Installation and Operation Manual for
Compact Receiver Multicoupler
Model 42-33/53/57/83A-01-XX

Manual Part Number

7-9280

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Warranty

This warranty applies for one year from shipping date.

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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.

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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.

CLAIMS:
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.

SPECIFICATION CHANGES OR MODIFICATIONS:
All designs and specifications of seller's products are subject to change without notice provided the changes or modifications do not affect performance.

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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.

ORDER CANCELLATION OR ALTERATION:
Cancellation or alteration of acknowledged orders by the buyer will be accepted only on terms that protect the seller against loss.

NON WARRANTY REPAIRS AND RETURN WORK:
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	07/10/01
2	10/23/03
3	02/04/04
4	02/21/05
5	02/21/06
6	01/23/07
7	03/13/14

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.

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TX RX SYSTEMS INC.

GENERAL DESCRIPTION

Your new Compact Receiver Multicoupler is the key component in an efficient received-signal distribution system. Signals from the receiving antenna are first presented to a required preselector, which provides a narrower receiving window ahead of the multicoupler. At the receiver multicoupler, signals are amplified and then split to the requisite number of output ports, which in turn connect to the antenna terminals of the station receivers. 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.

Bird Technologies manufactures a wide range of Compact Receiver Multicouplers in four basic product families covering most applications in the 118 - 901 MHz range. The four basic product families are listed in **Table 1** along with their coverage band.

Model Number	Frequency Range
42-33-01-XX	118 - 174 MHz
42-53-01-XX	220 - 400 MHz
42-57-01-XX	380 - 520 MHz
42-83A-01-XX	746 - 901 MHz

Table 1: Product Families/Frequency Ranges.

The Compact Receiver Multicoupler is designed for 19-inch rack mounting and requires only 1 Rack Unit of space. Models are available with a varying number of output ports (typically 4, 8, 12, or 16) and either AC or DC power requirements. All multicoupler subassemblies are attached to the main mounting deck as shown in **Figure 1**. See **Figure 2** for locations of power-indicator LEDs on the front panel of the unit. A functional block diagram of a typical AC powered deck is shown in **Figure 3** and a DC powered deck is shown in **Figure 4.**

