LETHAL VOLTAGE WARNING

VOLTAGES WITHIN THIS EQUIPMENT ARE SUFFICIENTLY HIGH TO ENDANGER LIFE.

COVERS MUST NOT BE REMOVED EXCEPT BY PERSONS QUALIFIED AND AUTHORISED TO DO SO AND THESE PERSONS SHOULD ALWAYS TAKE EXTREME CARE ONCE THE COVERS HAVE BEEN REMOVED.
RESUSCITATION
TREATMENT OF THE NON-BREATHING CASUALTY

1. SHOUT FOR HELP. TURN OFF WATER, GAS OR SWITCH OFF ELECTRICITY IF POSSIBLE
   Do this immediately. If not possible don’t waste time searching for a tap or switch.

2. REMOVE FROM DANGER: WATER, GAS, ELECTRICITY, FUMES, ETC.
   Safeguard yourself when removing casualty from hazard.
   If casualty still in contact with electricity, and the supply cannot be isolated, stand on dry non-conducting material (rubber mat, wood, linoleum).
   Use rubber gloves, dry clothing, length of dry rope or wood to pull or push casualty away from the hazard.

3. REMOVE OBVIOUS OBSTRUCTION TO BREATHING
   If casualty is not breathing start ventilation at once.

- LOOSEN NECKWEAR
- TILT HEAD BACKWARDS
- AND PUSH CHIN UPWARDS

- PINCH THE NOSE
- COMMENCE VENTILATION
- FOUR GOOD INFLATIONS
- MOUTH-TO-MOUTH

- CHECK PULSE
- POSITION OF PULSE

- IF CHEST DOES NOT RISE
- RE-CHECK AIRWAY, REMOVE OBSTRUCTION AND RE-INFLATE

- ONE FIRST AIDER
- 15 Compressions at 80 per minute followed by 2 inflations

- TWO FIRST AIDERS
- One conducts chest compressions, without pause at 60 per minute. The other conducts mouth-to-mouth ventilation or after each 5th compression

- When normal breathing commences
- Place casualty in recovery position

- Keep casualty at rest. Remove on a stretcher. Watch closely, particularly for difficulty in breathing. Lightly cover with blankets or other materials.

- HEART HAS STOPPED BEATING
- LAY ON BACK ON FIRM SURFACE
- LEGS FLAT
- COMMENCE EXTERNAL CHEST COMPRESSION AND CONTINUE MOUTH-TO-MOUTH VENTILATION

- Continue external chest compression and mouth-to-mouth ventilation until a normal pulse is felt and colour improves.

- Send for Doctor and Ambulance

<table>
<thead>
<tr>
<th>DOCTOR</th>
<th>AMBULANCE</th>
<th>HOSPITAL</th>
<th>Nearest First Aid Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>TELEPHONE</td>
<td>TELEPHONE</td>
<td>TELEPHONE</td>
<td></td>
</tr>
</tbody>
</table>

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WARNINGS

ANY SPECIAL SAFETY WARNINGS OR INSTRUCTIONS WHICH APPEAR IN THIS MANUAL MUST BE STRICTLY OBSERVED.

HIGH VOLTAGE

LETHAL VOLTAGES EXIST IN THE EQUIPMENT. GREAT CARE MUST BE TAKEN WHEN CARRYING OUT ADJUSTMENTS OR WHEN FAULT FINDING.

ENSURE THAT A RELIABLE SAFETY EARTH IS CONNECTED TO THE EQUIPMENT BEFORE POWER IS APPLIED.

ALL POWER SOURCES MUST BE ISOLATED AND ALL HIGH VOLTAGE POINTS DISCHARGED TO EARTH BEFORE ANY FAULT RECTIFICATION WORK IS UNDERTAKEN.

HIGH CURRENT

HIGH CURRENTS EXIST IN THE EQUIPMENT. CARE MUST BE TAKEN WHEN CARRYING OUT ADJUSTMENTS OR WHEN FAULT FINDING.

STATIC SENSITIVE DEVICES

THE EQUIPMENT CONTAINS COMPONENTS WHICH ARE SUSCEPTIBLE TO DAMAGE BY STATIC ELECTRICAL CHARGES. APPROPRIATE PRECAUTIONS SHOULD BE OBSERVED WHEN HANDLING SUCH COMPONENTS OR SUB-ASSEMBLIES CONTAINING THEM, OR WHEN MAKING DIAGNOSTIC TESTS.

CAUTION

'POZIDRIV' SCREWDRIVERS

METRIC THREAD CROSS-HEAD SCREWS FITTED TO RACAL EQUIPMENT ARE OF THE 'POZIDRIV' TYPE. PHILLIPS TYPE AND 'POZIDRIV' TYPE SCREWDRIVERS ARE NOT INTERCHANGEABLE, AND THE USE OF THE WRONG SCREWDRIVER WILL CAUSE DAMAGE. POZIDRIV IS A REGISTERED TRADE MARK OF G.K.N. SCREWS AND FASTENERS LIMITED. THE 'POZIDRIV' SCREWDRIVERS ARE MANUFACTURED BY STANLEY TOOLS LIMITED.
RA3790 SERIES RECEIVER

INTERFACE MANUAL

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CHAPTER 1  STANDARD RECEIVER INTERFACE
CHAPTER 2  SERIAL RS-423 (ASCII) INTERFACE
CHAPTER 3  IEEE-488 INTERFACE
CHAPTER 4  INTERFACE PROGRAMMING INFORMATION
CHAPTER 5  COMMAND INSTRUCTION SET
# CHAPTER 1

## STANDARD RECEIVER INTERFACE

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CHAPTER 1

STANDARD RECEIVER INTERFACE

INTRODUCTION

1. This chapter describes the receiver external connections and facilities loosely grouped under the heading 'standard receiver interface'; these are separate from, and additional to, any remote control interfaces that may be fitted, as described in the remaining chapters of this manual.

2. For general receiver installation information, reference should be made to the RA3790 Operators Manual, reference A5256. This manual also gives all external connections, plus connector type information, many of which are described in greater detail in this manual.

ANTENNA INPUT

3. A 50 ohm BNC coaxial socket, SK1, is mounted on the receiver rear panel for connection to a suitable antenna.

IF OUTPUT

4. A 50 Ohm BNC coaxial socket (SK3) is mounted on the rear panel for a 1.4 MHz IF output, or a programmed frequency (by the operator) IF output, in the range 10 kHz to 455 kHz in 5 kHz steps. The bandwidth is selected by the user as follows:

(1) Narrow band: Bandwidth equal to selected IF bandwidth, level -7 dBm nominal.

(2) Wideband: 12 kHz bandwidth, level nominally 50 dB above antenna input or -7 dB, whichever is the smaller.

This IF output is provided for external use for application to, for example, a suitable spectrum analyzer or a signal analysis unit.

REFERENCE IN/OUT CONNECTOR

5. The reference signal required by the receiver is provided either by an internal 10 MHz Frequency Standard or by an external source connected to a 50 Ohm BNC coaxial connector, SK2, on the receiver rear panel. When the reference signal is provided internally, a 1, 5 or 10 MHz reference signal is available at SK2 for external use.
REMOTE ANTENNA SELECTION

6. To facilitate remote antenna selection, using an external antenna selection unit, four antenna select lines are provided on the Master/Auxiliary Port Connector, a 15-way D-type plug (see table 1). These lines may be used simply to select one of four antennas, or binary-coding may be used where more than four antennas are required. The input and output signal requirements conform to Racal Specification DS147, as described at the end of this chapter.

MONITOR AUDIO CONNECTIONS

7. The monitor audio input allows an external audio signal to be routed to the front panel. When operating as a controller, this input is used to connect the slave receiver audio signal to the front panel. The monitor audio output is a tri-state line which carries the receiver audio output when the receiver is addressed via the auxiliary port. The line goes to the high impedance or tri-state condition when a new receiver is addressed.

FAULT INPUT/OUTPUT

8. The fault input/output line is bi-directional and is normally configured as an output. When a fault is detected, the output is at logic '1'.

9. When the receiver is operating as a controller, this line is configured as an input to allow faults on slave receivers connected to the line to be detected.

Note: The remaining Master/Auxiliary Port connections in Table 1 are concerned with the serial ASCII interface and are dealt with in Chapter 2.

IF VALID OUTPUT

10. This logic output (Tributary Port connector pin 11, table 2) is used to indicate that the IF is valid for the current receiver settings. When the IF is valid, the output is ON (0 V), when it is not valid the output is OFF (open-circuit).

SCAN INHIBIT INPUT

11. The scan inhibit input (Tributary Port connector pin 13, table 2) allows a channel scan or a frequency sweep to be halted. A logic '1' is required to inhibit the scan. Scanning is resumed when this input returns to logic '0'.

MUTE INPUT

12. An external mute signal can be applied to pin 14 of the Tributary Port connector (table 2). A logic '1' mute signal may be applied to mute the receiver where necessary, for example, from a press-to-talk (PTT) line circuit where the receiver is being used in conjunction with an associated transmitter.
13. This input (Tributary Port connector pin 15, table 2) allows the receiver AGC to be dumped by an external logic signal. A transition from '0' to '1' is required to dump the AGC.

Table 1: Master/Auxiliary Port Connector

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Logic ground</td>
</tr>
<tr>
<td>2</td>
<td>Transmit data</td>
</tr>
<tr>
<td>3</td>
<td>Receive data</td>
</tr>
<tr>
<td>4</td>
<td>Request to send (RTS) or clear to receive (CTR)</td>
</tr>
<tr>
<td>5</td>
<td>Clear to send (CTS)</td>
</tr>
<tr>
<td>6</td>
<td>Receive common</td>
</tr>
<tr>
<td>7</td>
<td>Transmit common (signal ground)</td>
</tr>
<tr>
<td>8</td>
<td>Monitor audio output</td>
</tr>
<tr>
<td>9</td>
<td>Monitor audio input</td>
</tr>
<tr>
<td>10</td>
<td>Audio ground</td>
</tr>
<tr>
<td>11</td>
<td>Fault input/output</td>
</tr>
<tr>
<td>12</td>
<td>Antenna 0 output</td>
</tr>
<tr>
<td>13</td>
<td>Antenna 1 output</td>
</tr>
<tr>
<td>14</td>
<td>Antenna 2 output</td>
</tr>
<tr>
<td>15</td>
<td>Antenna 3 output</td>
</tr>
</tbody>
</table>
Table 2: Tributary Port Connector

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Logic ground</td>
</tr>
<tr>
<td>2</td>
<td>Transmit data</td>
</tr>
<tr>
<td>3</td>
<td>Receive data</td>
</tr>
<tr>
<td>4</td>
<td>Request to send (RTS) or Clear to receive (CTR)</td>
</tr>
<tr>
<td>5</td>
<td>Clear to send (CTS)</td>
</tr>
<tr>
<td>6</td>
<td>Receive common</td>
</tr>
<tr>
<td>7</td>
<td>Transmit common (signal ground)</td>
</tr>
<tr>
<td>8</td>
<td>Not used</td>
</tr>
<tr>
<td>9</td>
<td>Not used</td>
</tr>
<tr>
<td>10</td>
<td>Not used</td>
</tr>
<tr>
<td>11</td>
<td>IF Valid output</td>
</tr>
<tr>
<td>12</td>
<td>Not used</td>
</tr>
<tr>
<td>13</td>
<td>Scan inhibit input</td>
</tr>
<tr>
<td>14</td>
<td>Mute input</td>
</tr>
<tr>
<td>15</td>
<td>Dump input</td>
</tr>
</tbody>
</table>

**Note:** The remaining Tributary Port connections in Table 2 are concerned with the serial ASCII Interface and are dealt with in Chapter 2.

**DSP/AUDIO CONNECTIONS**

14. A 25-way DSP/Audio connections socket SK4, from the Digital Board (two for the RA3792 Dual Receiver), is mounted on the rear panel. The connections are given in Table 3.

**Audio Line Outputs**

15. These two outputs each have three pins to provide a 600 ohm, balanced audio signal with a line ground pin. Line 1 output (DSP/Audio connector pins 1, 2 and 14) is the main audio output from the DSP demodulator. Line 2 output (DSP/Audio connector pins 3, 15 and 16) can be selected to carry the main audio signal or, where fitted, the LSB audio output of an ISB signal, from the DSP demodulator. The level of the signal on each line output can be selected independently, via the front-panel menu, to be in the range -30 dBm to +10 dBm for an RF signal under AGC.

16. Both line output connections can also be made into input connections, by changing links on the digital board. Signals can then be routed out of one and into the other for BITE testing.
Table 3: DSP/Audio Connector

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Line 1 output/input</td>
</tr>
<tr>
<td>2</td>
<td>Line 1 ground</td>
</tr>
<tr>
<td>3</td>
<td>Line 2 ground</td>
</tr>
<tr>
<td>4</td>
<td>Loudspeaker output</td>
</tr>
<tr>
<td>5</td>
<td>Audio ground</td>
</tr>
<tr>
<td>6</td>
<td>External audio input</td>
</tr>
<tr>
<td>7</td>
<td>Gain control input</td>
</tr>
<tr>
<td>8</td>
<td>FSK 2</td>
</tr>
<tr>
<td>9</td>
<td>Digital ground input</td>
</tr>
<tr>
<td>10</td>
<td>Differential strobe+</td>
</tr>
<tr>
<td>11</td>
<td>Differential data input+</td>
</tr>
<tr>
<td>12</td>
<td>Differential data output+</td>
</tr>
<tr>
<td>13</td>
<td>Differential clock+</td>
</tr>
<tr>
<td>14</td>
<td>Line 1 output/input</td>
</tr>
<tr>
<td>15</td>
<td>Line 2 input/output</td>
</tr>
<tr>
<td>16</td>
<td>Line 2 input/output</td>
</tr>
<tr>
<td>17</td>
<td>Loudspeaker ground</td>
</tr>
<tr>
<td>18</td>
<td>COR output</td>
</tr>
<tr>
<td>19</td>
<td>Gain control output</td>
</tr>
<tr>
<td>20</td>
<td>FSK Output</td>
</tr>
<tr>
<td>21</td>
<td>Digital ground output</td>
</tr>
<tr>
<td>22</td>
<td>Differential strobe-</td>
</tr>
<tr>
<td>23</td>
<td>Differential data input-</td>
</tr>
<tr>
<td>24</td>
<td>Differential data output-</td>
</tr>
<tr>
<td>25</td>
<td>Differential clock-</td>
</tr>
</tbody>
</table>

**Loudspeaker Output**

17. The loudspeaker audio output (DSP/Audio connector pins 4 and 17) is for a low impedance external loudspeaker. The audio signal is routed from the front panel and can be adjusted by the front-panel VOLUME CONTROL knob.

**External Audio Input**

18. The external audio input (DSP/Audio connector pins 5 and 6) is a 600 ohm input which allows an external signal (e.g. Monitor Output of another receiver) to be routed to the front panel. In addition it can be routed to the DSPs for BITE.
External Gain Control

19. The external gain control input and output connections (DSP/Audio connector pins 7 and 19 respectively) comprise an RS-423 ASCII interface running at 1200 baud, asynchronous with 1 start bit, 8 data bits, 1 data type bit and 1 stop bit. There are also connections for digital ground input and output (DSP/Audio connector pins 9 and 21 respectively). When there is an external gain input, the receiver sets the gain to that value if it is smaller than the gain that its own gain control system has calculated.

The format for the data is:

Data bits: 254 = Hold current gain and gain distribution. Otherwise the value is the receiver gain reduction value in dB relative to maximum gain, range 0 to 130.

Data type bit: 0 = Default or USB in ISB mode
1 = LSB in ISB mode.

FSK

20. The FSK output (DSP/Audio connector pin 20) is an RS-423 output, with a digital ground output on pin 21. When the output is from the FSK demodulator the data rate and format is the same as the incoming signal, with the polarity selected via the front panel. Where the FSK decoder is selected the output is ASCII (ITA5) with 1 start bit, 7 data bits, 1 parity bit and 1 stop bit. The baud rate, up to 19200 baud, and the polarity (none, even or odd) are selected via the front panel.

21. The FSK2 pin (DSP/Audio connector pin 8) can be either an RS-423 output or input. It is only used as an input for a loopback BITE for the FSK output.

Digital IF/AF

22. The digital IF/AF link is a three-signal RS-422 (i.e. differential) synchronous serial output, which allows simple interfacing to common DSP processors. The signals are a 1.536 MHz clock (DSP/Audio connector pins 13 and 25), a 64 kHz strobe (DSP/Audio connector pins 10 and 22) and data (DSP/Audio connector pins 12 and 24). There is also data input (DSP/Audio connector pins 11 and 23) but this is for future use. Details of the digital IF/AF link are given in the following paragraphs.
DIGITAL IF/AF INTERFACE

23. The following paragraphs detail the electrical characteristics, timing and data format for the digital IF/AF interface. This interface is a Synchronous Serial Interface (SSI) consisting of a clock output, a strobe output (frame sync) and data output. A data input signal is provided for future applications.

Clock

24. The clock rate is 1.536 MHz, the strobe rate is 64 kHz and the data words are 24-bits. This means that there is no gap between data bits. The strobe is bit length.

Electrical Characteristics

25. The digital IF/AF uses RS-422/V11 balanced line levels. Each driver can drive up to ten receivers. The maximum line length for a terminated line running at 1.536 MHz is 100 metres. With long cables it is recommended that a differential twisted pair cable and an RS-422 receiver are used to make the signal less susceptible to noise.

26. The interface is located on the DSP/Audio connector (Table 3) as follows:

| Clock Output + | Pin 13
| Clock Output - | Pin 25
| Strobe Output + | Pin 10
| Strobe Output - | Pin 22
| Data Output +  | Pin 12
| Data Output -  | Pin 24

27. The timings for the data lines at the DSP56002 output are as shown in Fig 1.1. An RS-422 line driver, with a maximum delay of 20 ns, converts these signals to the balanced signals at SK2.

