

# By Digital Signal Processing

## Versatile Accessory Functions

- Scan**  
 Designated memory channels can be scanned. The scanning time is user-defined.
- Sweep**  
 Designated frequencies can be swept. The sweep time is user-defined.
- Automatic Scan/Sweep Stop**  
 When squelch is activated during scan/sweep operation, the operation automatically stops and the frequency is received for a certain time duration.
- Mute Control**  
 The AF output of the receiver can be muted according to external grounding information.
- Clock/Timer**  
 The receiver's power supply is automatically set to on/off by setting the timer. Relay contact output can also be turned on/off.
- Sleep Timer**  
 The sleep timer is provided to automatically turn the power off during bed time (180 minutes max).
- Tuning/Torque Dial**  
 The torque of the tuning dial can be freely adjusted.
- RTTY Fine Tuning**  
 The demodulating filter to receive RTTY signals can be finely adjusted.
- Dimmer Control**
- RF Attenuator**
- Direct Entry of Frequencies from Ten-Key Pad**
- Built-In Speaker**
- Tuning Dial Lock**
- Up/Down Switch**
- Record Output**
- User-Defined Function Modification**
- Others**

## Options



■CHE-199  
Wide-Band Converter Unit

■6ZCJD00350  
RS-232C Cable



■ST-3  
Headphones  
Weight: Approx. 300g



■CGD-197  
Temperature Compensated X'tal Oscillator (TCXO)



■NVA-319  
External Speaker  
Impedance: 8 ohms  
Max. input: 3W  
Dimensions: 180W×130H×280D mm  
Weight: Approx. 3kg

## Specifications

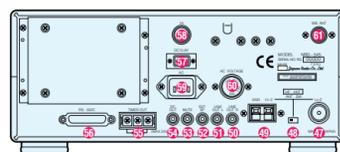
- Frequency range:** 0.1 to 29.999999MHz with option board (CHE-199) installed
- NRD-545G:** 100kHz to 1999.999MHz
- NRD-545U:** 849.100MHz to 868.900MHz  
894.100MHz to 1849.900MHz  
1910.100MHz to 1929.900MHz  
1990.100MHz to 1999.999MHz
- Type of reception:** USB,LSB,CW,RTTY,AM,FM WFM(with option board installed)
- Frequency stability:** ±10ppm or less for 5min. to 60min. after tuning the power on, thereafter ±2 ppm or less per hour, and ±0.5 ppm or less (with option TCXO installed)
- Adjustable Minimum tuning step:** 1Hz (10Hz, 100Hz, 1kHz, 5kHz, 6.25kHz, 9kHz, 10kHz, 12.5kHz, 20kHz, 25kHz, 30kHz, 50kHz or 100kHz steps available)
- Frequency memory:** 1000 channels (Frequency, mode, bandwidth, ATT, AGC, and tuning step)
- Receiving system:** Triple superheterodyne  
1st IF 70.455MHz  
2nd IF 455kHz  
3rd IF 20.22kHz
- Dynamic range:** 106dB (300Hz IF bandwidth)
- Image rejection:** 70dB or more
- Spurious response:** 60dB or more
- IF rejection:** 70dB or more
- PBS variable range:** ±2.3kHz (in 50Hz steps)
- Notch filter attenuation:** 40dB or more  
Notch variable range ±2.5kHz (in 10Hz steps)  
Notch tracking range ±10kHz
- Antenna impedance:** 50 ohms (Lo-Z terminal)  
600 ohms (Hi-Z terminal)
- Antenna input attenuator:** Approx. 20dB
- AGC characteristics:** The AF output varies 10dB or less for the antenna input of 3 μV to 100mV  
Release time:40msec. to 5.1sec. (20msec. steps)

	USB,LSB,CW,RTTY	AM	FM	WFM
0.1-0.499999 MHz	14dBμ(5μV)	24dBμ(15.8μV)	—	—
0.5-1.599999 MHz	6dBμ(2μV)	16dBμ(8.3μV)	—	—
1.6-29.999999 MHz	-10dBμ(0.32μV)	6dBμ(2μV)	-6dBμ(0.5μV)	—
30-1000 MHz	—	10dBμ(3.2μV)	-2dBμ(0.8μV)	—
1260-1300 MHz	—	10dBμ(3.2μV)	-2dBμ(0.8μV)	6dBμ(2μV)

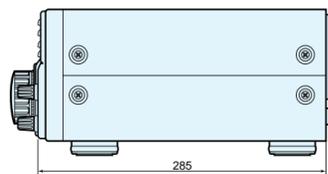
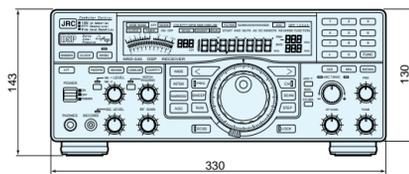
Bandwidth:(USB/LSB/CW/RTTY/AM) 2.4kHz  
S/N:10dB Modulation (AM):400Hz,30% (at AM measurement)  
12dB SINAD (FM/WFM)  
\*Fitted with option board for 30MHz or more.

