OPERATOR MANUAL

Fiberoptic Receiver

MODEL 4510A
4510B
4511A
4512A
4515A
4515B

Making Light *Work* For You

ORTEL™
CORPORATION

Service

Do not attempt to modify or service any part of the system other than in accordance with procedures outlined in this Operator's Manual. If the system does not meet its warranted specifications, or if a problem is encountered that requires service, return the apparently faulty plug-in or assembly to Ortel for evaluation in accordance with Ortel's warranty policy.

When returning a plug-in or assembly for service, include the following information: Owner, Model Number, Serial Number, Return Authorization Number (obtained in advance from Ortel Corporation's Customer Service Dept.), service required and/or a description of the problem encountered.

Warranty and Repair Policy

The Ortel Corporation Quality Plan includes product test and inspection operations to verify the quality and reliability of our products.

Ortel uses every reasonable precaution to ensure that every device meets published electrical, optical, and mechanical specifications prior to shipment. Customers are asked to advise their incoming inspection, assembly, and test personnel as to the precautions required in handling and testing ESD sensitive opto-electronic components.

These products are covered by the following warranties:

1. General Warranty
   Ortel warrants to the original purchaser all standard products sold by Ortel to be free of defects in material and workmanship for one (1) year from date of shipment from Ortel. During the warranty period, Ortel's obligation, at our option, is limited to repair or replacement of any product that Ortel proves to be defective. This warranty does not apply to any product which has been subject to alteration, abuse, improper installation or application, accident, electrical or environmental over-stress, negligence in use, storage, transportation, or handling.

2. Specific Product Warranty Instructions
   All Ortel products are manufactured to high quality standards and are warranted against defects in workmanship, materials and construction, and to no further extent. Any claim for repair or replacement of a device found to be defective on incoming inspection by a customer must be made within 30 days of receipt of the shipment, or within 30 days of discovery of a defect within the warranty period.

   This warranty is the only warranty made by Ortel and is in lieu of all other warranties, expressed or implied, except as to title, and can be amended only by a written instrument signed by an officer of Ortel. Ortel sales agents or representatives are not authorized to make commitments on warranty returns.

   In the event that it is necessary to return any product against the above warranty, the following procedure shall be followed:

   a. Return authorization shall be received from the Ortel Sales Department prior to returning any device. Advise the Ortel Sales Department of the model, serial number, and the discrepancy. The device shall then be forwarded to Ortel,

transportation prepaid. Devices returned freight collect or without authorization may not be accepted.

b. Prior to repair, Ortel Sales will advise the customer of Ortel test results and will advise the customer of any charges for repair (usually for customer caused problems or out-of-warranty conditions).

If returned devices meet full specifications and do not require repair, or if non-warranty repairs are not authorized by the customer, the device may be subject to a standard evaluation charge. Customer approval for the repair and any associated costs will be the authority to begin the repair at Ortel. Customer approval is also necessary for any removal of certain parts, such as connectors, which may be necessary for Ortel testing or repair.

c. Repaired products are warranted for the balance of the original warranty period, or at least 90 days from date of shipment.

3. Limitations of Liabilities

Ortel's liability on any claim of any kind, including negligence, for any loss or damage arising from, connected with, or resulting from the purchase order, contract, or quotation, or from the performance or breach thereof, or from the design, manufacture, sale, delivery, installation, inspection, operation or use of any equipment covered by or furnished under this contract, shall in no case exceed the purchase price of the device which gives rise to the claim.

EXCEPT AS EXPRESSLY PROVIDED HEREIN, ORTEL MAKES NO WARRANTY OF ANY KIND, EXPRESSED OR IMPLIED, WITH RESPECT TO ANY GOODS, PARTS AND SERVICES PROVIDED IN CONNECTION WITH THIS AGREEMENT INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. ORTEL SHALL NOT BE LIABLE FOR ANY OTHER DAMAGE INCLUDING, BUT NOT LIMITED TO, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF OR IN CONNECTION WITH FURNISHING OF GOODS, PARTS AND SERVICE HEREUNDER, OR THE PERFORMANCE, USE OF, OR INABILITY TO USE THE GOODS, PARTS AND SERVICE.

Ortel will not be responsible for loss of output or reduced output of opto-electronic devices if the customer performs chip mounting, ribbon bonding, wire bonding, fiber coupling, fiber connectorization, or similar operations. These processes are critical and may damage the device or may affect the device's output or the fiber output.

