Installation and Operation Manual for Multicoupling Amplifier System Models DDX1000A, 42-57-XX/48, 42-68-07130-XX

Manual Part Number

7-9281-7

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Warranty

This warranty applies for one year from shipping date.

TX RX Systems Inc. warrants its products to be free from defect in material and workmanship at the time of shipment. Our obligation under warranty is limited to replacement or repair, at our option, of any such products that shall have been defective at the time of manufacture. **TX RX Systems Inc.** reserves the right to replace with merchandise of equal performance although not identical in every way to that originally sold. **TX RX Systems Inc.** is not liable for damage caused by lightning or other natural disasters. No product will be accepted for repair or replacement without our prior written approval. The purchaser must prepay all shipping charges on returned products. **TX RX Systems Inc.** shall in no event be liable for consequential damages, installation costs or expense of any nature resulting from the purchase or use of products, whether or not they are used in accordance with instructions. This warranty is in lieu of all other warranties, either expressed or implied, including any implied warranty or merchantability of fitness. No representative is authorized to assume for **TX RX Systems Inc.** any other liability or warranty than set forth above in connection with our products or services.

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PRICES AND TERMS:
Prices are FOB seller's plant in Angola, NY domestic packaging only, and are subject to change without notice. Federal, State and local sales or excise taxes are not included in prices. When Net 30 terms are applicable, payment is due within 30 days of invoice date. All orders are subject to a $100.00 net minimum.

QUOTATIONS:
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Acceptance of orders is valid only when so acknowledged in writing by the seller.

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Unless otherwise agreed at the time the order is placed, seller reserves the right to make partial shipments for which payment shall be made in accordance with seller's stated terms. Shipments are made with transportation charges collect unless otherwise specified by the buyer. Seller's best judgement will be used in routing, except that buyer's routing is used where practicable. The seller is not responsible for selection of most economical or timeliest routing.

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All claims for damage or loss in transit must be made promptly by the buyer against the carrier. All claims for shortages must be made within 30 days after date of shipment of material from the seller's plant.

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Product or material may be returned for credit only after written authorization from the seller, as to which seller shall have sole discretion. In the event of such authorization, credit given shall not exceed 80 percent of the original purchase. In no case will Seller authorize return of material more than 90 days after shipment from Seller's plant. Credit for returned material is issued by the Seller only to the original purchaser.

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Consult seller's plant for pricing. Buyer must prepay all transportation charges to seller's plant. Standard shipping policy set forth above shall apply with respect to return shipment from TX RX Systems Inc. to buyer.

DISCLAIMER

Product part numbering in photographs and drawings is accurate at time of printing. Part number labels on TX RX products supersede part numbers given within this manual. Information is subject to change without notice.

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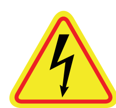
Version Number	Version Date
1	08/27/01
2	04/22/03
3	01/07/05
4	05/15/07
5	04/18/08
6	01/23/09
7	09/15/14

Symbols Commonly Used


WARNING !!!

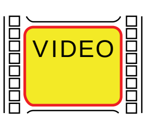

High Voltage


CAUTION or ATTENTION


Hot Surface

Important Information


ESD Electrostatic Discharge



Training Video Available


Electrial Shock Hazard


Heavy Lifting


Safety Glasses Required

Changes to this Manual

We have made every effort to ensure this manual is accurate. If you discover any errors, or if you have suggestions for improving this manual, please send your comments to our Angola, New York facility to the attention of the Technical Publications Department. This manual may be periodically updated. When inquiring about updates to this manual refer to the manual part number and revision number on the revision page following the front cover.

Contact Information

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TX RX SYSTEMS INC.

PRODUCT DESCRIPTION

Your new Multicoupling Amplifier (MCA) System is a key component in an efficient received-signal distribution system. The MCA system amplifies signals and then splits them to the requisite number of output ports, where the antenna terminals of the station receivers can be connected. Models are available with 4, 8, or 16 output ports and AC or DC power requirements, refer to **Table 1**. All of the models listed in Table 1 operate in the 380 to 512 MHz range.

Model Number	Output Ports	Power Requirement
DDX1000A	16	AC
42-57-03	8	AC
42-57-04	4	AC
42-57-02-48	16	+/- 48 VDC
42-57-03-48	8	+/- 48 VDC
42-57-04-48	4	+/- 48 VDC
42-68-07130-XX *	8	AC

* This model uses N-Type connectors for outputs to receivers.

Table 1: Available models.

The system uses a quadrature-coupled amplifier (also called a quad-amp) to create a redundant amplifier configuration. The quad-amp provides two simultaneously used, essentially parallel paths of amplification within the single amplifier assembly. In addition, the system has fault detection circuitry that senses any significant change in the power consumption of the system. It provides a visual alarm (LED) on the front panel of the MCA, along with a change of state in a set of Form-C contacts, thus indicating that trouble has developed. In most cases, near normal operation will continue on one of the two parallel pathways within the quadrature-coupled amplifier, thus allowing time for repair without an abrupt change in performance. Failure of one path of amplification within the quad-amplifier results in an overall gain reduction of only 6 dB. System specifications are listed in **Table 2**.

About the Design

Amplification precedes signal splitting so that the best possible noise figure can be maintained. The design has been optimized to handle very strong signals without overloading, while maintaining a good noise figure. **Figure 1** shows the locations of the amplifier status LED and current meter on the front panel of the MCA.

UNPACKING

Inspect the MCA for shipping damage immediately after removing it from the shipping carton. It is the customer's responsibility to file damage claims with

Electrical specifications	
Frequency Range	380 to 512 MHz
Multicoupler Net Gain	Adjustable in 1 dB increments using electronic attenuators
Preamplifier Type	2-stage, Quadrature-coupled
Gain	26 dB min.
Noise Figure	2.0 dB max.
3rd Order Input IP	11 dBm
Impedance	50 ohms
VSWR	2.0 : 1
Outputs/Split Loss	16 / 14 dB 8 / 11 dB 4 / 8 dB
Alarm Warning Contacts	Two Form-C contacts
Power Requirements	85 to 264 VAC - 47 to 63 Hz 250 mA typ @ 110 VAC or 400 mA typ @ +/-48 VDC
Battery Backup Power	730 mA max @ 22 to 26 VDC
Operating Temp Range	-10° C to +50° C
Mechanical specifications	
Enclosure	Standard EIA 19” rack mount
Connectors RF Input Output to Receivers 42-68-07130-XX (only)	 N-Type(f) BNC(f) N-Type(f)
Dimensions (HWD)	1.5” x 19” x 14” (38 x 483 x 356 mm)
Net Weight	9 lbs (4.1 kg)

Table 2: System specifications.
Values are typical unless noted otherwise.

