SAFETY PRECAUTIONS

GENERAL

This instrument has been designed and tested to ensure reasonable personal protection and protection of the surrounding area against damage, and has been supplied in a safe condition. The following precautions must be observed by the user to ensure safe operation and to retain the instrument in a safe condition.

BEFORE SUPPLYING POWER

Verify that the instrument is set to suit the available mains voltage and that the correct fuse is installed.

PROTECTIVE EARTH

The protective earth of the instrument must be connected to the earth before connecting the instrument to the product input or output terminals. A protective ground connection by way of the grounding conductor in the power cable is essential for safe operation.
The plug shall only be inserted into a socket outlet provided with a protective earth contact.

SAFETY SYMBOLS

Instruction manual symbol : The instrument will be marked with this symbol when it is necessary for the user to refer to the instruction manual for safety.

High voltage symbol : Dangerous voltage exceeding 1 kV is indicated by this symbol.

Protective earth terminal.

WARNING

The WARNING sign is a heading of the requirement(s) that should be observed to avoid personal or fire hazards.

CAUTION

The CAUTION sign leads the precaution(s) that should be observed to avoid damage or destruction of the instrument.

POWER SOURCE

This instrument is intended to operate from a mains supply that will not be more than 250 volts rms.
For suitable voltage selection, see the INSTALLATION paragraph in this manual.

HAZARD ARISING FROM LOSS OF GROUND

The protective action must not be negated by the use of an extension cord without protective conductor.
If this instrument is to be energized via an autotransformer for voltage reduction make sure the common terminal is connected to the earth terminal of the power source.

DAMAGE IN TRANSPORT OR STORAGE

Whenever it is likely that protection has been impaired, for example as a result of damage caused by abnormal stresses in transport or storage, the instrument shall be made inoperative and be secured against any unintended operation.

USE OF PROPER FUSE

Use only the fuse of correct type, voltage rating and current rating as specified in the INSTALLATION paragraph in this manual.

REMOVAL OF COVERS

Removal of covers is likely to expose live parts although reasonable precautions have been taken in the design of the instrument to shield such parts. The instrument shall be disconnected from the supply before carrying out any adjustment, replacement or maintenance and repair during which the instrument shall be opened. If any adjustment, maintenance or repair under voltage is inevitable it shall only be carried out by a qualified personnel who is aware of the hazard involved.

DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES

To avoid explosion, do not operate the instrument in an explosive atmosphere.

WARNING

- Dangerous voltages exist at several points in this instrument.
  Internal servicing must be performed by qualified service personnel.

- Disconnect the power cable from the power source before removing the covers.

- When servicing with power on, particular care must be paid to avoid personal injury. After removing the covers with the power cable disconnected, mount the instrument on the bench securely so that the portion to be serviced is easily accessible. Then connect the power cable and turn the power on. Do not touch exposed connections or components while the power is on.

- Do not service alone. Do not perform internal service unless another person capable of rendering first aid and resuscitation is present.

CONTENTS

SECTION I
GENERAL

1-1 DESCRIPTION

The model VP-8122A is a standard signal generator which provides a remote control function and generates CW, FM, AM, and mixed AM- FM signals in the 10 kHz to 280 MHz range. This instrument has an FM stereo modulator based on the FM stereo broadcasting system as well as an AM stereo modulator based on the AM stereo C-QUAM system (Motorola system) built in.

A frequency between 140 and 280 MHz is the directly generated fundamental wave. A signal in the 10 kHz to 35 MHz range is generated by heterodyne down-conversion. 1 / 4- and 1 / 2-dividers are provided to generate a signal in the range of 35 to 70 MHz and 70 to 140 MHz, respectively.

The model VP-8122A may also be defined as a synthesized signal generator. The instrument generates a precise RF frequency that is always phase-locked to the built-in reference crystal oscillator. The frequency resolution is 10 Hz (RF ≦ 140 MHz) or 20 Hz (RF > 140 MHz). In the AM stereo mode with RF 2 MHz or less, however, the resolution is 1 Hz. The ΔF function directly reads increment and decrement from the currently designated reference frequency. The response time required for switching frequencies is 70 ms or less.

An output level can be set in the ranges of − 133 to + 19 dBm (50 Ω) and − 134.8 to + 17.2 dBm (75 Ω). The output level resolution is 0.1 dB. Units can be selected out of seven ; dBm, dBμV, mV, and μV (50 Ω / 75 Ω matched) and dBμV EMF, mV EMF, and μV EMF (open end). The ΔdB function directly reads increment and decrement from the designated reference output level.

The model VP-8122A provides a modulation of FM, AM, and stereo waves obtained from the built-in stereo modulator. An RF frequency of 2 MHz or less can be modulated with the C-QUAM system, one of the AM stereo broadcasting systems, while that exceeding 2 MHz can be modulated with the FM stereo broadcasting system. Also the instrument provides an mixed AM-FM modulation by combining an internal and external modulation signal. For more information on the stereo modulator, refer to the following paragraph.

The instrument has the assorted preset function which stores up to 100 sets of parameters for a frequency, output level, modulation status, and external control output signal. The stored parameters can be recalled as desired.

Battery backup is available so that the state set with panel operation is retained even after the power has been turned off.

The GP-IB and external control interfaces are provided as a standard remote function for the VP-8122A.

These features allow the generator to be used to automate production and inspection of high performance FM-AM receivers, communication equipment, and components, as well as to generate measuring signals for maintenance, research, and development.

1-2 FM STEREO MODULATOR

(1) FM stereo broadcasting

As outlined in Figure 1-1, a broadcasting using the carrier suppression AM-FM system is generally called an FM stereo broadcasting. This system was established by FCC (Federal Communications Commission) and EBU (European Broadcasting Union), and is now submitted to the Radio Regulatory Council of the Post and Telecommunications Ministry. Though established by FCC originally, the SCA (Subsidiary Communications Authorization) indicated by a dotted line in the figure is considered by EBU as a traffic information transmission signal. This frequency range is called the second sub-channel in Japan.

The VP-8122A contains the functions of both a stereo modulator and standard signal generator, as shown in Figure 1-1.

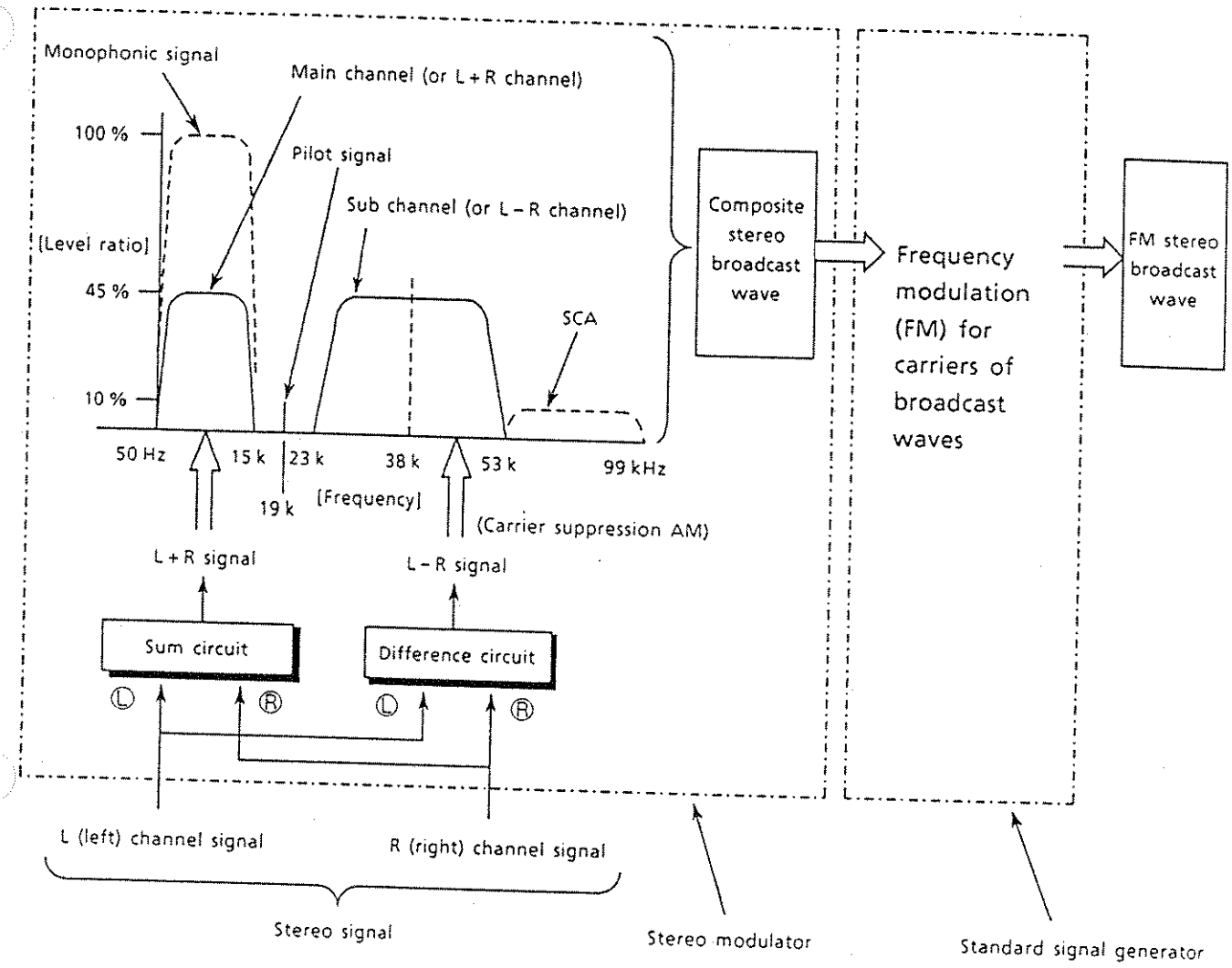


Figure 1-1 Outline of FM stereo broadcasting

(2) Modulation mode

Eight types of modulation modes are available.

(a) Modulation off

Both a main- and sub-channel signal are turned off.

(b) Monophonic

Without stereo modulation, only a main-channel signal is generated. The PILOT signal is turned off.

As a test tone, an internal AF signal or an externally supplied sine wave ranging from 50 Hz to 15 kHz can be used.

(c) L = R mode

The same test tone is applied to both L and R inputs shown in Figure 1-1 at the same phase to generate a composite stereo signal. The resultant signal composes of the main-channel signal component only.

As a test tone, an internal AF signal or an externally supplied sine wave ranging from 50 Hz to 15 kHz can be used.

(d) L mode

A test tone is applied only to the L input in Figure 1-1 to generate a composite stereo signal. The resultant signal composes of the main- and sub-channel signal components with the same level.

When demodulated in a stereo receiver, the signal appears only at the L channel.

As a test tone, an internal AF signal or an externally supplied sine wave ranging from 50 Hz to 15 kHz can be used.

(e) R mode

On the contrary to the L mode, a test tone is applied only to the R input in Figure 1-1 to generate a composite stereo signal. The resultant signal has the same composition as in the L mode.

When demodulated in a stereo receiver, the signal appears only at the R channel.

As a test tone, an internal AF signal or an externally supplied sine wave ranging from 50 Hz to 15 kHz can be used.

(f) L = – R mode

The same test tone is applied to both L and R inputs in Figure 1-1 at the reversed phase to generate a composite stereo signal. The resultant signal composes of the sub-channel signal component only.

As a test tone, an internal AF signal or an externally supplied sine wave ranging from 50 Hz to 15 kHz can be used.

(g) INT L-EXT R mode

An internal AF signal is applied to the L input in Figure 1-1 and an externally supplied signal to the R input to generate a composite stereo signal.

(h) EXT L, R mode

Externally supplied signals are applied to the L and R input in Figure 1-1 to generate a composite signal. Applying a left and right speech signal generates a pseudo stereo broadcast wave.

(3) PILOT signal

The 19 kHz PILOT signal can be turned on / off independently and used to specify a signal level ratio. When the modulation mode is set to monophonic, however, this signal is turned off.

(4) Pre-emphasis

The VP-8122A provides the main- and sub-channel with the pre-emphasis feature. The time constant can be selected out of 25 μs, 50 μs, and 75 μs.

The pre-emphasis feature of this instrument shows the same level for pre-emphasis on and pre-emphasis off in the flat zone below 400 Hz. Thus increasing the frequency of a test tone causes both main- and sub-channel signal to be saturated. When turning the pre-emphasis feature on, be sure to specify the level ratio between a main- and sub-channel signal so that they are not saturated.

(5) SCA input

The VP-8122A is equipped with an SCA input terminal. When the SCA key is turned on, an input signal applied to the SCA input terminal is multiplexed with a composite stereo signal. An SCA input signal equals the level ratio of 10 % at about 0.56 Vp-p.

1-3 AM STEREO MODULATOR

(1) AM stereo system

The basic block diagram of AM stereo is shown in Figure 1-2. The VP-8122A has a built-in modulator using the AM stereo (C-QUAM) system, which was developed by Motorola. Figure 1-3 shows the block diagram of the C-QUAM system. This system cross modulates the carrier with a sum signal and difference signal, and excludes AM components from the cross modulated wave to obtain a new carrier, which then amplitude modulates with the sum signal.

(2) Modulation mode

Modulation with an external L and R signal, and modulation in L = R mode (main-channel only), L mode, R mode, and L = − R mode (sub-channel only) with an external or internal test tone are available.

The main-channel is amplitude modulated in the range of 0 to 100 %, while the sub-channel is modulated to the degree which is automatically specified depending on the modulation mode.

A main-channel signal allows for a negative peak clipper.

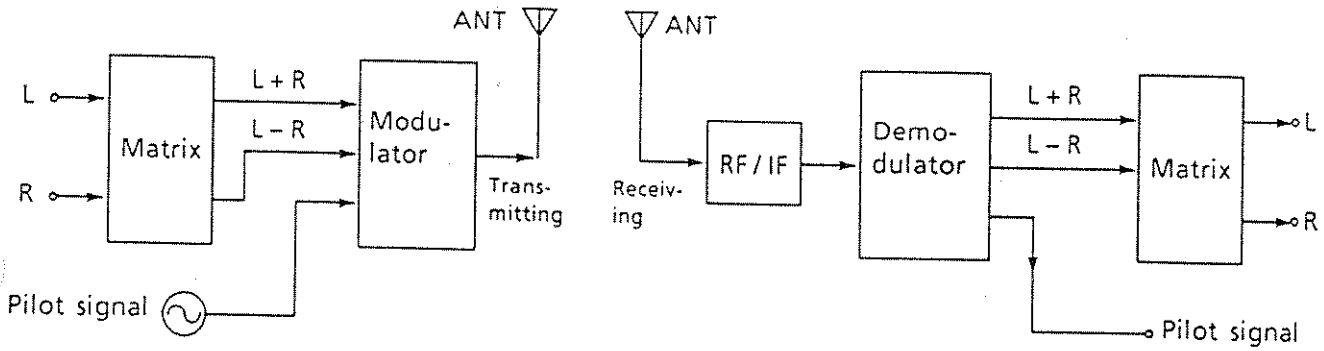


Figure 1-2 Basic block diagram of AM stereo

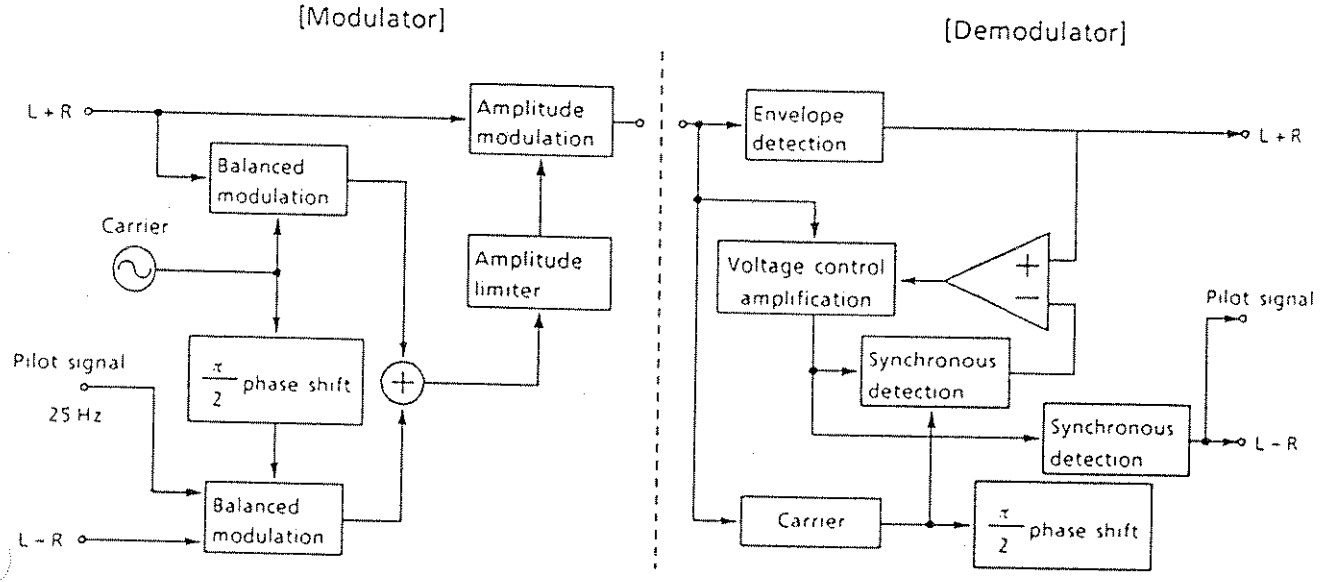


Figure 1-3 C-QUAM system

1-4 FEATURES

Given below are main features of the instrument.

(1) Wide band and high output level

The VP-8122A provides the high output level of 19 dBm (50 Ω) or 17.2 dBm (75 Ω) in the wide frequency range of 10 kHz to 280 MHz.

(2) Built-in stereo modulator

A built-in FM stereo modulator and AM stereo modulator are available. Thus this instrument alone can generate a stereo modulation wave which is used to test and measure a receiver for FM stereo broadcasting as well as that for AM stereo broadcasting with the C-QUAM system.

(3) High stability

An RF output signal is always phase-locked to the built-in crystal oscillator and kept in $\pm 2 \times 10^{-6}$ stability.

(4) High S/N ratio and low distortion factor

In the frequency ranges of 10.7 ± 1 MHz and 76 to 108 MHz, the FM component of residual modulation (S/N) is 90 dB or more, and the FM distortion factor is kept below 0.01 % so that the instrument is useful for testing a high performance FM stereo tuner.

(5) ΔF and ΔdB direct reading functions

The ΔF function displays the relative value of an RF frequency as an increment and decrement from a given reference value. The ΔdB function displays the relative value of an output level as an increment and decrement from a given reference value.

(6) Continuous control of output level

An output level can be decremented continuously from a desired value by 0.1 dB steps within the range of 0 to 10 dB. This feature is useful for test and measurement in which a signal should not be interrupted momentarily to change its output level.

(7) Assorted preset memory

The instrument stores up to 100 sets of parameters for a frequency, output level, and modulation status. The stored parameters can be recalled as desired.

(8) Modification of output signal parameters

The instrument modifies any digit of the parameters for an RF frequency, output level, and modulation status with the two rotary knobs, one of which is for an output level and the other is for a frequency, output level, and modulation degree.

(9) Remote control

The instrument is equipped with the GP-IB and external control interfaces at standard.

SECTION II
SPECIFICATIONS

2-1 FREQUENCY (RF)

(1) Range — 0.01 to 280 MHz

(2) Band division and resolution

Band	RF frequency range (MHz)	Resolution (Hz)	Note
4	140.00002 to 280.00000	20	
3	70.00001 to 140.00000	10	
2	35.00001 to 70.00000		
1	0.01000 to 35.00000		
	0.010000 to 2.000000	1	In AM stereo mode

(3) Switching speed — 70 ms or less (To be within 100 Hz of final frequency)
Processor : (15 ms or less)
Frequency setup : (55 ms or less)

(4) Accuracy — $\pm 2 \times 10^{-6} \pm 1$ digit

(5) Internal reference oscillator
Aging rate : $\pm 2 \times 10^{-7}$ / week
Temperature effect : $\pm 2 \times 10^{-6}$ (10 to 35 °C)

2-2 OUTPUT

(1) Range
Output impedane 50 Ω : − 133 to + 19 dBm (0.05 μV to 2 V)
Output impedane 75 Ω : − 134.8 to + 17.2 dBm (0.05 μV to 2 V)

(2) Resolution — 0.1 dB

(3) Accuracy — ± 1 dB (When output level ≧ − 113 dBm)
± 1.5 dB (When output level < − 113 dBm)

(4) Attenuator step accurcy — ± 0.5 dB (When output level ≧ − 113 dBm)
± 0.7 dB (When output level < − 113 dBm)

(5) Flatness — Within ± 1 dB (output level at + 8 dBm)

(6) Impedance — 50 Ω / 75 Ω,
VSWR ≦ 1.2 (When 50 Ω, output level ≧ + 8 dBm)

(7) Radiation — With the receiver sensitivity set at 1.0 μV, a 25 mm 2-turn loop feeding the receiver cannot detect a signal at a distance greater than 25 mm from generator.

(8) Units — dBm, dBμV, dBμV EMF,
mV, μV, mV EMF, μV EMF

2-3 SPECTRAL PURITY

(1) Spurious output signals

(a) Harmonics (2nd, 3rd)

Band 1 (0.01 to 35 MHz): – 30 dBc (When output level > + 13 dBm)
– 40 dBc (When output level ≦ + 13 dBm)

Bands 2 to 4
(35.00001 to 280 MHz): – 30 dBc (When output level ≦ + 13 dBm)

(b) Non-harmonically related (± 10 kHz or more offset from carrier): – 60 dBc

(2) Residual modulation

(a) FM component (as S/N relative to 75 kHz deviation with 1 kHz modulation frequency)

① 90 dB or more (10.7 MHz ± 1 MHz, 76 to 108 MHz)

② 80 dB or more (Bands 1 to 4; 0.3 to 280 MHz)

Post-detection BW: 50 Hz to 15 kHz

De-emphasis: 50 μs

(b) AM component (as S/N relative to 30 % AM with 1 kHz modulation frequency)

① 65 dB or more (Band 1; 0.4 to 1.7 MHz)

② 60 dB or more (Bands 1 to 4; 0.15 to 280 MHz)

Post-detection BW: 50 Hz to 15 kHz

(Beat components excluded)

2-4 MODULATION (common items)

(1) Internal modulation frequency 400 Hz, 1 kHz within ± 3 %

(2) External modulation input impedance 10 kΩ, approx.

(3) External modulation input voltage 1 Vpeak, approx.

(4) FM and AM mixed modulation

The instrument has two modes of the mixed modulation. Each mode has four kinds of combination.

(a) FM mono and AM mono

① FM mono (EXT) and AM mono (INT)

② FM mono (INT) and AM mono (EXT)

③ FM mono (EXT) and AM mono (EXT)

④ FM mono (INT) and AM mono (INT)

(b) FM stereo and AM mono

① FM stereo (EXT) and AM mono (INT)

② FM stereo (INT) and AM mono (EXT)

③ FM stereo (EXT) and AM mono (EXT)

④ FM stereo (INT) and AM mono (INT)

2-5 AMPLITUDE MODULATION

(1) Band division and resolution

Mode	Range	Resolution
MONO	0 to 99.5 %	0.5%
	100 to 125 %	1 %
Others	0 to 125 %	1 %

(Output level ≦ + 13 dBm, RF frequency ≧ 0.15 MHz)

(2) Accuracy (with 1 kHz modulation frequency)

± (0.04 × rdg + 2) % (Modulation degree ≦ 80 %, Band 1 ; 0.4 to 1.7 MHz)

± (0.06 × rdg + 2) % (Modulation degree ≦ 80 %, Bands 1 to 4 ; 0.15 to 280 MHz)

(3) Distortion factor (with 50 Hz to 15 kHz post-detection BW, and 1 kHz modulation frequency)

Distortion (%)			Band
0 to 30 % AM	30 to 60 % AM	60 to 80 % AM	
0.1 or less	0.5 or less	1 or less	1 (0.4 to 1.7 MHz)
1 or less	2 or less	3 or less	1 to 4 (0.15 to 280 MHz)

(Beat components excluded)

(4) Incidental FM (at 30 % AM, with 1 kHz modulation frequency)

75 Hz or less (Band 1 ; 0.4 to 1.7 MHz)

200 Hz or less (Bands 1 to 4 ; 0.15 to 280 MHz)

(5) External modulation frequency response (with reference to 1 kHz, Maximum allowable modulation degree is up to 2 % of carrier frequency for 30 % AM.)

① Within ± 1 dB in the range 20 Hz to 10 kHz. (MONO, RF ≧ 0.15 MHz)

② Within ± 1 dB in the range 50 Hz to 10 kHz. (Other than MONO, 0.2 MHz ≦ RF < 2 MHz)

2-6 FREQUENCY MODULATION (FM)

(1) Frequency deviation and resolution

Range	Resolution
100 to 300 kHz	1 kHz
10.0 to 99.9 kHz	100 Hz
0.00 to 9.99 kHz	10 Hz

Performance-guaranteed maximum deviation in band 1 is up to 25 % of carrier frequency.

(2) Accuracy ± (0.08 × rdg + 1 digit)

(3) Distortion factor

At 1 kHz rate and 75 kHz deviation, with post-detection BW of 50 Hz to 15 kHz and with 50 μs de-emphasis:

Distortion factor (%)	Band
0.5 or less	4 (140.00002 to 280 MHz)
0.1 or less	1 to 3 (0.3 to 140.00000 MHz)
0.01 or less	(10.7 ± 1 MHz, 76 to 108 MHz)

(4) Separation for MPX stereo signal

At 100 % modulation (67.5 kHz deviation), with 1 kHz modulation frequency ; 60 dB or more (76 to 108 MHz)

(5) Incidental AM

At 75 kHz deviation, with 1 kHz modulation frequency ; 0.5 % or less (10.7 ± 1 MHz, 76 to 108 MHz)

(6) External modulation frequency response

AC mode (MONO, 20 Hz to 100 kHz, with reference to 1 kHz)

① Within ± 1 dB (0.3 to 280 MHz)

② Within ± 0.3 dB (76 to 108 MHz)

AC mode (Other than MONO, 20 Hz to 15 kHz, with reference to 1 kHz)

Within ± 1 dB

2-7 AM STEREO

(1) Stereo system : C-QUAM (Motorola)

(2) RF frequency

Performance-guaranteed range : 0.200000 to 2.000000 MHz

(3) Residual modulation

(a) AM component (as S / N relative to 50 % main-channel modulation with 1 kHz modulation frequency) : 65 dB or more

Post-detection BW : 50 Hz to 10 kHz

(b) PM component (as S / N relative to 50 % sub-channel modulation with 1 kHz modulation frequency) : 54 dB or more

Post-detection BW : 50 Hz to 10 kHz

(4) Main / sub-channel signal, modulation mode

Modulation mode	Mod. signal source	Description
OFF	—	Pilot signal modulation
L = R L R L = – R	INT / EXT R INT / EXT R INT / EXT R INT / EXT R	Stereo modulation with a single signal
MONO	INT / EXT R	Monophonic modulation
EXT L, R	Lch : EXT L Rch : EXT R	Stereo modulation with external two signals

(5) Main-channel modulation

Kind of modulation :	AM
Setting range :	0 to 100 % (Output level ≦ 13 dBm)
Display range :	0 to 125 %
Resolution :	1.0 %
Accuracy :	± (0.05 × rdg + 2) % (Modulation degree: 0 to 99 %)

Distortion (Post-detection BW : 50 Hz to 10 kHz, modulation frequency : 1 kHz) :
0.2 % or less (Modulation degree : 50 %)

(6) Sub-channel modulation

Kind of modulation :	PM
Setting range :	0 to 100 % (100 % = ± 45°)
Display range :	0 to 125 %
Resolution :	1.0 %
Accuracy :	± (0.05 × rdg + 2) % (Modulation degree: 0 to 99 %)

Distortion (Post-detection BW : 50 Hz to 10 kHz, modulation frequency : 1 kHz) :
1 % or less (Modulation degree : 50 %)

(7) L, R modulation

Setting range :	0 to 80 %
Resolution :	1.0 %
Accuracy :	± (0.05 × rdg + 2) %

Distortion (Post-detection BW : 50 Hz to 10 kHz, modulation frequency : 1 kHz) :
1 % or less (Modulation degree : 50 %)

(8) Crosstalk

(a) Main to sub-channel (at 50 % modulation with 1 kHz modulation frequency) : 40 dB or more

(b) Sub to main-channel (at 50 % modulation with 1 kHz modulation frequency) : 46 dB or more

(c) Separation

① 36 dB or more	(Modulation frequency : 400 Hz to 4 kHz)
② 26 dB or more	(Modulation frequency : 100 Hz to 7.5 kHz)

(9) Pilot signal

Frequency :	25 Hz
Frequency accuracy :	± 1 % or less
Modulation degree range :	0.0 to 10.0 % (Display range : 0.0 to 12.5 %)
Resolution :	0.1 %
Modulation degree accuracy :	± (0.05 × rdg + 2) %

(10) Negative peak clipper

ON / OFF control :	Possible
Setting value :	95 %, Variable over ± 5 %

2-8 FM STEREO

(1) RF frequency range : 2.00001 to 280 MHz

(2) Main / sub-channel signal, modulation mode

Modulation mode	Mod. signal source	Description
OFF	—	Pilot signal modulation
L = R L R L = – R	INT / EXT L INT / EXT L INT / EXT L INT / EXT L	Stereo modulation with a single signal
MONO	INT / EXT L	Monophonic modulation
INT L – EXT R	Lch : INT Rch : EXT R	Stereo modulation with internal and external two signals
EXT L, R	Lch : EXT L Rch : EXT R	Stereo modulation with external two signals

(3) Signal level ratio (M + S variable)

Range : 0 to 114 % (Except modulation mode MONO)
0 to 127 % (Modulation mode MONO)

Resolution : 1%

Accuracy : ± 5 %

(4) Composite output (Modulation mode : other than MONO)

Level setting range : 0.0 to 9.99 Vp-p at open end

Resolution : 0.01 Vp-p

Accuracy : ± 5 %

Output impedance : Approx. 75 Ω

(5) Stereo separation : 60 dB or more (at 90 % level ratio)

(6) Distortion : 0.01 %

(7) S / N : 90 dB or more (at 100 % level ratio)

(8) 38 kHz subcarrier leakage : – 50 dB or less

(9) Pre-emphasis : 25 μs, 50 μs, 75 μs, OFF

(10) Pilot signal (Modulation mode : other than MONO)

Frequency : 19 kHz

Frequency accuracy : ± 1 Hz

Level ratio range : 0.0 to 19.9 %

Resolution : 0.1 %

Accuracy : ± 1 %

(11) 19 kHz output(Sine wave synchronized with the pilot signal. Modulation mode : other than MONO)

Output level : Approx. 1 Vrms

Output impedance : Approx. 1 kΩ

(12) SCA signal

Frequency range : 20 to 99 kHz ± 1 dB (with reference to 57 kHz)

Input level : 0.56 Vp-p (0.2 Vrms), equivalent to 10 % level ratio

Input impedance : Approx. 10 kΩ

2-9 PRESET FUNCTION

Assorted preset : Stores and recalls a set of frequency, output level, modulation status (such as AM / FM, INT / EXT signal, modulation mode, modulation degree, on / off and external control output signal).
Up to 100 assorted data can be preset.