Ortel test reports or data indicating mean-time-to-failure, mean-time-between-failure, or other reliability data are design guides and are not intended to imply that individual products or samples of products will achieve the same results. These numbers are to be used as management and engineering tools, and are not necessarily indicative of expected field operation. These numbers assume a mature design, good parts, and no degradation of reliability due to manufacturing procedures and processes.

Ortel is not liable for normal laser output degradation or fiber coupling efficiency degradation over the life of the device.

ORIEL CORPORATION

SERIES 451X OPERATING MANUAL
FIBEROPTIC RECEIVERS

1.0 GENERAL INFORMATION

1.1 DESCRIPTION

This manual describes the following fiberoptic receivers:

4510A	dc - 3 GHz
4510B	dc - 6 GHz
4511A	.01 - 2 GHz, with amplifier
4512A	2 - 6 GHz, with amplifier
4515A	0.1 - 10 GHz
4515B	0.1 - 12 GHz

The 45xx series fiberoptic receivers are intended for the reception of RF and microwave analog signals on singlemode optical fiber at 1300 nm wavelength. They contain InGaAs high speed photodiodes in a proprietary high speed package, which features a coaxial 50 ohm output and a guaranteed low optical reflection coefficient. Selected units contain amplifiers to overcome the insertion loss of the link.

The receiver contains electronic circuits to operate the photodiode and monitor the dc photocurrent over a wide range of operating conditions. An alarm circuit is included for use in systems that require self diagnosis and failure analysis.

The signal output is via a coaxial SMA connector in a 50 ohm output circuit. The optical input is a singlemode fiber with suitable optical connectors, or pigtailed fiber, depending on the application.

CAUTION Before operating this product, carefully read all the information in Section 3 of this manual.

1.2 SPECIFICATIONS

For detailed specifications of the products described in this manual, consult the individual Product Specification Table (PST) included with your manual. If the PST is missing, you can obtain a duplicate from the Oriel Sales Department, (818) 281-3636.

Specifications apply over the entire specified operating range of the product and are guaranteed for 1 year after the date of shipment.

1.3 IDENTIFICATION AND MODEL NUMBERS

Each product is assigned a unique model number and serial number, which appears on the label of the transmitter. Model numbers for this series have the form

45NNX

where NN is a 2 digit numeric designation, and X is a letter designation.

1.3.1 OPTIONS

Many products have standard performance options, which are designated by numeric suffixes to the model number, separated by a hyphen. Thus,

4510B-003

describes a 6 GHz bandwidth receiver, with optional dc coupling of the RF input selected (Option 003). The complete performance of a standard product (with any standard options) is described on the Product Specification Table.

Changes to the PST can be accommodated by requesting non-standard options to meet specific performance requirements. Such options are designated by an alpha-numeric suffix,

-XNN

where X is alpha, and N is numeric. Such custom options must be agreed upon in advance with the Ortel Sales Department.

1.4 SERVICE

Do not attempt to modify or service any part of the receiver. If the receiver does not meet its warranted specifications, or if a problem is encountered that requires service, it must be returned to Ortel for evaluation, in accordance with Ortel's warranty policy.

When returning the receiver for service, include the following information: owner, model number, serial number, return authorization number (obtained from Ortel Corporation Customer Service), service required and/or a description of the problem encountered.

1.5 ADDITIONAL MANUALS

Additional copies of this manual are available through the Ortel Sales Department. Specify the model number and serial number series from the title page.

2.0 SAFETY CONSIDERATIONS

Semiconductor photodiode receivers are high performance electronic devices that provide highly reliable performance when operated in conformance with their intended design.

For best results when using this product, general safety precautions must be observed during handling and operation.

Failure to comply with these general safety precautions and with the specific precautions described elsewhere in this manual violates the safety standards of the design, manufacture and intended use of this product. Ortel Corporation assumes no liability for the customer's failure to comply with these precautions.

2.1 SAFETY SYMBOLS

ESD Sensitive Device - Observe electrostatic precautionary procedures.

DANGER — Indicates a hazard. It is to call attention to a procedure or practice which, if ignored, could lead to personal injury. Do not continue beyond the DANGER sign until the described conditions are fully understood and met.

CAUTION — Indicates a hazard. It is to call attention to a procedure or practice which, if ignored, could lead to damage to the photodiode module or other equipment. Do not continue beyond the CAUTION sign until the described conditions are fully understood and met.

2.2 ESD SENSITIVE

Semiconductor photodiodes are static sensitive devices, and products containing them should be treated accordingly. Static electricity can be conducted to the photodiode from the center pin of the RF output SMA connector, and through the DC connector pins. When unpacking and handling the receiver, prior to installing it, use ESD precautionary procedures, such as grounded wrist straps and grounded work mats. After the receiver is installed in an operational circuit, these pins are protected from casual contact and ESD sensitivity is greatly reduced.

