

DATA SHEET

Introduction and Applications for Ceramic Band Pass Filters

Features

- High Q ceramic
- Rugged
- Temperature compensated
- Custom designs
- Available lead (Pb)-free, RoHS-compliant, and Green

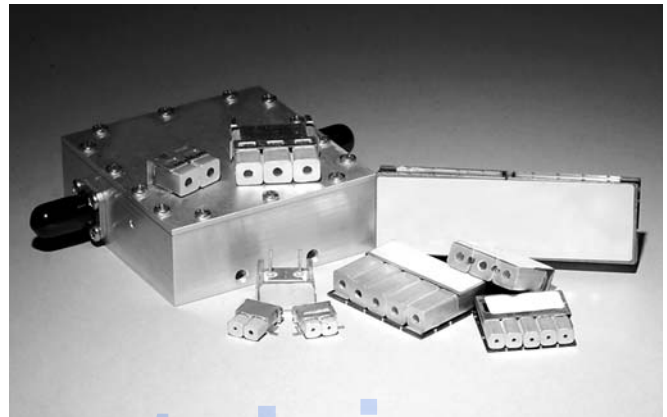
Benefits

- Low insertion loss
- Small compact design
- Frequency stability
- Mechanical stability

NEW



Skyworks Green products are lead (Pb)-free, RoHS (Restriction of Hazardous Substances)-compliant, conform to the EIA/EICTA/JEITA Joint Industry Guide (JIG) Level A guidelines, and are free from antimony trioxide and brominated flame retardants.



Introduction

Skyworks is a world-class supplier of high performance ceramic band pass filters. Specializing in band pass, notch and diplexing applications, Skyworks can cover a frequency range from 300 MHz to 6000 MHz with surface mount or connectorized devices.

Utilizing state of the art assembly automation, Skyworks provides cost-effective solutions meeting high performance specifications.

Skyworks surface mount PCB configured filters are designed to comply with “green” manufacturing initiatives eliminating heavy metal elements. This configuration is designed to comply with pending European regulations regarding the elimination of lead in electronic assemblies. Custom assemblies can be obtained with flat pack style SMT devices, through-hole or Sn/Pb coated PCB surface mount designs.

Skyworks assembly methodology offers a wide array of designs, from 2 mm x 2 pole – 8 mm x 10 pole band pass filters and diplexers, to advanced band stop (notch) designs and high-pass or low-pass filters. For typical applications and ranges of products, refer to the Standard Filters/Duplexers listing included in

this document. Detailed specifications, both mechanical and electrical, are maintained for many popular designs on our Web site, or by contacting your local sales representative.

The nature of applications utilizing a band pass filter, duplexer or notch filter, necessitates the close interaction of the customer and Skyworks application engineering. Our application engineers employ the latest in simulation and circuit analysis software with accurately defined design rules to provide rapid turnaround on new filter designs. With our experience and design aids, Skyworks can provide the necessary support for your application from prototype through production. In addition to the personal attention, Skyworks offers a computer-aided design tool, CRaFT, to assist engineers designing filters (the latest version can be downloaded from our Web site, www.skyworksinc.com).

The strength of Skyworks designs begin with our ability to produce our own coaxial resonators from proprietary ceramic formulations. These resonators provide a high Q element that allows us to maintain our low filter insertion loss values. With numerous design package styles, Skyworks offers aggressive leadtimes on both prototype and volume applications.

*These products are produced by Trans-Tech (a wholly-owned subsidiary of Skyworks Solutions, Inc.)

Standard Filter Selection Guide

Skyworks has a wide range of standard filters, as well as the capability to rapidly create new custom designs. Figure 1.1 illustrates our general capability for filters. If a desired requirement falls within the listed categories, Skyworks can easily offer a suitable design. Beyond this general list, Skyworks has a staff of experienced filter designers who can provide new custom and more technologically difficult filters. In addition, the CRaFT program functions as a useful tool when analyzing filter requirements. Skyworks welcomes the chance to review specifications and determine a design solution.

Standard Filters/Duplexers*

This list contains Skyworks most popular filter and diplexer designs. A variety of footprints and configurations are available for application-specific needs. Please contact the factory or your local representative with your specifications or for more information on any of these designs. Skyworks maintains a list of over 700 active filters and duplexers. We welcome every opportunity to assist in the selection or creation of a filter or diplexer that will meet your specifications.

