

Figure 1-1. Overall View, RA6790/GM HF Receiver

SECTION I GENERAL DESCRIPTION

1.1 ELECTRICAL CHARACTERISTICS

The RA6790/GM HF Receiver, shown in Figure 1-1, is a fully synthesized, microcomputer-based, tunable, solid-state receiver designed to provide reception capabilities for CW(A1), AM(A3), LSB/USB (A3J), FM(F3) and ISB (A3B-Optional), emissions over the frequency range of 0.5 MHz to 30 MHz. Frequency tuning is accomplished by either keyboard entry (numerical keypad) or single knob control for continuous tuning with selectable rates, FAST (1000 Hz), SLOW (30 Hz), FINE (1 Hz) increments and BFO continuous in 10 Hz increments. Front panel indication of frequency data are presented as 8 LCD (Liquid Crystal Display) digits of tuned frequency and 3 digits and sign readout of BFO data relative to IF Center ± 8.0 kHz. Other front panel displays are: RF Meter, AF Meter, Bandwidth, AGC, Mode, Remote and Fault indication (LED). Additionally, provision is made on the front panel, selectable by use of the RF Gain Control, to manually control the AGC threshold anywhere within the range of 110 dB above the preset AGC threshold level.

Full remote control (optional) of all Receiver parameters is available by either; (1) serial asynchronous, ASCII character-oriented with strap selectable baud rate of 50 baud to 19.2 kilobaud, selectable MIL-STD-188C or EIA Standard RS-232-C/RS-422/RS-423 compatible, 2-byte-serial, (2) byte-serial bit parallel IEEE standard 488C-1978 compatible or (3) other user specified interface format.

Built-In Test Equipment (BITE) is provided in the Receiver circuitry to find, test and report operational status to the lowest replaceable unit (LRU) with both local and remote notification.

The internal frequency tuning circuitry of the Receiver includes a single loop digital 1st LO Synthesizer, phase lock loop 2nd LO and BFO Synthesizers, which in combination determine tuned frequency to a resolution of 1 Hz. The synthesized BFO tunes ± 8 kHz in 10 Hz increments with a pushbutton selectable parameter for immediate zero reference.

The Receiver is designed to operate with up to seven IF filters, using slots provided on the Main IF/AF circuit card assembly. Unless otherwise specified, the Receiver is factory equipped with six mechanical filters and one bypass link to provide seven selectable bandwidths. Audio output of the Receiver is either through a PHONES jack on the front panel or through an AF OUT connector on the rear panel. The PHONES jack provides a nominal 10 milliwatts into 600 ohms and is adjustable through the AF GAIN control on the front panel. The AF OUT connector provides a nominal 1 milliwatt, 600 ohm balanced line output and an output of nominally 1 Watt in 8 ohms, suitable for an 8 ohm speaker.

Rear panel features include BNC connectors for providing the Receiver second IF 455 kHz output, supplying or receiving external/internal reference signals used in conjunction with a slide switch, S2. A 25-pin D-type connector provides audio, AGC and fault status outputs while an N-type connector provides RF input from an external antenna. An optional remote control interface connector, either round 26 pin (188C/232C/422/423) or elongated 24 pin (IEEE-488), is provided when specified. A standard 3 prong male connector for connection of an ac line cord completes the rear panel assembly.

Input signals from the antenna are connected to a low pass filter which rejects signals above 30 MHz. The output of this filter is then coupled to a mixer stage where the RF signal is mixed with the synthesized local oscillator signal. The frequency of the local oscillator can be varied

from 40.955 to 70.455 MHz. This signal is brought through a filter and AGC controlled amplifier stages to the second mixer.

The 40.455 MHz first IF is combined with the fixed 40 MHz output from the second oscillator synthesizer to produce a 455 kHz second IF. After amplification, this second IF is routed to the plug-in 455 kHz filters which provides the main Receiver selectivity.

A second AGC-controlled amplifier follows before demodulation takes place. In the SSB/CW/AM modes, a product synchronous detector is used. In the CW mode, the BFO synthesizer may be varied ± 8 kHz (above or below the 455 kHz center frequency) through front panel controls. For FM reception, the 455 kHz second IF is input to a limiting amplifier and subsequently to a separate FM detector. All three outputs from the synthesizers are referenced to an internal 5 MHz standard frequency source, or to an external reference of 1 MHz. The demodulated signal is fed through an audio crosspoint switch to separate AF amplifiers which provide outputs for a 600 ohm line, a head-phone jack, and an external loudspeaker.

