≦ 6.6 Hz (51 dB)	≦ 14 Hz (72 dB)

The residual FM component is expressed by the unit of rms.

* Value obtained when 50μs de-emphasis is on.

AM component: ≦ -76 dBc

Demodulation band width = 50 Hz to 15 kHz (≧60 dB relative to 30% depth) CW mode

- Modulation

Modulation mode: Selection can be made from the following signal sources for FM, AM, FM-AM simultaneous, and DC·FM:

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

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

Internal modulation frequency: 400 Hz and 1 kHz (selective); ±3%

External modulation

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

2) Input voltage: 1 V peak

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

[FM]

Frequency deviation range and resolution

The guaranteed deviation is 400kHz.

Frequency		Range		
2.5MHz - 127.5MHz	Freq. deviation	0-9.99kHz	10-99.9kHz	100-250kHz
	Resolution	10 Hz	100 Hz	1 kHz
127.5 - 260 MHz	Freq. deviation	0-9.99kHz	10-60.0kHz	
	Resolution	10 Hz	100 Hz	
260 - 520 MHz	Freq. deviation	0-9.99kHz	10-99.9kHz	100-125kHz
	Resolution	10 Hz	100 Hz	1 kHz
520MHz - 1.04GHz	Freq. deviation	0-9.99kHz	10-99.9kHz	10-250kHz
	Resolution	10 Hz	100 Hz	1 kHz
1.04GHz - 2GHz	Freq. deviation	0-9.98kHz	10-99.8kHz	100-500kHz
	Resolution	20 Hz	200 Hz	2 kHz

Note: When the value of RF is smaller than or equal to 2.5 MHz, 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 characteristic: ±1 dB 20 Hz to 70 kHz, 1 kHz reference

Distortion of modulation: ≦0.5%

For Demodulation band width = 50 Hz to 15 kHz, Modulation frequency = 1 kHz, and Deviation = 22.5 kHz

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

DC·FM mode (closed loop system)

Frequency accuracy: ±(Reference frequency + 125 Hz) 127.5 to 255 MHz
±(Reference frequency + 250 Hz) 255 to 510 MHz
±(Reference frequency + 500 Hz) 0.1 to 127.5 MHz
510 to 1040 MHz
±(Reference frequency + 1 kHz) 1020 to 2000 MHz

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

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

[AM]

Setting range: 0 to 99.9%

Depth: 0 to 80% Output ≦ 120 dB (≦1.02 GHz)
Output ≦ 114 dB (> 1.02 GHz)

Resolution: 0.1%

Display: 3-digit readout

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

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

Modulation distortion: ≦1.5% ≦1.02 GHz
≦2.5% >1.02 GHz
Depth < 60%
≦3% ≦1.02 GHz
For Demodulation band width = 50 Hz to 15 kHz, Modulation frequency = 1 kHz, and Depth = 30%

Incidental FM: ≦200 Hz peak (≦1.02 GHz)
For Demodulation band width = 0.3 to 3 kHz, Modulation frequency = 1 kHz, Depth = 30%, and Output < 120 dB (+7 dBm)
≦ 400 Hz peak (> 1.02 GHz)
For Output ≦ 114 dB (+1 dBm)

- Special functions (additional functions)

1) Memory protection
2) FM two-tone modulation (FM-FM simultaneous modulation)
   a) Internal 400 Hz and external signal source
   b) Internal 1 kHz 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.
      During 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) Numeric keys and rotary knob (with cursor position) for setting carrier frequency, output level, modulation level, and memory.
2) Step keys for carrier frequency, output level, and modulation level
3) Preset keys for 1.75 kHz and 3.5 kHz (for FM) and 30% (for AM)

Note: When the carrier frequency is higher than 1.02 GHz, the value preset by the 1.75 kHz key is 1.74 kHz.

- Memory function

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

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

- Download function

  Peripheral equipment control function
  Host computer: HP9816 (HP Basic)

- Remote control

  The carrier frequency, output level, and modulation level can be stored/recalled, they can be incremented/decremented by steps or continuously by rotary knob, modulation can be turned on/off, etc.

- GP-IB interface

  SH1, AH1, T6, L3, SR1, RL1, PP0, DC1, DT0, C1, C2, C3, C28

- Leakage field strength

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

- Backup battery is provided.

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

Frequency:	50 Hz/60 Hz
Power dissipation:	76 VA approx.

- Size and weight

Dimensions:	430(W) × 99(H) × 400(D) mm
	(16.93(W) × 3.90(H) × 15.75(D) in.)
	445(W) × 119(H) × 455(D) mm (Full envelope)
	(17.52(W) × 4.69(H) × 17.91(D) in.)
Weight:	13.5 kg (30 lbs) approx.

- Environmental conditions (temperature and humidity)

Range to satisfy specifications:	5 to 35°C (41 to 95°F)
	85% or less
Allowable range for operation:	0 to 40°C (32 to 104°F)
	90% or less

- Accessories:

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

- Factory-installed options

1) External reference frequency modification
   The standard model of KSG4700T supports the reference signal input frequency of 10 MHz, but it can be changed to the following 5 MHz or 1 MHz:
   a) 5 MHz ± 100 Hz (± 0.002%)
   b) 1 MHz ± 20 Hz (± 0.002%)

2) Accessories: See Section 9.5.3.

- Special order (Please consult our Sales Office)

1) High stability reference crystal oscillator
   Frequency: 10 MHz
   Temperature stability: $\pm 5 \times 10^{-8}$
   Aging rage: $\pm 2 \times 10^{-8}$/day 24 hours after power on
2) High stability reference crystal oscillator
   Frequency: 10 MHz
   Temperature stability: $\pm 1 \times 10^{-7}$
   Aging rate: $\pm 5 \times 10^{-8}$/day 24 hours after power on

3. PREPARATION FOR USE

3.1 Unpacking and Inspection

Before being shipped from the factory, the KSG4700T goes through thorough mechanical and electrical examinations and inspections, and its correct operation is confirmed and guaranteed.

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

3.2 Line Voltage and Fuse Selection

Select a voltage range from the table below by the voltage selection plug on the rear panel of KSG4700T, and the instrument can be used in the selected voltage range.

Before connecting the power supply cord to the instrument, confirm that the voltage selection 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 out of the selected range will cause incomplete operation or failure of the instrument.

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

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

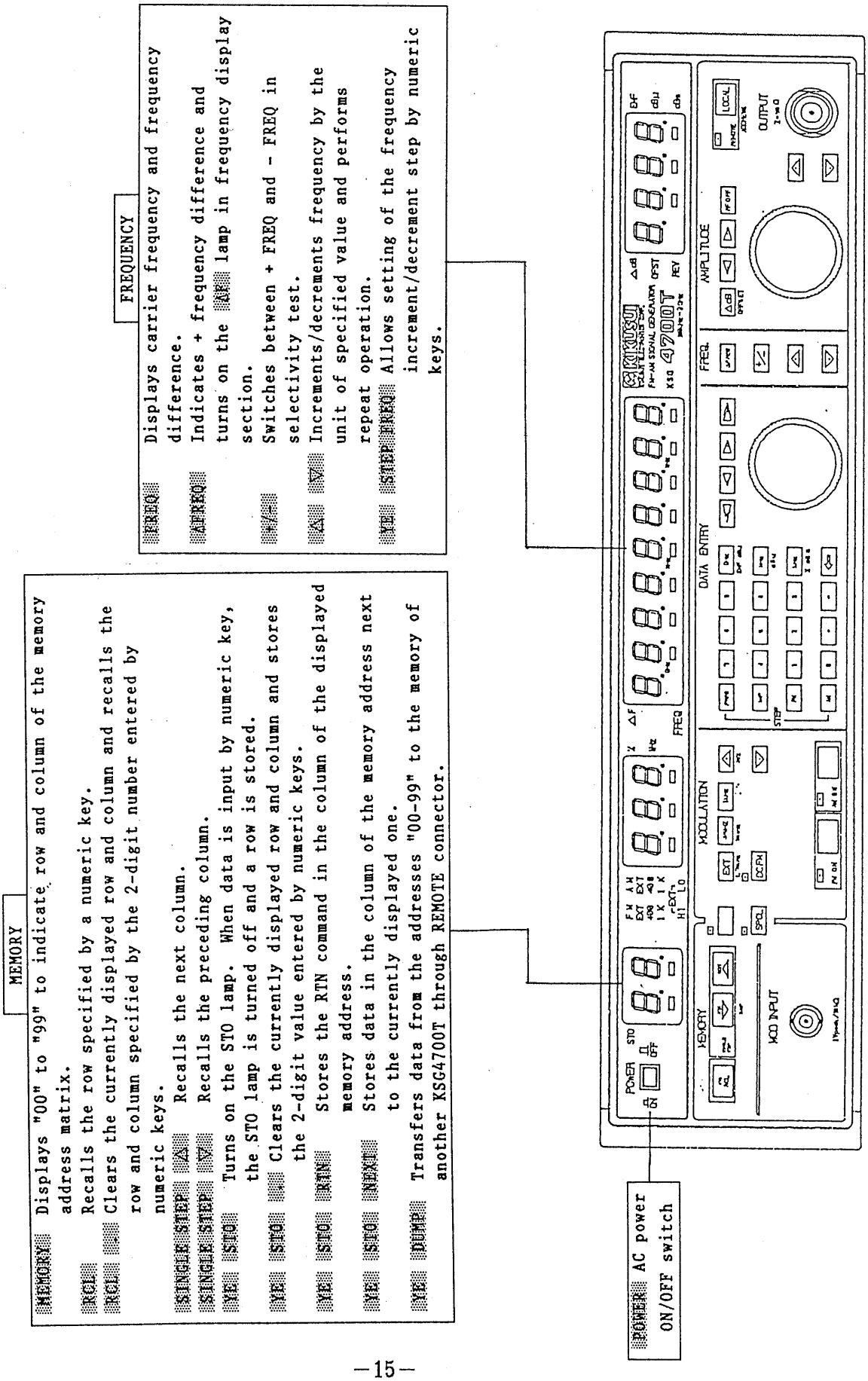
The KSG4700T operates correctly in temperatures from 0 to 40°C (32 to 104°F). If the instrument is used or placed under high temperature or humidity for a long time, failures may occur and the life of the instrument will be shortened.

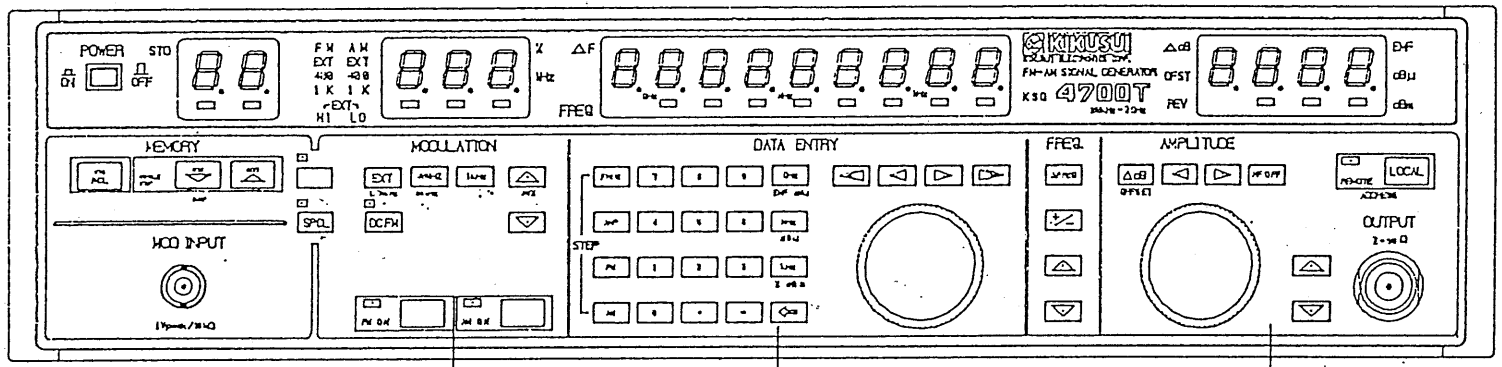
The instrument requires the warm-up time of 30 minutes.

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

4. OPERATION

4.1 Front Panel Features





MODULATION

SPCL Sets the instrument in 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 Indicates FM mode.

AM EXT/400/1K Indicates AM mode.

EXT HI/LO Indicates external modulation input level range. The range is normal when **HI** and **LO** are 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 the instrument in DC-FM mode.

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

FM ON Turns on/off FM modulation.

AM ON Turns on/off AM modulation.

YE 1.75kHz 3.5kHz Presets FM deviation at 1.75 kHz or 3.5 kHz.

YE 30% Presets AM depth at 30%.

DATA ENTRY

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

FREQ Allows the setting of frequency by numeric keys.

AMP Allows the setting of output level by numeric keys.

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

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

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

GHz MHz kHz Keys for selecting unit

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

◁◁ ▷▷ Moves cursor to a different block.

◁ ▷ Moves cursor within a block.

Rotary knob Modifies the value at cursor position

AMPLITUDE

AMPLITUDE Displays RF output level by four digits

ΔdB Displays difference of output level.

◁ ▷ Moves cursor.

RF OFF Turns on/off RF output.

