Blonder Tongue

SOLUTIONS FOR ALL YOUR APPLICATIONS

Stock No. 7411 USER MANUAL

FRRA Series

Fiber Optic Receiver/Distribution Amplifiers

Model	Stock No.	
FRRA-S4A-860-43P	7411P84B	860 MHz, FC/APC Connector
FRRA-S4S-860-43P	7411P84BS	860 MHz, SC/APC Connector
FRRA-S4A-1000	7411P14	1000 MHz, FC/APC Connector
FRRA-S4A-1000	7411P14S	1000 MHz, SC/APC Connector

Status	Date	Document No.	Issue No.	Author
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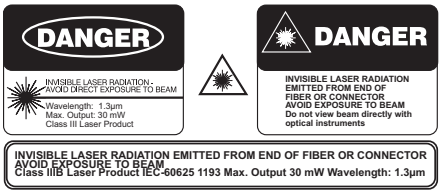
800-523-6049

www.blondertongue.com



Warning: The optical emissions from the units are laser-based and present eye hazards. Follow all safety precautions

TO REDUCE THE RISK OF ELECTRICAL SHOCK, DO NOT REMOVE COVER FROM THIS UNIT.
NO USER-SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.

Safety Precautions

The optical emissions from the units are laser-based Class IIIb, and may present eye hazards if improperly used. **NEVER USE ANY KIND OF OPTICAL INSTRUMENT TO VIEW THE OPTICAL OUTPUT OF THE UNIT**. As always, be careful when working with optical fibers. Fibers can cause painful injury if they penetrate the skin.

Laser Safety Procedures

ALWAYS read the product data sheet and the laser safety label before powering the product. Note the operating wavelength, optical output power, and safety classifications.

If safety goggles or other eye protection are used, be certain that the protection is effective at the wavelength(s) emitted by the device under test **BEFORE** applying power.

ALWAYS connect a fiber to the output of the device **BEFORE** power is applied. Power should never be applied without an attached fiber output. If the device has a connector output, a connector should be attached that is connected to a fiber. This ensures that all light is confined within the fiber waveguide, virtually eliminating all potential hazard.

NEVER look in the end of a fiber to see if light is coming out. **NEVER!** Most fiber optic laser wavelengths (1310 nm and 1550 nm) are totally invisible to the unaided eye and will cause permanent damage. Shorter wavelength lasers (e.g. 780 nm) are visible and are very damaging. Always use instruments, such as an optical power meter, to verify light output.

NEVER, NEVER, NEVER look into the end of a fiber on a power device with ANY sort of magnifying device. This includes microscopes, eye loupes, and magnifying glasses. This **WILL** cause permanent, irreversible burn on your retina. Always double check that power is disconnected before using such devices. If possible, completely disconnect the unit from any power source.

If you have questions about laser safety procedures, please call Blonder Tongue before powering your product.

Laser safety classes for the FRRA are as follows:

Class	Wavelength Range	Optical Power Accession Limits
IIIb	180 nm to 400 nm 400 nm to 10^6 nm	Varies with ג and exposure time. 0.5 Watt

Storing the Unit

If a unit is to be out of use for an extended period of time, the following steps should be taken to ensure the preservation of the unit:

1. The storage temperature range is -20°C to +70°C.
2. A low humidity environment is preferable for long term storage.
3. All connectors should be covered with active device receptacle caps.

Description

The FRRA is a fiber optic receiver module integrated with a rack mounted broadband distribution amplifier (RMDA). The FRRA is used as a launch amplifier in a coaxial distribution sub-system fed from a single mode broadband fiber network. The FRRA's optical receiver section provides exceptional CNR performance at low optical input levels. This feature is also a cost saving one, since it permits the use of lower power optical transmitters. The FRRA has two RF bandwidths available, 860 MHz and 1000 MHz, and features power doubling hybrid amplifier technology for high RF output levels and low distortion. The FRRA operates with the FIBT Series of transmitters as well as those from other leading manufacturers.