For ISB operation, the optional ISB board provides the LSB signal path, while the main IF/AF board provides the USB signal path. The LSB component of the 455 kHz second IF is processed through similar circuitry with the common BFO synthesizer providing the reinserted carrier for demodulation. A separate audio amplifier provides a 600 ohm line output.

All command signals, whether from the front panel controls or from an extended or remote operating position, are processed by the microcomputer assembly. Two separate buses carry control data and address information to and from the microcomputer control assembly to the synthesizers for frequency selection, and to the appropriate switching circuits controlling the different operating modes.

1.2 MECHANICAL CHARACTERISTICS

The RA6790/GM Receiver mounts in a standard 19-inch (48.3 cm) equipment rack, and occupies 5.25 inches (13.33 cm) of vertical space, 19 inches (48.3 cm) wide, 18.5 inches (47 cm) deep and weighs 30 pounds (13.5 kg).

A rigid, die-cast full width chassis is used as the base for the main frame of the Receiver. Mounted within compartments on the underside of this chassis are the mixer boards and the frequency generation system. The input low pass filter, main IF/AF, optional ISB IF/AF and power supply modules are located on the top surfaces of the die-cast chassis while the control and digital I/O modules are attached on the Receiver main frame. All modules are accessible for maintenance and can be removed or replaced using simple hand tools without the use of a soldering iron.

Manual controls and indicators for operation and monitoring of the Receiver are contained on the front panel while input/output jacks and connectors are provided on the rear panel. A PHONES jack, for audio connection to optional headphones, is contained on the front panel for convenient access. A primary power fuse is accessible from the rear panel.

1.3 EQUIPMENT SUPPLIED

The equipment supplied consists of the following:

1. RA6790/GM HF Receiver
2. W18, Primary Power Input Cable
3. Connector, Mating for J3

4. Six Mechanical Filters.
Unless otherwise specified the filters shall conform to Racal part numbers 07883-1 thru 07883-6. Refer to Paragraph 1.4, Item #2 below for details.

1.4 OPTIONAL EQUIPMENT

The following optional equipment is available for use with the RACAL RA6790/GM HF Receiver. Additional information regarding these and other options should be made through your RACAL representative or directly to RACAL Communications, Inc., Rockville, Maryland, USA.

1. Independent Sideband Module (ISB, A5);
2. Selectable IF Bandwidth Mechanical Filters:

	Bandwidth	Description	Shape Factor 3 dB: 60 dB	Racal Number
1.	0.3 kHz	Symmetrical BPF	1:6.7	07883-1
2.	1.0 kHz	Symmetrical BPF	1:4.5	07883-2
3.	3.2 kHz	Symmetrical BPF	1:2.7	07883-3
4.	4.0 kHz	Symmetrical BPF	1:2.5	3600001
5.	5.0 kHz	Symmetrical BPF	1:2.5	3600002
6.	6.0 kHz	Symmetrical BPF	1:2.3	07883-4
7.	450 Hz to 3000 Hz	ISB/USB BPF	1:1.92	07883-5
8.	450 Hz to 3000 Hz	ISB/LSB BPF	1:1.92	07883-6
9.	350 Hz to 2700 Hz	USB BPF	1:1.66	08669
10.	300 Hz to 2200 Hz	USB BPF	1:1.97	08771

Note that input and output matching capacitors are required with mechanical filters only, contained on assembly A4.

3. Selectable IF Bandwidth Crystal Filters:

The Receiver may be operated with one to seven different crystal bandwidth filters. There are currently a total of 23 different filters available; however, depending on Receiver configuration, some filters are mandatory. (Refer to the Installation Section of this manual for definition of IF Bandwidth Filter Installation.)

