



**Installation and Operation Manual for
Short Haul Control Station Combiner
Model Number 43-05-01A Series**

**Manual Part Number
7-9504**



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This warranty applies for five years from shipping date.

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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	09/15/10
2	02/21/12
3	04/17/13
4	09/24/13
5	11/27/13

Symbols Commonly Used



WARNING !!!



High Voltage



CAUTION or ATTENTION



Hot Surface



Important Information



ESD Electrostatic Discharge



Training Video Available



Electrical 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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Table of Contents

General Description	1
Expansion Kits	3
Multiband Coupler.....	3
Unpacking.....	3
Installation	3
Operation	4
Maintenance	4

Figures and Tables

Figure 1: Rear View of the 8 Channel Model	2
Figure 2: 2-Way External Splitter/Combiner.....	2
Figure 3: Functional Block Diagram	3
Figure 4: 4 Channel Interconnect / Layout Drawing.....	4
Figure 5: 8 Channel Interconnect / Layout Drawing.....	4
Figure 6: 12 Channel Interconnect / Layout Drawing.....	5
Figure 7: 16 Channel Interconnect / Layout Drawing.....	5
Figure 8: 20 Channel Interconnect / Layout Drawing.....	6
Figure 9: 24 Channel Interconnect / Layout Drawing.....	7
Figure 10: 28 Channel Interconnect / Layout Drawing.....	8
Figure 11: 32 Channel Interconnect / Layout Drawing.....	9
 Table 1: Specifications.....	1
Table 2: Available Expansion Kits.....	3

Appendixes

Appendix A: Installation Instructions for the SHCSC Expansion Kits.....	10
General Description	10
4 - 8, 12 -16, 20 - 24, 28 - 32 Channel Expansion (43-05-01A-01-KIT)	10
Kit Contents	10
Required Tools	10
Procedure	10
8 - 12 Channel Expansion (43-05-01A-03-KIT).....	12
Kit Contents	12
Required Tools	12
Procedure	12
16 - 20, 24 - 28 Channel Expansion (43-05-01A-02-KIT)	13
Kit Contents	13
Required Tools	13
Procedure	13
 Appendix B: Multiband Coupler Data Sheet.....	14 - 15



GENERAL DESCRIPTION

Bird Technologies Short Haul Control Station Combiners are used to reduce the number of antennas required within a multi-user environment. They allow multiple control station radios to operate regardless of operating band which reduces cost as well as tower loading. Control stations can be connected to the combiner without regard to frequency. The short haul control station combiners are specifically designed with higher insertion losses than regular control stations. They are designed for applications where the control stations are within close proximity to the base site.

The combiners ensure that predictable radio-to-radio isolation is maintained regardless of the individual radios transmit or receive operating mode or antenna isolation characteristic. Short haul control station combiners from Bird Technologies are frequency agile with predictable isolation, are both analog and digital compatible, and their low profile provides for space efficient installations. These combiners can significantly reduce tower clutter and loading, as well as simplify cabling installation at control center facilities.

Bird Technologies short haul control station combiners use power attenuators at their inputs along with signal combining techniques to provide fixed

Parameter	Specification							
Channels	4	8	12	16	20	24	28	32
Frequency Range (MHz)	100 - 1000							
TX or RX Insertion Loss (dB) typical	29	32.5	40	40	40	40	40	40
TX/TX or RX/RX Isolation (dB) typical	60							
Input Return Loss (dB) Min	28							
Output Return Loss (dB) Min	18							
Maximum Power Rating (Watts)	50 Watts @ 20% duty on all ports 25 Watts @ 40% duty on all ports 10 Watts @ 100% duty on all ports							
Operating Temperature (°C)	-30 to +60							
Connector 50 Ohm	N-type (F)							
Weight (lbs.)	~ 5.3	~ 11.6	~21.8	~ 27.0	~ 34.5	~ 39.6	~ 47.1	~ 52.3
Dimension W x D x H (inches)	19.0(W) x 8.50(D) x 1.72(H)	19.0(W) x 11.06(D) x 1.72(H)	19.0(W) x 11.06(D) x 6.90(H)	19.0(W) x 11.06(D) x 6.90(H)	19.0(W) x 11.06(D) x 10.34(H)	19.0(W) x 11.06(D) x 10.34(H)	19.0(W) x 11.06(D) x 13.78(H)	19.0(W) x 11.06(D) x 13.78(H)
Rack Spaces Used	1 RU	1 RU	4 RU	4 RU	6 RU	6 RU	8 RU	8 RU
Table 1: Short Haul Control Station Combiner specifications.								

isolation between the control stations. This results in a constant isolation between the control stations regardless of frequency. The use of attenuators in the combiners results in high insertion losses which protects receivers at the base site and the control stations from being overloaded by transmitters in close proximity.

Specifications for the control station combiner are listed in **Table 1**. There are multiple styles available, either 4, 8, 12, 16, 20, 24, 28, or 32 channels. All of the available models are constructed from the basic 4 channel model. The 8 thru 32 channel models use an external splitter/combiner combination in order to provide the requisite number of TX/RX ports. As an example the rear view of an 8 channel system is shown in **Figure 1**. A close up view of the 2-way external splitter/combiner used to interconnect the individual 4 channel assemblies is shown in **Figure 2**. For ease of installation the control station combiner is constructed in modular shelves. The 4 and 8 channel model requires 1 RU of shelf space, the 12 and 16 channel models require 4 RU, the 20 and 24 channel models require 6 RU, and the 28 and 32 channel models require 8 RU. Note that the 12 thru 32 channel

models must be mounted with a minimum 1 RU gap between the decks for proper air circulation and the decks must be mounted with the heat sinks facing upwards as shown in figure 1.

A functional block diagram of a Short Haul Control Station Combiner is shown in **Figure 3**. Once again the eight port system is used as an example. Also, interconnect and layout diagrams for the 4 through 32 channel models are shown in **Figure 4** through **Figure 11** respectively.



Figure 2: 2-Way external splitter/combiner.

