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Split Operation

The same frequency is used for both reception and transmission during normal communication. Select either VFO A or VFO B in this case. However, depending on the circumstances, a different frequency may be chosen for reception and transmission. In this case, it is necessary to use two VFOs. This is known as "split operation". "Split operation" is used in cases such as when using an FM repeater or when calling a DX station.

1 Press [SPLIT].
<< SPLIT >> lights up when the transceiver enters the split mode.

2 Press [A/B] to select "VFO A" or "VFO B".
The value on the left is the RX frequency. (Indicated by ◀🅐 in the example)
The value on the right is the TX frequency. (Indicated by 🅑▶ in the example)

3 Select a frequency.
• To copy a selected VFO frequency to the other VFO, press and hold **[A/B]**.

4 Press [A/B] to select the other VFO.

5 Select a frequency.

Exiting Split Operation

6 Press [SPLIT].
The transceiver switches to the simplex mode and the light for << SPLIT >> goes off.

Direct Input of Frequency Difference Specified by DX Station

To directly configure the frequency difference between the frequency specified by the DX station and the RX frequency, perform the steps below while receiving signals from the DX station.

1 Press and hold [SPLIT].
• << SPLIT >> starts to blink.

2 Enter the frequency specified by the DX station in units of kHz.
To exit the configuration process, press **[CLR]**.
If the frequency specified by the DX station is a positive value, enter the specified frequency in units of kHz using the numeric keypad. If the frequency specified by the DX station is a negative value, enter a "0" at the beginning of the frequency value.
For example, if "+5 kHz" is specified, enter "5". If "-5 kHz" is specified, enter "0" followed by "5".
After input is complete, the TX frequency is configured and split operation is now enabled.
• << SPLIT >> changes from a blinking to a solid display.

Turning the Tuning Control to Search for a TX Frequency

To search for a TX frequency by turning the **Tuning** control, perform the steps below while receiving signals from the DX station.

1 Press and hold [SPLIT].
• << SPLIT >> starts to blink.

2 Turn the Tuning control to search for a TX frequency.
To exit the configuration process, press **[CLR]**.

3 Press [SPLIT].
The frequency that is found in step 2 is configured as the TX frequency and split operation is now enabled.
• << SPLIT >> changes from a blinking to a solid display.

⊿F Display

This item displays the difference between the RX frequency and TX frequency during split operation.

⬤ Configure in Menu [6-15] "Delta Frequency Display"

Setting Value	Off/ On (default)

• When the ⊿F display is ON, << ⊿F >> is displayed below the TX frequency display during split operation.
• When << ⊿F >> is displayed below the TX frequency, the band memory number on the right will not be displayed.
• When RIT or XIT is ON, the ⊿F value is the difference between the TX frequency and the RX frequency with the RIT or XIT frequency added.

Changing the split frequency using the [RIT/XIT] control

While in the split mode with the RIT/XIT function set to OFF, the split frequency can be adjusted by turning the **[RIT/XIT]** control.

⬤ Configure in Menu [3-12] "Split Frequency Offset by RIT/XIT Control"

Setting Value	Off (default)/ TX Frequency Offset while RX/ RX Frequency Offset while TX/ Both

TX Frequency Offset while RX: Split transmission frequency can be adjusted while receiving. While receiving signals from a DX station, turning the **[RIT/XIT]** control changes the TX frequency in advance to the frequency specified by the target station.
RX Frequency Offset while TX: Split reception frequency can be adjusted while transmitting. While one's own station is transmitting as a DX station, turning the **[RIT/XIT]** control changes the RX frequency in advance to the frequency specified for the target station.
Both: Enables both the above.

📝 ● Adjustment of the split frequency using this function is disabled during TF-SET.

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Configuring the Band Direct Key during Split Operation

Three options are available for selection with regard to the behavior when the band direct key is pressed during split operation.

● Configure in Menu [3-13] "Band Direct Keys in Split Mode"

Setting Value	RX Band (default)/ RX Band and Cancel Split Mode/ RX/ TX Band

RX Band: Changes the receiving band.
RX Band and Cancel Split Mode: Changes the receiving band and cancels the split mode.
RX/TX Band:
- Changes both the receiving and transmitting bands at the same time.
- The transmitting band and receiving band is assigned with the same memory number.
- Each band can be adjusted while maintaining the split status.

TF-SET (Setting the TX Frequency)

TF-SET is a function for temporarily switching the TX frequency and RX frequency. Signals can be received at one's own frequency while the TF-SET switch is pressed and held down, and the TX frequency can also be changed in this state. Doing so allows checking of whether there is interference in the newly-selected TX frequency.
- A call is made to the target station when there is no interference and at the right timing to ensure smooth communication with DX stations that are receiving calls from a large number of stations. In other words, the communication status of the DX station in the presence of interfering signals are taken into consideration and transmission is carried out using the TF-SET function at the instant when the DX station is in the receiving state and there is no transmission from other stations. Putting this function to good use enables communication with a larger number of DX stations.

1 **Configure the split operation frequency.**

2 **Press and hold [TF-SET].**
The TX frequency and RX frequency are switched.

3 **Turn the Tuning control while pressing and holding [TF-SET], or press [UP]/[DWN] on the microphone.**
Signals are received at the new TX frequency.

4 **Release [TF-SET].**
Reception starts at the original RX frequency.

> ● Adjustment of the split frequency using the **[RIT/XIT]** control is disabled during TF-SET.
> ● Turning on the frequency lock before using the TF-SET function helps to prevent the transceiver from losing communication with the DX station due to erroneous operation.

AGC

AGC (Automatic Gain Control) is a function for controlling the IF gain automatically so as to minimize fluctuations in the strength of the signal that is being received.
- The AGC time constant is configured to FAST, MID or SLOW according to the receiving status and operation mode (other than FM mode).
- The digital AGC circuit of this transceiver divides the time constant into 20 levels from SLOW to FAST, with "1" being the fastest and "20" the slowest.
- Generally, the time constant is configured to a fast time constant in the CW and FSK modes where fluctuations in the signal strength are well defined, and a slow time constant is used in the SSB and AM modes where changes are gradual.
- However, a fast time constant is also useful in the SSB and AM modes to perform tuning quickly or when receiving weak signals.
- AGC can also be turned off.
- A different default time constant for AGC is configured for each mode as shown below.

Default AGC Time Constant Setting

| Mode	Setting	Display
SSB	SLOW	AGC-S
SSB-DATA	SLOW	
CW	FAST	AGC-F
FSK	FAST	
PSK	FAST	
AM	SLOW	AGC-S
AM-DATA	SLOW	

Switching the AGC Time Constant

1 Select a mode other than FM.

2 Press [AGC] to select an AGC time constant.
Pressing **[AGC]** each time switches the selection in the following sequence: "AGC-F" → "AGC-M" → "AGC-S".

Adjusting the AGC Time Constant Preset Value

1 Press and hold [AGC] to display the AGC configuration screen.
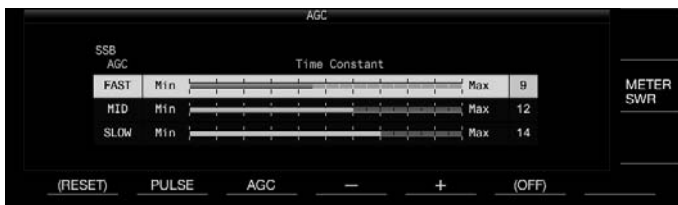
2 Press F3 [AGC] or [AGC] to select "FAST", "MID" or "SLOW".

3 Press F4 [–]/ F5 [+] or turn the [MULTI/CH] control to change the AGC time constant.

Setting Value	1 to 20

The AGC time constant is fastest when it is configured to "1", and slowest when configured to "20".
• The default AGC time constant values in the respective operation modes are as follows.

Mode	FAST	MID	SLOW
SSB	9	12	14
SSB-DATA	9	12	14
CW	9	12	14
FSK	7	11	14
PSK	7	11	14
AM	9	13	16
AM-DATA	9	13	16

4 Press and hold [AGC] or press [ESC] to end the process.

AGC OFF

Turns off AGC according to the status of the signals received. RF gain is fixed when AGC is set to OFF, which makes it easier to hear weak signals in some cases.

> ● If AGC is turned OFF while the S meter is deflecting due to the signal, sound may be output to the speaker or headphones at an unexpectedly loud volume.

Turn the **[RF]** control to turn down the RF gain level in advance. After turning off AGC, adjust RF gain by turning the **[RF]** control until the signal can be heard clearly.
To turn off AGC, perform the steps below.

1 Press and hold [AGC] to display the AGC configuration screen.

2 Press and hold F6 [(OFF)] to configure AGC to OFF.
<< AGCOFF >> lights up and the preset value display area is grayed out.

3 Press and hold [AGC] or press [ESC] to end the process.

AGC Quick Recovery

This function performs recovery from the suppression that occurs when the RX signal contains pulse noise.

1 Press and hold [AGC] to display the AGC configuration screen.

2 Press F2 [PULSE] to display the AGC Quick Recovery configuration screen.

3 Press F3 [ON/OFF] to set the function to "On".

4 Press F4 [–]/ F5 [+] or turn the [MULTI/CH] control to change the threshold level.
Configuring to a larger value activates this function when signal level difference between the RX signal and pulse noise is small.

Setting Value	1 to 5 (default) to 10

> ● This function may not be effective for pulse noise occurring in short time interval.
> ● Configuring to a value with a high threshold level may cause the transceiver to malfunction and distort the RX audio depending on the condition of the RX signal.

5 Press and hold [AGC] or press [ESC] to end the process.

RX Equalizer

This function allows the sound quality to be altered by adjusting the characteristics of the RX frequency. 6 types of RX equalizer are available, which can be configured separately for each mode. A set of equalizer characteristics can be configured freely for each of the options between "User 1" and "User 3".

Turning ON/OFF RX Equalizer

● **Press F [RX EQ].**
Pressing **F [RX EQ]** each time toggles the RX equalizer between ON and OFF.

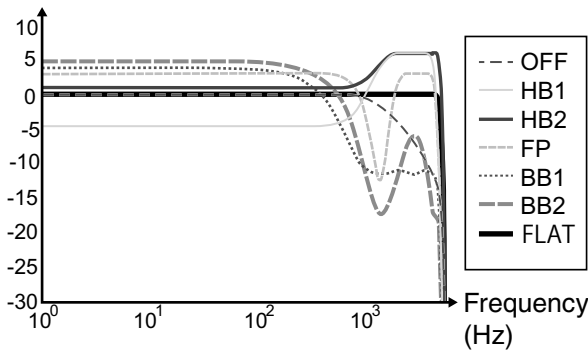### Selecting an RX Equalizer Characteristic

1 Press and hold F [RX EQ] to display the RX Equalizer configuration screen.

2 Press F2[▲] / F3[▼] or turn the [MULTI/CH] control to select an equalizer characteristic.
The selected equalizer characteristic turns on.

Characteristic	Purpose
High Boost 1 (HB1)	Boosts the high frequency component. This is effective for audio sound that contains a low frequency component.
High Boost 2 (HB2)	Boosts the high frequency component. The low frequency attenuation level for this option is half of that of the High Boost 1 option.
Formant Pass (FP)	This option attenuates frequency components that is outside the audio bandwidth so that the audio can be heard more clearly.
Bass Boost 1 (BB1)	Boosts the low frequency component. This is effective for audio sound that contains a high frequency component.
Bass Boost 2 (BB2)	Boosts the low frequency component. The low frequency is further boosted compared to Bass Boost 1.
Flat (FLAT)	This option has a flat frequency response.
User 1 (U1)	Frequency characteristics can be adjusted according to the user's preferences and stored in the options between User 1 and User 3. The flat frequency characteristic is selected in the default setting.
User 2 (U2)	
User 3 (U3)	

**3 Press and hold F [RX EQ] or press [ESC] to end the process.**

RX Characteristic Curve

📝 ● When the RX DSP equalizer is set to ON, the effect ("HB1"/ "HB2"/ "FP"/ "BB1"/ "BB2"/ "FLAT"/ "U1"/ "U2"/ "U3") is displayed at the lower end of the key guide.
● When the RX DSP equalizer is OFF, "OFF" is displayed at the lower end of the key guide.

Adjusting the Equalizer Characteristics

The equalizer characteristics can be customized according to the user's preferences. Also, the customized characteristics can be stored as user-defined settings.

1 Press and hold F [RX EQ] to display the RX Equalizer configuration screen.

2 Select an equalizer characteristic.

3 Press F4 [ADJ] to display the RX Equalizer Adjustment screen.
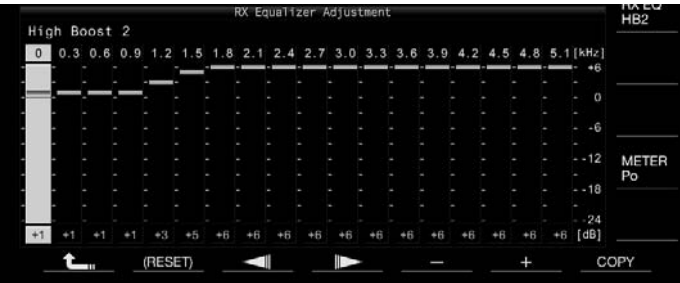
4 Press F3[◄||] / F4[||►] to select the frequency to adjust.

5 Press F5 [–]/ F6 [+] or turn the [MULTI/CH] control to adjust the frequency level.
• Touching a point on the RX Equalizer Adjustment screen selects the corresponding band and changes the frequency to the selected level.
An alternative way is to touch a rough point followed by fine-tuning in steps 3 and 4.
• Pressing and holding **F2 [(RESET)]** resets all the frequency levels to the default setting.

6 Press and hold F [RX EQ] or press [ESC] to end the process.

📝 ● Besides the User 1 to User 3 options, the equalizer characteristics of the other options can also be altered on the RX Equalizer Adjustment screen.
● If the configured level of the RX DSP equalizer deviates from the configured level of the adjacent frequency, the desired amount of attenuation may not be obtained.

Copying Equalizer Data

The customized equalizer characteristics can be copied to one of the options from "User 1" to "User 3".

1 **Press and hold F [RX EQ] to display the RX Equalizer configuration screen.**

2 **Press F2[▲] / F3[▼] to select the equalizer to save.**
   - Pressing **F4 [ADJ]** on the RX Equalizer screen displays the RX Equalizer Adjustment screen. Equalizer data can be copied from either the RX Equalizer screen or RX Equalizer Adjustment screen.

3 **Press F5 [COPY].**
   A message appears prompting you to confirm the destination to copy the equalizer characteristics.
   - Pressing **F7 [CANCEL]** ends the equalizer data copy operation without copying and restores the display to the RX Equalizer screen or RX Equalizer Adjustment screen.

4 **Press F2 [USER 1], F3 [USER 2] or F4 [USER 3] to specify the destination to copy the data to.**
   The equalizer selected in step 2 is copied to "USER 1", "USER 2" or "USER 3".
   - After copy is complete, the message to confirm the destination for copying the equalizer characteristics disappears and the display is restored to the RX equalizer screen or RX equalizer adjustment screen.

5 **Press and hold F [RX EQ] or press [ESC] to end the process.**

Saving Equalizer Data

Multiple sets of customized DSP equalizer settings data can be created and saved.
   - Before doing so, configure the destination for saving the data in "File Storage Location" of the "USB/File Management Menu" to "Internal Memory" or "USB Flash Drive". (See 11-2)
   - To save the data to a USB flash drive, insert a USB flash drive formatted using this transceiver into ⟵⟶ (USB-A).

1 **Press and hold F [RX EQ] to display the RX Equalizer configuration screen.**

2 **Press F2[▲] / F3[▼] to select the equalizer to save.**

3 **Press F7 [SAVE].**
   A message indicating that saving is complete is displayed.

4 **Press F4 [OK].**

5 **Press and hold F [RX EQ] or press [ESC] to end the process.**

   - The saved file is named in the "yyyymmdd_hhmmss" format. The extension of the saved file is "equ". (Example) If the date is 10:20:30 a.m., February 15, 2018: 20180215_102030.equ
   - The name of the destination folder is as follows. (The name varies depending on the destination for saving files.)
     - USB flash drive: "KENWOOD\TS-890\SETTINGS \RX_EQ"
     - Built-in memory: "SETTINGS\RX_EQ"
   - When removing the USB flash drive, make sure to execute "Safely Removing the USB Flash Drive" (11-6).

Reading Equalizer Data

RX DSP equalizer data that is saved in the internal memory or USB flash drive can be read.
   - To read the data from a USB flash drive, insert the USB flash drive containing the RX equalizer data into ⟵⟶ (USB-A).

1 **Press and hold F [RX EQ] to display the RX Equalizer configuration screen.**

2 **Press F2[▲]/ F3[▼] to select the equalizer to read.**

3 **Press F6 [READ] to display the screen for selecting the file to read.**

4 **Select the file to read.**
   - To read data from the internal memory, press **F7 [INT.MEM]**.
   - To read data from the USB flash drive, press **F7 [USB.MEM]**. (If a USB flash drive is not connected, a message screen will appear prompting you to get ready the USB flash drive.)
   - Pressing **F5 [NAME]** allows the file name to be changed.
   - Pressing **F6 [DELETE]** displays a message to confirm deletion of the file. Pressing **F4 [OK]** deletes the file.

5 **Press F2[▲]/ F3[▼] to select the RX equalizer data file to read.**
   Alternatively, the RX equalizer data file can also be selected by turning the **[MULTI/CH]** control.

6 **Press F4 [OK].**
   - After the RX equalizer data has been read successfully, a message indicating that reading is complete is displayed.

7 **Press F4 [OK] again.**

8 **Press and hold F [RX EQ] or press [ESC] to end the process.**

Preamplifier

The preamplifier can be configured to one of the two options: low gain type that places priority on IMD (PRE 1) and high gain type that places priority on sensitivity (PRE 2).

● **Press F [ANT/PRE].**
Pressing **F [ANT/PRE]** each time switches the selection in the following sequence: "PRE 1" → "PRE 2" → "OFF".
• The preamplifier selection is stored for each antenna selection band.
• The default values are as follows.
Less than 7.5 MHz: OFF
7.5 MHz to less than 21.5 MHz: PRE 1
More than 21.5 MHz: PRE 2

RX Monitor

If weak signals are received while the squelch is closed, the signals tend to be interrupted. Also, you may sometimes want to monitor the condition of the RX frequency while in the CTCSS standby state. In this case, the RX monitor is used to open the squelch temporarily.
"RX Monitor" (Menu [0-15] to [0-31]) can be assigned to a PF key. While the PF key that is assigned with "RX Monitor" is pressed and held down, the squelch opens and the RX frequency can be monitored. The RX monitor turns OFF once the key is released. Scanning is paused while **PF [RX Monitor]** is pressed.

SWL (BCL) Mode

The SWL (BCL) mode is intended for SWL (Short Wave Listening) and BCL (Broadcast Listening) by displaying the horizontal dial of the "9R-59" communications receiver on the screen.

1 **Press [MENU].**

2 **Press F [SWL] to display the SWL screen.**
• If **F [SWL]** is not displayed, press **F [MORE]**.
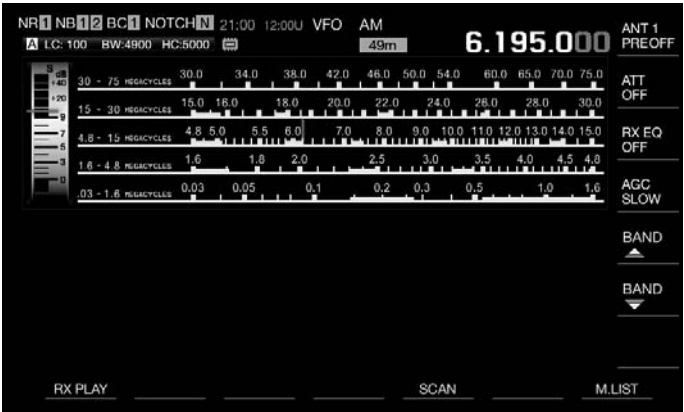
3 **Press [MENU] followed by F [SWL].**
Returns to the normal screen.

📝 ● Switching to the SWL mode is not possible while the transverter is ON.
● An indicator is not displayed if a memory channel that is not registered is being called up.

• Restrictions are applied to the following functions in the SWL mode.

Function	Status
Transmission	Disabled
Sending of voice message	Disabled
Decoding/Encoding	Disabled
Sending of CW message	Disabled
TX output power limiter	Disabled
Meter switching	Disabled
TX filter switching	Disabled
Turning ON transverter	Disabled
FM tone	Disabled
Antenna tuning	Disabled
Configuration of the TX equalizer and related settings	Disabled

Band Switching in the SWL Mode (VFO Mode)

● **Press F [BAND ▲]/ F [BAND ▼].**
• The "broadcast/meter band" is displayed when the frequency falls within the band range. The preset broadcast bands are shown in the table below.

Broadcast/ Meter Band	Lower Limit [kHz]	Upper Limit [kHz]	Default [kHz]/ Mode	
LW	145	285	145	
MW	525	1705	525	
120 m	2300	2495	2300	
90 m	3200	3400	3200	
60 m	4750	5060	4750	
49 m	5900	6200	5900	
41 m	7200	7450	7200	
31 m	9400	9900	9400	AM
25 m	11600	12100	11600	
21 m	13570	13870	13570	
19 m	15100	15800	15100	
16 m	17480	17900	17480	
15 m	18900	19020	18900	
13 m	21450	21850	21450	
11 m	25670	26100	25670	

• The band segments of the SWL mode that is preconfigured on this transceiver are represented in a slightly different way compared to conventional meter bands. Different band segments are used so as to achieve wider coverage to include the broadcast bands of the different regions and other bands.

Transmission in Data Mode

Transmission via PTT Switch, SS Terminal and SEND

Switch transmission by making use of the **[PTT]** switch on the microphone, SS terminal of the REMOTE connector and **[SEND]** on the front panel. Under normal circumstances, the microphone audio is transmitted via this operation.
- This transceiver continues to transmit signals while **[PTT]** on the microphone is pressed and held down.
- This transceiver transmits signals when the SS terminal of the REMOTE connector is short-circuited to GND.
- Pressing **[SEND]** each time toggles between transmission and reception.

Transmission via DATA PTT or DATA SEND

DATA PTT (PKS terminal of ACC 2 connector) or the PF key that is assigned with "DATA SEND" is used to switch between transmission and reception. For more details, please refer to "PF Keys (Programmable Function Keys)" (16-2).
This function comes in handy when transmitting audio or data from an external device.
This operation transmits normal audio signals or audio signals that are input to the ANI terminal of the ACC 2 connector. A different audio path can be specified. For more details, please refer to "Configuration of the Input Path of TX Audio" (8-1).
- This transceiver continues to transmit signals while DATA PTT (PKS terminal of the ACC 2 connector) is short-circuited to GND.
- Pressing the PF key that is assigned with "DATA SEND" toggles between transmission and reception.

