microwave

Ferrite products

the complete microwave solution

teledynemicrowaveteledynemicrowave

Ferrite

Isolators and Circulators

Basic Description of Operation

The typical junction circulator is basically made up of a 3-arm stripline circuit sandwiched between 2 wafers of ferrite and dielectric material (known as pucks) and further sandwiched between an upper and lower ground plane. When a magnetic field is applied through the vertical axis of the stripline assembly, a directivity or circulation of energy results from one connector to the other depending on from which direction the energy approaches the device as shown in Fig. 1.

Microwave signals entering Port 1 are directed to Port 2, signals entering Port 2 are directed to Port 3, etc. If Port 3 is terminated in a 50 Ω load, the device becomes an isolator, i.e. a device that passes signals with low loss in one direction (Port 1 to Port 2) and with high loss in the reverse direction (Port 2 to Port 1). As such, it is used to “isolate” one microwave device from another.

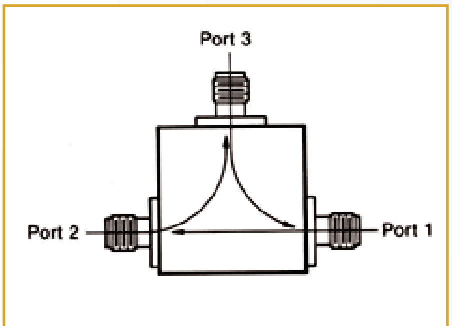

Figure 1

Bandwidth vs Performance

Since the characteristic impedance of the ferrite junction is usually less than 50 Ω, the circulator must always contain some type of impedance transformation. In all Teledyne Microwave circulators, one or more quarter-wavelength transformers are used depending on the operating bandwidth of the unit. The overall performance of the unit is therefore a function of how well the impedance transformation is realized in going from 50 Ω to junction and back to 50 Ω.

Temperature Effects

The performance of a circulator or isolator is largely dependent on whether enough magnetic field is applied to saturate the ferrite material to its specified saturation magnetization, or 4πMs. A sample of ferrite is made up of many magnetic domains which, in the unmagnetized state, appears in a random fashion (See Figure 2).

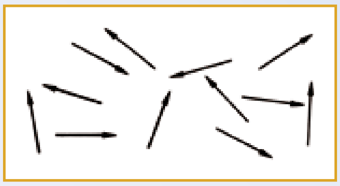

Figure 2 Ferrite in Unmagnetized state

The 4πMs value of the specific ferrite coincides with the amount of externally applied magnetic field needed to align the domains. When all domains are aligned, the material is fully saturated (See Figure 3).

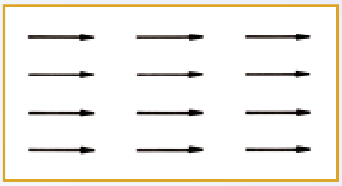

Figure 3 Ferrite in Magnetized state

TELEDYNE MICROWAVE
1274 Terra Bella Avenue, Mountain View, CA 94043
Tel: 1.800.832.6869 or +1.650.962.6944 Fax: +1.650.962.6845
www.teledynemicrowave.com microwave@teledyne.com

Ferrite Isolators and Circulators

If the ferrite is only partially magnetized, the device will exhibit lowfield losses due to the fact that all the domains are not perfectly aligned. The $4\pi Ms$ value of the ferrite can be plotted as a function of the applied field, H (See Figure 4).

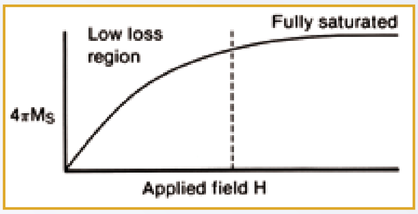

Figure 4 $4\pi Ms$ vs Applied Field

Once saturation has been obtained, Ms will still vary as a function of temperature. As the temperature is raised, the domains will shift position in a random fashion and will not always realign. This results in a lowering of the saturation magnetization. If the temperature is raised even further, the domains will move faster and be more misaligned. If this process is continued, the result is that at some given temperature, the $4\pi Ms$ becomes zero because the thermal energy within the ferrite is greater than that supplied by the external field. The temperature at which this occurs is called the Curie Temperature (See Figure 5).

