FLIGHT TERMINATION RECEIVER CATALOG

WHITE SANDS MISSILE RANGE
KWAJALEIN MISSILE RANGE
YUMA PROVING GROUND
DUGWAY PROVING GROUND
ELECTRONIC PROVING GROUND

ATLANTIC FLEET WEAPONS TRAINING FACILITY
NAVAL AIR WARFARE CENTER WEAPONS DIVISION
NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
NAVAL UNDERSEA WARFARE CENTER DIVISION NEWPORT

30TH SPACE WING
45TH SPACE WING
AIR FORCE FLIGHT TEST CENTER
AIR FORCE DEVELOPMENT TEST CENTER
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DETACHMENT 2, SPACE AND MISSILE SYSTEMS CENTER

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This catalog provides reference information on ultra-high frequency flight termination receivers used at various U.S. missile ranges and test facilities. It is not intended to be a comprehensive review of all available flight termination receivers. Inclusion in this catalog does not constitute approval or endorsement for use at any government installation. Information in this catalog has been extracted from manufacturers' specifications.
FLIGHT TERMINATION
RECEIVER CATALOG

FEBRUARY 1993

Prepared by
FLIGHT TERMINATION SYSTEM SUBCOMMITTEE
RANGE SAFETY GROUP

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FOREWORD

This catalog provides reference information on ultrahigh-frequency flight termination receivers used at various U. S. missile ranges and test facilities. It is not intended to be a comprehensive review of all available flight termination receivers, and inclusion of hardware in this catalog does not constitute approval or endorsement for use at any government installation. Use of a specific receiver at a missile range or test facility requires the approval of the commander of that installation. Approval for use of a particular receiver on a given missile at one installation does not constitute automatic approval for use of the same receiver on other missiles at the same installation or on the same missile at other installations.

The information in this catalog has been extracted from manufacturers' specifications. It is provided as reference material only and is not intended as an endorsement of any model.
1. A. R. F. PRODUCTS, INCORPORATED
2559 75th Street
Boulder, Colorado 80301-4699
(Phone: 303-443-4844)

FLIGHT TERMINATION RECEIVERS/DECODERS

Model AR-9B
Model AR-10
Model AR-17
Model AR-34
1. **GENERAL DESCRIPTION**

The receiver is a solid-state design consisting of the following general sections:

**Receiver Section**
- RF Low-pass Filter
- RF Preselector
- RF Amplifier
- First Mixer (passive)
- First IF (60 MHz)
- Second Mixer (Active)
- Second IF (10.7 MHz)
- Crystal Filter
- Limiting Amplifier
- Quadrature Detector
- Video Buffer Amplifier

**Decoder Section**
- Four Channel Decoders (PPL)
- Relay Drivers
- Four Output Relays (Dry contact)

**Power**
- 24 to 34 Vdc
- Latching Relay Control (for remote operation)

**Telemetry Outputs**
- Input RF Level Monitor
- Battery Voltage

2. **BACKGROUND**

The Model AR-9B has been used on the following programs: Pershing, Aerobee, Black Brant, PQM-102, GBU-15, Standard Arm, Aries/Aries Chaser, QF-85, QF-100, QF-102, QF-106 and MGGB.
### TECHNICAL SPECIFICATIONS

<table>
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<th>3.1</th>
<th>Frequency Range (Tuneable)</th>
<th>400 to 550 MHz</th>
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<tr>
<td>3.2</td>
<td>Frequency Deviation</td>
<td>30 kHz per channel (nominal)</td>
</tr>
<tr>
<td>3.2</td>
<td>Threshold Sensitivity</td>
<td>-110 dBm</td>
</tr>
</tbody>
</table>
| 3.3 | Operating Bandwidth        | 180 kHz minimum at -3 dB  
 600 kHz maximum at -60 dB |
| 3.4 | Maximum Useable RF Input   | 1 Vrms |
| 3.5 | Input RF Impedance         | 50 ohms |
| 3.6 | VSWR                       | 2.0:1 maximum |
| 3.7 | Local Oscillator Stability | ±0.003 percent |
| 3.8 | Tuning Accuracy            | 0.005 percent |
| 3.9 | Tuning Increments          | Continuous |
| 3.10| RFI Suppression            | MIL-STD-461; CS08 Limit A - 50 dBm,  
 Limit B - 0 dBm, CS01, CE01, CE02, CE03,  
 CE04, CE06 |
| 3.11| AM Rejection               | No interference at 90 percent modulation |
| 3.12| Noise Immunity             | Very high (uses PLL decoders) |
| 3.13| Buffered Video Output      | 0.5 Vrms (approximately) |
| 3.14| Decoded Output Channels    | 4 |
| 3.15| Usable Tones               | 4 (simultaneous) |
| 3.16| Tone Channel Bandwidth     | ±3 percent < BW > ±5 percent |
| 3.17| Adjacent Channel Rejection | PLL decoders will not respond to adjacent channels |
| 3.18| Output (relay) Current     | 2.0 Amps (make or break) |
3.19 Output Isolation >1.0 Mohm
3.20 Command Response Time <25 milliseconds
3.21 Command Change Delay <25 milliseconds
3.22 Power Requirements
   Standby <130 milliamps (RCVR Active)
   Command Activation <30 milliamps increase for each channel activated
3.23 Temperature Range
   Operating -40 to +71°C
   Non-operating -60 to +85°C
3.24 Humidity 0 to 95 percent relative
3.25 Altitude No limit
3.26 Shock 100 g-peak, 11 ms, halfsine
          150 g-peak, 1 ms, halfsine
3.27 Acceleration 100 g, any axis (centrifuge)
3.28 Vibration 20 g-peak, swept sin, 20-2,000 Hz
3.29 Volume 59 cubic inches
3.30 Dimensions 5.20 X 4.312 X 2.625 inches
3.31 Weight 3.75 pounds maximum
3.32 Mounting Attitude Non-restricted
3.33 External Adjustments None
3.34 External Connections See Outline Drawing
3.35 Mounting Dimensions 3.875 X 4.750 inches
Figure 1-1. A.R.F. Model AR-9B Range Safety Receiver.
A. R. F. PRODUCTS, INCORPORATED

COMMAND DESTRUCT RECEIVER

MODEL AR-10

1. GENERAL DESCRIPTION

The A.R.F. Model AR-10 Command Destruct Receiver is basically the same design as the Model AR-9B. The receiver consists of the following general sections:

Receiver Section

- RF Low-pass Filter
- RF Preselector
- RF Amplifier
- First Mixer (passive)
- First IF (60 MHz)
- Second Mixer (Active)
- Second IF (10.7 MHz)
- Crystal Filter
- Limiting Amplifier
- Quadrature Detector
- Video Buffer Amplifier

Decoder Section

- Four Channel Decoders (PPL)
- Relay Drivers
- Four Output Relays (Dry contact)

Power

- 24 to 34 Vdc
- Latching Relay Control (for remote operation)

Telemetry Outputs

- Input RF Level Monitor
- Battery Voltage

2. BACKGROUND

The Model AR-10 has been used on the SRAM program.
3. **TECHNICAL SPECIFICATIONS**

3.1 Frequency Range (Tuneable) 400 to 550 MHz

3.2 Frequency Deviation 30 kHz per channel (nominal)

3.2 Threshold Sensitivity -110 dBm

3.3 Operating Bandwidth 180 kHz minimum at -3 dB
600 kHz maximum at -60 dB

3.4 Maximum Useable RF Input 1 Vrms

3.5 Input RF Impedance 50 ohms

3.6 VSWR 2.0:1 maximum

3.7 Local Oscillator Stability ±0.003 percent

3.8 Tuning Accuracy 0.005 percent

3.9 Tuning Increments Continuous

3.10 RFI Suppression MIL-STD-461; CS08 Limit A - 50 dBm,
Limit B - 0 dBm, CS01, CE01, CE02, CE03, CE04, CE06

3.11 AM Rejection No interference at 90 percent modulation

3.12 Noise Immunity Very high (uses PLL decoders)

3.13 Buffered Video Output 0.5 Vrms (approximately)

3.14 Decoded Output Channels 4

3.15 Usable Tones 4 (simultaneous)

3.16 Tone Channel Bandwidth ±3 percent < BW > ±5 percent

3.17 Adjacent Channel Rejection PLL decoders will not respond to adjacent channels

3.18 Output (relay) Current 2.0 Amps (make or break)

3.19 Output Isolation >1.0 Mohm
3.20 Command Response Time
3.21 Command Change Delay
3.22 Power Requirements
   Standby
   Command Activation
3.23 Temperature Range
   Operating
   Non-operating
3.24 Humidity
3.25 Altitude
3.26 Shock
3.27 Acceleration
3.28 Vibration
3.29 Volume
3.30 Dimensions
3.31 Weight
3.32 Mounting Attitude
3.33 External Adjustments
3.34 External Connections
3.35 Mounting Dimensions
3.36 Internal Construction

<25 milliseconds
<25 milliseconds
<130 milliamps (RCVR Active)
<30 milliamps increase for each channel activated
-40 to +71°C
-60 to +85°C
0 to 95 percent relative
No limit
100 g-peak, 11 ms, halfsine
150 g-peak, 1 ms, halfsine
100 g, any axis (centrifuge)
20 g-peak, swept sine, 20-2,000 Hz
59 cubic inches
6.10 X 3.99 (maximum) inches
3.75 pounds maximum
Non-restricted
None
See Outline Drawing
3.590 X 5.800 inches (mounting screws captive)
All components selected from the PPL (basically JAN thru JANTXV)
Figure 1-2. A.R.F. Model AR-10 Range Safety Receiver.
1. **GENERAL DESCRIPTION**

**Receiver Section**
- RF Preselector
- RF Amplifier
- First Mixer (active)
- First IF (60 MHz)
- Second Mixer (Active)
- Second IF (10.7 MHz)
- Crystal Filter (10.7 MHz)
- Limiting Amplifier
- Quadrature Detector
- Video Buffer Amplifier

**Decoder Section**
- Four Channel Decoders (PPL)
- Solid-State Outputs (2 channel)

**Power**
- 18 to 35 Vdc
- Latching Relay Control

**Telemetry Outputs**
- Input RF Level Monitor
- Battery Voltage
- Individual Channel Activation Monitor

2. **BACKGROUND**

The Model AR-17 has been used on the Pershing II and ALCM programs.
### TECHNICAL SPECIFICATIONS

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<th>Specification</th>
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<td>3.2</td>
<td>Frequency Deviation</td>
<td>30 kHz per channel (nominal)</td>
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<tr>
<td>3.3</td>
<td>Threshold Sensitivity</td>
<td>-110 dBm</td>
</tr>
<tr>
<td>3.4</td>
<td>Operating Bandwidth</td>
<td>180 kHz minimum at -3 dB, 600 kHz maximum at -60 dB</td>
</tr>
<tr>
<td>3.5</td>
<td>Maximum Useable RF Input</td>
<td>1 Vrms</td>
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<tr>
<td>3.6</td>
<td>Input RF Impedance</td>
<td>50 ohms</td>
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<td>3.7</td>
<td>VSWR</td>
<td>2.0:1 maximum</td>
</tr>
<tr>
<td>3.8</td>
<td>Local Oscillator Stability</td>
<td>±0.003 percent</td>
</tr>
<tr>
<td>3.9</td>
<td>Tuning Accuracy</td>
<td>±0.005 percent</td>
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<td>3.10</td>
<td>Tuning Increments</td>
<td>Continuous</td>
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<td>3.11</td>
<td>RFI Suppression</td>
<td>MIL-STD-461; CS08 Limit A - 50 dBm, Limit B - 0 dBm, CS01, CE01, CE02, CE03, CE04, CE06</td>
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<tr>
<td>3.12</td>
<td>AM Rejection</td>
<td>No interference at 90 percent modulation</td>
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<td>3.13</td>
<td>Noise Immunity</td>
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<td>Buffered Video Output</td>
<td>0.5 Vrms (approximately)</td>
</tr>
<tr>
<td>3.15</td>
<td>Decoded Output Channels</td>
<td>4</td>
</tr>
<tr>
<td>3.16</td>
<td>Useable Tones</td>
<td>4 (simultaneously)</td>
</tr>
<tr>
<td>3.17</td>
<td>Tone Channel Bandwidth</td>
<td>±3 percent &lt; BW &gt; ±5 percent</td>
</tr>
<tr>
<td>3.18</td>
<td>Adjacent Channel Rejection</td>
<td>PLL decoders will not respond to adjacent channels</td>
</tr>
<tr>
<td>3.19</td>
<td>Output Type</td>
<td>Solid-state</td>
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<td>3.20</td>
<td>Output Current Capability</td>
<td>10 A pulse 2 A continuous</td>
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<td>3.21</td>
<td>Output Leakage</td>
<td>500 μA maximum</td>
</tr>
<tr>
<td>3.22</td>
<td>Output Isolation</td>
<td>Common ground</td>
</tr>
<tr>
<td>3.23</td>
<td>Command Response Time</td>
<td>&lt;25 milliseconds</td>
</tr>
<tr>
<td>3.24</td>
<td>Command Change Delay</td>
<td>&lt;25 milliseconds</td>
</tr>
<tr>
<td>3.25</td>
<td>Power Requirements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Standby</td>
<td>≤60 milliamps (RCVR active)</td>
</tr>
<tr>
<td></td>
<td>Command Activation</td>
<td>30 to 50 milliamps per channel</td>
</tr>
<tr>
<td>3.26</td>
<td>Temperature</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Operating</td>
<td>-40 to +71°C</td>
</tr>
<tr>
<td></td>
<td>Non-operating</td>
<td>-60 to +85°C</td>
</tr>
<tr>
<td>3.27</td>
<td>Humidity</td>
<td>0 to 95 percent relative</td>
</tr>
<tr>
<td>3.28</td>
<td>Altitude</td>
<td>Unlimited</td>
</tr>
<tr>
<td>3.29</td>
<td>Shock</td>
<td>100 g-peak, 11 ms, halfsine 150 g-peak, 1 ms, halfsine</td>
</tr>
<tr>
<td>3.30</td>
<td>Vibration</td>
<td>20 g-peak, swept sine, 20-2,000 Hz</td>
</tr>
<tr>
<td>3.31</td>
<td>Acceleration</td>
<td>100 g, any axis (centrifuge)</td>
</tr>
<tr>
<td>3.32</td>
<td>Volume</td>
<td>49 cubic inches</td>
</tr>
<tr>
<td>3.33</td>
<td>Dimensions</td>
<td>5.200 X 4.312 X 2.000 inches</td>
</tr>
<tr>
<td>3.34</td>
<td>Weight</td>
<td>2.25 pounds maximum</td>
</tr>
<tr>
<td>3.35</td>
<td>Mounting Attitude</td>
<td>Non-restricted</td>
</tr>
<tr>
<td>3.36</td>
<td>External Adjustments</td>
<td>None</td>
</tr>
</tbody>
</table>

1-12
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.37</td>
<td>External Connections</td>
<td>See Outline Drawing</td>
</tr>
<tr>
<td>3.38</td>
<td>Mounting Dimensions</td>
<td>3.875 X 4.750 inches</td>
</tr>
</tbody>
</table>
1. **GENERAL DESCRIPTION**

The A. R. F. Model AR-34 Command Destruct Receiver is a solid-state design utilizing surface mount technology to reduce the weight and increase the reliability of the basic design.

**Receiver Section**

- RF Bandpass Filter
- RF Amplifier
- First Mixer (Passive)
- Second Mixer (Active)
- Second IF Amplifier (10.7 MHz)
- Crystal Filter (10.7 MHz)
- Limiting Amplifier
- Quadrature Detector
- Video Buffer Amplifier

**Decoder Section**

- PLL Tone Decoders (3)
- Command Decode Circuit
- Relay Drivers (4)
- Output Relays (4)

**Power**

- 24 to 36 Vdc Input
- Switching Power Regulator

**Telemetry Outputs**

- Input RF Level Monitor

2. **BACKGROUND**

The receiver is designed to meet the requirements of NWC 1638.
### TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 Frequency Range (Tuneable)</td>
<td>406 to 550 MHz</td>
</tr>
<tr>
<td>3.2 Frequency Deviation</td>
<td>30 kHz per channel (nominal)</td>
</tr>
<tr>
<td>3.3 Threshold Sensitivity</td>
<td>-110 dBm maximum</td>
</tr>
<tr>
<td>3.4 Operating Bandwidth</td>
<td>180 kHz minimum at -3 dB</td>
</tr>
<tr>
<td></td>
<td>360 kHz maximum at -60 dB</td>
</tr>
<tr>
<td>3.5 Maximum Useable RF Input</td>
<td>-20 dBm minimum</td>
</tr>
<tr>
<td>3.6 RF Input Impedance</td>
<td>50 ohms</td>
</tr>
<tr>
<td>3.7 VSWR</td>
<td>1.5:1 maximum</td>
</tr>
<tr>
<td>3.8 Local Oscillator Tolerance</td>
<td>±0.005 percent</td>
</tr>
<tr>
<td>3.9 Tuning Increments</td>
<td>Continuous</td>
</tr>
<tr>
<td>3.10 Image and Spurious Rejection</td>
<td>60 dB minimum</td>
</tr>
<tr>
<td>3.11 RF Signal Strength Output</td>
<td>0.5 to 5.0 Vdc</td>
</tr>
<tr>
<td>3.12 Dynamic Stability</td>
<td>Unconditional</td>
</tr>
<tr>
<td>3.13 Usable Input Channels</td>
<td>3</td>
</tr>
<tr>
<td>3.14 Decoded Output Channels</td>
<td>4</td>
</tr>
<tr>
<td>3.15 Usable Tones</td>
<td>3 (simultaneously)</td>
</tr>
<tr>
<td>3.16 Output (relay) Current</td>
<td>2.0 A (make or break)</td>
</tr>
<tr>
<td>3.17 Output Isolation</td>
<td>&gt;1.0 Mohm</td>
</tr>
<tr>
<td>3.18 Command Response Time</td>
<td>&lt;25 ms</td>
</tr>
<tr>
<td>3.19 Command Change Delay</td>
<td>&lt;25 ms</td>
</tr>
<tr>
<td>3.20 Power Requirements</td>
<td></td>
</tr>
<tr>
<td>Standby</td>
<td>&lt;180 mA (RCVR active)</td>
</tr>
<tr>
<td>Command Activation</td>
<td>&lt;300 mA (maximum active commands)</td>
</tr>
</tbody>
</table>
3.21 Reverse Polarity Protection 40 Vdc reverse input (no damage)

3.22 Temperature Range
- Operating -50 to +85°C
- Non-operating -50 to +85°C

3.23 Humidity 0 to 95 percent relative

3.24 Altitude Unlimited

3.25 Shock
- 50 g-peak terminal sawtooth, 11 ms
- 30 g-peak trapezoidal, 10 ms

3.26 Vibration
- 8.9 g rms, random, 20 - 2,000 Hz,
- 0.04 g²/Hz

3.27 Dimensions 3.000 x 4.390 x 1.500-in

3.28 Weight 23 ounces maximum

3.29 Mounting Attitude Non-restricted

3.30 External Adjustments None

3.31 External Connections See Outline Drawing

3.32 Mounting Dimensions 2.740 X 3.700 inches

NOTES:

1. The standard receiver decoding setup is as follows:

<table>
<thead>
<tr>
<th>Command Output</th>
<th>Input Tone(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPTIONAL</td>
<td>2 and 5 &quot;ON&quot;</td>
</tr>
<tr>
<td>ARM</td>
<td>1 and 5 &quot;ON&quot;</td>
</tr>
<tr>
<td>DESTRUCT</td>
<td>1 and 5 &quot;ON&quot;, 5 &quot;OFF&quot;, 2 &quot;ON&quot;</td>
</tr>
<tr>
<td></td>
<td>or 1 and 5 &quot;ON&quot;, 2 &quot;ON&quot;, 5 &quot;OFF&quot;</td>
</tr>
<tr>
<td>MONITOR</td>
<td>5 &quot;ON&quot;</td>
</tr>
</tbody>
</table>

The tones are standard IRIG tones as specified in RCC Document 313-89.
Figure 1-4. A.R.F. Model AR-34 Range Safety Receiver.
2. AYDIN VECTOR DIVISION
Post Office Box 328
Newtown, Pennsylvania 18940-0328
(Phone: 215-968-4271)

FLIGHT TERMINATION RECEIVERS/DECODERS

Model VFTR-300
Model VFTR-301
Model VFTR-321

COMMAND AND CONTROL RECEIVERS/DECODERS

Model RCC-100/TDC-100
Model RCC-200/TDC-100
Model RCC-500
AYDIN VECTOR DIVISION
FLIGHT TERMINATION RECEIVER/DECODER
MODEL VFTR-300

1. GENERAL DESCRIPTION

The Vector Model VFTR-300 Receiver/Decoder is specifically designed to meet the stringent electrical, environmental, and reliability requirements of missile flight termination usage. The receiver/decoder completely satisfies the requirements of Range Commanders Council (RCC) Document 313-89, Design, Performance and Test Standards for Flight Termination Receiver/Decoders, Volume I, Design and Performance Requirements. It employs standard missile range logic for three or four tones with up to four double-pole, double-throw (DPDT) relays. Flexibility of decoder circuitry allows the use of various logic schemes, including loss of carrier and prime power fail-safes.

An ultrahigh reactive quality (Q) preselector and high intermediate frequency (IF) allow the use of a simple single-heterodyne receiver front end, which is both more cost effective and reliable than alternate approaches. Components preceding the IF filter have sufficient dynamic range and power output capability to meet susceptibility requirements of RCC Document 313-89 and MIL-STD-461/462. Front end gain and noise tolerance provide a threshold sensitivity of better than 1 microvolt (μV). Required selectivity is assured by use of an IF filter with a 60 decibel (dB) bandwidth of less than 350 kilohertz (kHz).

Refinement of decoder design has eliminated the common problems of unstable bandwidth center frequency at decoder threshold, resulting in a virtually rectangular filter characteristic with a very stable threshold. In the interest of reliability, no tuned audio inductors are used.

Modular packaged subassemblies are rigidly mounted in the 16-in³ housing, which provides mechanical support as well as internal shielding for electromagnetic interference (EMI) considerations and ease of assembly. Machined compartment walls sufficiently stiffen and rigidize this light-weight structure and maximize vibration resonance frequencies. MIL-grade staking compounds preclude relative component movement, preventing vibration lead fatigue and mechanical detuning of critical circuits. Parts were selected for a maximum reliability and minimum stress. Hermetic parts are used exclusively. Vector manufactures hybrids screened to MIL-STD-883, ultrastable resistors and capacitors (when required) and MIL-STD parts are used throughout. Optional design packages as high reliability components (S-level, MIL-STD-883B, JAN/TV), audio output are available upon request. All VFTR-300 receivers/decoders are extensively tested (including vibration and temperature) before shipment.

2 - 2
2. **BACKGROUND**

The VFTR-300 was developed under a company sponsored independent research and development (IR&D) program for specific use as a flight termination receiver. Among programs that the VFTR-300 was qualified on are: AMRAAM, HARM, ALARM, PERSHING, DELILA, and ARROW.

3. **TECHNICAL SPECIFICATIONS**

### 3.1 RF SECTION

3.1.1 Frequency Range (Tuneable) 400 to 550 MHz

3.1.2 Threshold Sensitivity (Command Output) 1 µV

3.1.3 Maximum Useable RF Input 2 Vrms

3.1.4 Operating Bandwidth ±45 kHz minimum

3.1.5 Antenna Impedance 50 ohms

3.1.6 VSWR 2:1 maximum

3.1.7 Local Oscillator Stability 0.003 percent

3.1.8 Tuning Accuracy 0.005 percent

3.1.9 Tuning Method Crystal-controlled local oscillator

### 3.2 IF SECTION

3.2.1 IF Frequency 21.4 MHz

3.2.2 Selectivity, 60 dB ±180 kHz minimum; other available

3.2.3 Capture Ratio 1 dB maximum

### 3.3 AUDIO SECTION

3.3.1 Audio Amplifier Response 3 dB, 5 to 100 kHz

3.3.2 Audio Amplifier Distortion ≤5 percent
3.3.3 Audio Output Optional

3.3.4 Frequency Deviation ±27 to ±33 kHz per tone for activation

3.4 DECODER SECTION

3.4.1 Number of Decoder Channels Up to 4

3.4.2 Number of Simultaneous Useable Tones Up to 4

3.4.3 Tone Channel Bandwidth ±1 percent, 2 dB maximum; ±4 percent, 20 dB maximum

3.4.4 Adjacent Channel Rejection Infinite

3.4.5 Decoder Threshold Deviation ±4 kHz minimum per tone for no command

3.5 OUTPUT

3.5.1 Types of Output Relay closure, solid-state optional

3.5.2 Output Current Capability 2 A resistive at 28 Vdc per contact

3.5.3 Output Leakage 1,000 Mohms minimum insulation resistance per contact set

3.5.4 Logic Circuit 1 & 5 = Arm; 2 & 5 = opt. Command & Monitor; 1 & 5 ON, 5 OFF, 2 ON = Arm and Destruct; 5 = Monitor, other sequences and circuits, including fail-safes, available

3.5.5 Response Time for Commands 25 ms maximum; other response times available

3.5.6 Transition Time Between Commands 3 ms

3.5.7 Output Isolation Common ground; isolation available for some options

3.5.8 Noise Immunity Interruption of primary power or carrier will not cause decoder operation

3.5.9 Telemetry Outputs Signal level indication; additional status monitors optional
3.6 POWER SUPPLY

3.6.1 Supply Voltage 22 to 36 Vdc

3.6.2 Power Requirements
Standby: 180 mA maximum
Interrogate: 180 mA plus 23 mA per energized channel at 28 Vdc (30 mA per channel at 36 Vdc)

3.6.3 Power Supply Isolation Connected to chassis; isolation optional

3.6.4 Turn-On Power Control for Receiver Available with some configurations

3.6.5 Other Controls Optional controls available, such as fail-safe enable

3.7 ELECTROMAGNETIC INTERFERENCE

3.7.1 RFI Suppression MIL-STD-461/462, except limits A & B; CS04 and CS08 are 60 dB

3.7.2 Pulse Rejection Application of C-Band and X-Band radar transponder signal of +27 dBm at the antenna will not degrade receiver sensitivity and/or cause false command output

3.7.3 AM Rejection Application of AM carrier will not cause any command output

3.7.4 Image Rejection 60 dB minimum

3.8 ENVIRONMENTAL CHARACTERISTICS

3.8.1 Operating Temperature Range (Continuous) -40°C to +77°C (-54°C to +85°C optional)

3.8.2 Nondestructive Temperatures (Shelf Storage) -55°C to +110°C

3.8.3 Humidity 95 percent

3.8.4 Altitude Unlimited
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.8.5</td>
<td>Shock</td>
<td>1,500 g SRS</td>
</tr>
<tr>
<td>3.8.6</td>
<td>Acceleration</td>
<td>150 g</td>
</tr>
<tr>
<td>3.8.7</td>
<td>Vibration (random)</td>
<td>21 g rms, 20 to 2,000 Hz</td>
</tr>
<tr>
<td>3.8.8</td>
<td>Acoustics</td>
<td>Not measured</td>
</tr>
<tr>
<td>3.8.9</td>
<td>Pressurization</td>
<td>Not required</td>
</tr>
<tr>
<td>3.8.10</td>
<td>Operating Life</td>
<td>≥2,000 hours</td>
</tr>
<tr>
<td>3.8.11</td>
<td>Shelf Life</td>
<td>8 years</td>
</tr>
</tbody>
</table>

### 3.9 PHYSICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.9.1</td>
<td>Volume</td>
<td>16-in³</td>
</tr>
<tr>
<td>3.9.2</td>
<td>Dimensions</td>
<td>See Outline Drawing</td>
</tr>
<tr>
<td>3.9.3</td>
<td>Weight</td>
<td>20 ounces maximum</td>
</tr>
<tr>
<td>3.9.4</td>
<td>Mounting Attitude</td>
<td>Any</td>
</tr>
<tr>
<td>3.9.5</td>
<td>External Adjustments</td>
<td>None</td>
</tr>
<tr>
<td>3.9.6</td>
<td>Connector Types</td>
<td>Antenna: SMA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Power/Signal/Control: 15-pin per</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MIL-C-24308 (others available)</td>
</tr>
</tbody>
</table>
Figure 2-1. Outline drawing of Aydin Vector Division Model 
VFTR-300 Flight Termination Receiver/Decoder.

2-7
GENERAL DESCRIPTION

The Vector Model VFTR-301 Receiver/Decoder is specifically designed to meet the requirements for flight termination receivers/decoders, as specified in NAVAIRSYSCOM specifications 642AS8859 and 642AS8961. The VFTR-301 meets the stringent electrical, environmental, and reliability requirements of missile flight termination usage and completely satisfies the requirements of RCC Document 313-89. It employs standard missile range logic for three or four tones with up to four DPDT relays. Flexibility of decoder circuitry allows the use of various logic schemes, including loss of carrier and prime power fail-safes.

An ultrahigh Q preselector and high IF allow the use of a simple single-heterodyne receiver front end, which is both more cost effective and reliable than alternative approaches. Components preceding the IF filter have sufficient dynamic range and power output capability to meet the susceptibility requirements of RCC Document 313-89 and MIL-STD-461/462. Front-end gain and noise tolerance provide a threshold sensitivity of better than $1 \mu$V. Required selectivity is assured by use of a 60 dB bandwidth of less than 350 kHz.