Data Format

28. The digital IF/AF data can either be one of five IF/AF data formats or can be an IF spectrum. The selection between these six options is via the front panel menu system.

29. In the IF data modes there are four data words per 16 kHz sample (giving the output word rate of 64 kHz).

30. The unfiltered IF is a complex baseband signal, where one data word is the in-phase component and another word is the quadrature component, taken before the final IF filtering (the bandwidth of the signal is 12 kHz).
31. The filtered IF is also a complex baseband signal, where one data word is the in-phase component and another word is the quadrature component, taken after the final IF filtering and AGC. In the ISB mode, both USB and LSB signals are available.

32. The receiver attenuation is a measure of the signal strength within the final IF bandwidth, representing the attenuation from maximum receiver gain (the larger the signal the greater the attenuation). In the ISB mode, both USB and LSB attenuations are available.

33. The audio signal is the real baseband signal taken after the demodulator. The real unfiltered IF signal is real 8 kHz IF signal sampled at 32 kHz, hence there are two data samples per 16 kHz group. As the signal is taken before the final IF filters, its bandwidth is 12 kHz.

34. **Configuration A**

<table>
<thead>
<tr>
<th>Word 1</th>
<th>23-bit filtered IF In-phase component (USB in ISB mode), lsb = 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word 2</td>
<td>23-bit filtered IF Quadrature component (USB in ISB mode), lsb = 0</td>
</tr>
<tr>
<td>Word 3</td>
<td>8-msb receiver attenuation (from maximum gain) in dB, 15-bit audio (USB in ISB mode), lsb = 0</td>
</tr>
<tr>
<td>Word 4</td>
<td>8-msb receiver attenuation (from maximum gain) in dB, 15-bit audio (LSB in ISB mode), lsb = 0</td>
</tr>
</tbody>
</table>

35. **Configuration B**

<table>
<thead>
<tr>
<th>Word 1</th>
<th>23-bit filtered IF In-phase component (LSB in ISB mode), lsb = 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word 2</td>
<td>23-bit filtered IF Quadrature component (LSB in ISB mode), lsb = 0</td>
</tr>
<tr>
<td>Word 3</td>
<td>8-msb receiver attenuation (from maximum gain) in dB, 15-bit audio (USB in ISB mode), lsb = 0</td>
</tr>
<tr>
<td>Word 4</td>
<td>8-msb receiver attenuation (from maximum gain) in dB, 15-bit audio (LSB in ISB mode), lsb = 0</td>
</tr>
</tbody>
</table>

36. **Configuration C**

<table>
<thead>
<tr>
<th>Word 1</th>
<th>23-bit unfiltered IF In-phase component, lsb = 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word 2</td>
<td>23-bit unfiltered IF Quadrature component, lsb = 0</td>
</tr>
<tr>
<td>Word 3</td>
<td>8-msb = receiver attenuation (from maximum gain) in dB, 15-bit audio (USB in ISB mode), lsb = 0</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Word 4</td>
<td>8-msb = receiver attenuation (from maximum gain) in dB, 15-bit audio (LSB in ISB mode), lsb = 0</td>
</tr>
</tbody>
</table>

37. **Configuration D**

<table>
<thead>
<tr>
<th>Word 1</th>
<th>8-msb = receiver attenuation (from maximum gain) in dB, 15-bit IF In-phase component (USB in ISB mode), lsb = 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word 2</td>
<td>8-msb = receiver attenuation (from maximum gain) in dB, 15-bit IF Quadrature component (USB in ISB mode), lsb = 0</td>
</tr>
<tr>
<td>Word 3</td>
<td>8-msb = receiver attenuation (from maximum gain) in dB, 15-bit IF In-phase component (LSB in ISB mode), lsb = 0</td>
</tr>
<tr>
<td>Word 4</td>
<td>8-msb = receiver attenuation (from maximum gain) in dB, 15-bit IF Quadrature component (LSB in ISB mode), lsb = 0</td>
</tr>
</tbody>
</table>

38. **Configuration E**

<table>
<thead>
<tr>
<th>Word 1</th>
<th>23-bit unfiltered real IF (even sample), lsb = 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word 2</td>
<td>23-bit unfiltered real IF (odd sample), lsb = 0</td>
</tr>
<tr>
<td>Word 3</td>
<td>23-bit filtered IF In-phase component, lsb = 0</td>
</tr>
<tr>
<td>Word 4</td>
<td>23-bit filtered IF Quadrature component, lsb = 0</td>
</tr>
</tbody>
</table>

**Spectrum Output**

39. The spectrum is produced by carrying out a 512-point FFT on the complex baseband filtered signal after AGC, but shifted so that the centre of the spectrum is the centre of the IF filter, i.e. sideband filters do not appear offset. The input data is windowed using a Kaiser window with minimum side lobe attenuation of 110 dB. This window has a loss of 8.6 dB and an equivalent noise bandwidth (ENBW) of 1.946 bins.

40. The spectrum output sends out data points at a rate of 64 kHz. The data is a 24-bit word, but only the bottom 16 are significant. These bottom 16-bits represent values in $\text{dB}_{\text{full-scale}}/256$.

41. The first four data values are:

   (1) A sync pulse ($+1/256$)
(2) Calibration level for 0 dB_{fs}

(3) Calibration level for -50 dB_{fs}

(4) Calibration level for -100 dB_{fs}

42. These calibration levels account for the window loss and a correction for rms to peak (i.e. 0 dB_{fs} is for a signal whose peak to peak voltage is +/- 1 out of the ADC. These are followed by the 512 points of the spectrum.

43. The -100 dB_{fs} level is then sent out until the next spectrum is ready to be transmitted. The spectrum is always 512 points but the sample rate varies with bandwidth.

<table>
<thead>
<tr>
<th>IF Bandwidth</th>
<th>Sample Rate</th>
<th>Cell Size</th>
<th>Effective Cell Size for Noise</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 Hz - 220 Hz</td>
<td>500 Hz</td>
<td>0.98 Hz</td>
<td>1.9 Hz</td>
</tr>
<tr>
<td>220 Hz - 450 Hz</td>
<td>1 kHz</td>
<td>1.95 Hz</td>
<td>3.8 Hz</td>
</tr>
<tr>
<td>450 Hz - 890 Hz</td>
<td>2 kHz</td>
<td>3.91 Hz</td>
<td>7.6 Hz</td>
</tr>
<tr>
<td>900 Hz - 1.78 kHz</td>
<td>4 kHz</td>
<td>7.81 Hz</td>
<td>15.2 Hz</td>
</tr>
<tr>
<td>1.79 kHz - 3.57 kHz</td>
<td>8 kHz</td>
<td>15.625 Hz</td>
<td>30.4 Hz</td>
</tr>
<tr>
<td>3.58 kHz - 12 kHz</td>
<td>16 kHz</td>
<td>31.25 Hz</td>
<td>60.8 Hz</td>
</tr>
</tbody>
</table>

44. The effective cell size for noise is the cell size times the equivalent noise bandwidth. The level of the spectrum is thus the noise level in that bandwidth.

---

**Fig. 1.1** Timing Diagram: Digital IF/AF Output (spectrum)
COR OUTPUT

45. This output (DSP/Audio connector pin 18) indicates whether the signal exceeds the COR threshold. A logic '1' indicates a signal level in excess of the threshold.

LOGIC INTERFACE SPECIFICATION

46. All static or low-speed logic input and output external connections comply with Racal Specification DS147, as described briefly in the following paragraphs. Before external equipment is connected to the receiver, or where the design of an external interface circuit is called for, ensure that the following requirements are met.

Logic Inputs

47. These are designed with pull-up resistors and the two logic states are represented at the input by a short-circuit to 0 V or an open-circuit.

Input voltage: \( V_i \)
Input current: \( I_i \) (current out of input is positive)

(1) ON state (short-circuit to 0 V): Logic '1'
    \[ 100 \, \mu A < I_i < 40 \, mA \text{ for } V_i = 0 \, V \]

(2) OFF state (open circuit): Logic '0'
    \[ 0 < V_i < 28 \, V \text{ for } I_i = 0 \, A \]

The voltage at this terminal, including transients, shall at no time exceed +30 Volts.

Logic Outputs

48. These are designed to provide a short-circuit to 0 V and an open circuit to represent the two logic states.

Output voltage: \( V_o \)
Output current: \( I_o \) (current into output is positive)

(1) ON state (short-circuit to 0 V): Logic '1'
    \[ 0 < V_o < 0.5 \, V \text{ for } 0 < I_o < 10 \, mA \]
    \[ 0 < V_o < 1.0 \, V \text{ for } 10 \, mA < I_o < 40 \, mA \]
(2) OFF state (open-circuit): Logic '0'

-1 mA < Io < 20 μA for 0 < Vo < 30 V (The negative current allows an internal loopback circuit to be connected to the output).

Timing

49. In some systems, it may be necessary to include decoupling components on logic input and output circuits. In such cases, care must be taken to ensure that the slew rates are not extended to such an extent that component or system performance is impaired.

Typical Circuits

50. Some typical interface circuits are given in Fig. 1.2.

Fig. 1.2 Typical Interface Circuits
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<th>Page</th>
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CHAPTER 2

SERIAL RS-423 (ASCII) INTERFACE

INTRODUCTION

1. This chapter details the RS-423 electrical characteristics, packet format, timing, link control characteristics, communications protocol and configuration information. Refer to chapter 4 for interface programming information, and to chapter 5 for the command instruction set.

INTERFACE

2. The RA3790 series equipments have two RS-423 serial control ASCII ports, one of which is a Master port and the other a Tributary port. In the RA3792 Dual Receiver, each receiver has a Master/Auxiliary port and a Tributary port.

3. The electrical interface is a multi-drop version of RS-423A, and is compatible with RS-232C and V28. The protocol used conforms to the Racal DS145 standard control protocol. Two 15-way D-type plugs are provided on the rear panel, one for each of the two ports.

4. Cable lengths between controller and controlled equipments using RS-232C are restricted to a maximum of 50 feet, whereas for RS-423A, this is extended to a maximum of 4000 feet.

ELECTRICAL CHARACTERISTICS

5. The serial RS-423 electrical characteristics comply with CCITT recommendation V10 and EIA standard RS423-A. Additionally, the data output may be set to the high-impedance state. This allows a multi-address system to be configured with several slave equipments connected to the same control lines (i.e. a multi-drop system). The data outputs from all slave equipments not currently being addressed by the controller are set to the high impedance state.

6. The serial interface is also capable of inter-operation with equipments complying with V28/RS232-C. Although the serial interface is designed to operate with RS423-A remote control systems, it may also be operated with RS232-C systems simply by altering the signal return arrangements (see later). RS423-A is designed for longer length lines with each of the two data lines having their own return line, this being twisted together with the data line. RS232-C systems utilise a common return line.
7. Each serial remote control interface is provided with a 15-way D-type connector for connecting to external equipment employing interfaces according to the above standards. The pin connections (same as far as the ASCII interface is concerned for both the Master/Auxiliary Port and Tributary Port connectors) are listed in Table 2.1, and some typical configurations using these connections are shown in Fig. 2.1.

8. To accommodate either type of serial interface, the signal return arrangements are connected as follows:

RS423: The 'send common' of the sending ends and 'receive common' of the receiving ends are connected together and earthed at the 'send common' ends only (see Fig. 2.2).

RS232: The signal grounds of both ends are connected together. Also the 'receive common' is linked to earth at the receiving ends by means of an external link (see Fig. 2.3).

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Protective Ground</td>
</tr>
<tr>
<td>2</td>
<td>Data Out (Transmit data)</td>
</tr>
<tr>
<td>3</td>
<td>Data In (Receive data)</td>
</tr>
<tr>
<td>4</td>
<td>CTR/RTS Output</td>
</tr>
<tr>
<td>5</td>
<td>CTS Input</td>
</tr>
<tr>
<td>6</td>
<td>Receive Common</td>
</tr>
<tr>
<td>7</td>
<td>Signal Earth</td>
</tr>
<tr>
<td>8</td>
<td>Transmit Common (signal ground)</td>
</tr>
<tr>
<td>9</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Various connections not associated</td>
</tr>
<tr>
<td>12</td>
<td>with the serial ASCII interfaces. See</td>
</tr>
<tr>
<td>13</td>
<td>chapter 1 for details.</td>
</tr>
<tr>
<td>14</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

Table 2.1 Serial ASCII Interface Connections
(Master/Auxiliary Port and Tributary Port connectors)

CHARACTER FRAMING

9. Communications between the controller and the receiver is by means of strings of ASCII characters which are grouped together to form data packets. Transmitted and received characters are asynchronous and are comprised as follows:
10. The data transmission speed is selectable from the following:

   75, 110, 150, 300, 600, 1200, 1800, 2000, 2400, 4800, 9600 bps.

11. Character parity is selectable from 'odd', 'even' or 'off', where 'off' means that the parity bit is not sent.

12. The data bits are encoded in accordance with the CCITT ITA-5 (7 bit ISO/ASCII) alphabet (see Table 2.2 at the end of this chapter). Printing characters from columns 2 to 7 of Table 2.2 may occur as well as the following non-printing characters.

   0/10 Line Feed (LF)
   0/13 Carriage Return (CR)
   1/1 DC1 (X-ON)
   1/3 DC3 (X-OFF)

**PACKET FRAMING**

13. The ASCII characters are assembled into packets of up to 256 (or more, as defined) characters as follows:

<table>
<thead>
<tr>
<th>LF Char</th>
<th>0 or 1 Link Control Chars</th>
<th>0,1 or 2 Address Chars</th>
<th>Up to 248 (+) Printing Data Chars</th>
<th>0 or 3 Check Chars</th>
<th>CR Char</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 or 1 Link Control Chars</td>
<td>0,1 or 2 Address Chars</td>
<td>Up to 248 (+) Printing Data Chars</td>
<td>0 or 3 Check Chars</td>
<td>CR Char</td>
<td></td>
</tr>
</tbody>
</table>

(1) The first character in the packet is a line feed.

(2) The equipment must be configured at the time of installation as to whether a Link Control Character (LCC) is included in transmitted or received messages. If not used, unacceptable packets are ignored. Configuration details and details of the LCC are included later in this chapter.

(3) The equipment must be configured at the time of installation to set the number of address characters as follows:

   0 one-to-one operation
   1 up to 9 Tributary ports
   2 up to 99 Tributary ports
The data characters contain the actual command or data being sent over the link. Details of the command instruction set for the RA3790 Series are contained in chapter 5.

The equipment must be configured at the time of installation as to whether check characters are included in the transmitted and received messages. If selected, a 16 bit Cyclic Redundancy Check (CRC) is used. Details are contained in this chapter.

The final character in the packet is a carriage return.

**Packet Timing**

The rules for packet timing are given in the following paragraphs. The values given are the longest total response time allowed for the system, including any transmission delays. The aim in general for good system operation would be to respond considerably faster than this, and the response times given should be treated as maximum values rather than design targets.

1. A valid packet is a series of asynchronous characters beginning with (LF) and terminated by (CR). A packet is also terminated by the receipt of another (LF). Such a packet is not valid and will not cause a response. The terminating (LF) may be the first character of another packet.

2. At a Master port, a received packet is considered terminated if no character is received within the one second timeout period. Such a packet is not valid.

3. At a Master port, a one second timeout period is allowed from the end of an output frame for the receipt of the (LF) of the reply packet, before assuming a packet failure.

4. At a Tributary port, gaps between characters are ignored and there is an indefinite wait for the next character.

5. The gaps between the transmitted characters in a packet should be no longer than 100 ms. During any such gap the Data output is held at a MARK.

6. After receipt of the last bit of a packet at a Tributary, the first bit of the reply packet (LF) should be placed on the Data Output within 100 ms.

7. At a Tributary port, there is an indefinite wait for a response from a Master port.

8. No data (other than X-ON/X-OFF) is placed on the output of a port while a packet is being received at the input of that port.
 Whilst sending a packet from the output of a port, no input data (other than X-ON/ X-OFF) is valid.

 At a Master port, packets may be generated as required (except that paragraph (9) must be observed).

 At a Tributary port, packets are never generated except in response to a correctly addressed valid packet.

 At a Tributary port, packets are always generated in response to a correctly addressed valid packet.

**BUS DRIVER TIMING**

15. The rules for bus driver timing are given below:

1. Tributary port outputs are normally in the open-circuit (O/C) condition and must default to this state at power-ON. If the unit has been configured for un-addressed operation, then the output will normally remain active (not O/C) at all times.

2. On receipt of its own address within a packet, a Tributary port's data output will be placed in the MARK (binary 1) state within 0.5 ms.

3. If a Tributary port data output is held in the active state whilst receiving a packet which subsequently becomes invalid, then the data output will be returned to the O/C state immediately.

4. The Tributary data output must remain at MARK for at least one character length at the send data rate in use before starting to send (LF). Note that for any packet other than a minimum length packet with no CRC, this condition is guaranteed by para. (2).

5. On receipt of a packet containing an address other than its own, a Tributary port will be returned to the O/C condition within 0.5 ms after receipt of the last character of that address. For good system operation, it is recommended that a delay of at least 0.2 ms occurs before the line is returned.

6. The output of a Master port must be active at all times.

7. If several Master ports are connected together, only one may be the active link master. Arbitration for mastership will normally be manual.
CHECK CHARACTERS

16. The equipment may be configured to send check characters with the data packet so that integrity of the data can be checked at the receiving end of the link. This feature is useful on noisy links to prevent corrupted data from causing incorrect responses and allows for a repeat of corrupted data to be requested. If the LCC is not in use, the equipment will not reply to a packet which contains incorrect check characters.

17. The equipment may be configured so that check characters are not sent. This will give a slight improvement of data throughput on good quality links. The three check characters are calculated as follows:

(1) A 16-bit Cyclic Redundancy Check (CRC) character is calculated using the CRC-16 polynomial. The (LF), (CR) and check characters are excluded. Parity, if present, is masked to zero and the data is treated as 8-bit characters.