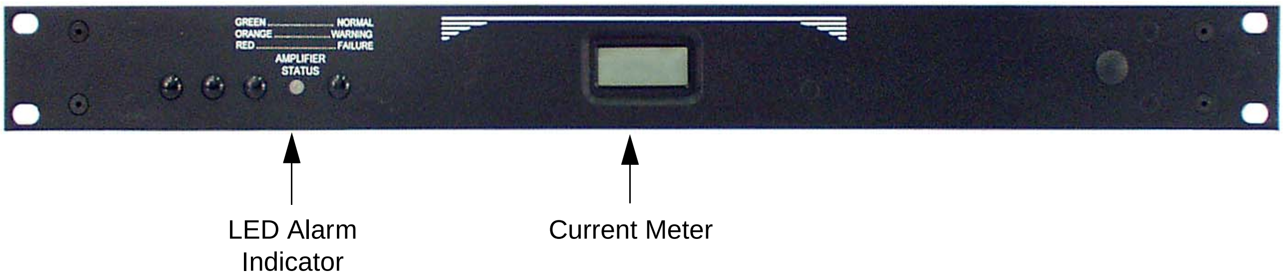


Figure 1: Front view of the MCA.

the shipping carrier within a short period of time after delivery (1 to 5 days).

INSTALLATION

The installation of a preselector filter between the main feedline and the MCA is required. Contact your Bird Technologies sales representative for assistance in selecting the best model preselector filter for your overall system design. Both the MCA and preselector are designed for indoor mounting in a common 19-inch relay rack or cabinet. Subassemblies on the MCA are attached to the main mounting deck as shown in **Figure 2**. All connections to or from the Multicoupling Amplifier System should be made with double-shielded or semi-rigid heliax cable. The following steps are required for proper installation.

1) A ground terminal is provided on the back of the main mounting deck, to the left of the Form-C contacts, for connection to the station ground bus. We recommend solid copper wire up to size #8 for this purpose.

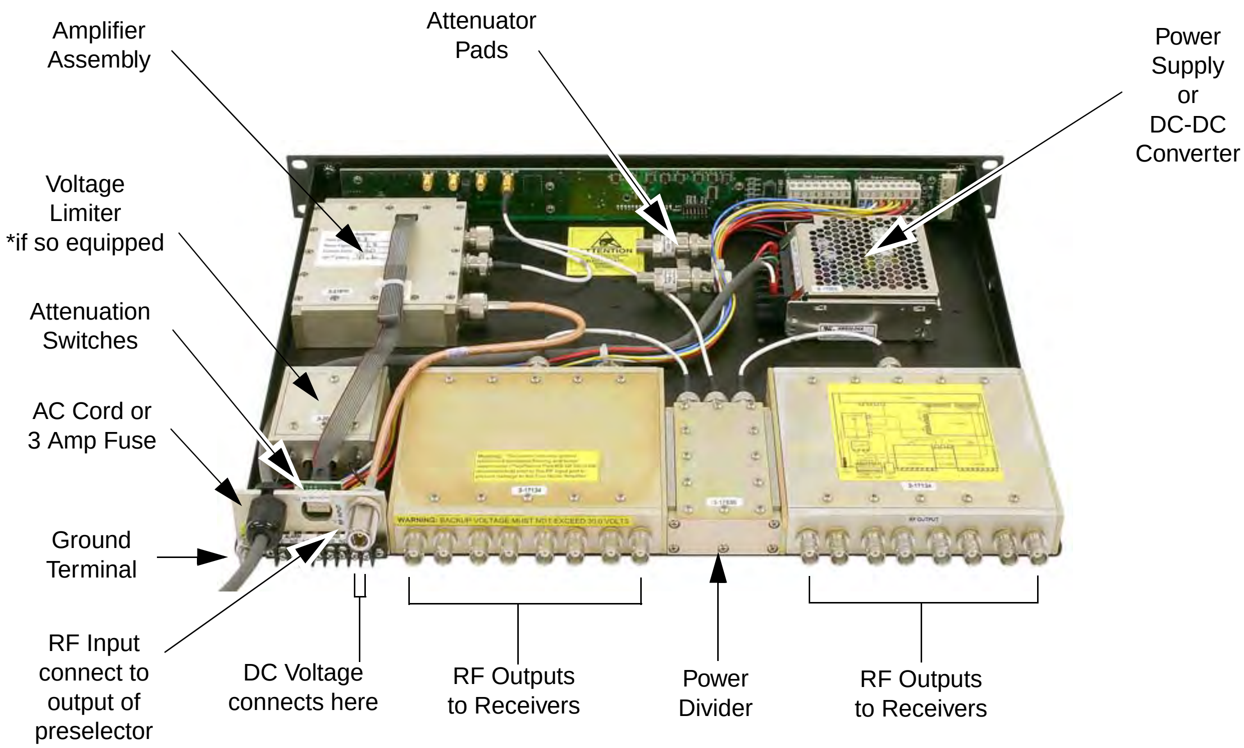


Figure 2: Chassis view of the MCA. Model DDX1000A shown as example.