Refinement of the decoder design has eliminated the common problems of unstable bandwidth and center frequency at decoder threshold, resulting in a virtually rectangular filter characteristic with a very stable threshold. In the interest of reliability, no tuned audio inductors are used.

Modular packaged subassemblies are rigidly mounted in the 19.2-in$^3$ housing, which provides mechanical support as well as internal shielding for EMI considerations and ease of assembly. Machined compartment walls sufficiently stiffen and rigidize this lightweight structure and maximize vibration resonance frequencies. MIL-grade staking compounds preclude relative component movement, preventing vibrational lead fatigue and mechanical detuning of critical circuits. Parts were selected for maximum reliability and minimum stress. Hermetic parts are used exclusively. Vector manufactures hybrids screened to MIL-STD-883, ultrastable resistors and capacitors (when required) and MIL-STD parts are used throughout. Upgraded parts and parts screening are available as options. Optional design packages as high reliability components (S-level, MIL-STD-883B, JANTXV) audio output, are available upon request. All VFTR-301 receivers/decoders are extensively tested (including vibration and temperature) before shipment.
2. **BACKGROUND**

The VFTR-301 is a repackaging of the VFTR-300 Receiver/Decoder. The VFTR-301 conforms to the connector, size, and mounting requirements of specifications 642AS8859 and 642AS8961. Modules incorporated in the VFTR-300 and VFTR-301 are completely interchangeable.

The VFTR-301 was developed under a company sponsored IR&D program for specific use as a missile flight termination receiver. Among programs that the VFTR-301 was qualified on are: VANDAL, TACIT RAINBOW, and PEGASUS.

3. **TECHNICAL SPECIFICATIONS**

3.1 RF SECTION

3.1.1 Frequency Range (Tuneable) 400 to 475 MHz or 475 to 550 MHz

3.1.2 Threshold Sensitivity (Command Output) 1 μV

3.1.3 Maximum Useable RF Input 2 Vrms

3.1.4 Operating Bandwidth ±45 kHz minimum

3.1.5 Antenna Impedance 50 ohms

3.1.6 VSWR 2:1 maximum

3.1.7 Local Oscillator Stability 0.003 percent

3.1.8 Tuning Accuracy 0.005 percent

3.1.9 Tuning Method Crystal-controlled local oscillator

3.2 IF SECTION

3.2.1 IF Frequency 21.4 MHz

3.2.2 Selectivity, 60 dB ±180 kHz maximum; other available

3.2.3 Capture Ratio 1 dB maximum
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3.3 AUDIO SECTION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.3.1 Audio Amplifier Response</td>
<td></td>
<td>3 dB, 5 to 100 kHz</td>
</tr>
<tr>
<td>3.3.2 Audio Amplifier Distortion</td>
<td></td>
<td>≤5 percent</td>
</tr>
<tr>
<td>3.3.3 Audio Output</td>
<td></td>
<td>Optional</td>
</tr>
<tr>
<td>3.3.4 Frequency Deviation</td>
<td></td>
<td>±27 to ±33 kHz per tone for activation</td>
</tr>
<tr>
<td><strong>3.4 DECODER SECTION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.4.1 Number of Decoder Channels</td>
<td></td>
<td>Up to 4</td>
</tr>
<tr>
<td>3.4.2 Number of Simultaneous Useable Tones</td>
<td></td>
<td>Up to 4</td>
</tr>
<tr>
<td>3.4.3 Tone Channel Bandwidth</td>
<td></td>
<td>±1 percent, 2 dB minimum; ±4 percent, 20 dB maximum</td>
</tr>
<tr>
<td>3.4.4 Adjacent Channel Rejection</td>
<td></td>
<td>Infinite</td>
</tr>
<tr>
<td>3.4.5 Decoder Threshold Deviation</td>
<td></td>
<td>±4 kHz minimum per tone for no command</td>
</tr>
<tr>
<td><strong>3.5 OUTPUT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5.1 Types of Output</td>
<td></td>
<td>Relay closure, solid-state optional</td>
</tr>
<tr>
<td>3.5.2 Output Current Capability</td>
<td></td>
<td>2 A resistive at 28 Vdc per contact</td>
</tr>
<tr>
<td>3.5.3 Output Leakage</td>
<td></td>
<td>1,000 Mohms minimum insulation resistance per contact set</td>
</tr>
<tr>
<td>3.5.4 Logic Circuit</td>
<td></td>
<td>1 &amp; 5 = Arm; 2 &amp; 5 = opt. Command &amp; Monitor; 1 &amp; 5 ON, 5 OFF, 2 ON = Arm and Destruct; 5 = Monitor; other sequences and circuits, including fail-safes, available</td>
</tr>
<tr>
<td>3.5.5 Response Time for Commands</td>
<td></td>
<td>25 ms maximum; other response times available</td>
</tr>
<tr>
<td>3.5.6 Transition Time Between Commands</td>
<td></td>
<td>3 ms</td>
</tr>
<tr>
<td>Section</td>
<td>Description</td>
<td>Details</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td>--------</td>
</tr>
<tr>
<td>3.5.7</td>
<td>Output Isolation</td>
<td>Common ground; isolation available for some options</td>
</tr>
<tr>
<td>3.5.8</td>
<td>Noise Immunity</td>
<td>Interruption of primary power or carrier will not cause decoder operation</td>
</tr>
<tr>
<td>3.5.9</td>
<td>Telemetry Outputs</td>
<td>Signal level indication; additional status monitors optional</td>
</tr>
<tr>
<td>3.6</td>
<td>POWER SUPPLY</td>
<td></td>
</tr>
<tr>
<td>3.6.1</td>
<td>Supply voltage</td>
<td>22 to 36 Vdc</td>
</tr>
<tr>
<td>3.6.2</td>
<td>Power Requirements</td>
<td>Standby: 180 mA maximum Interrogate: 180 mA plus 23 mA per energized channel at 28 Vdc (30 mA per channel at 36 Vdc)</td>
</tr>
<tr>
<td>3.6.3</td>
<td>Power Supply Isolation</td>
<td>Connected to chassis; isolation optional</td>
</tr>
<tr>
<td>3.6.4</td>
<td>Turn-On Power Control for Receiver</td>
<td>Available with some configurations</td>
</tr>
<tr>
<td>3.6.5</td>
<td>Other Controls</td>
<td>Optional controls available, such as fail-safe enable</td>
</tr>
<tr>
<td>3.7</td>
<td>ELECTROMAGNETIC INTERFERENCE</td>
<td></td>
</tr>
<tr>
<td>3.7.1</td>
<td>RFI Suppression</td>
<td>MIL-STD-461/462, except limits A &amp; B; CS04 and CS08 are 60 dB</td>
</tr>
<tr>
<td>3.7.2</td>
<td>Pulse Rejection</td>
<td>Application of C-Band and X-Band radar transponder signal of +27 dBm at the antenna will not degrade receiver sensitivity and/or cause false command output</td>
</tr>
<tr>
<td>3.7.3</td>
<td>AM Rejection</td>
<td>Application of AM carrier will not cause any command output</td>
</tr>
<tr>
<td>3.7.4</td>
<td>Image Rejection</td>
<td>60 dB minimum</td>
</tr>
</tbody>
</table>
### ENVIRONMENTAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.8.1</td>
<td>Operating Temperature Range</td>
<td>-40°C to +77°C (Continuous) (-54°C to +85°C optional)</td>
</tr>
<tr>
<td>3.8.2</td>
<td>Nondestructive Temperatures (Shelf Storage)</td>
<td>-55°C to +110°C</td>
</tr>
<tr>
<td>3.8.3</td>
<td>Humidity</td>
<td>95 percent</td>
</tr>
<tr>
<td>3.8.4</td>
<td>Altitude</td>
<td>Unlimited</td>
</tr>
<tr>
<td>3.8.5</td>
<td>Shock</td>
<td>1,500 g SRS</td>
</tr>
<tr>
<td>3.8.6</td>
<td>Acceleration</td>
<td>150 g</td>
</tr>
<tr>
<td>3.8.7</td>
<td>Vibration</td>
<td>21 g rms random, 20 to 2,000 Hz</td>
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<td>3.8.8</td>
<td>Acoustics</td>
<td>Not measured</td>
</tr>
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<td>3.8.9</td>
<td>Pressurization</td>
<td>Not required</td>
</tr>
<tr>
<td>3.8.10</td>
<td>Operating Life</td>
<td>≥2,000 hours</td>
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<tr>
<td>3.8.11</td>
<td>Shelf Life</td>
<td>8 years</td>
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### PHYSICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Specification</th>
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<tbody>
<tr>
<td>3.9.1</td>
<td>Volume</td>
<td>16-in³</td>
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<td>3.9.2</td>
<td>Dimensions</td>
<td>See Outline Drawing</td>
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<tr>
<td>3.9.3</td>
<td>Weight</td>
<td>25 ounces maximum</td>
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<tr>
<td>3.9.4</td>
<td>Mounting Attitude</td>
<td>Any</td>
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<td>3.9.5</td>
<td>External Adjustments</td>
<td>None</td>
</tr>
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</table>
| 3.9.6   | Connector Types | J1: Antenna - TNC Receptacle  
J2: MS3112E-8-4P  
J3: MS3112E-10-6S  
J4: MS3112E-8-4S |
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<tr>
<th>CONNECTOR</th>
<th>PIN</th>
<th>VFTR-301A</th>
<th>VFTR-301B</th>
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<td>TNC</td>
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<tr>
<td>J2</td>
<td>A</td>
<td>+28 Vdc</td>
<td>+28 Vdc</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>28 V RTN</td>
<td>28 V RTN</td>
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<tr>
<td></td>
<td>C</td>
<td>Case End</td>
<td>Case End</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>Spare</td>
<td>Spare</td>
</tr>
<tr>
<td>J3</td>
<td>A</td>
<td>MON Out</td>
<td>MON Out</td>
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<tr>
<td></td>
<td>B</td>
<td>OPT Command</td>
<td>OPT Command</td>
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<td></td>
<td>C</td>
<td>MON RTN</td>
<td>MON RTN</td>
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<td></td>
<td>D</td>
<td>OPT Command RTN</td>
<td>OPT Command RTN</td>
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<td></td>
<td>E</td>
<td>ARM RTN</td>
<td>ARM Command RTN</td>
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<td></td>
<td>F</td>
<td>ARM Out</td>
<td>ARM Command</td>
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<td>J4</td>
<td>A</td>
<td>SIG STR</td>
<td>SIG STR</td>
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<td></td>
<td>B</td>
<td>SIG STR RTN</td>
<td>SIG STR RTN</td>
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<td></td>
<td>C</td>
<td>DEST Out</td>
<td>Term Command</td>
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<tr>
<td></td>
<td>D</td>
<td>DEST RTN</td>
<td>Term Command RTN</td>
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<tr>
<td>SPEC</td>
<td></td>
<td>642AS8961</td>
<td>642AS8859</td>
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</table>
Figure 2-3. Outline drawing of Aydin Vector Division Model VFTR-301 Flight Termination Receiver/Decoder.
AYDIN VECTOR DIVISION

MINIATURE FLIGHT TERMINATION RECEIVER/DECODER

MODEL VFTR-321

1. GENERAL DESCRIPTION

The Vector Model VFTR-321 Receiver/Decoder is specifically designed to meet the requirements of today's missile and Remote Piloted Vehicle (RPV) for lighter weight and smaller size while maintaining the stringent electrical, environmental, and reliability of the VFTR-300 and VFTR-301 series.

The receiver/decoder is designed to meet the requirements of RCC Document 313-89; Design, Performance and Test Standards for Flight Termination Receiver/Decoders, Volume I, Design and Performance Requirements. It features an Erasable Programmable Logic Device (EPLD) which could be easily programmed (or reprogrammed) to meet standard missile range logic or any other requirement.

An ultrahigh reactive quality (Q) preselector and high IF allow the use of a simple single-heterodyne receiver front end, which is both more cost effective and reliable than alternative approaches. Components preceding the IF filter have sufficient dynamic range and power output capability to meet the susceptibility requirements of RCC Document 313-89 and MIL-STD-461/462. Front-end gain and noise tolerance provide a threshold sensitivity of better than 1 μV. Required selectivity is assured by use of an IF crystal filter with a 60 dB bandwidth of less than 350 kHz.

Optimization of the Phase Lock Loop (PLL) Tone Decoder guarantees bandwidth stability from threshold to maximum tone deviation, resulting in virtually rectangular filter characteristics.

Modular packaged subassemblies are rigidly mounted in the 6.25-in³ housing, which provides mechanical support as well as internal shielding for EMI considerations and ease of assembly. Machined compartment walls sufficiently stiffen and rigidize this lightweight structure and maximize vibration resonance frequencies. MIL-grade staking compounds preclude relative component movement, preventing vibrational lead fatigue and mechanical detuning of critical circuits. Parts were selected for maximum reliability and minimum size and stress. To comply with minimum size and weight, Vector designed hybrids are used. When required, high reliability parts S-level, MIL-STD-883B, JANTX could be used.

2. BACKGROUND

The VFTR-321 was developed under a company sponsored IR&D program for specific use as a miniature flight termination receiver.
3. **TECHNICAL SPECIFICATIONS**

3.1 **RF SECTION**

3.1.1 Frequency Range (Tuneable) 400 to 550 MHz

3.1.2 Threshold Sensitivity (Command Output) 1 µV

3.1.3 Maximum Useable RF Input 2 Vrms

3.1.4 Operating Bandwidth ±45 kHz minimum

3.1.5 Antenna Impedance 50 ohms

3.1.6 VSWR 2:1 maximum

3.1.7 Local Oscillator Stability 0.003 percent

3.1.8 Tuning Accuracy 0.005 percent

3.1.9 Tuning Method Crystal-controlled local oscillator

3.2 **IF SECTION**

3.2.1 IF Frequency 21.4 MHz

3.2.2 Selectivity, 60 dB ±180 kHz maximum; other available

3.2.3 Capture Ratio 1 dB maximum

3.3 **AUDIO SECTION**

3.3.1 Audio Amplifier Response 3 dB, 5 to 100 kHz

3.3.2 Audio Amplifier Distortion ≤5 percent

3.3.3 Audio Output Optional

3.3.4 Frequency Deviation ±27 to ±33 kHz per tone for activation
3.4 DECODER SECTION

3.4.1 Number of Decoder Channels
Up to 4

3.4.2 Number of Simultaneous Useable Tones
Up to 4

3.4.3 Tone Channel Bandwidth
±1 percent, 2 dB minimum;
±4 percent, 20 dB maximum

3.4.4 Adjacent Channel Rejection
Infinite

3.4.5 Decoder Threshold Deviation
±4 kHz minimum per tone for no command;
optional deviations are available

3.5 OUTPUT

3.5.1 Types of Output
Relay closure, solid-state optional

3.5.2 Output Current Capability
2 A resistive at 28 Vdc per contact

3.5.3 Output Leakage
1,000 Mohms minimum insulation resistance
per contact set

3.5.4 Logic Circuit
1 & 5 = Arm; 2 & 5 = opt. Command &
Monitor; 1 & 5 ON, 5 OFF, 2 ON = Arm and
Destruct; 5 = Monitor; other sequences and
circuits, including fail-safes, available

3.5.5 Response Time for Commands
25 ms maximum; other response times
available

3.5.6 Transition Time Between Commands
3 ms

3.5.7 Output Isolation
All output returns isolated from case ground

3.5.8 Noise Immunity
 Interruption of primary power or carrier
 will not cause decoder operation

3.5.9 Telemetry Outputs
Signal level indication; additional status
monitors optional
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.6</td>
<td>POWER SUPPLY</td>
<td>3.6.1 Supply voltage 22 to 36 Vdc&lt;br&gt;3.6.2 Power Requirements&lt;br&gt;Standby: 180 mA maximum&lt;br&gt;Interrogate: 180 mA plus 23 mA per energized channel at 28 Vdc (30 mA per channel at 36 Vdc)&lt;br&gt;3.6.3 Power Supply Isolation&lt;br&gt;Isolated from chassis; chassis ground optional&lt;br&gt;3.6.4 Turn-On Power Control for Receiver&lt;br&gt;Available with some configurations&lt;br&gt;3.6.5 Other Controls&lt;br&gt;Optional controls available, such as fail-safe enable</td>
</tr>
<tr>
<td>3.7</td>
<td>ELECTROMAGNETIC INTERFERENCE</td>
<td>3.7.1 RFI Suppression&lt;br&gt;MIL-STD-461/462, except limits A &amp; B; CS04 and CS08 are 60 dB&lt;br&gt;3.7.2 Pulse Rejection&lt;br&gt;Application of C-Band and X-Band radar transponder signal of +27 dBm at the antenna will not degrade receiver sensitivity and/or cause false command output&lt;br&gt;3.7.3 AM Rejection&lt;br&gt;Application of AM carrier will not cause any command output&lt;br&gt;3.7.4 Image Rejection&lt;br&gt;60 dB minimum</td>
</tr>
<tr>
<td>3.8</td>
<td>ENVIRONMENTAL CHARACTERISTICS</td>
<td>3.8.1 Operating Temperature Range (Continuous)&lt;br&gt;-40°C to +77°C (-54°C to +85°C optional)&lt;br&gt;3.8.2 Nondestructive Temperatures (Shelf Storage)&lt;br&gt;-55°C to +110°C&lt;br&gt;3.8.3 Humidity&lt;br&gt;95 percent&lt;br&gt;3.8.4 Altitude&lt;br&gt;Unlimited</td>
</tr>
</tbody>
</table>
### 3.8.5 Shock
- 1,500 g SRS

### 3.8.6 Acceleration
- 150 g

### 3.8.7 Vibration
- 21 g rms random, 20 to 2,000 Hz

### 3.8.8 Acoustics
- Not measured

### 3.8.9 Pressurization
- Not required

### 3.8.10 Operating Life
- ≥2,000 hours

### 3.8.11 Shelf Life
- 8 years

### 3.9 PHYSICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>3.9.1 Volume</th>
<th>6.25-in³</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.9.2 Dimensions</td>
<td>See Outline Drawing</td>
</tr>
<tr>
<td>3.9.3 Weight</td>
<td>8 ounces maximum</td>
</tr>
<tr>
<td>3.9.4 Mounting Attitude</td>
<td>Any</td>
</tr>
<tr>
<td>3.9.5 External Adjustments</td>
<td>None</td>
</tr>
</tbody>
</table>
| 3.9.6 Connector Types | Antenna - SMA  
| | Power/Signal/Control: 15-pin per  
| | MIL-C-24308 (others available) |
Figure 2-5. Outline drawing of Aydin Vector Division Model VFTR-321 Flight Termination Receiver.
AYDIN VECTOR DIVISION
COMMAND AND CONTROL RECEIVER/DECODER
MODEL RCC-100/TDC-100

1. GENERAL DESCRIPTION

The Vector Model RCC-100 Series Very High Frequency (VHF) Command and Control Receivers are designed for operation in the 200- to 550-MHz band for aerospace applications where size, weight, ruggedness and power consumption are critical. The receiver is compatible with the majority of communication and telemetry FM data links (such as voice, FM/FM, Pulse Amplitude Modulation (PAM)/FM, and Pulse Code Modulation (PCM)/FM). The Vector TDC-100 Tone Decoder directly interfaces mechanically and electrically with the RCC-200 for command and control applications with up to four tones. The RCC-100 has mounting provisions for stacking one or more TDC-100 modules for operation with more than four tones.

2. BACKGROUND

The RCC-100/TDC-100 Receivers/Decoders have been successfully flown on numerous National Aeronautics and Space Administration (NASA), military, foreign and commercial programs with communications, telemetry, and command and control applications.

3. TECHNICAL SPECIFICATIONS

3.1 RF SECTION

3.1.1 Frequency Range (Tuneable) RCC-101: 200 to 290 MHz
RCC-102: 290 to 400 MHz
RCC-103: 400 to 550 MHz

3.1.2 Threshold Sensitivity (Command Output) 3 µV maximum for decoder operation with 200 kHz IF filter

3.1.3 Maximum Useable RF Input 2 Vrms maximum

3.1.4 Operating Bandwidth ±45 kHz with 200 kHz, 3 dB IF bandwidth and up to 4 simultaneous tones (wider for other filters - 400-, 600-, 800-, 1,000-kHz and others available)

3.1.5 Antenna Impedance 50 ohms
3.1.6 VSWR 2:1 maximum
3.1.7 Local Oscillator Stability ±0.003 percent
3.1.8 Tuning Accuracy ±0.005 percent
3.1.9 Tuning Method Crystal-controlled local oscillator

3.2 IF SECTION
3.2.1 IF Frequency 21.4 MHz
3.2.2 Selectivity, 60 dB 3.75 times 3 dB IF bandwidth
3.2.3 Capture Ratio 1 dB with decoder

3.3 AUDIO SECTION
3.3.1 Audio Amplifier Response 100 Hz to 1/4 times 3 dB IF bandwidth (±1 dB)
3.3.2 Audio Amplifier Distortion 2 percent maximum for peak-to-peak deviation of 1/4 times 3 dB IF bandwidth
3.3.3 Audio Output 0.01 V peak per kHz deviation into 600 ohm load
3.3.4 Frequency Deviation Up to 1.5 MHz peak-to-peak (depending on IF filter)

3.4 DECODER SECTION
3.4.1 Number of Decoder Channels Up to 4 per TDC-100 housing (housings stackable)
3.4.2 Number of Simultaneous Useable Tones Up to 4 with 200 kHz IF bandwidth (more tones with wider bandwidth)
3.4.3 Tone Channel Bandwidth ±1 percent, 2 dB minimum;
±4 percent, 20 dB maximum
3.4.4 Adjacent Channel Rejection 34 dB minimum
3.4.5 Decoder Threshold Deviation ±4 kHz minimum per tone for no command; ±27 to ±33 kHz per tone for activation

3.5 OUTPUT
3.5.1 Types of Output Relay closure for decoder output
3.5.2 Output Current Capability 2 A resistive at 28 Vdc
3.5.3 Output Leakage 1,000 Mohms minimum insulation resistance per relay contact
3.5.4 Logic Circuit Two contacts per channel (DPDT); internal logic sequence optional
3.5.5 Response Time for Commands 25 ms maximum
3.5.6 Transition Time Between Commands 3 ms
3.5.7 Output Isolation Common ground; isolation optional
3.5.8 Noise Immunity Interruption of primary power or carrier will not cause decoder operation
3.5.9 Telemetry Outputs Signal level indication (0 to 4 Vdc nominal into 10 kohms)

3.6 POWER SUPPLY
3.6.1 Supply Voltage 24 to 36 Vdc
3.6.2 Power Requirements RCC-100: 60 mA maximum
TDC-100: 10 mA plus 15 mA per decoder channel (plus 23 mA per energized relay)
3.6.3 Power Supply Isolation Returns connected to chassis; isolation optional
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.6.4</td>
<td>Turn On Power Control for Receiver</td>
<td>N/A</td>
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<td>3.6.5</td>
<td>Other Controls</td>
<td>None</td>
</tr>
<tr>
<td>3.7</td>
<td>ELECTROMAGNETIC INTERFERENCE</td>
<td></td>
</tr>
<tr>
<td>3.7.1</td>
<td>RFI Suppression</td>
<td>MIL-STD-461B, except limits A &amp; B; CS04 is 40 dB</td>
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<tr>
<td>3.7.2</td>
<td>Pulse Rejection</td>
<td>Not measured</td>
</tr>
<tr>
<td>3.7.3</td>
<td>AM Rejection</td>
<td>Not measured</td>
</tr>
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<td>3.7.4</td>
<td>Image Rejection</td>
<td>60 dB minimum</td>
</tr>
<tr>
<td>3.8</td>
<td>ENVIRONMENTAL CHARACTERISTICS</td>
<td></td>
</tr>
<tr>
<td>3.8.1</td>
<td>Operating Temperature Range (Continuous)</td>
<td>-40°C to +70°C</td>
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<td>3.8.2</td>
<td>Nondestructive Temperatures (Shelf Storage)</td>
<td>-50°C to +90°C</td>
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<td>3.8.3</td>
<td>Humidity</td>
<td>95 percent</td>
</tr>
<tr>
<td>3.8.4</td>
<td>Altitude</td>
<td>Unlimited</td>
</tr>
<tr>
<td>3.8.5</td>
<td>Shock</td>
<td>1/2 sine at 50 g for 11 ms</td>
</tr>
<tr>
<td>3.8.6</td>
<td>Acceleration</td>
<td>100 g</td>
</tr>
<tr>
<td>3.8.7</td>
<td>Vibration</td>
<td>20 g sine, 20 to 2,000 Hz</td>
</tr>
<tr>
<td>3.8.8</td>
<td>Acoustics</td>
<td>Not measured</td>
</tr>
<tr>
<td>3.8.9</td>
<td>Pressurization</td>
<td>Not required</td>
</tr>
<tr>
<td>3.8.10</td>
<td>Operating Life</td>
<td>&gt;1,500 hours</td>
</tr>
<tr>
<td>3.8.11</td>
<td>Shelf Life</td>
<td>5 years</td>
</tr>
</tbody>
</table>

2-27
3.9 PHYSICAL CHARACTERISTICS

3.9.1 Volume
- RCC-100: 12.8-in³
- TDC-100: 7.3-in³

3.9.2 Dimensions
- See Outline Drawing (units stackable)

3.9.3 Weight
- RCC-100: 13.0 ounces maximum
- TDC-100: 7.5 ounces maximum

3.9.4 Mounting Attitude
- Any

3.9.5 External Adjustments
- None

3.9.6 Connector Types
- RCC-100 - Power and output: Bendix JT1H-8-6P
- RF input: TNC female
- TDC-100 - 1- to 3-channel: Cannon DBH25P102
- 4-channel: Cannon MDM37S
PIN CONNECTIONS

POWER AND OUTPUT CONNECTOR

<table>
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<th>PIN NO.</th>
<th>FUNCTION</th>
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<tr>
<td>1</td>
<td>+28V</td>
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<tr>
<td>2</td>
<td>Power Return</td>
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<td>3</td>
<td>Case Ground</td>
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<tr>
<td>4</td>
<td>Audio Out</td>
</tr>
<tr>
<td>5</td>
<td>Signal Return</td>
</tr>
<tr>
<td>6</td>
<td>Signal Strength Monitor</td>
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</table>

Figure 2-7. Outline drawing and pin connections of Aydin Vector Division Model RCC-100 Command and Control Receiver.
Figure 2-8. Outline drawing and channel frequencies of Aydin Vector Division TDC-100 Series Tone Decoders.
Figure 2-9. Aydin Vector Division Model RCC-103-1 Command and Control Receiver.
Figure 2-10. Aydin Vector Division Model TDC-103 Tone Decoder.
AYDIN VECTOR DIVISION

COMMAND AND CONTROL RECEIVER/DECODER

MODEL RCC-200/TDC-100

1. GENERAL DESCRIPTION

The Vector Model RCC-200 Series double-superheterodyne Ultrahigh-Frequency (UHF) Command and Control Receivers are designed for operation in the 1435- to 2400-MHz band for aerospace applications where size, weight, ruggedness and power consumption are critical. The receiver is compatible with the majority of communication and telemetry FM data links (such as voice, FM/FM, PAM/FM, and PCM/FM). The Vector TDC-100 Tone Decoder directly interfaces mechanically and electrically with the RCC-200 for command and control applications with up to four tones. The RCC-200 has mounting provisions for stacking one or more TDC-100 modules for operation with more than four tones.

2. BACKGROUND

The RCC-200/TDC-100 Receivers/Decoders have been successfully flown on numerous National Aeronautics and Space Administration (NASA), military, foreign and commercial programs with communications, telemetry, and command and control applications.