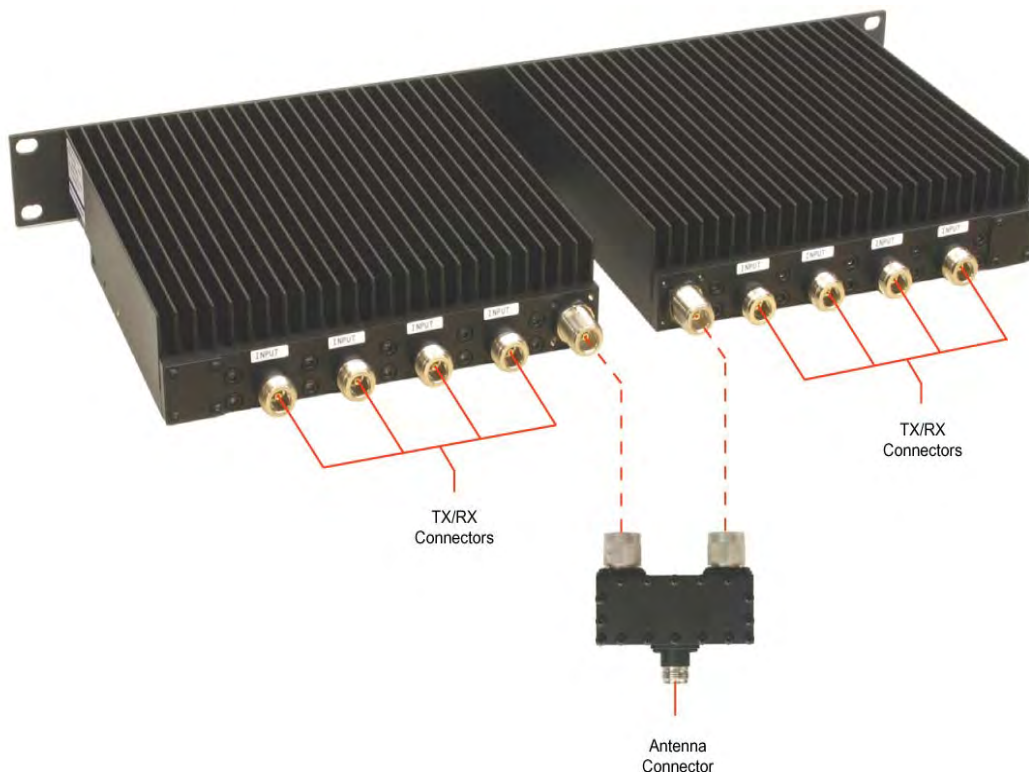


Figure 1: Rear view of the 8 channel control station combiner.

EXPANSION KITS

Bird Technologies Short Haul Control Station Combiners are easily expandable from 4 to 32 channels by the addition of expansion kits to your existing system. Three kits are available as shown in **Table 2**. Installation of the kits is straight forward and complete instructions are provided in **Appendix A**. It is important to note that when expanding from an 8 to a 12 channel system two additional rack spaces will be required in order to accommodate the addition of a 4-Way splitter/combiner to the system.

From / To Channels	Kit Part Number
4 to 8, 12 to 16, 20 to 24, 28 to 32	43-05-01A-01-KIT
8 to 12	43-05-01A-03-KIT
16 to 20, 24 to 28	43-05-01A-02-KIT

Table 2: Available expansion kits.

MULTIBAND COUPLER

Bird Technologies also offers a versatile Multiband Coupler (part# 80-05-14) which allows multiband operation of tower transmission lines. The use of the coupler allows a reduction in the number of transmission lines required in the system and also helps reduce rigging costs. In addition, the coupler provides a means of connecting multiple antennas to the control station combiner. Specifications for the Multiband Coupler are listed in **Appendix B**.

UNPACKING

After factory final-testing your Control Station Combiner is packaged then shipped motor freight or UPS. It is important to report any visible damage to the carrier immediately. It is the customer's responsibility to file damage claims with the carrier within a short period of time after delivery (1 to 5 days). Factory final-test results are packaged with the unit and should be retained by the customer for future reference.

INSTALLATION

The system is designed to be mounted in a standard EIA 19" rack. After the decks are installed they should be interconnected as needed as shown in figures 4 through 11. The required inter-

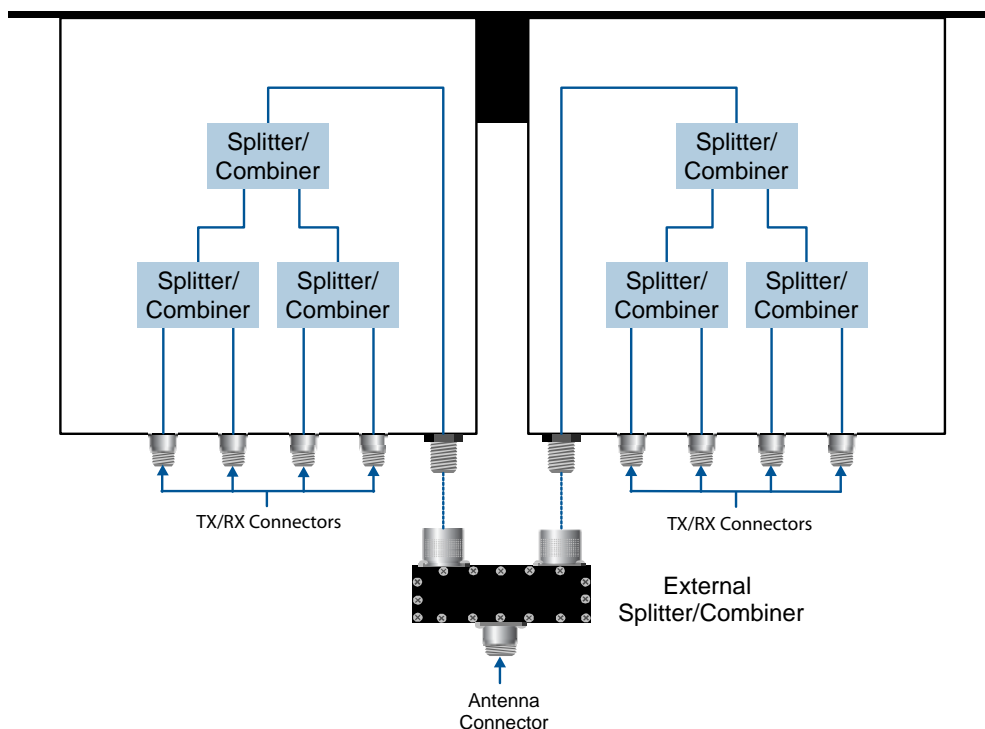


Figure 3: Functional block diagram. Eight channel system shown as an example.

connect cables, screws, loads, and attenuators are included in the shipment.

The system should be securely installed in a dry vibration free environment. Avoid areas of high heat or direct sunlight. All cable connections are N style (female). All cable connections to the combiner should be made with double-shielded or semi-rigid heliax cable. High quality N style connectors that use either silver or gold plated contacts should be used. It is also important to observe the power handling ratings of any cables in transmit systems. Connect the control stations and antenna to the combiner making sure to connect the correct equipment to the correct port. Labels are affixed next to each port to help you make the right connections.