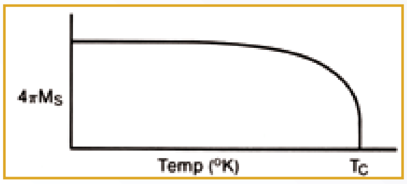

Figure 5 Effect on $4\pi Ms$ as Temperature is raised

The variation in the $4\pi Ms$ can be compensated to some degree, and the ferrite device can be made relatively stable over selected temperature ranges. However, due to the intrinsic composition of the ferrite material, temperature effects cannot be totally negated.

Model Numbers

T - 12 S 4 3 U - 30

X - XX X X X X - XX X X

Model
- T Isolator
- C Circulator

Starting Frequency
(Rounded to lowest GHz)
Example 12.8 GHz = 12

Connectors
- S SMA
- T TNC
- N N

% of Bandwidth (Approximate)
Example: 0 = 0-9%
1 = 10-19%
2 = 20-29%

Number of Ports
- 3 3 port model
- 4 4 port model
- 5 5 port model

Customer Mounting Holes
- M Metric threads

Connectors — Isolators only [1]
- A Female P1, Male P2
- B Male P1, Female P2
- C Male P1, Male P2

Model Finish [2]
- U Zinc plate and chemical film
- P Paint (min. humidity and no silver) [3]
- T Paint (humidity and RFI up to -50 dB) [3]
- S Paint (humidity and RFI up to -100 dB) [3]
- H Paint (100% humidity and RFI up to -50 dB) [3]
- C Custom order

[1] Catalog models have SMA female connectors on Port 1 and Port 2.
[2] Standard catalog models have zinc plate and chemical film finish.
[3] Gray epoxy paint color #36231.

TELEDYNE MICROWAVE
1274 Terra Bella Avenue, Mountain View, CA 94043
Tel: 1.800.832.6869 or +1.650.962.6944 Fax: +1.650.962.6845
www.teledynemicrowave.com microwave@teledyne.com

Ferrite Applications

Above and Below Resonance Designs

At operating frequencies below 3 GHz, three distinct design options are available. The lumped constant design produces a unit that can operate at very low frequencies, is temperature stable, and can be constructed in a small package. The limitations of this type of design are bandwidth (approximately 10% maximum) and power handling capability (low power only). The above resonance approach, so named because the ferrite resonant frequency is above the operating band, can be made in a small to medium size, and is temperature stable. This unit is also limited by bandwidth, which can approach 35%. The final design is the below resonance configuration, where the ferrite resonant frequency is below the operating band. This unit offers extremely wide bandwidths (in excess of 70%). The only disadvantages of units of this type are larger size and decreased temperature stability. Above 3 GHz, however, the below resonance approach results in a highly dependable and efficient unit. Teledyne Microwave evaluates individual requirements and chooses the design best tailored to satisfy them.