Specifications

Optical Receiver

Bandwidth:	45 to 1000 MHz
Bandpass Flatness:	1 dB P/V
Operating Wavelength:	1310/1550 nm
Optical Input Range:	-3 to +3.0 dBm
Carrier Noise Ratio (CNR):	
-1 dBm input, 40 Channel Load:	54 dB
-1 dBm input, 79 Channel Load:	53 dB
-1 dBm input, 110 Channel Load:	52 dB

Distribution Amplifier

Impedance (All Ports):	75 Ω
Return Loss Input:	16 dB
Return Loss Output:	16 dB
Test Port Level:	-30, ±2 dB
Gain Control Range:	10 dB
Slope Control Range:	8 dB
Channel Loading:	110
Flatness:	±0.75 dB
Output Level:	34/42 dBmV
Composite Triple Beat (CTB):	-60 dB
Composite Second Order (CSO):	-58 dB
Hum Modulation:	-70 dB

General

Dimensions (W x H x D):	19" x 1.75" x 6.25" (483mm x 45mm x 159mm)
Weight:	5.75 lbs. (2.61 kg)
Operating Temperature Range:	-20 to +60 °C
Number Of Hybrids:	2
Hybrid Technology:	Power Doubling

Power

Power Supply Requirements:	117 VAC, 60 Hz, 28 W

Connectors

Optical Input:	FC/APC or SC/APC (Model dependent)
RF Output and Test Ports:	"F" Female

Indicators

Power:	LED, Green
Optical Input Alarm:	LED, Tri-colored

	Optical Input dBm	Optical Input mW		
	-10	0.10		
	-9	0.13	Increase Optical Input Power Orange Optical LED Indication	
	-8	0.16		
	-7	0.20		
	-6	0.25	0 dB	
	-5	0.32	2 dB	
	-4	0.40	4 dB	
GREEN LED	-3	0.50	6 dB	Recommended Attenuator Plug-in Value (9320-xx)
GREEN LED	-2	0.63	8 dB	Recommended Attenuator Plug-in Value (9320-xx)
GREEN LED	-1	0.79	10 dB	Recommended Attenuator Plug-in Value (9320-xx)
GREEN LED	0	1.00	12 dB	Recommended Attenuator Plug-in Value (9320-xx)
GREEN LED	1	1.26	14 dB	Recommended Attenuator Plug-in Value (9320-xx)
GREEN LED	2	1.58	16 dB	Recommended Attenuator Plug-in Value (9320-xx)
GREEN LED	3	2.00	18 dB	Recommended Attenuator Plug-in Value (9320-xx)
	4	2.51	Decrease Optical Input Power Red Optical LED Indication	
	5	3.16		

