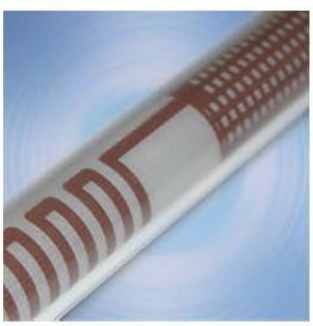
User’s Manual

CONTROL STATION COMBINER
Broad Band Short Haul
40-960MHz

Document Number: INS40976-1



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Company Overview

RFI has been serving the needs of the wireless communications market for over 30 years. First founded in 1979 as a manufacturer of antenna systems, RFI has grown to be a key player in the development, manufacturing and distribution of wireless technology and energy products.

Today RFI is Australia's leading privately owned communications equipment vendor with a highly skilled workforce in excess of 200 employees internationally.

The cornerstones of the success of the company over such a sustained period of time are two fundamental business objectives:

"Retain our existing customers and attract new customers with superior service offered with trust, respect, creativity, integrity and a clear conscience"

"Provide a strong and supportive employment environment whilst remaining environmentally sensitive in all aspects of our business"

These underpinning objectives have driven a company wide team culture of loyalty and respect among not only our staff but our long term customer base.

RFI operates from 5 state offices across Australia as well as offices in New Zealand, the UK, and North America delivering specialist RF communications services to the following sectors;

- Public Safety
- Land Mobile Radio
- Cellular Infrastructure
- Mining and Industrial

RFI's capabilities include the design and manufacture of both active and passive communications equipment, distribution of in excess of 6000 product lines and the design and installation of both solar photovoltaic electricity generation systems and in-building communications systems for both industry and government.

With the continued dynamic leadership, investment in our people and drive to be the best in out chosen fields, RFI will remain at the forefront of this continually evolving and fast paced industry.

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Disclaimer

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

Table of Contents

Tables and Figures

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General Description

RFI's range of **B**road **B**and **S**hort **H**aul **C**ontrol **S**tation **C**ombiners accommodate shared Tx output / Rx input (T/R) ports from control station radios and combine them into a single antenna port without the need to provide additional Tx to Rx antenna isolation.

Available in building block units of 4-Way and 8-Way expandable up to 32-Way, the frequency range from 40 up to 960MHz provides the user truly broad band frequency agile capability.

Analog and digital compatibility with fixed Tx to Rx isolation effectively allowing multiple control station radios in different bands, frequencies and modulation types to be connected to the same BB SH CSC.

The Broad Band Short Haul CSC ensures predictable radio-to-radio isolation regardless of the individual radios TX or RX operating mode.

The input power handling capability of the 4 or 8-Way optional building block units is 50Watts conditioned by the number of channels and respective duty cycles. Refer to input power de-rating Tables 2 & 3.

The higher insertion loss characteristic along with the high Tx to Rx fixed isolation of these Broad Band Short Haul CSC's limits their application to control station sites located typically less than 5km from either the BTS or repeater.

Specifications

	CS0496-xx05-31				
Model	CS0496-0405-31	CS0496-0805-31	CS0496-1605-31	CS0496-2405-31	CS0496-3205-31
Channel Capacity	1-4	1-8	1-16	1-24	1-32
Frequency Range	40-960MHz				
Insertion Loss T/R to Antenna Port – Typ.	27.5dB +/- 1.5dB	31dB +/- 1.5dB	35dB +/- 2.5dB	38.5dB +/- 2.5dB	38.5dB +/- 2.5dB
Antenna Port to T/R Port Isolation – Typ.	27dB	30.5dB	35dB +/- 2.5dB	38.5dB +/- 2.5dB	38.5dB +/- 2.5dB
T/R Port to T/R Port Isolation	> 60dB				
T/R Port Return Loss	>20dB				
Antenna Port Return Loss	>14dB				
Input power rating per channel – Max.	50W (note1)				
Temperature range - operational	- 30° to +50° C / -22° to +122°F				
RF Termination Connectors	N (F)				
Depth dimensions mm / inch's – Approx. (excluding connectors)	103mm / 4"	216mm / 8.5"			
Rack Unit Height requirement	1RU	1RU	2RU	4RU	5RU
Weight kg / lbs. – Approx.	3kg / 6.6lbs	5.35kg / 11.66lbs	10.85kg / 23.9lbs	19.05kg / 42lbs	24.4kg / 53.7lbs
Grounding	M6 Earth Stud				

Table 1

Five different channel capacity models are available. There are four basic BB SH CSC building block decks that are used to make up the different channel model options.