Four Port Type

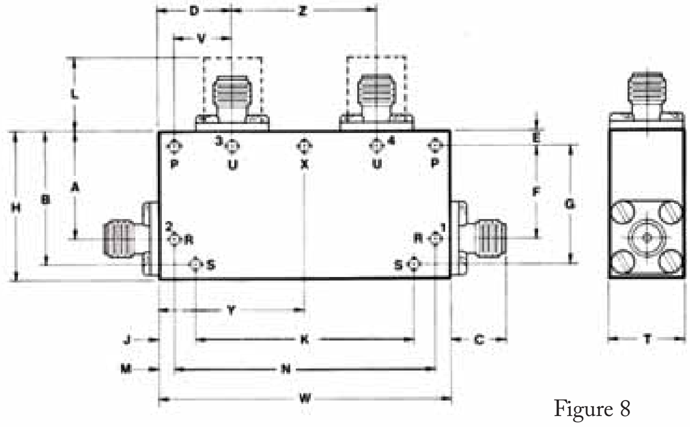

Figure 8

Single Junction Tee Type

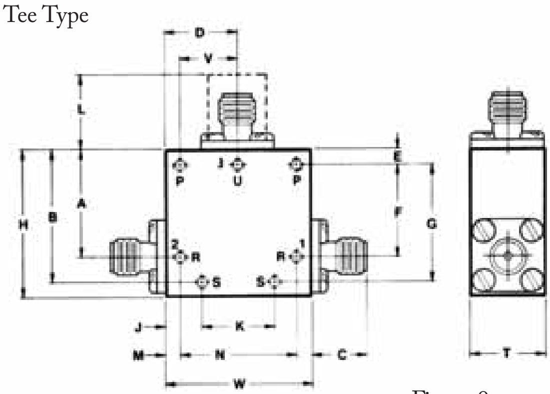

Figure 9

Several mounting options are provided. For specific models, use these drawings for reference and consult the factory, or ask for a mechanical outline drawing.

Bandwidth	Typ Frequency Range	Design Approach and Basic Characteristics
Up to 100%	500 MHz to 1.5 GHz	Lumped Constant Small size, temperature stable.
Up to 10%	1.5 GHz to 18 GHz	Below Resonance Small size, low insertion loss, temperature stable.
Up to 25%	500 MHz to 2.5 GHz	Above Resonance Medium size, excellent temperature stability.
Up to 30%	2.0 GHz to 26.5 GHz	Below Resonance Medium size, good insertion loss, average temperature stability.
30% to 40%	1.5 GHz to 26.5 GHz	Below Resonance Maximally flat tuned, excellent return loss and isolation, high performance unit good for communication band and high ratio applications.
Up to 67%	500 MHz to 26.5 GHz	Below Resonance Standard octave band design, medium size.
Up to 90%	1.0 GHz to 18.0 GHz	Below Resonance Standard octave-plus design provides extended band coverage. Higher loss and larger size at lower frequencies.

OFOISR App 06-S-1942

TELEDYNE MICROWAVE

1274 Terra Bella Avenue, Mountain View, CA 94043
Tel: 1.800.832.6869 or +1.650.962.6944 Fax: +1.650.962.6845
www.teledynemicrowave.com microwave@teledyne.com

Ferrite Applications

Isolator Input VSWR

The effective input VSWR of an isolator will vary as a function of the load VSWR. Considering a typical 20 dB isolator, the basic input VSWR with a 50 Ω load on the output will be 1.22:1. As the output load mismatch is increased, energy is reflected to the termination port, attenuated by 20 dB, and the balance is reflected back to the input. This will increase the total input VSWR seen at the input. The obvious worst case is when the output is terminated in a short circuit and the input sees two 1.22:1 VSWRs adding up in some phase. If the designer must maintain a certain maximum VSWR under any load condition, he may have to specify a higher isolation unit which could be either a higher performance single junction design or a multiple junction unit. Curves illustrating the inter-relationship of input VSWR, isolation required, and load VSWR are shown below (Figure 6).