Figure 1.1 Standard Capabilities*

Center frequency	300 MHz to 6 GHz
Standard filter type	Ceramic band pass, diplexer, notch, LPF
Number of poles	2–10
Resonator sizes	2, 3, 4, 6, 8 and 12
Bandwidth	1.0%–10% (May vary depending on resonator size, F_0 & ϵ_R)
Insertion loss	1–4 dB typical by design
Attenuation	Varies by number of poles
Impedance	50 or 75 Ω
VSWR	2.0:1 maximum
Operating temperature range	-40 to +85 °C
Mechanical packaging options	PCB surface mount, thru-hole, & flat pack surface mount
Power handling (continuous)	1 W typical*

* Contact Skyworks application engineering for assistance with any other requirement.

CATV

Part Number	Filter Type	Size/Poles	Center Frequency (MHz)	Bandwidth (MHz)	Insertion Loss (dB)	Package
TT3P2-1068P0-3507	Band Pass	3 mm/2 pole	1068	35	0.7	PCB SMT
TT4P2-1013P2-2020	Band Pass	4 mm/2 pole	1013	20	2	PCB SMT
TT4P2-1082.5P2-0720	Band Pass	4 mm/2 pole	1082.5	7	2	PCB SMT
TT4P2-1082P2-0620	Band Pass	4 mm/2 pole	1082	6	2	PCB SMT
TT4P2-1090P2-0610	Band Pass	4 mm/2 pole	1090	6	1	PCB SMT
TT4P3-1030P2-1535	Band Pass	4 mm/3 pole	1030	15	3.5	PCB SMT
TT4P3-1067P2-4420	Band Pass	4 mm/3 pole	1067	44	2	PCB SMT
TT6P4-1080P4-7015	Band Pass	6 mm/4 pole	1080	70	1.5	PCB SMT
TT6P4-1090P2-1036	Band Pass	6 mm/4 pole	1090	10	3.6	PCB SMT

WCS

Part Number	Filter Type	Size/Poles	Center Frequency (MHz)	Bandwidth (MHz)	Insertion Loss (dB)	Package
TT6P6-0750P0-5017	Band Pass	6 mm/4 pole	750	50	1.7	PCB SMT
TT6P5-0765P0-11225	Band Pass	6 mm/5 pole	765	112	2.5	PCB SMT
TT6P2-0770T-1215	Band Pass	6 mm/2 pole	770	12	1.5	PCB SMT
TT6P3-0770T-1225	Band Pass	6 mm/3 pole	770	12	2.5	PCB SMT
TT6P3-0770T-2020	Band Pass	6 mm/3 pole	770	20	2	PCB SMT

MDS

Part Number	Filter Type	Size/Poles	Center Frequency (MHz)	Bandwidth (MHz)	Insertion Loss (dB)	Package
TT4P3-2120P2-6020	Band Pass	4 mm/3 pole	2120	60	2	PCB SMT
TT4P6-2122P0-2835	Band Pass	4 mm/6 pole	2122	28	3.5	PCB SMT
TT6P4-2158P2-14220	Band Pass	4 mm/4 pole	2158	14	2	PCB SMT
TT6P6-2500P3-3635	Band Pass	6 mm/6 pole	2500	36	3.5	PCB SMT

ISM

Part Number	Filter Type	Size/Poles	Center Frequency (MHz)	Bandwidth (MHz)	Insertion Loss (dB)	Package
TT4P2-0915P2-2620	Band Pass	4 mm/2 pole	915	26	2	PCB SMT
TT6P2-0902F-2518	Band Pass	6 mm/2 pole	902	25	1.8	PCB SMT
TT6P2-0915T-2518	Band Pass	6 mm/2 pole	915	25	1.8	PCB SMT
TT6P3-0902T-2520	Band Pass	6 mm/3 pole	902	25	2	PCB SMT
TT6P3-0915T-2520	Band Pass	6 mm/3 pole	915	25	2	PCB SMT
TT6P3-0917F-1425	Band Pass	6 mm/3 pole	917	14	2.5	PCB SMT
TT3P3-2400P1-1030	Band Pass	3 mm/3 pole	2400	10	3	PCB SMT
TT3P3-2450P1-1445	Band Pass	3 mm/3 pole	2450	14	4.5	PCB SMT
TT6P3-2467P0-3330	Band Pass	6 mm/3 pole	2467	33	3	PCB SMT

