Tuning Instructions
Q - Series, Res-lok 4
Q-Circuit Duplexers
CM-351

Model Q 2330E
S/N (4172) 3136

Duplexer Returned 10/17/97 To Kenwood Rptr

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DUPLEXER INSTALLATION PROCEDURE

THIS DUPLEXER COMES TO YOU TUNED AND READY TO INSTALL IN THE SYSTEM, NO FIELD TUNING HAS TO BE DONE ON THE DUPLEXER. THE FOLLOWING STEPS SHOULD BE FOLLOWED TO INSURE PROPER INSTALLATION.

1. VERIFY THAT YOUR STATION DUPLEX FREQUENCIES ARE THE SAME AS THOSE TO WHICH THE DUPLEXER IS TUNED. THESE FREQUENCIES ARE ON THE UNIT IDENTIFICATION LABEL.

2. WITHOUT THE DUPLEXER IN THE SYSTEM, TUNE THE TRANSMITTER INTO THE STATION ANTENNA AND MEASURE THE OUTPUT AND REFLECTED POWER. THESE READINGS WILL BE USED AS THE PARAMETERS TO WHICH THE DUPLEXER IS COMPARED.

3. INSTALL THE DUPLEXER INTO THE SYSTEM WITH THE WATTMETER BETWEEN THE TRANSMITTER AND DUPLEXER. CONNECT THE STATION ANTENNA TO THE DUPLEXER ANTENNA TERMINAL. RETUNE THE TRANSMITTER AND READ THE FORWARD AND REFLECTED POWER. FROM THE CHART ON THE BACK OF THIS PAGE, USING THESE POWER READINGS, THE VSWR OF THE DUPLEXER CAN BE FOUND. THE TYPICAL VSWR IS 1.25:1 OR LESS, THE MAXIMUM IS 1.5:1.

4. NEXT, MEASURE THE OUTPUT POWER FROM THE DUPLEXER INTO THE STATION ANTENNA. DIVIDE THIS READING BY THE NET INPUT POWER (NET INPUT POWER = INPUT POWER - REFLECTED POWER FROM #3). GO TO PAGE CI-099 AT THE END OF THIS MANUAL AND LOOK DOWN THE HEADING POWER RATIO, FOR A NUMBER THAT IS CLOSEST TO THE CALCULATED VALUE. THEN LOOK TO THE RIGHT OF THIS NUMBER, UNDER THE DB COLUMN, AND READ THE INSERTION LOSS OF THE DUPLEXER. THIS VALUE SHOULD BE EQUAL TO, OR LESS THAN, THE SPECIFICATION OF THE DUPLEXER.

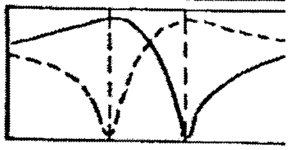
5. TO CHECK THE RECEIVER INSERTION LOSS, INJECT THE RECEIVER FREQUENCY INTO THE RECEIVER WITH A SIGNAL GENERATOR AND OBTAIN AN UNSATURATED FIRST LIMITER READING. NOTE THE GENERATOR OUTPUT LEVEL. NEXT CONNECT THE RECEIVER TERMINAL OF THE DUPLEXER TO THE RECEIVER AND INJECT THE RECEIVER FREQUENCY INTO THE ANTENNA TERMINAL OF THE DUPLEXER. ADJUST THE GENERATOR FOR THE SAME LIMITER READING AND NOTE THE GENERATOR OUTPUT LEVEL. THE DIFFERENCE BETWEEN THIS READING AND FIRST READING IS THE INSERTION LOSS OF THE DUPLEXER.