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

Rotary knob Modifies the value at cursor position

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

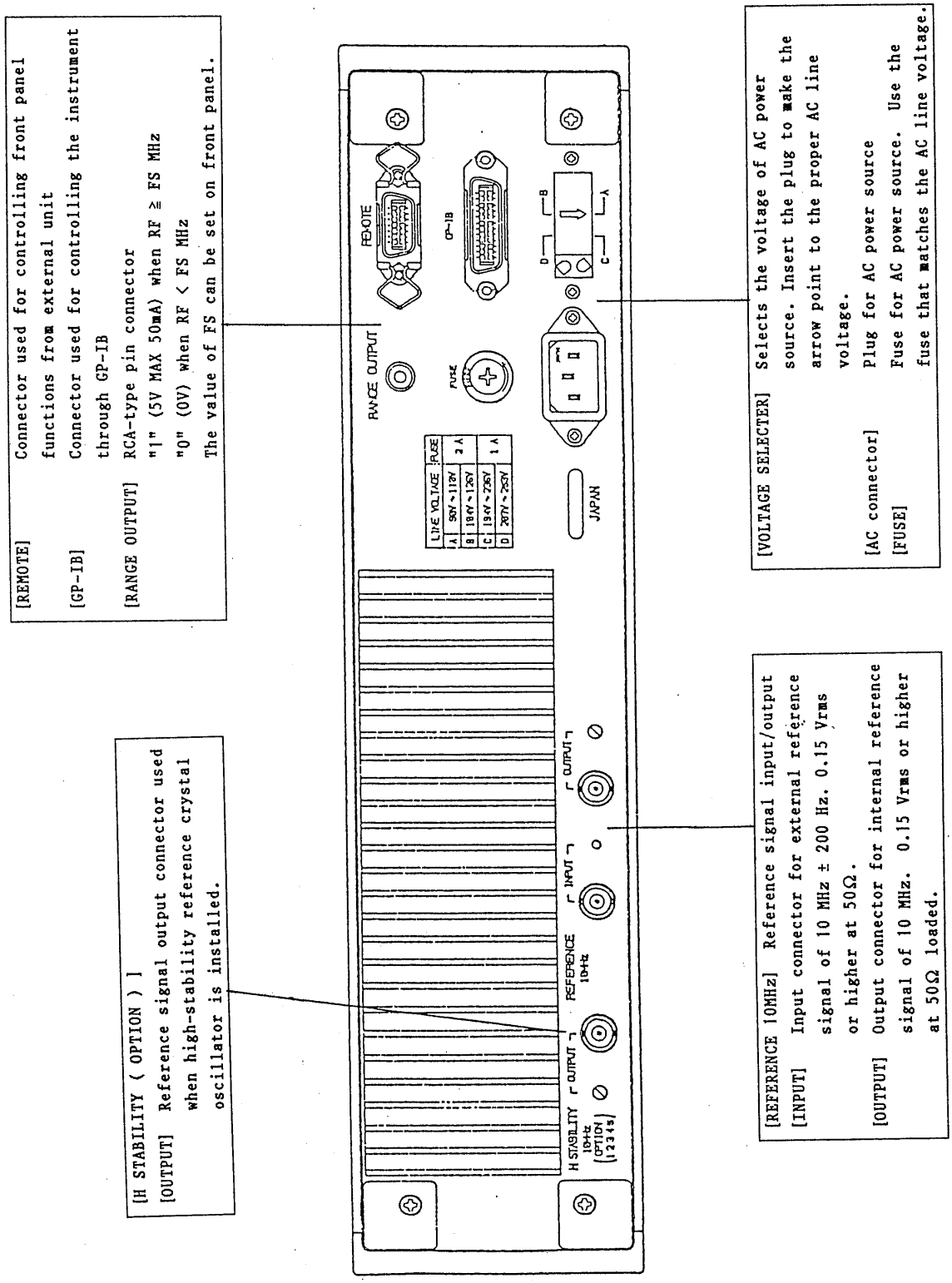
OUTPUT N type connector for RF output. -20.0dBμ to 126.0 dBμ at open circuit. The signal source impedance is 50Ω.

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

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

YE ADDRESS Displays GP-IB address.

4.2 Rear Panel Features

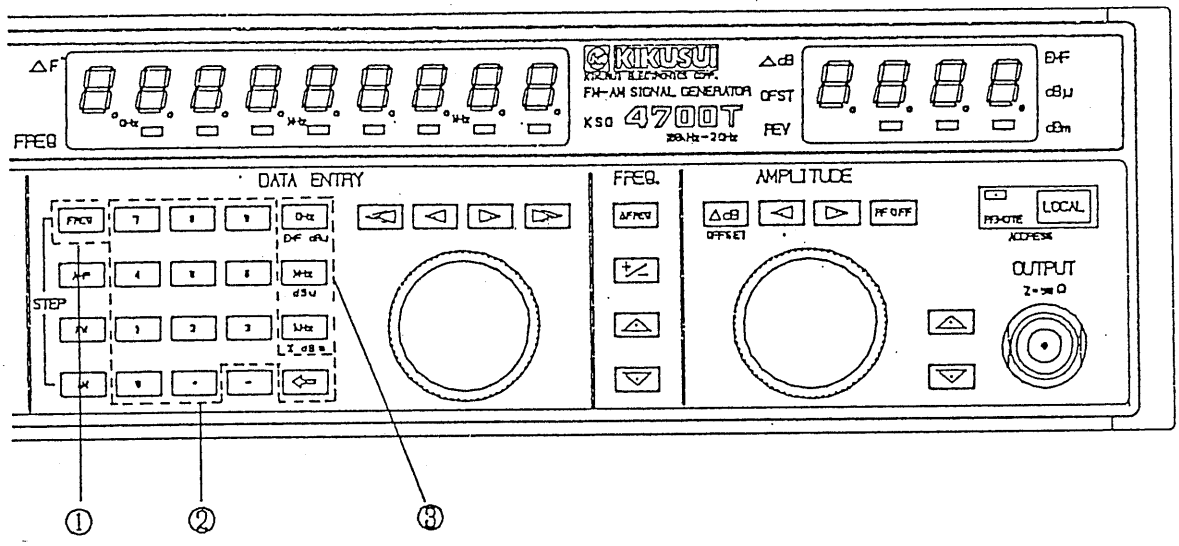


4.3 Initial Operation

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

4.4 Setting Frequency

4.4.1 Setting frequency by numeric keys



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

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

The range of the frequency that can be specified is 0 to 2000 MHz. Since the frequency resolution of the instrument is 10/20 Hz, a fraction smaller than 10/20 Hz is ignored when the unit key is pressed.

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

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

a) Example: To input 123.45678 MHz

× ..... Undefined

␣ ..... Turned off

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

b) Example: To input 455 kHz

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

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

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

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

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

Key operation	[FREQUENCY] display
FREQ	␣␣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

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

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

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

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

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

4.4.2 Rotary knob

The rotary knob increases or decreases the values of the digits at and above the cursor position in FREQUENCY display section.
If the cursor is not found in the FREQUENCY display section, bring it into the section by the ◁◁ or ▷▷ key; to move the cursor within the section, use the ◁ or ▷ key.
When setting the frequency by the rotary knob, the unit key (GHz, MHz, or kHz need not be pressed.

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

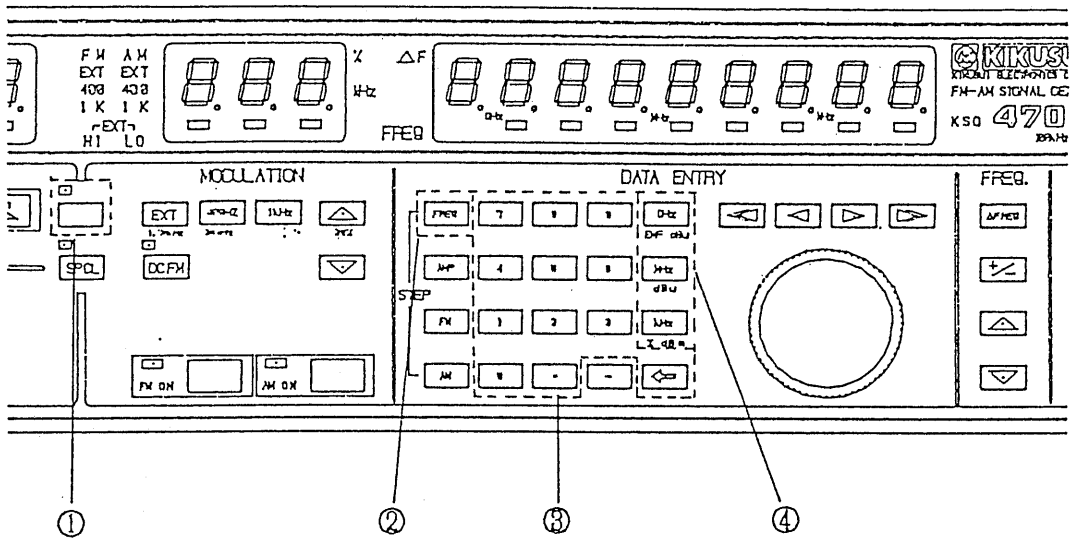
Key operation		[FREQUENCY] display
		␣100.000.00
◁	Press once.	␣100.000.00
	Turn the rotary knob clockwise by two steps.	␣100.020.00

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

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

4.4.3 Setting frequency step for △ and ▽ keys

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



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

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

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

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

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

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

4.4.4 Frequency difference △FREQ and +/− keys

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

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

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

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

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

b) Example: 100 MHz is set currently.

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

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

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

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

4.4.5 Reference signal input/output terminals

(1) Reference signal output (REFERENCE OUTPUT)

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

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

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

The fine adjustment, however, cannot be done while the LED of REFERENCE INPUT is on to indicate that the reference signal is being input.
Since the half-fixed resistor is adjusted properly before the instrument is shipped from the factory, keep it unchanged.

(2) Reference signal input (REFERENCE INPUT)

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

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

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

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

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

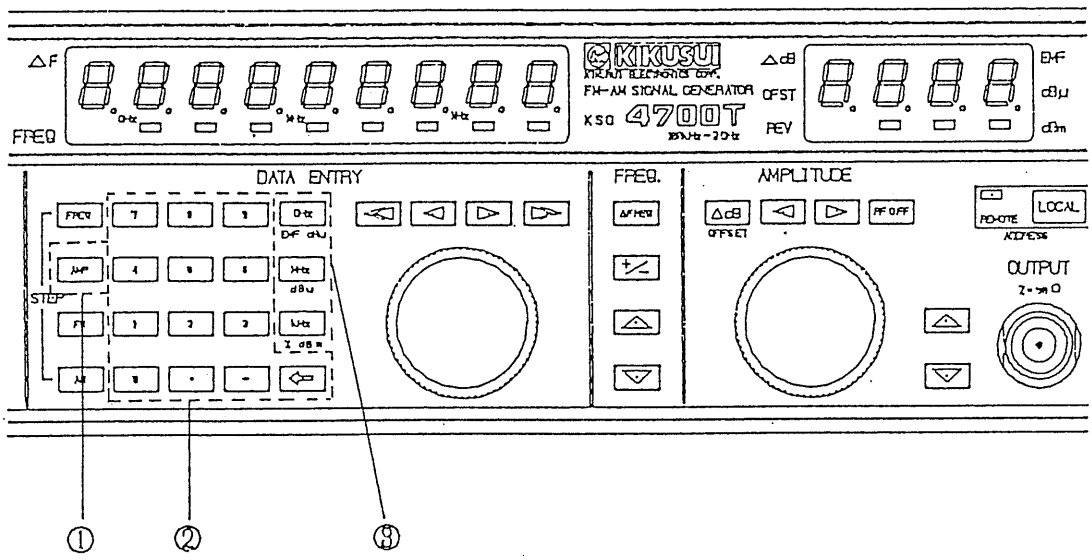
If the optional high stability reference crystal oscillator is installed, the signal whose frequency is 10 MHz and whose voltage is 0.15 Vrms or higher is output from the H STABILITY OUTPUT terminal.

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

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

4.5 Setting Output Level

4.5.1 Setting output level by numeric keys



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

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

After entering a value by numeric keys, press the required unit key. Then, the value is displayed in the AMPLITUDE section correctly.

To select the unit of output level, press EMF dBμ (GHz), dBμ (MHz), or dBm (kHz) after pressing AMP.

a) Example: To set 10 dBμ

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

b) Example: To set -5 dBm

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 set immediately after another output level.

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

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 entry of a value 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 using numeric keys again.
If a value smaller than or greater than the range allowed to the selected unit is specified, the previously set value is displayed.

See Section 4.5.8 for the range allowed to each unit.

4.5.2 Rotary knob

The rotary knob increases or decreases the values of the digits at and above the cursor position in the AMPLITUDE display section.

Use the ◁ and ▷ keys for moving the cursor.

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

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

The mark "_" denotes the cursor position.

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

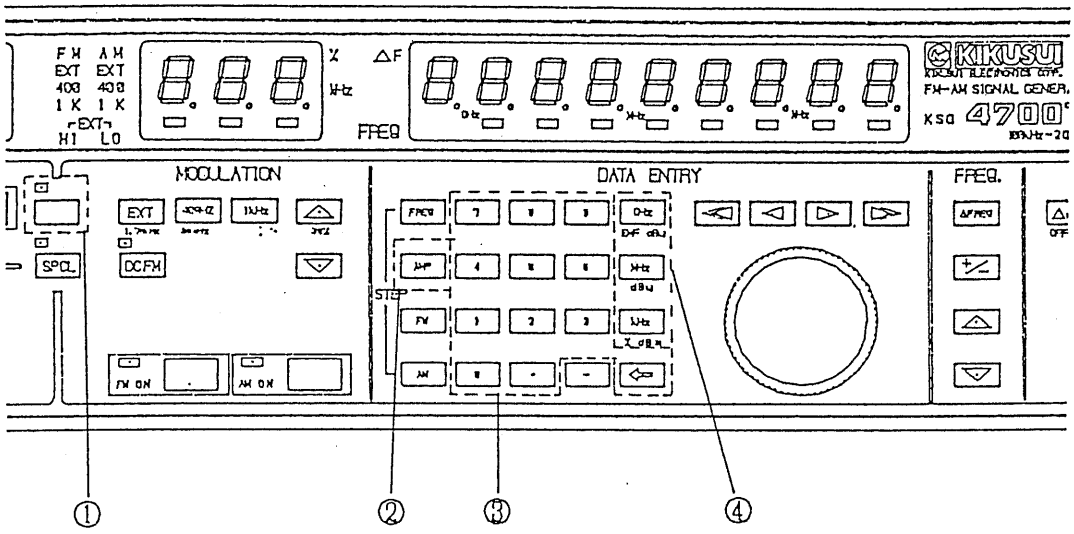
b) Example: To change output level from 66 dB to 60 dB

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

When setting the output level by rotary knob, the unit key (EMF dBμ, dBμ, or dBm) need not be pressed.

