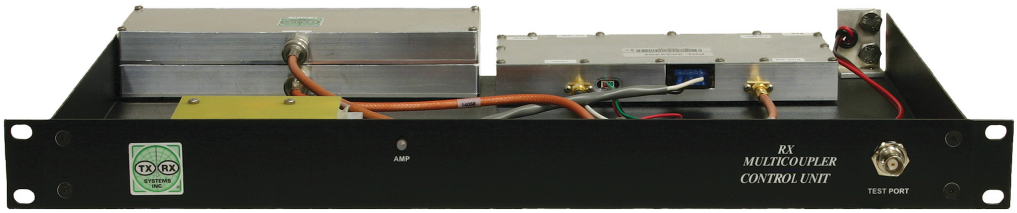
Manual
Part #
7-9626-1

Installation and Operation Manual for
Receive Multicouplers
Models 42-36C-05-XXN/B-XX



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Symbols Commonly Used

WARNING

High Voltage

CAUTION or ATTENTION

Hot Surface

Important Information

ESD Electrostatic Discharge

Training Video Available

Electrical Shock Hazard

Changes to this Manual

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.

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 facility to the attention of the Technical Publications Department. This manual may be periodically updated. When inquiring about updates to the manual refer to the manual part number and revision number which can be found in the revision table.

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Sales Support at 716-549-4700

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Table of Contents

Figures and Tables

GENERAL DESCRIPTION

The 42 Series Receiver Multicoupler is a key component in an efficient received-signal distribution system. The system is designed to increase the performance of a base radio while ensuring reliable communications for critical public safety applications. The Receiver Multicoupler amplifies received signals and then splits them to the requisite number of output ports. The design has been optimized to handle strong signals without overloading, while maintaining a good noise figure.

Unlike a TTA system the Receiver Multicoupler system does not use a tower-top mounted amplifier to overcome transmission line cable loss. It is assumed that the antenna feedline loss is less than 1.5 dB. If not, you may want to consider the use of a TTA system instead. Twelve different models are available in the 42-36C-05 family as shown in the model matrix listed in **Table 1**. Six of the models have 8 output ports and six models have 16 output ports. A field installed expansion kit is available to convert models with 8 output ports into 16 output ports.

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. A form of built-in redundancy. 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 indication (LED) on the front panel of the unit, along with a change of state in a set of Form-C contacts at the rear of the unit, thus indicating that trouble has developed. In most cases, should an alarm occur, near normal operation will continue on one of the two parallel pathways within the quadrature-coupled amplifier, allowing time for repair without an abrupt loss of 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

Model Number	Number of Ports	System Gain (max)*	Power Requirements	Receive Connectors	Dimensions
42-36C-05-08N	8	18 dB	85 - 264 VAC	N	1RU x 19” x 14”
42-36C-05-08N-48	8	18 dB	-48 VDC	N	1RU x 19” x 14”
42-36C-05-08N-DC	8	18 dB	9 - 36 VDC	N	1RU x 19” x 14”
42-36C-05-08B	8	18 dB	85 - 264 VAC	BNC	1RU x 19” x 14”
42-36C-05-08B-48	8	18 dB	-48 VDC	BNC	1RU x 19” x 14”
42-36C-05-08B-DC	8	18 dB	9 - 36 VDC	BNC	1RU x 19” x 14”
42-36C-05-16N	16	15 dB	85 - 264 VAC	N	2RU x 19” x 14”
42-36C-05-16N-48	16	15 dB	-48 VDC	N	2RU x 19” x 14”
42-36C-05-16N-DC	16	15 dB	9 - 36 VDC	N	2RU x 19” x 14”
42-36C-05-16B	16	15 dB	85 - 264 VAC	BNC	1RU x 19” x 14”
42-36C-05-16B-48	16	15 dB	-48 VDC	BNC	1RU x 19” x 14”
42-36C-05-16B-DC	16	15 dB	9 - 36 VDC	BNC	1RU x 19” x 14”

* Electronic attenuator (0 to 15 dB range) in each unit can be used to reduce system gain for optimal performance.

Table 1: Model Matrix.