The stand-alone 4-Way and an 8-Way BB SH CSC decks provide the first two model platforms.

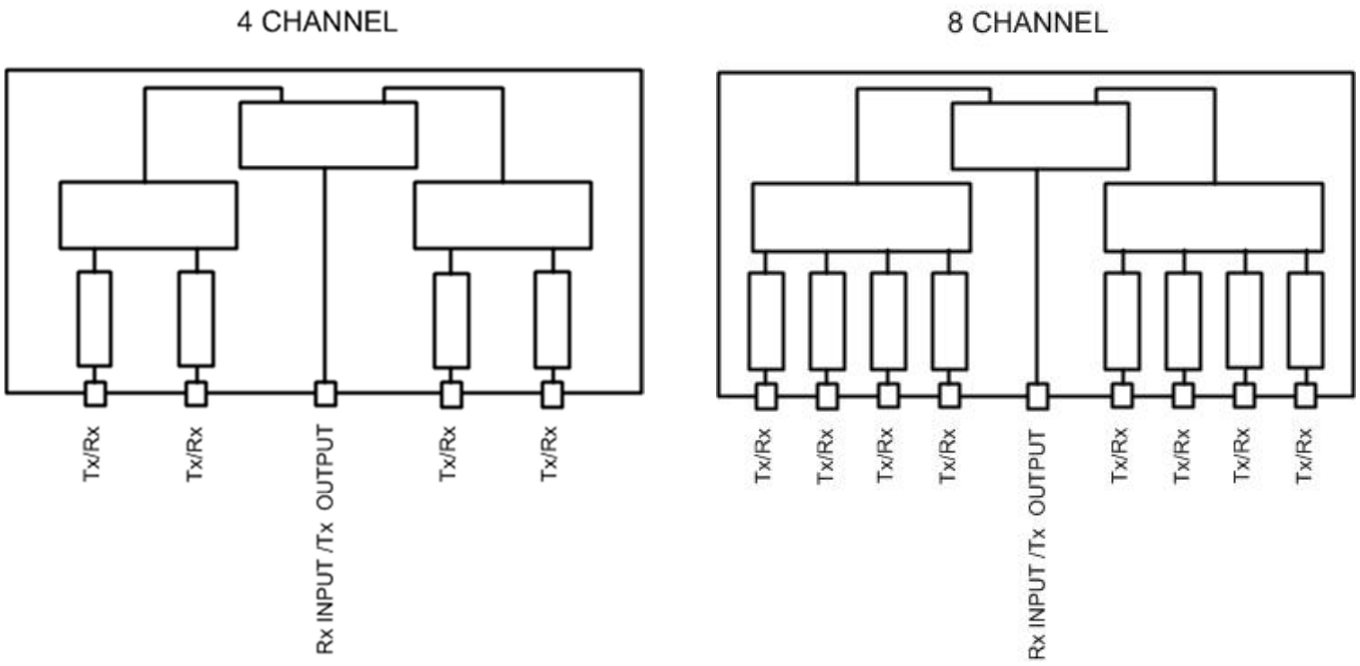


Figure 1:

Functional Block Diagram of 4 and 8-Way Broad Band Short Haul Control Station Combiners

Figure 2:

Rear view of 4-Way BB SH CSC (CS0496-0405-31).

Figure 3:

Rear view of 8-Way BB SH CSC (CS0496-0805-31).

Further to the standard 4-Way and 8-Way standard decks are the 4-Way and 8-Way BB SH CSC "EX" Expansion decks, CS0496-0405-EX and CS0496-0805-EX respectively, used as illustrated in Figures 6 & 7 illustrating the interconnection between the BB SH CSC Decks on the 16, 24 and 32-Way models.

Each modular deck requires 1RU of 19" rack height milled from an aluminum block with heat sink fins to facilitate efficient heat transfer in a robust and compact design.

Primarily used to reduce the number of antennas and manage co-location interference on a communications site, the BB SH CSC uses no active amplification in either the transmit or receive paths.

Control Station Combiners significantly reduce tower clutter and removes the need to find adequate space on an antenna mounting platform such as a tower or roof-top and hence reduce wind loading considerations, as well as greatly simplify coaxial feeder cabling installations at control center facilities.