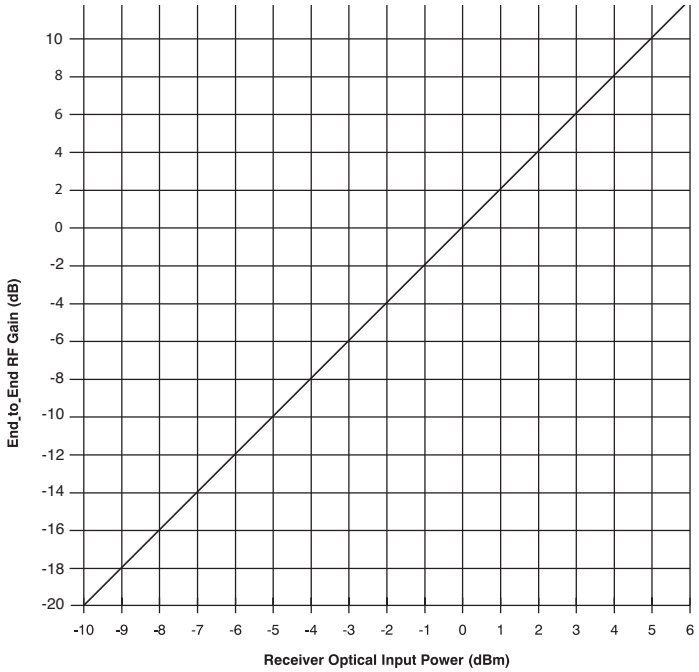


Figure 1 - End-to-End Link

Figure 1 shows the end-to-end RF gain of the Transmitter/Receiver combination. The main factor that determines the end-to-end gain is the amount of light that reaches the receiver. A typical transmitter/receiver combination will have unity gain (0 dB) at a received optical power of 0 dBm (1 milliwatt). The RF gain changes by 2 dB for every 1 dB change in received optical power. This curve will shift up and down by 3 or 4 dB due to variations in the lasers and amplifiers, however the slope will always be 2.

The receiver contains a tri-colored indicator LED that may be used to determine the optical signal strength reaching the receiver. When the LED is green, the signal is at optimum input levels. When the LED is yellow, the optical signal has dropped to insufficient levels (<-3 dBm), and when the LED is red, the signal is overloading the receiver (>+3 dBm). Because the LED is always lit, it also serves as a positive indication that the unit is turned on.

The Fiber Optic Link is optimized for single-mode operation only. Use of multi-mode fiber is not recommended, even for short distances, because of the large amount of modal noise that could result.

This product conforms to European Community Directive #89-336-EE-C for electromagnetic compatibility requirements.

Operating Instructions

WARNING!

The optical emission from the units are laser-based and may present eye hazards if improperly used. As always, be careful when working with optical fibers. Fibers can cause painful injury if they penetrate the skin.

NEVER USE ANY KIND OF OPTICAL INSTRUMENT TO VIEW THE OPTICAL OUTPUT OF THE UNIT.

Input Optical Power

The FRRA's power monitor provides a proportional DC voltage output to optical milli-Watt input. The scale is 1 Volt DC equals 1 mW or 0 dBm of optical input. A standard voltmeter can be used to accurately determine the optical input level into the node. Prior to applying AC power, make sure the gain and slope controls are fully counter-clockwise. Connect the optical input and apply AC power. Insert the voltmeter's positive probe into the jack marked "optical power 1V/mW", and the negative probe into the "ground" jack (see Figure 2). Measure the DC voltage and refer to the FRRA Configuration Table in Figure 4 for the corresponding optical input level conversion to mW and dBm.

Figure. 2

1310/1550 Wavelength Setting

Receivers are shipped from the factory configured for 1310 nm operation to compliment Blonder Tongue's FIBT-S3A Series Transmitters. If it is necessary to change the wavelength of operation setting to 1550 nm, first disconnect AC power, then remove the top cover and locate the 1310nm/1550nm 3 pin header near the receiver module. Using needle nose pliers move the jumper from the 1310 position to the 1550 position. Refer to Figure 3. Replace cover and re-apply AC power.

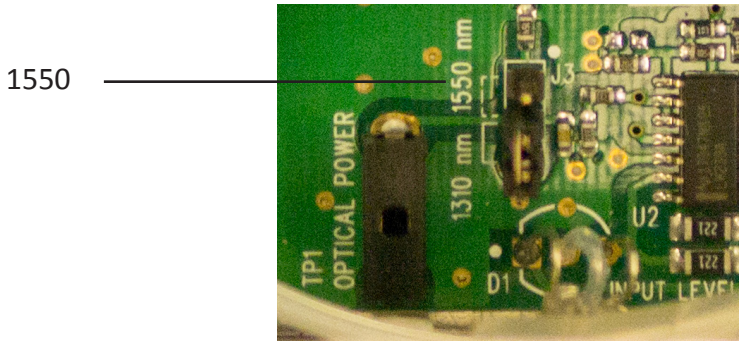


FIGURE 3

Attenuator Selection

The RF output level from the optical receiver module varies considerably over its operational optical input range. It is also dependent upon the transmitter's channel loading, its resultant RF input level and the FRRA's RF output capability. In order not to overload the amplifier section input, an attenuator must be installed in the "RF Loop" on the rear panel. With the optical source and AC power connected, measure the RF signal level at "RF Loop" output connector. Choose the appropriate attenuator value to set this level to +5 dBmV, ± 5 dB. A Blonder Tongue model FAM-xx (Stock No. 4006A-xx) or equivalent attenuator can be used for this application. (See Figure 5)

Install the attenuator on the RF loop output connector. Check that the desired +5 dBmV nominal signal level has been obtained, or change value accordingly. Install a coaxial jumper between the attenuator and the RF Loop input. Note that measured levels below 0 dBmV (without attenuator) indicates a low optical input and should therefore be investigated. The FRRA gain and slope controls can now be adjusted for desired output.