3. TECHNICAL SPECIFICATIONS

3.1 RF SECTION

3.1.1 Frequency Range (Tuneable) RCC-201: 1435 to 1540 MHz
RCC-202: 1710 to 1850 MHz
RCC-203: 2200 to 2300 MHz
RCC-204: 2300 to 2400 MHz

3.1.2 Threshold Sensitivity (Command Output) 5 μV maximum for decoder operation with 200 kHz IF filter

3.1.3 Maximum Useable RF Input 2 Vrms maximum

3.1.4 Operating Bandwidth ±45 kHz with 200 kHz, 3 dB IF bandwidth and up to 4 simultaneous tones (wider for other filters - 400-, 600-, 800-, 1,000-kHz and others available)

3.1.5 Antenna Impedance 50 ohms

2-33
3.1.6 VSWR 2:1 maximum
3.1.7 Local Oscillator Stability ±0.003 percent
3.1.8 Tuning Accuracy ±0.005 percent
3.1.9 Tuning Method Crystal-controlled local oscillator

3.2 IF SECTION
3.2.1 IF Frequency 21.4 MHz
3.2.2 Selectivity, 60 dB 3.75 times 3 dB IF bandwidth
3.2.3 Capture Ratio 1 dB with decoder

3.3 AUDIO SECTION
3.3.1 Audio Amplifier Response 100 Hz to 1/4 times 3 dB IF bandwidth (±1 dB)
3.3.2 Audio Amplifier Distortion 2 percent maximum for peak-to-peak deviation of 1/4 times 3 dB IF bandwidth
3.3.3 Audio Output 0.01 V peak per kHz deviation into 600 ohm load
3.3.4 Frequency Deviation Up to 1.5 MHz peak-to-peak (depending on IF filter)

3.4 DECODER SECTION
3.4.1 Number of Decoder Channels Up to 4 per TDC-100 housing (housings stackable)
3.4.2 Number of Simultaneous Useable Tones Up to 4 with 200 kHz IF bandwidth (more tones with wider bandwidth)
3.4.3 Tone Channel Bandwidth ±1 percent, 2 dB minimum; ±4 percent, 20 dB maximum
### 3.4.4 Adjacent Channel Rejection
34 dB minimum

### 3.4.5 Decoder Threshold Deviation
±4 kHz minimum per tone for no command; ±27 to ±33 kHz per tone for activation

### 3.5 OUTPUT

#### 3.5.1 Types of Output
Relay closure for decoder output

#### 3.5.2 Output Current Capability
2 A resistive at 28 Vdc

#### 3.5.3 Output Leakage
1,000 Mohms minimum insulation resistance per relay contact

#### 3.5.4 Logic Circuit
Two contacts per channel (DPDT); internal logic sequence optional

#### 3.5.5 Response Time for Commands
25 ms maximum

#### 3.5.6 Transition Time Between Commands
3 ms

#### 3.5.7 Output Isolation
Common ground

#### 3.5.8 Noise Immunity
 Interruption of primary power or carrier will not cause decoder operation

#### 3.5.9 Telemetry Outputs
Signal strength indication (0 to 4 Vdc nominal into 10 kohms)

### 3.6 POWER SUPPLY

#### 3.6.1 Supply Voltage
24 to 36 Vdc

#### 3.6.2 Power Requirements
RCC-200: 120 mA maximum
TDC-100: 10 mA plus 15 mA per decoder channel (plus 22 mA per energized relay)

#### 3.6.3 Power Supply Isolation
Returns connected to chassis

#### 3.6.4 Turn-On Power Control for Receiver
N/A

#### 3.6.5 Other Controls
None
3.7 ELECTROMAGNETIC INTERFERENCE

3.7.1 RFI Suppression
MIL-STD-461B, except limits A & B; CS04 is 40 dB

3.7.2 Pulse Rejection
Not measured

3.7.3 AM Rejection
Not measured

3.7.4 Image Rejection
60 dB minimum

3.8 ENVIRONMENTAL CHARACTERISTICS

3.8.1 Operating Temperature Range (Continuous)
-40°C to +70°C

3.8.2 Nondestructive Temperatures (Shelf Storage)
-50°C to +90°C

3.8.3 Humidity
95 percent

3.8.4 Altitude
Unlimited

3.8.5 Shock
1/2 sine at 50 g for 11 ms

3.8.6 Acceleration
100 g

3.8.7 Vibration
20 g sine, 20 to 2,000 Hz

3.8.8 Acoustics
Not measured

3.8.9 Pressurization
Not required

3.8.10 Operating Life
>1,300 hours

3.8.11 Shelf Life
5 years
<table>
<thead>
<tr>
<th>Section</th>
<th>Physical Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.9.1</td>
<td>Volume</td>
</tr>
<tr>
<td></td>
<td>RCC-200: 20.1-in³</td>
</tr>
<tr>
<td></td>
<td>TDC-100: 7.3-in³</td>
</tr>
<tr>
<td>3.9.2</td>
<td>Dimensions</td>
</tr>
<tr>
<td></td>
<td>See Outline Drawing</td>
</tr>
<tr>
<td></td>
<td>(units stackable)</td>
</tr>
<tr>
<td>3.9.3</td>
<td>Weight</td>
</tr>
<tr>
<td></td>
<td>RCC-200: 26.0 ounces maximum</td>
</tr>
<tr>
<td></td>
<td>TDC-100: 7.5 ounces maximum</td>
</tr>
<tr>
<td>3.9.4</td>
<td>Mounting Attitude</td>
</tr>
<tr>
<td></td>
<td>Any</td>
</tr>
<tr>
<td>3.9.5</td>
<td>External Adjustments</td>
</tr>
<tr>
<td></td>
<td>None</td>
</tr>
<tr>
<td>3.9.6</td>
<td>Connector Types</td>
</tr>
<tr>
<td></td>
<td>RCC-200 - Power and output: Bendix JTIH-8-6P</td>
</tr>
<tr>
<td></td>
<td>RF input: TNC receptacle</td>
</tr>
<tr>
<td></td>
<td>TDC-100 - 1- to 3-channel: Cannon DBH25P102</td>
</tr>
<tr>
<td></td>
<td>4-channel: Cannon MDM37S</td>
</tr>
</tbody>
</table>
Figure 2-11. Outline drawing and pin connections of Aydin Vector Division Model RCC-200 Command and Control Receiver.
Figure 2-12. Outline drawing and channel frequencies of Aydin Vector Division TDC-100 Series Tone Decoders.
Figure 2-13. Aydin Vector Division Model RCC-204-5 Command and Control Receiver.
Figure 2-14. Aydin Vector Division Model TDC-103 Tone Decoder.
1. **GENERAL DESCRIPTION**

The Vector Model RCC-500 Command and Control Receiver incorporates identical circuitry used in the VFTR line of receivers that was repackaged to comply with minimal space and weight.

The RCC-500 was specifically designed to the stringent electrical, environmental, and reliability of missile flight termination usage while providing the option of a variety of configurations determined by addition of external units. The receiver can recover data when driving an SBS-294 bit synchronizer or be used for command control when integrated with an external tone decoder TDC-100 series. The receiver (with the external decoder) will meet the requirements of Range Commanders Council (RCC) Document 313-89. An ultrahigh Q preselector and high IF allow the use of a single-heterodyne receiver front end, which provides more cost effective and reliable than other approaches. The receiver front end has sufficient dynamic range to meet the susceptibility requirements of RCC Document 313-89 and MIL-STD-461/462.

Subassemblies are rigidly mounted in 9-in³ housing which provides a mechanical support as well as an internal shielding for electromagnetic interference and ease of assembly. Parts were selected for maximum reliability and minimum stress. Hermetic parts are used exclusively. Vector-manufactured hybrids screened to MIL-STD-883 and other MIL-STD parts are used throughout. A variety of configurations are available to suit all environmental and budget constraints.

2. **BACKGROUND**

The RCC-500 was developed in response to a requirement from the SABIR Program for a small lightweight and high reliability receiver to work together with the SBS-294 bit synchronizer and recover data and clock for a highly secured guidance processor.

Vector has recently delivered Space Quality RCC-500 receivers to Swedish Space Corporation to be utilized on-board FREJA SCIENTIFIC SATELITE.

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3. TECHNICAL SPECIFICATIONS

3.1 RF SECTION

3.1.1 Frequency Range (Tuneable) 400 to 550 MHz

3.1.2 Threshold Sensitivity (Command Output) 1 μV with tone decoder
1 μV for S/N = 20 dB,
5 kHz Baseband Bandwidth

3.1.3 Maximum Useable RF Input 2 Vrms (Command Destruct Config.)

3.1.4 Operating Bandwidth ±45 kHz minimum (Command Destruct Config.)

3.1.5 Antenna Impedance 50 ohms

3.1.6 VSWR 2:1 maximum

3.1.7 Local Oscillator Stability 0.003 percent

3.1.8 Tuning Accuracy 0.005 percent

3.1.9 Tuning Method Crysta controlled local oscillator

3.2 IF SECTION

3.2.1 IF Frequency 21.4 MHz

3.2.2 Selectivity, 60 dB ±180 kHz maximum; other available

3.2.3 Capture Ratio 1 dB maximum

3.3 AUDIO SECTION

3.3.1 Audio Amplifier Response 3 dB, 300 Hz to 100 kHz

3.3.2 Audio Amplifier Distortion ≤5 percent

3.3.3 Audio Output Sensitivity 0.1 Vp-p per kHz, other sensitivities available

3.3.4 Audio Output Impedance 75 ohms; other impedances available
### 3.4 OUTPUT

#### 3.4.1 Type of Output
Audio AC coupled

#### 3.4.2 Telemetry Outputs
Signal Strength Indication

### 3.5 POWER SUPPLY

#### 3.5.1 Supply Voltage
22 to 36 Vdc

#### 3.5.2 Power Requirements
150 mA maximum

#### 3.5.3 Over Voltage
±40 Vdc

#### 3.5.4 Optional Output
15 V output to operate SBS-294 or TDC-100 Tone Decoder

### 3.6 ELECTROMAGNETIC INTERFERENCE

Designed to meet MIL-STD-461/462 requirements.

### 3.7 ENVIRONMENTAL CHARACTERISTICS

#### 3.7.1 Operating Temperature Range
-40°C to +77°C
(-55°C to +85°C optional)

#### 3.7.2 Nondestructive Temperatures
-55°C to +110°C

#### 3.7.3 Humidity
95 percent

#### 3.7.4 Altitude
Unlimited

#### 3.7.5 Shock
1,500 g SRS

#### 3.7.6 Acceleration
150 g

#### 3.7.7 Vibration
21 g sine, 20 to 2,000 Hz

#### 3.7.8 Acoustics
Not measured

#### 3.7.9 Pressurization
Not required
3.7.10 Operating Life  
Up to 27,000 hours, based on parts configuration

3.7.11 Shelf Life  
8 years

3.8 PHYSICAL CHARACTERISTICS

3.8.1 Volume  
9-in³

3.8.2 Dimensions  
See Outline Drawing

3.8.3 Weight  
10 ounces maximum

3.8.4 Mounting Attitude  
Any

3.8.5 External Adjustments  
None

3.8.6 Connector Types  

J1: Antenna - OSM
J2: Power & Output - MDM-9S
## TABLE 2-2

**PIN CONNECTION OPTIONS FOR RCC-500**

<table>
<thead>
<tr>
<th>CONNECTOR</th>
<th>PIN</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>-</td>
<td>RF IN</td>
</tr>
<tr>
<td>J2</td>
<td>1</td>
<td>Audio Out</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>N/C</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>N/C</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>N/C</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Chassis Grd.</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>+28 Vdc IN</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>N/C</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Signal Strength OUT</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Audio Return Chassis</td>
</tr>
</tbody>
</table>
Figure 2-15. Outline drawing of Aydin Vector Division Model RCC-500 Command and Control Receiver.

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Figure 2-16. Aydin Vector Division Model RCC-500 Command and Control Receiver.
3. CINCINNATI ELECTRONICS CORPORATION
7400 Innovation Way
Mason, Ohio 45040-9699
(Phone: 513-571-6100)

COMMAND RECEIVERS/DECODERS

Model CR-104B and CR-104C
Model CR-105
Model CR-110
Model CR-112
Model CR-116
Model CR-119
Model CRD-111/202
Model CRD-117/203
Model CRD-118/204
Model CRD-120/205
1. **GENERAL DESCRIPTION**

The Cincinnati Model CR-104B and CR-104C Command Receivers/Decoders employ a double-conversion superheterodyne design with a single crystal oscillator. Signal strength telemetry is obtained from the second IF automatic gain control (AGC) circuit and provides an 80 dB usable range that starts at 1 μV and has a near-logarithmic curve from 0 to 4 Vdc.

The decoder design uses passive noise-immune filters as the tone detectors. Channel logic and redundancy are combined to provide immunity to inadvertent command outputs under environmental extremes and/or in the event of a single component failure (fail-safe). A test connector is provided on the top cover to permit validation of the redundant circuitry. Command output signals are provided through high-current transistor switches rated at 50 A and 28 V. The “C” version provides a delayed “Destruct” output in addition to the other command outputs.

The receiver case design provides a moisture and radio-frequency interference (RFI) seal, and the mounting surface is provided with four through holes to accommodate 1/4-inch bolts.

2. **BACKGROUND**

The Model CR-104 Command Receiver/Decoder and successive versions “A”, “B” and “C” were designed, developed, and qualified for flight use under contract with the USAF Space Division. These units are the range safety flight termination receivers/decoders used on the THOR, ATLAS, and CENTAUR space launch vehicles. The original receiver design was accomplished in 1970, and the “B” and “C” versions are presently (1983) in manufacture.

3. **TECHNICAL SPECIFICATIONS**

3.1 **RF SECTION**

3.1.1 Frequency Range (Tuneable) 400 to 550 megahertz (MHz)

3.1.2 Threshold Sensitivity (Command Output) 0.7 μV (-110 dBm)

3.1.3 Maximum Useable RF Input 7 Vrms

3.1.4 Operating Bandwidth ±45 kHz
3.1.5 Antenna Impedance 50 ohms
3.1.6 VSWR 1.5:1
3.1.7 Local Oscillator Stability 0.0025 percent
3.1.8 Tuning Accuracy 0.005 percent
3.1.9 Tuning Method Continuous (crystal-controlled)

3.2 IF SECTION
3.2.1 IF Frequency 71 to 100 MHz and 10.7 MHz
3.2.2 Selectivity, 60 dB 360 kHz maximum
3.2.3 Capture Ratio >0.8

3.3 AUDIO SECTION
3.3.1 Audio Amplifier Response 1 dB, 1 to 35 kHz
3.3.2 Audio Amplifier Distortion <3 percent
3.3.3 Audio Output None
3.3.4 Frequency Deviation ±30 kHz peak per tone

3.4 DECODER SECTION
3.4.1 Number of Decoder Channels 3 (IRIG channels 1, 2, and 5)
3.4.2 Number of Simultaneous Useable Tones 3
3.4.3 Tone Channel Bandwidth ±1 percent minimum at 2 dB
3.4.4 Adjacent Channel Rejection ±4 percent maximum at 20 dB
3.4.5 Decoder Threshold Deviation ±4 kHz peak per tone
3.5 OUTPUT

3.5.1 Types of Output
- Transistor switches

3.5.2 Output Current Capability
- 50 A, tested at 20 A and 10 A

3.5.3 Output Leakage
- 0.2 mA maximum

3.5.4 Logic Circuitry
- 1-2-5 = Destruct
- 1-2-5 = Arm
- 1-2-5 = Optional Command

3.5.5 Response Time for Commands
- 20 ms maximum (13.5 ms typical)

3.5.6 Transition Time Between Commands
- 3 ms

3.5.7 Output Isolation
- Common ground (case)

3.5.8 Noise Immunity
- Noise-immune filters

3.5.9 Telemetry Outputs
- Channel 5 monitor
- RF signal level

3.6 POWER SUPPLY

3.6.1 Supply Voltage
- 22 to 35 Vdc

3.6.2 Power Requirements
- Standby: <1.5 W (nominal supply)
- Interrogate: <5.0 W (nominal supply)

3.6.3 Power Supply Isolation
- No (case common ground)

3.6.4 Turn-On Power Control for Receiver
- None

3.6.5 Other Controls
- None
3.7  ELECTROMAGNETIC INTERFERENCE

3.7.1 RFI Suppression  Meets MIL-STD-461A
3.7.2 Pulse Rejection  Not measured
3.7.3 AM Rejection  100 percent, 7 μV or more
3.7.4 Image Rejection  60 dB minimum

3.8  ENVIRONMENTAL CHARACTERISTICS

3.8.1 Operating Temperature Range  -40°C to +85°C  (Continuous)
3.8.2 Nondestructive Temperatures  -65°C to +100°C  (Shelf Storage)
3.8.3 Humidity  100 percent
3.8.4 Altitude  Unlimited
3.8.5 Shock  500 g, 0.4 ms
3.8.6 Acceleration  20 g
3.8.7 Vibration  50 g (50 to 100 Hz) sine
  28.8 g rms random
3.8.8 Acoustics  Not tested
3.8.9 Pressurization  Not required
3.8.10 Operating Life  500 hours
3.8.11 Shelf Life  5 years minimum

3.9  PHYSICAL CHARACTERISTICS

3.9.1 Volume  138-in³
3.9.2 Dimensions  6.0 x 5.1 x 4.5-in overall
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.9.3</td>
<td>Weight</td>
<td>4.2 pounds</td>
</tr>
<tr>
<td>3.9.4</td>
<td>Mounting Attitude</td>
<td>Any</td>
</tr>
<tr>
<td>3.9.5</td>
<td>External Adjustments</td>
<td>None</td>
</tr>
<tr>
<td>3.9.6</td>
<td>Connector Types</td>
<td>Antenna: TNC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Power: MS3112E12-10S</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Output: MS3112E12-10P</td>
</tr>
</tbody>
</table>
1. GENERAL DESCRIPTION

The Cincinnati Model CR-105 Command Receiver/Decoder employ a double-conversion superheterodyne design with a single crystal oscillator. Signal strength telemetry is obtained from the second IF AGC circuit and provides an 80 dB usable range that starts at 0.5-V floor and has a near-logarithmic curve to 4 Vdc. The useful signal strength telemetry range may be externally adjusted from 1 µV to 10,000 µV.

The decoder design uses passive noise-immune filters as the tone detectors. Standard four-channel range safety logic is implemented with sufficient redundant circuits to assure fail-safe operation. Command output signals are provided through 2-A rated relay closures.

The case is sealed against moisture and RFI and mounts by means of number 10 screws through four vibration isolators in the base.

2. BACKGROUND

The Model CR-105 Command Receiver/Decoder was designed, developed, and qualified for flight use for range safety application on NASA's Delta Launch Vehicle under contract with the McDonnell Douglas Corporation. The design was accomplished in 1972/1973. Qualification tests were performed by Cincinnati Electronics Corporation in March 1973 under McDonnell Douglas Purchase Order MDAC-W-72-1-020, NASA Prime Contract NAS-7-811, reference Report No. 80045 DRW 54/373.

3. TECHNICAL SPECIFICATIONS

3.1 RF SECTION

3.1.1 Frequency Range (Tuneable) 400 to 550 MHz
3.1.2 Threshold Sensitivity (Command Output) 0.5 µV
3.1.3 Maximum Useable RF Input 7 Vrms
3.1.4 Operating Bandwidth ±45 kHz minimum
3.1.5 Antenna Impedance 50 ohms
3.1.6 VSWR 1.5:1
3.1.7 Local Oscillator Stability 0.0025 percent
3.1.8 Tuning Accuracy 0.005 percent
3.1.9 Tuning Method Continuous (crystal-controlled)

3.2 IF SECTION
3.2.1 IF Frequency 71 to 100 MHz and 10.7 MHz
3.2.2 Selectivity, 60 dB 360 kHz maximum
3.2.3 Capture Ratio >0.8

3.3 AUDIO SECTION
3.3.1 Audio Amplifier Response 1 dB, 1 to 35 kHz
3.3.2 Audio Amplifier Distortion <3 percent
3.3.3 Audio Output None
3.3.4 Frequency Deviation ±30 kHz peak per tone

3.4 DECODER SECTION
3.4.1 Number of Decoder Channels 4 (IRIG channels 1, 2, 4, and 5)
3.4.2 Number of Simultaneous Usable Tones 4
3.4.3 Tone Channel Bandwidth ±1 percent minimum at 2 dB
3.4.4 Adjacent Channel Rejection ±4 percent maximum at 20 dB
3.4.5 Decoder Threshold Deviation ±4 kHz peak per tone
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5.1</td>
<td>Types of Output</td>
<td>DPDT Relay</td>
</tr>
<tr>
<td>3.5.2</td>
<td>Output Current Capability</td>
<td>20 A</td>
</tr>
<tr>
<td>3.5.3</td>
<td>Output Leakage</td>
<td>$32 \times 10^{-9}$ A maximum</td>
</tr>
<tr>
<td>3.5.4</td>
<td>Logic Circuitry</td>
<td>$1\cdot2\cdot5 = $ Destruct $1\cdot2\cdot5 = $ Arm $1\cdot2\cdot5 = $ Optional command $4 = $ Monitor</td>
</tr>
<tr>
<td>3.5.5</td>
<td>Response Time for Commands</td>
<td>15 ms maximum</td>
</tr>
<tr>
<td>3.5.6</td>
<td>Transition Time Between Commands</td>
<td>3 ms</td>
</tr>
<tr>
<td>3.5.7</td>
<td>Output Isolation</td>
<td>Common ground (case)</td>
</tr>
<tr>
<td>3.5.8</td>
<td>Noise Immunity</td>
<td>Noise-immune filters</td>
</tr>
<tr>
<td>3.5.9</td>
<td>Telemetry Outputs</td>
<td>RF signal level Destruct event Channel 4 monitor</td>
</tr>
</tbody>
</table>

### 3.6 POWER SUPPLY

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.6.1</td>
<td>Supply Voltage</td>
<td>24 to 32 Vdc (60 V maximum)</td>
</tr>
<tr>
<td>3.6.2</td>
<td>Power Requirements</td>
<td>Standby: &lt;1.5 W (nominal supply) Interrogate: &lt;6.0 W (nominal supply)</td>
</tr>
<tr>
<td>3.6.3</td>
<td>Power Supply Isolation</td>
<td>No (case common ground)</td>
</tr>
<tr>
<td>3.6.4</td>
<td>Turn-On Power Control for Receiver</td>
<td>None</td>
</tr>
<tr>
<td>3.6.5</td>
<td>Other Controls</td>
<td>None</td>
</tr>
</tbody>
</table>
3.7 ELECTROMAGNETIC INTERFERENCE

3.7.1 RFI Suppression  Meets MIL-STD-461A
3.7.2 Pulse Rejection  Not measured
3.7.3 AM Rejection  100 percent, 7 μV or more
3.7.4 Image Rejection  60 dB minimum

3.8 ENVIRONMENTAL CHARACTERISTICS

3.8.1 Operating Temperature Range  
(Continuous)  -40°C to +72°C
3.8.2 Nondestructive Temperatures  
(Shelf Storage)  -65°C to +100°C
3.8.3 Humidity  100 percent
3.8.4 Altitude  Unlimited
3.8.5 Shock  100 g-peak (0.1 to 4.0 kHz)
3.8.6 Acceleration  20 g
3.8.7 Vibration  55 g rms random
3.8.8 Acoustics  Not tested
3.8.9 Pressurization  Not required
3.8.10 Operating Life  300 hours
3.8.11 Shelf Life  5 years minimum

3.9 PHYSICAL CHARACTERISTICS

3.9.1 Volume  63-in³ (less mounting feet)
3.9.2 Dimensions  6.0 x 3.5 x 3.0-in overall
<table>
<thead>
<tr>
<th>3.9.3</th>
<th>Weight</th>
<th>3.75 pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.9.4</td>
<td>Mounting Attitude</td>
<td>Any</td>
</tr>
<tr>
<td>3.9.5</td>
<td>External Adjustments</td>
<td>Access to TLM adjust</td>
</tr>
<tr>
<td>3.9.6</td>
<td>Connector Types</td>
<td>Antenna: TNC  Others: Deutsch DBA-50</td>
</tr>
</tbody>
</table>
Figure 3-2. Cincinnati Electronics Corporation Model CR-105 Command Receiver.
1. **GENERAL DESCRIPTION**

The Cincinnati Model CR-110 Command Receiver/Decoder employs a double-conversion superheterodyne design with a single crystal-controlled transistor quadrupler circuit that provides excellent spurious response performance. Typical receiver sensitivity is less than 1 µV.

The decoder design uses phase-lock-loop integrated circuit tone detectors. These provide ±1 percent bandwidth selectivity and exhibit a narrow skirt ratio that provides protection against outputs due to noise.

In the four-channel configuration, the unit has a 16-in³ volume and weighs less than 1 pound. Four 0.174-in (nominal) radius holes are provided for mounting.

2. **BACKGROUND**

The Model CR-110 Command Receiver/Decoder was designed and developed on a Cincinnati Electronics Corporation internally funded program in 1975. Variations of this design have resulted in the evolution of a whole family of CR-110 receivers/decoders. Versions of the CR-110 can accommodate any number of standard IRIG tone channels, various logic configurations, relay or solid-state outputs, and several different connector configurations.

Qualification tests were conducted by White Sands Missile Range (WSMR) during the periods of May 1978 through August 1978 and December 1978 through March 1979.

3. **TECHNICAL SPECIFICATIONS**

3.1 **RF SECTION**

3.1.1 Frequency Range (Tuneable) 400 to 550 MHz

3.1.2 Threshold Sensitivity (Command Output) 1 µV

3.1.3 Maximum Useable RF Input 1 Vrms

3.1.4 Operating Bandwidth ±45 kHz minimum
<table>
<thead>
<tr>
<th>Section</th>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1.5</td>
<td>Antenna Impedance</td>
<td>50 ohms</td>
</tr>
<tr>
<td>3.1.6</td>
<td>VSWR</td>
<td>1.5:1</td>
</tr>
<tr>
<td>3.1.7</td>
<td>Local Oscillator Stability</td>
<td>0.0025 percent</td>
</tr>
<tr>
<td>3.1.8</td>
<td>Tuning Accuracy</td>
<td>0.005 percent</td>
</tr>
<tr>
<td>3.1.9</td>
<td>Tuning Method</td>
<td>Continuous (crystal-controlled)</td>
</tr>
<tr>
<td>3.2</td>
<td>IF SECTION</td>
<td></td>
</tr>
<tr>
<td>3.2.1</td>
<td>IF Frequency</td>
<td>21.4 MHz</td>
</tr>
<tr>
<td>3.2.2</td>
<td>Selectivity, 60 dB</td>
<td>360 kHz maximum</td>
</tr>
<tr>
<td>3.2.3</td>
<td>Capture Ratio</td>
<td>&gt;0.8</td>
</tr>
<tr>
<td>3.3</td>
<td>AUDIO SECTION</td>
<td></td>
</tr>
<tr>
<td>3.3.1</td>
<td>Audio Amplifier Response</td>
<td>3 dB, 5 to 100 kHz</td>
</tr>
<tr>
<td>3.3.2</td>
<td>Audio Amplifier Distortion</td>
<td>&lt;5 percent</td>
</tr>
<tr>
<td>3.3.3</td>
<td>Audio Output</td>
<td>Optional</td>
</tr>
<tr>
<td>3.3.4</td>
<td>Frequency Deviation</td>
<td>±30 kHz peak per tone</td>
</tr>
<tr>
<td>3.4</td>
<td>DECODER SECTION</td>
<td></td>
</tr>
<tr>
<td>3.4.1</td>
<td>Number of Decoder Channels</td>
<td>Optional! (up to 10 IRIG channels available)</td>
</tr>
<tr>
<td>3.4.2</td>
<td>Number of Simultaneous Useable Tones</td>
<td>4</td>
</tr>
<tr>
<td>3.4.3</td>
<td>Tone Channel Bandwidth</td>
<td>±1 percent minimum</td>
</tr>
<tr>
<td>3.4.4</td>
<td>Adjacent Channel Rejection</td>
<td>±3.5 percent maximum</td>
</tr>
<tr>
<td>3.4.5</td>
<td>Decoder Threshold Deviation</td>
<td>±4 kHz peak per tone</td>
</tr>
</tbody>
</table>
### OUTPUT

<table>
<thead>
<tr>
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<th>Description</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td>3.5.1</td>
<td>Types of Output</td>
<td>Optional (DPDT relay or transistor switch)</td>
</tr>
<tr>
<td>3.5.2</td>
<td>Output Current Capability</td>
<td>20 A (relay output)</td>
</tr>
<tr>
<td>3.5.3</td>
<td>Output Leakage</td>
<td>$35 \times 10^{-9}$ A maximum (relay output)</td>
</tr>
<tr>
<td>3.5.4</td>
<td>Logic Circuitry</td>
<td>Various</td>
</tr>
<tr>
<td>3.5.5</td>
<td>Response Time for Commands</td>
<td>25 ms maximum</td>
</tr>
<tr>
<td>3.5.6</td>
<td>Transition Time Between Commands</td>
<td>3 ms</td>
</tr>
<tr>
<td>3.5.7</td>
<td>Output Isolation</td>
<td>Common ground (case)</td>
</tr>
<tr>
<td>3.5.8</td>
<td>Noise Immunity</td>
<td>Yes - no lockup with receiver noise</td>
</tr>
<tr>
<td>3.5.9</td>
<td>Telemetry Outputs</td>
<td>RF signal level</td>
</tr>
</tbody>
</table>

### POWER SUPPLY

<table>
<thead>
<tr>
<th>Section</th>
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<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.6.1</td>
<td>Supply Voltage</td>
<td>22 to 35 Vdc</td>
</tr>
</tbody>
</table>
| 3.6.2   | Power Requirements | Standby: 180 mA  
Interrogate: 25 mA additional per channel |
| 3.6.3   | Power Supply Isolation | No (case common ground) |
| 3.6.4   | Turn-On Power Control for Receiver | Latching relay for ON-OFF control is available |
| 3.6.5   | Other Controls | None |

### ELECTROMAGNETIC INTERFERENCE

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Details</th>
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</thead>
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<tr>
<td>3.7.1</td>
<td>RFI Suppression</td>
<td>Meets MIL-STD-461A</td>
</tr>
<tr>
<td>3.7.2</td>
<td>Pulse Rejection</td>
<td>Not measured</td>
</tr>
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<td>3.7.3</td>
<td>AM Rejection</td>
<td>50 percent, 7 μV or more</td>
</tr>
<tr>
<td>3.7.4</td>
<td>Image Rejection</td>
<td>60 dB minimum</td>
</tr>
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</table>
3.8 ENVIRONMENTAL CHARACTERISTICS

3.8.1 Operating Temperature Range
(Continuous) -40°C to +75°C

3.8.2 Nondestructive Temperatures
(Shelf Storage) -60°C to +100°C

3.8.3 Humidity 90 percent

3.8.4 Altitude Unlimited

3.8.5 Shock 100 g

3.8.6 Acceleration 100 g

3.8.7 Vibration 25.0 g (10 to 3,000 Hz)
29.4 g rms random

3.8.8 Acoustics Not tested

3.8.9 Pressurization Not required

3.8.10 Operating Life 200 hours

3.8.11 Shelf Life 3 years minimum

3.9 PHYSICAL CHARACTERISTICS

3.9.1 Volume 16-in³ (4-channel version)

3.9.2 Dimensions 4.39 x 2.50 x 1.50-in (4-channel version)

3.9.3 Weight <1 pound (4-channel version)

3.9.4 Mounting Attitude Any

3.9.5 External Adjustments None

3.9.6 Connector Types Antenna: SMA type
Others: M24308/3-2 (various other connector configurations available)
Figure 3-3. Various configurations of the Cincinnati Electronics Corporation Model CR-110 family of command receivers.
1. **GENERAL DESCRIPTION**

The Cincinnati Model CR-112 Command Receiver/Decoder employs a single-conversion superheterodyne design and a crystal-controlled local oscillator design that provides excellent spurious response performance. Typical receiver sensitivity is less than 1 µV.