2-10 GP-IB CONTROL

(1) Has basic listener / talker, listen-only / talk-only, remote / local, and device clear functions.

(2) Interface functions

Function	Code	Description
Source handshake	SH1	Complete capability
Acceptor handshake	AH1	Complete capability
Talker	T7	Basic talker, talker release by MLA, talk only
Listener	L3	Basic listener, listener release by MTA, listen only
Service request	SR0	No capability
Remote / local	RL1	Complete capability
Parallel poll	PP0	No capability
Device clear	DC1	Complete capability
Device trigger	DT0	No capability
Controller	C0	No capability

2-11 EXTERNAL CONTROL INTERFACE (EXT CONTROL I / O)

(1) Remote sequential recall

(2) Remote modify

(3) Remote direct recall

(4) Control output

(5) Print out of memory contents (list output)

(6) Data read

(7) Relay drive output

2-12 OTHERS

(1) Mains voltage	100 V : 90 V to 110 V 120 V : 108 V to 132 V 230 V : 198 V to 244 V 240 V : 216 V to 250 V
(2) Mains frequency	50 / 60 Hz
(3) Power consumption	90 VA or less
(4) Dimensions	426 mm (W), 99 mm (H), 400 mm (D) (Knobs, connectors, handle and feet excluded)
(5) Mass	Approx. 15 kg
(6) Limit range of guaranteed performance	Temperature : 10 to 35 °C Relative humidity : 20 to 85 %
(7) Limit range of operation	Temperature : 0 to 40 °C Relative humidity : 20 to 90 %
(8) Storage and transportation	Temperature : – 20 to 70 °C Relative humidity : 20 to 90 %

2-13 ACCESSORIES FURNISHED

Power cable	1
Spare fuse	1
Instruction manual	1
GP-IB connector shield cap	1

SECTION III
INSTALLATION

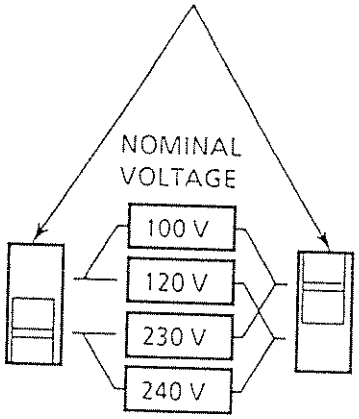
3-1 POWER REQUIREMENTS

The model VP-8122A can be operated from any power source supplying 100 V, 120 V, 230 V and 240 V (nominal values), 50 or 60 Hz. Power consumption is 90 VA or less.

WARNING

Before connecting AC power to the instrument, be sure it is set for the proper mains voltage and is properly fused as indicated on the rear panel. (See figure 3-1 below.)

Voltage selection switches (shown set for 230 V)



NOMINAL	RANGE
100 V	90 - 110 V
120 V	108 - 132 V
230 V	198 - 244 V
240 V	216 - 250 V

Figure 3-1 Voltage selection

3-2 MAINS VOLTAGE SELECTION

Refer to figure 3-1. Set the NOMINAL VOLTAGE switches to the setting (100 V, 120 V, 230 V or 240 V) that corresponds to the mains voltage to be used. The voltage must be within the range noted on the rear panel and in Figure 3-1.

3-3 FUSE

Verify the proper fuse is installed in the fuse holder. Ratings of the fuse are noted on the rear panel and listed below.

Nominal voltage	Fuse
100 V	250 V
120 V	1.25 A
230 V	250 V
240 V	0.63 A

WARNING

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of make-shift fuses and short-circuiting of fuse holders are prohibited.

3-4 POWER CABLE

The VP-8122A is equipped with a detachable power cable assembly. The type of the plug shipped with each instrument depends on the country of destination. Figure 3-2 illustrates four types of power cables available.

To order a power cable, include the instrument model number, instrument ID number, and the cable type shown in Figure 3-2. Address the order to the dealer or representative from which you purchased the instrument.

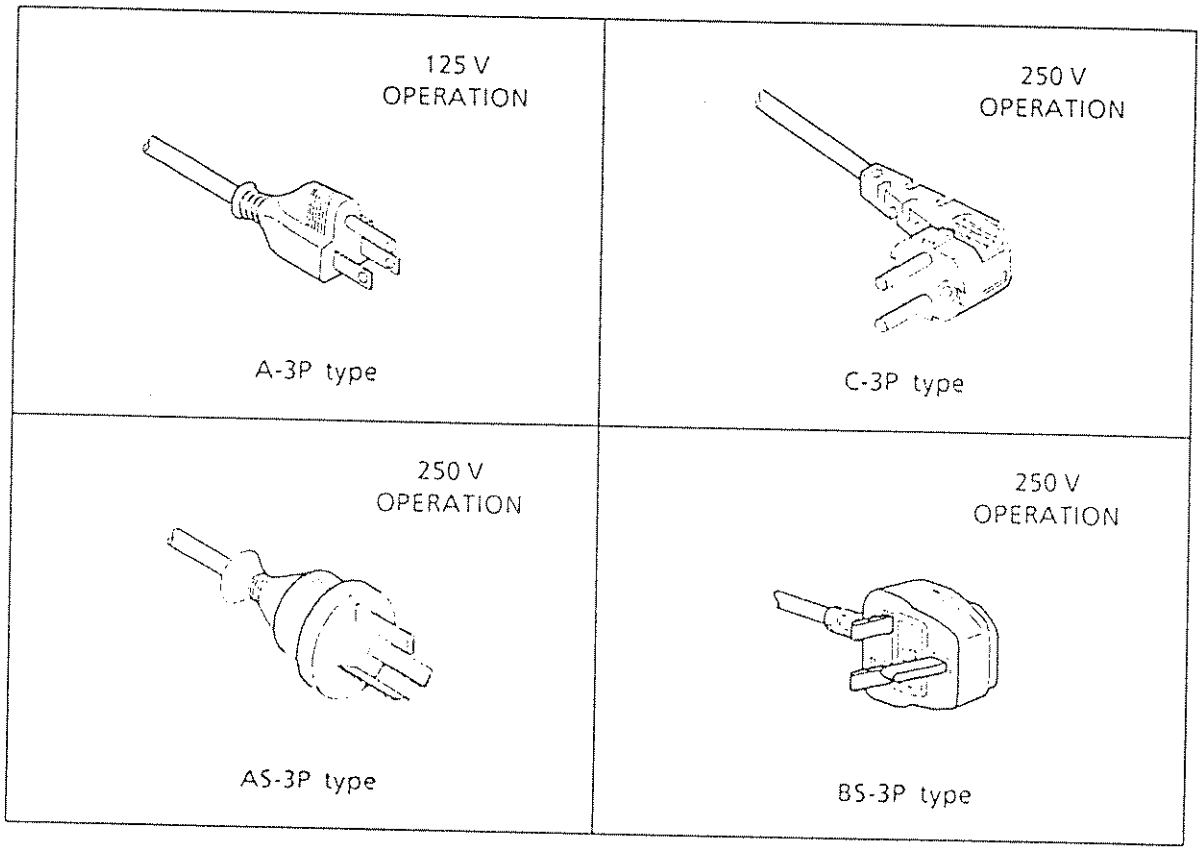


Figure 3-2 Power cables

3-5 INTERCONNECTIONS

Plug the power cable into a properly grounded 3-wire receptacle before connecting the instrument to other equipment. The interconnections are made with input / output coaxial connectors on the front panel and RCA-type pin connector GP-IB connector, EXT CONTROL I / O connector, and coaxial connector (option) on the rear panel.

All outer metal shells of coaxial connectors and RCA-type pin connector are directly connected to the chassis and frame of the instrument.

No hazardous voltage will appear on any pin of all types of connectors. The multi-pin rear panel connectors, GP-IB and EXT CONTROL I / O, should only be connected to the control devices meeting the specifications of the instrument. See sections V through VII of this manual.

Use the dedicated cable, VQ-023H10 for connecting the EXT CONTROL I / O connector of the instrument with a printer for memory list output. Otherwise it may result in failure.

CAUTION

Never apply reverse power to the coaxial output connectors or a failure may occur.

3-6 MOUNTING ON A BENCH

The instrument has plastic feet and a fold-away tilt stand. The tilt stand raises the front of the instrument for easier operation of the front panel controls.

Stacking with other instruments may be allowed only when it does not cause degradation of the performance due to interference such as vibration or electromagnetic induction.

3-7 RACK MOUNTING

If the instrument is rack mounted, a set of rack mount kit is required. The kit can be assembled easily and suited to 480 mm wide racks conforming to JIS C 6010. (Rack mount kit : VQ-069H10)

3-8 BATTERY

The battery for memory backup gets automatically charged during operation of the instrument. When, however, using the instrument for the first time or after more than a month interval, turn the power on the eight hours or more.

3-9 OTHERS

(1) Ambient temperature

The instrument can be operated within the temperature range of 0°C to 40°C. For fully-guaranteed performance, use the instrument in the range of 10°C to 35°C.

(2) Warm-up

Allow a warm-up period of at least 15 minutes before measurement.

(3) EMI PREVENTION

When the GP-IB connector is not used, cover the connector with the attached shield cap prior to operation of the instrument.

SECTION IV
OPERATION

4-1 GENERAL

This paragraph describes the basic panel operation procedures of the VP-8122A. The basic operation of the standard signal generator includes: (1) RF output signal frequency setup, (2) RF output signal output level setup, (3) AM / FM modulation status setup, (4) AM / FM stereo setup, (5) main- and sub-channel signal setup, (6) PILOT signal setup, and (7) SCA signal setup. In addition to these operations, the VP-8122A provides the preset memory function. As a remote control interface, the GP-IB and EXT CONTROL I/O are available.

The first portion in this paragraph contains an overall description of functions specific to this instrument, as well as definition of the terms used in this instruction manual. The second portion contains a brief explanation of the operation panel followed by the operation procedures for each function in the order below. The GP-IB program codes for each operation are given in the corresponding paragraph.

4-4 RF frequency
4-5 Output level
4-6 Continuous control of output level
4-7 Amplitude modulation (AM)
4-8 Main- and sub-channel signal of AM stereo
4-9 AM pilot signal
4-10 Negative peak clipper setting
4-11 Frequency modulation (FM)
4-12 Main- and sub-channel signal of FM stereo
4-13 FM pilot signal
4-14 Total FM deviation
4-15 Pre-emphasis
4-16 SCA signal
4-17 Composite signal output level
4-18 Assorted preset memory
4-19 Auto sequence of assorted preset memory

The items common to all GP-IB functions are explained in Sections V and VI, and the EXT CONTROL I/O interface functions are in Section VII. The lists of the GP-IB program codes and error codes are given at the end of this manual.

4-2 SPECIFIC FUNCTIONS AND TERM DEFINITION

(1) Assorted preset memory

This function stores an RF frequency, output level, modulation status, and stereo status in a set in the memory, and recalls the set at a time as desired. Once recalled, any parameter can be modified at will. The generator accommodates up to 100 sets of parameters.

(2) Auto sequence

This function sequentially recalls the assorted preset memory contents at a desired time interval.

(3) Error code display

To warn that an erroneous operation or a setting beyond the specified range is found, the ERR light of the MEMORY ADDRESS readout is turned on and an error code indicating the type of the error is displayed as a two-digit number. The error code remains displayed until the next operation is executed. The description of error codes is given in each operation involved, and a list of the codes is also provided at the end of this manual.

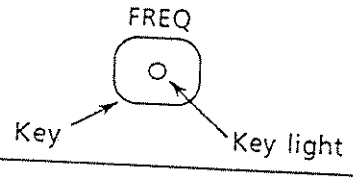
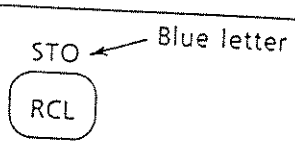
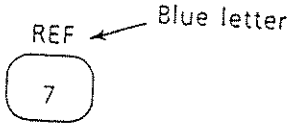
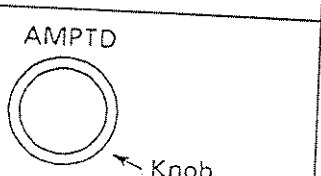
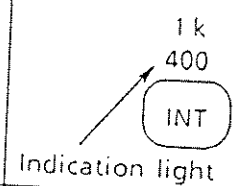
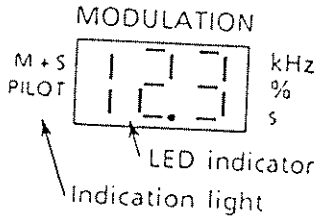
(4) Total FM deviation

Total FM deviation stands for a sum of M + S level ratio and PILOT level ratio in FM stereo.

(5) Expression of the operation panel according to categories

The controls and indicators on the operation panel are expressed as shown in the following list. Brief explanations of the categories 1 to 7 are given. For functions of the controls, see the paragraph 4-3 or later.

Expression of the operation panel according to categories

Category	Appearance on the front panel	Expression in text		Expression in operation example
1		FREQ key		FREQ
2		(a)	MHz key	MHz
		(b)	dBm	dBm
3		(a)	RCL	RCL
		(b)	<RCL> STO key	STO
4		(a)	DATA key [7] or [7] key	7
		(b)	<7> REF key	REF
5		AMPTD knob CW : clockwise CCW : counterclockwise		Knob 7 steps (CW) (CCW)
6		INT key INT 400 Hz		(1 k) 400 INT
7		FM deviation 12.3 kHz		1 2. 3 kHz

Category 1 : This key has one function. Though the key light is not expressed in the list, it is expressed in text as required.

Category 2 : This key has two functions of MHz and dBm.
The MHz key shown in item (a) means that the key is used as MHz or called as a general term independent of functions.
The dBm key shown in item (b) means that the key is used as dBm.

Category 3 : This key is used as the RCL key shown in item (a) in normal operation.
The <RCL> STO key shown in item (b) means that the key is used as the STO key when the function shifts from the RCL key to the STO key with the SHIFT key (see the paragraph 4-3). In the expression in operation examples, RCL is not expressed.

Category 4 : This key is used as the [7] key shown in item (a) in normal operation.
The <7> REF key shown in item (b) means that the function shifts from the [7] key to the REF key.

Category 5 : The knob is not illustrated in both the text and operation examples.

Category 6 : The light for either 400 Hz or 1 kHz that is effective is turned on. The example shows a case where 400 Hz is effective.

Category 7 : The expression is limited to those indication lights that are turned on.

NOTE

The signal generator is battery backed up and the setup conditions are retained even after the power is turned off.

4-3 OPERATION PANEL

The illustrations of the front and rear panel are available on a foldout page at the end of this manual. The keys and connectors are numbered from ① to ㉚. Given below are their names and brief descriptions of the functions.

(1) Front panel

① POWER switch : A button switch for turning the mains power on and off.

② REMOTE/LOCAL key : Switches from the GP-IB remote control to the local control condition. The key light is turned on for the remote control, and turned off for the local control.

③ MEMORY ADDRESS display

MEMORY ADDRESS readout : Displays an assorted preset memory address in normal operation. An error code will appear if an erroneous operation is executed for the RF frequency, output level, AM degree, FM deviation, M + S level ratio, or PILOT level ratio setup.

AUTO light : Turned on at the auto sequence operation of the assorted preset memory.

ERR light : Turned on if an erroneous operation is executed and an error code is displayed.

④ MODULATION display

MODULATION readout :

Displays a setting value in the following operations.

- AM degree, FM deviation, or total FM deviation setup.
- M + S level ratio, PILOT level ratio, or PILOT signal modulation degree setup.
- Interval time setup at the auto sequence operation of the assorted preset memory.

FM / L, AM / R HI / LO light :

Display the judgment result of the external modulation input signal level in the AM and FM external modulation operation.
If an input level is out of the reference value, the HI or LO light is turned on; it is within the reference value, both HI and LO lights are turned off.

M + S light :

Turned on when the M + S level ratio is displayed.

PILOT light :

Turned on when the PILOT level ratio is displayed.

kHz light :

Turned on in the FM modulation operation to advise kHz as a unit for FM deviation or total FM deviation.

% light :

Turned on in the AM modulation operation, M + S level ratio, PILOT level ratio, or PILOT signal modulation degree to advise % as a unit for AM degree or signal level ratio.

s light :

Turned on in the auto sequence operation of the assorted preset memory to advise s as a unit for interval time.

⑤ FREQUENCY display

FREQUENCY readout :

Displays a setting value in the following operations.

- RF frequency setup
- I / O mode setup related to GP-IB and external control interface.
- Setup of the auto sequence mode of the assorted preset memory.

ΔF light :

Turned on in the relative RF frequency (ΔF) display mode.

I / O light :

Turned on in the setup operation of the I / O and auto sequence modes.

⑥ AMPLITUDE display

AMPLITUDE readout :

Displays a setting value in the following operations.

- RF output level setup.
- Composite signal output level setup.

ΔdB light :

Turned on in the relative output level (ΔdB) display mode.

CONT light :

Turned on in the continuous control operation of an output level.

dBm light :

Turned on to indicate dBm is specified as a unit for an RF output level.

dBμV light :

Turned on to indicate dBμV is specified as a unit for an RF output level.

dB light :

Turned on to indicate the ΔdB display mode is selected and the unit is dB.

mV light :

If an output level value specified with μV or mV is in the range of 1 to 4000 mV, the light is turned on to indicate the unit of the AMPLITUDE displayed value is "mV."

μV light :

If an output level value specified with μV or mV is 999 μV or less, the light is turned on to indicate the unit of the AMPLITUDE displayed value is "μV."

EMF light :

Turned on to indicate an RF output level value is specified with the open end display.

⑦ RF OUTPUT block

OFF key :

Selects the RF output signal on / off. Turned on to indicate the output signal is off.

50 Ω / 75 Ω key :

Switches the output impedance between 50 Ω and 75 Ω. Turned on to indicate the output impedance is 75 Ω.

RF OUTPUT connector :

A BNC-type receptacle for an RF output signal.

⑧ MODIFY block

In the FREQ / MOD operation part

⊟ ⊟ keys :

Used in the following operations.

- Designating a digit to be modified for the setting value of an RF frequency, AM/FM modulation, M + S level ratio, PILOT level ratio, or PILOT signal modulation degree.
- Designating a digit to set the mode of the GP-IB, external control interface, or auto sequence.

FREQ / MOD knob :

Used in the following operations.

- Modifying the numeral at the designated digit of an RF frequency, AM / FM modulation, M + S level ratio, PILOT level ratio, or PILOT signal modulation degree setting value.

<⊟> ΔdB OFF key :

Pressing the SHIFT key ⑮ causes the function of the ⊟ key in the FREQ / MOD operation part to shift to ΔdB OFF. This key is used to cancel the ΔdB display of an RF output level.

<⊟> ΔF OFF key :

Pressing the SHIFT key ⑮ causes the function of the ⊟ key in the FREQ / MOD operation part to shift to ΔF OFF. This key is used to cancel the ΔF display of a frequency.

AMPTD operation part

⊟ ⊟ keys :

Used to designate a digit to be modified for the setting value of an output level.

AMPTD knob :

Used to modify the numeral at the designated digit of an output level value.

<⊟> EMF ON / OFF key :

Pressing the SHIFT key ⑮ causes the function of the ⊟ key in the AMPTD operation part to shift to EMF ON / OFF. Except when the display unit is dBm, this key is used as EMF ON and the output level is specified with open end display. Pressing the key again generates EMF OFF.

<⊟> CONT ON/OFF key: Pressing the SHIFT key ⑮ causes the function of the ⊟ key in the AMPTD operation part to shift to CONT ON / OFF. Thus the AMPTD knob in the MODIFY block allows for continuous control operation. Pressing the key again generates CONT OFF.

⑨ ENTER block

MHz or dBm key: Serves in two ways

MHz key ..... Selects the MHz unit at frequency setup.

dBm key ..... Selects the dBm unit at output level setup.

kHz or dBμV key: Serves in two ways

kHz key ..... Selects the kHz unit at frequency setup, FM deviation, or total FM deviation.

dBμV key ..... Selects the dBμV unit at output level setup.

mV or % key: Serves in two ways

mV key ..... Selects the mV unit at output level or composite signal output level setup.

% key ..... Selects the % unit at AM degree, PILOT level ratio, PILOT signal modulation degree, or M + S level ratio setup.

μV, or s key: Serves in two ways

μV key ..... Selects the μV unit at output level setup.

s key ..... Selects the s unit to set an interval time in the auto sequence of assorted preset memory.

When a value is entered with DATA keys in the DATA block ⑩, the key lights of the available units blink. Pressing an appropriate key to select a unit turns off the light.

⑩ DATA block

DATA keys [0] [1] ..... [9] [.] [−] :

The twelve keys are used to enter parameters required for the following readouts.

- MEMORY ADDRESS readout ③
- MODULATION readout ④
- FREQUENCY readout ⑤
- AMPLITUDE readout ⑥

<7> REF key: Pressing the SHIFT key ⑮ shifts the function of the DATA key [7] to REF.

The key is used to set a reference value of ΔF or ΔdB.

<4> DRIVE key: Pressing the SHIFT key ⑮ shifts the function of the DATA key [4] to DRIVE.

The key is used to set a reverse frequency of a relay drive output.

<1> INTVL key: Pressing the SHIFT key ⑮ shifts the function of the DATA key [1] to INTVL.

The key is used to select the interval time setup mode in the auto sequence operation of assorted preset memory.

<0> I/O MODE key :

Pressing the SHIFT key ⑮ shifts the function of the DATA key [0] to I/O MODE.
The key is used to select the I/O mode setup mode required for the following operations.

- GP-IB
- External control interface
- Auto sequence of preset memory

<8> FT-T key :

Pressing the SHIFT key ⑮ shifts the function of the DATA key [8] to FT-T.
The key is used to specify total FM deviation.

<5> LEVEL-C key :

Pressing the SHIFT key ⑮ shifts the function of the DATA key [5] to LEVEL-C.
The key is used to specify a composite signal level.

<2> PORT 1 key :

Pressing the SHIFT key ⑮ shifts the function of the DATA key [2] to PORT 1.
The key is used to set the mode for PORT 1 of the external control interface.

<.> PORT 2 key :

Pressing the SHIFT key ⑮ shifts the function of the DATA key [.] to PORT 2.
The key is used to set the mode for PORT 2 of the external control interface.

⑪ FUNCTION block

FREQ key :

Enables frequency setup with the key light turned on.

AMPTD key :

Enables output level setup with the key light turned on.

FM key :

Enables frequency modulation setup with the key light turned on.

AM key :

Enables amplitude modulation setup with the key light turned on.

⑫ MODULATION MODE block

MONO key :

Selects the monaural mode of FM stereo modulation and AM stereo modulation.

L=R key :

Selects the L=R mode of FM stereo modulation and AM stereo modulation.

L key :

Selects the L mode of FM stereo modulation and AM stereo modulation.

R key :

Selects the R mode of FM stereo modulation and AM stereo modulation.

L=−R key :

Selects the L=−R mode of FM stereo modulation and AM stereo modulation.

INT L-EXT R key :

Selects the stereo modulation with one external signal and one internal signal.

EXT L, R key :

Selects the stereo modulation with two external signals.

OFF key :

Turns a main- and sub-channel signal off. The key light is turned on when the main- and sub-channel signal setup is off.

FM ON key :

Alternately turns frequency modulation on or off. The key light is turned on at its ON state.

AM ON key :

Alternately turns amplitude modulation on or off. The key light is turned on at its ON state.

SCA key :

Alternately turns the SCA signal on or off. The key light is turned on at its ON state.
Any signal externally applied to the SCA INPUT terminal on the rear panel of this instrument is superimposed on the output signal from the instrument.

NEG PEAK CLIPPER key :

Alternately turns the negative peak clipper on or off to avoid excessive AM degree. The key light is turned on at its ON state.

M + S key :

Enables the main- to sub-channel signal level ratio setup with the key light turned on.

PILOT ON key :

Alternately turns the PILOT signal on or off. The key light is turned on at its ON state. If the modulation mode is set to MONO, however, the PILOT signal cannot be turned on.

LEVEL key :

Pressing the SHIFT key ⑮ shifts the function of the PILOT ON key to PILOT LEVEL. The key can be used to specify a PILOT level ratio, and the modulation degree of the PILOT signal with the key light turned on.

⑬ AM / R block
INT key :

Used to select an internal modulation signal of 400 Hz or 1 kHz for amplitude modulation.
Either frequency is selected alternately by pressing the key.

400 Hz light / 1 kHz light :

The AC light of the EXT key is turned off.
The frequency light selected with the INT key is turned on.

EXT key :

Used to select an external modulation signal for amplitude modulation.

AC light :

The 400 Hz / 1 kHz light of the INT key is turned off.
Turned on by pressing the EXT key.

⑪ FM / L block
INT key :

Used to select an internal modulation signal of 400 Hz or 1 kHz for frequency modulation.
Either frequency is selected alternately by pressing the key.

400 Hz light / 1 kHz light :

The AC light of the EXT key is turned off.
The frequency light selected with the INT key is turned on.

EXT key :

Used to select an external modulation signal for frequency modulation.

AC light :

The 400 Hz / 1 kHz light of the INT key is turned off.
Turned on by pressing the EXT key.

⑮ SHIFT key :

Shifts one function to another function (blue letters) for those keys having two functions. Pressing the key turns on the key light; pressing the key to be shifted turns off the light.

⑯ PRE-EMPHASIS key :

Used to specify the time constant when the main- and sub-channel signal are provided with the pre-emphasis feature. Pressing the key allows several pre-emphasis conditions to be selected in the following order. The key light indicating the selected time constant is turned on. Every key light is turned off at the PRE- EMPHASIS key OFF state.

OFF → 25 μs → 50 μs → 75 μs → OFF

⑰ MEMORY BLOCK

↑ key :

If the key is pressed in sequentially recalling assorted preset memory, the address after the currently displayed memory is recalled.

↓ key :

If the key is pressed in sequentially recalling assorted preset memory, the address before the currently displayed memory is recalled.

CLR key :

If the key is pressed in sequentially recalling assorted preset memory, the start address is recalled.

RCL key :

Used for direct recall operation of the assorted preset memory and for group designation operation in sequential recall of the assorted preset memory.

<↑> AUTO/MANU key :

Pressing the SHIFT key ⑮ shifts the function of the ↑ key to AUTO / MANU.

The key is used to execute the auto sequence of assorted preset memory.

To stop the auto sequence, execute the same operation as above.

<↓> COPY key :

Pressing the SHIFT key ⑮ shifts the function of the ↓ key to COPY.

The key is used to transfer the assorted preset memory data via the GP-IB interface between the VP-8122A generators.

<CLR> LIST key :

Pressing the SHIFT key ⑮ shifts the function of the CLR key to LIST.

The key is used to print out the assorted preset memory contents via the external control interface.

<RCL> STO key :

Pressing the SHIFT key ⑮ shifts the function of the RCL key to STO.

The key is used for store operation and for grouping operation in sequential recall of assorted preset memory.

⑱ EXT INPUT block

FM / L connector :

A BNC-type receptacle for applying the following signals.

1. FM external modulation signal.
2. External modulation signal at the L side in the EXT L, R modulation mode.

AM / R connector :

A BNC-type receptacle for applying the following signals.

1. AM external modulation signal.
2. External modulation signal at the R side in the INT L-EXT R or EXT L, R modulation mode.

(2) Rear panel

⑲ DRIVE OUTPUT connector : An RCA-type pin connector for obtaining a signal for an external relay drive.

⑳ EXT CONTROL I/O connector : A 36-pin connector for connecting the external control interface.

㉑ GP-IB connector : A 24-pin connector for connecting the GP-IB interface.

㉒ NOMINAL VOLTAGE switch : Selects a mains voltage appropriate for the local AC supply.

㉓ MAINS INPUT connector : Accepts a power cable.

㉔ FUSE holder : Holds the mains input fuse.

㉕ RF OUTPUT : The reserved place to which the RF OUTPUT connector on the front panel will be moved.

㉖ PILOT connector : A BNC-type receptacle for obtaining the PILOT output signal.

㉗ COMPOSITE connector : A BNC-type receptacle for obtaining an FM stereo modulation signal

㉘ SCA connector : A BNC-type receptacle for obtaining the SCA signal externally.

㉙ FM / L connector : The reserved place to which the FM / L connector on the front panel will be moved.

㉚ AM / R connector : The reserved place to which the AM / R connector on the front panel will be moved.

4-4 RF FREQUENCY

The basic operation of the RF frequency includes :

- Direct setup with DATA keys in the DATA block.
- Modification with the FREQ / MOD knob in the MODIFY block.
- Setup of the relative value (ΔF) display.