(2) The 16-bit residue is transmitted in the three check characters as (MS 4 bits), (next 6 bits), (LS 6 bits). The number 32 decimal (20 Hex) is added to each character to provide ASCII printing characters.

(3) If a packet is received with the terminating (CR) immediately following the (LF) or [Link Control Character] or [Address Characters] (total packet less than six characters), the CRC is not performed.

COMMUNICATIONS PROTOCOL

18. Units transmit alternately over the link (half-duplex operation). Each responds to a packet from the other, even if they have no data to send. A minimum length (link status) packet comprises the following (the Link Control Characters and Address Characters are sent only if selected):

(LF) [Link Control Character] [Address Character] (CR).

19. Link Masters may break the alternate transmission rule with one equipment by changing the Message Address. Since wrongly addressed messages are ignored by Tributaries, each Tributary is 'unaware' of this lack of continuity. Masters normally arrange status responses to each Tributary to prevent spurious error reports from the Tributary.

20. Tributaries wait indefinitely for a response from the Master. Masters wait for at least one second for a response before assuming loss of the packet. After such a timeout, the last packet may be re-transmitted.

21. Tributaries respond only to input packets containing their own address. Tributary responses include their address.
FLOW CONTROL

22. Link Control Characters and X-ON/X-OFF may be sent in order to control the flow of messages over the link. A CTR/RTS output and a CTS input are also provided.

Link Control Characters

23. Packet flow control is achieved using the link control character (LCC) which enables the sender to indicate its status with respect to input and output packets, and consists of a bit-significant printing character, as follows:

- **bit 0** = OUTPUT-READY
  
  This bit indicates that the sender has data awaiting transmission over and above the packet containing the Link Control Character.

- **bit 1** = OUTPUT-PHASE
  
  This bit is a modulo-2 packet count. It alternates, 0 to 1, 1 to 0, when a new packet is sent and remains unchanged when a packet is re-transmitted. The Output-Phase is intended to detect unwanted duplication of packets.

- **bit 2** = INPUT-ACCEPT
  
  This bit indicates that the sender has accepted the last packet received. A packet will be accepted if received with appropriate address and without protocol, parity or CRC error. Note that acceptance at this level does not imply that the packet was entirely valid or has been actioned.

- **bit 3** = INPUT-PERMIT
  
  This bit indicates that the sender is prepared to receive an (other) input data packet. If this flow control facility is not used the bit will be set always to 1. If input-permit has not been set any received input may be ignored.

- **bit 4** = INPUT-PHASE
  
  This bit is a copy of the OUTPUT-PHASE bit of the last input packet to have been accepted by the sender.

- **bit 5** = 0

- **bit 6** = 1

- **bit 7** = Parity, if transmitted.
24. The rules for the use of link control characters are as follows:

(1) Following correct reception of a packet, a packet will be returned, including an LCC with INPUT-ACCEPT set to 1. INPUT PHASE will be a copy of the OUTPUT-PHASE bit in the LCC of the correctly received message. INPUT-PERMIT will be set to 1 if the sender is prepared to receive a further data packet.

(2) If the packet is not received correctly, the return packet will have INPUT-ACCEPT set to 0, and INPUT-PHASE will be left at the values most recently sent. If a transmitted packet fails to obtain a positive INPUT-ACCEPT response, it is recommended that a maximum of eight re-tries are attempted.

(3) The sender will transmit a data packet (a packet containing data bytes other than address/LCC/CRC etc.) if data has to be sent, and INPUT-PERMIT of the most recently received LCC is set to 1. Failing this, a status packet (LCC/address) will be transmitted.

(4) As each packet is sent (data or status), the OUTPUT-PHASE bit will be alternated, 1 to 0, 0 to 1. If a packet is re-transmitted due to non-acceptance, the OUTPUT-PHASE bit is re-transmitted unchanged. Note that there is no requirement for other LCC bits to be left unchanged on re-transmission.

(5) In each packet sent, the OUTPUT-READY bit indicates (if set to 1) that the sender has further data packets over and above the data in the packet being sent, if any.

(6) When powered up, an equipment will initially go into a 'receive' state with zero LCC link status.

X-ON/X-OFF Characters

25. X-ON/X-OFF is a serial flow control protocol sent via the data path. It may be disabled, and is not used in multi-address bus configurations. The rules for the use of X-ON/X-OFF characters are as follows:

(1) All ports will respond to X-ON/X-OFF and may generate them if required.

(2) On receipt of an X-OFF character (1/3, DC3) (see Table 2.2) at any time, a port will be disabled from sending data. If the port was sending data, then no more than 16 additional characters will be sent.

(3) A port disabled by X-OFF may still hold the RTS line ON and in this condition must hold the data output at MARK.
(4) A port disabled by X-OFF can only be re-enabled by receipt of an X-ON (1/1, DC1) character.

(5) Tributaries will wait indefinitely for the X-ON character. Link Masters will wait for a programmable timeout period before assuming Tributary failure.

(6) A port which may generate X-ON/X-OFF characters will only do so when enabled by CTS.

(7) At power-up, the port will assume the enabled condition.

**CTR/RTS Output and CTS Input**

26. These outputs and inputs provide a hard-wired means of controlling data flow. The terminology is defined as follows. These lines are not used in multi-address systems.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CTR</td>
<td>Clear to Receive</td>
</tr>
<tr>
<td>RTS</td>
<td>Request to Send</td>
</tr>
<tr>
<td>CTS</td>
<td>Clear to Send</td>
</tr>
</tbody>
</table>

27. The RA3790 Series equipments are always configured as data terminal equipments (DTE). When connected to a data communications equipment (DCE), e.g. a modem, the CTR/RTS output should be configured as RTS. When connected to another DTE, e.g. a computer, the CTR/RTS output should be configured as CTR.

28. Configuration of the CTR/RTS output is achieved using the receiver menu system.

**RTS/CTS Operation**

The equipments should be connected as follows:

<table>
<thead>
<tr>
<th>DTE (receiver)</th>
<th>DCE (modem)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTS output</td>
<td>to</td>
</tr>
<tr>
<td>CTS input</td>
<td>from</td>
</tr>
</tbody>
</table>

29. The rules for RTS/CTS operation are as follows:

(1) RTS/CTS operation is identical for Tributary and Master ports and overrides all other protocol considerations.

(2) The RTS output of a port may be placed in the ON state as soon as there is data to send from that port.
(3) After RTS is placed in the ON condition, a unit will wait for the CTS line to respond with an ON condition.

(4) RTS must be maintained in the ON condition until the last bit has been transmitted, after which it must be returned to the OFF condition.

CTR/CTS Operation

30. The equipments should be connected as follows:

<table>
<thead>
<tr>
<th>DTE (receiver)</th>
<th>DTE (computer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTR output</td>
<td>to CTS input</td>
</tr>
<tr>
<td>CTS input</td>
<td>from CTR output</td>
</tr>
</tbody>
</table>

31. The rules for CTR/CTS operation are as follows:

(1) CTR/CTS operation is identical for Tributary and Master ports and overrides all other protocol considerations.

(2) The CTR output will be placed in the ON state whenever the port is able to receive data.

(3) The CTR output may be returned to the OFF condition at any time.

(4) When the CTS input is in the OFF condition the data output will be maintained at MARK (binary 1). A port will wait indefinitely for the CTS ON condition.

(5) When the CTS line goes to the ON condition, data may be transmitted from the port.

(6) If CTS changes from ON to OFF whilst data is being transmitted, then no more than two additional characters will be sent.

(7) When CTS protocol is not used, the inputs should be pulled to the ON condition.

(8) At power-up, the RTS line if selected will be set to the OFF condition. The CTR line if selected will be set to the ON condition.

Remote Link Configuration

32. The link parameters are normally configured via the front panel of the receiver but may be configured remotely from the controller, using the ASCII command (see instruction set regarding format).
REMOTE CONTROL CONFIGURATION

33. On RA3791 and RA3792 receivers, the ASCII master port interface parameters can be set up locally using the front panel menu system, thus allowing the receiver to function either as a master or a slave in a remote control system (see the Operators Manual for further details).

34. The ASCII auxiliary and tributary port interface parameters are set up locally using switches provided on the digital board, as follows.

Selection of ASCII Tributary and Auxiliary Port Settings

35. The settings for the Tributary and Auxiliary ports are selected using three banks of switches (SW2, SW3 and SW4) on the digital board. Each switch consists of eight individual switches numbered 1 to 8 (for example SW2-7 is switch 7 on switch bank SW2). These settings are read only on power up. To enable any changes, the receiver should be turned off and then back on.

Tributary Port Baud Rate

36. Switches SW2-1 to SW2-4 control the baud rate

<table>
<thead>
<tr>
<th>SW2-4</th>
<th>SW2-3</th>
<th>SW2-2</th>
<th>SW2-1</th>
<th>Baud Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>75</td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>110</td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>150</td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>300</td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>600</td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>1200</td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>1800</td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>2000</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>2400</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>4800</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>9600</td>
</tr>
</tbody>
</table>
37. Switches SW3-1 to SW3-4 define the least significant digit of the address (range 0 to 9). The switches are binary weighted, i.e., to select an address of 5, then SW3-1 and SW3-3 should be on and SW3-2 and SW3-4 should be off (see table below). If the address selected is greater than 9 then the link is set to un-addressed operation.

38. Switches SW3-5 to SW3-8 similarly select the most significant digit of the address (range 0 to 9). If this is set to greater than 9, then the link is set to a single address character as selected by the least significant address switches.

<table>
<thead>
<tr>
<th>SW3-8</th>
<th>SW3-7</th>
<th>SW3-6</th>
<th>SW3-5</th>
<th>LSB Address</th>
<th>MSB Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

39. SW4-2 selects the use of Link Control Characters (LCC's) where:

- OFF = LCC's off
- ON = LCC's on

Tributary Port Cyclic Redundancy Check (CRC) Characters

40. SW4-3 selects the use of the CRC facility, where:

- OFF = CRC off
- ON = CRC on
Tributary Port Parity

41. SW4-4 and SW4-5 select the parity, as follows:

<table>
<thead>
<tr>
<th>SW4-5</th>
<th>SW4-4</th>
<th>Parity</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>ODD</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>EVEN</td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
</tr>
</tbody>
</table>

Tributary Port Flow

42. SW4-6 selects the flow control, where:

OFF = RTS
ON  = CTR

Auxiliary Port Settings

43. The auxiliary port settings are fixed, as follows, the exception being the use of an address (as selected by SW4-1):

<table>
<thead>
<tr>
<th>Baud Rate</th>
<th>9600</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCC</td>
<td>Off</td>
</tr>
<tr>
<td>CRC</td>
<td>Off</td>
</tr>
<tr>
<td>Flow Control</td>
<td>RTS</td>
</tr>
<tr>
<td>Parity</td>
<td>Even</td>
</tr>
</tbody>
</table>

SW4-1 defined address usage, where:

OFF  = un-addressed
ON   = same address as tributary port
Table 2.2 The ASCII Character Set

<table>
<thead>
<tr>
<th>b7</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>1</th>
<th>1</th>
<th>1</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>b6</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>b5</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>b4</td>
<td>b3</td>
<td>b2</td>
<td>b1</td>
<td>Raw</td>
<td>Col 0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>00</td>
<td>00</td>
<td>00</td>
<td>00</td>
<td>SP</td>
<td>0</td>
<td>@</td>
<td>P</td>
<td>.</td>
</tr>
<tr>
<td>00</td>
<td>01</td>
<td>01</td>
<td>11</td>
<td>x-on</td>
<td>l</td>
<td>1</td>
<td>A</td>
<td>Q</td>
</tr>
<tr>
<td>00</td>
<td>10</td>
<td>10</td>
<td>20</td>
<td>&quot;</td>
<td>2</td>
<td>B</td>
<td>R</td>
<td>b</td>
</tr>
<tr>
<td>00</td>
<td>10</td>
<td>11</td>
<td>31</td>
<td>x-off</td>
<td>£</td>
<td>3</td>
<td>G</td>
<td>S</td>
</tr>
<tr>
<td>01</td>
<td>00</td>
<td>00</td>
<td>00</td>
<td>$</td>
<td>4</td>
<td>D</td>
<td>T</td>
<td>d</td>
</tr>
<tr>
<td>01</td>
<td>01</td>
<td>01</td>
<td>15</td>
<td>%</td>
<td>5</td>
<td>E</td>
<td>U</td>
<td>e</td>
</tr>
<tr>
<td>01</td>
<td>10</td>
<td>10</td>
<td>66</td>
<td>&amp;</td>
<td>6</td>
<td>F</td>
<td>V</td>
<td>f</td>
</tr>
<tr>
<td>01</td>
<td>11</td>
<td>11</td>
<td>77</td>
<td>'</td>
<td>7</td>
<td>G</td>
<td>W</td>
<td>g</td>
</tr>
<tr>
<td>10</td>
<td>00</td>
<td>00</td>
<td>00</td>
<td>(</td>
<td>8</td>
<td>H</td>
<td>X</td>
<td>h</td>
</tr>
<tr>
<td>10</td>
<td>00</td>
<td>10</td>
<td>00</td>
<td>)</td>
<td>9</td>
<td>I</td>
<td>Y</td>
<td>i</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>LF</td>
<td>*</td>
<td>J</td>
<td>Z</td>
<td>j</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>+</td>
<td>;</td>
<td>K</td>
<td>[</td>
<td>k</td>
</tr>
<tr>
<td>11</td>
<td>00</td>
<td>00</td>
<td>00</td>
<td>,</td>
<td>&lt;</td>
<td>L</td>
<td>\</td>
<td>l</td>
</tr>
<tr>
<td>11</td>
<td>01</td>
<td>13</td>
<td>CR</td>
<td>-</td>
<td>=</td>
<td>M</td>
<td>]</td>
<td>m</td>
</tr>
<tr>
<td>11</td>
<td>01</td>
<td>01</td>
<td>14</td>
<td>.</td>
<td>&gt;</td>
<td>N</td>
<td>^</td>
<td>n</td>
</tr>
<tr>
<td>11</td>
<td>11</td>
<td>11</td>
<td>15</td>
<td>/</td>
<td>?</td>
<td>O</td>
<td>_</td>
<td>o</td>
</tr>
</tbody>
</table>
(1) ONE-TO-ONE

(2) MULTI-DROP SYSTEM

(3) REMOTE CONTROLLED DUAL RECEIVER

Fig. 2.1  Typical Configurations
Fig. 2.2  Typical RS-423 Interface Connections
Fig. 2.3 Typical RS-232 Ground Connections
CHAPTER 3

IEEE-488 INTERFACE

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<table>
<thead>
<tr>
<th>Para.</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3-1</td>
</tr>
<tr>
<td>4</td>
<td>3-1</td>
</tr>
<tr>
<td>6</td>
<td>3-2</td>
</tr>
<tr>
<td>8</td>
<td>3-2</td>
</tr>
<tr>
<td>9</td>
<td>3-3</td>
</tr>
<tr>
<td>10</td>
<td>3-4</td>
</tr>
<tr>
<td>11</td>
<td>3-4</td>
</tr>
<tr>
<td>12</td>
<td>3-4</td>
</tr>
<tr>
<td>13</td>
<td>3-5</td>
</tr>
<tr>
<td>17</td>
<td>3-6</td>
</tr>
<tr>
<td>20</td>
<td>3-6</td>
</tr>
<tr>
<td>28</td>
<td>3-8</td>
</tr>
</tbody>
</table>

Illustrations

Fig. 3.1  Typical System Configurations  3-9
CHAPTER 3

IEEE-488 INTERFACE

INTRODUCTION

1. A single IEEE-488 port is provided, which can be configured as a Master (Client) or a Tributary (Server). In the RA3792 Dual Receiver, each receiver has an independent port.

2. This interface, which is also known as the general purpose interface bus (GPIB) and the Hewlett Packard interface bus (HPIB), is the dominant control interface used for communications between computers and test equipment.

3. The electrical interface complies with IEEE-488.1-1987 (IEC-625); the protocol conforms to the Racal DS145 Standard Control Protocol. The 25-way D-type socket on the rear panel has the following pin connections:

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DIO1</td>
<td>13</td>
<td>DIO5</td>
</tr>
<tr>
<td>2</td>
<td>DIO2</td>
<td>14</td>
<td>DIO6</td>
</tr>
<tr>
<td>3</td>
<td>DIO3</td>
<td>15</td>
<td>DIO7</td>
</tr>
<tr>
<td>4</td>
<td>DIO4</td>
<td>16</td>
<td>DIO8</td>
</tr>
<tr>
<td>5</td>
<td>EO1</td>
<td>17</td>
<td>REN</td>
</tr>
<tr>
<td>6</td>
<td>DAV</td>
<td>18</td>
<td>Gnd. (6)</td>
</tr>
<tr>
<td>7</td>
<td>NRFD</td>
<td>19</td>
<td>Gnd. (7)</td>
</tr>
<tr>
<td>8</td>
<td>NDAC</td>
<td>20</td>
<td>Gnd. (8)</td>
</tr>
<tr>
<td>9</td>
<td>IFC</td>
<td>21</td>
<td>Gnd. (9)</td>
</tr>
<tr>
<td>10</td>
<td>SRQ</td>
<td>22</td>
<td>Gnd. (10)</td>
</tr>
<tr>
<td>11</td>
<td>ATN</td>
<td>23</td>
<td>Gnd. (11)</td>
</tr>
<tr>
<td>12</td>
<td>Shield</td>
<td>24</td>
<td>Logic Ground</td>
</tr>
</tbody>
</table>

NOTE: Gnd.(n) refers to the signal ground return of the referenced contact.