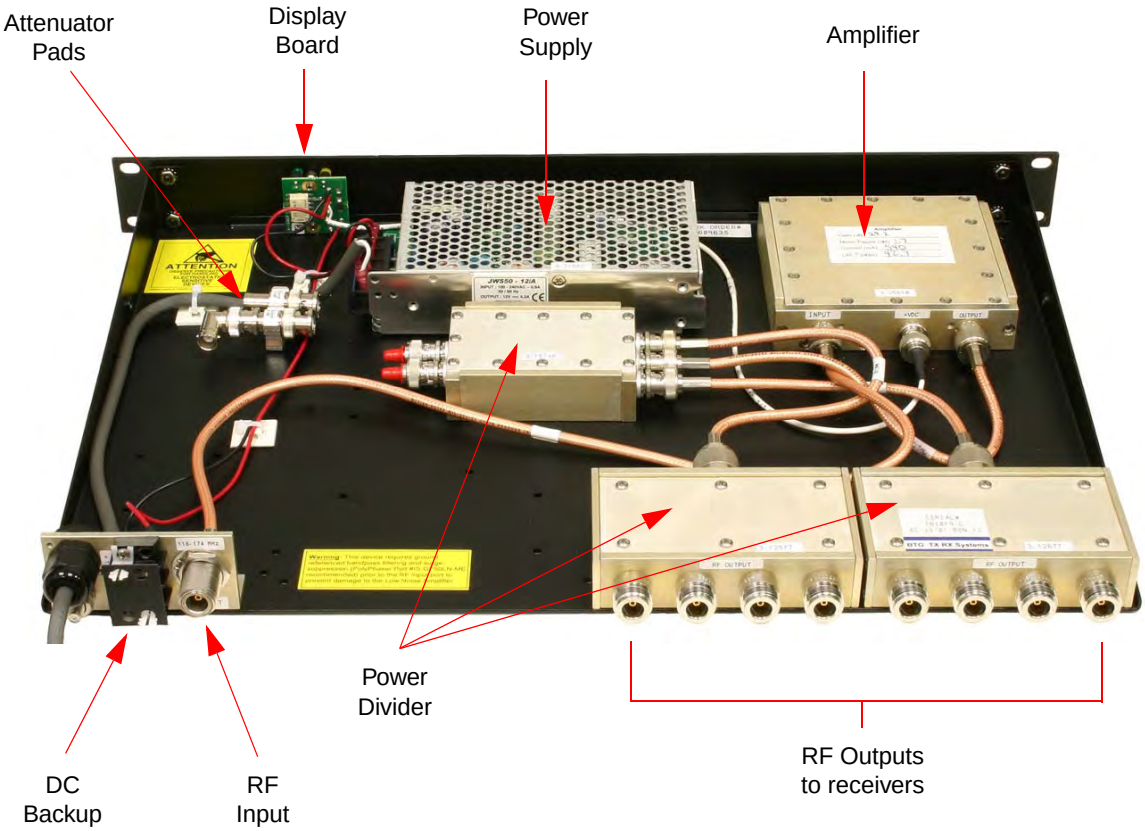

Figure 1: Chassis view of a typical compact receiver multicoupler. Model 42-33-01-08N-12 shown as an example.

Figure 2: Front view of the unit.

UNPACKING

Inspect the Compact Receiver Multicoupler for shipping damage immediately after removing it 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).

INSTALLATION

The installation of a preselector filter between the main antenna feedline and the receiver multicoupler is required. Contact your Bird Technologies sales representative for assistance in selecting the best model preselector filter for your overall system design. Both the receiver multicoupler and required preselector are designed for indoor mounting in a common 19-inch relay-rack or cabinet. All connections to or from the multicoupler should be made with double-shielded or semi-rigid heliax cable.

The following steps are required to properly install the receiver multicoupler system.

1) Install the unit into the rack or cabinet with four mounting screws included with the hardware kit (part # 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. Overtightening the mounting screws may damage the front panel.

2) A required preselector filter MUST be installed between the RF input of the receiver multicoupler and the in-building Polyphaser Impulse Suppressor as shown in **Figure 5**. Connect the incoming antenna lead to the input port of the required preselector and the output port of the preselector to the RF input port on the rear of

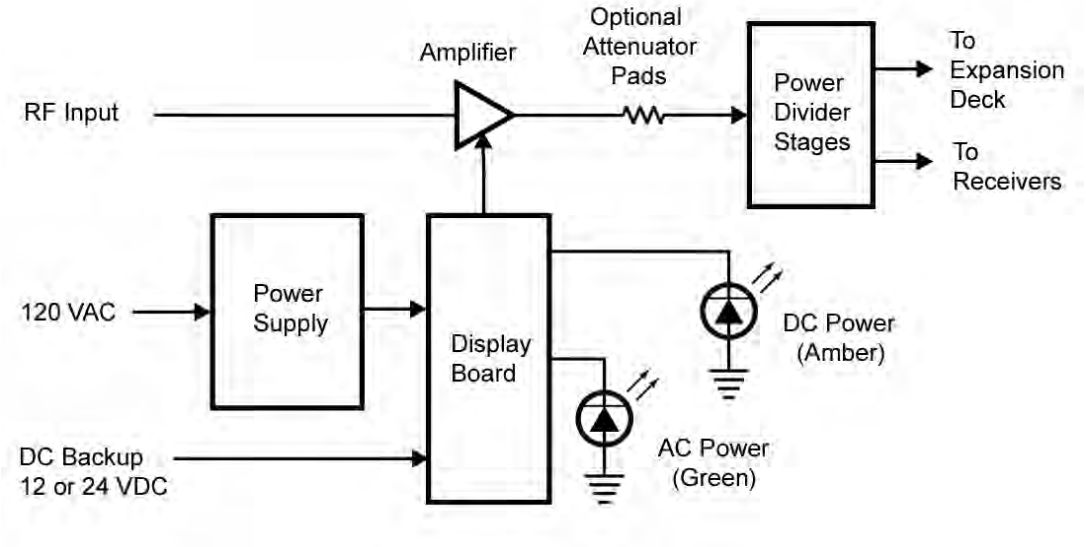

Figure 3: Block diagram of the typical AC powered Compact Receiver Multicoupler.