(1) Readout and frequency band

An RF frequency is displayed in the FREQUENCY readout within the range of 0.01000 to 280.00000 MHz. The decimal point denotes the place of MHz.

The frequency ranges for operationally divided bands and their setting resolutions are listed in Table 4-1, and the relationship between an RF frequency and the AM / FM bands shown in Table 4-2.

Table 4-1 Frequency range for each band

Band	Frequency range (MHz)	Resolution (Hz)	Note
4	140.00002 to 280.00000	20	
3	70.00001 to 140.00000	10	
2	35.00001 to 70.00000		
1	0.01000 to 35.00000		
	0.010000 to 2.000000	1	In AM stereo mode

Table 4-2 Relationship between an RF frequency and AM / FM bands

Frequency (MHz)	AM / FM band	Note
2.00001 to 280.00000	FM band	FM : monophonic / stereo, AM : monophonic only
0.010000 to 2.000000	AM band	FM : monophonic only, AM : monophonic / stereo

NOTE

FM and AM mixed modulation is disabled in AM stereo mode.

Setting a frequency beyond the acceptable range might cause an error to occur. In such a case, study (6) in this paragraph to find out the contents of the error and then again execute the required setup.

In the relative value display mode, an actual frequency will never exceed the range. The ΔF light of the FREQUENCY readout is turned on to indicate the relative value display mode is selected. How to select the relative value display mode is explained (4) in this paragraph.

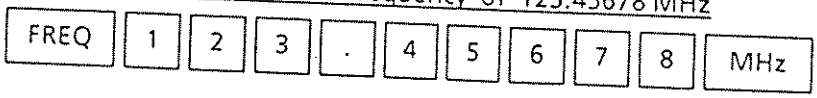
(2) Direct setup with DATA keys

- Press the FREQ key of the FUNCTION block.
- Enter a numeric value with DATA keys of the DATA block.
- Press either MHz or kHz key of the ENTER block.

A desired frequency can be directly set through the above key operation.

Although the setup is acceptable in either unit of MHz or kHz, the set frequency value will be displayed in MHz only.

Example 4-1) Setting the RF frequency of 123.45678 MHz



Example 4-2A) Setting the RF frequency of 1.234 MHz when the modulation mode of the AM band is MONO.

Step	Keystroke	FREQUENCY readout	Note
①	1	1	ENTER key block MHz and kHz lights blink.
②	2	12	
③	3	123	
④	4	1.234	ENTER key block MHz light blinks, kHz light turns off.
⑤	MHz	1.234 00	

Example 4-2B) Setting the RF frequency of 1.234 MHz when the modulation mode of the AM band is other than MONO.

Step	Keystroke	FREQUENCY readout	Note
①	1	1	ENTER key block MHz and kHz lights blink.
②	2	12	
③	3	123	
④	4	1.234	ENTER key block MHz light blinks, kHz light turns off.
⑤	MHz	1.234 000	

(3) Modification with the FREQ/MOD knob

- Press the FREQ key of the FUNCTION block.
- Specify a digit to be modified with the ⊖ ⊕ keys of the FREQ/MOD operation part in the MODIFY block.
- Modify the value with the FREQ/MOD knob of the MODIFY block.

A desired digit can be modified through the above key operation.

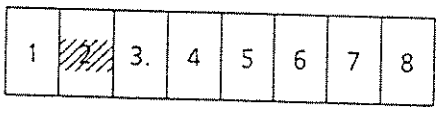
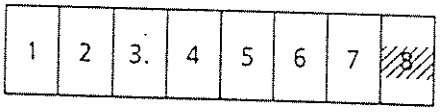
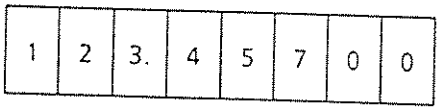
Use the ⊖ ⊕ keys to specify the digit to be modified with the FREQ/MOD knob. The specified digit will blink.

The FREQ/MOD knob rotates endlessly; rotating the knob clockwise increments the frequency while rotating it counterclockwise decrements the frequency. As the modified digit reaches 9 (incrementing) or 0 (decrementing), the digit to its left will increment or decrement.

Example 4-3) Shifting the digit to be modified with the ⊖ ⊕ keys of the FREQ/MOD operation part

Step	Keystroke	FREQUENCY readout	Note
①	FREQ ⊖	1 2 3. 4 5 6 7 8	The digit currently modifiable begins to blink. At first, the modifiable digit does not shift.
②	⊖	1 2 3. 4 5 6 7 8	The modifiable digit shifts to a higher place.
③	⊖ ... ⊖	1 2 3. 4 5 6 7 8	The modifiable digit shifts to a higher place.
④	⊖	1 2 3. 4 5 6 7 8	The modifiable digit shifts to the lowest place.
⑤	⊖	1 2 3. 4 5 6 7 8	The modifiable digit shifts to a higher place again.
⑥	⊕	1 2 3. 4 5 6 7 8	The modifiable digit shifts to a lower place.
⑦	⊕	1 2 3. 4 5 6 7 8	The modifiable digit shifts to the highest place.
⑧	⊕	1 3. 4 5 6 7 8	Blinking stops in above five seconds.

Example 4-4) Modifying the frequency from 123.45678 to 123.45700 MHz

Step	Keystroke	FREQUENCY readout	Note
①	FREQ ←		The digit currently modifiable begins to blink.
②	← ←		Cause the lowest digit to blink.
③	CW		Blinking stops to show the frequency has been modified. Knob 22 steps

(4) Relative value display

The relative value of an RF frequency can be displayed as an increment or decrement from a designated reference value.

The relative RF frequency value can be set in the range of -199.99999 to 199.99999 MHz.

NOTE

In AM stereo, the resolution of the relative RF frequency setting value is 1 Hz.

(a) Setting a reference frequency

- Press the SHIFT key.
- Press the <7> REF key of the DATA block.
- Press the FREQ key of the FUNCTION block.
- Enter a numeric value with DATA keys of the DATA block.
- Press either MHz or kHz key of the ENTER block.

A reference frequency for the relative value display is set through the above key operation.

Once the reference frequency is set, the frequency will be displayed for about one second. Then the ΔF light of the FREQUENCY readout is turned on and the FREQUENCY readout will display the relative value.

The setting range and resolution are same as the direct setup, shown in Table 4-1.

Example 4-5) Setting a reference frequency to 100 MHz

Step	Keystroke	FREQUENCY readout	Note
①		1 2 3. 4 5 6 7 8	Current frequency set value.
②	SHIFT REF FREQ 1 0 0 MHz		
		1 0 0. 0 0 0 0 0	Displayed for about one second.
③	ΔF	2 3. 4 5 6 7 8	Relative value display.

If no DATA key is entered in the above operation, the frequency currently displayed will serve as a reference value.

Example 4-6) Using the frequency currently displayed as a reference value

Step	Keystroke	FREQUENCY readout	Note
①		1 2 3. 4 5 6 7 8	Current frequency set value.
②	SHIFT REF FREQ MHz		
		1 2 3. 4 5 6 7 8	Displayed for about one second.
③	ΔF	0. 0 0 0 0 0	Relative value display.

During the relative value display mode (the ΔF light on), no reference frequency can be set.

Example 4-7) Verifying the reference value

Keystroke	FREQUENCY readout	Note
SHIFT REF FREQ		
ΔF	1 0 0. 0 0 0 0 0	Displayed for about five seconds.

The reference value can be verified only in the relative display mode (the ΔF light on).

NOTE

Entering a reference value is allowed only for about ten seconds after the <7> REF and FREQ keys are pressed, during which the keys of the ENTER block are blinking. Be sure to start pressing a key in the DATA block within five seconds after pressing the <7> REF and FREQ keys. Otherwise the reference value setting mode will be canceled.

(b) Setting a relative frequency value

The relative frequency setting operation includes setting with DATA keys and modification with the FREQ / MOD knob. During the relative value display mode (the ΔF light on), the operation is executed in a manner similar to those discussed in (2) and (3) except that every set value will be treated as a relative value.

If a modulation mode is set to any mode other than MONO, however, no relative frequency can be set beyond the range for each AM and FM band shown in Table 4-2.

If both AM MONO and FM MONO are selected, a relative frequency beyond each band range is acceptable, though the modulation mode cannot be changed from MONO to others in the subsequent operation. To change the modulation mode, the relative value display mode should be canceled (the ΔF light off).

Example 4-8A) Setting – 1 MHz for a relative frequency value with the reference frequency set to 100 MHz

Step	Keystroke	FREQUENCY readout	Note
①	ΔF	2 3. 4 5 6 7 8	Current relative frequency set value.
	FREQ – 1 MHz		
②	ΔF	– 1. 0 0 0 0 0	The actual frequency is 99 MHz.

Example 4-8B) Setting the relative RF frequency within the range for AM band when the modulation mode is other than MONO

Step	Keystroke	FREQUENCY readout	Note
①	ΔF	0. 0 0 0 0 0	Reference frequency : 10 MHz Modulation mode of FM band : L = R Modulation mode of AM band : MONO
	FREQ – 9 MHz		
②	ΔF	0. 0 0 0 0 0	Set frequency is 10 – 9 = 1 MHz. Since the frequency is in the range for AM band, error 12 occurs (setting is invalid).
	MONO		
③	ΔF	0. 0 0 0 0 0	Modulation mode of FM band is set to MONO.
	FREQ – 9 MHz		
④	ΔF	– 9. 0 0 0 0 0	Relative frequency can be set in the range of AM band, since both the modulation modes of AM and FM band are MONO.
	L = R		
⑤	ΔF	– 9. 0 .0 0 0 0	The modulation mode of AM band cannot be changed from MONO to others since the reference frequency is in the range of FM band.

(c) Canceling the relative value display mode

The relative frequency value display mode is canceled by pressing the SHIFT key and then <⊖> ΔF OFF key of the MODIFY block. The ΔF light of the FREQUENCY display will be turned off and the normal frequency will be recovered in the FREQUENCY readout.

(5) GP-IB program code

As for an RF frequency, the GP-IB can control the direct setup of a frequency in a numeric value. Table 4-3 gives the program codes.

Table 4-3 GP-IB program codes for an RF frequency

Header code	Data code	Unit code	Description
FR	0.01000 to 280.00000 10.00000 to 280000.00	MZ KZ	Sets an RF frequency in MHz. Sets an RF frequency in kHz.

(6) Error

When an erroneous operation is done during the RF frequency control, an error code listed in the table 4-4 will appear in the MEMORY ADDRESS readout. If the instrument operates under the remote control with the GP-IB, no error code will appear.

Table 4-4 Possible errors during RF frequency setup

Error code	Error description	Occurs upon :	Result
10	Setting value of the RF frequency is beyond the range of 0.01 to 280.00000 MHz.	Pressing the ENTER key.	The setting value is unacceptable.
11	In any case of the following : ① Setting value of the reference frequency is beyond the range of 0.01 to 280.00000 MHz. ② Reference frequency is set beyond the range of ± 199.99999 MHz from the current RF frequency. ③ Reference frequency is set to the point exceeding 2 MHz from the current RF frequency.	Pressing the ENTER key.	The setting value is unacceptable.
12	In any case of the following : ① Setting value of the relative frequency is beyond the range of − 199.99999 to 199.99999 MHz. ② Relative frequency is set so that the actual RF frequency exceeds the range of 0.01 to 280 MHz. ③ Relative frequency is set to the point exceeding 2 MHz from the reference frequency.	Pressing the ENTER key.	The setting value is unacceptable.

Table 4-4 Possible errors during RF frequency setup (Cont'd)

Error code	Error description	Occurs upon :	Result
13	RF frequency is set to the value less than two times the current FM deviation.	Pressing the ENTER key.	The setting value is acceptable and FM modulation is turned off.
14	RF frequency is set within the AM band under the following conditions : ① The modulation mode is set to any mode other than MONO in the AM band. ② FM modulation is ON in the FM band.	Pressing the ENTER key.	The setting value is acceptable and FM modulation is turned off.
15	RF frequency is set within the AM band under the following conditions : ① The modulation mode is set to any mode other than MONO in the FM band. ② The product of the M + S level ratio by the FM deviation is 271 kHz or more.	Pressing the ENTER key.	The setting value is acceptable and FM modulation is turned off.
16	RF frequency is set to the value less then two times the current FM deviation under the following conditions : ① The modulation mode is set to any mode other than MONO in the AM band. ② FM modulation is ON in the FM band.	Pressing the ENTER key.	The setting value is acceptable and FM modulation is turned off.
17	RF frequency is set to the value less then 600 kHz under the following conditions : ① The modulation mode is set to any mode other than MONO in the FM band. ② The product of the M + S level ratio by the FM deviation is 271 kHz or more.	Pressing the ENTER key.	The setting value is acceptable and FM modulation is turned off.
18	RF frequency is set within the FM band under the following conditions : ① The modulation mode is set to L / R in the AM band. ② AM modulation degree is set to 63 % or more.	Pressing the ENTER key.	The setting value is acceptable and AM modulation degree is changed to 125 %.

4-5 OUTPUT LEVEL

The basic operation of an output level includes :

- Direct setup with DATA keys.
- Change of a unit with a unit key of the ENTER block.
- Modification with the AMPTD knob of the MODIFY block.
- Relative value (ΔdB) display.
- EMF (open end) display
- Turning on / off of RF output

(1) Readout and unit

An output level is displayed in the AMPLITUDE readout. Table 4-5 shows the display ranges and units.

Table 4-5 Display ranges and units of output levels

Mode	Display range	Unit	Resolution	Note
1	– 133.0 to 19.0 – 134.8 to 17.2	dBm	0.1 dB	0 dBm : 1 mW (50 Ω) 0 dBm : 1 mW (75 Ω)
2	– 26.0 to 126.0	dBμV	0.1 dB	0 dB : 1 μVrms across 50 Ω load (dBμV)
3	– 20.0 to 132.0	dBμV EMF	0.1 dB	0 dB : 1 μVrms at open end (dB EMF)
4	0.050 to 0.999 1.00 to 9.99 10.0 to 99.9 100 to 999 1.00 to 9.99 10.0 to 99.9 100 to 2000	μV μV μV μV mV mV mV	0.001 μV 0.01 μV 0.1 μV 1 μV 0.01 mV 0.1 mV 1 mV	RMS voltage across 50 Ω / 75 Ω load
5	0.100 to 0.999 1.00 to 9.99 10.0 to 99.9 100 to 999 1.00 to 9.99 10.0 to 99.9 100 to 4000	μV EMF μV EMF μV EMF μV EMF mV EMF mV EMF mV EMF	0.001 μV 0.01 μV 0.1 μV 1 μV 0.01 mV 0.1 mV 1 mV	RMS voltage at open end

Since the signal generator uses an attenuator of 0.1 dB resolution, the voltage in modes 4 and 5 will appear as a value rounded off to be as near as possible to the actual output voltage.

Table 4-5 shows the display ranges without modulation. The VP- 8122A has a different output level setting range for AM modulation as shown in Tables 4-6.

Table 4-6 Performance-guaranteed range of output level for AM modulation

Output level range
– 133 to + 13 dBm (Output impedance 50 Ω)
– 134.8 to + 11.2 dBm (Output impedance 75 Ω)
– 26.0 to 120.0 dBμV
– 20.0 to 126.0 dBμV EMF
0.050 μV to 1000 mV
0.100 μV EMF to 2000 mV EMF

The ΔdB display range is 0.0 to ± 152 dB, but the actual output level cannot exceed the acceptable range. The + sign will be omitted for the display. The unit is dB. The operation procedure for the relative value display is provided in (5) of this paragraph.

(2) Change of a unit with a unit key

- Press the AMPTD key of the FUNCTION block.
- Press the SHIFT key.
- Press an appropriate level unit key of the ENTER block.

The currently displayed output level unit can be changed through the above key operation.

Example 4-9) Changing the output level unit from dBm to mV (in case of 50 Ω)

Step	Keystroke	AMPLITUDE readout	Note
①	AMPTD	– 1 2. 3 dBm	Current output level set value.
②	SHIFT mV	5 4. 2 mV	Changes the output level unit.

(3) Direct setup with DATA keys

- Press the AMPTD key of the FUNCTION block.
- Enter a numeric value with DATA keys of the DATA block.
- Press an appropriate level unit key of the ENTER block.

A desired output level can be directly set through the above key operation. The value is set in dBm, dBμV, mV, or μV.

Example 4-10) Setting the output level of – 12.3 dBm

AMPTD	–	1	2	.	3	dBm

(4) Modification with the AMPTD knob

- Specify a digit to be modified with the ⊖ ⊖ keys of the AMPTD operation part in the MODIFY block.
- Modify the value with the AMPTD knob of the MODIFY block.

A desired digit of the output level display value can be modified through the above key operation.

Use the ⊖ ⊖ keys to specify the digit to be modified with the AMPTD knob. The specified digit will blink.

The AMPTD knob rotates endlessly; rotating the knob clockwise increments the output level while rotating it counterclockwise decrements the output level. As the modified digit reaches 9 (incrementing) or 0 (decrementing), the digit to its left will increment or decrement.

NOTE

The same modification operation can be done with the FREQ/MOD knob and the ⊖ ⊖ key in the MODIFY block during the light of the AMPTD key in the FUNCTION block is on.

Example 4-11) Shifting the digit to be modified with the ⊖ ⊖ keys of the AMPTD operation part

Step	Keystroke	AMPLITUDE readout	Note
①	⊖	− 1 2. 3 dBm	The digit currently modifiable begins to blink. At first, the modifiable digit does not shift.
②	⊖	− 1 2 3 dBm	The modifiable digit shifts to a higher place.
③	⊖	− 1 2. 3 dBm	The modifiable digit shifts to a higher place.
④	⊖	− 1 2. 3 dBm	The modifiable digit shifts to the lowest place.
⑤	⊖	− 1 2 3 dBm	The modifiable digit shifts to a higher place.
⑥	⊖	− 1 2. 3 dBm	The modifiable digit shifts to a lower place.
⑦	⊖	− 1 2. 3 dBm	The modifiable digit shifts to the highest place.
⑧	⊖	− 1 2 3 dBm	The modifiable digit shifts to a lower place. Blinking stops in about five seconds.

Example 4-12) Modifying the output level from − 12.3 dBm to − 13 dBm

Step	Keystroke	AMPLITUDE readout	Note
①	⊖	− 1 2 3 dBm	The digit currently modifiable begins to blink.
②	⊖ ⊖	− 1 2. 3 dBm	Cause the lowest digit to blink.
③	CCW	− 1 3. 0 dBm	Blinking stops to show the output level has been modified. Knob 7 steps

(5) Relative value display

The relative value of an output level can be displayed as an increment or decrement from a designated reference value.

(a) Setting a reference level

- Press the SHIFT key.
- Press the <7> REF key OF the DATA block.
- Press the AMPTD key of the FUNCTION block.
- Enter a numeric value with DATA keys of the DATA block.
- Press an appropriate level unit key of the ENTER block.

A reference level for the relative value display is set through the above key operation.

Once the reference level is set, the unit is changed to dB. Then the AMPTD readout contains the relative value display, and the ΔdB light is turned on.

The output impedance cannot be changed with the 50 Ω / 75 Ω key in the RF OUTPUT block in the relative value display mode (ΔdB light is on).

The setting range and resolution are same as the direct setup, shown in Table 4-5.

Example 4-13) Setting a reference level to – 12 dBm

Step	Keystroke	AMPLITUDE readout	Note
①		– 1 2. 3 dBm	Current output level set value.
②	SHIFT REF AMPTD – 1 2 dBm		
		– 1 2. 0 dBm	Displayed for about one second.
③	ΔdB	– 0. 3 dB	Relative value display.

If no DATA key is entered in the above operation, the output level currently displayed will serve as a reference value.

Example 4-14) Using the output level currently displayed as a reference level

Step	Keystroke	AMPLITUDE readout	Note
①		– 1 2. 3 dBm	Current output level set value.
②	SHIFT REF AMPTD dBm		
		– 1 2. 3 dBm	Displayed for about one second.
③	ΔdB	0. 0 dB	Relative value display.

No reference level can be set during the relative value display mode (ΔdB light is on).

Example 4-15) Verifying the reference level

Keystroke	AMPLITUDE readout	Note
SHIFT, REF, AMPTD	– 1 2. 0 dBm	Displayed for about five seconds.

The reference level can only be verified in the relative value display mode (ΔdB light is on).

NOTE

1) When dBm or dBμV is selected for the unit of the current output level, mV or μV cannot be selected for the unit of the reverence level. Similarly mV or μV is selected for the unit of the current output level, dBm or dBμV cannot be selected for the unit of the reference level.
2) Entering a reference level is allowed only for about five seconds after the <7> REF and AMPTD keys are pressed, during which the keys of the ENTER block are blinking. Be sure to start pressing a key in the DATA block within five seconds after pressing the <7> REF and AMPTD keys. Otherwise the reference value setting mode will be canceled.

(b) Setting a relative output level value

The relative output level setting operation includes setting with DATA keys and modification with the AMPTD knob. The operation is executed in a manner similar to those discussed in (3) and (4) of this paragraph. If the (3) and (4) operations are executed during the relative value display (the unit is dB), every set value will be treated as a relative value.

Example 4-16) Setting – 34 dB for a relative output level value with the reference level set to – 12 dBm

Step	Keystroke	AMPLITUDE readout	Note
①	ΔdB	– 0. 3 dB	Current relative output level value.
②	AMPTD – 3 4 dBm		
	ΔdB	– 3 4. 0 dB	Since the reference level is – 12 dBm, the actual output level is – 46 dBm.

(c) Canceling the relative value display mode

- Press the SHIFT key.
- Press the <(∓)> ΔdB OFF key of the MODIFY block.

The relative output level value display mode is canceled through the above key operation. Then the AMPLITUDE readout will contain the current output level setting value.

(6) Selecting and canceling the EMF display mode

(a) With an output level displayed in any unit other than dBm, press the SHIFT key.

(b) Press the <⊟> EMF ON/OFF key of the MODIFY block.

The above key operation causes the EMF light of the AMPLITUDE readout to be turned on and an output level to be displayed at open end. To cancel the EMF display mode, execute the above operations (a) and (b) again. The EMF light is turned off to indicate that the mode is canceled.

(c) dBm unit and EMF display

- If an output level is set in dBm during the EMF display mode, the EMF display mode will be canceled.
- Setting an output level in a unit other than dBm again returns the mode to EMF.

(7) Turning an RF output signal on/off

Pressing the OFF key of the RF OUTPUT block turns the key light on and RF output off.

The output level with RF output set to OFF is below −130 dBm (−23 dBμV, −17 dBμV EMF, 0.071 μV, or 0.142 μV EMF).

To turn RF output on, perform the same operation as above. The OFF key light is turned off to indicate that an RF output signal is turned on.

(8) Output impedance

Press the 50 Ω/75 Ω key of the RF OUTPUT block to switch the output impedance alternatively between 50 Ω and 75 Ω. The key light is turned on to indicate that 75 Ω is selected.

The output impedance cannot be changed during the relative value display mode (ΔdB light is on) or the output level continuous control function is enabled (CONT light is on).

(9) GP-IB program code

As for an output level, the GP-IB can control the procedures for ; 1) turning the RF output on/off, 2) setting an output level in a numeric value, and 3) selecting and canceling an EMF display mode. Table 4-7 gives the program codes.

Table 4-7 GP-IB program codes for an output level

Header code	Data code	Unit code	Description
AP or LE	−133.0 to 19.0 −26.0 to 126.0 0.000050 to 2000 0.050 to 2000000 ON OF 50 75	DM DB MV UV	Sets an output level in dBm. Sets an output level in dBμV. Sets an output level in mV. Sets an output level in μV. Turns an RF output signal on. Turns an RF output signal off. Sets the output impedance to 50 Ω. Sets the output impedance to 75 Ω.
EM	ON (1) OF (0)		Enables display at open end. Cancels display at open end (and enables display at terminal).

(10) Error

If an erroneous operation is done during the output level control, an error code listed in the table 4-8 will appear in the MEMORY ADDRESS readout. If the instrument operates under the remote control with the GP-IB, no error code will appear.

Table 4-8 Possible errors during the output level control

Error code	Error description	Occurs upon :	Result
20	Setting value of the output level is beyond the specified range.	Pressing the ENTER key.	The setting value is unacceptable.
21	Setting value of the reference level is beyond the specified range.	Pressing the ENTER key.	The setting value is unacceptable.
22	Setting value of the relative level beyond the range of 0.0 to ±152 dB or the actual output level is beyond the specified range.	Pressing the ENTER key.	The setting value is unacceptable.
23	EMF display mode is selected when any condition out of ① to ③ is true. ① An output level is to be displayed in dBm. ② The relative level display mode is provided. ③ The output level continuous control function is enable.	Pressing the ENTER key.	EMF display mode cannot be selected.
24	Output impedance is changed when any condition out of ① and ② is true. ① The relative level display mode is provide. ② The output level continuous control function is enabled.	Pressing the 50 Ω / 75 Ω key.	The output impedance cannot be changed.

4-6 CONTINUOUS CONTROL OF OUTPUT LEVEL

An output level can be decremented continuously from a desired value by 0.1 dB steps within the range of 0 to 10 dB without momentary interruption.

The basic operation includes turning the function on/off, and incrementing/decrementing the level.

(1) Turning the function on / off

- Press the SHIFT key.
- Press the <⊟> CONT ON / OFF key of the MODIFY block.

After the above key operation, the CONT light of the AMPLITUDE readout is turned on, and now the output level will be continuously variable.

To turn the function off, perform the same operation as above. The CONT light of the AMPLITUDE readout is turned off and the output level returns to the original value before the function is turned on.

When this function works, the generator is not allowed to turn the EMF display mode on/off, nor to change the output impedance with the 50 Ω / 75 Ω key of the RF OUTPUT block.

(2) Level control

(a) Use the AMPTD knob of the MODIFY block to control the level.

(b) Turn the AMPTD knob clockwise to increment the level and turn it counterclockwise to decrement the level.

(c) One step of the AMPTD knob varies the level by 0.1 dB regardless of the displayed unit of an output level. Therefore the level displayed in μV, mV, or V will appear as if it varies at unequal interval.

(d) Since the function only allows decrementing within the range of 0 to 10 dB, the level will not vary even if the knob is rotated clockwise immediately after the function is turned on.

(e) To verify the amount of decrement from the output level at the function on, press the AMPTD key of the FUNCTION block with the continuous control function turned on.

(f) When the function is turned on,

- Press the shift key.
- Press the <7> REF key of the DATA block.
- Press the AMPTD key.
- Press any key of the ENTER block.

Through the above key operation, the relative value display (dB) is available with reference to the output level at the time when the function is turned on.

Example 4-17) Continuous control from the output level of – 12.3 dBm

Step	Keystroke	AMPLITUDE readout	Note
①		– 1 2. 3 dBm	Current output level set value.
②	SHIFT CONT ON/OFF		
		CONT – 1 2. 3 dBm	Turns the continuous control function on.
③	CW	CONT – 1 2. 3 dBm	CW (incrementing) rotation is ineffective.
④	CCW	CONT – 1 2. 4 dBm	Knob 1 step. Decremented by 0.1 dB.
⑤	CCW	CONT – 1 4. 0 dBm	Knob 16 steps. Decremented by 1.6 dB.
⑥	CW	CONT – 1 3. 9 dBm	Knob 1 step. Incremented by 0.1 dB.
⑦	AMPTD	ΔdB CONT 1. 6 dB	The amount of decrement appears for about five seconds.
⑧	SHIFT REF AMPTD dBm		
		ΔdB CONT – 1. 6 dB	The relative value displayed.
⑨	CCW	ΔdB CONT – 2. 0 dB	Knob 4 steps. Decremented by 0.4 dB.
⑩	SHIFT ΔdB OFF		
		– 1 4. 3 dBm	The relative value display mode canceled.
⑪	SHIFT CONT ON/OFF		
		– 1 2. 3 dBm	Turns the continuous control function off.

(3) GP-IB program code

As for the continuous control of an output level, the GP-IB can control the procedures for ; 1) turning the function on/off, 2) incrementing / decrementing the level, and 3) setting the amount of decrement from the current output level in a numeric value. Table 4-9 shows the GP-IB program codes for continuous control of an output level.

Table 4-9 GP-IB program codes for continuous control of an output level

Header code	Data code	Unit code	Description
CO	ON		Turns the function on.
	OF		Turns the function off.
	UP		Increments by 0.1 dB.
	DN		Decrements by 0.1 dB.
	0.0 to 10.0		Sets the amount of decrement (0.0 to 10.0 dB) from the current output level.

4-7 AMPLITUDE MODULATION (AM)

The basic operation of the amplitude modulation includes :

- Turning the modulation on / off
- Selecting a modulation signal
- Direct setup of AM degree with DATA keys
- AM degree modification with the FREQ / MOD knob of the MODIFY block

(1) Readout

The data on amplitude modulation appear in the MODULATION MODE block and MODULATION readout. The MODULATION MODE block shows whether the modulation function is on or off, and which signal is now selected to use for modulation. The MODULATION readout contains an AM degree and the judgment result of an external modulation input signal level.

The MODULATION MODE block readout is described in (2) and (3), while the judgment result of an external modulation input signal level in (6).

Table 4-10 lists the AM degree setting ranges, and Table 4-11 shows the AM degree setting ranges and their resolutions.

The AM degree setting range depends on the stereo mode. The AM degree with the stereo mode set to L or R is half of that given with the stereo mode set to MONO, L = R, L = -R, or EXT L, R.