SINCLAIR

TECHNICAL BULLETIN

RETUNING INSTRUCTIONS

Q-CIRCUIT DUPLEXERS - RES-LOK 4

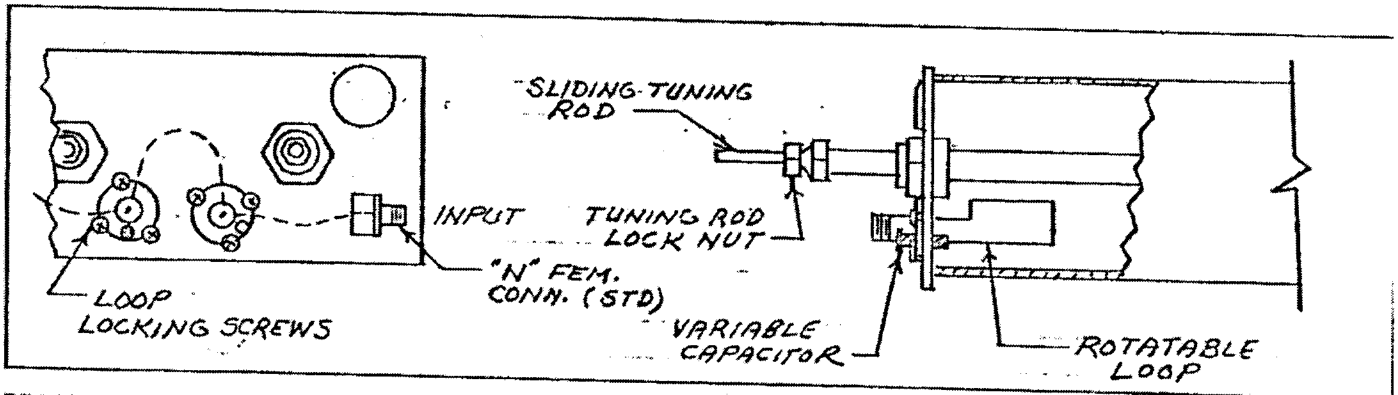


The duplexers can be retuned to the minimum separation as specified in their respective bands of 66-88 MHz, 132-174 MHz, 406-511 MHz or 800-1000 MHz.

EQUIPMENT

Minimum equipment requirements for retuning are: FM Signal Generator (Measurements Model 560M or equivalent), receivers on each of two duplex frequencies (or one which will tune both), and a First Limiter Monitor Meter.

MECHANICAL DETAIL

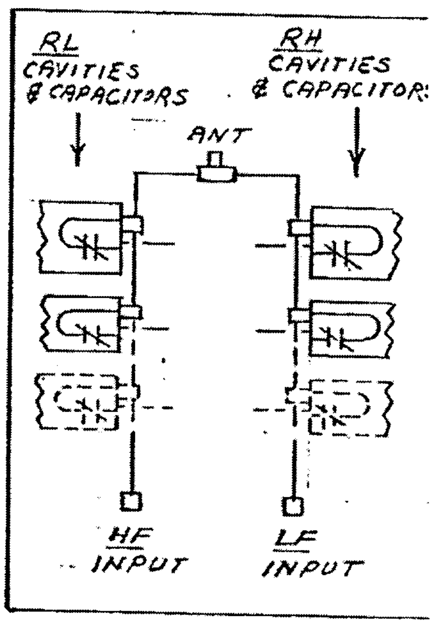


PROCEDURE

The rotatable loops have been factory adjusted for a particular insertion loss as specified on the original order. These loops have been locked in place with three locking screws and no further adjustment should be necessary.

In following the retuning steps below, monitor the output of the signal generator and adjust to maintain a readable but unsaturated level on the First Limiter Monitor.

1. Loosen the tuning rod lock nut on all cavities.
2. Inject the high duplex frequency into the HF terminal and detect it at the antenna terminal. (Monitor the 1st Limiter of the receiver on that frequency.) Adjust the RL cavity tuning rods for maximum signal at the receiver.
3. Inject the low duplex frequency into the LF terminal and detect it at the antenna terminal. Adjust the RH cavity tuning rods for maximum signal at the receiver.
4. Inject the low duplex frequency into the HF terminal and detect it at the LF terminal. Adjust the capacitors on the RL cavities for minimum signal to the receiver.
5. Inject the high duplex frequency into the LF terminal. Adjust the capacitors on the RH cavities for minimum signal to the receiver.
6. Repeat Step 2, then lock the RL tuning rods in position.
7. Repeat Step 3, then lock the RH tuning rods in position.
8. Repeat Step 4.
9. Repeat Step 5.