The decoder design uses passive, inductive-capacitive (LC), noise-immune filters as the tone detectors. Standard four-channel range safety logic is implemented with sufficient redundant circuits to assure fail-safe operation. Command output signals are provided from discrete differential line-driver circuits.

The unit is packaged in an aluminum cast housing. The mounting surface contains four tapped holes to accommodate number 10-32 mounting bolts.

2. **BACKGROUND**

The Model CR-112 Command Receiver/Decoder was designed, developed, and qualified for flight use for range safety application for the Peacekeeper (MX) Missile. The design was accomplished in 1980/1981 under Martin Marietta Corporation for USAF/BMO. Qualification tests were performed by Cincinnati Electronics Corporation during the period of January 1982 through November 1982.

3. **TECHNICAL SPECIFICATIONS**

3.1 **RF SECTION**

3.1.1 Frequency Range (Tuneable) 400 to 550 MHz

3.1.2 Threshold Sensitivity (Command Output) <1.5 µV

3.1.3 Maximum Useable RF Input 5 Vrms

3.1.4 Operating Bandwidth ±45 kHz minimum

3.1.5 Antenna Impedance 50 ohms

3.1.6 VSWR 1.5:1

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<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1.7</td>
<td>Local Oscillator Stability</td>
<td>0.0025 percent</td>
</tr>
<tr>
<td>3.1.8</td>
<td>Tuning Accuracy</td>
<td>0.005 percent</td>
</tr>
<tr>
<td>3.1.9</td>
<td>Tuning Method</td>
<td>Continuous (crystal-controlled)</td>
</tr>
<tr>
<td>3.2</td>
<td>IF SECTION</td>
<td></td>
</tr>
<tr>
<td>3.2.1</td>
<td>IF Frequency</td>
<td>21.4 MHz</td>
</tr>
<tr>
<td>3.2.2</td>
<td>Selectivity, 60 dB</td>
<td>360 kHz maximum</td>
</tr>
<tr>
<td>3.2.3</td>
<td>Capture Ratio</td>
<td>&gt;0.8</td>
</tr>
<tr>
<td>3.3</td>
<td>AUDIO SECTION</td>
<td></td>
</tr>
<tr>
<td>3.3.1</td>
<td>Audio Amplifier Response</td>
<td>1 dB, 1 to 35 kHz</td>
</tr>
<tr>
<td>3.3.2</td>
<td>Audio Amplifier Distortion</td>
<td>&lt;3 percent</td>
</tr>
<tr>
<td>3.3.3</td>
<td>Audio Output</td>
<td>None</td>
</tr>
<tr>
<td>3.3.4</td>
<td>Frequency Deviation</td>
<td>±30 kHz peak per tone</td>
</tr>
<tr>
<td>3.4</td>
<td>DECODER SECTION</td>
<td></td>
</tr>
<tr>
<td>3.4.1</td>
<td>Number of Decoder Channels</td>
<td>4 (IRIG channels 1, 2, 4, and 5)</td>
</tr>
<tr>
<td>3.4.2</td>
<td>Number of Simultaneous Useable Tones</td>
<td>4</td>
</tr>
<tr>
<td>3.4.3</td>
<td>Tone Channel Bandwidth</td>
<td>±1 percent minimum</td>
</tr>
<tr>
<td>3.4.4</td>
<td>Adjacent Channel Rejection</td>
<td>±4 percent maximum</td>
</tr>
<tr>
<td>3.4.5</td>
<td>Decoder Threshold Deviation</td>
<td>±4 kHz peak per tone</td>
</tr>
<tr>
<td>3.5</td>
<td>OUTPUT</td>
<td></td>
</tr>
<tr>
<td>3.5.1</td>
<td>Types of Output</td>
<td>Discrete differential line drivers</td>
</tr>
<tr>
<td>3.5.2</td>
<td>Output Current Capability</td>
<td>40 mA at within 2 V of B+ for destruct; other outputs at logic levels</td>
</tr>
<tr>
<td>Section</td>
<td>Description</td>
<td>Details</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td>---------</td>
</tr>
<tr>
<td>3.5.3</td>
<td>Output Leakage</td>
<td>Differential line driver output</td>
</tr>
</tbody>
</table>
| 3.5.4   | Logic Circuitry | 1-2-5 = Destruct  
1-2-5 = Arm  
1-2-5 = Optional Command |
| 3.5.5   | Response Time for Commands | 15 ms |
| 3.5.6   | Transition Time Between Commands | 3 ms |
| 3.5.7   | Output Isolation | Yes |
| 3.5.8   | Noise Immunity | Noise-immune filters |
| 3.5.9   | Telemetry Outputs | RF signal level  
Channel 4 monitor |
| 3.6     | POWER SUPPLY | |
| 3.6.1   | Supply Voltage | 28 ±4 Vdc |
| 3.6.2   | Power Requirements | Standby: 150 mA  
Interrogate: 320 mA |
| 3.6.3   | Power Supply Isolation | DC-to-dc converter power supply design |
| 3.6.4   | Turn-On Power Control for Receiver | None |
| 3.6.5   | Other Controls | None |
| 3.7     | ELECTROMAGNETIC INTERFERENCE | |
| 3.7.1   | RFI Suppression | Meets MIL-STD-461A |
| 3.7.2   | Pulse Rejection | Not tested |
| 3.7.3   | AM Rejection | 50 percent, 12 µV |
| 3.7.4   | Image Rejection | 60 dB minimum |
3.8 ENVIRONMENTAL CHARACTERISTICS

3.8.1 Operating Temperature Range (Continuous) -0°C to +61°C

3.8.2 Nondestructive Temperatures (Shelf Storage) -53°C to +67°C

3.8.3 Humidity 90 percent

3.8.4 Altitude Unlimited

3.8.5 Shock 7,000 g pyro

3.8.6 Acceleration 13 g

3.8.7 Vibration 8.8 g rms random

3.8.8 Acoustics Not tested

3.8.9 Pressurization Not required

3.8.10 Operating Life 1,000 hours minimum

3.8.11 Shelf Life 5 years minimum

3.9 PHYSICAL CHARACTERISTICS

3.9.1 Volume 74-in³ (plus connectors)

3.9.2 Dimensions 6.0 x 4.1 x 3.0-in (plus connectors)

3.9.3 Weight <3.75 pounds

3.9.4 Mounting Attitude Any

3.9.5 External Adjustments None

3.9.6 Connector Types
   Antenna: TNC
   Others: D38999/42FB35PN
   D38999/42FC35PN
Figure 3-4. Cincinnati Electronics Corporation Model CR 112 Command Receiver/Decoder.
1. **GENERAL DESCRIPTION**

The Cincinnati Model CR-116 Command Receiver/Decoder is a single-conversion superheterodyne design. The RF preselector is implemented using Surface Acoustic Wave (SAW) devices, and the IF is 21.4 MHz, which allow the receiver to exhibit exceptional image rejection and spurious response performance. Typical receiver sensitivity is less than 1 μV.

The IRIG audio tone detection is accomplished by a microprocessor and associated circuitry. The audio signal is digitized and processed using a Finite Impulse Response (FIR) filter algorithm. The tone detection threshold self-adjusts to the signal and noise characteristics of the audio signal, thus providing excellent tone detection and decoding performance. In addition, under control of the microprocessor, the AGC voltage level and unit temperature data are processed to provide a precision telemetry output. A 0 to 5 V linear, temperature stable, signal is thereby provided as an indication of the receiver RF input signal strength to within ±1 dB.

A 50 ampere (rated) transistor switch is used to provide the high-current "Destruct" output. Other command outputs are implemented with transistor switches with 3 A capabilities.

The unit is packaged in an aluminum cast housing. The mounting surface contains four tapped holes on 6.5 x 2.0-inch centers to accommodate number 10-32 mounting screws.

2. **BACKGROUND**

The Model CR-116 Command Receiver/Decoder was developed and qualified for range safety application for the Minuteman III Missile. The design was accomplished in 1985/1986 under contract with USAF/OALC. Qualification tests were performed by Cincinnati Electronics Corporation during the period of December 1986 through March 1987.

3. **TECHNICAL SPECIFICATIONS**

3.1 RF SECTION

3.1.1 Frequency Range (Tuneable) 400 to 550 MHz

3.1.2 Threshold Sensitivity (Command Output) 3 μV (1 μV typical)

3.1.3 Maximum Useable RF Input 1 Vrms
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1.4</td>
<td>Operating Bandwidth</td>
<td>±45 kHz minimum</td>
</tr>
<tr>
<td>3.1.5</td>
<td>Antenna Impedance</td>
<td>50 ohms</td>
</tr>
<tr>
<td>3.1.6</td>
<td>VSWR</td>
<td>1.25:1</td>
</tr>
<tr>
<td>3.1.7</td>
<td>Local Oscillator Stability</td>
<td>0.0025 percent</td>
</tr>
<tr>
<td>3.1.8</td>
<td>Tuning Accuracy</td>
<td>0.005 percent</td>
</tr>
<tr>
<td>3.1.9</td>
<td>Tuning Method</td>
<td>Continuous (crystal-controlled)</td>
</tr>
<tr>
<td>3.2</td>
<td>IF SECTION</td>
<td></td>
</tr>
<tr>
<td>3.2.1</td>
<td>IF Frequency</td>
<td>21.4 MHz</td>
</tr>
<tr>
<td>3.2.2</td>
<td>Selectivity, 3 dB BW</td>
<td>180 kHz (minimum)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>360 kHz (maximum)</td>
</tr>
<tr>
<td>3.2.3</td>
<td>Capture Ratio</td>
<td>&gt;0.8</td>
</tr>
<tr>
<td>3.3</td>
<td>AUDIO SECTION</td>
<td></td>
</tr>
<tr>
<td>3.3.1</td>
<td>Audio Amplifier Response</td>
<td>1 dB, 5 to 15 kHz</td>
</tr>
<tr>
<td>3.3.2</td>
<td>Audio Amplifier Distortion</td>
<td>&lt;2 percent</td>
</tr>
<tr>
<td>3.3.3</td>
<td>Audio Output</td>
<td>None</td>
</tr>
<tr>
<td>3.3.4</td>
<td>Frequency Deviation</td>
<td>±30 kHz peak per tone</td>
</tr>
<tr>
<td>3.4</td>
<td>DECODER SECTION</td>
<td></td>
</tr>
<tr>
<td>3.4.1</td>
<td>Number of Decoder Channels</td>
<td>4 (IRIG channels 1, 2, 4, and 5)</td>
</tr>
<tr>
<td>3.4.2</td>
<td>Number of Simultaneous Useable Tones</td>
<td>4</td>
</tr>
<tr>
<td>3.4.3</td>
<td>Tone Channel Bandwidth</td>
<td>±1 percent minimum at 2 dB</td>
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<tr>
<td>3.4.4</td>
<td>Adjacent Channel Rejection</td>
<td>±3.5 percent maximum at 20 dB</td>
</tr>
<tr>
<td>3.4.5</td>
<td>Decoder Threshold Deviation</td>
<td>±12 kHz peak per tone</td>
</tr>
</tbody>
</table>
3.5 OUTPUT

3.5.1 Types of Output

Transistor Switch

3.5.2 Output Current Capability

Destruct Output: 16.0 A for 10 seconds
All Other Commands: 0.5 A continuous

3.5.3 Output Leakage

1 μA (maximum)

3.5.4 Logic Circuitry (List Sequence)

In accordance with RCC 313-80

3.5.5 Response Time for Commands

15 ms (maximum)

3.5.6 Output Isolation

Outputs isolated from case

3.5.7 Noise Immunity

Yes - software programmable variable threshold

3.5.8 Telemetry Outputs

Power Input Voltage: 0 to 5 V linearly for 20 to 32 Vdc
Channel 4 Command: 0 V for no command, 5 V for command
RF Signal Strength: 0 to 5 precision telemetry

3.6 POWER SUPPLY

3.6.1 Supply Voltage

20 to 32 Vdc

3.6.2 Power Requirements

Standby: 4.5 W (maximum)
Interrogate: 6.0 W (maximum)

3.6.3 Power Supply Isolation

Yes, dc-to-dc converter

3.7 ELECTROMAGNETIC INTERFERENCE

3.7.1 RFI Suppression

Meets MIL-STD-461A

3.7.2 AM Rejection

50 percent, 7 μV or more

3.7.3 Image Rejection

60 dB (minimum), 100 dB typical

3.7.4 Spurious Response Rejection

80 dB (minimum), 100 dB typical
3.8 ENVIRONMENTAL CHARACTERISTICS

3.8.1 Operating Temperature Range 
+10°C to +65°C

3.8.2 Nondestructive Temperatures (Shelf Storage)
-55°C to +65°C

3.8.3 Humidity
90 percent

3.8.4 Altitude
Unlimited

3.8.5 Shock
100 g (non-operating)
30 g (operating)
2,500 g pyro (operating)

3.8.6 Acceleration
Not specified

3.8.7 Vibration (sine)
40 g-peak, 5 to 300 Hz
3.5 g rms, 300 to 2,000 Hz

3.8.8 Vibration (random)
26.4 g rms overall

3.8.9 Pressurization
Not required

3.8.10 Operating Life
500 hours

3.8.11 Shelf Life
5 years

3.9 PHYSICAL CHARACTERISTICS

3.9.1 Volume
73-in³ (plus connector protrusions)

3.9.2 Dimensions
7.6 x 3.3 x 2.9-in

3.9.3 Weight
4 pounds

3.9.4 Mounting Attitude
Any

3.9.5 External Adjustments
None

3.9.6 Connector Types
J1, RF Input:
J2, Power:
J3, Destruct Output:
TNC
M83723/82R1415N
M83723/82R1407N

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CINCINNATI ELECTRONICS CORPORATION
COMMAND RECEIVER/DECODER
MODEL CR-119

1. GENERAL DESCRIPTION

The Cincinnati Model CR-119 Command Receiver/Decoder design reflects extensive use of surface mounted components which result in a miniature receiver with a volume of less than 5.5 cubic inches (excluding mounting feet and connector protrusions) and a weight of less than 6 ounces. It is a single-conversion superheterodyne design with a preselector of Surface Acoustic Wave (SAW) devices.

The IRIG audio tone detection is accomplished by phase-lock-loop integrated circuits. The decoder logic circuitry is compatible with the traditional range safety modulation/decoding technique (tones 1, 2, and 5). Closure of contacts, rated at 1 A continuous at 28 Vdc, are provided for each command output.

The unit, which weighs less than 6 ounces, is packaged in an aluminum housing. Two 7/32-inch through-holes are provided in the flange surface for mounting the receiver.

2. BACKGROUND

The Model CR-119 Command Receiver/Decoder was developed for range safety application for the Short Range Attack Missile II (SRAM II). The design was accomplished in 1989/1990 under contract with Boeing. Qualification tests were completed in April 1991.

3. TECHNICAL SPECIFICATIONS

3.1 RF SECTION

3.1.1 Frequency Range (Tuneable) 275 to 550 MHz
3.1.2 Threshold Sensitivity (Command Output) -101 dBm (-107 dBm typical)
3.1.3 Maximum Useable RF Input 2 Vrms
3.1.4 Operating Bandwidth ±45 kHz minimum

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<th>Parameter</th>
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<td>3.1.5 Antenna Impedance</td>
<td>50 ohms</td>
<td></td>
</tr>
<tr>
<td>3.1.6 VSWR</td>
<td>1.5:1</td>
<td></td>
</tr>
<tr>
<td>3.1.7 Local Oscillator Stability</td>
<td>0.0025 percent</td>
<td></td>
</tr>
<tr>
<td>3.1.8 Tuning Accuracy</td>
<td>0.005 percent</td>
<td></td>
</tr>
<tr>
<td>3.1.9 Tuning Method</td>
<td>Continuous (crystal-controlled)</td>
<td></td>
</tr>
<tr>
<td>3.2 IF SECTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2.1 IF Frequency</td>
<td>21.4 MHz</td>
<td></td>
</tr>
<tr>
<td>3.2.2 Selectivity, 3 dB BW</td>
<td>180 kHz (minimum)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>60 dB BW</td>
<td></td>
</tr>
<tr>
<td></td>
<td>360 kHz (maximum)</td>
<td></td>
</tr>
<tr>
<td>3.2.3 Capture Ratio</td>
<td>&gt;0.8</td>
<td></td>
</tr>
<tr>
<td>3.3 AUDIO SECTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.3.1 Audio Amplifier Response</td>
<td>1 dB, 5 to 15 kHz</td>
<td></td>
</tr>
<tr>
<td>3.3.2 Audio Amplifier Distortion</td>
<td>&lt;2 percent</td>
<td></td>
</tr>
<tr>
<td>3.3.3 Audio Output</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>3.3.4 Frequency Deviation</td>
<td>±30 kHz peak per tone</td>
<td></td>
</tr>
<tr>
<td>3.4 DECODER SECTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.4.1 Number of Decoder Channels</td>
<td>4 (IRIG channels 1, 2, 4, and 5)</td>
<td></td>
</tr>
<tr>
<td>3.4.2 Number of Simultaneous Useable Tones</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>3.4.3 Tone Channel Bandwidth</td>
<td>±1 percent minimum at 2 dB</td>
<td></td>
</tr>
<tr>
<td>3.4.4 Adjacent Channel Rejection</td>
<td>±3.5 percent maximum at 20 dB</td>
<td></td>
</tr>
<tr>
<td>3.4.5 Decoder Threshold Deviation</td>
<td>±9 kHz peak per tone</td>
<td></td>
</tr>
</tbody>
</table>
3.5 OUTPUT

3.5.1 Types of Output Relay*

3.5.2 Output Current Capability 1 A continuous
(Destruct, Arm, and OC)

3.5.3 Output Leakage None

3.5.4 Logic Circuitry In accordance with RCC 313, Opt., Arm & Destruct

3.5.5 Response Time for Commands 25 ms

3.5.6 Output Isolation Outputs isolated from case

3.5.7 Telemetry Outputs
   Channel 4 Command 0 V for No Command, 28 V for Command
   RF Signal Strength 0 to 5 V
   Command Outputs Arm, Optional and Destruct Monitors

3.6 POWER SUPPLY

3.6.1 Supply Voltage 18 to 35 Vdc

3.6.2 Power Consumption Standby: 60 mA
    Interrogate: 140 mA

3.6.3 Power Supply Isolation Yes

3.7 ELECTROMAGNETIC INTERFERENCE

3.7.1 RFI Suppression Meets MIL-STD-461A

3.7.2 AM Rejection 50 percent, 7 μV or more

3.7.3 Image and Spurious Rejection 60 dB minimum, 100 dB typical
3.8 ENVIRONMENTAL CHARACTERISTICS

3.8.1 Operating Temperature Range  
-55°C to +85°C

3.8.2 Nondestructive Temperatures  
(Shelf Storage)  
-55°C to +125°C

3.8.3 Humidity  
90 percent

3.8.4 Altitude  
Unlimited

3.8.5 Shock  
150 g (operating)

3.8.6 Acceleration  
30 g

3.8.7 Vibration  
15.4 g rms random

3.8.8 Operating Life  
500 hours

3.8.9 Shelf Life  
15 years

3.9 PHYSICAL CHARACTERISTICS

3.9.1 Volume  
5.5-in³

3.9.2 Dimensions  
3.975 x 1.750 x 0.795-in

3.9.3 Weight  
6 ounces

3.9.4 Mounting Attitude  
Any

3.9.5 External Adjustments  
None

3.9.6 Connector Types  
J1, Power & Output  
M24308/23-2  
J2, RF Input  
M39012/60-3002

*Solid-state on request
Figure 3-6. Cincinnati Electronics Corporation Model CR-119 Command Receiver/Decoder.
CINCINNATI ELECTRONICS CORPORATION
COMMAND RECEIVER/DECODER
MODEL CRD-111/202

1. GENERAL DESCRIPTION

The Cincinnati Model CRD-111/202 Command Receiver/Decoder employs a single-conversion superheterodyne design, and the decoder uses a microprocessor. Tone detection of the high-alphabet command characters is accomplished by the microprocessor using a Fast Fourier Transform algorithm that provides nearly ideal filter performance for each of the seven audio tones used in the modulation format. In addition, detection of a "Pilot Tone" is accomplished, and a telemetry indication of its presence is provided.

The message decoding process is accomplished by the microprocessor and the associated circuitry. The sequence of detected characters (a character consists of two simultaneously transmitted audio tones) is compared to the previously stored "code-of-the-mission". If the comparison is favorable, an output command is generated; if the sequence does not compare, the decoder is reset. A nonvolatile memory is contained within the unit to store the selected (2-tone) 11 character codes. The unit is field-programmed with a KYK-13 Electronic Transfer Device, and it provides automatic verification to the programming device whenever a new code is entered.

The CRD-111/202 provides for five solid-state command outputs. When a proper code has been decoded, a 28 Vdc output is provided for a duration of 45 ms.

The unit is packaged in an aluminum housing. The mounting surface of the housing is provided with four through-holes in a 4-inch square pattern to accommodate 1/4-inch bolts.

2. BACKGROUND

The Model CRD-111/202 Command Receiver/Decoder was designed, developed and qualified for flight use under contract with the National Aeronautics and Space Administration Marshall Space Flight Center (NASA/MSFC). This unit is the range safety flight termination receiver/decoder used on the Space Shuttle Launch Vehicle. The design was accomplished in 1979/1980 and is compatible with the "high-alphabet" and the selectable "code-of-the-mission" range safety coding technique used for manned space flight launches. In addition, the CRD-111/202 is designed to be recovered and reused for a number of launches.

Qualification tests were performed by Cincinnati Electronics Corporation under contract with NASA/MSFC (Contract NAS8-33440). Tests were initiated in October 1981, and single mission qualification tests were completed in January 1982. Seven mission qualification tests were completed in April 1982.
### 3. TECHNICAL SPECIFICATIONS

#### 3.1 RF SECTION

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range (Tuneable)</td>
<td>400 to 550 MHz</td>
</tr>
<tr>
<td>Threshold Sensitivity (Command Output)</td>
<td>&lt;3 μV (1 μV typical)</td>
</tr>
<tr>
<td>Maximum Useable RF Input</td>
<td>+13 dBm</td>
</tr>
<tr>
<td>Operating Bandwidth</td>
<td>±45 kHz minimum</td>
</tr>
<tr>
<td>Antenna Impedance</td>
<td>50 ohms</td>
</tr>
<tr>
<td>VSWR</td>
<td>1.5:1</td>
</tr>
<tr>
<td>Local Oscillator Stability</td>
<td>0.0025 percent</td>
</tr>
<tr>
<td>Tuning Accuracy</td>
<td>0.005 percent</td>
</tr>
<tr>
<td>Tuning Method</td>
<td>Continuous (crystal-controlled)</td>
</tr>
</tbody>
</table>

#### 3.2 IF SECTION

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IF Frequency</td>
<td>10.7 MHz</td>
</tr>
<tr>
<td>Selectivity, 60 dB</td>
<td>360 kHz (minimum)</td>
</tr>
<tr>
<td>Capture Ratio</td>
<td>&gt;0.8</td>
</tr>
</tbody>
</table>

#### 3.3 AUDIO SECTION

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio Amplifier Response</td>
<td>1.5 dB, 7 to 14 kHz</td>
</tr>
<tr>
<td>Audio Amplifier Distortion</td>
<td>&lt;10 percent</td>
</tr>
<tr>
<td>Audio Output</td>
<td>None</td>
</tr>
<tr>
<td>Frequency Deviation</td>
<td>±30 kHz peak per tone</td>
</tr>
</tbody>
</table>
3.4 DECODER SECTION

3.4.1 Number of Decoder Channels
- 8 (nonstandard IRIG)
  - Tone 1 - 7.35 kHz
  - Tone 2 - 8.40 kHz
  - Tone 3 - 9.45 kHz
  - Tone 4 - 10.50 kHz
  - Tone 5 - 11.55 kHz
  - Tone 6 - 12.60 kHz
  - Tone 7 - 13.65 kHz
  - Pilot Tone - 15.45 kHz

3.4.2 Number of Simultaneous Useable Tones
- 2 tones per character, 11 character sequence

3.4.3 Tone Channel Bandwidth
- 150 Hz minimum effective bandwidth

3.4.4 Adjacent Channel Rejection
- ±4 percent maximum at 20 dB

3.4.5 Decoder Threshold Deviation
- ±4 kHz peak per tone

3.5 OUTPUT

3.5.1 Types of Output
- Five command outputs through transistor switches

3.5.2 Output Current Capability
- 28 ±3 Vdc into 175 ohms worst case for 45 ±1 ms

3.5.3 Output Leakage
- 5 μV maximum

3.5.4 Logic Circuitry (List Sequence)
- Microprocessor-controlled, programmable, high-alphabet code modulation

3.5.5 Response Time for Commands
- CLASSIFIED

3.5.6 Transition Time Between Commands
- CLASSIFIED

3.5.7 Output Isolation
- 107 ohms minimum

3.5.8 Noise Immunity
- Yes (uses “code-of-the-mission”)

3.5.9 Telemetry Outputs
- RF Signal Level
  - Power On/Pilot Tone Present

3.36
### 3.6 POWER SUPPLY

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.6.1 Supply Voltage</td>
<td>24 to 36 Vdc</td>
</tr>
<tr>
<td>3.6.2 Power Requirements</td>
<td>15 W maximum (steady-state)</td>
</tr>
<tr>
<td>3.6.3 Power Supply Isolation</td>
<td>DC-to-dc converter power supply</td>
</tr>
<tr>
<td>3.6.4 Turn-On Power Control for Receiver</td>
<td>None</td>
</tr>
<tr>
<td>3.6.5 Other Controls</td>
<td>None</td>
</tr>
</tbody>
</table>

### 3.7 ELECTROMAGNETIC INTERFERENCE

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.7.1 RFI Suppression</td>
<td>Meets JSC-SL-E-002</td>
</tr>
<tr>
<td>3.7.2 Pulse Rejection</td>
<td>2 ms RF blanking pulse</td>
</tr>
<tr>
<td>3.7.3 AM Rejection</td>
<td>Not measured</td>
</tr>
<tr>
<td>3.7.4 Image Rejection</td>
<td>60 dB minimum</td>
</tr>
</tbody>
</table>

### 3.8 ENVIRONMENTAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.8.1 Operating Temperature Range (Continuous)</td>
<td>-20°F to +155°F</td>
</tr>
<tr>
<td>3.8.2 Nondestructive Temperatures (Shelf Storage)</td>
<td>-40°F to +165°F</td>
</tr>
<tr>
<td>3.8.3 Humidity</td>
<td>100 percent</td>
</tr>
<tr>
<td>3.8.4 Altitude</td>
<td>Unlimited</td>
</tr>
<tr>
<td>3.8.5 Shock</td>
<td>30 g peak, 150 ms impact 1,875 g-peak, (4,000 to 10,000 Hz)</td>
</tr>
<tr>
<td>3.8.6 Acceleration</td>
<td>Not tested</td>
</tr>
<tr>
<td>3.8.7 Vibration</td>
<td>19 g rms random</td>
</tr>
<tr>
<td>3.8.8 Acoustics</td>
<td>Overall SPL 152 dB, 60 s</td>
</tr>
<tr>
<td>3.8.9 Pressurization</td>
<td>Not required</td>
</tr>
<tr>
<td>Section</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>3.8.10</td>
<td>Operating Life</td>
</tr>
<tr>
<td>3.8.11</td>
<td>Shelf Life</td>
</tr>
<tr>
<td>3.9</td>
<td>PHYSICAL CHARACTERISTICS</td>
</tr>
<tr>
<td>3.9.1</td>
<td>Volume</td>
</tr>
<tr>
<td>3.9.2</td>
<td>Dimensions</td>
</tr>
<tr>
<td>3.9.3</td>
<td>Weight</td>
</tr>
<tr>
<td>3.9.4</td>
<td>Mounting Attitude</td>
</tr>
<tr>
<td>3.9.5</td>
<td>External Adjustments</td>
</tr>
<tr>
<td>3.9.6</td>
<td>Connector Types</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 3-7. Cincinnati Electronics Corporation Model CRD-111/22 Command Receiver/Decoder.
GENERAL DESCRIPTION

The Cincinnati Model CRD-117/203 Command Receiver/Decoder is a single-conversion superheterodyne design. The RF preselector is implemented using Surface Acoustic Wave (SAW) devices, and the IF is 21.4 MHz. These allow the receiver to exhibit exceptional image rejection and spurious response performance. Typical receiver sensitivity is less than 1 μV.