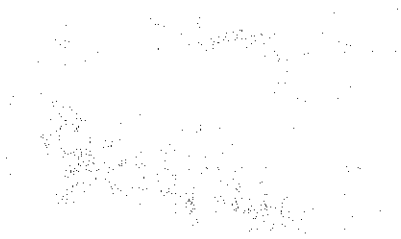
Table 4-10 AM degree setting ranges

AM stereo mode	AM degree range
MONO	0.0 to 125 %
L = R	0.0 to 125 %
L	0.0 to 80 %
R	0.0 to 80 %
L = – R	0.0 to 125 %
EXT L, R	0.0 to 125 %

Table 4-11 AM degree ranges and their resolutions

MODE	AM degree range	Resolution
MONO	0 to 99.5 %	0.5%
	100 to 125 %	1 %
Any mode other than MONO	0 to 125 %	1 %

The MODULATION readout usually shows either AM degree or FM deviation. The AM and FM keys of the FUNCTION block can be used to switch between the AM degree and FM deviation display.



NOTE

The performance-guaranteed range of the output level is changed when AM modulation is turned on. See the table 4-6 in the paragraph 4-5 for details.

(2) Turning the modulation on / off

The amplitude modulation is turned on or off with the AM ON key of the MODULATION MODE block. The AM ON key switches alternately; the key light is turned on to indicate AM is on; turned off to indicate AM is off.

NOTE

Even turning the modulation off leaves the AM degree display in the MODULATION readout unchanged.

(3) Selecting an AM modulation signal

Either one of the following three can be selected as an AM modulation signal.

- An internal sine wave of 400 Hz (INT 400 Hz)
- An internal sine wave of 1 kHz (INT 1kHz)
- An external signal of 20 Hz to 10 kHz (EXT)

A modulation signal is selected with the INT or EXT key of the AM/R block.

Press the INT key to select the INT 400 Hz or INT 1 kHz signal. Pressing the INT key switches alternately between the INT 400 Hz and INT 1 kHz signal. Either 400 Hz or 1 kHz light is turned on to indicate the selection state.

Press the EXT key to select EXT. The AC light is turned on to indicate the selection state.

The procedures after selection of the external modulation signal are described in (6) of this paragraph.

Example 4-18) Selecting a modulation signal

Step	Keystroke	AM / R block readout	Note
①		(1 k) 400 INT	Current selection (INT 400 Hz)
②	INT	1 k (400) INT	Selects INT 1 kHz
③	INT	(1 k) 400 INT	Selects the INT 400 Hz
④	EXT	AC EXT	Selects the external modulation signal. AC light turned on.
⑤	INT	(1 k) 400 INT	Selects the INT 400 Hz sine wave.

(4) AM degree setup with DATA keys

- Press the AM key of the FUNCTION block.
- Enter a numeric value with DATA keys of the DATA block.
- Press the % key of the ENTER block.

A desired AM degree can be set through the above key operation.

Example 4-19) Setting the AM degree of 34.5 %

AM	3	4	.	5	%

NOTE

Setting an AM degree with DATA keys or GP-IB code automatically turns the AM modulation on.

(5) Modification with the FREQ/MOD knob

- Press the AM key of the FUNCTION block.
- Specify a digit to be modified with the ⊖ ⊖ keys of the FREQ/MOD operation part in the MODIFY block.
- Modify the value with the FREQ/MOD knob of the MODIFY block.

A desired digit of the AM degree readout value can be modified through the above key operation.

Use the ⊖ ⊖ keys to specify the digit to be modified with the FREQ/MOD knob. The specified digit blinks.

The FREQ/MOD knob rotates endlessly; rotating the knob clockwise increments the AM degree while rotating it counterclockwise decrements the AM degree. As the modified digit reaches 9 (incrementing) or 0 (decrementing), the digit to its left will increment or decrement.

Example 4-20) Shifting the digit to be modified with ⊖ ⊖ keys

Step	Keystroke	MODULATION readout	Note
①	AM ⊖	3 4. 5 %	The digit currently modifiable begins to blink.
②	⊖	3 4 5 %	The modifiable digit shifts to a higher place.
③	⊖	3 4. 5 %	The modifiable digit shifts to a higher place.
④	⊖	3 4. 5 %	The modifiable digit shifts to the lowest place.
⑤	⊖	3 4 5 %	The modifiable digit shifts to a higher place again.

Step	Keystroke	MODULATION readout	Note
⑥	⊟	3 4. 5 %	The modifiable digit shifts to a lower place.
⑦	⊟	3 4. 5 %	The modifiable digit shifts to the highest place.
⑧	⊟	3 4 5 %	The modifiable digit shifts to a lower place. Blinking stops in above five seconds.

Example 4-21) Modifying the AM degree from 34.5 % to 30 %

Step	Keystroke	MODULATION readout	Note
①	⊟	3 4 5 %	The digit currently modifiable begins to blink.
②	⊟ ⊟	3 4. 5 %	Cause the lowest digit to blink.
③	CCW	3 0. 0 %	Blinking stops to show the AM degree has been modified. Knob 9 steps

(6) External modulation

A modulation signal can be externally supplied by connecting the signal to the AM/R connector of the EXT INPUT block.

(a) External amplitude modulation characteristics

Table 4-12 gives the characteristics of the external amplitude modulation.

Table 4-12 Characteristics of external amplitude modulation

Item	Specification	Note
Input impedance	Approx. 10 kΩ	
Reference input level	1 Vpk ± 2 %	
Frequency band	20 Hz to 10 kHz*	± 1 dB, 1 kHz reference

* The maximum modulation frequency is limited to 2 % of the RF frequency for 30 % modulation. (RF ≧ 0.15 MHz)

(b) Making the AM modulation external

Pressing the EXT key of the AM/R block turns the AC light on and makes the AM external. For information on how to select a modulation signal, see (3) of this paragraph.

(c) External AM degree and input signal level

If the external modulation input signal falls within the reference value (1 Vpk ±2 %), its AM degree can be displayed in the MODULATION readout and set or modified with DATA keys or the FREQ/MOD knob of the MODIFY block, just like in internal modulation.

When external modulation is enabled, the external modulation input level will be detected. If the detected value is beyond the reference level, the HI or LO light of AM/R of the MODULATION readout is turned on. Control the input signal level so that both lights are turned off.

(7) GP-IB program code

As for amplitude modulation, the GP-IB can control the procedures for ; 1) turning the function on/off, 2) selecting a modulation signal, and 3) setting an AM degree directly in a numeric value. Table 4-13 shows the GP-IB program codes for amplitude modulation.

Table 4-13 GP-IB program codes for amplitude modulation

Header code	Data code	Unit code	Description
AM	OF		Turns the modulation off.
	ON		Turns the modulation on.
	T4		Modulation signal : INT 400 Hz
	T1		Modulation signal : INT 1 kHz
	XD		Modulation signal : EXT
	0.0 to 125		Sets an AM degree of 0 to 125 %.

(8) Error

If an erroneous operation is done during the amplitude modulation control, an error code listed in the table 4-14 will appear in the MEMORY ADDRESS readout. If the instrument operates under the remote control with the GP-IB, no error code will appear.

Table 4-14 Possible errors during amplitude modulation

Error code	Error description	Occurs upon :	Result
30	Setting value of the AM modulation degree is beyond the specified range.	Pressing the ENTER key.	The setting value is unacceptable.
31	Internal modulation signal is selected for L or R when the modulation mode is set to EXT L, R in the AM band.	Pressing the INT key of FM /L or AM/R.	The internal modulation signal cannot be selected.

See Table 4-10 in (1) of this paragraph for the relationship between stereo modes and AM degree setting ranges.

4-8 MAIN- AND SUB-CHANNEL SIGNAL OF AM STEREO

The basic operation of AM stereo includes :

- Specifying a modulation mode with keys of the MODULATION MODE block
- Selecting an internal AF signal for main- and sub-channel modulation

(1) Specifying a modulation mode

For AM stereo main- and sub-channel modulation, this instrument allows the modulation modes as listed in Table 4-15.

Table 4-15 Modulation mode (AM stereo)

Modulation signal source	Modulation mode	Note
Internal signal (one signal)	MONO INT R (Monophonic) L = R INT R (Stereo) L INT R (Stereo) R INT R (Stereo) L = − R INT R (Stereo)	Main-channel component only L-channel signal only R-channel signal only Sub-channel component only
External signal (R input, one signal)	MONO EXT R (Monophonic) L = R EXT R (Stereo) L EXT R (Stereo) R EXT R (Stereo) L = − R EXT R (Stereo)	Main-channel component only L-channel signal only R-channel signal only Sub-channel component only
L : External signal R : External signal	EXT L, R (Stereo)	Stereo modulation with two external signals
	OFF	The main- and sub-channel signal turned off.

If one of those modulation modes listed in Table 4-15 is specified with the RF frequency of this instrument, explained in the paragraph 4-4, set to 2.0 MHz or less, then the generator works in the AM stereo mode. To specify a modulation mode, press an appropriate key of the MODULATION MODE block and turn on its key light.

The MONO, L = R, L, R, L = − R, EXT L, R, and OFF key clear one another. During the AM stereo mode, the INT L-EXT R modulation mode cannot be specified. Also frequency modulation is not available except in the MONO mode.

A signal source for each of MONO, L = R, L, R, and L = − R is selected internally or externally depending on whether the INT or EXT key light of the AM/R block is turned on.

(2) Selecting an internal AF signal

Either one of the following two can be selected as an internal AF signal.

- An internal sine wave of 400 Hz (INT 400 Hz)
- An internal sine wave of 1kHz (INT 1kHz)

Pressing the INT key in the AM / R block switches alternately between the INT 400 Hz and INT 1 kHz signal. Either 400 Hz or 1 kHz light is turned on to indicate the selection state.

(3) GP-IB program code

As for a main- and sub-channel, the GP-IB can control the procedures for specifying a modulation mode of a main- and sub- channel signal, and selecting an AF signal for AM stereo modulation. Table 4-16 shows the GP-IB program codes for a main- and sub-channel.

Table 4-16 GP-IB program codes for a main- and sub-channel (AM stereo)

Header code	Data code	Unit code	Description
MS	00		Main- and sub-channel modulation mode OFF
	01		Main- and sub-channel modulation mode MONO INT
	02		Main- and sub-channel modulation mode L = R INT
	03		Main- and sub-channel modulation mode L INT
	04		Main- and sub-channel modulation mode R INT
	05		Main- and sub-channel modulation mode L = – R INT
	11		Main- and sub-channel modulation mode MONO EXT
	12		Main- and sub-channel modulation mode L = R EXT
	13		Main- and sub-channel modulation mode L EXT
	14		Main- and sub-channel modulation mode R EXT
	15		Main- and sub-channel modulation mode L = – R EXT
	17		Main- and sub-channel modulation mode EXT L, R
AM	T4		Modulation signal : INT 400 Hz
	T1		Modulation signal : INT 1 kHz
	XD		Modulation signal : EXT

(4) Error

If an erroneous operation is done during the AM stereo mode, an error code listed in the table 4-17 will appear in the MEMORY ADDRESS readout. If the instrument operates under the remote control with the GP-IB, no error code will appear.

Table 4-17 Possible errors during main- and sub-channel signal operation (in the AM stereo mode)

Error code	Error description	Occurs upon :	Result
50	Modulation mode is set to INT L-EXT R in the AM band.	Pressing the INT L-EXT R key.	Setting the modulation mode is unacceptable.
51	Modulation mode is set to OFF, MONO, L = R, L = – R, or EXT L, R under the following condition : ① The current modulation mode is L or R in AM band. ② AM modulation degree is 63 % or more.	Pressing the OFF, MONO, L = R, L = – R, or EXT L, R key.	Setting the modulation mode is acceptable and AM modulation degree is changed to 125 %.
52	Modulation mode is set to the other than MONO under the following condition : ① The reference frequency is set within the FM band. ② The relative frequency is set so that the actual frequency is within the AM band.	Pressing the OFF, L = R, L, R, L = – R, or EXT L, R key.	Setting the modulation mode is unacceptable.

Table 4-17 Possible errors during main- and sub-channel signal operation (in the AM stereo mode) (Cont'd)

Error code	Error description	Occurs upon :	Result
53	Modulation mode is set to AM stereo (other than MONO) when FM modulation is ON.	Pressing the OFF, L = R, L = – R, or EXT L, R key.	Setting the modulation mode is acceptable and FM modulation is turned off.

4-9 AM PILOT SIGNAL

The basic operation of the AM PILOT signal includes :

- Turning the AM PILOT signal on / off with the PILOT ON key
- Direct setup of the modulation degree with DATA keys
- Modification of the level ratio or modulation degree with the FREQ / MOD knob of the MODIFY block

(1) Readout

The data on the PILOT signal appear in the MODULATION MODE block and MODULATION readout. The MODULATION MODE block shows whether the PILOT signal is on or off, while the MODULATION readout contains the modulation degree of the PILOT signal.

A PILOT modulation degree is the modulation degree of the 25 Hz PILOT signal in the AM stereo mode.

The MODULATION MODE block readout is described in (2). The PILOT modulation degree in the AM stereo mode is described in (3) and (4).

Table 4-18 shows the setting range of a PILOT modulation degree in the AM stereo mode.

Table 4-18 Setting range for a PILOT modulation degree in the AM stereo mode

Level ratio (%)	Resolution (%)
0.0 to 12.5	0.1

(2) Turning the PILOT signal on / off

The PILOT signal is turned on or off with the PILOT ON key of the MODULATION MODE block. The PILOT ON key switches alternately ; the key light is turned on to indicate the PILOT signal is on; turned off to indicate the PILOT signal is off.

NOTE

The PILOT ON key is ineffective in MONO modulation mode.

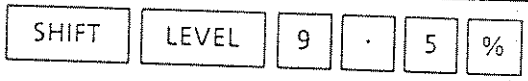
(3) Direct setup with DATA keys

- Press the SHIFT key.
- Press the LEVEL key of the MODULATION MODE block.
- Enter a numeric value with DATA keys of the DATA block.
- Press the % key of the ENTER block.

A desired PILOT modulation degree can be set through the above key operation.

Once the PILOT modulation degree is set, the displayed unit is changed to % and the PILOT light in the MODULATION readout is turned on.

Example 4-22) Setting the PILOT modulation degree of 9.5 %



(4) Modification with the FREQ/MOD knob

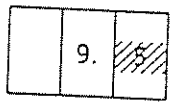
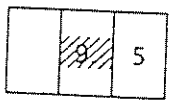
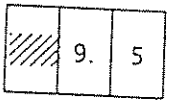
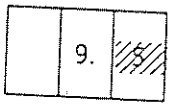
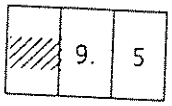
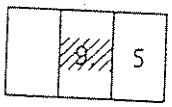
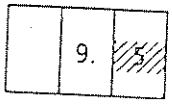
- Press the SHIFT key.
- Press the LEVEL key of the MODULATION MODE block.
- Specify a digit to be modified with the ⊖ ⊖ keys of the FREQ/MOD operation part in the MODIFY block.
- Modify the value with the FREQ/MOD knob of the MODIFY block.

A desired digit of the modulation degree readout value can be modified through the above key operation.

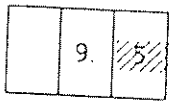
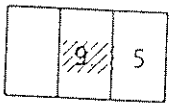
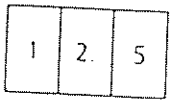
Use the ⊖ ⊖ keys to specify the digit to be modified with the FREQ/MOD knob. The specified digit blinks.

The FREQ/MOD knob rotates endlessly; rotating the knob clockwise increments the modulation degree while rotating it counterclockwise decrements the modulation degree. As the modified digit reaches 9 (incrementing) or 0 (decrementing), the digit to its left will increment or decrement.

Example 4-23) Shifting the digit to be modified with ⊖ ⊖ keys

Step	Keystroke	MODULATION readout	Note
①	SHIFT LEVEL ⊖		The digit currently modifiable begins to blink. At first, the modifiable digits does not shift.
②	⊖		The modifiable digit shifts to a higher place.
③	⊖		The modifiable digit shifts to the highest place.
④	⊖		The modifiable digit shifts to the lowest place.
⑤	⊖		The modifiable digit shifts to the highest place.
⑥	⊖		The modifiable digit shifts to a lower place.
⑦	⊖		The modifiable digit shifts to a lower place. Blinking stops in above five seconds.

Example 4-24) Modifying the PILOT modulation degree from 9.5 % to 12.5 %

Step	Keystroke	MODULATION readout	Note
①	⊖		The digit currently modifiable begins to blink.
②	⊖		Cause the higher digit to blink.
③	CW		Blinking stops to show the PILOT modulation degree has been modified. Knob 3 steps

(5) GP-IB program code

As for the AM PILOT signal, the GP-IB can control the procedures for turning the function on/off, and setting a signal modulation degree. Table 4-19 shows the GP-IB program codes for the PILOT signal.

Table 4-19 GP-IB program codes for the AM PILOT signal

Header code	Data code	Unit code	Description
PL	ON		Turns the PILOT signal on.
	OF		Turns the PILOT signal off.
	0.0 to 12.5	(PC)	Sets a PILOT modulation degree of 0.0 to 12.5 %.

The unit code enclosed parentheses can be omitted.

(6) Error

If an erroneous operation is done during the AM PILOT signal control, an error code listed in the table 4-20 will appear in the MEMORY ADDRESS readout. If the instrument operates under the remote control with the GP-IB, no error code will appear.

Table 4-20 Possible errors during AM PILOT signal operation

Error code	Error description	Occurs upon :	Result
54	Pilot modulation degree in AM stereo is set beyond the range of 0 to 12.5 %.	Pressing the ENTER key.	The setting value is unacceptable
55	Pilot signal is turned on when the modulation mode is MONO in the AM band.	Pressing the PILOT ON key.	The pilot signal cannot be turned on.

4-10 NEGATIVE PEAK CLIPPER SETTING (AM stereo)

While operating in the AM stereo modulation mode, this instrument allows clipping a modulation signal so that the AM degree does not exceed a certain value.
The basic operation is turning the negative peak clipper on / off.

(1) Turning the negative peak clipper on / off

The negative peak clipper can be turned on and off with the NEG PEAK CLIPPER key of the MODULATION MODE block. The NEG PEAK CLIPPER key switches alternately ; the key light is turned on to indicate the negative clipper is on, and turned off to indicate the negative clipper is off.

(2) GP-IB program code

The GP-IB controls turning the negative peak clipper on/off. Table 4-21 shows the program codes for the negative peak clipper.

Table 4-21 GP-IB program codes for the negative peak clipper

Header code	Data code	Unit code	Description
NP	OF (0) ON (1)		Turns the negative peak clipper on. Turns the negative peak clipper off.

(3) Error

If an erroneous operation is done during the negative peak clipper setting, an error code listed in the table 4-22 will appear in the MEMORY ADDRESS readout. If the instrument operates under the remote control with the GP-IB, no error code will appear.

Table 4-22 Possible errors during the negative peak clipper operation

Error code	Error description	Occurs upon :	Result
56	Negative peak clipper is turned on in any case of the following. ① AM modulation is off in the AM band. ② The modulation mode is MONO in the AM band. ③ The current RF frequency is in the FM band.	Pressing the NEG PEAK CLIPPER key.	The negative peak clipper cannot be turned on.

4-11 FREQUENCY MODULATION (FM)

The basic operation of frequency modulation includes :

- Turning the modulation on / off
- Selecting a modulation signal
- Direct setup of FM deviation with DATA keys
- FM deviation modification with the FREQ / MOD knob of the MODIFY block

(1) Readout

The data on frequency modulation appear in the MODULATION MODE block and MODULATION readout. The MODULATION MODE block shows whether the modulation function is on or off, and which signal is now selected to use for modulation. The MODULATION readout contains an FM deviation and the judgment result of an external modulation input signal level.

The MODULATION MODE block readout is described in (2) and (3), while the judgment result of an external modulation input signal level in (6).

Table 4-23 lists the FM deviation setting ranges and their resolutions.

Table 4-23 FM deviation setting ranges

FM deviation setting range	Resolution
100 to 300 kHz	1 kHz
10.0 to 99.9 kHz	100 Hz
0.0 to 9.99 kHz	10 Hz

NOTE

The maximum FM deviation setting range is allowed up to 50 % of the RF frequency. The performance-guaranteed range of the maximum FM deviation is up to 25 % of the RF frequency.

The MODULATION readout usually shows either AM degree or FM deviation. The AM and FM keys of the FUNCTION block can be used to switch between the AM degree and FM deviation display.

(2) Turning the modulation on / off

The frequency modulation is turned on or off with the FM ON key of the MODULATION MODE block. The FM ON key switches alternately ; the key light is turned on to indicate FM is on ; turned off to indicate FM is off. In every AM stereo mode (except for MONO), however, the frequency modulation cannot be turned on.

NOTE

Even turning the modulation off leaves the FM deviation display in the MODULATION readout unchanged.

(3) Selecting an FM modulation signal

Either one of the following three can be selected as an FM modulation signal.

- An internal sine wave of 400 Hz (INT 400 Hz)
- An internal sine wave of 1 kHz (INT 1 kHz)
- An external signal of 20 Hz to 100 kHz (AC)

A modulation signal is selected with the INT or EXT key of the FM/L block.

Press the INT key to select the INT 400 Hz or INT 1 kHz signal. Pressing the INT key switches alternately between the INT 400 Hz and INT 1 kHz signal. Either 400 Hz or 1 kHz light is turned on to indicate the selection state.

Press the EXT key to select EXT. The AC light is turned on to indicate the selection state.

The procedures after selection of the external modulation signal are described in (6) of this paragraph.

Example 4-25) Selecting a modulation signal

Step	Keystroke	FM/L block readout	Note
①		(1 k) 400 INT	Current selection (INT 400 Hz)
②	INT	1 k (400) INT	Selects INT 1 kHz.
③	INT	(1 k) 400 INT	Selects INT 400 Hz.
④	EXT	AC EXT	Selects the external modulation signal. AC light turned on.
⑤	INT	(1 k) 400 INT	Selects INT 400 Hz.

(4) FM deviation setup with DATA keys

- Press the FM key of the FUNCTION block.
- Enter a numeric value with DATA keys of the DATA block.
- Press the kHz key of the ENTER block.

A desired FM deviation can be set through the above key operation.

Example 4-26) Setting the FM deviation of 12.3 kHz

FM 1 2 . 3 kHz

NOTE

Setting an FM deviation with DATA keys or GP-IB code automatically turns the FM modulation on.

(5) Modification with the FREQ / MOD knob

- Press the FM key of the FUNCTION block.
- Specify a digit to be modified with the ⊖ ⊖ keys of the FREQ / MOD operation part in the MODIFY block.
- Modify the value with the FREQ/MOD knob of the MODIFY block.

A desired digit of the FM deviation readout value can be modified through the above key operation.

Use the ⊖ ⊖ keys to specify the digit to be modified with the FREQ / MOD knob. The specified digit blinks.

The FREQ / MOD knob rotates endlessly; rotating the knob clockwise increments the FM deviation while rotating it counterclockwise decrements the FM deviation. As the modified digit reaches 9 (incrementing) or 0 (decrementing), the digit to its left will increment or decrement.

Example 4-27) Shifting the digit to be modified with ⊖ ⊖ keys

Step	Keystroke	MODULATION readout	Note
①	FM ⊖	1 2. 3 kHz	The digit currently modifiable begins to blink.
②	⊖	1 2 3 kHz	The modifiable digit shifts to a higher place.
③	⊖	2. 3 kHz	The modifiable digit shifts to a higher place.
④	⊖	1 2. 3 kHz	The modifiable digit shifts to the lowest place.
⑤	⊖	1 2 3 kHz	The modifiable digit shifts to a higher place again.
⑥	⊖	1 2. 3 kHz	The modifiable digit shifts to a lower place.
⑦	⊖	2. 3 kHz	The modifiable digit shifts to the highest place.
⑧	⊖	1 2 3 kHz	The modifiable digit shifts to a lower place. Blinking stops in above five seconds.

Example 4-28) Modifying the FM deviation from 12.3 kHz to 15 kHz

Step	Keystroke	MODULATION readout	Note
①	←	1 [▨] 3 kHz	The digit currently modifiable begins to blink.
②	← ←	1 2. [▨] kHz	Cause the lowest digit to blink.
③	CW	1 5. 0 kHz	Blinking stops to show the FM deviation has been modified. Knob 27 steps

(6) External modulation

A modulation signal can be externally supplied by connecting the signal to the FM/L connector of the EXT INPUT block.

(a) External frequency modulation characteristics

Table 4-24 gives the characteristics of the external frequency modulation.

Table 4-24 Characteristics of external frequency modulation

Item	Specification	Note
Input impedance	Approx. 10 kΩ	
Reference input level	1 Vpk ± 2 %	
Frequency band	20 Hz to 100 kHz	±1 dB, 1 kHz reference

(b) Making FM modulation external

Pressing the EXT key of the FM/L block turns the AC light on and makes FM modulation external. For information on how to select a modulation signal, see (3) of this paragraph.

(c) Setting a deviation of the FM external modulation

If the external modulation input signal falls within the reference value (1 Vpk ±2 %), the FM deviation can be displayed in the MODULATION readout and set or modified with DATA keys or the FREQ/MOD knob of the MODIFY block, just like in internal modulation.

When external modulation is enabled, the external modulation input level will be detected. If the detected value is beyond the reference level, the HI or LO light of FM/L of the MODULATION readout is turned on. Control the input signal level so that both lights are turned off.

(d) Input signal level and FM deviation

As shown in Figure 4-1, FM deviation changes linearly with respect to an input signal level. Thus If the external signal is attenuated to one-tenth (20 dB) with the FM deviation of the external modulation set to 75 kHz (MODULATION readout: 75 kHz, and the HI and LO lights of the FM/L block off), then the LO light is turned on and the deviation of 7.5 kHz (equal to 10 %, assuming 75 kHz is 100 %) is obtained exactly. The deviation readout remains 75 kHz.

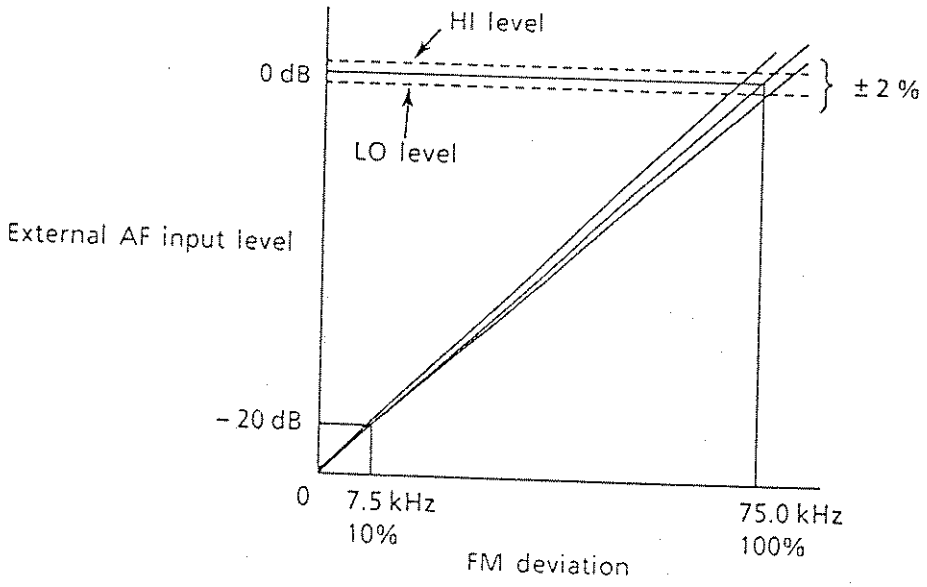


Figure 4-1 External AF input level and FM deviation

(7) GP-IB program code

As for frequency modulation, the GP-IB can control the procedures for ; 1) turning the function on/off, 2) selecting a modulation signal, and 3) setting an FM deviation directly in a numeric value. Table 4-25 shows the GP-IB program codes for frequency modulation.

Table 4-25 GP-IB program codes for frequency modulation

Header code	Data code	Unit code	Description
FM	OF		Turns the modulation off.
	ON		Turns the modulation on.
	T4		Modulation signal : INT 400 Hz
	T1		Modulation signal : INT 1 kHz
	XD		Modulation signal : EXT
	100 to 300		Sets an FM deviation of 100 to 300 kHz.
	10.0 to 99.9		Sets an FM deviation of 10.0 to 99.9 kHz.
	0.00 to 9.99		Sets an FM deviation of 0.00 to 9.99 kHz.

(8) Error

If an erroneous operation during the frequency modulation control, an error code listed in the table 4-26 will appear in the MEMORY ADDRESS readout. If the instrument operates under the remote control with the GP-IB, no error code will appear.

Table 4-26 Possible errors during frequency modulation

Error code	Error description	Occurs upon :	Result
40	Setting value of the FM deviation is beyond the range of 0 to 300 kHz.	Pressing the ENTER key.	The setting value is unacceptable.
41	FM deviation is set to the value more than one half the RF frequency.	Pressing the ENTER key.	The setting value is acceptable and FM modulation is turned off.
42	FM deviation is set so that the product of the FM deviation by the M + S level ratio exceeds 300 kHz when the modulation mode is set to MONO in the FM band.	Pressing the ENTER key.	The setting value is acceptable and FM modulation is turned off.
43	FM modulation is turned on in any case of the following. ① The FM deviation is set to the value more than one half the RF frequency. ② The total FM deviation is set to the value more than 300 kHz when the modulation mode is MONO.	Pressing the FM ON key.	FM modulation cannot be turned on.

※ See Table 4-23 in (1) of this paragraph for the relationship between RF frequencies and FM deviation setting ranges.
See (1) in the paragraph 4-14 for the relationship between FM deviation and total FM deviation.

4-12 MAIN- AND SUB-CHANNEL SIGNAL OF FM STEREO

The basic operation of FM stereo includes :

- Specifying a modulation mode with keys of the MODULATION MODE block
- Selecting an internal AF signal for main- and sub-channel modulation
- Direct setup of a level ratio with DATA keys
- Modification of a level ratio with the FREQ/MOD knob of the MODIFY block

(1) Specifying a modulation mode

For FM stereo main- and sub-channel modulation, this instrument allows the modulation modes as listed in Table 4-27.