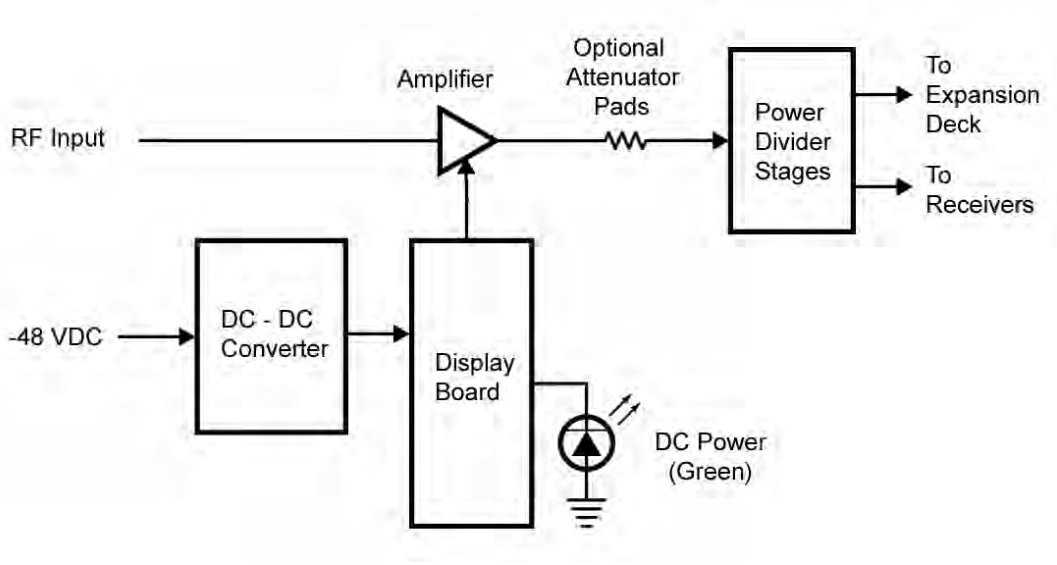

Figure 4: Block diagram of the typical DC powered Compact Receiver Multicoupler.

the receiver multicoupler. 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 narrow pass window for the receiver multicoupler. The filter should be mounted in the same rack just below the receiver multicoupler.

3) An optional preselector filter may be added to the RF signal path between the output of the amplifier assembly and the input of the power divider. To install this filter remove the existing cable between the amplifier and the 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 divider. This places the optional filter in series between the amplifier and the divider. This 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 mounted directly above the receiver multicoupler.

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

5) Connect the incoming antenna lead (from the output port of the required preselector) to the RF input connector (N-type female) on the back of the deck. We recommend using high-quality N connectors with gold-plated center pins and shielded contacts for maximum intermodulation suppression. All connections to or from the receiver multicoupler should be made with double-shielded or semi-rigid heliax cable.

6) Connect the antenna inputs of the station receivers to the RF output ports on the receiver multicoupler. Compact receiver multicoupler models are available with either BNC or N-type RF output connectors and with either 4, 8, 12, or 16 outputs.

7) On AC powered units connect the AC power cord to a grounded receptacle of the proper voltage.