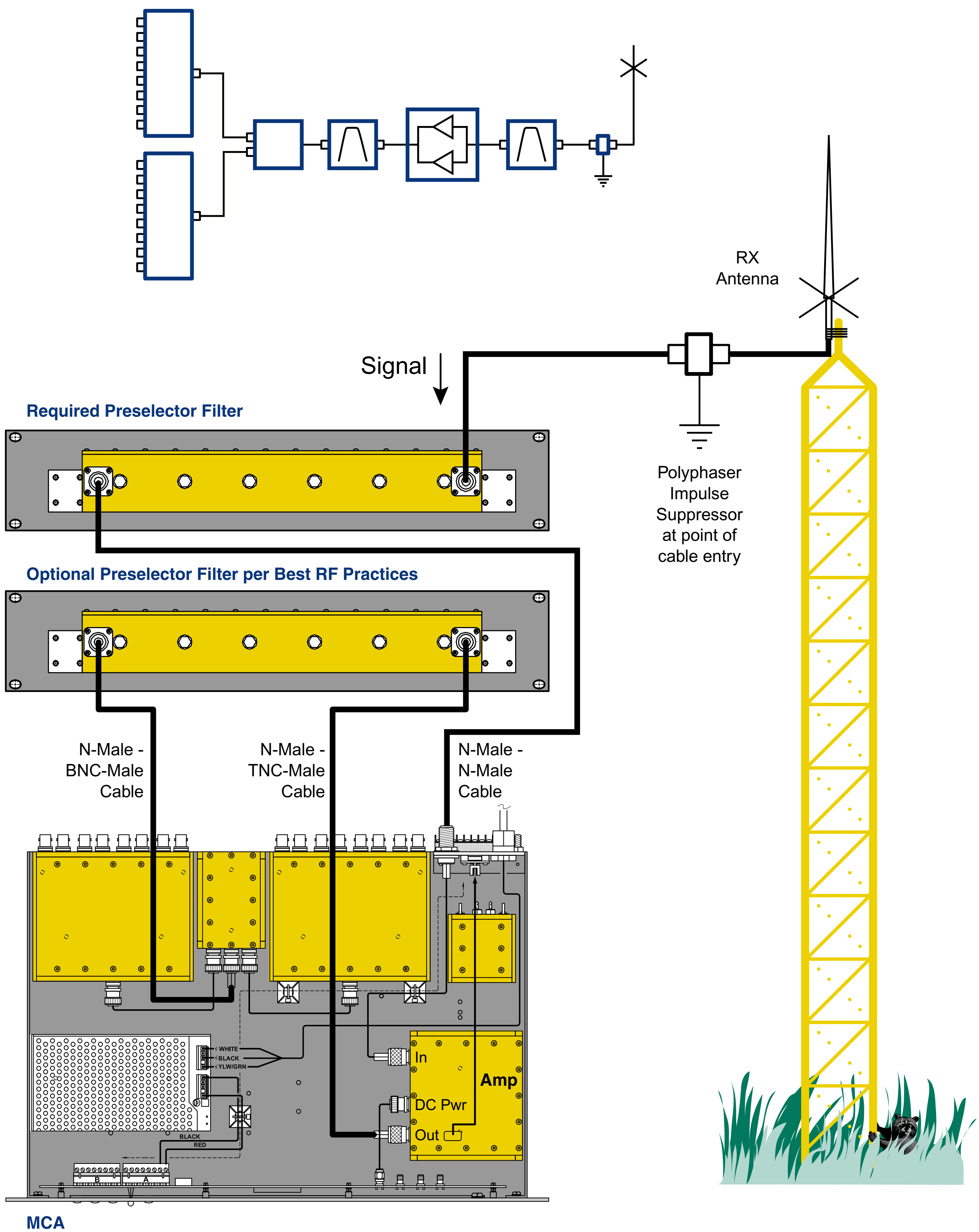


Figure 3: Typical system installation. Model DDX1000A shown as an example.

2) A required preselector filter <u>MUST</u> be installed between the antenna input of the MCA and the PolyPhaser Impulse Suppressor (at the cable point of entry) as shown in **Figure 3**.

Connect the incoming antenna lead to the input of the required preselector and the output of the preselector to the RF input connector on the back of the MCA deck. We recommend using high-quality N connectors with gold-plated center pins for maximum intermodulation suppression.

NOTE

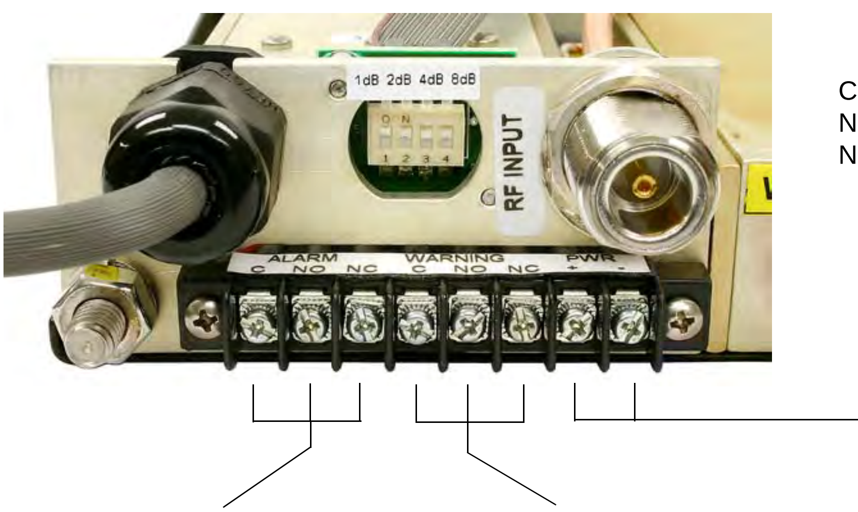
The required preselector filter must have a grounded coupling loop which provides a DC path to ground for the center conductor of the transmission cable. The filter provides transient protection for the amplifier assembly as well as a narrower pass window for the MCA. The filter should be mounted in the same rack just below the MCA.

3) An optional preselector filter may be added to the RF signal path between the amplifier assembly and the 2-way divider as shown in figure 3. On the MCA deck remove the existing cable between the amplifier and the 2-way divider. Connect the input of the optional filter to the output of the amplifier and the output of the filter to the input of the 2-way divider. This places the optional filter in series between the amplifier and the divider.

NOTE

The optional filter will help to further tighten the pass window of the system. Although the filter is optional, its use is recommended when installing systems to a “Best RF Practices” standard. The optional filter should be installed in the rack just above the MCA deck.

4) Connect the antenna inputs of the station receivers to the RF outputs at the back of the MCA with high-quality, double-shielded, 50-Ohm coaxial cable. Flexible jumper cables prevent strain and possible damage to the connections. We also recommend the use of high-quality connectors. Cable assemblies using these types of connectors are available from Bird Technologies.



Legend

C = Common
NC = Normally Closed
NO = Normally Open

Connect DC power here

These contacts change state when the amplifier enters an **alarm** condition.

These contacts change state when the amplifier enters a **warning** condition.

Figure 4: Alarm/warning and power terminals.

5) If you have a supervisory alarm monitoring system, you may connect it at the alarm/warning terminal screws at the back of the MCA (see **Figure 4**). Normally open ("NO") and normally closed ("NC") contacts are available. Refer to the system block diagram on page 14 for a detailed description of the Form-C contacts labeling and functionality.

6) For **Model 42-57-XX-48,** which includes a DC-to-DC converter, connect the leads from a 48 VDC source to the terminal screws labeled "+" and "-" at the back of the MCA. Be careful to observe the proper polarity. Insulated #20 size wire may be used, because the maximum current does not exceed 0.5 amps.