	Bandwidth	6dB	60dB	
WIDE	4.5kHz	4.5kHz or more	8kHz or less	Left bandwidths in WIDE, INTER, and NARROW are examples, but variable between 0.01 to 9.99kHz (except for AMS, FM and WFM).
INTER	2.4kHz	2.4kHz or more	5kHz or less	
NARROW	1kHz	1.0kHz or more	4kHz or less	
FM	10kHz	10kHz or more	—	

## Dimensions



- ① Antenna connector (low impedance)
- ② Antenna switch
- ③ Antenna terminal (high impedance)
- ④ Line output (R) jack
- ⑤ Line output (L) jack
- ⑥ External speaker jack
- ⑦ MUTE terminal
- ⑧ DC output jack
- ⑨ Timer output terminal
- ⑩ RS-232C connector
- ⑪ DC power connector
- ⑫ Fuse holder
- ⑬ AC power connector
- ⑭ AC voltage selector
- ⑮ Wide band antenna connector



Specifications and appearance may be subject to change without notice.

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**JRC**

DSP RECEIVER  
**NRD-545**

*Enjoy Clear Digital Sound!*



**JRC** Japan Radio Co., Ltd.

# Clear, Distortion-Free Sound Reproduced

The quality of radio reception, especially in the shortwave bands, is greatly affected by the performance of the receiver, because of the high density of the shortwave radio spectrum and its wide dynamic range (of small to large signals). The receiver's sensitivity (capacity of receiving small signals) is constricted by the noise from the space or the atmosphere, and by the internal noise generated by the receiver itself, while the capacity of handling large signals is affected by intermodulation between strong radio signals.

If it is required to reject intermodulation distortion over a wide dynamic range, then digital signal processing (DSP) achieves a remarkable advantage. Signal quantization (conversion of analog signals to digital quantities) is performed in a completely linear domain over the entire range, thus never generating any intermodulation distortion.

The NRD-545 DSP Receiver is loaded with a 40-bit extended floating point DSP IC (digital signal processor IC), a  $\Delta\Sigma$ -type 18-bit over-sampling A/D converter, and a 16-bit D/A converter. The DSP IC performs signal processing in all the circuits after the intermediate frequency (IF) stage. The functions of 13 types of circuits after the IF stage, which have previously been configured as analog circuits, are now handled by the DSP IC.

The digital IF filter, one of the DSP features, provides a sharper attenuation gradient and frequency characteristic than a crystal filter, thus allowing continuous bandwidth adjustment. All traditional crystal filters and mechanical filters that have previously determined the selectivity characteristics of receivers are eliminated from the new DSP receiver.

In addition to JRC's recognized receiver front end, complete digital signal processing in all the circuits after the IF stage has been realized. Thus, the new-generation NRD-545 receiver has come into the world.

Digital signal processing uses an algebraic operation method for signal detection, generation, inference, processing, or transmission. Compared to analog signal processing circuits, digital signal processors are more advantageous: They only require less precise components; they are robust against drift and interference; they are easier to integrate with high precision; and they offer greater flexibility with software processing.

The DSP IC consists of a multiplier, an adder-subtractor, and a memory (shift register). The digital signal processing algorithm is based on repetition of operations such as data readout from the memory, multiplication, addition and subtraction.

## Digital Signal Processing by One-Chip DSP

**DSP All-Mode Detection**  
The DSP IC performs signal detection in all the modes including LSB, USB, CW, RTTY, FM, AM and ECSS (Exalted Carrier Selectable Sideband).

**DSP Digital IF Filter**  
Superior selectivity performance is achieved by a simultaneous Chebyshev type digital IF filter with an IIR (infinite impulse response) configuration. Pass bandwidth is continuously adjustable in a range of 10Hz to 9.99kHz in 10Hz steps (BWC). Default values can also be set for each mode in NARROW, INTERmediate, and WIDE positions (except for AMS, FM and WFM modes).

