Microdyne's Model RCB-4000 compact receiving system unit combines two high performance telemetry receivers, a dynamic Pre-Detection Diversity Combiner, a DSP-based Multi-mode Demodulator with programmed FIR IF and Video Filters, and an optional programmable Bit Synchronizer within a single 5.25 in rack mounted chassis. The receiving system unit offers the following features and performance characteristics:

- Fully compatible with IRIG Tier-II Phase Noise specifications.
- Dual Independently Tunable Receivers with multiple first and second IF bandwidths, an internal Pre-D AM/AGC Controlled Diversity Combiner, a Wideband DSP-based Digital Multimode Demodulator, and optional Bit Sync.
- Excellent Adjacent Channel Rejection by using multiple SAW First IF bandwidth filters along with highly selectable FIR second IF filters.

Features (Continued)

- Optimal Ratio Combiner using high speed AGC/AM driven control signals. Combiner may be operated in Optimal Select mode for frequency diversity.
- Superior handling of Fast/Deep fades (50 kHz Combiner Break Frequency).
- Multiple, User selected second IF FIR preprogrammed filters. Bandwidths from 50 kHz to 30 MHz are available for each channel. The unit comes preprogrammed with all IRIG filters. Other bandwidths can be programmed (consult factory).
- Multimode FM, PM, AM, BPSK, QPSK/OQPSK Demodulator.
- Compatible with both conventional Auto-Tracking Antenna Systems and Linear Predictor Antenna Tracking Systems (common in Phased Array Antennas).
- Small, lightweight & rugged design
- Easy to use Front Panel and Remote Control via RS-232, Ethernet and IEEE-488.
- Windows Application Software supplied, providing remote operation of front panel controls via Ethernet interface.

*Feher Patented FPQSK Technologies
OPTIONS:

- Internal single or dual channel programmable Bit Synchronizer with data rates from 30 kbps to 20 Mbps, NRZ and Biphase -L, M & S. Also includes de-interleaver and 3 bit soft decision per I and Q outputs. See 3362 data sheet for detailed dual bit sync specifications.

- Multi-Band Tuners

- 3 Channel record Down Converter (CH1, CH2, Combined)

- Feher Patented “FQPSK Demodulation

- SOQPSK Demodulation

- Trellis FM Demodulator for improved signal-to-noise ratio

- Spectrum Display Unit

RCB-4000 APPLICATIONS

Applications include:

- Data Reception
- AM Tracking Receiver
- Signal Analysis
- Satellite TT&C
- Satellite image reception
- Aircraft testing and evaluation
- Video reception from RPV/UAV vehicles
- Expendable launcher data collection
- Unmanned telemetry sites requiring complete computer control
- Low Earth Orbit (LEO) satellite data collection
- Mobile tracking and data systems

- Microdyne has been manufacturing general and special purpose receivers and combiners for over 30 years and continues to be the undisputed leader in telemetry receiving products which enable highly sophisticated data and signal processing over a wide frequency spectrum. The RCB-4000 exemplifies this leadership with state-of-the-art performance in a compact, easy-to-use form factor.

RCB-4000 BENEFITS

RCB-4000 Digital Receiver System - leading edge technology and performance

This advanced digital technology with flexibility will provide customers with viable technology as requirements develop for years to come. This phenomenal design has resulted in a broad array of benefits.

BENEFITS:

- Internal bit synchronizer eliminates need for external components
- Easy-to-use front panel controls all operations resulting in saving setup time, eliminating errors and resolving status issues
- Programmed digital FIR filters eliminate costly IF upgrades
- Two independent receivers and one Combiner in a single package
- The combiner allows for both polarization and frequency diversity.

REDUCES:

- Rack Space
- Power consumption
- Rack wiring problems
- Cost
- Weight
- Remote control complexities
- Spares
- Maintenance issues
Simplified Block Diagram

Single-Ended Bit Synchronizer Diagram
The RCB-4000 contains a dual channel tuner in the base unit covering the same frequency band with an option to add up to two additional tuner bands. Tuners are independently tunable, thus allowing for frequency diversity.

Available frequency ranges include: 2185 MHz to 2485 MHz, 1429 MHz to 1545 MHz, 1700 MHz to 1850 MHz and 215 MHz to 320 MHz. The tuner’s center frequency can be selected with a resolution of 100 kHz either from the front panel or by remote control. For other frequency ranges, consult the factory.

The RCB-4000 Series has both an internal 10 MHz reference oscillator and the ability to use an external 10 MHz or 5 MHz reference.

AM detection is provided after the 2nd IF FIR filters, providing excellent adjacent channel rejection. The AM frequency response is determined by selection of the AGC time constant and the IF bandwidth. Individual AM outputs are provided for each tuner in the standard configuration.

