OPERATION MANUAL

FM/AM SIGNAL GENERATOR

KSG4700

Second Edition

KIKUSUI ELECTRONICS CORPORATION

(KIKUSUI PART NO. Z1-478-120)

M-90121

Power Requirements of this Product

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

☐ Input voltage

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

☐ Input fuse

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

WARNING

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

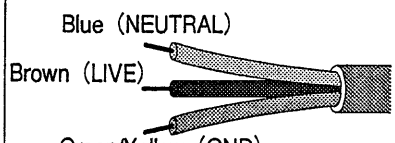
☐ AC power cable

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

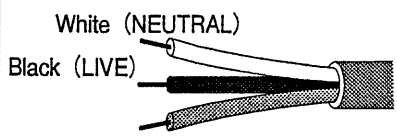
WARNING

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

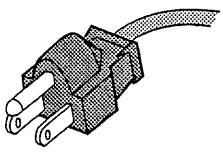
☐ Without a power plug



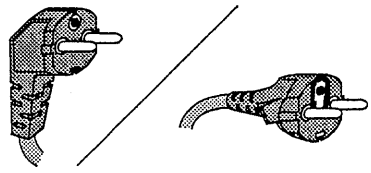
☐ Without a power plug



☐ Plugs for USA



☐ Plugs for Europe



☐ Provided by Kikusui agents

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

☐ Another Cable _____

 Kikusui Part No. Z9-000-027 IB001681

KIKUSUI

CONTENTS

CONTENTS

(Cont'd)

CONTENTS

(Cont'd)

CONTENTS

(Cont'd)

1. INTRODUCTION

1.1 General Description

The KSG4700 is an FM/AM standard signal generator that covers the frequency of 100kHz to 2GHz. Since the PLL method is adopted, the resolution of the frequency lower than 1GHz is 10Hz and that of the frequency higher than 1GHz is 20Hz (a doubler is used for the frequency higher than 1GHz). Thus, the instrument is useful in simulating satellite communication systems, testing radar systems, adjusting SSB receivers, and measuring the characteristics of MCAs, personal radios, car telephones, UHF/VHF TV sounds, and various receivers of FM and AM bands. It can be operated easily as it adopts recall and numeric data entry methods.

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

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

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

Since the KSG4700 gives a very low FM distortion rate of 0.5% or less (for 1kHz modulation frequency, 75kHz deviation), it is suitable for the adjustment of FM tuners and it can be used for the development and production of MCAs, personal radios, car telephones, and audio circuits of UHF/VHF TV sets. Also, the frequency modulation by external DC coupling is possible.

The AM external modulation range is from 50Hz to 10kHz with very little incidental FM; so the AM suppression ratio of an FM tuner can be measured accurately.
For the pulse width modulation, the rising/falling time charactersitic is less than 0.5μs and the ON/OFF ratio is approximately 40dB.

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.

Since the KSG4700 has a GP-IB local controller function, it can be used as a controller. The KSG4700 has a text area for memory steps, and it can read listener addresses and their corresponding commands from the text area and execute 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 KSG4700, the instrument can execute the program by its local controller function without the host computer.

A remote control function is also provided for control of all operations possible from the panel. Since the standard model of KSG4700 supports the GP-IB control, it reduces labor on production lines.

1.2 Features

(1) Since the KSG4700 covers a wide band range of 100kHz to 2GHz, it can be used for testing various radios and communication instruments.

(2) The carrier frequency can be specified with a 9-digit number, and the value of a desired digit (designated by cursor) can be changed continuously by a rotary knob. Also, the KSG4700 has the ΔFREQ (frequency difference) display function and the ±½ function to check selectivity.

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

(4) The output level can be selected from a wide range of −20.0dBμ to 120.0dBμ (open circuit), and it can be specified with a 4-digit number in units of 0.1dB. Also, an output level ON/OFF function is provided.

(5) Since the KSG4700 can generate highly pure signals, it can be used for testing not only FM/AM but also SSB receivers.

(6) The settling time is only 50ms approximately.

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

(8) The KSG4700 can control its peripheral instruments by a downloaded program.

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

(10) Data can be copied from the memory of one KSG4700 to that of another KSG4700 by the pressing of DUMP key.

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

(12) The KSG4700 has a GP-IB interface.

(13) Since the KSG4700 can be connected to one another in chain mode by the refernce frequency input and output connectors (10MHz) provided on them, the relative error of the measured frequency can be reduced to zero.

2. SPECIFICATIONS

- Frequency (RF)

  Range : 100kHz to 2GHz

  Resolution : 10Hz ≦ 1.02GHz
  : 20Hz > 1.02GHz

  Accuracy : Same as reference oscillator

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

- Reference oscillator

  Frequency : 50MHz

  Accuracy : $\pm 5 \times 10^{-6}$

  Stability : Temperature $\pm 5 \times 10^{-6}$ (5 to 35°C (41 to 95°F))
  : Aging rate $\pm 2 \times 10^{-6}$/Week
  : Refer to the High stability crystal oscillator (Options, on page 12)

  Internal reference signal output

  Output frequency: 10MHz

  Output level : ≧ 0.15Vrms 50Ω loaded

  External reference signal (requires)

  Input impedance : 50Ω

  Input frequency : 10MHz±200Hz (±0.002%)

  Input level : ≧ 0.15Vrms

○ RF Output

Range : Maximum output

Unit	≦ 1.02GHz		> 1.02GHz	
	For FM	For AM	For FM	For AM
EMF dBμ	126dBμ	120dBμ	120dBμ	114dBμ
dBμ	120dBμ	114dBμ	114dBμ	108dBμ
dBm	+13dBm	+7dBm	+7dBm	+1dBm

: Minimum output (Guaranteed ranges)

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

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

Resolution : 0.1dB

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

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

Standard level accuracy : At the output level of 113dB (0dBm)
1) ±1dB RF ≦ 1.02GHz
2) ±1.5dB RF > 1.02GHz

Attenuator accuracy:

	≦ 1.3GHz	> 1.3GHz
±1dB	≧ 20dB (-93dBm)	
±1.5dB	≧ 0dB (-113dBm)	≧ 20dB (-93dBm)
±2dB	< 0dB (-113dBm)	< 20dB (-93dBm)

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

Output impedance : 50Ω N type connector

VSWR : Output level ≦ 100dB (-13dBm)
≦ 1.3 ≦ 1GHz
≦ 1.8 > 1GHz

Reverse power protection: Maximum 25W, 25V DC

Spurious signals (Fundamental wave = 0dBc)

Harmonics : ≦ −25dBc Output ≦ 113dB (0dBm)

Sub-harmonics : ≦ −25dBc > 1.02GHz

Non-harmonics : At CW mode, offset carrier 5kHz
≦ −60dBc ≦ 1.02GHz
≦ −54dBc > 1.02GHz

SSB phase noise : At CW mode, offset carrier 20kHz
≦ −104dBc/Hz > 1.02GHz
≦ −110dBc/Hz 0.1 to 127.5MHz, 510MHz to 1.02GHz
≦ −116dBc/Hz 225 to 510MHz
≦ −122dBc/Hz 127.5 to 255MHz

Residual modulation (S/N)

FM component :

Frequency	Demodulation band width	
	0.3 to 3kHz 3.5kHz deviation	50Hz to 15kHz 75kHz deviation
100kHz to 127.5MHz	≦ 12Hz (50dB)	≦ 16Hz (73dB)
127.5 to 255 MHz	≦ 3Hz (61dB)	≦ 4Hz (85dB)
255 to 520MHz	≦ 6Hz (55dB)	≦ 8Hz (79dB)
520MHz to 1.02GHz	≦ 12Hz (50dB)	≦ 16Hz (73dB)
1.02 to 2GHz	≦ 24Hz (43dB)	≦ 32Hz (67dB)

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

o Modulation

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

1) External
2) Internal 400Hz
3) Internal 1kHz
4) Internal 3kHz
5) External DC·FM
6) External Pulse modulation

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

Internal modulation frequency: 400Hz, 1kHz and 3kHz; ±3%

External modulation

1) Input impedance: 10kΩ approx. (unbalanced)
2) Input voltage requirement for external modulation: 1.5Vpeak approx. (3Vp-p approx.)

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

[FM]

Maximum frequency deviation range and resolution (Guaranteed ranges≦400kHz)

Frequency		Range		
2.5MHz to 127.5MHz	Freq. deviation	0 to 9.99kHz	10 to 99.9kHz	100 to 250kHz
	Resolution	10Hz	100Hz	1kHz
127.5 to 255MHz	Freq. deviation	0 to 9.99kHz	10 to 24.9kHz	25 to 60kHz
	Resolution	10Hz	100Hz	1kHz
255 to 510MHz	Freq. deviation	0 to 99.9kHz	10 to 49.9kHz	50 to 125kHz
	Resolution	10Hz	100Hz	1kHz
510MHz to 1.04GHz	Freq. deviation	0 to 9.99kHz	10 to 99.9kHz	100 to 250kHz
	Resolution	10Hz	100Hz	1kHz
1.04GHz to 2GHz	Freq. deviation	0 to 99.8kHz	10 to 99.8kHz	100 to 500kHz
	Resolution	20Hz	200Hz	1kHz

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

Display : 3-digit readout

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

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

Distortion of internal modulation : For Demodulation band width = 300Hz to 15kHz, Modulation frequency = 1kHz, and Deviation = 75kHz
≦ 0.5%

Incidental AM : For Demodulation band width = 300Hz to 15kHz, Modulation frequency = 1kHz, Deviation = 60kHz and RF > 2.5MHz
≦ 0.5%

DC·FM mode

	≦ 1.02 GHz	> 1.02 GHz
Frequency accuracy	±(Reference frequency +2kHz)	±(Reference frequency + 4kHz)
Stability	≦ 2kHz/10 minutes	≦ 4kHz/10 minutes

2 hours after power on

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

[Pulse modulaton]

ON/OFF ratio : > 40dB

Rise and fall time : > 0.5μS

Duty cycle : 0 to 100%
(for EXT modulation)

External modulation : Input palse level TTL

[AM]

Settable : 0 to 99.9%

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

Resolution : 0.1%

Display : 3-digit readout

Accuracy : ≦ (Displayed value ±5)% Depth 0 to 80%

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

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

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

o Setting Functions : 1) The numeric keys and rotary knob (with cursor designation) for specifying carrier frequency, output level, modulation level, and memory.

2) Step keys for specifying carrier frequency, output level, and modulation level.

3) Preset keys for specifying 1.75kHz, 3.5kHz and 22.5kHz (for FM) and 30% (for AM).

- Memory Function : 1) 100 point for carrier frequency, output level, modulation level, modulation mode, etc.

  2) The memory can be used in blocks of 10 points or as a continuous space of 100 points.

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

- Download Function :

- Remote Control : The carrier frequency, output level, and modulation level can be stored/recalled, the carrier frequency and output level can be incremented/decremented by steps or continuously by rotary knob, modulation can be turned ON/OFF, etc.

- GP-IB Interface : SH1, AH1, T6, L3, SR1, RL1, PP0, DC1, DT0, C1, C2, C3, C28

- Range Out (dummy antenna switching output):

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

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

○ Backup Battery is provided.

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

Frequency : 50Hz/60Hz

Power dissipation : Approx. 74VA

○ Size and Weight

Dimensions : 430(W) × 99(H) × 400(D) mm
(16.93(W) × 3.90(H) × 15.75(D) in.)

445(W) × 119(H) × 455(D) mm (Full envelope)
(17.52(W) × 4.69(H) × 17.91(D) in.)

Weight : Approx. 13.5 kg (30 lbs)

○ Environmental Conditions (temperature and humidity)

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

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

○ Accessories

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

○ Options

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

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

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

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

a) 5MHz±100Hz (±0.002%)

b) 1MHz±20Hz (±0.002%)

3. PREPARATION FOR USE

3.1 Unpacking and Inspection

Before being shipped from the factory, the KSG4700 goes through thorough mechanical and electrical examinations and inspections, and its correct operation is confirmed and guaranteed.

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

3.2 Line Voltage and Fuse Selection

Select a voltage range from the table below by the voltage selection pulg on the rear panel of KSG4700, and the instrument can be used in the selected voltage range.

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

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

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

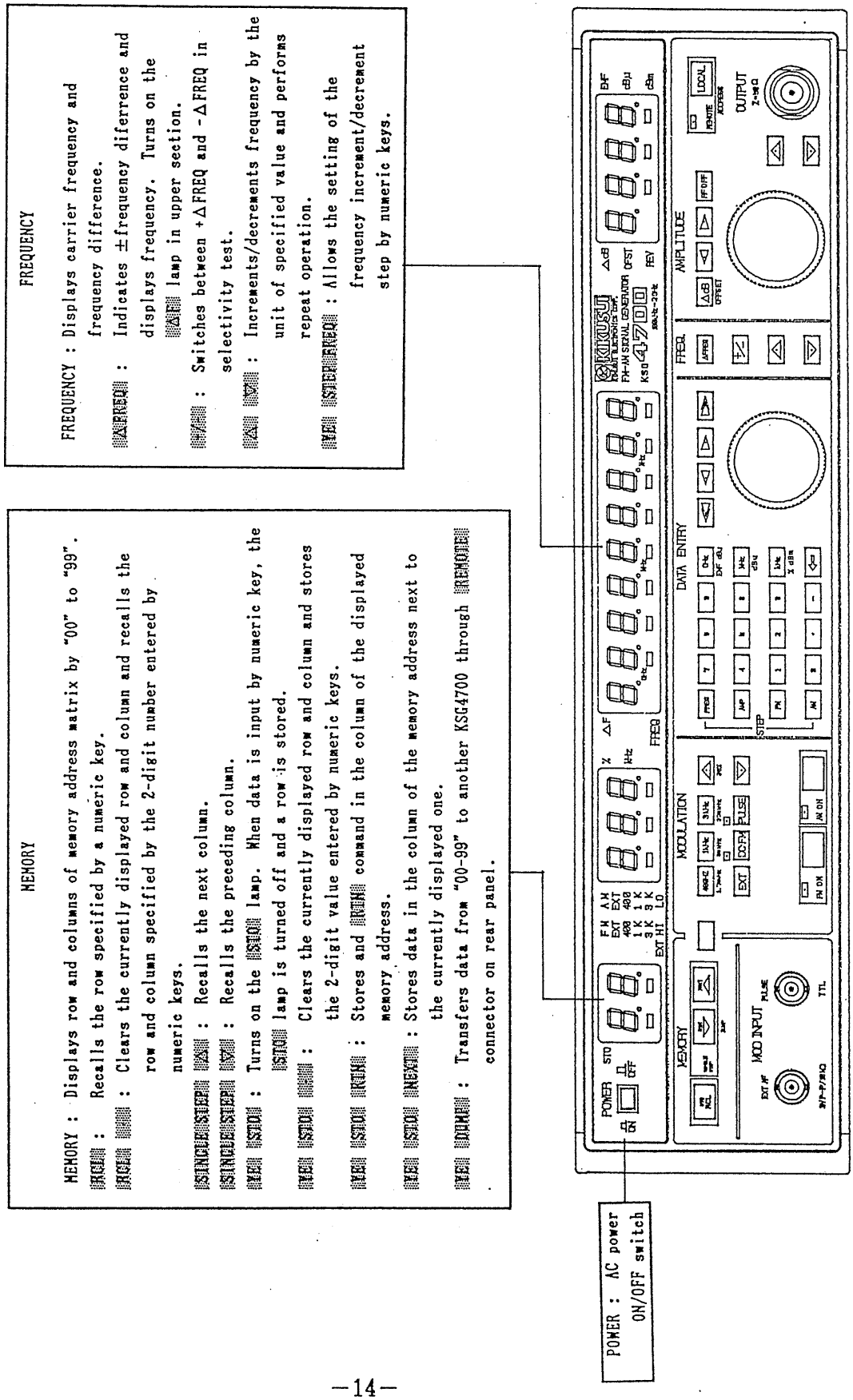
3.3 Surrounding Temperature/Humidity, Warm-up Time, and Installation Place