4.5.3 Setting output-level step for △ and ▽ keys

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



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

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

Key operation	[AMPLITUDE] display	
YE	␣60.0	YE indicator is turned on.
STEP AMP	␣␣␣␣	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 2 dB, keep pressing the AMPLITUDE △ or ▽ key (the key has a repeat function).

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 in this order. When YE OFFSET is pressed again, the offset output level is displayed.

The offset value can be set within the range of ±50 dB.

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

Key operation	[AMPLITUDE] display	
AMP	100.0	
-	−␣␣␣	
6	−6␣␣	
YE OFFSET	100.0	YE 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 △dB key

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

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

The value set for △dB must be within the range from the minimum value of output level to the maximum value of it.

Within the range of ±5 dB from the value effective when △dB is pressed, the output level can be changed without using the main attenuator. See Section 4.7.7 for the operation method.

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

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

4.5.6 RF.OFF key

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

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

4.5.7 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.

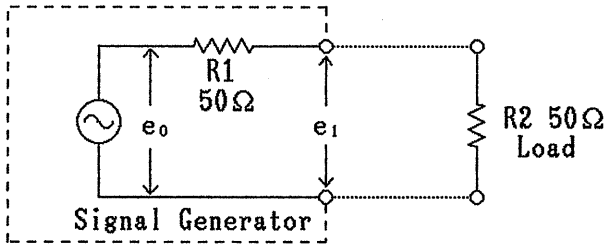
To reset the protector function, press the RF.OFF key twice.

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 for output used in the KSG4700T is as follows.



The output level can be set in the following ranges:

a) EMF dBμ: Open circuit voltage -20.0 dBμ to 126.0 dBμ
The voltage e_0 in the above chart is normalized by "0 dBμ = 1 μVrms".
The unit indicator "EMF dBμ" is turned on in the AMPLITUDE section.

b) dBμ: Loaded voltage -20.0 dBμ to 120.0 dBμ
The voltage e_1 in the above chart is normalized by "0 dBμ = 1 μVrms".
The unit indicator "dBμ" is turned on in the AMPLITUDE section.

c) dBm: Power indication -133.0 dBm to +13.0 dBm
The power consumed by R2 in the above chart is normalized by "0 dBm = $\sqrt{1\text{mW} \times 50\Omega}$ = 0.2236 Vrms".
The unit indicator "dBm" is turned on in the AMPLITUDE section.

4.6 Setting Modulation

4.6.1 YE key

a) Press YE 1.75 kHz, and the FM peak frequency deviation is set to 1.75 kHz.

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

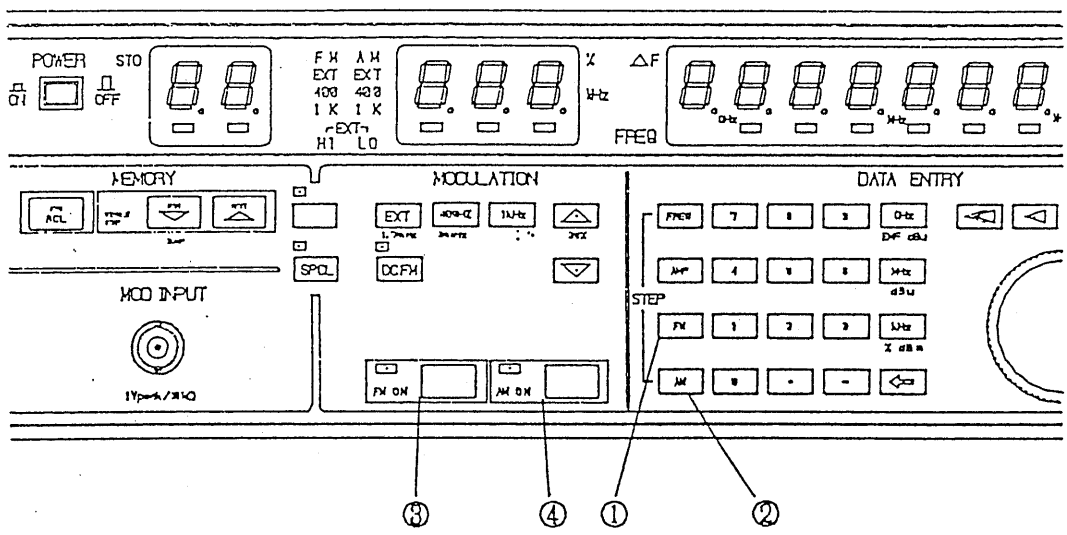
c) Press YE 30%, and the AM depth is set to 30%.

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 DATA ENTRY section or by the FM ON ③ and AM ON ④ keys in 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 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 Section 4.6.8 for the DC-FM mode.



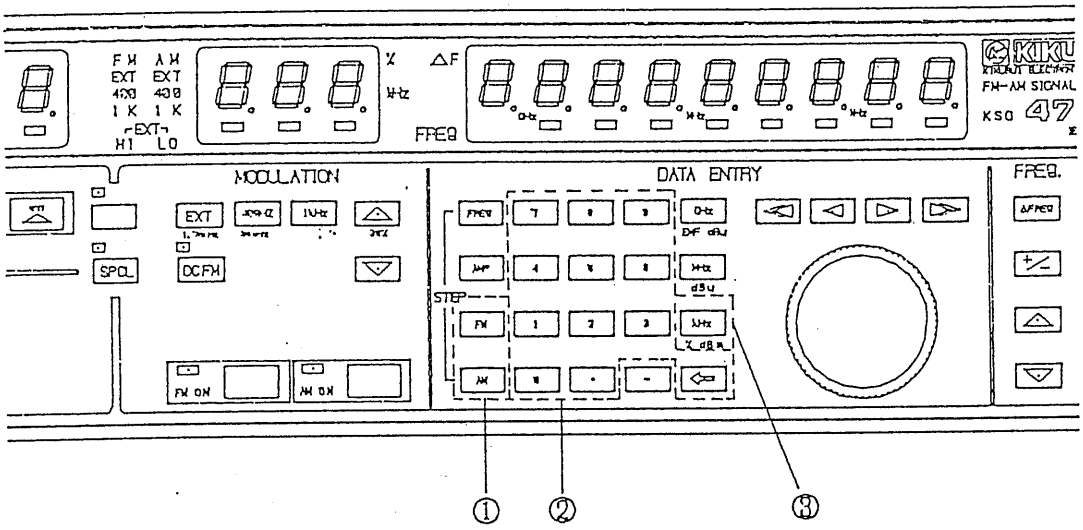
a) Example: To set 50 kHz deviation for 400 Hz internal FM source

Key operation	[MODULATION] display
FM	××.× ... Previously set value
	kHz indicator is turned on.
400Hz	FM 400Hz indicator is turned on.
5	5 ␣ ␣
0	5 0 ␣
kHz	5 0.0

b) Example: To turn off the modulation

Press key ③, and the FM ON indicator is turned off and the modulation is terminated.
At this time, the MODULATION display shows AM depth if AM is on (lamp ④ is on), and it shows 0 kHz 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 in MODULATION section with its unit.

Next, 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 MODULATION section with the specified unit.

Any desired value can be entered by the numeric keys (0-9, .), but if the entered value is not within the allowable range, the previous value is displayed.
The relationships between the carrier frequency and maximum/minimum deviation are listed below. See Chapter 2 "SPECIFICATIONS" for the guaranteed ranges of the specifications. See Section 4.6.4 for the overlapping ranges of frequency.

Carrier frequency	Maximum deviation	Minimum deviation
0 - 130MHz	250 kHz	10Hz, 100Hz, or 1kHz
127.5MHz - 260MHz	60 kHz	10Hz, or 100Hz
255 MHz - 520MHz	125 kHz	10Hz, 100Hz, or 1kHz
510 MHz - 1040MHz	250 kHz	10Hz, 100Hz, or 1kHz
1020 MHz - 2000MHz	500 kHz	20Hz, 200Hz, or 2kHz

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

a) Example: To set FM 25 kHz

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

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

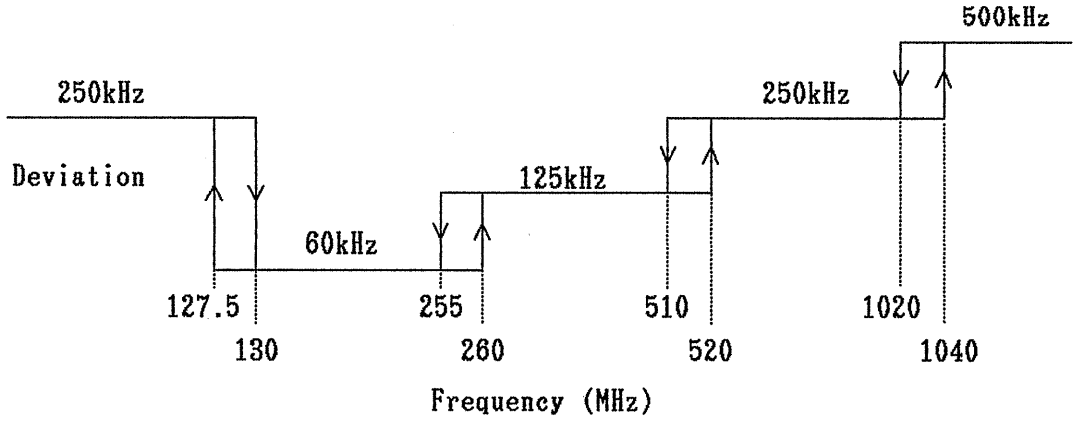
Key operation	[MODULATION] display
AM	××.× ... Previously set value
	% is displayed as unit.
3	3␣␣
0	30␣
%, dBm (kHz)	30.0

4.6.4 MODULATION display

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



For example, specify the deviation of 125 kHz for the frequency of 300 MHz and reduce the frequency. When the frequency is reduced to 255 MHz or lower, the MODULATION display shows 60 kHz as the value of deviation. After that, even if the frequency is increased to the band of 300 MHz, the displayed value of deviation (60 kHz) remains unchanged. To get the deviation of 125 kHz 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 (the values of the digits above the cursor position may also be changed as a result of carry or borrow). When the cursor is not found in the MODULATION section, bring it into the section by ◁◁ or ▷▷ key; when it is in the section, move it by ◁ or ▷ key.

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

Key operation		[MODULATION] display
FM		2 5 . 0
◁	Press once.	2 5 . 0
	knob clockwise by	3 5 . 0
	one step.	

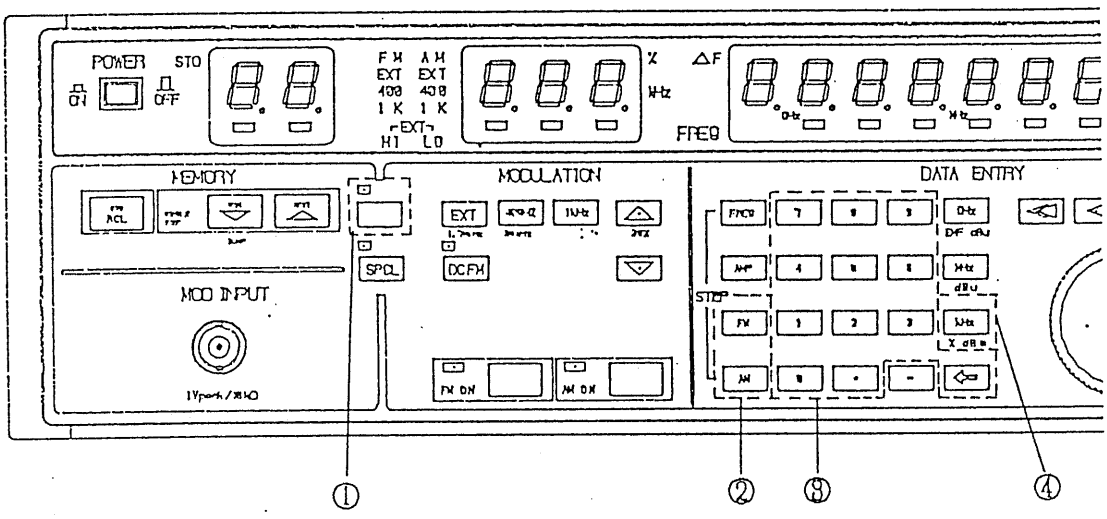
b) Example: To change AM depth from 30% to 25%

Key operation		[MODULATION] display
AM		3 0 . 0
▷	Press once.	3 0 . 0
	knob counterclock-	2 5 . 0
	wise by five steps.	

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

4.6.6 Setting modulation rate step for △ and ▽ keys

Set a desired step value (minimum 10/20 Hz, 100/200 Hz, or 1/2 kHz for FM according to frequency deviation range or 0.1% for AM) for the MODULATION △ and ▽ keys, and the modulation rate can be incremented or decremented by the unit of that value.



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

Example: To set 2.5 kHz as FM deviation step

Key operation		[MODULATION] display	
YE		75.0	kHz YE indicator is turned on.
STEP FM		␣␣ ␣	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 is kept being pressed, a repeat function is applied). The AM depth can be incremented/decremented in the same way as FM deviation.

