

**ICOM**

**INSTRUCTION MANUAL**

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UHF REPEATER  
**IC-GR8520**

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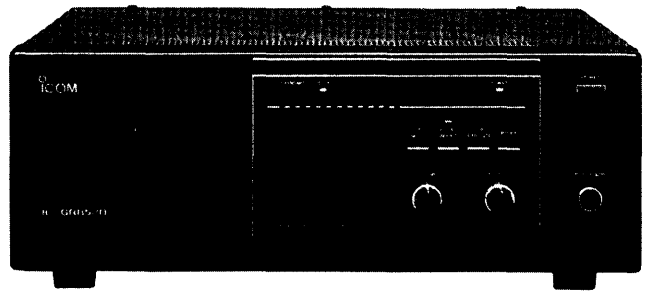
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## IMPORTANT

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**READ THIS INSTRUCTION MANUAL** carefully and completely before using the IC-GR8520.

**SAVE THIS INSTRUCTION MANUAL.** This instruction manual contains important safety and installation instructions.

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## EXPLICIT DEFINITIONS

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WORD	DEFINITION
<b>WARNING</b>	Personal injury, fire hazard or electric shock may occur.
<b>CAUTION</b>	Equipment damage may occur.
<b>NOTE</b>	If disregarded, inconvenience only. No personal injury, fire hazard or electric shock will occur.

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## FOREWORD

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Thank you for purchasing the **IC-GR8520 UHF REPEATER**. This repeater is designed to meet professional communications requirements.

If you have any questions, contact your nearest authorized Icom Dealer or Service Center.

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## TABLE OF CONTENTS

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<b>1 PANEL DESCRIPTION</b> .....	<b>2-3</b>
■ Front panel .....	2
■ Rear panel .....	3
■ Microphone connector .....	3
<b>2 INSTALLATION</b> .....	<b>4-5</b>
<b>3 INTERNAL SETTINGS</b> .....	<b>6-9</b>
■ Internal views .....	6
■ Rotary switches .....	7
■ Frequency setting .....	7
■ Frequency setting examples .....	7
■ Frequency set table .....	8
■ Time-out timer setting .....	8
■ Hang-up timer setting .....	8
■ Access-inhibit timer setting .....	8
■ Frequency setting from the [ACC(1)] socket ...	9
<b>4 SPECIFICATIONS</b> .....	<b>10</b>

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## PRECAUTIONS

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**NEVER** connect the repeater to an AC outlet or to a power source of more than 16 V DC. These connections will damage the repeater.

**NEVER** connect the repeater to a power source using reverse polarity. This connection will damage the repeater.

**DISCONNECT** the DC power cable from the repeater before performing any internal work.

**NEVER** use non-rated fuses. Non-rated fuses could cause a fire or damage the repeater.

**NEVER** touch the antenna connector, ground terminal or antenna while transmitting.

**NEVER** touch internal parts while transmitting. Stop transmitting when internal adjustments are performed.

**NEVER** allow children to touch the repeater.

**GROUND** the repeater through the [GND] terminal to prevent electric shocks, TVI, BCI and other problems.

**NEVER** connect the [GND] terminal to a gas or electrical pipe, since the connection could cause an explosion or electric shock.

**NEVER** expose the repeater to rain, snow or any liquids.

**NEVER** let metal, wire or other objects touch any internal parts. This could cause an electric shock.

**DO NOT** use or place the repeater in areas with temperatures below  $-20^{\circ}\text{C}$  or over  $+60^{\circ}\text{C}$  or, in areas subject to direct sunlight.

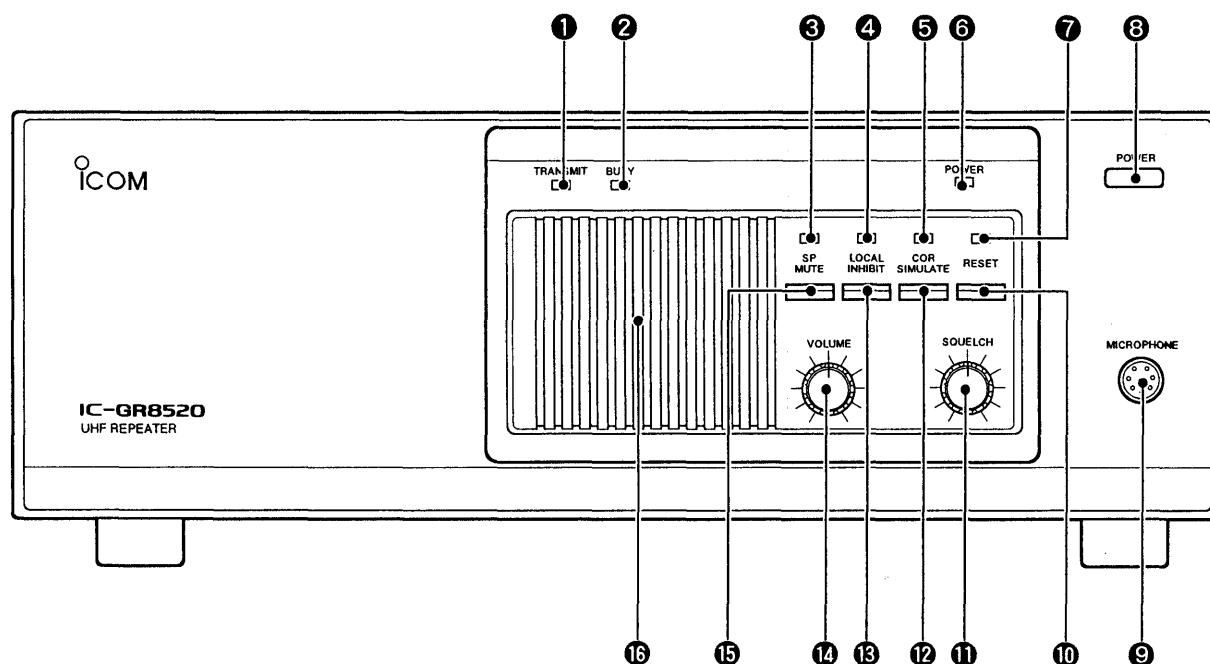
**AVOID** the use of chemical agents such as benzine or alcohol when cleaning, as they can damage the repeater surfaces.