	Optical Input			
	dBm	mW		
	-10	0.10		
	-9	0.13	Increase Optical Input Power Orange Optical LED Indication	
	-8	0.16		
	-7	0.20		
	-6	0.25	0 dB	
	-5	0.32	2 dB	
	-4	0.40	4 dB	
GREEN LED	-3	0.50	6 dB	Recommended Attenuator Plug-in Value (9320-xx)
	-2	0.63	8 dB	
	-1	0.79	10 dB	
	0	1.00	12 dB	
	1	1.26	14 dB	
	2	1.58	16 dB	
	3	2.00	18 dB	
	4	2.51	Decrease Optical Input Power Red Optical LED Indication	
	5	3.16		

Figure 4 - Configuration Table

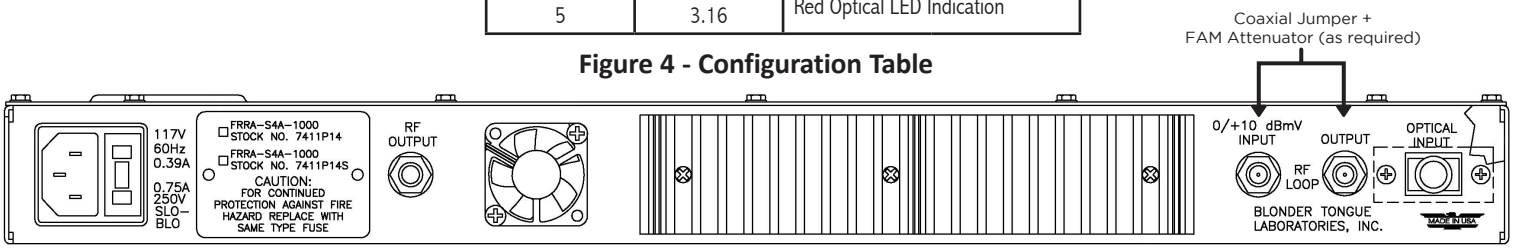


Figure 5 - Rack Mount Rear Panel

Maintenance

Cleaning

If the units need to be cleaned, avoid the use of all solvents and use low-pressure clean air to remove loose dirt. Use low-pressure clean air to clear the connectors of any debris. Dirty or scratched connector end faces will greatly reduce the unit's performance. Foam-tipped swabs such as the 2.5mm Mini Foam Swab offered by Fiber Instrument Sales (P/N F1-0005) may be saturated with denatured alcohol* and inserted into the optical port for cleaning. DO NOT INSERT A DRY SWAB INTO THE OPTICAL PORT AS THIS MAY DAMAGE THE FIBER END FACE. Many fiber optic installations experience degraded performance due to dirty optical connector end faces. The following procedure should be used to properly clean the optical connector end faces.

Required Cleaning Equipment

- Kimwipes® or any lens-grade, lint-free tissue. The type sold for eyeglasses work quite well.
- Denatured Alcohol.*

  * NOTE: Use only industrial grade 99% pure isopropyl alcohol. Commercially available isopropyl alcohol is for medicinal use and is diluted with water and a light mineral oil. Industrial grade isopropyl alcohol should be used exclusively.
- 30X Microscope.
- Canned Dry Air.

