OMP designs and builds a wide range of RF & Microwave Subsystems and Antennas. This product data sheet is one in a series of publications where we present general specifications of products that we developed. These documents are intended to give you an overview of the type of work we do and they will help you in determining your requirements for a specific application.

Application

The most basic version of this transponder is designed to lock onto a constant carrier uplink tone and to subsequently generate a constant carrier downlink tone that is phase-coherent with the uplink. In this way, the relative velocity between the earth station and the transponder can be established to great precision. The applications range from spacecraft tracking, tracking of small celestial bodies to observation of planetary dynamics, etc.

Advanced versions of this transponder can include features such as pseudo-noise sequence ranging, data transfer, telemetry, command-and-control functions, landing beacon.

Configurations

The transponder enclosure consists of a set of ultra-light aluminium shells for maintaining rigidity of the structure as well as providing excellent electromagnetic shielding. A thick base plate is included to act as a heat spreader for the transmit power amplifier and to provide a sturdy mounting point to the spacecraft superstructure (and for integration into any special spacecraft thermal systems). Micro-D connectors provide an interface between the transponder and the spacecraft power and control systems. The RF inputs and outputs are straight panel-mount female SMA connectors providing 50 ohm input and output impedance.

KEY FEATURES

- Operation on 7.1GHz uplink and 8.4GHz downlink
- Constant carrier tracking for precision Doppler metrology
- Compact 13x10cm footprint
- Sturdy Al 6061 enclosure
- Dual conversion receiver
- Switchable loop bandwidth
- Switchable coherent/noncoherent automatic receiver gain control
- Temperature compensated precision tunable crystal oscillator local reference
- DC supply is galvanically isolated
- TTL compatible control lines
- RS232 serial link provided for ground testing/verification

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PRODUCT SERIES DATA SHEET

C/X Band Transponder
**Brief system description**

There are five main subsystems that make up the transponder:

1. Power supply unit
2. Downconverter
3. Coherent detector/reference generator
4. Transmitter
5. Control unit

The power supply unit is a transformer coupled DC-DC converter that provides galvanic isolation to the spacecraft power supply as well as providing the full set of regulated voltages to the transponder subsystems. It should be noted that the power supply makes no use of opto-couplers, to reduce sensitivity to radiation effects.

The down converter provides the frequency translation and most of the gain needed to make the transponder work. There are two local oscillators that are locked to the common precision reference provided by the coherent detector. Variable gain amplifiers in the downconverter are also used as part of the automatic gain control function.

The coherent detector/reference generator contains a final frequency conversion stage to a baseband signal that controls the frequency control loop as well as the automatic gain control loop. The control voltage of the frequency control loop is used to tune a low-noise voltage-controlled crystal oscillator to track the uplink carrier. This reference is used to generate the downconverter local oscillator signals as well as the coherent downlink carrier. In this way, uplink and downlink phases are kept in strict “lockstep.” Further functionality includes carrier detect circuitry and special switched-bandwidth loop filters.

The transmitter consists of a local oscillator that is locked to the precision reference signal and an RF power amplifier. Optionally, a modulator can be added, but the basic constant-carrier transmitter does not need one.

The control unit is a small microcontroller that programs all the phase-locked loops and sets the default transponder state on power-up. It also performs basic control and telemetry interfacing with the spacecraft control systems. A simple RS-232 serial link is provided for ground testing. Options exist for more advanced communications capabilities (RS485, CAN bus, ethernet, etc.) if desired.
Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uplink frequency</td>
<td>7.15-7.19GHz</td>
<td></td>
</tr>
<tr>
<td>Downlink frequency</td>
<td>8.4-8.45GHz</td>
<td></td>
</tr>
<tr>
<td>Tx/Rx ratio</td>
<td>880/749</td>
<td></td>
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<tr>
<td>Frequency tracking</td>
<td>±15kHz</td>
<td></td>
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<tr>
<td>Rx power</td>
<td>3W</td>
<td></td>
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<tr>
<td>Acquisition power</td>
<td>&lt;134dBm</td>
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<tr>
<td>Tracking power level</td>
<td>&lt;134dBm</td>
<td>-140dBm typical</td>
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<tr>
<td>IF bandwidth</td>
<td>3.5kHz</td>
<td></td>
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<tr>
<td>Noise figure</td>
<td>&lt;3dB</td>
<td></td>
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<tr>
<td>ADEV</td>
<td>$10^{-13}$</td>
<td>60 sec, $P_{\text{in}} \geq 130\text{dBm}$</td>
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<tr>
<td>Power supply</td>
<td>26-32V</td>
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</tr>
</tbody>
</table>

Optional modifications

- Fully digital tracking loop
- Digital modulator/demodulator
- Regenerative pseudo-noise sequence ranging
- Data modem functionality
- Telemetry/Command and control
- Beacon
- Other frequency bands

If you have different requirements for a similar design or a completely new set of requirements, please contact us at the numbers listed below or via mail or refer to the sales page on our website for a representative in your area.
Our customers have needs beyond standard products. OMP is who you come to when your application needs to go beyond the ordinary to accomplish something unique and remarkable.

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Our model is to design ‘at cost’, acting as a true partner with our customers, profiting only once we’ve entered production with the final product. And unlike traditional design companies who part ways at the critical stage of production, OMP retains responsibility for the entire product lifecycle - all the way to integration into the final system.

Since we are not a catalog manufacturer who depends on high volume production, your custom requirement is our only priority. Let Orban Microwave Products help you achieve something extraordinary.

- OMP designs and builds to customer’s specifications
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- OMP uses state-of-the-art circuit and 3D electromagnetic simulations tools
- OMP uses rapid prototyping for fast turnaround
- We will work with our customers on the integration of products designed
- We work with selected partners for agency approval.

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