**AVOID** placing the repeater against walls or putting anything on the top of the repeater. This could obstruct heat dissipation.

**AVOID** using the repeater in excessively dusty environments.

Protect your repeater from lightning using a lightning arrester.

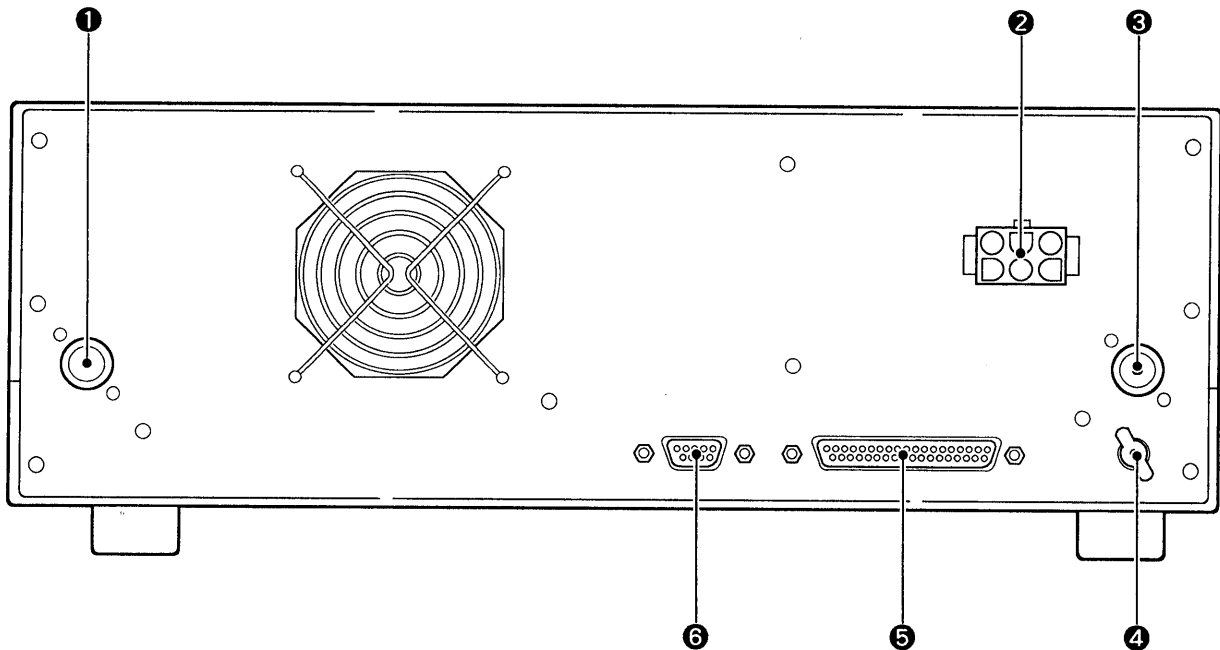
## ■ Front panel



- 1 TRANSMIT INDICATOR [TRANSMIT]**  
Lights up in red when transmitting.
- 2 BUSY INDICATOR [BUSY]**  
Lights up in green when receiving with the squelch open.
- 3 SPEAKER MUTE INDICATOR [SP MUTE]**  
Lights up in green when the speaker is muted.
- 4 LOCAL INHIBIT INDICATOR [LOCAL INHIBIT]**  
Lights up in yellow when the repeater function is inhibited.
- 5 COR SIMULATE INDICATOR [COR SIMULATE]**  
Lights up in red when the COR (Carrier-Operated Relay) simulate function is activated.
- 6 POWER INDICATOR [POWER]**  
Lights up in green while the power is turned ON.
- 7 RESET INDICATOR [RESET]**  
Lights up in yellow momentarily when the [RESET] switch is pushed.
- 8 POWER SWITCH [POWER]**  
Turns the power ON and OFF.
- 9 MICROPHONE CONNECTOR [MICROPHONE]**  
Connects an optional hand microphone. Refer to p. 3 for microphone operation.
- 10 RESET SWITCH [RESET]**  
Resets the repeater when pushed. Clears the operating condition and sets the operating frequency to the dip switch settings. (p. 6)
- 11 SQUELCH CONTROL [SQUELCH]**  
Functions while the local inhibit function is in use for setting the squelch threshold level. This setting is ignored for normal repeater operation.
- 12 COR SIMULATE SWITCH [COR SIMULATE]**  
Sets the repeater to simulate continuous signal receiving and transmit a signal with FM noise modulation. Use the COR (Carrier-Operated Relay) simulate function for checking an operation such as the transmit frequency, time-out timer, etc.
- 13 LOCAL INHIBIT SWITCH [LOCAL INHIBIT]**  