Directions for Cleaning

1) Fold the tissue twice so it is four layers thick.
2) Saturate the tissue with alcohol.
3) First clean the sides of the connector ferrule. Place the connector ferrule in the tissue, and apply pressure to the sides of the ferrule. Rotate the ferrule several times to remove all contamination from the ferrule sides.
4) Now move to a clean part of the tissue. Be sure it is still saturated with alcohol and that it is still four layers thick. Put the tissue against the end of the connector ferrule. Put your fingernail against the tissue so that it is directly over the ferrule. Now scrape the end of the connector until it squeaks. It will sound like a crystal glass that has been rubbed when it is wet.
5) Use the microscope to verify the quality of the cleaning. If it isn't completely clean repeat the steps with a clean tissue.
6) Mate the connector immediately! Don't let the connector lie around and collect dust before mating.
7) Air can be used to remove lint or loose dust from the port of a transmitter or receiver to be mated with the connector. Never insert any liquid into the ports.

Connector Handling

1) **NEVER TOUCH THE FIBER END FACE OF THE CONNECTOR.**
2) Connectors not in use should be covered over the ferrule by a plastic dust cap. It is important to note that inside of the ferrule dust caps contains a sticky gelatinous residue that is the by-product of the making of the dust cap. This residue will remain on the ferrule end after the cap is removed. Therefore it is critical that the ferrule end be cleaned thoroughly BEFORE it is mated to the intended unit.

Troubleshooting

Commercially available test equipment such as an Optical Signal Locator (OSL) is an effective tool for locating problems with the fiber optic cables. The OSL can also be used to verify that the transmitter is indeed putting out light. Other common problems include using a transmitter as a receiver and vice versa, lack of continuity in the optical fiber, lack of power, or improper input levels. If problems persist contact Blonder Tongue's Technical Solutions Department.

Problems and Comments

Problem	LED Status-Check	Comments
No optical power at the Node. Orange Optical Power LED	Check power at the Tx.	If there is power at the Tx, verify proper fiber is connected to the node. If the proper fiber is connected, ensure the integrity of the fiber.
Signal out of node is noisy. Orange Optical Power LED	Check optical power input via power monitor jack at the node.	See Specifications on Page 3 for proper minimum levels (>=- 3 dBm).
No RF signal out of node. Green Optical Power LED	Check the node power connection. Check attenuator/jumper installation	Check 117 VAC at the power supply.
Signal out of node is distorted. Status LED - Green or Red	Verify RF input signal on Tx.	Fiber must be 9/125 µm. The Rx optical input power and RF output level are within specifications.
	Verify fiber size/singlemode. Check optical power at the node input. Verify RF output level.	
	Verify RF output level.	If RF output is >48 dBmV, the RF amplifier is being overdriven. Use an attenuator (Stock No. 4006A-xx) to decrease RF output from optical board to the RF amplifier stage. Refer to "Attenuator Selection" on page 6.

Returning Product for Repair (or Credit)

A Return Material Authorization (RMA) Number is required on all products returned to Blonder Tongue, regardless if the product is being returned for repair or credit. Before returning product, please contact the Blonder Tongue Service Department at 1-800-523-6049, Ext. 4256 or visit our website: www.blondertongue.com for further information.

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Extended Warranty Program

STANDARD TERMS & CONDITIONS OF THE EXTENDED WARRANTY

A. THE EXTENDED WARRANTY AGREEMENT (EWA)

If during the period following the expiration of the Blonder Tongue Manufacturers' Standard Warranty (Copy Included) the products which constitute the subject matter of the extended warranty, manifest any manufacturing or similar such defects then Blonder Tongue shall at its option repair or replace the product. It is emphasized that the extended warranty is in effect an extension of the Blonder Tongue Warranty and covers the items stipulated in Paragraph B to the exclusion of the terms in Paragraph C of this agreement. Eligibility to purchase EW is limited to 90 days following initial shipment on selected products of sufficient value.

The product/products included in this extended warranty agreement are listed in the invoice that accompanies the EWA. Term of the extension will be _____ year(s). Purchase Order is required for extended warranty coverage.