IEEE-448 LINK PROTOCOL

4. This section describes the link protocol used for transferring data over the IEEE-488 bus. A port is configured as a 'Server' if the equipment is being used as a slave, or as a 'System Controller' if the equipment is in control of the link. At any time there must be only one active system controller on a bus. Typical system configurations are shown in Fig. 3.1.
5. Before an equipment can be used in a remote control system, various parameters must be preset so that all equipments in the system are compatible. Also, each equipment must be allocated a unique address. Some parameters are set up using the receiver menu system, as described in the RA3790 Operators Manual; additional configuration information is given later in this chapter.

IEEE-488 BUS

6. The IEEE-488 interface is a communications bus between up to 15 equipments. Data is sent in a bit-parallel, byte-serial format, and there are 16 transmission lines within the interface, as follows:

   (1) Eight data lines to transfer data between equipments and to carry certain IEEE-488 commands, dependent upon the state of the management lines.

   (2) Three handshake lines to control data transfer.

   (3) Five management lines (see 'Interchange circuits' below).

7. The link controller is responsible for assigning who will talk on the bus (the 'talker') and who will listen (the 'listeners'). An equipment that is not addressed to talk or to listen will take no part in, or have any effect upon data transfers. The handshake lines are used to ensure that a talker does not send data until all listeners are ready to accept. Thus, the data transfer will take place at the speed of the slowest listener.

Lines on the Bus

8. Details of the lines on the bus are defined in ANSI/IEEE Std. 488-1978. A summary is included below:

   (1) Management Lines:

      ATN (Attention): Used to switch the use of the data lines between application dependent data and IEEE-488 commands.

      IFC (Interface Clear): When asserted (for at least 100 us), causes each interface on the bus to move to its quiescent state.

      REN (Remote Enable): Used to switch a responding interface between remote and local modes.
SRQ (Service Request): Used by a tributary to request service from the link controller. The link controller will then need to interrogate each equipment on the bus to determine the originator of the SRQ.

EOI (End or Identify): Serves two purposes. When EOI is asserted at the same time as ATN, it is a request for parallel poll data. Otherwise, it is asserted to indicate the last byte of a data stream (packet).

(2) Data Lines:

The eight data lines are used to convey bit-parallel data between equipments, one byte at a time.

(3) Handshake Lines:

The handshake lines are used to control the transfer of bytes across the data lines. They consist of:

NRFD (Not Ready for Data): When no listener is driving this line low, the talker may send data.

DAV (Data Valid): Driven low by the talker when the data on the data lines is valid.

NDAC (Not Data Accepted): Driven low by a listener until it has accepted the data on the data lines.

Capabilities

9. The RA3790 Series equipments support the following features within the IEEE-488 standard:

Link Controller Capabilities

- Capability to issue the IFC command
- Capability to issue the REN command
- Capability to respond to SRQ
- Passing and receiving control

Server Capabilities

- Equipments respond to IFC
- Equipments configurable to respond to REN (RL function)
- Capability to generate an SRQ
Capability Identification Codes

The IEEE-488 capability identification codes are dependant on the mode of receiver operation:

(a) Remotely controlled receivers:

AH1, SH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0, E2

(b) Receiver or receiver controller acting as master or diversity master:

AH1, SH1, T7, L3, SR0, RL0, PP0, DC0, DT0, C1, C2, C3, C4, C28, E2

ELECTRICAL CHARACTERISTICS

10. The electrical characteristics are defined in ANSI/IEEE Std. 488-1978.

PACKET FRAMING

11. Characters are assembled into packets of up to 252 characters (or more, as defined for a particular equipment) as follows:

<table>
<thead>
<tr>
<th>UP to 248 + printable data characters</th>
<th>Terminating Character(s)</th>
</tr>
</thead>
</table>

(1) The data characters contain the actual command or data being sent over the link. Details of the command instruction set for the RA3790 series equipment are contained in chapter 5.

(2) The equipment must be configured at the time of installation as to which terminating characters are required. Either carriage return (CR) or carriage return plus line feed (CR + LF) may be selected.

PACKET TIMING

12. The rules for packet timing are given in the following paragraphs. The values given are the longest total response times allowed for the system, including any transmission delays. The aim, in general, for good system operation, would be to respond considerably faster, and the response times given to be treated as maximum rather than design targets.
A packet will be regarded as starting with the data that is immediately received following the unit being addressed to listen. A packet is terminated by receipt of a (CR). If a unit is re-addressed before receipt of the (CR), then any data received prior to the re-addressing is discarded.

At a system controller, a received packet may be considered terminated if no byte is received within the programmable timeout period and such a packet will not be valid.

At a tributary, a received packet may be considered terminated if IFc is detected and such a packet will not be valid.

It is recommended that gaps between the transmitted bytes should not exceed 100 ms although, subject to the above time-outs, no error should result if this time is exceeded.

At a tributary the reply should be available for transmission within 100 ms from the end of a received packet. Failure to meet this criterion, subject to the above clauses, will not, however, cause error.

At a tributary, there will be an indefinite wait for data from the link controller.

At a system controller, packets may be generated as required.

At a tributary, packets will always and only be generated in response to valid packets.

COMMUNICATIONS PROTOCOL

13. Units transmit alternately over the link (half-duplex operation). Each responds to a packet from the other by sending a link status (minimum length) packet, even if they have no data to send. Such a packet comprises a terminating character alone.

14. A link controller may break the alternate transmission rule with one equipment by addressing another. Since packets not addressed to a tributary are ignored by that tributary, each tributary is unaware of this lack of continuity.

15. Physical control of byte transfers is accomplished by the handshake process as described in ANSI/IEEE Std. 488-1978.

16. Before any packet can be sent, the controller must establish the correct talker and listener using the commands defined in ANSI/IEEE Std 488-1978.
CHECK CHARACTERS

17. The equipment may be configured to send check characters with the data packet so that integrity of the data can be checked at the receiving end of the link. The equipment will not reply to a packet which has incorrect check characters.

18. The equipment may be configured so that check characters are not sent. This will give a slight improvement of data throughput on good quality links.

19. The three check characters are calculated as follows:

(1) A 16-bit Cyclic Redundancy Check character is calculated using the CRC-16 polynomial. The (LF), (CR) and check characters are excluded. Parity, if present, is masked to zero and the data treated as 8-bit characters.

(2) The 16-bit residue is transmitted in the three check characters as (MS 4 bits), (next 6 bits), (LS 6 bits). The number 32 decimal (20 Hex) is added to each character to provide ASCII printing characters.

(3) If a packet contains only a terminator character, the CRC is not performed.

SERVICE REQUEST OPERATION

20. The service request facility when selected allows a tributary to signal a controller certain defined status data. The tributary signals a request by asserting the SRQ line, and the controller responds by performing a serial poll sequence, as described in ANSI/IEEE Std. 488.1-1987 or IEC 625.1.

21. During a serial poll sequence, as each device is polled, it will return a status byte. The byte returned from a slave receiver is as follows:

<table>
<thead>
<tr>
<th>Status Byte Data</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 = Signal detection status changed</td>
<td>1 = Sweep/Scan limit reached</td>
<td>1 = Mute status changed</td>
<td>For future expansion</td>
<td>1 = Message available</td>
<td>1 = CRC error on last message</td>
<td>1 = SRQ active from this device</td>
<td>Not used</td>
</tr>
</tbody>
</table>

Only those actions enabled by the 'SRQn' bits (bits 0 to 5) will cause the tributary to assert the SRQ line. After the SRQ sequence has occurred, the status bits are cleared to allow new events to trigger the SRQ sequence.
Signal Detection Status - bit 0

22. This status bit is used to show when useful changes in the state of the currently selected signal detector (COR or Signal Detector) have occurred. This bit is set when one of the following events occurs:

(1) The COR output line changes from the released to the asserted state, eg when a transmission starts on a monitored channel.

(2) The COR output line has been released, due to the COR hang time expiring, eg when a transmission ends on a monitored channel.

(3) While sweeping or scanning, the SCAN INHIBIT input line is either asserted or released, eg an external detector stops or starts a scan.

(4) After attempting to resume a sweep or scan (eg by sending the ENTER or SCAN remote commands as appropriate), the sweep or scan is stopped because either the COR output line or the SCAN INHIBIT input line is asserted, eg when a scan has stopped on a usable signal, the controller may send the ENTER command to advance the sweep or scan to a new channel or frequency. In this case, the status bit is set only if a signal is detected on the new channel or frequency. This prevents SRQ signals being generated if the next channel or frequency is of no interest.

(5) After dumping the AGC and COR hang time (eg by sending the ENTER remote command), the COR output line is still asserted because a signal is still being detected. eg If a long or latched COR hang time is selected, the controller can send the ENTER command to dump the COR output. If a signal is still present after the dump, the status bit is set. If there is no signal detected after the dump, no action is taken as the signal is no longer of interest.

The above conditions ensure that only events outside the control of the remote controller report changes in the signal detection status.

Sweep/Scan Limit Status Bit

23. This status bit is set after a frequency sweep or channel scan has completed, when the start frequency/channel is re-selected.

Mute Status Bit

24. This SRQ status bit is used to show when the mute status has changed due to either:

(1) The MUTE line being asserted or released.
A front end overload status change.

Message Available Status Bit

25. This status bit is set whenever the receiver has a reply or unsolicited report to send back to the controller.

CRC Error Status Bit

26. This status bit is set whenever a CRC error is detected on an incoming packet.

SRQ Active Bit

27. This status bit is set if the SRQ line has been asserted by this receiver.

REMOTE CONTROL CONFIGURATION

28. On RA3791 and RA3792 receivers, certain IEEE-488 interface parameters can be set locally using the front panel menu system, thus allowing the receiver to function either as a Controller or as a Listener (see the Operators Manual for further details). Additional configuration information is given below.

29. To be issued later
Fig. 3.1 Typical System Configurations
## CHAPTER 4

### INTERFACE PROGRAMMING INFORMATION

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Chapter 4

Interface Programming Information

Introduction

1. Chapters 2 and 3 define the standards for data transmission between equipments for the error-free transport of ASCII characters. This chapter defines the standards for formatting the strings of characters (for the application layer) to perform equipment control functions, and provides guidelines for the development of software to control RA3790 series equipments. The command instruction set is given in Chapter 5.

Application Layer Syntax

2. The following paragraphs describe the general rules for the application layer syntax, and are in accordance with IEEE Std-728.

Syntax Diagram Notation

3. The syntax diagram is a formal means to describe the alternatives for constructing application layer messages. The four types of symbol used to define the message elements are as follows:

   (1) Rectangular shaped symbols are used to indicate explicitly defined message elements.

   (2) Circular shaped symbols are used to indicate literal data, for example a specific ASCII character.

   (3) An arrow, left to right, is used to indicate the assembly sequence of successive message elements and the bypass paths around indicated message elements.
(4) A reverse arrow indicates the feedback loop for the repetition of one or more message elements.

Message Elements

4. Message elements comprise the alpha characters A to Z, (upper case), and the digit characters 0 to 9.

Packet Syntax

5. When present, the application data in a packet is split into one or more frames, as shown in the following syntax diagrams.

6. The above diagrams show that a packet can hold no frames at all or a number of complete frames; a frame cannot be sent part in one frame and part in the next. The semi-colon is used to delimit frames within the packet and to mark the end of the application field.
7. The header (HR1) is as above; a header is terminated by the first character of the following data.

Data Syntax

Numeric Syntax

4-3
Numeric Representation Syntax

NR0

DIGIT

eg 123

NR1

+

-

SP

NR0

eg -123

NR2

NR1

.

NR0

eg -123.456
8. The K and M suffices denote $10^3$ and $10^6$ respectively. The syntax is arranged so that lower levels are valid forms of higher levels. The following examples all indicate 123,000 Hz.

- 123000: NR0 with no suffix
- 123K: NR0 with suffix
- +123000: NR1 with no suffix
- +123K: NR1 with suffix
- 0.123M: NR2 with suffix
- 123E+3: NR3 with no suffix
- 1.23E+5: NR3 with no suffix
- 1.23E+2K: NR3 with suffix
- 1.23E-1M: NR3 with suffix

Note: The exponent is limited to two digits.
String Representation Syntax

\[
\text{ANY PRINTABLE ASCII (COLUMN 27) EXCEPT} \\
\text{\$ " DEL ;}
\]

\[
\text{@ , A-Z []} \\
\text{- \$ \* SP {}}
\]

<table>
<thead>
<tr>
<th>CHARACTER</th>
<th>SENT AS</th>
</tr>
</thead>
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<tr>
<td>$</td>
<td>$$</td>
</tr>
<tr>
<td>=</td>
<td>$</td>
</tr>
<tr>
<td>NUL</td>
<td>@$</td>
</tr>
<tr>
<td>SOH</td>
<td>$A</td>
</tr>
<tr>
<td>;</td>
<td>$</td>
</tr>
<tr>
<td>LF</td>
<td>$J</td>
</tr>
<tr>
<td>CR</td>
<td>$M</td>
</tr>
<tr>
<td>US</td>
<td>$</td>
</tr>
<tr>
<td>DEL</td>
<td>$SP</td>
</tr>
<tr>
<td>;</td>
<td>$</td>
</tr>
</tbody>
</table>

eg "This is the first line. $M$J This is the second."

"Quote $" you shot him!$""
MESSAGE FORMATS

9. Messages are formatted as follows:

[frame 1] [frame 2] .... [frame n]

where a sequence of frames may cross the boundaries between link layer packets without restriction, but where each packet must contain a whole number of frames.

10. The data portion of the packet is capable of carrying a message for any protocol; all messages however, must comprise printable characters only.

FRAME TYPES

11. There are four types of frame, as follows:

(1) A forward COMMAND frame. This is actioned without the generation of a reply frame unless it is in error, in which case an error REPORT frame (see below) is generated.

   eg F12.345M is a command to change receiver frequency.

(2) A QUERY frame which requests an equipment to respond with a REPLY frame (see below). Query frames all commence with the letter Q.

   eg QF is a query frame requesting the receiver frequency.

(3) A REPLY frame which is sent in reply to a query frame.

   eg F12.345M sent in reply to QF is a revertive REPLY frame indicating the receiver frequency.

(4) An unsolicited REPORT frame may be generated by the receiver at any time.

PROGRAMMING REMOTE CONTROL INTERFACES

12. The following paragraphs provide guidelines for the development of software to control the RA3790 Series equipments.

13. It is important to understand that there is no relationship between the transfer of packets at the link layer and the processing and generation of command, query, reply and report frames. There is no requirement for all the query frames in a packet to be processed and all the reply frames to be generated for the immediate reply packet.
14. After sending a query frame, link communications should be continued until the reply frame requested is received. The best practice is to keep the link layer running at all times so that any unsolicited report frames are seen.

15. For each RA3790 series equipment under control, a separate inbound and outbound frame buffer is required (to hold encoded ASCII frames), between the application layer and the ASCII or IEEE link layer software, as shown below.

16. For the ASCII interface, if a packet containing one query frame is received, the reply frame is normally held in the reply to the next packet received, although it can occasionally be generated in reply to the packet holding the query frame.

17. For the IEEE interface, reply frames are copied to the output buffer and are then sent back to the controller, when the receiver has been addressed to talk. This means that a controller may delay addressing a receiver to talk until the receiver has processed any query frame(s).

The Application Program

18. This is the main part of the controller program, to control the operation of receivers to meet the system requirements. It should include a parser capable of decoding and checking frames of characters using the application layer syntax already described, and an encoder for generating frames of the correct syntax (programmers are advised to approach Racal Communications Systems Limited to obtain suitable C-language encoding/decoding software).
19. When the application program requires to send a frame to the controlled equipment, it simply encodes a frame and places it in the outbound buffer; if required, it flags the presence of the frame to the link layer software. To check whether any information is returned, it must check the inbound buffer, either periodically or when flagged to by the link layer software.

**LCC Store (ASCII Interface only)**

20. An LCC store (which holds the inbound and outbound Link Control Characters) is required for each controlled equipment so that the correct output-phase alternation etc. may be continued with each equipment.

**The Frame Buffers**

21. As previously mentioned, a separate buffer for inbound and outbound frames should be provided for each controlled equipment. The inbound buffer should be twice as long as a maximum length packet (generally 512 characters, although it can be larger than this) so that the LCC input-permit logic may be operated simply. The length of the outbound buffer is dependant on the application.

**The Link Layer Software (ASCII Interface only)**

22. This software should maintain a link layer with all controlled equipments. It might endlessly perform the following functions to operate the link layer:

1. Selection of an equipment for the next bus transaction. Various priority schemes might be appropriate.

2. Insertion of the correct address into the outbound packet.

3. Filling of the outbound packet from the outbound frame buffer. In general, as many frames as possible should be placed in a packet. If Link Control Characters are in use, first check that the receiving equipment has the Input-Permit bit in the stored inbound LCC set.

4. Generation of outbound LCC from the stored inbound LCC:
   
   (a) Input-Permit set if the inbound frame buffer has space for all the frames in a maximum length packet, clear otherwise.
   
   (b) Output-Ready set if there are further frames in the outbound frame buffer.
   
   (c) Output-Phase set to the inverse of the outbound output-phase stored (unless this is a retry).
(d) Input-Accept set to 1 if this is a new transaction, 0 if it is a retry following packet rejection.

(e) Input-Phase set equal to the last stored inbound output-phase.

(5) Generation of CRC characters if required.

(6) Initiation of outbound packet transmission.

(7) Monitoring of the progress of the link transaction, including the application of the following timeouts:
   (a) Master X-OFF.
   (b) Server (tributary) response time.
   (c) Server inter-character gaps.

(8) Reply packet validation, including address, CRC and LCC checks:
   (a) Inbound Input-Phase = Output-Phase sent.
   (b) Inbound Input-Accept set.

(9) Unpacking of all the frames in the reply packet into the inbound frame buffer.

(10) Storing of the inbound and outbound Link Control Characters.