It is not necessary to load unused input ports of the control station combiner because of the high port to port isolation. However, it's commonly considered "good practice" to terminate any unused port, if you do decide to terminate the unused input ports with a 50 Ohm load we recommend Bird Technologies part# 83-01-01 or an equivalent 1/4 Watt minimum N-type male termination.



Caution: Do not make or break connections to or from the combiner with transmit power applied. Ensure the control stations are turned OFF before you touch the cables.

OPERATION

After connecting the control stations and antenna the system is ready for operation. The combiner is a passive device requiring no external power source.

MAINTENANCE

No special maintenance is required for the combiner. This is a passive device of rugged mechanical and electrical design. Check for loose or corroded connectors on the interconnect cables whenever an inspection is performed on other station equipment. Remove any dust or debris from between the heat sink fins and insure adequate air flow around the unit.

Because the combiner is a passive, and non-tunable device, field repairs are not required. Field repair is limited to the replacement or repair of damaged cables. Failure of the unit is usually due to excessive transmit power levels or lightning damage. Damaged units should be returned to the factory for repair.

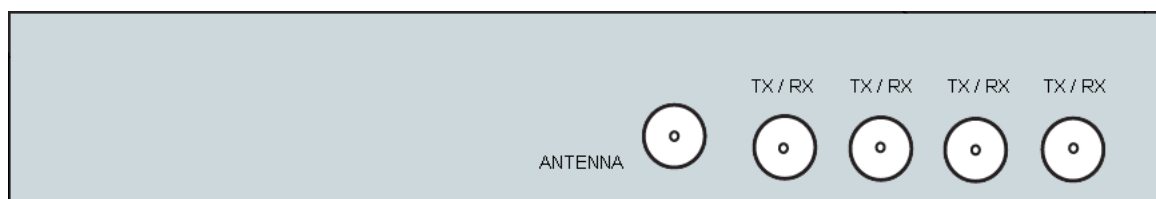


Figure 4: Interconnect/ layout of the 4 channel model.

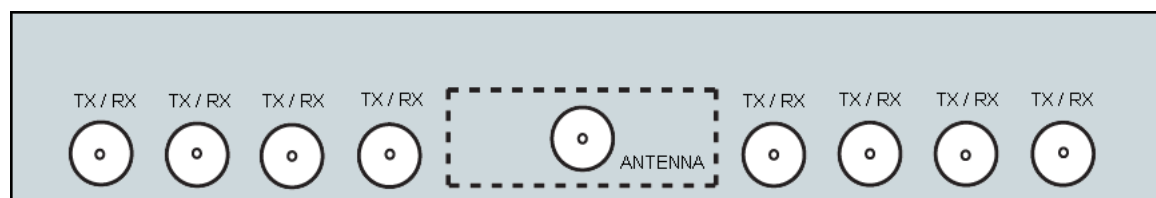


Figure 5: Interconnect/ layout of the 8 channel model.

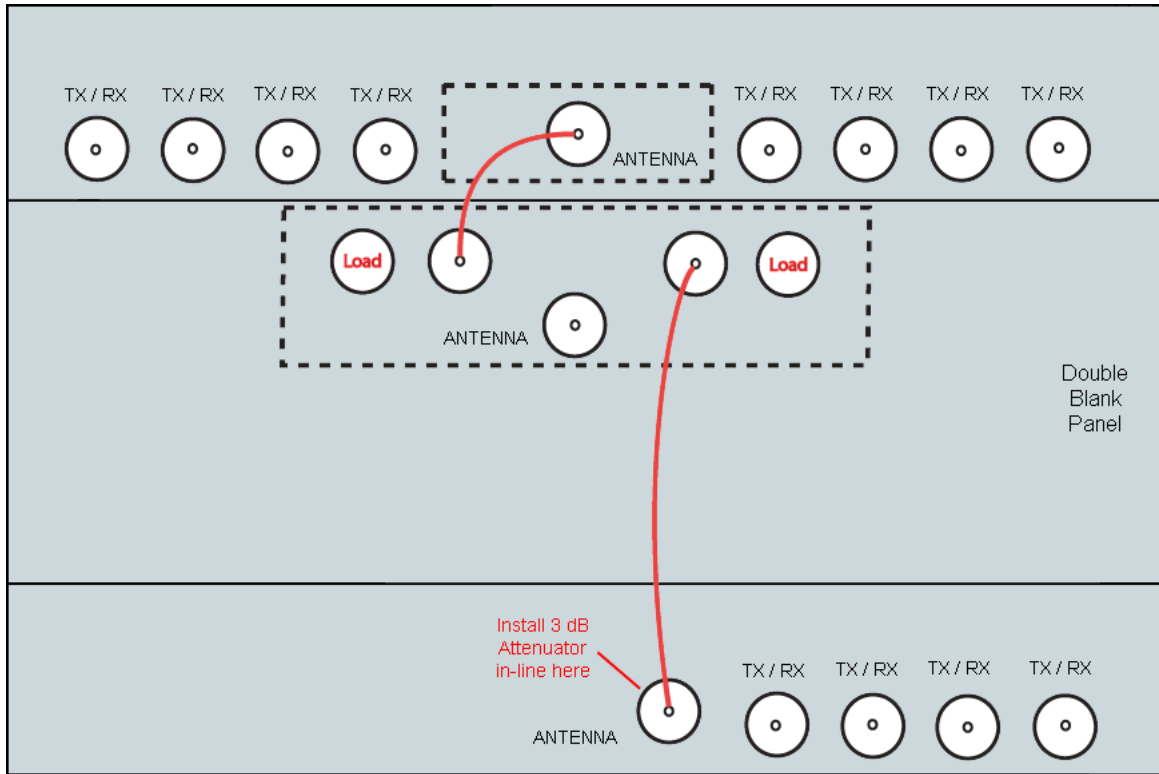


Figure 6: Interconnect/ layout of the 12 channel model.