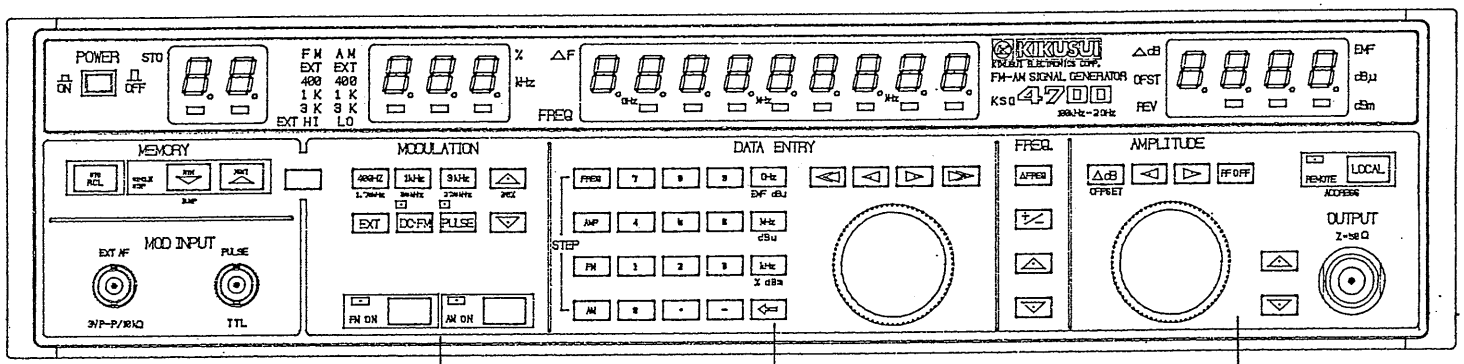
The KSG4700 operates correctly in temperatures from 0 to 40°C (32 to 104°F). If the instrument is used or placed under high temperature and humidity for a long time, failures will occur and the life of the instrument will be shortened.

The instrument requires the warm-up time of 30 minutes. Do not use the instrument near a strong magnetic field or electromagnetic waves.

4. OPERATION

4.1 Front Panel Features





MODULATION

MODULATION : Displays FM/AM modulation rate by three digits

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

FM EXT 400 1K : Display FM mode

AM EXT 400 1K : Display AM mode

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

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

kHz : Indicates FM frequency deviation by the unit of 0.1kHz.

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

DC FM : Sets DC · FM modulation mode.

PULSE : Sets PULSE modulation mode.

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

FM ON : Turns ON/OFF FM modulation.

AM ON : Turns ON/OFF AM modulation.

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

F2 30% : Presets AM depth at 30%.

DATA ENTRY

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

FREQ : Allows the setting of frequency by numeric keys.

AMP : Allows the setting of output level by numeric keys.

FM : Allows the setting of FM deviation by numeric keys.

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

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

GHz EMF dB MHz dB kHz % dBm : Enter units.

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

◁◁ ▷▷ : Move cursor into block.

◁ ▷ : Move cursor within block.

Rotary knob : Modifies the value at cursor position.

AMPLITUDE

AMPLITUDE : Displays RF output level by four digits.

△dB : Displays deviation of output level.

◁ ▷ : Moves cursor.

RF OFF : Turns ON/OFF output level.

LOCAL : Releases the instrument from remote control by GP-IB.

Rotary knob : Modifies the value at cursor position.

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

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

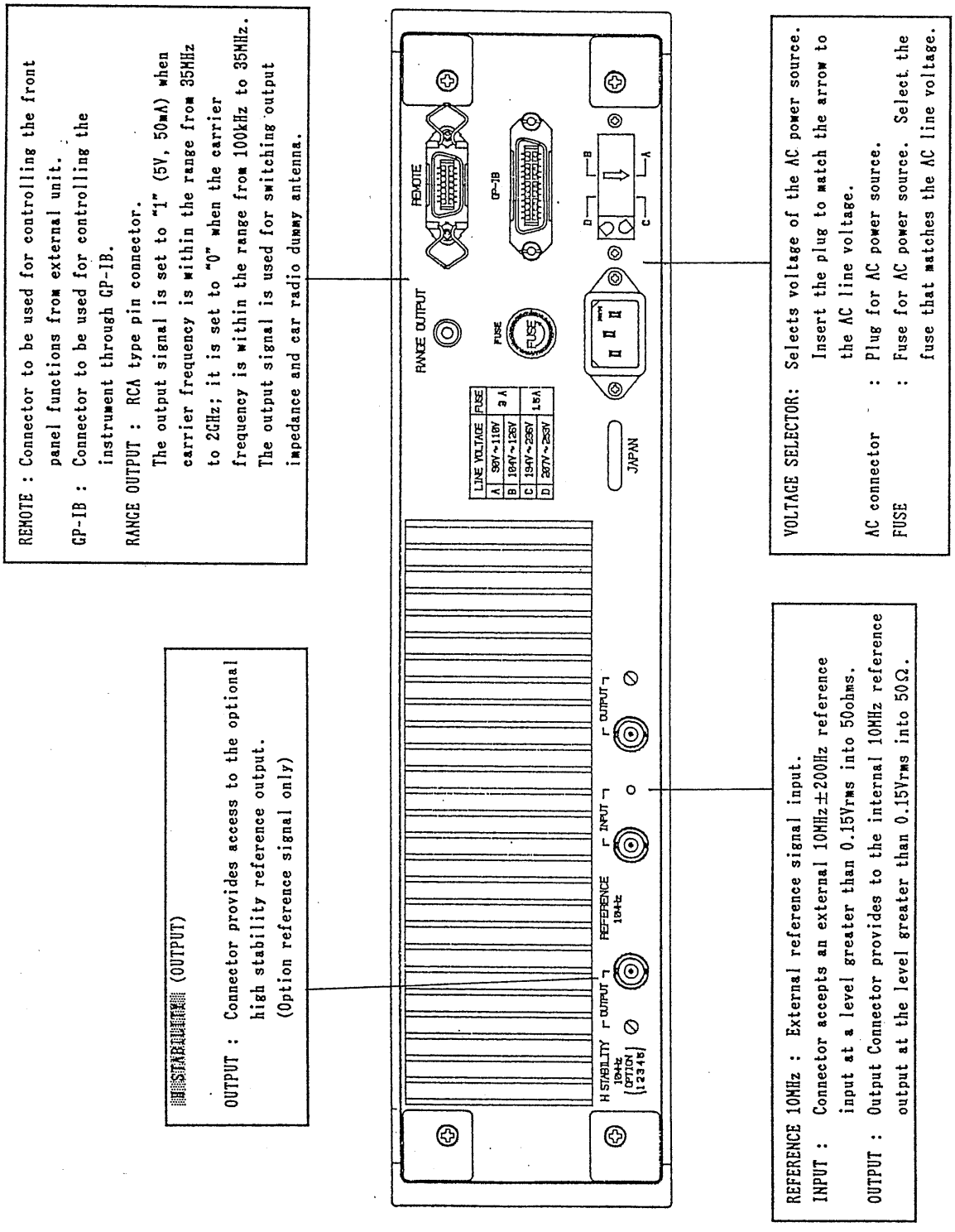
F1 STEP AMP : Allows the setting of the output level increment/decrement step by numeric keys.

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

F3 UNIT : Sets a unit.

F4 ADDRESS : Displays GP-IB address.

4.2 Rear Panel Features

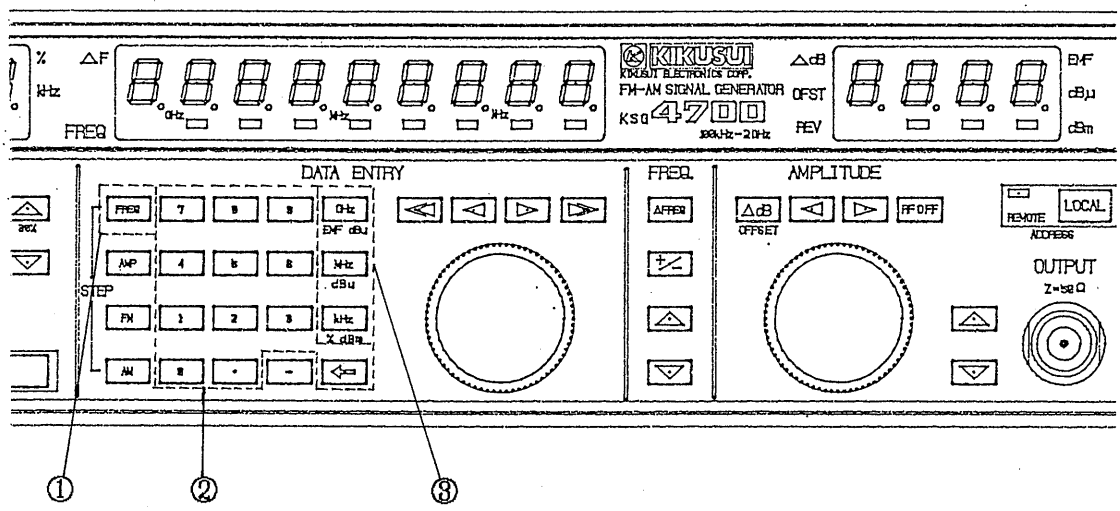


4.3 Turning on the Power Supply

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

4.4 Setting Frequency

4.4.1 Setting frequency by numeric keys



Press the FREQ key and enter a desired value by numeric keys (0～9, ·). Press keys in the order of ①, ②, and ③ in the above chart. If a key outside of the frame [ ] is pressed, the value found before the FREQ key was pressed is displayed.

Press the GHz, MHz or kHz key on completion of the numeric key entry, and the specified value is displayed in the [FREQUENCY] section correctly. The maximum number of digits for the input value is 9; a value of more than eight digits is not accepted.
The range of the frequency that can be specified is 0 to 2000MHz.
Since the frequency resolution of the instrument is 10Hz, a value less than 10Hz is ignored when the unit key is pressed.
When pressing a numeric key by mistake, press the FREQ key again and enter the desired value by numeric keys or correct the value of the particular digit by the ⇦ (back space) key.

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

(a) Example: 123.4567MHz is input.

× ..... Undefined
␣ ..... Turned off

Key operation	FREQUENCY display	
FREQ	××××.×××.××	Previous value
1	1␣␣␣ ␣␣␣ ␣␣	
2	12␣␣ ␣␣␣ ␣␣	
3	123␣ ␣␣␣ ␣␣	
.	123.␣␣␣␣ ␣␣	
4	123.4␣␣␣ ␣␣	
5	123.45␣␣ ␣␣	
6	123.456␣ ␣␣	
7	123.4567 ␣␣	
MHz	␣123.456.70	

(b) Example: 455kHz is input.

Key operation	FREQUENCY display
FREQ	␣123.456.70
4	4␣␣␣ ␣␣␣ ␣␣
5	45␣␣ ␣␣␣ ␣␣
5	455␣ ␣␣␣ ␣␣
kHz	␣␣␣␣ 455.00

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

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

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

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

Key operation		FREQUENCY display
FREQ		␣␣11.000.00
8		8␣␣␣ ␣␣␣ ␣␣
6	"6" was pressed for "5" by mistake	86␣␣ ␣␣␣ ␣␣
.		86.␣ ␣␣␣ ␣␣
7		86.7 ␣␣␣ ␣␣
⇦	Press twice	86␣␣ ␣␣␣ ␣␣
⇦	Press twice	␣␣11.000.00

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

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

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

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

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

4.4.2 Rotary knob

The rotary knob increases or decreases the value of the digits at and above the cursor position in the [FREQUENCY] display section.
If the cursor is not found in the [FREQUENCY] display section, bring it into the section by the ◁◁ or ▷▷ key; to move the cursor within the section, use the ◁ or ▷ key.
There is no need to set the GHz, MHz or kHz unit keys when making setting with the Rotary knob.

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

The mark "_" denotes the cursor position

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

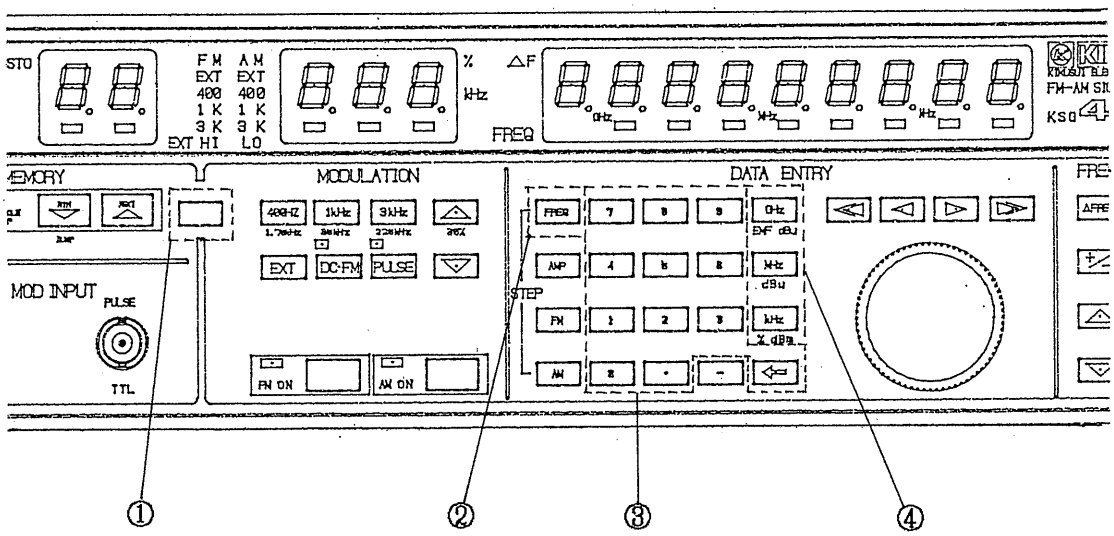
(b) Example: To change frequency from 100.02MHz to 98.02MHz

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

4.4.3 Setting frequency step for △ and ▽ keys

Set a desired step value (minimum 10Hz) for the [FREQUENCY] △ and ▽ keys, and the frequency can be incremented or decremented by the unit of that value.