Cellular/PCS/DCS/UMTS

Part Number	Filter Type	Size/Poles	Center Frequency (MHz)	Bandwidth (MHz)	Insertion Loss (dB)	Package
TT3P2-1880P0-6010	Band Pass	3 mm/2 pole	1880	60	1	PCB SMT
TT3P3-0881.5P2-2530	Band Pass	3 mm/3 pole	881.5	25	3	PCB SMT
TT3P3-1880P0-6022	Band Pass	3 mm/3 pole	1880	60	2.2	PCB SMT
TT3P3-1960P0-6022	Band Pass	3 mm/3 pole	1960	60	2.2	PCB SMT
TT3P3-1960P2-6030	Band Pass	3 mm/3 pole	1960	60	3	PCB SMT
TT3P4-0836.5P2-2525	Band Pass	3 mm/4 pole	836.5	25	2.5	PCB SMT
TT3P4-0881.5P2-2525	Band Pass	3 mm/4 pole	881.5	25	2.5	PCB SMT
TT3P4-1880P2-6020	Band Pass	3 mm/4 pole	1880	60	2	PCB SMT
TT3P4-1880P2-6030	Band Pass	3 mm/4 pole	1880	60	3	PCB SMT
TT4P3-0863P0-0585	Band Pass	4 mm/3 pole	863	5	8.5	PCB SMT
TT4P3-2180P1-2540	Band Pass	4 mm/3 pole	2180	25	4	PCB SMT
TT4P4-1880P0-6216	Band Pass	4 mm/4 pole	1880	62	1.6	PCB SMT
TT4P4-1960P0-6216	Band Pass	4 mm/4 pole	1960	62	1.6	PCB SMT
TT4P5-2240P2-1032	Band Pass	4 mm/5 pole	2240	10	3.2	PCB SMT
TT4P6-0860.5P0-1937	Band Pass	4 mm/6 pole	860.5	19	3.7	PCB SMT
TT6P3-0836T-2520	Band Pass	6 mm/3 pole	836	25	2	PCB SMT
TT6P3-0860P3-2020	Band Pass	6 mm/3 pole	860	20	2	PCB SMT
TT6P3-0860T-2020	Band Pass	6 mm/3 pole	860	20	2	PCB SMT
TT6P3-0881F-2520	Band Pass	6 mm/3 pole	881	25	2	PCB SMT
TT6P5-1960P0-6025	Band Pass	6 mm/5 pole	1960	60	2.5	PCB SMT
TT6P5-2280P1-7032	Band Pass	6 mm/5 pole	2280	70	3.2	PCB SMT
TT6P6-1900P3-8035	Band Pass	6 mm/6 pole	1900	80	3.5	PCB SMT
TT6P3-2140P2-6011	Band Pass	6 mm/3 pole	2140	60	1.1	PCB SMT
TT6P10-R1950-T2140	Diplexer	6 mm/10 pole	1950	-	-	PCB SMT

GPS

Part Number	Filter Type	Size/Poles	Center Frequency (MHz)	Bandwidth (MHz)	Insertion Loss (dB)	Package
TT4P4-R1227.6-T1575.42	Diplexer	6 mm/3 pole	1227.6	-	-	PCB SMT
TT4P3-1227.6P1-2030	Band Pass	6 mm/3 pole	1227.6	20	3	PCB SMT
TT4P3-1575.42P2-2040	Band Pass	6 mm/3 pole	1575.42	20	4	PCB SMT
TT3P3-1227.6P1-1030	Band Pass	6 mm/3 pole	1227.6	10	3	PCB SMT
TT3P3-1575.42P2-1030	Band Pass	6 mm/3 pole	1575.42	10	3	PCB SMT