RIT/XIT

RIT (Receiver Incremental Tuning)

RIT is a function for fine-tuning only the RX frequency in 10 Hz steps within the ±9.99 kHz range without altering the TX frequency. This is used such as when the TX frequency of the station that this transceiver is communicating with has become slightly deviated.
- When the FINE mode is ON, the offset frequency of RIT switches to a step size of 1 Hz. RIT functions in the same way in all modes as well as when VFO or the memory channel mode is in use.

1 **Press [RIT].**
The [RIT] LED lights up and the RIT offset frequency is displayed.

2 **Turn the [RIT/XIT] control.**
Fine-tune the RX frequency for RIT.
- To clear the offset frequency for RIT, press **[CL]**. The RIT offset frequency value is reset to 0.

3 **Press [RIT] to end the process.**
RIT is turned off. The RX frequency is restored to the value prior to performing step 1.

RIT Shift

This is a function for setting the frequency adjusted with RIT to a RX band.

● **Press and hold [RIT].**
The RX frequency that is adjusted using RIT is set to an RX band. The RIT frequency is then cleared and the RIT function is turned off.

XIT (Transmitter Incremental Tuning)

XIT is a function that can be used to fine-tune the TX frequency in 10 Hz steps within the ±9.99 kHz range without altering the RX frequency.
- When the FINE mode is ON, the offset frequency of XIT switches to a step size of 1 Hz.

1 **Press [XIT].**
The [XIT] LED lights up and the XIT offset frequency is displayed.

2 **Turn the [RIT/XIT] control.**
Fine-tune the TX frequency for XIT.
- To clear the offset frequency for XIT, press **[CL]**. The XIT offset frequency value is reset to 0.

3 **Press [XIT] to end the process.**
XIT is turned off. The TX frequency is restored to the value prior to performing step 1.

XIT Shift

This is a function for shifting from operation using XIT to the split mode at one touch.

● **Press and hold [XIT].**
When the TX frequency that is adjusted using XIT is set to a TX band, the operation switches to the split mode at the same time. The XIT frequency is then cleared and the XIT function is turned off.
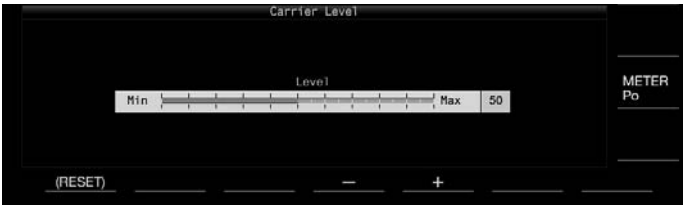
● If the frequency is changed in the entry mode, the RIT/XIT function is automatically turned off.

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Adjusting the Carrier Level

The steps to adjust the carrier level in the CW, FSK, PSK and AM modes are as follows.

1 Press [CAR] to display the Carrier Level configuration screen.

2 Transmit in the CW, FSK, PSK or AM mode.

3 Press F4 [–]/ F5 [+] or turn the [MULTI/CH] control to adjust the carrier level while referring to the ALC meter.

Setting Value	0 to 50 (default) to 100 (1 step)

- CW/ FSK mode: Adjust the carrier level while ensuring that the ALC meter reading does not exceed the ALC zone.
- AM/ PSK mode: Adjust the carrier level until the ALC meter needle starts to deflect.
- SSB/ FM mode: The carrier level value is fixed. (Cannot be adjusted)

4 Press [CAR] or [ESC] to end the process.

> ● Note that the TX output will be disabled if the setting value of carrier level is "0".

Operation in CW Mode

In the world of amateur radio, there is active communication in the CW mode. This is because this mode of communication consumes less power than SSB, and can be regarded as the simplest type of digital communication that combines the use of "dots" and "dashes".

- The built-in electronic keyer of this transceiver offers a wide variety of functions to support the operation of the users. For more details, please refer to "Electronic Keyer" (5-13).

1 Select band and frequency.
Select a frequency band and configure the frequency.

2 Press [CW/ CW-R] to select CW mode.

3 Press [SEND] to transmit.

4 Operate the electronic keyer or paddle to transmit a Morse code signal.
While transmission is in progress, a sidetone for monitoring the Morse code of one's own station can be heard. The frequency of the sidetone changes in tandem with the pitch frequency.

5 After the Morse code is transmitted, press [SEND] to end the transmission.
This transceiver is restored to the receiving state.

> ● The sidetone volume can be adjusted in Menu [1-02] "Sidetone Volume".

CW Break-in

Break-in is a convenient function that places this transceiver in the TX mode simply by switching to the key-down state when in the CW mode, and restores this transceiver to the RX mode upon switching to the key-up state. Break-in is divided into 2 types, full break-in and semi break-in.

Full Break-in

Switches this transceiver from the TX mode to the RX mode at almost the same time as the key-up operation.

Semi Break-in

This transceiver does not return to the RX mode immediately after the key-up operation, but remains in the TX mode and switches to the RX mode only after the preconfigured delay time has elapsed.

Turning ON/OFF Break-in

● **Press [VOX].**
Pressing **[VOX]** each time toggles break-in between the ON and OFF states.
- When break-in is ON, the [VOX] LED lights up.

Adjusting the Break-in Mode and Break-in Delay Time

1 Press [VOX] to set break-in to ON.

2 Turn the [DELAY] control to adjust the delay time after key-up.

Setting Value	FULL-BK/ 50 to 500 (default) to 1000 [ms] (50 step)

- Turn the **[DELAY]** control all the way to the left, and the full break-in mode is activated when "FULL-BK" is displayed.
- Turning the control to the right lengthens the delay time while turning the control to the left shortens it.
- "FULL-BK" or "DELAY:nn" ([nn: 1 to 20 (equivalent to 50ms to 1000ms)]) is displayed at the top right corner of the filter information area.

3 Operate the electronic keyer or paddle.
Transmission/reception is repeated automatically according to the dot and dash Morse code.

> ● Before using this transceiver in combination with a linear amplifier, check whether the linear amplifier supports full break-in. If its compatibility with full break-in is unknown or if it is not compatible, operate using the semi break-in mode.
> ● Full break-in and semi break-in cannot be used at the same time.

Adjusting the Sidetone and Pitch Frequency

- During key-down in the CW mode, a tone can be heard from the speaker of this transceiver. This tone is known as a sidetone. When this tone is heard, it means it is possible to monitor the Morse code transmitted by one's own station.
- In the CW mode for direct keying of the carrier, a BFO (beat frequency oscillator) is needed to convert the carrier wave into audible sound. The difference in frequency between the BFO and carrier wave can be heard in the form of a beat. This difference in frequency is called RX pitch.
- Both the sidetone and the RX pitch have the same frequency.

● **Turn the [MIC/PITCH] control.**
Configure to a sidetone frequency that can be heard most clearly. Turning the **[MIC/PITCH]** control to the right increases the frequency, while turning the control to the left decreases it.

Setting Value	300 to 700 (default) to 1100 [Hz] (5-step)

Adjusting the Sidetone Volume

● **Configure in Menu [1-02] "Sidetone Volume"**

Setting Value	Off/ 1 to 10 (default) to 20 (1 step)

- Sidetone volume like the playback volume of the CW message cannot be altered using the **[AF]** control.

CW Rise Time

The rise time of CW refers to the time interval from key-down to the point where the output waveform reaches the highest peak.

● **Configure in Menu [5-15] "CW Rise Time"**

Setting Value	1/ 2/ 4/ 6 (default) [ms]

- The default setting (6 [ms]) is suited for low-speed to medium-speed keying. For high-speed keying, configure to "4 [ms]", "2 [ms]" or "1 [ms]".

Auto Zero-in (CW Auto Tune)

This function automatically tunes the TX frequency to coincide with the RX frequency of the target station in order to communicate with a station receiving in the CW mode.

1 **Turn the Tuning control and adjust roughly until the RX audio of CW can be heard.**
2 **Press [CW T.] to set auto zero-in (CW auto tune) to ON.**

- << CW TUNE >> starts to blink.
- The TX frequency is automatically adjusted to match the RX frequency of the target station, and the pitch of the RX signal coincides with the sidetone and RX pitch frequency.
- After auto zero-in (CW auto tune) has ended, << CW TUNE >> disappears. If auto zero-in (CW auto tune) cannot be started up, the frequency is restored to the original value.

- Using auto zero-in (CW auto tune) allows tuning up to ±50 Hz from the RX frequency of the target station.
- Auto zero-in (CW auto tune) may not be successful when the keying speed at the receiving station is slow, when there is interference or when the signals are weak.
- When RIT is ON, auto zero-in (CW auto tune) functions with respect to the frequency shifted using RIT.
- The operable range of auto zero-in (CW auto tune) varies depending on the status of reception. For example, if the DSP filter width is 500 Hz, auto zero-in (CW auto tune) will function with respect to RX signals within an approximate RX pitch frequency range of ±300 Hz.

CW BFO Sideband

This is a function for switching CW (USB) and CW-R (LSB) with CW (LSB) and CW-R (USB).
Example: Set the CW carrier point to LSB so that the CW RX tone rises at the same time when the frequency is raised.

● **Configure in Menu [5-05] "CW BFO Sideband"**

Setting Value	USB (default)/ LSB

CW Automatic Transmission from SSB Mode

When the menu below is configured to ON and paddle or key-down of the electronic keyer is performed during operation in the SSB mode, the SSB mode switches automatically to the CW mode and transmission is enabled in the CW mode. The mode switches automatically from USB to CW or LSB to CW-R.

- Upon shifting from the SSB mode to the CW mode, carrier frequency offset will function even when "Carrier Frequency Offset (SSB Mode to CW Mode)" is set to OFF. For this reason, to call a station that transmitted a CW after the CW is received during operation in the SSB mode, this can be done easily using the paddle or electronic keyer operation.

● **Configure in Menu [5-06] "Automatic CW TX with Keying in SSB Mode"**

Setting Value	Off (default)/ On

- Menu [5-06] "Automatic CW TX with Keying in SSB Mode" does not function during transmission and when in the split mode.

Frequency Offset when Shifting from SSB to CW Mode

Upon switching to the CW mode to communicate with a station that transmitted a CW after the CW signal is received during operation in the SSB mode, it is usually necessary to correct the frequency by turning the **Tuning** control slightly. However, turning on this function enables the frequency to be corrected automatically.

● **Configure in Menu [5-07] "Carrier Frequency Offset (SSB Mode to CW Mode)"**

| Setting Value	Off (default)/ On

Encoding/Decoding Morse Code

Below are the steps to decode the RX signals of CW and display them as character strings on the screen. Details of the transmitted CW signals are also displayed as character strings.
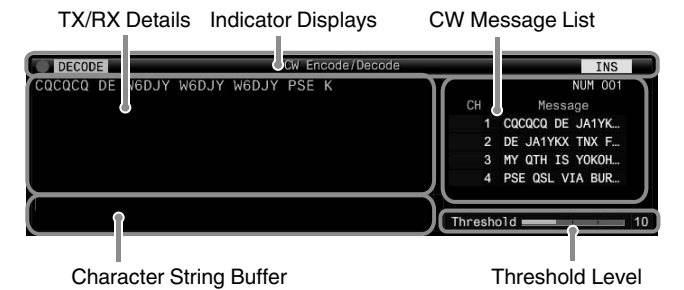
Displaying the CW Communication Screen

1 **Set to the CW mode.**
2 **Press F3 [DECODE] to display the CW communication screen.**
   - If **F3 [DECODE]** is not displayed in the key guide, press **[ESC]** to exit the configuration screen and bandscope.

Decoding in Progress (Decodes and Displays the Received Signal)
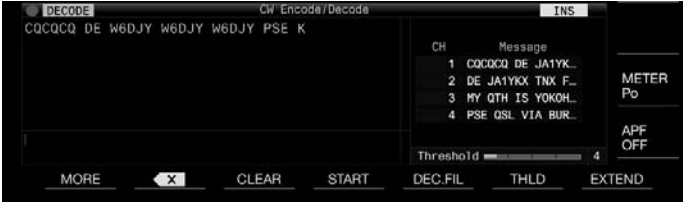
Encoding in Progress (Analyzes and Displays the Transmission Code)

TX/RX Details   Indicator Displays   CW Message List

Character String Buffer   Threshold Level

Indicator Displays

Indicates the status of the function.

TX/RX Details

Displays the character strings that are transmitted or received.

Character String Buffer

Displays the character strings to be transmitted.

CW Message List

Displays the fixed phrases that are registered in the CW message memory. The number of channels displayed varies according to the display screen size. (Standard: 4CH; Expanded: 8CH)

Threshold Level

Displays the adjustment value of the decode threshold level.

Operating the CW Communication Screen

Key	Behavior
F1 [MORE]	Switches the key guide.
F2 [X]	Clears the characters of the character string buffer one at a time. Pressing and holding down the key clears the characters continuously.
F3 [CLEAR]	Clears the character strings of the character string buffer area. Pressing and holding down the key clears the information inside the TX/RX details display area all at once.
F4 [START]	Starts encoding of the character strings in the character string buffer.
F4 [STOP]	Stops encoding and returns to the decoding state.
F5 [DEC.FIL]	Switches the decoding filter.
F6 [THLD]	Switches to the threshold level configuration mode.
F7 [EXTEND]	Enlarges the size of the CW communication screen. Pressing it again restores the screen to the standard size.
F2 [CH 1]/F2 [CH 5]	Copies the character strings registered in CH 1/CH 5 of the CW message memory to the character string buffer.
F3 [CH 2]/F3 [CH 6]	Copies the character strings registered in CH 2/CH 6 of the CW message memory to the character string buffer.
F4 [CH 3]/F4 [CH 7]	Copies the character strings registered in CH 3/CH 7 of the CW message memory to the character string buffer.
F5 [CH 4]/F5 [CH 8]	Copies the character strings registered in CH 4/CH 8 of the CW message memory to the character string buffer.
F7 [NEXT]	Replaces **F2 [CH 1]** to **F5 [CH 4]** with **F2 [CH 5]** to **F5 [CH 8]**.
F2 [LOG]	Turns ON/OFF the communication log function. Pressing and holding this key displays the screen for selecting a log file that is saved.
F3 [PAUSE]	Pauses update of the TX/RX details display. Pressing the key again resumes the update.
F4 [QUICK]	Turns ON/OFF the quick mode.
F5 [DEC.OFF]	Stops decoding.
F5 [DEC.ON]	Resumes the decode function.
F6 [CW.MSG]	Switches to the CW message screen.
F6 [CW.DEC]	Switches to the CW communication screen.

Indicator Displays

Display	Behavior
●	Appears when the log function is ON.
○	Appears when the log function is ON and in the standby mode.
DECODE	Appears when signal decoding is in progress.
ENCODE	Appears when encoding the character strings in the TX character string buffer.
DECODE	Appears when the decode function is stopped or disabled.
⟳	Appears when CW message is configured to the repeat setting.
WAIT	Appears during the repeat interval of the CW message.
QUICK	Appears when the quick mode is ON.
INS	Appears when in the insert mode.
⊞	Appears when it is a count-up trigger message of the contest number.

- Eight code abbreviations are supported, namely $\overline{BT}$, $\overline{AR}$, $\overline{AS}$, $\overline{HH}$, $\overline{SK}$, $\overline{KN}$, $\overline{BK}$ and $\overline{SN}$.
- The code abbreviation received is displayed in 2 alphabets. For example, when "$\overline{AR}$" (code with no space between "A" and "R") is received, "AR" is displayed.
- The codes might not be decoded correctly depending on the signal quality.
- If the keying speed of the target signal changes halfway, the characters immediately before or after the change cannot be decoded correctly.
- Characters that cannot be decoded are indicated using an underscore (_).
- Time stamp and frequency information can be added to the TX/RX details display area. (5-28)
- This transceiver does not support Japanese characters.
- Press **[Page Up]** / **[Page Down]** on the USB keyboard to scroll through the information displayed in the TX/RX details display area.
- Noise Reduction 1, Noise Reduction 2, audio peak filter and RX DSP equalizer do not function during CW decoding.

Adjusting the Decode Threshold Level

The threshold value for the signal strength to activate decoding can be adjusted as follows. Raising the threshold level may reduce erroneous detection due to noise.

1 **Press F6 [THLD] in the CW communication screen to switch to the threshold level configuration mode.**
- If **F6 [THLD]** is not displayed in the key guide, press **F1 [MORE]** to toggle the key guide display.

2 **Press F4 [–]/ F5 [+] or turn the [MULTI/CH] control to select a threshold level.**

Setting Value	1 to 10 (default) to 30 (1-step)

- Adjust the threshold value in the ascending order according to the receiving status of noise, for example. Start from a small value between the range of 1 to 30 and configure the threshold value to a point where reception is good.
- Pressing and holding **F2 [(RESET)]** resets the threshold level to the default setting.

3 **Press F1 [⬆] to end the process.**

Decode Filter

A decode filter (narrow-band filter used exclusively for decoding) can be used when there is significant interference or noise while decoding the Morse code.

● **Press F5 [DEC.FIL] in the CW communication screen.**
- If **F5 [DEC.FIL]** is not displayed in the key guide, press **F1 [MORE]** to toggle the key guide display.
Pressing **F5 [DEC.FIL]** each time switches the decode filter mode (Off/Normal/ Narrow).
- The selected mode is displayed for about 2 seconds.

Transmitting Character Strings via USB Keyboard Operation

Text input by the USB keyboard can be transmitted in Morse code.

1 **Connect the USB keyboard (commercially available) to this transceiver.**

2 **Press F4 [QUICK].**
- If **F4 [QUICK]** is not displayed in the key guide, press **F1 [MORE]** to toggle the key guide display.
Press **F4 [QUICK]** each time toggles the quick mode between ON and OFF.
- << QUICK >> appears when the quick mode is ON.

3 **Enter a character string using the USB keyboard.**

When Quick Mode is ON:

The characters entered using the USB keyboard appear in the character string buffer and encoding starts immediately.

When Quick Mode is OFF:

The characters entered using the USB keyboard appear in the character string buffer. To start encoding, press **[Enter]** on the USB keyboard or the **F4 [START]** key.
- Sending a character string using the USB keyboard while the update of TX/RX details display is paused cancels the paused state.
- The maximum number of characters that can be entered in the character string buffer is 4300 characters.
- To send a consecutive code (code abbreviation), input the characters after inputting "~" (tilde). The characters are encoded as a consecutive code until a space is inserted.
- For example, when "~ HH" and "~ OSO" are input, they become the code abbreviations for correction code and emergency communication respectively.
- To start encoding from a consecutive code while quick mode is ON, input the first character of the consecutive code within the time interval equivalent to 7 dots (space between words) after inputting "~" (tilde).

Encoding Character Strings Using the CW Message Memory

Fixed phrases can be registered in the CW message memory for use during transmission.
- Use the CW message memory when transmitting a fixed phrase. Otherwise, the USB keyboard can also be used to input the character string.

● **Press F2 [CH 1] to F5 [CH 4] or F2 [CH 5] to F5 [CH 8] in the CW communication screen.**
  - If **F2 [CH 1]** to **F5 [CH 4]** or **F2 [CH 5]** to **F5 [CH 8]** are not displayed in the key guide, press **F1 [MORE]** to toggle the key guide display.
  - Press **F7 [NEXT]** to switch between **F2 [CH 1]** to **F5 [CH 4]** and **F2 [CH 5]** to **F5 [CH 8]**.
  The phrase registered in the corresponding message channel is displayed in the character string buffer and encoding starts immediately.

- If a character string already exists in the character string buffer, encoding starts after the fixed phrase is added to the end of the character string.
- If encoding of a character string is already in progress, the fixed phrase is added to the end of the character string and encoding will continue.
- A space is inserted before the fixed phrase when it is added to the end of an existing character string.
- Message CH supports only messages registered via text input. (Even when "Paddle" is selected for registering messages in the menu, the message CH information registered via text input using the USB keyboard is displayed on the CW communication screen.)
- If the message displayed in the message list is too long to fit into the display range, this will be indicated by a "..." display to the right of the truncated message.

Encoding Operation of Message Channel with Repeat Function Enabled

- Upon pressing the key that corresponds to a message channel for which the repeat function is enabled, << 🔁 >> lights up.
- After encoding of the character strings in the character string buffer is complete, the transceiver switches to the "repeat wait" mode. After the specified time interval has elapsed, the same character strings of the channel for which the repeat function is enabled is encoded again, and this process goes on.
- << WAIT >> lights up while in the "repeat wait" mode.
- When the specified time interval after entering the "repeat wait" state has elapsed, << WAIT >> disappears and encode operation resumes.
- Pressing **F4 [STOP]** or **[ESC]** on the USB keyboard stops the encoding operation or "repeat wait" state and returns the transceiver to the decoding state.
- While << 🔁 >> is illuminated, character strings cannot be added using the USB keyboard or the **F2 [CH 1]** to **F5 [CH 4]** keys.
- While << 🔁 >> is illuminated, characters cannot be deleted using the backspace key of the USB keyboard or the **F2 [◀ X]** key.

Contest Number Behavior

- To use a contest number, "%N" needs to be embedded in the message of the message channel.
- The "%N" portion will be substituted with the current contest number during encoding.
- The contest number is counted up after all the contents in the character string buffer are encoded.

Paddle Operation on CW Communication Screen

Morse code that is input via paddle operation (straight key, bug key, etc.) can be converted into text and displayed on the screen. This function can also be used to practice the input of Morse code.

Paddle Operation when the Character String Buffer is Empty

- When break-in is ON, the Morse code input is transmitted and information that is keyed is displayed in the TX details display area character by character.
- When break-in is OFF, the Morse code input is not transmitted and information that is keyed is displayed in the character string buffer character by character.

📝
- Encoding does not start even when the quick mode is set to ON.
- Encoding does not start even when characters are added using the USB keyboard after the character strings that are added via paddle operation.
- To enable encoding of the character strings displayed in the character string buffer, press **F4 [START]** or **[Enter]** on the USB keyboard.

Paddle Operation during Encoding of Character Strings in the Character String Buffer

- When Interrupt Keying is ON, encoding of character strings is temporarily stopped and resumes only after keying is complete.
- When Interrupt Keying is OFF, encoding of character strings is stopped.
- If the signals input via paddle operation are codes that cannot be converted into text, the characters are not displayed.

Saving CW Communication Logs

The CW, RTTY and PSK communication screens can be saved using the communication log function. Please refer to "Communication Log" on page 5-27.

Electronic Keyer

This transceiver comes with a built-in electronic keyer that can be used simply by connecting a paddle to the PADDLE jack on the front panel. Depending on the settings, it can also be used as a bug key (semi-auto electronic keyer).
• A straight key can also be connected to the PADDLE jack.