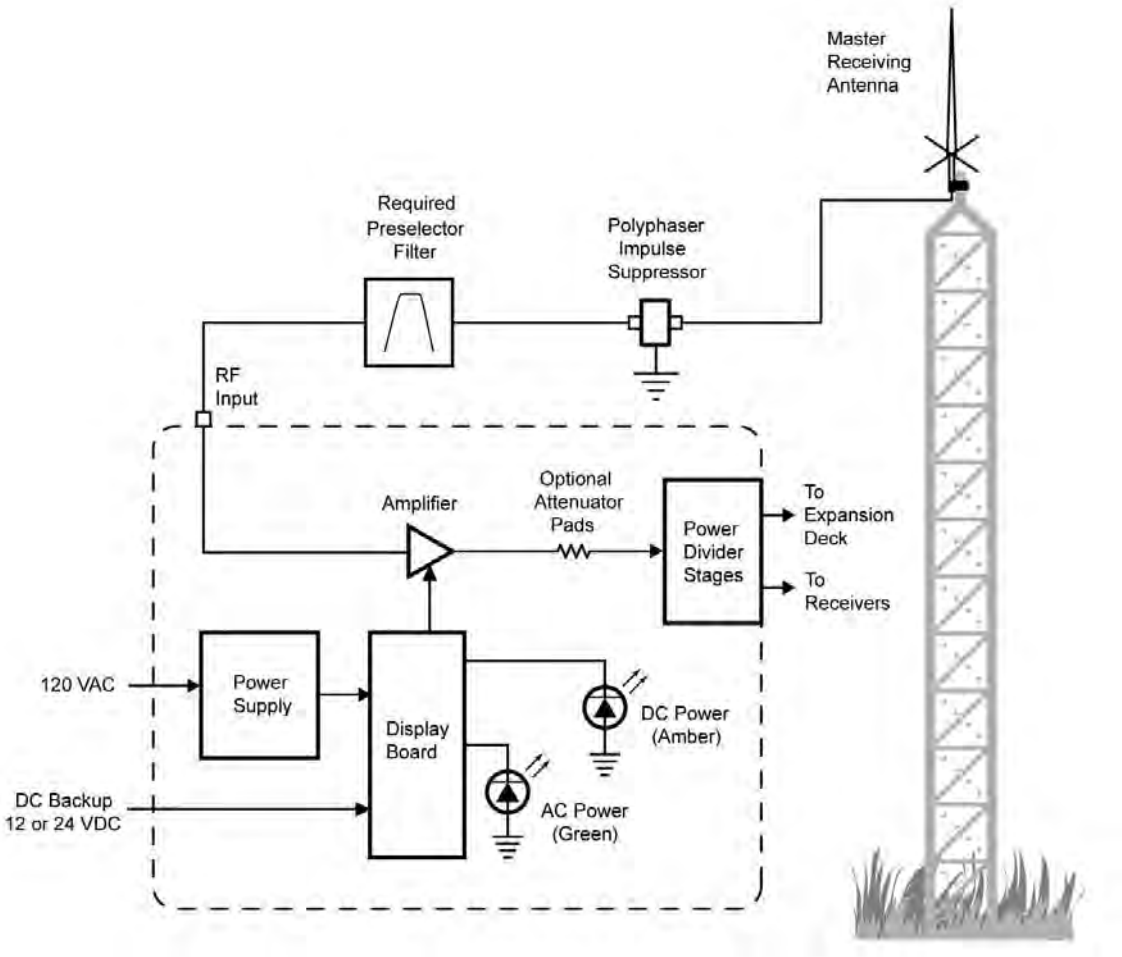

Figure 5: Typical installation of the Compact Receiver Multicoupler system.
AC powered unit shown as an example.

8) On AC powered models, connect a +12 or +24 VDC power source to the backup power screw-terminals on the rear of the deck. Be careful to observe the proper polarity. Insulated #20 size wire may be used.

9) Models requiring a -48 VDC power source use a DC-DC converter instead of a power supply. In these cases connect the -48 VDC source to the screw terminals at the back of the deck being careful to observe the correct polarity.

OPERATION

For AC powered units, an illuminated green LED on the front panel indicates that the unit is operational and is running off AC power. An illuminated amber LED indicates that the unit is operating on DC backup power. All AC operated models are equipped with automatic DC backup power switching, which activates if AC power fails.

For DC powered units, an illuminated green LED on the front panel indicates that the unit is operational and is running off DC power. There is no DC backup power feature for DC powered decks.

ADDITIONAL INSTALLATION CONSIDERATIONS

The following are additional considerations when installing a Compact Receiver Multicoupler.

Preselector Filter

It is required that a preselector filter be used in the receiving system to keep unwanted signals, which are picked up by the receiving antenna, from entering the receiver multicoupler. In most installations, the receiving antenna will be in close proximity to transmitting antenna(s). Therefore, added selectivity between the receiving antenna and the multicoupler RF input is a must, to protect the amplifier in the receiver multicoupler as well as the receivers themselves from overloading due to strong transmitter carriers. In so doing, the filter will aid in the suppression of receiver-generated intermodulation products. Figure 5 shows the proper location of the required preselector in the system.