Other

Part Number	Filter Type	Size/Poles	Center Frequency (MHz)	Bandwidth (MHz)	Insertion Loss (dB)	Package
TT3P4-2513P2-5055	Band Pass	6 mm/3 pole	2513	50	5.5	PCB SMT
TT3P5-3687P1-7466	Band Pass	6 mm/3 pole	3687	74	6.6	PCB SMT
TT4P3-3417P2-0220	Band Pass	6 mm/3 pole	3417	2	2	PCB SMT
TT4P5-1090P0-1050	Band Pass	6 mm/3 pole	1090	10	5	PCB SMT
TT6P5-0810P3-5030	Band Pass	6 mm/3 pole	810	50	3	PCB SMT
TT6P4-0509P7-0148	Band Pass	6 mm/3 pole	509	1	4.8	PCB SMT
TT4P4-1000P2-1030	Band Pass	6 mm/3 pole	1000	10	3	PCB SMT
TT6P3-0826.5P3-0520	Band Pass	6 mm/3 pole	826.5	5	2	PCB SMT
TT6P3-0827P3-0620	Band Pass	6 mm/3 pole	825	6	2	PCB SMT
TT6P6-1000P5-8530	Band Pass	6 mm/3 pole	1000	85	3	PCB SMT
TT6P6-0545P6-3022	Band Pass	6 mm/3 pole	545	30	2.2	PCB SMT
TT4P3-3500P2-10020	Band Pass	6 mm/3 pole	3500	10	2	PCB SMT
TT6P6-0889P3-4029	Band Pass	6 mm/3 pole	889	40	2.9	PCB SMT
TT6P4-0722P4-4817	Band Pass	6 mm/3 pole	722	48	1.7	PCB SMT
TT3P3-1088P2-9015	Band Pass	6 mm/3 pole	1088	90	1.5	PCB SMT
TT6P3-0740P3-2020	Band Pass	6 mm/3 pole	740	20	2	PCB SMT
TT6P5-1950P3-6040	Band Pass	6 mm/3 pole	1950	60	4	PCB SMT
TT3P4-0917P2-4524	Band Pass	6 mm/3 pole	917	45	2.4	PCB SMT
TT6P3-1090P2-1029	Band Pass	6 mm/3 pole	1090	10	2.9	PCB SMT
TT6P4-0770P0-1240	Band Pass	6 mm/3 pole	770	12	4	PCB SMT
TT6P3-1030P2-1029	Band Pass	6 mm/3 pole	1030	10	2.9	PCB SMT
TT6P5-0881.5P0-2530	Band Pass	6 mm/3 pole	881.5	25	3	PCB SMT
TT6P3-0730P3-1213	Band Pass	6 mm/3 pole	730	12	1.3	PCB SMT
TT6P3-0445.25T-0145	Band Pass	6 mm/3 pole	445.25	1	4.5	PCB SMT
TT4P3-2400P1-20015	Band Pass	6 mm/3 pole	2400	20	1.5	PCB SMT
TT6P3-1080P2-0650	Band Pass	6 mm/3 pole	1080	6	5	PCB SMT
TT6P3-0745.3P3-1920	Band Pass	6 mm/3 pole	745.3	19	2	PCB SMT
TT6P4-0435P0-3019-NS	Band Pass	6 mm/3 pole	435	30	1.9	PCB SMT
TT3P4-0895.5P2-3926	Band Pass	6 mm/3 pole	895.5	39	2.6	PCB SMT

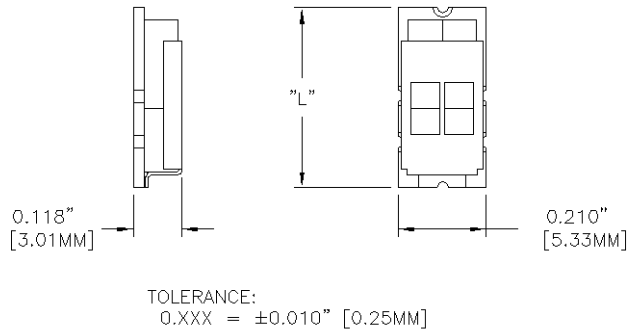
Available Packages

Skyworks offers filters in a number of standard packages. In addition to SMT, Skyworks offers a flat-pack and through-hole configuration. Mechanical drawings are provided for most of our filters. In addition to our standard offering, Skyworks has the capability and experience to meet many unique footprint layouts and custom packages.

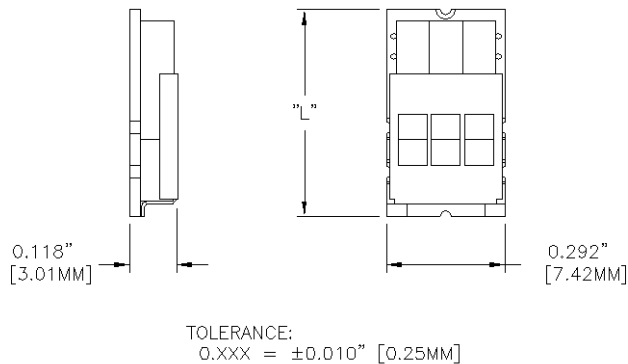
For each of our 2 to 6 pole packages, Skyworks can offer profiles ranging from 2 mm to 6 mm.