Selecting the PADDLE Jack Behavior

Select the device to be connected to the PADDLE jack.

● **Configure the behavior in Menu [5-00] "Paddle Jack Configuration (Front)"**

Setting Value	Straight Key/ Paddle (default)/ Paddle (Bug Key Mode)

Selecting the KEY Jack Behavior

For operation in the CW mode without using the built-in electronic keyer, connect the plug of a straight key, bug key, external electronic keyer or PC keyer to the "KEY" jack. The built-in electronic keyer can also be used by connecting a paddle to the "KEY" jack.
Select the device to be connected to the "KEY" jack on the rear panel.

● **Configure in Menu [5-01] "Key Jack Configuration (Rear)"**

Setting Value	Straight Key (default)/ Paddle/ Paddle (Bug Key Mode)

🖉 • Connect a PC keyer or an external electronic keyer with a positive-polarity wire using a shield wire.
• Behavior when Paddle (Bug Key Mode) is selected
  • While dots are combined according to the usual keyer, dashes are keyed while the paddle is pressed.
  • The keying speed is variable, but the message memory function does not work.
• When both dot and dash are configured to ON at the same time, priority is given to dash.

Operation Mode of the Electronic Keyer

2 operation modes of the built-in electronic keyer are available for selection (A or B).

● **Configure in Menu [5-02] "Electronic Keyer Squeeze Mode"**

Setting Value	Mode A/ Mode B (default)

Mode A: When both paddles are open, code transmission ends after the code elements (dot or dash) are transmitted. Both dot and dash memory are not active.
Mode B: When both paddles are open, code transmission ends after a dash (or dot) is transmitted following the dot (or dash) that is currently being transmitted. Both dot and dash memory are active.

Reversing Dot and Dash

It is possible to reverse dot and dash of the paddle without having to rewire the electronic keyer. Reversing the position for operating the paddle according to the operator's preferences or dominant hand helps to ease keying.

● **Configure in Menu [5-03] "Dot and Dash Reversed Keying"**

Setting Value	Off (default)/ On

• Dot and dash is reversed when this function is set to "On".

🖉 • This setting applies to both the mic paddle mode and paddle that is connected to the PADDLE or KEY jack.

Mic Paddle Mode

The [UP] and [DOWN] keys of the microphone is used in place of the paddle for keying.

● **Configure in Menu [5-04] "Paddle (Microphone Up/ Down Keys)"**

Setting Value	Off (default)/ On

• When this is "On", keying can be performed using the [UP] and [DOWN] keys of the microphone.

🖉 • Response will be slower in the mic paddle mode compared to the normal paddle operation.
• In the default setting, the [DOWN] key is assigned with dot and the [UP] key with dash.

Adjusting the Keying Speed

The keying speed of the electronic keyer can be adjusted freely. To ensure that CW is transmitted precisely, it is necessary to adjust the keying speed according to the skill level of the user. Also, it is recommended that the keying speed be as closely aligned as possible with the CW speed of the target station.

● **Turn the [KEY] control to adjust the keying speed.**
The keying speed can be adjusted within the range of 4 to 60 [wpm] (20 to 300 characters/minute).
• Turning the **[KEY]** control to the right increases the keying speed, while turning the control to the left slows it down.
• The keying speed is displayed while the **[KEY]** control is being operated.
• After operating the **[KEY]** control, the TX output power display shows the keying speed for a duration of 2 seconds.

🖉 • Only dots are supported in the bug key mode.

Changing the Weighting

The electronic keyer allows the dot-dash weighting to be adjusted automatically. Weighting is the ratio of the dash length to the dot length.
- 2 weighting modes are available for selection: the "auto weighting" mode changes the ratio automatically in tandem with the keying speed, while the ratio is fixed in the "manual weighting" mode and not affected by the keying speed.
- When [2.5] (1:2.5) to [4.0] (1:4) is selected, the dot-dash weight ratio is fixed regardless of the keying speed.

● Configure in Menu [5-08] "CW Keying Weight Ratio"

Setting Value	Automatic (default)/ 2.5 to 4.0 (0.1 step)

- When this is configured to "Automatic", the keying speed and weight ratio settings are as follows.

Adjusting the Keying Speed	Weight
4 to 24	1:2.8
25 to 44	1:3.0
45 to 60	1:3.2

Weight Ratio Reverse

When the weighting mode is configured to "Automatic", increasing the keying speed increases the weight ratio. Configuring the menu below to ON decreases the weight ratio when the keying speed increases.

● Configure in Menu [5-09] "CW Keying Reversed Weight Ratio"

Setting Value	Off (default)/ On

- When weight reverse is enabled in the "Automatic" weighting mode, the keying speed and weight ratio settings are as follows.

Adjusting the Keying Speed	Weight
4 to 24	1:3.2
25 to 44	1:3.0
45 to 60	1:2.8

CW Message Memory

This transceiver comes with memory channels that can store up to 8 CW messages. In addition to paddle operation, a message can be registered by entering a text using the USB keyboard or via operating this transceiver.
- CW message memory channels come in handy for messages that are repeatedly transmitted as registering the messages in advance allows them to be used repeatedly such as during contest.

Switching the Method of Registering CW Messages

A method for registering messages can be selected from the options below.

● Configure in Menu [5-11] "CW Message Entry"

Setting Value	Text String/ Paddle (default)

Text String: Registers messages using text strings.
Paddle: Registers messages via paddle operation.

Registering CW Messages via Text Input

Check to ensure that the CW message registration method in Menu [5-11] is configured to "Text String", followed by performing the steps below to register a CW message. CW messages can be stored in any of the channels from 1 to 8.

1 Press F2 [KEYER] to display the CW Message screen (for text input).
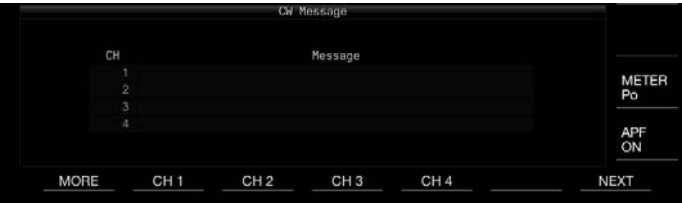
📝
- When this transceiver is in a mode other than CW, **F2 [KEYER]** is not displayed in the key guide. Press **[CW/CW-R]**.
- If the channel to register the CW message is not displayed in the key guide, press **F1 [MORE]**. Doing so switches the key guide.

2 Press and hold F2 [CH 1] to F5 [CH 4] or F2 [CH 5] to F5 [CH 8] to select the channel to register the CW message.
The CW message edit screen is displayed.
- Pressing **F7 [NEXT]** each time switches between **F2 [CH 1]** to **F5 [CH 4]** and **F2 [CH 5]** to **F5 [CH 8]**.

3 Use the function keys, [MULTI/CH] control or USB keyboard to enter a CW message.
- Enter a message that contains not more than 50 characters. The default setting is blank.

Key	Behavior
F1 [SPACE]	Inserts a space.
F2 [–]/ F3 [+]	Selects a character.
F4 [◀▮▮]/ F5 [▮▶]	Moves the cursor.
F [BACK SPACE]	Deletes the character to the left of the cursor.
F [DEL]	Deletes the character to the right of the cursor.
F [CHAR]	Switches the type of character to edit. Pressing the key each time switches the selection in the following sequence: ABC (upper case) → !"# (symbols) → ABC (upper case)

- Pressing **F7 [CANCEL]** returns the display to the CW message screen without registering the input message.
- When "%N" is saved as part of a CW message, this will be substituted with a contest number during transmission.
- A continuous text string that is input after "~" and up to that before an inserted space becomes a consecutive code such as AR or BT.
- Characters that can be input are as follows.

A	B	C	D	E	F	G	H	I	J	K	L	M
N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9			
/	?	.	,	'	(	)	:	=	+	-	_	"
@	~	%	<	>							Space	

4 Press F6 [SAVE] to save the CW message.

Registering CW Messages via Paddle Operation

Check to ensure that the CW message registration method in Menu [5-11] is configured to "Paddle", followed by performing the steps below to register a CW message. CW messages can be stored in any of the channels from 1 to 8.

1 Press F2 [KEYER] to display the CW Message screen.
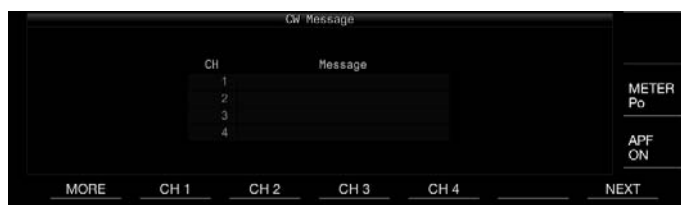
2 Press and hold F2 [CH 1] to F5 [CH 4] or F2 [CH 5] to F5 [CH 8] to select the channel to register the CW message.
A message prompting registration of a CW message is displayed.
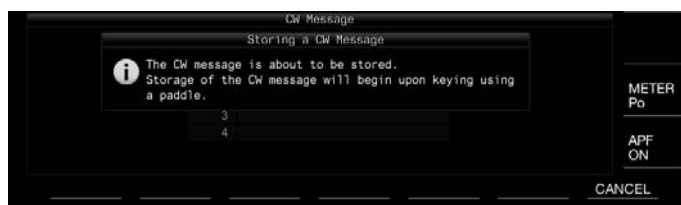
- While in the input standby mode, pressing **F7 [CANCEL]** returns the display to the CW message screen without registering the message.

3 Register a CW message via keying with a paddle.
When keying using a paddle starts, the display switches to a CW message (paddle) registration screen. Continuing keying in this state registers the CW message. During registration of a CW message, memory usage (%) is displayed on the screen.
- If paddle operation is not performed during the registration process, a space will be inserted at every interval equivalent to 7 dots.

4 Press F6 [STOP] to end registration of the CW message.
- The display returns to the CW Message screen.
- If the memory is used up (indicated as 100%), the CW message registration process ends automatically even when it is still in progress.
- Morse code that is input is converted into text strings and displayed in the channel list of the CW Message screen.

- For channels that do not contain any CW message, the corresponding channel numbers are displayed in gray.
- CW messages cannot be registered if the PADDLE or KEY jack is not configured to the PADDLE mode. Operate the paddle to register a CW message.
- The Morse code displayed in the channel list uses the same functions as "Decoding Morse code". For this reason, the spacing may be wider or different characters may be displayed depending on the habit and the speed of the operator performing the keying.
- The "*" symbol and code abbreviations are also displayed in the same way as "Decoding Morse code".
- Japanese texts can be registered but will not be displayed correctly.

Contest Number

Configuring the Starting Contest Number (Text Input Only)

The starting contest number can be configured when the contest numbers are 3-digit serial numbers that run from 001 (001 method).

● **Configure in Menu [5-12] "Contest Number"**

Setting Value	001 (default) to 9999 (1 step)

Selecting a Method for Sending out Contest Number (Text Input Only)

When a CW message that contains a "%N" input is transmitted, numeric values "1", "9" and "0" are converted into alphabets "A", "N" and "O" (or "T") respectively in the Morse code format and sent out as a contest number.

● **Configure in Menu [5-13] "Contest Number Format"**

Setting Value	Off (default)/ 190 to ANO/ 190 to ANT/ 90 to NO/ 90 to NT

Coding Example

Option	Text String Sent out as Contest Number	Output Code
190 to ANO	190	ANO (·− −· −−−)
190 to ANT		ANT (·− −· −)
90 to NO	90	NO (−· −−−)
90 to NT		NT (−· −)

Selecting a Channel for Counting up the Contest Numbers (Text Input Only)

The CW message channel for which contest numbers are counted up can be registered using this setting.

● **Configure in Menu [5-14] "Channel Number (Count-up Message)"**

Setting Value	Off (default)/ Channel 1 to Channel 8

Decrementing the Contest Number (Text Input Only)

If communication is not established after a contest number is sent to the receiving station, the contest number that is sent next will be decremented (reduced) by 1.

1 **Press F2 [KEYER] to display the CW Message screen.**

2 **Press F7 [NEXT] to select a channel group for which the contest numbers are to be displayed.**
   - << ⌖ >> is displayed beside the channel for counting up the contest number, and **F6 [-1]** is displayed in the key guide.
   - Pressing **F7 [NEXT]** each time switches between **F2 [CH 1]** to **F5 [CH 4]** and **F2 [CH 5]** to **F5 [CH 8]**.

3 **Press F6 [-1] to reduce the contest number by 1.**

📝 ● When the setting of the channel for counting up the contest number in Menu [5-14] is configured to "Off", << ⌖ >> is not displayed and **F6 [-1]** is also not shown in the key guide.

Playing/Transmitting CW Messages

This transceiver can be configured as follows to play back or transmit a registered CW message. The CW message screen and function key displays are different when Menu [5-11] "CW Message Entry" is configured to "Paddle" and when it is configured to "Text String". Descriptions in this manual are based on the "Paddle" setting, but the steps are the same when it is configured to "Text String". Also, a CW message needs to be registered in advance before it can be played back or transmitted.

1 **Press F2 [KEYER] to display the CW Message screen.**

2 **To play back a CW message, press [VOX] to set break-in to OFF.**
   - When break-in is set to OFF, the [VOX] LED light goes off.
   - To transmit a CW message, set break-in to ON. When break-in is set to ON, the [VOX] LED lights up.

3 **Press F2 [CH 1] to F5 [CH 4] or F2 [CH 5] to F5 [CH 8] to select a CW message.**
   - Playback or transmission starts. To cancel the operation, press **F5 [STOP]**.
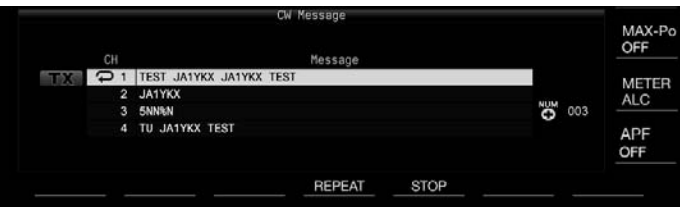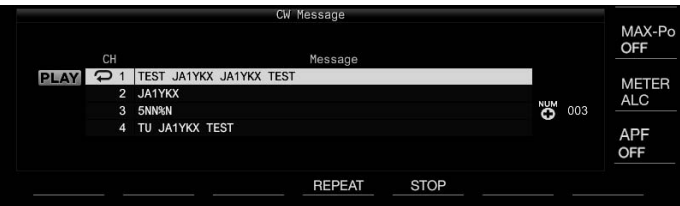
📝 ● When Menu [5-14] "Channel Number (Count-up Message)" is configured to a setting other than "Off", the contest number is added immediately after playback or transmission of the CW message for the selected channel has ended.
   ● Operating the paddle while Menu [5-10] "Interrupt Keying" is "On" pauses playback or transmission of the message memory. After paddle operation has ended, playback or transmission resumes from the paused state. Operating the paddle while "Off" is configured stops playback or transmission of the message memory.
   ● To transmit a CW message without using break-in, press **[SEND]** instead of performing step 2.

Repeat Playback of CW Messages

● **Press F4 [REPEAT].**
Pressing **F4 [REPEAT]** each time toggles the repeat function between ON and OFF.
   - When the repeat mode is ON, << ⌒ >> lights up for the selected CW message memory.

Configuring the Repeat Playback Interval

The time interval for repeating playback of a CW message can be configured.

● **Configure in Menu [5-16] "CW/Voice Message Retransmit Interval Time"**

Setting Value	0 to 10 (default) to 60 [s] (1 step)

Configuring to a larger value lengthens the playback interval.

Interrupt Keying

Operating the paddle while playback or transmission of a CW message is in progress allows the CW message playback or transmission process to be interrupted for the Morse code input using the paddle to be inserted.

● **Configure in Menu [5-10] "Interrupt Keying"**

Setting Value	Off (default)/ On

Deleting a CW Message

The steps to delete a CW message that is registered in Channel 1 to Channel 8 are as follows.

1 **Press F2 [KEYER] to display the CW Message screen.**

2 **Select a channel number that contains the CW message to delete.**

3 **Press and hold F5 [(DELETE)] to delete the CW message.**

RTTY Operation

This transceiver comes with a built-in demodulator for RTTY operation, a RX decoder and a TX encoder. It is possible to operate in RTTY (FSK) independently by combining the use of a commercially available USB keyboard. Also, it is possible to operate in the RTTY mode by connecting an external device.

> ● Before operating in the RTTY mode, adjust the carrier level while checking the ALC meter.

Displaying the RTTY Communication Screen

1 **Press [FSK/PSK] to select RTTY (FSK) mode.**

2 **Press F3 [DECODE].**
The RTTY communication screen appears.

Text Display Area + FFT Scope

**Text Display Area + X-Y Scope**

Switching between the FFT Scope and X-Y Scope Display

The display toggles between the FFT scope and X-Y scope each time the scope display is touched.

> ● The RTTY communication screen will not be displayed if Menu [2-06] "FSK Spacing" is not configured to "170 [Hz]".
> ● Noise Reduction 1, Noise Reduction 2, Beat Canceler 1, Beat Canceler 2, audio peak filter and RX DSP equalizer do not function during decoding of RTTY messages.

The layout of the RTTY communication screen is as follows.
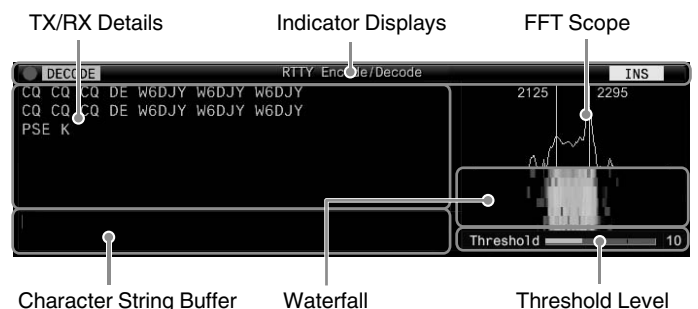
TX/RX Details   Indicator Displays   FFT Scope

Character String Buffer   Waterfall   Threshold Level

Indicator Displays

Indicates the status of the function.

TX/RX Details

Displays the character strings that are transmitted or received.

Character String Buffer

Character strings to be transmitted.

FFT Scope

The audio FFT scope is used for viewing the tuning status.
The two vertical lines on the left and right represent the mark and space frequencies respectively. Adjust the tuning frequency while receiving a signal such that the two peaks overlap evenly with the two lines.

Waterfall

The waterfall is a time-series display of the RX signal spectrum which functions in tandem with the FFT scope. The entire waterfall display can also be shifted in tandem with changes in the RX frequency.

X-Y Scope

The X-Y scope displays the tuning status in the RTTY (FSK) mode as a cross pattern. The cross patterns bisect at right angles (90 degrees) when this transceiver is correctly tuned to the signal.

Threshold Level

Displays the threshold value of the RX signal level for decoding.

Operating the RTTY Encode/Decode Screen

The following operations are enabled when the RTTY communication screen opens.
- Pressing the **[Page Up]** or **[Page Down]** key scrolls the display of the TX or RX details.

Key	Behavior
F1 [MORE]	Switches the key guide.
F3 [PAUSE]	Pauses update (drawing) of the TX/RX details display area. Pressing the key again resumes the update (drawing).
F4 [LOG]	Turns ON/OFF the communication log function. Pressing and holding this key displays the screen for selecting a log file that is saved.
F4 [(CLEAR)]	Pressing and holding the key clears the text displayed on the TX/RX details screen.
F5 [THLD]	Switches to the threshold level configuration mode.
F5 [MEMORY]	Switches to the RTTY Message screen.
F6 [X-Y LEV]	Switches between the speed and density of the X-Y scope.
F7 [EXTEND]	Enlarges the size of the RTTY communication screen. Pressing it again restores the screen to the standard size.

Indicator Displays

Display	Behavior
●	Appears when the communication log function is ON.
○	Appears when the communication log function is ON and in the standby mode.
DECODE	Appears when signal decoding is in progress.
ENCODE	Appears when encoding the characters in the TX buffer.
DECODE	Appears when the decode function is stopped or disabled.
WAIT	Appears when transmitting the message memory.
INS	Appears when in the insert mode.
OVRWR.	Appears when in the overwrite mode.

Saving RTTY Communication Logs

The CW, RTTY and PSK communication screens can be saved using the communication log function. Please refer to "Communication Log" on page 5-27.

Adjusting the RTTY Decode Threshold Level

Noise that occurs when there is no signal may sometimes be erroneously detected as text, which results in the display of unwanted text. To reduce the occurrence of such issues, adjust the threshold level.
- Raise the threshold level when there is frequent erroneous detection due to noise.

1 **Press F5 [THLD].**
The threshold level setting can now be adjusted.

2 **Press F4 [–]/ F5 [+] or turn the [MULTI/CH] control to adjust the level.**

Setting Value	1 to 10 (default) to 30 (1 step)

- Adjust the threshold value in the ascending order according to the receiving status of noise, for example. Start from a small value between the range of 1 to 30 and configure the threshold value to a point where reception is good.
- To restore the default setting, press and hold **F2 [(RESET)]**.

3 **Press F1 [⬆] to end the process.**

FFT Scope/X-Y Scope Display Setting

The tuning scope displayed on the RTTY communication screen can be switched to an "FFT scope" or "X-Y scope" display.
● **Configure in Menu [2-09] "RTTY Tuning Scope"**

Setting Value	FFT Scope (default)/ X-Y Scope

- The display toggles between the "FFT Scope" and "X-Y Scope" each time the scope display on the screen is touched.

FFT Scope Waveform Averaging

The waveform displayed on the FFT scope can be averaged. Averaging of the waveform reduces random noise and makes observation of the target signal easier.
● **Configure in Menu [2-00] "FFT Scope Averaging (RTTY Decode)"**

Setting Value	0 (default) to 9 (1 step) (minimum to maximum averaging)

Selecting a Waterfall Display Type

● Configure in Menu [2-17] "Waterfall when Tuning (RTTY/PSK Audio Scope)"

Setting Value	Straight (default)/ Follow

Straight: Uses a straight line to show transition in the level of the target signal displayed on the waterfall when the RX frequency is altered.
Follow: Tracks and displays the latest FFT scope level at the portion where the waterfall starts flowing when the RX frequency is altered.

Tracking Speed/Density Level of X-Y Scope

Switch between the speed and density of the X-Y scope.

● Press F6 [XY LEV.].
Pressing **F6 [XY LEV.]** each time switches the level. The tracking speed is displayed on the X-Y scope display.

Setting Value	Lv1/ Lv2 (default)/ Lv3

Transmitting Character Strings Using USB Keyboard

A commercially available USB keyboard can be used to input and transmit character strings.