The "high-alphabet" tone frequency detection is accomplished by a microprocessor and associated circuitry. The audio signal as recovered by the receiver section is digitized and processed using a Fast Fourier Transform (FFT) algorithm. The tone detection threshold self-adjusts to the signal and noise characteristics of the audio signal. This provides excellent tone detection performance for the seven audio tones used in the modulation format. In addition, detection of a "pilot tone" is accomplished, and a telemetry indication of its presence is provided.

The message decoding is accomplished by a microprocessor and associated circuitry. The sequence of detected characters (a character consists of two simultaneously transmitted tones) is compared with the prestored code-of-the-mission. If the comparison is favorable, a command output is issued; if the sequence does not compare, no command is issued. A non-volatile memory is contained within the unit to store the selected 11 character codes. This unit is field-programmed with a KYK-13 Electronic Transfer Device, and it provides automatic verification to the programming device whenever a new code is entered.

A 28 Vdc, 54 A transistor-switched command destruct output is provided for a duration of 250 ms. Arm and OC outputs are 28 Vdc, 5 A and 28 Vdc, 0.5 A (respectively) transistor-switched, continuous.

In addition, under control of the microprocessor, the AGC voltage level and unit temperature data are processed to provide a precision telemetry output. A 0 to 5 V linear, temperature stable, signal is thereby provided as an indication of the receiver RF input signal strength to within ±1 dB.

The unit is packaged in an aluminum cast housing. The mounting surface contains six tapped holes on 6.50 x 1.75-inch centers to accommodate number 10-32 mounting screws.
2. **BACKGROUND**

The Model CRD-117/203 Command Receiver/Decoder was developed and qualified for range safety application for the Titan family (Titan II, Titan III, and Titan IV) of space launch vehicles. The design was accomplished in 1986/1987 under contract with Martin Marietta Corporation. Qualification tests were performed by Cincinnati Electronics Corporation during the period of December 1987 through March 1988.

3. **TECHNICAL SPECIFICATIONS**

3.1 **INPUT SIGNAL CHARACTERISTICS**

3.1.1 Type

Frequency-modulated UHF command transmission

3.1.2 Command Format

Eleven sequential character command codes (high-alphabet)

3.1.3 Character Definition

Each character is comprised of two audio tone frequencies for a duration of 6-2/3 ms

3.1.4 Audio Tone Frequencies

<table>
<thead>
<tr>
<th>TONE</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7.35 kHz</td>
</tr>
<tr>
<td>2</td>
<td>8.40 kHz</td>
</tr>
<tr>
<td>3</td>
<td>9.45 kHz</td>
</tr>
<tr>
<td>4</td>
<td>10.50 kHz</td>
</tr>
<tr>
<td>5</td>
<td>11.55 kHz</td>
</tr>
<tr>
<td>6</td>
<td>12.60 kHz</td>
</tr>
<tr>
<td>7</td>
<td>13.65 kHz</td>
</tr>
<tr>
<td>Pilot Tone</td>
<td>15.45 kHz</td>
</tr>
</tbody>
</table>

3.2 **RF SECTION**

3.2.1 Frequency Range

400 to 550 MHz

3.2.2 Threshold Sensitivity

3 μV (1 μV typical)

3.2.3 Maximum Useable RF

1 Vrms

3.2.4 Operating Bandwidth

±45 kHz minimum

3.2.5 Antenna Impedance

50 ohms
<table>
<thead>
<tr>
<th>3.2.6</th>
<th>VSWR</th>
<th>2.0:1</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2.7</td>
<td>Local Oscillator Stability</td>
<td>0.0025 percent</td>
</tr>
<tr>
<td>3.2.8</td>
<td>Tuning Accuracy</td>
<td>0.005 percent</td>
</tr>
<tr>
<td>3.2.9</td>
<td>Tuning Method</td>
<td>Continuous (crystal-controlled)</td>
</tr>
</tbody>
</table>

### 3.3 IF SECTION

<table>
<thead>
<tr>
<th>3.3.1</th>
<th>IF Frequency</th>
<th>21.4 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3.2</td>
<td>Selectivity, 3 dB BW</td>
<td>180 kHz (minimum)</td>
</tr>
<tr>
<td></td>
<td>60 dB BW</td>
<td>360 kHz (maximum)</td>
</tr>
<tr>
<td>3.3.3</td>
<td>Capture Ratio</td>
<td>&lt;0.8</td>
</tr>
</tbody>
</table>

### 3.4 AUDIO SECTION

<table>
<thead>
<tr>
<th>3.4.1</th>
<th>Audio Amplifier Response</th>
<th>1 dB, 5 to 15 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.4.2</td>
<td>Audio Amplifier Distortion</td>
<td>&lt;2 percent</td>
</tr>
<tr>
<td>3.4.3</td>
<td>Audio Output</td>
<td>None</td>
</tr>
<tr>
<td>3.4.4</td>
<td>Frequency Deviation</td>
<td>±30 kHz peak per tone</td>
</tr>
</tbody>
</table>

### 3.5 DETECTOR/DECODER SECTION

<table>
<thead>
<tr>
<th>3.5.1</th>
<th>Number of Decoder Channels</th>
<th>7 (high-alphabet tones)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5.2</td>
<td>Number of Simultaneous Useable Tones</td>
<td>High-alphabet message</td>
</tr>
<tr>
<td>3.5.3</td>
<td>Tone Filter Implementation</td>
<td>Microprocessor-controlled digital filter</td>
</tr>
<tr>
<td>3.5.4</td>
<td>Tone Channel Bandwidth</td>
<td>150 Hz minimum effective BW</td>
</tr>
<tr>
<td>3.5.5</td>
<td>Logic Circuitry</td>
<td>Microprocessor-controlled programmable decoding</td>
</tr>
<tr>
<td>3.5.6</td>
<td>Code Insertion</td>
<td>Field programmable with KYK-13 and adapter</td>
</tr>
</tbody>
</table>

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3.5.7 Code Verification
Only when new code is entered

3.5.8 Memory
Non-volatile

3.5.9 Command Validity
Unit provides output only when input code matches prestored code

3.6 OUTPUT

3.6.1 Types of Output
Transistor Switch

3.6.2 Output Current Capability
- Destruct Output: 54 A for 250 ±10 ms, B+ less 2 V
- Arm Output: 5 A continuous
- OC Output: 0.5 A continuous

3.6.3 Output Leakage
1 mA (maximum)

3.6.4 Output Isolation
3 Mohm (minimum)

3.6.5 Noise Immunity
Yes - software programmable variable threshold

3.6.6 Telemetry Outputs
- Pilot Tone Command: 0 V for No Command, 5 V for Command
- RF Signal Strength: 0 V to 4.75 V precision telemetry (goes to >5 V with Destruct Command)

3.7 POWER SUPPLY

3.7.1 Supply Voltage
22 to 38 Vdc

3.7.2 Power Consumption
Standby: 0.42 A
Interrogate: 0.42 A

3.7.3 Power Supply Isolation
Yes, dc-to-dc converter

3.8 ELECTROMAGNETIC INTERFERENCE

3.8.1 RFI Suppression
Meets MIL-STD-461A

3.8.2 AM Rejection
50 percent, 3 μV or more
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.8.3</td>
<td>Image Rejection</td>
<td>60 dB (minimum), 100 dB typical</td>
</tr>
<tr>
<td>3.8.4</td>
<td>Spurious Response Rejection</td>
<td>80 dB (minimum), 100 dB typical</td>
</tr>
<tr>
<td>3.9</td>
<td>ENVIRONMENTAL CHARACTERISTICS</td>
<td></td>
</tr>
<tr>
<td>3.9.1</td>
<td>Operating Temperature Range</td>
<td>-7°C to +52°C</td>
</tr>
<tr>
<td>3.9.2</td>
<td>Nondestructive Temperatures (Shelf Storage)</td>
<td>-50°C to +55°C</td>
</tr>
<tr>
<td>3.9.3</td>
<td>Humidity</td>
<td>100 percent</td>
</tr>
<tr>
<td>3.9.4</td>
<td>Shock</td>
<td>960 g at 2,000 Hz</td>
</tr>
<tr>
<td>3.9.5</td>
<td>Vibration</td>
<td>15.6 g rms random</td>
</tr>
<tr>
<td>3.9.6</td>
<td>Pressurization</td>
<td>Not required</td>
</tr>
<tr>
<td>3.9.7</td>
<td>Shelf Life</td>
<td>3 years</td>
</tr>
<tr>
<td>3.10</td>
<td>PHYSICAL CHARACTERISTICS</td>
<td></td>
</tr>
<tr>
<td>3.10.1</td>
<td>Volume</td>
<td>&lt;111-in³</td>
</tr>
<tr>
<td>3.10.2</td>
<td>Dimensions</td>
<td>3.32 x 7.60 x 4.40-in (plus connector protrusions)</td>
</tr>
<tr>
<td>3.10.3</td>
<td>Weight</td>
<td>5 pounds maximum</td>
</tr>
<tr>
<td>3.10.4</td>
<td>Mounting Attitude</td>
<td>Any</td>
</tr>
<tr>
<td>3.10.5</td>
<td>External Adjustments</td>
<td>None</td>
</tr>
<tr>
<td>3.10.6</td>
<td>Connector Types</td>
<td></td>
</tr>
<tr>
<td></td>
<td>J1, RF Input</td>
<td>N-Series</td>
</tr>
<tr>
<td></td>
<td>J2, Power</td>
<td>MS3112E-14-19</td>
</tr>
<tr>
<td></td>
<td>J3, Command Outputs</td>
<td>MS3112E-6-10PW</td>
</tr>
<tr>
<td></td>
<td>J4, Code Insertion</td>
<td>MS3112E-14-19SW</td>
</tr>
</tbody>
</table>
CINCINNATI ELECTRONICS CORPORATION

COMMAND RECEIVER/DECODER

MODEL CRD-118/204

1. GENERAL DESCRIPTION

The Cincinnati Model CRD-118/204 Command Receiver/Decoder is a single-conversion superheterodyne design. Surface Acoustic Wave (SAW) filters incorporated in the receiver preselector and an IF of 21.4 MHz provide exceptional image rejection and spurious response performance.

The "high-alphabet" tone frequency detection is accomplished by a microprocessor and associated circuitry. The audio signal as recovered by the receiver section is digitized and processed using a Fast Fourier Transform (FFT) algorithm. The tone detection threshold self-adjusts to the signal and noise characteristics of the audio signal. This provides excellent tone detection performance for the seven audio tones used in the modulation format. In addition, detection of a "Pilot Tone" is accomplished, and a telemetry indication of its presence is provided.

The message decoding is accomplished by a microprocessor and associated circuitry. The sequence of detected characters (a character consists of two simultaneously transmitted tones) is compared with the prestored code-of-the-mission. If the comparison is favorable, a command output is issued; if the sequence does not compare, no command is issued. A non-volatile memory is contained within the unit to store the selected 11 character codes. This unit is field-programmed with a KYK-13 Electronic Transfer Device, and it provides automatic verification to the programming device whenever a new code is entered.

Some additional features incorporated in the unit design include:

- Power Changeover Function - An internal/external signal input causes the receiver to switch to either ground power source or vehicle battery.
- Inadvertent Separation Destruct Signal (ISDS) - When two of three break wires show vehicle break-up, the unit issues Arm/Destruct Command sequence.
- Delayed Destruct - A destruct output delayed by 30 ms from the primary destruct output.

Redundant 10 A outputs via transistor switches are provided for Arm, Destruct, and Delayed Destruct commands.

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A precision signal strength telemetry output is also provided. Under control of the microprocessor, the AGC voltage level and unit temperature data are processed to provide a 0 to 5 V, linear, temperature stable signal as an indication of the receiver RF input signal strength to within ±2 dB.

The unit is packaged in an aluminum cast housing. The mounting surface contains four 0.281-inch diameter holes on 5.5 x 6.0-inch centers.

2. **BACKGROUND**

The Model CRD-118/204 Command Receiver/Decoder was developed and qualified for range safety application for the Atlas II space launch vehicle. The design was accomplished in 1990 under contract with General Dynamics. Qualification tests were completed in mid 1991.

3. **TECHNICAL SPECIFICATIONS**

3.1 INPUT SIGNAL CHARACTERISTICS

3.1.1 Type

Frequency-modulated UHF command transmission

3.1.2 Command Format

Eleven sequential character command codes (high-alphabet)

3.1.3 Character Definition

Each character is comprised of two audio tone frequencies for a duration of 6-2/3 ms

3.1.4 Audio Tone Frequencies

<table>
<thead>
<tr>
<th>TONE</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7.35 kHz</td>
</tr>
<tr>
<td>2</td>
<td>8.40 kHz</td>
</tr>
<tr>
<td>3</td>
<td>9.45 kHz</td>
</tr>
<tr>
<td>4</td>
<td>10.50 kHz</td>
</tr>
<tr>
<td>5</td>
<td>11.55 kHz</td>
</tr>
<tr>
<td>6</td>
<td>12.60 kHz</td>
</tr>
<tr>
<td>7</td>
<td>13.65 kHz</td>
</tr>
<tr>
<td>Pilot Tone</td>
<td>15.45 kHz</td>
</tr>
</tbody>
</table>

3.2 RF SECTION

3.2.1 Frequency Range

400 to 550 MHz

3.2.2 Threshold Sensitivity

1 µV (0.3 µV typical)
<table>
<thead>
<tr>
<th>Section</th>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2.3</td>
<td>Maximum Useable RF</td>
<td>1 V:ms</td>
</tr>
<tr>
<td>3.2.4</td>
<td>Operating Bandwidth</td>
<td>±45 kHz minimum</td>
</tr>
<tr>
<td>3.2.5</td>
<td>Antenna Impedance</td>
<td>50 ohms</td>
</tr>
<tr>
<td>3.2.6</td>
<td>VSWR</td>
<td>2.0:1 (maximum)</td>
</tr>
<tr>
<td>3.2.7</td>
<td>Local Oscillator Stability</td>
<td>0.0025 percent</td>
</tr>
<tr>
<td>3.2.8</td>
<td>Tuning Accuracy</td>
<td>0.005 percent</td>
</tr>
<tr>
<td>3.2.9</td>
<td>Tuning Method</td>
<td>Continuous (crystal-controlled)</td>
</tr>
<tr>
<td>3.3</td>
<td>IF SECTION</td>
<td></td>
</tr>
<tr>
<td>3.3.1</td>
<td>IF Frequency</td>
<td>21.4 MHz</td>
</tr>
<tr>
<td>3.3.2</td>
<td>Selectivity, 3 dB BW</td>
<td>180 kHz (minimum)</td>
</tr>
<tr>
<td></td>
<td>60 dB BW</td>
<td>360 kHz (maximum)</td>
</tr>
<tr>
<td>3.3.3</td>
<td>Capture Ratio</td>
<td>&gt;0.8</td>
</tr>
<tr>
<td>3.4</td>
<td>AUDIO SECTION</td>
<td></td>
</tr>
<tr>
<td>3.4.1</td>
<td>Audio Amplifier Response</td>
<td>1 dB, 5 to 15 kHz</td>
</tr>
<tr>
<td>3.4.2</td>
<td>Audio Amplifier Distortion</td>
<td>&lt;2 percent</td>
</tr>
<tr>
<td>3.4.3</td>
<td>Audio Output</td>
<td>None</td>
</tr>
<tr>
<td>3.4.4</td>
<td>Frequency Deviation</td>
<td>±30 kHz peak per tone</td>
</tr>
<tr>
<td>3.5</td>
<td>DETECTOR/DECODER SECTION</td>
<td></td>
</tr>
<tr>
<td>3.5.1</td>
<td>Number of Decoder Channels</td>
<td>7 (high-alphabet tones)</td>
</tr>
<tr>
<td>3.5.2</td>
<td>Number of Simultaneous Useable Tones</td>
<td>High-alphabet message &amp; Pilot Tone</td>
</tr>
<tr>
<td>3.5.3</td>
<td>Tone Filter Implementation</td>
<td>Microprocessor-controlled digital filter</td>
</tr>
</tbody>
</table>
3.5.4 Tone Channel Bandwidth
150 Hz minimum effective BW

3.5.5 Logic Circuitry
Microprocessor-controlled programmable decoding

3.5.6 Code Insertion
Field programmable with KYK-13 and adapter

3.5.7 Code Verification
Only when new code is entered

3.5.8 Memory
Non-volatile

3.5.9 Command Validity
Unit provides output only when input code matches prestored code

3.6 OUTPUT

3.6.1 Types of Output
Transistor Switch

3.6.2 Output Current Capability
Destruct Output
10 A (each output)
Delay Destruct
10 A (each output)
Arm Output
10 A (each output)
Disable Output
0.25 A

3.6.3 Output Leakage
10 mA (maximum)

3.6.4 Output Isolation
3.0 Mohm (minimum)

3.6.5 Noise Immunity
Yes - software programmable variable threshold

3.6.6 Telemetry Outputs
Pilot Tone Command
0 V for No Command, 5 V for Command
RF Signal Level
0 V to 4.75 V precision telemetry
Temperature
0-5 Vdc linear, 0 Vdc for -40°C to 5 Vdc for +85°C
ARM
28 Vdc with Command, 0 Vdc no Command
DESTRUCT
28 Vdc with Command, 0 Vdc no Command
DELAY DESTRUCT
28 Vdc with Command, 0 Vdc no Command
SELF TEST
28 Vdc with Command, 0 Vdc no Command
DISABLE
28 Vdc with Command, 0 Vdc no Command
Internal/External
28 Vdc with Command, 0 Vdc no Command
Reset
28 Vdc with Command, 0 Vdc no Command
3.7 POWER SUPPLY

3.7.1 Supply Voltage 22 to 38 Vdc

3.7.2 Power Consumption
Standby: 0.16 A
Interrogate: 0.16 A (plus output current)

3.7.3 Power Supply Isolation Yes, dc-to-dc converter

3.8 ELECTROMAGNETIC INTERFERENCE

3.8.1 RFI Suppression Meets MIL-STD-461A

3.8.2 AM Rejection 100 percent, 3 µV or more

3.8.3 Image Rejection 60 dB (minimum), 100 dB typical

3.8.4 Spurious Response Rejection 80 dB (minimum), 100 dB typical

3.9 ENVIRONMENTAL CHARACTERISTICS

3.9.1 Operating Temperature Range -65°C to +185°C

3.9.2 Nondestructive Temperatures
(Shelf Storage) -65°C to +160°C

3.9.3 Humidity 100 percent

3.9.4 Shock 2,000 g at 1,200 Hz

3.9.5 Vibration 27.8 g rms random

3.9.6 Pressurization Not required

3.9.7 Shelf Life 10 years

3.10 PHYSICAL CHARACTERISTICS

3.10.1 Volume <115-in³

3.10.2 Dimensions 2.45 x 7.50 x 6.00-in
(see Outline Drawing)
3.10.3 Weight 5 pounds maximum

3.10.4 Mounting Attitude Any

3.10.5 External Adjustments None

3.10.6 Connector Types

<table>
<thead>
<tr>
<th>Connector</th>
<th>Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>RF Input</td>
<td>TNC, M39012/32-0001</td>
</tr>
<tr>
<td>J2</td>
<td>Power</td>
<td>MS27505E-15-F19PC</td>
</tr>
<tr>
<td>J3</td>
<td>Command Outputs</td>
<td>MS27505E-15-F19S</td>
</tr>
<tr>
<td>J4</td>
<td>Command Outputs</td>
<td>MS27505E-15-F19SA</td>
</tr>
<tr>
<td>J5</td>
<td>Telemetry</td>
<td>MS27505E-15-F19SB</td>
</tr>
<tr>
<td>J6</td>
<td>Code Insertion</td>
<td>MS3112E-10-6PW</td>
</tr>
<tr>
<td>J7</td>
<td>ISDS Enable</td>
<td>MS27505E-9-F35S</td>
</tr>
<tr>
<td>J8</td>
<td>ISDS Sensing</td>
<td>MS27505E-9-F35PA</td>
</tr>
</tbody>
</table>
Figure 3-10. Cincinnati Electronics Corporation Model CRD-118/204 Command Receiver/Decoder.
CINCINNATI ELECTRONICS CORPORATION

COMMAND RECEIVER/DECODER

MODEL CRD-120/205

1. GENERAL DESCRIPTION

The Cincinnati Model CRD-120/205 Command Receiver/Decoder is a single-conversion superheterodyne design. Surface Acoustic Wave (SAW) filters incorporated in the receiver preselector and an IF of 21.4 MHz provide exceptional image rejection and spurious response performance.

The "high-alphabet" tone frequency detection is accomplished by a microprocessor and associated circuitry. The audio signal as recovered by the receiver section is digitized and processed using a Fast Fourier Transform (FFT) algorithm. The tone detection threshold self-adjusts to the signal and noise characteristics of the audio signal. This provides excellent tone detection performance for the seven audio tones used in the modulation format. In addition, detection of a "Pilot Tone" is accomplished, and a telemetry indication of its presence is provided.

The message decoding is accomplished by a microprocessor and associated circuitry. The sequence of detected characters (a character consists of two simultaneously transmitted tones) is compared with the prestored code-of-the-mission. If the comparison is favorable, a command output is issued; if the sequence does not compare, no command is issued. A non-volatile memory is contained within the unit to store the selected 11 character codes. This unit is field-programmed with a KYK-13 Electronic Transfer Device, and it provides automatic verification to the programming device whenever a new code is entered.

Some additional features incorporated in the unit design include:

- Power Changeover Function - An internal/external signal input causes the receiver to switch to either ground power source or vehicle battery.

- Inadvertent Separation Destruct Signal (ISDS) - When two of four break wires show vehicle break-up, the unit issues Arm/Destruct Command sequence.

- Electro-explosive Device (EED) Monitor - The unit contains a circuit that measures the resistance of the external load on the Destruct Outputs and provides this data via telemetry signals.
Redundant 10 A outputs via transistor switches are provided for Destruct Command, and redundant 1 A transistor switches are provided for the Arm Command.

A precision signal strength telemetry output is also provided. Under control of the microprocessor, the AGC voltage level and unit temperature data are processed to provide a 0 to 5 V, linear, temperature stable, signal as an indication of the receiver RF input signal strength to within ±2 dB.

The unit is packaged in an aluminum cast housing. The mounting surface contains four 0.281-inch diameter holes on 6.25 x 6.50-inch centers.

2. BACKGROUND

The Model CRD-120/205 Command Receiver/Decoder is for range safety application for the Delta II space launch vehicle. This design is being accomplished in 1992 under contract with McDonnell Douglas Space Systems Company. Qualification tests are scheduled to take place in the early part of 1993.

3. TECHNICAL SPECIFICATIONS

3.1 INPUT SIGNAL CHARACTERISTICS

3.1.1 Type Frequency-modulated UHF command transmission

3.1.2 Command Format Eleven sequential character command codes (high-alphabet)

3.1.3 Character Definition Each character is comprised of two audio tone frequencies for a duration of 6-2/3 ms

3.1.4 Audio Tone Frequencies

<table>
<thead>
<tr>
<th>TONE</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7.35 kHz</td>
</tr>
<tr>
<td>2</td>
<td>8.40 kHz</td>
</tr>
<tr>
<td>3</td>
<td>9.45 kHz</td>
</tr>
<tr>
<td>4</td>
<td>10.50 kHz</td>
</tr>
<tr>
<td>5</td>
<td>11.55 kHz</td>
</tr>
<tr>
<td>6</td>
<td>12.60 kHz</td>
</tr>
<tr>
<td>7</td>
<td>13.65 kHz</td>
</tr>
<tr>
<td>Pilot Tone</td>
<td>15.45 kHz</td>
</tr>
<tr>
<td>Section</td>
<td>Parameter</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>RF</td>
<td>Frequency Range</td>
</tr>
<tr>
<td></td>
<td>Threshold Sensitivity</td>
</tr>
<tr>
<td></td>
<td>Maximum Useable RF</td>
</tr>
<tr>
<td></td>
<td>Operating Bandwidth</td>
</tr>
<tr>
<td></td>
<td>Antenna Impedance</td>
</tr>
<tr>
<td></td>
<td>VSWR</td>
</tr>
<tr>
<td></td>
<td>Local Oscillator Stability</td>
</tr>
<tr>
<td></td>
<td>Tuning Accuracy</td>
</tr>
<tr>
<td></td>
<td>Tuning Method</td>
</tr>
<tr>
<td>IF</td>
<td>IF Frequency</td>
</tr>
<tr>
<td></td>
<td>Selectivity, 3 dB BW</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Capture Ratio</td>
</tr>
<tr>
<td>AUDIO</td>
<td>Audio Amplifier Response</td>
</tr>
<tr>
<td></td>
<td>Audio Amplifier Distortion</td>
</tr>
<tr>
<td></td>
<td>Audio Output</td>
</tr>
<tr>
<td></td>
<td>Frequency Deviation</td>
</tr>
</tbody>
</table>
### DETECTOR/DECODER SECTION

<table>
<thead>
<tr>
<th>3.5.1</th>
<th>Number of Decoder Channels</th>
<th>7 (high-alphabet tones)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5.2</td>
<td>Number of Simultaneous Useable Tones</td>
<td>High-alphabet message &amp; Pilot Tone</td>
</tr>
<tr>
<td>3.5.3</td>
<td>Tone Filter Implementation</td>
<td>Microprocessor-controlled digital filter</td>
</tr>
<tr>
<td>3.5.4</td>
<td>Tone Channel Bandwidth</td>
<td>150 Hz minimum effective BW</td>
</tr>
<tr>
<td>3.5.5</td>
<td>Logic Circuitry</td>
<td>Microprocessor-controlled programmable decoding</td>
</tr>
<tr>
<td>3.5.6</td>
<td>Code Insertion</td>
<td>Field programmable with KYK-13 and adapter</td>
</tr>
<tr>
<td>3.5.7</td>
<td>Code Verification</td>
<td>Only when new code is entered</td>
</tr>
<tr>
<td>3.5.8</td>
<td>Memory</td>
<td>Non-volatile</td>
</tr>
<tr>
<td>3.5.9</td>
<td>Command Validity</td>
<td>Unit provides output only when input code matches prestored code</td>
</tr>
</tbody>
</table>

### OUTPUT

<table>
<thead>
<tr>
<th>3.6.1</th>
<th>Types of Output</th>
<th>Transistor Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.6.2</td>
<td>Output Current Capability&lt;br&gt; Destruct Output</td>
<td>10 A (each of two separate outputs)</td>
</tr>
<tr>
<td></td>
<td>Arm Output</td>
<td>1 A (each of two separate outputs)</td>
</tr>
<tr>
<td>3.6.3</td>
<td>Output Leakage</td>
<td>10 mA (maximum)</td>
</tr>
<tr>
<td>3.6.4</td>
<td>Output Isolation</td>
<td>3 Mohm (minimum)</td>
</tr>
<tr>
<td>3.6.5</td>
<td>Noise Immunity</td>
<td>Yes - software programmable variable threshold</td>
</tr>
</tbody>
</table>
3.6.6 Telemetry Outputs

- **Pilot Tone Command**: 0 V for no Command, 4.5 V for Command
- **RF Signal Level**: 0 V to 4.75 V precision telemetry
- **Power Voltage Monitor**: 0 V to 4.5 V linear, 0 V for 24 Vdc B+, 4.5 V for 32 Vdc B+
- **Temperature Monitor**: 0 to 4.85 V linear, 0 V for -40°C, 4.85 V for +85°C
- **EED Monitor**: 0 V to 4.5 V, proportional to resistance across Destruct output
  - 0.5 V for 1 ohm, 3.5 V for 25 ohms (active only for 5 seconds after self-test)
- **Battery Voltage Monitor**: Differential Output, 0 mV for 0 Vdc, 100 mV for 40 Vdc
- **Input Current Monitor**: Differential Output, 0 mV for 0 A, 50 mV for 10 A
- **ARM**: 4.5 V with Command, 0 V no Command
- **DESTRUCT**: 4.5 V with Command, 0 V no Command
- **Disable**: 4.5 V with Command, 0 V no Command
- **Reset**: 4.5 V with Command, 0 V no Command
- **Self Test**: 4.5 V for 15 seconds following Command, 0 V for no Command
- **ISDS Loop**: 4.5 V for closed breakwire, 0 V for open breakwire
- **ISDS Safe/Arm**: 4.5 V for ISDS Armed, 0 V for ISDS not Armed
- **INTERNAL ON**: 4.5 V for ON condition, 0 V for OFF
3.7 POWER SUPPLY

3.7.1 Supply Voltage
24 to 35 Vdc

3.7.2 Power Consumption
Standby: 0.16 A
Interrogate: 0.16 A (plus output current)

3.7.3 Power Supply Isolation
Yes, dc-to-dc converter

3.8 ELECTROMAGNETIC INTERFERENCE

3.8.1 RFI Suppression
Meets MIL-STD-461B

3.8.2 AM Rejection
100 percent, 3 µV or more

3.8.3 Image Rejection
60 dB (minimum), 100 dB typical

3.8.4 Spurious Response Rejection
80 dB (minimum), 100 dB typical

3.9 ENVIRONMENTAL CHARACTERISTICS

3.9.1 Operating Temperature Range
-34°C to +71°C

3.9.2 Nondestructive Temperatures
(Shelf Storage)
-34°C to +71°C

3.9.3 Humidity
100 percent

3.9.4 Shock
1,000 g (0.8 to 3.0 kHz)

3.9.5 Vibration
33.4 g rms random

3.9.6 Pressurization
Not required

3.9.7 Shelf Life
10 years

3.10 PHYSICAL CHARACTERISTICS

3.10.1 Volume
<160-in³

3.10.2 Dimensions
3.0 x 7.0 x 7.5-in
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.10.3</td>
<td>Weight</td>
<td>5.5 pounds (typical)</td>
</tr>
<tr>
<td>3.10.4</td>
<td>Mounting Attitude</td>
<td>Any</td>
</tr>
<tr>
<td>3.10.5</td>
<td>External Adjustments</td>
<td>None</td>
</tr>
<tr>
<td>3.10.6</td>
<td>Connector Types</td>
<td></td>
</tr>
<tr>
<td></td>
<td>J1, RF Input</td>
<td>TNC M39012/32-0001</td>
</tr>
<tr>
<td></td>
<td>J2, Power</td>
<td>MS27505E-15-F19PC</td>
</tr>
<tr>
<td></td>
<td>J3, Telemetry</td>
<td>MS27505E-13-F35S</td>
</tr>
<tr>
<td></td>
<td>J4, Code Insertion</td>
<td>MS3112E-10-6PW</td>
</tr>
<tr>
<td></td>
<td>J5, ARM</td>
<td>ST396R8N4SN</td>
</tr>
<tr>
<td></td>
<td>J6, ISDS Breakwire A</td>
<td>MS27505-9-F35SA</td>
</tr>
<tr>
<td></td>
<td>J7, ISDS Breakwire B</td>
<td>MS27505E-9-F35S</td>
</tr>
<tr>
<td></td>
<td>J8, DESTRUCT</td>
<td>ST222R10N3SY</td>
</tr>
<tr>
<td></td>
<td>J9, DESTRUCT B</td>
<td>ST222R10N3SN</td>
</tr>
</tbody>
</table>
4. LORAL CONIC
   9020 Balboa Ave.
   San Diego, CA 92123-1595
   (Phone: 619-279-0411)

FLIGHT TERMINATION RECEIVERS
   Model FTR-515
   Model FTR-550
   Model FTR-551
   Model FTR-575
   Model FTR-905
   Model FTR-915

COMMAND DESTRUCT RECEIVERS
   Model CCR-200
   Model CDR-200
   Model CDR-222
   Model CDR-555
1. **GENERAL DESCRIPTION**

The Loral Conic Model FTR-515 Flight Termination Receiver is designed for missile range safety usage on programs with stringent environmental requirements. The design comprises a dual-conversion receiver, phase-locked tone decoders and relay logic. The unit also features fail-safe circuits for both carrier and power. Several design versions of the FTR-515 exist offering solid state outputs, power control and wider IF bandwidth for external audio/decoder interface.

