

Applications

- Satcom microwave antenna signal distribution
- EW Systems
- Broadband delay-line and signal processing systems
- Frequency distribution systems
- Radar system calibration
- Phased array antenna systems, interferometric antenna arrays

Features/Benefits

- 50 MHz – 40 GHz
 - *Eliminates the performance and cost penalty of block up/down conversion*
- Low RIN Source Laser
 - Provides high dynamic range of $>112 \text{ dB-Hz}^{2/3}$ sub-octave
- Microprocessor-based transmitter control for laser bias, modulator bias and link gain
 - *Provides consistent high performance operation*
 - *Allows for modulator low-bias operation and higher SFDR*
- SNMP V.1 and RS-232 Monitor and Control Interface
 - *Flexible user interface options*
- Compatible with Emcore's modular Optiva platform
 - *Allows multiple format and frequency transport in a single chassis*
- DWDM Operation
 - *Increases transport capacity without increasing fiber count*

Optiva Ku and Ka-Band Transport System



The EMCORE Optiva Ku and Ka band microwave fiber optic transport system is a family of SNMP managed fiber optic transmitters, receivers, optical amplifiers and RF amplifiers that provide high-performance 0.05 – 40 GHz transport within the Optiva modular platform.

The units can be used to construct transparent links for antenna remoting and other high-dynamic-range applications. The broad bandwidth supports applications such as electronic warfare systems. Other applications include delay lines and signal processing systems.

The standard transmitter provides a single optical output with up to 10 dBm optical output power. Optional internal erbium doped fiber amplifiers (EDFA) in the transmitter and receiver provide higher optical output powers and higher link gain options.

The system operates at a nominal wavelength of 1550 nm. Wavelength selected lasers on the ITU grid are also available to support multi-channel DWDM applications.

Performance Highlights

| | Min | Typical | Max | Units |
|----------------------|-----|---------|-----|-------|
| Frequency Range | .05 | -- | 40 | GHz |
| RF input power dBm | -- | -- | +25 | dBm |
| Wavelength | | 1550 | | nm |
| Optical Output Power | 10 | -- | 24* | dBm |
| Temperature Range | -40 | -- | 70 | °C |

See following pages for complete specifications and conditions.