Transmitting the Input Character String Immediately

1 **Connect the USB keyboard to ●⟵⟶ (USB-A).**

2 **Press F3 [DECODE] to display the RTTY communication screen.**

3 **Press [F12] on the USB keyboard to enter the TX mode.**
The [BUSY/TX] LED lights up in red, and << ENCODE >> is displayed in the status bar.

4 **Enter a character string using the USB keyboard.**
   • The input character string is displayed in the character string buffer and transmitted immediately.
   • In the character string buffer, the color of the individual characters change successively once they are transmitted.
   • Characters that have been transmitted appear successively in the TX/RX details display area.

5 **Press [F12] on the USB keyboard to end transmission.**

> 📝 • If there remain characters in the character string buffer that are not transmitted when **[F12]** is pressed in step 5, << WAIT >> is displayed in the status bar. After transmission of all the character strings is complete, the transceiver switches to the RX mode and the light of the [BUSY/TX] LED and << WAIT >> display go off.

Temporarily Placing Character Strings in the Character String Buffer before Transmission

1 **Connect the USB keyboard to ●⟵⟶ (USB-A).**

2 **Press F3 [DECODE] to display the RTTY communication screen.**

3 **Enter a character string using the USB keyboard.**
The input character string is displayed and temporarily placed in the character string buffer.

4 **Press [F12] on the USB keyboard to send out the character string.**
   • Character strings that are stored in the character string buffer are sent out by this transceiver.
   • Upon entering the TX mode, the [BUSY/TX] LED lights up in red, and << ENCODE >> is displayed in the status bar.
   • In the character string buffer, the color of the individual characters change successively once they are transmitted. Character strings that have been transmitted appear successively in the TX/RX details display area.

5 **Press [F12] on the USB keyboard to end transmission.**

> 📝 • If there remain characters in the character string buffer that are not transmitted when **[F12]** is pressed in step 5, << WAIT >> is displayed in the status bar. After transmission of all the character strings is complete, the transceiver switches to the RX mode and the light of the [BUSY/TX] LED and << WAIT >> display go off.
> • Pressing **[ESC]** while transmission of the character strings is in progress switches this transceiver to the RX mode. Transmission of the character strings stops, and character strings in the character string buffer that are not yet transmitted are cleared.
> • Time stamp and frequency information can be added to the TX or RX data that is displayed in the TX details display area. Refer to "Displaying a Time Stamp" (5-28).
> • Sending a character string using the USB keyboard while the TX/RX display is paused by pressing **F3 [PAUSE]** cancels the paused state.
> • The character strings that can be placed temporarily in the character string buffer can contain a maximum of 4300 characters.
> • Alphanumeric characters and symbols that can be input using a USB keyboard are as follows.

A	B	C	D	E	F	G	H	I	J	K	L	M	N
O	P	Q	R	S	T	U	V	W	X	Y	Z	0	1
2	3	4	5	6	7	8	9	!	"	#	$	&	'
(	)	.	,	-	?	:	;	/	Space		Line Break		

RTTY Message Memory

Fixed phrases that are often used in the RTTY mode can be registered in advance as an RTTY message in the RTTY message memory. Configuring a message to be saved to auto transmission (Auto TX) or auto reception (Auto RX) enables the RTTY message to be transmitted via simple operation. Up to 8 types of RTTY messages can be registered to Channels 1 to 8 in the memory.

Registering RTTY Messages

1 **Press F5 [MEMORY] on the RTTY communication screen to display the RTTY Message screen.**

2 **Press F3[▲] / F4[▼] or turn the [MULTI/CH] control to select the channel for saving the RTTY message.**

3 **Press F5 [MSG] to enter the RTTY message memory edit mode.**

4 **Use the function keys, [MULTI/CH] control or USB keyboard to enter a character string.**

Key	Behavior
F1 [SPACE]	Inserts a space.
F2 [–]/ F3 [+]	Selects a character.
F4 [◀‖]/ F5 [‖▶]	Moves the cursor.
F [BACK SPACE]	Deletes the character to the left of the cursor.
F [DEL]	Deletes the character to the right of the cursor.
F [CHAR]	Switches the type of character to edit. Pressing the key each time switches the selection in the following sequence: ABC (upper case) → !"# (symbols) → ABC (upper case)

5 **Press F6 [SAVE] to save the RTTY message.**
- Pressing **F7 [CANCEL]** discards the content that is currently being edited and exits the character string input mode.
- Alphanumeric characters and symbols that can be input (up to 70 characters)

A	B	C	D	E	F	G	H	I	J	K	L	M	N
O	P	Q	R	S	T	U	V	W	X	Y	Z	0	1
2	3	4	5	6	7	8	9	!	"	#	$	&	'
(	)	.	,	-	?	:	;	/	Space		Line Break		

Configuring Auto TX/RX for the RTTY Message Memory

The transmission and reception behavior can be configured when an RTTY message memory channel is selected.
- Auto TX places this transceiver in the TX mode before transmitting a message when a message memory channel is selected, and maintain the TX mode after all messages have been sent out.
- For auto RX, pressing **[F12]** after selecting a message memory channel for transmission places this transceiver in the TX mode. When the message is sent out, this transceiver is automatically restored to the RX mode.
- Combining auto TX and auto RX enables both transmission and reception to be performed automatically.

1 **Press F3[▲] / F4[▼] or turn the [MULTI/CH] control to select the message for auto TX/RX.**

2 **Press F6 [AUTO.TX] to set auto TX to ON.**
<< **AUTO TX** >> is displayed to the right of the RTTY message.

- When auto TX is set to OFF, the << **AUTO TX** >> display goes off, and the RTTY message of the channel is temporarily placed in the character string buffer but not transmitted automatically.

3 **Press F7 [AUTO.RX] to set auto RX to ON.**
<< **AUTO RX** >> is displayed to the right of the RTTY message.
- When auto RX is set to OFF, the << **AUTO RX** >> display goes off, and this transceiver is not restored to the RX mode after the RTTY message for the channel has been sent out.

✎ ● To sent an RTTY message for which "AUTO TX" is configured to "OFF", select the channel in which the RTTY message is stored. Check to ensure that the character string (RTTY message) is forwarded to the character string buffer, followed by pressing **[F12]** on the USB keyboard.
● To switch this transceiver to the RX mode after transmitting an RTTY message for which "AUTO RX" is set to OFF, press **[F12]** on the USB keyboard after the RTTY message has been sent out.

Transmitting Character Strings from the RTTY Message Memory

A message that is registered in the RTTY message memory can be transmitted as follows.

1 **Press F5 [MEMORY] to display the RTTY Message screen.**
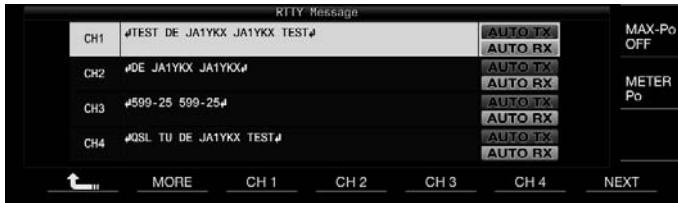
2 **Press F3 [CH 1] to F6 [CH 4] or F3 [CH 5] to F6 [CH 8] to select the channel that contains the message to be transmitted.**
The RTTY message of the channel corresponding to the function key is being transmitted automatically.
- If the channel guide is not displayed, press **F2 [MORE]**.
- Pressing **F7 [NEXT]** each time switches between **F3 [CH 1]** to **F6 [CH 4]** and **F3 [CH 5]** to **F6 [CH 8]**.
- After transmitting the RTTY message that is indicated by an << **AUTO RX** >> display beside it, this transceiver returns to the RX mode.

Settings Related to RTTY Encode/Decode

Enabling Decode UOS (Unshift on Space)

If a space character is included in the RTTY signal that is received, the character following the space can be forcibly interpreted as a character code (alphabet).
In RTTY, garbled characters may appear due to the signal strength or noise. To avoid this from happening as much as possible, the character after a space character is interpreted as a more frequently used character code (alphabet).

● **Configure in Menu [2-01] "RX UOS"**

Setting Value	Off/ On (default)

On: Encodes space characters.
Off: Does not encode space characters.
- To receive a numeric value or symbol that immediately follows a space character, turn off the UOS function.

Newline Code Setting

Configure the newline code when receiving an RTTY signal.

● **Configure in Menu [2-02] "Newline Code"**

Setting Value	CR+LF/ All (default)

All: Inserts a line break for every newline code.
CR+LF: Inserts a line break only when a CR+LF code is received.

Diddle Operation

Diddle allows the user to select the type of code to transmit when the characters to be sent run out during transmission in the RTTY (FSK) mode.

● **Configure in Menu [2-03] "Diddle"**

Setting Value	Off/ Blank Code (default)/ Letters Code

Off: Does not send out a character code.
Blank Code: Sends out a space character.
Letters Code: Sends out a character code.

Encode UOS

This is used for sending out a numeric value or symbol that immediately follows a space during transmission in the RTTY (FSK) mode. Enabling this function allows the receiving station to recognize the code that comes after a space as a numeric value or symbol, thus reducing the occurrence of garbled characters.

● **Configure in Menu [2-04] "TX UOS"**

Setting Value	Off/ On (default)

On: Uses encode UOS.
Off: Does not use encode UOS.

Sending a Newline Code at the Start or End of a Transmission

A newline code (CR+LF) can be sent out when RTTY encode/decode starts or ends. A line break is inserted before and after the RTTY message on the decode screen of the receiving station, which makes it easier to identify the transmitted RTTY message.

● **Configure in Menu [2-05] "Automatic Newline Insertion"**

Setting Value	Off/ On (default)

On: Sends out a newline code.
Off: Does not send out a newline code.

RTTY Parameters

Configuring the Mark Frequency

Configure the frequency of the mark signal that is used for communication in the RTTY (FSK) mode. The 1275 Hz frequency is referred to as a low tone, and the 2125 Hz frequency as a high tone. The high tone is used under normal circumstances.

● **Configure in Menu [2-08] "FSK Tone Frequency"**

Setting Value	1275/ 2125 (default) [Hz]

Configuring the RTTY Shift Width

The difference between the mark signal frequency and space signal frequency is called shift width. Configure the shift width during communication in the RTTY mode.

● **Configure in Menu [2-06] "FSK Spacing"**

Setting Value	170 (default)/ 200/ 425/ 850 [Hz]

- RTTY shift width cannot be altered when the RTTY communication screen is open.
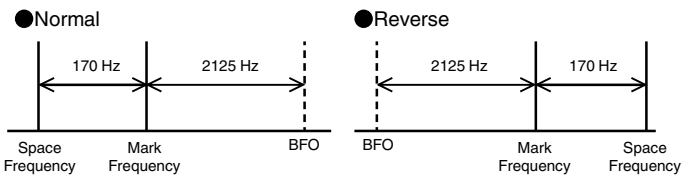- When the shift width in RTTY exceeds 170 Hz, the audio peak filter for the selected band cannot be set to ON.

📝 ● To operate in the RTTY mode using the built-in demodulator, encoder and decoder of this transceiver, configure the setting to "170 [Hz]".

Frequency Reverse in RTTY Mode

Decoding cannot be performed correctly when the RTTY signal received is in the reverse state (frequencies of the mark signal and space signal are reversed). When this occurs, press and hold **[FSK/ PSK]** to reverse the RTTY signal received so that the reverse signal can be decoded.

● Normal

170 Hz 2125 Hz

Space Frequency   Mark Frequency   BFO

● Reverse

2125 Hz 170 Hz

BFO   Mark Frequency   Space Frequency

Operating RTTY (FSK) Using an External Device

To operate in the RTTY mode using a PC or other external devices (such as RTTY device or PC connection interface) instead of the built-in encoder and decoder functions of this transceiver while this transceiver is configured to the RTTY (FSK) mode, connect using the USB port or ACC 2 connector on the rear panel of this transceiver.

When connecting to a PC (using the USB port)

- RTTY keying: Configure the USB keying function to "RTTY Keying".
- TX control: Use PC commands ("TX;" to start transmission and "RX;" to end transmission). Or configure the USB keying function to "PTT".
- Audio output: Select "USB AUDIO CODEC" for the recording device using the sound setting on the PC.
  For more details on the USB keying function, please refer to "USB Keying" (16-12).

When connecting to other external devices (using the ACC 2 connector)

- RTTY keying: Connect pin 2 (RTTY) of the ACC 2 connector to the keying output line of the external device.
- TX control: Connect pin 13 (SS) of the ACC 2 connector to the TX control (PTT) line of the external device.
- Audio output: Connect pin 3 (ANO) of the ACC 2 connector to the demodulation input line of the external device.
  * For more details on the ACC 2 connector, please refer to "ACC 2 Connector" (1-7).

For more details on other connections and settings, please refer to "PC Connection for Data Communication" (1-4).

RTTY (FSK) Keying Polarity Setting

● Configure in Menu [2-07] "FSK Keying Polarity"

Setting Value	Off (default)/ On

- Configure the RTTY keying polarity according to the specifications of the external device. When Menu [2-07] "FSK Keying Polarity" is configured to "Off" and pin 2 (RTTY) is short-circuited to GND, signals are transmitted at the mark frequency configured in Menu [2-08] "FSK Tone Frequency".
- When Menu [2-07] "FSK Keying Polarity" is configured to "On", signals are transmitted as space signals with the mark frequency shifted by the amount configured in Menu [2-06] "FSK Spacing".

Audio Peak Filter

Using the audio peak filter may help to improve the decodability of RTTY messages when operating in the RTTY (FSK) mode with this transceiver connected to an external device.

● Press F [APF] to set the audio peak filter to ON.
- When audio peak filter is turned on, "ON" is displayed in the lower row of **F [APF]**.
- When audio peak filter is turned off, "OFF" is displayed in the lower row of **F [APF]**.

PSK Operation

This transceiver is equipped with a built-in demodulator, encoder and decoder for operating in the PSK31 and PSK63 modes. Operation in the PSK31 or PSK63 mode can be performed easily by connecting a commercially available USB keyboard. PSK can also be operated using a data communication software program that makes use of the sound function of a PC.

📝 ● When transmitting in the PSK mode, adjust the carrier until the ALC meter starts to deflect.
   ● When an external device is used, adjust the audio signal level from the external device, followed by adjusting the ALC meter until it starts to deflect.
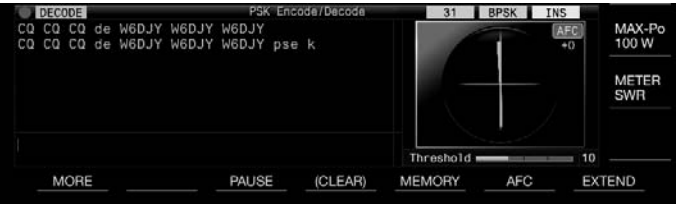
Displaying the PSK Communication Screen

1 **Press [FSK/PSK] to select PSK mode.**
2 **Press F3 [DECODE].**
   The PSK communication screen appears.

Text Display Area + FFT Scope


Text Display Area + Vectorscope

Switching between the FFT Scope and Vectorscope Display

The display toggles between the "FFT scope" and "Vector Scope" each time the scope display on the screen is touched.

📝 ● Noise Reduction 1, Noise Reduction 2, Beat Canceler 1, Beat Canceler 2 and RX DSP equalizer do not function during decoding of PSK messages.

The layout of the PSK communication screen is as follows.

Indicator   TX/RX Details   FFT Scope

Character String Buffer   Waterfall   Threshold Level
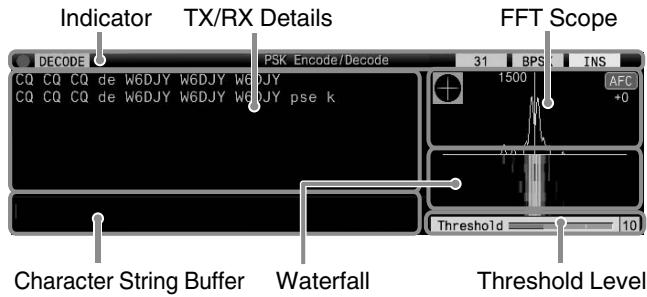
Indicator

Indicates the status of the function.

TX/RX Details

Displays the character strings that are transmitted or received.

Character String Buffer

Character strings to be transmitted.

FFT Scope

The audio FFT scope is used for viewing the tuning status.
If there are multiple signals in the band, the target signal is tuned such that it becomes a 1500 Hz tone.
Zero-in needs to be performed accurately in the PSK mode. Zero-in the target signal while monitoring the FFT scope and vectorscope.

Waterfall

Displays the transition in the spectrum of the TX audio signal in tandem with the FFT scope.

Vectorscope

The vectorscope indicates the way in which the PSK signals received are tuned. It comes in handy when tuning to the signal of the target station while monitoring the waveform on the vectorscope.

Threshold Level

Displays the threshold value of the RX signal input level for decoding.

Operating the PSK Communication Screen

The following operations are enabled when the PSK communication screen opens.
• Pressing the **[Page Up]** or **[Page Down]** key scrolls the display of the TX or RX details.

Key	Behavior
F1 [MORE]	Switches the key guide.
F2 [B/QPSK]	Switches between the BPSK and QPSK modes.
F3 [31/63]	Switches between the PSK31 and PSK63 modes.
F3 [PAUSE]	Pauses update (drawing) of the TX/RX details display area. Pressing the key again resumes the update (drawing).
F4 [LOG]	Turns ON/OFF the communication log function. Pressing and holding this key displays the screen for selecting a log file that is saved.
F4 [(CLEAR)]	Pressing and holding the key clears the text displayed on the TX/RX details screen.
F5 [THLD]	Switches to the threshold level configuration mode.
F5 [MEMORY]	Switches to the PSK Message screen.
F6 [AFC]	Switches the AFC function.
F7 [EXTEND]	Enlarges the size of the PSK communication screen. Pressing it again restores the screen to the standard size.

Indicator Displays

Display	Behavior
●	Appears when the communication log function is ON.
○	Appears when the communication log function is ON and in the standby mode.
DECODE	Appears when signal decoding is in progress.
ENCODE	Appears when encoding the character strings in the TX character string buffer.
DECODE	Appears when the decode function is stopped or disabled.
WAIT	Appears when transmitting the auto standby channel during transmission of the message memory.
31 / 63	Displays the baud rate.
BPSK / QPSK	Displays the communication mode.
INS	Appears when in the insert mode.
OVRWR.	Appears when in the overwrite mode.
AFC	Appears when AFC is ON. Displays the difference in frequency at the bottom.
NET	Appears when NET is ON.

Saving PSK Communication Logs

The CW, RTTY and PSK communication screens can be saved using the communication log function. Please refer to "Communication Log" on page 5-27.

Adjusting the PSK Decode Threshold Level

Noise that occurs when there is no signal may sometimes be erroneously detected as text, which results in the display of unwanted text. To reduce the occurrence of such issues, adjust the threshold level. Raise the threshold level when there is frequent erroneous detection due to noise.

1 Press F5 [THLD].
The threshold level setting can now be adjusted.

2 Press F4 [–]/ F5 [+] or turn the [MULTI/CH] control to adjust the level.

Setting Value	1 to 10 (default) to 30 (1 step)

• Adjust the threshold value in the ascending order according to the receiving status of noise, for example. Start from a small value between the range of 1 to 30 and configure the threshold value to a point where reception is good.

3 Press F1 [⬆] to end the process.

5 COMMUNICATING AIDS

FFT Scope/Vectorscope Display Setting

The tuning scope displayed on the PSK communication screen can be switched to an "FFT scope" or "vectorscope" display.

● Configure in Menu [2-13] "PSK Tuning Scope"

Setting Value	FFT Scope (default)/ Vector Scope

• The display toggles between the "FFT scope" and "Vector Scope" each time the scope display on the screen is touched.

FFT Scope Waveform Averaging

The waveform displayed on the FFT scope can be averaged. Averaging of the waveform reduces random noise and makes observation of the target signal easier.

● Configure in Menu [2-10] "FFT Scope Averaging (PSK Decode)"

Setting Value	0 (default) to 9 (1 step) (minimum to maximum averaging)

Selecting a Waterfall Display Type

● Configure in Menu [2-17] "Waterfall when Tuning (RTTY/PSK Audio Scope)"

Setting Value	Straight (default)/ Follow

Straight: Uses a straight line to show transition in the level of the target signal displayed on the waterfall when the RX frequency is altered.
Follow: Tracks and displays the latest FFT scope level at the portion where the waterfall starts flowing when the RX frequency is altered.

Vectorscope

Turn the **Tuning** control to perform tuning such that the emission lines displayed on the vectorscope radiate from the center into the same direction.

In Tune (BPSK)

In Tune (QPSK)

Idle Signal of BPSK or QPSK

Unmodulated Carrier Signal

✎ ● Make use of the fine-tuning function if there is difficulty in performing tuning.
● While transmission is in progress, the vectorscope does not function and points to the 12 o'clock direction.

AFC (Automatic Frequency Control)

The AFC (Automatic Frequency Control) function can be used to tune the PSK signal that is being received.

● Press F6 [AFC] to set the AFC function to "On".

• Pressing **F6 [AFC]** each time toggles the option in the following sequence: "OFF" → "AFC ON" → " AFC&NET ON" → "OFF".
• When the AFC function is ON, the << AFC >> display lights up. The amount of frequency correction made by the AFC function is displayed below "AFC".
• Pressing and holding **F6[AFC]** while the AFC function is ON increases or decreases the displayed frequency which indicates the amount of correction made by the AFC function.

Configuring the AFC Tuning Range

Configure the frequency range for tuning the PSK signals that are received using the AFC function.
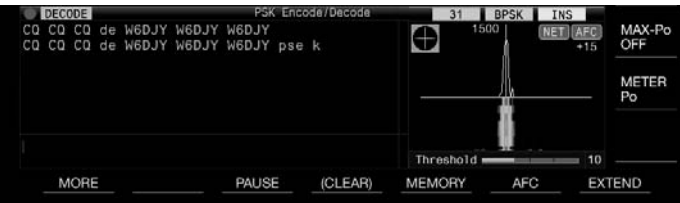
● Configure in Menu [2-11] "PSK AFC Tuning Range"

Setting Value	±8/ ±15 (default) [Hz]

NET

The NET function transmits signals by applying the frequency that is automatically tuned by AFC.

● Press F6 [AFC] to select "AFC & NET".

• Pressing **F6 [AFC]** each time toggles the option in the following sequence: "OFF" → "AFC function ON" → " AFC function & NET function ON" → "OFF".
• << AFC >> and << NET >> light up.

Switching between BPSK and QPSK

The PSK mode is further divided into 2 sub-modes, namely BPSK and QPSK. BPSK is the more commonly used mode. QPSK excels at correcting errors and boasts a higher decoding rate than BPSK.