4.6.7 Connecting and setting external modulation signal

(1) Connecting and setting method

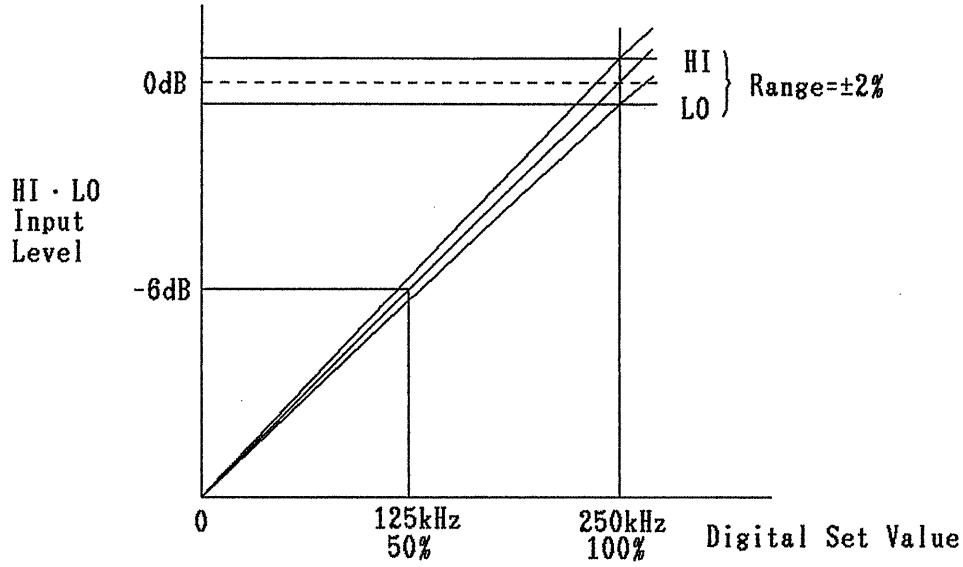
Connect an external modulation signal source to MOD INPUT on the front panel. The input impedance is approximately 10 kn, and the proper input level is about 1 Vpeak.

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

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

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

(2) Setting range



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

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

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

For example, after setting the input level within the range of HI and LO and the FM peak frequency deviation to 250 kHz, attenuate the input level by 6 dB. Then, 250 kHz (= 100%) remains displayed but the actual peak frequency deviation is reduced to 125 kHz (= 50%).

At this time, the LO lamp is turned on, but modulation is done correctly at the peak frequency deviation of 125 kHz.

4.6.8 DC·FM modulation mode

When the DC·FM key is selected, external modulation signal is input through DC coupling.

In the DC·FM mode, a closed loop DC·FM method is used. 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 instrument is set in the DC.FM mode 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 is reduces deviation and distorts waveform in the modulation by a low frequency signal because the PLL follows the low frequency signal.

The stabilization by closed loop DC·FM enables modulation by a DC signal, and it can give a modulated waveform without sag even if a signal of square waveform of less than 1 Hz is used for the modulation, but it cannot reduce the frequency error to zero.

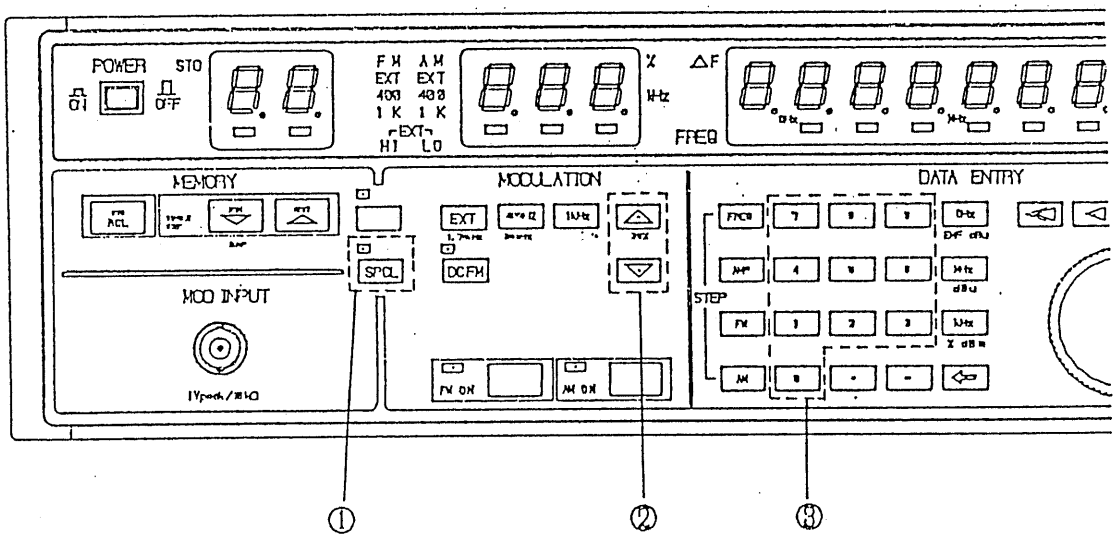
Switching between these modes requires a transient time of approximately 5 seconds for the stabilization of frequency. Therefore, the instrument should be set in the DC·FM mode in advance of the modulation that uses the EXT DC·FM mode.

To obtain accurate frequency, use the normal FM mode.

4.7 Special Functions

In addition to the basic functions described in the preceding sections, special functions are provided to increase the usefulness of the KSG4700T.

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



Press the SPCL key ①, and the KSG4700T 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 enter its 2-digit code by numeric keys ⑧. The entered 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 in active (see Table 1). Note that the special functions cannot be stored in MEMORY (address 00 - 99). Table 1 lists the special functions.

Table 1 Special functions and their codes

Code	GP-IB code	Explanation
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: △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:	2000 MHz
Output level:	-13.9 EMF dBμ
Frequency modulation:	On, 1 kHz
FM deviation:	1.75 kHz
Amplitude modulation:	Off
Cursor position:	Digit of 1 kHz for frequency
	Digit of 0.1 dB for output level
Memory address:	00

Key operation	MODULATION display	FREQUENCY display	
	× ××	× ××× ××× ××	Previous value
SPCL	␣ ␣␣	␣ ␣␣␣ ␣␣␣ ␣␣	SPCL indicator is
0	␣ ␣␣	0 ␣␣␣ ␣␣␣ ␣␣	turned on.
0	␣ ␣␣	0 0␣␣ ␣␣␣ ␣␣	
SPCL	1.75	2.000.000.00	SPCL indicator is turned off.

The value "00" is displayed and flickers once.
Then, the value "1.75" 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 display	FREQUENCY display	
	×× ×	×××××××××	Previous value
SPCL	␣␣ ␣	␣␣␣␣␣␣␣␣␣	SPCL indicator is
1	␣␣ ␣	1␣␣␣␣␣␣␣␣	turned on.
* 1	␣␣ ␣	1 1␣␣␣␣␣␣␣	
SPCL	××.×	×××××××××	SPCL indicator is turned off.

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 that the character "1" marked with "*" is replaced with the character "0". By this operation, the SPCL indicator is turned off.

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

In the FM two-tone 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 10 Hz. 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)
  ② 400 Hz (Internal 400 Hz)
  ③ 1 kHz (Internal 1 kHz)
  ④ EXT and 400 Hz
  ⑤ EXT and 1 kHz
  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 by specifications.
- Resolution of frequency deviation: 10 Hz minimum
- External modulation input voltage: 1 Vpeak ±2%
  (HI-LO indicator off)

- External modulation frequency characteristic:
  ±1 dB (20 Hz to 70 kHz)
- System standard preset values (The values conform to the EIAJ TR-027 ±2.5 kHz modulation)

  External tone signal: External modulation
  FM deviation = 0.35 kHz

  Internal tone signal: Internal modulation 1 kHz
  FM deviation = 1.4 kHz

  Combined deviation: 1.75 kHz

(2) Operation

a) Key operation | MODULATION display | FREQUENCY display

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

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

b) Supply the input voltage (approx. 1 Vpeak) to MOD INPUT, confirming that the EXT HI LO indicator in MODULATION section is off.

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

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

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

This section gives an example of two-tone modulation by setting 0.4 kHz deviation for external tone and 1.55 kHz deviation for internal 1 kHz tone. The table below lists the keys to be pressed, data to be displayed in MODULATION section, and states of 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
1 kHz	"0.35" kHz External modulation deviation is displayed.	EXT is selected and indicator remains on. 1 kHz is unselected and 1 kHz indicator is turned off.
FM, 0, ., 4, kHz	[0.40] kHz External modulation deviation is displayed.	EXT is selected and indicator remains on. 1 kHz is unselected and 1 kHz indicator remains off.
1 kHz	[1.80] kHz Combined deviation is displayed.	EXT is selected and indicator remains on. 1 kHz is selected and 1 kHz indicator is turned on.
FM, 1, ., 9, 5, kHz	[1.95] kHz Combined deviation is displayed.	EXT is selected and indicator remains on. 1 kHz is selected and 1 kHz indicator remains on.
EXT	[1.55] kHz Deviation of internal 1 kHz is displayed.	EXT is unselected and indicator is turned off. 1 kHz is selected and 1 kHz indicator remains on.
EXT	[0.40] kHz External modulation deviation is displayed.	EXT is selected and indicator is turned on. 1 kHz is selected and 1 kHz indicator remains on.
1 kHz	[0.40] kHz External modulation deviation is displayed.	EXT is selected and indicator remains on. 1 kHz is unselected and 1 kHz indicator is turned off.
1 kHz	[1.95] kHz Combined deviation is displayed.	EXT is selected and indicator remains on. 1 kHz is selected and 1 kHz indicator is turned on.

The data values 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 |<<| or |>>| key if the cursor is not found in MODULATION display, and move it by |<| or |>| key if it is found in the MODULATION display.

Note 1: To manipulate internal modulation when the FM signal source indicator "EXT" is on and either the "400Hz" or "1kHz" indicator is on:

a) Press the key of either 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 value of external modulation frequency deviation. A value lower than that cannot be input by numeric keys, either.

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

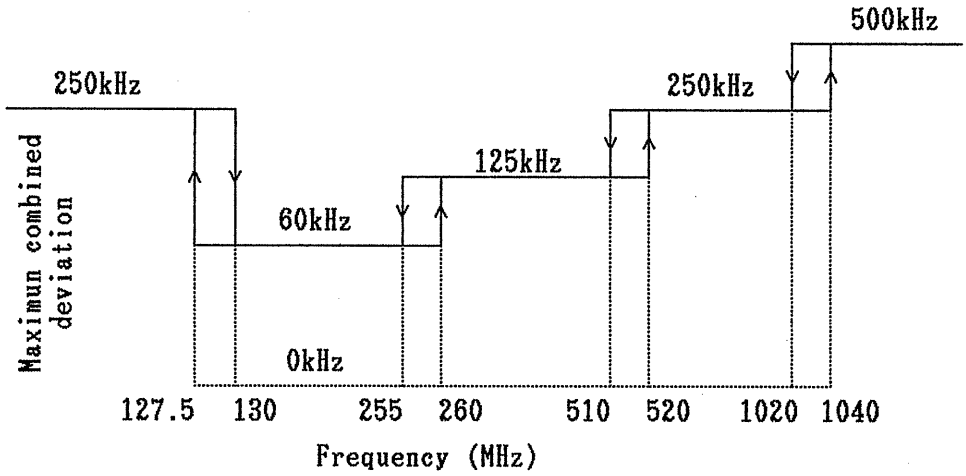
For the FM two-tone modulation, the adjacent frequency deviation bands overlap each other as in the case of single tone modulation (see Section 4.6.4).

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

When the frequency is changed from band A to band B, assuming that 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 if the frequency is changed as above.

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

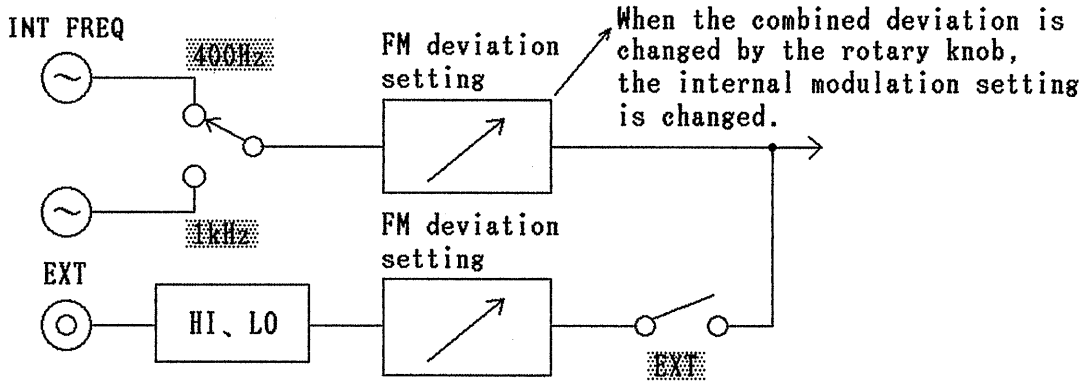


For example, specify the combined deviation of 125 kHz for the frequency of 300 MHz and reduce the frequency. When the frequency is reduced to 255 MHz or lower, the MODULATION display shows "0".

To perform the FM two-tone modulation in the frequency range of 130 MHz to 255 MHz, set the combined deviation again to 60 kHz or lower.

If the combined deviation is set lower than 60 kHz 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 through GP-IB

"SP21"]: Sets two-tone mode.

"FE0.35KZ": Sets external modulation deviation to 0.35 kHz.

"FMS21": Sets internal frequency to 400 Hz (for 1 kHz, specify "S31").

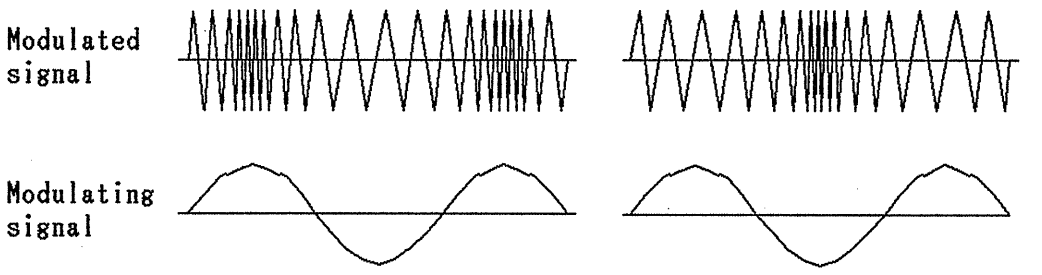
"FM1.75KZ": Sets combined deviation to 1.75 kHz.