Parameter	Specification
Frequency Range	135 - 175 MHz
System Gain	See Model Matrix (table 1)
Amplifier Type	Quadrature Coupled
Amplifier Noise Figure	< 1.5 dB
Amplifier OIP3	> +40 dBm
Number of Output Ports	See Model Matrix (table 1)
RF Port Return Loss	> 14 dB
Test Port Coupling	-30 dB
Antenna Connector	N - Female
Receiver Connector	See Model Matrix (table 1)
Test Port Connector	BNC - Female
Rx - Rx Port Isolation (min)	> 20 dB
Total Power Dissipation	5 Watts
Attenuator Setting	15 dB in 1 dB steps
Alarm Contacts	Form-C contacts
Power Requirements	See Model Matrix (table 1)
Operating Temperature Range	0°C to +50°C
Enclosure	Standard EIA 19” Rack Mount
Dimensions (HWD)	See Model Matrix (table 1)
Net Weight	9 lbs.

Table 2: Specifications.

design has been optimized to handle very strong signals without overloading, while maintaining a good noise figure. **Figure 1** shows the location of the amplifier status LED and the test port on the front panel of the unit.

UNPACKING

Inspect the system for shipping damage immediately after removing from the shipping carton. It is the customer's responsibility to file damage claims with the shipping carrier within a short period of time after delivery (1 to 5 days). The system is well packaged for damage free shipping to any place in the world. However, a high impact during shipping can have a detrimental effect. A damaged shipping container is a sure sign of rough handling.

INSTALLATION

The installation of a preselector filter between the antenna feedline and the amplifier assembly is required. Significant damage to the amplifier unit will occur without the preselector. The multicoupler deck is designed for indoor mounting in a common 19-inch relay rack or cabinet. Sub assemblies on the receiver multicoupler are attached to the main mounting deck as shown in **Figure 2**. **Figure 3** shows all of the connectors on the rear of the unit. All RF connections to or from the receiver multicoupler system should be made with double-shielded or semi-rigid heliax cable. The following steps are required for proper installation.

1) Install the deck into the rack or cabinet with four mounting screws from the hardware kit (part #

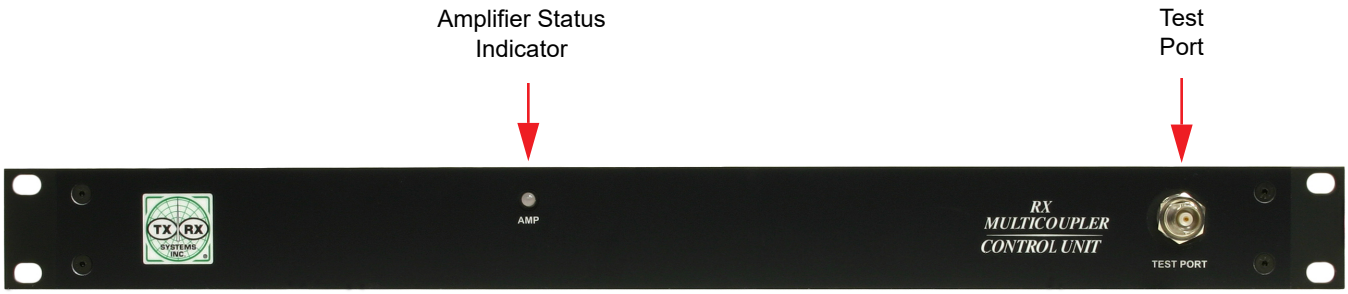

Figure 1: Front Panel.

3-16509) which is included with your shipment. Make sure you use a nylon washer under the head of the screws in order to protect the front panel. Torque the mounting screws to no more than 15 in/lbs. Over tightening the mounting screws may damage the front panel.

2) Install the required preselector filter in the rack or cabinet above the deck with four mounting screws from the hardware kit (part# 3-16509) which is included with your filter shipment. Make sure you use a nylon washer under the head of the screws in order to protect the front panel. Torque the mounting screws to no more than 15 in/lbs. Over tightening the mounting screws may damage the front panel.

3) Connect the input/output ports of the preselector to the respective input/output ports on the rear of the multicoupler deck.