Envelope AGC is derived from a peak AM detector with five selectable time constant settings.

A programmable manual gain control is provided for each RF Section, which is controlled through the remote digital interface or by the front panel.

The RCB-4000 provides the capability to freeze the gain of the receiver with the remote digital interface or via the front panel. Receiver gain is held to the value at the time the Freeze command is detected.

AGC monitor outputs are provided for each RF section. An AGC zero capability is provided to optimize the performance of the Pre-Detection Combiner. Adjustment of this offset does not affect AGC slope. Auto zero capability is programmable through the remote digital interface or through the front panel. A single control for each receiver channel zeros the AGC monitor outputs.

Additional signal strength record outputs are provided with switchable output polarity.

**TUNER SPECIFICATIONS**

**RF Dual**
Conversion Superheterodyne

**Frequency Ranges Available**
2185-2485 MHz, 1429-1545 MHz, 1700-1850 MHz
215-320 MHz (others available)

**Second IF Center Frequency**
70 MHz

**AM Output Level**
2 Vp-p into 75 ohm for 50% modulation

**Envelope AM Frequency Response**
High end response 50 kHz Low end response determined by AGC TC

**Receiver LO Stability**
±1.5 ppm

**AGC Type**
Envelope

**AGC Time Constants**
0.1, 1, 10, 100, 1000 mS

**Receiver Tuning Resolution**
100 kHz

**Manual Gain, AGC Freeze**
Variable by digital control

**Noise Figure**
8 dB max.

**Image Rejection**
60 dB

**Input Impedance**
50 ohms (unbalanced)

**VSWR**
1.5:1 Typical, 2.0:1 max

**Operating Dynamic Range**
Threshold to -10 dBm

**Maximum Input**
+10 dBm

**IF Rejection**
70 dB min., 80 dB typical

**Spurious Rejection**
60 dB

**First LO Type**
Synthesized
DIVERSITY COMBINER

The RCB-4000 provides circuitry for diversity pre-detection combining of the incoming signals. The combining takes place at 70 MHz. Selections are offered through the front panel or through the remote interfaces to perform Optimal Ratio Combining for polarization diversity combining. The combiner may be operated in Optical Select mode for frequency diversity applications, thus eliminating the need for a post-detection combiner.

When operating under normal conditions, the AGC levels from the tuners are a true measure of the quality of the received data, and combiner weighting is a direct function of these levels. Certain applications, (high multipath environments, for example), may require that the combiner weighting include the addition of an AM component. This is handled in the combiner where the AM component is summed with the AGC levels to provide optimal combining under high fade rate conditions.

The Pre-Detection Combiner provides 2.5 dB signal-to-noise improvement with equal S/N ratio inputs. (With unequal inputs S/N ratio) S/N combiner = 10 log (pr1 + pr2) - .5 dB. Where Pr1 = C/N power ratio CH1 and Pr2 = C/N power ratio of CH2.

DIGITAL FIR IF FILTERS

The internal pre-programmed FIR Second IF filters provide bandwidths from 50 kHz to 30 MHz without the need for module replacement.

Bandwidth selection is made through the remote interfaces or by the front panel. All standard IRIG filters are included. Contact factory for additional filter requirements.

The standard delivered FIR filters offered are as follows: 50 kHz, 100 kHz, 150 kHz, 300 kHz, 375 kHz, 500 kHz, 750 kHz, 1 MHz, 1.3 MHz, 1.5 MHz, 2 MHz, 2.4 MHz, 3 MHz, 3.3 MHz, 4 MHz, 5 MHz, 6 MHz, 7.5 MHz, 10 MHz, 12 MHz, 15 MHz, 20 MHz, 22 MHz, 25 MHz, 30 MHz.

DIGITAL MULTI-MODE DEMODULATOR

The Multi-Mode Demodulator employs the latest application specific technology in processing the 70 MHz IF signal. The demodulator provides FM, PM, BPSK, QPSK/OQPSK, and optional *FQPSK and SOQPSK operation. Data rates of up to 20 Mbps can be supported. The flexible nature of the demodulator and its associated IF and video filtering allows it to be used for a wide range of applications and it can easily be reconfigured as applications change.

Two analog video outputs are provided for monitoring both I & Q channel video signals in QPSK/OQPSK and optional *FQPSK operation. Programmed FIR video filters provide maximally flat group delay filters. Video filters are provided with the -3 dB bandwidths from 150 kHz to 15 MHz.