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



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

The [YE] key in the explanation below means the yellow key of number ①. This key functions as a shift key; the function of a yellow key on the panel pressed after the [YE] key is different from that of the same key pressed without [YE] key.

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

Key operation	FREQUENCY display
[YE]	␣␣␣1.000.00
[STEP] [FREQ]	␣␣␣1.000.00
[9]	9␣␣␣ ␣␣␣ ␣␣
[kHz]	␣␣␣1.000.00
[△] Press once	␣␣␣1.009.00

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

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

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

When the [ΔFREQ] key is pressed, the [ΔF] indicator in the [FREQUENCY] display section is turned on and the frequency difference (ΔFREQ) is displayed.

(a) Example: 100MHz is set currently.

Key operation	FREQUENCY display	
[YC] [STEP FREQ]	×××× ××× ××	
[1]	1␣␣␣ ␣␣␣ ␣␣	
[0]	1 0␣␣ ␣␣␣ ␣␣	
[0]	1 0 0␣ ␣␣␣ ␣␣	
[kHz]	×××× ××× ××	
[FREQ]	×××× ××× ××	
[1]	1␣␣␣ ␣␣␣ ␣␣	
[0]	1 0␣␣ ␣␣␣ ␣␣	
[0]	1 0 0␣ ␣␣␣ ␣␣	
[MHz]	␣1 0 0.0 0 0.0 0	
[ΔFREQ]	␣␣␣␣ 1 0 0.0 0	[ΔF] indicator is turned on
[FREQUENCY] [▽]	−␣␣␣ 1 0 0.0 0	Carrier frequency 99.9MHz
[⇦]	␣␣␣␣ ␣␣0.0 0	

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

(b) Example: 100MHz is set currently.

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

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

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

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

4.4.5 Reference signal input/output terminals

1) Referece signal output (REFERENCE OUTPUT)

The REFERENCE OUTPUT terminal outputs a reference signal (Frequency = 10MHz; Voltage = 0.15Vrms or higher). When this signal is applied to the reference signal input terminals of other instruments, the relative difference in reference signal frequency among the instruments can be redused.

The half-fixed resistor on the right side of the output connector is to be used for fine adjustment of the output frequency.
The fine adjustment, however, cannot be done while the LED indicator is on after a signal is input to the reference signal input terminal (REFERENCE INPUT). The half-fixed resistor is set to the standard value before the instrument is shipped from the factory.

2) Reference signal input (REFERENCE INPUT)

The reference signal of 10MHz and 0.15Vrms or higher voltage can be applied to this terminal from an external instrument or from the optional high stability standard crystal oscillator. When this reference signal is applied, the LED indicator on the right side of the input connector is turned on and the frequency of the internal reference signal is locked to the frequency of the external reference signal or optional high stability crystal oscillator signal.
Thus, the relative difference between these signals is reduced.

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

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

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

If the H STABILITY OUTPUT terminal is connected to the REFERENCE INPUT terminal by the BNC cable provided with the instrument, the accuracy of the frequency used in the instrument can be made the same as the accuracy of the frequency output from the high stability standard crystal oscillator.
See the section explaining the optional items for details.

4.5 Setting Output Level

4.5.1 Setting unit key

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

In the RF·OFF state, however, the unit and other modes cannot be set.

The output level can be set in the ranges below. For the frequency ranging from 1.02GHz to 1.04GHz, however, the displayed value may change because the allowable output level ranges overlap each other. The overlapping range is shown below. See chapter 2 "Specifications" for the guaranteed ranges.

(a) EMF dBμ: Open circuit voltage

−20.0dBμ to 126.0dBμ ≦ 1.02GHz
−13.9dBμ to 120.0dBμ > 1.02GHz

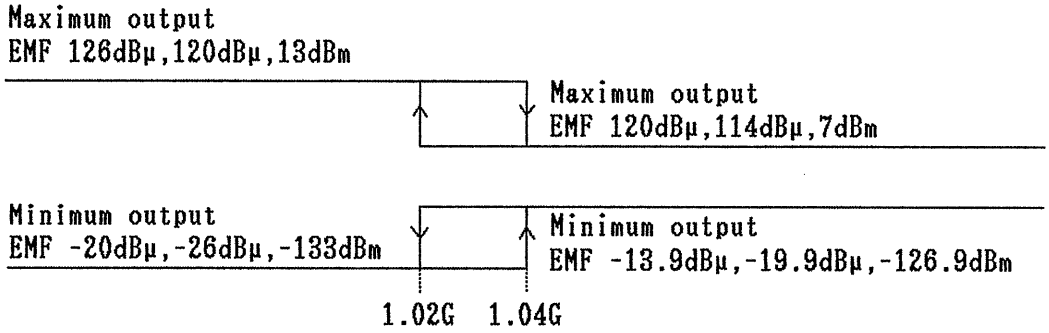
The EMF dBμ indicator in the [AMPLITUDE] section is turned on.

(b) dBμ: Loaded voltage −26.0dBμ to 120.0dBμ ≦ 1.02GHz
−19.9dBμ to 114.0dBμ > 1.02GHz

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

(c) dBm: Power indication −133.0dBm to 13.0dBm ≦ 1.02GHz
−126.9dBm to 7.0dBm > 1.02GHz

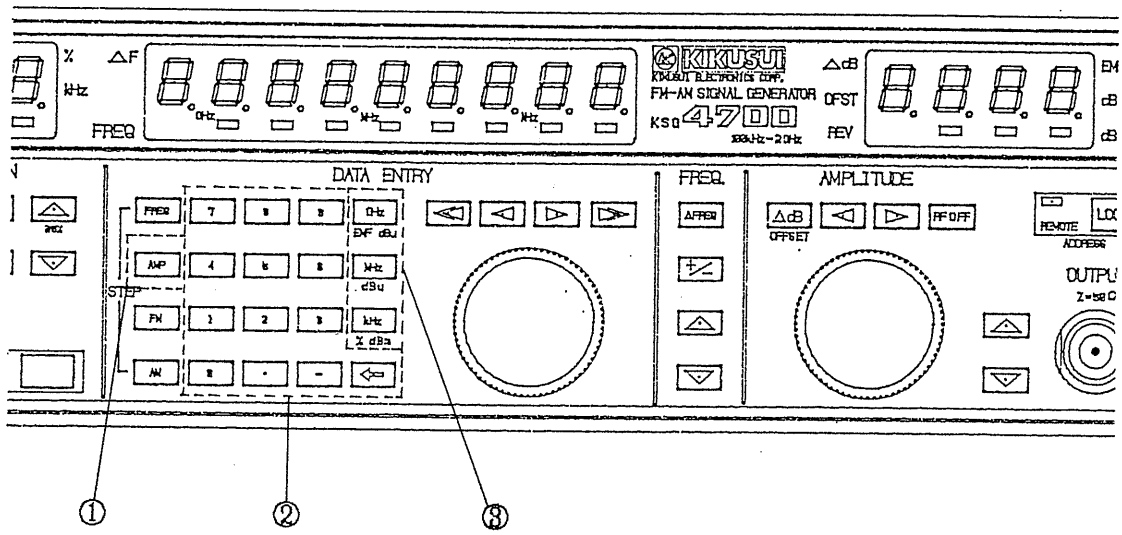
The dBm indicator in the [AMPLITUDE] section is turned on.



For example, set the output level to −20dBμ (EMF dBμ) for the frequency of 1GHz and then increase the frequency. When the frequency exceeds 1.04GHz, the displayed value of output level changes from −20dBμ to −13.9dBμ. After that, reduce the frequency, but the displayed value (-13.9dBμ) remains unchanged.
To display −20dBμ, set the output level again.

If the specified output level is not within the range allowed to each unit, the previous value is displayed.

4.5.2 Setting output level by numeric keys



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

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

After entering a value by numeric keys, press the EMF dBμ (GHz), dBμ (MHz) or dBm (kHz) key.
Then, the value is displayed in the [AMPLITUDE] section correctly.

(a) Example: To set EMF 10dB

Key operation	AMPLITUDE display	
AMP	×××.×	..... Previous value
1	1␣␣␣	
0	10␣␣	
EMF dBμ	␣10.0	EMF dBμ Indicator is turned on.

(b) Example: To set −5dB

Key operation	AMPLITUDE display	
AMP	␣10.0	
−	−␣␣␣	
5	−5␣␣	
dBμ	−␣5.0	dBμ Indicator is turned on.

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

(c) Example: 13dBm was to be set, but an error was made during the setting (Unit = EMF dBμ)

Key operation		AMPLITUDE display	
AMP		−␣5.0	
1		1␣␣␣	
2	"2" was pressed for "3" by mistake	12␣␣	
⇦		1␣␣␣	
3		13␣␣	
dBm		␣13.0	dBm Indicator is turned on.

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

4.5.3 Rotary knob

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

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

The mark "_" denotes the cursor position

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

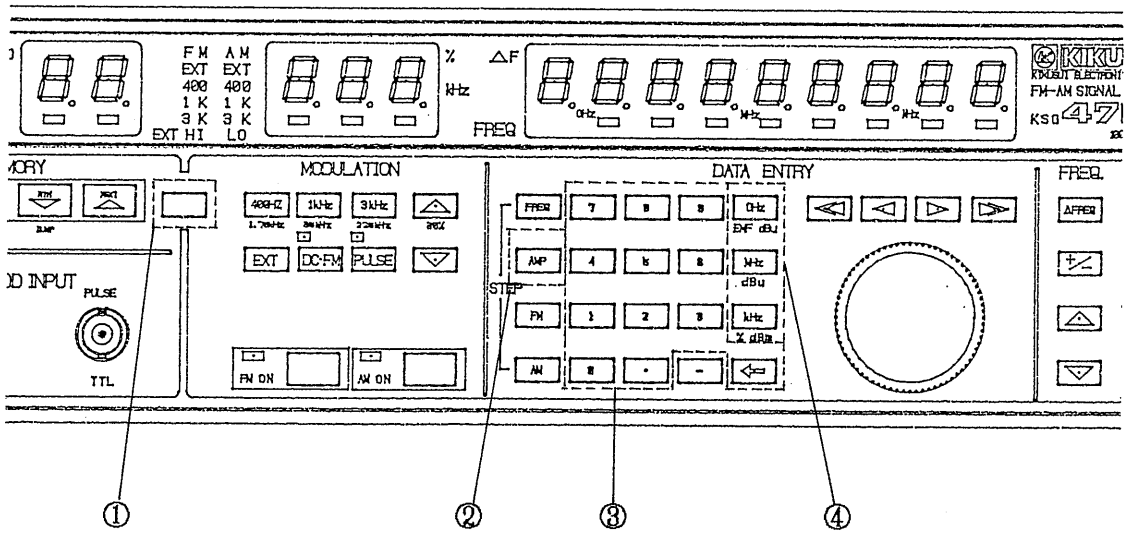
(b) Example: To change output level from 66dB to 60dB

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

There is no need to press the unit key (EMF dBμ, dBμ, dBm, etc.) when making setting with the Rotary knob.

4.5.4 Setting output level step for △ and ▽ keys

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



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

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

Key operation	AMPLITUDE display
YE STEP AMP	␣60.0
2	2␣␣␣
EMF dBμ (GHz)	␣60.0
△ Press once	␣62.0

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

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

4.5.5 Setting offset value

The offset function is used for compensating the gain in amplifier and loss in dummy antenna and cable.
To set an offset value for the output level, press the AMP key, numeric keys (0~9 , . , ±) and YE OFFSET.
When YE OFFSET is pressed, the offset output level is displayed.
The offset value can be adjusted within the range of ±50dB.

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

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

4.5.6 Output level difference Δ dB key

The Δ dB function, to check the value of change in output level, is useful for measuring the band width of a receiver and attenuation characteristic of a filter.

Note that the Δ dB indicator in the [AMPLITUDE] section is turned on when the Δ dB key is pressed.

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

When to release the Δ dB function, press Δ dB key again.

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

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

4.5.7 RF.OFF key

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

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

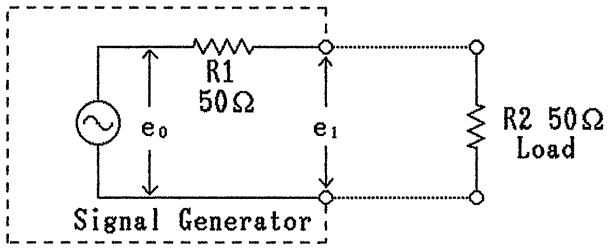
4.5.8 Reverse power protector

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

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

4.5.9 Unit of output level

The units of output level used for the KSG4700 are as follows:



(a) EMF dBμ (open circuit voltage)

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

(b) dBμ (loaded voltage)

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

(c) dBm (power indication)

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

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

4.6 Setting the Modulation

4.6.1 [YE] key

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

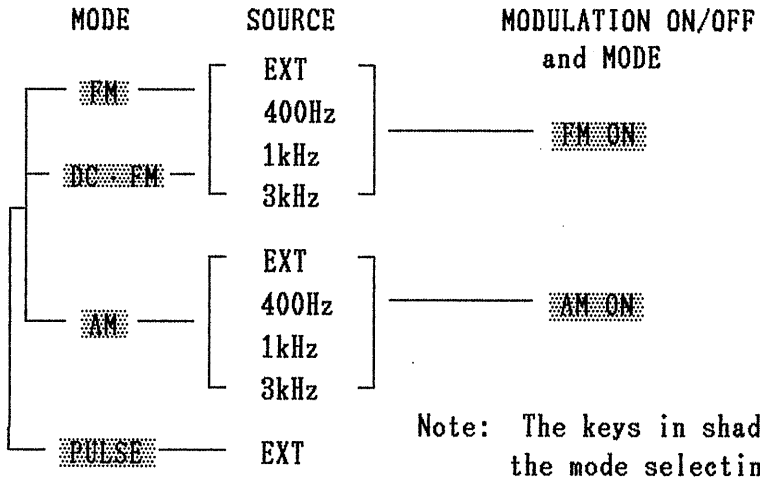
b) Press [YE] [3.5kHz], and the FM peak frequency deviation is set to 3.5kHz.