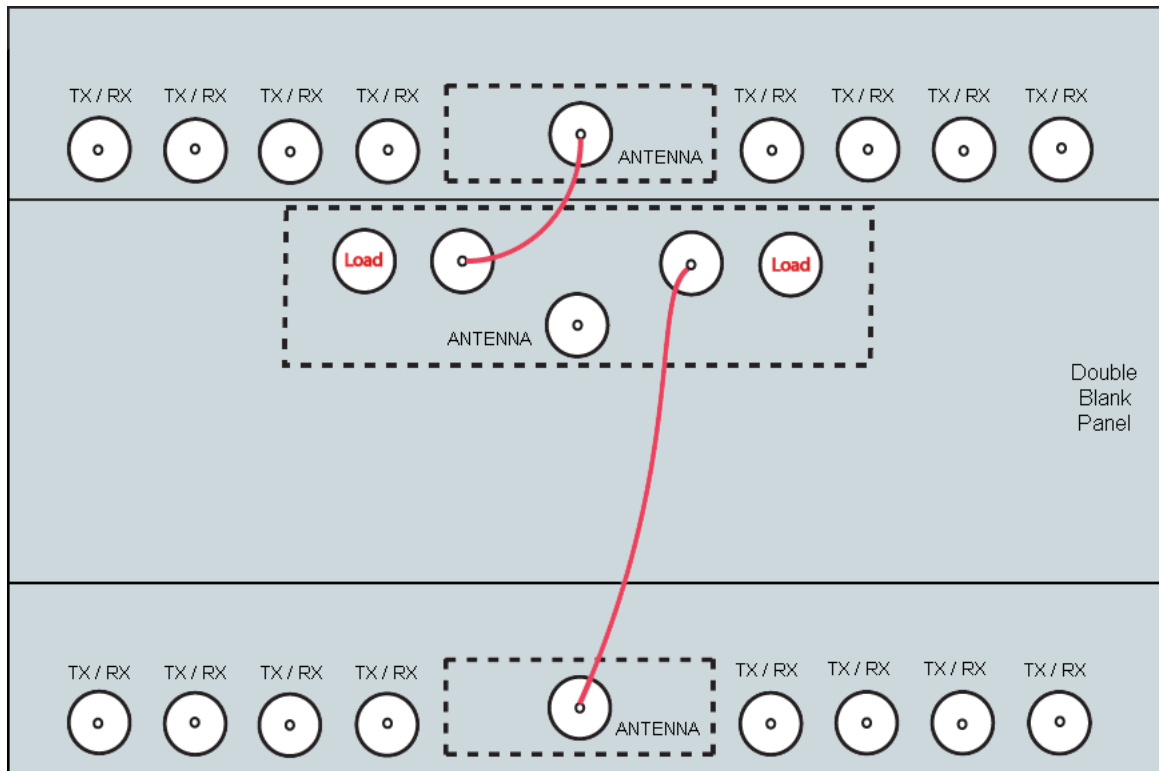


Figure 7: Interconnect/ layout of the 16 channel model.

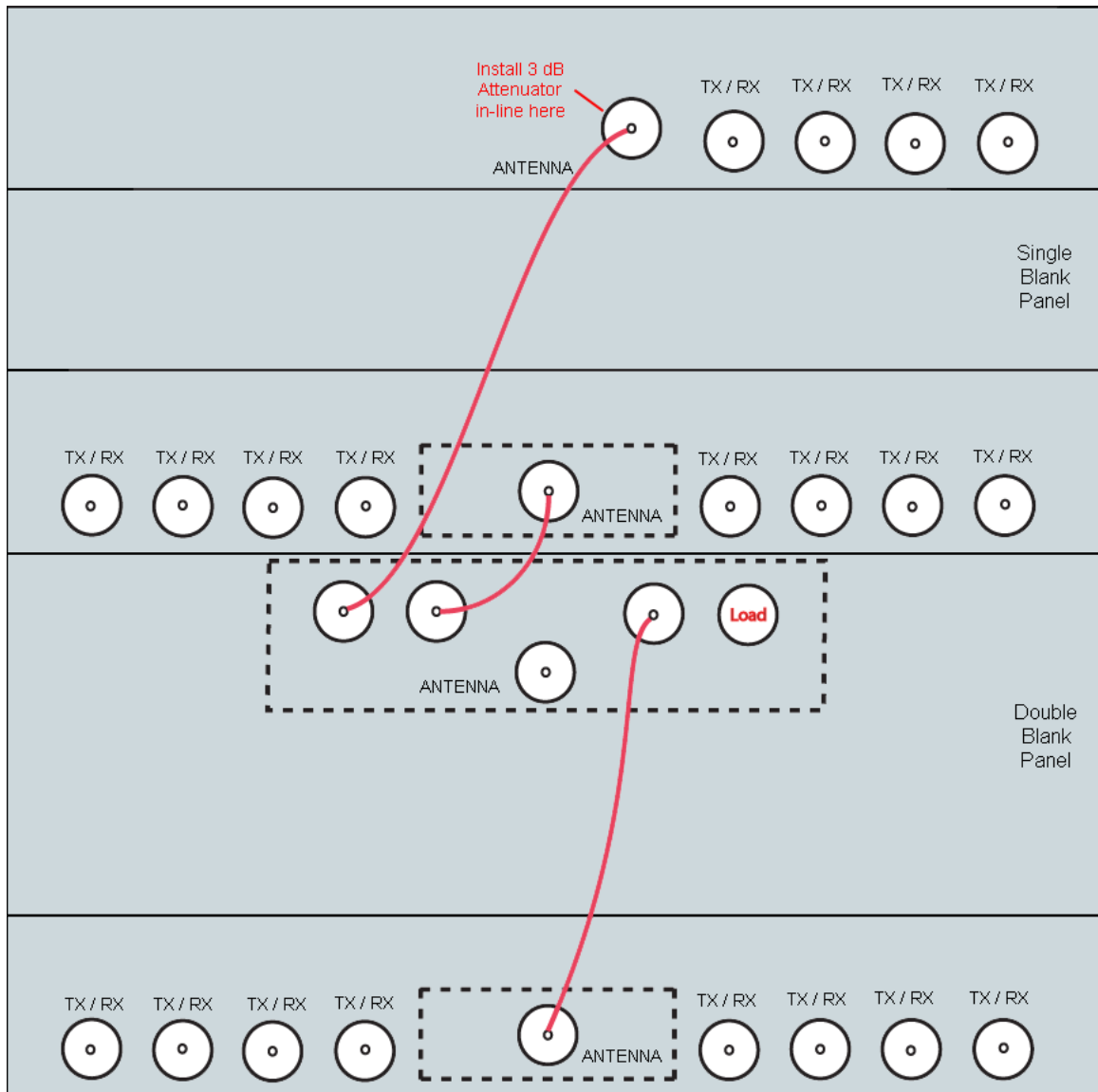


Figure 8: Interconnect/ layout of the 20 channel model.