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

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 SPCL, numeric keys (0-9, ., +/-), GHz (or MHz or kHz), 4, 1, SPCL, and △FREQ in this order, and the offset frequency is obtained.

a) Example: To offset 5 MHz for 100 MHz

Key operation	MODULATION display	FREQUENCY display	
	×××	×××× ××× ××	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 the value "41" flickers once, the previous value is displayed.
△FREQ	×××	␣100.000.00	△F indicator is turned on. In this stage, a signal of 105 MHz is output.
△FREQ	×××	␣100.000.00	△F indicator is turned off. In this stage, a signal of 100 MHz is output.

To terminate this mode, press keys as follows:

SPCL → 4 → 0 → SPCL

To check the offset value, press SPCL and let the MODULATION display show the value "41" by using △ or ▽ 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 rear panel.

For the standard value of the switching frequency, see Chapter 6 "OUTPUT IMPEDANCE AND DUMMY ANTENNA SWITCHING SIGNAL".

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

	Key operation	MODULATION display	FREQUENCY display	
	SPCL	␣␣␣	␣␣␣␣ ␣␣␣ ␣␣	SPCL indicator is turned on.
	1	␣␣␣	1␣␣␣ ␣␣␣ ␣␣	
	0	␣␣␣	10␣␣ ␣␣␣ ␣␣	
	0	␣␣␣	100␣ ␣␣␣ ␣␣	
	MHz	␣␣␣	␣␣␣␣ ␣␣␣ ␣␣	
	5	␣␣␣	5␣␣␣ ␣␣␣ ␣␣	
*	1	␣␣␣	51␣␣ ␣␣␣ ␣␣	
	SPCL	×××	×××× ××× ××	SPCL indicator is turned on. After the value "51" flickers once, the previous value is displayed.

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

If the value "1" marked with "*" in the above example is replaced with the value "2", the polarity is changed; that is, the RANGE OUTPUT terminal outputs "0" when the frequency is within the range from 100.00000 MHz to 1040 MHz, and its outputs "1" when the frequency is within the range from 100 kHz to 99.99999 MHz.

To set the switching frequency to the standard value, press keys as follows:

SPCL → 5 → 0 → SPCL

To check the switching frequency, press SPCL and let the MODULATION display show the value "51" or "52" by using △ or ▽ in MODULATION section. The switching frequency appears on the FREQUENCY display.

Note, however, that the switching frequency is not displayed when it is set to the standard value (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 output level because the main attenuator is switched at every 4 dB normally.

If this mode is used, however, the output level can be changed continuously without the switching of main attenuator for the range of ±5 dB from the currently set level.

To use this mode, press keys as follows:

SPCL → 6 → 1 → SPCL → △dB

In this mode, the AMPLITUDE display does not show the offset value even when △dB is pressed.

Therefore, for SPCL61, the △dB simply functions as the output level continuous changing mode on/off key.

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 rows and 10 columns (100 points in total).

The following is the memory address allocation diagram:

MEMORY address (2-digit 7-segment display)

00	01	02	08	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 address (row and column) can be called directly by the entry of a 2-digit number by numeric keys 0-9 after clearing the MEMORY display by the RCL and . keys.
In the following examples, it is assumed that the carrier frequency, output level, modulation mode, etc. that are set according to the explanations in Section 4.4 to 4.6 are stored in the memory by the operation explained in Section 4.8.2.

a) Example: Method of recalling memory by rotary knob
When the cursor is not found in the MEMORY display, bring it into the display by the ◁◁ key; when it is in the MEMORY display, move it by the ◁ or ▷ key.

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

b) Example: To recall memory address "10"

	MEMORY display
RCL, 1	"10"

c) Example: To recall memory address "43"

RCL, 4

Press MEMORY △ three times. "43"

d) Example: To recall memory address "85"

RCL, 8

Press MEMORY △ five times. "85"

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

Press RCL and ., and the MEMORY display is cleared. Press the numeric keys 5 and 6, and "56" is displayed. To recall the address "78" subsequently, omit pressing RCL and simply press the . key. The MEMORY display is cleared by the . key. Then, press the numeric keys 7 and 8, and "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 Section 4.8.1, but the step values of frequency, output level, and modulation factor and the △FREQ, △dB, RF.OFF, and special functions cannot be stored.

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

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

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

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

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

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

③ AM 1kHz ××.×
%E 30% 30.0 %

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

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

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

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

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

① Set frequency, output level, modulation mode, etc.
② Press %E, STO, and ., and MEMORY display is cleared.
③ Press numeric keys 4 and 5, and the data set by step ① is stored.

Note 1: If an attempt is made to store data when the instrument is in memory protect mode (SPCL11), the STO LED goes on and soon goes off to indicate that the memory is protected.

Note 2: When data is to be stored continuously, pressing of [YE], [STO], and [.] cannot be omitted.

Note 3: When the [RTN] key explained in Section 4.8.3 is used, the memory address (row and column) cannot be specified directly.

4.8.3 Storing data into a part of memory block (Setting [RTN] function)

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

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

[How to use the function]

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

4.8.4 How to reset [RTN] function

The following two methods are available:

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

By the above operation, all the ten columns of the block become available as they were before the RTN function was set.

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

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

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

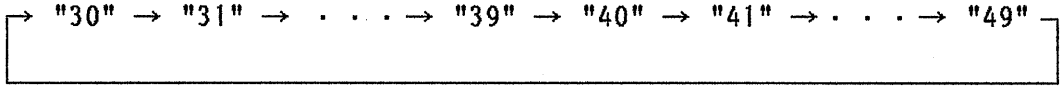
Normally, memory addresses are recalled by the unit of ten columns (00-09, 10-19, ..., 90-99), but more than ten columns can be recalled continuously by the following operation:

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

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

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

The memory addresses are recalled as follows:



4.8.6 How to reset NEXT function

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

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

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

4.8.7 Copying memory data to another KSG4700T

(1) The 100-point memory data can be copied to another unit of KSG4700T.

(2) Memory data copying procedure

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

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

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

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

Optional DUMP cable (SA510) is recommended.

5. REMOTE CONTROL

5.1 General Description

5.1.1 Outline

The KSG4700T has a 14-pin connector for remote control. Most of the functions on the front panel can be controlled through this connector.

5.2 How to Use Remote Control Function

5.2.1 Explanation of remote control connector

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

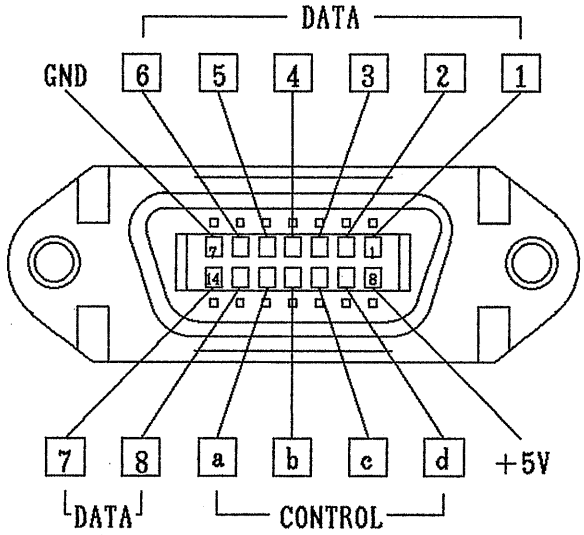


Fig. 5-1

[Explanation of terminals]

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

(1) DATA terminals ▒1▒ - ▒8▒ (Pins 1 - 6, 13, and 14)
The DATA terminals are used as a bidirectional bus for both input and output, and they are connected to the internal bus for the front panel features.

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

(2) CONTROL terminals [illegible] and [illegible] (Pins 11 and 12)

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

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

(3) CONTROL terminals [illegible] and [illegible] (Pins 9 and 10)

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

(4) +5V terminal (Pin 8)

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

(5) GND terminal (Pin 7)

5.2.2 Input data timing

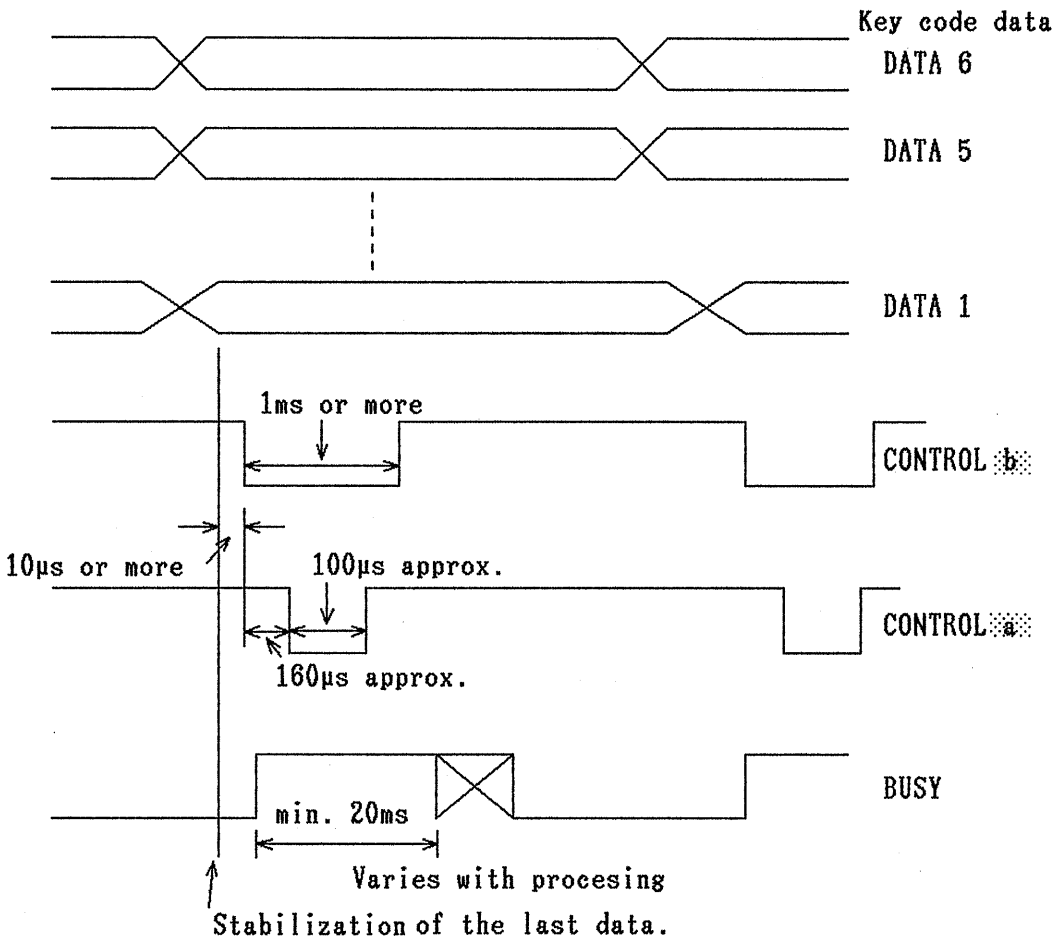


Fig. 5-2

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

Approximately 160 µs after the falling of CONTROL b, CONTROL a which is output from the KSG4700T is set to "0" for approximately 100 µs.

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

After CONTROL [b] falls and before CONTROL [a] falls, (160 μs approx.), the BUSY signal, which indicates that the key code data is being processed, rises to "1".
The next key code data should be input after the BUSY signal is set to "0".

5.2.3 Panel key code table

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

Table 5-10

	DATA input pin number					
	6	5	4	3	2	1
Key name	MSB ← Key Code → LSB					
[MEMORY] [RCL] / [STO]	0	0	0	1	0	0
" [▽] / [RTN]	0	0	0	1	1	1
" [△] / [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
" [▽]	0	1	1	1	1	1
[FM ON]	0	0	1	1	1	0
[AM ON]	0	0	1	1	1	1
[DATA ENTRY] [FREQ] / [STEP FREQ]	0	1	0	0	1	0
" [AMP] / [STEP AMP]	0	1	0	0	1	1
[DATA ENTRY] [FM] / [STEP FM]	0	1	0	1	0	0
" [AM] / [STEP AM]	0	1	0	1	0	1
" [0]	1	1	0	0	0	0

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

5.2.4 Setting frequency by remote control (example)

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

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

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

(3) Set the data for "82." according to the key code table, and send it by setting CONTROL [b] to "0" for 1 ms or longer.