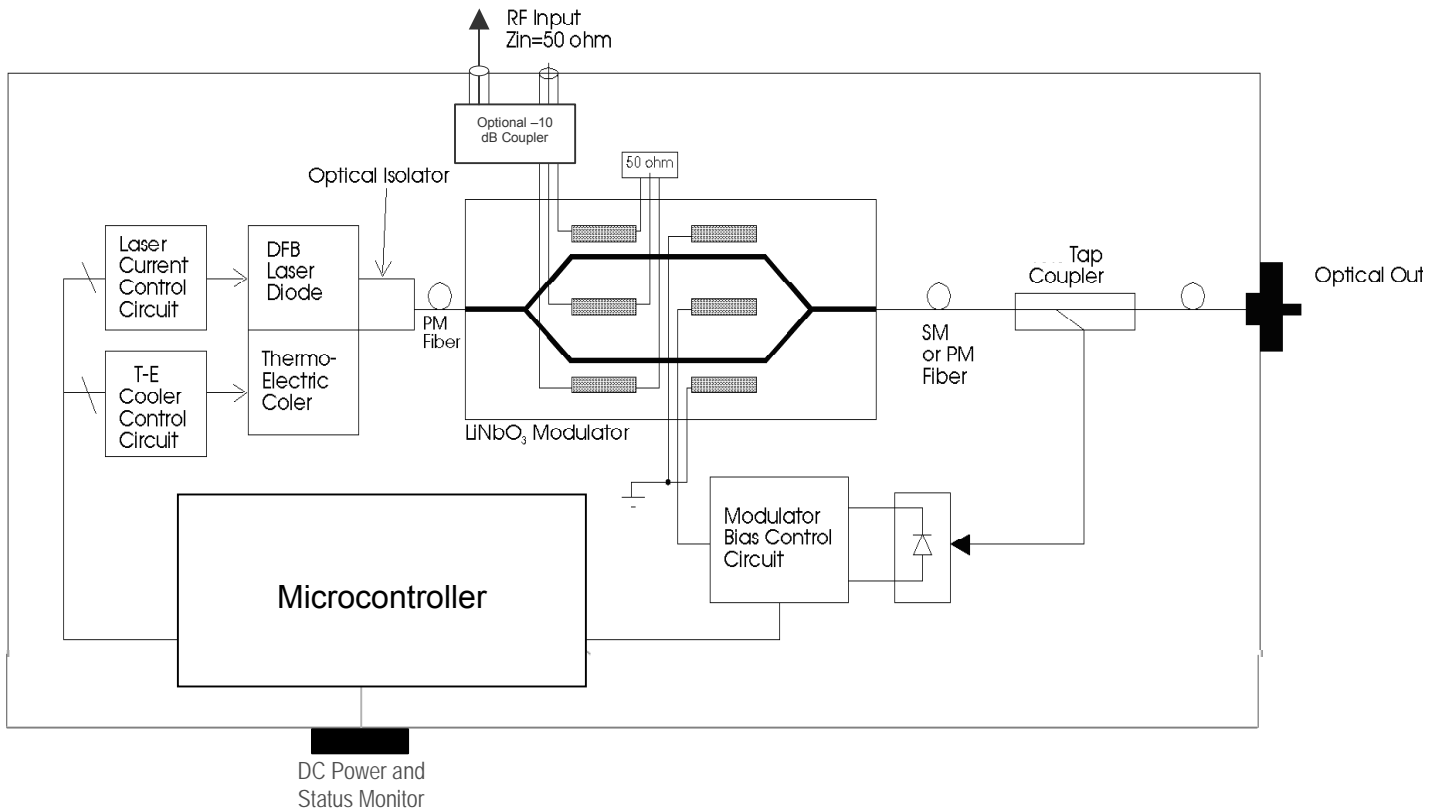
*With internal EDFA

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

| Parameter | Symbol | Min | Max | Units |
|---|------------------|-----|-----|-------|
| Operating Temperature (within specifications) | T _{OP} | 0 | 50 | °C |
| Operating Temperature (with degraded performance) | T _{OP} | -40 | 70 | °C |
| Storage Temperature | T _{STG} | -40 | 70 | °C |
| RF Input | S _{in} | NA | 25 | dBm |

Transmitter Reference Block Diagram



TX & RX Optical Characteristics

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|------------------------------------|-----------|---------------------|------|------|------|------|
| Wavelength | λ | - | 1530 | 1550 | 1562 | nm |
| Optical Output Power – non EDFA TX | P_L | - | 10 | 11 | 12 | dBm |
| Optical Output Power –TX w/ EDFA | P_L | - | - | - | 24 | dBm |
| Connector Return Loss | - | - | 60 | -- | -- | dB |
| Optical Connector Type | | SC/APC | | | | |
| Receiver Optical Input Power | P_{in} | 18 & 22 GHz Version | | | +12 | dBm |
| | P_{in} | 40 GHz Version | | | +10 | dBm |
| Receiver Responsivity | | 18 & 22 GHz Version | 0.7 | | | A/W |
| | | 40 GHz Version | 0.5 | | | A/W |

Note: In order to prevent reflection-induced distortion degradation, the laser should be connected to an optical cable having a return loss of at least 55 dB for discrete reflections and 30 dB for distributed reflections.

TX and RX RF Characteristics

| Parameter | Condition | Min | Typ | Max | Unit |
|---|----------------------------|--------------------|-----|-----|----------|
| Operational Bandwidth | TX-18 Version | 0.05 | | 18 | GHz |
| | TX-22 Version | | | 22 | |
| | TX-40 Version | | | 40 | |
| RF Input Impedance | - | | 50 | | Ω |
| RF Return Loss | | 9 | 15 | | dB |
| 2 nd Harmonic Suppression | RF input 0 dBm | | -70 | -45 | dBc |
| 1 dB Compression Point | @18 GHz | | +17 | | dBm |
| | @22 GHz | | +20 | | |
| | @40 GHz | | +25 | | |
| RF Connectors | 18 GHz Modules | SMA Female | | | |
| | \geq 22 GHz Modules | 2.92 mm (K) Female | | | |
| RF Test Point Reference Value, Relative to RF input or RF output* | 18 GHz Units: 0.5 – 18 GHz | -9 | -10 | -11 | dB |
| | 22 GHz Units: 1 – 22 GHz | | | | |
| | 40 GHz Units: 1 – 40 GHz | | | | |