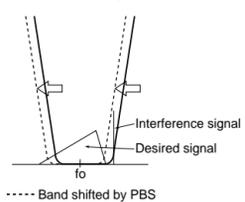


One-chip DSP

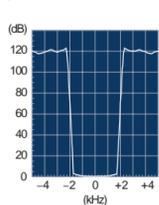
## DSP Pass-Band Shift (PBS)

Radio interference is pushed out of the band by shifting the center frequency of the digital IF filter upward or downward in the variable range of within  $\pm 2.3$ kHz (in 50Hz steps).

### ●PBS concept



### ●Digital filter simulation curve

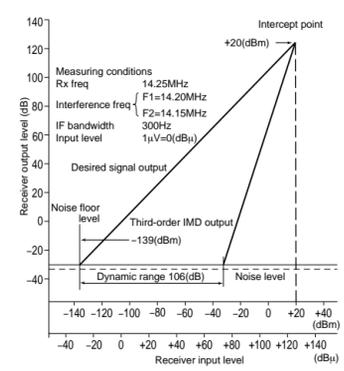


# By Digital Signal Processing

## High Sensitivity & Wide Dynamic Range

A wide dynamic range and improved sensitivity is achieved by four junction type FFTs with low noise and superior cross modulation characteristic which are used each in the first-stage RF amplifier and the first mixer. The RF amplifier employs a high power gain circuit in which 4 FETs are interconnected in parallel in order to improve the receiving sensitivity. For the first mixer, a double-balanced mixer with 4 FETs in a quadruple connection is used in order to reduce odd-order intermodulation distortion (IMD).

### ●Dynamic range



## DSP Noise Reduction (NR)

Received signals become audible, emerging from mixed noise, because the spectrum of the periodic signals is enhanced while random signals such as noise are attenuated. Signal processing is adjustable in 256 steps, allowing the most audible conditions to be set. The NR feature is also very effective for such noise which the previous noise blanker has not been able to handle.

## DSP Beat Cancellor (BC)

Completely periodic signals such as beat sounds are exalted and cancelled. However, voice signals are not processed as periodic signals in this BC, but processed to be free from distortion. Signal processing can be set in 256 steps to achieve the most effective condition. The BC is also effective for multiple beats.

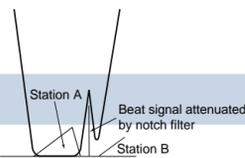
## DSP Noise Blanker (NB)

Like the previous noise blanker, this NB detects noise amplitudes and removes noise depending on the amplitude level on the time axis. NB1 (narrow blanking width) and NB2 (wide blanking width) can be switched over, and the NB detection level is adjustable.

## DSP Notch Filter (NOTCH)

Beat sounds are attenuated (at 40dB or more) using the steep attenuation characteristic of the IIR notch filter. Despite its steep characteristic, beat sounds are digitally processed and stably attenuated when once the NOTCH is preset. It is adjustable within  $\pm 2.5$ kHz in 10Hz steps. With the notch tracking set to ON, the notch filter follows in the range of  $\pm 10$ kHz even when the tuning dial is rotated.

### ●Notch filter characteristic



## DSP AGC

Digital AGC is applied to all modes except in the WFM mode. An AGC loop is not only configured inside the DSP, but AGC is also applied to the primary IF amplifier via a D/A converter. Although the discharge time constant is fixed in the FM, WFM, AM and AMS modes, AGC is continuously adjustable between 0.04sec. and 5.1sec. in 20 msec. steps in the other modes.

## DSP BFO

The beat frequency oscillator (BFO) generates the BFO signals to demodulate the received signals in the LSB, USB, CW and RTTY modes.

## DSP RF Gain

The information transferred to the RF GAIN control via the A/D converter is entered into the DSP to adjust the gain inside the DSP and the gain of the primary IF amplifier.

## DSP Squelch (SQ)

The squelch function is operated in all the modes. If an input signal is small, noise squelch is activated, while signal level squelch is operated as the input signal becomes larger.

## DSP Tone Control (TONE)

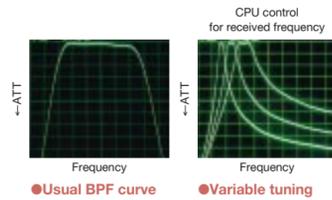
The sound quality of the audio output can be continuously adjusted in a range of the low bandwidth of 1kHz or less to the high bandwidth of 10kHz (except in the RTTY and WFM modes).

## DSP S-Meter

The signal level is determined in reference to the input signal to the DSP, and the level is converted into an antenna input level, which activates the S-meter.