Bandwidth	Description	Shape Factor 3 dB: 60 dB	Differential Delay μ S	Racal Number
1.0 kHz	Symmetrical BPF	1:6	25	3600003
3.0 kHz	Symmetrical BPF	1:6	13	3600004
6.0 kHz	Symmetrical BPF	1:6	10	3600005
1.0 kHz	Symmetrical BPF	1:2.5	1080	3600006
3.0 kHz	Symmetrical BPF	1:2.5	360	3600007
6.0 kHz	Symmetrical BPF	1:2.5	180	3600008
0.125 kHz	Symmetrical BPF	1:5.33	—	08699
0.4 kHz	Symmetrical BPF	1:6.2	—	08406
1.2 kHz	Symmetrical BPF	1:6	—	08407
6.8 kHz	Symmetrical BPF	1:3.3	—	08408
350 Hz to 3050 Hz	ISB/LSB BPF	1:1.6	800	08409
350 Hz to 3050 Hz	ISB/USB	1:1.6	800	08410
0.4 kHz	Symmetrical BPF	1:2.5	2000	08411

1.2 kHz	Symmetrical BPF	1:2	1000	08412
3.24 kHz	Symmetrical BPF	1:1.33	1000	08413
6.8 kHz	Symmetrical BPF	1:2	1000	08414
16.0 kHz	Symmetrical BPF	1:2	40	08415
0.5 kHz	Symmetrical BPF	1:6	80	08416
1.0 kHz	Symmetrical BPF	1:6	40	08417
2.0 kHz	Symmetrical BPF	1:6	20	08418
3.0 kHz	Symmetrical BPF	1:6	20	08419
6.0 kHz	Symmetrical BPF	1:6	20	08420
0.075 kHz	Symmetrical BPF	1:6.67	-	08589

4. Remote Control Options (A6A1):

- a. RS-232/RS-422/RS-423 Serial Asynchronous Remote Interface Module
- b. IEEE 488C-1978 Compatible;

- 5. Improved internal frequency standard ± 3 parts 10^{-9} ;
- 6. RF Amplifier for greater receiver sensitivity;
- 7. LF/MF/HF low frequency - 10 kHz to 30 MHz;
- 8. Broadband IF output.

1.5 REFERENCE DATA

Table 1-1 identifies the technical specifications for the RA6790/GM HF Receiver. The Receiver provides reception capabilities for CW (A1), AM (A3), LSB/USB (A3J), FM (F3) and optionally ISB (A3B) operation. Figure 1-2 depicts the International Reception Mode Codes.