*Test point performance beyond the stated frequency range is provided; only the test point reference value tolerance may increase beyond the above stated +/- 1 dB

22 GHz RF Amplifier Module Characteristics

| RF Amplifier | RF Bandwidth (GHz) | Min Gain (dB) | Max RF Input (dBm) | NF (dB) | Output P1dB (dBm) | Output IP3 (dBm) | Gain Flatness 1 – 22 GHz (dB) | RF Connectors |
|-------------------|--------------------|---------------|--------------------|---------|-------------------|------------------|-------------------------------|--------------------|
| OTS-RF-K5-0522-15 | 0.1 - 22 | 14 | +10 | 4 | +25 | +35 | 5 | 2.92 mm (K) Female |
| OTS-RF-K5-0522-25 | | 24 | 0 | 4 | +25 | +35 | 5 | |
| OTS-RF-K5-0522-35 | | 34 | -10 | 4 | +25 | +35 | 5 | |

EDFA Module Characteristics

| Optical Amplifier | Optical Wavelength (nm) | Optical Input Power (dBm) | Optical Output Power (dBm) | Max NF (dB) | Output Power Stability (dB) | Gain Flatness, Typ (dB)* |
|-------------------|-------------------------|---------------------------|----------------------------|-------------|-----------------------------|--------------------------|
| OTS-OA-1400 | 1530-1562 | -10 to +12 | +14.0 | 5.0 | +/- 0.1 | 1dB |
| OTS-OA-1700 | | | +17.0 | | | |
| OTS-OA-2000 | | | +20.0 | | | |
| OTS-OA-2200 | | | +22.0 | | | |

* - for constant and defined optical input power



DC Power Consumption – Max

| Module Type | Input Voltage (VDC) | Max Current (@+70°C) |
|--------------|---------------------|----------------------|
| TX | +12 | 500 mA |
| RX | | 500 mA |
| EDFA | | 1000 mA |
| RF Amplifier | | 1000 mA |

Network Management

All modules are compliant with SNMP V.1 through the Optiva NMS card (OPV-CTLR-IC)

Broadband Link Performance

OTS-2T/S5-0518-10 transmitter @ quadrature bias with 0 dBm RF input and OTS-RX-1800 receiver with 0 dBm optical input (unless otherwise indicated)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---------------------------------------|--------|--|------|------------|---------|----------------------|
| RF Bandwidth | | | 0.05 | | 18 | GHz |
| Link Gain (non-EDFA TX)* | G | @ 10 GHz @ 18 GHz | | -47 -48 | | dB |
| Link Gain (+10 dBm RX optical input)* | G | @ 10 GHz @ 18 GHz | | -27 -28 | | |
| Noise Figure | NF | @ 10GHz @ 18 GHz | | 55 60 | | dB |
| Input IP3 | IIP3 | @ 10 GHz @ 18 GHz | | +24 +25 | | |
| Spurious Free Dynamic Range | SFDR | @ 0 dBm RX Optical Input @ +10 dBm RX Optical Input | | 95 100 | | dB·Hz ^{2/3} |
| Gain Variation | | 50 MHz to 1 GHz 1 GHz to 18 GHz | | | 5 10 | |

*Receiver RF output will change 2 dB for each 1 dB of RX optical input power level change

OTS-2T/K5-0522-10 transmitter @ quadrature bias with 0 dBm RF input and OTS-RX-2200 receiver with 0 dBm optical input (unless otherwise indicated)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---------------------------------------|--------|--|------|------------|---------|----------------------|
| RF Bandwidth | | | 0.05 | | 22 | GHz |
| Link Gain (non-EDFA TX)* | G | @ 10 GHz @ 22 GHz | | -42 -43 | | dB |
| Link Gain (+10 dBm RX optical input)* | G | @ 10 GHz @ 22 GHz | | -22 -23 | | |
| Noise Figure | NF | @ 10 GHz @ 22 GHz | | 51 51 | | dB |
| Input IP3 | IIP3 | @ 10 GHz @ 22 GHz | | +28 +28 | | |
| Spurious Free Dynamic Range | SFDR | @ 0 dBm RX Optical Input @ +10 dBm RX Optical Input | | 100 105 | | dB·Hz ^{2/3} |
| Gain Variation | | 50 MHz to 1 GHz 1 GHz to 22 GHz | | | 5 10 | |