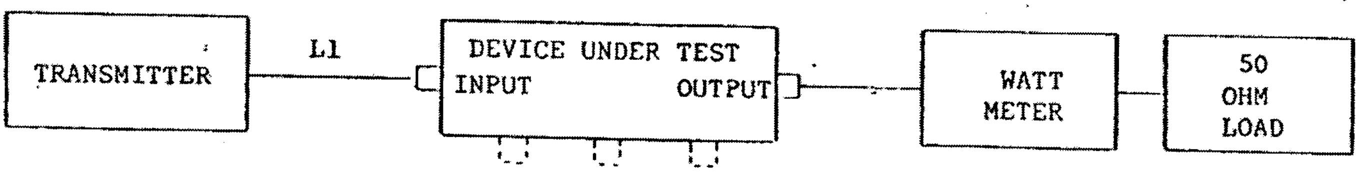
ATTENTUATION AND INSERTION LOSS FIELD MEASUREMENT TECHNIQUES

These instructions are intended to provide reasonably accurate insertion loss and attenuation measurements on filters, duplexers and multicouplers in the field using minimum test equipment.

INSERTION LOSS MEASUREMENTS

Two methods are presented, the first is used for measuring transmitter insertion loss using the transmitter and a wattmeter. The second method is general and can be used for either transmitter or receiver insertion loss measurements.

TRANSMITTER INSERTION LOSS MEASUREMENTS - The VSWR of the wattmeter should be 1.2:1 or less and the use of numerous adaptors in making connections should be avoided because the VSWR of these is often poor and will degrade the measuring system. UHF adaptors and connectors should be avoided when ever possible because their impedance characteristics vary widely with frequency.



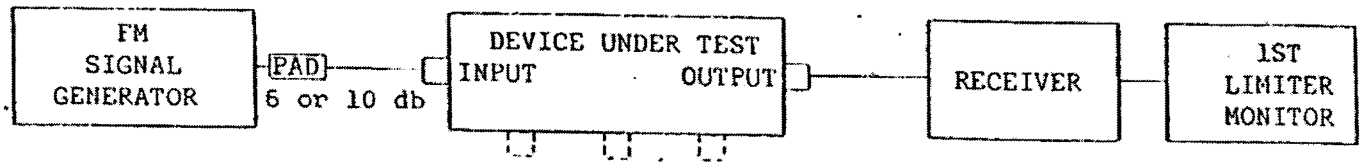
Install the device to be measured in the circuit as shown above, tune the transmitter for maximum power out. If the reflected power is not zero or near zero, then cable L1 should be adjusted to give the highest output power (lowest reflected power) when tuning the transmitter into the device. There will be some VSWR looking into the device and length L1 will determine the reactive component reflected to the transmitter. Because the adjustment range of the transmitter output is limited, it has been found that adjustment of L1 for maximum output can prove advantageous for lowest insertion loss.

An arbitrary length for L1 may be chosen and then varied by the addition of 1/8, 1/4, or 3/8 wavelengths, each time retuning the transmitter. The addition of one of these lengths, or the initial length of L1 will give maximum power out with a minimum of plate current. The trial lengths for polyethylene dielectric (solid) cables can be computed from these formulas.

$\lambda g/8$ = 973/freq. in MHz, $\lambda g/4$ = 1946/freq. in MHz, $3\lambda g/8$ = 2919/freq. in MHz

When maximum power output has been obtained through the device, note this power, then disconnect the device from the final length of L1 and connect directly to the wattmeter and load. Retune the transmitter, maintaining the same coupling and note the power output. You can now compute the power ratio, which is equal to power out (with device)/power out (without device). Page CI-099 will give the insertion loss value for the calculated power ratio.

SUBSTITUTION METHOD FOR INSERTION LOSS MEASUREMENT - Assemble the test set up as shown on the next page. The remaining terminals need not be terminated if the device under test is a duplexer or multicoupler. Inject the frequency and obtain a reference level on the first limiter monitor, taking care not to saturate the limiter circuit. Note the microvolt signal level and the generator output (dbm). Next, inject the signal directly into the receiver and decrease the signal generator output until the same reference level is obtained. The insertion loss is the difference in dbm as taken from the generator dial or the ratio of microvolts, using the following relationship,



and then referring to the table on CI-099.