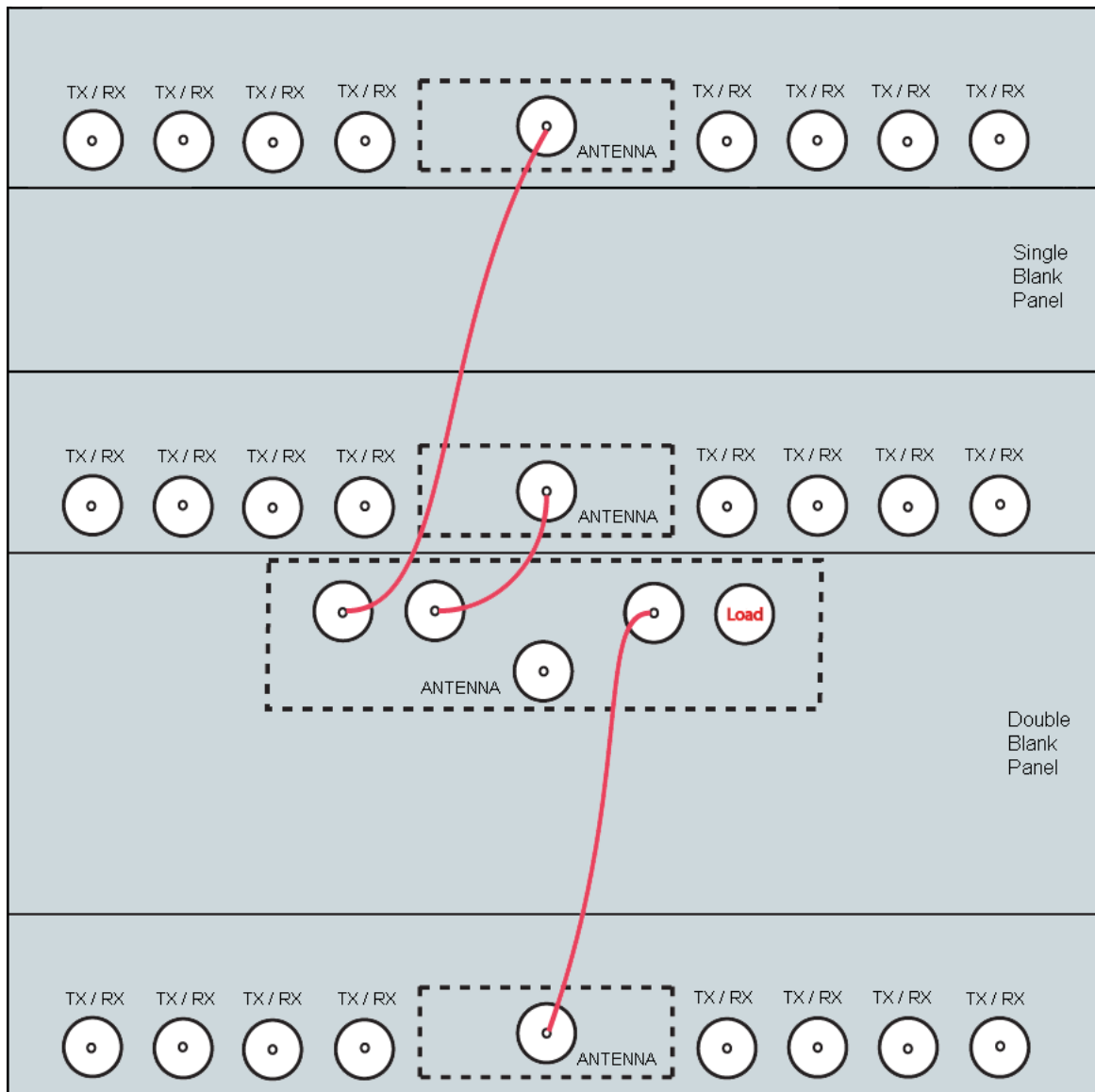


Figure 9: Interconnect/ layout of the 24 channel model.