4) A ground terminal is provided on the back of the receiver multicoupler deck for connection to the station ground bus. We recommend solid copper wire up to size #8 for this purpose.

5) Install a DC blocking surge suppressor in-line with the antenna feedline at the building entry point. Make sure that the surge suppressor is grounded properly.

6) Connect a jumper from the in-building surge suppressor to the port labeled Main on the rear of the deck. We recommend using high-quality N connectors with gold-plated center pins for maximum intermodulation suppression.

7) Connect the antenna inputs of the station receivers to the RF outputs at the back of the receiver multicoupler 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 TX RX Systems.

NOTE Unused RF output ports on the receive multicoupler do not need to be terminated under normal operating conditions. However, when installing systems to a “best practices” standard any unused RF outputs should be terminated with a reasonable quality 50 Ohm load. This will ensure that the output signal strength is as balanced as possible between the output ports and it will improve the port-to-port isolation.

8) If you have a supervisory alarm system, you may connect it at the alarm terminal screws at the back of the deck. Normally open (“NO”) and normally closed (“NC”) contacts are available.

9) For models which include a DC-to-DC Converter, connect the leads from a suitable VDC source to the red and black wires at the back of the unit. Be careful to observe the proper polarity. Insulated #20 size wire may be used. Models are available with DC operating range of either -48 VDC or +9 to +36 VDC. Make sure your VDC source matches the model your installing.

10) For models which include an AC Power Supply plug the decks power cord into a suitable 120 VAC outlet.

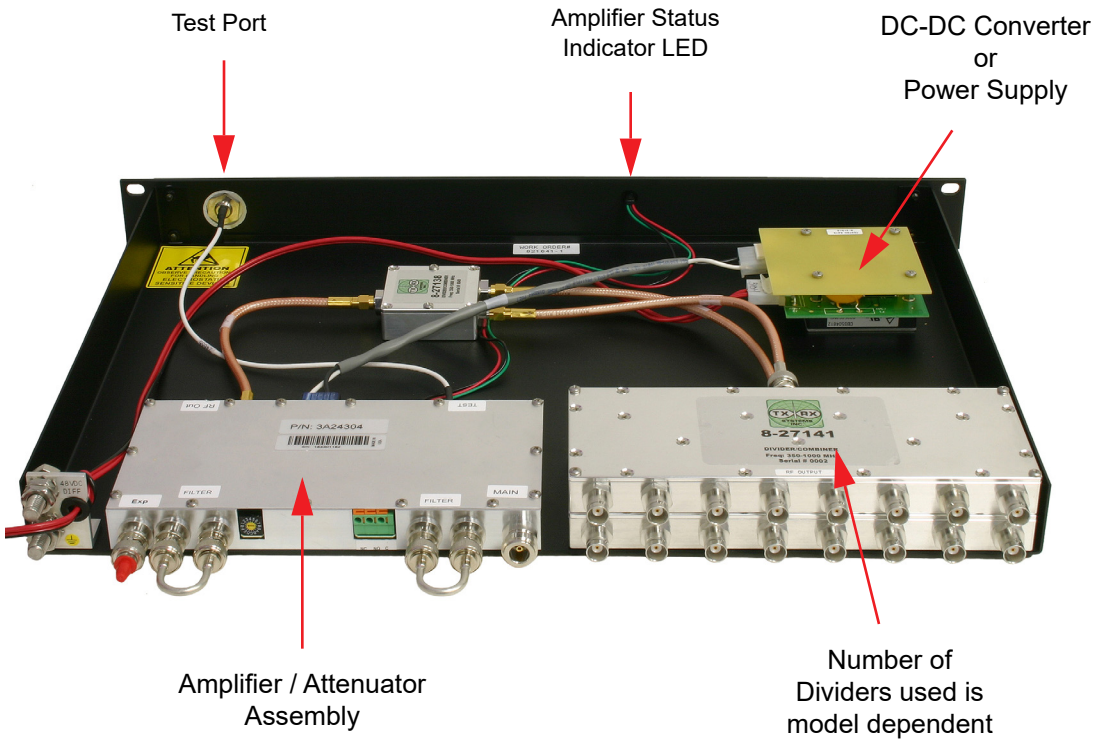

Figure 2: Top rear view. Model 42-36C-05-16B-48 shown as an example.