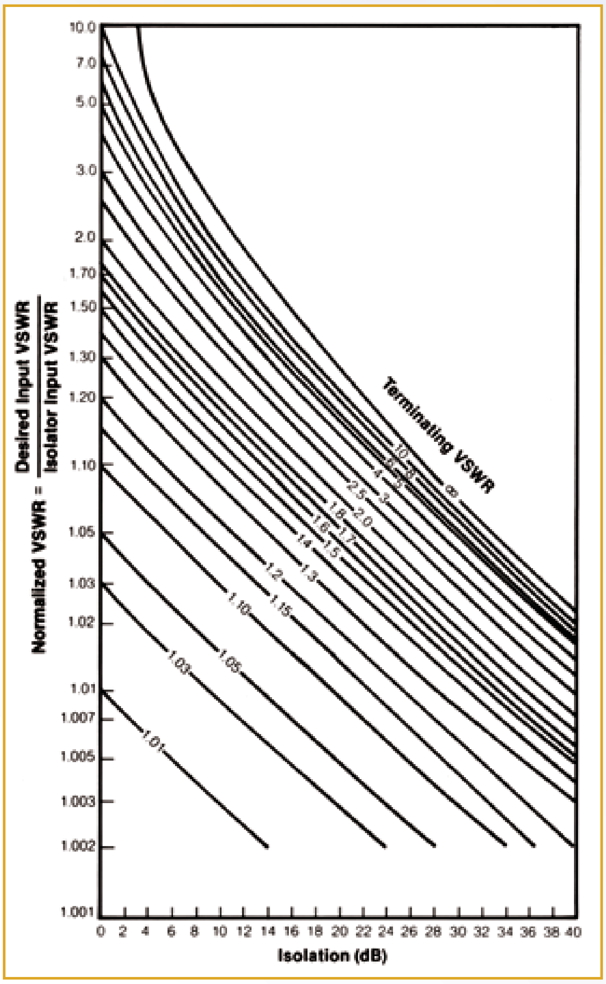

Figure 6

VSWR Reduction using a Ferrite Isolator

Notes:

To determine the worst case resultant VSWR with a known value of isolation:

1. Determine the intersection of isolation and the device VSWR terminating the isolator. Read the normalized VSWR from the ordinate.

2. Multiply the normalized VSWR by the isolators input VSWR to obtain the resultant reduced input VSWR.

Example: You have an isolator with an input VSWR of 1.25:1 and isolation of 20 dB. You are terminating this unit with a device that has a 4.0:1 VSWR. The resultant normalized VSWR is 1.15:1 and the resultant reduced input VSWR is 1.25 x 1.15 = 1.44:1.

To determine the value of isolation needed to reduce the input VSWR to a desired value.

1. Divide the desired reduced input VSWR by the isolator's input VSWR to obtain the normalized VSWR.

2. Determine the intersection of the normalized VSWR and the device VSWR terminating the isolator. Read the required isolation from the abscissa.

Example: You have a device with an input VSWR of 5.0:1 and you would like to reduce this to 1.50:1 using a ferrite isolator with a 1.20:1 input VSWR. The normalized VSWR is 1.50/1.20 = 1.25, the terminating VSWR is 5.0:1 and the resultant required isolation is 17 dB.

Stripline Circulators and Isolators

Virtually all of the standard Teledyne Microwave ferrite designs can be provided with outputs that mate with stripline. Consult our engineers to coordinate the most desirable interface configuration.

Discussion of 4-Port Circulator/Isolator Parameters

A 4-port circulator is shown in Figure 7. The isolator equivalent would have both ports 3 and 4 terminated. The given insertion loss spec would be valid for a signal traveling from ports 1-2 and the isolation valid for a signal traveling from ports 2-1. These numbers are indicative of the isolator only (i.e. ports 3 and 4 terminated). When specifications on a circulator are discussed, some guide-lines should be followed.

TELEDYNE MICROWAVE

1274 Terra Bella Avenue, Mountain View, CA 94043
Tel: 1.800.832.6869 or +1.650.962.6944 Fax: +1.650.962.6845
www.teledynemicrowave.com microwave@teledyne.com

Ferrite Applications

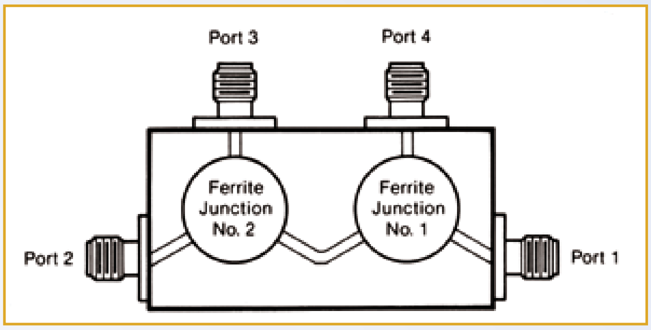

Figure 7

Example: If a 4-port circulator is quoted with the following parameters:

VSWR	1.25:1
Insertion Loss	0.6 dB max.
Isolation	40 dB min.

1) The given VSWR applies to all ports.

2) The given insertion loss is the loss obtained when crossing 2 ferrite junctions. This loss applies from ports 1 to 2, and from ports 3 to 4. All other paths cross only 1 junction, therefore, the loss is equal to ½ the specified loss.