2 mm SMT

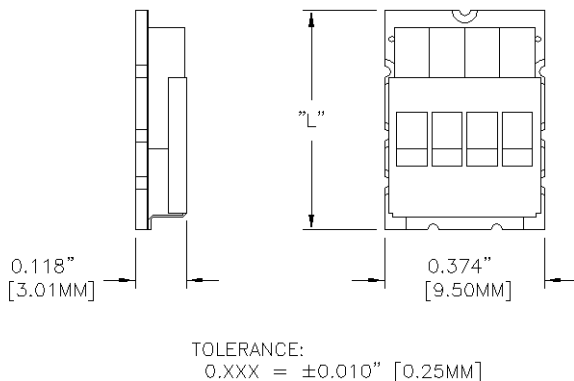
TT2P2—P—



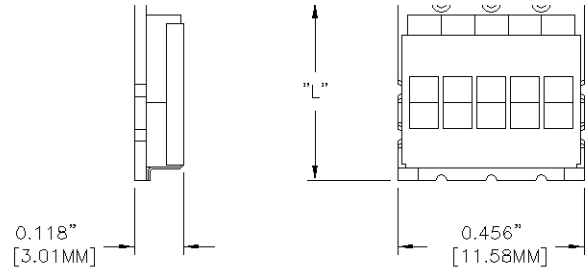
TT2P3—P—



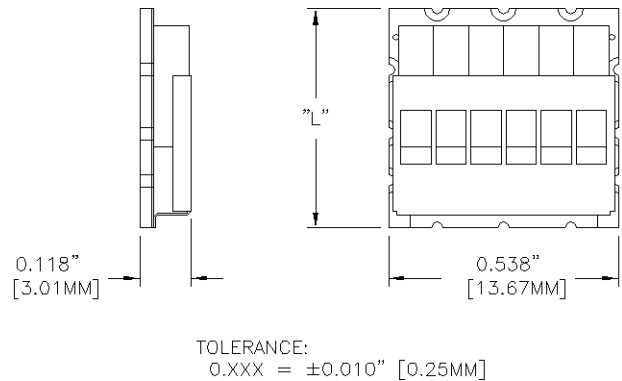
TT2P4—P—



TT2P5—P—



TT2P6—P—



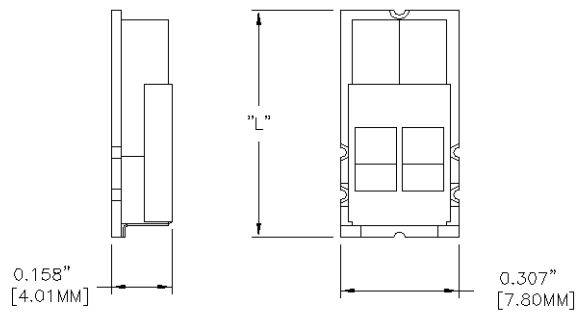
SMT Filter Length

Filter	Inches	mm
P1	0.434	11
P2	0.512	13
P3	0.590	15
P4	0.669	17
P5	0.748	19
P6	0.827	21
P7	0.906	23
P0	Custom	Custom

Dimension 'L' will vary in length dependent upon filter's frequency.
All dimensions are in inches.

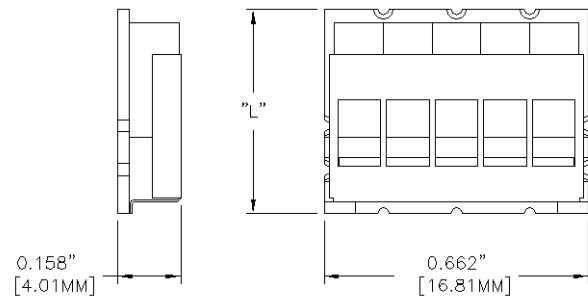
3 mm SMT

TT3P2—P—



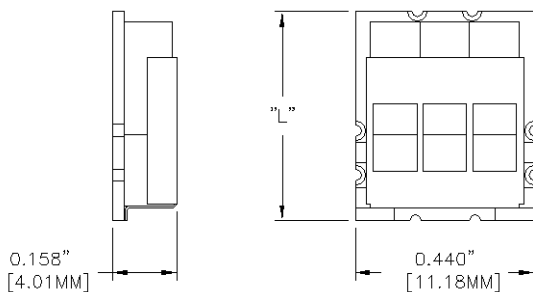
TOLERANCE:
0.XXX = ± 0.010 " [0.25MM]