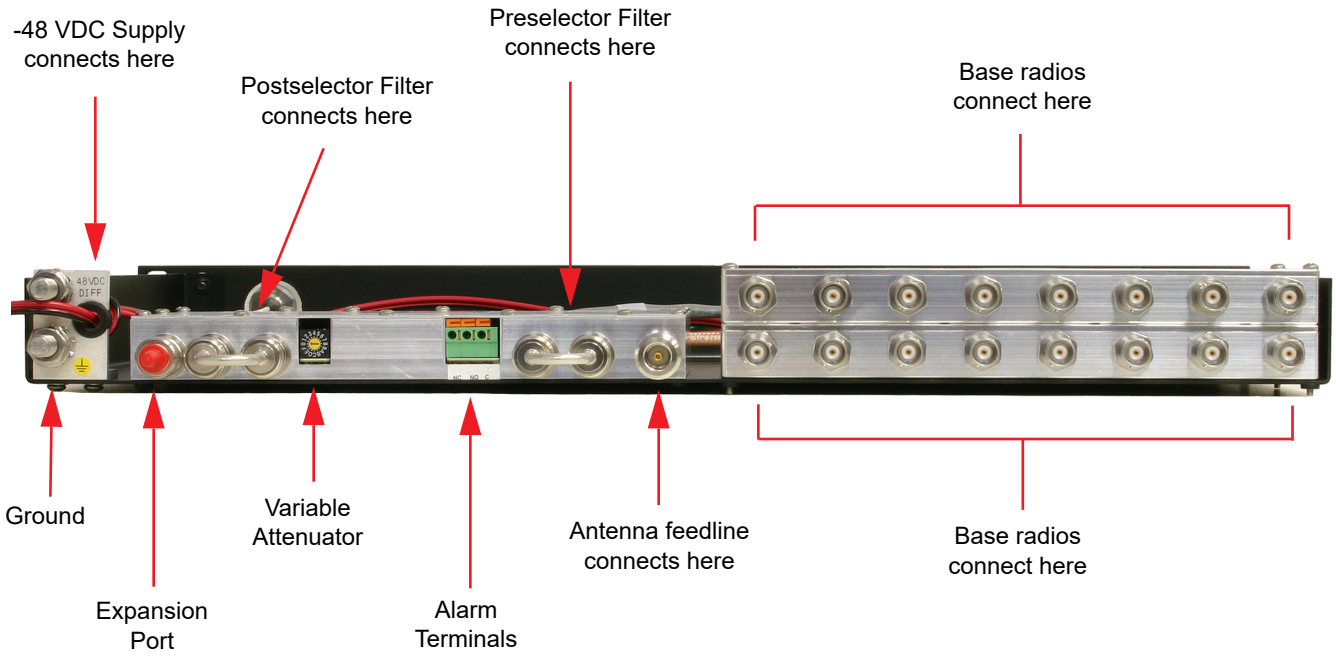

Figure 3: Rear view. Model 42-36C-05-16B-48 shown as an example.

TESTING FOR PROPER OPERATION (SENSITIVITY TEST)

After installation, a measurement should be made to insure that the Receiver Multicoupler is operating properly. The procedure is a basic system sensitivity measurement. It is important to use a high-quality, double-shielded coaxial cable (RG223 or RG142) for connecting the signal generator to the Receiver Multicoupler.

1) Select one of your station receivers and determine the stand-alone sensitivity of the receiver.

2) Connect a SINAD or Bit Error Rate meter to the receiver.

3) Inject a test signal into the antenna port (labeled Main) on the deck. Set the signal generator to an in-use channel frequency. Be sure the signal generator is setup for a 3 KHz deviation with a 1000 Hz tone (analog) or proper pattern for 5% BER testing. The generator output level should be the same as or better than the output level that was obtained by a sensitivity measurement of the receiver only (within a dB or two). Use the same cable for the generator that was used in step 1 for the receiver only sensitivity measurement. Record the systems Sensitivity value for future reference. Repeating this same procedure at a later date should yield similar performance, within a dB or two, in a properly operating system.