3) The given isolation also applies only when crossing 2 ferrite junctions. Thus, this is the isolation from ports 2-1 with ports 3 and 4 terminated in matched loads. The isolation between ports separated by only 1 ferrite junction is equal to ½ the specified isolation.

Single Junction Tee Type

Teledyne Microwave supplies a wide range of circulators and isolators with full MIL-Spec performance capabilities. Through the utilization of computer aided design and numerically controlled fabrication, catalog units cover all standard and straddle octave band, octave-plus band, and commonly used narrow band frequency ranges. See specifications listed in the tables. Major octave band units are now available.

General Specifications

Connectors: 3 mm. SMA female connectors are standard on catalog models. Other types including N, TNC and SMA in male, right angle, bulkhead and 1.7 mm are readily available. Unit size and weight will be the same except where prohibited by connector flange dimensions. Consult factory regarding any performance variations with optional connectors.

Terminations: All circulator designs are available with internal terminations for use as isolators. See part numbers listed in tables.

Power Handling: Circulators: 1 KW peak, 50 watts average.

Isolators: 2 watts average reverse power, with standard termination. Higher power models are available on special order.

Temperature: With only a few exceptions, the standard units listed in the specification tables will operate over typical MIL-Spec temperature ranges of -54 to +85˚C. In many cases performance can be maintained up to + 125 ˚C. Consult factory regarding any performance degradation over the full MIL-Spec temperature range.

Environment: Standard catalog models meet shock and vibration per MIL-E-5400, Class II. Up to 100% humidity requirements can be met on special order.

Mechanical Mounting: Standard catalog models now feature mounting holes on both sides of the unit. Figures 8 and 9 depict the various mounting configurations available.

Finishing & Sealing: Our standard catalog models are now finished with zinc plate per QQ-Z-325a and chemical film per MIL-C-5541. Catalog models can be ordered with special finishes to meet shielding and humidity requirements.

Shielding: Both magnetic and EMI/RFI shielding are available when specified.

Marking: Standard catalog models are marked as a minimum with the following information: federal manufacturer code identification number, manufacturer model number, port identification, and date of inspection for shipment. The date of inspection is a four digit date code per MIL-STD-1285A.

TELEDYNE MICROWAVE
1274 Terra Bella Avenue, Mountain View, CA 94043
Tel: 1.800.832.6869 or +1.650.962.6944 Fax: +1.650.962.6845
www.teledynemicrowave.com microwave@teledyne.com

Single Junction Isolators & Circulators

Standard Octave Band Isolators & Circulators

Isolator	Circulator	Freq Range	Isola-tion (dB)	IL (dB)	VSWR	Weight (oz)	Weight (gm)	Size (in)			Size (mm)		
								H	W	T	H	W	T
T-0S63U-10	C-0S63U-10	0.5-1.0	17	0.8	1.35:1	70.0	1988	5.20	5.59	1.20	132.1	142.0	30.5
T-1S63U-40	C-1S63U-40	1.0-2.0	18	0.5	1.35:1	16.0	454	2.75	2.75	.88	69.9	69.9	22.4
T-1 S63U-30	C-1S63U-30	1.5-3.0	17	0.5	1.35:1	11.0	312	2.50	2.50	.75	63.5	63.5	19.1
T-2S63U-60	C-2S63U-60	2.0-4.0	20	0.5	1.25:1	5.0	142	1.63	1.63	.75	41.4	41.4	19.1
T-2S63U-70	C-2S63U-70	2.6-5.2	17	0.5	1.35.1	2.5	71	1.25	1.25	.63	31.7	31.7	16.0
T-3S63U-10	C-3S63U-10	3.0-6.0	17	0.6	1.35:1	2.0	57	1.10	1.10	.63	27.9	27.9	16.0
T-3S63U-30	C-3S63U-30	3.2-6.5	17	0.5	1.35:1	2.0	57	1.10	1.10	.63	27.9	27.9	16.0
T-3S63U-20	C-3S63U-20	3.5-7.0	17	0.5	1.35:1	2.0	57	1.10	1.10	.63	27.9	27.9	16.0
T-4S63U-50	C-4S63U-50	4.0-8.0	20	0.4	1.25:1	2.0	57	1.10	1.10	.63	27.9	27.9	16.0
T-4S63U-60	C-4S63U-60	4.0-8.0	17	0.4	1.35:1	1.0	28	.75	.75	.38	19.1	19.1	9.7
T-4S63U-70	C-4S63U-70	4.5-9.0	17	0.5	1.35:1	2.0	57	1.10	1.10	.63	27.9	27.9	16.0
T-5S63U-10	C-5S63U-10	5.2-10.4	17	0.5	1.35:1	2.0	57	1.10	1.10	.63	27.9	27.9	16.0
T-6S63U-10	C-6S63U-10	6.5-13.0	17	0.5	1.35:1	1.25	36	.80	.63	54	20.3	16.0	13.7
T-8S63U-30	C-8S63U-30	8.0-16.0	17	0.5	1.35:1	1.0	28	.75	.63	.52	19.1	16.0	13.2
T-10S63U-20	C-10S63U-20	10.0-20.0	17	0.7	1.35.1	1.0	28	.68	.50	56	17.3	12.7	14.2
T-13S63U-10	C-13S63U-10	13.0-26.5	16	0.8	1.50:1	1.0	28	.68	.50	.53	17.3	12.7	13.5