Interference & Intermodulation Considerations

The location of the receiving antenna in relation to any transmitting antennas plays an important role in determining the amount of selectivity necessary in a 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. As isolation of transmitting and receiving antennas increases, the size and cost of the preselector required decreases.

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. No amount of receiving-system filtering can correct this problem. 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 5 shows a Polyphaser impulse suppressor installed in the receiving antenna line. 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 a compact receiver multicoupler. The multicoupler provides the desired low-noise front end. The multicoupler 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

Operation with unterminated and unused RF output ports is possible but a slight increase in interference susceptibility may result. It will not damage the multicoupler to operate it without a 50 ohm termination on each unused RF output port, and you may be able to get by doing so. However, we recommend termination of the unused ports for three reasons:

1) In order for all power divider ports to have equal signal levels, all ports need to be terminated in 50 ohms.

2) We specify an output port–to–output port isolation value of -20 dB minimum. This isolation helps prevent a type of interference caused by Local Oscillator (LO) leakage from one receiver to another via the multicoupler, which can cause a receiver to have undesired responses to the wrong channel. Port-to-port isolation can drop to rather low levels if there are unterminated ports.

3) Any unterminated port can act as a small antenna, causing unwanted signals to be coupled into the receiving system, which results in interference. This is a distinct possibility in a high-density RF environment.

For uncompromising performance, terminate all unused ports with 50 Ohms. When this is done, receivers may be connected to any output, in any order, with no change in performance. Laboratory quality loads are not necessary; any load with a 20 dB (1.3 : 1 VSWR) or greater return loss will work. Bird Technologies has an inexpensive 50 Ohm load available for this purpose.

Attenuator (Gain Reduction) Pads

An additional fixed attenuator pad/pads are supplied with the multicoupler and are mounted in spring-clips located on the chassis (see figure 1). Under normal circumstances, the additional attenuator pads are not needed and the multicoupler is operated at the factory set gain. However, gain reduction may be helpful in combating interference problems.

Attention: Fixed attenuator pads installed by the factory at the time of shipment should not be removed.

When used, additional pads should be installed between the output of the amplifier and the input of the power divider. Intermodulation products that may be generated in a station receiver can be dramatically reduced by small amounts of gain reduction in the gain-stage (multicoupler) 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 multicoupler is part of a system that uses a tower-mounted amplifier, pads may be installed on the input of the multicoupler amplifier, or (with an adaptor) on the multicoupler RF input connector.

SIGNAL FLOW

Referring to figure 5, 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. Signals are then applied to the required preselector and pass through to the RF input connector on the back of the unit. Once on the deck signals pass directly to the amplifier assembly and then are split to the station receivers by the power divider assemblies. The exact type and number of power dividers in the unit will vary based on the exact model number ordered from the factory.

OPTIONS

Optional assemblies may be purchased to increase the performance of the receiver multicoupler, including a multi-port expansion deck and an optional narrowband preselector filter. The expansion deck will increase the total system outputs while the optional preselector will help further limit the multicoupler bandwidth.

Receiver Multicoupler Expansion Deck

The Compact Receiver Multicoupler is easily expanded in the field to additional output ports. With the expansion deck installed additional receivers can be connected, with the system gain remaining constant for all receivers.

The receiver multicoupler expansion deck includes additional power dividers mounted on a 19-inch deck. These dividers are designed to be connected to the unused outputs of the receiver multicoupler's initial power divider. Cables are provided for connecting the expansion deck to the receiver multicoupler. It is recommended that the receiver multicoupler expansion deck be mounted in the same rack and below the Compact Receiver Multicoupler and required preselector.

Narrowband Optional Preselector Filter

This option is designed to be added to the RF signal path just after the output of the amplifier. The

additional filter will provide a narrower pass window for the system.

TROUBLESHOOTING AND REPAIR

Most receiver multicoupler failures are due to lightning damage or excessively high RF signal input levels. Troubleshooting includes (1) verifying that the power supply is outputting the proper DC voltage and (2) measuring amplifier gain. A damaged power supply assembly is simply replaced. A damaged amplifier may be returned to the factory for repair or replacement.