B. WHAT IS COVERED?

1. If a product has been determined to have failed, which falls within the Terms & Conditions of this EWA, Blonder Tongue Inc. may at its sole discretion repair, modify or replace its component parts that are defective at 100% coverage for parts and labor.
2. A loaner unit may be available on request; PO required.
3. Product is manufactured by Blonder Tongue.
4. Extended warranty period is up to and not to exceed 24 months and sold in increments of 12 months. Order # 9981 for 1 year and #9982 for 2 year extensions.
5. Return of repair or replaced product shipping costs for ground shipments.
6. Firmware upgrades at no charge with automatic notification.

C. WHAT IS NOT COVERED?

1. The warranty does not cover any defects caused by foreign objects /connection errors .
2. Use other than by the customer at the declared address appearing in this document.
3. Failure by the end user to comply with the manufacturers' instructions for installation, maintenance or use.
4. The use of accessories which have not been approved by Blonder Tongue.
5. The application and/or use of any incorrect or abnormal electrical supply to the product.
6. Any defect in wiring or electrical connections which does not form part of the product at the time of the original purchase.
7. Neglect, misuse, or willful abuse of the product.
8. Any repairs or attempted repairs of the product by any person other than Blonder Tongue Service Department.
9. Any modification of the product by any person other than Blonder Tongue Service Department.
10. Fire, flood, war, civil disturbance, industrial action, acts of God or any other causes beyond the reasonable control of Blonder Tongue.
11. Any defect caused by lightning strike or power surges.
12. Shipping costs to return products to Blonder Tongue for warranty service.
13. Blonder Tongue will not in any circumstances be liable for any consequential loss or damages suffered by the customer whether directly or indirectly related defect in the product to the extent permissible by law.
14. Repairs may not be effected without prior authorization from Blonder Tongue Laboratories.

D. GENERAL

1. The customer shall notify Blonder Tongue Laboratories in writing within ten days of any change of his or her address.
2. Customer must provide original ***purchase receipt*** and ***serial number*** to initiate extended warranty coverage.
3. The fee paid for the warranty is not refundable under any circumstances unless cancelled within seven days of purchase.
4. The customer shall take all reasonable precautions to maintain the product is maintained in good working order.
5. The warranty contract ceases to exist if the product is replaced or a credit is given to the customer. Any monies paid for the warranty contract are forfeited and not refundable. This is only applicable when the product is out of the manufacturer's warranty.
6. The extended warranty period as stated on the Extended Warranty Agreement shall be the governing period notwithstanding any additional supplier warranty on specific components.
7. The warranty shall in no way effect the terms and conditions of the sale agreement in terms of which the customer bought the product.
8. The extended warranty is limited to the terms and conditions herein contained
9. No agreement, varying, adding to, amended, deleting, or cancelling this warranty shall be effective unless given in writing (email is acceptable) and signed by or on behalf of both parties.
10. The cost of the extended warranty is 8% of the purchase price for a 1 or 2 year extension beyond the Blonder Tongue standard warranty. e.g. A product price of $1000 will be $80 for the 1st year (12 mos) and additional $80 for 2 year (24 mos) extension for a total of $160.
11. Warranty product return postage paid to: Blonder Tongue Laboratories, Inc.
    Attn: Warranty Service Dept.
    1 Jake Brown Road
    Old Bridge, NJ 08857

Contact Blonder Tongue at 800-523-6049 ext. 555 to order extended warranty service.