7) For **Model DDX1000A, 42-57-XX and 42-68-07130-XX,** plug the MCA power cord into a suitable outlet.

8) Customers with a battery backup supply can connect it to the terminal screws labeled "+" and "-" at the back of the MCA for models **DDX1000A, 42-57-XX and 42-68-07130-XX.**

NOTE

It is recommended that a 5 amp fuse be incorporated into the output circuit of the backup supply.

On units without the voltage limiter (part# 3-20015) the backup voltage can not exceed 26.7 volts. Units which are equipped with the voltage limiter the backup voltage can not exceed 30.0 volts.

TESTING FOR PROPER OPERATION (STATIC SYSTEM SENSITIVITY TEST)

After installation, a measurement should be made to insure that the MCA is operating properly. **Figure 5** shows how the equipment should be interconnected for this test. The procedure is a basic system sensitivity measurement. It is important to

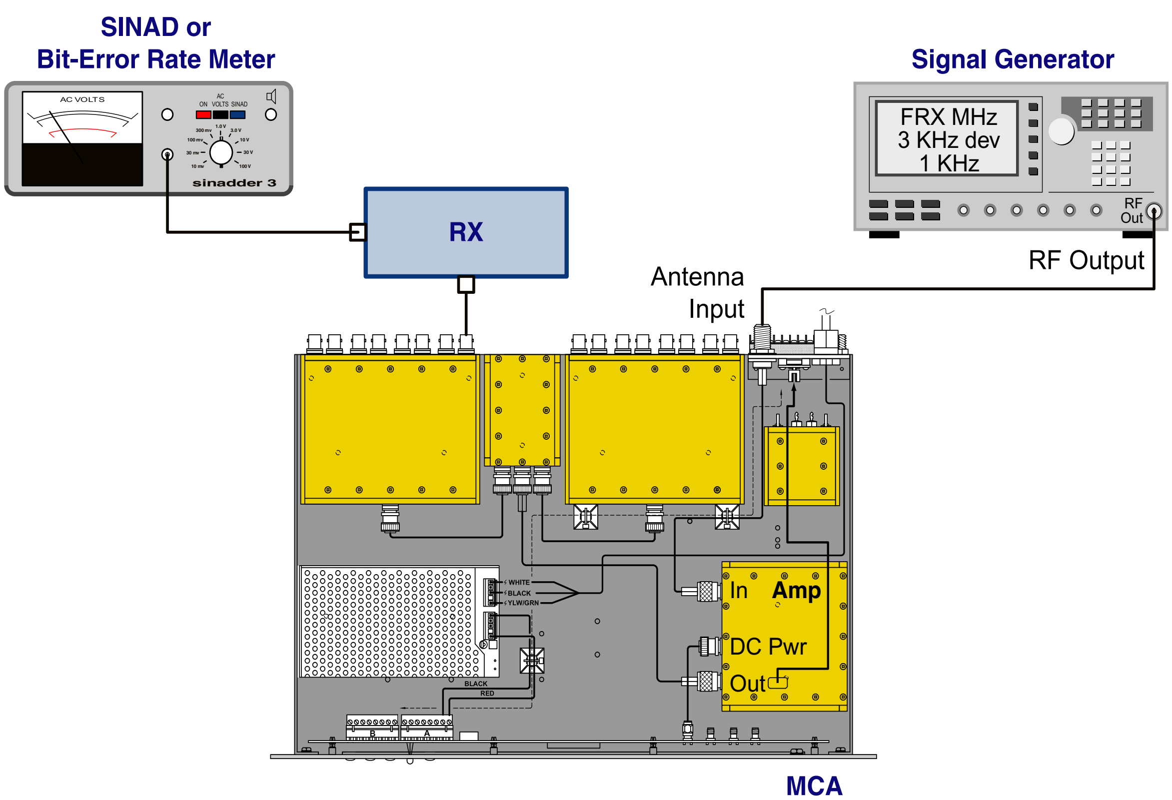


Figure 5: Equipment interconnection for static system sensitivity test.
Model DDX1000A shown as an example.

use a high-quality, double-shielded coaxial cable (RG223 or RG142) for connecting the signal generator to the MCA.

It is assumed that the sensitivity of the receiver-only has been measured and recorded for a reference and that the same length and type of coaxial cable is being used for connecting the signal generator to the receiver or MCA. Set the signal generator to an in-use channel frequency with the appropriate modulation levels and connect its output to the RF input of the MCA. Adjust the level of the signal generator to obtain a standard-reference signal-to-noise ratio on the SINAD or bit-error rate meter connected to the corresponding receiver. The generator output level should be the same as or better than (within a dB or two) the output level obtained by a sensitivity measurement of the receiver only. *Record the generator output level for future reference* (see “Maintenance” on page 16).

If the sensitivity is low, check the following:

1) The front-panel Amplifier Status LED should be glowing green, indicating that the MCA has power applied and that the amplifier is drawing proper current.

2) Examine all coaxial cable assemblies by flexing and moving them to check for intermittent connections.

OPERATION

Depending on your model, plug in the AC cord or connect to a 48 VDC power source. The front-panel Amplifier Status LED should illuminate green and the LCD current meter should become active.

The meter displays the relative current being drawn by the amplifier assembly (about 430 to 510 mA). The LED illuminates in one of three colors, indicating the status of the amplifier. For more details about the current meter and LED, see “System Status Monitoring” and “Alarms” later in this manual.

ADDITIONAL INSTALLATION CONSIDERATIONS

The following are additional considerations when installing a Multicoupling Amplifier System.

Interference & Intermodulation Considerations

The location of the receiving antenna in relation to any transmitting antennas plays an important role in augmenting the amount of selectivity provided by the preselector filter. In general, vertical separation between the receiving antenna and any transmitting antennas is desirable. Vertical separation provides a much higher degree of isolation or path loss for each foot or meter of physical antenna separation as compared with horizontal separation.

On the transmitter side, it is most likely that some type of transmitter combiner is being used, and a cavity-ferrite combiner type is preferred. Most combiners of this type use a single bandpass cavity filter for each transmit channel. This cavity helps to diminish transmitter broadband noise that appears at the receiving frequencies. It is usually assumed that antenna isolation, along with the attenuation provided by the bandpass filter, will reduce the transmitter noise enough to prevent interference. Unfortunately, this assumption is based upon another assumption: that the transmitting and receiving antennas are vertically separated, yielding a relatively large amount of antenna isolation.