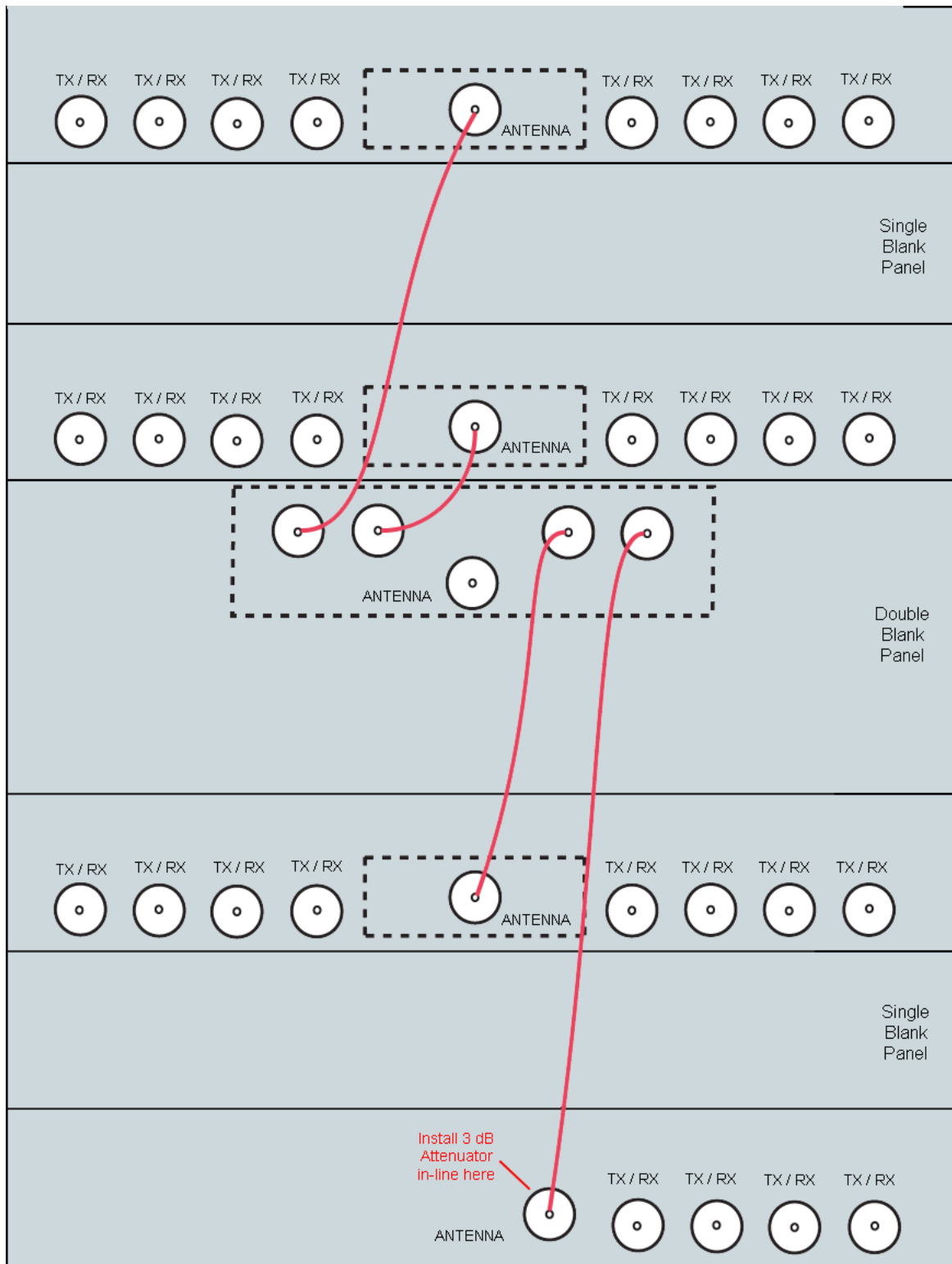


Figure 10: Interconnect/ layout of the 28 channel model.

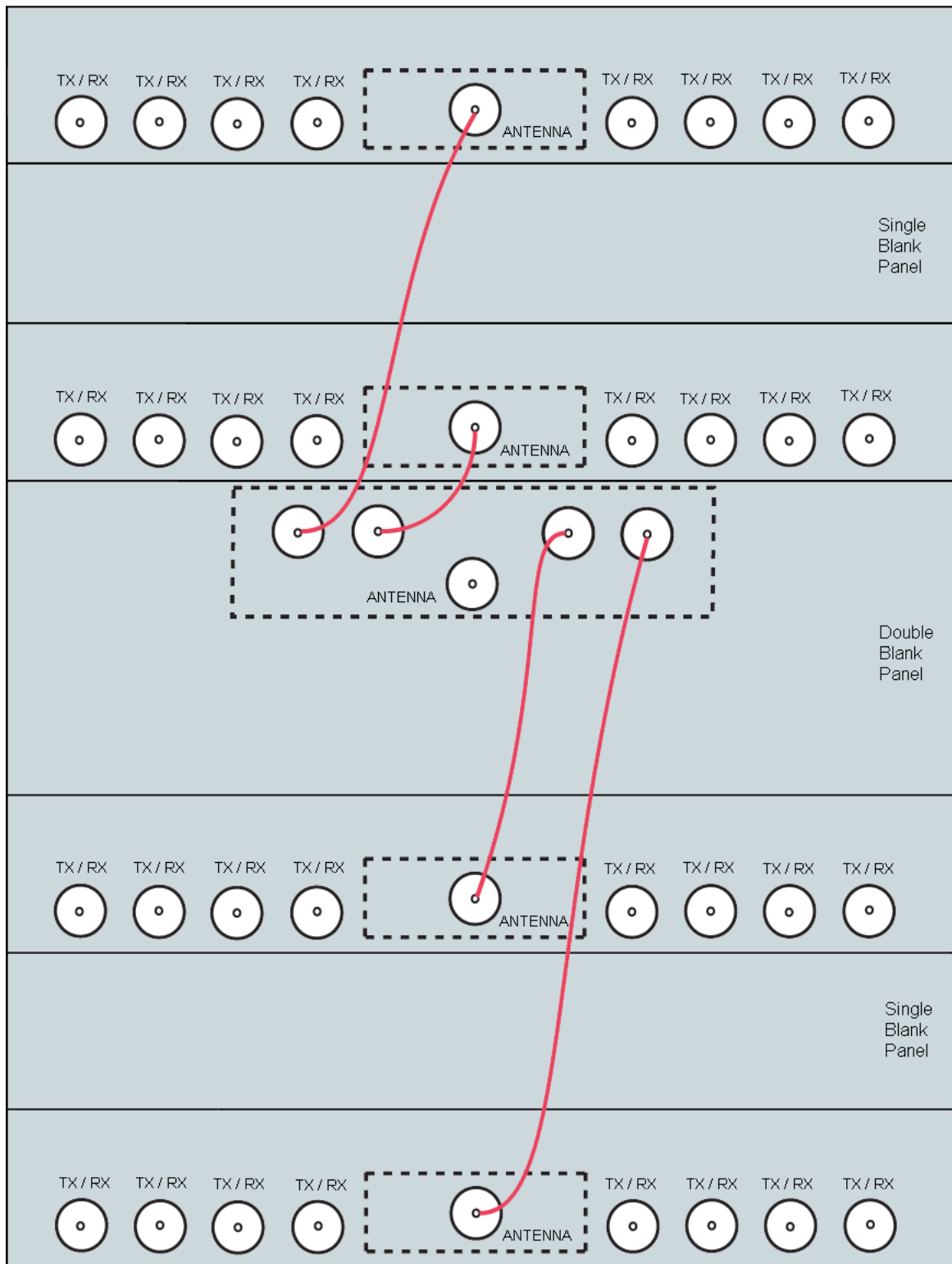


Figure 11: Interconnect/ layout of the 32 channel model.

Appendix A

Installation Instructions for the SHCSC Expansion Kits Models 43-05-01A-01/02/03-KIT

GENERAL DESCRIPTION

These instructions detail in a step-by-step fashion the process for adding an expansion kit to your existing short haul control station combiner. The expansion kits allow an increase in the number of channels available at the control station combiner. Three kits are available as shown in table 2. The kits are designed to increase the size of the control station combiner by 4 channels per kit.

4 - 8, 12 - 16, 20 - 24, 28 - 32

CHANNEL EXPANSION (43-05-01A-01-KIT)

This kit is used to expand systems that have an expandable deck. An expandable deck is one that has only 4 channels out of 8 possible channels. This is the easiest expansion kit to install requiring the addition of a 4 channel combiner assembly and a 2-way splitter/combiner. **Figure A1** shows the basic interconnect diagram for this expansion kit. The 12 - 16, 20 - 24, and 28 - 32 expansions are exactly the same.

Kit Contents

- (1) 3-23621-1 4 Channel Combiner Assembly
- (1) 3-25012 2-Way External Splitter/Combiner
- (4) 8-6198 8-32 x 1/2" Screw

Required Tools

- Cable Pliers
- #2 Phillips Screwdriver
- 1/8" Allen Wrench
- 9/64" Allen Wrench

Procedure

Installation should be performed by a qualified technician familiar with the communications system. Follow the procedure listed below in a step-by-step fashion.