● Press F2 [B/QPSK].

Pressing the key each time toggles the mode between BPSK and QPSK. The display to the right of the status bar toggles between << BPSK >> and << QPSK >> when the mode is switched.

✎ ● This is fixed at BPSK when the PSK63 mode is selected.

Switching between PSK31 and PSK63

This transceiver supports PSK31 as well as PSK63. The latter has a transfer rate that is twice that of the BPSK mode. Perform the following step to toggle between PSK31 and PSK63.

● **Press F3 [31/63].**
It is possible to toggle between BPSK31 and BPSK63 or between QPSK31 and QPSK63. The display to the right of the status bar toggles between << 31 >> and << 63 >> when the mode is switched.

📝 ● This is fixed at BPSK when the PSK63 mode is selected.

Transmitting Character Strings from USB Keyboard

A commercially available USB keyboard can be used to input and transmit character strings.

Transmitting the Input Character String Immediately

1 **Connect the USB keyboard to •⟵⟶ (USB-A).**

2 **Press F3 [DECODE] to display the PSK communication screen.**

3 **Press [F12] on the USB keyboard to switch this transceiver to the TX mode.**
The [BUSY/TX] LED lights up in red, and << ENCODE >> is displayed in the status bar.

4 **Enter a character string using the USB keyboard.**
   • The input character string is displayed in the character string buffer and transmitted immediately.
   • In the character string buffer, the color of the individual characters change successively once they are transmitted.
   • Characters that have been transmitted appear successively in the TX/RX details display area.

5 **Press [F12] on the USB keyboard to switch this transceiver to the RX mode.**

📝 ● If there remain characters in the character string buffer that are not transmitted when **[F12]** is pressed in step 5, << WAIT >> is displayed in the status bar. After transmission of all the character strings is complete, the transceiver switches to the RX mode and the light of the [BUSY/TX] LED and << WAIT >> display go off.

Temporarily Placing Character Strings in the Character String Buffer before Transmission

1 **Connect the USB keyboard to •⟵⟶ (USB-A).**

2 **Press F3 [DECODE] to display the PSK communication screen.**

3 **Enter a character string using the USB keyboard.**
The input character string is stored temporarily in the character string buffer.

4 **Press [F12] on the USB keyboard to send out the character string that is stored in the character string buffer.**
   • Upon entering the TX mode, the [BUSY/TX] LED lights up in red, and << ENCODE >> is displayed in the status bar.
   • In the character string buffer, the color of the individual characters change successively once they are transmitted.

5 **Press [F12] on the USB keyboard to switch this transceiver to the RX mode.**

📝 ● If there remain characters in the character string buffer that are not transmitted when **[F12]** is pressed in step 5, << WAIT >> is displayed in the status bar. After transmission of all the character strings is complete, the transceiver switches to the RX mode and the light of the [BUSY/TX] LED and << WAIT >> display go off.
● Pressing **[ESC]** while transmission of the character strings is in progress switches this transceiver to the RX mode. Transmission of the character strings stops, and character strings in the character string buffer that are not yet transmitted are cleared.
● Time stamp and frequency information can be added to the TX or RX data that is displayed in the TX/RX details display area.
● Sending a character string using the USB keyboard while the TX/RX display is paused by pressing **F3 [PAUSE]** cancels the paused state.
● The character strings that can be placed temporarily in the character string buffer can contain a maximum of 4300 characters.
● Characters and symbols that can be input using a USB keyboard are as follows.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
P	Q	R	S	T	U	V	W	E	X	Y	Z			
0	1	2	3	4	5	6	7	8	9					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
p	q	r	s	t	u	v	w	x	y	z				
À	Á	Â	Ã	Ä	Å	Æ	Ç	È	É	Ê	Ë	Ì	Í	Î
Ï	Ð	Ñ	Ò	Ó	Ô	Õ	Ö	Ø	Ù	Ú	Û	Ü	Ý	Þ
à	á	â	ã	ä	å	æ	ç	è	é	ê	ë	ì	í	î
ï	ð	ñ	ò	ó	ô	õ	ö	ø	ù	ú	û	ü	ý	þ
ÿ	ß													
!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
:	;	<	=	>	?	@	[	\	]	^	_	`	{	|
}	~	¡	¢	£	¤	¥	¦	§	¨	©	ª	«	¬	®
¯	°	±	²	³	´	µ	¶	•	¸	¹	º	»	¼	½
¾	¿	No	÷							Space		Line Break		

   • The chart above shows the characters and symbols that can be input when "English" is selected in Menu [9-01]. To input Japanese characters, please download and refer to the Japanese instruction manual from our website.

PSK Message Memory

Fixed phrases that are often used in the PSK mode can be registered in advance as a message in the message memory. Adding the auto TX and auto RX functions to the fixed phrases enables messages to be sent out via simple operation.
• Up to 8 types of messages can be registered.

Registering Messages

1 **Press F3 [DECODE] to display the PSK communication screen.**

2 **Press F5 [MEMORY] to display the PSK Message screen.**

3 **Press F3 [▲]/ F4 [▼] or turn the [MULTI/CH] control to select the channel for registering the message.**
• If **F3 [▲]** and **F4 [▼]** are not displayed in the key guide, press **F2 [MORE]** to toggle the key guide display.

4 **Press F5 [MSG].**

5 **Use the function keys, [MULTI/CH] control or USB keyboard to enter a character string.**

Key	Behavior
F1 [SPACE]	Inserts a space.
F2 [–]/ F3 [+]	Selects a character.
F4 [◀▌]/ F5 [▌▶]	Moves the cursor.
F [BACK SPACE]	Deletes the character to the left of the cursor.
F [DEL]	Deletes the character to the right of the cursor.
F [CHAR]	Switches the type of character to edit. Pressing the key each time switches the selection in the following sequence: ABC (upper case) → abc (lower case) → !"# (symbols) → ABC (upper case)

• Pressing **F7 [CANCEL]** discards the content that is currently being edited and exits the character string input mode.

6 **Press F6 [SAVE] to save the edited message.**

Configuring Auto TX/RX for the PSK Message Memory

The transmission and reception behavior can be configured when a PSK message memory channel is selected.
• Auto TX places this transceiver in the TX mode before transmitting a message when a message memory channel is selected, and maintain the TX mode after all messages have been sent out.
• For auto RX, pressing **[F12]** after selecting a message memory channel for transmission places this transceiver in the TX mode. When the message is sent out, this transceiver is automatically restored to the RX mode.
• Combining auto TX and auto RX enables both transmission and reception to be performed automatically.

1 **Press F3 [DECODE] to display the PSK communication screen.**

2 **Press F5 [MEMORY] to display the PSK Message screen.**

3 **Press F3[▲]/ F4[▼] or turn the [MULTI/CH] control to select the channel containing the message for auto TX/RX.**

4 **Press F6 [AUTO.TX] to set auto TX to ON.**
<< **AUTO TX** >> is displayed to the right of the PSK message.

• When auto TX is set to OFF, the << **AUTO TX** >> display goes off, and the PSK message of the channel is temporarily placed in the character string buffer but not transmitted automatically.

5 **Press F7 [AUTO.RX] to set auto RX to ON.**
<< **AUTO RX** >> is displayed to the right of the PSK message.
• When auto RX is set to OFF, the << **AUTO RX** >> display goes off, and this transceiver is not restored to the RX mode after the PSK message for the channel has been sent out.

📝 ● To sent a PSK message for which "AUTO TX" is set to ON, select the channel in which the PSK message is stored. Check to ensure that the character string (PSK message) is forwarded to the character string buffer, followed by pressing **[F12]** on the USB keyboard.
● To switch this transceiver to the RX mode after transmitting a PSK message for which "AUTO RX" is set to OFF, press **[F12]** on the USB keyboard after the PSK message has been sent out.

Transmitting Character Strings from the PSK Message Memory

A message that is registered in the PSK message memory can be transmitted as follows.

1 Press F3 [DECODE] to display the PSK communication screen.

2 Press F5 [MEMORY] to display the PSK Message screen.
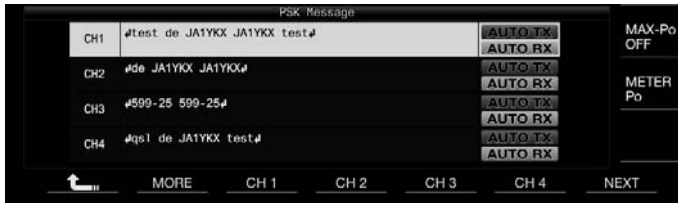
3 Press F3 [CH 1] to F6 [CH 4] or F3 [CH 5] to F6 [CH 8] to select the channel that contains the message to be transmitted.

The PSK message of the channel corresponding to the function key is being transmitted automatically.

- However, the PSK message will not be transmitted automatically if auto TX is set to OFF.
- If the channel guide is not displayed, press **F2 [MORE]**.
- Pressing **F7 [NEXT]** each time switches between **F3 [CH 1]** to **F6 [CH 4]** and **F3 [CH 5]** to **F6 [CH 8]**.
- After transmitting the PSK message that is indicated by an << **AUTO RX** >> display beside it, this transceiver returns to the RX mode.

Settings Related to PSK

Configuring the PSK Tone Frequency

Configure the tone frequency when signals are received in the PSK mode.

● **Configure in Menu [2-12] "PSK Tone Frequency"**

Setting Value	1.0/ 1.5 (default)/ 2.0 [kHz]

Reversing the Direction of Phase Change in the QPSK Mode

- When the QPSK signal received cannot be decoded correctly, try decoding with the BFO frequency switched from the LSB side to the USB side.
- Decoding cannot be performed correctly when the BFO frequency of the PSK signal received is in the reverse state (frequencies of the lower and upper sidebands are reversed).
- Pressing and holding the **[FSK/PSK]** mode key enables reverse signals to be decoded.

PSK Operation Using a PC

For details on operation in the PSK mode using a data communication software program that makes use of the sound function of a PC instead of the built-in encoder and decoder functions of this transceiver while this transceiver is configured to the SSB-DATA mode, please refer to "PC Connection for Data Communication" (1-4).

✎ ● As audio from an external input cannot be transmitted in the PSK mode, make use of the SSB or SSB-DATA mode.
● Alternatively, audio from an external device can also be transmitted using the DATA VOX function.

Communication Log

The CW, RTTY and PSK communication screens can be saved using the communication log function.

- Before doing so, configure the destination for saving the data in "File Storage Location" of the "USB/File Management Menu" (11-2) to "Internal Memory" or "USB Flash Drive".
- To save the data to a USB flash drive, insert a USB flash drive formatted using this transceiver into ●←⤳ (USB-A).

1 Set to the CW, RTTY (FSK) or PSK mode.

2 Press F3 [DECODE] to display the corresponding communication screen.

3 Press F4 [LOG] to set the communication log function to "On".

Pressing **F4 [LOG]** each time toggles the communication log function between ON and OFF.

- "Log: On" appears on the communication screen for about 1 second when the communication log function is ON, and "Log: Off" is displayed for about 1 second when the function is OFF.
- When the communication log function is functioning in the ON mode, the communication log ON indicator is displayed on the title bar.
- When the communication log function is ON and the transceiver is in the standby mode, "◯" is displayed on the title bar. (When there is insufficient space in the USB flash drive or when a USB flash drive is not inserted when the destination for saving the logs is configured to a USB flash drive.)

✎ ● The file name is made up of the date and time in numerical format together with an underscore. The extension of the file is based on the selection made in Menu [2-14] "CW/RTTY/PSK Log File Format". The date and time is expressed in the following sequence: yyyymmdd_hhmmss.
- (Example)
- If the date is 10:20:30 a.m., February 15, 2018:
- 20180215_102030.txt
● The file is stored in the following folder.
- CW: KENWOOD\TS-890\DECODE\CW
- RTTY: KENWOOD\TS-890\DECODE\RTTY
- PSK: KENWOOD\TS-890\DECODE\PSK
● When removing the USB flash drive, make sure to execute "Safely Removing the USB Flash Drive" (11-6).

Selecting a Log File Format

Select a format for the log file to be saved.

● **Configure in Menu [2-14] "CW/RTTY/PSK Log File Format"**

Setting Value	html/ txt (default)

html: Saves the log file in the html format.
txt: Saves the log file in the text format.

Displaying a Time Stamp

A time stamp is inserted when there is a change in the encoding or decoding status.

Selecting a Time Stamp Type

It is possible to select whether to display only the time stamp or to display both the time stamp and frequency.

● **Configure in Menu [2-15] "CW/RTTY/PSK Time Stamp"**

Setting Value	Off/ Time Stamp/ Time Stamp+Frequency (default)

Off: Does not display a time stamp.
Time Stamp: Displays only the time stamp.
Time Stamp+Frequency: Displays both the time stamp and frequency.

Selecting a Clock Type

Configure the clock for displaying the time stamp to a "Local Clock" or "Secondary Clock".

● **Configure in Menu [2-16] "Clock (CW/RTTY/PSK Time Stamp)"**

Setting Value	Local Clock (default)/ Secondary Clock

• When encoding or decoding starts, a line break and time stamp will be inserted before displaying the encoded or decoded character string.

Editing the Communication Log File

1 **In the CW communication screen, press and hold F2 [LOG]. In the RTTY and PSK communication screens, press and hold F4 [LOG].**
The screen for selecting log file appears.
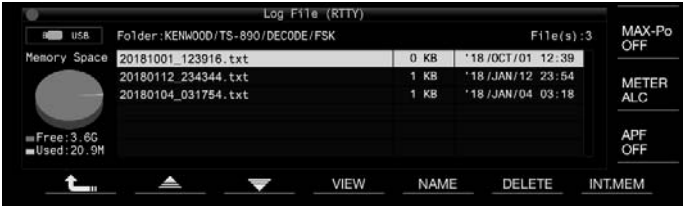
2 **Press F2[▲]/ F3[▼] to select a file.**
• Pressing **F4 [VIEW]** displays the log information of the selected file.

• To read data from the internal memory, press **F7 [INT.MEM]**.
• To read data from the USB flash drive, press **F7 [USB.MEM]**. (If a USB flash drive is not connected, a message will appear prompting you to get ready the USB flash drive.)
• Pressing **F5 [NAME]** allows the file name to be changed.
• Pressing **F6 [DELETE]** displays a message to confirm deletion of the file. Pressing **F4 [OK]** deletes the file.

Operation in FM Mode

Operating in the FM mode enables high-quality voice communication as well as communication that is noise-resistant. Communication in the FM mode is also supported on the 29 MHz, 50 MHz and 70 MHz (E type) bands. To communicate with a distant station for which communication cannot be established directly, do so via a repeater.

Adjusting Microphone Gain during Operation in FM Mode

1 **Adjust the frequency.**
2 **Press [FM/AM/FM-N] to select FM mode.**
3 **Press [MENU].**
4 **Press F [ADV.] to display the Advanced Menu screen.**
   • If **F [ADV.]** is not displayed, press **F [MORE]** to display **F [ADV.]**.
5 **Select Advanced Menu [10] "Microphone Gain (FM Mode)".**
6 **Press [SEND], or press and hold [PTT] on the microphone.**
This transceiver is placed in the TX mode and a level meter is displayed.
7 **Speak into the microphone in the normal tone and loudness.**
8 **Press F4 [–]/ F5 [+] or turn the [MULTI/CH] control to adjust the microphone gain.**

Setting Value	0 to 50 (default) to 100 (1 step)

   • Adjust the microphone gain level such that the peak value of the level meter falls within the zone.
9 **Press [SEND] or release [PTT] on the microphone.**
Doing so places this transceiver in the RX mode.
10 **Press F1 [🔼].**

📝 ● When using a microphone with a low sensitivity such as the MC-90, adjust the microphone gain to a higher level.
● When a microphone with a low sensitivity is used, the modulation factor may stabilize by setting the speech processor to ON.

Operation in Narrow FM Mode

It is possible to switch to a narrow bandwidth during operation in the FM mode. The occupied bandwidth and maximum modulation factor are shown in the table below. Selecting FM Narrow according to the modulation factor of the target station helps to avoid distortion and deterioration in the clarity of the RX audio.

Mode	Occupied Bandwidth	Maximum Modulation Factor
FM (Wide)	16 kHz or lower	±5 kHz or lower
FM Narrow	10 kHz or lower	±2.5 kHz or lower

● **Press and hold [FM/AM].**
Pressing and holding **[FM/AM]** each time switches between "FM" and "FMN (Narrow)".

Operating the FM Repeater

Switching this transceiver to split operation and turning on the tone signal while in the FM mode enables this transceiver to be used in the repeater operation mode.
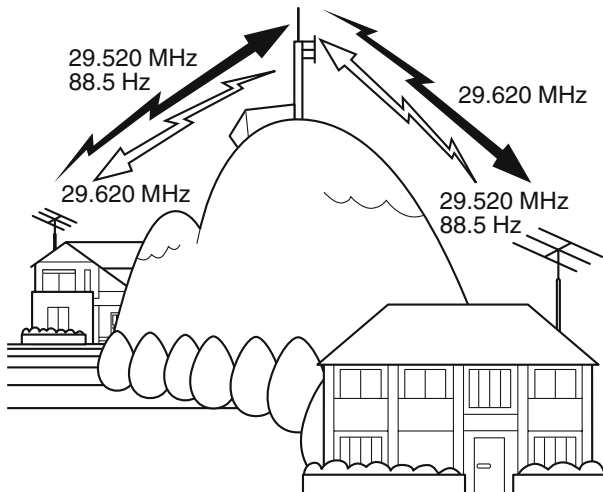
Configuring the Tone Signal

📝
● Registering the tone settings to a memory channel and calling up the frequency or operation information from the memory channel eliminates the need to configure the tone frequency each time. For more details on the memory channel settings, please refer to "MEMORY CHANNELS" (9-1).
● The tone frequency may vary depending on the country or region this transceiver is being used.

Selecting a Tone

● **Press F4 [TONE] to select "TONE".**
Pressing **F4 [TONE]** each time toggles the tone signal selection in the following sequence: "TONE" → "CTCSS (CT)" → "CROSS" → Blank (deselected).
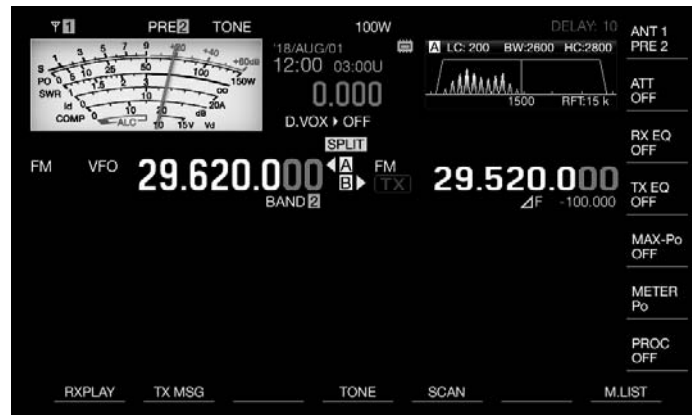
Configuring the Tone Frequency

1 **Press and hold F4 [TONE] while "TONE" is selected to display the FM Tone Frequency screen.**
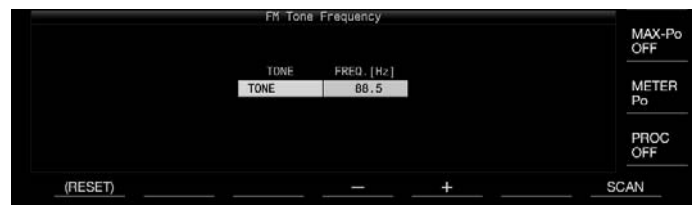
2 **Press F4 [–]/ F5 [+] or turn the [MULTI/CH] control to select the tone frequency.**

Tone Frequency (Hz)						
67.0	88.5	114.8	151.4	177.3	203.5	250.3
69.3	91.5	118.8	156.7	179.9	206.5	254.1
71.9	94.8	123.0	159.8	183.5	210.7	1750
74.4	97.4	127.3	162.2	186.2	218.1	
77.0	100.0	131.8	165.5	189.9	225.7	
79.7	103.5	136.5	167.9	192.8	229.1	
82.5	107.2	141.3	171.3	196.6	233.6	
85.4	110.9	146.2	173.8	199.5	241.8	

• The default setting is "88.5 Hz".
• To restore the default setting, press and hold **F1 [(RESET)]**.

3 **Press [ESC] to end the process.**

Tone Frequency Scan

Tone frequency that is contained in signals received in the FM mode can be searched and displayed with the following steps. This is useful when there is a need to know the tone frequency of the repeater station.

1 **Press and hold F4 [TONE] while "TONE" is selected to display the FM Tone Frequency screen.**

2 **Press F7 [SCAN] to start tone frequency scan.**
• Scanning stops when a tone frequency is detected, and the frequency is displayed in the "FREQ. [Hz]" field.
• Pressing **F7 [SCAN]** while tone frequency scan is in progress stops the scan operation. Pressing **F7 [SCAN]** again resume scanning.
• The scan operation stops when the RX signal is interrupted during tone frequency scan. Scanning resumes when a RX signal is detected by this transceiver.

3 **Press [ESC] to end the process.**

CTCSS Operation

CTCSS is the abbreviation for Continuous Tone Coded Squelch System. It is used to add a CTCSS tone frequency that is determined in advance with the target station to the audio signal to be transmitted. When the CTCSS tone frequency contained in the RX signal received from the target station coincides with the CTCSS tone frequency of one's own station, the squelch opens and the RX audio can be heard.

- A different value can be selected for CTCSS tone frequency and tone frequency, but CTCSS and tone cannot be used concurrently.
- CTCSS tone frequency: Squelch opens upon receiving a CTCSS tone for which the FM wave is superimposed with the same CTCSS tone frequency as that configured on this transceiver.
- During CTCSS frequency scan, it is possible to detect the CTCSS tone frequency that is contained in the RX signal.
- When a signal is received while CTCSS tone frequency scan is in progress, the RX audio can be heard even when the CTCSS tone frequency does not coincide with that configured on this transceiver.

Selecting CTCSS

● **Press F4 [TONE] to select "CTCSS (CT)".**
Pressing **F4 [TONE]** each time toggles the tone signal selection in the following sequence: "TONE" → "CTCSS (CT)" → "CROSS" → Blank (deselected).