When the transmitting and receiving antennas are separated horizontally (such as on a rooftop or common tower), much lower levels of isolation are achieved. These lower levels of isolation can result in transmitter noise raising the noise floor at the receiving frequencies, which will limit the receiving system’s sensitivity and range. This problem can only be corrected by additional filtering of the transmitter output. Additional receiver filtering can eliminate carrier desense, but no amount of receiving system filtering can correct transmitter noise problems. Using high gain and very low noise figure amplifiers in the receiving system will only make matters worse.

Lightning Protection

To maximize the receiving system’s reliability, additional lightning protection is desirable. Figure 3 shows a Polyphaser impulse suppressor installed in the receiving antenna line where the line enters the radio building. Proper techniques for achieving the best protection are beyond the scope of this manual, so we recommend contacting the manufacturer of this equipment for additional advice.

Receiver Preamplifiers

It is common practice to try to improve the weak-signal sensitivity of a receiver by adding a low-noise preamplifier to the existing receiver. Although these preamplifiers will generally increase receiver sensitivity, they will also raise the level of other undesired signals, effectively decreasing the overload and intermodulation resistance of the receiver. In addition, these preamplifiers generally lack any substantial filtering, and will therefore be more prone to overload and intermodulation problems themselves. It is our recommendation that these preamplifiers be removed when connecting a receiver to an MCA. The MCA provides the desired low-noise front end. The MCA will have considerably more resistance to overloading than any garden-variety preamplifier, and also will be superior to many receivers without external preamplifiers.

Unused Output Ports and Terminations

In situations where there will be unused output ports make sure that the number of used output ports is evenly distributed between output power dividers. For example when using the model DDX1000A shown in figure 3, if you are going to use only 10 output ports, connect the receivers to 5 ports on one 8-way divider and 5 ports on the second 8-way divider. This balanced arrangement provides a better termination for the amplifier than having 8 receivers connected to one divider and 2 connected to the other. If you have an odd number of receivers, one 8-way divider will necessarily have one more used port than the other, but this is still a minimal imbalance.

Attenuation Adjustments

When receiving levels at the MCA outputs are maintained at below -35 dBm, the reserve gain of the system is correct and does not need adjustment. However, when the levels are above -35 dBm, as measured with a spectrum analyzer, the reserve gain may have to be reduced.

The amplifier assembly has built-in adjustable attenuation which is set using dip switches located on the back panel near the alarm terminal strip, refer to figure 4. Each of the four attenuation switches provides 1, 2, 4, or 8 dB of attenuation when the associated switch is in the ON position. The attenuation is ADDITIVE so a maximum of 15 dB of attenuation would be realized if all four switches were in the ON position at the same time.

Some models of the MCA system are provided with two additional fixed attenuator pads of 3 and 6 dB, mounted in spring clips on the MCA chassis. These are for instances where further gain reduction (beyond that available with the built-in attenuation) may be required. Gain reduction may be helpful in combating interference problems. The pads may be used separately or together on the input of the power divider (see **Figure 6**) to reduce the gain further by either 3, 6 or 9 dB.

Insert pads, if necessary, at the input of the power divider.

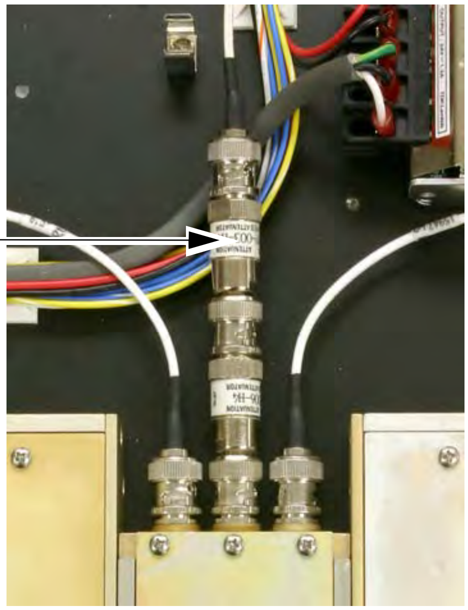


Figure 6: Further gain reduction using inline pads.

Intermodulation products that may be generated in a station receiver can be dramatically reduced by using small amounts of gain reduction in the gain-stage (MCA) that precedes the receiver. For example: third-order intermodulation products (2A-B products) drop at a 3:1 rate compared with the fundamental signals. It follows directly that a 3 dB reduction in the fundamental signals will result in a 9 dB reduction in the resultant IM products. A 6 dB gain reduction will yield an 18 dB reduction in the same situation. Such gain reduction would have minimal impact on the receiving system performance of other channels that are not interfered with.

If the MCA is part of a system that uses a tower-mounted amplifier, the pad(s) should be installed on the input of the MCA quad-amplifier, or (with an adaptor) at the MCA's RF input connector.

NOTE

Attenuator pads installed by the factory at the time of shipment should not be removed. They insure that system gain meets the customers original specifications.

SIGNAL FLOW

Referring to **Figure 7**, Signals are picked up by the receive antenna and passed down the tower by the transmission line to a polyphaser impulse suppressor located at the point of cable entry into the building. A required preselector filter must be placed in-line prior to the MCA in order to protect the amplifier assembly from transients and provide a nar-