2.3 POWER SUPPLY

A power supply is required to provide power to the photodiode. Operating the receiver outside of its recommended power supply values may cause damage to the product. To prevent potential transient damage to the receiver, avoid connecting the 9-pin connector to the transmitter housing while the power supply is on.

2.4 INPUT POWER

The photodiode can be overdriven and damaged by the application of excessive optical power. Refer to the specific Product Specification Table for information about the maximum permissible optical power to the receiver.

2.5 GROUNDING

All power supplies should be connected to an earth ground.

2.6 STORAGE

Observe ESD precautions while storing the receiver module (i.e. anti-static containers) and store away from corrosive materials. Storage temperature: -55 to 85 C.

3.0 THEORY OF OPERATION

The Model 45XX series fiberoptic receivers uses an Ortel high speed photodiode module to convert an intensity modulated optical signal at 1300 nm wavelength to an microwave signal. For more complete information on the operating principles of analog fiberoptic links, consult Ortel's RF/Microwave Fiberoptic Link Design Guide.

3.1 EXTERNAL DISPLAYS AND CONTROLS

The fiberoptic receiver needs no external controls or adjustments. The operating bias point is preset at the factory to provide optimum performance according to the specifications published in the Product Specification Table.

3.1.1 LED DISPLAYS

There is one external visual LED display that provides information about the operating state of the receiver. This LED is normally ON, and indicates that +15 V is present at Pin #1 of the dc 9-pin connector. If the LED remains off after applying dc power to the receiver, recheck all power connections. If the condition persists, consult with Ortel's Customer Service department.

3.1.2 STATUS MONITORS

A single monitor voltage is available on Pin 6 of the dc connector. This voltage is proportional to the dc photocurrent in the photodiode. The proportionality factor is 1V/mA, ±2%. This voltage provides a means of measuring changes in the incident average optical power to the receiver.

3.1.3 ALARM FUNCTIONS

In addition to the LED visual display on the receiver, there is an alarm circuit that can be used to drive remote indicators. The alarm is designed to provide a positive interrupt capability if the operating conditions at the receiver are not within nominal values.

The alarm circuit is designed to interface with user supplied circuits. The alarm is an open collector output capable of sinking 20 mA when ON and withstanding 15 Vdc when OFF. Normal operation of the alarm circuit is the OFF state. A suggested implementation of an external circuit would be a series connection of an external LED, or a relay, from the system 15 V supply through a 1 Kohm resistor. Assuming negligible voltage drop through the LED or relay, this would provide a 15 mA activation current when the alarm is active.

4.0 INSTALLATION

4.1 UNPACKING AND VISUAL INSPECTION

The product described herein was inspected before shipment and found to be free of mechanical and electrical defects. Observe ESD precautions while handling the receiver. Unpack and examine the product for any damage due to shipping. Keep all packing materials until you are satisfied that the product works according to specifications. Verify that the pins and connectors are free from obvious shipping or handling damage. If damage is discovered, file a claim with the carrier immediately. Notify the Ortel Sales Department as soon as possible.

4.2 OPERATING CONDITIONS

This product is designed and tested to withstand harsh environmental operating and storage conditions. The basic design and manufacturing processes have been subjected to rigorous product qualification tests of temperature cycling, mechanical shock, and vibration. Every product is warranted to operate within specification over the temperature range from -40 to 70 C, and to withstand storage temperatures from -55 to 85 C without degradation.

4.3 CONNECTION INSTRUCTIONS

To operate the receiver at room temperature in a laboratory setting, it can be placed on a convenient flat surface without any particular concern for a good heatsink. In a field operating environment, to obtain reliable operation over the full temperature range, fasten the receiver to a solid metallic surface with a good heat sink using screws through the mounting holes provided.

4.3.1 ELECTRICAL CONNECTION

Observe the following procedures while making electrical connection to the receiver.

4.3.1.1 DC CONNECTION:

Connect the receiver to the required dc voltages using a standard 9-pin DSUB connector. Do not solder wires directly to the pins of the dc connector. The transmitter contains an internal regulator and transient suppression circuits. Most high quality power supplies will provide excellent results. For best results, make the dc connection to the receiver before switching on the supply.

When turning the receiver on, there is a "slow start" circuit that introduces a 2-3 second delay in the turn on. When the LED is lit, the receiver is ready to use.