TELEDYNE MICROWAVE

1274 Terra Bella Avenue, Mountain View, CA 94043
Tel: 1.800.832.6869 or +1.650.962.6944 Fax: +1.650.962.6845
www.teledynemicrowave.com microwave@teledyne.com

Single Junction Isolators & Circulators

Standard Octave Plus Band Isolators & Circulators

Isolator	Circulator	Freq Range	Isola-tion (dB)	IL (dB)	VSWR	Weight (oz)	Weight (gm)	Size (in)			Size (mm)		
								H	W	T	H	W	T
T-1S83U-10	C-1S83U-10	1.7-4.2	16	0.7	1.50:1	5.25	149	1.75	1.75	.75	44.5	44.5	19.1
T-2S73U-20	C-2S73U-20	2.0- 4.5	16	0.6	1.401	5.0	142	1.63	1.63	.75	41.4	41.4	19.1
T-2S83U-10	C-2S83U-10	2.6- 6.7	15	0.7	1.501	2.75	78	1.25	1.25	.63	31.8	31.8	16.0
T-3S73U-10	C-3S73U-10	3.7- 8.3	16	0.7	1.45:1	2.0	57	1.10	1.10	.63	27.9	27.9	16.0
T-4S73U-10	C-4S73U-10	4.4-10.0	16	0.7	1.40:1	2.0	57	1.10	1.10	.63	27.9	27.9	16.0
T-5S73U-10	C-5S73U-10	5.9-13.0	17	0.6	1.35:1	1.25	36	.80	.63	.54	20.3	16.0	13.7
T-6S103U-10	C-6S103U-10	6.0-18.0	15	1.0	1.501	1.5	43	.92	.77	.52	23.4	19.6	13.2
T-6S83U-10	C-6S83U-10	6.5-16.5	16	0.7	1.451	1.0	28	.75	.63	.52	19.1	16.0	13.2
T-7S83U-30	C-7S83U-30	7.0-17.0	16	0.7	1.40:1	1.0	28	.75	.63	.52	19.1	16.0	13.2
T-7S73U-20	C-7S73U-20	7.6-16.2	17	0.7	1.351	1.0	28	.75	63	.52	19.1	16.0	13.2
T-7S83U-40	C-7S83U-40	7.6-18.0	16	0.8	1.50:1	1.0	28	.75	.63	.52	19.1	16.0	13.2
T-8S73U-20	C-8S73U-20	8.0-18.0	17	0.7	1.401	1.0	28	.75	63	52	19.1	16.0	13.2
T-8S83U-10	C-8S83U-10	8.0-20.0	14	1.1	1.50:1	1.0	28	.68	.50	.56	17.3	12.7	14.2