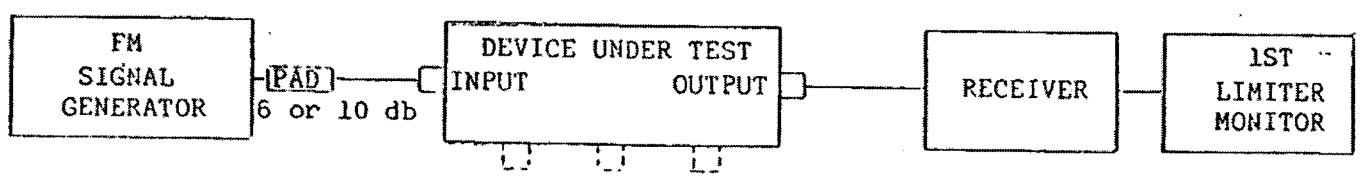
Voltage ratio = microvolts (w/o device)/microvolts (w/device)

A step attenuator providing small db increments (0.1, 0.2, 0.5, 1.0) can be used to provide more accurate readings. The attenuator should be connected to the generator output. Snap in and leave in about 6 db to pad the generator output. Take the reading with the device in the circuit, then remove the device and connect the two leads together. Snap in attenuation to bring the level down to the same reference level. The insertion loss is the equal to the amount of dbs snapped in (do not count in the value you had for padding purposes).

EQUIPMENT NOTES:

1. Quick slip connectors can be made by sawing off the outer barrel of male plugs. They can then be inserted in a variety of female contacts such as "N", "BNC", or "TNC" jack.
2. Use a minimum of adaptors in test cables, especially UHF and conversion types between "N", "UHF", or "BNC". The VSWR and associated phase shift of "UHF" type connectors can cause erroneous readings, especially when measuring low values of insertion loss.
3. FM signal generator may be measurements model 560 M or equivalent. The step attenuator is one providing 0.1 db increments for measurement of low insertion losses using the substitution method. This may be omitted and the attenuator on the signal generator substituted, but with substantial loss of resolution. (Kay model 1/432 C or equivalent).
4. The length between the duplexer and the receiver may have some effect on insertion loss and may be adjusted if desired, but it has been found that the receiver is not as sensitive or as easily disturbed by slight mismatches.

ATTENUATION MEASUREMENTS



Insert the two terminals, between which the attenuation is to be measured, into the test circuit above. If the device has more than two terminals, as a duplexer or multi-coupler, terminate all remaining terminals with 50 ohms before making measurements.

Using a signal generator and receiver on the test frequency, set the signal generator drive for a readable but unsaturated level on the list limiter monitor. Note a reference level on the first limiter monitor and the dbm level on the signal generator attenuator or the microvolt reading on the generator attenuator. Remove the filter terminals and connect leads of the test circuit together. Reduce the output on the signal generator until the reference level on the 1st limiter monitor is obtained. Note the dbm level on the signal generator attenuator. The difference between this and the previous level represents the filter attenuation in db. If the microvolt readings are used, the attenuation can be obtained from the ratio of the two readings, then referring to the chart on CI-099 using the closest tabulated value.

Voltage ratio = microvolts (w/o device)/microvolts (w/device)