4.3.1.2 RF CONNECTION:

CAUTION: Connect the RF receiver to the SMA output connector. Do not apply excessive torque to the SMA connector. The improper use of standard wrenches can damage the connector. Use 7-9 inch pounds of torque. The use of a torque wrench is <u>strongly recommended.</u>

The output impedance of the receiver is 50 ohms. Use receivers with the same characteristic impedance.

4.3.2 OPTICAL CONNECTION

The receiver is designed to operate with singlemode optical fiber at a nominal wavelength of 1310 nm. Receivers are available with bulkhead optical connectors, pigtail fibers with connectors, and pigtail fibers without connectors.

When splicing two bare fibers, the fiber tip must be cleaved well and the tip must be clean. If not properly cleaved or cleaned, optical power may be scattered and the insertion loss may be high. For temporary splices, the use of index matching fluid is recommended to reduce reflections.

Optical connectors will exhibit repeatable performance when certain precautions are observed. The connector end surfaces must be kept free of dirt and dust. Before mating, clean with a cotton swab and alcohol, and low dry with a lint free aerosol air spray. Many high quality connectors use keying polarity, and it is important to observe such mating requirements.

Some connectors can be improved by the use of index matching fluid. Consult with the connector manufacturer or Ortel for recommendations regarding specific connectors. Tighten the connectors finger tight. Do not use a wrench, as it will cause excessive optical loss and can damage the connector end faces.

4.4 INITIAL TURN ON PROCEDURE

For initial operation of the receiver, the use of a simple test circuit as shown in Figure 3.1 is recommended. A fiberoptic transmitter of sufficient bandwidth is required to convert an RF signal to optical form. Because of their superior operating characteristics for analog signals, the use of Ortel transmitters is recommended. Choose a bandwidth that matches the frequency range of the receiver.

The suggested test equipment for an initial evaluation is as follows:

DESCRIPTION	RANGE	PRESET TO
Signal Generator	.01-10 GHz -10 to 10 dBm	1 GHz 0 dBm
Power Supply — 3 way		+15 V, ±5 V
Power Supply — single		+15 V
Spectrum Analyzer	.01-10 GHz	1 GHz
Optical Power Meter	1300 nm 5 mW scale	
Amplifier (optional)	1 GHz 30 dB gain	
Fiberoptic Transmitter	Match to receiver	
Digital Voltmeter	0-10 V	

The link insertion loss is approximately 40 dB for receivers without internal amplifiers. A typical link will have a noise figure of 55-65 dB. With a 40 dB link loss, the output noise power will be 15-25 dB above thermal noise. Most spectrum analyzers have a noise figure of about 40 dB, so the output noise of the link will not be measurable without a preamplifier. A 30 dB gain preamplifier inserted before the spectrum analyzer will effectively reduce the analyzer's noise figure to a low enough level to measure the output noise of the link. The preamplifier is also useful when measuring low distortion levels such as harmonics or intermodulation products.

4.4.1 DC OPERATION

Turn on the transmitter and receiver. Verify that the LED is lit. If the LED is not lit, double check the power supply connections. If the trouble persists, contact Ortel Customer Service for advise.

Use the optical power meter to verify that the transmitter is delivering its rated optical power level.