Configuring the CTCSS Frequency

1 **Press and hold F4 [TONE] while "CTCSS" is selected to display the FM Tone Frequency screen.**
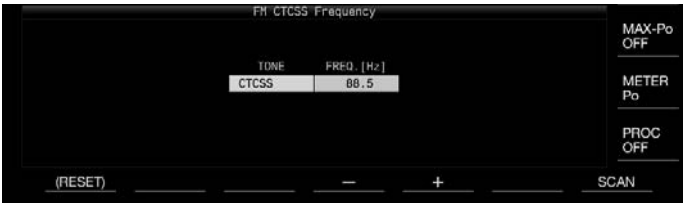
2 **Press F4 [–]/ F5 [+] or turn the [MULTI/CH] control to select the CTCSS frequency.**

CTCSS Frequency (Hz)						
67.0	88.5	114.8	151.4	177.3	203.5	250.3
69.3	91.5	118.8	156.7	179.9	206.5	254.1
71.9	94.8	123.0	159.8	183.5	210.7	
74.4	97.4	127.3	162.2	186.2	218.1	
77.0	100.0	131.8	165.5	189.9	225.7	
79.7	103.5	136.5	167.9	192.8	229.1	
82.5	107.2	141.3	171.3	196.6	233.6	
85.4	110.9	146.2	173.8	199.5	241.8	

- The default setting is "88.5 Hz".
- To restore the default setting, press and hold **F1 [(RESET)]**.

3 **Press [ESC] to end the process.**

CTCSS Frequency Scan

CTCSS frequency that is contained in signals received in the FM mode can be searched and displayed with the following steps. This is useful when there is a need to know the CTCSS frequency of the mobile station.

1 **Press and hold F4 [TONE] while "CTCSS" is selected to display the CTCSS Frequency screen.**

2 **Press F7 [SCAN] to start tone frequency scan.**
- Scanning stops when a CTCSS frequency is detected, and the frequency is displayed in the "FREQ. [Hz]" field.
- Pressing **F7 [SCAN]** while CTCSS frequency scan is in progress stops the scan operation. Pressing **F7 [SCAN]** again resume scanning.
- The scan operation stops when the RX signal is interrupted during CTCSS frequency scan. Scanning resumes when a RX signal is detected by this transceiver.

3 **Press [ESC] to end the process.**

Cross Tone

Make use of cross tone for communication with a repeater that requires a different tone for transmission to the repeater (uplink) and reception from the repeater (downlink).

- Cross Tone frequency uses the tone frequency during transmission and the CTCSS frequency during reception.
- The tone squelch operates using the CTCSS frequency during reception, while the preconfigured tone frequency is used to transmit a tone during transmission.
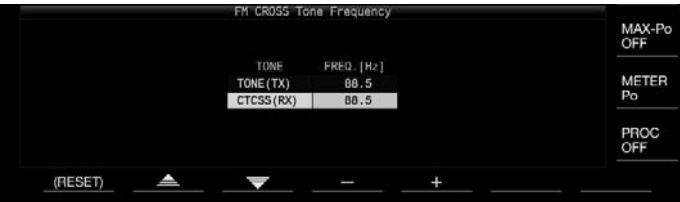
Selecting Cross Tone

● **Press F4 [TONE] to select "CROSS".**
Pressing **F4 [TONE]** each time toggles the tone signal selection in the following sequence: "TONE" → "CTCSS (CT)" → "CROSS" → Blank (deselected).

Configuring the TX/RX Tones

1 **Press and hold F4 [TONE] while "CROSS" is selected to display the FM Cross Tone Frequency screen.**

2 **Press F2 [▲]/ F3 [▼] to select "TONE (TX)" or "CTCSS (RX)".**

3 **Press F4 [–] / F5 [+] or turn the [MULTI/CH] control to select the tone frequency or CTCSS frequency.**
- To restore the default setting of the selected row, press and hold **F1 [(RESET)]**.

4 **Press [ESC] to end the process.**

6 REJECTING INTERFERENCE

Attenuator

The attenuator is a function for attenuating the RX signals. If there is interference due to strong signals near the target signal, turning on the attenuator helps to reduce interference caused by nearby frequencies.

It is also effective in situations where the RX audio is distorted when the RX signal is too strong. This transceiver comes with three different types of attenuators.

● Press F [ATT].
Pressing **F [ATT]** each time switches the attenuation level.

Setting Value	Off (default)/ 6 dB/ 12 dB/ 18 dB

- Pressing and holding **F [ATT]** each time switches the options in the reverse sequence.
- The attenuation level is stored for each antenna selection band.
- The status of the attenuator (attenuation level) is displayed in the key guide.

Switching the RX Filter Band Characteristics

Switching the RX Filter (A, B, C)

The setting for the band characteristics of the RX filter on this transceiver can be switched at one touch according to the operating status to one of the three types (A, B or C).

- The band characteristics are configured by combining the roofing filter or IF and AF filter, high cutoff/low cutoff and WIDTH/SHIFT. A different RX filter setting (A, B or C) can be stored for each of the SSB, CW, FSK, PSK, FM and AM modes.

● Press [IF FIL].
Pressing **[IF FIL]** each time switches the RX filter in the order of "A", "B" and "C".
- The selected filter is displayed at the top left of the filter scope.

> The RX filter does not switch to Type C if Menu [6-10] "RX Filter Numbers" below is configured to "2".

Configuring the Selectable Types of RX Filters

The selectable types of RX filters can be configured to three (A, B and C) or two (A and B).
Configure in Menu [6-10] "RX Filter Numbers"

Setting Value	2/ 3 (default)

Filter Scope

The following information is displayed on the filter scope screen.
- Selected RX filter (A, B or C)
- Image of the RX filter passband characteristics (trapezoid)
- Audio spectrum of the RX audio
- Parameters including the IF filter passband width
- Pitch frequency in the CW mode
- Notch point of the notch filter
- Passband width of the roofing filter

SSB
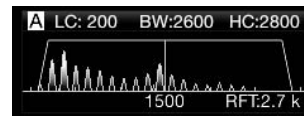
CW

FSK
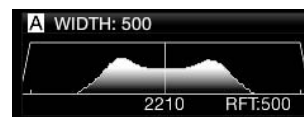
PSK
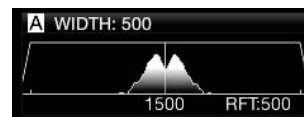
AM/FM
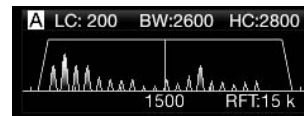
> ● The audio spectrum is not shown on the filter scope while the audio scope screen is displayed.
> ● The audio spectrum is not shown on the filter scope while the RTTY/PSK communication screen is displayed.
> ● An out-of-range marker ◀ ▶ is displayed when the image of the passband cannot be displayed within the display area because the shift amount of the filter in the CW mode is large.
> ● The audio spectrum is usually displayed within the image of the passband. However, it may be displayed beyond the image of the passband if there are excessively high input signals.
> ● When the notch filter is ON, the indicator representing the notch point is displayed in white. The indicator is displayed in white when the notch point is on the positive side of the carrier wave in the AM mode. If the notch point moves towards the minus side of the carrier wave, the indicator changes to orange and moves from the left edge of the screen to the right edge.

Configuring the RX Filter

The steps to configure the settings for the different types of RX filters are as follows.

Selecting a Roofing Filter

A roofing filter helps to reduce strong interference signals that are next to the target signal.

1 **Press and hold [IF FIL] to display the RX Filter screen.**

2 **Press [IF FIL] or F2 [FILTER] to select an RX filter (FIL-A/B/C).**

3 **Press F3 [ROOF].**
Pressing **F3 [ROOF]** each time switches the passband width.

Setting Value	Auto (default)/ 270/ 500/ 2.7 k/ 6 k/ 15 k [Hz]

Auto: A roofing filter with a bandwidth wider than the passband width of the DSP filter is automatically selected using high cutoff/low cutoff or Width/Shift. (If there are 2 or more bandwidths that satisfy the conditions, the narrower one is selected.)
- In the AM mode, a 6 kHz roofing filter is automatically selected if the high cutoff frequency is 3 kHz or lower, and a 15 kHz roofing filter is selected if the high cutoff frequency is higher than 3 kHz.
- In the FM mode, the option is fixed at 15 kHz and cannot be changed.
- 270 Hz is available for selection when the optional YG-82CN-1 is attached.
- Pressing and holding **F3 [ROOF]** each time switches the options in the reverse sequence.
- The passband width can also be altered by turning the **[MULTI/CH]** control.
- "RFT:xxxx" is displayed at the bottom right of the filter scope. [xxxx:270/ 500/ 2.7k/ 6k/ 15k]

4 **Press and hold [IF FIL] or press [ESC] to end the process.**

📝 ● The IF passband width for the AM mode is twice the value of the high cutoff frequency.
Example: If the frequency is 3,000 Hz, the IF passband width will be 6 kHz.

Switching the IF Filter Shape

3 types of IF filter shapes are available for selection according to the condition of interference and operation.

1 **Press and hold [IF FIL] to display the RX Filter screen.**

2 **Press [IF FIL] or F2 [FILTER] to select an RX filter.**

3 **Press F4 [IF].**
Pressing **F4 [IF]** each time switches the shape of the filter.

Setting Value	Medium (default)/ Soft/ Sharp

- Pressing and holding **F4 [IF]** each time switches the options in the reverse sequence.
- The filter shape can also be altered by turning the **[MULTI/CH]** control.
- The IF filter option is displayed as "-" and cannot be altered in the FM mode.

4 **Press and hold [IF FIL] or press [ESC] to end the process.**

Switching the AF Filter Type

3 types of audio frequency passbands are available for selection.

1 **Press and hold [IF FIL] to display the RX Filter screen.**

2 **Press [IF FIL] or F2 [FILTER] to select an RX filter.**

3 **Press F5 [AF].**
Pressing **F5 [AF]** each time switches the shape of the IF filter.

Setting Value	Medium (default)/ Wide/ Narrow

- Pressing and holding **F5 [AF]** each time switches the options in the reverse sequence.

4 **Press and hold [IF FIL] or press [ESC] to end the process.**

Configuring the Behavior of the HI/SHIFT and LO/WIDTH Controls (SSB/SSB-DATA Only)

The high cutoff/low cutoff selection in the SSB mode and Shift/Width selection in the SSB-DATA mode are preconfigured in the default setting, but they can be changed in the menu.

SSB Mode

● **Configure in Menu [6-11] "Filter Control in SSB Mode (High/Low and Shift/Width)"**

| Setting Value	High & Low Cut (default)/ Shift & Width

SSB-DATA Mode

● **Configure in Menu [6-12] "Filter Control in SSB-DATA Mode (High/Low and Shift/Width)"**

Setting Value	High & Low Cut/ Shift & Width (default)

Changing the Cutoff Frequency

In the SSB, AM and FM modes, the passband width of the filter can be altered by changing the cutoff frequency (low or high). The passband width can be changed so that the interfering signal falls outside the bandwidth of the filter.
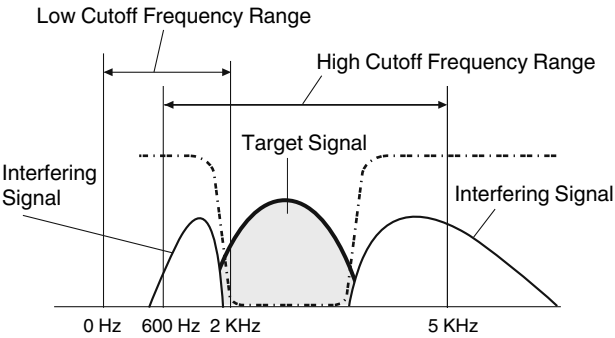
1 Press the mode key to select LSB, USB, FM or AM mode.

2 Press and hold [IF FIL] to display the RX Filter screen.

3 Turn the [HI/SHIFT] or [LO/WIDTH] control.
- Turning the **[HI/SHIFT]** control to the right increases the cutoff frequency (high) while turning the control to the left decreases the frequency.
- Turning the **[LO/WIDTH]** control to the right increases the cutoff frequency (low) while turning the control to the left decreases the frequency.
- The amount of change and the filter shape are displayed on the filter scope and RX Filter screen.

4 Press and hold [IF FIL] or press [ESC] to end the process.

Mode	Low Cutoff Frequency (Hz)	High Cutoff Frequency (Hz)
	Setting Value	Setting Value
SSB/ SSB-DATA	0/ 50/ 100 to 200 (default) to 2000 (100-step)	600 to 2800 (default) to 3000 (100-step)/ 3400/ 4000/ 5000
AM/ AM-DATA	0/ 100 (default)/ 200/ 300	2000 to 3000 (100-step)/ 3500/ 4000/ 5000 (default)
FM/ FM-DATA	0/ 50/ 100 to 200 (default) to 1000 (100-step)	1000 to 2800 (default) to 3000 (100-step)/ 3400/ 4000/ 5000

- When configured to "Auto", a roofing filter with a bandwidth wider than the passband width of the DSP filter is selected using high cutoff/low cutoff or Width/Shift.
- When "Auto" is configured in the AM mode, a 6 kHz roofing filter is automatically selected if the high cutoff frequency is 3 kHz or lower, and a 15 kHz roofing filter is selected if the high cutoff frequency is higher than 3 kHz.
- In the FM mode, the option is fixed at 15 kHz and cannot be changed.
- When the low cutoff frequency is increased until it reaches the high cutoff frequency, the high cutoff frequency will also change at the same time while keeping the passband width at 0 Hz.
- When the high cutoff frequency is decreased until it reaches the low cutoff frequency, the low cutoff frequency will also change at the same time while keeping the passband width at 0 Hz.

Changing the Passband Width and Shift Amount

When in the CW or SSB-DATA mode, the passband width and shift amount of the DSP filter can be altered. When in the RTTY (FSK) or PSK mode, the passband width can be changed. The passband width can be changed so that the interfering signal falls outside the bandwidth of the filter.
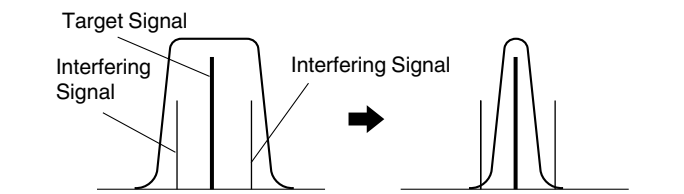
1 **Press the mode key to select CW, USB-DATA, LSB-DATA, FSK or PSK mode.**

2 **Press and hold [IF FIL] to display the RX Filter screen.**

3 **Turn the [LO/WIDTH] control to change the passband width.**
Turning the control to the right widens the passband width, while turning to the left narrows it.

4 **Turn the [HIGH/SHIFT] control to shift the frequency band.**
Turning the control to the right shifts the frequency to the high bandwidth, while turning to the left shifts it to the low bandwidth.
  • The shift frequency band cannot be adjusted in the FSK and PSK modes.
  • The amount of change and the filter shape are displayed on the filter scope and RX Filter screen.

Mode	Passband Width (Hz)	Shift Frequency (Hz)	
	Setting Value	Setting Value	Step
SSB/ SSB-DATA	50/ 80/ 100/ 150/ 200/ 250/ 300/ 350/ 400/ 450/ 500/ 600/ 700/ 800/ 900/ 1000/ 1100/ 1200/ 1300/ 1400/ 1500/ 1600/ 1700/ 1800/ 1900/ 2000/ 2100/ 2200/ 2300/ 2400/ 2500/ 2600 (default)/ 2700/ 2800/ 2900/ 3000	50 to 1500 (default) to 2500	50
CW	50/ 80/ 100/ 150/ 200/ 250/ 300/ 350/ 400/ 450/ 500 (default)/ 600/ 700/ 800/ 900/ 1000/ 1500/ 2000/ 2500	-800 to 0 (default) to +800	10
FSK	250/ 300/ 350/ 400/ 450/ 500 (default)/ 1000/ 1500	–	
PSK	50/ 80/ 100/ 150/ 200/ 250/ 300/ 350/ 400/ 450/ 500 (default)/ 600/ 700/ 800/ 900/ 1000/ 1200/ 1400/ 1500/ 1600/ 1800/ 2000/ 2200/ 2400/ 2600/ 2800/ 3000	–	

5 **Press and hold [IF FIL] or press [ESC] to end the process.**

Preset Passband Characteristics

The frequently-used filter settings (high cutoff, low cutoff and WIDTH/SHIFT) can be preset according to the style in which this transceiver is used.

1 Press and hold [IF FIL] to display the RX Filter screen.

2 Press [IF FIL] or F2 [FILTER] to select an RX filter.

3 Press F6 [FIL SET].
The current filter settings (high cutoff, low cutoff and WIDTH/ SHIFT) are stored as the preset values.
- When preset values are applied, the values will be highlighted in the display for approximately 0.5 seconds.
- Pressing **F7 [FIL CLR]** restores the passband width changed using the **[HI/SHIFT]** and **[LO/WIDTH]** controls to the preset value.

4 Press and hold F [IF FIL] or press [ESC] to end the process.

Audio Peak Filter in the CW Mode

During reception in the CW mode, if the signal intelligibility deteriorates due to noise or other reasons, allowing the RX signal to pass through the bandwidth with the pitch frequency as the center frequency helps to improve the intelligibility of the RX signal.

Turning ON/OFF Audio Peak Filter

1 Select CW mode.

2 Press F [APF].
- Pressing **F [APF]** each time toggles the audio peak filter of the selected band between ON and OFF.
- When audio peak filter is on, "ON" is displayed on the key guide. "OFF" is displayed when the audio peak filter is turned off.

Switching the Passband Characteristics

3 types frequency passbands are available for selection for the audio peak filter.

1 Select CW mode.

2 Press and hold F [APF] to display the audio peak filter (APF) screen.
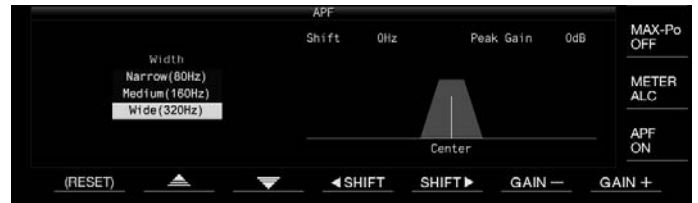
3 Press F2[▲]/ F3[▼] to select a passband width.

Setting Value	Wide (320Hz)/ Medium (160Hz) (default)/ Narrow (80Hz)

4 Press and hold F [APF] or press [ESC] to end the process.

Shifting the Passband Width

Shifting the passband width of the audio peak filter helps to avoid interference with nearby frequencies.

1 Select CW mode.

2 Press and hold F [APF] to display the audio peak filter (APF) screen.

3 Press F2[▲]/ F3[▼] to select the passband width to be shifted.

4 Press F4[◀SHIFT] or F5[SHIFT▶], or turn the [MULTI/CH] control to shift the passband width.

Setting Value	-200 to 0 (default) to +200 [Hz] (5-step)

- The shift amount of the passband width is ±200 Hz with the pitch frequency as the center frequency.
- The selected passband width for the audio peak filter shifts from the pitch frequency toward a higher or lower bandwidth.

5 Press and hold F [APF] or press [ESC] to end the process.

Configuring the Peak Gain

To further enhance the target CW signal, raise the gain level.

1 **Select CW mode.**

2 **Press and hold F [APF] to display the audio peak filter (APF) screen.**

3 **Press F6 [GAIN +] or F7 [GAIN -] to adjust the gain level.**

Setting Value	0dB (default) to +6dB

4 **Press and hold F [APF] or press [ESC] to end the process.**

Audio Peak Filter in the FSK Mode

When receiving signals in the FSK mode, allowing both the mark and space frequencies to have a peak help to reduce the occurrence of garbled characters, thus improving the decodability. This audio peak filter is compatible with the high tone (mark frequency of 2125 Hz) as well as the low tone (mark frequency of 1275 Hz).

1 **Select FSK mode.**

2 **Press F [APF].**
   - Pressing **F [APF]** each time toggles the audio peak filter of the selected band between ON and OFF.
   - When audio peak filter is on, "ON" is displayed on the key guide. "OFF" is displayed when the audio peak filter is turned off.

📝 ● When the shift width in RTTY exceeds 170 Hz, the audio peak filter for the selected band cannot be set to ON.
   ● Internally demodulated signals are not processed for the audio filter in the FSK mode.
   ● The passband cannot be shifted for the audio peak filter in the FSK mode.

Noise Blanker

The noise blanker is used to reduce pulse noise. This transceiver is equipped with two types of noise blankers: NB1 that employs analog signal processing and NB2 that performs DSP (digital signal processing) at the IF level. Furthermore, two types of NB2 with different operating principles are available for selection. NB1 and NB2 can be selected for use according to the noise conditions. They can also be employed at the same time.

📝 ● Noise blanker cannot be used in the FM mode.

Turning ON/OFF Noise Blanker 1/2

● **Press [NB1] or [NB2].**
   Pressing **[NB1]** or **[NB2]** each time toggles noise blanker 1 and noise blanker 2 respectively between ON and OFF.
   - When noise blanker 1 or 2 is ON, << NB 1 >> or << NB 2 >> is displayed on the screen.
   - When both noise blanker 1 and 2 are ON, << NB 1|2 >> is displayed on the screen.

Adjusting the NB1 Level

1 **Press and hold [NB1] to display the Noise Blanker 1 configuration screen.**
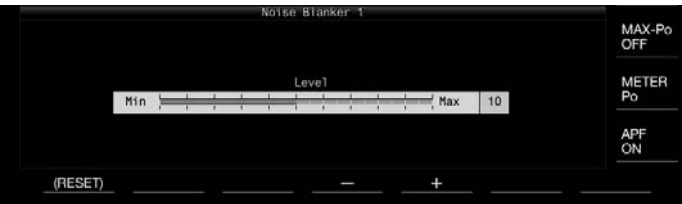
2 **Press F4 [–] or F5 [+], or turn the [MULTI/CH] control to change the level.**

Setting Value	1 to 10 (default) to 20 (1 step)

   - Configuring to a larger value reduces the noise further.

📝 ● Configuring the noise blanker level to a larger value may cause the transceiver to malfunction and distort the RX audio depending on the condition of the RX signal or interfering signal.

3 **Press and hold [NB1] or press [ESC] to end the process.**

NB2

NB2 is a function for blanking pulse noise with a long pulse width which cannot be blanked by NB1. NB2 is further divided into Type A and Type B, which can be employed according to the circumstances. NB2 can also be used together with NB1.

Type A

Pulse Noise

Target Signal
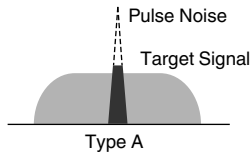
Type A

Type A suppresses mainly the pulse noise without blanking the target signal. The level of the effect (Level) can be adjusted.

📝
- As pulse noise remains after blanking when "Type A" is used, pulse noise might be audible when the target signal is strong or when there is strong interference within the passband. Even in such a situation, it has the effect of bringing up the target signal when AGC gain is low due to pulse noise.
- "Type A" is most effective in cases where weak target signals are buried in strong pulse noise.