2. **BACKGROUND**

The Model FTR-515 Flight Termination Receiver has been used on the AMRAAM program. Later configurations of the design have been used on HEDI, Pershing II, Eris, FOGM, and ERINT.

3. **TECHNICAL SPECIFICATIONS**

3.1 RF SECTION

3.1.1 Frequency Range (Tuneable) 405 to 486 MHz

3.1.2 Threshold Sensitivity (Command Output) 1 μV

3.1.3 Maximum Useable RF Input 2 Vrms

3.1.4 Operating Bandwidth ±45 kHz

3.1.5 Antenna Impedance 50 ohms (nominal)

3.1.6 VSWR 2:1 maximum

3.1.7 Local Oscillator Stability ±0.003 percent

3.1.8 Tuning Accuracy ±0.005 percent

3.1.9 Tuning Method Fixed frequency, crystal-controlled
### IF SECTION (DUAL CONVERSION)

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2.1 IF Frequency</td>
<td>10.7 MHz 2nd IF</td>
</tr>
<tr>
<td>3.2.2 Selectivity, 60 dB</td>
<td>±180 kHz maximum</td>
</tr>
<tr>
<td>3.2.3 Capture Ratio</td>
<td>&lt;1 dB</td>
</tr>
</tbody>
</table>

### AUDIO SECTION

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3.1 Audio Amplifier Response</td>
<td>500 Hz to 80 kHz</td>
</tr>
<tr>
<td>3.3.2 Audio Amplifier Distortion</td>
<td>&lt;3 percent</td>
</tr>
<tr>
<td>3.3.3 Audio Output</td>
<td>1 Vp-p for 30 kHz peak deviation (selected configuration only)</td>
</tr>
<tr>
<td>3.3.4 Frequency Deviation</td>
<td>30 ±6 kHz peak per tone</td>
</tr>
</tbody>
</table>

### DECODER SECTION

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.4.1 Number of Decoder Channels</td>
<td>3</td>
</tr>
<tr>
<td>3.4.2 Number of Simultaneous Useable Tones</td>
<td>3</td>
</tr>
<tr>
<td>3.4.3 Tone Channel Bandwidth</td>
<td>&gt;±1 percent at 2 dB</td>
</tr>
<tr>
<td>3.4.4 Adjacent Channel Rejection</td>
<td>34 dB</td>
</tr>
<tr>
<td>3.4.5 Decoder Threshold Deviation</td>
<td>15 kHz (nominal)</td>
</tr>
</tbody>
</table>

### OUTPUT

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5.1 Types of Output</td>
<td>Relay or solid-state (28 V out)</td>
</tr>
<tr>
<td>3.5.2 Output Current Capability</td>
<td>3 A relay</td>
</tr>
<tr>
<td></td>
<td>2 A solid-state</td>
</tr>
<tr>
<td></td>
<td>7.5 A peak 10 ms</td>
</tr>
</tbody>
</table>
3.5.3 Output Leakage

3.5.4 Logic Circuit

3.5.5 Response Time for Commands

3.5.6 Transition Time Between Commands

3.5.7 Output Isolation

3.5.8 Noise Immunity

3.5.9 Telemetry Outputs

3.5.9.1 Signal Strength

3.5.9.2 Output Arm Monitor

3.5.9.3 Output Enable Monitor

3.5.9.4 Tone Monitors

<table>
<thead>
<tr>
<th>AMRAAM Logic Only</th>
<th>Present</th>
<th>Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other Tone Monitor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Levels Available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tone 1</td>
<td>&quot;1&quot;</td>
<td>&quot;0&quot;</td>
</tr>
<tr>
<td>Tone 2</td>
<td>&quot;1&quot;</td>
<td>&quot;0&quot;</td>
</tr>
<tr>
<td>Tone 3</td>
<td>&quot;1&quot;</td>
<td>&quot;0&quot;</td>
</tr>
</tbody>
</table>

Logic "1" = 18 ±3 Vdc
Logic "0" = 0.0 to 0.5 Vdc

3.6 POWER SUPPLY

3.6.1 Supply Voltage

3.6.2 Power Requirements
<table>
<thead>
<tr>
<th>3.6.3</th>
<th>Power Supply Isolation</th>
<th>Return connected to case or can be isolated greater than 1 Mohm</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.6.4</td>
<td>Turn-On Power Control for Receiver</td>
<td>Available by 28 V latching relay</td>
</tr>
<tr>
<td>3.6.5</td>
<td>Other Controls</td>
<td>Loss of carrier fail-safe (circuit can be enabled by using external transistor-transistor logic (TTL) level or internal level provided at connector)</td>
</tr>
</tbody>
</table>

3.7 ELECTROMAGNETIC INTERFERENCE

<table>
<thead>
<tr>
<th>3.7.1</th>
<th>RFI Suppression</th>
<th>Meets MIL-STD-461</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.7.2</td>
<td>Pulse Rejection</td>
<td>Not measured</td>
</tr>
<tr>
<td>3.7.3</td>
<td>AM Rejection</td>
<td>AM carriers will not cause command output</td>
</tr>
<tr>
<td>3.7.4</td>
<td>Image Rejection</td>
<td>60 dB minimum</td>
</tr>
</tbody>
</table>

3.8 ENVIRONMENTAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>3.8.1</th>
<th>Operating Temperature Range (Continuous)</th>
<th>-40°C to +77°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.8.2</td>
<td>Nondestructive Temperatures (Shelf Storage)</td>
<td>-65°C to +125°C</td>
</tr>
<tr>
<td>3.8.3</td>
<td>Humidity</td>
<td>95 percent</td>
</tr>
<tr>
<td>3.8.4</td>
<td>Altitude</td>
<td>Unlimited</td>
</tr>
<tr>
<td>3.8.5</td>
<td>Shock</td>
<td>60 g, 5 ms</td>
</tr>
<tr>
<td>3.8.6</td>
<td>Acceleration</td>
<td>40 g, each axis</td>
</tr>
<tr>
<td>3.8.7</td>
<td>Vibration</td>
<td>16 g rms, random</td>
</tr>
<tr>
<td>3.8.8</td>
<td>Acoustics</td>
<td>Not measured</td>
</tr>
<tr>
<td>3.8.9</td>
<td>Pressurization</td>
<td>Not measured</td>
</tr>
<tr>
<td>Section</td>
<td>Description</td>
<td>Details</td>
</tr>
<tr>
<td>---------</td>
<td>----------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>3.8.10</td>
<td>Operating Life</td>
<td>MTBF = 5,000 hours minimum</td>
</tr>
<tr>
<td>3.8.11</td>
<td>Shelf Life</td>
<td>5 years</td>
</tr>
<tr>
<td>3.9</td>
<td>PHYSICAL CHARACTERISTICS</td>
<td></td>
</tr>
<tr>
<td>3.9.1</td>
<td>Volume</td>
<td>18-in$^3$</td>
</tr>
<tr>
<td>3.9.2</td>
<td>Dimensions</td>
<td>See Outline Drawing</td>
</tr>
<tr>
<td>3.9.3</td>
<td>Weight</td>
<td>22 ounces</td>
</tr>
<tr>
<td>3.9.4</td>
<td>Mounting Attitude</td>
<td>Any</td>
</tr>
<tr>
<td>3.9.5</td>
<td>External Adjustments</td>
<td>None</td>
</tr>
<tr>
<td>3.9.6</td>
<td>Connector Types</td>
<td>RF Input (J1): SMA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Power, Command (J2): DAH-15P-101</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Subminiature connectors available</td>
</tr>
</tbody>
</table>
Figure 4-1. Outline drawing of LC Model FTR-515 Flight Termination Receiver.
1. GENERAL DESCRIPTION

The Loral Conic Model FTR-550 Flight Termination Receiver is designed specifically for missile range safety usage on programs with stringent environmental and reliability requirements. The dual-conversion receiver, phase-locked tone decoders and logic circuitry are features of a design that meets the latest range requirements. Each unit undergoes extensive burn-in and acceptance testing prior to shipment. The FTR-550 is well suited for high-reliability applications where ruggedized, lightweight, miniature construction and high performance are required.

2. BACKGROUND

The Model FTR-550 is fully qualified to NAVAIR Drawing Number 642AS8859 in both solid-state and relay versions. The FTR-550 has been used the HARPOON, SLAM, SLAT, and VANDAL programs. The FTR-550 replaces the Loral Model CDR-200.

3. TECHNICAL SPECIFICATIONS

3.1 RF SECTION

3.1.1 Frequency Range (Tuneable) 405 to 486 MHz

3.1.2 Threshold Sensitivity (Command Output) 2 μV

3.1.3 Maximum Useable RF Input 2 Vrms

3.1.4 Operating Bandwidth ±45 kHz

3.1.5 Antenna Impedance 50 ohms (nominal)

3.1.6 VSWR 2:1 maximum

3.1.7 Local Oscillator Stability ±0.005 percent

3.1.8 Tuning Accuracy ±0.005 percent

3.1.9 Tuning Method Fixed frequency, crystal-controlled
<table>
<thead>
<tr>
<th>Section</th>
<th>Specification Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3.2 IF SECTION (DUAL CONVERSION)</strong></td>
<td>109 MHz to 130 MHz 1st IF (center frequency controlled)</td>
</tr>
<tr>
<td>3.2.1 IF Frequency</td>
<td>10.7 MHz 2nd IF</td>
</tr>
<tr>
<td>3.2.2 Selectivity, 60 dB</td>
<td>±180 kHz maximum</td>
</tr>
<tr>
<td>3.2.3 Capture Ratio</td>
<td>&lt;0.8 dB</td>
</tr>
<tr>
<td><strong>3.3 AUDIO SECTION</strong></td>
<td></td>
</tr>
<tr>
<td>3.3.1 Audio Amplifier Response</td>
<td>500 Hz to 80 kHz</td>
</tr>
<tr>
<td>3.3.2 Audio Amplifier Distortion</td>
<td>&lt;3 percent</td>
</tr>
<tr>
<td>3.3.3 Audio Output</td>
<td>N/A</td>
</tr>
<tr>
<td>3.3.4 Frequency Deviation</td>
<td>30 ±6 kHz peak per tone</td>
</tr>
<tr>
<td><strong>3.4 DECODER SECTION</strong></td>
<td></td>
</tr>
<tr>
<td>3.4.1 Number of Decoder Channels</td>
<td>3 (4 on request)</td>
</tr>
<tr>
<td>3.4.2 Number of Simultaneous Useable Tones</td>
<td>3 (4 on request)</td>
</tr>
<tr>
<td>3.4.3 Tone Channel Bandwidth</td>
<td>±1 percent minimum at 2 dB</td>
</tr>
<tr>
<td>3.4.4 Adjacent Channel Rejection</td>
<td>40 dB</td>
</tr>
<tr>
<td>3.4.5 Decoder Threshold Deviation</td>
<td>15 kHz (nominal)</td>
</tr>
<tr>
<td><strong>3.5 OUTPUT</strong></td>
<td></td>
</tr>
<tr>
<td>3.5.1 Types of Output</td>
<td>Relay, 28 V (nominal) or solid-state</td>
</tr>
<tr>
<td>3.5.2 Output Current Capability</td>
<td>2 A per command all within 1 V of supply voltage for relay outputs. Solid-state within 2.5 V for destruct and 1.5 V for all other command outputs</td>
</tr>
</tbody>
</table>
### 3.5.3 Output Leakage

None - for relay

50 μA (maximum) (typically 0.5 μA) solid-state

### 3.5.4 Logic Circuit

1, 5 ON = Monitor, Arm
1 ON = Arm
2, 5 ON = Monitor, Optional
1, 2, 5 ON = Monitor, Arm, Optional
5 ON = Monitor
1, 2, 5 ON Remove 5 = Terminate, Arm

### 3.5.5 Response Time for Commands

15 ms (nominal); 25 ms (maximum)

### 3.5.6 Transition Time Between Commands

3 ms

### 3.5.7 Output Isolation

>1 Mohm from chassis

### 3.5.8 Noise Immunity

>12 dB for decoder channels on unquieted noise (interruption of primary power or RF power to unit will not cause relay closure)

### 3.5.9 Telemetry Outputs

With no RF input, the quiescent level is a nominal 0.50 ±0.25 V, increasing to a value not to exceed 4.75 ±0.25 V at an RF level of -40 dBm. The slope is positive and does not change direction over the RF signal dynamic range.

### 3.6 POWER SUPPLY

#### 3.6.1 Supply Voltage

24 to 36 Vdc

#### 3.6.2 Power Requirements

180 mA standby; 300 mA for commands

#### 3.6.3 Power Supply Isolation

1 Mohm from chassis and signal strength monitor

#### 3.6.4 Turn-On Power Control for Receiver

N/A

#### 3.6.5 Other Controls

N/A
### 3.7 ELECTROMAGNETIC INTERFERENCE

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.7.1 RFI Suppression</td>
<td>Meets MIL-STD-461 for antenna, power and signal leads</td>
<td>RS03: 20 V/m, CS04, CS08: Limits A and B, 60 dB</td>
</tr>
<tr>
<td>3.7.2 Pulse Rejection</td>
<td>Immune to C-Band and X-Band radar transponder signals applied to antenna port at peak power levels of +27 dBm</td>
<td></td>
</tr>
<tr>
<td>3.7.3 AM Rejection</td>
<td>Application of carrier amplitude modulated up to 95 percent will not cause command outputs</td>
<td></td>
</tr>
<tr>
<td>3.7.4 Image Rejection</td>
<td>60 dB minimum</td>
<td></td>
</tr>
</tbody>
</table>

### 3.8 ENVIRONMENTAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.8.1 Operating Temperature Range (Continuous)</td>
<td>-54°C to +80°C</td>
<td></td>
</tr>
<tr>
<td>3.8.2 Nondestructive Temperatures (Shelf Storage)</td>
<td>-65°C to +125°C</td>
<td></td>
</tr>
<tr>
<td>3.8.3 Humidity</td>
<td>95 percent</td>
<td></td>
</tr>
<tr>
<td>3.8.4 Altitude/Temperature</td>
<td>100,000 feet minimum at -54°C</td>
<td></td>
</tr>
<tr>
<td>3.8.5 Shock</td>
<td>Relay 100 g, 6.0 ms, Solid-state 1,100 g for 0.5 ms</td>
<td></td>
</tr>
<tr>
<td>3.8.6 Acceleration</td>
<td>100 g</td>
<td></td>
</tr>
<tr>
<td>3.8.7 Vibration</td>
<td>15 g-peak sinusoidal; 0.06 g² random or 10 g rms</td>
<td></td>
</tr>
<tr>
<td>3.8.8 Acoustics</td>
<td>Not measured</td>
<td></td>
</tr>
<tr>
<td>3.8.9 Pressurization</td>
<td>30 lb/in² 30 minutes</td>
<td></td>
</tr>
</tbody>
</table>
3.8.10 Operating Life
MTBF = 5,000 hours minimum

3.8.11 Shelf Life
5 years

3.9 PHYSICAL CHARACTERISTICS

3.9.1 Volume
25-in³

3.9.2 Dimensions
See Outline Drawing

3.9.3 Weight
22 ounces maximum

3.9.4 Mounting Attitude
Any

3.9.5 External Adjustments
None

3.9.6 Connector Types
RF Input (J1): TNC receptacle
Power (J2): MS3112E-8-4P
Command (J3): MS3112E-10-6S
Monitor (J4): MS3112E-8-4S
Figure 4-3. Outline drawing of LC Model FTR-550 Flight Termination Receiver.
Figure 4-4. LC Model FTR-550 Flight Termination Receiver.
1. **GENERAL DESCRIPTION**

   The Loral Conic Model FTR-551 Flight Termination Receiver is designed specifically for missile range flight safety usage on programs with stringent environmental and reliability requirements. The dual-conversion receiver, a tone decoder and logic circuitry comprise a design that meets the latest range requirements. Each unit undergoes extensive burn-in and acceptance testing prior to shipment. The FTR-551 is well suited for high-reliability applications where ruggedized, lightweight, miniature construction and high performance are required.

2. **BACKGROUND**

   The Model FTR-551 is fully qualified to NAVAIR Drawing Number 1588AS103. The FTR-551 has been used with AQM-37C.

3. **TECHNICAL SPECIFICATIONS**

   **3.1 RF SECTION**

   3.1.1 Frequency Range (Tuneable) 405 to 486 MHz
   3.1.2 Threshold Sensitivity (Command Output) 2 μV
   3.1.3 Maximum Useable RF Input 2 Vrms
   3.1.4 Operating Bandwidth ±45 kHz
   3.1.5 Antenna Impedance 50 ohms (nominal)
   3.1.6 VSWR 2:1 maximum
   3.1.7 Local Oscillator Stability ±0.005 percent
   3.1.8 Tuning Accuracy ±0.005 percent
   3.1.9 Tuning Method Fixed frequency, crystal-controlled
3.2 IF SECTION (DUAL CONVERSION)

3.2.1 IF Frequency
- 109 MHz to 130 MHz 1st IF
- 10.7 MHz 2nd IF

3.2.2 Selectivity, 60 dB
±375 kHz maximum

3.2.3 Capture Ratio
<1 dB

3.3 AUDIO SECTION

3.3.1 Audio Amplifier Response
500 Hz to 80 kHz

3.3.2 Audio Amplifier Distortion
<3 percent

3.3.3 Audio Output
1 Vp-p at 10 kHz

3.3.4 Frequency Deviation
30 ±6 kHz peak per tone

3.4 DECODER SECTION

3.4.1 Number of Decoder Channels
3

3.4.2 Number of Simultaneous Useable Tones
3

3.4.3 Tone Channel Bandwidth
±1 percent minimum at 2 dB

3.4.4 Adjacent Channel Rejection
40 dB

3.4.5 Decoder Threshold Deviation
16 kHz (nominal)

3.5 OUTPUT

3.5.1 Types of Output
Solid-state

3.5.2 Output Current Capability
2.0 A per command within 2.5 V of supply voltage for destruct and 1.5 V for all other commands

3.5.3 Output Leakage
50 μA maximum
### 3.5.4 Logic Circuit
- `5 ON = Monitor`
- `2, 5 ON = Monitor, Optional`
- `1, 5 ON = Arm, Monitor`
- `1, 2, 5 ON = Arm, Monitor, Optional`
- `1, 2, 5 ON, 5 OFF = Arm, Terminate`

### 3.5.5 Response Time for Commands
- 15 ms (nominal); 20 ms (maximum)

### 3.5.6 Transition Time Between Commands
- 3 ms

### 3.5.7 Output Isolation
- >1 Mohm from chassis

### 3.5.8 Noise Immunity
- 12 dB minimum noise margin on decoder channels for unquilted noise; no command output will occur during application or removal of primary power

### 3.5.9 Signal Strength Telemetry Output
With no RF input, the quiescent level is a nominal 0.50 ±0.25 V, increasing to a value not to exceed 4.75 ±0.25 V at an RF level of -40 dBm. The slope is positive and does not change direction over the RF signal dynamic range.

### 3.6 POWER SUPPLY

#### 3.6.1 Supply Voltage
- 24 to 36 Vdc

#### 3.6.2 Power Requirements
- 180 mA standby; 300 mA for commands

#### 3.6.3 Power Supply Isolation
- The unit has a minimum of 1 Mohm between:
  - Case and primary power return
  - Case and command outputs
  - Case and signal strength telemetry
  - Primary power return and signal strength telemetry

#### 3.6.4 Turn-On Power Control for Receiver
- N/A

#### 3.6.5 Other Controls
- N/A
3.7 ELECTROMAGNETIC INTERFERENCE

3.7.1 RFI Suppression

Meets MIL-STD-461 for antenna, power and signal leads

RS03: 20 V/m
CS04, CS08: Limits A and B, 60 dB

3.7.2 Pulse Rejection

Specific band signal rejection at the antenna port

Bands D & E at +10 dBm
Bands G, H, I, & J at +40 dBm

3.7.3 AM Rejection

AM carriers will not cause command output

3.7.4 Image Rejection

60 dB minimum

3.8 ENVIRONMENTAL CHARACTERISTICS

3.8.1 Operating Temperature Range

(Continuous)

-54°C to +80°C

3.8.2 Nondestructive Temperatures

(Shelf Storage)

-65°C to +125°C

3.8.3 Humidity

95 percent

3.8.4 Altitude/Temperature

100,000 feet minimum at -54°C

3.8.5 Shock

100 g for 6 ms

3.8.6 Acceleration

100 g

3.8.7 Vibration

10 g random
15 g sine

3.8.8 Acoustics

Not measured

3.8.9 Pressurization

30 lb/in², 30 minutes

3.8.10 Operating Life

MTBF = 5,000 hours minimum

3.8.11 Shelf Life

5 years
### 3.9 PHYSICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>3.9.1</th>
<th>Volume</th>
<th>25-in³</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.9.2</td>
<td>Dimensions</td>
<td>See Outline Drawing</td>
</tr>
<tr>
<td>3.9.3</td>
<td>Weight</td>
<td>22 ounces maximum</td>
</tr>
<tr>
<td>3.9.4</td>
<td>Mounting Attitude</td>
<td>Any</td>
</tr>
<tr>
<td>3.9.5</td>
<td>External Adjustments</td>
<td>None</td>
</tr>
</tbody>
</table>
| 3.9.6 | Connector Types | RF Input (J1): TNC receptacle  
Power (J2): MS3112E-8-4P  
Monitor (J3): MS3112E-10-6S  
Command (J4): MS3112E-8-4S |
Figure 4-5. Outline drawing of LC Model FTR-551 Flight Termination Receiver.
LORAL CONIC

FLIGHT TERMINATION RECEIVER

MODEL FTR-575

1. GENERAL DESCRIPTION

The Loral Conic Model FTR-575 Flight Termination Receiver is designed for missile range flight safety usage on programs with stringent environmental requirements. The FTR-575 is a redundant unit, each supplied by either of two antenna connectors via a RF power divider combiner. Phase-locked tone decoders and solid state output commands are featured in this unit.

2. BACKGROUND

The Model FTR-575 has used with SICBM. The unit is fully qualified.

3. TECHNICAL SPECIFICATIONS

3.1 RF SECTION

3.1.1 Frequency Range (Tuneable) 405 to 486 MHz
3.1.2 Threshold Sensitivity (Command Output) 3 \( \mu V \)
3.1.3 Maximum Useable RF Input 2 Vrms
3.1.4 Operating Bandwidth \( \pm 50 \) kHz
3.1.5 Antenna Impedance 50 ohms (nominal)
3.1.6 VSWR 1.5:1 maximum
3.1.7 Local Oscillator Stability \( \pm 0.003 \) percent
3.1.8 Tuning Accuracy \( \pm 0.003 \) percent
3.1.9 Tuning Method Fixed frequency, crystal-controlled
3.2 IF SECTION (DUAL CONVERSION)
3.2.1 IF Frequency
101.5 MHz 1st IF
10.7 MHz 2nd IF
3.2.2 Selectivity, 60 dB
±180 kHz maximum
3.2.3 Capture Ratio
<1 dB

3.3 AUDIO SECTION
3.3.1 Audio Amplifier Response
500 Hz to 80 kHz
3.3.2 Audio Amplifier Distortion
<3 percent
3.3.3 Audio Output
N/A
3.3.4 Frequency Deviation
30 ±6 kHz peak per tone

3.4 DECODER SECTION
3.4.1 Number of Decoder Channels
4
3.4.2 Number of Simultaneous Useable Tones
4
3.4.3 Tone Channel Bandwidth
>1 percent at 2 dB
3.4.4 Adjacent Channel Rejection
34 dB
3.4.5 Decoder Threshold Deviation
14 kHz (nominal)

3.5 OUTPUT
3.5.1 Types of Output
Solid-state
3.5.2 Output Current Capability
1 A
3.5.3 Output Leakage
50 μA maximum
3.5.4 Logic Circuit
Tone 4 = Check
Tone 1, Tone 2, Tone 3 = Arm
Tone 1, Tone 2, Tone 3 OFF = Arm, Destruct
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5.5</td>
<td>Response Time for Commands</td>
<td>15 ms maximum</td>
</tr>
<tr>
<td>3.5.6</td>
<td>Transition Time Between Commands</td>
<td>&lt;5 ms</td>
</tr>
<tr>
<td>3.5.7</td>
<td>Output Isolation</td>
<td>Power and command returns isolated from chassis (can be connected)</td>
</tr>
<tr>
<td>3.5.8</td>
<td>Noise Immunity</td>
<td>13 dB minimum noise margin on decoder channels for unquieted noise</td>
</tr>
<tr>
<td>3.5.9</td>
<td>Telemetry Outputs</td>
<td></td>
</tr>
<tr>
<td>3.5.9.1</td>
<td>Signal Strength</td>
<td>No RF: 0.50 ±0.25 Vdc; -97.4 dBm: 0.25 Vdc above no RF reading; -40.0 dBm: 4.75 ±0.20 Vdc</td>
</tr>
<tr>
<td>3.5.9.2</td>
<td>Tone Monitors</td>
<td>Monitors Tone Channel Status:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Present: &quot;1&quot; Absent: &quot;0&quot;</td>
</tr>
<tr>
<td></td>
<td>Tone 1</td>
<td>&quot;1&quot; &quot;0&quot;</td>
</tr>
<tr>
<td></td>
<td>Tone 2</td>
<td>&quot;1&quot; &quot;0&quot;</td>
</tr>
<tr>
<td></td>
<td>Tone 3</td>
<td>&quot;1&quot; &quot;0&quot;</td>
</tr>
<tr>
<td></td>
<td>Tone 4</td>
<td>&quot;1&quot; &quot;0&quot;</td>
</tr>
<tr>
<td></td>
<td>Logic &quot;1&quot;</td>
<td>3.5 ±1.5 Vdc</td>
</tr>
<tr>
<td></td>
<td>Logic &quot;0&quot;</td>
<td>0.0 to 0.8 Vdc</td>
</tr>
<tr>
<td>3.6</td>
<td>POWER SUPPLY</td>
<td></td>
</tr>
<tr>
<td>3.6.1</td>
<td>Supply Voltage</td>
<td>22 to 33 Vdc</td>
</tr>
<tr>
<td>3.6.2</td>
<td>Power Requirements</td>
<td>284 mA standby; 350 mA for command</td>
</tr>
<tr>
<td>3.6.3</td>
<td>Power Supply Isolation</td>
<td>Return isolated by from case</td>
</tr>
<tr>
<td>3.6.4</td>
<td>Turn-On Power Control for Receiver</td>
<td>None</td>
</tr>
<tr>
<td>3.6.5</td>
<td>Other Controls</td>
<td>None</td>
</tr>
</tbody>
</table>
3.7 ELECTROMAGNETIC INTERFERENCE

3.7.1 RFI Suppression Meets MIL-STD-461
3.7.2 Pulse Rejection Not measured
3.7.3 AM Rejection AM carriers will not cause command output
3.7.4 Image Rejection 60 dB minimum

3.8 ENVIRONMENTAL CHARACTERISTICS

3.8.1 Operating Temperature Range -10°C to +71°C (Continuous)
3.8.2 Nondestructive Temperatures -65°C to +125°C (Shelf Storage)
3.8.3 Humidity 95 percent
3.8.4 Altitude Unlimited
3.8.5 Shock 60 g, 5 ms 25 kg peak pyro
3.8.6 Acceleration 40 g, each axis
3.8.7 Vibration 25.5 g rms, random
3.8.8 Acoustics Not measured
3.8.9 Pressurization Not measured
3.8.10 Operating Life MTBF = 5,000 hours minimum
3.8.11 Shelf Life 5 years

3.9 PHYSICAL CHARACTERISTICS

3.9.1 Volume 51-in\(^3\)
3.9.2 Dimensions See Outline Drawing
3.9.3 Weight
2 pounds, 12 ounces maximum

3.9.4 Mounting Attitude
Any

3.9.5 External Adjustments
None

3.9.6 Connector Types
RF Input (J1, J2): SMA
J3: D38999/41YB5PN
J4: D38999/41YB5PA
J5: D38999/41YB35PN
J6: D38999/41YB55PA
Figure 4-7. Outline drawing of LC Model FTR-575 Flight Termination Receiver.
1. GENERAL DESCRIPTION

The Loral Conic Model FTR-905 Miniature Flight Termination Receiver is specifically designed for today's missiles range safety usage on programs with stringent environmental requirements requiring smaller and lightweight components. The FTR-905 accomplishes this by use of state-of-the-art hybrid technology. The FTR-905 accomplishes this by use of state-of-the-art hybrid technology. The FTR-905 represents a major breakthrough in miniaturization. The modular design of the unit lends itself well to other configurations and mounting provisions. The unit also features fail-safe circuits for both carrier and power.