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

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

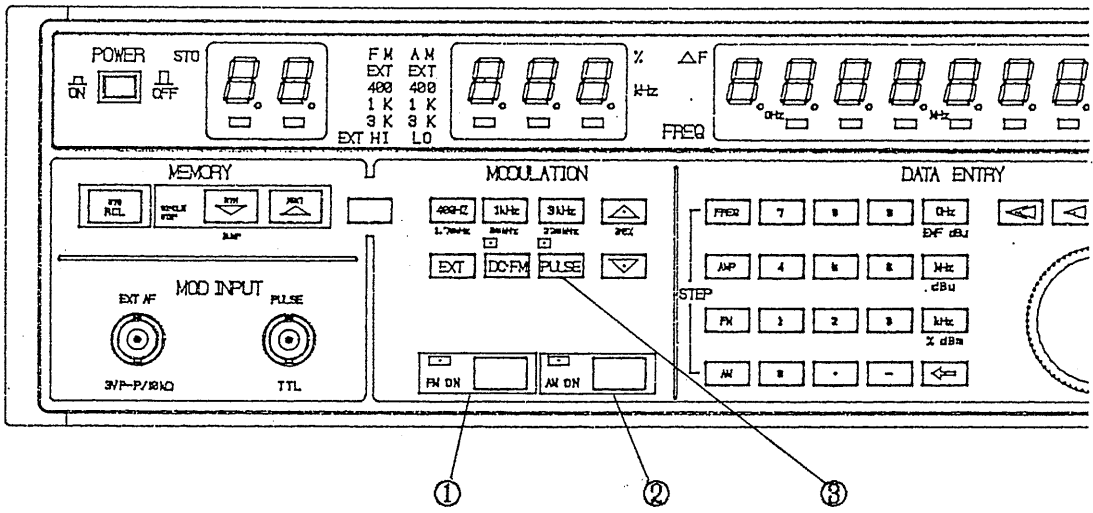
4.6.2 Setting modulation mode and source

See Sections 4.6.7 to 4.6.9 for the modulation with external sources.



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

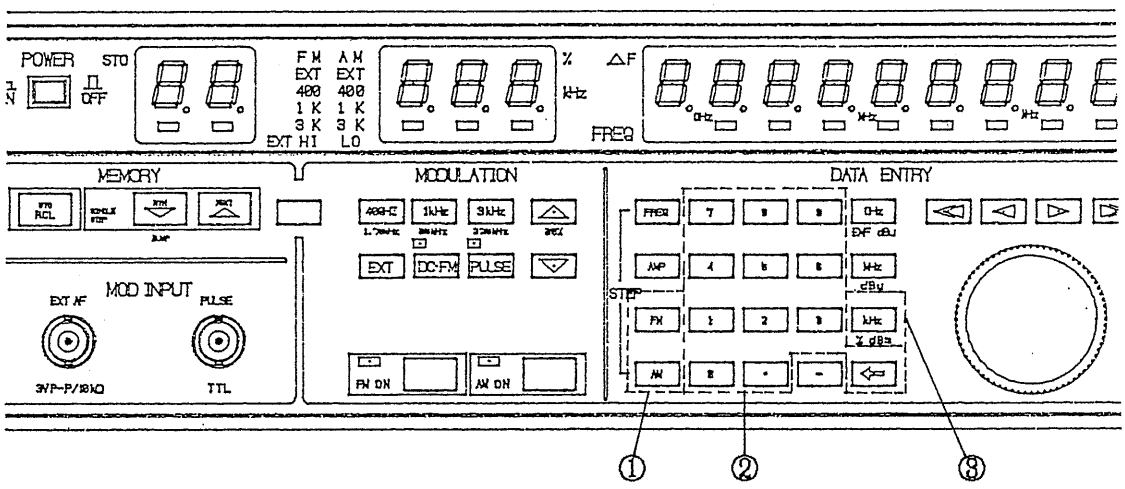
When a modulation mode switching key is pressed, the modulation mode of the displayed symbol (%=AM and kHz=FM or DC·FM) is selected and the corresponding indicator is turned on.
For switching the source, use the [EXT], [400Hz], [1kHz] or [3kHz] key. Keys ① and ② turn ON/OFF FM, DC·FM and AM respectively, and key ③ turns ON/OFF PULSE modulation. Each time ①, ② or ③ is pressed, the relevant modulation is turned on and off alternately.
The key has the function to select the mode also.



(a) Example: Simultaneous modulation and modulation factor confirmation

By pressing the FM or AM key when FM MOD or AM MOD is on, the modulation factor can be confirmed and set.

4.6.3 Setting modulation by numeric keys



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

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

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

Any desired value can be input by the numeric keys (0 - 9 and .), but if the input value is not within the allowable range, the previous value is displayed.

The relationships between the carrier frequency and maximum/minimum deviation are listed below. See chapter 2 "Specifications" for the guaranteed ranges of the specifications.

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

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

(a) Example: To set FM 25kHz

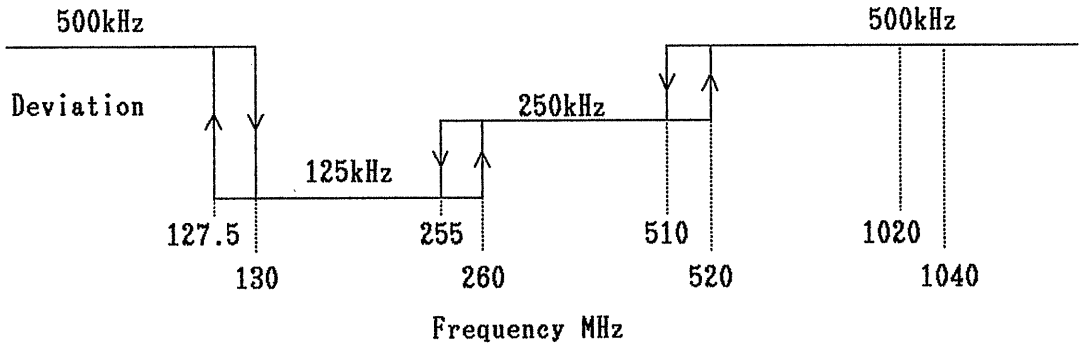
Key operation	MODULATION display
FM	××.× .... Previously set value kHz is displayed as unit
2	2␣␣
5	25␣
kHz (%, dBm)	25.0

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

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

4.6.4 [MODULATION] section

For the frequency modulation, the frequency is divided into several bands and the adjacent bands overlap each other. When the frequency is changed from one band to another and the specified deviation exceeds the maximum deviation of the new band, the maximum deviation of the new band is displayed instead of the specified deviation.
The overlapping ranges of frequency are as follows:



For example, specify the deviation of 250kHz for the frequency of 300MHz and reduce the frequency. When the frequency is reduced to 255MHz or lower, the [MODULATION] indicator displays 125kHz as the value of deviation. After that, even if the frequency is increased to the band of 300MHz, the displayed value of deviation (125kHz) remains unchanged. To get the deviation of 250kHz again, specify the deviation again.

4.6.5 Rotary knob

The rotary knob can modify the FM deviation and AM depth by increasing or decreasing the value of the digit at the cursor position in [MODULATION] section. When the cursor is not found in the [MODULATION] section, bring it into the section by the ◁ or ▷ key; when it is found in the section, move it by the ◁◁ or ▷▷ key.
After changing the modulation factor by the rotary knob, the unit key (kHz or %) need not be pressed.

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

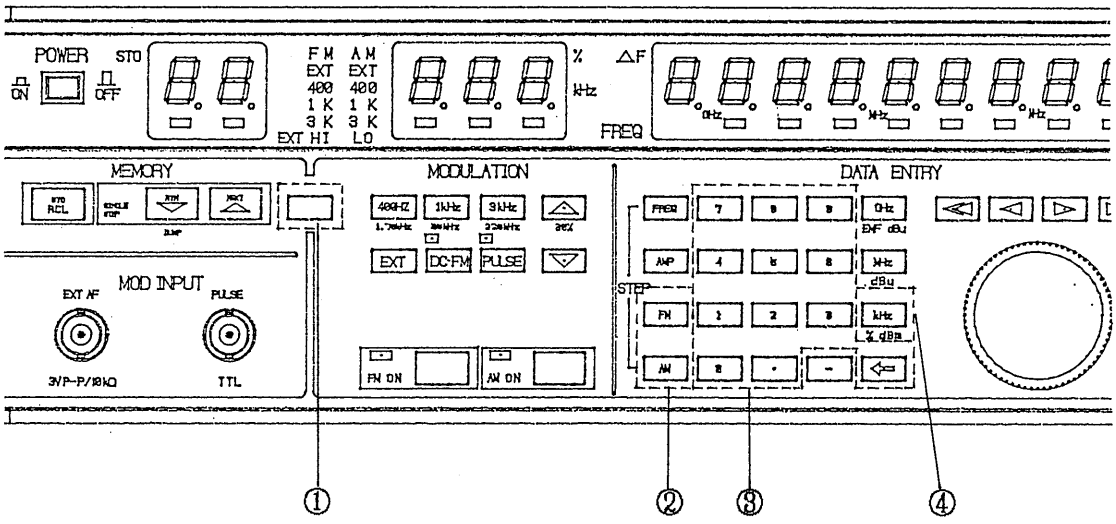
Key operation		MODULATION display
FM		2 5 . 0
◁	Press once	2 5 . 0
	Turn the rotary knob clockwise by one step	3 5 . 0

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

Key operation		MODULATION display
AM		3 0 . 0
▷	Press once	3 0 . 0
	Turn the rotary knob counter-clockwise by five step	2 5 . 0

4.6.6 Setting Modulation Step for △ and ▽ Keys

Set a desired step value (minimum 10Hz, 100Hz or 1kHz for FM, or 0.1% for AM) for the [MODULATION] △ and ▽ keys, and the modulation can be incremented or decremented by the unit of that value.



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

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

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

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

4.6.7 External modulation signal connection and setting

(1) Connection and setting method

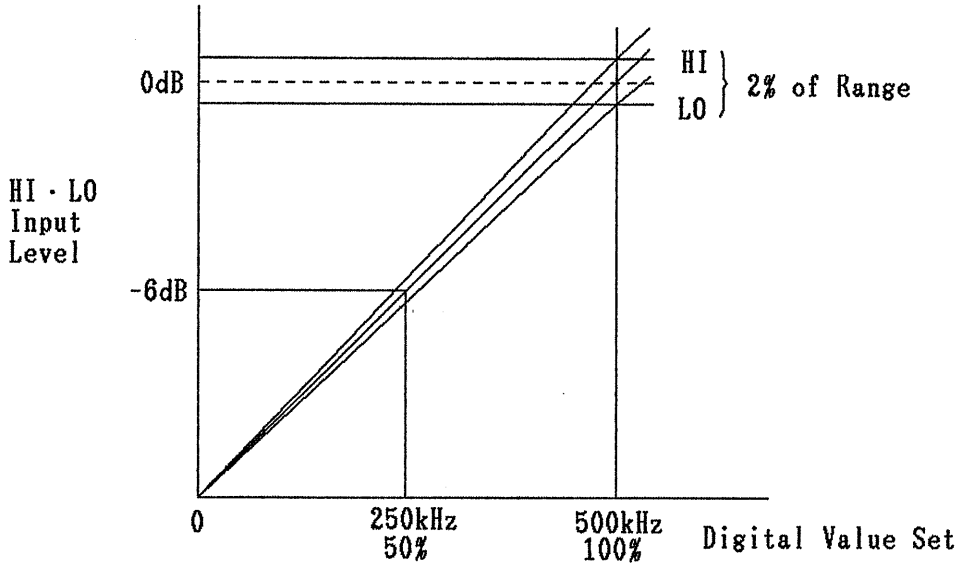
Connect the external modulation signal source to MOD INPUT (EXT AF) on the front panel. The input impedance is approximately 10kΩ, and appropriate input level is about 1.5Vpeak.

The appropriate input level range is obtained when both HI and LO of EXT LEVEL are turned off. Adjust the level of external modulation signal source to the range that turns off both HI and LO.

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

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

(2) Setting range



The above chart shows the relationship between modulation and input level.
When the input level is adjusted to the range of HI and LO, it is set within the error range of ±2%. The modulaion is converted into a digitalvalue internally on the basis of this input level.
Whether the input signal is a composite wave signal or single wave signal, the instrument checks if the peak of the signal is within the range of HI and LO and the modulation is proportioned to the input level as shown in the above chart.

For example, after setting the input level within the range of HI and LO and the FM peak frequency deviation to 500kHz, attenuate the input level by −6 dB.
Then, 500kHz (= 100%) remains displayed but the actual peak freauency deviation is reduced to 250kHz (= 50%). At this time, the LO lamp isturned on, but modulation is done correctly at the peak freauency deviation of 250kHz.

When the input level is set within the range of HI and LO, the HI and LO lamps are turned off, but when the MAIN, LEFT, RIGHT, and SUB switches of the stereo signal generator are manipulated, the HI and LO lamps may be turned on alternately.
Since the range of HI and LO is very narrow, the HI and LO lamps may be turned on alternately but that does not mean a serious error.

4.6.8 DC·FM modulation mode

When the DC·FM key is selected, external modulation is done by DC coupling and the frequency of FM VCO enters a free run state.

In this state, the frequency can be shifted by the DC signal.
The displayed modulation is accomplished by 1.5V DC or 1.5Vpeak.

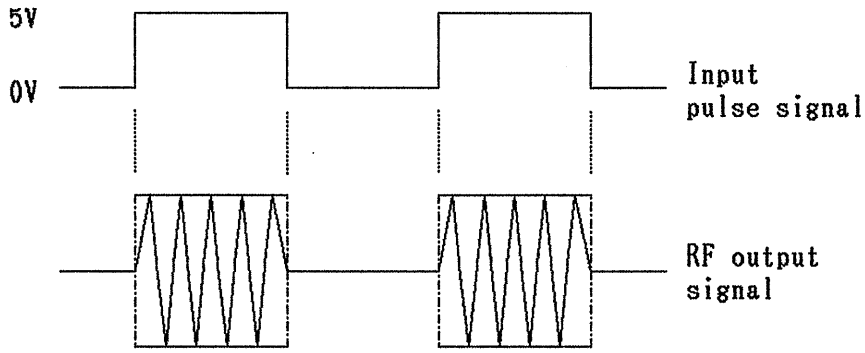
Note: After the modulation mode is changed from the DC·FM mode to the normal mode, it takes approximately 5 seconds for the signal to become stable.