*Receiver RF output will change 2 dB for each 1 dB of RX optical input power level change



OTS-2T/K5-0540-XX10-YY transmitter @ quadrature bias with 0 dBm RF input and OTS-2R/K5-0540-XX-YY receiver with 0 dBm optical input (unless otherwise indicated)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---------------------------------------|--------|----------------------------|------|-----|-----|----------------------|
| RF Bandwidth | | | 0.05 | | 40 | GHz |
| Link Gain (non-EDFA TX)* | G | @ 20 GHz | | -48 | | dB |
| | | @ 40 GHz | | -53 | | |
| Link Gain (+10 dBm RX optical input)* | G | @ 20 GHz | | -28 | | dB |
| | | @ 40 GHz | | -33 | | |
| Noise Figure | NF | @ 20 GHz | | 55 | | dB |
| | | @40 GHz | | 59 | | |
| Input IP3 | IIP3 | @ 20 GHz | | +29 | | dBm |
| | | @ 40 GHz | | +34 | | |
| Spurious Free Dynamic Range | SFDR | @ 0 dBm RX Optical Input | | 100 | | dB·Hz ^{2/3} |
| | | @ +10 dBm RX Optical Input | | 105 | | |
| Gain Variation | | 50 MHz to 1 GHz | | | 5 | dB |
| | | 1 GHz to 40 GHz | | | 15 | |

*Receiver RF output will change 2 dB for each 1 dB of RX optical input power level change

RF amplified OTS-2T/K5-0522-XX10-YY transmitters @ quadrature bias with 0 dBm RF input and RF amplified OTS-2R/K5-0522-XX-YY receiver with 0 dBm optical input (unless otherwise indicated)*

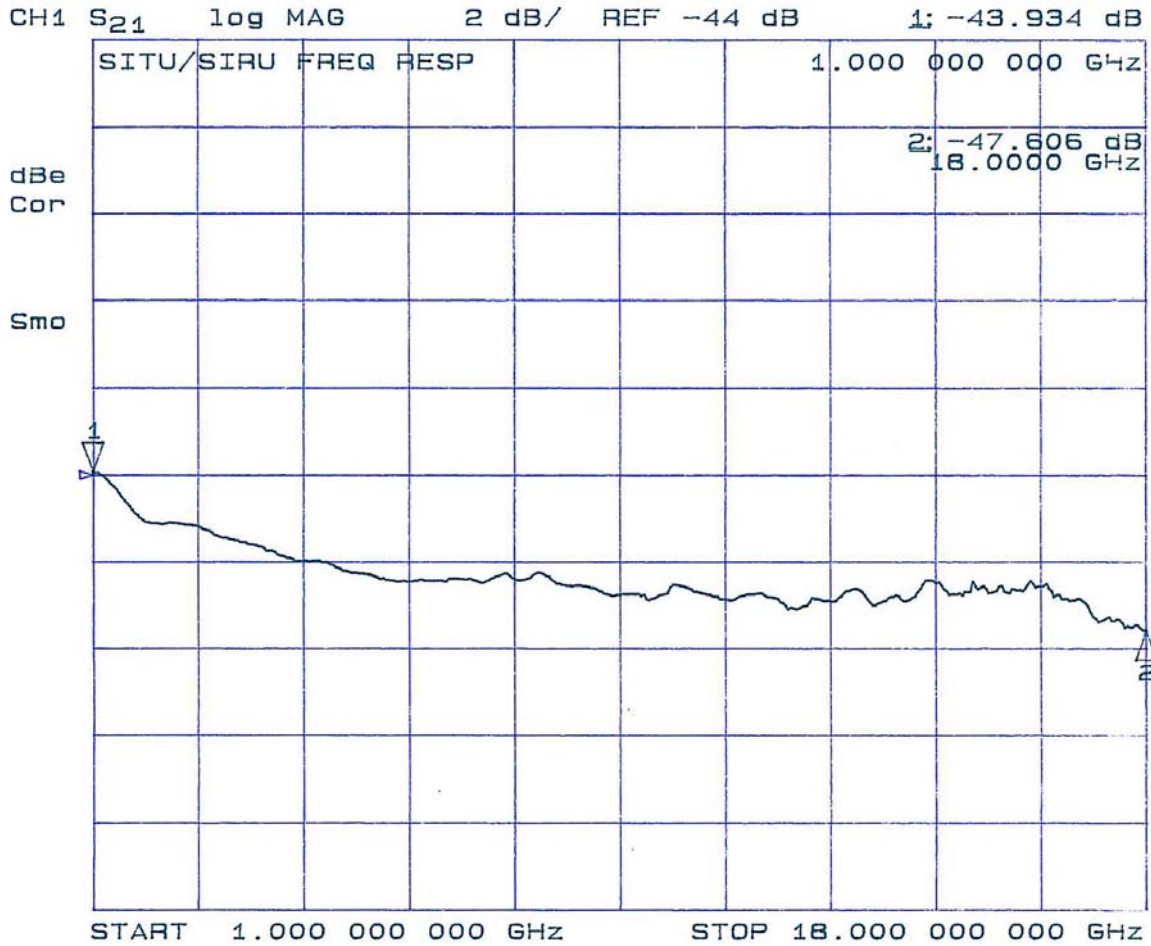
| RF Amplifier Configuration | RF Bandwidth (GHz) | Link Gain (dB) | Max RF Input (dBm) | NF (dB) | Input P1dB (dBm) | Input IP3 (dBm) | SFDR (dB·Hz ^{2/3}) | Gain Flatness 0.1 – 22 GHz (dB) |
|-------------------------------|--------------------|----------------|--------------------|---------|------------------|-----------------|------------------------------|---------------------------------|
| +15 dB TX/+35 dB RX Amplifier | 0.1 – 22 | 0 | 0 | 35 | +10 | +20 | 105 | 20 |
| +25 dB/+35 dB RX Amplifier | 0.1 – 22 | +10 | -10 | 25 | 0 | +10 | 110 | 20 |