Limited Warranty

Seller will at its sole option, either repair or replace (with a new or factory reconditioned product, as Seller may determine) any product manufactured or sold (or in the case of software, licensed) by Seller which is defective in materials or workmanship or fails to meet the applicable specifications that are in effect on the date of shipment or such other specifications as may have been expressly agreed upon in writing: (i) for a period of three (3) years from the date of original purchase for all stock hardware products (other than those specifically referenced herein below having a shorter warranty period); (ii) for a period of one (1) year from the date of original purchase, with respect to all MegaPort™, IPTV products, test equipment and fiber optics receivers, transmitters, couplers and integrated receiver/distribution amplifiers; (iii) for a period of one (1) year from the date of original purchase (or such shorter period of time as may be set forth in the license agreement specific to the particular software being licensed from Seller) with respect to all software products licensed from Seller (other than Core Product Software) that is (a) developed for a specific function or application, (b) complimentary to and does not function without the Core Product Software, and (c) listed with a specific model number and stock number in Seller's Price List ("**Non-Core Software**"); (iv) for a period of ninety (90) days from the date of original purchase, with respect to non-serialized products and accessories, such as parts, sub-assemblies, splitters and all other products sold by Seller (other than Core Product Software and Refurbished/Closeout Products) not otherwise referred to in clauses (i) through (iii) above. The warranty period for computer programs in machine-readable form included in a hardware product, which are essential for the functionality thereof as specifically stated in the published product specifications ("**Core Product Software**") will be coincident with the warranty period of the applicable hardware product within which such Core Product Software is installed.

Software patches, bug fixes, updates or workarounds do not extend the original warranty period of any Core Product Software or Non-Core Software.

Notwithstanding anything herein to the contrary,

(i) Seller's sole obligation for software that when properly installed and used does not substantially conform to the published specifications in effect when the software is first shipped by Seller, is to use commercially reasonable efforts to correct any reproducible material non-conformity (as determined by Seller in its sole discretion) by providing the customer with: (a) telephone or e-mail access to report non-conformance so that Seller can verify reproducibility, (b) a software patch or bug fix, if available or a workaround to bypass the issue if available, and (c) where applicable, replacement or damaged or defective external media, such as CD-ROM disk, on which the software was originally delivered;

(ii) Seller does not warrant that the use of any software will be uninterrupted, error-free, free of security vulnerabilities or that the software will meet the customer's particular requirements; and the customer's sole and exclusive remedy for breach of this warranty is, at Seller's option, to receive (a) suitably modified software, or part thereof, or (b) comparable replacement software or part thereof;

(iii) Seller retains all right, title and interest in and to and ownership of all software (including all Core Product Software and Non-Core Software) including any and all enhancements, modifications and updates to the same; and

(iv) in some cases, the warranty on certain proprietary sub-assembly modules manufactured by third-party vendors and contained in Seller's products, third party software installed in certain of Seller's products, and on certain private-label products manufactured by third-parties for resale by Seller, will be of shorter duration or otherwise more limited than the standard Seller limited warranty. In such cases, Seller's warranty with respect to such third-party proprietary sub-assembly modules, third-party software and private-label products will be limited to the duration and other terms of such third-party vendor's warranty, if any. In addition, certain products, that are not manufactured by Seller, but are resold by Seller, may carry the original OEM warranty for such products, if any. The limited warranty set forth above does not apply to any product sold by Seller, which at the time of sale constituted a Refurbished/Closeout Product, the limited warranty for which is provided in the following paragraph.

Seller will at its sole option, either repair or replace (with a new or factory-reconditioned product, as Seller may determine) any product sold by Seller which at the time of sale constituted a refurbished or closeout item ("**Refurbished/Closeout Product**"), which is defective in materials or workmanship or fails to meet the applicable specifications that are in effect on the date of shipment of that product or fails to meet such other specifications as may have been expressly agreed upon in writing between the parties, for a period of ninety (90) days from the date of original purchase. Notwithstanding the foregoing, in some cases the warranty on certain proprietary sub-assembly modules manufactured by third-party vendors and contained in Seller products, third party software installed in certain of Seller's products, and on certain private-label products manufactured by third-parties for resale by Seller will be of shorter duration or otherwise more limited than Seller limited warranty for Refurbished/Closeout Products. In such cases, Seller's warranty for Refurbished/Closeout Products constituting such third party proprietary sub-assembly modules, third party software, and private-label products will be limited to the duration and other terms of such third-party vendor's warranty, if any. In addition, notwithstanding the foregoing, (i) certain Refurbished/Closeout Products that are not manufactured (but are resold) by Seller, may carry the original OEM warranty for such products, if any, which may be longer or shorter than Seller's limited warranty for Refurbished/Closeout Products. All sales of Refurbished/Closeout Products are final.