- 1) In the case of the 12 to 16, 20 to 24, and 28 to 32 channel expansions disconnect the existing

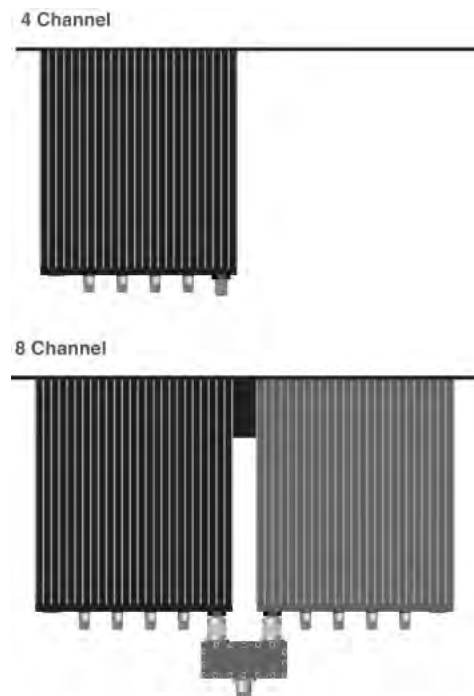


Figure A1: Interconnect diagram for the 4 to 8 channel expansion kit.

cable that is connected to the output of the 4 channel combiner assembly on the expandable deck. Discard the in-line 3 dB attenuator as it will not be used in the expanded system layout.

- 2) Disconnect the stabilizer bracket from the bottom of the existing 4 Channel Combiner assembly. This bracket is held in place with four (4) screws. Refer to **Figure A2**.
- 3) Disconnect the three (3) hex screws and nuts from the unused front panel mounting holes. Discard the nuts as they will not be reused.

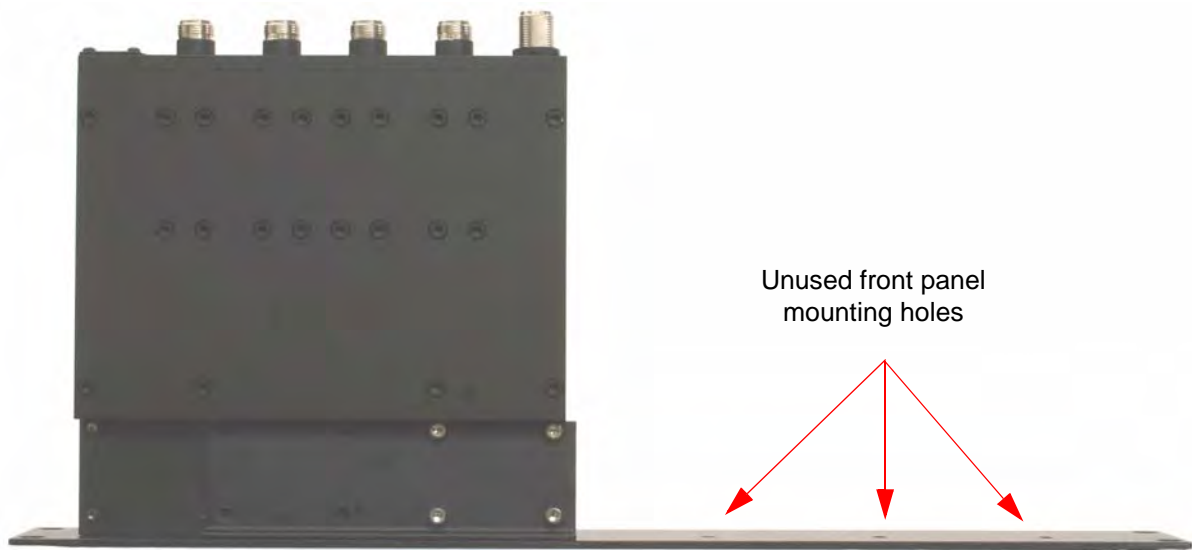


Figure A2: Stabilizer bracket attached to a single 4 Channel Control Station.

- 4) Mount the new additional 4 channel combiner assembly to the front panel using the three hex screws removed in step 2.
- 5) Re-attach the bracket stabilizer plate beneath both 4 channel combiner assemblies as shown in **Figure A3**. The stabilizer bracket will now provide support for both assemblies. Use the four additional 8-32 x 1/2" SS screws provided in the kit.
- 6) Connect the supplied 2-way external splitter/combiner to the output port of both 4 channel combiner assemblies as shown in figure A1.

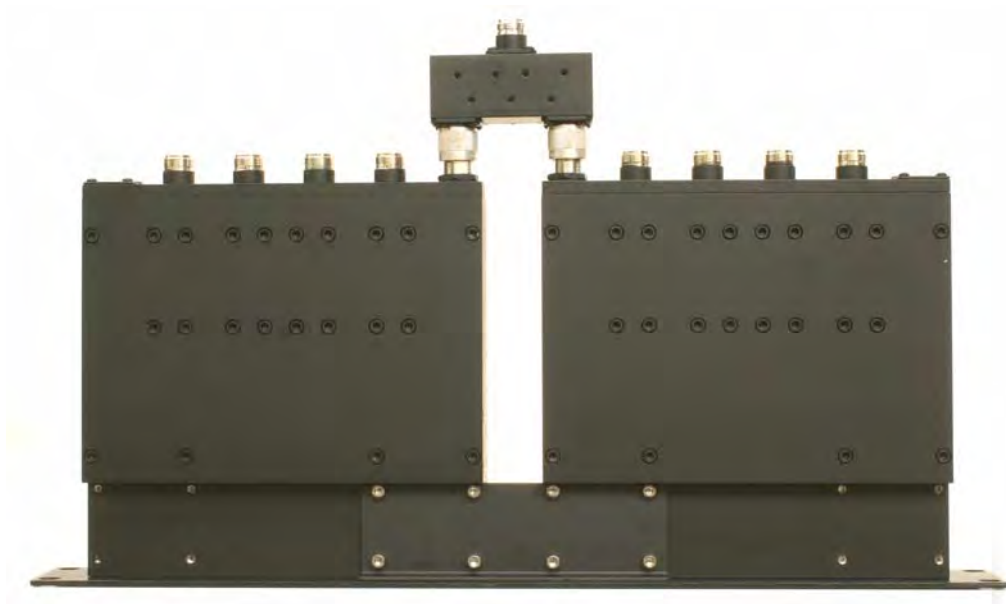


Figure A3: Stabilizer bracket attached to a pair of 4-Way Control Stations.