TELEDYNE MICROWAVE

1274 Terra Bella Avenue, Mountain View, CA 94043
Tel: 1.800.832.6869 or +1.650.962.6944 Fax: +1.650.962.6845
www.teledynemicrowave.com microwave@teledyne.com

Single Junction Isolators & Circulators

Standard Narrow Band Isolators and Circulators

Isolator	Circulator	Freq Range	Isolation (dB)	IL (dB)	VSWR	Weight (oz)	Weight (gm)	Size (in)			Size (mm)		
								H	W	T	H	W	T
T-OS03U-20	C-OS03U-20	.490-.510	20	0.5	1.20:1	2.0	57	1.00	1.00	.62	25.4	25.4	15.8
T-OS03U-30	C-OS03U-30	.880-.950	20	0.5	1.25:1	1.0	28	.75	.75	.50	19.1	19.1	12.7
T-0S23U-30	C-0S23U-30	0.95-1.225	20	0.5	1.25:1	2.5	71	1.25	1.25	.75	31.8	31.8	19.1
T-1S23U-20	C-1S23U-20	1.2-1.6	17	0.5	1.35:1	2.5	71	1.25	1.25	.75	31.8	31.8	19.1
T-1S13U-50	C-1S13U-50	1.4-1.7	20	0.4	1.25:1	2.5	71	1.25	1.25	.75	31.8	31.8	19.1
T-1S43U-10	C-1S43U-10	1.4- 2.3	17	0.6	1.35:1	9.0	256	2.37	2.37	.80	60.2	60.2	20.3
T-1S13U-30	C-1S13U-30	1.7- 2.0	20	0.4	1.25:1	2.5	71	1.25	1.25	.75	31.8	31.8	19.1
T-1 S33U-10	C-1 S33U-10	1.7- 2.3	21	0.4	1.20:1	5.5	156	2.0	2.0	1.0	50.8	50.8	25.4
T-1S13U-40	C-1S13U-40	1.9- 2.3	20	0.4	1.25:1	2.5	71	1.25	1.25	.75	31.8	31.8	19.1
T-2S33U-10	C-2S33U-10	2.6- 3.8	20	0.5	1.25:1	2.5	71	1.25	1.25	63	31.8	31.8	16.0
T-3S13U-30	C-3S13U-30	3.7- 4.2	30	0.3	1.10:1	4.0	114	1.45	1.44	.88	36.8	36.6	22.4
T-3S13U-40	C-3S13U-40	3.7- 4.2	25	0.25	1.10:1	1.0	28	75	.75	.50	19.1	19.1	12.7
T-4S13U-10	C-4S13U-10	4.4- 5.0	21	0.3	1.20:1	1.0	28	.75	.75	.50	19.1	19.1	12.7
T-4S33U-10	C-4S33U-10	4.4- 6.5	17	0.5	1.35:1	1.0	28	.75	.75	.50	19.1	19.1	12.7
T-5S03U-20	C-5S03U-20	5.4- 5.9	26	0.3	1.10:1	1.0	28	.75	.75	.50	19.1	19.1	12.7
T-5S53U-10	C-5S53U-10	5.8-10.6	17	0.4	1.30:1	1.5	43	85	.75	.60	21.6	19.1	15.2
T-5S03U-30	C-5S03U-30	5.9- 6.4	26	0.3	1.10:1	1.0	28	.75	.75	.50	19.1	19.1	12.7
T-7S43U-30	C-7S43U-30	7.0-11.0	28	0.4	1.10:1	1.5	43	.85	.75	.60	21.6	19.1	15.2
T-7S53U-10	C-7S53U-10	7.0-12.4	18	0.4	1.30:1	1.25	36	.80	.63	.54	20.3	16.0	13.7
T-8S43U-20	C-8S43U-20	8.0--12.4	18	0.4	1.30:1	1.25	36	.80	.63	54	20.3	16.0	13.7
T-12S43U-30	C-12S43U-30	12.0-18.0	18	0.5	1.30:1	1.0	28	.68	.50	.56	17.3	12.7	14.2
T-18S33U-20	C-18S33U-20	18.0-26.5	17	1.0	1.501	10	28	68	50	53	17.3	12.7	13.5

TELEDYNE MICROWAVE

1274 Terra Bella Avenue, Mountain View, CA 94043
Tel: 1.800.832.6869 or +1.650.962.6944 Fax: +1.650.962.6845
www.teledynemicrowave.com microwave@teledyne.com

Four Port Isolators & Circulators

Teledyne Microwave four port circulators and isolators are realized by optimally integrating two single junction circulators in a Single package.