Repeatability of these measurements can be affected by a number of factors, so please keep the following points in mind to obtain the most consistent results:

1) Use the same signal generator, receiver and bit-error meter for all measurements.

2) All test equipment should have a valid calibration certification.

3) Use the same length and type of coaxial cable test lead on the output of the signal generator. The signal loss factor of the cable varies with length and cable type. This fact also implies that if the cable used to connect the Receiver Multicoupler to the receiver changes, it will have an effect on the measured values.

If the sensitivity is low, check the following:

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

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

OPERATION

Power is applied to the system by plugging the decks AC cord into a suitable AC outlet (for AC supplied systems) or connecting the DC power cable to a suitable VDC supply (for DC supplied systems). The front-panel Amplifier Status LED should illuminate green indicating normal operation.

ADDITIONAL INSTALLATION CONSIDERATIONS

The following are additional considerations when installing a Receiver Multicoupler 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 required 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 required preselector 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 help eliminate carrier desense, but no amount of receiving system filtering can correct transmitter noise problems. Using high gain and very low noise figure preamplifiers in the receiving system will only make matters worse.

Lightning Protection

To maximize the receiving system's reliability, additional lightning protection is desirable. A surge impulse suppressor must be installed in the receiving antenna line where the line enters the equipment shelter. 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 preamplifier's 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 preamplifier's generally lack any substantial filtering, and will therefore be more prone to overload and intermodulation problems themselves. It is our recommendation that these preamplifier's be removed when connecting a receiver to the Receiver Multicoupler. The Receiver multicoupler will have considerably more resistance to overloading than any garden-variety preamplifier, and also will be superior to many receivers without external preamplifier's.

Attenuation Adjustments

When receiving levels at the Receiver Multicoupler outputs are maintained at below -35 dBm, the Net 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 Net Gain may have to be reduced.

The amplifier assembly has built-in adjustable attenuation which is set using a rotary switch located on the back panel near the alarm terminal strip. The attenuation is adjustable from 0 to 15 dB in 1 dB increments. The attenuator is labeled such that the zero position equates to 0 dB and the F position equates to 15 dB.

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.

TEST PORT

The front-panel test port is connected to a signal sampler at the input of the amplifier assembly. This test port allows any signals entering the Receiver Multicoupler to be observed, but at a level that is 30 dB below the actual value due to the signal sampler coupling loss.

SIGNAL FLOW

As part of the signal flow discussion refer to **Figures 4 and 5** which show the functional block diagrams of both the 8 port and 16 port Receiver Multicoupler decks. In both block diagrams receive signals are picked up by the antenna and passed down the tower by the antenna feedline to a surge impulse suppressor located at the point of cable entry into the building. Signals then enter the RF input connector on the back of the deck and pass directly to the required preselector. The preselector protects the amplifier assembly from transients and provides a narrower pass window for the system. After passing through the preselector, the signals are applied to the amplifier/attenuator assembly where they are amplified by a factor of 18 dB or 15 dB depending on model number. The amplifier is used to overcome the losses associated with distribution.

Prior to distribution the signals are routed off of the deck to a postselector for further filtering if needed. If the postselector is not used as part of the installation then a loop cable must be installed in its place in order to route the signals back onto the deck. Distribution can be to either 8 ports or 16 ports depending on the model of the receiver multicoupler.

In the 16 port models, after the signals return from the postselector (or loop cable) they enter a 2-way divider. Each output port of the 2-way is used to feed the input of an 8-way resulting in 16 total outputs.The 16 outputs can be either BNC or N-Type