4.6.9 PULSE modulation mode

The pulse modulation means to turn on and off the carrier wave at a high speed by the TTL pulse wave using the GaAs switch.
The TLL pulse wave is input from the MOD INPUT (PULSE) terminal.

When the PULSE key is pressed, the instrument is set in the pulse modulation mode and the PULSE key indicator is turned on.

Only the external source is allowed to the pulse modulation, and the input pulse must be of the TLL level. As to the polarity, only the positive logic is used, and the high frequency signal is turned on only when the input pulse is at the high level (5V).
(See the illustration below)



Note: If the external pulse is not input when the pulse modulation is specified, the high frequency signal is not turned on.

4.7 Memory

4.7.1 Memory recall method

Memory addresses are allocated in a matrix of 10 raws and 10 columns (100 points in total).

The following is the memory address allocation diagram:

	MEMORY address			2-digit 7-segment display					
00	01	02	03	04	05	06	07	08	09
10									.
20									.
30									.
40									.
50									.
60									.
70									.
80									.
90	. . . . .								99

Basically, the recall operation means to call the row number by the RCL key and numeric key (0~9) and to call the column number by the [MEMORY] △ key.
Also, a memory row and column can be called directly by the entry of a 2-digit number by numeric keys (0~9) after clearing the [MEMORY] display by the RCL and kyes.
When repeating the recall operation continuously, it is only necessary to press the RCL key the first time.
In the following examples, it is assumed that the carrier frequency, output level, modulation mode, etc. are set as explained in Section 4.4 to 4.6 and that they are stored in memory by the operation explained in Section 4.7.2:

(a) Example: Method of recalling memory by rotary knob

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

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

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

	MEMORY display
RCL key, 1 key	"10"

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

RCL key, 4 key

Press [MEMORY] △ key three times "43"

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

RCL key, 8 key

Press [MEMORY] △ key five times "85"

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

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

When the address "78" is to be called subsequently, omit pressing the RCL key and simply press the . key. When the [MEMORY] display is cleared by the . key, press the numeric keys 7 and 8. Then, "78" is displayed.

4.7.2 Memory store method

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

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

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

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

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

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

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

③	AM, 1kHz	××.×
	YE, 30 %	30.0 %

Besides the above method, the modulation level and mode may be set by numeric keys (0~9) and modulation mode key.
Aftere setting the above data, press YE, STO (STO green indicator is turned on), and 1.
Then, the data is stored into memory address "10".

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

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

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

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

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

② Clear [MEMORY] display by [YE], [STO], and [.].

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

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

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

4.7.3 Storing data into a part of memory row

(Setting [RTN] key)

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

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

[How to use the function]

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

4.7.4 How to release RTN key

The following two methods are available:

(1) Display "19" by RCL "19"

RCL . 1 9

Press YE STO ▽ "19"

By the above operation, all the ten columns become available as they were before the RTN key was pressed.

(2) Display "13" by RCL, "13"

RCL 1 , and △ keys (Press three times)

Press YE STO △ "14" RTN command is stored

.. at "14"

..

YE STO △ (Press five times) "19"

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

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

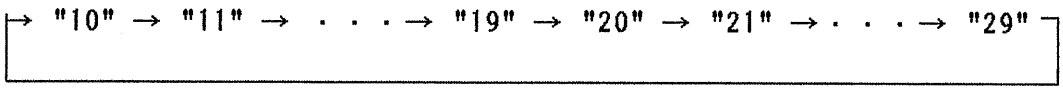
Normally, up to ten memory columns (00 - 09, 10 - 19, ..., 90 - 99) can be recalled at a time, but more than ten columns can be recalled continuously by the following operation:

Display column number "9" in [MEMORY] section and press YE, STO, and NEXT keys; then, another ten columns can be recalled without specifying the next row number.

(a) Example: To recall memory addresses 10 - 29 continuously

Key operation	MEMORY display	
RCL, 9	"19"	Previous value
YE	"19"	
STO	"19"	STO LED comes on
NEXT	"20"	STO LED comes off

The memory addresses are recalled as follows:



4.7.6 How to release NEXT key

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

(a) Example: To reset the continous recall of memory addresses 10 - 29 (to recall 10 - 19 and 20 - 29 separately)

Key operation	MEMORY display	
RCL, 9	"19"	Previous value
YE	"19"	
STO	"19"	STO LED comes on
RTN	"19"	STO LED comes off

4.7.7 Copying memory data to another KSG4700

(1) The 100-point memory data can be copied to another unit of KSG4700.

(2) Memory data copying method

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

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

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

Note: DUMP cable Model SA510 (Option)
(Amphenol-type connector (keep pins 8 - 10 unconnected))

5. REMOTE CONTROL

5.1 General Discription

5.1.1 Outline

The KSG4700 has a 14-pin connector for remote control.

5.2 Operation Procedure

5.2.1 Explanation of Remote Control Connector

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

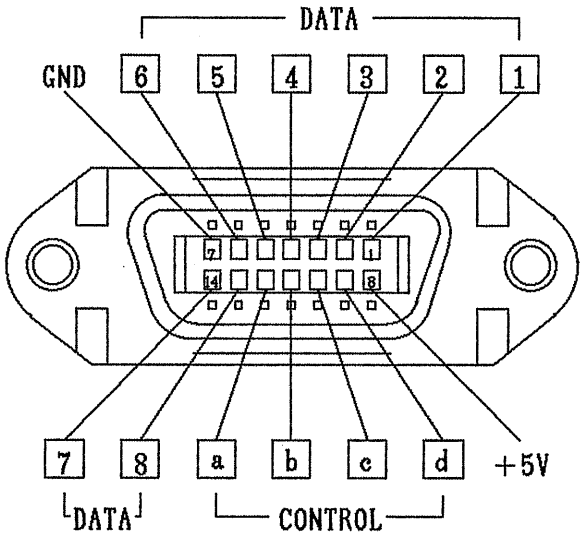


Figure 5-1

[Explanation of terminals]

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

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

The DATA terminals are used for connecting a bus to the rear panel of the KSG4700. Since the bus is bidirectional, it can be used for both input and output.

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

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

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

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

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

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

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

4) +5V (Pin 8)

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

5) GND (Pin 7)

5.2.2 Input data timing

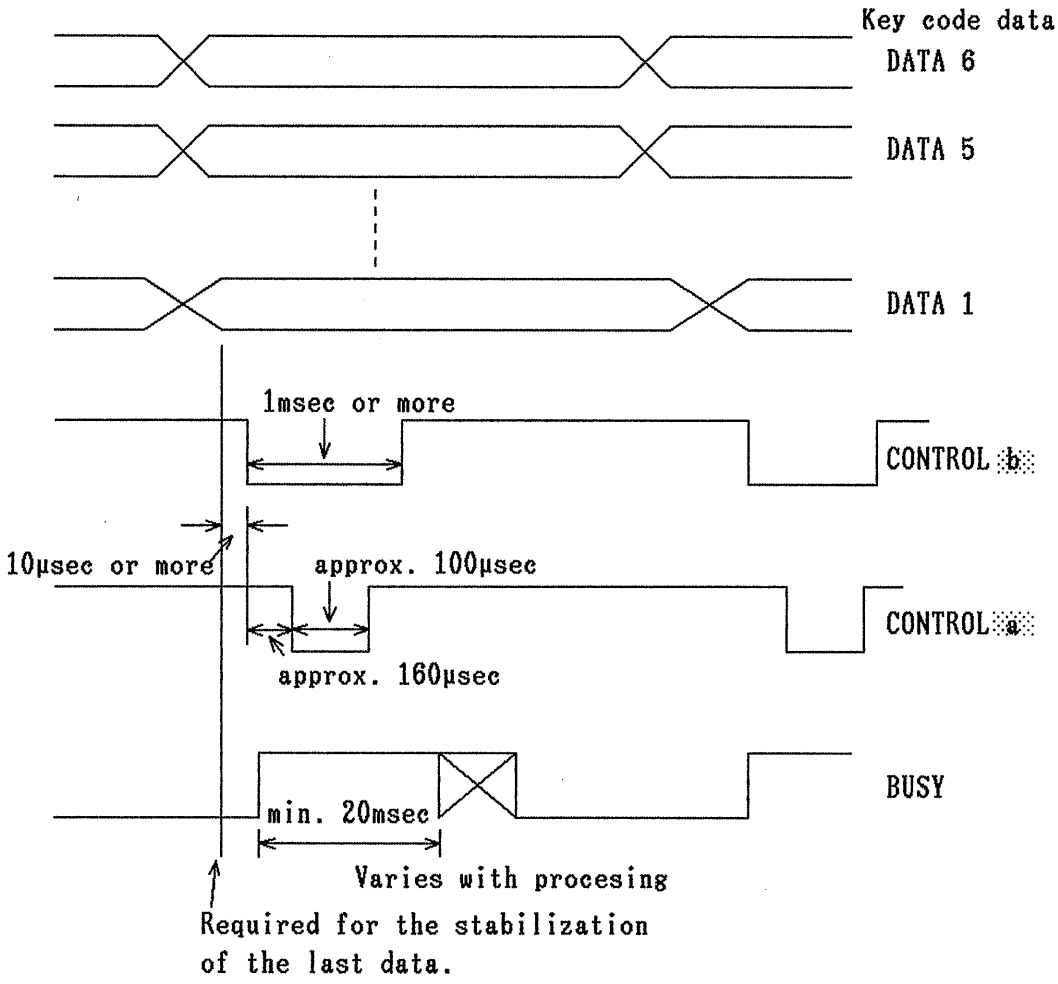


Figure 5-2

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

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

5.2.3 Panel key code table

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

Table 5-1

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

(Cont'd)

Table 5-1

Key name	MSB	← Key Code →				LSB
DATA ENTRY 5	1	1	0	1	0	1
DATA ENTRY 6	1	1	0	1	1	0
DATA ENTRY 7	1	1	0	1	1	1
DATA ENTRY 8	1	1	1	0	0	0
DATA ENTRY 9	1	1	1	0	0	1
DATA ENTRY .	1	0	1	1	1	0
DATA ENTRY (-)	1	0	1	1	0	1
DATA ENTRY ⇦	0	0	1	0	0	0
DATA ENTRY GHz , EMF dB	1	0	1	0	0	0
DATA ENTRY MHz , dB	0	1	0	1	1	0
DATA ENTRY kHz , Ω , dBw	1	0	0	1	0	1
DATA ENTRY ⇐	0	1	0	1	1	1
DATA ENTRY ⇐	1	1	1	1	0	0
DATA ENTRY ⇨	1	1	1	1	1	0
DATA ENTRY ⇨	0	1	1	0	0	0
DATA ENTRY Rotary knob UP	0	0	0	0	0	0
DATA ENTRY Rotary knob DOWN	0	0	0	0	0	1
FREQUENCY △FREQ	1	1	1	1	0	1
FREQUENCY +/-	1	0	1	0	0	1
FREQUENCY △	0	1	1	0	0	1
FREQUENCY ▽	0	1	1	0	1	0
AMPLITUDE △dB	1	0	0	0	0	1
AMPLITUDE ◁	1	0	0	0	1	0
AMPLITUDE ▷	1	0	0	0	1	1
AMPLITUDE RF OFF	1	0	0	1	0	0
AMPLITUDE △	1	0	0	1	1	0
AMPLITUDE ▽	1	0	0	1	1	1
AMPLITUDE Rotary knob UP	0	0	0	0	1	0
AMPLITUDE Rotary knob DOWN	0	0	0	0	1	1
LOCAL	1	0	1	1	1	1

5.2.4 Setting frequency by remote control (example)

The frequency of 82.5MHz is to be set.

1) Set the FREQ code "010010" according to the panel key code table (Table 5-1).
2) Send CONTROL ▒b▒ which is set to "0" for 1msec or longer as shown in Figure 5-2 (input data timing).
3) Set the data "82." according to the code table and send CONTROL ▒b▒ signal as shown in Figure 5-3.