TT3P5—P—



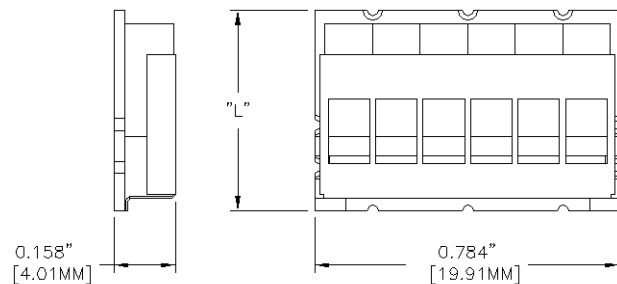
TOLERANCE:
0.XXX = ± 0.010 " [0.25MM]

TT3P3—P—



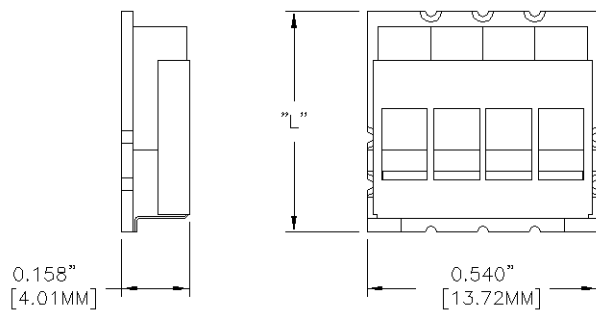
TOLERANCE:
0.XXX = ± 0.010 " [0.25MM]

TT3P6—P—



TOLERANCE:
0.XXX = ± 0.010 " [0.25MM]

TT3P4—P—



TOLERANCE:
0.XXX = ± 0.010 " [0.25MM]

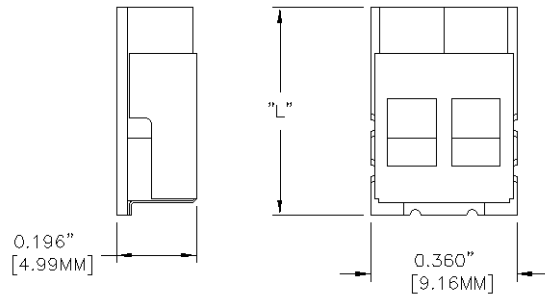
SMT Filter Length

Filter	Inches	mm
P1	0.434	11
P2	0.512	13
P3	0.590	15
P4	0.669	17
P5	0.748	19
P6	0.827	21
P7	0.906	23
P0	Custom	Custom

Dimension 'L' will vary in length dependent upon filter's frequency.
All dimensions are in inches.

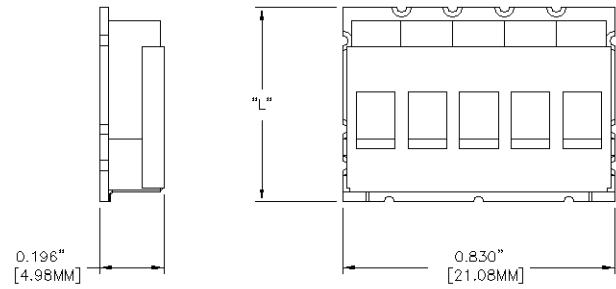
4 mm SMT

TT4P2—P—



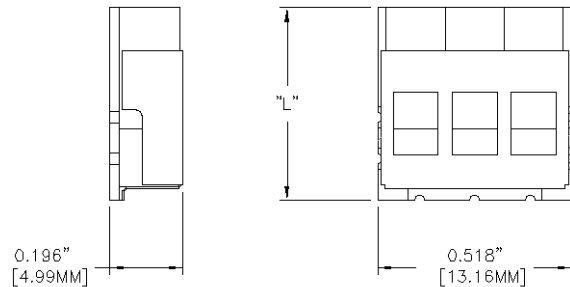
TOLERANCE:
0.XXX = ± 0.010 " [0.25MM]

TT4P5—P—



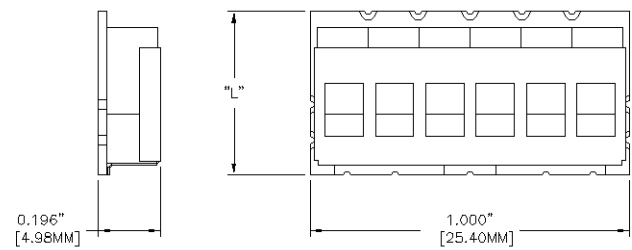
TOLERANCE:
0.XXX = ± 0.010 " [0.25MM]