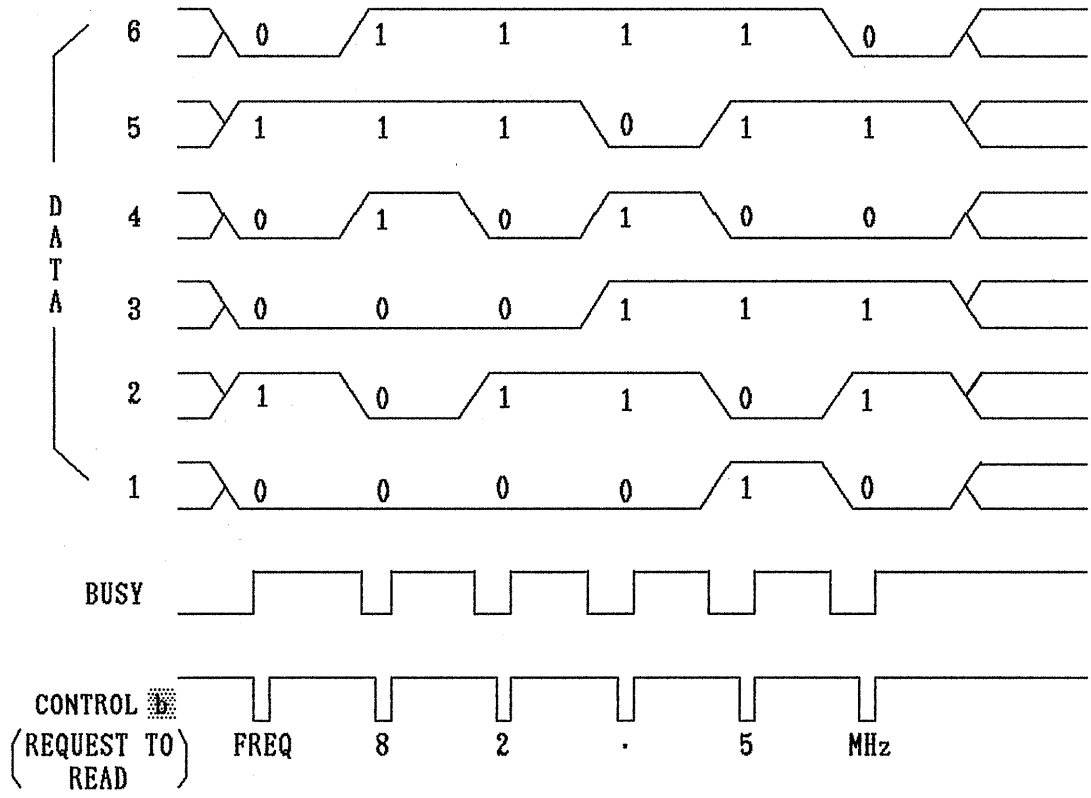


Fig. 5-3

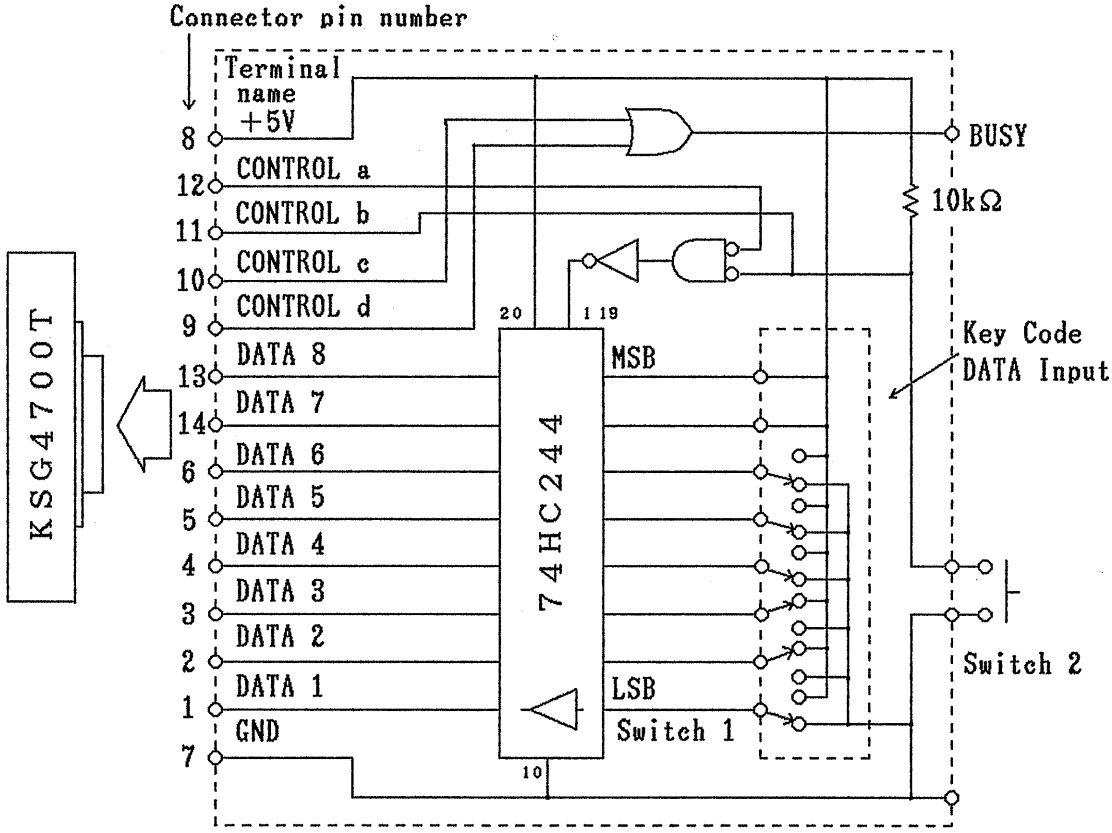
(4) Send the data "110101" for "5" by setting CONTROL [b] to "0" in the same way as above.

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

(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 and its operation (example)

Since the data lines of the remote control connector are bidirectional bus lines, it is recommended to use a circuit such as the one shown in Figure 5-4 when controlling the signal generator by a remote unit.
The circuit in Figure 5-4 is a remote control circuit that increments the displayed memory address by 1 each time the switch is pressed.



The chattering prevention circuit is not described.

Fig. 5-4

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

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

5.2.6 MEMORY display output circuit (example)

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

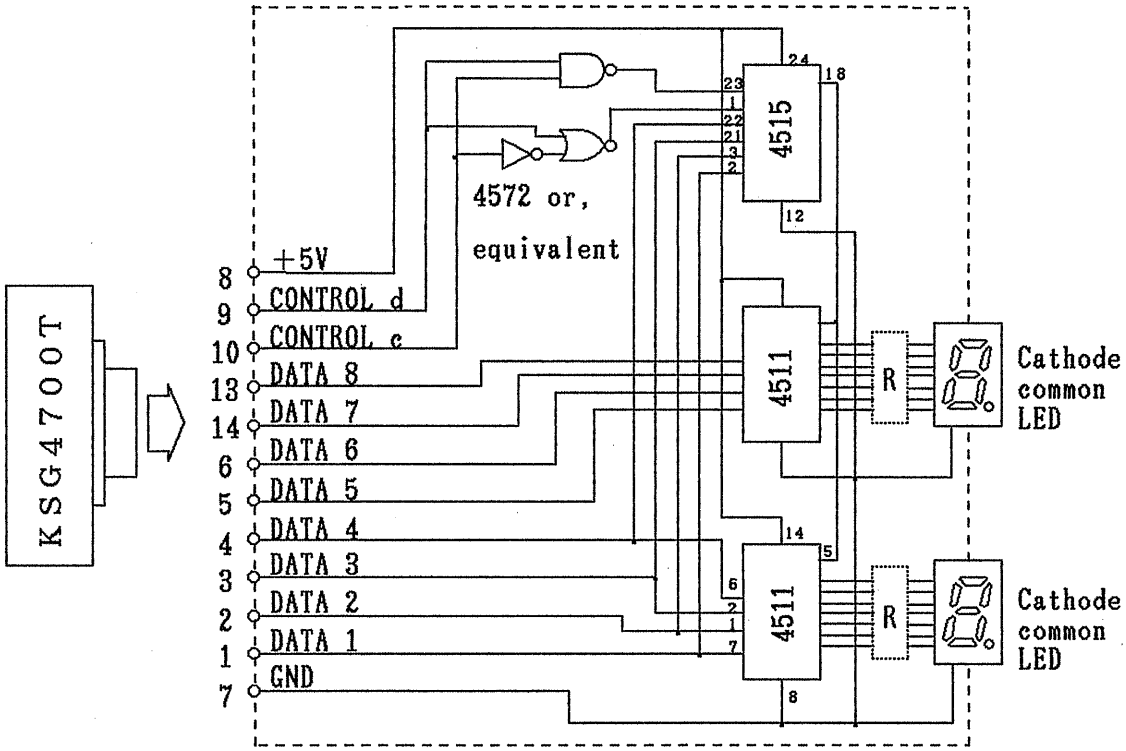


Fig. 5-5

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

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

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

6. OUTPUT IMPEDANCE AND DUMMY ANTENNA SWITCHING SIGNAL

6.1 "RANGE OUTPUT" RCA Pin Connector

The standard setting of the switching frequency and polarity is as follows: When the frequency is within the range from 35.0000 MHz to 1040 MHz, the output signal is set to "1" (5V, 50 mA), and when it is within the range from 100 kHz to 34.9999 MHz, the output signal is set to "0".

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

The switching frequency can be set to any desired value by a special function (see Section 4.7.6).

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

7. BACKUP BATTERY AND CPU RESET

7.1 Backup Battery

The KSG4700T uses a memory backup battery, and the battery may discharge its electricity when the Signal Generator is not used for a long time.

Since the Signal Generator has a charging circuit, the battery will be charged when the Signal Generator is powered on.

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

[Battery position and replacement method]

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

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

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

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

7.2 CPU Reset

7.2.1 Hardware reset

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

7.2.2 Software reset

Turn on the power switch while pressing the [Y] key on the panel, and the CPU is reset. By this operation, the values stored in the memory and the values for steps are not cleared but the GP-IB address is set to its initial value.

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

8. GP-IB (General Purpose Interface Bus)

8.1 General Description

8.1.1 Outline

The kSG4700T has a GP-IB interface, and it can be controlled through the IEEE488 standard interface bus.

8.1.2 Features

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

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

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

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

8.2 Performance

8.2.1 Electrical specifications related to interface system

Conforms to IEEE Std 488-1975.

8.3 Operation

8.3.1 Preparation for use

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

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

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

(3) After the hardware/software reset of CPU, the device address is set to "07", the initial value.
After the CPU reset, press a key such as [←].

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

8.3.2 Address setting method

(1) Address setting by software

Press [YE] and [LOCAL] (ADDRESS), and the current address is displayed while the keys are being pressed. Enter a 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 KSG4700T is set to "07" before the instrument is delivered from the factory.

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

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

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

After setting the address, put back the PC board and aluminum sash case to their original positions. Then, execute the software or hardware reset of CPU (see Section 7.2).

a) Table 8-1 lists the DIP-SW positions and the addresses determined by them.
b) ON position of DIP-SW means the level of "0".
c) Figure 8-1 shows how S2 is set for address "07".

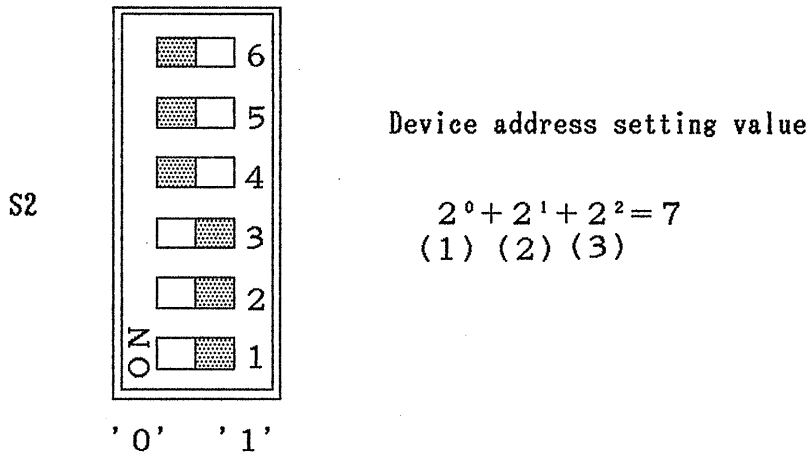


Fig. 8-1

Table 8-1

Listener address Device number	Address switch 1 2 3 4 5 6
00	0 0 0 0 0 0
01	1 0 0 0 0 0
02	0 1 0 0 0 0
03	1 1 0 0 0 0
04	0 0 1 0 0 0
05	1 0 1 0 0 0
06	0 1 1 0 0 0
07	1 1 1 0 0 0
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 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 makes the instrument ready to receive data when the listener address is specified. If the LOCAL key on the front panel is pressed in this state, the REMOTE indicator goes off and the instrument 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 a universal command.
LOCAL	Turns off the REMOTE indicator and sets the instrument in local mode to allow manual operation on the front panel.
CLEAR	Sets the instrument 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.

8.3.4 Program code table

Programs for the KSG4700T should be described with the codes listed in Table 8-3 "GP-IB function setting method".

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

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

Table 8-3 GP-IB function setting method

Item	Program code	Data	Unit
Frequency	FR	oo.o	HZ, KZ, MZ, GZ
Output level unit			
" EMF dBμ	EM	---	---
" dBμ	DU	---	---
" dBm	DM	---	---
Output level	AP	oo.o	DB
" OFF	RO, ROF	---	---
" ON	R1, RON	---	---
Modulation			
AM depth	AM	oo.o	PC
"	AM	oo.o	%
Amplitude modulation OFF	AMS5, AMOF	---	---
FM peak frequency deviation	FM	oo.o	KZ
* External frequency deviation (for two-tone modulation only)	FE	oo.o	KZ
Frequency modulation OFF	FMS5, FMOF	---	---
DC·FM	DC	---	---
Release of DC·FM	AC	---	---
External modulation	S1AM, S1FM	---	---
* Simultaneous modulation (for two-tone modulation only)	S21FM, FMS21 S31FM, FMS31	--- ---	--- ---
Internal modulation 400Hz	S2AM, S2FM	---	---
Internal modulation 1kHz	S3AM, S3FM	---	---
Special function	SP	oo	---
Memory control			
Memory recall	RC	oo	---
Memory store	ST	oo	---

Note: 1. The mark "---" means an optional item.
2. The mark "oo" means that the data may be specified with one digit up to the maximum number of digits.
3. Data must be expressed in integers or real numbers; it must not be expressed in E format.
4. Alphabetic characters may be expressed in small letters.
5. See Item (5) of Section 4.7.3 "FM two-tone modulation mode" for the items marked with "*".