Table 4-27 Modulation mode (FM stereo)

Modulation signal source	Modulation mode	Note
Internal signal (one signal)	MONO INT L (Monophonic) L = R INT L (Stereo) L INT L (Stereo) R INT L (Stereo) L = − R INT L (Stereo)	Main-channel component only L-channel signal only R-channel signal only Sub-channel component only
External signal (L input, one signal)	MONO EXT L (Monophonic) L = R EXT L (Stereo) L EXT L (Stereo) R EXT L (Stereo) L = − R EXT L (Stereo)	Main-channel component only L-channel signal only R-channel signal only Sub-channel component only
L : Internal signal R : External signal	INT L-EXT R (Stereo)	Stereo modulation with one external signal and one internal signal.
L : External signal R : External signal	EXT L, R (Stereo)	Stereo modulation with two external signals
	OFF	The main- and sub-channel signal turned off.

If one of those modulation modes listed in Table 4-27 is specified with the RF frequency of this instrument, explained in the paragraph 4-4, set to 2.00001 MHz or more, then the instrument works in the FM stereo mode. To specify a modulation mode, press an appropriate key of the MODULATION MODE block and turn on its key light.

The MONO, L = R, L, R, L = − R, INT L-EXT R, EXT L, R, and OFF key clear one another. A signal source for each of MONO, L = R, L, R, and L = − R is selected internally or externally depending on whether the INT or EXT key light of the FM / L block is turned on.

(2) Selecting an internal AF signal

Either one of the following two can be selected as an internal AF signal.

- An internal sine wave of 400 Hz (INT 400 Hz)
- An internal sine wave of 1 kHz (INT 1 kHz)

Press the INT key of the FM/L block to select the INT 400 Hz or INT 1 kHz signal. Pressing the INT key switches alternately between the INT 400 Hz and INT 1 kHz signal. Either 400 Hz or 1 kHz light is turned on to indicate the selection state.

(3) Readout

M + S level ratio has the following two meanings :

1. The ratio of M + S level to FM deviation

Example) The total FM deviation at the RF output is given as follows :

$$75\,(\text{kHz}) \times \frac{90}{100} = 67.5\,\text{kHz}$$

where the modulation mode is MONO, the FM deviation is 75 kHz, and the M + S level ratio is 90 %.

2. The ratio of M + S level to composite signal output level

Example) The M + S level at the composite signal output is given as follows :

$$9000\,(\text{mV}) \times \frac{90}{100} = 8100\,\text{mV}$$

where the modulation is L = R, the composite signal output level is 9000 mV, and the M + S level ratio is 90 %.

An M + S level ratio appears in the MODULATION readout.

Its setting range is related with a modulation mode as follows.

(a) A value set in the MONO modulation mode is increased about 0.9 times in another modulation mode.

(b) A value set in a modulation mode other than MONO is increased about 1.11 times in the MONO modulation mode.

Thus the setting range for a M + S level ratio is varied depending on a modulation mode.

When a modulation mode is MONO 0 to 127 %

When a modulation mode is any mode other than MONO 0 to 114 %

NOTE

When the pre-emphasis is turned on, the level ratio displayed in the MODULATION readout is not equal to the actual level ratio.

(4) Direct setup of a level ratio with DATA keys

- Press the M + S key of the MODULATION MODE block.
- Enter a numeric value with DATA keys of the DATA block.
- Press the % key of the ENTER block.

A desired level ratio can be set through the above key operation.

Once the M + S level ratio is set, the displayed unit is changed to % and the M + S light in the MODULATION readout is turned on.

Example 4-29) Setting the M + S level ratio of 85 %

M + S	8	5	%

(5) Modification with the FREQ / MOD knob

- Press the M + S key of the MODULATION MODE block.
- Specify a digit to be modified with the ⊟ ⊟ keys of the FREQ/MOD operation part in the MODIFY block.
- Modify the value with the FREQ / MOD knob of the MODIFY block.

A desired digit of the level ratio readout value can be modified through the above key operation.

Use the ⊟ ⊟ keys to specify the digit to be modified with the FREQ / MOD knob. The specified digit blinks.

The FREQ / MOD knob rotates endlessly ; rotating the knob clockwise increments the level ratio while rotating it counterclockwise decrements the level ratio. As the modified digit reaches 9 (incrementing) or 0 (decrementing), the digit to its left will increment or decrement.

Example 4-30) Shifting the digit to be modified with ⊖ ⊖ keys

Step	Keystroke	MODULATION readout	Note
①	M+S ⊖	8 5 %	The digit currently modifiable begins to blink. At first, the modifiable digit does not shift.
②	⊖	8 5 %	The modifiable digit shifts to a higher place.
③	⊖	8 5 %	The modifiable digit shifts to the highest place.
④	⊖	8 5 %	The modifiable digit shifts to the lowest place.
⑤	⊖	8 5 %	The modifiable digit shifts to the highest place.
⑥	⊖	8 5 %	The modifiable digit shifts to a lower place.
⑦	⊖	8 5 %	The modifiable digit shifts to a lower place. Blinking stops in above five seconds.

Example 4-31) Modifying the M+S level ratio from 85 % to 105 %

Step	Keystroke	MODULATION readout	Note
①	⊖	8 5 %	The digit currently modifiable begins to blink.
②	⊖	8 5 %	Cause the higher digit to blink.
③	CW	1 0 5 %	Blinking stops to show the M+S level ratio has been modified. Knob 2 steps

(6) GP-IB program code

As for a main- and sub-channel, the GP-IB can control the procedures for specifying a modulation mode of a main- and sub- channel signal and setting a level ratio for FM stereo modulation. Table 4-28 shows the GP-IB program codes for a main- and sub-channel.

Table 4-28 GP-IB program codes for a main- and sub-channel (FM stereo)

Header code	Data code	Unit code	Description
MS	00		Main- and sub-channel modulation mode OFF
	01		Main- and sub-channel modulation mode MONO INT
	02		Main- and sub-channel modulation mode L = R INT
	03		Main- and sub-channel modulation mode L INT
	04		Main- and sub-channel modulation mode R INT
	05		Main- and sub-channel modulation mode L = – R INT
	11		Main- and sub-channel modulation mode MONO EXT
	12		Main- and sub-channel modulation mode L = R EXT
	13		Main- and sub-channel modulation mode L EXT
	14		Main- and sub-channel modulation mode R EXT
	15		Main- and sub-channel modulation mode L = – R EXT
	16		Main- and sub-channel modulation mode INT L – EXT R
	17		Main- and sub-channel modulation mode EXT L, R
	0 to 127		Setting an M + S level ratio of 0 to 127 %
FM	T4		Modulation signal : INT 400 Hz
	T1		Modulation signal : INT 1 kHz
	XD		Modulation signal : EXT

(7) Error

If an erroneous operation is done during the FM stereo mode an error code listed in the table 4-29 will appear in the MEMORY ADDRESS readout. If the instrument operates under the remote control with the GP-IB, no error code will appear.

Table 4-29 Possible errors during main- and sub-channel signal operation (in the FM stereo mode)

Error code	Error description	Occurs upon :	Result
61	Modulation mode is set to MONO under the following conditions: ① The current modulation mode is set to any mode other than MONO. ② The product of the M + S level ratio by FM deviation is 271 kHz or more.	Pressing the MONO key.	The modulation mode is changed to MONO and FM modulation is turned off.
62	Modulation mode is set to the other than MONO under the following conditions : ① Reference frequency is set within the AM band. ② Relative frequency is set so that the actual frequency is within the FM band.	Pressing the OFF, L = R, L, R, L = – R, or EXT L, R key.	Setting the modulation mode is unacceptable.

Table 4-29 Possible errors during main- and sub-channel signal operation (in the FM stereo mode) (Cont'd)

Error code	Error description	Occurs upon :	Result
65	Setting value of the M + S level ratio is beyond the specified range.	Pressing the ENTER key.	The setting value is unacceptable.
66	M + S level ratio is set so that the product of the FM deviation by the M + S level ratio exceeds 300 kHz when the modulation mode is set to MONO in the FM band.	Pressing the ENTER key.	The setting value is acceptable and FM modulation is turned off.

※ See (1) in the paragraph 4-9 for the relationship between an M + S level ratio and total FM deviation.

4-13 FM PILOT SIGNAL

The basic operation of the FM PILOT signal includes :

- Turning the FM PILOT signal on / off with the PILOT ON key
- Direct setup of the level ratio with DATA keys
- Modification of the level ratio with the FREQ / MOD knob of the MODIFY block

(1) Readout

The data on the PILOT signal appear in the MODULATION MODE block and MODULATION readout. The MODULATION MODE block shows whether the PILOT signal is on or off, while the MODULATION readout contains the level ratio of the PILOT signal.

Pilot signal level ratio has the following two meanings :

1. The ratio of pilot signal level to FM deviation

   Example) The total FM deviation at the RF output is given an follows :

$$75\,(\text{kHz}) \times \frac{80 + 10}{100} = 67.5\,\text{kHz}$$

   where the modulation mode is L = R, the FM deviation is 75 kHz, the M + S level ratio is 80 %, and the pilot signal level ratio is 10 %.

2. The ratio of pilot signal level to composite signal output level

   Example) The pilot signal level at the composite signal output is given as follows :

$$9000\,(\text{mV}) \times \frac{10}{100} = 900\,\text{mV}$$

   where the composite signal output level is 9000 mV and the pilot signal level ratio is 10 %.

The MODULATION MODE block readout is described in (2). The PILOT level ratio in the FM stereo mode is described in (3) and (4).

Table 4-30 lists the setting range of a PILOT level ratio in the FM stereo mode.

Table 4-30 Setting range for a PILOT level ratio in the FM stereo mode

Level ratio (%)	Resolution (%)
0.0 to 19.9	0.1

(2) Turning the PILOT signal on / off

The PILOT signal is turned on or off with the PILOT ON key of the MODULATION MODE block. The PILOT ON key switches alternately ; the key light is turned on to indicate the PILOT signal is on ; turned off to indicate the PILOT signal is off.

NOTE

The PILOT ON key is ineffective in MONO modulation mode.

(3) Direct setup with DATA keys

- Press the SHIFT key.
- Press the LEVEL key of the MODULATION MODE block.
- Enter a numeric value with DATA keys of the DATA block.
- Press the % key of the ENTER block.

A desired PILOT level ratio can be set through the above key operation.

Once the PILOT level ratio is set, the displayed unit is changed to % and the PILOT light in the MODULATION readout is turned on.

Example 4-32) Setting the PILOT level ratio of 9.5 %.

SHIFT | LEVEL | 9 | . | 5 | %

(4) Modification with the FREQ / MOD knob

- Press the SHIFT key.
- Press the LEVEL key of the MODULATION MODE block.
- Specify a digit to be modified with ⊟ ⊟ keys of the FREQ / MOD operation part in the MODIFY block.
- Modify the value with the FREQ / MOD knob of the MODIFY block.

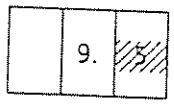
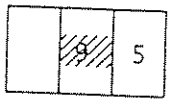
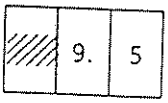
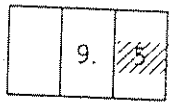
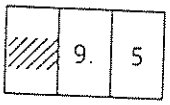
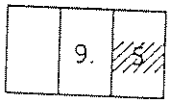
A desired digit of the level ratio readout value can be modified through the above key operation.

Use the ⊟ ⊟ keys to specify the digit to be modified with the FREQ / MOD knob. The specified digit blinks.

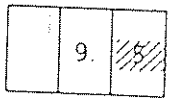
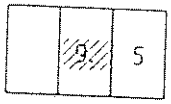
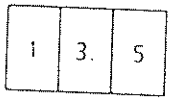
The FREQ / MOD knob rotates endlessly : rotating the knob clockwise increment the level ratio while rotating it counterclockwise decrements the level ratio.

As the modified digit reached 9 (incrementing) or 0 (decrementing), the digit to its left will crement or decrement.

Example 4-33) Shifting the digit to be modified with ⊖ ⊖ keys

Step	Keystroke	MODULATION readout	Note
①	SHIFT LEVEL ⊖		The digit currently modifiable begins to blink. At first, the modifiable digits does not shift.
②	⊖		The modifiable digit shifts to a higher place.
③	⊖		The modifiable digit shifts to the highest place.
④	⊖		The modifiable digit shifts to the lowest place.
⑤	⊖		The modifiable digit shifts to the highest place.
⑥	⊖		The modifiable digit shifts to a lower place.
⑦	⊖		The modifiable digit shifts to a lower place. Blinking stops in above five seconds.

Example 4-34) Modifying the PILOT level ratio from 9.5 % to 13.5 % (in the FM stereo mode)

Step	Keystroke	MODULATION readout	Note
①	⊖		The digit currently modifiable begins to blink.
②	⊖		Cause the higher digit to blink.
③	CW		Blinking stops to show the PILOT level ratio has been modified Knob 4 steps

(5) GP-IB program code

As for the PILOT signal, the GP-IB can control the procedures for turning the function on / off, and setting a signal level ratio or modulation degree. Table 4-31 shows the GP-IB program codes for the PILOT signal.

Table 4-31 GP-IB program codes for the PILOT signal

Header code	Data code	Unit code	Description
PL	ON		Turns the PILOT signal on.
	OF		Turns the PILOT signal off.
	0.0 to 19.9	(PC)	Turns the PILOT level ratio of 0.0 to 19.9 %.

The unit code enclosed parentheses can be omitted.

(6) Error

If an erroneous operation is done during the PILOT signal control, an error code listed in the table 4-32 will appear in the MEMORY ADDRESS readout. If the instrument operates under the remote control with the GP-IB, no error code will appear.

Table 4-32 Possible errors during PILOT signal operation

Error code	Error description	Occurs upon :	Result
63	Pilot signal level ratio in FM stereo is set beyond the range of 0 to 19.9 %.	Pressing the ENTER key.	The setting value is unacceptable.
64	Pilot signal is turned on when the modulation mode is MONO in FM band.	Pressing the PILOT ON key.	The pilot signal cannot be turned on.

※ See (1) in the paragraph 4-14 for the relationship between an M + S level ratio and a total FM deviation.

4-14 TOTAL FM DEVIATION

The basic operation of total FM deviation includes :

- Display of total FM deviation
- Direct setup of total FM deviation with DATA keys
- Total FM deviation modification with the FREQ/MOD knob of the MODIFY block

(1) Readout

Total FM deviation appears in the MODULATION readout as follows.

Total FM deviation = FM deviation x (M + S level ratio + PILOT level ratio) / 100

Total FM deviation setting ranges are :

When the modulation mode is MONO

0 to FM deviation x 1.27

When the modulation mode is any mode other than MONO

FM deviation x PILOT level ratio/100 to FM deviation x (114 + PILOT level ratio) / 100

The resolutions are shown in table 4-33. During the total FM deviation setting operation, all LEDs in the FUNCTION block are turned off.

Table 4-33 Resolution of total FM deviation

Setting range	Resolution
100 to 402 kHz	1 kHz
10.0 to 99.9 kHz	100 Hz
0.0 to 9.99 kHz	10 Hz

(2) Total FM deviation setup with DATA keys

- Press the SHIFT key.
- Press the <8> FM-T key of the DATA block.
- Enter a numeric value with DATA keys of the DATA block.
- Press the kHz key of the ENTER block.

A desired total FM deviation can be set through the above key operation.

Example 4-35) Setting the total FM deviation of 75.0 kHz

SHIFT	FM-T	7	5	.	0	kHz

Setting a total FM deviation might cause the current FM deviation or M + S level ratio setting value to be beyond its acceptable range, resulting in an error. If such an error occurs, study (5) of this paragraph to find out the relevant error contents and set the total FM deviation again.

NOTE

When a total FM deviation is set with DATA keys, the M + S level ratio is derived from the following expression.

M + S level ratio = (Total FM deviation x 100/FM deviation) - PILOT level ratio

(3) Modification with the FREQ/MOD knob

- Press the SHIFT key.
- Press the <8> FM-T key of the DATA block.
- Specify a digit to be modified with the ⊖ ⊖ keys of the FREQ/MOD operation part in the MODIFY block.
- Modify the value with the FREQ/MOD knob of the MODIFY block.

A desired digit of the total FM deviation readout value can be modified through the above key operation.

Use the ⊖ ⊖ keys to specify the digit to be modified with the FREQ/MOD knob. The specified digit blinks.

The FREQ/MOD knob rotates endlessly; rotating the knob clockwise increments the total FM deviation while rotating it counterclockwise decrements the total FM deviation. As the modified digit reaches 9 (incrementing) or 0 (decrementing), the digit to its left will increment or decrement.

Example 4-36) Shifting the digit to be modified with ⊖ ⊖ keys

Step	Keystroke	MODULATION readout	Note
①	SHIFT FM-T ⊖	7 5. 0 kHz	The digit currently modifiable begins to blink.
②	⊖	7 5. 0 kHz	The modifiable digit shifts to a higher place.
③	⊖	7 5. 0 kHz	The modifiable digit shifts to a higher place.
④	⊖	7 5. 0 kHz	The modifiable digit shifts to the lowest place.
⑤	⊖	7 5. 0 kHz	The modifiable digit shifts to a higher place again.
⑥	⊖	7 5. 0 kHz	The modifiable digit shifts to a lower place.
⑦	⊖	7 5. 0 kHz	The modifiable digit shifts to the highest place.
⑧	⊖	7 5. 0 kHz	The modifiable digit shifts to a lower place. Blinking stops in above five seconds.

Example 4-37) Modifying the total FM deviation from 75.0 kHz to 78.3 kHz

Step	Keystroke	MODULATION readout	Note
①	⊢	7 [▨] 0 kHz	The digit currently modifiable begins to blink.
②	⊢ ⊢	7 5. [▨] kHz	Cause the lowest digit to blink.
③	CW	7 8. 3 kHz	Blinking stops to show the total FM deviation has been modified. Knob 33 steps

(4) GP-IB program code

As for total FM deviation, the GP-IB can control the direct setup of a total FM deviation in a numeric value. Table 4-34 shows the GP-IB program codes for total FM deviation.

Table 4-34 GP-IB program codes for total FM deviation

Header code	Data code	Unit code	Description
FT	100 to 402 10.0 to 99.9 0.00 to 9.99		Sets a total FM deviation of 100 to 402 kHz. Sets a total FM deviation of 10.0 to 99.9 kHz. Sets a total FM deviation of 0.00 to 9.99 kHz.

(5) Error

If an erroneous operation is done during the total FM deviation control, an error code listed in the table 4-35 will appear in the MEMORY ADDRESS readout. If the instrument operates under the remote control with the GP-IB, no error code will appear.

Table 4-35 Possible errors during the total FM deviation control

Error code	Error description	Occurs upon :	Result
67	Total FM deviation is set to a value below. ① Setting value is beyond the range of 0 kHz to FM deviation × 1.27 in the modulation mode MONO. ② Setting value is FM deviation × pilot level ratio / 100 or less or FM deviation × (114 + pilot level ratio) / 100 or more in the modulation mode other than MONO.	Pressing the ENTER key.	The setting value is acceptable. FM modulation is turned off if the total FM deviation is 300 kHz or more in the modulation mode MONO.

4-15 PRE-EMPHASIS (FM STEREO MODE)

A main- and sub-channel signal in the FM stereo modulation mode can be provided with the pre-emphasis feature as shown in Figure 4-2.

The basic operation includes selection of a time constant for the pre-emphasis feature.

(1) Selecting a time constant

A time constant for the pre-emphasis feature can be selected out of 25, 50, and 70 μs.

A desired time constant readout can be turned on with the key of the PRE-EMPHASIS block to set the time constant for the pre-emphasis. When all lights are off, the pre-emphasis is also off.

Pressing the key of the PRE-EMPHASIS block causes several pre- emphasis conditions to be selected in the following order.

OFF → 25 μs → 50 μs → 75 μs →OFF

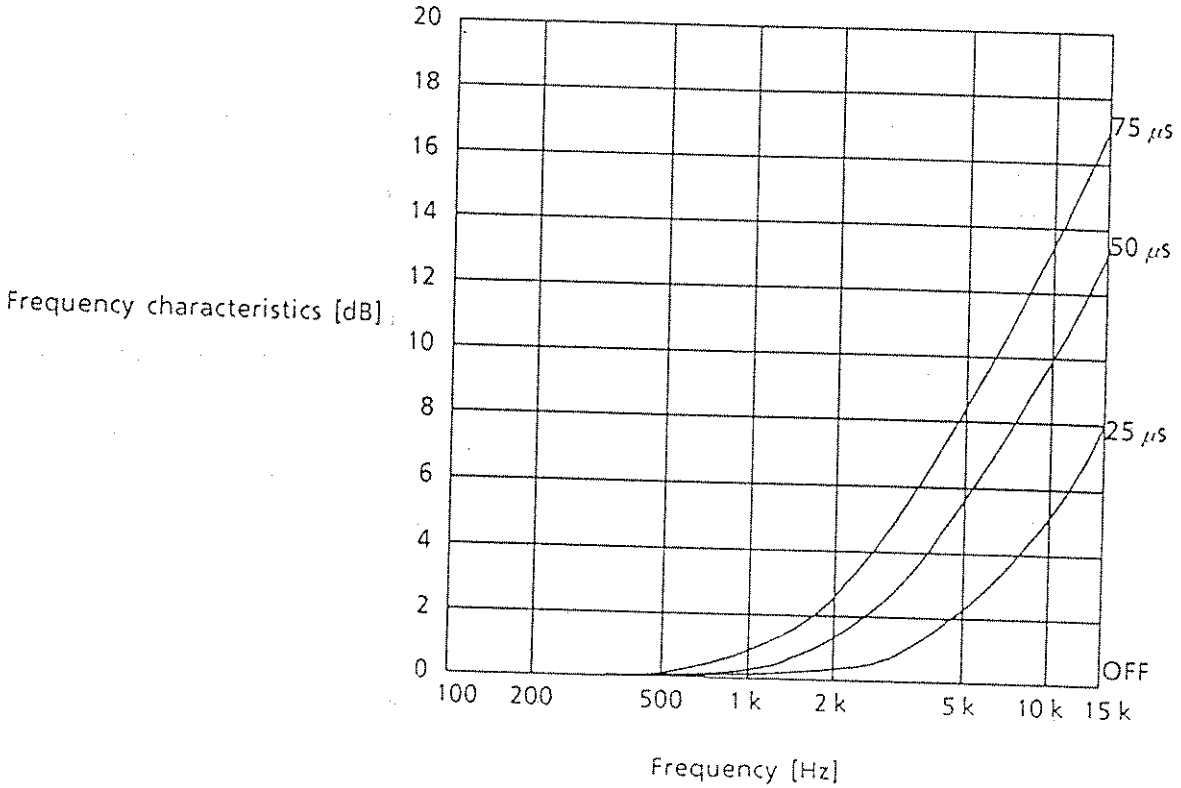


Figure 4-2 Standard pre-emphasis feature

NOTE

The pre-emphasis feature is fixed to OFF during the modulation mode is MONO or the setting frequency is in the AM band range.

(2) GP-IB program code

The GP-IB can control selection of a time constant for the pre- emphasis feature. Table 4-36 shows the GP-IB program codes for the pre-emphasis feature.

Table 4-36 GP-IB program codes for the pre-emphasis feature

Header code	Data code	Unit code	Description
PR	0		Pre-emphasis OFF
	1		Pre-emphasis 25 μs
	2		Pre-emphasis 50 μs
	3		Pre-emphasis 75 μs

(3) Error

If an erroneous operation is done during the pre-emphasis operation, an error code listed in the table 4-37 will appear in the MEMORY ADDRESS readout. If the instrument operates under the remote control with the GP-IB, no error code will appear.

Table 4-37 Possible errors during the pre-emphasis operation

Error code	Error description	Occurs upon :	Result
69	Pre-emphasis feature is turned on in any case of the following. ① Modulation mode is set to MONO in the FM band. ② Current RF frequency is in the AM band.	Pressing the PRE-EMPHASIS key.	Pre-emphasis feature cannot be turned on.

4-16 SCA SIGNAL (FM STEREO MODE)

When the SCA function is turned on, any signal externally applied to the SCA INPUT terminal on the rear panel of this instrument is superimposed on the output signal from this instrument. Given below are the specifications of the SCA signal.

Frequency characteristics : 20 to 99 kHz ± 1 dB (with reference to 57 kHz)
Input level : Approx. 0.56 Vp-p (equivalent with 10 % level ratio)

The basic operation is turning the SCA signal on / off.

(1) Turning the SCA signal on and off

The SCA signal can be turned on and off with the SCA key of the MODULATION MODE block. The SCA key switches alternately; the key light is turned on to indicate the SCA signal is on, turned off to indicate the SCA signal is off.

NOTE

The SCA signal cannot be turned on when the modulation mode is MONO or the setting frequency is in the AM band.

(2) GP-IB program code

The GP-IB can control turning the SCA signal on / off. Table 4-38 shows the GP-IB program codes for the SCA signal.

Table 4-38 GP-IB program code for the SCA signal

Header code	Data code	Unit code	Description
SC	ON (1) OF (0)		Turns the SCA signal on. Turns the SCA signal off.

(3) Error

If an erroneous operation is done during the operation the SCA signal function, an error code listed in the table 4-39 will appear in the MEMORY ADDRESS readout. If the instrument operates under the remote control with the GP-IB, no error code will appear.

Table 4-39 Possible errors during the operation of the SCA signal function

Error code	Error description	Occurs upon :	Result
68	SCA function is turned on in any case of the following. ① Modulation mode is set to MONO in the FM band. ② Current RF frequency is in the AM band.	Pressing the SCA ON key.	SCA function cannot be turned on.

4-17 COMPOSITE SIGNAL OUTPUT LEVEL

The basic operation of a composite signal output level includes :

- Direct setup of a composite signal output level with DATA keys
- Modification with the AMPTD knob of the MODIFY block

(1) Readout

A composite signal output level appears in the AMPLITUDE readout. A signal with a specified composite level is output from the COMPOSITE terminal on the rear panel of this instrument as an FM stereo output signal. An M + S level ratio and PILOT level ratio, described previously, are set in percentage, assuming the current specified composite output level is 100 %.

NOTE

A composite signal can be outputted only when the modulation mode is the other than MONO in the FM band (FM stereo).

The setting range and resolution of a composite signal output level (at open end) are 0 to 9990 mV and 10 mV, respectively.

(2) Direct setup with DATA keys

- Press the SHIFT key.
- Press the <5> LEVEL-C key of the DATA block.
- Enter a numeric value with DATA keys of the DATA block.
- Press the mV key of the ENTER block.

A desired composite signal output level can be set through the above key operation. Since the resolution is 10 mV, the lowest digit (1 mV's digit) is rounded down and not displayed even if specified.

Example 4-38) Setting the composite signal output level of 7800 mV

SHIFT	LEVEL-C	7	8	0	0	mV

NOTE

In the composite signal output level setting, the output level value entered following the SHIFT key and <5> LEVEL-C key appears in the AMPLITUDE readout for about 10 seconds.

(3) Modification with the AMPTD knob

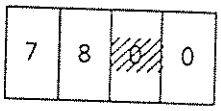
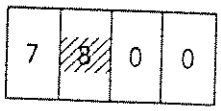
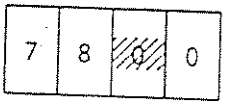
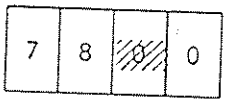
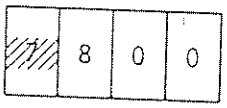
- Press the SHIFT key.
- Press the <5> LEVEL-C key of the DATA block.
- Specify a digit to be modified with the ⊣ ⊢ keys of the AMPTD operation part in the MODIFY block. (The ⊖ ⊕ keys of the FREQ/MOD operation part also work similarly.)
- Modify the value with the AMPTD knob of the MODIFY block.
  (The FREQ/MOD knob of the FREQ/MOD operation part also work similarly.)

A desired digit of the composite signal output level readout value can be modified through the above key operation.

Use the ⊟ ⊟ keys to specify the digit to be modified with the AMPTD knob. The specified digit blinks.

The AMPTD knob rotates endlessly ; rotating the knob clockwise increments the output level while rotating it counterclockwise decrements the output level. As the modified digit reaches 9 (incrementing) or 0 (decrementing), the digit to its left will increment or decrement.

Example 4-39) Shifting the digit to be modified with ⊟ ⊟ keys

Step	Keystroke	AMPLITUDE readout	Note
①	AMPTD ⊟	 mV	The digit currently modifiable begins to blink. At first, the modifiable digit does not shift.
②	⊟	 mV	The modifiable digit shifts to a higher place.
③	⊟	 mV	The modifiable digit shifts to a higher place.
④	⊟	 mV	The modifiable digit shifts to the lowest place. The lowest digit does not blink because of the 10 mV resolution.
⑤	⊟	 mV	The modifiable digit shifts to a higher place again.
⑥	⊟	 mV	The modifiable digit shifts to a lower place.
⑦	⊟	 dBm	The modifiable digit shifts to the highest place.
⑧	⊟	 mV	The modifiable digit shifts to a lower place. Blinking stops in above five seconds.

Example 4-40) Modifying the composite output level from 7800 mV to 7960 mV

Step	Keystroke	AMPLITUDE readout	Note
①	⊟	7 8 0 0 mV	The digit currently modifiable begins to blink.
②	⊟ ⊟	7 8 9 0 mV	Cause the lowest place to blink.
③	CW	7 9 6 0 mV	Blinking stops to show the output level has been modified. Knob 16 steps

NOTE

During the composite signal output level setting, all ⊟ and ⊟ keys in the MODIFY block are available.

(4) GP-IB program code

As for a composite signal output level, the GP-IB can control the direct setup of an output level in a numeric value. Table 4-40 shows the GP-IB program codes for a composite signal output level.

Table 4-40 GP-IB program codes for a composite signal output level

Header code	Data code	Unit code	Description
LV	00 to 9990		Sets a composite signal output level of 0 to 9990 mV.

4-18 ASSORTED PRESET MEMORY

The assorted preset memory stores up to 100 sets of parameters for functions given so far in this manual. Any set of data stored can be recalled at a time as required.