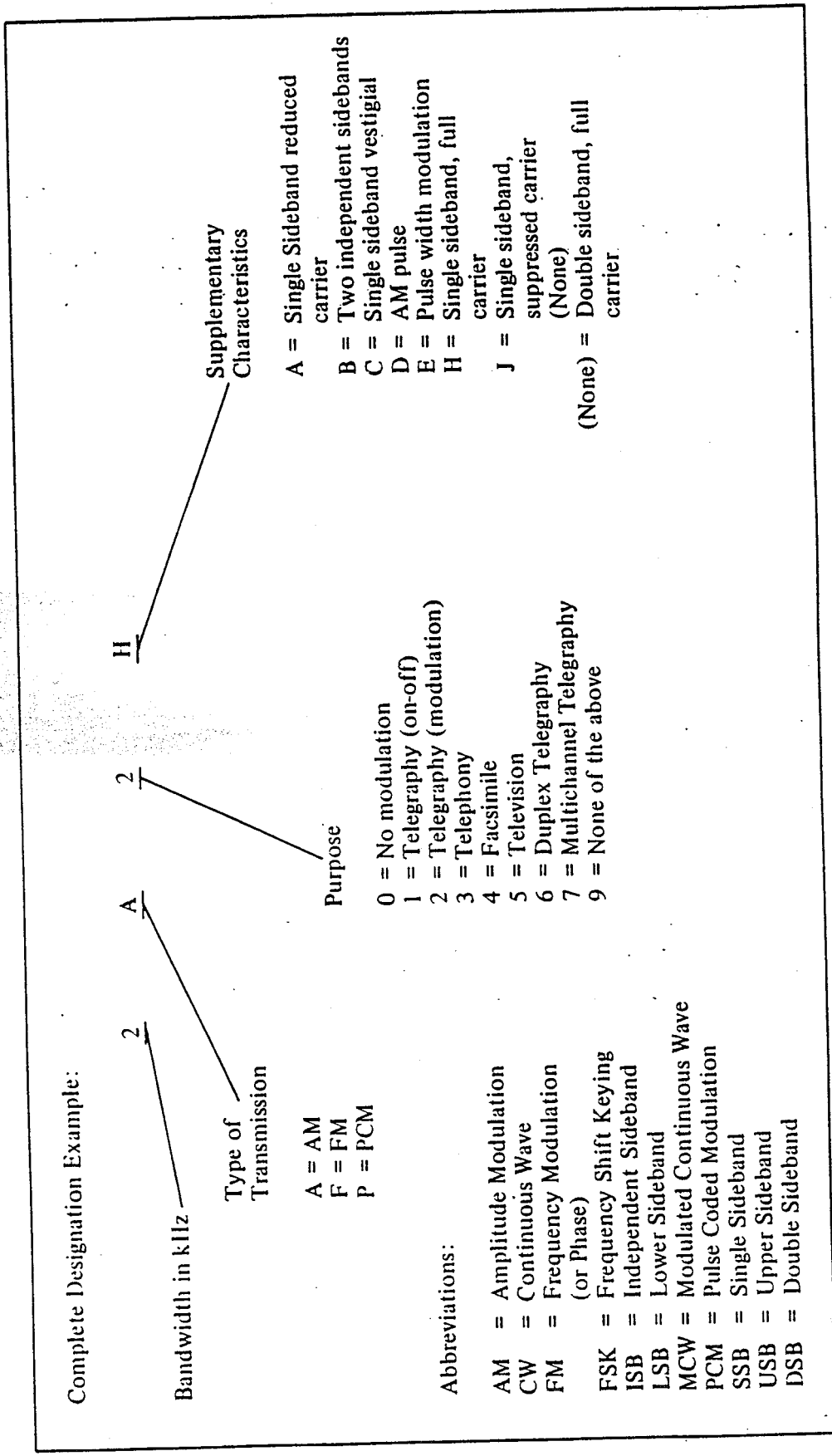


Figure 1-2. International Reception Mode Codes

TABLE 1-1. RA6790/GM HF RECEIVER SPECIFICATIONS

Frequency Range	0.5 kHz to 29.999999 MHz
Frequency Resolution	1 Hz increment
Frequency Tuning	By keyboard entry or continuous tuning with selectable rates, FAST (1000 Hz), SLOW (30 Hz), and FINE (1 Hz) increments; BFO continuous in 10 Hz increments.
Frequency Indication	8 digit electronic readout of tuned frequency to 1 Hz; 3 digit and sign readout of BFO relative to IF center ± 8.0 kHz.
Frequency Stability	± 5 parts in the 10^8 per 10°C temperature increment over the range of 0°C to 50°C using internal 5 MHz reference oscillator. Provision for an external 1, 5 or 10 MHz reference input/output. 0 dBm nominal into 50 Ohms.
Detection Modes	CW/A1 Continuous Wave; CW/A2 Modulated Continuous Wave; USB/LSB (upper/lower sideband) A3A, A3H, A3J, A2A, A2H, A2J; AM/A3 Amplitude Modulation; A4 (Facsimile) ISB/A3B Independent Side Band (optional); FM/F3 Telephony.
Gain Control Modes:	
AGC	Control Range: An increase of 110 dB above AGC threshold will result in a change of output of less than 3 dB. Threshold Range (preset): -113 dBm to -100 dBm Time Constants: Attack: 20 msecs Decay: Short < 30 msecs Medium 200 + 100 msecs Long 3.75 seconds ± 1.25 msecs
Manual/Automatic Gain Control	Provision is made on the front panel to select, and by use of the RF Gain Control, to manually control the AGC threshold anywhere within the range of 110 dB above the preset AGC threshold level.
Input Impedance	50 ohm nominal, 2:1 VSWR Type N Connector
Synthesized BFO	455 ± 8 kHz in 10 Hz steps
Noise Figure	< 15 dB
Dynamic Range	RF: > 180 dB/Hz

TABLE 1-1. RA6790/GM HF RECEIVER SPECIFICATIONS (Cont.)

Sensitivity
(500 kHz to 30 MHz):

1. SSB
2. AM

-113 dBm (0.5 μ V) for 10 dB (S+N)/N Ratio.
-99 dBm (2.5 μ V) for 10 dB (S+N)/N Ratio in a
6 kHz bandwidth.