Where antenna bandwidth limitations are to be considered, RFI recommend the use of cross-band couplers to split the frequencies into typical usable antenna bandwidths.

Standard CSC's with significantly less insertion loss are available for applications where greater distances exist between the control station and the BTS or repeater

Power Handling

4-Way BB SH Control Station Combiner

The 4-Way BB SH CSC can dissipate a total of 50Watts of power at an operating ambient temperature of 50ºC (122ºF). This could be 4 inputs of 12.5W continuous power or 4 inputs of 50W power at 25% duty cycle. Other combinations of number of inputs, power and duty cycle are shown in Table 2 and can be calculated from the formulas provided. For operation above 50ºC (122ºF) refer to the de-rating curves.

Number of Inputs (N)	Power per Input (P)	Duty Cycle (D)
2	25W	100%
2	50W	50%
3	20W	83%
3	50W	33%
4	12.5W	100%
4	25W	50%
4	50W	25%

Table 2:
CSC BB SH 4-Way operation up to an ambient temperature of 50ºC (122ºF)

Formulas for calculating operating parameters for combiner operation at an ambient temperature of 50ºC (122ºF)

D = 5000 ÷ (N x P)
P = 5000 ÷ (N x D)
N = 5000 ÷ (P x D)

Where;

D = Duty Cycle – in percentage (0 to 100)
N = Number of inputs (1 to 4)
P = Power per input – in Watts (1 to 50)

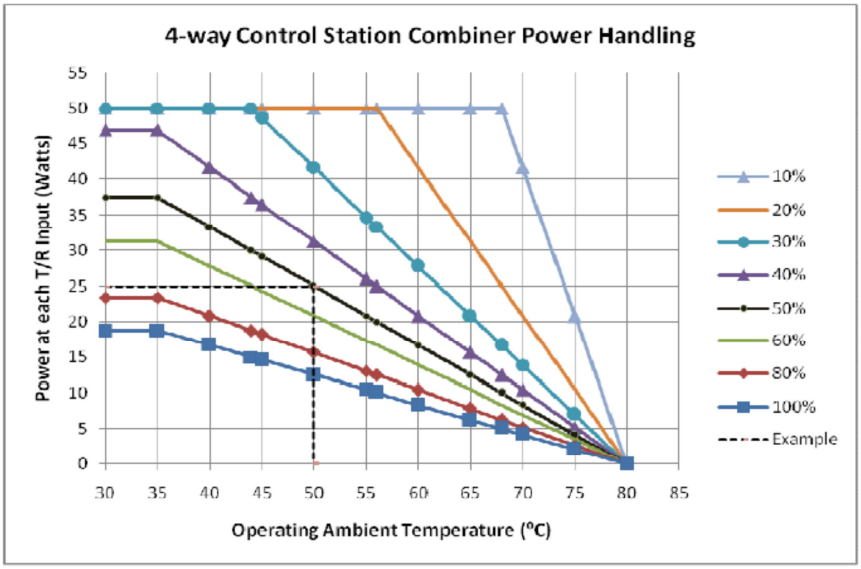


Figure 4: 4-Way power handling Vs. temperature de-rating curves

8-Way BB SH Control Station Combiner

The 8-Way BB SH CSC can dissipate a total of 80Watts of power at an operating ambient temperature of 50ºC (122ºF). This could be 8 inputs of 10W continuous power or 8 inputs of 50W power at 20% duty cycle. Other combinations of number of inputs, power and duty cycle are shown in Table 3 and can be calculated from the formulas provided. For operation above 50ºC (122ºF) refer to the de-rating curves.

Number of Inputs (N)	Power per Input (P)	Duty Cycle (D)
4	20W	100%
4	25W	80%
4	50W	40%
6	25W	53%
8	10W	100%
8	25W	40%
8	50W	20%

Table 3:
CSC BB SH 8-Way operation up to an ambient temperature of 50ºC (122ºF)

Formulas for calculating operating parameters for combiner operation at an ambient temperature of 50ºC (122ºF)

D = 8000 ÷ (N x P)
P = 8000 ÷ (N x D)
N = 8000 ÷ (P x D)

Where;

D = Duty Cycle – in percentage (0 to 100)
N = Number of inputs (1 to 8)
P = Power per input – in Watts (1 to 50)