(1) Data that can be stored in a set in the assorted preset memory

Table 4-41 lists the data storable in the assorted preset memory.

Table 4-41 Data stored in the assorted preset memory

Item	Parameter
RF frequency	
Frequency	0.01000 to 280.00000 MHz
Relative frequency	– 199.99999 to 199.99999 MHz
Output level	
Level	– 133.0 to 19 dBm – 26.0 to 126.0 dBμV – 20.0 to 132.0 dBμV EMF 0.050 μV to 2000 mV 0.100 μV EMF to 4000 mV EMF
Relative level	0 to ± 152 dB
Continuous control	ON / OFF
Output	ON / OFF
Impedance	50 Ω / 75 Ω
Amplitude modulation	
Modulation	ON / OFF
Modulation signal	INT 400 Hz / INT 1 kHz / EXT
Modulation degree	0.0 to 125 %
NEG PEAK CLIPPER	ON / OFF
Frequency modulation	
Modulation	ON / OFF
Modulation signal	INT 400 Hz / INT 1 kHz / EXT
Frequency deviation	0.00 to 300 kHz
Total frequency deviation	0.00 to 300 kHz
Main- and sub-channel signal	
Modulation mode	MONO / L = R / L / R / L = – R INT L – EXT R / EXT L, R / OFF
Level ratio	0 to 127 % (MONO) 0 to 114 % (Except for MONO)
Pre-emphasis	25 μs / 50 μs / 75 μs / OFF
Pilot signal	
Signal	ON / OFF
Level ratio	0 0 to 19.9 % (FM stereo)
Modulation degree	0.0 to 12.5 % (AM stereo)
SCA signal	ON / OFF
Setting item selection state	AMPTD / FREQ / FM / AM
External control output	
Port 1	0 to 255
Port 2	0 to 255
Preset revers frequency for the relay drive output	– 280 to 280

(2) Memory address

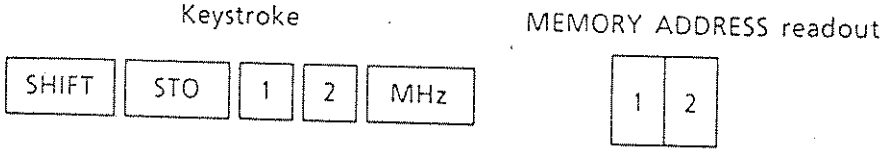
The 100 sets of preset memory are registered at memory addresses 00 to 99. A memory address will appear in the MEMORY ADDRESS readout.

(3) Storing operation

- Set an item to be stored (see Table 4-41) to the required value.
- Press the SHIFT key.
- Press the <RCL> STO key of the MEMORY block.
- Specify a memory address with DATA keys of the DATA block.
- Press any key of the ENTER block.

The data can be stored in the preset memory by following the above procedure.

Example 4-41) Storing the current setup conditions at the memory address 12

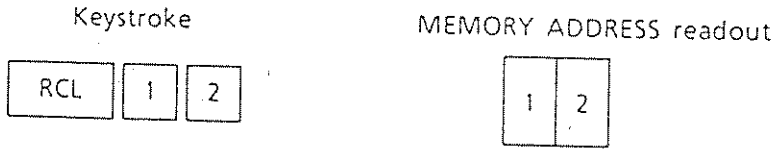


(4) Direct recalling

- Press the RCL key of the MEMORY block.
- Specify a memory address to be recalled with DATA keys of the DATA block.

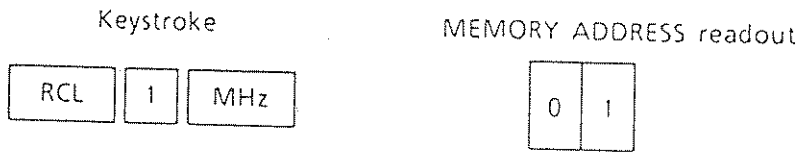
Data in the specified preset memory can be recalled by following the above procedure.

Example 4-42) Recalling the memory address 12



Addresses 00 to 09 can be also recalled by following the procedure shown in Example 4-43.

Example 4-43) Recalling the memory address 1



(5) Sequential recalling

(a) General

Data at the addresses between the desired start and end addresses can be sequentially recalled in single key operation. Given below are the procedures for setting a pair of start and end address and executing sequential recalling.

(b) Setting a pair of start and end address

- Press the SHIFT key.
- Press the <RCL> STO key of the MEMORY block.
- Press the point key [.] of the DATA block.
- Specify a two-digit start address with DATA keys of the DATA block.
- Press the point key [.] of the DATA block.
- Specify a two-digit end address with DATA keys of the DATA block.
- Press any key of the ENTER block.

A desired pair of start and end address can be specified through above key operation.

Example 4-44) Specifying 12 for the start address, and 34 for the end address

Keystroke	MEMORY ADDRESS readout	Note
SHIFT STO . 1 2 . 3 4 MHz	1 2.	The decimal point of the lower digit is turned on.

The canceling procedure for the specified pair of start and end address is as shown in Example 4-45.

Example 4-45) Canceling the specified pair of start and end address

Keystroke	MEMORY ADDRESS readout
SHIFT STO . . MHz	0 0

NOTE

The generator always judges the smaller address as the start address. If the sequential recalling is executed with the setting as follows,

SHIFT STO . 3 4 . 1 2 MHz

the addresses will be recalled in the order of 12 → 13 → → 33 → 34.

If the same value is specified for both start and end addresses, the result will be same as the canceling operation of the start and end address.

(c) Sequential recalling

The data stored in preset memories can be sequentially recalled by operating an appropriate key of the MEMORY block.

Press the ↑ key to recall the memory address next to the address currently displayed. If the address currently displayed is the end address, pressing the ↑ key recalls the start address.

Press the ↓ key to recall the memory address before the address currently displayed. If the address currently displayed is the start address, pressing the ↓ key recalls the end address.

Press the CLR key to recall the start address. If the CLR key is pressed with the start and end address canceled, the address 00 will be recalled.

Example 4-46) Sequential recalling (12 for the start address, 34 for the end address)

Step	Keystroke	MEMORY ADDRESS readout	Note
①		1 2.	Current address displayed
②	↑	1 3.	The address next to 12
③	↓	1 2.	The start address
④	↓	3 4.	The end address
⑤	↓	3 3.	
⑥	CLR	1 2.	The start address

(6) Grouped sequential recalling

(a) General

Preset memories can be divided into ten groups at maximum. One out of the divided groups can be specified to perform sequential recalling. Basic operation includes:

- Grouping
- Group specification for sequential recalling
- Canceling of sequential recalling within a group

(b) Groping

- Press the SHIFT key.
- Press the <RCL> STO key of the MEMORY block.
- Press the point key [.] of the DATA block.
- Specify a two-digit start address with DATA keys of the DATA block.
- Press the point key [.] of the DATA block.
- Specify a two-digit end address with DATA keys of the DATA block.
- Press the point key [.] of the DATA block.
- Specify a one-digit group number with a DATA key of the DATA block.
- Press any key of the ENTER block.

A desired pair of start and end address as well as group number can be set through the above key operation.

Example 4-47) Defining group 5 with its start address 12 and end address 34.

Keystroke	MEMORY ADDRESS readout	Note
SHIFT STO . 1 2 . 3 4 . 5 MHz	1 2.	The decimal point of the lower digit is turned on.

Two or more groups can share the same addresses.

Example 4-48) Dividing into three groups that share the same addresses

Step	Keystroke	MEMORY ADDRESS readout
①	SHIFT STO . 0 0 . 2 0 . 1 MHz	0 0.
②	SHIFT STO . 1 0 . 3 0 . 2 MHz	1 0.
③	SHIFT STO . 2 0 . 4 0 . 3 MHz	2 0.

(c) Specifying a group for sequential recalling

- Press the RCL key of the MEMORY block.
- Press the point key [.] of the DATA block.
- Specify a one-digit group number with a DATA key of the DATA block.
- Press any key of the ENTER block.

A desired group for sequential recalling can be specified through the above key operation.

Example 4-49) Specifying group 1

Keystroke	MEMORY ADDRESS readout	Note
RCL . 1 MHz	0 0.	The decimal point of the lower digit is turned on.

(d) Canceling sequential recalling within a group

The procedure for canceling the specified pair of start and end address is shown in Example 4-50. However, the divided groups are still stored in memories.

Example 4-50) Canceling sequential recalling within a group

Keystroke	MEMORY ADDRESS readout	Note
SHIFT STO . . MHz	0 0	The decimal point of the lower digit is turned on.

NOTE

If the same value is specified for both start and end addresses, the result will be same as the canceling operation of the start and end address.

(6) GP-IB program code

As for preset memory, the GP-IB can control only storing and direct recalling operations. Table 4-42 shows the GP-IB program codes for the preset memory operation.

Table 4-42 GP-IB program codes for preset memory

Header code	Data code	Unit code	Description
RC	00 to 99		Recalls data in preset memories of addresses 00 to 99.
ST	00 to 99		Stores data in preset memories of address 00 to 99.

4-19 AUTO SEQUENCE OF ASSORTED PRESET MEMORY

The auto sequence function allows the assorted preset memory described in the paragraph 4-17 to be sequentially recalled at a desired time interval. The basic operation of the auto sequence includes :

- Setting an interval time
- Selecting an auto sequence mode
- Starting and ending the auto sequence function

(1) Interval time

The auto sequence function is used to set a time interval after a certain memory is recalled until the next memory is recalled. An interval time can be changed for each memory address.

(a) Setting range and resolution

An interval time appears in seconds in the MODULATION readout only during the setting and verifying operations. The setting range and resolution are as follows.

Setting range	Resolution
0.10 to 9.99 s	0.01 s
10.0 to 60.0 s	0.1 s

(b) Setting procedure

- Press the SHIFT key.
- Press the <1> INTVL key of the DATA block.
- Enter a numeric value with DATA keys of the DATA block.
- Press the s key of the ENTER block.

A desired interval time can be set through the above key operation. The following three procedures can be used to set an interval time for different target addresses.

- A procedure for setting an interval time for the memory address currently displayed.
- A procedure for setting an interval time for all addresses between any two addresses at a time.
- A procedure for setting an interval time for all addresses between the start and end address for sequential recalling at a time.

Given below are the example operations, where the start address of the preset memory has been set to 00 and the end address to 19.

Example 4-51) Setting the interval time to one second for a memory address

Step	Keystroke	MODULATION readout	Note
①		1 2. 5 kHz	Current modulation degree set value
②	SHIFT INTVL	0. 1 0 s	Interval time set for the memory address currently displayed
③	1 s	1. 0 0 s	Set the interval time to one second
④		1 2. 5 kHz	Current modulation degree set value

Example 4-52) Setting the interval time to two seconds for the memory addresses 3 to 9

Step	Keystroke	MODULATION readout	Note
①		1 2. 5 kHz	Current modulation degree set value
②	SHIFT INTVL	0. 1 0 s	Interval time set for the memory address currently displayed
③	2 – 3 – 9 s	2. 0 0 s	Set the interval time to two seconds 3 – 9 ··· Address data
④		1 2. 5 kHz	Current modulation degree set value

Example 4-53) Setting the interval time to three seconds for all the memory addresses between the start and end address

Step	Keystroke	MODULATION readout	Note
①		1 2. 5 kHz	Current modulation degree set value
②	SHIFT INTVL	0. 1 0 s	Interval time set for the memory address currently displayed
③	3 - - s	3. 0 0 s	Set the interval time to three seconds
④		1 2. 5 kHz	Current modulation degree set value

Example 4-54) Verifying the interval time set for the memory address currently displayed

Step	Keystroke	MODULATION readout	Note
①		1 2. 5 kHz	Current modulation degree set value
②	SHIFT INTVL	3. 0 0 s	Interval time set for the memory address currently displayed appears for about five seconds.
③		1 2. 5 kHz	Current modulation degree set value

NOTE

The s(second) light of the MODULATION readout is turned on for only about five seconds after the SHIFT key and <1> INTVL keys are pressed. Press a DATA key of the DATA block to set an interval time while the light is on. Otherwise the setting value will not be accepted.

(2) Selecting a mode for auto sequence

The following four modes are available for auto sequence operation.

- Repeat up : Repeats auto sequence in the start-to-end direction.
- Single up : Executes auto sequence only once in the start-to-end direction.
- Repeat down : Repeats auto sequence in the end-to-start direction.
- Single down : Executes auto sequence only once in the end-to-start direction.

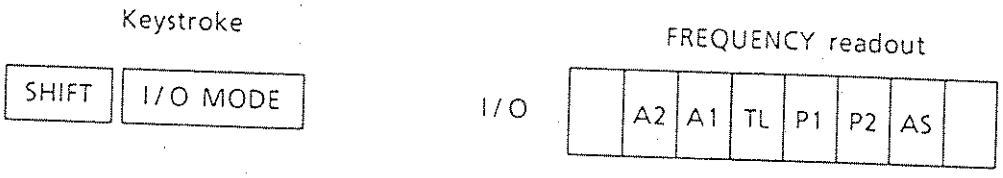
(a) Readout

The auto sequence mode is displayed in the FREQUENCY readout only during the selecting and verifying operations. At that time, the FREQUENCY readout also contains the parameters for other I/O modes.

- Press the SHIFT key.
- Press the <0> I/O MODE key of the DATA block.

The selected auto sequence mode is displayed in the FREQUENCY readout as shown in Example 4-55 through the above key operation.

Example 4-55) Verifying the auto sequence mode



The auto sequence mode appears in the AS digit of the FREQUENCY readout. Given below is the relationship between the AS numeric values and modes.

AS	Mode
0	Repeat up
1	Single up
2	Repeat down
3	Single down

The digits other than AS are explained as follows. For more information, see the paragraph in parentheses.

- A1, A2 : Displays the GP-IB device address in a decimal number from 0 to 30. (See the paragraph 6-3.)
- TL : Displays the master/slave settings of the memory sync and memory copy functions. (See the paragraph 6-10.)
- P1 : Displays the mode of port 1 of the EXT CONTROL I/O. (See the paragraph 7-3.)
- P2 : Displays the mode of port 2 of the EXT CONTROL I/O. (See the paragraph 7-3.)

(b) Selecting procedures

- Press the SHIFT key.
- Press the <0> I/O MODE key of the DATA block.
- Specify the AS digit with the ⊟ ⊟ keys of the FREQ/MOD operation part in the MODIFY block.
- Press either one of the [0] to [3] keys of the DATA block to select a mode.
- Press any key of the ENTER block.

A desired auto sequence mode can be selected through the above key operation.

Example 4-56) Selecting the Repeat down mode "2"

Step	Keystroke	FREQUENCY readout	Note
①		1 2 3. 4 5 6 7 8	Current RF frequency set value
②	SHIFT I/O MODE	I/O 1 0 0 0 0 0	Current I/O mode set value
③	← ··· ← or → ··· →	I/O 1 0 0 0 0 0	Causes the AS digit to blink.
④	2 MHz	I/O 1 0 0 0 0 2	Set the mode to 2. Displayed for about five seconds.
⑤		1 2 3. 4 5 6 7 8	Current RF frequency set value.

(3) Starting and ending the auto sequence

- Press the SHIFT key.
- Press the <⊡> AUTO/MANU key of the MEMORY block.

The above key operation causes the AUTO light of the MEMORY ADDRESS readout to be turned on and the auto sequence to start. No operation except for the ending operation is effective during the auto sequence operation.

The ending procedure is same as the starting one. The AUTO light of the MEMORY ADDRESS readout is turned off to indicate that the auto sequence has been ended.

NOTE

The execution of the auto sequence pauses when the SHIFT key is pressed.

(4) GP-IB control

As for auto sequence function, the GP-IB can control interval time setting and operation mode selection. Table 4-43 gives the GP-IB program codes for auto sequence.

Table 4-43 GP-IB program codes for auto sequence

Header code	Data code	Unit code	Description
NT	t $t - a_1 - a_2$ t – – t (Interval time) : 0.10 to 60.0 a_1, a_2 (Address) : 00 to 99 ($a_1 < a_2$)		Sets the interval time to t (s) for the currently displayed address. Sets the interval time to t (s) for the addresses a_1 to a_2. Sets the interval time to t(s) for the addresses between the start and end address.
AS	0 1 2 3		Selects the Repeat up mode. Selects the Single up mode. Selects the Repeat down mode. Selects the Single down mode.

(5) Error

If an erroneous operation is done during auto sequence, an error code listed in the table 4-44 will appear in the MEMORY ADDRESS readout. If the instrument operates under the remote control with the GP-IB, no error code will appear.

Table 4-44 Possible error during auto sequence

Error code	Error description	Occurs upon :	Result
75	Interval time is set beyond the range of 0.10 to 60 s.	Pressing the ENTER key.	The setting value is unacceptable.

SECTION V
GP-IB OVERVIEW

5-1 GENERAL

The GP-IB (General Purpose Interface Bus) has been known as a special bus structure defined by the IEEE Standard 488. The overall purpose of the interface system is to provide an effective communication link over which messages are carried in an unambiguous way among a group of interconnected devices.

5-2 DEVICES IN THE SYSTEM

The communication link requires three basic functional elements to organize and manage the flow of information to be exchanged among devices : (1) A device acting as a listener, (2) a device acting as a talker, and (3) a device acting as a controller.

A talker sends data to listeners on the bus, a listener receives data from the talker on the bus, and a controller controls the activity of the bus. Many devices are both a talker and listener, but there are devices that can be fixed to act as a talker only or a listener only with the "Only" mode of operation. Besides, there are devices that act inherently as a listener only (e.g., a printer).

The controller is the only device capable of sending commands by which the activities on the bus are altered. The controller can pick out a specific device and instruct it to be a talker or listener.

5-3 MESSAGE PATHS AND BUS STRUCTURE

The GP-IB contains a set of sixteen signal lines used to carry all information, interface messages, and device dependent messages among interconnected devices. Figure 5-1 is a diagram of the interface connection and bus structure.

The bus structure is organized into three sets of signal lines:

(1) Data bus, 8 signal lines (DIO 1 ... 8)

(2) Handshake lines or data byte transfer control bus, 3 signal lines (DAV, NRFD and NDAC)

(3) Control lines or interface management bus, 5 signal lines (ATN, IFC, SRQ, REN and EOI)

The bus consists of a 24-line passive cable of which sixteen lines are used for signal lines described above and the remaining eight are used for ground connection. Since the bus has a negative logic convention, a less positive voltage level is referred to as TRUE (binary 1) and a more positive voltage level is FALSE (binary 0).

5-4 DATA LINES (DATA BUS)

The data lines carry message bytes in a bit-parallel byte-serial form, asynchronously, and generally in a bidirectional manner. These lines carry either data or command information, depending upon the condition of the ATN management line. Normally, a seven-bit ASCII code represents each byte of messages, leaving the eighth bit available for parity checking.

Commands are categorized into two groups, one Addressed Command Group effective only for listeners and another Universal Command Group effective for all devices. The following are typical commands with brief descriptions.

Addressed commands:

GTL Go To Local. Returns the listening device(s) to local front panel control.

SDC Selected Device Clear. Returns the listening device(s) to a predefined device-dependent state.

GET Group Execute Trigger. Causes the listening device(s) to perform a device-dependent action.

UNL Unlisten. Releases all listening devices from being listeners.

Universal commands:

LLO Local Lockout. Prevents the device operator from manually inhibiting remote program control.

DCL Device Clear. Sets the device to its initial conditions.

SPE Serial Poll* Enable. Places the device under serial poll mode.

SPD Serial Poll Disable. Releases the device from serial poll mode.

* Polling is a mean by which a controller can identify a device that needs interaction with it. The controller may poll devices for their operational condition one at a time, which is termed a serial poll, or as groups of devices simultaneously, which is termed a parallel poll.

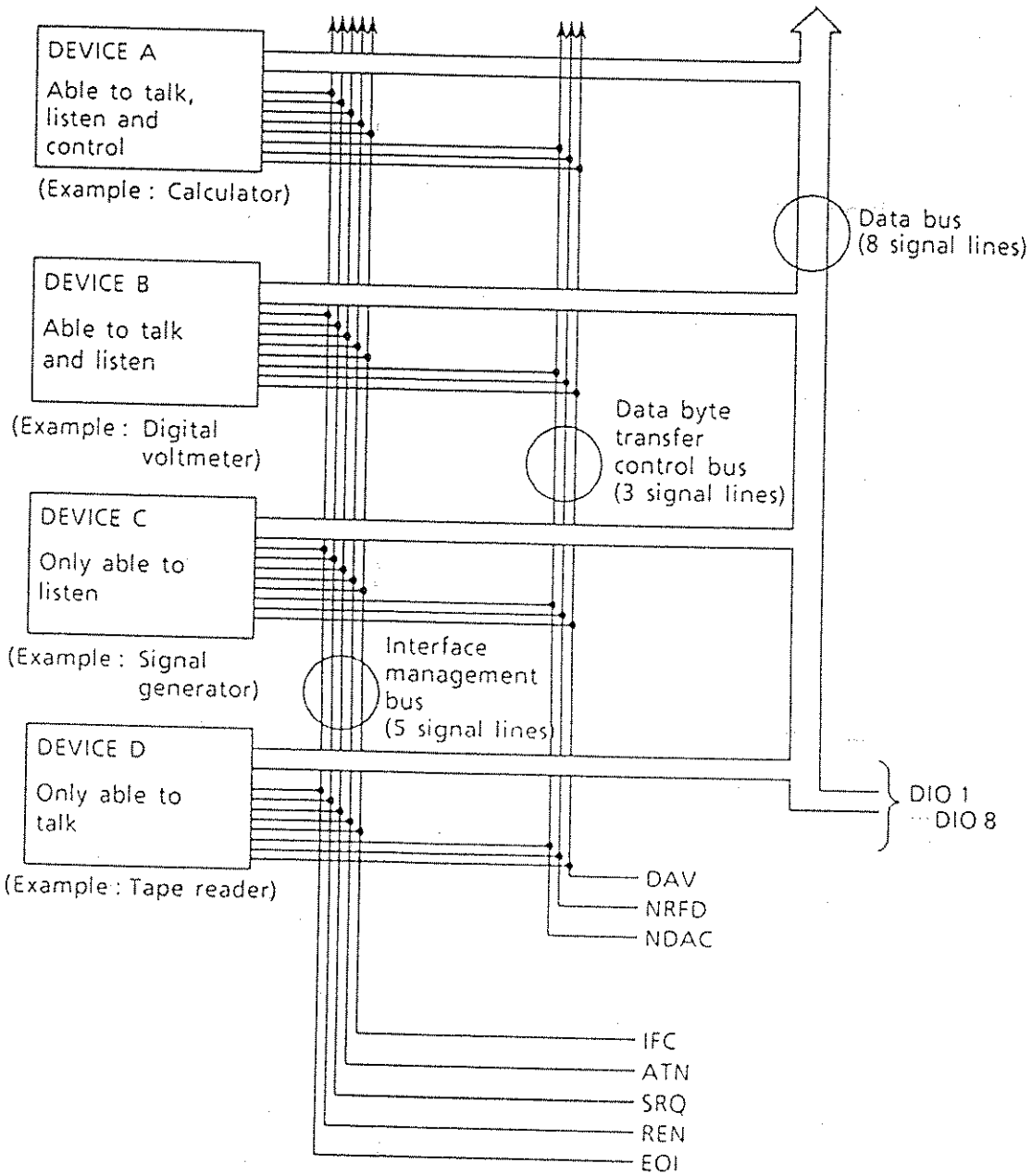


Figure 5-1 Interface connection and bus structure

The commands are sent from the controller when the ATN line is Low (TRUE). MLA (My Listen Address) and MTA (My Talk Address) are used to designate the devices as a listener or talker respectively.

Each device has a 5-bit address switch usually on the rear panel to be used for assigning an address. Using this address the device can respond to addressed commands.

5-5 HANDSHAKE LINES (DATA BYTE TRANSFER CONTROL BUS)

A set of three interface signal lines (DAV, NRFD, and NDAC) operate in what is called a three-wire interlocked handshake process to transfer each data byte across the interface :

(1) DAV line (Data Valid) is used to indicate the condition (availability and validity) of information on the DIO signal lines.

(2) NRFD line (Not Ready for Data) is used to indicate the condition of readiness of device(s) to accept data.

(3) NDAC line (Not Data Accepted) is used to indicate the condition of acceptance of data by device(s).

The handshake process timing diagram is shown in Figure 5-2, and its flow diagram is shown in Figure 5-3.

Each byte of data transferred by the interface uses the handshake process between a source and acceptor. In a typical example, the source is a talker and the acceptor is a listener.

The talker waits for NRFD (all listeners become ready to receive) and, after receiving NRFD, it generates and sends a DAV. The listener receives data after receiving this DAV, releases NDAC when all data have been received, and releases NRFD when the device is ready to receive the next byte of data. This sequence allows consecutive data transfer. A wired-OR configuration in the NRFD and NDAC lines permit data transfer at the rate of the slowest device. This enables the data transfer rate of these lines to match that of the device, assuring accurate data transfer.

5-6 CONTROL LINES (INTERFACE MANAGEMENT BUS)

Five interface signal lines are used to manage an orderly flow of information across the interface:

(1) ATN Attention. Identifies the information on the data bus.
Data can be sent when the ATN line is High, and the commands can be sent when it is Low.

(2) IFC Interface Clear. Initializes the bus to an idle state.

(3) SRQ Service Request. Indicates the need for attention and to request an interruption of the current sequence of events.

(4) REN Remote Enable. Places instruments under remote program control. When the REN line is Low, devices are made to be ready for operation in remote mode.

(5) EOI End or Identify. Indicates the end of a multiple byte transfer sequence or, in conjunction with ATN, to execute a polling sequence.