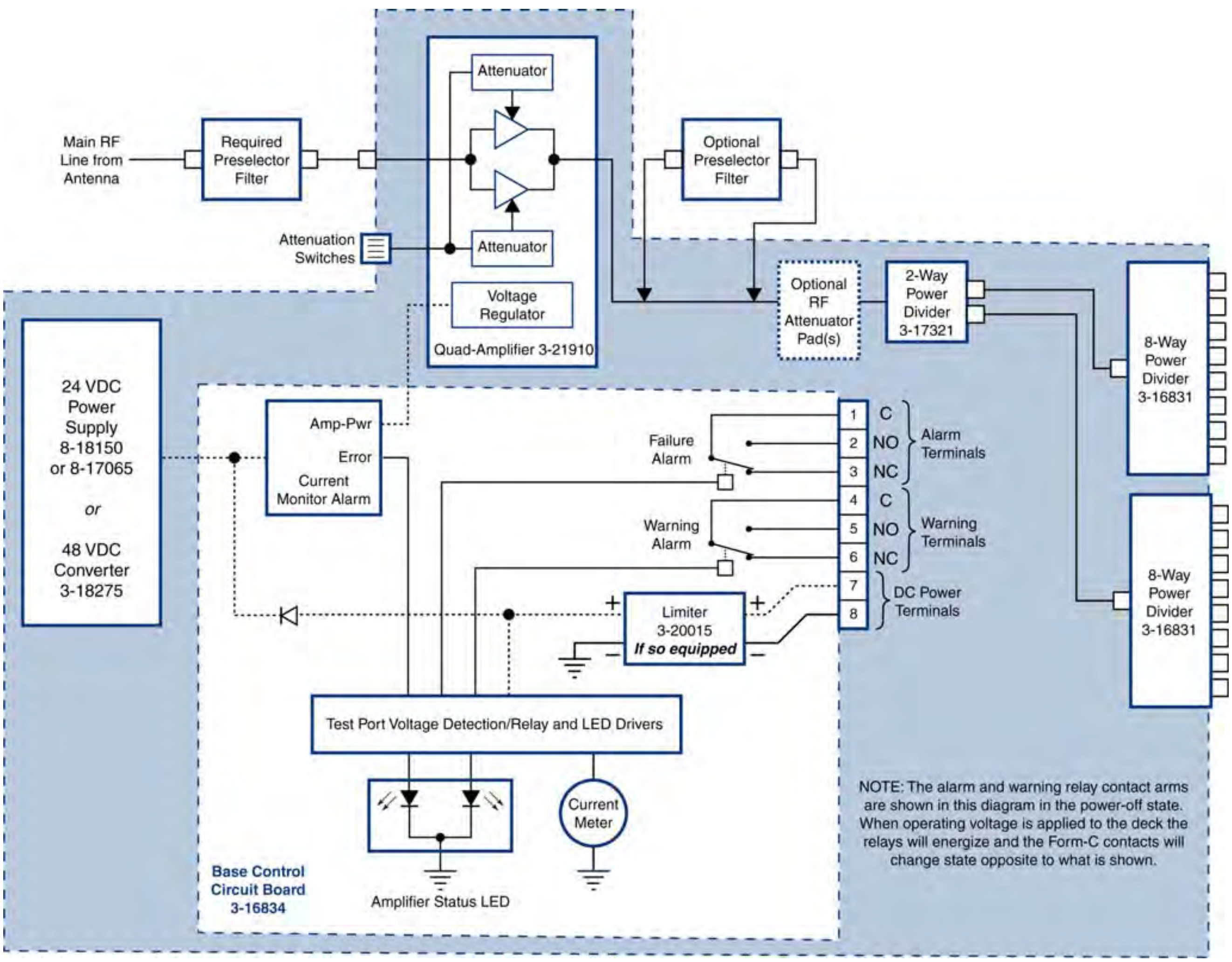


Figure 7: Block diagram of the MCA. Model DDX1000A shown as an example.

rower pass window for the MCA. Signals then enter the RF input connector on the back of the MCA and pass directly to the quad-amplifier assembly, where they are amplified by a factor of 26 dB. The amplified signals are then split into multiple paths by the first power divider. Each path is further split into additional outputs by the second power divider before being passed on to the station receivers.

SYSTEM STATUS MONITORING

Referring to the MCA block diagram (Figure 7), additional circuitry on the control board is used to monitor the current drawn by the amplifier. The Multicoupling Amplifier System reveals the status of the amplifier in three ways: LCD current meter, status-indicator LED and Form-C contacts ("screw terminals"). **Table 3** summarizes the status of the LED, the Form-C contacts and system gain for various amplifier conditions.

Current Meter

The LCD current meter provides an indication of the relative current being drawn by the amplifier assembly.

NOTE

The value displayed on the LCD meter (about 430 to 510 mA) can vary slightly among MCA's due to different component tolerances among systems.

Status-Indicator LED

The Amplifier Status LED illuminates in one of three colors. The meaning of each color is summarized on the front panel of the MCA and in Table 3. During normal operation, the LED glows green.

Form-C Contacts

ALARM and WARNING Form-C relay contacts are located at the back of the MCA (see Figure 4). These screw terminals are intended for connection to the customer's supervisory and data acquisition system. Form-C contacts have very low voltage drop because they use mechanical contacts and they are well isolated from each other well into the RF spectrum.

NOTE

Both the alarm and warning Form-C contacts will have continuity between the COM and NC terminal screws when the deck is not powered. When operating voltage is applied to the deck the relays will energize and there will be continuity between the COM and NO terminals.

ALARMS

The system has two distinct failure notification levels including warnings and alarms, each is discussed in detail next.

Warning

A warning alarm trips when the amplifier current differs from the normal displayed current by approximately 20%. The LED on the front panel turns orange during a persistent warning condition. The warning Form-C contacts also change state.

Alarm

An alarm condition occurs when the amplifier current differs from the normal displayed current by approximately 30% or greater. The LED glows a solid red, and the alarm Form-C contacts change state.

Reset

Alarms reset automatically when the amplifier current drain returns to normal values.

LED Color	Amplifier Status	Form C Contact Status	MCA Gain
Green	**Normal Operation**: Amplifier is turned "on" and amplifying.	Normal	Normal
Orange	**Warning**: Amplifier current draw is abnormal.	Warning contacts change state	Reduction possible
Red	**Alarm**: Amplifier current draw is *highly* abnormal.	Alarm contacts change state	Reduction likely

Table 3: Amplifier status indicators.

MAINTENANCE

Because it is possible that the current alarm *may not* detect a fault affecting RF gain, we recommend measuring system gain every six months. See "Testing for Proper Operation (Static System Sensitivity Test)".

TROUBLESHOOTING AND REPAIR

Most MCA failures are due to lightning damage or excessively high RF signal input levels. Troubleshooting includes (1) observing the alarm/warning indicators, (2) verifying that the power supply or DC-to-DC converter is outputting the proper DC voltage and (3) measuring amplifier gain. A damaged power supply assembly or DC-to-DC converter is simply replaced. A damaged quad-amplifier may be returned to the factory for repair or replacement.

Amplifier Replacement

The amplifier assembly is field replaceable. This involves two basic operations; Physically replace the amplifier assembly and adjust the current alarm trip point for the replacement amplifier.

The quadrature amplifier assembly in the MCA is held in place by screws, which are accessible from the bottom of the deck. To change the amplifier assembly perform the following steps.

1) TURN OFF the MCA power. For models DDX1000A, 42-57-XX and 42-68-07130-XX unplug the MCA's AC power cord. For model 42-57-XX-48 disconnect the 48 VDC power source.

2) Disconnect the input and output cables (TNC connectors) as well as the DC power cable (BNC connector) and the ribbon cable from the amplifier assembly.

3) Remove the hold-down screws, which are accessible from the bottom of the deck, and remove the defective amplifier assembly.