*Requires the use of Optiva K-band RF amplifier modules



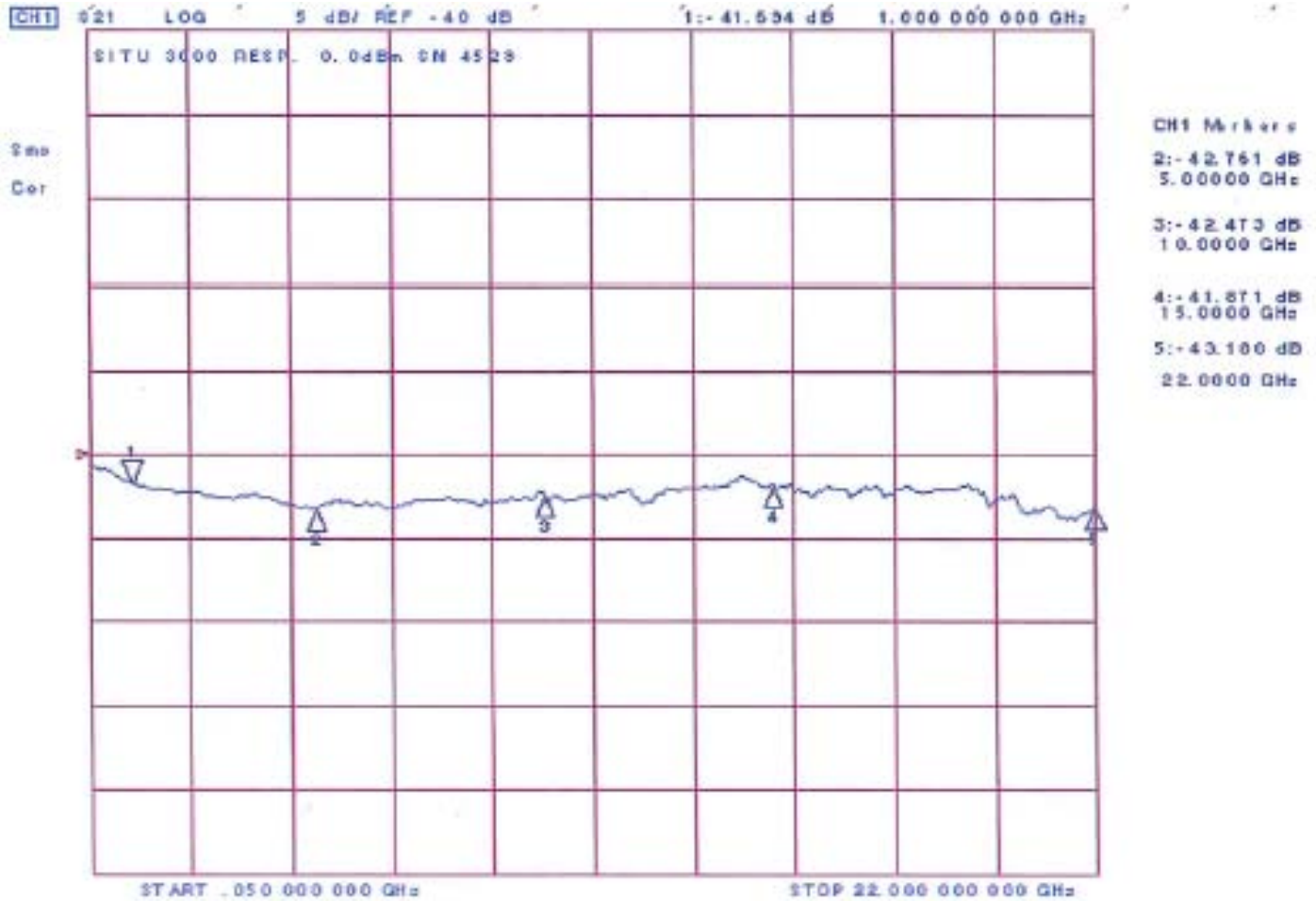
Typical S21 Frequency Response

OTS-2T/S5-0518-XX10-YY & transmitter with 0 dBm RF input and OTS-2R/S5-0518-XX-YY receiver with 0 dBm optical input