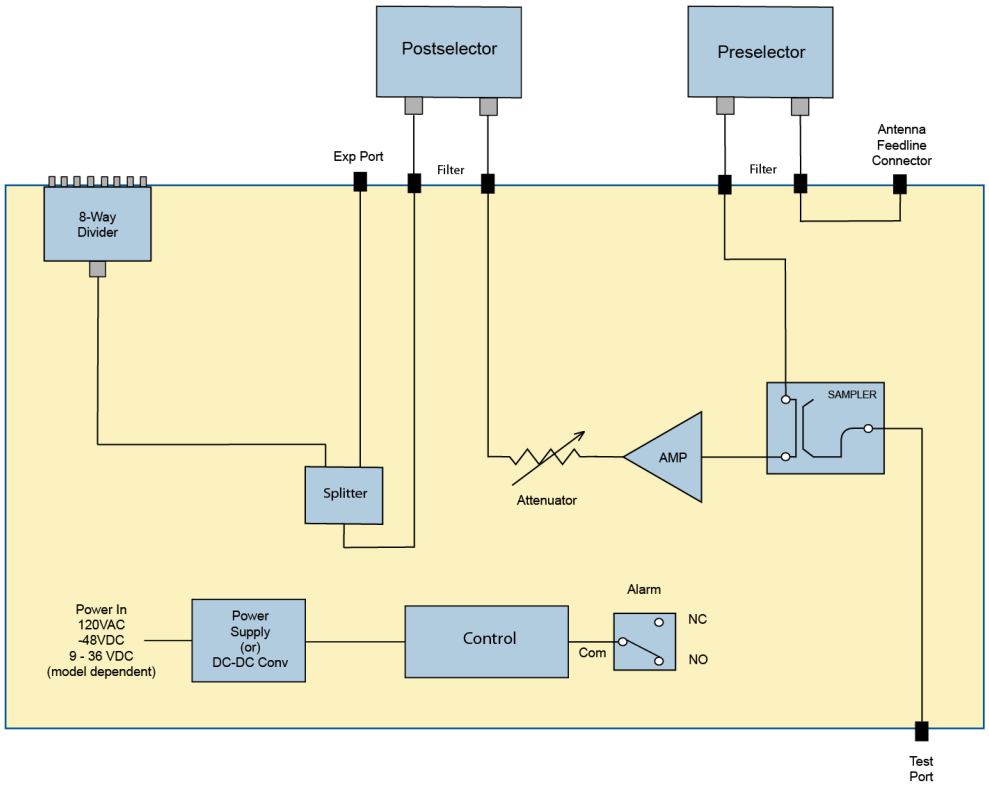

Figure 4: Functional Block Diagram. 8 Port models.

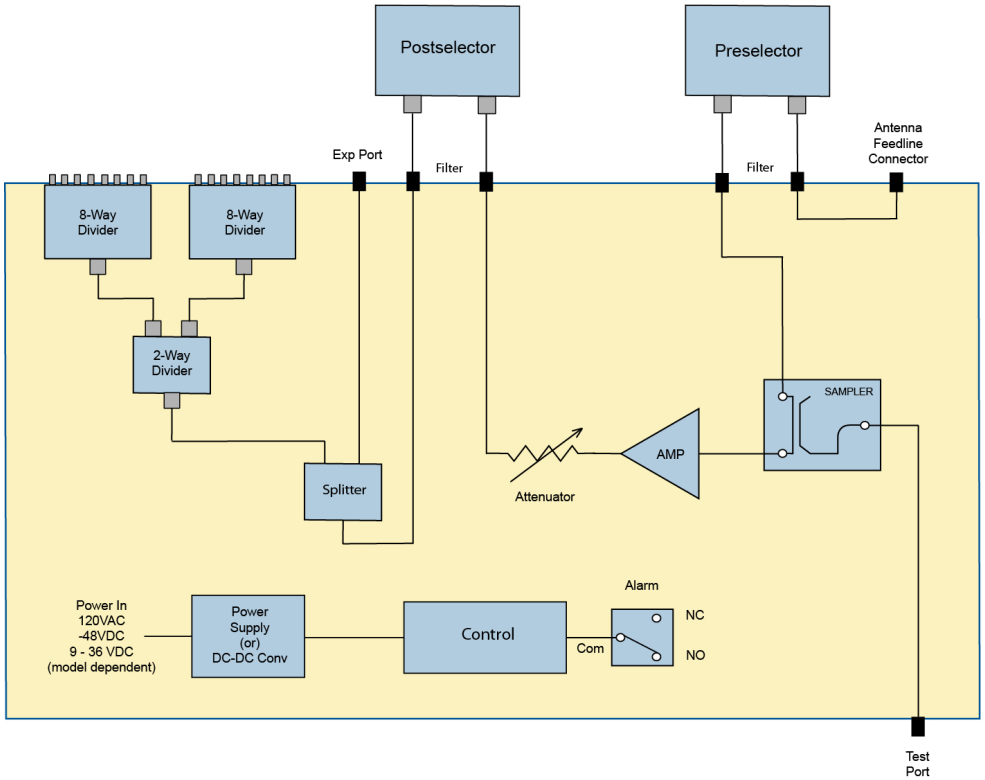

Figure 5: Functional Block Diagram.16 Port models.