4) To install the replacement amplifier repeat steps 1 through 3 in reverse order.

Adjusting the Alarm Trip Point

The adjustment procedure will require the use of a multimeter (micro-clips would be helpful) and a thin-blade adjustment tool. To adjust the alarm trip point for the amplifier assembly perform the following steps;

NOTE

Before starting the adjustment procedure check the front panel display and make sure the current value shown is within the normal range of about 430 to 510 mA. The adjustment procedure may not work correctly if the amplifier is operating outside of its normal current operating range.

Clip multimeter leads to the 2 pins labeled "base".

Note: The red (positive) lead of your meter should be connected to the bottom pin of the header labeled "meas" and the black (negative) lead should be connected to the top header pin labeled "set".

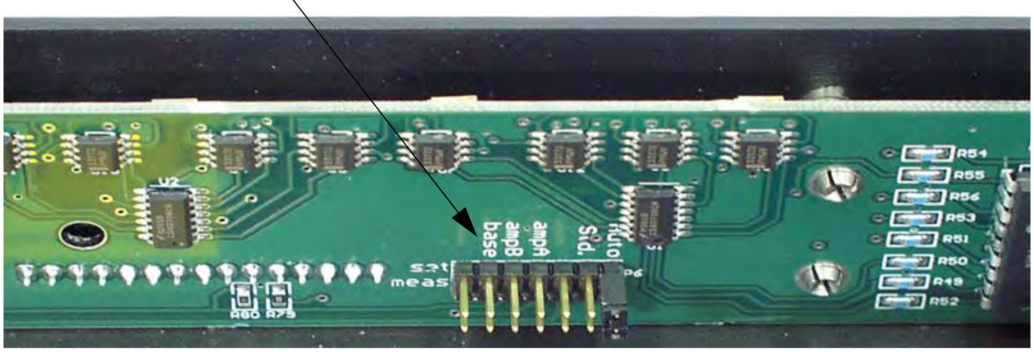


Figure 8: Clip multimeter leads to 2 pins labeled "base" on control circuit board.

1) Make sure the power to the base unit is off.

2) Set your multimeter to measure DC voltage (use the hundredth range). Clip the test leads of your meter to the two pins on the control board labeled “base” (see **Figure 8**). **Note:** The red (positive) lead of your meter should be connected to the bottom pin of the header labeled “meas” and the black (negative) lead should be connected to the top header pin labeled “set”.

3) Supply power to the base unit.

4) On the control board, locate the trim pot to the left of the label “Base Adj” (see **Figure 9**). Use a thin blade adjustment tool and rotate the pot until the front panel LED is green. This “non-alarm” condition will be your starting point for the adjustment procedure.

5) Slowly rotate the pot in a clockwise direction until the front panel LED glows orange. You should hear a click of the relays when the LED changes color from green to orange. Record the value in millivolts that are now displayed on your meter.

6) Repeat step 5, except this time turn the pot in the opposite (or counter clockwise) direction. The LED should go from orange back to green and finally to orange again. When you hear the click and the LED changes from green to orange record the value in millivolts that are displayed on your meter.

7) The millivolt levels from steps 5 and 6 represent the upper and lower warning threshold levels. Typically one value will be positive and one value will be negative (for example -141 and +91). You need to calculate the midpoint between the two values. Add the absolute values of the two numbers to get the full range and then divide by 2 to get the half range value. In the example, the range between -141 and +91 is 232. Half of 232 is 116. Subtract the half range value from the positive value to arrive at the midpoint (91 - 116 = -25). This represents the midpoint between the warning high threshold and low threshold.

8) Rotate the pot as required in order to set the meter display to the midpoint value. This calibrates the sensing circuit to the middle of the warning range.

9) Disconnect power from the base unit and remove your test leads, then power up the system as usual.

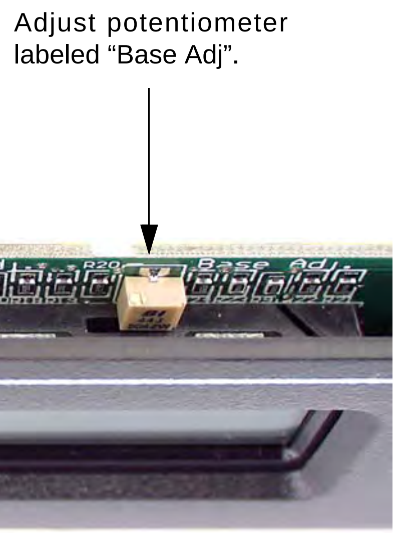
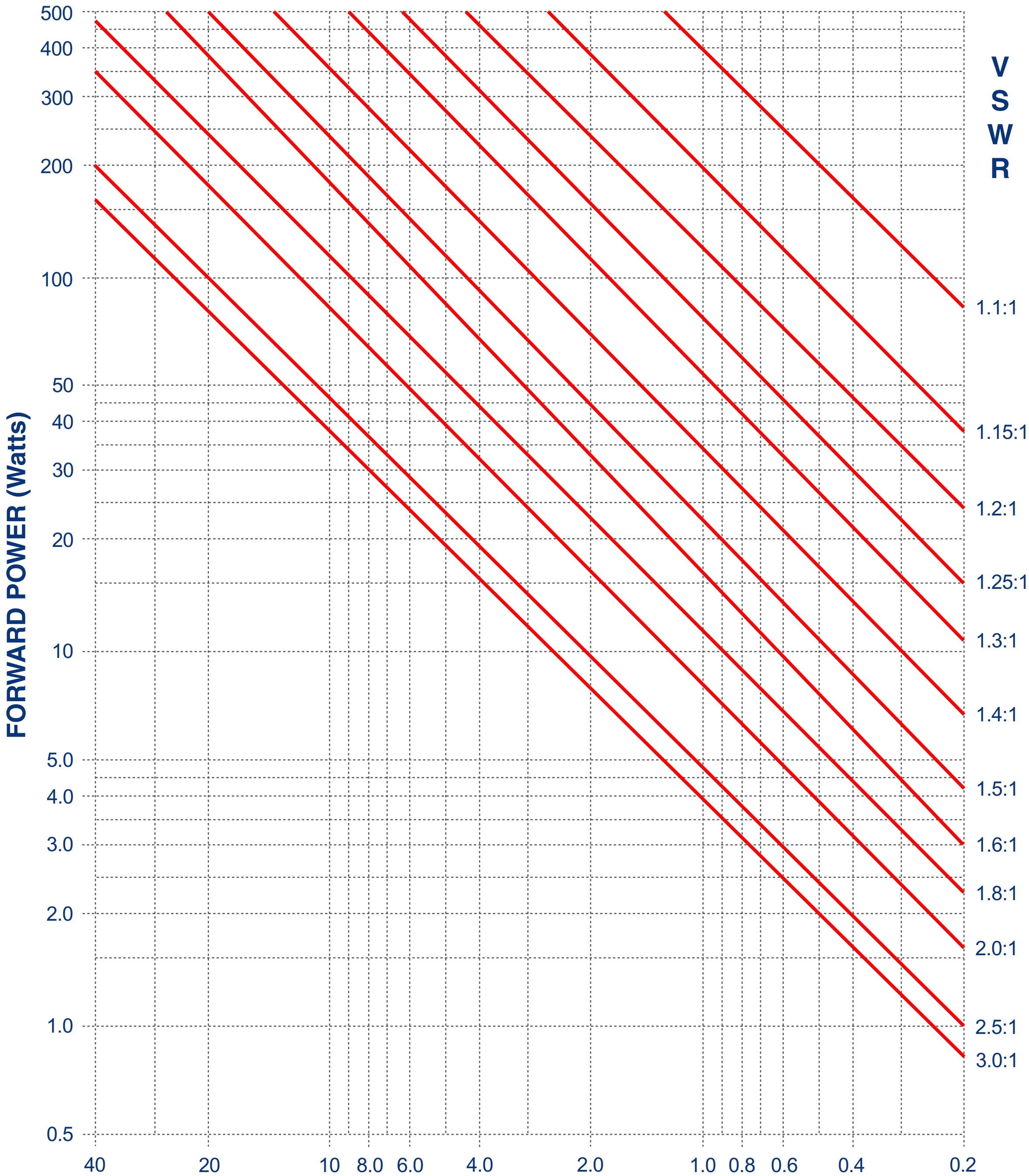