Inhibits the repeater function — sets no relation between receiver and transmitter. The repeater operates as a semi-duplex transceiver.
- 14 VOLUME CONTROL [VOLUME]**  
Adjusts the audio output level from the speaker.
- 15 SPEAKER MUTE SWITCH [SP MUTE]**  
Turns the speaker mute function ON and OFF without changing the [VOLUME] control.
- 16 SPEAKER**  
Monitors the received signal.

# 1 PANEL DESCRIPTION

## ■ Rear panel



- ① TRANSMIT ANTENNA CONNECTOR [TX ANT]** (p. 4)  
Outputs the transmit power to an antenna via duplexer.
- ② DC POWER SOCKET [DC 13.8V]** (p. 4)  
Accepts 13.8 V DC through the supplied DC power cable (OPC-025A).
- ③ RECEIVE ANTENNA CONNECTOR [RX ANT]** (p. 4)  
Inputs receive signals from an antenna via duplexer.

- ④ GROUND TERMINAL [GND]** (p. 4)  
Ground the repeater through this terminal to prevent electric shocks, TVI, BCI and other problems.
- ⑤ ACCESSORY SOCKET 1 [ACC(1)]** (p. 5)  
Inputs and outputs signals for external equipment.
- ⑥ ACCESSORY SOCKET 2 [ACC(2)]** (p. 5)  
Inputs and outputs signals for external equipment.

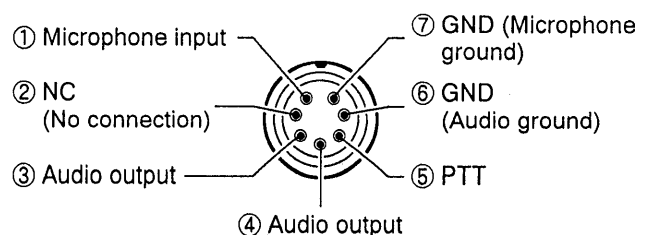
## ■ Microphone connector

Connect an optional HM-4 HAND MICROPHONE to the [MICROPHONE] connector.

- When [LOCAL INHIBIT] is OFF:  
Pushing [PTT] on the microphone transmits manually and your voice is superimposed over the received signal.
- When [LOCAL INHIBIT] is ON:  
Push [PTT] on the microphone to transmit your voice; release [PTT] to receive. The repeater functions as a semi-duplex transceiver.

**DO NOT** hold the microphone too close to your mouth or speak loudly. This may distort the signal.

Front panel view





## ■ Rear panel connections

### [13.8V DC] socket

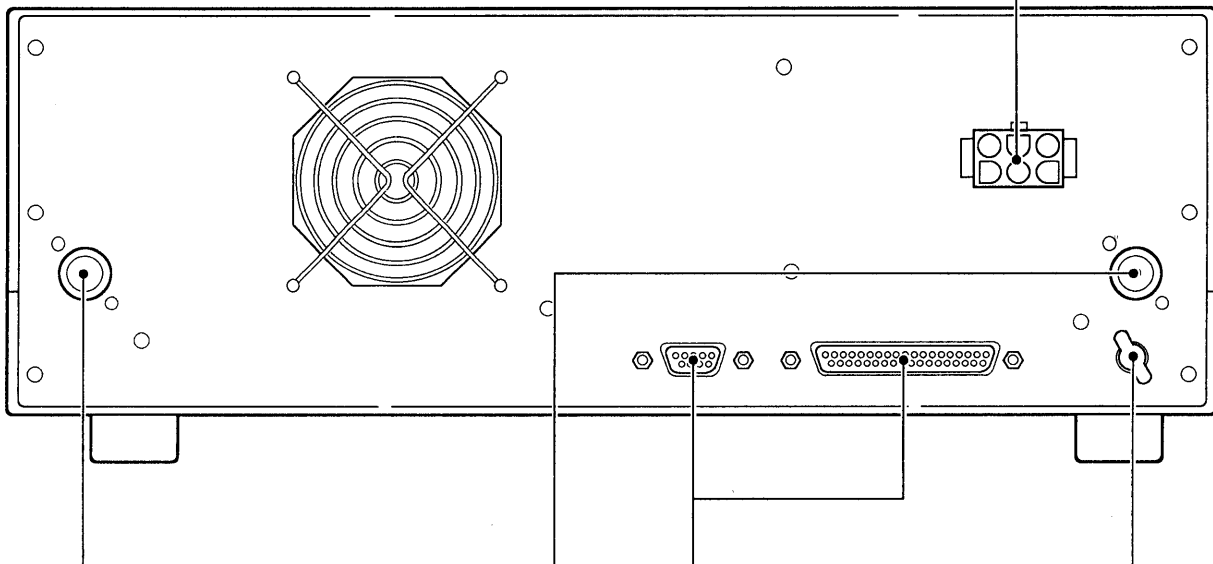
Use the supplied DC power cable and a DC power supply which has more than 15 A current capacity.