Celsius to Fahrenheit Conversion Table

CELCIUS	FAHRENHEIT
105	221.0
104	219.2
103	217.4
102	215.6
101	213.8
100	212.0
99	210.2
98	208.4
97	206.6
96	204.8
95	203.0
94	201.2
93	199.4
92	197.6
91	195.8
90	194.0
89	192.2
88	190.4
87	188.6
86	186.8
85	185.0
84	183.2
83	181.4
82	179.6
81	177.8
80	176.0
79	174.2
78	172.4
77	170.6
76	168.8
75	167.0
74	165.2
73	163.4
72	161.6
71	159.8
70	158.0
69	156.2
68	154.4
67	152.6

CELCIUS	FAHRENHEIT
66	150.8
65	149.0
64	147.2
63	145.4
62	143.6
61	141.8
60	140.0
59	138.2
58	136.4
57	134.6
56	132.8
55	131.0
54	129.2
53	127.4
52	125.6
51	123.8
50	122.0
49	120.2
48	118.4
47	116.6
46	114.8
45	113.0
44	111.2
43	109.4
42	107.6
41	105.8
40	104.0
39	102.2
38	100.4
37	98.6
36	96.8
35	95.0
34	93.2
33	91.4
32	89.6
31	87.8
30	86.0
29	84.2
28	82.4

CELCIUS	FAHRENHEIT
27	80.6
26	78.8
25	77.0
24	75.2
23	73.4
22	71.6
21	69.8
20	68.0
19	66.2
18	64.4
17	62.6
16	60.8
15	59.0
14	57.2
13	55.4
12	53.6
11	51.8
10	50.0
9	48.2
8	46.4
7	44.6
6	42.8
5	41.0
4	39.2
3	37.4
2	35.6
1	33.8
0	**32.0**
-1	30.2
-2	28.4
-3	26.6
-4	24.8
-5	23.0
-6	21.2
-7	19.4
-8	17.6
-9	15.8
-10	14.0
-11	12.2

CELCIUS	FAHRENHEIT
-12	10.4
-13	8.6
-14	6.8
-15	5.0
-16	3.2
-17	1.4
-18	-0.4
-19	-2.2
-20	-4.0
-21	-5.8
-22	-7.6
-23	-9.4
-24	-11.2
-25	-13.0
-26	-14.8
-27	-16.6
-28	-18.4
-29	-20.2
-30	-22.0
-31	-23.8
-32	-25.6
-33	-27.4
-34	-29.2
-35	-31.0
-36	-32.8
-37	-34.6
-38	-36.4
-39	-38.2
-40	-40.0
-41	-41.8
-42	-43.6
-43	-45.4
-44	-47.2
-45	-49.0
-46	-50.8
-47	-52.6
-48	-54.4
-49	-56.2
-50	-58.0

Return Loss vs. VSWR

Return Loss	VSWR
30	1.06
25	1.11
20	1.20
19	1.25
18	1.28
17	1.33
16	1.37
15	1.43
14	1.50
13	1.57
12	1.67
11	1.78
10	1.92
9	2.10

Watts to dBm

Watts	dBm
300	54.8
250	54.0
200	53.0
150	51.8
100	50.0
75	48.8
50	47.0
25	44.0
20	43.0
15	41.8
10	40.0
5	37.0
4	36.0
3	34.8
2	33.0
1	30.0

dBm = 10log P/1mW
Where P = power (Watt)

Insertion Loss

Input Power (Watts)

Insertion Loss	50	75	100	125	150	200	250	300
3	25	38	50	63	75	100	125	150
2.5	28	42	56	70	84	112	141	169
2	32	47	63	79	95	126	158	189
1.5	35	53	71	88	106	142	177	212
1	40	60	79	99	119	159	199	238
.5	45	67	89	111	134	178	223	267

Output Power (Watts)

Free Space Loss

Distance (miles)

Frequency (MHz)	.25	.50	.75	1	2	5	10	15
150	68	74	78	80	86	94	100	104
220	71	77	81	83	89	97	103	107
460	78	84	87	90	96	104	110	113
860	83	89	93	95	101	109	115	119
940	84	90	94	96	102	110	116	120
1920	90	96	100	102	108	116	122	126

Free Space Loss (dB)
Free space loss = 36.6 + 20log D + 20log F
Where D = distance in miles and F = frequency in MHz

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