23. In addition, the link layer software must handle the retry of failed transactions (a maximum of three retries might be sensible). If retries are to be interleaved with communications with other equipments, then care must be taken to enable the easy regeneration of retry packets. If Link Control Characters are in use, CRC calculation is normally necessary as the CRC covers the LCC.

24. If the LINK command is to be used to configure one equipment on a bus, care should be taken to ensure that only the relevant configure pin is asserted and that the other equipments are not set to 600 baud.

25. It cannot be stressed too strongly that there is no intended synchronisation whatsoever between the application layer and the link layer communications.

The Link Layer Software (IEEE Interface only)

26. This software should maintain a link layer with all controlled equipments. It might endlessly perform the following functions to operate the link layer:
Selection of an equipment for the next bus transaction. Various priority schemes might be appropriate, eg. polling each equipment in turn or responding to a recent Service request (SRQ).

Initiate a command packet, ie. set up a talker and a listener.

Filling of the outbound packet from the outbound frame buffer. In general, as many frames as possible should be placed in a packet. If an error is detected on the last packet sent, the last packet may be re-transmitted.

Generation of CRC characters, as required.

Initiation of outbound packet transmission.

Monitoring of the link timeout.

Reply packet CRC validation.

Unpacking of all the frames in the reply packet into the inbound frame buffer.

Processing Service Requests (SRQs).

In the event of a link timeout, the link must be restarted (IFC etc.).

If the correct allowances are made for command execution times, the link layer may be synchronised to the application layer, although this is not necessary.

RA3790 Series Equipments Acting as Controllers

Any RA3790 series equipment (and MA3790) may be used as a controller of other receivers which have the same type of remote control interface. There are several methods of operating as a controller, and each has differences with respect to the remote control interface. These are:

Recall Operation: Initiated by pressing the ADDR and RCL pushbuttons or the RESTART remote command, the slave settings are recalled to the controller front panel. The slave settings can then be altered from the controller front panel without affecting the controller's local receiver (if applicable).

Hand-off Operation: Initiated by pressing the ADDR and ENTER pushbuttons or the RESTART remote command, the slave is initially set to the same settings as those of the controller. The slave settings can then be altered from the controller front panel without affecting the controller's local receiver (if applicable).
(3) **Diversity Master Operation:** Initiated by the DIV MASTR menu option, or by the DIVM or RESTART remote commands. The diversity slave is initially set to, and continues to be set to, the diversity master settings.

30. When one of the above modes is initiated via a pushbutton operation, or after power-on, the controller performs a start-up sequence. This attempts to establish communication and sends a string of remote commands to the slave.

31. With the exception of an RA3791 acting as a diversity master, once communication is established, the controller polls the slave for metering, mute and COR status. When BITE is being run on the slave, the controller polls it for BITE status.

**Link Start-up (IEEE Interface)**

32. The IEEE controller start-up sequence is as follows:

(1) Release REN line for > 100 microseconds.

(2) Assert REN line.

(3) Assert IFC line for > 100 microseconds

(4) Release IFC line.

(5) Assert ATN line.

(6) Send device clear (DCL) command.

(7) Start normal link MTA, UNL, MLA.....data....EOI etc.

**Link Start-up (Serial ASCII Interface)**

33. The serial ASCII controller start-up sequence is as follows:

(1) Send out status packets until the slave replies.

(2) Start normal link <LF>, addr...data....<CR> etc.
## CHAPTER 5

### COMMAND INSTRUCTION SET

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CHAPTER 5

COMMAND INSTRUCTION SET

INTRODUCTION

1. The instruction set is described below. The highest numeric form each parameter can take is identified together with an indication of whether the parameter is optional or not. The following coding scheme is used.

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<td>mnr0ns</td>
<td>Mandatory NR0 no suffix</td>
</tr>
<tr>
<td>onr0ns</td>
<td>Optional NR0 no suffix</td>
</tr>
<tr>
<td>mnr2</td>
<td>Mandatory NR2 with optional suffix</td>
</tr>
<tr>
<td>mnr3</td>
<td>Mandatory NR3 with optional suffix</td>
</tr>
<tr>
<td>ms</td>
<td>Mandatory String</td>
</tr>
<tr>
<td>os</td>
<td>Optional String</td>
</tr>
</tbody>
</table>

INSTRUCTION SET

2. In revertive or report frames parameters marked as mandatory are always returned; optional parameters are returned if relevant. In command frames mandatory parameters must be sent, optional parameters need not be, but delimiting commas are still required if subsequent parameters are to be sent.

3. Details of number ranges and command availability are contained in the summary tables at the end of this chapter.

4. Unless otherwise stated, settings that are changed are changed in EEPROM and will be used when the receiver is next powered up or is returned to local control.

(1) **AF Level**

QAFL
AFLlevel
mnr0ns

QAFL is a status frame requesting that the revertive frame AFL be returned. The *level* of the AF audio output is returned as a number in the range 0-255 and should be interpreted as shown in the table below. During ISB operation the level of the monitored sideband is returned. If the receiver is running BITE other than level 0 then a level of 0 is returned.
AF Levels:

<table>
<thead>
<tr>
<th>VALUE</th>
<th>LEVEL (approx)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-67</td>
<td>-10 dBm</td>
</tr>
<tr>
<td>68-75</td>
<td>-9 dBm</td>
</tr>
<tr>
<td>76-84</td>
<td>-8 dBm</td>
</tr>
<tr>
<td>85-95</td>
<td>-7 dBm</td>
</tr>
<tr>
<td>96-107</td>
<td>-6 dBm</td>
</tr>
<tr>
<td>108-120</td>
<td>-5 dBm</td>
</tr>
<tr>
<td>121-134</td>
<td>-4 dBm</td>
</tr>
<tr>
<td>135-151</td>
<td>-3 dBm</td>
</tr>
<tr>
<td>152-170</td>
<td>-2 dBm</td>
</tr>
<tr>
<td>171-190</td>
<td>-1 dBm</td>
</tr>
<tr>
<td>191-214</td>
<td>0 dBm</td>
</tr>
<tr>
<td>215-240</td>
<td>1 dBm</td>
</tr>
<tr>
<td>241-255</td>
<td>2 dBm</td>
</tr>
</tbody>
</table>

(2) **AGC mode**

\[
\text{QAGC} \\
\text{AGCgain-mode, time-constant, ISB - Time-constant mnr0ns mnr0ns onr0ns}
\]

The AGC command frame is used to set the type and time constant of gain control in use. The status frame QAGC generates the revertive AGC frame which indicates the settings in use and has the same form as the command frame.

The values of *gain-mode* are as below:

- **0** - AGC
- **1** - Manual Gain Control (gain knob or G command sets gain)
- **2** - Threshold (gain knob or G command sets the signal level above which AGC becomes active).
The values of time-constant are as below:

0 - Short  
1 - Medium  
2 - Long  
3 - Link 11 data  
4 - Link 11 normal

In Manual Gain Control mode the time constant must still be sent but is ignored; it will be reverted as 0.

The values of ISB-time-constant have the same meaning as the time-constant parameter, except applied to the other ISB channel.

**Note:** This parameter is only sent when the operating mode is ISB/L or ISB/U (see M command).

(3) **AGC Time Constants**

QAGCTC

AGCTC mode, hang, decay

mnr0ns nr2 nr2

This is used to set the hang and decay times for the short, medium and long AGC. The QAGCTC status frame causes the receiver to generate the AGCTC frame.

The mode parameter is used to specify the AGC mode as follows:

0 - Short  
1 - Medium  
2 - Long

The time constants for LK11d and LK11n are fixed.

The hang parameter specifies the hang time in milliseconds, in the range 0 to 9.999 seconds.

The decay parameter specifies the decay time in milliseconds, in the range 0 to 9.999 seconds.

(4) **Request All Operational Settings**

QALL

The status frame QALL generates the following revertive frames:

ANT, AGC, BFO, B, CORL, F, FLG, G, M, PASSB, PASSF, BWL.
It should not be repeated until all the revertive frames have been received. In delta mode, delta settings will be returned (see DLTA).

(5) **Receiver Antenna Outputs**

QANT
ANTantenna-number
mnr0ns

The command frame ANT is used to program the parallel output port of the receiver used for antenna selection. The four lines ANT0-ANT3 are set to the binary representation of the antenna-number received (range 0-15). QANT causes the revertive ANT frame to be generated with an indication of the current setting.

(6) **Audio Switching**

AUDIOloudspeaker
mnr0ns

The receiver powers up with its detector outputs switched to its loudspeaker amplifier. For some applications (eg. DF) it is desirable to break this connection. This is accomplished with the AUDIO command frame.

The loudspeaker parameter should be set as below:

- 0 - Audio path to loudspeaker connected to external input
- 1 - Audio path to loudspeaker connected to received signal

(7) **Audio Line Level**

QAUDLVL
AUDLVLline1,lined2
onr2 onr2

This is used to set the audio line level. The QAUDLVL status frame causes the receiver to generate the AUDLVL frame.

The line1 parameter is used to specify the line 1 level and the line2 parameter for the line 2 level. The range for both parameters is +12 dBm to -32 dBm in 0.5 dB steps. Values within range are rounded to the nearest 0.5 dB.

(8) **Beat Frequency Oscillator**

QBFO
BFOfrequency
mnr2
The BFO command frame is used to set the BFO frequency during CW operation. The status frame QBF0 causes the revertive BFO frame to be returned indicating the current BFO frequency. The revertive frame has the same form as the command frame. The valid BFO frequency range is -8.00 to +8.00 kHz. To allow compatibility with the RA3700 series receivers, up to plus and minus 9.99 kHz will be accepted, but the receiver will be set to and return plus or minus 8.00 kHz. If units or fractions of Hz are specified they are ignored.

(9) **IF Bandwidth**

```
QB
bandwidth,bandwidth-offset,ISB-bandwidth,ISB-bandwidth-offset
mnr2 onr2 onr2 onr2
```

The command frame `B` causes the receiver to select a particular IF bandwidth. The status frame `QB` causes the revertive B frame to be generated indicating the IF bandwidth in use.

**Bandwidth** This parameter specifies the IF bandwidth and must be within the following range:

- **CW, AM, FSK or FM modes:** 70 Hz to 12 kHz
- **Sideband modes:** 70 Hz to 6 kHz

Units and fractions of Hz are ignored.

The `bandwidth-offset` specifies the offset from the carrier frequency to the centre of the filter passband for sideband filters. If this parameter is not supplied it will default to the current filter offset. In CW, AM, FM or FSK modes this parameter is ignored. Units and fractions of Hz are ignored.

The values of `ISB-bandwidth` and `ISB-bandwidth-offset` have the same meaning as the `bandwidth` and `bandwidth-offset` parameters, except applied to the other ISB channel.

**Note:** These parameters are only sent when the operating mode is ISB/L or ISB/U (see M command).

(10) **Bandwidth Configuration**

```
QBCON bandwidth-type,bandwidth-number
mnr0ns mnr0ns
BCON bandwidth-type,bandwidth-number,filter-position,
mnr0ns mnr0ns mnr0ns
lower-pbf,upper-pbf,frequency-offset,insert-remove
mnr2 mnr2 mnr2 mnr0ns
```

5-5
The BCON command frame is used to configure the IF bandwidths that are available in the receiver. The QBCON status frame is used to request that the details of a particular bandwidth be returned in a revertive BCON frame. The revertive BCON frame has the same form as the BCON command frame. The parameters used are described below:

- **bandwidth-type**
  - 0 - not used (revertive only)
  - 1 - USB
  - 2 - LSB
  - 3 - Symmetrical

- **bandwidth-number**
  Bandwidth identifier in the range 0-49

- **filter-position**
  Not used

- **lower-pbf**
  The Filter Lower passband frequency (-6.00 to +6.00 kHz)

- **upper-pbf**
  The Filter Upper passband frequency (-6.00 to +6.00 kHz)

- **frequency-offset**
  Not used

- **insert-remove**
  0 - remove bandwidth from configuration
  1 - add bandwidth to configuration

After bandwidth configuration, the bandwidth list (see BWL) will include all the bandwidths for which the receiver has been configured.

(11) **Built-In-Test-Equipment**

QBITE
BITE\texttt{bite-level,sub-test}
\texttt{mnr0ns onr0ns}

The BITE command frame is used to set the receiver to perform BITE tests of a specified level. The QBITE status frame causes the revertive BITE frame to be generated. A BITE report frame is generated whenever a particular level of BITE, including power up, is completed.

In all BITE frame types the **bite-level** is as below:

- 0 - Continuous BITE (normal operation)
- 1 - Power Up BITE
- 2 - Full Unit Confidence Test BITE
- 3 - Not used
- 4 - Fault Finding BITE (Select Test)
- 5 - Not used
The sub-test represents the number of an individual test at which testing is to start or which is currently being run.

The BITE command frame causes the following actions:

Level 0 & 6: The current BITE level is exited and continuous BITE is resumed. Any sub-test specified is ignored.

Level 1: The receiver simulates a Power Up and consequently runs Power Up BITE. Any sub-test specified is ignored.

Level 2 & 8: BITE testing starts at the specified sub-test (or at the first test if no sub-test was specified) and increments automatically until a fault is found or until the last test is performed. If a fault is found, then a FAULT report frame is generated. When the last test is completed, a BITE2 report frame is generated. In both cases, the receiver awaits further BITE commands.

Level 4: The test indicated by the sub-test is repeated continuously until otherwise instructed. No BITE or FAULT report frame is generated.

Level 7: In response to this command, the receiver sends details, as a FAULT report frame, of the first fault with a test number higher than that specified or a BITE7 report frame if there are no such faults.

A BITE0, BITE6 or RCL command frame is used to return the receiver to normal operation.

The QBITE status frame generates the revertive BITE frame. The revertive BITE frame indicates the current BITE level and sub-test. If a level has completed a sub-test of 999 is returned.

Example: Run Unit Confidence Test

Tell the receiver to start Full Unit Confidence BITE by sending

BITE2

Send QBITE to monitor the progress of testing

QBITE
The receiver replies with

BITE2,nnn

where nnn varies as testing progresses

If a test fails the receiver reports

FAULT5,2,rnnn

indicating that test nnn has failed with result r (see FAULT)

To continue testing, skipping the failing test send

BITE2,nnn+1

When the receiver completes testing it will report

BITE2

Return the receiver to normal operation by sending

BITE0

(12) Bandwidth List

QBWL

BWL|bandwidth-type,bandwidth-number| (up to 48 times)
onr0ns   onr0ns

The QBWL status frame causes the revertive BWL frame to be generated. The revertive BWL frame lists the configured IF bandwidths within the first 16 bandwidths in the list (see BCON).

bandwidth-type 1 - USB
2 - LSB
3 - Symmetrical

bandwidth-number Bandwidth identifier in the range 0-15

The list is returned with USB bandwidths first followed by LSB and the Symmetrical bandwidths. There is no relationship between the bandwidths listed in the revertive BWL frame and the menu system's bandwidth list facility (see Operators Manual).
(13) **COR Status**

QC
Ccor-status, scan-inhibit

The status frame QC generates the revertive frame C. The revertive C frame indicates whether the COR level has been exceeded and whether the rear panel scan-inhibit input is asserted.

cor-status 1 - COR level exceeded
0 - COR level not exceeded

scan-inhibit 1 - SCAN INHIBIT asserted
0 - SCAN INHIBIT not asserted

(14) **Store COR/IF Gain In Channels.**

QCCH
CCHstorage-mode

The CCH command frame is used to enable or disable the storage of COR or IF Gain level in channels. The QCCH status frame causes the CCH frame to be returned indicating the current setting. The storage-mode parameter is used as below:

0 - Disable storage of COR/IF Gain level in channels.
1 - Enable storage of COR/IF Gain level in channels.

When the storage-mode facility is enabled, the COR level will be stored or recalled for channels operating in AGC mode, and the IF Gain level will be stored or recalled for channels operating in Manual gain or Threshold AGC modes (See AGC).

(15) **Channel Data**

QCDCchannel-number

CD Frequency, Demodulation, Bandwidth, Gain-mode, Time-constant, BFO-frequency, FSK-polarity, ISB-bandwidth, ISB-time-constant, Channel-number, Scan-flag, COR-gain, Bandwidth-offset, ISB-bandwidth-offset
The status frame QCD causes the receiver to reply with the revertive CD frame, indicating either:

(a) If no Channel-number is supplied, the current receiver settings or the delta settings if in remote delta mode.

(b) If a Channel-number is supplied, the contents of the required channel.

The CD command frame is used to change either:

(a) If no Channel-number is supplied, the current receiver settings or the delta settings if in remote delta mode.

(b) If a Channel-number is supplied, the contents of the required channel.

The following parameters can be supplied:

(i) Frequency
   The operating frequency (see F command)

(ii) Demodulation
   The demodulation mode (see M command)

(iii) Bandwidth
   The IF bandwidth applicable to the current demodulation mode (see B command)

(iv) Gain-mode
   The AGC gain mode (see AGC command)

(v) Time-constant
   The AGC time constant (see AGC command)

(vi) BFO-frequency
   The BFO frequency in CW demodulation mode (see BFO command).

(vii) FSK-polarity
   The FSK signal polarity; only applicable in FSK demodulation modes (see FSKPOL command)

(viii) ISB-bandwidth
   The background bandwidth; only applicable in ISB demodulation modes (see B command)
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ix) ISB-time-constant</td>
<td>The background AGC time constant; only applicable in ISB demodulation modes (see AGC command)</td>
<td></td>
</tr>
<tr>
<td>(x) Channel-number</td>
<td>The destination channel (see CHAN command). If the channel being updated is currently selected, the channel display is cleared, as the receiver will no longer be operating on that channel.</td>
<td></td>
</tr>
<tr>
<td>(xi) Scan-flag</td>
<td>The scan flag state of the specified channel-number (see FLG command).</td>
<td></td>
</tr>
<tr>
<td>(xii) cor-gain</td>
<td>The COR threshold (see CORL command) or gain setting (see G command).</td>
<td></td>
</tr>
<tr>
<td>(xiii) bandwidth-offset</td>
<td>The IF bandwidth offset applicable to the current demodulation mode (see B command).</td>
<td></td>
</tr>
<tr>
<td>(xiv) ISB-bandwidth-offset</td>
<td>The background bandwidth offset, only applicable in ISB demodulation modes (see B command).</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Parameters should only be sent if they are applicable, otherwise a revertive error (ERR) message will be generated, eg the following would cause an error message to be generated:

If the scan-flag is sent and no channel number is specified.