Make sure the DC power cable polarity is correct.

- Red : Positive ⊕ terminal
- Black : Negative ⊖ terminal

If a fuse blows or the repeater stops functioning, find the source of the problem if possible, and replace the damaged fuse with a new, rated fuse (FGB 20 A).

**NOTE:** The internal fuse also could be blown in this case. See p. 9 for fuse location.



### [TX ANT] and [RX ANT] connectors

To obtain maximum performance from the repeater, select a high-quality antenna and mount it in a good location. An omnidirectional 50 Ω antenna is recommended for ordinary conditions. VSWR should be less than 1.5:1. Use heavy-duty stainless steel mounting hardware to protect the antenna from bad weather.

Use 50 Ω coaxial cables as feedlines. The coaxial cables should be as short in length and as thick as possible.

A duplexer is separately required when only one antenna is used for both transmitting and receiving. Select a duplexer according to transmit and receive frequencies. Ask your Icom Dealer for details.

**CAUTION:** Protect your repeater from lightning using a lightning arrester.

### [GND] terminal

To prevent electric shocks, TVI, BCI and other problems, ground the repeater through the [GND] terminal.

For the best results, connect a heavy gauge cable to a long earth-sunk copper rod. Make the distance between the [GND] terminal and copper rod as short as possible.

**WARNING: NEVER** connect the [GND] terminal to a gas or electric pipe, since the connection could cause an explosion or electric shock.

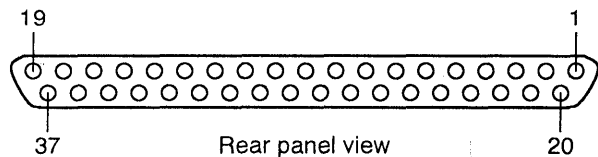
### [ACC(1)] and [ACC(2)] sockets

See the next page for details.

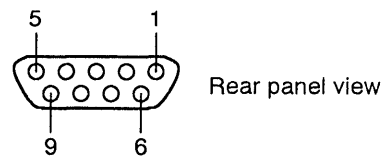
## 2 INSTALLATION

### ■ Accessory sockets

#### • ACC(1) socket



#### • ACC(2) socket



#### • ACC(1) socket

PIN No.	PIN NAME	DESCRIPTION	PIN No.	PIN NAME	DESCRIPTION
1-3	A0-A2	3-bit address data for the frequency setting switch (S1-S8 on the LOGIC unit).	16	SP +	Amplified audio output for an external speaker.
4	STB	Strobe signal for frequency setting.	17	NC	No connection.
5	DO	Detected signal output with no de-emphasis. (0 dBm output with 600Ω load when a 1 kHz/ ± 3.5 kHz deviation signal is received.)	18, 19	GND	Ground for + 13.8 V DC output.
			20-23	D3-D0	4-bit data for the frequency setting switch (S1-S8 on the LOGIC unit).
6	DI	Direct modulation signal input bypassing the emphasis circuit. ( ± 3.5 kHz deviation with 1 kHz/100 mVrms input.)	24	GND	Ground for the "DO" signal (pin 5).
			25	GND	Ground for the "DI" signal (pin 6).
7	GND	Ground.	26	S-METER	Outputs an S-meter signal.
8	TX EXT	Becomes "LOW" while transmitting.	27	GND	Ground for the "S-METER" signal (pin 26).
9	BUSY	Becomes "LOW" while receiving.	28-31	NC	No connection.
10	GND	Ground.	32	GND	Ground for the "LO" signal (pin 13).
11, 12	NC	No connection.	33	LI	Modulation signal input with 300-3000 Hz 6 dB/oct. emphasis. ( ± 3.5 kHz deviation with 1 kHz/100 mVrms input.)
13	LO	Detected signal output with 300-3000 Hz 6 dB/oct. de-emphasis. (0 dBm output with 600Ω load when a 1 kHz/ ± 3.5 kHz deviation signal is received.)			
			14	GND	Ground for the "LI" signal (pin 33).
15	EXT PTT	External PTT input. Connect to ground to transmit.	36, 37	+ 13.8V	Outputs 13.8 V DC and 2 A maximum for external equipment.