TT4P3—P—



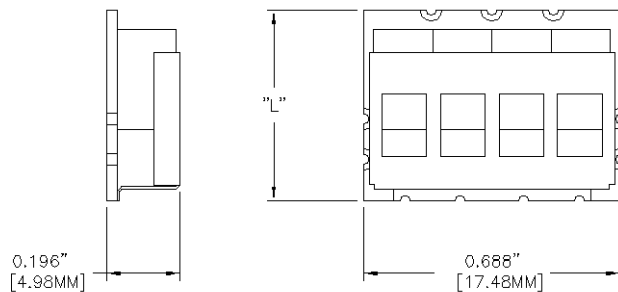
TOLERANCE:
0.XXX = ± 0.010 " [0.25MM]

TT4P6—P—



TOLERANCE:
0.XXX = ± 0.010 " [0.25MM]

TT4P4—P—



TOLERANCE:
0.XXX = ± 0.010 " [0.25MM]

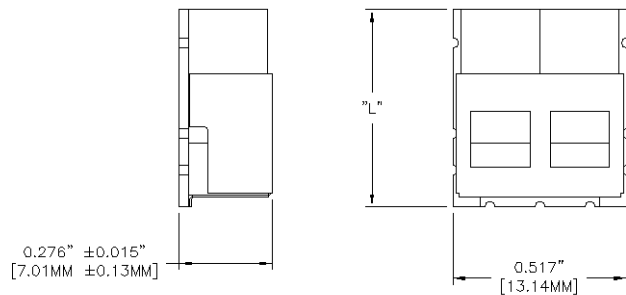
SMT Filter Length

Filter	Inches	mm
P1	0.434	11
P2	0.512	13
P3	0.590	15
P4	0.669	17
P5	0.748	19
P6	0.827	21
P7	0.906	23
P0	Custom	Custom

Dimension 'L' will vary in length dependent upon filter's frequency.
All dimensions are in inches.

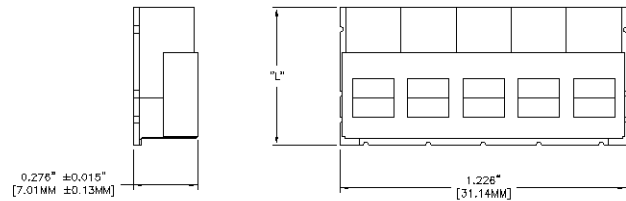
6 mm SMT

TT6P2—P—



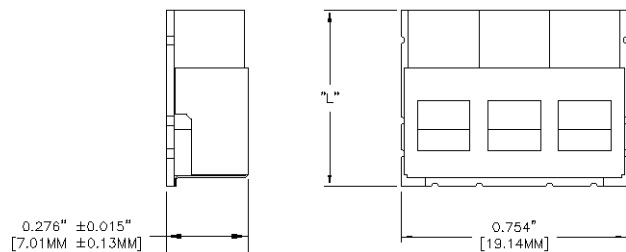
TOLERANCE:
0.XXX = $\pm 0.010"$ [0.25MM]

TT6P5—P—



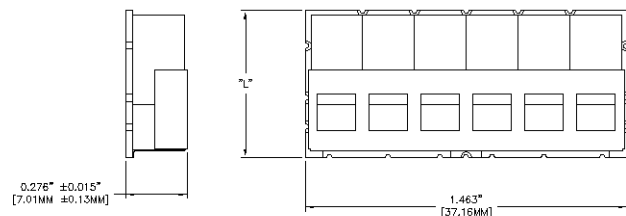
TOLERANCE:
0.XXX = $\pm 0.010"$ [0.25MM]

TT6P3—P—



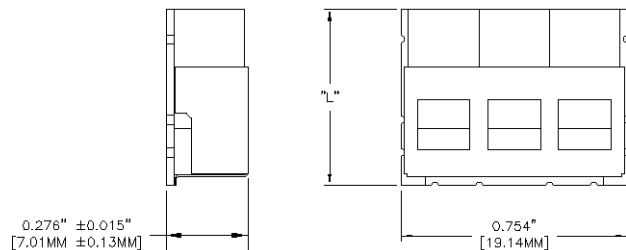
TOLERANCE:
0.XXX = $\pm 0.010"$ [0.25MM]

TT6P6—P—



TOLERANCE:
0.XXX = $\pm 0.010"$ [0.25MM]

TT6P4—P—



TOLERANCE:
0.XXX = $\pm 0.010"$ [0.25MM]