Table 8-4 GP-IB program codes

Alphabetic order

Program code	Explanation	Remarks
AC	Releases DC·FM	Switches modulation signal source
AM	Amplitude modulation	Function mode
AMOF	Amplitude modulation OFF	Switches modulation signal source
AP	Output level	Output level unit
DB	Output level unit	Unit
DC	DC·FM	Switches modulation signal source
DU	dBμ	Unit
DM	dBm	Unit
EM	EMF dBμ	Unit
*FE	Sets external frequency deviation	(For two-tone modulation only)
FM	Frequency modulation	Function mode
FMOF	Frequency modulation OFF	Switches modulation signal source
FR	Frequency	Function mode
GZ	GHz (Frequency)	Unit
HZ	Hz (Frequency, modulation)	Unit
KZ	kHz (Frequency, modulation)	Unit
MZ	MHz (Frequency)	Unit
PC	Percent for AM depth	Unit
RC	Memory recall	Function mode
RO, ROF	Output level OFF	Function mode
R1, RON	Output level ON	Function mode
S1	External modulation ON	Switches modulation signal source
S2	Internal modulation 400 Hz	Switches modulation signal source
S3	Internal modulation 1kHz	Switches modulation signal source
S5	Modulation OFF	Switches modulation signal source
*S21	Simultaneous modulation of S2 and S1	(For two-tone modulation only)
*S31	Simultaneous modulation of S3 and S1	(For two-tone modulation only)
*SP	Special function	Function mode
ST	Memory store	Function mode
0 - 9	Numeric value	Data
-	Minus sign	Data
.	Decimal point	Data
%	Percent for AM depth	Unit

Note: The codes marked with "*" are used for special functions (See Section 4.7).

Table 8-5 GP-IB program codes

Classified by function

Function	Program code
Frequency	FR
Output level	AP
Output level OFF	RO, ROF
Output level ON	R1, RON
Modulation	
Amplitude modulation	AM
Frequency modulation	FM
Sets frequency deviation	FE (For two-tone modulation only)
EXT	S1
400 Hz	S2
1 kHz	S3
Modulation OFF	S5
Internal 400Hz and external signal	S21 (For two-tone modulation only)
Internal 1 kHz and external signal	S31 (For two-tone modulation only)
Amplitude modulation OFF	AMOF, AMS5
Frequency modulation OFF	FMOF, FMS5
DC·FM	DC
Releases 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 recall	RC
Memory store	ST

8.3.5 Basic data setting method

100 MHz carrier frequency, EMF 120 dBμ output level, 1 kHz internal modulation frequency, and 75 kHz FM frequency deviation are to be set. In the following examples, HP9816 is used:

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

Output command	Frequency data	Output level data	FM deviation data

Normally, CRLF or EOI is sent.

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

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

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

Example 3 To set the carrier frequency to 88.2 MHz:

a) "FR88.2MZ"

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

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

Example 5 To set the output level to 100 dBμ:

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

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

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

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

a) "S2AM30%" b) "S2AM30PC" c) "S2AM", "AM30%"

Example 8 To set external FM deviation to 75 kHz:

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

Note: S1 only is invalid.

Example 9 To turn off modulation:

a) "AMS5" b) "AMOF" c) "FMS5" d) "FMOF"

Example 10 Memory recall and store:

To recall data from memory address "36" and to store it to memory address "36":

a) "RC36" b) "ST36"

8.3.6 Reference (Program example)

An example of a program for HP9816 is given below. This program is to set the data of frequency, output level, and modulation rate, to store the data into the Signal Generator (memory "00" - "09"), and to recall the data from it.
This program is just for reference, and it may not be the best one.

Since the program description method varies with the system to control the Signal Generator, code the program in the most suitable way for the system.

```
 10  Dev=707                          Interface select code * 100 +
                                      Device address
 20  Frequency=100*1.E+6              100 MHz
 30  Freqstep=10*1.E+6                10 MHz
 40  Level=120                        120 dB
 50  Levelstep=-10                    -10dB
 60  Fm=75                            75 kHz
 70  Fmstep=-5                        -5 kHz
 80  CLEAR Dev                        Clear selected device
 90  WAIT 2
100   OUTPUT Dev;"R1"                 Output level ON
110   OUTPUT Dev;"AMS5"               Amplitude modulation OFF
120   FOR N=0 TO 9
130     Freq=Frequency + Freqstep*N
140     Lev=Level+Levelstep*N
150     Fmlev=Fm+Fmstep*N
```

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

9. DOWNLOAD PROGRAM

9.1 General Description

Since the KSG4700T has a controller function, it can control the instruments with GP-IB interface, such as audio analyzers, electronic voltmeters, oscilloscopes, power supply units, and jigs, by using a user program downloaded from the host computer. That is, a small-scale system can be established without the host computer.

Since the strong editing and debugging functions of the measurement computer that has been used up to date can be applied to the user program, the user program can be developed in a short time.

o Controller function

The user program (command string) is activated by the memory keys (RCL, △, △, etc.) of the KSG4700T, and the command string is output from the GP-IB port. When the command string is transferred to instruments, the instruments are set in the states specified by the command string. Thus, the preparation for measurement is done quite easily.

o User program development and debugging

The user program is developed on the host computer, and the developed program is run on the host computer for the purpose of debugging and checking operation. The user program is completed after it is debugged and its operation is checked.
With this user program and host computer, a small-scale system can be established.

o User program downloading and activation

The user program is transferred (downloaded) to the KSG4700T by the transfer program on the host computer. At this time, the user program must be coded in ASCII.
Disconnect the host computer to use the KSG4700T as the controller.

By manipulating the memory keys (RCL, △, △), the user program is activated and the command string is transferred to instruments through the GP-IB port of the KSG4700T.
In this stage, a small-scale system is established without the host computer.
The CPU of the KSG4700T is active only when the GP-IB port commands are transferred. Therefore, an operation such as the measurement of receive sensitivity in a shield room is not disturbed by computer noise.

o User program uploading and debugging

When the user program is transferred (uploaded) from the KSG4700T to the host computer, it can be modified and debugged by the editing function of the host computer.

9.2 Features

(1) The downloaded program can use the memory area "00" to "99" for setting functions on the panel, and this function makes the program more useful in various applications.

(2) The program can be named.

(3) In the program, variables can be used as listener addresses.

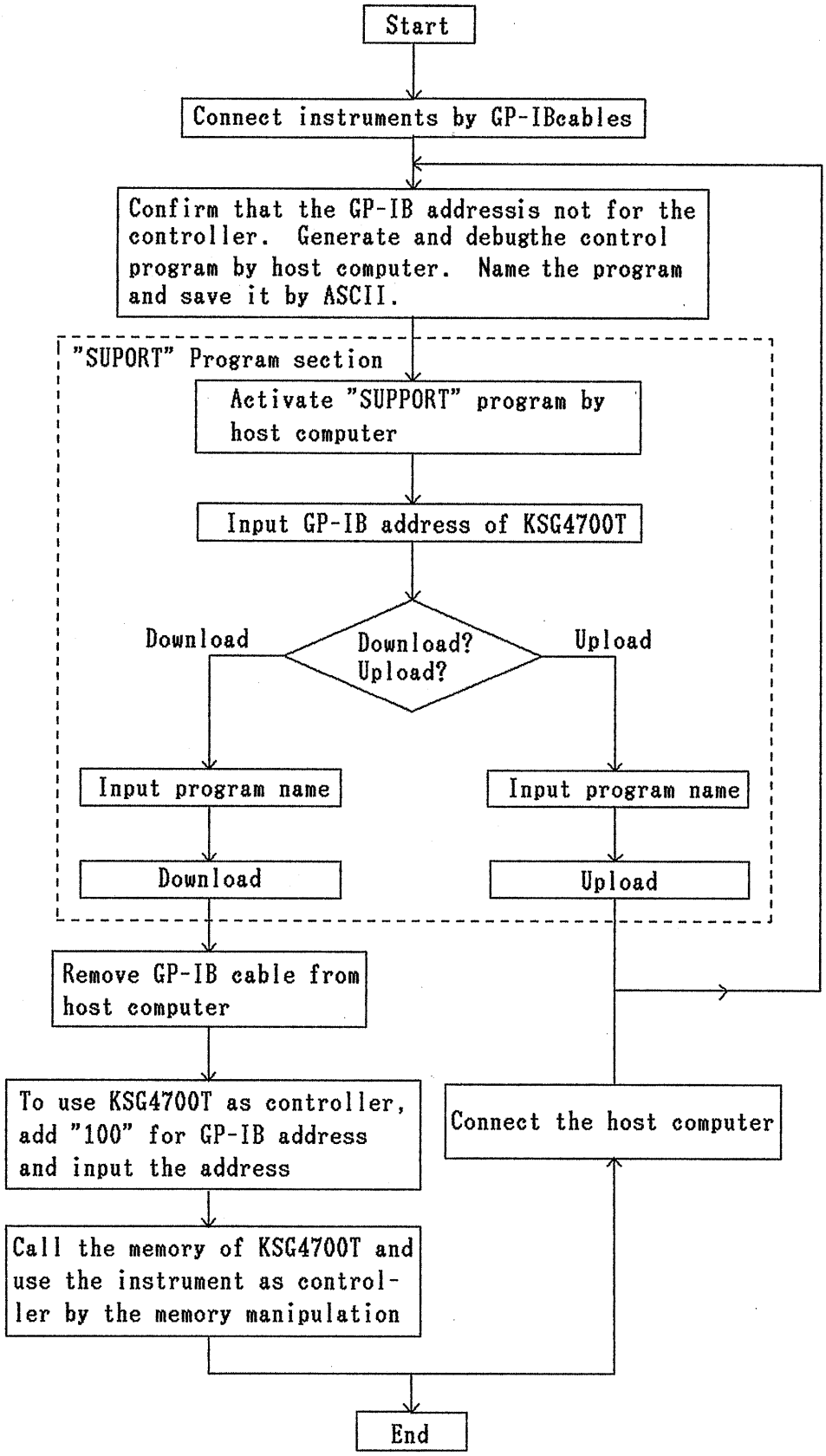
(4) The program downloaded to the KSG4700T can be uploaded, and this function can be used for managing and debugging the program.

(5) The BASIC program is developed (input, edited, and debugged) by the host computer.

By using these features effectively, a system with GP-IB interface can be established easily.
A computer provided by HP can be used as the host computer.

9.3 Operation

9.3.1 Operation flow



9.3.2 Example: Using HP9816 as host computer

In this example, the modulation frequency characteristics of an FM receiver, namely, the LEFT and RIGHT signals, are measured at three frequency points (100 Hz, 1 kHz, and 10 kHz) by the use of HP9816 (as host computer), KSG4700T, multiplex signal generator KSG3200, and two-indicator AC voltmeter AVM23R.

(1) Set the instruments as follows:

a) KSG4700T:
- Frequency: 83 MHz
- Output level: -60 dBm
- AM: OFF
- Pulse modulation: OFF
- FM: Stereo modulation with 75 kHz

b) KSG3200:
- Output level: 3 Vp-p
- Pilot level: 10%
- MAIN signal: 90%
- Pre-emphasis: OFF
- Internal modulation frequency: 1 kHz

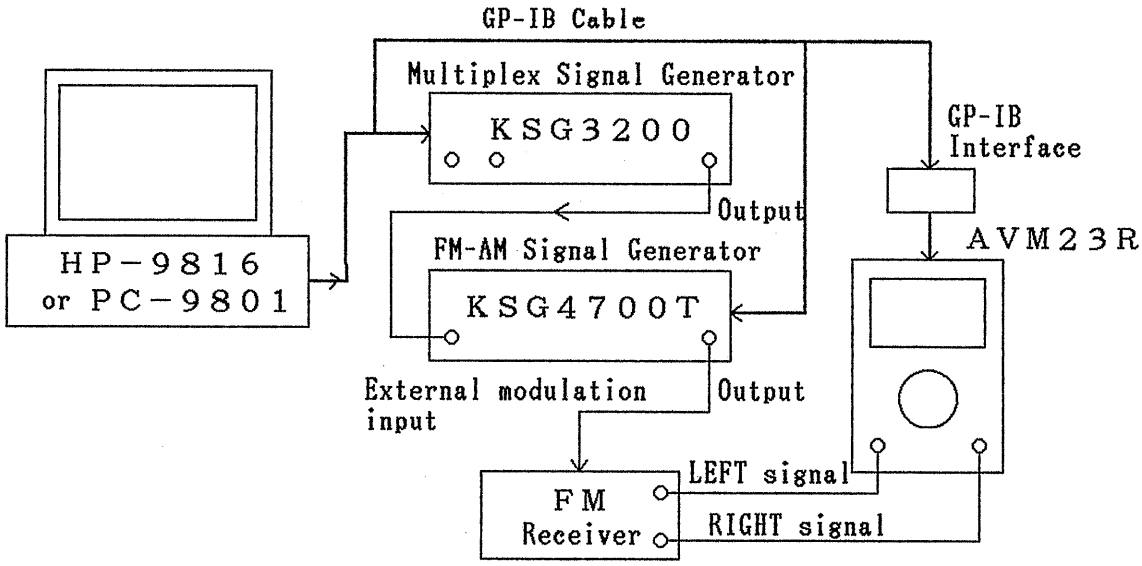
c) Change the internal modulation frequency of KSG3200 to 100 Hz.

d) Change the internal modulation frequency of KSG3200 to 10 kHz.

(2) Setting of instruments and operation of FM receiver (summary)

	Setting of instruments	FM receiver operation and measurement
Step 1	On the KSG4700T, set the frequency to 83.0MHz and output level to -60 dBm, turn off AM and pulse modulation, set FM to AC 75 kHz, and specify external FM. On the KSG3200, set the output level to 3.00V, pilot level to 10%, and function to 90% MAIN, turn off the pre-emphasis, and set the internal modulation frequency to 1 kHz. On the AVM23R, set the range to 1V.	Adjust the balance volume of the FM receiver till the indicators of the AVR23R indicate the same value for L and R signals. Adjust the output volume to 0dBV.
Step 2	On the KSG3200, set the internal modulation frequency to 100 Hz.	Read the value indicated by the AVM23R.
Step 3	On the KSG3200, set the internal modulation frequency to 10 kHz.	Read the value indicated by the AVR23R.