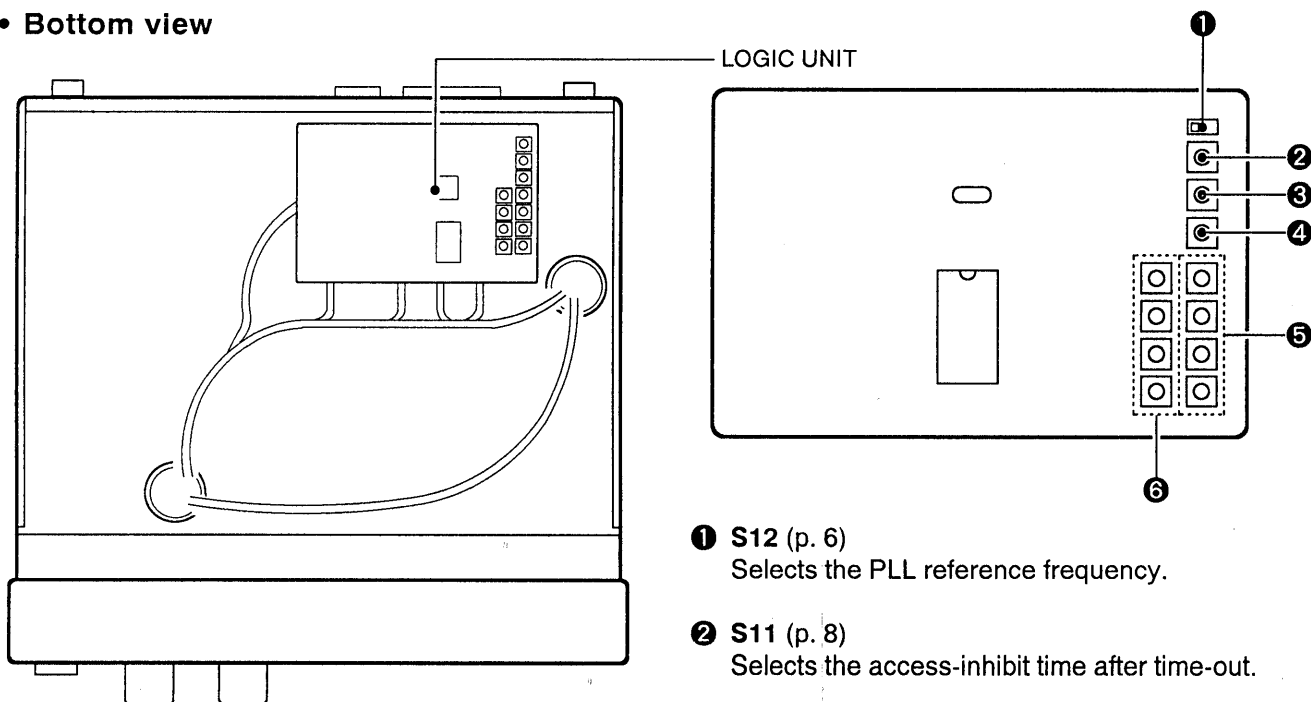
#### • ACC(2) socket

PIN No.	PIN NAME	DESCRIPTION	PIN No.	PIN NAME	DESCRIPTION
1	+ 13.8V	Outputs 13.8 V DC and 1 A maximum for external equipment.	5	EXT PTT	External PTT input. Connect to ground to transmit.
2	LI	Modulation signal input with 300-3000 Hz 6 dB/oct. emphasis. ( ± 3.5 kHz deviation with 1 kHz/100 mVrms input.)	6	BUSY	Becomes "LOW" while receiving.
			7	DI	Direct modulation signal input bypassing the emphasis circuit. ( ± 3.5 kHz deviation with 1 kHz/100 mVrms input.)
3	GND	Ground for the "LI" and "LO" signals (pins 2, 4).	8	GND	Ground for the "DI" and "DO" signals (pins 7, 9).
4	LO	Detected signal output with 300-3000 Hz 6 dB/oct. de-emphasis. (0 dBm output with 600Ω load when a 1 kHz/ ± 3.5 kHz deviation signal is received.)	9	DO	Detected signal output with no de-emphasis. (0 dBm output with 600Ω load when a 1 kHz/ ± 3.5 kHz deviation signal is received.)