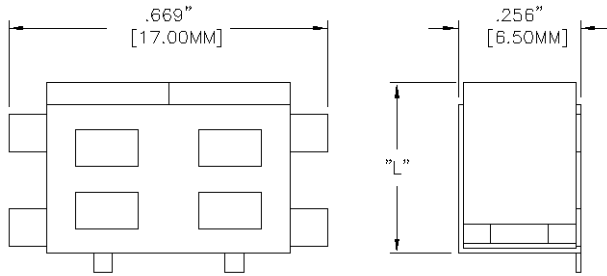
SMT Filter Length

Filter	Inches	mm
P1	0.434	11
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P6	0.827	21
P7	0.906	23
P0	Custom	Custom

Dimension 'L' will vary in length dependent upon filter's frequency.
All dimensions are in inches.

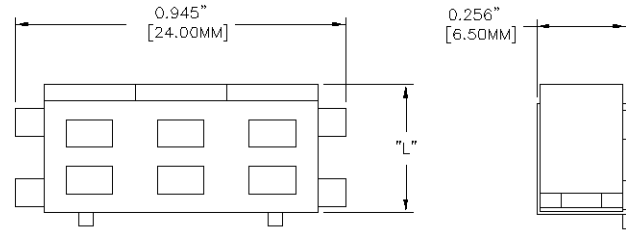
6 mm Flat Pack (F)

TT6P2—F



TOLERANCE:
0.XXX = ± 0.005 " [0.13MM]

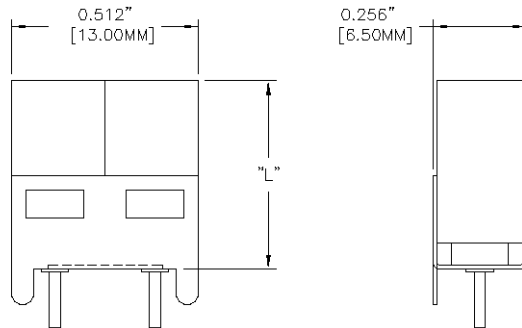
TT6P3—F



TOLERANCE:
0.XXX = ± 0.005 " [0.13MM]

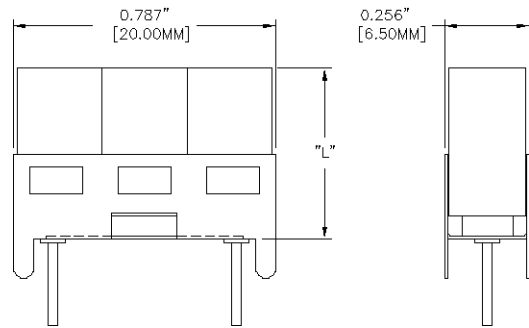
6 mm Thru-Hole (T)

TT6P2—T



TOLERANCE:
0.XXX = ± 0.005 " [0.13MM]

TT6P3—T



TOLERANCE:
0.XXX = ± 0.005 " [0.13MM]

Dimension 'L' will vary in length dependent upon filter's frequency.
All dimensions are in inches.

Design Solutions Software

CRaFT Program

Example

Designing a 915 MHz ISM band filter is a typical example of how to use the CRaFT software. Knowing the design parameters in advance helps to narrow down the initial design. Use the following procedures to complete design of this filter.

1. Use the Start button to enter the Programs menu.
2. Select Trans-Tech Design Guides and click on CRaFT.
3. Enter the desired center frequency, 915 MHz, for the filter.
4. Enter the total bandwidth, 25 MHz, necessary for the new design.
5. Use a bandwidth definition of 1 dB.
6. For the example we are going to use a 4 mm package style with 3 poles to the filter.
7. The D9000 material has been preselected for optimum performance. Other material types are included for fine tuning a design.
8. The design is now complete. The part number is listed, TT4P3-0915P3-2530, and the design guide can easily be printed out. In addition a typical plot has been generated to look at attenuation where necessary.

9. As a final aid, there is a list of previously designed filters. If timing is of importance, selecting one from this list removes the time needed for prototyping a new design.
10. Sometimes a filter specification might come up with no solution. In this case, please consult the factory for assistance in the design.
11. After the design has been finalized, the filter can be printed.
12. Click file, choose print data sheet.

Fill out the appropriate information and fax to the number listed on the printed quotation form. At any time, click on Help for details and hints.



Trans-Tech's design software is available by visiting our website; trans-techinc.com or calling us at 301.695.9400.