connectors depending on the model chosen. Because the 16 port models use a 2-way divider in the distribution path and the 8 port models do not, the 16 port models have 3 dB less gain available.

In the design of the 8 port models, after the signals return from the postselector (or loop cable) they are applied directly to the input of the 8-way. The 8 outputs can be either BNC or N-Type connectors depending on the model chosen.

SYSTEM STATUS MONITORING

The Receiver Multicoupler System reveals the status of the current drawn by the amplifier in two ways; front panel status-indicator LED and Form-C contacts ("terminals") located at the rear of the deck.

Status-Indicator LED

The Amplifier Status LED illuminates in one of two colors. Green for normal operation and red for an alarm condition.

Form-C Contacts

Form-C relay contacts are located at the back of the Receiver Multicoupler. These terminals are intended for connection to the customer's supervisory and data acquisition system. Both normally open and normally closed contacts are available. The Form-C contacts have very low voltage drop because they use mechanical contacts and they are isolated from each other well into the RF spectrum. Specifications for the Form-C contacts are: Nominal switching capacity (resistive load) of 2 Amps @ 30 VDC or 0.5 Amps @ 125 VAC, and Maximum switching power (resistive load) of 60 Watts.

When power is applied to the receiver multicoupler the Form-C relay will energize. The common terminal will then be connected to the normally closed terminal. This is the normal mode of operation. Normal operation is defined as the unit fully powered-up and running as usual with no alarm conditions active. When an alarm condition occurs or the operating power is removed the relay will DE-energize and the contacts will change state indicating an alarm condition. **Figure 6** is a schematic representation of the Form-C contacts functionality. The contacts are shown in the drawing in the DE-energized state.

ALARMS

The system will alarm when an abnormal current flows in the amplifier assembly. The amplifier status indicator LED will glow a solid red and the Form-C contacts located at the back of the unit will change state.

PERIODIC MAINTENANCE

The following procedures can be followed as part of a periodic maintenance program.

1) TX RX Systems recommends that tests for establishing the performance level of the sys-

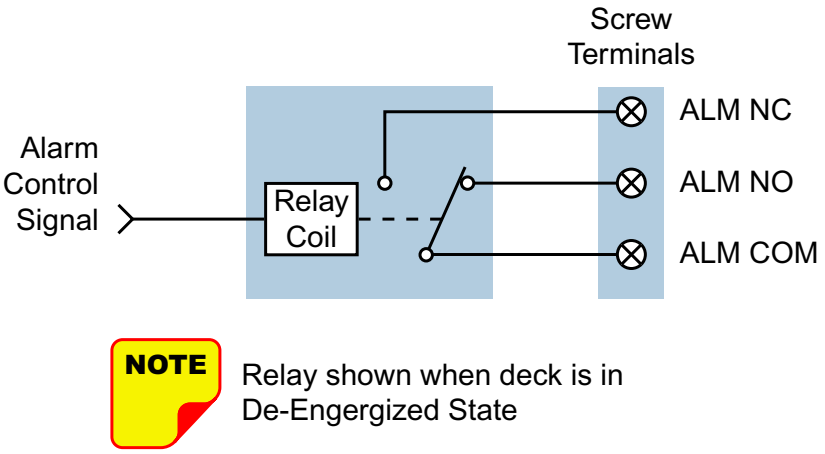

Figure 6: Schematic representation of the Form-C contact functions.

tem, as outlined in this manual, be performed every six months.

2) Because it is possible that the current alarms *may not* detect a fault affecting RF performance, we recommend measuring system sensitivity every six months and comparing this value against the recorded value. See “Testing for Proper Operation (Static Sensitivity Test)” for detailed instructions on performing this test.