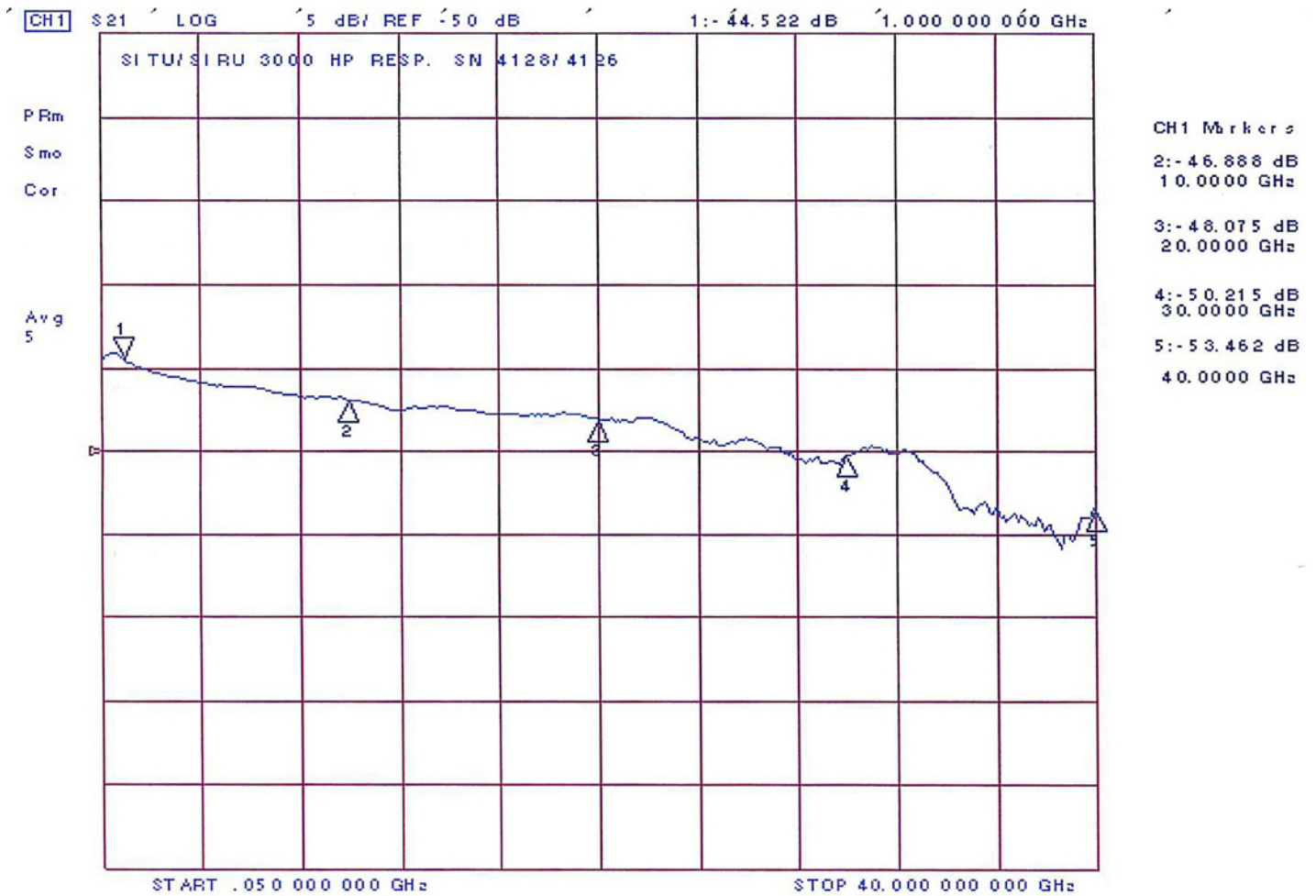
Typical S21 Frequency Response

OTS-2T/S5-0522-XX10-YY & transmitter with 0 dBm RF input and OTS-2R/S5-0522-XX-YY receiver with 0 dBm optical input



Typical S21 Frequency Response

OTS-2T/S5-0540-XX10-YY & transmitter with 0 dBm RF input and OTS-2R/S5-0548-XX-YY receiver with 0 dBm optical input



Ordering Information

Transmitter Modules

OTS-2T/S5-0518-10-yy-zz 0.05 – 18 GHz Externally Modulated Fiber Optic Transmitter Module, +10 dBm
 OTS-2T/K5-0522-10-yy-zz 0.05 – 22 GHz Externally Modulated Fiber Optic Transmitter Module, +10 dBm
 OTS-2T/K5-0522-xx-yy-zz 0.05 – 22 GHz Externally Modulated Fiber Optic Transmitter Module with xx dBm Integrated EDFA (xx = 14, 17 or 20)
 OTS-2T/K5-0540-10-yy-zz 0.05 – 40 GHz Externally Modulated Fiber Optic Transmitter Module, +10 dBm
 OTS-2T/K5-0540-xx-yy-zz 0.05 – 40 GHz Externally Modulated Fiber Optic Transmitter Module with xx dBm integrated EDFA (xx = 14, 17,20, 22 or 24)