Video filter values are as follows: 150 kHz, 187.5 kHz, 250 kHz, 375 kHz, 500 kHz, 750 kHz, 1 MHz, 1.2 MHz, 1.5 MHz, 1.65 MHz, 2 MHz, 2.4 MHz, 2.5 MHz, 3 MHz, 3.3 MHz, 3.75 MHz, 4 MHz, 5 MHz, 6 MHz, 7 MHz, 7.5 MHz, 10 MHz and 15 MHz.

Custom video filter bandwidths can be implemented by changing the receiver firmware (contact factory).

The RCB-4000 provides user controllable video output levels with 63 dB levels in 1 dB steps. The user can also control the video coupling (AC/DC) and video polarity.

DEMODULATOR SPECIFICATIONS

Demodulation Modes
FM, PM, AM, BPSK, QPSK/OQPSK, *FQPSK (option), SOQPSK

Acquisition and Tracking
±250 kHz

Doppler Tracking Center Frequency
2.8125 MHz nominal

Reference Stability
±1.5 ppm

Video Output Level (Adjustable)
4 Vp-p nominal, 8 V pp max

Video Bandwidths
Digital FIR

Video Output Impedance
75 ohms unbalanced

Reference Oscillator
10 MHz Internal, 5 or 10 MHz External
RECORD TAPE CARRIER (OPTIONAL)

Record carrier outputs are available as an option for each receiver channel and for the combiner. Record carrier frequencies, selectable through the remote digital interface or through the front panel, are in 25 kHz steps from 25 kHz to 20 MHz. The record carrier output level is 1 V RMS. The output impedance is 75 ohms.

PROGRAMMABLE BIT SYNCHRONIZER (OPTIONAL)

An optional programmable Bit Synchronizer is available inside the RCB-4000 supporting data rates up to 20 Mbps per channel. The outputs of the bit sync are NRZ-L data with clock along with three soft decision bits for I & Q channels. The user can select the following:

- Input code - NRZ-L/M/S, Bi-Phase-L/M/S
- Bit Rate - 30 kbps to 20 Mbps (NRZ-L) per channel
- De-interleaver - in or out (10 Mbps maximum)
- Clock and data polarity per channel maximum control
- 15 bit Derandomizer on or off

Settings can be changed via the front panel or through the remote digital interface.

SPECTRUM DISPLAY UNIT (OPTIONAL)

The SDU unit provides basic spectrum analyzer capabilities to the RCB-4000. The SDU unit allows the user to view incoming RF spectrum on channel 1 and 2. This allows the user to verify that the input signal is compatible with the receiver configuration. Additionally, the spectrum can also be provided to a remote computer via the standard RCB-4000 remote interfaces. An additional 70 MHz input is provided on rear panel.

SDU SPECIFICATIONS

**Display**
Logarithmic 60 dB

**Span**
50 kHz to 20 MHz (selectable)

**Reference Amplitude**
-10 to -40 dBm (selectable)

**Resolution Bandwidth**
1 kHz to 300 kHz (selectable)

**Video Bandwidth**
1 kHz to 300 kHz (selectable)

**Inputs**
Ch1, CH2 and External (70 MHz)

**Markers**
Peak & Delta Measurements (selectable)
## RCB-4000 General Specifications

<table>
<thead>
<tr>
<th>Graphics Display Type</th>
<th>Electroluminescent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graphics Display Size</td>
<td>3&quot; x 8.25&quot;</td>
</tr>
<tr>
<td>Graphics Display Color</td>
<td>Amber on Black</td>
</tr>
<tr>
<td>Data Entry</td>
<td>16 Button Keypad</td>
</tr>
<tr>
<td>Stored Setups</td>
<td>Stores up to 9 setups in non-volatile memory</td>
</tr>
<tr>
<td>AGC Modes</td>
<td>AGC, Manual Gain, AGC Freeze</td>
</tr>
<tr>
<td>Interface Baud Rate</td>
<td>Up to 19.2 Kbps</td>
</tr>
<tr>
<td>Remote Interface Formats</td>
<td>Ethernet, IEEE-488.1, RS-232</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operating Temperature Range</th>
<th>0 to 50 degrees C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Operating Temperature Range</td>
<td>-55 to + 65 degrees C</td>
</tr>
<tr>
<td>Humidity</td>
<td>Up to 90% non-condensing</td>
</tr>
<tr>
<td>EMI/RFI</td>
<td>Designed to meet 89/336/EEC</td>
</tr>
<tr>
<td>Dimensions</td>
<td>5.25&quot; H x 19&quot; W x 22&quot; D</td>
</tr>
<tr>
<td>Weight</td>
<td>Less than 45 lbs.</td>
</tr>
<tr>
<td>Power Requirements</td>
<td>115/230 VAC (auto select)</td>
</tr>
<tr>
<td></td>
<td>50 - 400 Hz</td>
</tr>
<tr>
<td></td>
<td>200 watts maximum</td>
</tr>
</tbody>
</table>
### RCB-4000 Rear Panel Connector