These devices can be furnished with full MIL-Spec performance. Catalog units cover all standard and straddle octave bands, octave plus bands and commonly used narrow bands. The units listed in this section are only a sample of the components available. All bands listed in the single junction tee tables are available as four port models.

Multiple Junction Designs

Multiple junction units with 5, 6 or more ports are available in all of the bands listed in the part number tables below and on single junction tee page. Contact the factory or our representatives for specifications and special configurations.

General Specifications

All general specifications for single junction tee type circulators and isolators apply to the four port type.

Insertion Loss: Insertion loss is specified on a "per-pass" basis through the ferrite junction. The sample tables below show the loss of a four port (2 junction) isolator. For circulator/isolator combinations, the loss is a function of how many passes the signal makes through the ferrite junction.

Standard 4 Port Isolators & Circulators

Isolator	Circulator	Freq Range	Isolation (dB)	IL (dB)	VSWR	Weight (oz)	Weight (gm)	Size (in)			Size (mm)		
								H	W	T	H	W	T
T-1S64U-40	C-1S64U-40	10- 2.0	35	1.2	1.25:1	32.0	909	2.75	5.50	88	69.9	139.7	22.4
T-2S64U-60	C-2S64U-60	2.0- 4.0	40	1.2	1.251	10.0	284	1.63	3.26	.75	41.4	82.8	19.1
T-3S64U-30	C-3S64U-30	32- 6.5	35	1.0	1.35:1	4.0	114	1.10	2.20	.63	27.9	55.9	16.0
T-6S64U-10	C-6S64U-10	6.5-13.0	35	1.0	1.351	2.5	71	80	1.26	.54	20.3	32.0	13.7
T-10S64U-20	C-10S64U-20	10.0-20.0	35	1.4	1.35:1	2.0	57	68	1.0	.53	17.3	25.4	13.5
T-2S74U-20	C-2S74U-20	2.0- 4.5	32	1.2	1.40:1	10.0	284	1.63	3.26	.75	41.4	82.8	19.1
T-7S84U-40	C-7S84U-40	7.6-18.0	32	1.6	1.50:1	2.0	57	.68	1.0	.56	17.3	25.4	14.2
T-1S44U-10	C-1S44U-10	1.4- 2.3	35	1.2	1.35:1	18.0	512	2.37	4.74	.80	60.2	120.4	20.3
T-1S14U-30	C-1S14U-30	17- 2.0	40	0.8	1.25:1	5.0	142	1.25	2.50	.75	31.8	63.5	19.1
T-3S14U-30	C-3S14U-30	37- 4.2	60	0.6	1.101	10.0	284	1.45	2.86	.88	36.8	72.7	22.4
T-3S14U-40	C-3S14U-40	3.7- 4.2	50	0.5	1.10:1	2.0	57	.75	1.50	.50	19.1	38.1	12.7
T-5SO4U-30	C-5SO4U-30	5.9- 6.4	50	0.6	1.101	2.0	57	.75	1.50	.50	19.1	38.1	12.7
T-7S44U-30	C-7S44U-30	7.0-11.0	55	0.8	1.101	3.0	85	.85	1.50	.60	21.6	38.1	15.2
T-8S44U-20	C-8S44U-20	8.0-12.4	35	1.0	1.301	2.5	71	80	1.26	54	20.3	32.0	13.7
T-12S44U-30	C-12S44U-30	12.0-18.0	35	1.2	1.35:1	2.0	57	68	1.00	.56	17.3	25.4	13.5

TELEDYNE MICROWAVE
1274 Terra Bella Avenue, Mountain View, CA 94043
Tel: 1.800.832.6869 or +1.650.962.6944 Fax: +1.650.962.6845
www.teledynemicrowave.com microwave@teledyne.com