- 7) In the case of a 4 to 8 channel expansion this completes the installation of the expansion kit. In the case of the 12 to 16, 20 to 24, and 28 to 32 channel expansion the expanded deck must also be connected to the 4-way splitter/combiner. Reuse the cable that was disconnected in step 1. Do not re-install the in-line attenuator.

8 - 12

CHANNEL EXPANSION (43-05-01A-03-KIT)

It is important to note that when expanding from an 8 to 12 channel system three additional rack spaces will be required. This is to accommodate the addition of a 4-way splitter/combiner and an additional 4 channel combiner assembly to the system.

Kit Contents

- (1) 3-23632 4 Channel Combiner Assembly
- (1) 3-0452 Cable, RG-142, 12", N-M, N-M
- (1) 5-A-MFN-03 3 dB Attenuator
- (1) 1-6445 Panel, Double Spaced
- (1) 3-24897 4-way Splitter/Combiner
- (2) 3-2299 Load, 50 Ohm
- (2) 8-6065 Screw, 8-32 x 3/4 SS PHMS

Required Tools

- Cable Pliers
- #2 Phillips Screwdriver

- 1/8" Allen Wrench
- 9/64" Allen Wrench

Procedure

Installation should be performed by a qualified technician familiar with the communications system. Follow the procedure listed below in a step-by-step fashion.

- 1) Remove the existing 8 channel deck from the rack.



Figure A4: 4-way Splitter/Combiner.

Remove existing screw and replace with new longer screw when mounting 4-way to bottom of 8 channel deck.

Remove existing screw and replace with new longer screw when mounting 4-way to bottom of 8 channel deck.

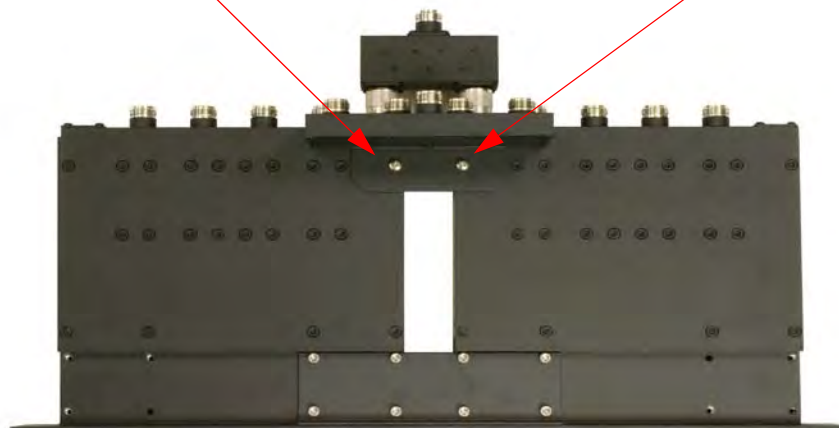


Figure A5: Installing the 4-way Splitter/Combiner.

- 2) Install the 4-way splitter/combiner (see **Figure A4**) to the bottom of the 8 channel deck by removing two screws one from each 4 channel assembly as shown in **Figure A5**). Install the 4-way as shown in figure A5 using two longer screws (8-32 x 3/4") supplied with the kit.
- 3) Re-install the existing 8 channel deck.
- 4) Install the double wide blank panel to the rack below the position of the 8 channel deck.
- 5) Install the new 4 channel deck below the position of the double wide blank panel.
- 6) Install the in-line 3 dB Attenuator to the output of the 4 channel deck.
- 7) Connect a cable from the in-line attenuator to one of the inputs on the 4-way splitter/combiner.
- 8) Connect a cable from the output of the 8 channel deck to one of the inputs on the 4-way splitter/combiner.
- 9) Attach 50 Ohm loads to the unused inputs on the 4-way splitter/combiner.

This completes the installation of the expansion kit.

16 - 20, 24 - 28

CHANNEL EXPANSION (43-05-01A-02-KIT)

This kit is used to expand systems that require the addition of an expandable deck. An expandable deck is one that has only 4 channels out of 8 possible channels. When expanding from a 16 to 20 or 24 to 28 channel system two additional rack spaces will be required. This is to accommodate the addition of an expandable deck and a single wide blank panel for air circulation.

Kit Contents

- (1) 3-23632 4 Channel Combiner Assembly
- (1) 3-0452 Cable, RG-142, 12", N-M, N-M
- (1) 5-A-MFN-03 3 dB Attenuator
- (1) 1-1647 Panel, Single Spaced

Required Tools

Cable Pliers
#2 Phillips Screwdriver

Procedure

Installation should be performed by a qualified technician familiar with the communications sys-

tem. Follow the procedure listed below in a step-by-step fashion.

- 1) Install a single spaced blank panel on the rack. In the case of the 16 to 20 channel expansion install the blank panel above the existing decks and in the case of the 24 to 28 channel expansion install it below the existing decks. Note that the interconnect cables from the decks to the 4-way are fixed in length so it is important to space out the decks such that the interconnect cables will reach.
- 2) Next install the new expandable 4 channel deck to the rack. For the 16 to 20 channel expansion install above the blank panel and for the 24 to 28 channel expansion install below the blank panel.
- 3) Install the in-line 3 dB Attenuator to the output of the expandable 4 channel deck.
- 4) Remove a 50 Ohm termination load from the 4-way splitter/combiner freeing up an input port. Connect a cable from the in-line attenuator on the 4 channel deck to the open input on the 4-way splitter/combiner.

This completes the installation of the expansion kit.

Appendix B



TX RX Systems

Multiband Coupler

80-05-14

TX RX System brand Multiband Coupler allows multiband operation of tower transmission lines.

PROBLEMS ► SOLUTIONS

Many bands on site with frequencies from VHF to 1.3 GHz

- Multiband coupler allows operation in multiple bands which reduces cost and tower loading.

Cost Savings

- Reduces number of transmission lines, reduces rigging costs, reduces possible rooftop loading on small rooftop structures and the amount of space used in cable risers and buildings.

Requires isolation between bands

- Coupler guarantees out of band isolation

Limited Installation time

- Only one component to install especially if work needs to be done after hours

APPLICATIONS

Sites where operation must occur from VHF to 1.3 GHz where a reduction of tower transmission lines is desirable

A solution to providing multiple antennas for the Multiband Control Station Combiner



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 = $10\log P/1\text{mW}$
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 = $36.6 + 20\log D + 20\log F$
Where D = distance in miles and F = frequency in MHz

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