Type B

Pulse Noise

Target Signal
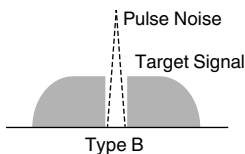
Type B

As with NB1, Type B blanks the pulse noise together with target signal. The pulse sensitivity level (Level), blanking duration (Width) and attenuation level (Depth) can be adjusted.

📝 When pulse noise with a long pulse width is blanked using "Type B", the time interval for which the target signal is removed becomes longer due to the long blanking time, and this causes the silence period to stand out.

1 Press and hold [NB2] to display the Noise Blanker 2 configuration screen.

2 Press F6 [TYPE].
Pressing **F6 [TYPE]** each time toggles the screen between "Type A" and "Type B".

Type A Screen
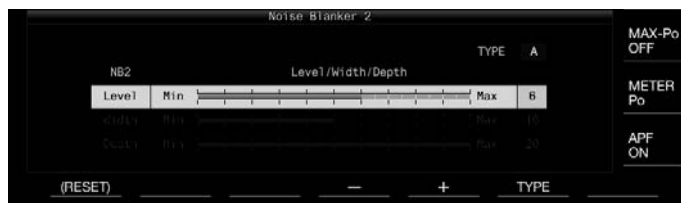
Type B Screen
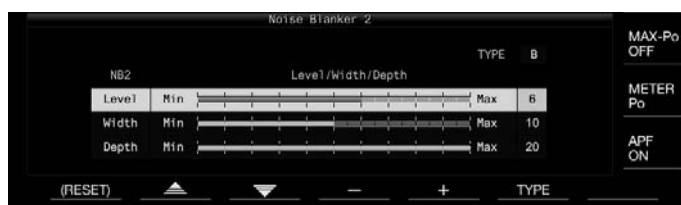
3 Press and hold [NB2] or press [ESC] to end the process.

📝
- Pressing and holding **[NB2]** displays the noise blanker 2 screen which shows the current type in use.
- The default setting is "Type A".
- Type selection can be configured separately for audio mode (SSB/AM (including DATA mode)) and non-audio mode (CW/FSK/PSK).

Configuring the NB2 Effect Level (Type A)/ NB2 Pulse Sensitivity Level (Type B)

1 Press and hold [NB2] to display the Noise Blanker 2 configuration screen.

2 While the Type B screen is displayed, press F2 [▲]/ F3 [▼] to select "Level".

3 Press F4 [–]/ F5 [+] or turn the [MULTI/CH] control to change the level.

Setting Value	1 to 6 (default) to 10 (1 step)

- Type A: Configuring to a larger value reduces the noise further.
- Type B: Configuring to a larger value blanks pulse noises with small level difference from the RX signal.

4 Press and hold [NB2] or press [ESC] to end the process.

📝
- Configuring to a value with a higher level of noise blanker effect may cause the transceiver to malfunction and distort the RX audio depending on the condition of the RX signal or interfering signal.

Configuring the Blanking Duration (Type B Only)

1 Press and hold [NB2] to display the Noise Blanker 2 configuration screen.

2 While the Type A screen is displayed, press F6 [TYPE] to switch to Type B.

3 Press F2 [▲]/ F3 [▼] to select "Width".

4 Press F4 [–]/ F5 [+] or turn the [MULTI/CH] control to change the blanking duration.

Setting Value	1 to 10 (default) to 20 (1 step)

- Configuring to a larger value lengthens the blanking time.

5 Press and hold [NB2] or press [ESC] to end the process.

Configuring the NB2 Attenuation Level (Type B Only)

1 Press and hold [NB2] to display the Noise Blanker 2 configuration screen.

2 While the Type A screen is displayed, press F6 [TYPE] to switch to Type B.

3 Press F2 [▲]/ F3 [▼] to select "Depth".

4 Press F4 [–]/ F5 [+] or turn the [MULTI/CH] control to change the attenuation level.

Setting Value	1 to 20 (default) (1 step)

- Configuring to a larger value increases the attenuation level.

5 Press and hold [NB2] or press [ESC] to end the process.

Notch Filter

Notch filter is capable of suppressing beat interference at the IF level. It can be employed to eliminate beat noise and bring up weak signals or during operation while checking the noise condition. The notch filter can be used in the SSB, CW, FSK, PSK and AM modes.

Turning ON/OFF Notch Filter

1 Press [NCH].
Pressing **[NCH]** each time toggles the notch filter between ON and OFF.
   - When the notch filter is ON, "NOTCH" is displayed on the screen.
   - When notch filter is ON, an indicator showing the notch point is displayed in the RX filter passband characteristics inside the filter scope.

2 Turn the [NOTCH] control.
Adjust the notch frequency to the point where beat or interference is to be suppressed.
   - The notch point indicator moves as the notch frequency changes.

> ● Once the notch point has been set in the CW mode, altering the PITCH and SHIFT values will not change the notch point set for beat suppression.

Switching the Notch Filter Bandwidth

The bandwidth of the stopband for the notch filter can be configured to normal, middle or wide. The middle and wide stopbands are wider than the bandwidth of the normal stopband by two and three times respectively.

● **Press and hold [NCH].**
Pressing and holding **[NCH]** each time switches the bandwidth and changes the display as follows.
<< NOTCH N >> (Normal) → << NOTCH M >> (Middle) →
<< NOTCH W >> (Wide)

Noise Reduction

This transceiver comes with two types of noise reduction functions NR1 and NR2 which are effective for reducing continuous noise. When NR1 is used, the optimal method is activated according to the mode in use.

Noise Reduction 1 (NR1)

   - In the SSB, FM and AM modes, noise reduction uses a spectrum subtraction system that places focus on the clarity.
   - In the CW, FSK and PSK modes, noise reduction employs an LMS filter system that emphasizes the periodic signal.
   - The noise reduction effect for NR1 can be adjusted.

Noise Reduction 2 (NR2)

   - NR2 employs an SPAC system for all modes which extracts the periodic signal. This system detects periodic signals that are contained in the RX signals, connects the detected periodic signals and plays them as part of the RX audio. For this reason, this method is effective for signals with a single frequency such as CW signals.
   - NR2 allows configuration to the optimal RX conditions by varying the autocorrelation time for periodic signal detection.
   - NR2 is most effective in the CW mode. (Use of NR1 is recommended for modes other than CW.)

> ● Beat signals are also suppressed when NR1 is used in the SSB, FM and AM modes as it suppresses stationary signals. This is a theoretical behavior and not a malfunction.
> ● When NR2 is set to ON in the SSB mode, the signal clarity may deteriorate, or pulse noise or distortion may occur. This is a theoretical behavior and not a malfunction.
> ● NR2 cannot be used in the FM mode.

Turning ON/OFF Noise Reduction

1 Press [NR].
Pressing **[NR]** each time toggles the option in the following sequence: "NR1" → "NR2" → "OFF".
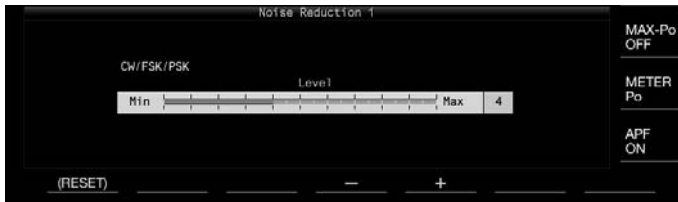   - When NR1 or NR2 is ON, << NR 1 >> or << NR 2 >> is displayed on the screen.

> ● NR1 and NR2 cannot be turned on at the same time.

Configuring the NR1 Effect Level

1 **Press [NR] to select Noise Reduction 1.**

2 **Press and hold [NR] to display the Noise Reduction 1 effect level configuration screen.**

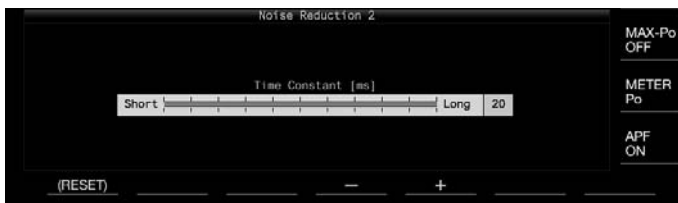*3* **Press F4 [–]/ F5 [+] or turn the [MULTI/CH] control to change the level of effect.**

Setting Value	1 to 5 (default) to 10 (1 step)

- For NR1, configuring to a larger value reduces the noise further. However, as the impact on the RX audio also gets stronger if the effect level is excessively high, adjust it to an appropriate level.

4 **Press and hold [NR] or press [ESC] to end the process.**

Configuring the NR2 Correlation Time

1 **Press [NR] to select Noise Reduction 2.**

2 **Press and hold [NR] to display the NR2 Time Constant configuration screen.**

3 **Press F4 [–]/ F5 [+] or turn the [MULTI/CH] control to change the correlation time.**

Setting Value	2 to 20 (default) [ms] (2-step)

- As the optimal correlation time varies with the RX signal and noise type when NR2 is used, configure the correlation time while receiving the signals.

4 **Press and hold [NR] or press [ESC] to end the process.**

> - NR2 adjusts the correlation time for periodic signal extraction. It is different from NR1, which adjusts the effect level.

Beat Canceler

Beat canceler is capable of suppressing multiple periodic interfering signals (beats) within the RX bandwidth through digital processing at the AF level.
This function can be used in the SSB, AM and FM modes.

Turning ON/OFF Beat Canceler

● **Press [BC].**
Pressing **[BC]** each time switches the beat canceler mode in the following sequence: "Beat Canceler 1" → "Beat Canceler 2" → "OFF".
- When beat canceler 1 or beat canceler 2 is ON, << **BC 1** >> or << **BC 2** >> is displayed on the screen.
- Beat canceler 1 suppresses weak beats and continuous beats. Beat canceler 2 suppresses intermittent beats such as CW signals.

> - Although the beat canceler suppresses the overall auditory beat, the gain of the target signal cannot be recovered using the AGC function. Thus, if the beat signal is larger than the target signal, using a notch filter activates the AGC function to enhance the clarity of the target signal.

DSP Monitor

DSP monitor is a function for temporarily expanding the passband width of the IF filter and AF filter via DSP in order to monitor the signal condition of nearby frequencies such as when receiving a specific frequency using a filter with a narrow passband width during contesting.

Assigning DSP Monitor to PF Key

● **Register "DSP MONITOR" in Menu [0-15] "PF A: Key Assignment" to Menu [0-31] "Microphone UP: Key Assignment"**

Expanding the Passband Width Using DSP Monitor

● **Press and hold down the PF key that is assigned with the DSP monitor function.**
The passband width of the filter is expanded while the key is held down.

> - During DSP monitoring, the audio peak filter is forcibly turned OFF.

7 SCOPE FUNCTIONS

Bandscope

With the signal strength represented on the vertical axis and frequency on the horizontal axis, the bandscope provides a visual representation of the condition of the RX frequency band.

- The bandscope of this transceiver comes in the following 3 modes.
  Auto Scroll Mode: A mode where the lower and upper frequency limits of the frequency band to be displayed are fixed, and the scope range scrolls automatically when the marker exceeds the lower or upper limit of the scope range.
  Fixed mode: A mode where the lower and upper frequency limits of the frequency band to be displayed are fixed for each amateur band.
  Center mode: A mode where the RX frequency is always at the center of the horizontal axis.
- By displaying a waterfall below the spectrum scope display, the RX frequency, surrounding conditions as well as transition in the signal strength over time can be viewed.
- The vertical axis of the waterfall display represents time while the horizontal axis represents frequency.
- Signal strength in the waterfall display is represented in a gradation of color in the order of green to blue (weak), red to yellow (medium) and white (strong). The amount of color change with respect to the signal strength can be altered in the menu. Refer to "Configuring the Gradation of the Waterfall" (7-5).
- The speed of the waterfall drop can be changed to 4 different speed levels. Refer to "Configuring the Speed of Waterfall Drop" (7-2).
- When the waterfall is displayed, the height of the spectrum scope display is reduced to one-third of the original size.
- The filter passband is constantly represented by a translucent display in the bandscope.

Displaying the Bandscope

● **Press [SCP] to display the scope screen.**
Pressing and holding **[SCP]** each time toggles the display between "Bandscope" and "Audio Scope".
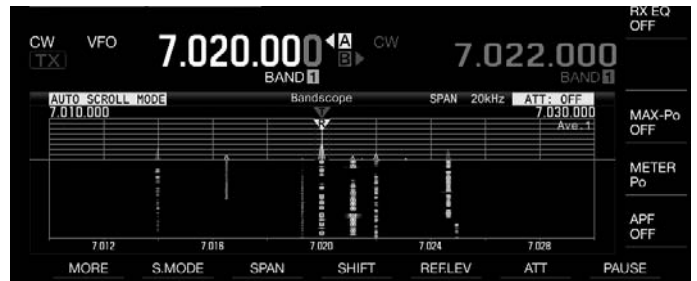
Bandscope
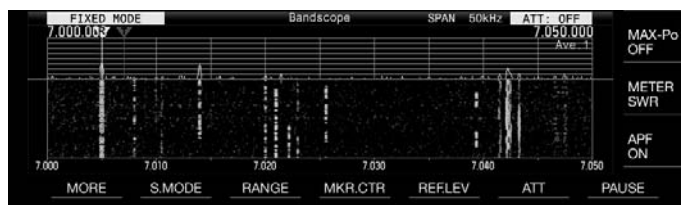
Audio Scope
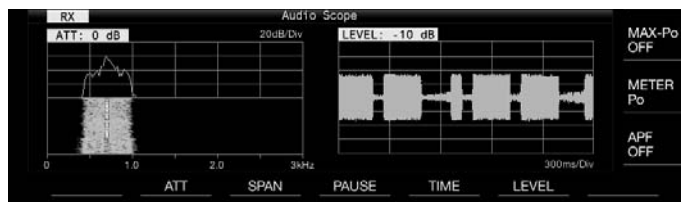
Switching the Bandscope Display Type
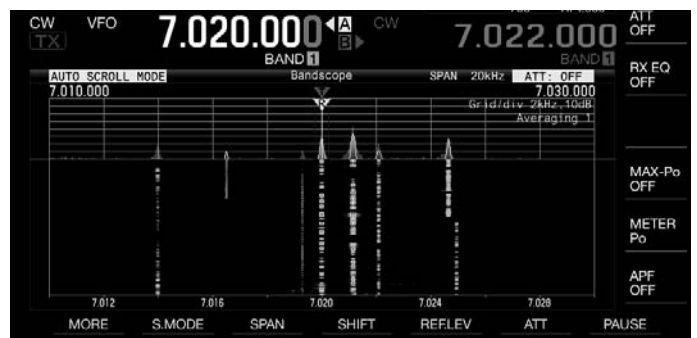
1 **Display the bandscope.**

2 **Press [SCP].**
Pressing **[SCP]** each time switches the selection in the following sequence.
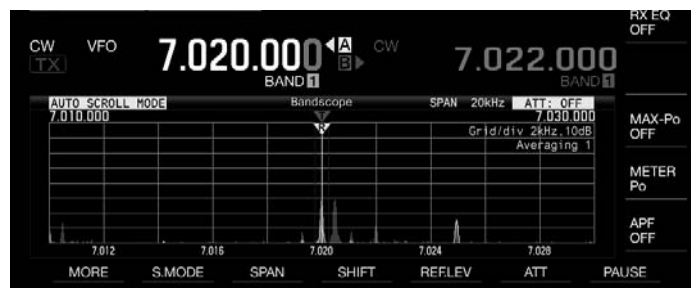
"Spectrum scope + Waterfall" (Standard size)
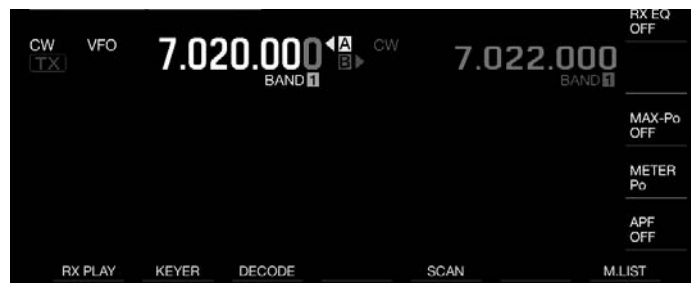

↓

"Spectrum scope + Waterfall" (Enlarged size)

↓

"Spectrum scope only" (Standard size)

↓

No scope display (ends scope display)

- While a bandscope is displayed, pressing **[ESC]** ends the bandscope display.

Adjusting the Reference Level

Adjust the reference level of the bandscope to make it easier to distinguish the target signal from the noise.

1 **Press F5 [REF.LEV] to display the setting value of the reference level at the center of the bandscope screen.**
   - If **F5 [REF.LEV]** is not displayed, press **F1 [MORE]** to display **F5 [REF.LEV]**.

2 **Turn the [MULTI/CH] control to adjust the reference level while observing the spectrum scope waveform and waterfall color level on the bandscope screen.**

Setting Value	-20 to 0 (default) to +10 dB (0.5 dB step)

3 **Press F5 [REF.LEV] to end adjustment of the reference level.**

> - The reference level is slightly compensated for each span internally on this transceiver so that the view of the waterfall does not change even when the display frequency span switches. For this reason, the height of the waveform on the spectrum scope also changes gradually when the span switches.
> - The adjustment value of the reference level is stored for each amateur band.

Switching the Bandscope Attenuator

If the target signal cannot be identified on the bandscope screen even after adjusting the reference level due to the excessively high input signals, attenuate the input level to the bandscope by switching to a different attenuator for the bandscope.

● **Press F6 [ATT] to switch to a different attenuator.**
   - If **F6 [ATT]** is not displayed, press **F1 [MORE]** to display **F6 [ATT]**.
   Pressing **F6 [ATT]** each time switches the attenuator.

Setting Value	Off (default)/ 10 dB/ 20 dB/ 30 dB

   - Pressing and holding **F6 [ATT]** each time switches the options in the reverse sequence.
   - The current attenuator level setting is displayed at the top of the bandscope.

> - "SCP OVF" (scope overflow) may be displayed in the toolbar of the bandscope screen if the input to the bandscope becomes excessive. In such cases, press **F6 [ATT]** to configure the attenuator for the bandscope to lower the input level to the bandscope.
> - Switching the attenuator for the bandscope does not affect the RX sensitivity.
> - The setting value of the bandscope attenuator is stored for each amateur band.

Configuring the Speed of Waterfall Drop

The speed at which the waterfall is flowing can be selected from the options available.

● **Press F1 [MORE] followed by F4 [SPEED].**
   Pressing **F4 [SPEED]** each time switches the flow speed.

Setting Value	Speed1/ Speed2/ Speed3/ Speed4 (default)

   - After altering the speed, "Speed n" is displayed in the waterfall area for about 1 second.
   - Pressing and holding **F4 [SPEED]** switches the options in the reverse sequence.

Waterfall Display during Tuning (Center Mode)

This is a function for switching the behavior of the waterfall display when the frequency is altered in the center mode.

● **Configure in Menu [8-03] "Waterfall when Tuning (Center Mode)"**

Setting Value	Straight (default)/ Follow

Straight: Pauses the target signal level traces displayed on the waterfall and moves the traces horizontally across the screen when the frequency is altered.
Follow: Tracks and displays the latest FFT level at the portion where the waterfall starts flowing when the frequency is altered.

Reduced Bandscope Display

A small bandscope (with a waterfall display) can be displayed on screens such as those for the different settings, RTTY communication and PSK communication.

1 **Display the menu, configuration modes except equalizer configuration and the RTTY/PSK communication screen.**

2 **Press [SCP].**
   A small bandscope is displayed.
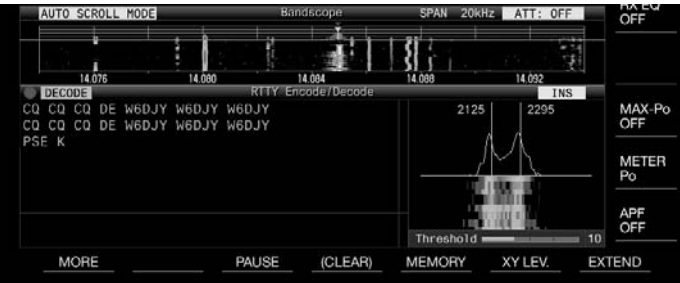
> - While the reduced bandscope is displayed, the horizontally arrayed F keys are switched to the function keys of the configuration screen and thus the bandscope settings cannot be changed.

Switching the Scope Display Mode

1 **Display the bandscope screen.**

2 **Press F2 [S.MODE].**
   • If **F2 [S.MODE]** is not displayed, press **F1 [MORE]** to display **F2 [S.MODE]**.
   Pressing **F2 [S.MODE]** each time switches the selection to "Auto Scroll Mode", "Fixed Mode" and "Center Mode" in sequence.

Auto Scroll Mode (AUTO SCROLL MODE)

Moves the marker of the tuning frequency to within the scope range. If the lower or upper limit of the display range is exceeded, the scope range is automatically scrolled by half a screen.

Fixed Mode (FIXED MODE)

Moves the marker of the tuning frequency to within the scope range preconfigured for each amateur band. Up to 3 scope ranges can be preconfigured for one amateur band.
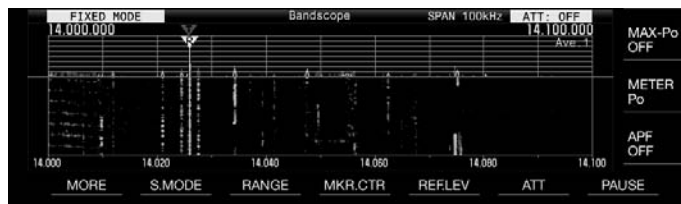
Center Mode (CENTER MODE)

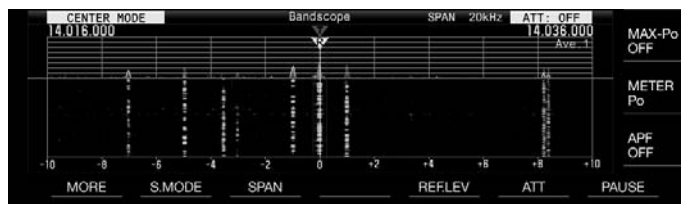The marker of the tuning frequency is normally fixed at the center.

Auto Scroll Mode
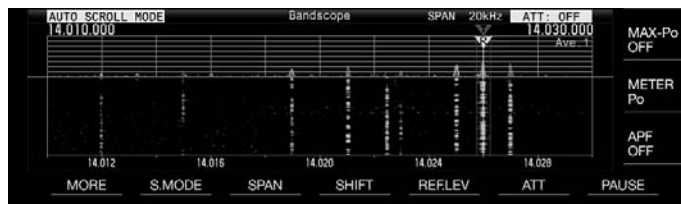
Fixed Mode

Center Mode

Switching the Display Frequency Span

When the bandscope is displayed in the Auto Scroll mode or Center mode, the display frequency span (the width between the lower and upper frequency limits in the bandscope screen) can be adjusted.