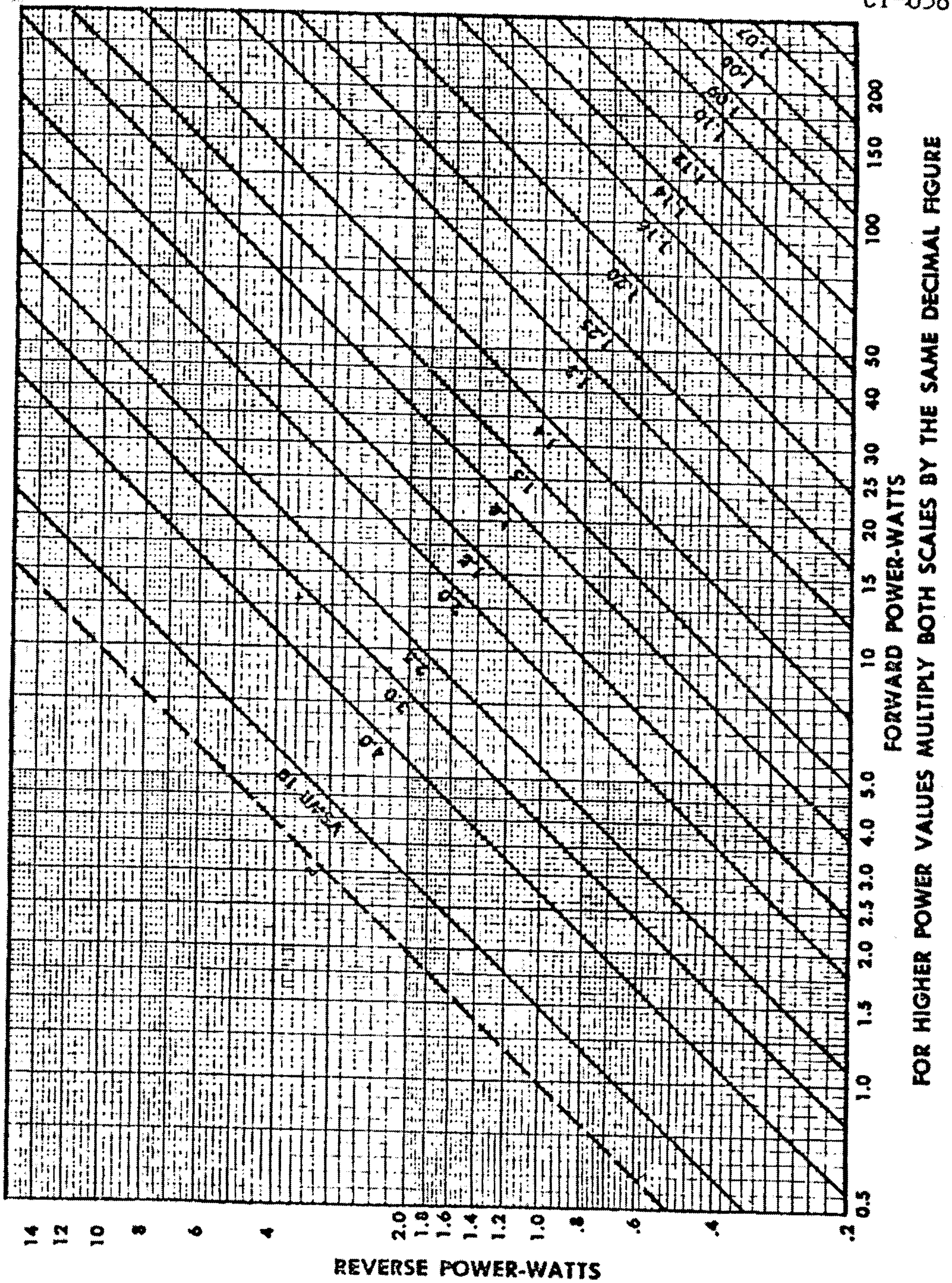
Consult the data Sheet or Detailed Tuning Procedure of the particular model under test for typical values of Insertion loss and attenuation.

PRECAUTIONARY MEASURES FOR MORE RELIABLE MEASUREMENTS - RF leakage is occasionally a problem when measuring filter attenuations in the area of 60 db or greater. When measuring attenuations over 80 db, RG-58/u cable should not be used because of excessive radiation. RG-8A/u or RG-213/u cable will permit measurements of 100-110 db only if input and output filter cables are not in close proximity. Double shielded cable, as RG-9/u or RG-142/u, is advised for measurements over 80 db. Occasionally, RF leakage occurs because of excessive radiation from the signal source, insufficient shielding of the receiver or a combination of all the above. If the measurements of a filter section indicates a lower level of attenuation than expected, a parallel path of lower attenuation (RF leakage) may be the reason. If this occurs, you will not be able to measure attenuations greater than the leakage path. If leakage is suspected, a simple test can be made as follows: insert the terminals of the filter under test and obtain a reference level on the first limiter monitor, using sufficient generator drive for a readable but unsaturated level. Note the dbm level of drive on the signal generator. Now insert a known level of attenuation in series with the filter section, as a 6 or 10 db pad. It should be necessary to increase the signal generator drive, in dbm, by the amount of attenuation added to obtain the previous reference level on the first limiter monitor. If RF leakage is occurring, the signal generator drive will be practically the same, indicating a path for RF other than thru the filter section. It can be easily shown if the filter section is responsible for the RF leakage. The results of the leakage test should be unaffected by placing the additional attenuation before or after the filter section in the test circuit, allowing for slight variation due to possible VSWR level of the attenuator. The 10 db pad should be left on the generator output at all times since the generator is looking into an unmatched line at this frequency. In actual practice, the cable length connecting the transmitter to the duplexer will affect the total amount of noise suppression, since the transmitter is an unmatched source of receiver noise power on the receiver frequency and is looking into a reflective load. The cable length which gives the greatest mismatch at the receiver frequency will provide the best noise suppression. Likewise, an adverse length can be chosen which will actually reduce the noise suppression by about 6 db less than the value measured, using a padded signal source. Unfortunately, this length is already adjusted for the best transmitter output through the duplexer. Since there are a few other uncontrollable factors affecting noise suppression such as varying frequency separations and internal extension cable lengths in the duplexer, the best solution is to provide an adequate safety margin of 10-15 db above the theoretical value specified by the manufacturer or systems supplier.