Overall Selectivity
(Standard Mechanical
Filter Complement)

A wide variety of mechanical and crystal filters is available for optional requirements such as general purpose, low ripple, low shape factor, controlled delay, or linear phase. The standard filter complement is provided by six mechanical filters that are supplied with the receiver. This includes two sideband filters and four symmetrical filters. The seventh filter slot is linked in order to provide a fifth symmetrical bandwidth defined by the selectivity of the 20 kHz roofing filters. The -3 dB and -60 dB bandwidths are defined as follows:

LSB/USB	-3 dB	>450 Hz to >3000 Hz
	-60 dB	>-600 Hz to <4300 Hz

The remaining five bandwidths are symmetrical

	-3 dB	-60 dB
BW1	>300 Hz	<2 kHz
BW2	>1 kHz	<4.5 kHz
BW3	>3.2 kHz	<8 kHz
BW4	>6 kHz	<14 kHz
BW5	>20 kHz	<80 kHz

Intermodulation
(Out of Band)*

For signals 100 kHz or more from receiver tuned frequency the third order intercept point is greater than +30 dBm. Second order intercept point is greater than +60 dBm. *Below 1.5 MHz these limits may be exceeded.

Intermodulation (In Band)

Better than -50 dB for two -10 dBm input signals within the IF passband when measured at the IF or line AF output.

Cross Modulation

The level of a 30% modulated signal, 50 kHz off-tune necessary to cross modulate an on-tune carrier to a depth of 3% shall be greater than +21 dBm (2.5 volts).

Blocking

1. On Tune: Less than 10% distortion for +13 dBm (1 volt) 30% Modulated AM input signals.
2. Off Tune: 1 dB on a 30% modulated on-tune signal when in the presence of a +23 dBm (3 volt) unmodulated carrier 50 kHz off-tune.

Reciprocal Mixing

The apparent noise appearing at the receiver input when in a 3 kHz bandwidth, caused by a 0 dBm signal 100 kHz off tune is less than -100 dBm.

TABLE 1-1. RA6790/GM HF RECEIVER SPECIFICATIONS (Cont.)

Image and Spurious Rejection	Greater than 80 dB, for signals at least ± 50 kHz from tuned frequency.
Internal Spurious Responses Outputs	<p>< -124 dBm</p> <ol style="list-style-type: none"> 1. IF: Frequency 455 kHz, Impedance 50 Ohms. Level - 10 dBm nom. Connector BNC. 2. Following outputs available at rear panel audio connector (25 pin Type D). <ul style="list-style-type: none"> AF: 100 Hz to 16 kHz for -3 dB. <ol style="list-style-type: none"> a. 1W nominal into 8 Ohm load. Distortion $< 3\%$ at 500 mW. b. Monitor: Metered AF line output. 1 mW, 600 ohms balanced $< 2\%$ distortion. All receiver modes selectable at front panel. c. Line 1. AF line output. 1 mW, 600 ohms balanced $< 2\%$ distortion. Operable only with ISB option. All modes select at front panel except LSB. d. Line 2. AF line output. 1 mW, 600 ohms balanced $< 2\%$ distortion. Operable only with ISB option, OSB mode. <p>AGC: Diversity Connection with ground which provides dc voltage 10 volts to 4 volts to signal levels between threshold and $+110$ dB. Similar connection for ISB channel when fitted.</p> <p>Fault: Indication of fault condition is available at the rear panel.</p> <ol style="list-style-type: none"> 3. Phone: 30 mW into 600 Ohm load. Distortion $< 3\%$ at 10 mW. Connector: Front Panel Phone Jack 4. REFERENCE OUT: Selectable TCX0 Reference frequency of either 1, 5, or 10 MHz (selected by links on A8 assembly) Connector: Rear panel BNC
Environmental	<ol style="list-style-type: none"> 1. Operating Temperature: 0°C to 50°C 2. Operating Humidity: 10% to 85% non-condensing. 3. Altitude: Operation to 15,000 ft. 4. Bench Handling: MIL-STD-810C, Method 516.2, Procedure V 5. Vibration: MIL-STD-810C. Method 514.2 Procedure X 6. Storage Conditions: <ol style="list-style-type: none"> a. Temperature Range: -40°C to $+70^{\circ}\text{C}$ b. Relative Humidity: 10% to 95% non-condensing. c. Altitude: Up to 40,000 feet d. Fungis: Fungis identified in MIL-STD-810, Method 508.1, Procedure I.
Power Consumption	Less than 40 Watts (nominal)
Power Requirements	115/230 Vac $\pm 10\%$, 48 Hz to 420 Hz, single phase.
Dimensions	<p>Suitable for 19 inch (48.3 cm) rack or desk top console mounting:</p> <p>Heights: 5.25 in. (13.33 cm) Width: 19 in. (48.3 cm) Depth: 18.5 in. (47 cm)</p>
Weight (approximate)	32 lbs. (14.5 kg)