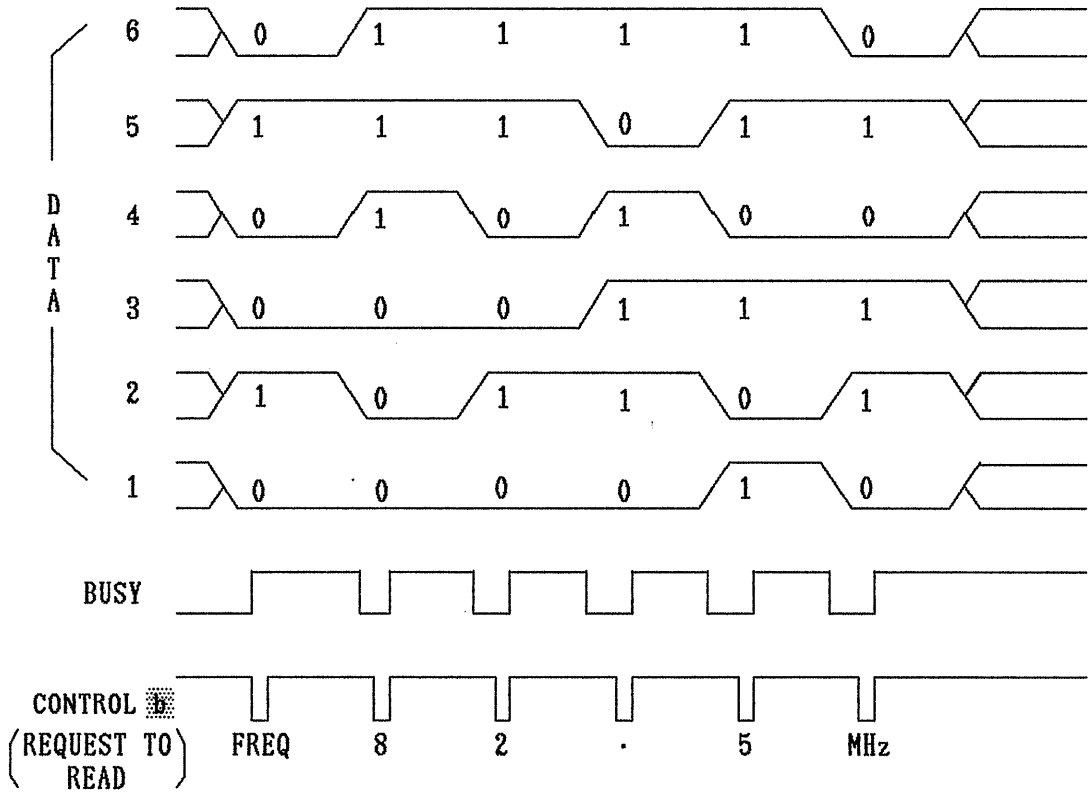


Figure 5-3

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

5.2.5 Remote Control circuit diagram example and operation.

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

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

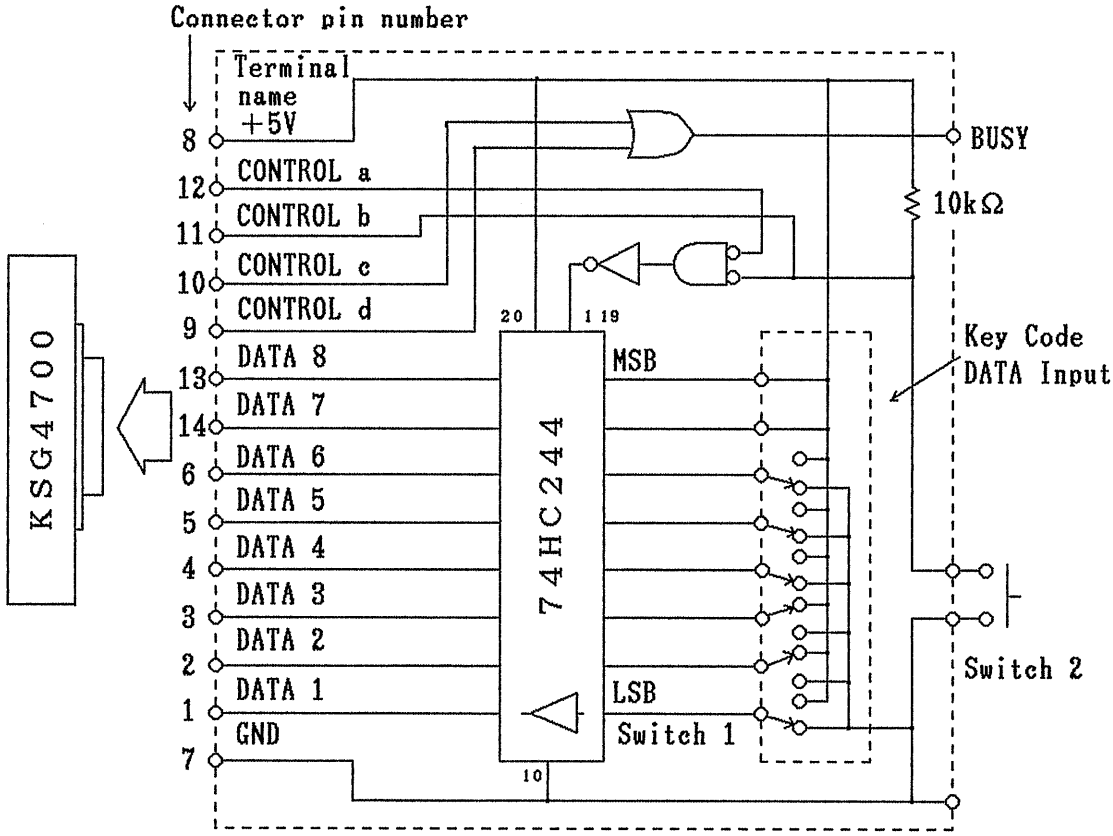


Figure 5-4

Set the data of MEMORY RCL △ on Key Code Data Input Switch 1 according to the key code table (Table 5-1) and set CONTROL [illegible] to "0" (Press Switch 2). Then, approximately 160μsec later, CONTROL [illegible] is set to "0" and Enable A and B (pins 1 and 19) of 74HC244 are set to "0". The data is sent to the KSG4700 during the period of approximately 100μsec when CONTROL [illegible] is "0"

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

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

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

5.2.6 Memory Display output circuit example

Figure 5-5 shows an example circuit.

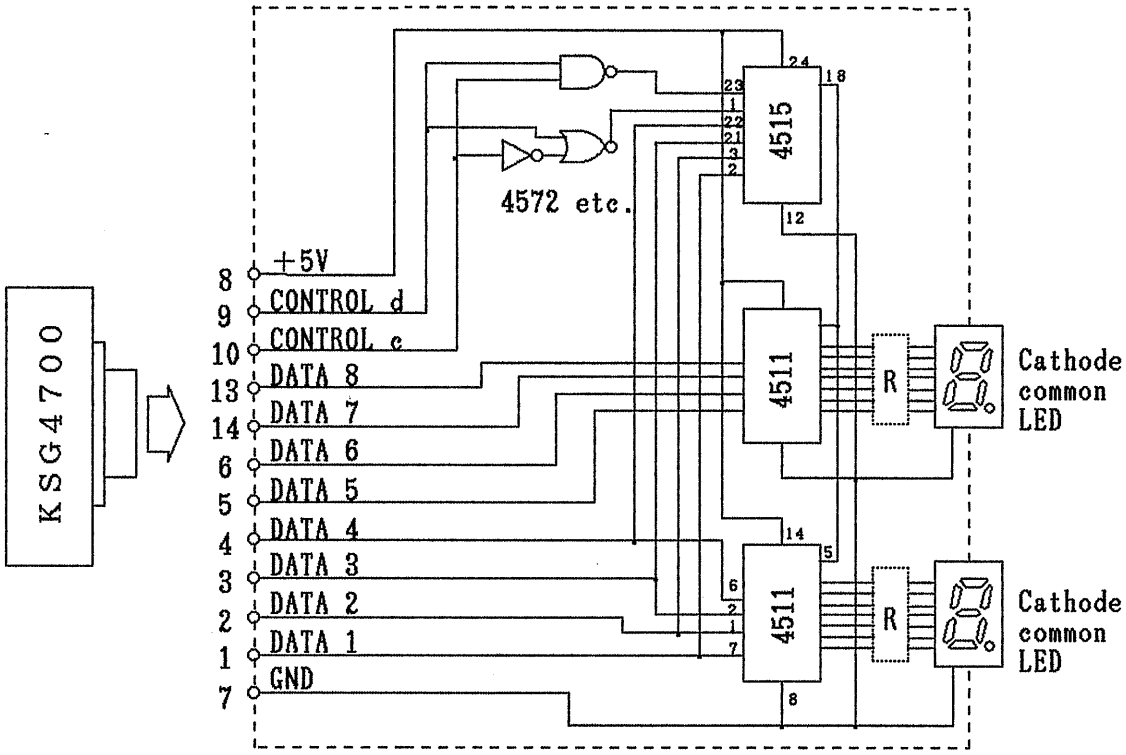


Figure 5-5

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

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

6. OUTPUT IMPEDANCE AND DUMMY ANTENNA SWITCHING SIGNAL

6.1 "RANGE OUTPUT" RCA Pin Connector

When the carrier frequency is within the range from 35.0000MHz to 2000MHz, the output signal is set to "1" (5V, 50mA); when it is within the range from 100kHz to 34.9999MHz, the output signal is set to "0".

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

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

7. BACKUP BATTERY AND INITIALIZING CPU

7.1 Backup Battery

The KSG4700 uses a memory backup battery, and the battery may discharge all its electricity when the signal generator is not used for a long time.

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

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

[Battery position and replacement method]

Remove the top panel of the instrument, and the aluminum sash cases attached to the left side of the instrument contains the CPU printed curcuit board, and the battery is mounted on this board.

Remove two screws from the left side, take out the aluminum sash case, pull out the PC board, and replace the battery with a new one.
After replacing the battery, insert the PC board into the aluminum sash case and fasten the two screws.
Then, be sure to execute the CPU hardware reset.

7.2 Initializing CPU

(1) Hardware reset

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

(2) Software reset

Turn on the power switch while pressing the [illegible] key on the panel; then, the CPU is reset. At this time, the values stored in the memory and the values for steps are not cleared.

8. GP-IB

(General Purpose Interface Bus)

8.1 Introduction

8.1.1 General description

The KSG4700 has a GP-IB interface, and it can be controlled by the IEEE 488 standard interface bus.

8.1.2 Features

(1) The functions of the signal generator can be controlled by the IEEE 488 standard interface bus.

(2) The remote mode can be verified by the [REMOTE] indicator.

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

(4) The device address assigned to the signal generator can be displayed in the [AMPLITUDE] section.

8.2 Performance

8.2.1 Electrical specifications related to interface system

Compiles to IEEE Std 488-1975.

8.3 Operation Procedure

8.3.1 Preparation for use

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

(1) Press the LOCAL key after the YE key, and device address is displayed in the [AMPLITUDE] section.

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

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

(4) Connect the GP-IB cable when the power is off.

8.3.2 Address setting method

(1) Address setting by software

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

(2) Address setting by hardware

The address of the KSG4700 is set at "07" when the instrument is delivered from the factory.
The address switch is mounted on the CPU board in the signal generator. To set a new address, remove the top panel and shield board and manipulate the address switch S2 on the PC board 90-SIG-90104 found in the left aluminum sash case viewed from the front panel.
The address "07" can be changed to a desired address.

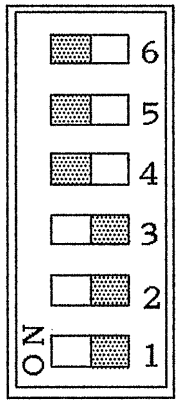
Remove the two screws on the right side the aluminume sash case.

The aluminum sash case can be taken out. Lift the case, and pull out the case.
After setting the address, put the board back to its original position. Then, execute the software or hardware reset of CPU (see Section 7.2).

a) Table 8-1 lists the values of S2 and corresponding addresses.

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

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



Device address setting value

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

Figure 8-1

Table 8-1

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

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

DIP SW

1 = OFF 0 = ON

8.3.3 Available control command and bus line commands

Table 8-2

Control command and bus line command (for hp BASIC)	Explanation
OUTPUT	Specifies the listener address and sends program data.
REMOTE	Turns on the [REMOTE] indicator (red) and prepares for receiving data when the listener adrress is specified. If the LOCAL key on the front panel is pressed in this state, the [REMOTE] indicator is turned off and the signal generator is set in local mode to enable manual operation on the front panel.
LOCAL LOCKOUT	Disables manual operation on all the devices on GP-IB. The LOCAL LOCKOUT command is an universal command.
LOCAL	Turns off the [REMOTE] indicator and sets the signal generator in local mode to allow manual operation on the front panel.
CLEAR	Sets the signal generator in the same state as the initial power-on state.

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

8.3.4 Program code table

Set the measuring conditions for KSG4700 with the codes listed in Table 8-3 GP-IB Function Setting Method.
Table 8-4 gives the program codes in alphabetical order, and Table 8-5 list the codes are classified by function. See these tables also.

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

Table 8-3 GP-IB Function Setting Method

Item	Program code	Data	Unit
Carrier frequency			
Carrier frequency	FR	○○.○	HZ,KZ,MZ,GZ
Output level unit			
Output level EMF dBμ	AP	○○.○	DBEMUV
Output level dBμ	AP	○○.○	DBUV
Output level dBm	AP	○○.○	DM
Output level OFF	RO, ROF	---	---
Output level ON	R1, RON	---	---
Modulation			
AM depth	AM	○○.○	PC
AM depth	AM	○○.○	%
Amplitude modulation OFF	AMS5	---	---
Amplitude modulation OFF	AMOF	---	---
FM peak frequency deviation	FM	○○.○	KZ
Frequency modulation OFF	FMS5	---	---
Frequency modulation OFF	FMOF	---	---
AC coupling	AC·FM	---	---
DC coupling	DC·FM	---	---
External modulation ON	S1AM, S1FM	---	---
Modulation signal source 400Hz	S2AM, S2FM	---	---
Modulation signal source 1kHz	S3AM, S3FM	---	---
Modulation signal source 3kHz	S4AM, S4FM	---	---
Pulse modulation OFF	PUO, PUOF	---	---
Pulse modulation ON	PU1, PUon	---	---
Memory control			
Memory recall	RC	○○	---
Memory store	ST	○○	---

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

2: The mark "○○" means than the data may be specified with one digitup to the maximum number of digits.

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

4: Alphabetic characters may be expressed in small letters.

Table 8-4 GP-IB Program Codes

Alphabetical order

Program code	Explanation	Remarks
AC	Modulation AC·FM	Function mode
AM	Amplitude modulation	Function mode
AMOF	Modulation OFF	Modulation signal source switching
AP	Output level	Function mode
DBEMUV	Output level Unit EMF dBμ	Unit
DBUV	Output level Unit dBμ	Unit
DC	Modulation DC·FM	Function mode
DM	Output level Unit dBm	Unit
FM	Frequency modulation	Function mode
FMOF	Modulation OFF	Modulation signal source switching
FR	Carrier frequency	Function mode
GZ	GHz Frequency	Unit
HZ	Hz Frequency, Modulation	Unit
KZ	kHz Frequency, Modulation	Unit
MZ	MHz Frequency	Unit
PC	Modulation in percent	Unit
PU0, PUOF	Pulse modulation OFF	Function mode
PU1, PUON	Pulse modulation ON	Function mode
RC	Memory recall	Function mode
R0, ROF	Output level OFF	Function mode
R1, RON	Output level ON	Function mode
S1	External modulation ON	Modulation signal source switching
S2	Internal modulation 400Hz	Modulation signal source switching
S3	Internal modulation 1kHz	Modulation signal source switching
S4	Internal modulation 3kHz	Modulation signal source switching
S5	Modulation OFF	Modulation signal source switching
ST	Memory store	Function mode
0 - 9	Numeric value	Data
-	Minus sign	Data
.	Decimal point	Data
%	Modulation in percent	Unit

Table 8-5 GP-IB Program Code

Classified by function

Function	Program code
Carrier frequency	FR
Output level	AP
Output level OFF	RO, ROF
Output level ON	R1, RON
Modulation	
Amplitude modulation	AM
Frequency modulation	FM
AC coupling	AC
DC coupling	DC
External modulation ON	S1
Int. modulation 400Hz	S2
Int. modulation 1kHz	S3
Int. modulation 3kHz	S4
Modulation OFF	S5
Amplitude modulation OFF	AMOF, AMS5
Frequency modulation OFF	FMOF, FMS5
Pulse modulation OFF	PUO, PUOF
Pulse modulation ON	PU1, PUON
Data	
Numeric value	0 - 9
Minus sign	-
Decimal point	.
Unit	
GHz	GZ
MHz	MZ
kHz	KZ
Hz	HZ
EMF dBμ	DBEMUV
dBμ	DBUV
dBm	DM
%	PC or %
Memory	
Memory recall	RC
Memory store	ST