3) All feedline connections should be inspected for tightness and waterproofing integrity. Water seeping into the antenna feedline will cause system degradation.

TROUBLESHOOTING AND REPAIR

Most failures are due to lightning damage or excessively high RF signal input levels. Troubleshooting includes (1) observing the alarm indicator LED, (2) verifying that the power supply or DC-to-DC converter is outputting the proper DC operating voltage and (3) measuring system static sensitivity. A damaged power supply assembly or DC-to-DC converter is simply replaced. A damaged quad-amplifier assembly may be returned to the factory for repair or replacement. System problems fall under these main categories:

1) Performance problems characterized by poor receiver sensitivity and possibly accompanied by activation of the alarm system. RF interference or component problems can be the cause.

2) Hardware problems.

3) Power Supply.

Performance Degradation

Most performance difficulties manifest as an intermittent or continuous loss of effective receive channel sensitivity sometimes accompanied by audible interference in FM systems or dropouts in digital radios. Sensitivity loss on a continuous basis is more likely to indicate a hardware problem which may produce an alarm condition.

Hardware Problems

Two of the most common reasons for hardware problems are direct lightning strikes and vandalism. It is possible to shut the system down, especially if a component such as a transmission line or antenna is damaged.

LIGHTNING & LIGHTNING ARRESTERS

The system should be installed with lightning arresters at the building entry ground plate for the antenna feedline. Although no practical amount of protection can prevent catastrophic failure as the result of a direct hit, the lightning arresters are very effective in preventing damage from nearby strikes and smaller direct hits. Lightning arresters do not last forever and can eventually fail, especially after a direct hit. A damaged arrester can cause low gain. An arrester with lightning damage will exhibit increased insertion loss and poor return loss.

VANDALISM

Damage to the antenna caused by hunters or target-shooters in remote locations is not uncommon. Penetrating bullets may open or short transmission lines. Serious damage to this cable can prevent system operation.

AC Line Fuse (120 VAC Models)

A failure of the power supply will obviously shut down the system because of high signal loss through the amplifier on the deck. The power supply is located on the deck and has a replaceable 250 volt, 2 amp fuse for the AC line. The supply has a green status LED located next to the connectors which illuminates when the supply is turned on.

RECOMMENDED SPARE PARTS

It is recommended that one amplifier/attenuator assembly be kept on hand for emergency repairs. The part number of the amplifier/attenuator is 3A24533.

EXPANSION KIT

An optional expansion kit part number 75-36C-08N (using N-type connectors) or 75-36C-08B (using BNC connectors) can be purchased from TX RX Systems in order to increase the performance of your system. The field installed expansion kit will increase the total multicoupler outputs of an 8 port model to 16 ports.

PRESELECTORS AND POSTSELECTORS

The system is designed to accommodate preselector filters which are required for normal system operation and postselector filters which are optional. The preselector filter is designed to be

added to the system before the amplifier in the base unit and the postselector is designed to be added after the amplifier. These filters are connected to the back of the control unit at the BNC connectors labeled FILTER as shown in figure 3.

The preselector attaches to the BNC connectors that are closest to the RF Input Port (where the antenna feedline connects) and the postselector attaches to the BNC connectors near the Expansion Port. In both cases the small jumper cable (loop) between the BNC connectors must be removed before the filter is installed. The jumper cable is used to maintain the RF signal path through the system whenever a filter is not connected. It's a good idea to hang on to the jumper cable in case you ever want to remove the filter for some reason.

The required preselector filter must have a grounded coupling loop design which provides a DC path to ground for the center conductor of the antenna feedline cable. The preselector filter provides transient protection for the amplifier assembly as well as provides a narrower pass window for the system. The required preselector filter should be mounted in the same rack just above the base unit.

The optional postselector filter will help to further tighten the pass window of the system if required. Although the postselector filter is optional, its use is recommended when installing systems to a "best practices" standard. The postselector filter should be installed in the rack just below the control unit.

Contact your TX RX Systems sales representative for assistance in selecting the best preselector and postselector filter for your overall system design.

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