 TX Optical Output -1y Single TX Optical Output
 -2y Dual TX Optical Output Option
 Test Port Option -y1 No RF Test Port
 -y2 -10dB RF Front Panel Test Port
 ITU TX Option Insert ITU channel number in -zz suffix to any TX module to indicate ITU wavelength channel (00 = default 1520 – 1580 nm). Available ITU channels are shown below:

| ITU Channel | Frequency (THz) | Wavelength (nm) |
|-------------|-----------------|-----------------|
| 62 | 196.2 | 1527.99 |
| 61 | 196.1 | 1528.77 |
| 60 | 196.0 | 1529.55 |
| 59 | 195.9 | 1530.33 |
| 58 | 195.8 | 1531.12 |
| 57 | 195.7 | 1531.90 |
| 56 | 195.6 | 1532.68 |
| 55 | 195.5 | 1533.47 |
| 54 | 195.4 | 1534.25 |
| 53 | 195.3 | 1535.04 |
| 52 | 195.2 | 1535.82 |
| 51 | 195.1 | 1536.61 |
| 50 | 195.0 | 1537.40 |
| 49 | 194.9 | 1538.19 |
| 48 | 194.8 | 1538.98 |
| 47 | 194.7 | 1539.77 |
| 46 | 194.6 | 1540.56 |
| 45 | 194.5 | 1541.35 |
| 44 | 194.4 | 1542.14 |
| 43 | 194.3 | 1542.94 |
| 42 | 194.2 | 1543.73 |
| 41 | 194.1 | 1544.53 |
| 40 | 194.0 | 1545.32 |