● **Press F3 [SPAN].**
   • If **F3 [SPAN]** is not displayed, press **F [MORE]** to display **F3 [SPAN]**.
   Pressing **F3[SPAN]** each time switches the frequency span.

Setting Value	5kHz/ 10kHz/ 20kHz/ 30kHz/ 50kHz/ 100kHz/ 200kHz/ 500kHz

   • The display frequency span can be configured separately for audio mode (SSB/AM/FM (including DATA mode)) and non-audio mode (CW/FSK/PSK).
   • The default settings of the audio mode and non-audio mode are "50Hz (± 25Hz)" and "10kHz (± 5Hz)" respectively.
   • Pressing and holding **F3[SPAN]** each time switches the options in the reverse sequence.
   • The selected display frequency span is displayed in the toolbar of the bandscope screen as "SPAN 50kHz", for example.

Marker Shift

This function shifts the scope range in the auto scroll mode operation so that the marker is displayed at an easy to observe position.

Shifting the Marker

● **Press F4 [SHIFT].**
   • If **F4 [SHIFT]** is not displayed, press **F [MORE]** to display **F4 [SHIFT]**.
   The marker shifts close to the preset shift position (default value is center).

> ● Depending on the relationship between the RX frequency and the span, deviation of 1 grid to the left or right may occurred in the shift operation.

Changing the Shift Position of Marker Shift

1 **Press and hold F4 [SHIFT].**
   • If **F4 [SHIFT]** is not displayed, press **F [MORE]** to display **F4 [SHIFT]**.
   The transceiver enters the shift position configuration mode. The value indicating the position of the selected vertical grid line is displayed.

2 **Move the shift position to the desired position using the [MULTI/CH] control.**
   • Pressing and holding **F4 [SHIFT]** moves the shift position to the center.

3 **Press F4 [SHIFT].**
   The transceiver exits the shift position configuration mode.

> ● When observing the condition of the frequency calling the DX station or the condition in the RX passband during digital communication such as FT8, change the shift position of the marker to display the RX frequency marker at the edge. Doing so widens the width for displaying the signal compared to when the marker is near the center.

Expand

This function expands the frequency range for spectral analysis to prevent the waterfall display from being interrupted when the frequency is changed while in the auto scroll mode or center mode (when the waterfall display during tuning is configured to "Straight").

● **Press F1 [MORE] followed by F2 [EXPAND].**
Pressing **F2 [EXPAND]** each time toggles the expand function between ON and OFF.
  - When the expand function is ON, "Expand" is displayed below the lower frequency limit display.
  - When the expand function is ON, the image becomes slightly grainy.
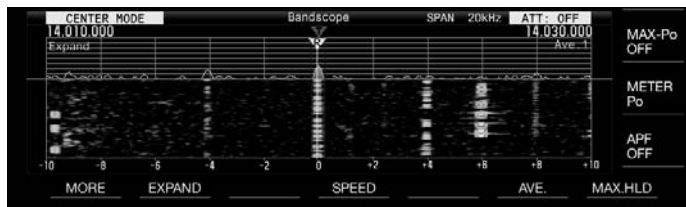
Scope Range of Each Band (Fixed Mode)

The steps to configure the scope range for each of the amateur bands when the bandscope is displayed in the Fixed mode are described below. Three types of scope range are available for selection for each band.

Switching the Scope Range

● **Press F3 [RANGE].**
  - If **F3 [RANGE]** is not displayed, press **F [MORE]** to display **F3 [RANGE]**.
Pressing **F3 [RANGE]** each time switches the scope range.

Setting Value	Range No.1 (default)/ Range No.2/ Range No.3

Configuring the Scope Range

1 **Press and hold F3 [RANGE] to display the screen for configuring the scope range in the Fixed mode.**

2 **Press F3 [RANGE] to select the scope range "Range No.1", "Range No.2" and "Range No.3".**

3 **Press F4 [LOWER] or F5 [UPPER] to select the frequency to adjust.**

4 **Press F6 [–]/ F7 [+] or turn the [MULTI/CH] control to select the frequency.**

- Details of the configurable frequency range are shown in the table below.

Band	Configurable Frequency Range [MHz]	Range No.	Default Lower Limit [MHz]	Default Upper Limit [MHz]
LF Band	0.03 ≦ f < 0.300	1	0.130	0.140
		2	0.130	0.140
		3	0.130	0.140
MF Band1	0.300 ≦ f < 0.522	1	0.470	0.480
		2	0.470	0.480
		3	0.470	0.480
MF Band2	0.522 ≦ f < 1.705	1	0.750	1.250
		2	0.750	1.250
		3	0.750	1.250
1.8 MHz Band	1.705 ≦ f < 2.00	1	1.800	2.000
		2	1.800	1.840
		3	1.840	2.000
3.5 MHz Band	2.00 ≦ f < 4.00	1	3.500	4.000
		2	3.500	3.600
		3	3.600	4.000
5 MHz Band	4.00 ≦ f < 6.00	1	5.000	5.500
		2	5.000	5.500
		3	5.000	5.500
7 MHz Band	6.00 ≦ f < 8.00	1	7.000	7.300 (K type) 7.200 (E type)
		2	7.000	7.125 (K type) 7.050 (E type)
		3	7.125 (K type) 7.050 (E type)	7.300 (K type) 7.200 (E type)
10 MHz Band	8.00 ≦ f < 11.00	1	10.100	10.150
		2	10.100	10.130
		3	10.130	10.150
14 MHz Band	11.00 ≦ f < 15.00	1	14.000	14.350
		2	14.000	14.150 (K type) 14.100 (E type)
		3	14.150 (K type) 14.100 (E type)	14.350
18 MHz Band	15.00 ≦ f < 20.00	1	18.068	18.168
		2	18.068	18.110
		3	18.110	18.168
21 MHz Band	20.00 ≦ f < 22.00	1	21.000	21.450
		2	21.000	21.200 (K type) 21.150 (E type)
		3	21.200 (K type) 21.150 (E type)	21.450

Band	Configurable Frequency Range [MHz]	Range No.	Default Lower Limit [MHz]	Default Upper Limit [MHz]
24 MHz Band	22.00 ≦ f < 26.00	1	24.890	24.990
		2	24.890	24.930
		3	24.930	24.990
28 MHz Band	26.00 ≦ f < 30.00	1	28.000	28.500
		2	28.000	28.300 (K type) 28.200 (E type)
		3	28.300 (K type) 28.200 (E type)	28.800 (K type) 28.700 (E type)
50 MHz Band	30.00 ≦ f < 60.00	1	50.000	50.500
		2	50.000	50.100
		3	50.100	50.300
70 MHz Band (E Type)	30.00 ≦ f < 74.80	1	70.000	70.500
		2	70.000	70.250
		3	70.250	70.500

Marker Centering (Fixed Mode)

The scope range can be shifted temporarily with the display frequency span maintained such that the marker of the selected amateur band is displayed near the center (within one grid to the left or right from the center).

● **Press F4 [MKR.CTR].**
   • If **F4 [MKR.CTR]** is not displayed, press **F [MORE]** to display **F4 [MKR.CTR]**.
   The scope range is shifted with the frequency span maintained.
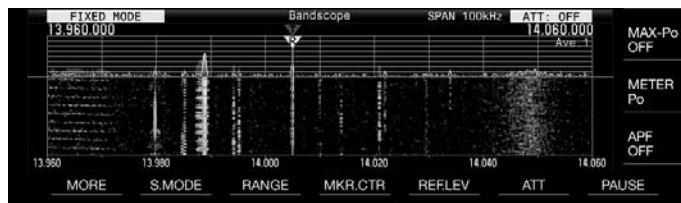
📝 ● Changes in the lower and upper frequency limits due to the marker centering operation are temporary, and does not alter the preconfigured lower and upper frequency limits of the scope band in question.

## Notification on Exceeding the Lower or Upper Limit (Fixed Mode)

If the marker frequency falls outside the display range of the bandscope when a frequency marker is displayed on the bandscope in the Fixed mode, a display appears to inform the user that the marker has moved out of the bandscope range.
A "◁" icon appears at the left edge of the bandscope screen if the marker frequency value is smaller than the lower frequency limit, and a "▷" appears at the right edge if the marker frequency value is larger than the upper frequency limit.
The markers indicating that the lower or upper limit is exceeded are color coded as follows.
White: RX frequency
Red: TX frequency
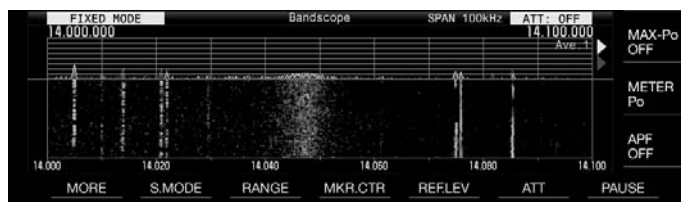
Selecting Relative or Absolute Frequency Display for the Grid (Center Mode)

During carrier point center display in the Center mode, the mode of frequency scale display at the bottom of the bandscope can be switched to one of the options available.

● **Configure in Menu [8-06] "Frequency Scale (Center Mode)"**

Setting Value	Relative Frequency (default)/ Absolute Frequency

Relative Frequency: The frequency scale display at the bottom of the scope area represents the relative frequency from the center of the scope.
Absolute Frequency: The frequency scale display at the bottom of the scope area represents the absolute frequency.
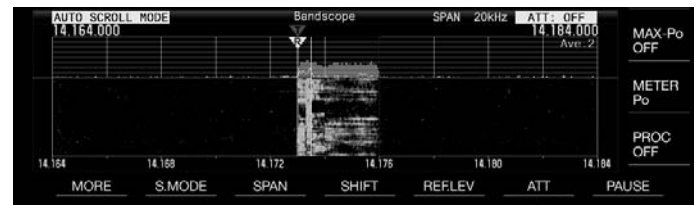
Displaying Tuning Assist Line (SSB Only)

A tuning auxiliary line (yellow) referred to as assist line can be displayed parallel to the RX frequency marker during operation in the SSB mode.
Set the assist line at 400 Hz to 500 Hz (near the peak of a typical frequency spectrum of a human voice) for voice communication and at the frequency of the subcarrier for data communication.
Zero-in can be performed easily by adjusting the assist line to the strongest point of the spectrum on the waterfall.

● **Configure in Menu [8-05] "Tuning Assist Line (SSB Mode)"**

Setting Value	Off (default)/ 300/ 400/ 500/ 600/ 700/ 800/ 1000/ 1500/ 2210 [Hz]

📝 ● This function works in the Center mode only when Menu [8-03] "Waterfall when Tuning (Center Mode)" is configured to "Straight".
   ● The tuning assist line is displayed on the upper side with respect to the carrier point in the case of USB and on the lower side in the case of LSB.

Configuring the Gradation of the Waterfall

The amount of color change with respect to the signal strength in the waterfall display can be configured from a scale of 1 to 10. Configuring a larger value increases the amount of color change making it easier to find weak signals. Configuring a smaller value reduces the amount of color change making it easier to observe strong signals.

● **Configure in Menu [8-04] "Waterfall Gradation Level"**

Setting Value	1 to 7 (default) to 10 (1 step)

Touchscreen Tuning

This function enables signals to be received by touching the desired point in the spectrum scope display area or waterfall display area.
- When in the Auto Scroll mode and Fixed mode, touching a point moves the marker to the corresponding frequency.
- When in the Center mode, touching a point sets the corresponding frequency as the center frequency.
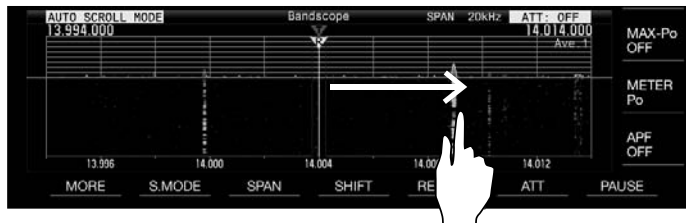
Turning ON/OFF Touchscreen Tuning

● Configure in Menu [0-14] "Touchscreen Tuning"

Setting Value	Off/ On (default)

📝 ● The following operations are prohibited even when touchscreen tuning is ON.
- When the frequency lock function is ON.
- When the memory channels are empty or when temporary change of memory channels is disabled.
- When an area outside the frequency range of the memory channel for specific band segments is touched.
- During transmission.
- When the TX frequency is received by TF-SET while only XIT is ON during simplex operation.

Correction steps for touchscreen tuning

● Touch with a finger on the corresponding point in the spectrum scope or waterfall display screen where signal is to be received.
- Step correction is performed according to the frequency step size of the **[MULTI/CH]** control configured in Menu [3-01] to [3-05] for each mode.
- Touching and holding in the CW mode activates the CW auto tune function.
- Step correction is always performed in the FM/AM mode.
- For the SSB/CW/FSK/PSK mode, configure to turn ON/OFF the step correction operation in Menu [8-7] as follows.

Turning ON/OFF Step Correction

Configure to turn ON/OFF the step correction operation during touchscreen tuning in the SSB/ CW/ FSK/ PSK mode.

● Configure in Menu [8-07] Touchscreen Tuning Step Correction (SSB/ CW/ FSK/ PSK)

Setting Value	Off/On (default)

TX/RX Frequency Marker Display

The positions of the TX and RX frequencies are indicated as markers on the bandscope screen.
During split operation, the TX frequency can be changed easily by moving the TX frequency marker to the desired frequency while monitoring the bandscope screen.
The markers are color coded as follows.
    White: RX Frequency
    Red: TX Frequency

📝 ● The RX frequency before TF-SET is performed appears as purple line while **[TF-SET]** is pressed.

Registering Frequency Marker

When a preferred frequency (up to 50 entries) is registered to the frequency marker list, the registered frequency is indicated by a marker on the bandscope (white dotted line). Registering the edge frequency of the frequency band used in a band plan or during contesting makes it easier to check the edge frequency on the bandscope.

1 **Press [MENU].**

2 **Press and hold F [F.MKR] to display the Frequency Marker list screen.**
- If **F [F.MKR]** is not displayed, press **F [MORE]** to display **F [F.MKR]**.

3 **Align with the frequency to register.**

4 **Press F4 [ADD] to register.**
- The current VFO frequency is added to the list.
- When RIT is ON, the display frequency with RIT added is registered.
- The list is automatically sorted in ascending order starting from the lowest frequency.
- If the frequency to be added is already registered, it will not be registered twice and there will be no response even when **F4 [ADD]** is pressed.
- If there are already 50 frequency entries in the list, the frequency will not be registered and pressing **F4 [ADD]** will have no response.

Deleting a Registered Frequency

1 **Press F2 [⬒]/ F3 [⬓] or turn the [MULTI/CH] control to select the frequency to delete.**
2 **Press and hold F5 [(DELETE)] to delete.**

Turning ON/OFF Marker Function

1 **Press [MENU].**
2 **Press F [F.MKR].**
    • If **F [F.MKR]** is not displayed, press **F [MORE]** to display **F [F.MKR]**.
    • Pressing **F [F.MKR]** each time toggles the marker function between ON and OFF.

Displaying the Maximum Value in the Waveform

The maximum value of the waveform shown on the spectrum scope screen can be displayed to get a better grasp of the signal status.

Turning ON/OFF Maximum Value Display

● **Press F1 [MORE] followed by F7 [MAX.HLD].**
Pressing **F7 [MAX.HLD]** each time toggles the maximum value display between ON and OFF.

Configuring the Hold Type

Select the method of displaying the maximum value of the waveform.

● **Configure in Menu [8-02] "Bandscope Maximum Hold"**

Setting Value	10 [s] (default)/ Continuous

10 [s]: Maximum value information is cleared after 10 seconds.
**Continuous:** Maximum value information is not cleared.

> ● The maximum value information is cleared automatically if the range of the span displayed changes regardless of whether "10 [s]" or "Continuous" is selected.

Pausing the Waveform Display

The waveform display on the bandscope screen can be paused.

● **Press F7 [PAUSE] to pause the waveform display.**
    • When the waveform display is paused, << PAUSE >> is displayed on the screen.
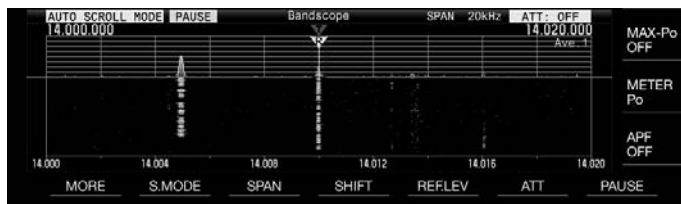
    • Pressing **F7 [PAUSE]** again cancels the paused state.

Averaging of Spectrum Scope Waveform

Averaging the waveform on the spectrum scope smoothens the changes in the waveform display making it easier to observe the intermittent signals.

● **Press F1 [MORE], then press F6 [AVE.] to switch the averaging level.**
    • Pressing **F6 [AVE.]** each time switches the selection in the following sequence: "Off" (averaging disabled) → "1" (minimum) → "2" → "3" (maximum) → "Off". The averaging level selected is displayed at the top right corner of the grid.
    • Pressing and holding **F6 [AVE.]** each time switches the options in the reverse sequence.
    • The averaging level can be configured separately for audio mode (SSB/AM/FM (including DATA mode)) and non-audio mode (CW/FSK/PSK).
    • The default settings of the audio mode and non-audio mode are "2" and "1" respectively.

Displaying the TX Signal Waveform

A waveform for the TX signal can be displayed when a bandscope for transmission is displayed in the Center mode.

● **Configure in Menu [8-00] "Bandscope Display during TX"**

Setting Value	Off (default)/ On

On: Displays the TX waveform in the bandscope while transmission is in progress.
Off: Does not display the waveform in the bandscope while transmission is in progress.

> ● The setting for this function cannot be switched while transmission is in progress.
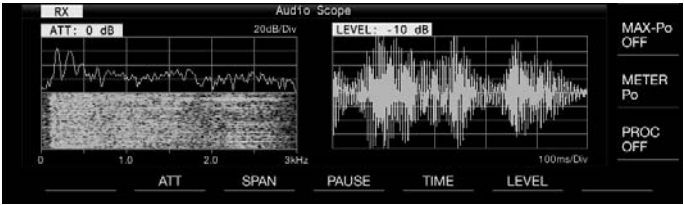
Audio Scope

The TX/RX audio can be displayed on an "audio scope screen" where a spectrum scope and an oscilloscope are displayed as well as on a "multi scope screen" where a reduced display of the bandscope appears at the top together with the "audio scope screen".

Displaying the Audio Scope

● **Press and hold [SCP] to display the Audio Scope screen.**
Pressing and holding **[SCP]** each time toggles the display between "Audio Scope" and "Bandscope".

Audio Scope Screen

Left: Spectrum scope
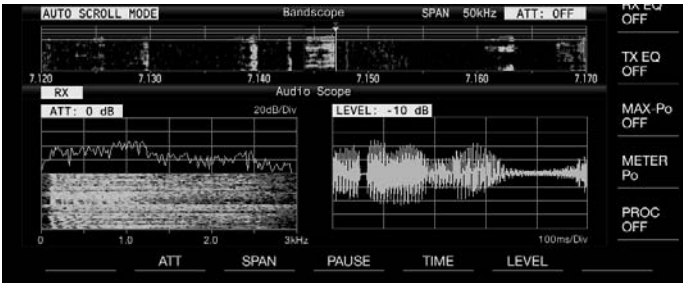Right: Oscilloscope

Switching the Audio Scope Display Type

1 **Display the Audio Scope screen.**

2 **Press [SCP].**
Pressing **[SCP]** each time switches the selection in the following sequence.
"Audio Scope screen"
↓
"Multi Scope screen"
↓
No scope display (ends scope display)

Multi Scope Screen

Top: Reduced bandscope display
Left: Spectrum scope
Right: Oscilloscope

3 **Press [ESC] to end the display.**

Switching the Spectrum Scope Attenuator

By switching the attenuator for the spectrum scope, the spectrum display can be adjusted to a level that is easy to see.

● **Press F2 [ATT].**
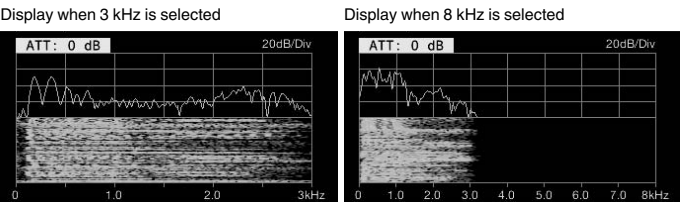Pressing **F2 [ATT]** each time switches the attenuator.

Setting Value	Off (default)/ 10 dB/ 20 dB/ 30 dB

• Pressing and holding **F2 [ATT]** each time switches the options in the reverse sequence.
• The current setting is displayed at the top of the spectrum scope.

Switching the Display Frequency Span of the Spectrum Scope

The display frequency span of the spectrum scope can be configured to 3 kHz or 8 kHz. Configure the display frequency span to an appropriate setting according to the filter band setting and frequency to observe.

● **Press F3 [SPAN].**
Pressing **F3 [SPAN]** each time toggles the span between "3 kHz (default)" and "8 kHz".

Display when 3 kHz is selected   Display when 8 kHz is selected

Switching the Oscilloscope Level

By switching the vertical level of the oscilloscope, the amplitude of the waveform can be adjusted to a size that is easy to see.

● **Press F6 [LEVEL].**
Pressing **F6 [LEVEL]** each time switches the level.

Setting Value	0 dB (default)/ -10 dB/ -20 dB/ -30 dB

• Pressing and holding **F6 [LEVEL]** each time switches the options in the reverse sequence.
• The current setting is displayed at the top of the oscilloscope.

Switching the Sweep Time

Switching the sweep time of the oscilloscope alters the time range of the oscilloscope display. The sweep time can be adjusted according to the status of the signal to be observed.

● **Press F5 [TIME].**
Pressing **F5 [TIME]** each time switches the sweep time.

Setting Value	1 ms/ Div/ 3 ms/ Div/ 10 ms/ Div/ 30 ms/ Div/ 100 ms/ Div (default)/ 300 ms/ Div

• Pressing and holding **F5 [TIME]** each time switches the options in the reverse sequence.
• The sweep time is displayed at the bottom of the oscilloscope.

Pausing the Audio Scope

When the waveform displayed on the Audio Scope screen is paused, the waveform is maintained until it is unpaused. The audio scope can be paused to enable analysis of the waveform without being interrupted whenever the display is refreshed.

● **Press F4 [PAUSE] to pause the waveform display.**
• When the waveform display is paused, << PAUSE >> is displayed and both the spectrum scope on the left and the oscilloscope on the right stop refreshing temporarily.
• Pressing **F4 [PAUSE]** again cancels the paused state.