Figure 9: Adjust the “Base Adj” trim pot.

POWER FWD./REV.
VS
VSWR

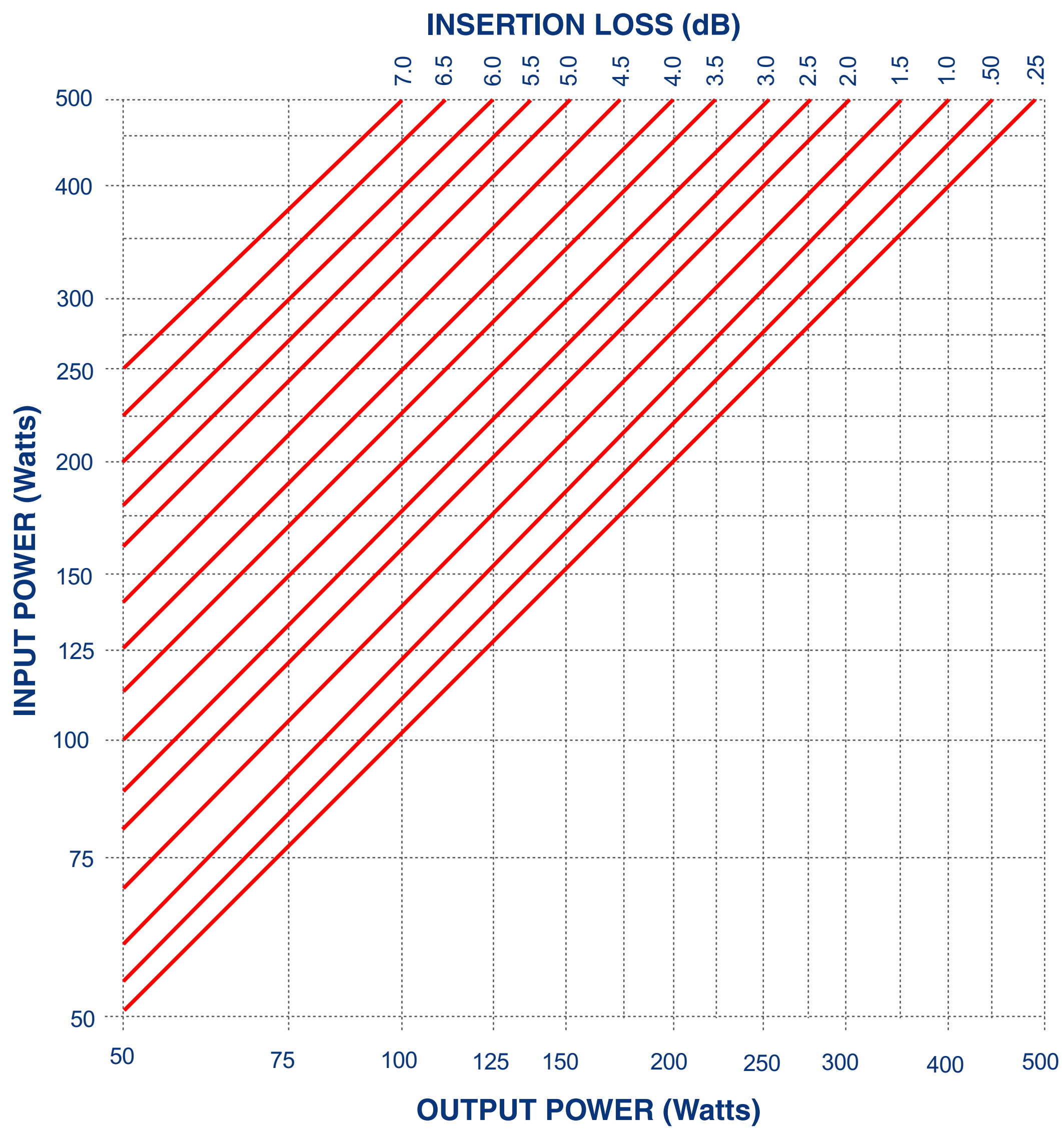


REFLECTED POWER (Watts)

FOR OTHER POWER LEVELS
MULTIPLY BOTH SCALES
BY THE SAME MULTIPLIER

POWER IN/OUT
VS
INSERTION LOSS

The graph below offers a convenient means of determining the insertion loss of filters, duplexers, multicouplers and related products. The graph on the back page will allow you to quickly determine VSWR. It should be remembered that the field accuracy of wattmeter readings is subject to considerable variance due to RF connector VSWR and basic wattmeter accuracy, particularly at low end scale readings. However, allowing for these variances, these graphs should prove to be a useful reference.



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