9.3.3 Connecting instruments for downloading program



Connect the instruments to the host computer (HP-9816) through GP-IB interface.

(1) Set the GP-IB select code of the host computer (HP-9816) to "7".

(2) Set the GP-IB address of the KSG4700T to "07".
This setting is done before the instrument is shipped from the factory. See Section 8.3.2 "Address setting method".

(3) Set the GP-IB address of the KSG3200 to "09".
This setting is done before the instrument is shipped from the factory. See Section 6.3.2 "GP-IB address setting method" in the KSG3200 Operation Manual.

(4) Set the interface address of the AC voltmeter AVM23R to "11".

9.3.4 Generating program to be downloaded

This section gives an example of the program for the setting explained in Section 9.3.2. The program to be downloaded is generated as commands are sent from the host computer HP-9816 and correct operation of the GP-IB interface is checked by the messages in the following format:

```
OUTPUT 717;"FR83MZ"
          |  |  |
          |  |  |____Masage
          |  |_______GP-IB address of the instrument to receive
          |          the message (two digits)
          |__________GP-IB select code
```

(1) List of the program to be downloaded

To set the instruments in the states explained in Item (2) of Section 9.3.1, the information of steps 1, 2, and 3 is stored in memory areas "00", "01", and "02" of the KSG4700T respectively.

Program	Explanation
10 REM demo_program_1	The program is named "demo_program_1".
20 REM ADDR Sg=707,Ssg=709,Dvm=711	The KSG4700T (Sg), KSG3200 (Ssg), and AVM23R (Dvm) are set t 707, 709, and 711 respectively. This setting is necessary when the addresses are expressed in variables.
30 Sg=707	Used by BASIC
40 Ssg=709	Used by BASIC
50 Dvm=711	Used by BASIC
60 REM MEM-00:	Beginning of memory "00"
70 OUTPUT Sg;"FR83MZ AP-60DM S5AM PUOF ACFM75KZ S1FM"	The frequency and output level are set to 83.0 MHz and -60 dBm respectively, AM and pulse modulation are turned off, FM is set to AC 75 kHz, and external FM is specified.
80 OUTPUT Ssg;"AP3.00V PL10% M1 AF90% PRE0 S5"	The output level, pilot, and function are set to 3.00V, 10%, and 90% MAIN respectively, pre-emphasis is turned off, and modulation source is set to 1 kHz.
90 OUTPUT Dvm;"A1 L7 R7"	A1 channel is selected, and L and R ranges of AVM23R are set to 1.0V respectively.
100 PRINT "MEMORY 00"	The above information is set in memory area "00".

```
110 PAUSE                          The program execution pauses; it is
                                   resumed by "cont".
120 REM MEM-01:                    Beginning of memory "01"
130 OUTPUT Ssg;"S3"                The internal modulation frequency is
                                   set to 100 Hz.
140 PRINT "MEMORY 01"              The above information is set in memory
                                   area "01".
150 PAUSE                          The program execution pause; it is
                                   resumed by "cont".
160 REM MEM-02:                    Beginning of memory "02"
170 OUTPUT Ssg;"S7"                The internal modulation frequency is
                                   set to 10 kHz.
180 PRINT "MEMORY 02 & END"        The above information is set in memory
                                   area "02", and all the setting is
                                   finished.
190 END
```

(2) Download and upload operation

Activate the program that supports download and upload (the program is named "SUPPORT"), select download, and enter the program name "demo_program_1" then, the program is downloaded to the KSG4700T.

The program to be downloaded should be saved in the host computer HP-9816 by a name in ASCII (in this example, it is saved by the name of "demo_program_1" which is the same as the program name).

Activate the "SUPPORT" program and select upload; then, the downloaded program is uploaded to the host computer HP-9816.

The uploaded program can be saved in the host computer by any desired name.

By using the above functions, the program can be debugged and managed effectively.

(3) Uploading the downloaded program

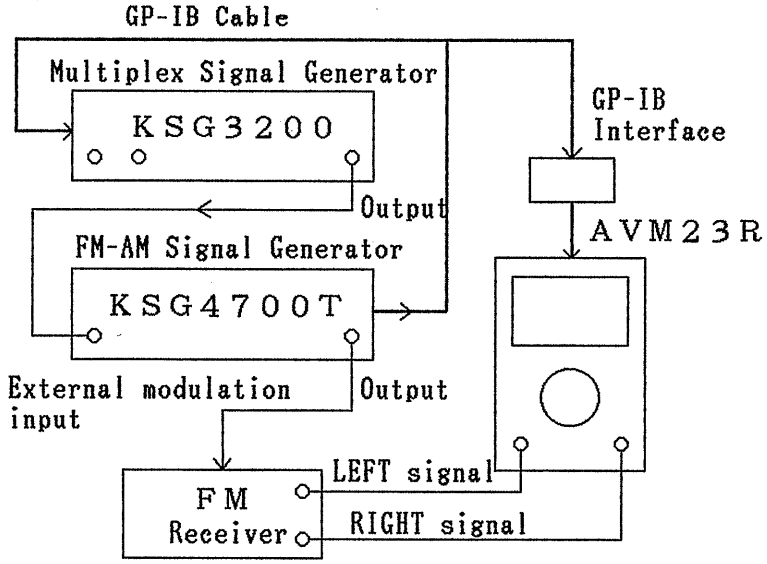
When the downloaded program is uploaded, the same program list as the one given in Item (1) of this section is output as follows:

```
10  REM demo_program_1
20  REM ADDR Sg=707,Ssg=709,Dvm=711
30  Sg=707
40  Ssg=709
50  Dvm=711
60  REM MEM-00:
70  OUTPUT Sg;"FR83MZ AP-60DM S5AM PUOF ACFM75KZ S1FM"
80  OUTPUT Ssg;"AP3.00V PL10% M1 AF90% PRE0 S5"
90  OUTPUT Dvm;"A1 L7 R7"
100 PRINT "MEMORY 00"
110 PAUSE
120 REM MEM-01:
130 OUTPUT Ssg;"S3"
140 PRINT "MEMORY 01"
150 PAUSE
160 REM MEM-02:
170 OUTPUT Ssg:"S7"
180 PRINT "MEMORY 02 & END"
190 END
```

The above uploaded program can be debugged, or a different program can be generated from it by adding new messages to it.

9.3.5 Connecting instruments for using KSG4700T as controller

(1) After the program is downloaded, disconnect the host computer HP9816.



(2) To use the KSG4700T as controller

The KSG4700T considered as the controller when 100 is added to its GP-IB address ("07" + "100" = 107).

To recall the memory areas of the KSG4700T in the order of "00" → "01" → "02" → "00" → "01" ..., write an RTN command in the memory area "02".

For the above operations, press keys as follows:

a) Press YE, LOCAL, 1, 0, 7, and LOCAL on the panel.
b) Press RCL, ., 0, and 2 to specify memory area "02".
c) Press YE, STO, and RTN. See Section 4.8.3.

With he instruments connected as in Item (1), execute the following operations.

KSG4700T key manipulation	Memory display	FM receiver operation and measurement
RCL, 0	00	Adjust the balance volume of FM receiver till the indicators of AVM23R indicate same value for L and R signals. Adjust the output volume of FM receiver to 0dBV
△ (NEXT)	01	Read the indication on AVM23R.
△ (NEXT)	02	Read the indication on AVM23R.
Above key manipulation	E1	GP-IB address error

9.4 Details of BASIC Commands

H P	Explanation
OUTPUT ad;"ms"	Outputs a message.
LOCAL sc	Local
REMOTE sc	Remote
WAIT t	Waits for the period of t sec
REM ADDR va0=ad[,val=ad]	Declares the variable of ad or la.
REM MEM-n:[mrm,msm]	Declares the beginning of memory n, and indicates the memory recall mode and the message setting mode for local instrument.
!	This code can be used in the place of REM.

ad Interface select code and listener address
sc × 100 + la

la Listener address

mrm Memory recall mode
RECALL: The memory is called, and the information in the memory is set in hardware.
NOT RECALL: The memory is not called (default).

msm Message setting mode for local instrument
SET: A message for the local linstrumen tis used and set in hardware (default).
NOT SET: A message for the local instrument is not used.

ms	Message
n	Memory number (0 < n < 99)
sc	Interface select code
t	Numeric value to indicate waiting time (unit = s)
text	Character string to represent ID
va	Variable name for ad or la. "va0" is for the SG itself.
[..]	The information in the brackets can be omitted.

9.5 Appendix

9.5.1 Supporting program "SUPPORT"

(1) For HP9816

```
1000        REM SUPPORT
1010        DIM A $[128]
1020        Esc=27
1030        PRINT CHR $(12)
1040 Start:!
1050        INPUT "Input GPIB address of SG", Gpadr
1060        IF Gpadr<0 OR 30<Gpadr THEN Start
1070        Gpadr=700+Gpadr
1080 Loop1:!
1090        OFF KEY
1100        ON KEY 5 LABEL "Download" GOSUB Download
1110        ON KEY 6 LABEL "Upload  " GOSUB Upload
1120        DISP "SELECT FUNCTION KEY ..."
1130 Loop2:GOTO Loop2
1140 !
1150 Download:!
1160        GOTO Download_file
1170 File_not_found:!
1180        BEEP
1190        DISP "! ! ! File is not found ! ! !"
1200        WAIT 1.5
```

```
1210 Download_file:!
1220       ON ERROR GOTO File_not_found
1230       INPUT "Source file name ? ",Source$
1240       IF Source$<>"E" THEN D_file_assign
1250          OFF ERROR
1260          RETURN
1270 D_file_assign:!
1280       ASSGN @Infile TO Source $
1290       OFF ERROR
1300 Down_check:!
1310       ON END @Infile GOTO Down_check_end
1320       OUTPUT Gpadr;"SPTA"
1330       ENTER Gpadr;Maxbyte
1340       Byte=0
1350 Down_check_loop:!
1360         ENTER @Infile;A$
1370         Byte=Byte+LEN(A$)+2
1380         GOTO Down_check_loop
1390 Down_check_end:!
1400       ASSIGN @Infile TO Source$
1410       ON END @Infile GOTO Down_end
1420       Byte=Byte+1
1430       DISP "<<< Bytes of source file  ";Byte;" >>>"
1440       PRINT
1450       PRINT "<<< Bytes of source file ";Byte;" >>>"
1460       PRINT
1470       IF Maxbyte<Byte THEN
1480          BEEP
1490          DISP " ! ! ! ! Source file is too long ! ! ! ! "
1500          OFF ERROR
1510          RETURN
1520       END IF
1530       DISP "< < < Start of download > > >"
1540       PRINT
1550       OUTPUT Gpadr;"SPTD"
```

```
1560 Down_loop:!
1570         ENTER @Infile;A$
1580         OUTPUT Gpadr;A$
1590         PRINT A$
1600         GOTO Down_loop
1610 Down_end:!
1620       OFF ERROR
1630       ASSIGN @Infile TO *
1640       OUTPUT Gpar;CHR$(27)
1650       DISP "< < < End of download > > >"
1660       PRINT
1670       RETURN
1680 !
1690 Upload:!
1700       INPUT "Distination file name ? ",Dist $
1710       IF Dist$="E" THEN RETURN
1720       OUTPUT Gpadr;"SPTB"
1730       ENTER Gpadr;Text_byte
1740       Rec=1+INT(Text_byte/256)
1750       ON ERROR GOTO Already_exist
1760       GREATE ASCII Dist $,Rec
1770       GOTO Unload_start
1780 Already_exist:!
1790       OFF ERROR
1800       BEEP
1810       INPUT "File is already exist , over write OK Y/N" ,C$
1820       IF C$< >"Y" AND C$< >"y" THEN Upload
1830       PURGE Dist $
1840       CREATE ASCII Dist $,Rec
1850 Upload_start:!
1860       ASSIGN @Outfile TO Dist $
1870       PRINT
1880       DISP "< < < Start of unload > > >"
1890       OUTPUT Gpadr;"SPTU"
```

```
1900 Upload_loop:!
1910        ENTER Gpadr;A $
1920        IF  NUM(A$)=Esc THEN GOTO Upload_end
1930            OUTPUT @Outfile;A$
1940            PRINT A$
1950            GOTO Upload_loop
1960 Upload_end:!
1970        ASSIGN @Outfile TO *
1980        DISP "< < < End of upload > > >"
1990        PRINT
2000        RETURN
2010 END
```

9.5.2 Accessories (optional)

(1) Dummy antennas

SA 100 Test loop (Loop antenna)
For generating standard field of medium/high frequency band
Frequency range: 100 kHz to 30 MHz
BNC type 50Ω Unbalanced

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

SA 115 Dummy antenna for FM receiver
For single signal
BNC load type 50Ω:300Ω Balanced

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

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

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

SA 153 Output adaptor for switching between test loop and dummy antenna
Frequency range: DC to 200 MHz
AM 50Ω:50Ω
FM 50Ω:50Ω

SA 154 Output adapter for switching between test loop and dummy antenna
Frequency range: DC to 200 MHz
AM 50Ω:50Ω
FM 50Ω:75Ω

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

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

(2) Coaxial and special cables

SA 500 Shielded cable
RCA-RCA pin plugs Length 0.8 m
For switching test loops, dummy antennas, etc.

SA 510 Dump cable
14 pin-14 pin connectors Length 1.5 m
Memory dump cable for KSG Series

SA 520 Cable for synchronizing memory timing
14 pin-14 pin connectors Length 0.3 m
For KSG3100 to 3210 and KSG4100 to 4700T

SA 550 RF cable

BNC(P)-BNC(P) connectors

50Ω RG-58A/U Length 1 m

Accessory cable for KSG4100 to 4300

SA 556 RF cable

N(P)-N(P) connectors

50Ω 5D-2W Length 1 m

Accessory cable for KSG4500 to 4700T

SA 570 RF cable

BNC(P)-BNC(P) connectors

75Ω 3C-2V Length 1 m

Accessory cable for KSG3100 to 3210