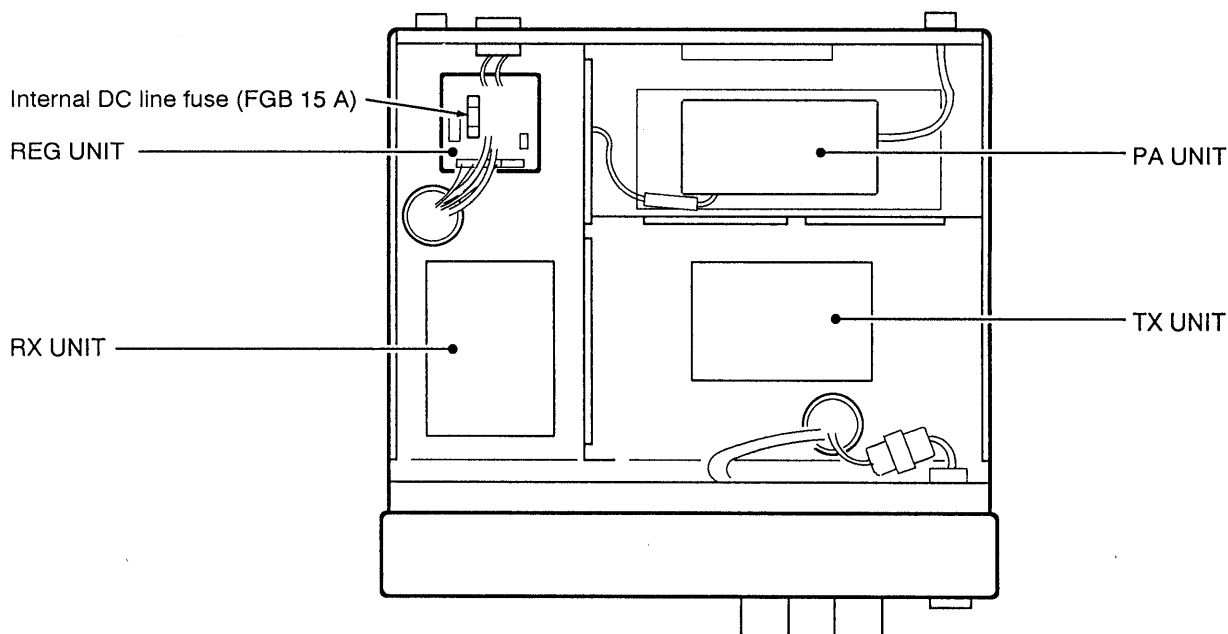
## Internal views

### • Bottom view



- ❶ **S12** (p. 6)  
Selects the PLL reference frequency.
- ❷ **S11** (p. 8)  
Selects the access-inhibit time after time-out.
- ❸ **S10** (p. 8)  
Selects the hang-up time.
- ❹ **S9** (p. 8)  
Selects the time-out time.
- ❺ **S5 to S8** (p. 6)  
Set the receive frequency.
- ❻ **S1 to S4** (p. 6)  
Set the transmit frequency.

### • Top view



### 3 INTERNAL SETTINGS

#### Rotary switches

Rotary switches for frequency setting or time-out timer setting, etc. are allocated on the LOGIC unit. To set these values, remove the bottom cover. Refer to p. 6 "Internal views" for the rotary switch locations.

**IMPORTANT:** After changing rotary switch position, turn power OFF then ON or push the [RESET] switch.

#### Frequency setting

- ① Turn power OFF, then disconnect the DC power cable.
- ② Unscrew 12 screws, then remove the bottom cover.
- ③ According to the tuning step, select either the 12.5 kHz or 5 kHz PLL reference frequency using the PLL reference frequency switch S12 on the LOGIC unit.
- ④ Calculate the frequency data as in the "Frequency setting examples" below.
- ⑤ Set the frequency data.
- ⑥ Replace the bottom cover and screws. Confirm that the set frequencies are correct.

**CAUTION:** Transmit and receive frequencies must be separated by more than 5 MHz.

#### Frequency setting examples

Calculate the frequency data as shown below. Using the table on the next page, subtract the maximum possible value from the calculated value that does not result in a negative number.

Repeat this process until the calculation becomes 0. Then, set the rotary switches according to the obtained values (hexadecimal notation).

##### Frequency setting example (12.5 kHz tuning step)

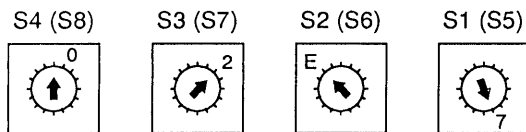
Desired frequency : 329.2875 MHz  
 PLL reference frequency : 0.0125 MHz (12.5 kHz)

$$\begin{aligned} \text{Frequency data} &= \frac{\text{Desired frequency} - 320.00 \text{ MHz}}{\text{PLL reference frequency}} \\ &= \frac{329.2875 - 320.00}{0.0125} \\ &= 743 \quad (= 2E7_{\text{HEX}}) \end{aligned}$$

Calculated value 743 - 512 (S3 position: 2) = 231  
 231 - 224 (S2 position: E) = 7  
 7 - 7 (S1 position: 7) = 0

Rotary switch	S4	S3	S2	S1
settings	0	2	E	7

##### Transmit frequency setting



Bracketed values are receive frequency settings.