8.3.5 Basic data setting method

100MHz carrier frequency, EMF 120dBμ output level, 1kHz internal modulation frequency, and 75kHz FM peak frequency deviation are to be set.
In the following examples, HP 9816 is used:

Example 1: OUTPUT 707; "FR100MZ, AP120DBEMUV, 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; "AP120DBEMUV"
OUTPUT 707; "S3FM75KZ"
```

Example 3: To set the carrier frequency at 88.2MHz

a) "FR88.2MZ"

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

a) "AP120DBEMUV"

Example 5: To set the output level at 100dBμ

a) "AP100DBUV"

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

a) "AP-3.5DM"

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

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

Example 8: To set external FM deviation 75kHz

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

Note : S1 only is invalid.

Example 9: To turn off modulation

a) "AMS5" b) "S5AM"
c) "AMOF" d) "FMS5"
e) "S5FM" f) "FMOF"

Example 10: To recall memory address "36"

a) "RC36"

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

b) "ST36"

8.3.6 Connector pin allocation diagram

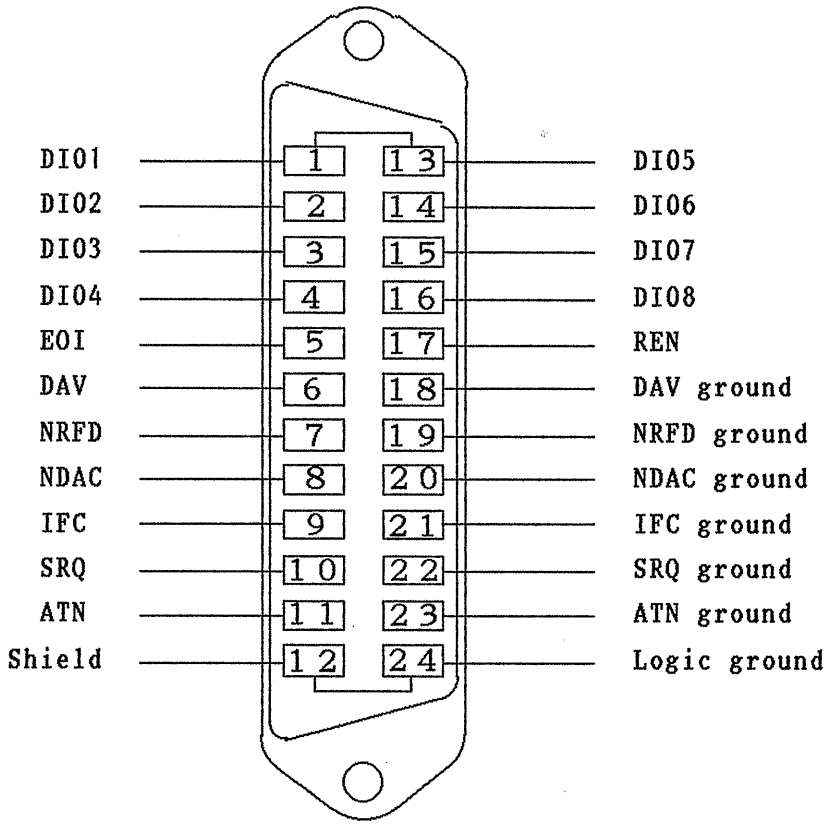


Figure 8-2

8.3.7 Reference (Program example)

An example of a program for HP 9816 is given below. This program is to set the data of frequency, output level, and modulation factor, to store the data into the signal generator (memory "00" - "09"), and to recall the data from it. This program is just for reference, and it may not be the best one. Since the program description method varies with the system to control the signal generator, code the program in the most suitable way for the system.

```
10      Dev=707                          Interface select code
                                         * 100 + Device address
20      Frequency=100*1.E+6              100Hz
30      Freqstep=10*1.E+6                10Hz
40      Level=120                        120dBμ
50      Levelstep=-10                    -10dB
60      Fm=75                            75kHz
70      Fmstep=-5                        -5kHz
80      CLEAR Dev                        Clear selected device
90      WAIT 2
100     OUTPUT Dev;"R1"                  Output level ON
110     OUTPUT Dev; Lev; "AMS5"          Turn off AM modulation
120     FOR N=0 TO 9
130       Freq=Frequency+Freqstep*N
140       Lev=Level+Levelstep*N
150       Fmlev=Fm+Fmstep*N
160       OUTPUT Dev;"FR";Freq/1.E+6;"MZ"  Set frequency
170       OUTPUT Dev;"AP";Lev;"DBUV"       Set output level
180       OUTPUT Dev;"S2FM";Fmlev;"KZ"     Set 400Hz internal
                                           modulation frequency and
                                           FM deviation
190       OUTPUT Dev;"ST";N                Store data into memory
200     NEXT N
210     FOR N=0 TO 9                       Recall data from memory
220       OUTPUT Dev;"RC";N
230     WAIT 2
240     NEXT N
250     END
```

9. DOWNLOAD PROGRAM

9.1 General Description

With the controller function of the KSG4700, a user program downloaded from the host computer to the KSG4700 can control the instruments having GP-IB interface such as audio analyzers, electronic voltmeters, oscillo-scopes, power supply units, and jigs. 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 data can be applied to the user program, the user program can be developed in a short time.

- Controller fuction

The user program (command string) is activated by the memory keys (RCL, △, ▽, etc.) of the KSG4700, and the command string is output from the GP-IB port. This command string in user program is transferred to instruments, and the instruments are set in the states specified by the command string. Thus, the preparation for measurement is done quite easily.

- 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 operation confirmation. The user program is completed after it is debugged and its operation is confirmed.
When the user program is completed, a small-scale system can be established with use of the host computer.

- User program downloading and activation

The user program is transferred (downloaded) to the KSG4700 by the transfer program on the host computer.

The host computer is disconnected, and the KSG4700 is used as the controller. By manipulating the memory keys (RCL, △, ▽), the user program is activated and a command string is transferred to instruments through the GP-IB port the KSG4700.

In this stage, a small-scale system is established without the host computer.

The CPU of the KSG4700 is active only when the GP-IB port commands are transferred. Therefore, such operation as the measurement of receive sensitivity in a shield room is not disturbed by computer noise.

- User program uploading and debugging

When the user program is transferred (uploaded) from the KSG4700 to the host computer, it can be modified and debugged by the editing function of the host computer.

9.2 Features

(1) The memory areas "00" to "99" for panel setting can be used by the downloaded program, and this function makes the program 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 KSG4700 can be uploaded, and this function can be used for managing and debugging the program.

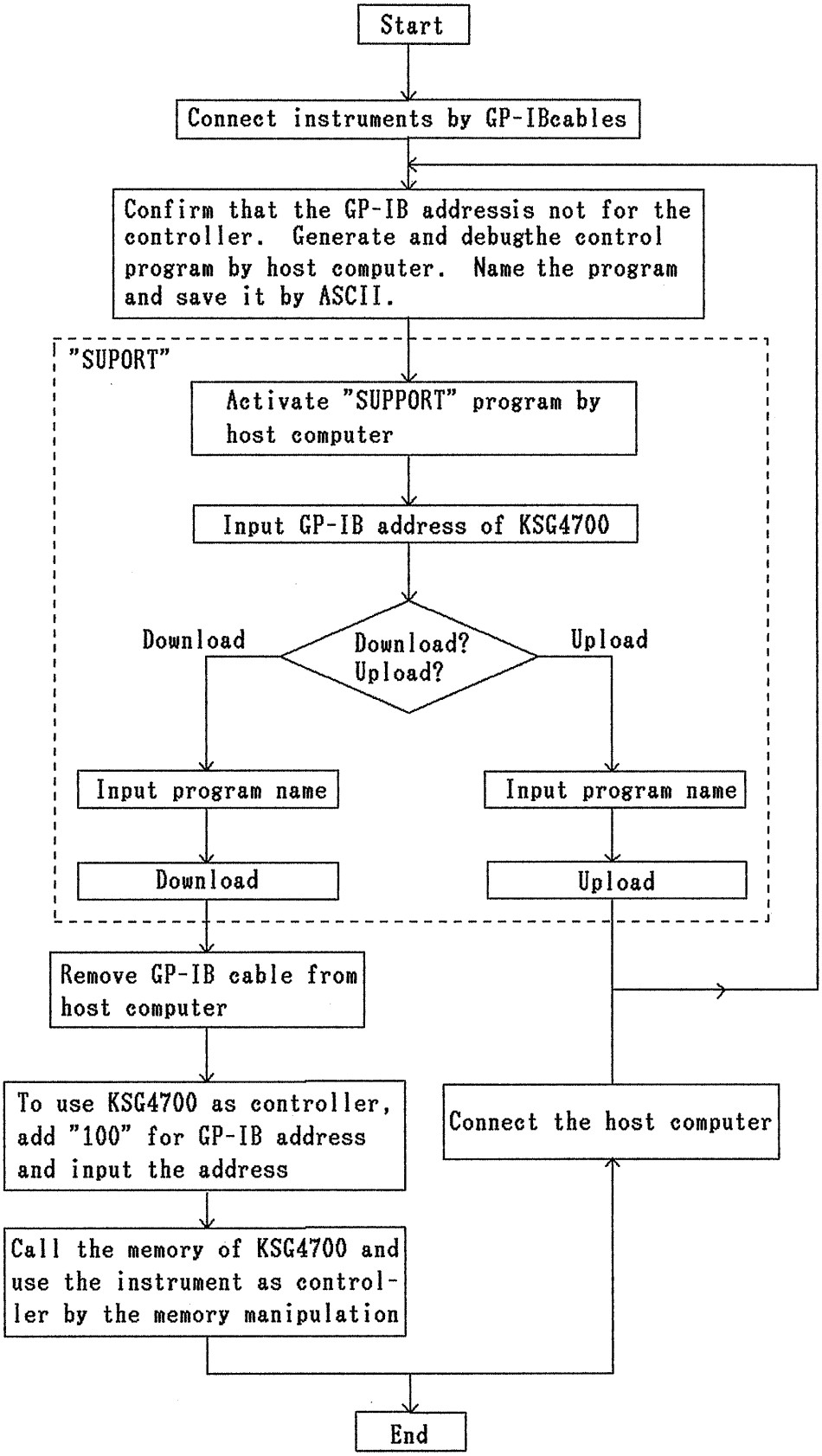
(5) The BASIC program is developed (input, edited, and debugged) by the host computer.

By using these features effectively, a system with GP-IB interface can be established easily.

A computer provided by HP or NEC can be used as the host computer.

9.3 Operation

9.3.1 Operation flow



9.3.2 Example: Using HP 9816 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 (100Hz, 1kHz, and 10kHz) by the use of HP 9816 (as host computer), KSG4700, multiplex signal generator KSG3200, and two-indicator AC voltmeter AVM23R.

(1) Set the instruments as follows:

(a) KSG4700: Frequency = 83MHz
Output level = −60dBm
AM = OFF
pulse modulation = OFF
FM = Stereo modulation with 75kHz

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

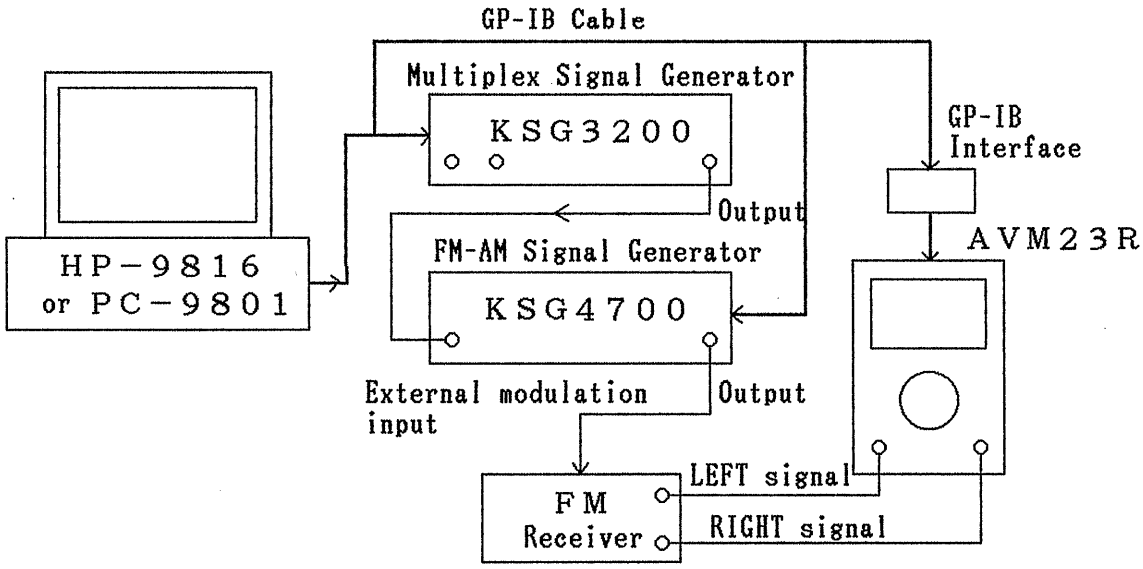
(C) Change the internal modulation frequency of KSG3200 to 100Hz.

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

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

	Setting of instruments	FM receiver operation and measurement
Step 1	On the KSG4700, set the frequency to 83.0MHz and output level to -60dBm, turn off AM and pulse modulation, set FM to AC 75kHz, 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 1kHz. On the AVM23R, set the range to 1V.	Adjust the balance volume of the FM receiver till the indicators of the AVM23R 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 100Hz.	Read the value indicated by the AVM23R.
Step 3	On the KSG3200, set the internal modulation frequency to 10kHz.	Read the value indicated by the AVM23R.

9.3.3 Connecting instruments for downloading program



Connect the instruments to the host computer (HP9816) through GP-IB interface.

(1) Set the GP-IB select code of the host computer (HP9816) to "7".

(2) Set the GP-IB address of the KSG4700 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

An example of the program for the setting explained in Section 9.3.2 is shown below. The program to be downloaded is generated as commands are sent from the host computer HP9816, and the correct operation of the GP-IB interface is checked by the following message:

```
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 explaiend in Item (2) of Section 9.3.1, the information on steps 1, 2, and 3 is stored in memory areas "00", "01", and "02" of the KSG4700 respectively.

Program	Comment
10 REM demo_program_1	The program is named "demo_ program_1".
20 REM ADDR Sg=707,Ssg=709,Dvm=711	The KSG4700 (Sg), KSG3200 (Ssg), and AVM23R (Dvm) are set to 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"
```

Message output for KSG4700
The frequency and output level are set to 83.0MHz and −60dBm respectively, AM and pulse modulation are turned off, FM is set to AC 75kHz, and external FM is specified.