When a CD reply is generated, only those parameters applicable are included.

(16) **Channel Recall**

```
QCHAN
CHAN channel-number
mnr0ns
```

The command frame CHAN causes the receiver to tune to the settings of the specified channel-number (0-99). The status frame QCHAN causes the
revertive CHAN frame to be generated indicating the currently or last used, channel number. The Channel settings include:

- Frequency
- Demodulation mode
- AGC mode and time constant
- BFO frequency if mode is CW
- IF bandwidth
- FSK polarity (FSK demodulation modes only)
- Scan Flag

17) **Clear All Channels**

CLEARALLCHANNELS

The command frame CLEARALLCHANNELS is used to erase the entire channel store of the receiver. After erasure the channels are set to frequency 0 Hz, CW, BFO 800 Hz, Bandwidth 1 kHz, short AGC, Scan Flag set, FSK polarity normal.

18) **Change All Scan Flags**

CHGF\[set-clear\]
mnr0ns

The CHGF command frame is use to set or clear all 100 channel scan flags. When its flag is clear a channel is excluded from a scan of channels that would otherwise include it. The set-clear parameter takes the value 0 for clear and 1 for set.

19) **Clear All Sweep Ranges.**

CLEARALLRANGES

The command frame CLEARALLRANGES is used to erase all of the frequency sweep and lockout ranges (see SFR command).

20) **COR/Squelch Level**

QCORL
CORL\[cor-level\]
mnr0ns

The CORL command frame is used to set the COR threshold or squelch threshold. This is the signal level which if exceeded causes the COR output to be asserted and below which the audio output is muted if squelch is enabled. The cor-level represents the COR threshold level and lies in the range 0 to 255 with 255 corresponding to the lowest (most sensitive) threshold. The status
frame QCORL generates the revertive CORL frame indicating the current level. The COR level set is used if local control is resumed but only until the IF gain control is moved.

(21) **COR control**

QCOR  
CORcor-mode,hang-time,detector  
mnr0ns mnr2 onr0ns

The COR command frame is used to set up how the rear panel COR output and front panel COR legend operate. The QCOR status frame causes the receiver to generate the revertive COR frame indicating its current COR set up. The *cor-mode* parameter is used as below:

0 - COR output disabled  
1 - COR output enabled

The *hang-time* represents the time taken for the COR output and COR legend to go off and/or the squelch mute to be asserted, after the signal falls below the COR threshold. The parameter is in the range:

(a) 0.0 to 9.9 representing time in seconds.  
(b) -1 if an infinite hang time is required.

**Note:** The COR hang will be determined when the AGC is dumped (ENTR command etc).

The *detector* parameter is to determine if either the COR level detector or signal to noise detection is used to indicate the presence of a usable signal. The allowed values are:

0 - COR level detection  
1 - Signal to noise detection

(22) **Diversity Control**

QDIVM  
DIVMdiversity-mode,slave-address  
mnr0ns onr0ns

The DIVM command frame is used to place a receiver pair in diversity mode. A diversity pair can be made from one of the following combinations:

(a) Two single receivers connected via a serial ASCII link from the diversity master's master port to the diversity slave's tributary
In this configuration, the DIVM command can also be sent to the diversity master in a reply packet (from a computer connected between the diversity master and one or more diversity slaves), as long as there is not an outstanding DIVM reply to a QDIVM command.

(b) Two single receivers connected via an IEEE-488 link from the diversity master to the diversity slave.

Note: In this configuration the DIVM command can only be sent to the diversity master (from a computer connected between a diversity master and one or more diversity slaves).

In diversity mode both receivers are set according to the commands received at the diversity master (or according to the local controls of the diversity master). In a dual receiver, the diversity master is the receiver that receives the DIVM1 command. The other (diversity slave) receiver's remote control facility is disabled during diversity operation. In a non dual IEEE-488 receiver the diversity master must be set up to be a 'system controller', and therefore cannot accept remote control commands from another controller.

The status frame QDIVM causes the receiver to reply with the revertive DIVM frame indicating its current diversity mode.

A special facility is included that allows the master and slave to be temporarily reversed so that BITE may be run on the slave. This is achieved with the DIVM2 command. After DIVM2 has been sent all BITE commands are routed to the slave. It is possible to distinguish whether a FAULT report relates to the master or the slave receiver by the presence of sub-address S frames (see S command). After sending DIVM2 no commands other than BITE or DIVM should be sent to the receiver.

The diversity-mode parameter holds one of the following:

0 - Diversity Operation Disabled
1 - Diversity Operation Enabled
2 - Diversity Operation Enabled, BITE and FAULT control of Slave

The Slave-address parameter holds the address of the slave receiver if applicable. If a serial ASCII interface is fitted, the slave-address is only valid if the slave link has one or two address characters selected. If an IEEE interface is fitted, this parameter is only allowed if variable addressing is used for the remote link (system controller operation).

(23) Step Scan or Dump AGC (Enter)

ENTR
Depending upon the current operating mode of the receiver, the command frame ENTR will cause one of the following actions:

(a) If currently sweeping or scanning (or stopped on sweep or scan), it will cause either:

(i) The channel scan to advance to the next channel.

(ii) The frequency sweep to advance by the number of frequency sweep steps that is greater than or equal to the current bandwidth.

(b) If neither of the above, it will cause an AGC dump (and COR hang termination if active) to be performed.

(24) Error

ERR severity, command, message
mnr0ns ms ms

The ERR report frame is generated whenever a command or status frame is in error either syntactically or semantically.

The severity is one of:

1 - Warning
2 - Error, command not actioned
3 - Severe, command not actioned

The receiver uses a severity of 1 or 2.

The command parameter holds the header of the frame in error (only the first 6 characters if it has more than 6, with * shown in place of a non-printing character).

The message is a description of the error. All possible error messages are listed in the summary tables of this chapter.

(25) Frequency

QF
F frequency
mnr3

The command frame F is used to tune the receiver to the specified frequency. The status frame QF causes the revertive F frame to be generated holding the current receiver frequency setting. If fractions of Hz are specified they are ignored.
The FAULT frame is sent by the receiver whenever a fault arises or in reply to the status frame QFAULT. The only type of fault in the receiver is a failed BITE test.

The severity is as follows:

0 - No fault
1 - Transient or temporary fault
2 - Warning
3 - Failure of redundant part
4 - Partial failure
5 - Serious failure
6 - Emergency

All receiver faults are severity 5 except the EEPROM write fault which has severity 2.

The bite-level is the level of BITE currently being run by the receiver as in the BITE frame.

The fault-number is a four digit number identifying the fault. The first digit indicates the result of the failing BITE test:

1 - Fail
2 - Failed High
3 - Failed Low
4 - Not applicable (Attempt to select invalid test)
5 - Module not fitted (Attempt to run test on absent hardware)

The lower three digits are the number of the failing BITE test using the same codes as the sub-test field in the BITE frame.

The description is a string of up to 30 characters describing the test and its result. It is only sent if fault messages have been enabled using the FAULTMSG command frame.

The status frame QFAULT causes a revertive FAULT frame to be generated for every current fault with the list terminated by the frame FAULT0.
(27) Fault Legend Status

QFAULTLEG
FAULTLEG on-off
mnr0ns

The QFAULTLEG status frame causes the revertive frame to be returned, indicating the state of the front panel fault legend. The on-off parameter is used as below:

1 - Fault legend is on
2 - Fault legend is off

(28) Fault Messages

FAULTMSG on-off
mnr0ns

This command frame is used to enable or disable the description parameter in revertive and report FAULT frames. Fault descriptions are always disabled at power up. The on-off parameter is used as below:

1 - Turn fault descriptions on
0 - Turn fault descriptions off

(29) Fault Text

QFAULTTEXT fault-number
mnr0ns

FAULTTEXT fault-number, description
mnr0ns ms

The status frame QFAULTTEXT causes the revertive FAULTTEXT frame to be generated and is used to obtain the description of a given fault-number. The description returned is that which would have been returned in a FAULT frame for the same fault-number if fault messages were enabled. It has a maximum length of 30 characters.

(30) Channel Scan Flag

QFLG
FLG on-off
mnr0ns

The command frame FLG is used to change the state of the scan flag stored with the current channel. The status frame QFLG causes the revertive frame FLG to be returned indicating the state of the scan flag stored with the present channel.
If no channel is in use then the state of the flag in the last used channel is returned. The on-off field is used as below:

0 - Scan flag clear  
1 - Scan flag set

A channel with its flag clear is excluded from a scan of channels that would otherwise include it.

(31) IF Gain

QG
Ggain-level
mnr0ns

The G command frame is used to set the receivers manual IF gain or AGC threshold (see AGC). It corresponds to the use of the Gain control. The status frame QG causes the receiver to generate the revertive G frame indicating the current gain level. The gain-level is a number in the range 0-255 with 255 corresponding to maximum gain. The last IF gain level sent is used if local control is resumed but only until the gain control is moved.

(32) Equipment Identification

QID
IDequipment-type,description,serial-number
ms ms ms

The QID status frame causes the receiver to reply with the revertive ID frame indicating its identity.

The equipment-type string will give the Racal type number of the equipment e.g. 'RA3790'.

The description simply describes the equipment e.g. 'HF RECEIVER'.

The serial-number is the equipment four-digit serial number (see SN)

The equipment-type and description are modified to identify all the options fitted to a receiver.

This command returns 'MA3790' as the unit identifier string when a controller or 'RA3790' when a receiver. Each half of a dual receiver is independent and will return the same identifier as a single receiver excluding any variation of options on either half. The following option codes may be appended to the reply to indicate the options fitted:
"SO FILTER /15" (Sub-Octave filter)
"ISB /5"
"DIG IF /31" (Digital IF/AF output)

(33) Analog/Digital Outputs

QIFOP
IFOP bandwidth,frequency,format
  onr0ns onr2 onr0ns

This command allows the format of the analog and digital IF/AF outputs to be selected remotely. The QIFOP status frame causes the receiver to generate the IFOP frame.

The bandwidth parameter defines the bandwidth of the analog IF output.

  0 - Narrow
  1 - Wideband

The frequency parameter defines the frequency of the analog IF output, over the range 10 kHz to 455 kHz in 5 kHz steps or 1.4 MHz.

The format parameter defines the format of the digital IF/AF output. This parameter is only valid if the Digital IF/AF option is fitted and will only be accepted or returned if this option is fitted. The range of values is 1 to 6, as follows:

  1 -
  2 -
  3 -
  4 -
  5 -
  6 -

(34) Link Configuration

QLINK port-select
  onr0ns

LINK flow,tx-baud,rx-baud,parity,lcc,address,crc,
  os onr0ns onr0ns os os os os
  free-tune, port-select,
  onr0ns onr0ns

The LINK command frame is used to configure the receiver with the settings used by the serial link communications. The QLINK status frame may be sent at any time to generate the revertive LINK frame indicating a port's settings.
The flow parameter defines the type of hardwired flow control used. It may be 'CTR' or 'RTS' (see the Physical and Link Layer Flow Control section of this chapter).

The tx-baud and rx-baud parameters define the baud rate to be used. They must both be the same. The following baud rates are supported:

75, 110, 150, 300, 600, 1200, 1800, 2000, 2400, 4800, 9600.

The parity parameter must be one of 'ODD', 'EVEN', 'OFF' or 'NONE' the last two having the same meaning.

The lcc parameter controls whether LCCs are used or not. It must be one of 'LCC' or 'NOLCC'.

The address parameter specifies the tributary address. The number of digits in the string specifies whether 0, 1 or 2 address characters are to be used. The value of the address is not relevant for the master port but the length is significant.

The crc parameter controls whether CRCs are used or not. It must be one of 'CRC' or 'NOCRC'.

The free-tune parameter defines whether a master port will use the free-tune protocol or not. The parameter is 1 to enable free tune and 0 to disable it. The tributary port is always enabled to receive the free-tune protocol (see the T command frame).

The port-type parameter is 0 to specify the tributary port, 1 to specify the master port, or 2 to specify the auxiliary port. If absent the tributary port is specified.

(35) Receiver Mode

QM
Mdemodulation
mnr0ns

The command frame M is used to select the receivers demodulation mode. The status frame QM causes the receiver to return the status frame M indicating its current mode. In delta mode delta settings are used (see DLTA).

The demodulation parameter is encoded as follows:

1 - USB
2 - LSB
3 - AM
4 - FM
ISB operation is an option, see the option section of the Operators Manual and the Maintenance Manual for more details.

(36) **Metering of Receiver Levels**

```
QMETERnumber
  mnrOns
```

```
METERnumber,data1,data2
  mnrOns mnr2 onr2
```

The command QMETER uses the METER reply frame to return the metered value of the requested parameter.

The *meter* parameter has the following values:

1 - RF Level
2 - Audio level
3 - SNR level
4 - FSK tuning meter

The *data1* parameter contains the measured value and has the following ranges:

- RF level: -127 to +127 dBµV.
- AF level: -60 to +9 dB relative to selected line output level
- SNR level: 0 to 127 dB
- FSK tuning meter low tone as a percentage of half IF bandwidth, 0 to -127 %

If BITE is running or the unit is a controller, then a zero result will be returned. Additionally for SNR, a zero result will be returned if SNR detection is not enabled. For ISB, the RF or audio level in the currently selected sideband will be returned; the SNR result is for the main channel only. For FSK tuning a zero result is returned if the current mode is not FSK.

The *data2* parameter contains the FSK tuning meter high tone as a percentage of half of the IF bandwidth, range 0 to +127%. This parameter is only returned in response to a QMETER4 command. A zero result is returned if the current mode is not FSK.
(37) Mute Receiver

QMUTE
MUTE mutes-state
mnte0ns

The MUTE command frame is used to mute or demute the receiver. The QMUTE status frame causes the receiver to return the revertive MUTE frame indicating its mute status. The mute-status parameter is encoded as below:

- 0 - Receiver demute
- 1 - Receiver mute
- 2 - Receiver overloaded (revertive frame only)

(38) Frame Marker

QOKmarker
OKmarker
mnte0ns

The QOK status frame is used to place a marker in the stream of application layer frames. When the receiver receives the status frame it generates the revertive OK frame returning the marker received. The marker must be in the range 0-255. The intended use of this facility is to provide an acknowledgement that the command frames preceding it have all been actioned.

(39) Passband Tuning

QPASSB
PASSB mode, bandwidth, bandwidth-number
mnte0ns onr0ns onr0ns

The PASSB command initiates passband or notch tuning. Passband tuning may only be used in USB or LSB modes. Notch tuning is available in all modes. The QPASSB frame causes the revertive PASSB frame to be generated indicating the currently used passband/notch mode. Any command changing the receiver’s setting (except PASSB or PASSF) and the RCL command cause passband or notch tuning to be quit and normal operation to resume.

The mode parameter specifies the passband tune/notch mode, as follows.

- 0 - Passband/notch tune disabled
- 1 - Passband tune
- 2 - Notch tune

The bandwidth parameter specifies the IF filter bandwidth within the following limits:
Passband tuning or notch tuning in ISB: 70 Hz to 6 kHz
Notch tuning (except in ISB): 70 Hz to 12 kHz

Units or fractions of a Hz will be ignored.

The *bandwidth-number* parameter is used in notch tuning only to select the bandwidth of the notch filter.

1 - 30 Hz
2 - 100 Hz
3 - 180 Hz
4 - 300 Hz

**Note:** This parameter is only sent when operating in notch mode.

(40) **Passband Frequency**

```
QPASSF
PASSFfrequency
mnr2
```

The PASSF command is used to set the IF filter centre frequency in passband tuning or to set the notch filter centre frequency during notch tuning. The status frame QPASSF causes the receiver to generate the revertive PASSF frame indicating the current IF filter centre frequency in passband tuning or notch centre frequency.

The *frequency* parameter specifies the frequency to be used and must be in the range -6.00 to 6.00 kHz. Units and fractions of Hz are ignored.

(41) **Remote Control Port**

```
QP
Pnumber,remote-state,addressl
mnr0ns mnr0ns ms
```

The QPORT status frame causes the revertive PORT frame to be generated.

The *number* parameter indicates on which port the status frame was received on and has the following values:

0 - Tributary port
1 - Master port
2 - Auxiliary port

The *remote-state* parameter contains the remote status of the receiver (see REM command).
The *address* parameter contains the tributary port address.

This allows a controller to determine which port it is using to control the receiver and to display the address of that receiver.

(42) **Recall**

RCL

The RCL command frame is used to cause BITE levels other than 0 or 1, passband tuning, channel scanning or frequency sweeping to be quit.

(43) **Re-assign Front Panel Control**

RESTART{link-type,address
mnrons onr0ns

The RESTART command frame, sent as either:

(a) An unsolicited reply frame, from a computer connected between a controller (master or diversity master) and its slave.

(b) A remote command.

It is sent to request that the receiver either starts or stops a link to a slave, or toggles the control of a dual receiver.

**Note:** If an IEEE interface is fitted, this command cannot be used to start a link to a slave if the receiver is not acting as a 'system controller', as the IEEE-488 port cannot be used as a controller and a tributary at the same time.

The *link-type* parameter is used as follows:

1 - Recall settings from destination *address*.

2 - Hand off settings to destination *address*.