To obtain service under this warranty, the defective product, together with a copy of the sales receipt, serial number if applicable, or other satisfactory proof of purchase and a brief description of the defect, must be shipped freight prepaid to Seller at the following address: One Jake Brown Road, Old Bridge, New Jersey 08857.

This warranty does not cover failure of performance or damage resulting from (i) use or installation other than in strict accordance with manufacturer's written instructions, (ii) disassembly or repair by someone other than the manufacturer or a manufacturer-authorized repair center, (iii) misuse, misapplication or abuse, (iv) alteration, (v) exposure to unusual physical or electrical stress, abuse or accident or forces or exposure beyond normal use within specified operational or environmental parameters set forth in applicable product specifications, (vi) lack of reasonable care or (vii) wind, ice, snow, rain, lightning, or any other weather conditions or acts of God.

OTHER THAN THE WARRANTIES SET FORTH ABOVE, SELLER MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND, EXPRESS OR IMPLIED, AS TO THE CONDITION, DESCRIPTION, FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR AS TO ANY OTHER MATTER, AND SUCH WARRANTIES SET FORTH ABOVE SUPERSEDE ANY ORAL OR WRITTEN WARRANTIES OR REPRESENTATIONS MADE OR IMPLIED BY SELLER OR BY ANY OF SELLER'S EMPLOYEES OR REPRESENTATIVES, OR IN ANY OF SELLER'S BROCHURES MANUALS, CATALOGS, LITERATURE OR OTHER MATERIALS. IN ALL CASES, BUYER'S SOLE AND EXCLUSIVE REMEDY AND SELLER'S SOLE OBLIGATION FOR ANY BREACH OF THE WARRANTIES CONTAINED HEREIN SHALL BE LIMITED TO THE REPAIR OR REPLACEMENT OF THE DEFECTIVE PRODUCT F.O.B. SHIPPING POINT, AS SELLER IN ITS SOLE DISCRETION SHALL DETERMINE. SELLER SHALL IN NO EVENT AND UNDER NO CIRCUMSTANCES BE LIABLE OR RESPONSIBLE FOR ANY CONSEQUENTIAL, INDIRECT, INCIDENTAL, PUNITIVE, DIRECT OR SPECIAL DAMAGES BASED UPON BREACH OF WARRANTY, BREACH OF CONTRACT, NEGLIGENCE, STRICT TORT LIABILITY OR OTHERWISE OR ANY OTHER LEGAL THEORY, ARISING DIRECTLY OR INDIRECTLY FROM THE SALE, USE, INSTALLATION OR FAILURE OF ANY PRODUCT ACQUIRED BY BUYER FROM SELLER.

All claims for shortages, defects, and non-conforming goods must be made by the customer in writing within five (5) days of receipt of merchandise, which writing shall state with particularity all material facts concerning the claim then known to the customer. Upon any such claim, the customer shall hold the goods complained of intact and duly protected, for a period of up to sixty (60) days. Upon the request of Seller, the customer shall ship such allegedly non-conforming or defective goods, freight prepaid to Seller for examination by Seller's inspection department and verification of the defect. Seller, at its option, will either repair, replace or issue a credit for products determined to be defective. Seller's liability and responsibility for defective products is specifically limited to the defective item or to credit towards the original billing. All such replacements by Seller shall be made free of charge f.o.b. the delivery point called for in the original order. Products for which replacement has been made under the provisions of this clause shall become the property of Seller. Under no circumstances are products to be returned to Seller without Seller's prior written authorization. Seller reserves the right to scrap any unauthorized returns on a no-credit basis. Any actions for breach of a contract of sale between Seller and a customer must be commenced by the customer within thirteen (13) months after the cause of action has accrued. A copy of Seller's standard terms and conditions of sale, including the limited warranty, is available from Seller upon request. Copies of the limited warranties covering third-party proprietary sub-assembly modules and private-label products manufactured by third-parties may also be available from Seller on request. **(Rev 0713)**

Blonder Tongue

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