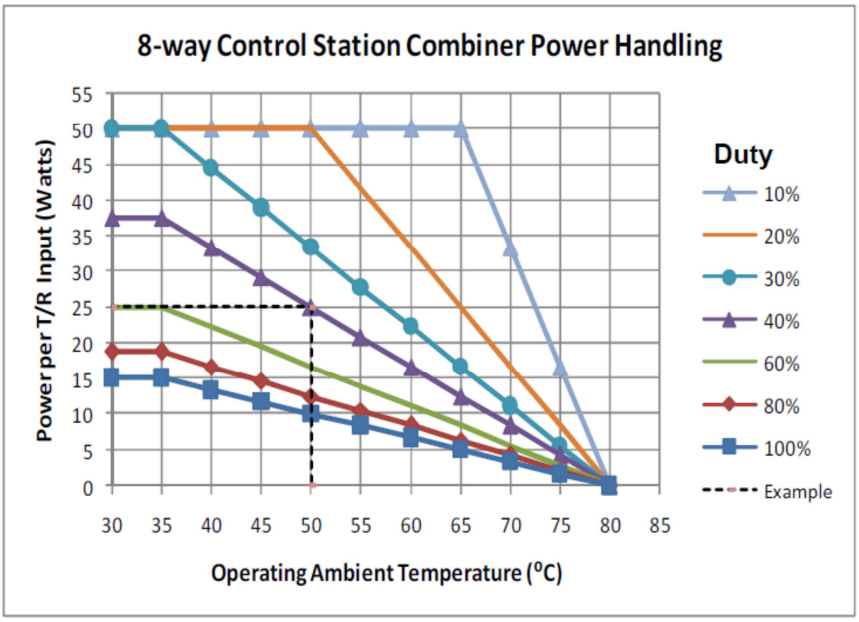


Figure 5: 8-Way power handling Vs. temperature de-rating curves

Unpacking

The Control Station Combiner is packaged and shipped after factory final-testing and QA inspection. On receipt of the product, inspect and report any visible damage to the delivery carrier immediately. It is the customer's responsibility to file damage claims with the carrier at the time of delivery or at least within a short period of time after delivery.

Factory test results are packaged with the unit and should be retained by the customer for future reference.

Installation

After fitting the respective 1RU shelf (or shelves depending on the CSC model) into the 19" rack frame or cabinet the control station radios can be connected directly to the respective T/R input ports on the BB SH CSC. We recommend the use of either a braided double shield or solid sheathed low loss 50 Ohm coaxial cable for connection to the control station radios and antenna. All the RF coaxial termination ports provided on the BB SH CSC are of the N female type and therefore N male gender connectors will be needed for the coaxial cables. For optimized performance all RF coaxial feeder cables should be kept as short as possible. All coaxial cables used to interconnect more than one shelf in multi-channel configurations are supplied with the CSC shelves.

Please refer to the connectivity illustrations in Figures 6 & 7 for inter-deck connectivity required for the 16, 24 and 32-Way CSC models.

Ensure that the antenna operational bandwidth is sufficient for the operational frequency spread of the control station radios.

Although it is not functionally important to terminate any un-used T/R ports with 50Ohm termination loads, this is considered good practice.

When making any measurements requiring disconnection of the cabling to the BB SH CSC or removal of the termination connectors to the BB SH CSC for inspection and maintenance purposes, it is important to disable the control station radios to prevent transmissions that may result in control station radio damage.

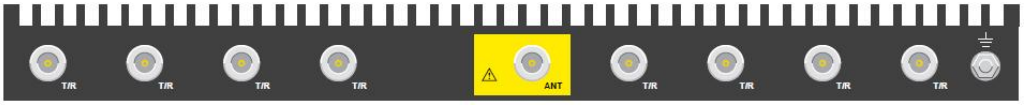
Important:

It is important to note the maximum power rating of the T/R ports and ensure that this is not exceeded at any time. The BB SH CSC is limited in its power handling capacity, requiring an understanding of the limitations in terms of duty cycle and temperature ratings. Refer to de-rating tables and curves for the respective 4 or 8-Way CSC decks.