The *address* parameter is used to determine which receiver that settings are to be recalled from or handed off to. The receiver will behave as if the ADDR and RCL/ENTER pushbuttons have been pressed. If this parameter is present, a link will be started to the slave with the appropriate *address*. If this parameter is not present, then one of the following will occur.

(a) If the receiver is currently acting as a master, the background local receiver will be selected.

(b) If the receiver is a single receiver or a receiver control unit, and
either zero address characters are selected on the master port (ASCII) or fixed addressing is selected (IEEE), then the receiver will start a link to the slave.

(c) If the receiver is a dual in non-controller mode, the front panel will toggle to the other receiver.

(44) Remote/Local (ASCII interface only)

**QREM**

REM*control-type*

mnr0ns

The REM command is used to select local front panel or remote operation of the receiver. In addition, when remote operation is selected, the front panel REM pushbutton may be disabled so preventing local control from being taken. The QREM status frame causes the receiver to generate the revertive REM frame indicating the current type of control. The *control-type* parameter takes one of the following values:

0 - Local Control
1 - Remote Control, REM pushbutton enabled.
2 - Remote Control, REM pushbutton disabled.

For receivers with the IEEE interface option, this function is performed using the REN line and LLO. In addition, the REM pushbutton is only available to place a remotely controlled receiver under local control, not the reverse.

(45) RF Amplifier

**QRFAMP**

RFAMP*on-off-auto*

mnr0ns

The RFAMP command is used to control the operation of the receiver's RF amplifier. The amplifier may be turned permanently off or on or set to auto. When set to auto the amplifier is enabled for frequencies above 480 kHz and disabled for frequencies below this (as its gain starts to fall off at this point). The status frame QRFAMP causes the receiver to return the revertive RFAMP frame indicating the current setting. The *on-off-auto* parameter takes one of the three values below:

0 - RF Amplifier off
1 - RF Amplifier on
2 - RF Amplifier auto
(46) **RF Level**

QRFL
RFL*rf-level*
mnr0ns

The QRFL status frame causes the receiver to return the revertive RFL frame indicating the level of the received signal at its antenna input. The *rf-level* parameter is encoded as below:

<table>
<thead>
<tr>
<th>VALUE</th>
<th>LEVEL dBuV (approx)</th>
</tr>
</thead>
<tbody>
<tr>
<td>226-255</td>
<td>0</td>
</tr>
<tr>
<td>215-225</td>
<td>10</td>
</tr>
<tr>
<td>203-214</td>
<td>20</td>
</tr>
<tr>
<td>191-202</td>
<td>30</td>
</tr>
<tr>
<td>180-190</td>
<td>40</td>
</tr>
<tr>
<td>168-179</td>
<td>50</td>
</tr>
<tr>
<td>156-167</td>
<td>60</td>
</tr>
<tr>
<td>145-155</td>
<td>70</td>
</tr>
<tr>
<td>133-144</td>
<td>80</td>
</tr>
<tr>
<td>121-132</td>
<td>90</td>
</tr>
<tr>
<td>110-120</td>
<td>100</td>
</tr>
<tr>
<td>98-109</td>
<td>110</td>
</tr>
<tr>
<td>0-97</td>
<td>120</td>
</tr>
</tbody>
</table>

(47) **RF Attenuation**

QRFATTEN
RFTATTEN*attenuation*
mnr0ns

The RFATTEN command frame is used to set up the RF attenuation setting. The QRFATTEN status frame causes the revertive RFATTEN frame to be generated, indicating the current attenuation level.
The attenuation is as follows:

- 0 - 0 dB
- 1 - 10 dB
- 2 - 20 dB
- 3 - 30 dB

Selecting any value other than 0 will set the RF amplifier setting to off (see RFAMP). Values greater than 1 are only valid if the sub-octave filter option is fitted.

(48) Sub Address

\[ S_{\text{sub-address}} \]

The S command is used to direct the subsequent frame to either the diversity slave or diversity master of a diversity pair. If the sub-address parameter is '1', the subsequent frame must be a status (Q) command, and this is passed to the diversity slave. Any reply frame originating from the diversity slave receiver will be sent as a reply frame from the diversity master, with an S frame immediately preceding it.

A reply frame from a diversity master will only be preceded with an S frame if the status command used to invoke it was preceded with one.

The sub-address parameter is encoded as follows:

- 0 - Diversity master receiver
- 1 - Diversity slave receiver

(49) Scan Control

\[ \text{QSCAN} \]
\[ \text{SCAN} \text{scan-type,scan-direction} \]

The SCAN command frame is use to start/stop a frequency sweep or channel scan and to control the direction of scan. The QSCAN status frame causes the receiver to generate the revertive SCAN frame which indicates the current type and direction of scan.

The scan-type parameter is encoded as below:

- 0 - Stop Sweep or Scan
- 1 - Start Frequency Sweep
- 2 - Start Channel Scan
- 3 - Receiver halted during Sweep (revertive only)
4 - Receiver halted during Scan (revertive only)

The *scan-direction* parameter is used to specify the direction of the sweep or scan and is encoded as below:

- 0 - Forward Scan or Sweep
- 1 - Reverse Scan or Sweep

(50) **Channel Scan Set Up**

QSCCH

SCCHstart-channel,stop-channel,dwell-time,stop-on-cor

| mnr0ns | mnr0ns | mnr2   | mnr0ns |

The SCCH command frame is used to set up the Channel Scan parameters of the receiver. The QSCCH status frame causes the receiver to generate the revertive SCCH frame indicating its current channel scan set up.

The *start-channel* parameter is a channel number in the range 0- 99. It is the channel number from which a channel scan will commence.

The *stop-channel* parameter is a channel number in the range 0- 99. It is the channel number at which the channel scan will end.

The *dwell-time* parameter is a number in the range 0.1 to 9.9 seconds that specifies how long the receiver dwells on each selected channel.

The *stop-on-cor* parameter indicates whether the receiver is to stop scanning if a signal above the COR threshold is received. A value of 1 means stop on COR and value of 0 means do not stop on COR. Stop on COR operation only works if the COR facility is enabled.

Unless stopped, a channel scan is repeated indefinitely from the start channel to the stop channel. Only those channels with their scan flags set are included in the scan.

(51) **Frequency Sweep Set Up**

QSCFR

SCFRstart-freq,stop-freq,step-size,sweep-rate,stop-on-cor

| mnr3  | mnr3  | mnr3  | mnr3  | mnr0ns |

The SCFR command frame is used to set up the frequency sweep parameters. The status frame QSCFR causes the receiver to generate the revertive SCFR frame indicating the current frequency sweep parameters.

The *start-freq* parameter is the frequency from which the sweep will start.
The *stop-freq* parameter is the frequency at which the sweep will end.

The *step-size* parameter controls the step size of the sweep. The receiver will tune itself to *start-freq*, *start-freq + step-size*, *start-freq + step-size + step-size* etc. until *stop-freq* is exceeded. The *step-size* must be in the range 0 to 999.9 kHz.

The *sweep-rate* parameter controls the speed of the sweep. It has units of HzS⁻¹. The *sweep-rate* must be in the range 0 to 999.99 kHzS⁻¹. The *sweep-rate* must be less than 100 times the *step-size*.

The *stop-on-cor* parameter indicates whether the receiver is to stop sweeping if a signal above the COR threshold is received. A value of 1 means stop on COR and value of 0 means do not stop on COR.

Unless stopped, a frequency sweep is repeated indefinitely from the start frequency to the stop frequency.

(52) **Number Of Sweep/Lockout Ranges.**

QSFN
SFNnumber-of-sweeps,lowest-spare-sweep,number-of-lockouts, mnr0ns mnr0ns mnr0ns
           lowest-spare-lockout
                mnr0ns

The QSFN status frame causes the revertive SFN to be returned indicating the number of frequency sweep and lockout ranges, and the first unused range number of each type (See SFR command).

The *number-of-sweeps* parameter reflects the highest configured frequency sweep range number.

The *lowest-spare-sweep* parameter reflects the lowest spare (un-configured) frequency sweep range that is available for configuration.

Example:

(a) If frequency sweep ranges 1 and 3 are configured but range 2 is not:
   
   $$
   \text{number-of-sweeps} = 3 \\
   \text{lowest-spare-sweep} = 2
   $$

(b) If frequency sweep range 1,2 and 3 are configured:

   $$
   \text{number-of-sweeps} = 3 \\
   \text{lowest-spare-sweep} = 4
   $$
Note: The *lowest-spare-sweep* will be returned as 0 if there are no spare frequency sweep ranges available.

The *number-of-lockouts* and *lowest-spare-lockout* parameters reflect the status of the lockout range list in exactly the same manner as the *number-or-sweeps* and *lowest-spare-sweep* parameters.

(53) **Frequency Sweep or Lockout Range**

```
QSFR range-number, range-type
  mnr0ns mnr0ns

SFR range-number, range-type, start-frequency, stop-frequency
  mnr0ns mnr0ns mnr0ns onr0ns
```

The SFR command frame is used to configure the receiver with either a frequency sweep or lockout range.

The status frame QSFR causes the receiver to reply with the revertive SFR frame indicating the current configuration of the specified sweep or lockout range.

The *range-number* parameter holds the specified sweep or lockout range number. This must be in the range 1 to 100.

The *range-type* parameter holds the type of range as follows:-

0 - Lockout range  
1 - Frequency sweep range

**Note:** When added together, the highest configured lockout *range-number* and the highest configured frequency sweep *range-number* must be less than or equal to 100.

The *Start-frequency* parameter holds the sweep or lockout range start frequency.

The *Stop-frequency* parameter holds the sweep or lockout range stop frequency. If this parameter is not received the stop frequency will be set to the start frequency.

**Note:** If the stop and start frequencies specified are both zero then the range will be de-configured from the list. The *stop-frequency* must not be less than the *start-frequency*.
(54) **Serial Number**

QSN
SNserial-number
ms

The command frame SN is used to program the receiver's serial number in EEROM. The status frame QSN causes the receiver to generate the revertive SN frame indicating the receiver's serial number.

The *serial-number* parameter is a four-character numeric string.

(55) **Service Request Enable (IEEE interface only)**

QSRE
SREenable-mask
mnr0ns

The SRE command frame is used to enable or disable the receivers service request (SRQ) facility.

The *enable-mask* parameter is between 0 and 63, and represents a binary mask to be applied to bits 0-5 of the SRQ status byte (see Service Request Operation). A '1' in the mask will enable the required function.

**Example:** If the mask is set to 17 (binary 010001):

- Bit 5 = 0: CRC error will not cause SRQ
- Bit 4 = 1: Messages present in O/P buffer will cause SRQ
- Bit 0 = 0: COR exceeded will cause SRQ

(56) **Squelch**

QSQU
SQUon-off
mnr0ns

The SQU command frame is used to turn the receiver's squelch facility on or off. The squelch facility is used to mute signals below the squelch threshold (see CORL). The status frame QSQU causes the generation of the revertive SQU frame indicating the current squelch setting.

The *on-off* parameter is 0 or 1 to indicate off or on respectively.

(57) **Store Channel Data**

STREchannel-number
mnr0ns
The STRE command frame is used to store current receiver settings into the channel specified by the *channel-number* parameter. The *channel-number* must be in the range 0 to 99. The following parameters are stored in the channel:

- Frequency
- Demodulation mode
- Gain Control type and time constant
- BFO frequency (if demodulation mode is CW)
- IF Bandwidth.
- FSK Polarity (FSK demodulation modes only)
- Scan Flag

(58) **Software Programme/Issue Number**

QSW

```
SW program-number,issue
  ms       ms
```

The QSW status frame causes the revertive SW frame to be generated.

The *program-number* parameter indicates the Racal identity of the software. It is a six-character string e.g. 'P90550'.

The *issue* parameter is the version number of the software. It is typically a two-digit string e.g. '01'.

(59) **Enter Free Tune Mode (ASCII interface only)**

```
Ttune-rate
   mnr0ns
```

The T command frame causes the receiver to enter free tune mode. The packet holding the T command will be responded to in the normal way before normal link layer operation is suspended. When in free tune mode any characters received are interpreted as frequency increments or decrements as defined in the free tune tables in the summary table section of this chapter. A null character should be sent when changing from frequency increment to frequency decrement and vice-versa. Free tune mode is terminated by receipt of a Linefeed character which may be the start of a normal packet.

The *tune-rate* parameter defines the increment and decrement step sizes (see the Summary table) and holds one of the following:

1 - Slow Tune Rate
2 - Medium Tune Rate
3 - Fast Tune Rate
4 - Variable Tune Rate.
(60) **Signal Detection Level**

**QSINLVL**

**SINLVLs**ignalt-to-noise

mnr0ns

The SINLVL command frame is used to set up the signal to noise detection threshold for Signal Detection. The QSINLVL status frame causes the revertive SINLVL frame to be generated, indicating the current threshold.

The *signal-to-noise* parameter represents signal to noise ratio in dB, and must be in the range 0 to 30.

(61) **FSK Configuration**

**QFSKMODE**

**FSKMODE**configuration

mnr0ns

The FSKMODE command frame is used to specify how decoded signals are routed to the one or two printers in use. The QFSKMODE status frame causes the revertive FSKMODE frame to be generated indicating the current configuration.

The *configuration* parameter is used as below:-

0 - This selects single channel printer operation, with the LAWES assessor in FIXED. The output of the receiver is routed to the printer.

1 - As for 0 but with the LAWES assessor in AUTO.

2 - This selects dual channel printer operation, known as diversity, with the LAWES assessor in FIXED. The stronger of the two signals is routed to the printer. In a dual receiver the two signals are taken from the two receivers. In a single receiver one signal is taken from the receiver and the other from the external input on the rear of the module.

3 - As for 2 but with the LAWES assessor in AUTO.

(62) **FSK Signal Polarity**

**QFSKPOL**

**FSKPOL**p**olarity**

mnr0ns
The FSKPOL command frame is used to specify the polarity of incoming signals. The QFSKPOL status frame causes the revertive FSKPOL frame to be generated, indicating the current polarity.

The *polarity* parameter is used as below:

- **0** - Normal: High frequency = Mark, Low frequency = Space
- **1** - Invert: High frequency = Space, Low frequency = Mark

In diversity mode (FSKMODE3) the polarity of both signals is controlled. The polarity of the final printer output may be controlled using the FSKOUTINV command.

(63) **Printer Polarity**

    QFSKOUTINV
    FSKOUTINV*polarity*
    mnr0ns

The FSKOUTINV command frame is used to specify the polarity of the printer in use. The QFSKOUTINV status frame causes the revertive FSKOUTINV frame to be generated indicating the current printer polarity.

The *polarity* parameter is used as below:

- **0** - Normal: Mark = negative voltage, Space = positive voltage
- **1** - Invert: Mark = positive voltage, Space = negative voltage

The FSKOUTINV and FSKPOL commands may be used together to ensure that the idle state of the printer output is as required.

(64) **Printer control**

    QFSKHOLD
    FSKHOLD*run-hold*
    mnr0ns

The FSKHOLD command is used to stop and start the printer. The QFSKHOLD status frame causes the revertive FSKHOLD frame to be generated indicating the current state of the printer.

The *run-hold* parameter is used as below:

- **0** - Stop printer, known as Hold.
- **1** - Start Printer, known as Run.
(65) FSK Tuning Metering

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>QTMET</td>
<td></td>
</tr>
<tr>
<td>TMETlevel1,level2</td>
<td></td>
</tr>
<tr>
<td>mnr0ns onr0ns</td>
<td></td>
</tr>
</tbody>
</table>

The QTMET status frame causes the receiver to generate the revertive TMET frame indicating the tuning meter reading. The level1 and level2 returned are between 0 and 255. See QMETER command.

Sub-Octave Filter Option Commands

The following commands are only available when the Sub-Octave filter is fitted.

(66) Sub-Octave Filtering

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>QSUBOCT</td>
<td></td>
</tr>
<tr>
<td>SUBOCTon-off</td>
<td></td>
</tr>
<tr>
<td>mnr0ns</td>
<td></td>
</tr>
</tbody>
</table>

The SUBOCT command frame is used to set up the Sub-Octave Filtering function for the Sub-Octave Filter option. The QSUBOCT status frame causes the revertive SUBOCT frame to be generated, indicating the current state of sub-octave filtering.