```
80  OUTPUT Ssg;"AP3.00V PL10% M1 AF90% PRE0 S5"
```

Message output for KSG3200
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 1kHz.

```
90  OUTPUT Dvm;"A1 L7 R7"
```

A1 channel is selected, and L and R ranges of AVM23R are set to 1.0V.

```
100 PRINT "MEMORY 00"
```

The above information is set in memory "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 100Hz.

```
140 PRINT "MEMORY 01"
```

The above information is set in memory "01".

```
150 PAUSE
```

The program execution pauses; it is resumed by "cont".

```
160 REM MEM-02:
```

Beginning of memory "02"

```
170 OUTPUT Ssg;"S7"
```

The internal modulation frequency is set to 10kHz.

```
180 PRINT "MEMORY 02 & END"
```

The above information is set in memory "02", and the setting is terminated.

```
190 END
```

See Section 9.5 "Appendix" for the list of the program downloaded by the NEC PC-9801.

(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" (eight characters for PC-9801); then, the program is downloaded to the KSG4700.

The program to be downloaded should be saved in the host computer HP9816 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 HP9816.

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:

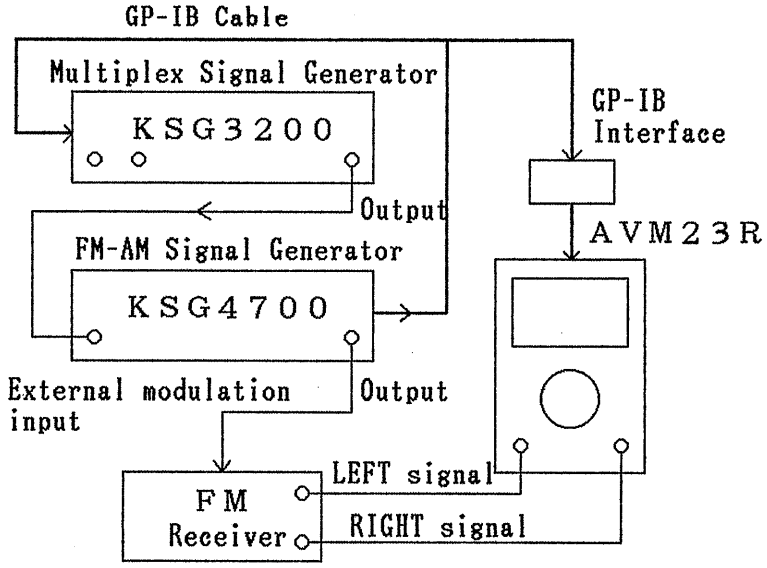
```
10  REM demo_program_1
20  REM ADDR Sg=707,Ssg=709,Dvm=711
30  Sg=707
40  Ssg=709
50  Dvm=711
60  REM MEM-00:
70  OUTPUT Sg;"FR83MZ AP-60DM S5AM PUOF ACFM75KZ S1FM"
80  OUTPUT Ssg;"AP3.00V PL10% M1 AF90% PRE0 S5"
90  OUTPUT Dvm;"A1 L7 R7"
100 PRINT "MEMORY 00"
110 PAUSE
120 REM MEM-01:
130 OUTPUT 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 KSG4700 as controller

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



(2) To use the KSG4700 as controller

The KSG4700 is considered as the controller when 100 is added to its GP-IB address ("07" + "100" = 107).

To recall the memory areas of the KSG4700 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 surface.

(b) Press RCL , . , 0 , and 2 to specify memory area "02".

(c) Press YE , STO , and RTN . See Section 4.7.3.

When the instruments are connected as in Item (1), manipulate keys as follows:

KSG4700 key manipulation	Memory display	FM receiver operation and measurement
RCL, 0	00	Adjust the balance volume of the FM receiver till the indicators of the AVM23R indicate the same value for L and R signals. Adjust the output volume of the FM receiver to 0 dBV.
△ (NEXT)	01	Read the indication on the AVM23R.
△ (NEXT)	02	Read the indication on the AVM23R.

9.4 Details of BASIC Commands

H P	N E C	Explanation
OUTPUT ad;"ms"	PRINT @la;"ms"	Outputs a massage.
LOCAL sc	IRESET REN	Local
REMOTE sc	ISET REN	Remote
WAIT t	REM WAIT t	Waits for the period of t sec.
REM ADDR va0=ad[,va1=ad]	REM ADDR va0=ad[,va1=la]	Declares the variable of ad or la.
REM MEM-n:[mrm,msm]	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 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 instrument is used and set in hardware (default).
NOT SET: A message for the local instrument is not used.
ms: Message
n: Message number (0 <= n <= 99)
sc: Select code
t: Numeric value to indicate waiting time (unit = s)
text: Character string to indicate 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 List of the program downloaded by the NEC PC-9801

Program	Comment
10 REM program	The program is named "program".
20 REM ADDR SG=7,SSG=9,DVM=11	The KSG4700 (SG), KSG3200 (SSG), and AVM23R (DVM) are set to 7, 9, and 11 respectively. This setting is necessary when the addresses are expressed in variables.
30 SG=7	Used by BASIC
40 SSG=9	Used by BASIC
50 DVM=11	Used by BASIC
60 REM MEM-00:	Beginning of memory "00"
70 PRINT @ SG;"FR83MZ AP-60DM S5AM PUOF ACFM75KZ S1FM"	Message output for KSG4700 The frequency and output level are set to 83.0MHz and −60dBm respectively, AM and pulse modulation are turned off, FM is set to AC 75kHz, and external FM is specified.
80 PRINT @ SSG;"AP3.00V PL10% M1 AF90% PRE0 S5"	Message output for KSG3200 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 1kHz.
90 PRINT @ DVM;"A1 L7 R7"	A1 channel is selected, and L and R ranges of AVM23R are set to 1.0V.
100 PRINT "MEMORY 00"	The above information is set in memory "00".
110 STOP	The program execution pauses; it is resumed by "cont".
120 REM MEM-01:	Beginning of memory "01"

```
130 PRINT @ SSG;"S3"          The internal modulation
                              frequency is set to 100Hz.
140 PRINT "MEMORY 01"         The above information is set in
                              memory "01".
150 STOP                      The program execution pauses;
                              it is resumed by "cont".
160 REM MEM-02:               Beginning of memory "02"
170 PRINT @ SSG;"S7"          The internal modulation
                              frequency is set to 10kHz.
180 PRINT "MEMORY 02 & END"   The above information is set in
                              memory "02", and the setting is
                              terminated.
190 END
```

9.5.2 Supporting program "SUPPORT"

(1) For Model 9816 computer of HP

```
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 Donwload
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$<>"E" THEN D_file_assign
1250           OFF ERROR
1260           RETURN
1270 D_file_assign:!
1280        ASSIGN @Infile TO Source$
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 Gpadr;CHR$(27)
1650        DISP "<<< End of download >>>"
1660        PRINT
1670        RETURN
1680 !
1690 Upload:!
1700        INPUT "Distination file name ? ",Dist$
1710        IF Dist$="E" THEN RETURN
1720        OUTPUT Gpadr;"SPTB"
1730        ENTER Gpadr;Text_byte
1740        Rec=1+INT(Text_byte/256)
1750        ON ERROR GOTO Already_exist
1760        CREATE ASCII Dist$,Rec
1770        GOTO Uuload_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 upload >>>"
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
```

(2) For Model PC-9801 computer of NEC

```
1000        REM SUPPORT
1010     ISET IFC : ISET REN : CMD DELIM = 0
1020        DIM A$[128]
1030        ESC=27
1040        PRINT CHR$(12)
1050 *START:'
1060        INPUT "Input GPIB address of SG ",GPADR
1070        IF GPADR < 0 OR 30 < GPADR THEN *START
1080 *MAIN.LOOP:'
1090        PRINT:PRINT "*** Select function ***":PRINT
1100        KEY 1,"Download"+CHR$(13):KEY 2,"Upload"+CHR$(13)
1110        KEY 3,"      "+CHR$(13):KEY 4,"      "+CHR$(13)
1120        KEY 5,"      "+CHR$(13):KEY 6,"      "+CHR$(13)
1130        KEY 7,"      "+CHR$(13):KEY 8,"      "+CHR$(13)
1140        KEY 9,"      "+CHR$(13):KEY 10,"END   "+CHR$(13)
1150        LINE INPUT ;FUNC$
1160     IF FUNC$="Download" THEN GOSUB *DOWNLOAD
1170     IF FUNC$="Upload"   THEN GOSUB *UPLOAD
1180     IF FUNC$="END"      THEN STOP
1190        GOTO *MAIN.LOOP
1200 '
1210 *DOWNLOAD:'
1220        ON ERROR GOTO *FILE.NOT.FOUND
1230        GOTO *DOWN.FILE
1240 *FILE.NOT.FOUND:'
1250        BEEP
1260        PRINT "!!!! File is not found !!!!":PRINT
1270     FOR N=0 TO 1500 : NEXT N
1280        RESUME *DOWN.FILE
1290 *DOWN.FILE:'
1300        PRINT:INPUT "Source file name ? ",Source$
1310        IF SOURCE$<>"E" THEN *D.FILE.ASSIGN
1320           ON ERROR GOTO 0
1330           RETURN
1340 *D.FILE.ASSIGN:'
1350        OPEN SOURCE$ FOR INPUT AS #1
1360        ON ERROR GOTO 0
```

```
1370 *DOWN.CHECK:'
1380       PRINT @ GPADR;"SPTA"
1390       INPUT @ GPADR;MAXBYTE
1400       BYTE=0
1410 *DOWN.CHECK.LOOP:'
1420       IF EOF(1) THEN *DOWN.CHECK.END
1430          LINE INPUT #1,A$
1440          BYTE=BYTE+LEN(A$)+2
1450          GOTO *DOWN.CHECK.LOOP
1460 *DOWN.CHECK.END:'
1470       BYTE=BYTE+1
1480       PRINT:PRINT "<<< Bytes of source file  ";BYTE;" >>>":
      PRINT
1490       CLOSE #1
1500       IF MAXBYTE>=BYTE THEN *DOWN.START
1510          BEEP
1520          PRINT "!!!! Source file is too long !!!!";PRINT
1530          FOR N=0 TO 1500:NEXT N
1540          ON ERROR GOTO 0
1550          RETURN
1560 *DOWN.START:'
1570       PRINT "<<< Start of download >>>":PRINT
1580       PRINT @ GPADR;"SPTD"
1590       OPEN SOURCE$ FOR INPUT AS #1
1600 *DOWN.LOOP:'
1610          IF EOF(1) THEN *DOWN.END
1620          LINE INPUT #1,A$
1630          PRINT @ GPADR;A$
1640          PRINT A$
1650          GOTO *DOWN.LOOP
1660 *DOWN.END:'
1670       CLOSE #1
1680       PRINT @ GPADR;CHR$(ESC)
1690       PRINT:PRINT "<<< End of download >>>":PRINT
1700       RETURN
1710 '
1720 *UPLOAD:'
1730       PRINT:PRINT "Distination file name ? ",DIST$
1740       IF DIST$="E" THEN RETURN
1750       ON ERROR GOTO *NOT.EXIST
```

```
1760        OPEN DIST$ FOR INPUT AS #1
1770       CLOSE #1
1780        BEEP
1790        PRINT
1800        INPUT "File is already exist , over write OK Y/N ",C$
1810        IF C$<>"Y" AND C$<>"y" THEN *UPLOAD
1820 *NOT.EXIST:'
1830        RESUME *UPLOAD.START
1840 *UPLOAD.START:'
1850        ON ERROR GOTO 0
1860        OPEN DIST$ FOR OUTPUT AS 1
1870        PRINT:PRINT "<<< Start of upload >>>":PRINT
1880        PRINT @ GPADR;"SPTU"
1890 *UP.LOOP:'
1900        INPUT @ GPADR;A$
1910        IF ASC(A$)=ESC THEN GOTO *UP.END
1920           PRINT #1,A$
1930           PRINT A$
1940           GOTO *UP.LOOP
1950 *UP.END:'
1960       CLOSE #1
1970        PRINT:PRINT "<<< End of upload >>>":PRINT
1980        RETURN
1990 '
2000 END
```

9.5.3 Accessories (Optional)

(1) Dummy antenna

SA 100 Test loop (Loop antenna)

Medium/High frequency band, generate for standard field

Frequency range: 100kHz to 30MHz

BNC type 50Ω Unbalanced type

SA 111 Dummy antenna for single signal, FM receiver

BNC Open type 50Ω:75Ω Unbalanced type

SA 115 Dummy for single signal, FM receiver

BNC Load type 50Ω:300Ω Balanced type

SA 150 Band aplitting filter for AM, FM receiver

(selector type)

Frequency range: DC to 130MHz

50Ω:50Ω Load type

SA 151 Dummy antenna for car radio

Frequency range: 50kHz to 200MHz

AM 50Ω:80Ω

FM 50Ω:75Ω Load type

SA 152 Dummy antenna for car radio

Frequency range: 50kHz to 200MHz

AM 50Ω:75Ω

FM 50Ω:75Ω Open type

SA 153 Output adaptor for Test loop/Dummy antenna switch

Frequency range: DC to 200MHz

AM 50Ω:50Ω

FM 50Ω:50Ω

SA 154 Output adaptor for Test loop/Dummy antenna switch

Frequency range: DC to 200MHz

AM 50Ω:50Ω

FM 50Ω:75Ω

SA 234 Impedance transformer

Frequency range: DC to 230MHz

BNC type 50Ω:75Ω Open type

SA 235 Impedance transformer

Frequency range: DC to 1.6GHz

N type 50Ω:75Ω Open type

(2) Coaxial and special cables

SA 500 Shielding cable

RCA-RCA pin plugs Length 0.8 m

For RANGE OUTPUT control signal, option

SA 510 Dump cable

14pin-14pin connectors Length 1.5 m

For KSG series, option

SA 520 Synchronized timing cable for memory

14pin-14pin connectors Length 0.3 m

For KSG3100 to 3210、4100 to 4700, option

SA 550 RF cable

BNC(P)-BNC(P) connectors 50 RG-58A/U Length 1 m

For KSG4100 to 4300, accessory

SA 556 RF cable

N(P)-N(P) connectors 50 5D-2W Length 1 m

For KSG4500 to 4700, accessory

SA 570 RF cable

BNC(P)-BNC(P) connectors 75 3C-2V Length 1 m

For KSG3100 to 3210, accessory