## Variable Tuning for Excellent Reception

A variable tuning system (electronic variable tuning by a capacitor diode) is employed in the front-end double tuning circuit. Continuous adjustment of the center frequency of the double tuning circuit is made by a CPU depending on the received frequency. This enables unwanted radio waves to be drastically attenuated, compared with the wide-band BPF having a fixed bandwidth. As a result, multi-signal characteristics are significantly improved, ensuring enhanced receiving performance.



## RTTY Demodulator Included

As an RTTY demodulation circuit is incorporated, demodulation is available in accordance with ITU-T No.2 codes for 170, 425 and 850Hz shifting widths at 37 to 75 baud rates. Demodulated output can be indicated on the display of a computer via RS-232C interface.

## ECSS

(Exalted Carrier Selectable Sideband)

The ECSS mode reduces signal distortion due to fading and beat interference from adjacent broadcast stations. This feature enables the receiver to selectively receive either USB or LSB which is suffering interference, ensuring clear reception with less degraded sound quality. To reject distortion due to fading, the signal synchronized with the carrier of the receiving signal is generated for signal detection.

✧ Fading is a phenomenon that sound becomes large or small, causing clear sound reception to be prevented in shortwave broadcasting. This is a bottleneck in shortwave reception.

✧ In AM broadcasting, the DSB (double sideband) system is adopted in which the modulation signal is transmitted on both USB and LSB. In many cases, however, beat interference due to adjacent stations appears either USB or LSB.

## Multifunctional, Large Color LCD

The multifunctional LCD presents a digital bargraph meter which can be seen in an analog fashion. Various indications such as all-digit frequency (down to the 10-Hz digit), memory channel, mode and bandwidth are also presented on the large color LCD.



## Remote Control by Personal Computer

Remote Control from a personal computer is available. All operations including receiving frequency setting can be remotely controlled by command from a personal computer. The data such as the receiver's setting conditions and S-meter values are also read out on the display screen.

Computer control software to be run on Windows 95 is available only for reference. This software includes display of RTTY signals on a computer screen, and display of panoramic reception (radio wave travelling in the air to be seen at a glance).

✧ This feature is just an appendix. So, JRC will not take any responsibility against software failure and JRC may not take inquiry for PC operation.

## Large Memory Capacity of 1,000 Channels

The receiver incorporates a memory of 1,000 channels with lithium battery backup. Each channel can store a receiving frequency, mode, bandwidth, AGC, ATT and time of timer on/off (channel 0 to 19).

## Wide-Band Converter Unit (Option)

The CHE-199 converter unit is designed to receive a wide band of 30MHz to 2,000MHz in order to meet the need of advanced users to get various types of radio communication information. This optional board enables receiving of aeronautical radio, FM broadcast, TV broadcast and other radio waves.



## High-Stability Crystal Oscillator (Option)

All the internal synthesizers are controlled by a standard frequency oscillator. The frequency stability can be enhanced to  $\pm 0.5$  ppm by the use of the CGD-197 TCXO (temperature compensated x'tal oscillator) which is optionally available.



## Plug-In PC Boards on Mother Board

All the PC boards installed in the receiver are plug-in type. All the units are interconnected on the mother board, eliminating wiring, and ensuring enhanced reliability and serviceability.

## Refined Design and Superior Functionality

The operation panel is designed to minimize controls and switches, and to realize refined design and superior functionality.

## Actual Size



## OPERATING PANEL AND DISPLAY

- 1 ENT/kHz switch
- 2 MHz switch
- 3 CLEAR switch
- 4 Pass Band Shift control
- 5 TONE control
- 6 FINE control
- 7 AF GAIN control
- 8 AGC Time switch
- 9 Bandwidth Control switch
- 10 Channel Select switch
- 11 Up switch
- 12 Channel switch
- 13 SCAN switch
- 14 STEP switch
- 15 LOCK switch
- 16 Main tuning control
- 17 Variable torque control
- 18 Down switch
- 19 Frequency switch
- 20 SWEEP switch
- 21 RUN switch
- 22 ECSS switch
- 23 WIDE switch
- 24 INTER switch
- 25 NARROW switch
- 26 AGC switch
- 27 NOTCH control
- 28 RF GAIN control
- 29 NOTCH switch
- 30 Noise Blanker LEVEL control
- 31 Squelch LEVEL control
- 32 Noise Blanker switch
- 33 RECORD jack
- 34 POWER switch
- 35 PHONES jack
- 36 ATT switch
- 37 FM/WFM switch
- 38 AM/AMS switch
- 39 USB/LSB switch
- 40 CW/RTTY switch
- 41 DIMMER switch
- 42 CLOCK switch
- 43 Noise Reduction/Beat Canceller switch
- 44 LCD Display
- 45 Ten-key pad
- 46 Function switch