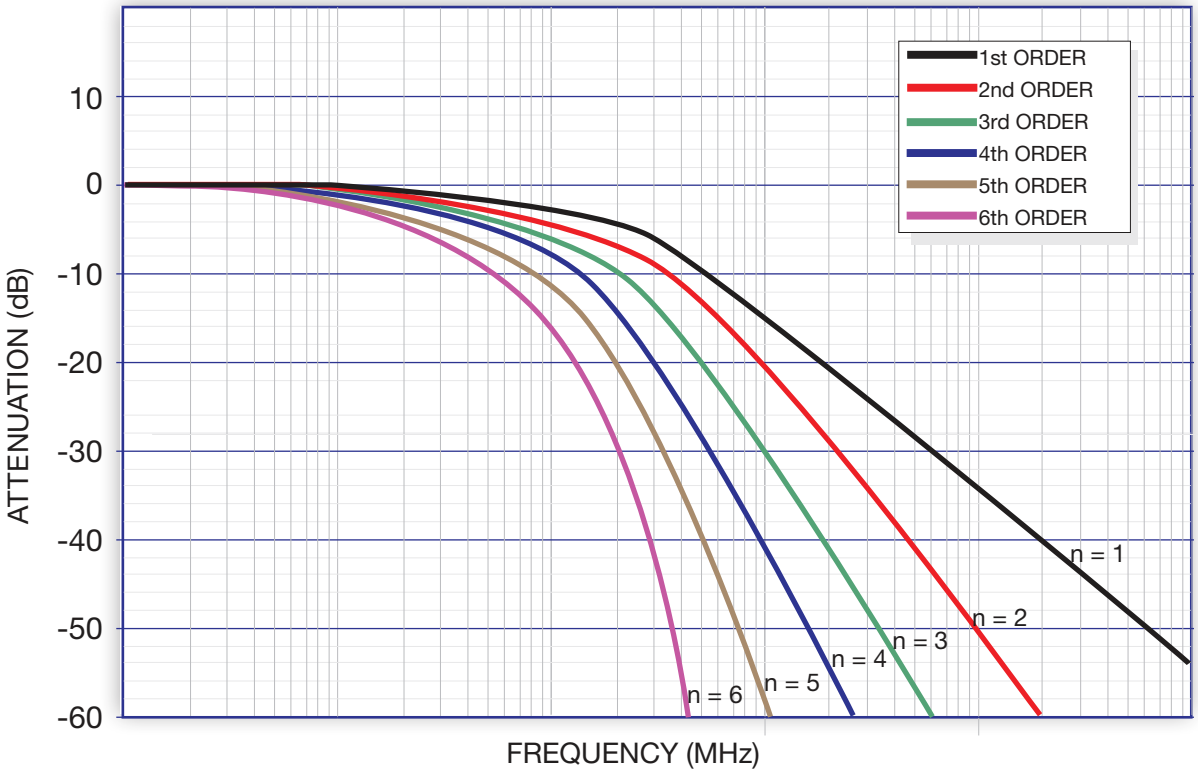
EMI Filter Circuits

The following is a brief description of the most popular types of EMI Filter circuits and their application.It should be pointed out that these are only general guidelines due to the fact that most impedance conditions and EMI profiles are dynamic, complex, and change with frequency.

- **C Circuit Feedthrough Capacitor, 1st Order:** A single element shunt feedthrough capacitor has attenuation characteristics that increases at a rate of 20 dB per decade. A feedthrough capacitor filter is usually the best choice for filtering lines that exhibit very high source and load impedances.
- **L-Circuit Filter, 2nd Order:** A two element network consisting of a series inductive component connected to a shunt feedthrough capacitor. This type of filter network has attenuation characteristics that increases at a rate of 40 dB per decade. An "L" circuit filter is best suited for filtering lines when the source and load impedances exhibit large differences. For most applications this type of network provides the greatest performance when the inductor is facing the lower of the two impedances.
- **PI-Circuit Filter, 3rd Order:** This is a three element filter consisting of two shunt feedthrough capacitors with a series inductive component connected between them. This three element filter has attenuation characteristics that increases at a rate of 60 dB per decade. A "PI" circuit filter is usually the best choice when high levels of attenuation are required and when the source and load impedances are of similar values and relatively high.
- **T-Circuit Filter, 3rd Order:** This also is a three element filter consisting of two inductive components with a single shunt feedthrough capacitors connected between them. Like the "PI" circuit filter, this device has attenuation characteristics that also increase at a rate of 60 dB per decade. A "T" circuit filter is the best choice when high levels of attenuation are required and when the source and load impedances are of similar values and relatively low.
- **Double Circuits, 4th, 5th, 6th Orders:** Double circuits consisting of four, five, and six elements are best suited when extremely high levels of attenuation are required. Double "L's" have a theoretical attenuation of 80 dB per decade, while double "PI's" and double "T's" have a theoretical attenuation of 100 dB per decade. The source and load impedance conditions that apply to the single circuit devices apply to the double circuit filters.