When the 12.5 kHz tuning step is selected, S4-S1 or S8-S5 change within the following range depending on versions.

326-346 MHz (#01) : 01E0 to 0820  
 346-366 MHz (#02) : 0820 to 0E60

##### Frequency setting example (5 kHz tuning step)

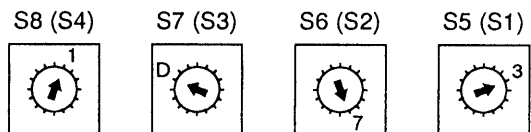
Desired frequency : 357.695 MHz  
 PLL reference frequency : 0.005 MHz (5 kHz)

$$\begin{aligned} \text{Frequency data} &= \frac{\text{Desired frequency} - 320.00 \text{ MHz}}{\text{PLL reference frequency}} \\ &= \frac{357.695 - 320.00}{0.005} \\ &= 7539 \quad (= 1D73_{\text{HEX}}) \end{aligned}$$

Calculated value 7539 - 4096 (S8 position: 1) = 3443  
 3443 - 3328 (S7 position: D) = 115  
 115 - 112 (S6 position: 7) = 3  
 3 - 3 (S5 position: 3) = 0

Rotary switch	S8	S7	S6	S5
settings	1	D	7	3

##### Receive frequency setting



Bracketed values are transmit frequency settings.

When the 5 kHz tuning step is selected, S4-S1 or S8-S5 change within the following range depending on versions.

326-346 MHz (#01) : 04B0 to 1450  
 346-366 MHz (#02) : 1450 to 23F0



## ■ Frequency set table

The following table shows the rotary switch values for frequency setting. Find your required values from the table.

ROTARY SWITCH POSITION	ROTARY SWITCHES			
	S1 or S5	S2 or S6	S3 or S7	S4 or S8
0	0	0	0	0
1	1	16	256	4096
2	2	32	512	8192
3	3	48	768	12288*
4	4	64	1024	16384*
5	5	80	1280	20480*
6	6	96	1536	24576*
7	7	112	1792	28672*
8	8	128	2048	32768*
9	9	144	2304	36864*
A	10	160	2560	40960*
B	11	176	2816	45056*
C	12	192	3072	49152*
D	13	208	3328	53248*
E	14	224	3584	57344*
F	15	240	3840	61440*

\* These values do not apply to the repeater.

## ■ Time-out timer setting

This function inhibits one station from monopolizing the repeater.

If a station accesses the repeater beyond the specified time-out time, the repeater automatically inhibits access for a specified time.

The time-out time is selectable via the time-out-timer switch S9.

S9 POSITION	TIME-OUT TIME	S9 POSITION	TIME-OUT TIME
0	1 min.	8	9 min.
1	2 min.	9	10 min.
2	3 min.	A	11 min.
3	4 min.	B	12 min.
4	5 min.	C	13 min.
5	6 min.	D	14 min.
6	7 min.	E	15 min.
7	8 min.	F	Unrestricted

Initial setting before shipping is 3 min.

## ■ Hang-up timer setting

When a receive signal from an accessing station disappears, the repeater continues transmitting for a specified hang-up time. If a signal is received within the hang-up time, the repeater transmits continuously with no interruption.

The hang-up time is selectable via the hang-up timer switch S10.

S10 POSITION	HANG-UP TIME	S10 POSITION	HANG-UP TIME
0	0 sec.	8	8 sec.
1	1 sec.	9	9 sec.
2	2 sec.	A	10 sec.
3	3 sec.	B	11 sec.
4	4 sec.	C	12 sec.
5	5 sec.	D	13 sec.
6	6 sec.	E	14 sec.
7	7 sec.	F	15 sec.

Initial setting before shipping is 1 sec.

## ■ Access-inhibit timer setting

This function allows you to set the access-inhibit time after time-out.

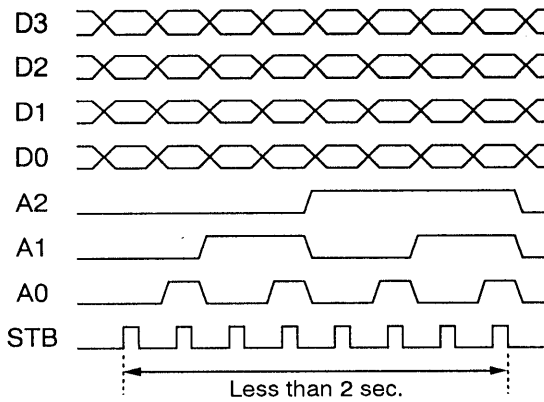
The access-inhibit time is selectable via the access-inhibit timer switch S11.