| ITU Channel | Frequency (THz) | Wavelength (nm) |
|-------------|-----------------|-----------------|
| 39 | 193.9 | 1546.12 |
| 38 | 193.8 | 1546.92 |
| 37 | 193.7 | 1547.72 |
| 36 | 193.6 | 1548.51 |
| 35 | 193.5 | 1549.32 |
| 34 | 193.4 | 1550.12 |
| 33 | 193.3 | 1550.92 |
| 32 | 193.2 | 1551.72 |
| 31 | 193.1 | 1552.52 |
| 30 | 193.0 | 1553.33 |
| 29 | 192.9 | 1554.13 |
| 28 | 192.8 | 1554.94 |
| 27 | 192.7 | 1555.75 |
| 26 | 192.6 | 1556.56 |
| 25 | 192.5 | 1557.36 |
| 24 | 192.4 | 1558.17 |
| 23 | 192.3 | 1558.98 |
| 22 | 192.2 | 1559.79 |
| 21 | 192.1 | 1560.61 |
| 20 | 192.0 | 1561.42 |
| 19 | 191.9 | 1562.23 |
| 18 | 191.8 | 1563.05 |

Receiver Modules

OTS-2R/S5-0518-x 0.05- 18 GHz Fiber Optic Receiver Module
 OTS-2R/S5-0522-x 0.05- 22 GHz Fiber Optic Receiver Module
 OTS-2R/S5-0540-x 0.05- 40 GHz Fiber Optic Receiver Module
 Test Port Option x-1 No RF Test Port
 x-2 -10dB RF Front Panel Test Port

Optical Amplifier Modules*

OTS-OA-1400 14 dBm Optical Amplifier Module
 OTS-OA-1700 17 dBm Optical Amplifier Module
 OTS-OA-2000 20 dBm Optical Amplifier Module
 OTS-OA-2200 22 dBm Optical Amplifier Module
 *EDFA operating wavelength is 1530 – 1562 nm

RF Amplifier Modules*

OTS-RF-S5-0522-15 0.1- 22 GHz 15 dB RF Amplifier Module
 OTS-RF-S5-0522-25 0.1- 22 GHz 25 dB RF Amplifier Module
 OTS-RF-S5-0522-35 0.1- 22 GHz 35 dB RF Amplifier Module

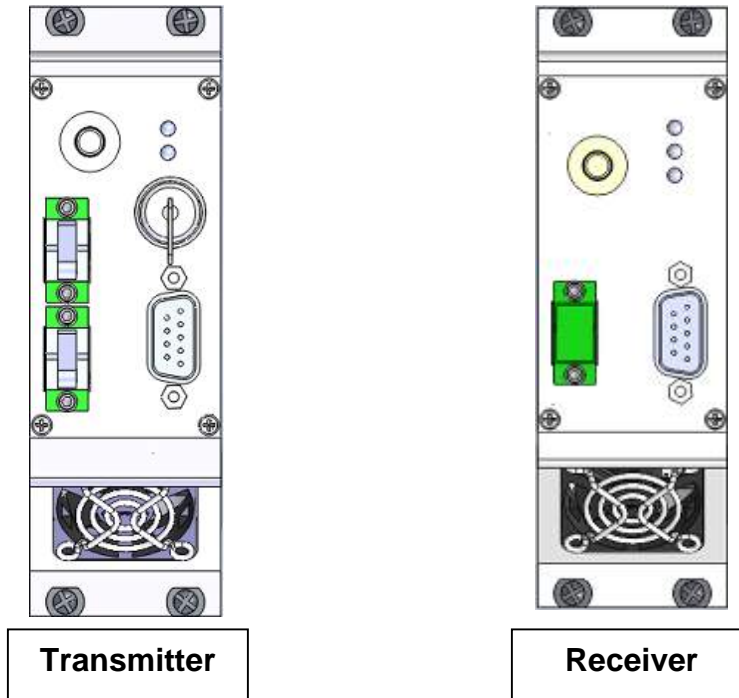
*RF amplifier operating bandwidth is 0.1 – 22 GHz



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Mechanical Configuration

Each TX and RX module occupies two slots in the Emcore Optiva chassis. Each EDFA and RF module occupies one slot in the Emcore Optiva Chassis



Laser Safety

Class IIIb Laser Product

FDA/CDRH Class IIIb laser product. All transmitter versions are Class IIIB laser products per CDRH, 21 CFR 2040 Laser Safety requirements. All versions are Class 3B laser products per IEC*60825-1:1993.

Maximum Power = 24 dBm

Caution: Use of controls, adjustments and procedures other than those specified herein may result in hazardous laser radiation exposure.

*IEC is a registered trademark of the International Electrotechnical Commission.