The values of on-off are as follows:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Sub-octave filters bypassed</td>
</tr>
<tr>
<td>1</td>
<td>Sub-octave filters selected according to frequency</td>
</tr>
</tbody>
</table>

SUMMARY TABLES

Commands Valid for Receiver Modes

5. The table below shows in which modes of receiver operation command frames sent from a controller are valid. The states in the table refer to the mode of operation on the slave. Command frames not valid over the IEEE-488 interface are marked with an asterisk (DIVM is allowed on dual IEEE receivers). Command frames not valid over the ASCII interface are marked with two asterisks.
<table>
<thead>
<tr>
<th>COMMAND IDENTIFIER</th>
<th>BITE</th>
<th>CHAN</th>
<th>FREQ SWEEP</th>
<th>PB/NOTCH TUNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGC</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>ANT</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>AUDIO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>B</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>BCON</td>
<td>NO</td>
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<td>NO</td>
<td>NO</td>
</tr>
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<td>BFO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
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<td>BITE</td>
<td>YES</td>
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<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>CHAN</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>CLEARALLCHANNELS</td>
<td>NO</td>
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<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>CLEARALLRANGES</td>
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<td>YES</td>
</tr>
<tr>
<td>CHGF</td>
<td>NO</td>
<td>NO</td>
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<td>NO</td>
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<tr>
<td>COR</td>
<td>NO</td>
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</tr>
<tr>
<td>CORL</td>
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<td>YES</td>
</tr>
<tr>
<td>DIVM</td>
<td>NO</td>
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</tr>
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<td>FAULTMSG</td>
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<td>YES</td>
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<td>YES</td>
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<td>FLG</td>
<td>NO</td>
<td>NO</td>
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<td>NO</td>
</tr>
<tr>
<td>FSKMODE</td>
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<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>FSKOUTINV</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>FSKHOLD</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>FSKPOL</td>
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<td>YES</td>
</tr>
<tr>
<td>G</td>
<td>NO</td>
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<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>LINK</td>
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<td>NO</td>
</tr>
<tr>
<td>M</td>
<td>NO</td>
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</tr>
<tr>
<td>MUTE</td>
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</tr>
<tr>
<td>PASSB</td>
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</tr>
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<td>PASSF</td>
<td>NO</td>
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<td>YES</td>
</tr>
<tr>
<td>REM</td>
<td>YES</td>
<td>YES</td>
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<td>YES</td>
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<tr>
<td>RESTART</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>RFAMP</td>
<td>NO</td>
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<td>YES</td>
</tr>
<tr>
<td>RFATTEN</td>
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<td>YES</td>
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<td>YES</td>
</tr>
<tr>
<td>RCL</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>SCAN</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>SCCH</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>SCFR</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>COMMAND IDENTIFIER</td>
<td>BITE</td>
<td>CHAN SCAN</td>
<td>FREQ SWEEP</td>
<td>PB/NOTCH TUNING</td>
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<tr>
<td>--------------------</td>
<td>------</td>
<td>-----------</td>
<td>------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>SINLVL</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>SN</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>SQU</td>
<td>NO</td>
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<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>SRE**</td>
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<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>STRE</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>SUBOCT</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>T*</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

6. In addition, Q status frames, which are responded to at all times, exist for all of the above, with the exceptions of:

   (1) CLEARALLCHANNELS
   (2) CHGF
   (3) ENTR
   (4) FAULTMSG
   (5) RCL
   (6) STRE
   (7) T (ASCII only)
   (8) CLEARALLRANGES

**Controller/Slave Commands**

7. The table below lists those frames which are valid when sent by a controller as a command frame to change the settings of a slave receiver and when sent by a slave in response to a status frame. Command frames not valid over the IEEE-488 interface are marked with an asterisk. Command frames not valid over the ASCII interface are marked with two asterisks. Number formats are as defined in the Application Layer section of chapter 4.
<table>
<thead>
<tr>
<th>Command Identifier</th>
<th>Parameter Meaning</th>
<th>Range</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Upper</td>
<td>Lower</td>
</tr>
<tr>
<td>AGC</td>
<td>AGC Gain Mode</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>AGCTC</td>
<td>Mode</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Hang</td>
<td>9999</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Decay</td>
<td>9999</td>
<td>0</td>
</tr>
<tr>
<td>ANT</td>
<td>Antenna Number</td>
<td>15</td>
<td>0</td>
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<tr>
<td>AUDLVL</td>
<td>Audio Line Level dbM</td>
<td>+12</td>
<td>-32</td>
</tr>
<tr>
<td>IFOP</td>
<td>Bandwidth</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Frequency</td>
<td>1.4 MHz</td>
<td>10 kHz</td>
</tr>
<tr>
<td></td>
<td>Format</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>AUDIO</td>
<td>Audio Path</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>Bandwidth</td>
<td>12000</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>Offset, ISB bandwidth offset</td>
<td>6000</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>ISB Bandwidth</td>
<td>6000</td>
<td>70</td>
</tr>
<tr>
<td>BCON</td>
<td>Configuration BW Type</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>BW Number</td>
<td>49</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Lower Passband Freq.(kHz)</td>
<td>+6.00</td>
<td>-6.00</td>
</tr>
<tr>
<td></td>
<td>Upper Passband Freq.(kHz)</td>
<td>+6.00</td>
<td>-6.00</td>
</tr>
<tr>
<td></td>
<td>Remove/Insert BW</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>BFO</td>
<td>BFO Frequency (kHz)</td>
<td>+9.99</td>
<td>-9.99</td>
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<td>BITE</td>
<td>Type of BITE Required</td>
<td>8</td>
<td>0</td>
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<tr>
<td></td>
<td>Module &amp; Test Number</td>
<td>999</td>
<td>001</td>
</tr>
<tr>
<td>CHAN</td>
<td>Channel Number</td>
<td>99</td>
<td>0</td>
</tr>
<tr>
<td>COR</td>
<td>COR Function</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>COR Hang Time (seconds)</td>
<td>9.9</td>
<td>-1.00</td>
</tr>
<tr>
<td></td>
<td>Detector Type</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>CORL</td>
<td>COR Level</td>
<td>255</td>
<td>0</td>
</tr>
<tr>
<td>DVM</td>
<td>Diversity Master</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>F</td>
<td>Frequency (Hz)</td>
<td>300000000</td>
<td>0</td>
</tr>
<tr>
<td>FLG</td>
<td>Channel Scan Flag</td>
<td>1</td>
<td>0</td>
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<tr>
<td>FSKMODE</td>
<td>Diversity Combiner Mode</td>
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<td>0</td>
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<td>FSKOUTINV</td>
<td>Terminal Output Polarity</td>
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<td>0</td>
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<tr>
<td>FSKHOLD</td>
<td>Hold/Run Output Channel</td>
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<td>0</td>
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<tr>
<td>FSKPOL</td>
<td>Channel Output Polarity</td>
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### Controller/Slave Commands (continued)

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<th>Format</th>
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<td>Gain Level</td>
<td>0 - 255</td>
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<td>LINK*</td>
<td>Flow Control (optional)</td>
<td>String</td>
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<td>Transmit Baud Rate (optional)</td>
<td>75 - 9600</td>
<td>NR0</td>
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<td></td>
<td>Receive Baud Rate (optional)</td>
<td>75 - 9600</td>
<td>NR0</td>
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<td></td>
<td>Parity (optional)</td>
<td>String</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LCC (optional)</td>
<td>String</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Address (optional)</td>
<td>String</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CRC (optional)</td>
<td>String</td>
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<tr>
<td></td>
<td>Free Tune (optional)</td>
<td>0 - 1</td>
<td>NR0</td>
</tr>
<tr>
<td></td>
<td>Port (optional)</td>
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<td>M</td>
<td>Demodulation Mode</td>
<td>1 - 8</td>
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<td>MUTE</td>
<td>Mute/Demute Receiver</td>
<td>0 - 2</td>
<td>NR0</td>
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<tr>
<td>PASSB</td>
<td>Passband/Notch Mode</td>
<td>0 - 2</td>
<td>NR0</td>
</tr>
<tr>
<td></td>
<td>Notch Bandwidth</td>
<td>0 - 4</td>
<td>NR0</td>
</tr>
<tr>
<td>PASSF</td>
<td>Frequency (kHz)</td>
<td>-6.00 - 6.00</td>
<td>NR2</td>
</tr>
<tr>
<td>REM*</td>
<td>Remote Status</td>
<td>0 - 1</td>
<td>NR0</td>
</tr>
<tr>
<td>RFAMP</td>
<td>RF Amplifier Function</td>
<td>0 - 2</td>
<td>NR0</td>
</tr>
<tr>
<td>RFATTEN</td>
<td>RF Attenuation</td>
<td>0 - 3</td>
<td>NR0</td>
</tr>
<tr>
<td>SCAN</td>
<td>Scan Mode</td>
<td>1 - 4</td>
<td>NR0</td>
</tr>
<tr>
<td></td>
<td>Scan Direction</td>
<td>0 - 1</td>
<td>NR0</td>
</tr>
<tr>
<td>SCCH</td>
<td>Start Channel</td>
<td>0 - 99</td>
<td>NR0</td>
</tr>
<tr>
<td></td>
<td>Stop Channel</td>
<td>0 - 99</td>
<td>NR0</td>
</tr>
<tr>
<td></td>
<td>Dwell Time (seconds)</td>
<td>0.1 - 9.9</td>
<td>NR2</td>
</tr>
<tr>
<td></td>
<td>Stop on COR</td>
<td>0 - 2</td>
<td>NR0</td>
</tr>
<tr>
<td>SCFR</td>
<td>Start Frequency (Hz)</td>
<td>0 - 30000000</td>
<td>NR2</td>
</tr>
<tr>
<td></td>
<td>Stop Frequency (Hz)</td>
<td>0 - 30000000</td>
<td>NR2</td>
</tr>
<tr>
<td></td>
<td>Step Frequency (Hz)</td>
<td>100 - 999999</td>
<td>NR2</td>
</tr>
<tr>
<td></td>
<td>Sweep Rate (Hz/second)</td>
<td>10 - 999999</td>
<td>NR2</td>
</tr>
<tr>
<td></td>
<td>Stop on COR</td>
<td>0 - 2</td>
<td>NR0</td>
</tr>
<tr>
<td>SINLVL</td>
<td>Signal to Noise Threshold</td>
<td>0 - 30</td>
<td>NR0</td>
</tr>
<tr>
<td>SN</td>
<td>Serial Number</td>
<td>String</td>
<td></td>
</tr>
<tr>
<td>SRE**</td>
<td>Enable Mask</td>
<td>0 - 127</td>
<td>NR0</td>
</tr>
<tr>
<td>SQU</td>
<td>Squelch</td>
<td>0 - 1</td>
<td>NR0</td>
</tr>
<tr>
<td>SUBOCT</td>
<td>Sub-Octave Filter Function</td>
<td>0 - 1</td>
<td>NR0</td>
</tr>
</tbody>
</table>

DIVM is available on dual IEEE receivers.
Controller Only Commands

8. The following is a list of the command frames which are only valid when sent from a controller. Command frames which are not valid over the IEEE-488 interface are marked with an asterisk:

(1) AUDIO
(2) CLEARALLCHANNELS
(3) CHGF
(4) ENTR
(5) FAULTMSG
(6) RCL
(7) STRE
(8) T*
(9) ALL Q COMMANDS

<table>
<thead>
<tr>
<th>Command Identifier</th>
<th>Parameter Meaning</th>
<th>Range</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUDIO</td>
<td>Break/Make Loudspeaker Connection</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>CHGF</td>
<td>Set/Clear all Scan Flags</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>REM*</td>
<td>Remote Status</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>STRE</td>
<td>Store Channel</td>
<td>99</td>
<td>0</td>
</tr>
<tr>
<td>T*</td>
<td>Enter Free Tune, Select Tune Rate</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>FAULTMSG</td>
<td>Enable/Disable Fault Messages</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
9. All Q status frames are parameterless with the following exceptions:

<table>
<thead>
<tr>
<th>Command Identifier</th>
<th>Parameter Meaning</th>
<th>Range</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>QBCON</td>
<td>Bandwidth Type</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Bandwidth Number</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>QLINK</td>
<td>Port Required (optional)</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>QMETER</td>
<td>Metered Level</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>QFAULT</td>
<td>Fault Number</td>
<td>5999</td>
<td>1001</td>
</tr>
<tr>
<td>TEXT</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Slave Only Commands**

10. The table below lists those report frames which are valid when sent from a slave receiver.

<table>
<thead>
<tr>
<th>Command Identifier</th>
<th>Parameter Meaning</th>
<th>Range</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERR</td>
<td>Error Severity (optional)</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Command (optional)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Error String</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BITE</td>
<td>BITE Level Completed</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>DIVM</td>
<td>Diversity Mode</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Slave Address (optional)</td>
<td>99(30)**</td>
<td>0</td>
</tr>
<tr>
<td>FAULT</td>
<td>Severity</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Level (optional)</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Number (optional)</td>
<td>5999</td>
<td>1001</td>
</tr>
<tr>
<td></td>
<td>Message (optional)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESTART*</td>
<td>Link Type (optional)</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Slave Address (optional)</td>
<td>99(30)**</td>
<td>00</td>
</tr>
</tbody>
</table>

* This command will only be sent as a reply from a computer acting as a slave receiver.
** Address upper limit for IEEE interface
11. The table below contains a list of those commands which are only valid when sent in response to Q commands.

<table>
<thead>
<tr>
<th>Command Identifier</th>
<th>Parameter Meaning</th>
<th>Range</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFL</td>
<td>Audio Frequency Level</td>
<td>255-0</td>
<td>NR0</td>
</tr>
<tr>
<td>BWL</td>
<td>Bandwidth Type</td>
<td>3-1</td>
<td>NR0</td>
</tr>
<tr>
<td>C</td>
<td>COR Line Status</td>
<td>1-0</td>
<td>NR0</td>
</tr>
<tr>
<td>FAULT</td>
<td>Fault Severity</td>
<td>6-0</td>
<td>NR0</td>
</tr>
<tr>
<td>FAULTLEG</td>
<td>Fault Legend Status</td>
<td>1-0</td>
<td>NF0</td>
</tr>
<tr>
<td>FAULTTEXT</td>
<td>Fault Number</td>
<td>5999-1001</td>
<td>NR0</td>
</tr>
<tr>
<td>ID</td>
<td>Equipment Type</td>
<td></td>
<td>String</td>
</tr>
<tr>
<td>ID</td>
<td>Description</td>
<td></td>
<td>String</td>
</tr>
<tr>
<td>ID</td>
<td>Serial Number</td>
<td></td>
<td>String</td>
</tr>
<tr>
<td>METER</td>
<td>Metering</td>
<td>4-1</td>
<td>NR0</td>
</tr>
<tr>
<td>OK</td>
<td>Number</td>
<td>255-0</td>
<td>NR0</td>
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<td>RFL</td>
<td>RF Level</td>
<td>255-0</td>
<td>NR0</td>
</tr>
<tr>
<td>SW</td>
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<td>String</td>
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<td>SW</td>
<td>Program Issue</td>
<td></td>
<td>String</td>
</tr>
<tr>
<td>TMET</td>
<td>FSK Tune Metering</td>
<td>255-0</td>
<td>NR0</td>
</tr>
</tbody>
</table>

Error Messages

12. The following list describes the error messages that may be generated by a slave receiver in response to commands received during unsuitable modes of operation.

E.1 GROUP 1 (ASCII only)

The following message is sent in reply to all commands received via the TRIBUTARY port, with the exceptions of the REM and Q commands, if the receiver is in local operation:

'RX NOT IN REMOTE'

The following message is sent in reply to all commands received via the auxiliary port with the exception of the REM and Q commands, if the receiver is in remote operation:

'RX NOT IN LOCAL'
E.2 GROUP 2

13. These messages are generated wherever a 'NO' occurs in the table given in para. 4, Commands Valid for Receiver Modes.

(1) 'BITE ACTIVE'

(2) 'SCAN ACTIVE'

(3) 'PASSBAND TUNING ACTIVE'

E.3 GROUP 3

14. This message is generated to all of the commands detailed in para. 7, Controller/Slave Commands.

'INVALID COMMAND'.

E.4 GROUP 4

(1) 'INVALID BANDWIDTH' - B and PASSB commands.

(2) 'NOT IN CW MODE' - BFO command.

(3) 'WRONG MODE' - PASSB command selection of passband tuning only valid during USB/LSB demodulation modes.

(4) 'INVALID PASSBAND FREQUENCY' - PASSF command.

(5) 'INVALID SERIAL NUMBER' - SN command.

(6) 'ISB OPTION NOT FITTED' - M command.

(7) 'PASS BAND TUNING NOT ACTIVE' - PASSF command.

(8) 'LIMITS ERROR' - BCON, IFOP, RESTART, DIVM and SCFR commands.

(9) 'INVALID SCAN RATE' - SCFR command.

(10) 'INVALID BAUD RATE' - LINK command.

(11) 'INVALID PARITY TEXT' - LINK command.

(12) 'INVALID LCC TEXT' - LINK command.

(13) 'INVALID CRC TEXT' - LINK command.
14. 'INVALID ADDRESS' - LINK command.
15. 'INVALID FLOW TEXT' - LINK command.
16. 'LEVEL NOT SUPPORTED' - BITE command.
17. 'INVALID BITE TEST' - BITE command.
18. 'INVALID FAULT NUMBER' - QFAULTTEXT command.
19. 'NO CHANNELS TO SCAN' - SCAN command.
20. 'SUB-OCT MODULE NOT FITTED' - RFATTEN and SUBOCT commands.
21. 'NOT DIVERSITY MASTER' - S command
22. 'INVALID AGC' - CD command.
23. 'INVALID SCAN FLAG' - CD command.
24. 'INVALID FSK POLARITY' - CD command.
25. 'NO RANGES TO SWEEP' - SCAN, B and SFR commands.
26. 'NO START/STOP FREQ' - SCFR command.
27. 'NO DIGITAL IF OPTION' - IFOP command.

16. In addition, the following error messages may be generated by a slave receiver in response to any command that it has received:

1. 'INVALID IDENTIFIER'
2. 'COMMAND TOO LONG'
3. 'NO OF PARAMETERS'
4. 'NUMERIC DIGIT ERROR'
5. 'PARAMETER OUT OF RANGE'
6. 'TEXT CHARACTER ERROR'
Free Tune Frequency Increments (ASCII only)

17. The table below defines the actual frequency increments and decrements corresponding to each valid free tune character.
Free Tune Frequency Increments

<table>
<thead>
<tr>
<th>ASCII Chars. &amp; Codes (Hex)</th>
<th>Frequency Increment/Decrement</th>
</tr>
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<tr>
<td>Decrement</td>
<td>Increment</td>
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<tr>
<td>SPACE</td>
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<td>!</td>
<td>21</td>
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<td>&quot;</td>
<td>22</td>
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<td>£</td>
<td>23</td>
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<td>$</td>
<td>24</td>
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<td>'</td>
<td>27</td>
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<tr>
<td>(</td>
<td>28</td>
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<td>29</td>
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<tr>
<td>*</td>
<td>2a</td>
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<tr>
<td>+</td>
<td>2b</td>
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<tr>
<td>,</td>
<td>2c</td>
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<tr>
<td>-</td>
<td>2d</td>
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<td>D</td>
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Free Tune Frequency Increments (continued)

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<th>ASCII Chars. &amp; Codes (Hex)</th>
<th>Frequency Increment/Decrement</th>
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