<table>
<thead>
<tr>
<th>Connector</th>
<th>Function</th>
<th>Connector Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>115/230 VAC, 50-400 Hz auto select</td>
<td>IEC-320 Appliance AC connector with strain relief</td>
</tr>
<tr>
<td>J2</td>
<td>RF Channel 1 Input, 50 ohm unbalanced</td>
<td>N</td>
</tr>
<tr>
<td>J3</td>
<td>RF Channel 2 Input, 50 ohm unbalanced</td>
<td>N</td>
</tr>
<tr>
<td>J4</td>
<td>Video Out 1, nominal 4 Vp-p, 75 ohms</td>
<td>BNC</td>
</tr>
<tr>
<td>J5</td>
<td>Video Out 2, nominal 4 Vp-p, 75 ohms</td>
<td>BNC</td>
</tr>
<tr>
<td>J6</td>
<td>Signal Strength Record Channel 1, 0 to +5 V or -5 V into a 1K load</td>
<td>BNC</td>
</tr>
<tr>
<td>J7</td>
<td>10 MHz Reference Out, 50 ohms</td>
<td>BNC</td>
</tr>
<tr>
<td>J8</td>
<td>AM Channel 1 Output, 2 Vp-p for 50% AM, 75 ohms</td>
<td>BNC</td>
</tr>
<tr>
<td>J9</td>
<td>AGC Channel 1, 0 to -5 V into a 1K load</td>
<td>BNC</td>
</tr>
<tr>
<td>J10</td>
<td>IF Channel 1 Out, 70 MHz, -10 dBm, 50 ohms</td>
<td>BNC</td>
</tr>
<tr>
<td>J11</td>
<td>Record Out CH. 1 (option), 75 ohms</td>
<td>BNC</td>
</tr>
<tr>
<td>J12</td>
<td>Signal Strength Record Channel 2, 0 to +5 V or -5 V into a 1K load</td>
<td>BNC</td>
</tr>
<tr>
<td>J13</td>
<td>10/5 MHz Reference In, 50 ohms</td>
<td>BNC</td>
</tr>
<tr>
<td>J14</td>
<td>AM Channel 2 Output, 2 Vp-p for 50% AM, 75 ohms</td>
<td>BNC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Connector</th>
<th>Function</th>
<th>Connector Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>J15</td>
<td>AGC Channel 2, 0 to -5 V into a 1K load</td>
<td>BNC</td>
</tr>
<tr>
<td>J16</td>
<td>IF Channel 2 Out, 70 MHz, -10 dBm, 50 ohms</td>
<td>BNC</td>
</tr>
<tr>
<td>J17</td>
<td>Record Out CH. 2 (option), 75 ohms</td>
<td>BNC</td>
</tr>
<tr>
<td>J18</td>
<td>OR'D AM 2Vp-p for 50% AM, 75 ohms</td>
<td>BNC</td>
</tr>
<tr>
<td>J19</td>
<td>OR'D AGC, 0 to -5 V into a 1K load</td>
<td>BNC</td>
</tr>
<tr>
<td>J20</td>
<td>IF Combined Out, 70 MHz, -10 dBm, 50 ohms</td>
<td>BNC</td>
</tr>
<tr>
<td>J21</td>
<td>Record Out Combined (option), 75 ohms</td>
<td>BNC</td>
</tr>
<tr>
<td>J22</td>
<td>Doppler, 2.8125 MHz</td>
<td>BNC</td>
</tr>
<tr>
<td>J23</td>
<td>Bit Sync Outputs - Soft decision,Clock and Data, (TTL levels)</td>
<td>Type “D”, 15 pin female</td>
</tr>
<tr>
<td>J24</td>
<td>Accessory</td>
<td>Type “D”, 25 pin female</td>
</tr>
<tr>
<td>J25</td>
<td>RS-232C Interface</td>
<td>RS-232C Standard 9 pin, Type “D” female</td>
</tr>
<tr>
<td>J27</td>
<td>Ethernet, 100Base-TX</td>
<td>RJ-45 Socket</td>
</tr>
<tr>
<td>J28</td>
<td>IEEE-488.1 Interface</td>
<td>IEEE-488.1 Standard</td>
</tr>
<tr>
<td>J29</td>
<td>Channel 1 Video Out</td>
<td>BNC</td>
</tr>
<tr>
<td>J30</td>
<td>Channel 2 Video Out</td>
<td>BNC</td>
</tr>
</tbody>
</table>

**Note:** Rear panel configuration may vary depending on the options chosen.