CONVERSION OF VOLTAGE AND POWER RATIOS TO DECIBELS

VOLTAGE RATIO	POWER RATIO	DB
1.0000	1.0000	0.0
.9886	.9772	0.1
.9772	.9550	0.2
.9661	.9333	0.3
.9550	.9120	0.4
.9441	.8913	0.5
.9333	.8710	0.6
.9226	.8511	0.7
.9120	.8318	0.8
.9016	.8128	0.9
.8913	.7943	1.0
.8810	.7762	1.1
.8710	.7586	1.2
.8610	.7413	1.3
.8511	.7244	1.4
.8414	.7079	1.5
.8318	.6918	1.6
.8222	.6761	1.7
.8218	.6607	1.8
.8035	.6457	1.9
.7943	.6310	2.0
.7852	.6166	2.1
.7762	.6026	2.2
.7674	.5888	2.3
.7586	.5754	2.4
.7499	.5623	2.5
.7413	.5495	2.6
.7328	.5370	2.7
.7244	.5248	2.8
.7161	.5129	2.9
.7079	.5012	3.0
.6998	.4898	3.1
.6918	.4786	3.2
.6839	.4677	3.3
.6761	.4571	3.4
.6683	.4467	3.5
.6607	.4365	3.6
.6531	.4266	3.7
.6457	.4169	3.8
.6383	.4074	3.9
.6310	.3981	4.0
.6237	.3890	4.1
.6166	.3802	4.2
.6095	.3715	4.3
.6026	.3631	4.4
.5957	.3548	4.5
.5888	.3467	4.6
.5821	.3388	4.7
.5754	.3311	4.8
.5689	.3236	4.9
.5623	.3162	5.0

VOLTAGE RATIO	POWER RATIO	ATTENTUATION DB
.5012	.2512	6
.3162	1×10^{-1}	10
.1778	$.3162 \times 10^{-1}$	15
1×10^{-1}	1×10^{-2}	20
$.5623 \times 10^{-1}$	$.3162 \times 10^{-2}$	25
$.3162 \times 10^{-1}$	1×10^{-3}	30
$.1778 \times 10^{-1}$	$.3162 \times 10^{-3}$	35
1×10^{-2}	1×10^{-4}	40
$.5623 \times 10^{-2}$	$.3162 \times 10^{-4}$	45
$.3162 \times 10^{-2}$	1×10^{-5}	50
$.1778 \times 10^{-2}$	$.3162 \times 10^{-5}$	55
1×10^{-3}	1×10^{-6}	60
$.5623 \times 10^{-3}$	$.3162 \times 10^{-6}$	65
$.3162 \times 10^{-3}$	1×10^{-7}	70
$.1778 \times 10^{-3}$	$.3162 \times 10^{-7}$	75
1×10^{-4}	1×10^{-8}	80
$.5623 \times 10^{-4}$	$.3162 \times 10^{-8}$	85
$.3162 \times 10^{-4}$	1×10^{-9}	90
$.1778 \times 10^{-4}$	$.3162 \times 10^{-9}$	95
1×10^{-5}	1×10^{-10}	100
5623×10^{-5}	$.3162 \times 10^{-10}$	105
$.3162 \times 10^{-5}$	1×10^{-11}	110
$.1778 \times 10^{-5}$	$.3162 \times 10^{-11}$	115
1×10^{-6}	1×10^{-12}	120



POWER VALUES vs. VSWR

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