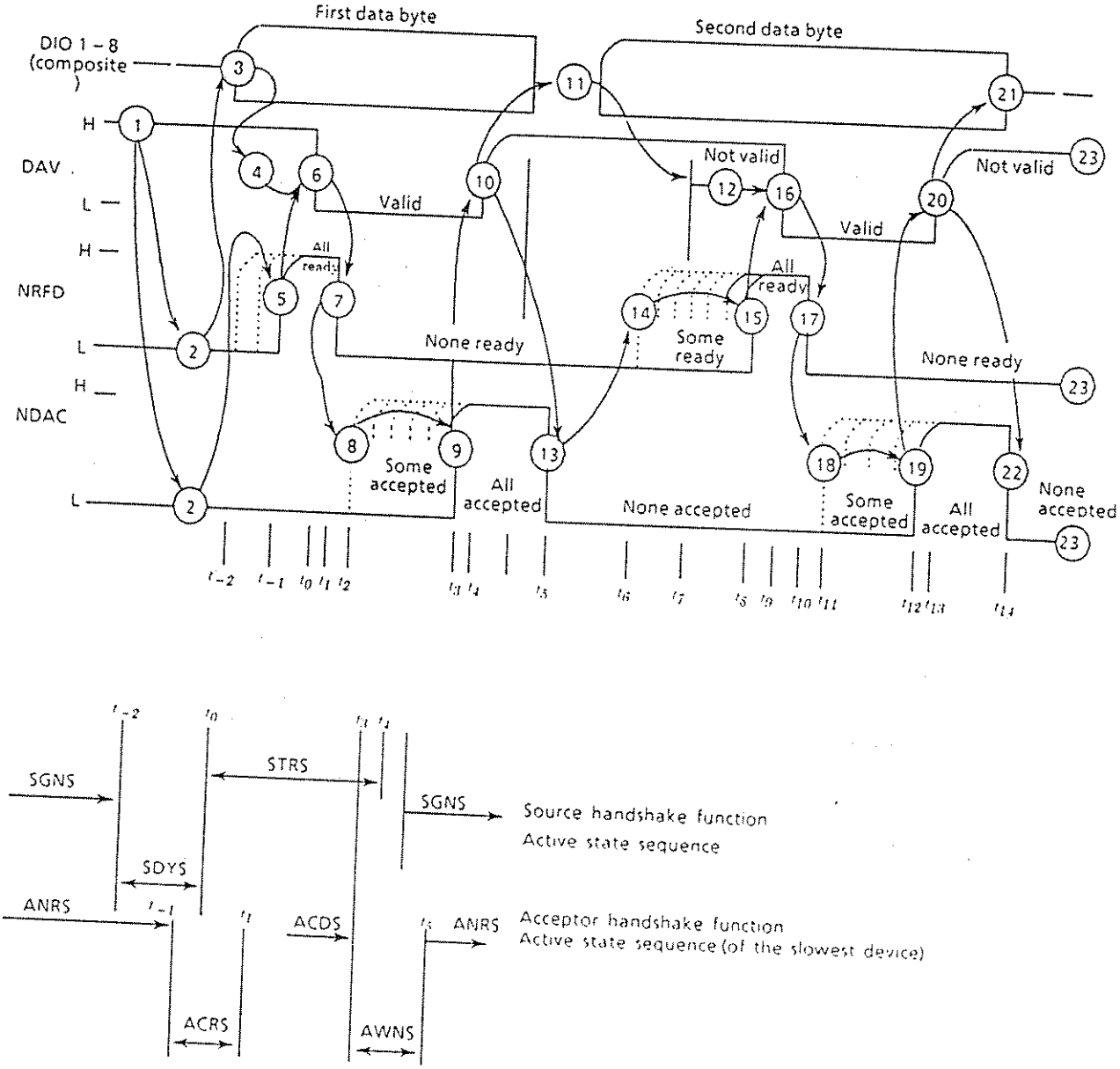


Figure 5-2 Handshake process timing diagram

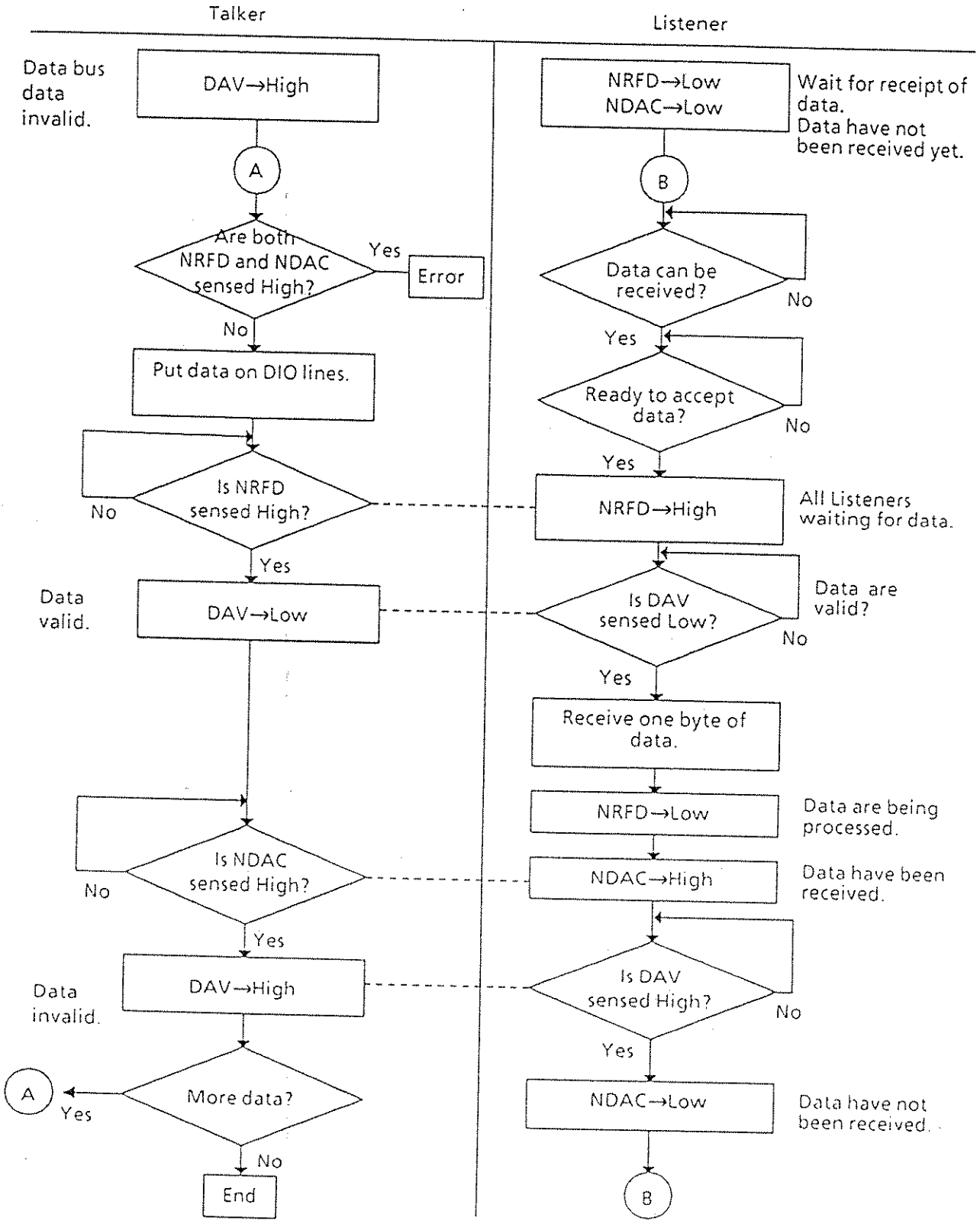


Figure 5-3 Handshake process flow diagram

5-7 MAJOR SPECIFICATIONS OF THE IEEE488, GP-IB

The maximum accumulative length of cable :	20 m
The maximum length between devices :	2 m
The maximum number of devices that can be connected, including controllers :	15
Transfer format:	3-wire handshaking
The maximum transfer rate :	1 M bytes / sec.
Data transfer :	8-bit parallel
Signal lines	
• Data lines (DIO 1 to DIO 8)	8 lines
• Control lines Handshaking lines (DAV, NRFD, NDAC) Interface management lines (ATN, REN, IFC, SRQ, EOI)	8 lines
• Signal / System ground	8 lines
Signal logic	Negative logic
• True : Level L	0.8 V or less
• False : Level H	2.0 V or more

Interface connector

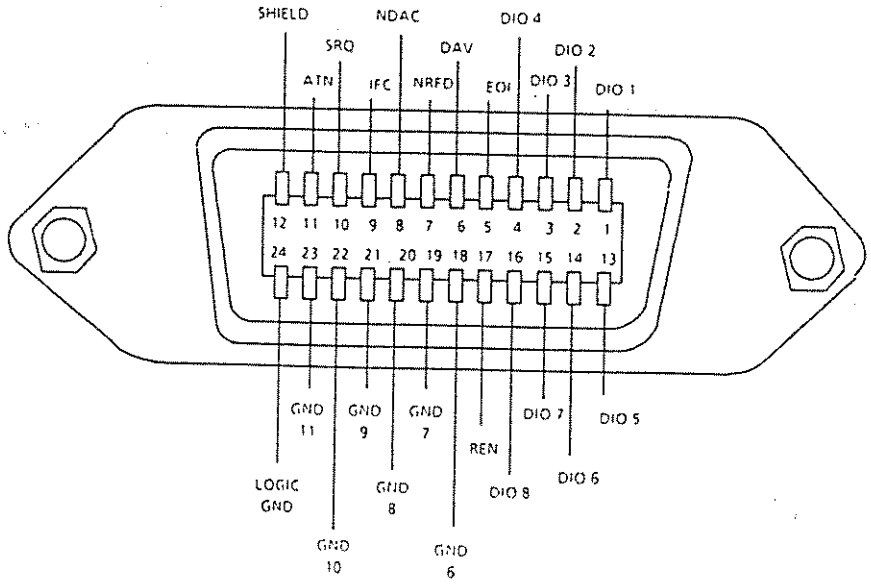


Table 5-1 Relationship between connector pin numbers and signal lines

Pin No.	IEC standard	IEEE standard	Pin No.	IEC standard	IEEE standard
1	DIO 1	DIO 1	14	DIO 5	DIO 6
2	DIO 2	DIO 2	15	DIO 6	DIO 7
3	DIO 3	DIO 3	16	DIO 7	DIO 8
4	DIO 4	DIO 4	17	DIO 8	REN
5	REN	EOI	18	Ground	Ground (6)
6	EOI	DAV	19	Ground (6)	Ground (7)
7	DAV	NRFD	20	Ground (7)	Ground (8)
8	NRFD	NDAC	21	Ground (8)	Ground (9)
9	NDAC	IFC	22	Ground (9)	Ground (10)
10	IFC	SRQ	23	Ground	Ground (11)
11	SRQ	ATN	24	Ground (11)	Logic Ground
12	ATN	Shield	25	Ground (12)	
13	Shield	DIO 5			

Note 1: Ground followed by parentheses indicates that the ground is for signal of pin number in parentheses.

Note 2: Ground of pin numbers 18 and 23 of the IEC standard may be used as a common logic ground.

5-8 CODE ASSIGNMENT OF COMMAND INFORMATION

Command information is the output from the controller when the ATN is Low.

Table 5-2 Code assignment of command information

Bits ② b_7 b_6 b_5					0 0 0	① MSG	0 0 1	MSG	0 1 0	MSG	0 1 1	MSG	1 0 0	MSG	1 0 1	MSG	1 1 0	MSG	1 1 1	MSG
b_4	b_3	b_2	b_1	Column → Row ↓	0		1		2		3		4		5		6		7	
0	0	0	0	0	NUL		DLE		SP		0		@		P		`		p	
0	0	0	1	1	SOH	GTL	DC1	LLO	!		1		A		Q		a		q	
0	0	1	0	2	STX		DC2		"		2		B		R		b		r	
0	0	1	1	3	ETX		DC3		#		3		C		S		c		s	
0	1	0	0	4	EOT	SDC	DC4	DCL	$		4		D		T		d		t	
0	1	0	1	5	ENQ	PPC ③	NAK	PPU	%		5		E		U		e		u	
0	1	1	0	6	ACK		SYN		&		6		F		V		f		v	
0	1	1	1	7	BEL		ETB		'		7		G		W		g		w	
1	0	0	0	8	BS	GET	CAN	SPE	(		8		H		X		h		x	
1	0	0	1	9	HT	TCT	EM	SPD	)		9		I		Y		i		y	
1	0	1	0	10	LF		SUB		*		:		J		Z		j		z	
1	0	1	1	11	VT		ESC		+		;		K		[		k		{	
1	1	0	0	12	FF		FS		,		<		L		¥		l		|	
1	1	0	1	13	CR		GS		-		=		M		]		m		}	
1	1	1	0	14	SO		RS		.		>		N		^		n		~	
1	1	1	1	15	SI		US		/		?	UNL	O		_	UNT	o		DEL	

MLA assigned to device

MLA assigned to device

MTA assigned to device

MTA assigned to device

Meaning defined by PCG code

Meaning defined by PCG code

Addressed command group (ACG)

Universal command group (UCG)

Listen address group (LAG)

Talk address group (TAG)

Primary command group (PCG)

Secondary command group (SCG)

Notes: ① MSG means an interface message.

② b_1 = DIO 1 ..... b_7 = DIO 7. DIO 8 is not used.

③ Requires secondary command.

SECTION VI
GP-IB INTERFACE

6-1 GENERAL

The GP-IB interface allows the VP-8122A to provide the following functions.

(1) Listener

Remotely controls an RF frequency, output level, and modulation with program codes sent out from the controller.

(2) Talker

Sends out to the controller RF frequency, output level, modulation, and other setup conditions or read data of the EXT CONTROL I/O (see the paragraph 7-10).

(3) Talk only/listen only

Memory sync and memory copy functions.

The detailed description for the above is given in the following paragraphs.

6-2 INTERFACE FUNCTION

The generator is provided with the basic listener/talker, listen only/talk only, and remote/local function. Table 6-1 lists the generator's interface functions.

Table 6-1 Interface functions

Function	Code	Description
Source handshake	SH1	Complete capability
Acceptor handshake	AH1	Complete capability
Talker	T7	Basic talker, talker release by MLA, and talk only
Listener	L3	Basic listener, listener release by MTA, and listen only
Service request	SR0	No capability
Remote/local	RL1	Complete capability
Parallel poll	PP0	No capability
Device clear	DC1	Complete capability
Device trigger	DT0	No capability
Controller	C0	No capability

6-3 GP-IB ADDRESS SETTING

A GP-IB device address is set with panel keys.

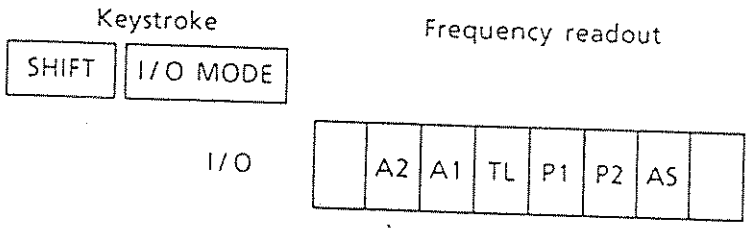
(1) Readout

The GP-IB address appears in the FREQUENCY readout with the parameters for other I/O modes only during setting and verifying operation.

- Press the SHIFT key.
- Press the <0> I/O MODE key of the DATA block.

The above key operation causes the address to appear in the FREQUENCY readout as shown in Example 6-1.

Example 6-1) Verifying the GP-IB address setting



The digits A1 and A2 in the FREQUENCY readout display the GP-IB device address as a decimal number of 0 to 30.

NOTE

- The DATA keys of the DATA block
- The ⊟ ⊟ keys, AMPTD knob, FREQ/MOD knob of the FREQ/MOD operation part in the MODIFY block

After completing the operation in Example 6-1, operating any key and knob other than mentioned above turns the I/O mode light of the FREQUENCY readout off; i.e. the generator returns to the normal setting state.

(2) Setting procedure

- Press the SHIFT key.
- Press the <0> I/O MODE key of the DATA block.
- Specify either A1 or A2 digit with the ⊣ ⊣ keys of the FREQ/MOD operation part in the MODIFY block.
- Enter a numeric value with DATA keys of the DATA block.
- Press any key of the ENTER block.

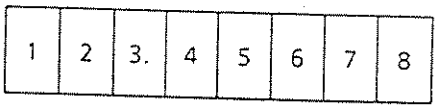
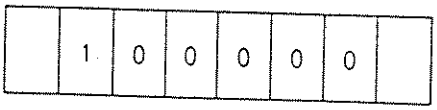
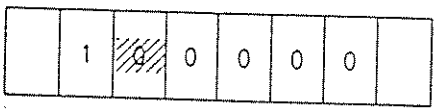
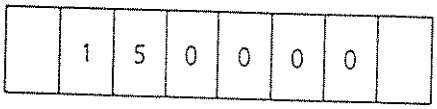
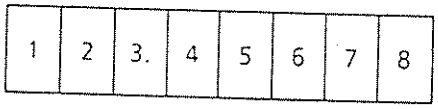
A desired GP-IB address is displayed in the FREQUENCY readout through the above key operation.

- Turn the POWER switch off.
- Again turn the POWER switch on.

NOTE

The above setting procedure is completed by turning the POWER switch off and then on. Note that if this step is omitted, the generator will maintain the previous setting.

Example 6-2) Setting the GP-IB address to 15

Step	Keystroke	FREQUENCY readout	Note
①			Current RF frequency set value
②	SHIFT I/O MODE		
	I/O		Current I/O mode set value
③	← ... ← or → ... →		
	I/O		Cause the A1 digit to blink.
④	1 5 MHz		
	I/O		Set the address to 15. Displayed for about five seconds.
⑤	POWER POWER		Turn the POWER switch off and then on.
			Current RF frequency set value.

6-4 DEVICE CLEAR

The DCL or SDC command clears the signal generator to the initial conditions shown in Table 6-2.

Table 6-2 Initial conditions

Item	Setting
Output level EMF display Continuous control Output impedance	– 133.0 dBm OFF OFF 50 Ω
RF frequency	280 MHz
FM modulation Modulation signal Deviation	OFF INT 1 kHz 0.00 kHz
AM modulation Modulation signal Modulation degree	OFF INT 1 kHz 0.0 %
Modulation degree display in the MODULATION readout	AM
Selection of the FUNCTION block	FREQ
Main- and sub-channel modulation signal Modulation mode Modulation level ratio	 MONO 100 % (MONO)
PILOT signal PILOT level ratio and modulation degree Pre-emphasis SCA signal Negative peak clipper	OFF 0 % OFF OFF OFF
I/O mode Operation mode for auto sequence (AS)	 0 (Repeat up)
External control output signal Port 1 Port 2	0 0
Memory address	00
Reverse frequency of relay drive output	30 MHz

6-5 FUNCTIONS REMOTELY UNCONTROLLABLE

Most of the instrument functions executed through panel operation can be remotely controlled via the GP-IB. Some functions, however, cannot be remotely controlled. Table 6-3 gives the functions remotely uncontrollable via the GP-IB.

Table 6-3 Functions remotely uncontrollable via the GP-IB

The AMPTD knob operation (except incrementing / decrementing of the output level in the continuous control operation)
The FREQ / MOD knob operation
The relative value display of an RF frequency (ΔF) and output level (ΔdB)
Sequential memory recall (the ↑, ↓, and CLR key operation)
Memory grouping
Group specification for sequential memory recall
Starting and ending of memory auto sequence
Setup of the I / O mode (except the operation mode for auto sequence)

6-6 REMOTE / LOCAL FUNCTION

The remote/local function is controlled with the system controller and the LOCAL key of the signal generator.

The VP-8122A is always in either of the three modes ; local, remote, and remote with lockout. Each mode is described in the following paragraph.

(1) Local mode

The VP-8122A enters the local mode when :

(a) the POWER switch is turned on,

(b) the LOCAL key is pressed to turn the key light off,

(c) the GTL command is received, or

(d) the REN line becomes false in the remote mode.

NOTE

When the mode is switched from remote to local, the setup condition in the remote mode remains effective in the local mode.

(2) Remote

The generator enters the remote mode if it receives the MLA command with the REN line true.

NOTE

1. In the remote mode, the POWER switch and LOCAL key are only effective.
2. When the mode is switched from local to remote, the setup condition in the local mode remains effective in the remote mode.

(3) Remote mode with lockout

In this mode, the LOCAL key cannot be used to switch to the local mode. To set the generator in the local mode, 1) issue the GTL address command, 2) make the REN line false, or 3) turn the power off and then on again.

6-7 RESPONSE TO COMMANDS

Table 6-4 lists the types of commands and the generator's response to each command.

Table 6-4 Response to commands

Type	Name	Description	Response
Universal command	DCL	Clears all devices.	○
	SPE	Enables serial polling.	×
	SPD	Clears serial polling.	×
	PPU	Clears parallel polling.	×
	LLO	Sets all devices in the local lockout mode to disable manual operation.	○
Address command	UNL	Releases the specified listener.	○
	UNT	Releases the specified talker.	○
	SDC	Clears the specified device.	○
	GTL	Sets the specified device in the local mode.	○
	PPC	Enables parallel polling line assignment to the specified listener during parallel polling.	×
	GET	Issues a trigger to the specified device.	×
	TCT	Transfers bus control to the talker-specified controller when the system has two or more controllers.	×

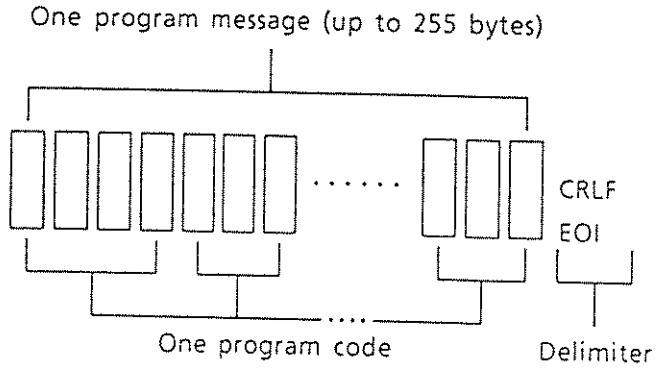
6-8 PROGRAM CODE INPUT FORMAT

This paragraph describes the input format for GP-IB program codes.

(1) Input program message format

To set the generator in a desired state through the GP-IB interface, several program codes must be sent from the controller to the generator.

The VP-8122A can receive a program message of up to 255 bytes of program codes in 7-bit ASCII code. The program message format is as follows.



(2) Delimiter for a program message

Either one of the following delimiters must be used for a program message.

(a) CRLF (0D + 0A in hexadecimal notation)

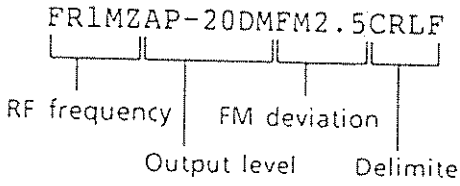
(b) LF (0A in hexadecimal notation)

(c) EOI (GP-IB uniline message)

(3) Delimiter for a program code

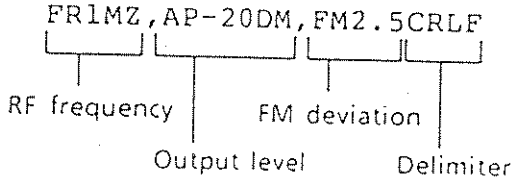
No delimiter is required between program codes, but a comma (,) or space (_) can be inserted. Given below are examples.

Example 6-3) When no delimiter is inserted between program codes

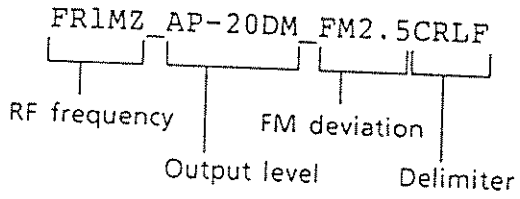


Setup value: RF frequency ..... 1 MHz
Output level ..... – 20 dBm
FM deviation ..... 2.5 kHz

Example 6-4) When a comma is inserted between program codes



Example 6-5) When a space is inserted between program codes



(4) Program code input format

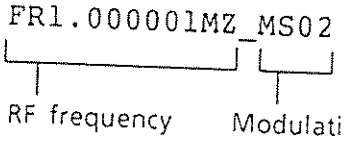
A GP-IB program code consists of a header code, data code, and unit code.

Most header codes consist of two English upper-cases. A data code is generally a numeric value. A unit code consists of one or two English upper-cases, but many of the program codes require no unit code.

For detailed description of the program codes for setting parameters, see the paragraphs 4-4 to 4-18, 7-8, and 7-11. The GP-IB program codes are given in a list at the end of this manual.

If a numeric value is entered in the unit of 1 Hz with the modulation mode set to MONO in the AM band, the value is rounded down, as shown in Example 6-6.

Example 6-6) Setting the parameters for the RF frequency and stereo mode in the AM band (with the mode set to MONO)



Setup value : RF frequency ..... 1.000000 MHz
Modulation mode ..... L=R INT

6-9 PROGRAM CODE OUTPUT FORMAT

(1) General

The generator has the basic talker function for sending data out. The contents of data for output depend on the talker mode in which the generator is set. The talker mode and data to be sent out are given below.

Talker mode	Data to be sent out
0	Setup state of the generator
1	Total FM deviation
2	Data applied to port 2 of the EXT CONTROL I/O interface. (Data read function)

The talker mode is selected with the program code having the header code "TM," and the data code "0 to 2."

The data is sent out in 7-bit ASCII code. The delimiters EOI and LF are sent out simultaneously. Given below is the output format of each talker mode.

(2) Talker mode 0 (TM0)

When assigned a talker with the talker mode 0 selected, the generator sends out its setup state. The output format in this talker mode is as follows :

FRddddddddddMZ_APddddddddd_EMdd_COdd_COdddd_APdd_MSdd_AMdddd_AMdd_AMdd_FMdddd_
<1> <2> <3> <4> <5> <6> <7> <8> <9> <10> <11>

FMdd_FMdd_MSddddPC_PRd_PLdddd_PLdd_SCdd_NPdd_DRddddd_ASd_NTdddd_P1dddd_P2dddd_CRLF
<12> <13> <14> <15> <16> <17> <18> <19> <20> <21> <22> <23> <24> <25>

ddd · · · : Data code (including a unit code)
_ : Space

The program codes <1> to <25> are described below.

	Program code	Data code	Description
<1>	FRddddddddddMZ	0.01000 to 280.00000	RF frequency setup value
<2>	APddddddddd	– 133.0 DM to 19.0 DM / – 26.0 DB to 126.0 DB / 0.000050 MV to 2000 MV / 0.050 UV to 999 UV	Output level setup value
<3>	EMdd	ON / OF	Enables / disables output level display at the open end
<4>	COdd	ON / OF	Turns the output level continuous control on and off.
<5>	COdddd	0.0 to 10.0	Setup value of 0 to – 10 dB for the reference level in output level continuous control
<6>	APdd	50 / 75	Output impedance
<7>	MSdd	00 to 17	Main- and sub-channel modulation mode
<8>	AMdddd	0.0 to 125	AM degree setup value
<9>	AMdd	ON / OF	Turns AM modulation on and off
<10>	AMdd	T4 / T1 / XD	AM modulation signal ; INT 400 Hz / INT 1 kHz / EXT
<11>	FMdddd	0.0 to 300	FM deviation setup value
<12>	FMdd	ON / OF	Turns FM modulation on and off
<13>	FMdd	T4 / T1 / XD	FM modulation signal ; INT 400 HZ / INT 1 kHz / EXT
<14>	MSddddPC	0.0 to 127	M + S level ratio setup value
<15>	PRd	0 to 3	Pre-emphasis setup value
<16>	PLdddd	0.0 to 19.9 0.0 to 12.5	Setup value of PILOT level ratio from 0.0 to 19.9 % Setup value of PILOT modulation degree from 0.0 to 12.5 %

Program code	Data code	Description
<17> PLdd	ON / OF	Turns the PILOT signal on and off
<18> SCdd	ON / OF	Turns the SCA signal on and off
<19> NPdd	ON / OF	Turns the negative peak clipper on and off
<20> DRdddddd	0 to 280 / – 0 to – 280	Setup value of the reverse frequency for the relay drive output
<21> ASd	0 to 3	Setup value of the operation mode for memory auto sequence
<22> NTdddd	0.10 to 60.0	Interval time setup value
<23> P1Dddd	0 to 255	Setup value of the external control output signal for port 1
<24> P2Dddd	0 to 255	Setup value of the external control output signal for port 2
<25> CRLF		Delimiter (EOI message generated simultaneously with LF)

(3) Talker mode 1 (TM1)

When assigned a talker with the talker mode 1 selected, the generator sends out the total FM deviation. The output format is as follows:

FT ddddCRLF dddd : 0.00 to 300
CRLF : Delimiter (EOI message generated simultaneously with LF)

(4) Talker mode 2 (TM2)

When assigned a talker with the talker mode 2 selected, the generator sends out the 8-bit input data of port 2 of the EXT CONTROL I / O interface in decimal notation. This is called the data read function, explained in the paragraph 7-10. The output format is as follows:

dddCRLF ddd : 0 to 255
CRLF : Delimiter (EOI message generated simultaneously with LF)

If the data read mode is not selected for the I / O mode of port 2 of the EXT CONTROL I / O interface, however, the generator sends out the following message.

MODE MISMATCHCRLF

Error message Delimiter

6-10 MEMORY SYNC AND MEMORY COPY FUNCTIONS

(1) General

The GP-IB interface allows the VP-8122A to have the memory sync function that simultaneously recalls assorted preset memory data of multiple instruments. It also allows the generator to have the memory copy function that transfers preset memory data mutually between the VP-8122A generators.

(a) Memory sync function

Use the GP-IB interface to connect a master set of the VP-8122A to one or more slave sets. When the master set starts the recalling operation of assorted preset memory data, it sends out the program code for recalling the memory data to the slave set(s). Consequently the same memory address will be recalled on the slave set(s) as well. Note that a slave set may not be necessarily the same model as the master set, provided that the slave mode is available for the memory sync function.

(b) Memory copy function

Use the GP-IB interface to connect a master set to one or more slave set(s). Starting the memory copy operation on the master set allows all or part of the preset memory data of the master set to be transferred to the slave set(s). Note that the master set and slave set(s) in this operation must be the same model.

The operating procedures are as follows :

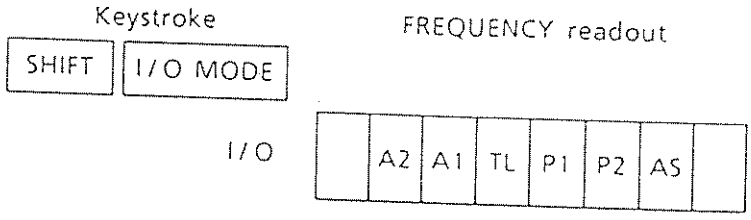
(2) Master / slave mode readout

The selected master or slave mode is displayed in the FREQUENCY readout with other I / O mode parameters only during the setup and verification operations.

- Press the SHIFT key.
- Press the <0> I/O MODE key of the DATA block.

The above key operation causes the FREQUENCY readout to appear in the FREQUENCY readout as shown in Example 6-7.

Example 6-7) Verifying the master / slave mode



The TL digit in the FREQUENCY readout indicates whether the master or slave mode is currently selected for the memory sync or memory copy operations.

Given below is the relationship between the TL numeric values and modes.

TL	Mode
0	Releases the master/slave mode.
1	Slave mode for memory sync.
2	Master mode for memory sync.
3	Slave mode for memory copy.
4	Master mode for memory copy.

The master/slave mode corresponds to the talk only / listen only function of the GP-IB. Therefore the master/slave mode must be released when the GP-IB control with addressing (normal GP-IB control) is required.

NOTE

- The DATA keys of the DATA block
- The ⊟ ⊟ keys, AMPTD knob, FREQ/MOD knob of the FREQ/MOD operation part in the MODIFY block.

After completing the operation in Example 6-7, operating any key and knob other than the mentioned above turns the I/O mode light of the FREQUENCY readout off; i.e. the generator returns to the normal setting state.

(3) Setting the master/slave mode

- Press the SHIFT key.
- Press the <0> I/O MODE key of the DATA block.
- Specify the TL digit with the ⊟ ⊟ keys of the FREQ/MOD operation part in the MODIFY block.
- Enter a numeric value with a DATA key of the DATA block.
- Press any key of the ENTER block.

A desired mode is displayed in the FREQUENCY readout through the above key operation.

- Turn the POWER switch off.
- Again turn the POWER switch on.

The master/slave mode is set by following the above procedure.

NOTE

The above setting procedure is completed by turning the POWER switch off and then on. Note that if this step is omitted, the generator will maintain the previous setting.

Example 6-8) Selecting the master mode for memory sync

Step	Keystroke	FREQUENCY readout	Note
①		1 2 3. 4 5 6 7 8	Current RF frequency set value.
②	SHIFT I/O MODE	I/O 1 0 0 0 0 0	Current I/O mode set value.
③	⊖ ... ⊖ or ⊖ ... ⊖	I/O 1 0 0 0 0 0 0	Cause the TL digit to blink.
④	2 MHz	I/O 1 0 2 0 0 0	Set the mode to 2. Displayed for about five seconds.
⑤	POWER POWER	1 2 3. 4 5 6 7 8	Turn the POWER switch off and then on. Current RF frequency set value.

(4) Memory sync operation

Recalling the memory data of the master set causes the memory data of the slave set to be recalled at the same time. The direct recalling, sequential recalling, and auto sequence operation can be synthesized. See the paragraphs given below.

- Paragraph 4-18 "Assorted preset memory"
- Paragraph 4-19 "Auto sequence of assorted preset memory"

(5) Memory copy operation

To enable the memory copy function, specify the range of the memory addresses to be copied and start the copy operation.

(a) Specifying a memory address range

Specify a pair of start and end address on the master set to start the copy operation. Then only the contents of the assorted preset memory between the start and end addresses are copied.

Canceling the start and end address allows the entire contents of the assorted preset memory to be copied.

See the paragraph 4-18 (5) "Sequential recall" for specifying and canceling the start and end address.