S11 POSITION	ACCESS-INHIBIT TIME	S20 POSITION	ACCESS-INHIBIT TIME
0	0 sec.	8	30 sec.
1	1 sec.	9	40 sec.
2	2 sec.	A	50 sec.
3	3 sec.	B	1 min.
4	5 sec.	C	2 min.
5	10 sec.	D	3 min.
6	15 sec.	E	5 min.
7	20 sec.	F	10 min.

Initial setting before shipping is 5 sec.

### Frequency setting from the [ACC(1)] socket

The operating frequency can be remotely set by serial data from external equipment. The frequency data must be sent within 2 sec. The operating frequency changes 2 sec. after the 1st strobe signal (STB) is received. One or more rotary switches' data can be changed. The following chart shows the timing.



The following table shows the rotary switch which the repeater assigns the 4-bit data to.

ROTARY SWITCH	ADDRESS DATA		
	A2	A1	A0
S1	HIGH	HIGH	HIGH
S2	HIGH	HIGH	—
S3	HIGH	—	HIGH
S4	HIGH	—	—
S5	—	HIGH	HIGH
S6	—	HIGH	—
S7	—	—	HIGH
S8	—	—	—

— : LOW

The following table shows the specified switch position which the repeater electronically sets.

ROTARY SWITCH VALUE	4-BIT DATA			
	D3	D2	D1	D0
0	—	—	—	—
1	—	—	—	HIGH
2	—	—	HIGH	—
3	—	—	HIGH	HIGH
4	—	HIGH	—	—
5	—	HIGH	—	HIGH
6	—	HIGH	HIGH	—
7	—	HIGH	HIGH	HIGH
8	HIGH	—	—	—
9	HIGH	—	—	HIGH
A	HIGH	—	HIGH	—
B	HIGH	—	HIGH	HIGH
C	HIGH	HIGH	—	—
D	HIGH	HIGH	—	HIGH
E	HIGH	HIGH	HIGH	—
F	HIGH	HIGH	HIGH	HIGH

— : LOW



## ■ GENERAL

- Frequency coverage : 326–346 MHz (#01)  
346–366 MHz (#02)
- Mode : FM
- Antenna impedance : 50 Ω (nominal)
- Power supply requirement : 13.8 V DC ± 15% (negative ground)
- Current drain :  
Repeated 10.0 A  
Rated audio output Less than 2.0 A  
Squelched Less than 1.5 A
- Offset frequency width : More than 5 MHz
- Selectable tuning steps : 5 or 12.5 kHz
- Usable temperature range : – 20 °C to + 60 °C
- Frequency stability : ± 2.5 ppm
- Dimensions : 425(W) × 149(H) × 368(D) mm (projections not included)  
480(W) × 171(H) × 417(D) mm (projections included with an optional MB-19 RACK MOUNTING HANDLES are attached.)
- Weight : 12 kg

## ■ TRANSMITTER

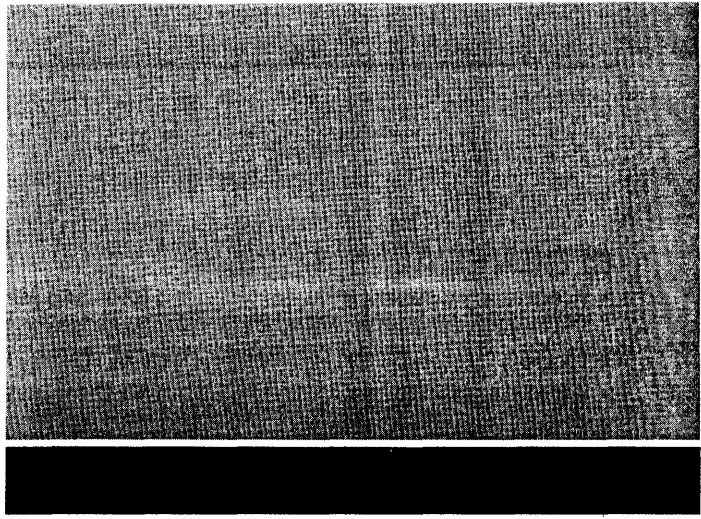
- Output power : 25 W
- Modulation system : Variable reactance and reference frequency modulation
- Maximum frequency deviation : ± 5.0 kHz
- Spurious emissions : Less than – 70 dB
- Transmit noise ratio : Less than – 40 dB
- Microphone impedance : 600 Ω

## ■ RECEIVER

- Receive system : Double-conversion superheterodyne
- Intermediate frequencies : 1st 30.875 MHz  
2nd 455 kHz
- Sensitivity (for 12 dB SINAD) : Less than 0.32 μV
- Squelch sensitivity : Less than 0.32 μV (at threshold)
- Adjacent channel selectivity : Less than – 70 dB
- Spurious response rejection ratio : More than 70 dB
- Intermodulation ratio : More than 70 dB
- Audio output power : More than 1.7 W at 10% distortion with the 8 Ω internal speaker.
- Audio output impedance : 8 Ω

All stated specifications are subject to change without notice or obligation.

**Count on us!**



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