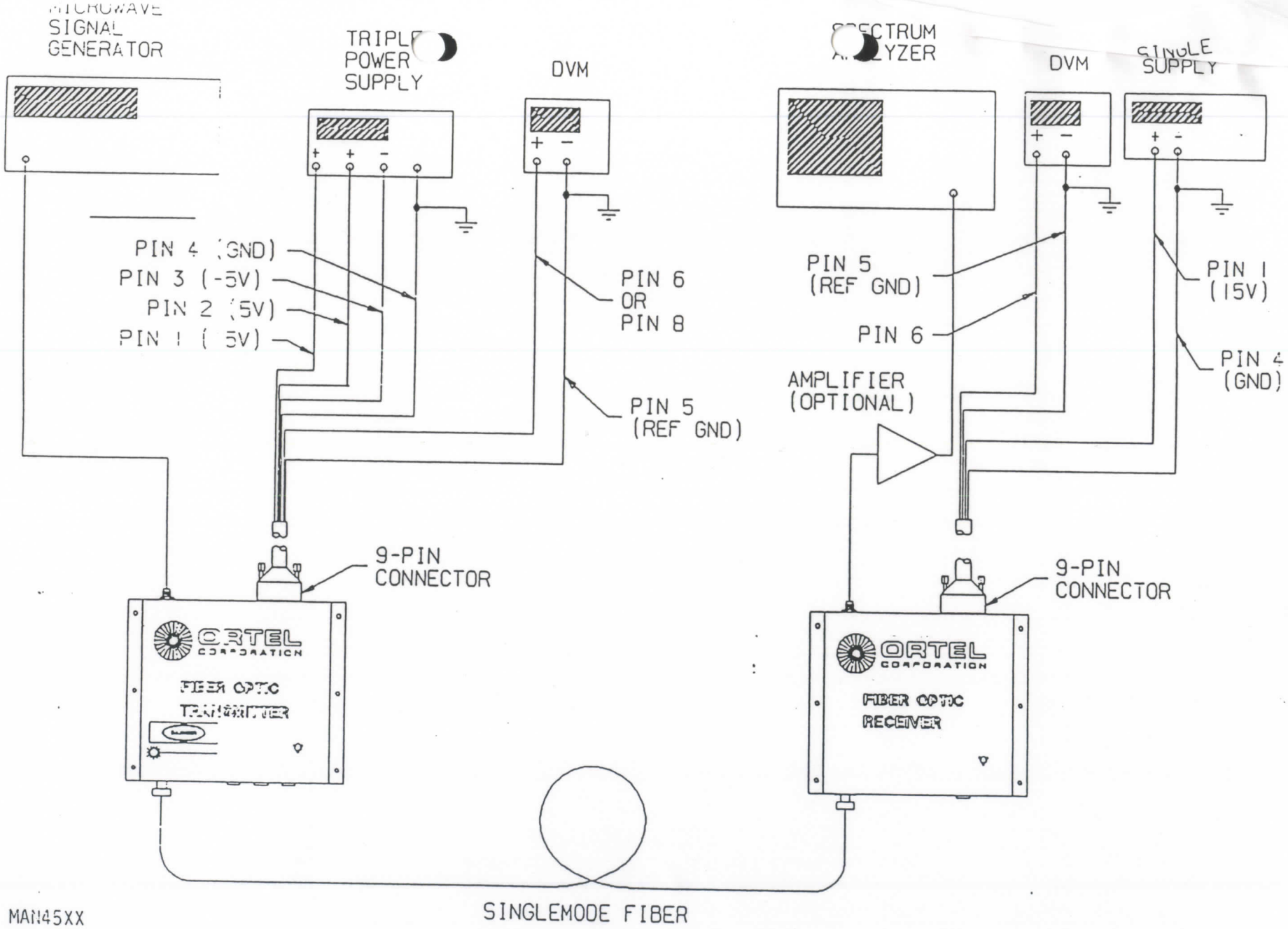
4.4.2 RF OPERATION

Preset the signal generator to 1 GHz at 0 dBm, or to some convenient frequency within the operating range of the transmitter. It is advisable to calibrate the signal generator and spectrum analyzer by making a direct connection to set a zero dB reference measurement level.

Apply the signal to the transmitter and measure the output of the receiver on the spectrum analyzer. Verify that the output signal is clean with no amplitude jitter or spurious signals.

Measure the power level of the receiver output. The gain of the fiberoptic link will depend on the transmitter and receiver characteristics, as well as the optical loss of the test cable. For short cables (<100 meters), good quality connectors and with an Ortel transmitter, the link insertion loss should be approximately 38 dB. Variations of ±3 dB in this value can occur and should not be considered unusual. If the receiver contains an internal amplifier, lower link insertion loss should be expected, depending on the gain of the amplifier.

Adjust the input power up and down by 3-4 dB and verify that the receiver output tracks the input power linearly. If the spectrum analyzer has sufficient bandwidth, measure the amplitude of the second harmonic as a function of input signal power. The second harmonic power should vary as 2:1 relative to the input power, indicating normal linear operation of the transmitter.


MICROWAVE
SIGNAL
GENERATOR
TRIPLE
POWER
SUPPLY
DVM
SPECTRUM
ANALYZER
DVM
SINGLE
SUPPLY
PIN 4 (GND)
PIN 3 (-5V)
PIN 2 (5V)
PIN 1 (5V)
PIN 6
OR
PIN 8
PIN 5
(REF GND)
PIN 5
(REF GND)
PIN 6
AMPLIFIER
(OPTIONAL)
PIN 1
(15V)
PIN 4
(GND)
9-PIN
CONNECTOR
9-PIN
CONNECTOR
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TRANSMITTER
ORTEL
CORPORATION
FIBER OPTIC
RECEIVER
SINGLEMODE FIBER
MAN45XX