(b) Starting the copy operation

- Press the SHIFT key of the master set.
- Press the <⇩> COPY key of the MEMORY block of the master set.

The above key operation gets the memory copy operation started. During the copy operation, the SHIFT key is turned on and every panel operation is disabled. Upon completion of the copy operation, the SHIFT key is turned off and panel operation is enabled.

SECTION VII
EXTERNAL CONTROL INTERFACE (EXT CONTROL I/O)

7-1 GENERAL

Besides the GP-IB interface, the VP-8122A has an external control interface and relay drive output. The dedicated connector is provided on the rear panel. Given below is a general introduction of the basic function.

(1) External control interface function

The following functions are available by using the EXT CONTROL I/O connector.

(a) Remote sequential recall

Memory sequential recall can be remotely controlled from the outside.

(b) Remote modify

Modification of an RF frequency or output level can be remotely controlled with an external rotary encoder.

(c) Remote direct recall

Memory direct recall can be remotely controlled from the outside.

(d) Control output

The TTL output signal of 8 bits × 2 ports for external device control is available.

(e) Print out of memory contents (list output)

The preset memory contents can be printed out to a printer.

(f) Data read

The 8-bit TTL signal externally applied can be read with the GP- IB controller.

(2) Relay drive output function

A drive signal is obtained from the DRIVE OUTPUT connector, which reverses between HIGH and LOW according to whether the frequency is higher or lower than the preset reverse frequency.

If the drive output is HIGH, a signal of +5 V, 50 mA is obtained. The signal can be used to drive a small reed relay and control a signal switch or dummy antenna switch.

How to use the external control interface is described in the paragraphs 7-2 to 7-10. How to use the relay drive output is also described in the paragraph 7-11.

7-2 INTERFACE CONNECTOR

(1) Pin connection

Figure 7-1 shows the pin connection of the EXT CONTROL I/O connector.

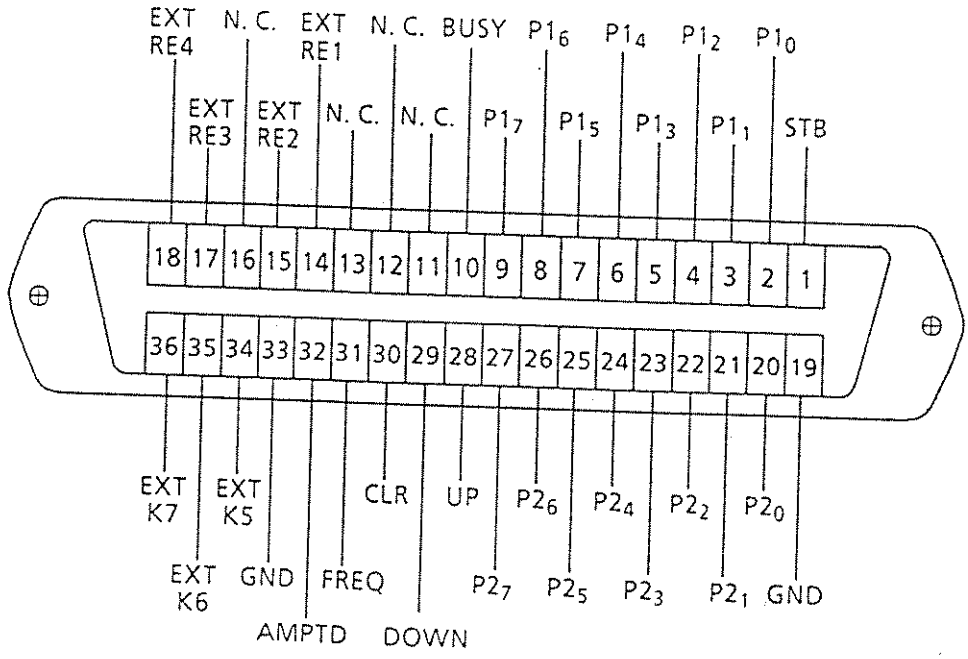


Figure 7-1 EXT CONTROL I/O connector pin assignment

Use a shield-type 36-pin plug and cable for connection. An unshielded plug or cable may cause an error due to electrostatic interference.

(2) Pin function

Number	Name	Function
1	STB	Input terminal for a timing pulse to read address data in memory direct recall, or for a printer acknowledge signal in memory list output.
2 to 9	$P1_0$ to $P1_7$	Input / output terminal for 8-bit data used in control output, memory direct recall, and memory list output functions. (port 1)
10	BUSY	Output terminal for a signal informing that the generator cannot receive data during memory direct recall, or for a strobe signal from the generator to the printer in memory list output.
11 ~ 13	N. C.	Not connected to the internal circuit.
14	EXT RE1	External rotary encoder terminal 1. (Corresponding to the FREQ/MOD knob)
15	EXT RE2	External rotary encoder terminal 2. (Corresponding to the FREQ/MOD knob)
16	N. C.	Not connected to the internal circuit.
17	EXT RE3	External rotary encoder terminal 3. (Corresponding to the AMPTD knob.)
18	EXT RE4	External rotary encoder terminal 4. (Corresponding to the AMPTD knob)
19	GND	Frame ground
20 to 27	$P2_0$ to $P2_7$	Input / output terminal for 8-bit data used in control output and data read functions. (port 2)
28	UP	Key input terminal for sequential recall.
29	DOWN	Key input terminal for sequential recall.
30	CLR	CLR key input terminal for sequential recall.
31	FREQ	FREQ key of the FUNCTION block input terminal.
32	AMPTD	AMPTD key of the FUNCTION block input terminal.
33	GND	Frame ground
34 to 36	EXT K5 to K7	Spare pins. Do not connect to any external devices.

7-3 MODE SETTING

Use panel keys to set the mode for the EXT CONTROL I/O interface.

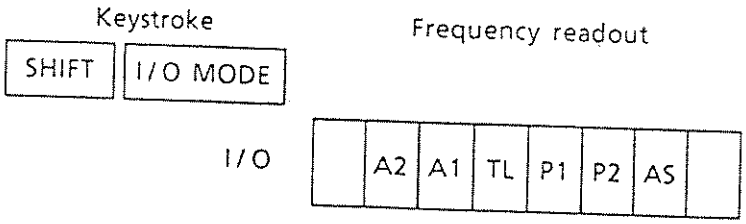
(1) Readout

The selected mode for the EXT CONTROL I/O interface is displayed with other I/O mode parameters only during the setup and verification operations.

- Press the SHIFT key.
- Press the <0> I/O MODE key of the DATA block.

The above key operation causes the mode to appear in the FREQUENCY readout as shown in Example 7-1.

Example 7-1) Verifying the EXT CONTROL I/O interface mode



The digits P1 and P2 in the FREQUENCY readout display the modes of port 1 and 2 of the EXT CONTROL I/O interface, respectively.

Given below are the relationship between the numeric values of P1 and P2 and modes.

P1	Mode
0	Control output
1	Memory direct recall
2	Memory list output

P2	Mode
0	Control output
1	Data read

NOTE

- The DATA keys of the DATA block
- The ⊟ ⊟ keys, AMPTD knob, FREQ/MOD knob of the FREQ/MOD operation part in the MODIFY block

After completing the operation in Example 7-1, operating any key and knob other than the mentioned above turns the I/O mode light of the FREQUENCY readout off; i.e. the generator returns to the normal setting state.

(2) Setting procedure

- Press the SHIFT key.
- Press the <0> I/O MODE key of the DATA block.
- Specify either P1 or P2 digit with the ⊟ ⊟ keys of the FREQ/MOD operation part in the MODIFY block.
- Enter a numeric value with a DATA key of the DATA block.
- Press any key of the ENTER block.

A desired mode is displayed in the FREQUENCY readout through the above key operation.

- Turn the POWER switch off.
- Again turn the POWER switch on.

The mode of the EXT CONTROL I/O interface is set by following the above procedure.

NOTE

The above setting procedure is completed by turning the POWER switch off and then on. Note that if this step is omitted, the generator will maintain the previous setting.

Example 7-2) Setting the mode of P1 to memory direct recall "1"

Step	Keystroke	FREQUENCY readout	Note
①		1 2 3. 4 5 6 7 8	Current RF frequency set value
②	SHIFT I/O MODE	I/O 1 0 0 0 0 0	Current I/O mode set value
③	⊖ ··· ⊖ or ⊖ ··· ⊖	I/O 1 0 0 0 0 0	Cause the P1 digit to blink.
④	1 MHz	I/O 1 0 0 1 0 0	Set the mode to 1. Displayed for about five seconds.
⑤	POWER POWER	1 2 3. 4 5 6 7 8	Turn the POWER switch off and then on. Current RF frequency set value.

7-4 COMMON ITEMS ON EVERY EXTERNAL CONTROL I/O OPERATION

The external control interface is a TTL-logic control I/O. Described in this paragraph are signals common to every EXTERNAL CONTROL interface operation.

(1) Input signal

An input signal is a TTL-level logic signal. Since each input connector pin is internally pulled up to +5 V, the applied signal is switched between HIGH and LOW by making the input connector pin and GND terminal open or short-circuited.

(2) Output signal

An output signal is also a TTL-level logic signal. The output fan-out of each connector is 1 (LS-TTL).

7-5 REMOTE SEQUENTIAL RECALL

(1) Feature

This function remotely controls UP (⊔), DOWN (⊓), and CLEAR (CLR) of assorted preset memory.

(2) Connector pins used

Number	Name	Function
28	UP	Connects the UP (⇧) signal.
29	DOWN	Connects the DOWN (⇩) signal.
30	CLR	Connects the CLR signal.
33	GND	Frame ground

(3) Specifications for electrical operation

The UP, DOWN, or CLEAR operation of the memory is activated at the rising edge where the signal applied to the UP, DOWN, or CLEAR connector changes from LOW to HIGH. The timing condition is shown in Figure 7-2.

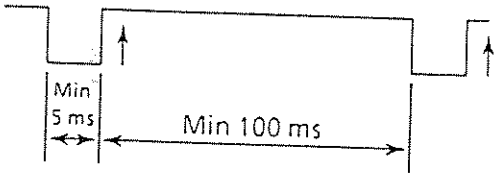


Figure 7-2 Timing diagram for the control signal of the preset memory

7-6 REMOTE MODIFY

(1) Feature

This function remotely controls the modifying operation with the two rotary encoders (FREQ / MOD and AMPTD). For the FREQ / MOD knob, either RF frequency (FREQ) and modulation (MOD) or output level (AMPTD) can be selected for modification.

(2) Connector pins used

Number	Name	Function
14	EXT RE1	External rotary encoder terminal 1 (Corresponding to the FREQ / MOD knob).
15	EXT RE2	External rotary encoder terminal 2 (Corresponding to the FREQ/MOD knob).
17	EXT RE3	External rotary encoder terminal 3 (Corresponding to the AMPTD knob).
18	EXT RE4	External rotary encoder terminal 4 (Corresponding to the AMPTD knob)
31	FREQ	FREQ key input terminal.
32	AMPTD	AMPTD key input terminal.
33	GND	Frame ground

(3) Specifications for electrical operation

The external rotary encoder terminals 1 and 2 can be used for frequency / modulation (FREQ / MOD) control or output level (AMPTD) control.

The FREQ / MOD control or AMPTD control is selected at the rising edge where the pulse applied to the FREQ / MOD or AMPTD pin changes from LOW to HIGH. The timing condition is same as that shown in Figure 7-2.

The external rotary encoder terminals 3 and 4 are independently used for the AMPTD control.

Use a rotary encoder of contact type dual-phase pulse output to connect to EXT RE1, EXT RE2, EXT RE3, and EXT RE4. Figure 7-3 shows the timing conditions for a modify signal. Since the relationship between EXT RE3 and EXT RE4 is same as that between EXT RE1 and EXT RE2, Figure 7-3 shows only EXT RE1 and EXT RE2.

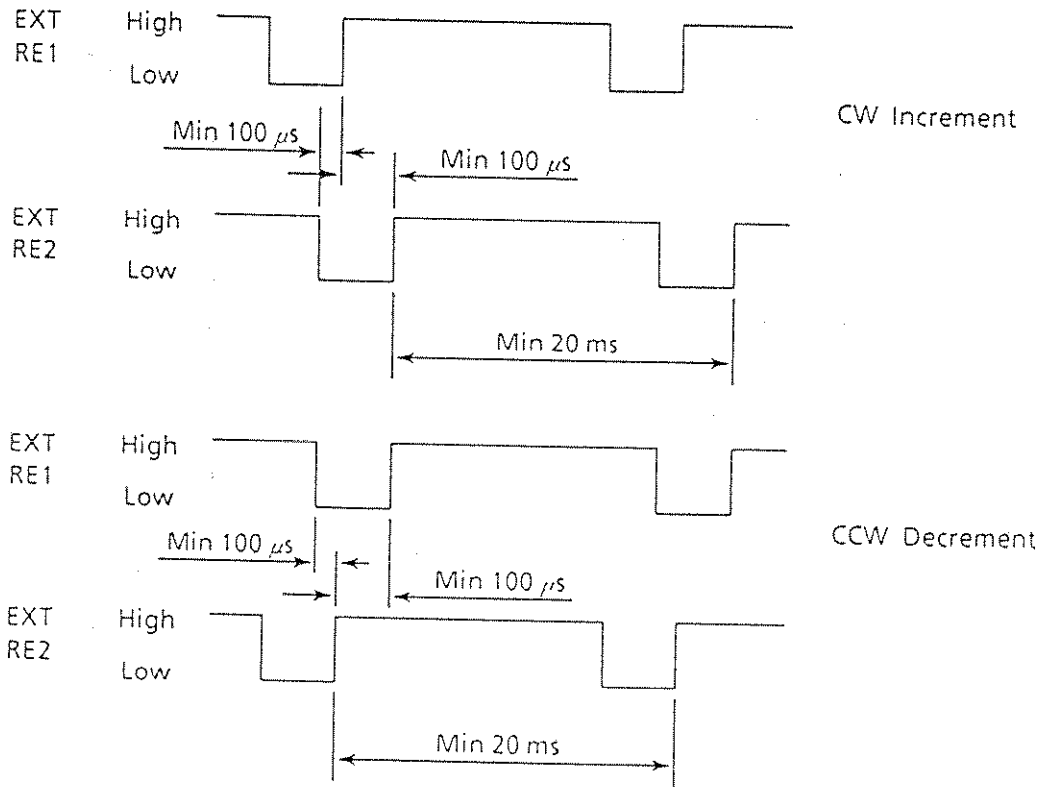


Figure 7-3 Timing diagram for a modify signal

7-7 REMOTE DIRECT RECALL

(1) Feature

This function remotely controls the memory direct recall.

(2) Connector pins used

Number	Name	Function
1	STB	Connects a timing pulse for reading data.
2 to 9	$P1_0$ to $P1_7$	Connects address data.
10	BUSY	Outputs a signal informing the generator cannot receive data
19	GND	Frame ground

(3) Specifications for electrical operation

For the pins $P1_0$ to $P1_7$, set the address data of 00 to 99 in BCD code. Given below are the relationship between a signal to be applied to each connector pin and its address data.

Output signal								Address data
$P1_7$	$P1_6$	$P1_5$	$P1_4$	$P1_3$	$P1_2$	$P1_1$	$P1_0$	
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	1
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
0	0	0	0	1	0	0	1	9
0	0	0	1	0	0	0	0	10
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
1	0	0	1	1	0	0	1	99

0 : Low (= 0 V) 1 : High (= + 5 V)

After the address data is set, applying a timing pulse to the STB pin causes the memory at the set address to be recalled. Figure 7-4 shows the timing condition for each connector.

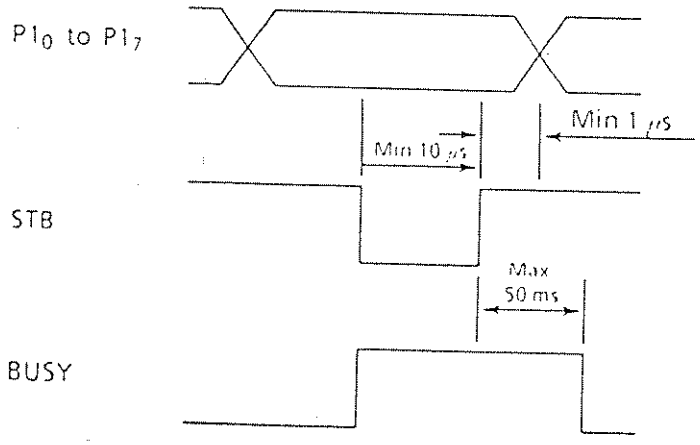


Figure 7-4 Timing diagram for address data

(4) Error code

When the address data for the remote direct recall is set in a form other than BCD code, such an error as shown in Table 7-1 occurs and the corresponding error code appears in the MEMORY ADDRESS readout.

Table 7-1 Possible errors during remote direct recall

Error code	Error description	Occurs upon :	Result
71	Address data for the remote direct recall is set incorrectly.	Applying a timing pulse to the STB pin.	Recall will not be executed.

7-8 CONTROL OUTPUT

(1) Feature

This function provides TLL signals of up to 8 bits × 2 ports for external device control.

(2) Connector pins used

Number	Name	Function
2 to 9	$P1_0$ to $P1_7$	Outputs 8-bit data (port 1)
20 to 27	$P2_0$ to $P2_7$	Outputs 8-bit data (port 2)
19	GND	Frame ground

(3) Readout

The set value for the control output signal is displayed in the FREQUENCY readout only during the setting and verifying operations. The readout value denotes the 8-bit data of port 1 or port 2, which is expressed as decimal data of 0 to 255 with $P1_0$ or $P2_0$ considered as LSB and $P1_7$ or $P2_7$ as MSB. Given below are the set values and the signals obtained from the EXT CONTROL I/O connector.

Set value	Output signal							
	$P1_7/P2_7$	$P1_6/P2_6$	$P1_5/P2_5$	$P1_4/P2_4$	$P1_3/P2_3$	$P1_2/P2_2$	$P1_1/P2_1$	$P1_0/P2_0$
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
254	1	1	1	1	1	1	1	0
255	1	1	1	1	1	1	1	1

0 : Low (= 0 V) 1 : High (= + 5 V)

(4) Setting procedures

- Press the SHIFT key.
- Press the <2> PORT 1 key of the DATA block.
- Enter a numeric value with DATA keys of the DATA block.
- Press any key of the ENTER block.

A desired control output signal for port 1 can be set through the above key operation.
And then,

- Press the SHIFT key.
- Press the < . > PORT 2 key of the DATA block.
- Enter a numeric value with DATA keys of the DATA block.
- Press any key of the ENTER block.

A desired control output signal for port 2 can be set through the above key operation.

Example 7-3) Setting control output for port 1 and 2

Step	Keystroke	FREQUENCY readout	Note
①		1 2 3. 4 5 6 7 8	Current RF frequency set value
②	SHIFT PORT 1		
		I/O 0	Current set value for port 1
③	1 2 MHz		
		I/O 1 2	Set 12 for port 1.
④	SHIFT PORT 2		
		I/O 0	Current set value for port 2.
⑤	3 4 MHz		
		I/O 3 4	Set 34 for port 2.

NOTE

After completing step ② or ④ in Example 7-3, the I/O MODE light of the FREQUENCY readout is turned on for only about five seconds, indicating the value for control output is acceptable. Pressing DATA keys of the DATA block while the I/O MODE light is on. Otherwise the setting will be unacceptable.

NOTE

- The DATA keys of the DATA block
- The ⊖ ⊖ keys, AMPTD knob, and FREQ / MOD knob of the FREQ / MOD operation part in the MODIFY block

Operating any key and knob other than the mentioned above turns the I / O MODE light of the FREQUENCY readout off ; i.e. the generator returns to the normal setting mode.

(5) GP-IB program codes

The setup of a control output signal can be controlled through the GP-IB. Table 7-2 gives the GP-IB program codes for control output.

Table 7-2 GP-IB program codes for control output

Header code	Data code	Unit code	Description
P1 or P2	B00000000 to B11111111		Sets control output for port 1 / port 2 in binary data.
	H00 to HFF		Sets control output for port 1/port 2 in hexadecimal data.
	D0 to D255		Sets control output for port 1 / port 2 in decimal data.
	S0 to S7		Sets (to 1) the specified bit of port 1 / port 2.
	R0 to R7		Resets (to 0) the specified bit of port1 / port 2.

(6) Error code

An erroneous operation during setting for control output causes such an error as shown in Table 7-3 to occur. An error code listed in the table is displayed in the MEMORY ADDRESS readout provided that the instrument operates locally. If the function is remotely controlled through the GP-IB, however, no error code appear.

Table 7-3 Possible error during control output operation

Error code	Error description	Occurs upon :	Result
72	Setting value of the control output is beyond the range of 0 to 255.	Pressing the ENTER key.	The setting value is unacceptable.

7-9 PRINT OUT OF MEMORY CONTENTS (LIST OUTPUT)

(1) Feature

This function can be used to output all or part of the assorted preset memory contents to a Centronics printer.

(2) Connector pins used

Number	Name	Function
1	STB	Connects an acknowledge signal from a printer.
2 to 9	$P1_0$ to $P1_7$	Outputs data to a printer.
10	BUSY	Outputs a strobe signal to a printer
19	GND	Frame ground

	Connector pin assignment										
Printer	1	2	3	4	5	6	7	8	9	10	19
VP-8122A	10	2	3	4	5	6	7	8	9	1	19

The other pins are N.C.

(3) Operating procedure

The operating procedure for list output is as follows :

(a) Refer to the paragraph 7-3 "MODE SETTING" to select the memory list output mode for port 1 (P1 = 2).

(b) Specify the start and end address to designate the part of the data to be output to a printer.

(c) Press the SHIFT key and then <CLR> LIST key of the MEMORY block to execute listing.

Given below is the sample of the list output.

```
ADDRESS      98
FREQUENCY      : 200.00000 MHz
AMPLITUDE      : 13 dBm (75)
AM             : 98 %
FM             : 75 kHz
TOTAL FM       : 83.3 kHz
DRIVE OUTPUT   : 50.00000 MHz
FUNCTION       : AMPTD
STEREO MODE    : MONO
PILOT LEVEL    : 0.0 %  OFF
NEG PEAK CLIPPER   : OFF
PRE EMPHASIS       : OFF
SCA                : OFF
I/O MODE  PORT 1   : 100

dF       : 0.00000 MHz
ddB      : 0.0 dB          CONT  : OFF
MODE     : 1 k OFF
MODE     : 400  ON

M + S LEVEL   : 111 %

PORT 2  : 200
```

Example 7-4) Memory list output

Step	Keystroke	Note
①	SHIFT I/O MODE	The selected I/O mode appears in the FREQUENCY readout.
②	⊖ … ⊖ or ⊖ … ⊖	Cause the P1 mode digit to blink.
③	2 MHz	Set the P1 mode to 2.
④	POWER POWER	Turn the power once off and again on.
⑤	STO . 1 2 . 3 4 MHz	Specify the start address 12 and end address 34.
⑥	STO . . MHz	To output all the data for listing, clear the start and end address.
⑦		Connect a printer to the EXT CONTROL I/O connector.
⑧	SHIFT LIST	Execute listing.

During the execution of listing, the SHIFT key light is turned on and every panel operation is disabled. Upon completion of the listing, the SHIFT key light is turned off and the panel operation will be enabled again.

(4) Error codes

An erroneous operation such as an improper connection to a printer causes an error with the corresponding error code given in Table 7-4 displayed in the MEMORY ADDRESS readout just after the listing attempt is executed.

Table 7-4 Possible errors during list output operation

Error code	Error description	Occurs upon :	Result
70	Improper I/O mode is set in case of the list output.	Pressing the LIST key.	The list will not be printed out.
73	Printer is inproperly connected.	Pressing the LIST key.	The list will not be printed out.

7-10 DATA READ

(1) Feature

The GP-IB allows reading the 8-bit TTL-level data supplied to the EXT CONTROL I/O connector.

(2) Connector pins used

Number	Name	Function
20 to 27	$P2_0$ to $P2_7$	Connects 8-bit data (port 2)
19	GND	Frame ground

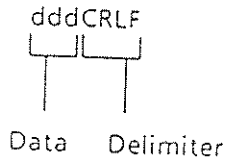
(3) Data output format

Data sent out over the GP-IB bus is obtained by converting the 8-bit signal applied to port 2 into decimal notation with $P2_0$ regarded as LSB and $P2_7$ as MSB. Given below are input signals at port 2 and the data sent out.

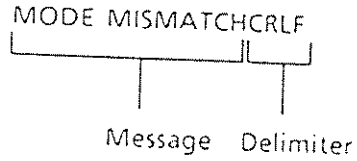
Input signal								Data sent out
$P2_7$	$P2_6$	$P2_5$	$P2_4$	$P2_3$	$P2_2$	$P2_1$	$P2_0$	
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	1
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
1	1	1	1	1	1	1	0	254
1	1	1	1	1	1	1	1	255

0 : Low (= 0 V) 1 : High (= + 5 V)

Data are sent out in 7-bit ASCII code with the delimiters EOI and LF simultaneously. The output format is :



If port 2 is not in the data read mode and the generator has been assigned a talker, the following error message will be sent out.



(4) Operating procedure

The operating procedure for data read is as follows :

(a) Refer to the paragraph 7-3 "MODE SETTING" to select the data read mode for port 2 (P2 = 1).

(b) Set the generator's talker mode to 2 on the controller (computer) through the GP-IB. (See the paragraph 6-9.)

(c) Then input data of $P2_0$ to $P2_7$ will be sent out to the controller.

Example 7-5) Operation in the data read mode

Step	Keystroke	Note
①	SHIFT I/O MODE	The selected I/O mode appears in the FREQUENCY readout.
②	⊟ ··· ⊟ or ⊟ ··· ⊟	Cause the P2 mode digit to blink
③	1 MHz	Set the P2 mode to 1.
④	POWER POWER	Turn the power once off and again on.
⑤		Connect the desired signal to be read to $P2_0$ to $P2_7$ of the generator's EXT CONTROL I/O connector.
⑥		Connect the generator to the controller with the GP-IB interface.
⑦		Send the program code TM2 from the controller to the generator.
⑧		On the controller, assign the generator a talker. The data of current $P2_0$ to $P2_7$ will be sent out to the controller.

7-11 RELAY DRIVE OUTPUT

(1) Feature

A drive output signal can be obtained from the DRIVE OUTPUT connector on the rear panel. The signal reverses between HIGH and LOW according to whether the frequency (F) is higher or lower than the preset reverse frequency (F_R).

When the drive output is HIGH, a +5 V / 50 mA signal can be obtained to drive a small reed relay. The signal is used for controlling a signal switch or dummy antenna switch. The setting range/resolution of the reverse frequency are :

0 to 280 MHz / 1MHz

The reverse frequency can be set with a minus (−) sign for an action reverse to that obtained when the reverse frequency is set without a minus sign.

Table 7-5 shows the relationship among a reverse frequency set value, RF frequency condition, and drive output signal obtained.

Table 7-5 Frequency and drive signal

Reverse frequency	Condition set value	Drive output
Set value F_R without a minus sign	$F < F_R$	Low
	$F \geqq F_R$	High
Set value F_R with a minus sign	$F < F_R$	High
	$F \geqq F_R$	Low

(2) Output connector

A drive output signal is obtained from the DRIVE OUTPUT connector on the rear panel. The connector is an RCA-type pin connector whose center conductor provides an output signal and outer conductor is connected to the frame ground. Connect the center conductor of the DRIVE OUTPUT connector with the + terminal of the coil of the relay to be controlled. Also connect the outer conductor with the - terminal of the coil. If the coil of the relay to be controlled has no polarity, connect the center conductor of the DRIVE OUTPUT connector with one terminal of the coil, and the outer conductor with the other terminal.

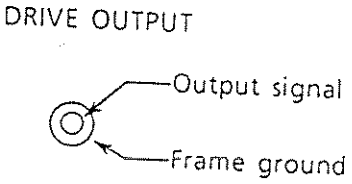


Figure 7-5 Drive output connector

(3) Setting procedure for a reverse frequency

- Press the SHIFT key.
- Press the <4> DRIVE key of the DATA block.
- Enter a numeric value with DATA keys of the DATA block.
- Press either MHz or kHz key of the ENTER block.

A desired reverse frequency of the relay drive output can be set through the above key operation.

Example 7-6) Setting a reverse frequency

Step	Keystroke	FREQUENCY readout	Note
①		1 2 3. 4 5 6 7 8	Current RF frequency set value
②	SHIFT DRIVE		
		I/O 3 0	Current reverse frequency set value
③	- 1 2 3 MHz		
		I/O - 1 2 3	Set the reverse frequency to 123 MHz with a minus sign.

NOTE

After completing step ② in Example 7-6, the I/O MODE light of the FREQUENCY readout is turned on for only about five seconds, indicating the value for the reverse frequency is acceptable. Press DATA keys of the DATA block for the desired value while the I/O MODE light is on. Otherwise the setting will be unacceptable.

(4) GP-IB program codes

The GP-IB control is available for setting the reverse frequency of the relay drive output. Table 7-6 gives the GP-IB program codes for setting the reverse frequency.

Table 7-6 GP-IB program codes for reverse frequency setting

Header code	Data code	Unit code	Description
DR	0 to 280	(MZ)	When RF frequency < reverse frequency, drive output is Low. When RF frequency ≧ reverse frequency, drive output is High.
	−0 to −280		Ignoring a minus sign, When RF frequency < reverse frequency, drive output is High. When RF frequency ≧ reverse frequency, drive output is Low.

The unit code in parentheses can be omitted.

(5) Error code

An erroneous operation during setting for an RF frequency causes such an error as shown in Table 7-7 to occur. An error code listed in the table is displayed in the MEMORY ADDRESS readout provided that the instrument operates locally. If the function is remotely controlled through the GP-IB, however, no error code appear.

Table 7-7 Possible error during reverse frequency setting

Error code	Error description	Occurs upon :	Result
74	Setting value of the reverse frequency is beyond the range of 0 to ±280 MHz.	Pressing the ENTER key.	The setting value is unacceptable.