2. BACKGROUND

The Model FTR-905 is being used on the AMRAAM program.

3. TECHNICAL SPECIFICATIONS

3.1 RF SECTION

3.1.1 Frequency Range (Tuneable) 406 to 550 MHz
3.1.2 Threshold Sensitivity (Command Output) 1 μV
3.1.3 Maximum Useable RF Input 1 Vrms
3.1.4 Operating Bandwidth ±45 kHz
3.1.5 Antenna Impedance 50 ohms (nominal)
3.1.6 VSWR 2:1 maximum
3.1.7 Local Oscillator Stability ±0.003 percent
3.1.8 Tuning Accuracy ±0.003 percent
3.1.9 Tuning Method Fixed frequency, crystal-controlled
3.2 IF SECTION

3.2.1 IF Frequency
24 MHz

3.2.2 Selectivity, 60 dB
±180 kHz maximum

3.2.3 Capture Ratio
<1 dB

3.3 AUDIO SECTION

3.3.1 Audio Amplifier Response
500 Hz to 80 kHz

3.3.2 Audio Amplifier Distortion
<3 percent

3.3.3 Audio Output
N/A

3.3.4 Frequency Deviation
30 ±6 kHz peak per tone

3.4 DECODER SECTION

3.4.1 Number of Decoder Channels
3

3.4.2 Number of Simultaneous Useable Tones
3

3.4.3 Tone Channel Bandwidth
>1 percent at 2 dB

3.4.4 Adjacent Channel Rejection
34 dB

3.4.5 Decoder Threshold Deviation
15 kHz (nominal)

3.5 OUTPUT

3.5.1 Types of Output
Solid-state

3.5.2 Output Current Capability
3 A

3.5.3 Output Leakage
50 µA maximum

3.5.4 Logic Circuit
Tone 2, Tone 3 = Optional, Monitor
Tone 1, Tone 3 = Monitor, Arm
Tone 1, Tone 3 OFF, Tone 2 = Destruct, Arm
3.5.5  Response Time for Commands  25 ms maximum
3.5.6  Transition Time Between Commands <3 ms
3.5.7  Output Isolation  Power and command returns isolated to chassis (can be connected)
3.5.8  Noise Immunity  12 dB minimum noise margin on decoder channels for unquieted noise; removal of prime power enables fail-safe circuit; fail-safe circuit immune to EMI on power leads
3.5.9  Telemetry Outputs
3.5.9.1  Signal Strength  No RF: 0.50 ±0.25 Vdc
-101 dBm: 0.25 Vdc above no RF reading
-41 dBm: 4.75 ±0.25 Vdc
3.5.9.2  Tone Monitors  Monitors Tone Channel Status

<table>
<thead>
<tr>
<th></th>
<th>Present</th>
<th>Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tone 1</td>
<td>&quot;1&quot;</td>
<td>&quot;0&quot;</td>
</tr>
<tr>
<td>Tone 2</td>
<td>&quot;1&quot;</td>
<td>&quot;0&quot;</td>
</tr>
<tr>
<td>Tone 3</td>
<td>&quot;1&quot;</td>
<td>&quot;0&quot;</td>
</tr>
<tr>
<td>Tone 4</td>
<td>&quot;1&quot;</td>
<td>&quot;0&quot;</td>
</tr>
</tbody>
</table>

Logic "1" = Vcc ±3 Vdc  
Logic "0" = 0.0 to 0.5 Vdc

3.6  POWER SUPPLY
3.6.1  Supply Voltage  Command Power: 22 to 35 Vdc  
Receiver Power: 19 to 21 Vdc
3.6.2  Power Requirements  230 mA
3.6.3  Power Supply Isolation  Return isolated from case by 1 Mohm minimum
3.6.4  Turn-On Power Control for Receiver  None
3.6.5  Other Controls  Loss of carrier fail-safe (circuit can be enabled by using external transistor-transistor logic (TTL) level or internal level provided at connector)
3.7 ELECTROMAGNETIC INTERFERENCE

3.7.1 RFI Suppression
Meets MIL-STD-461, CS04 limit 60 dB

3.7.2 Pulse Rejection
Immune to E-, G-, and I-Band at antenna port +27 dBm

3.7.3 AM Rejection
AM carriers will not cause command output

3.7.4 Image Rejection
60 dB minimum

3.8 ENVIRONMENTAL CHARACTERISTICS

3.8.1 Operating Temperature Range
(Continuous)
-40°C to +85°C

3.8.2 Nondestructive Temperatures
(Shelf Storage)
-65°C to +125°C

3.8.3 Humidity
97 percent

3.8.4 Altitude
100,000 feet minimum at -45°C

3.8.5 Shock
60 g, 5 ms

3.8.6 Acceleration
40 g, each axis

3.8.7 Vibration
10.28 g rms, random

3.8.8 Acoustics
Not measured

3.8.9 Pressurization
Not measured

3.8.10 Operating Life
MTBF = 5,000 hours minimum

3.8.11 Shelf Life
5 years

3.9 PHYSICAL CHARACTERISTICS

3.9.1 Volume
3.7-in³

3.9.2 Dimensions
See Outline Drawing

4-33
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.9.3</td>
<td>Weight</td>
<td>6.4 ounces</td>
</tr>
<tr>
<td>3.9.4</td>
<td>Mounting Attitude</td>
<td>Any</td>
</tr>
<tr>
<td>3.9.5</td>
<td>External Adjustments</td>
<td>None</td>
</tr>
<tr>
<td>3.9.6</td>
<td>Connector Types</td>
<td>RF Input (J2): SMA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Power, Command (J1): MDM-15S</td>
</tr>
</tbody>
</table>
Figure 4-9. Outline drawing of LC Model FTR-905 Miniature Flight Termination Receiver.
Figure 4-10. LC Model FTR-905 Miniature Flight Termination Receiver.
LORAL CONIC

FLIGHT TERMINATION RECEIVER

MODEL FTR-915

1. GENERAL DESCRIPTION

The Loral Conic Model FTR-915 Flight Termination Receiver is specifically designed for today's missile range safety usage on programs requiring smaller and lightweight components with stringent environmental requirements. The FTR-915 is a miniature, state-of-the-art Flight Termination Receiver/Decoder.

2. BACKGROUND

The Model FTR-915 uses modern hybrid technology and packaging techniques while retaining the highly reliable functional and environmental integrity of Loral designs is fully qualified.

3. TECHNICAL SPECIFICATIONS

3.1 RF SECTION

3.1.1 Frequency Range (Tuneable) 405 to 486 MHz

3.1.2 Threshold Sensitivity (Command Output) 2 μV

3.1.3 Maximum Useable RF Input 1 Vrms

3.1.4 Operating Bandwidth ±45 kHz

3.1.5 Antenna Impedance 50 ohms (nominal)

3.1.6 VSWR 2:1 maximum

3.1.7 Local Oscillator Stability ±0.005 percent

3.1.8 Tuning Accuracy ±0.005 percent

3.1.9 Tuning Method Fixed frequency, crystal-controlled
3.2 IF SECTION (DUAL CONVERSION)

3.2.1 IF Frequency 24 MHz

3.2.2 Selectivity, 60 dB ±180 kHz maximum ±375 kHz maximum/with audio

3.2.3 Capture Ratio <1 dB

3.3 AUDIO SECTION

3.3.1 Audio Amplifier Response 500 Hz to 20 kHz

3.3.2 Audio Amplifier Distortion <3 percent

3.3.3 Audio Output 1 Vp-p at 10 kHz peak deviation

3.3.4 Frequency Deviation 30 ±6 kHz peak per tone

3.4 DECODER SECTION

3.4.1 Number of Decoder Channels 3

3.4.2 Number of Simultaneous Useable Tones 3

3.4.3 Tone Channel Bandwidth >±1 percent at 2 dB

3.4.4 Adjacent Channel Rejection 80 dB

3.4.5 Decoder Threshold Deviation 15 kHz (nominal)

3.5 OUTPUT

3.5.1 Types of Output Solid-state

3.5.2 Output Current Capability 2 A; 7.5 A peak 10 ms

3.5.3 Output Leakage 50 µA
3.5.4 Logic Circuit
Tone 1, Tone 3 ON = Arm
Tone 1 ON, Tone 3 OFF, Tone 2 ON = Destruct
Other sequences available

3.5.5 Response Time for Commands
25 ms maximum

3.5.6 Transition Time Between Commands
<3 ms

3.5.7 Output Isolation
Power and command returns isolated from chassis (can be connected)

3.5.8 Noise Immunity
12 dB minimum noise margin on decoder channels for unquieted noise

3.5.9 Telemetry Outputs

3.5.9.1 Signal Strength
No RF: 0.50 ±0.25 Vdc
-101 dBm: 0.25 Vdc above no RF reading
-30 dBm: 4.75 ±0.25 Vdc

3.5.9.2 Tone Monitors
Monitors Tone Channel Status

<table>
<thead>
<tr>
<th>Present</th>
<th>Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tone 1</td>
<td>&quot;1&quot;</td>
</tr>
<tr>
<td>Tone 2</td>
<td>&quot;1&quot;</td>
</tr>
<tr>
<td>Tone 3</td>
<td>&quot;1&quot;</td>
</tr>
</tbody>
</table>

Logic "1" = Vcc ±3 Vdc
Logic "0" = 0.0 to 0.5 Vdc

3.6 POWER SUPPLY

3.6.1 Supply Voltage
22 to 35 Vdc

3.6.2 Power Requirements
200 mA

3.6.3 Power Supply Isolation
Return isolated by from case

3.6.4 Turn-On Power Control for Receiver
None

3.6.5 Other Controls
N/A
3.7 ELECTROMAGNETIC INTERFERENCE

3.7.1 RFI Suppression
Meet MIL-STD-461, CS04 A and B - 60 dB

3.7.2 Pulse Rejection
Immune to E-, G-, and l-Band applied to antenna port +27 dBm

3.7.3 AM Rejection
AM carriers will not cause command output

3.7.4 Image Rejection
60 dB minimum

3.8 ENVIRONMENTAL CHARACTERISTICS

3.8.1 Operating Temperature Range
(-Continuous)
-54°C to +85°C

3.8.2 Nondestructive Temperatures
(Shelf Storage)
-65°C to +125°C

3.8.3 Humidity
97 percent

3.8.4 Altitude
250,000 feet minimum at -40°C

3.8.5 Shock
50 g, 11 ms half sine
20 g, 11 ms sawtooth
1,100 g, 0.5 ms pulse

3.8.6 Acceleration
100 g, each axis

3.8.7 Vibration
14.2 g rms, random

3.8.8 Acoustics
Not measured

3.8.9 Pressurization
30 lb/in², 30 minutes

3.8.10 Operating Life
MTBF = 8,500 hours minimum

3.8.11 Shelf Life
5 years

4-40
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.9.1</td>
<td>Volume</td>
<td>5.5-in³</td>
</tr>
<tr>
<td>3.9.2</td>
<td>Dimensions</td>
<td>See Outline Drawing</td>
</tr>
<tr>
<td>3.9.3</td>
<td>Weight</td>
<td>8 ounces</td>
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<tr>
<td>3.9.4</td>
<td>Mounting Attitude</td>
<td>Any</td>
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<td>3.9.5</td>
<td>External Adjustments</td>
<td>None</td>
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<tr>
<td>3.9.6</td>
<td>Connector Types</td>
<td>RF Input (J1): SMA</td>
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<tr>
<td></td>
<td></td>
<td>Power, Command (J2):</td>
</tr>
<tr>
<td></td>
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<td>M83513/04-D11N</td>
</tr>
</tbody>
</table>
Figure 4-11. Outline drawing of LC Model FTR-915 Flight Termination Receiver.
LORAL CONIC
FLIGHT TERMINATION RECEIVER
MODEL CCR-200

1. GENERAL DESCRIPTION

The Loral Conic Model CCR-200 series solid state FM command receiver/decoder is designed to meet the severe environmental and stringent reliability requirements of missiles and spacecraft. The unit is well suited, however, for other applications requiring ruggedized, lightweight miniature construction, high performance and/or high reliability and long trouble-free service life. The unit is available with three to 11 relay channels operating in IRIG command channels 1 through 20 with high adjacent subcarrier channel rejection and freedom from false triggering by white noise or power supply voltage transients.

2. BACKGROUND

The Model CCR-200 is used on special military program, foreign and domestic.

3. TECHNICAL SPECIFICATIONS

3.1 RF SECTION

3.1.1 Frequency Range (Tuneable) 220 to 550 MHz
3.1.2 Threshold Sensitivity (Command Output) 3 μV
3.1.3 Maximum Useable RF Input 2 Vrms
3.1.4 Operating Bandwidth ±20 kHz minimum
3.1.5 Antenna Impedance 50 ohms (nominal)
3.1.6 VSWR 2:1 maximum
3.1.7 Local Oscillator Stability ±0.005 percent
3.1.8 Tuning Accuracy ±0.005 percent
3.1.9 Tuning Method Single frequency, crystal-controlled
3.2 IF SECTION (DUAL CONVERSION)

3.2.1 IF Frequency 21.4 MHz

3.2.2 Selectivity, 60 dB 1.5 MHz maximum

3.2.3 Capture Ratio <2 dB

3.3 AUDIO SECTION

3.3.1 Audio Amplifier Response 300 Hz to 80 kHz

3.3.2 Audio Amplifier Distortion <3 percent

3.3.3 Audio Output 30 mV rms per tone (12 ohm impedance)

3.3.4 Frequency Deviation 30 ±6 kHz

3.4 DECODER SECTION

3.4.1 Number of Decoder Channels 3 to 11 (optional)

3.4.2 Number of Simultaneous Useable Tones 3 (up to 6 by special request)

3.4.3 Tone Channel Bandwidth ±1 percent minimum at 2 dB

3.4.4 Adjacent Channel Rejection 34 dB minimum

3.4.5 Decoder Threshold Deviation ±5 kHz (nominal)

3.5 OUTPUT

3.5.1 Types of Output Relay, 28 V (nominal)

3.5.2 Output Current Capability 2 A per command within 1 V of supply voltage

3.5.3 Output Leakage None

3.5.4 Logic Circuitry None (single output for each channel - all relay poles available at connector)
3.5.5 Response Time for Commands <10 ms
3.5.6 Transition Time Between Commands <5 ms
3.5.7 Output Isolation 1 Mohm
3.5.8 Noise Immunity Relays will not operate on white noise or upon power “turn-on” and/or “turn-off”
3.5.9 Telemetry Outputs Signal level indication, 0 to 4 Vdc (nominal) into 10 kohm load

3.6 POWER SUPPLY
3.6.1 Supply Voltage 24 to 36 Vdc
3.6.2 Power Requirements Standby: 150 mA to 400 mA (3 to 11 channels)
Command: 32 mA per energized channel (700 mA maximum for 11 channels)
3.6.3 Power Supply Isolation >1 Mohm from chassis
3.6.4 Turn-On Power Control for Receiver N/A
3.6.5 Other Controls N/A

3.7 ELECTROMAGNETIC INTERFERENCE
3.7.1 RFI Suppression Meets MIL-STD-461, except limits A and B; CS04 and CS08 are 60 dB
3.7.2 Pulse Rejection Not measured
3.7.3 AM Rejection Not measured
3.7.4 Image Rejection 60 dB minimum
3.8 ENVIRONMENTAL CHARACTERISTICS

3.8.1 Operating Temperature Range
(Continuous) -40°C to +70°C

3.8.2 Nondestructive Temperatures
(Shelf Storage) -55°C to +80°C

3.8.3 Humidity 95 percent

3.8.4 Altitude Unlimited

3.8.5 Shock 50 g, 11 ms, 3 axes

3.8.6 Acceleration 100 g, 3 axes

3.8.7 Vibration 20 g sine, 20 to 2,000 Hz, 3 axes

3.8.8 Acoustics Not measured

3.8.9 Pressurization Not measured

3.8.10 Operating Life MTBF = 1,200 hours minimum

3.8.11 Shelf Life 5 years

3.9 PHYSICAL CHARACTERISTICS

3.9.1 Volume See Outline Drawing

3.9.2 Dimensions See Outline Drawing

3.9.3 Weight 44 ounces maximum (11 channels)

3.9.4 Mounattitude Any

3.9.5 External Adjustments None

3.9.6 Connector Types
RF Input (J1): TNC (GRFF 4068-0015)
Receiver Power and Signal: Cannon DEH-9P
Decoder Power and Signal: Cannon DBH-25P
(1 connector for 3 channels; 2 connectors for 4 to 11 channels)
Figure 4-13. Outline drawing of LC Model CCR-200 Series Flight Termination Receiver.
1. **GENERAL DESCRIPTION**

   The Loral Conic Model CDR-200 series solid state FM Command Destruct Receiver is designed specifically for the stringent environmental requirements of airborne missile programs. All components are derated a minimum of 50 percent of the manufacturer's rated values to ensure a high degree of performance reliability.

   The CDR-200 employs standard missile-range-required logic in the decoder sector to minimize the probability of a false destruct output due to unwanted RF radiation in the passband. The unit has successfully completed range qualification testing to IRMFSG 303-64. This unit has been replaced by Loral Model FTR-550 in form, fit and function that satisfies later range requirements.

2. **BACKGROUND**

   The Model CDR-200 has been used with the following missiles: Tomahawk Cruise, Standard Arm, HARM, Condor, VTV, Sea Skimmer, and ALVRJ.

3. **TECHNICAL SPECIFICATIONS**

   3.1 **RF SECTION**

   3.1.1 Frequency Range (Tuneable) 400 to 475 MHz (single frequency, crystal-controlled)

   3.1.2 Threshold Sensitivity (Command Output) 2 µV

   3.1.3 Maximum Useable RF Input 2 Vrms

   3.1.4 Operating Bandwidth ±45 kHz

   3.1.5 Antenna Impedance 50 ohms (nominal)

   3.1.6 VSWR 2:1 maximum

   *Listed for reference only.
3.1.7 Local Oscillator Stability  ±0.005 percent
3.1.8 Tuning Accuracy  ±0.005 percent
3.1.9 Tuning Method  Fixed frequency, crystal-controlled

3.2 IF SECTION
3.2.1 IF Frequency  21.4 MHz
3.2.2 Selectivity, 60 dB  700 kHz maximum
3.2.3 Capture Ratio  <2 dB

3.3 AUDIO SECTION*
3.3.1 Audio Amplifier Response  300 Hz to 80 kHz, 3 dB
3.3.2 Audio Amplifier Distortion  <3 percent
3.3.3 Audio Output  25 mV peak per kHz
3.3.4 Frequency Deviation  30 ±6 kHz per tone

3.4 DECODER SECTION
3.4.1 Number of Decoder Channels  3
3.4.2 Number of Simultaneous Useable Tones  3
3.4.3 Tone Channel Bandwidth  ±1 percent minimum at 2 dB
3.4.4 Adjacent Channel Rejection  34 dB
3.4.5 Decoder Threshold Deviation  12 kHz (nominal)

*Audio output available on -3 model only.
### 3.5 OUTPUT

<table>
<thead>
<tr>
<th>3.5.1</th>
<th>Types of Output</th>
<th>Relay, 28 V (nominal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5.2</td>
<td>Output Current Capability</td>
<td>2 A per command within 1 V of supply voltage</td>
</tr>
<tr>
<td>3.5.3</td>
<td>Output Leakage</td>
<td>None</td>
</tr>
</tbody>
</table>
| 3.5.4 | Logic Circuitry | 1 and 5 = Arm  
2 and 5 = Optional Command and Monitor  
1 and 5, 5 OFF, 2 ON = Arm, Destruct  
5 = Monitor  
1, 2, 5 ON = Monitor, Arm, Optional |
| 3.5.5 | Response Time for Commands | <10 ms |
| 3.5.6 | Transition Time Between Commands | <3 ms |
| 3.5.7 | Output isolation | 1 Mohm |
| 3.5.8 | Noise Immunity | Interruption of primary power or RF power to receiver will not cause decoder relay closure |
| 3.5.9 | Telemetry Outputs | Signal level indication, 0 to 4 Vdc (nominal) into 10 kohm load |

### 3.6 POWER SUPPLY

<table>
<thead>
<tr>
<th>3.6.1</th>
<th>Supply voltage</th>
<th>24 to 36 Vdc</th>
</tr>
</thead>
</table>
| 3.6.2 | Power Requirements | Standby: 100 mA  
Interrogate: 100 mA +38 mA per energized channel |
| 3.6.3 | Power Supply Isolation | >1 Mohm |
| 3.6.4 | Turn-On Power Control for Receiver | N/A |
| 3.6.5 | Other Controls | N/A |
### 3.7 ELECTROMAGNETIC INTERFERENCE

| 3.7.1  | RFI Suppression | Meets MIL-STD-461, except limits A and B; CS04 and CS08 are 60 dB |
| 3.7.2  | Pulse Rejection | Not measured |
| 3.7.3  | AM Rejection | Not measured |
| 3.7.4  | Image Rejection | 60 dB minimum |

### 3.8 ENVIRONMENTAL CHARACTERISTICS

| 3.8.1  | Operating Temperature Range (Continuous) | -40°C to +70°C |
| 3.8.2  | Nondestructive Temperatures (Shelf Storage) | -54°C to +100°C |
| 3.8.3  | Humidity | 95 percent |
| 3.8.4  | Altitude | Unlimited |
| 3.8.5  | Shock | 50 g, 11 ms, 3 axes |
| 3.8.6  | Acceleration | 100 g, 3 axes |
| 3.8.7  | Vibration | 20 g sine, 20 to 2,000 Hz, 3 axes |
| 3.8.8  | Acoustics | Not measured |
| 3.8.9  | Pressurization | Not measured |
| 3.8.10 | Operating Life | MTBF = 1,400 hours minimum |
| 3.8.11 | Shelf Life | 8 years |
### PHYSICAL CHARACTERISTICS

#### 3.9.1 Volume
- 38-in³

#### 3.9.2 Dimensions
- See Outline Drawing

#### 3.9.3 Weight
- 34 ounces maximum

#### 3.9.4 Mounting Attitude
- Any

#### 3.9.5 External Adjustments
- None

#### 3.9.6 Connector Types
- RF Input (J1): TNC
- Power: MS3112E-8-4P
- Arm: MS3112E-10-6S
- Destruct: MS3112E-8-4S
Figure 4-16. LC Model CDR-200 Command Destruct Receiver.
LORAL CONIC
COMMAND DESTRUCT RECEIVER
MODEL CDR-222

1. GENERAL DESCRIPTION

The Loral Conic Model CDR-222 Destruct Radio Frequency Unit (RFU) consists of a pair of redundant FM receivers and tone detectors, each supplied by either of two antenna connectors via a RF power divider/combiner. This unit is intended for use in range safety command systems to provide ground control of certain flight termination functions. The decoder logic is designed so that only one specific sequence of three tones will yield a destruct command output. The unit is designed for high-reliability applications, and all components are controlled by source control drawings. Phase-locked tone decoders and solid state output commands are featured in this unit.

2. BACKGROUND

The Model CDR-222 is being used with the Trident C-4. The units has been modified for the D5 Trident II program and is currently being manufactured in the new configuration.

3. TECHNICAL SPECIFICATIONS

3.1 RF SECTION

3.1.1 Frequency Range (Tuneable) 400 to 450 MHz
3.1.2 Threshold Sensitivity (Command Output) 1 μV
3.1.3 Maximum Useable RF Input 2 Vrms
3.1.4 Operating Bandwidth ±45 kHz
3.1.5 Antenna Impedance 50 ohms (nominal)
3.1.6 VSWR 2:1 maximum
3.1.7 Local Oscillator Stability ±0.005 percent
3.1.8 Tuning Accuracy ±0.005 percent
3.1.9 Tuning Method Fixed frequency, crystal-controlled
3.2 IF SECTION (DUAL CONVERSION)

3.2.1 IF Frequency
- 91.86 MHz 1st IF
- 10.7 MHz 2nd IF

3.2.2 Selectivity, 60 dB
- ±180 kHz maximum

3.2.3 Capture Ratio
- <1 dB

3.3 AUDIO SECTION

3.3.1 Audio Amplifier Response
- 5 Hz to 20 kHz, 3 dB

3.3.2 Audio Amplifier Distortion
- <3 percent

3.3.3 Audio Output
- N/A

3.3.4 Frequency Deviation
- 30 ±6 kHz per tone

3.4 DECODER SECTION

3.4.1 Number of Decoder Channels
- 3

3.4.2 Number of Simultaneous Useable Tones
- 3

3.4.3 Tone Channel Bandwidth
- >±1 percent at 2 dB

3.4.4 Adjacent Channel Rejection
- No level of adjacent channel deviation can activate desired channel!

3.4.5 Decoder Threshold Deviation
- 16 kHz (nominal)

3.5 OUTPUT

3.5.1 Types of Output
- Solid-state

3.5.2 Output Current Capability
- 100 A maximum (destruct command) each

3.5.3 Output Leakage
- <1 μA

*Audio output available on -3 model only.
3.5.4 Logic Circuitry (Sequential operation only)

<table>
<thead>
<tr>
<th>Modulating Tone</th>
<th>Tone Output</th>
<th>Destruct RFU Logic Monitor*</th>
<th>Destruct RFU Logic Umbilical Monitor*</th>
<th>Destruct Command</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>S</td>
</tr>
<tr>
<td>None</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>1 Only</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>2 Only</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>5 Only</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

**Sequence:**

- **1 ON:** + - - + - - + - - -
- **2 ON:** + - + - - + - + -
- **5 OFF:** + - - - - + - + -
- **2 ON:** + + - - - + - + -

* Condition: SAFE, ARM, or DESTRUCT

** Tones must be applied in sequence to produce destruct command

3.5.5 Response Time for Commands 15 ms

3.5.6 Transition Time Between Commands <5 ms

3.5.7 Output Isolation 1 Mohm

3.5.8 Noise Immunity Interruption of primary power or RF power to receiver will not cause decoder output
3.5.9 Telemetry Outputs

3.5.9.1 Signal Strength

- No RF: 0.50 ±0.25 Vdc
- 101 dBm: 0.25 Vdc minimum above no RF reading
- -53 dBm to +13 dBm: Positive increasing voltage to 4.75 ±0.25 Vdc

3.5.9.2 Logic and Umbilical Monitors

<table>
<thead>
<tr>
<th>Logic</th>
<th>Umbilical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safe</td>
<td>Safe 2.0 Vdc</td>
</tr>
<tr>
<td>Arm</td>
<td>Arm 10.0 Vdc</td>
</tr>
<tr>
<td>Destruct</td>
<td>Destruct 18.0 Vdc</td>
</tr>
<tr>
<td>Arm</td>
<td>Arm 3.5 Vdc</td>
</tr>
<tr>
<td>Destruct</td>
<td>Destruct 4.5 Vdc</td>
</tr>
</tbody>
</table>

* Depending on tone channel assignments, the logic safe level varies (0.6, 1.2, 1.8, 2.4 Vdc).