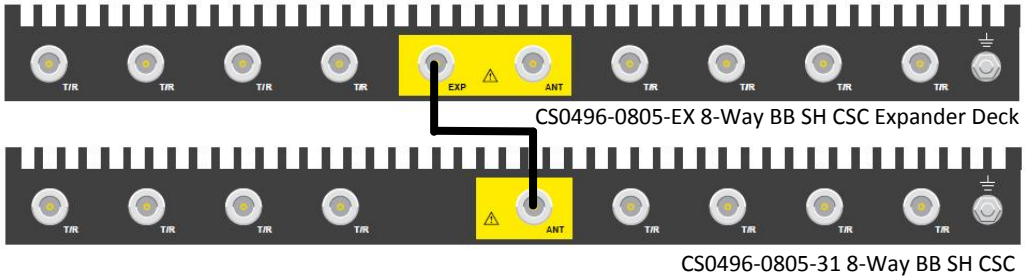
The T/R port input power rating of the 4-Way Expansion BB SH CSC is limited to 0.5W (+27dBm). The 4-Way Expansion BB SH CSC (CS0496-0405-EX) should not be connected directly to a control station radio, and is primarily used to couple any number of standard BB SH CSC units to a single antenna port as illustrated in Figures 6 & 7.

CS0496-0405-31 4-Way BB SH CSC

CS0496-0805-31 8-Way BB SH CSC



CS0496-1605-31 16-Way BB SH CSC



CS0496-2405-31 24-Way BB SH CSC

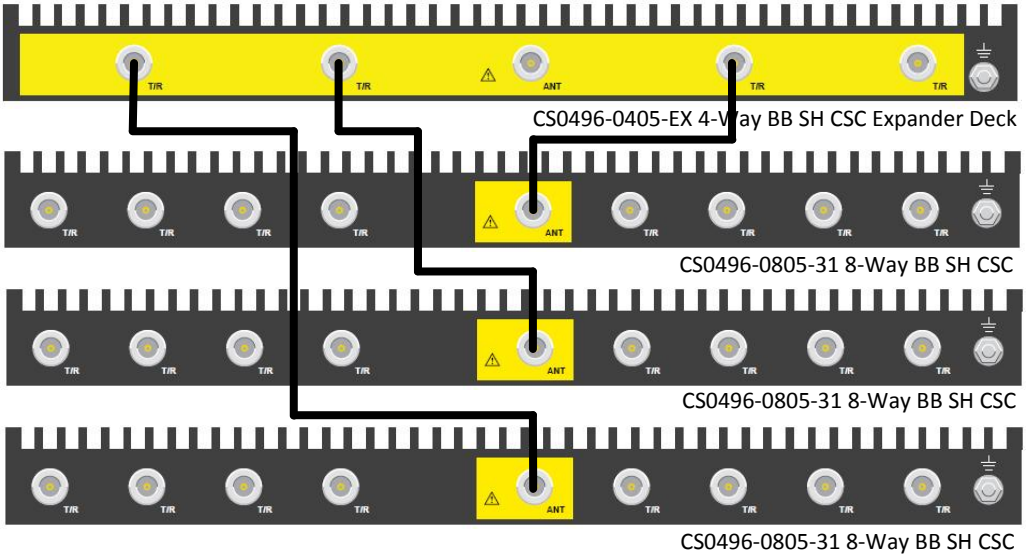


Figure 6:

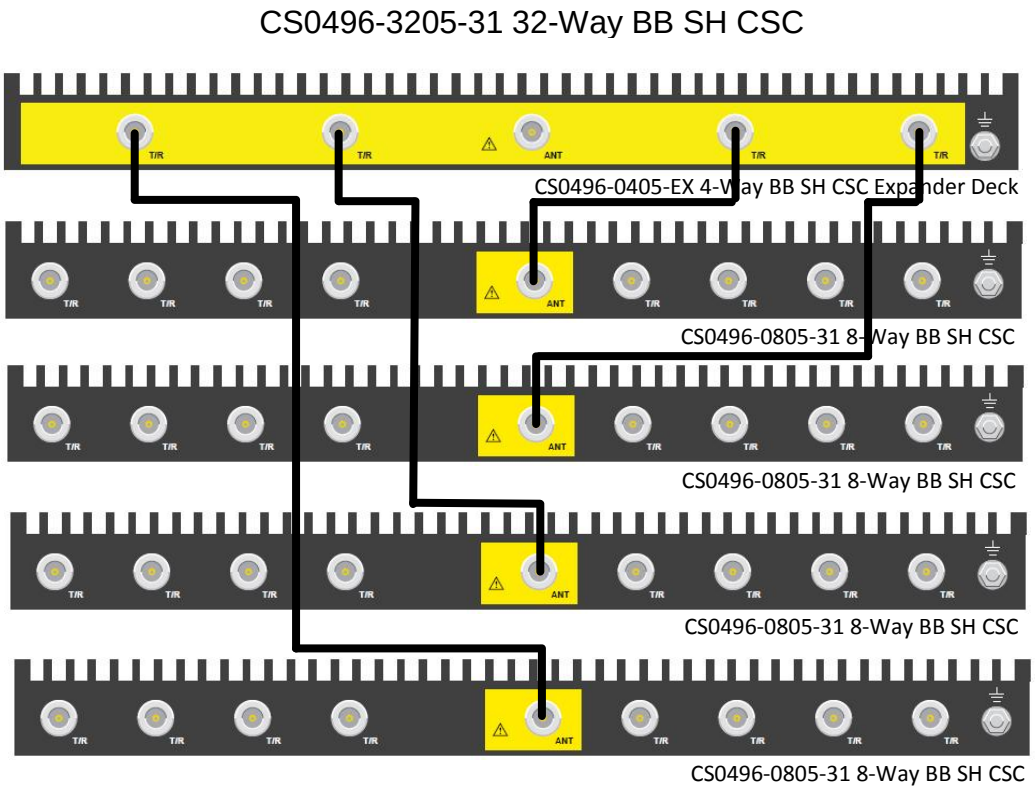


Figure 7:

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.

Celsius to Fahrenheit Conversion: Table 4.

Celsius	Fahrenheit	Celsius	Fahrenheit	Celsius	Fahrenheit	Celsius	Fahrenheit
105	221.0	66	150.8	27	80.6	-12	10.4
104	219.2	65	149.0	26	78.8	-13	8.6
103	217.4	64	147.2	25	77.0	-14	6.8
102	215.6	63	145.4	24	75.2	-15	5.0
101	213.8	62	143.6	23	73.4	-16	3.2
100	212.0	61	141.8	22	71.6	-17	1.4
99	210.2	60	140.0	21	69.8	-18	-0.4
98	208.4	59	138.2	20	68.0	-19	-2.2
97	206.6	58	136.4	19	66.2	-20	-4.0
96	204.8	57	134.6	18	64.4	-21	-5.8
95	203.0	56	132.8	17	62.6	-22	-7.6
94	201.2	55	131.0	16	60.8	-23	-9.4
93	199.4	54	129.2	15	59.0	-24	-11.2
92	197.6	53	127.4	14	57.2	-25	-13.0
91	195.8	52	125.6	13	55.4	-26	-14.8
90	194.0	51	123.8	12	53.6	-27	-16.6
89	192.2	50	122.0	11	51.8	-28	-18.4
88	190.4	49	120.2	10	50.0	-29	-20.2
87	188.6	48	118.4	9	48.2	-30	-22.0
86	186.8	47	116.6	8	46.4	-31	-23.8
85	185.0	46	114.8	7	44.6	-32	-25.6
84	183.2	45	113.0	6	42.8	-33	-27.4
83	181.4	44	111.2	5	41.0	-34	-29.2
82	179.6	43	109.4	4	39.2	-35	-31.0
81	177.8	42	107.6	3	37.4	-36	-32.8
80	176.0	41	105.8	2	35.6	-37	-34.6
79	174.2	40	104.0	1	33.8	-38	-36.4
78	172.4	39	102.2	0	32.0	-39	-38.2
77	170.6	38	100.4	-1	30.2	-40	-40.0
76	168.8	37	98.6	-2	28.4	-41	-41.8
75	167.0	36	96.8	-3	26.6	-42	-43.6
74	165.2	35	95.0	-4	24.8	-43	-45.4
73	163.4	34	93.2	-5	23.0	-44	-47.2
72	161.6	33	91.4	-6	21.2	-45	-49.0
71	159.8	32	89.6	-7	19.4	-46	-50.8
70	158.0	31	87.8	-8	17.6	-47	-52.6
69	156.2	30	86.0	-9	15.8	-48	-54.4
68	154.4	29	84.2	-10	14.0	-49	-56.2
67	152.6	28	82.4	-11	12.2	-50	-58.0

Return Loss Vs. VSWR

RL	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

Table 5

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)

Table 6

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

Table 7

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

Table 8

NOTES:

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