3.5.9.3 Tone Output Monitors

Tones X, Y and Z outputs, 4.5 ±0.5 Vdc with 1 Kohm output impedance

3.6 POWER SUPPLY

3.6.1 Supply Voltage

24 to 36 Vdc

3.6.2 Power Requirements

Standby: <300 mA
Interrogate: <300 mA (no destruct load)

3.6.3 Power Supply Isolation

>1 Mohm from chassis

3.6.4 Turn-On Power Control for Receiver

N/A

3.6.5 Other Controls

N/A
3.7 ELECTROMAGNETIC INTERFERENCE

3.7.1 RFI Suppression
Meets MIL-STD-461, CS04 limits A and B, 60 dB

3.7.2 Pulse Rejection
Not susceptible to pulse radar interference

3.7.3 AM Rejection
Tone channels will not respond to carrier’s sinewave modulated at 95 percent for input levels of -110 ohms to -47 dBm

3.7.4 Image Rejection
60 dB minimum

3.8 ENVIRONMENTAL CHARACTERISTICS

3.8.1 Operating Temperature Range
(Continuous)
-40°C to +70°C

3.8.2 Nondestructive Temperatures
(Shelf Storage)
-55°C to +100°C

3.8.3 Humidity
95 percent

3.8.4 Altitude
Unlimited

3.8.5 Shock
50 g, 11 ms

3.8.6 Acceleration
100 g, 3 axes

3.8.7 Vibration
20 g sine, 20 to 2,000 Hz, 3 axes; random, 9 g rms

3.8.8 Acoustics
N/A

3.8.9 Pressurization
75 psi, high pressure; 0.17 mm Hg, low pressure

3.8.10 Operating Life
MTBF = 1,600 hours minimum

3.8.11 Shelf Life
8 years

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<table>
<thead>
<tr>
<th>3.9</th>
<th>PHYSICAL CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.9.1</td>
<td>Volume</td>
</tr>
<tr>
<td></td>
<td>94-in³</td>
</tr>
<tr>
<td>3.9.2</td>
<td>Dimensions</td>
</tr>
<tr>
<td></td>
<td>See Outline Drawing</td>
</tr>
<tr>
<td>3.9.3</td>
<td>Weight</td>
</tr>
<tr>
<td></td>
<td>5 pounds maximum</td>
</tr>
<tr>
<td>3.9.4</td>
<td>Mounting Attitude</td>
</tr>
<tr>
<td></td>
<td>Any</td>
</tr>
<tr>
<td>3.9.5</td>
<td>External Adjustments</td>
</tr>
<tr>
<td></td>
<td>None</td>
</tr>
<tr>
<td>3.9.6</td>
<td>Connector Types</td>
</tr>
<tr>
<td></td>
<td>See Outline Drawing</td>
</tr>
</tbody>
</table>
Figure 4-17. Outline drawing of LC Model CDR-222 Flight Termination Receiver.
LORAL CONIC
COMMAND DESTRUCT RECEIVER
MODEL CDR-555

1. GENERAL DESCRIPTION

The Loral Conic Model CDR-555 contains two receiver/destruct decoders and a control decoder integrated as a system. The unit thus provides redundancy for range safety. Two versions of the standard CDR-555 are available. The standard -1 version contains an 8-channel control decoder with a 5-bit word output, while the -2 versions features a 6-channel decoder with a 4-bit word output.

Each receiver has an antenna input and a three-channel tone decoder providing four coded command outputs. The control decoder section of the unit selects and decodes the audio signal from each receiver and outputs the parallel word. A validity bit and a carrier presence bit are provided for system status. The decoder responds to two-and-only-two simultaneous tones, yielding 28 combinations of 5-bit data for the -1 version and 15 combinations of 4-bit data for the -2.

The Model CDR-555 is well suited for high-reliability applications where ruggedized, lightweight, miniature construction and high performance are required.

2. BACKGROUND

The Model CDR-555 has been used with the Air Launched Cruise Missile, the Tomahawk, and other cruise missiles.

3. TECHNICAL SPECIFICATIONS

3.1 RF SECTION

3.1.1 Frequency Range (Tuneable) 405 to 486 MHz

3.1.2 Threshold Sensitivity (Command Output) 2 μV

3.1.3 Maximum Useable RF Input 2 Vrms

3.1.4 Operating Bandwidth ±45 kHz
### 3.1 Antenna Impedance
- **Impeance**: 50 ohms (nominal)

### 3.1.6 VSWR
- **Transfer**: 2:1 maximum

### 3.1.7 Local Oscillator Stability
- **Stability**: ±0.005 percent

### 3.1.8 Tuning Accuracy
- **Accuracy**: ±0.005 percent

### 3.1.9 Tuning Method
- **Method**: Fixed frequency, crystal-controlled

### 3.2 IF SECTION

#### 3.2.1 IF Frequency
- **Frequency**: 10.7 MHz

#### 3.2.2 Selectivity, 60 dB
- **Selectivity**: ±350 kHz maximum

#### 3.2.3 Capture Ratio
- **Ratio**: <1 dB

### 3.3 AUDIO SECTION

#### 3.3.1 Audio Amplifier Response
- **Response**: 500 Hz to 100 kHz, 1 dB

#### 3.3.2 Audio Amplifier Distortion
- **Distortion**: <3 percent

#### 3.3.3 Audio Output
- **Output**: 35 mVp-p per kHz peak

#### 3.3.4 Frequency Deviation
- **Deviation**: 30 ±6 kHz per tone

### 3.4 DECODER SECTION

#### 3.4.1 Number of Decoder Channels
- **Channels**:
  - Each Range Safety Receiver: 3
  - Control Decoder: 8 or 6 channels
  - (Any two tones produce 5- or 4-bit word)
3.4.2 Number of Simultaneous Useable Tones

Each Range Safety Receiver: 3 tones
Control Decoder: 2 tones
(Range safety receiver commands will not be interfered with by simultaneous tones applied to control decoder)

3.4.3 Tone Channel Bandwidth
All decoders, ±1 percent at 2 dB

3.4.4 Adjacent Channel Rejection
34 dB

3.4.5 Decoder Threshold Deviation
30 ±6 kHz peak per tone

3.5 OUTPUT

3.5.1 Types of Output

Range Safety Receivers: Relays, 28 V (nominal)
Control Decoder (Word Validity, Loss of RF): Solid-state, TTL differential

3.5.2 Output Current Capability

Range Safety Receivers: 2 A continuous within 1 V of supply
Control Decoder (Word Validity, Loss of RF): Designed to drive differential input line receivers

3.5.3 Output Leakage

Range Safety Receivers: None
Control Decoder: 1 μA maximum
3.5.4 Logic Circuitry

Range Safety Receiver:
- 1, 5 ON = Monitor, Arm
- 2, 5 ON = Monitor, Optional
- 1, 5 ON, 5 OFF, 2 ON = Monitor, Arm, Destruct
- 5 ON = Monitor

Control Decoder:

OUTPUT CODE FORMAT (-1)

<table>
<thead>
<tr>
<th>TONE PAIR</th>
<th>DATA WORD</th>
<th>VALIDITY BIT</th>
<th>CARRIER PRESENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20 21 22 23 24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carrier Threshold</td>
<td>1 1 1 1 1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Carrier - 101 dBm</td>
<td>1 1 1 1 1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6,8</td>
<td>1 0 0 0 0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>6,12</td>
<td>0 1 0 0 0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>6,14</td>
<td>1 1 0 0 0</td>
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<tr>
<td>14,15</td>
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<td>1</td>
<td>1</td>
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<tr>
<td>7,8</td>
<td>1 0 1 0 0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>7,12</td>
<td>0 1 1 0 0</td>
<td>1</td>
<td>1</td>
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<tr>
<td>8,14</td>
<td>1 1 1 0 0</td>
<td>1</td>
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</tr>
<tr>
<td>13,15</td>
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<td>8,14</td>
<td>1 1 0 1 0</td>
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</tr>
<tr>
<td>6,15</td>
<td>1 1 0 0 1</td>
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<tr>
<td>7,11</td>
<td>1 1 0 1 1</td>
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<td>7,13</td>
<td>0 1 1 0 1</td>
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<tr>
<td>11,13</td>
<td>0 1 1 1 1</td>
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<tr>
<td>11,15</td>
<td>1 1 1 1 1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

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3.5.5 Response Time for Commands

Range Safety Receivers: 20 ms maximum
Control Decoder: 25 ms maximum

3.5.6 Transition Time Between Commands

Range Safety Receivers: <3 ms
Control Decoder: <10 ms

3.5.7 Output Isolation

Range Safety Receivers: >1 Mohm from chassis
Control Decoder: >1 Mohm from chassis and power return

3.5.8 Noise Immunity

>12 dB for decoder channels on unquieted noise (interruption of primary power or RF power to unit will not cause relay closure)

3.5.9 Telemetry Outputs

With no RF input, the quiescent level is a nominal 0.50 ±0.25 V, increasing to a value not to exceed 4.75 ±0.25 V at an RF level of -40 dBm. The slope is positive and does not change direction over the RF signal dynamic range.

3.6 POWER SUPPLY

3.6.1 Supply Voltage 23 to 34 Vdc, all sections

3.6.2 Power Requirements

Range Safety Receiver: 180 mA standby, 300 mA command
Control Decoder: 500 mA maximum

3.6.3 Power Supply Isolation >1 Mohm from chassis

3.6.4 Turn-On Power Control for Receiver N/A

3.6.5 Other Controls N/A
### 3.7 ELECTROMAGNETIC INTERFERENCE

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.7.1</td>
<td>RFI Suppression</td>
<td>Meets MIL-STD-461, CS04 and CS08 limits. A and B are 60 dB.</td>
</tr>
<tr>
<td>3.7.2</td>
<td>Pulse Rejection</td>
<td>Not measured</td>
</tr>
<tr>
<td>3.7.3</td>
<td>AM Rejection</td>
<td>AM carrier will not produce command or control outputs.</td>
</tr>
<tr>
<td>3.7.4</td>
<td>Image Rejection</td>
<td>60 dB minimum</td>
</tr>
</tbody>
</table>

### 3.8 ENVIRONMENTAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.8.1</td>
<td>Operating Temperature Range (Continuous)</td>
<td>-54°C to +80°C</td>
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<tr>
<td>3.8.2</td>
<td>Nondestructive Temperatures (Shelf Storage)</td>
<td>-54°C to +125°C</td>
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<tr>
<td>3.8.3</td>
<td>Humidity</td>
<td>95 percent</td>
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<tr>
<td>3.8.4</td>
<td>Altitude</td>
<td>Unlimited</td>
</tr>
<tr>
<td>3.8.5</td>
<td>Shock</td>
<td>50 g, 11 ms</td>
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<tr>
<td>3.8.6</td>
<td>Acceleration</td>
<td>100 g</td>
</tr>
<tr>
<td>3.8.7</td>
<td>Vibration</td>
<td>10 g rms</td>
</tr>
<tr>
<td>3.8.8</td>
<td>Acoustics</td>
<td>Not measured</td>
</tr>
<tr>
<td>3.8.9</td>
<td>Pressurization</td>
<td>Not measured</td>
</tr>
<tr>
<td>3.8.10</td>
<td>Operating Life</td>
<td>MTBF = 5,000 hours minimum</td>
</tr>
<tr>
<td>3.8.11</td>
<td>Shelf Life</td>
<td>10 years</td>
</tr>
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</table>
3.9 PHYSICAL CHARACTERISTICS

3.9.1 Volume \[53\text{-in}^3\]

3.9.2 Dimensions See Outline Drawing

3.9.3 Weight \[50\text{ ounces maximum}\]

3.9.4 Mounting Attitude Any

3.9.5 External Adjustments None

3.9.6 Connector Types

- RF Input (J1): SMA Receptacle, Receiver A
- Command (J2): MS27476Y 10E98P, Receiver A
- Power (J3): MS27476Y 10E98PA, Receiver A
- RF Input (J4): SMA Receptacle, Receiver B
- Command (J5): MS27476T 10E98P, Receiver B
- Power (J6): MS27476Y 10E98PA, Receiver B
- All Functions (J7): M24308/9-3 (modified) Decoder
Figure 4-19. Outline drawing of LC Model CDR-555 Flight Termination Receiver.
5. SERVO CORPORATION OF AMERICA
111 New South Road
Hicksville, New York 11802
(Phone: 516-938-9700)

FLIGHT TERMINATION RECEIVERS

Model 505000
1. GENERAL DESCRIPTION

The Servo Model 505000 Flight Termination Receiver has been assigned the nomenclature R-2449(V)/DRW and is compliant with NAVAIR Drawing 642AS8859. It is built to all weapons specification construction requirements of both WS-6535 and MIL-STD-2000.

The receiver is intended for range safety functions in unmanned vehicles, operating in extreme environments, each unit is subjected to burn-in, shock, vibration and extended term extreme temperature testing. Operation has been demonstrated with humidity, pressures corresponding to 100,000 feet altitude down to two atmospheres, and over a full spectrum of electromagnetic compatibility requirements.

To assure the utmost in reliability, the terminate output cannot be unintentionally activated through the failure of any one component.

2. BACKGROUND

The Model 505000 was originally procured for use on the VANDAL U.A.V and was qualified in 1989.

3. TECHNICAL SPECIFICATIONS

3.1 RF SECTION

3.1.1 Frequency Range (Tuneable) 406 to 450 MHz
3.1.2 Threshold Sensitivity (Command Output) 2 μV rms
3.1.3 Maximum Useable RF Input 0.02 Vrms
3.1.4 Operating Bandwidth ±45 kHz
3.1.5 Antenna Impedance 50 ohms (nominal)
3.1.6 VSWR <2:1
3.1.7 Passband Center Frequency within ±0.005 percent
3.2 IF SECTION

3.2.1 IF Frequency 10.7 MHz
3.2.2 Selectivity, 60 dB ±180 kHz maximum

3.3 DECODER SECTION

3.3.1 Number of Decoder Channels 3
3.3.2 Number of Simultaneous Useable Tones 3
3.3.3 Tone Channel Bandwidth ±1 percent minimum, ±4 percent maximum
3.3.4 Deviation 30 ±3 kHz nominal

3.4 OUTPUT

3.4.1 Command Outputs:

3.4.1.1 Output Type Solid-state (28 V)
3.4.1.2 Output Current Capability 1.2 A
3.4.1.3 Output Leakage 1 μA
3.4.1.4 Output Logic Sequence 1, 5 ON = Monitor & Arm
1 ON = Arm
2, 5 ON = Arm & Terminate
3.4.1.5 Output Response Delay 25 ms maximum; 10 ms typical
3.4.1.6 Output Isolation 1 Mohm minimum

3.4.2 Auxiliary Outputs:

3.4.2.1 Signal Level, no signal 0.50 ±0.25 Vdc
3.4.2.2 Signal Level, maximum signal 4.25 to 5.00 Vdc
3.5 POWER SUPPLY

3.5.1 Supply Voltage 24 to 36 Vdc

3.5.2 Current drain, no signal 190 mA maximum

3.5.3 Current drain, all commands 300 mA maximum

3.5.4 Power Supply Isolation 1 Mohm, minimum

3.6 ELECTROMAGNETIC INTERFERENCE

3.6.1 RFI Suppression

3.6.1.1 MIL-STD-461B Tests: CE01, CE03, CE06, RE02, RS02, RS03, CS01-CS06

3.6.1.2 MIL-STD-1399 Tests: Section 401

3.6.2 Telemetry Signal Rejection 2.2 to 2.3 GHz at +10 dBm

3.6.3 Pulse Rejection 5.4 to 5.9 GHz at +27 dBm

9.0 to 9.5 GHz at +27 dBm

3.7 ENVIRONMENTAL CHARACTERISTICS

3.7.1 Operating Temperature Range -55°C to +76°C

3.7.2 Humidity MIL-STD-810, Method 507.1

3.7.3 Altitude 100,000 feet

3.7.4 Shock 1,100 g, 0.5 ms

3.7.5 Vibration 16 g rms, random

Random: 0.06g²/Hz
Sinusoidal: 15 g rms

3.7.6 Pressurization To 30 psia.
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.8</td>
<td>PHYSICAL CHARACTERISTICS</td>
<td></td>
</tr>
<tr>
<td>3.8.1</td>
<td>Dimensions</td>
<td>See Outline Drawing</td>
</tr>
<tr>
<td>3.8.2</td>
<td>Weight</td>
<td>25 ounces</td>
</tr>
<tr>
<td>3.8.3</td>
<td>Mounting Attitude</td>
<td>Any</td>
</tr>
<tr>
<td>3.8.4</td>
<td>External Adjustments</td>
<td>None</td>
</tr>
</tbody>
</table>
Figure 5-1. Servo Corporation Model 505000 Flight Termination Receiver.
6. HERLEY INDUSTRIES, INC.
   10 Industry Drive
   Lancaster, Pennsylvania
   (Phone: 717-397-2777)
   (Fax: 717-397-4475)

FLIGHT TERMINATION RECEIVER/DECODER
   Model HFTR 110-1

RANGE SAFETY COMMAND RECEIVER
   Model HFTR 100-1
HERLEY INDUSTRIES, INC.

FLIGHT TERMINATION RECEIVER/DECODER
MODEL HFTR110-1

1. GENERAL DESCRIPTION

The Herley Model HFTR110-1 Flight Termination Receiver/Decoder is a three (3) channel unit designed for missile and target applications. This unit is compact, and desirable for usage where size and weight are important considerations. The HFTR110-1 is a single-conversion receiver, with phase-locked loop tone decoders, and redundant solid-state output circuitry for high reliability, and single-point failure protection.

The HFTR110-1 is designed to the requirements of the RCC 313-89 document. The design employs the latest in devices, circuitry, and modern production processes to provide a reliable product with high quality consistency. Of particular interest is the receiver sensitivity where the HFTR110-1 is significantly better than the specification requirements.

The Herley design has significantly reduced the complexity of the receiver with far fewer parts required than previous models. The high stability of the subassembly circuitry has eliminated the need for any tuning elements in both the RF and IF sections. The HFTR110-1 includes various production processes which combine electrical and mechanical functions that result in improved performance and reduced susceptibility to shock and vibration.

This unit is intended for programs and applications with stringent environmental, EMI, and reliability requirements.

2. BACKGROUND

The unit is presently completing qualification testing to NAVAIR Specification 1588AS103.

3. TECHNICAL SPECIFICATIONS

3.1 RFSECTION

3.1.1 Frequency Range (Tuneable) 406 to 450 MHz
3.1.2 Threshold Sensitivity (Command Output) 2 μV (-101 dBm)
3.1.3 Maximum Usable RF Input 1 Vrms (+13 dBm)
3.1.4 Operating Bandwidth ±45 KHz min
3.1.5 Antenna Impedance 50 Ω (nominal)
3.1.6 VSWR Less than 2:1
3.1.7 Local Oscillator Stability ±0.0025%
3.1.8 Tuning Accuracy: ±0.005%
3.1.9 Tuning Method: Fixed frequency, crystal controlled

3.2 IF SECTION
3.2.1 IF Frequency: 21.4 MHz
3.2.2 Selectivity, 60 dB: ±375 KHz
3.2.3 Capture Ratio: Less than 0.8

3.3 AUDIO SECTION
3.3.1 Audio Amplifier Response: 7 KHz to 75 KHz
3.3.2 Audio Amplifier Distortion: Less than 3%
3.3.3 Audio Output: 1V P-P with ±30 KHz Deviation
3.3.4 Frequency Deviation: ±30 KHz per tone (nominal)

3.4 DECODER SECTION
3.4.1 Number of Decoder Channels: 3
3.4.2 Number of Simultaneous Usable Tones: 3
3.4.3 Tone Channel Bandwidth: ±1% minimum at 2 dB
3.4.4 Adjacent Channel Rejection: Greater than 40dB
3.4.5 Decoder Threshold Deviation: 14 KHz (nominal)

3.5 OUTPUT
3.5.1 Types of Output: Solid state
3.5.2 Output Current Capability: 2 Amps per output
3.5.3 Output Leakage: 50 μA maximum, less than 1μA typical
3.5.4 Logic Circuitry, (List Sequence): 5 ON Monitor
2, 5 ON Optional &monitor
1,2 & 5 ON Arm, optional & monitor
1 & 5 ON Arm & monitor
Then 5 OFF Destruct & arm
3.5.5  Response Time for Commands 15 msec. nominal, 25 msec max.
3.5.6  Transition Time Between Commands 3 msec.
3.5.7  Output Isolation All outputs and battery greater than 1 megohm from chassis
3.5.8  Noise Immunity Greater than 12 dB
3.5.9  Telemetry Outputs With no RF input, the quiescent is 0.5V ± 0.25V nominal increasing to a value not to exceed 4.75V ± 0.25V at an RF level of 2240μV. The slope is always positive over the RF signal dynamic range and does not exceed 5.0 volts at maximum RF input.

3.6  POWER SUPPLY

3.6.1  Supply Voltage 22 to 36 VDC
3.6.2  Power Requirements 180 mA standby maximum, 40 mA typical. 60 mA typical commanded.
3.6.3  Power Supply Isolation 1 Megohm minimum from chassis and signal strength monitor.
3.6.4  Turn-On Power Control for Receiver Remote
3.6.5  Other Controls None

3.7  ELECTROMAGNETIC INTERFERENCE

3.7.1  RFI Suppression Meets MIL-STD-461 for antenna, power and signal leads for Air Force & Navy Category A1a Receivers, tests CE03, CE06, CE07, LS01, CS02, CS03, CS05, CS06, RE02, RS02, RS03. CS04 limits A & B are 60 db.
3.7.2  Pulse Rejection Rejects D,E,G thru J Band radar transponder signals up to +10dBm.
3.7.3  AM Rejection Commands will not respond up to 100% AM signals
3.7.4  Image Rejection Greater than 60 dB
3.8 ENVIRONMENTAL CHARACTERISTICS

3.8.1 Operating Temperature Range
(Continuous) 
-54 °C to +71 °C

3.8.2 Nondestructive Temperatures
(Shelf Storage)
-62 °C to +95 °C

3.8.3 Humidity
95%

3.8.4 Altitude
Unlimited

3.8.5 Shock
100g, 11 msec., half-sine
1100g, 0.5 msec., half-sine

3.8.6 Acceleration
30g

3.8.7 Vibration
Sine 15g peak
Random 0.1g²/Hz (12 g's rms)

3.8.8 Acoustics
Not tested

3.8.9 Pressurization
Not required

3.8.10 Operating Life
Design MTBF greater than 8,000 hours

3.8.11 Shelf Life
5 years minimum

3.9 PHYSICAL CHARACTERISTICS

3.9.1 Volume
25 cubic inches

3.9.2 Dimensions
4.5 x 3.1 x 1.8 inches, less connectors. (See outline drawing)

3.9.3 Weight
25 ounces maximum

3.9.4 Mounting Attitude
Any

3.9.5 External Adjustments
None

3.9.6 Connector Types
RF input (J1) TNC receptacle
Power (J2) MS3112E-8-4P
Command (J3) MS3112E-10-6S
Monitor (J4) MS3112E-8-4S
1. GENERAL DESCRIPTION

The Herley Model HFTR100-1 Range Safety Command Receiver is a four (4) channel unit designed for missile and target applications. The HFTR100-1 is a single-conversion receiver, with phase-locked loop tone decoders, and relay outputs to provide complete isolation from the command functions.

The HFTR100-1 is designed to the requirements of the RCC 313-89 document. The design employs the latest in devices, circuitry, and modern production processes to provide a reliable product with high quality consistency. Of particular interest is the receiver sensitivity where the HFTR100-1 is considerably better than the specification requirements.

The Herley design has significantly reduced the complexity of the receiver with far fewer parts required than previous models. The high stability of the subassembly circuitry has eliminated the need for any tuning elements in both the RF and IF sections. The HFTR100-1 includes various production processes which combine electrical and mechanical functions that result in improved performance and reduced susceptibility to shock and vibration.

This unit is intended for programs and applications with stringent environmental, EMI, and reliability requirements.

2. BACKGROUND

The unit is presently completing qualification testing to White Sands Missile Range PD No. 0009-91-B.

3. TECHNICAL SPECIFICATIONS

3.1 RF SECTION

3.1.1 Frequency Range (Tuneable) 406 to 550 MHz
3.1.2 Threshold Sensitivity (Command Output) 0.7 μV (-110 dBm)
3.1.3 Maximum Usable RF Input 1 Vrms (+13 dBm)
3.1.4 Operating Bandwidth Greater than ± 45 KHz
3.1.5 Antenna Impedance 50 ohms nominal
3.1.6 VSWR Less than 2:1
3.1.7 Local Oscillator Stability 0.0025%
3.1.8 Tuning Accuracy 0.005%
3.1.9 Tuning Method Fixed frequency, crystal controlled
3.2 IF SECTION
3.2.1 IF Frequency 21.4 MHz
3.2.2 Selectivity, 60 dB ±300 KHz maximum
3.2.3 Capture Ratio Less than 0.8
3.3 AUDIO SECTION
3.3.1 Audio Amplifier Response 7.5 KHz to 32 KHz
3.3.2 Audio Amplifier Distortion Less than 3%
3.3.3 Audio Output 0.5 V rms at ±30 KHz Deviation
3.3.4 Frequency Deviation ±30 KHz per tone nominal
3.4 DECODER SECTION
3.4.1 Number of Decoder Channels 4
3.4.2 Number of Simultaneous Usable Tones 4
3.4.3 Tone Channel Bandwidth Greater than ±1.0% at 2 dB
3.4.4 Adjacent Channel Rejection Greater than 40 dB
3.4.5 Decoder Threshold Deviation 8 KHz nominal
3.5 OUTPUT
3.5.1 Types of Output Relay
3.5.2 Output Current Capability 2 amps per output
3.5.3 Output Leakage None (open relay contacts)
3.5.4 Logic Circuitry, (List Sequence) None
3.5.5 Response Time for Commands 25 msec. maximum, 15 msec. typical
3.5.6 Transition Time Between Commands 3 msec.
3.5.7 Output Isolation Greater than 1 megohm from chassis
HERLEY INDUSTRIES, INC. RANGE SAFETY COMMAND RECEIVER MODEL HFTR100-1

3.5.8 Noise Immunity
Greater than 12 dB

3.5.9 Telemetry Outputs
With no RF input, the quiescent level is 0.5V ± 0.25V increasing at a rate greater than 0.02V/db from -110 dbm to -80dbm. The slope is always positive over the RF signal dynamic range and does not exceed 5.0 volts at maximum RF input.

3.6 POWER SUPPLY

3.6.1 Supply Voltage
24 to 32 VDC

3.6.2 Power Requirements
Maximum 130mA uncommanded, plus 45mA per channel activated. Typical: 70mA plus 25mA per channel activated

3.6.3 Power Supply Isolation
Return connected to chassis

3.6.4 Turn-On Power Control for Receiver
Magnetic latch relay

3.6.5 Other Controls
None

3.7 ELECTROMAGNETIC INTERFERENCE

3.7.1 RFI Suppression
Meets MIL-STD-461 for antenna, power and signal leads for Army category A1a receivers, tests CE01, CE03, CE02, RE02, RS03.2, CS04 and CS08 Limit A 60 dB, Limit B 80 dB

3.7.2 Pulse Rejection
Rejects VHF and D, G, and E Band radar transponder signals to 0 dBm.

3.7.3 AM Rejection
Rejects AM modulation to 100%

3.7.4 Image Rejection
Greater than 60 dB

3.8 ENVIRONMENTAL CHARACTERISTICS

3.8.1 Operating Temperature Range (Continuous)
-40˚C to +71˚C

3.8.2 Nondestructive Temperatures (Shelf Storage)
-55˚C to +85˚C

3.8.3 Humidity
95%
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.8.4</td>
<td>Altitude</td>
<td>Unlimited</td>
</tr>
<tr>
<td>3.8.5</td>
<td>Shock</td>
<td>100g, 10 msec half-sine, 1150g, 1 msec half-sine 100g.</td>
</tr>
<tr>
<td>3.8.6</td>
<td>Acceleration</td>
<td>100g</td>
</tr>
<tr>
<td>3.8.7</td>
<td>Vibration</td>
<td>Sine 20g's peak, Random 0.3 g²/Hz (20.7grms)</td>
</tr>
<tr>
<td>3.8.8</td>
<td>Acoustics</td>
<td>Not tested</td>
</tr>
<tr>
<td>3.8.9</td>
<td>Pressurization</td>
<td>Not required</td>
</tr>
<tr>
<td>3.8.10</td>
<td>Operating Life</td>
<td>MTBF calculated to be greater than 7,000 hours</td>
</tr>
<tr>
<td>3.8.11</td>
<td>Shelf Life</td>
<td>Greater than 5 years</td>
</tr>
<tr>
<td>3.9</td>
<td>PHYSICAL CHARACTERISTICS</td>
<td></td>
</tr>
<tr>
<td>3.9.1</td>
<td>Volume</td>
<td>Less than 60 cubic inches</td>
</tr>
<tr>
<td>3.9.2</td>
<td>Dimensions</td>
<td>5.20 x 4.32 x 2.65 inches, less connectors. (see outline drawing)</td>
</tr>
<tr>
<td>3.9.3</td>
<td>Weight</td>
<td>Less than 3.5 pounds</td>
</tr>
<tr>
<td>3.9.4</td>
<td>Mounting Attitude</td>
<td>Any</td>
</tr>
<tr>
<td>3.9.5</td>
<td>External Adjustments</td>
<td>None</td>
</tr>
<tr>
<td>3.9.6</td>
<td>Connector Types</td>
<td>RF input (J1) TNC receptacle, Power (J2) MS3112E-12-10SW, Command Output (J3) MS3112E-14-19S, Monitor (J4) MS3112E-12-10S</td>
</tr>
</tbody>
</table>
HERLEY MODEL HFTR100-1

Figure 6-2. Outline drawing of Herley Model HFTR 100-1 Range Safety Command Receiver.