Low Pass Filter Frequency Response

(1st, 2nd, 3rd, 4th, 5th, 6th Orders)



Filter Installation Guides

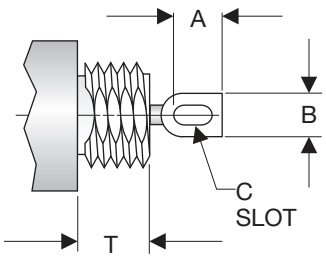
Cylindrical Style Working Practices

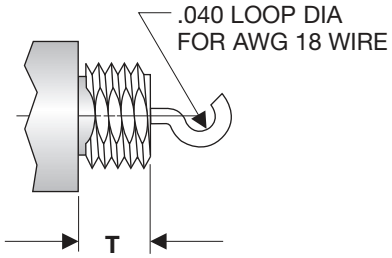
- Observe the recommended torque requirements for the specific thread size; 1/4-28 UNF-2A require 44±4 oz-in. and 5/16-24-UNF-2A require 60±4 oz-in.
- Avoid mechanical stress on the filter body. Pliers or other tools capable of excessive pressure on the case must be avoided in all instances. The pressure is capable of cracking the internal ceramic capacitor and/or the glass seals on the terminals.
- Filters are capable of withstanding temperature extremes but care should be observed to avoid rapid heat up and cool down as this can crack the internal ceramic capacitor.
  - Pre-heating the filter prior to soldering is recommended whenever possible.
  - Recommended pre-heat: +120ºC ±5ºC, for 15/20 minutes.
  - Forced air cool down post soldering is not recommended.
- Soldering techniques:
  - Use a heat sink between the filter body and the point of soldering whenever possible.
  - Use a temperature controlled soldering iron with a tip temperature of +325ºC ±25ºC.
  - Use of an 25-40 watt soldering iron is recommended, the use of a larger wattage iron may cause the high temperature solder used in the inside diameter of the terminal tubelet to reflow defeating the hermetic seal and possibly cause heat related damage the ceramic capacitor (thermal fractures).
  - Use 60/40 or SN 63 RMA flux core solder.
  - Solder iron tip to point of contact on the terminal flag should be limited to 5-10 seconds when soldering wire to the terminal. Excessive contact may possibly reflow the high temperature solder at the tubelet and damage the hermetic seal.
  - **Use caution when soldering wire to the terminal flag. Assure that the correct wire size is specified for the flag terminal slot. Forcing a size wire through the terminal slot that is larger than the slot may cause undue mechanical stress on the terminal and may crack the glass seal. This may also transmit stress to the ceramic capacitor causing micro-fractures.**

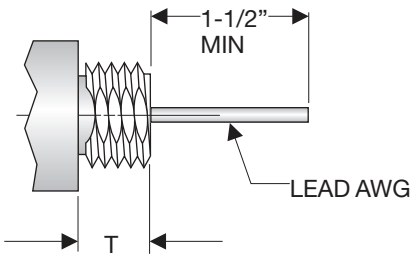
Solder-In Style WorkingPractices

- Soldering techniques:
  - Pre-Heat unit to +150ºC prior to installation
  - Increase soldering temperature at a rate of 2ºC-3ºC / second until solder temperature, 300ºC max., is achieved.
  - The maximum time at solder temperature is 30 seconds;
    - If lead length permits a heat sink clip is recommended.
    - A 15 to 20 watt iron is recommended with an iron tip temperature of 238ºC max. and do not apply heat longer than 30 seconds.
    - 60/40 solder is recommended.
  - Avoid mechanical stress on the filter leads;
    - The stress is capable of cracking the glass and damaging the internal discoidal capacitor element.

Mechanical and Hardware Information







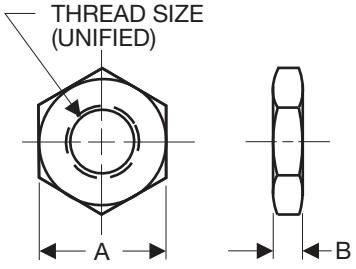
THREAD SIZE	TERMINAL AND HEADER DETAIL			
	A	B	C	T
1/4-28	.095 ±.005	.105 ±.005	.055 x .075	.190 ±.005
				.312 ±.005
5/16-24	.140 ±.005	.115 ±.005	.062 x .125	.190 ±.005
				.312 ±.005

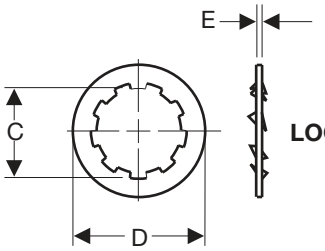
* LEAD AWG	
UP TO 5 AMPS	AWG 24
10 AMPS	AWG 22
15 AMPS	AWG 19

*Other lead gages available upon request.

THREAD SIZE	RECOMMENDED TORQUE
#4-40 UNC-2A	32 ± 4 oz-in
#8-32 UNC-2A	64 ± 4 oz-in
#12-32 UNEF-2A	64 ± 4 oz-in
1/4-28 UNF-2A	44 ± 4 oz-in
5/16-24 UNF-2A	64 ± 4 oz-in

HEX NUT





LOCKWASHER

THREAD SIZE	A	B	C	D	E
#4-40 UNC-2A	.185/.175	.067/.057	.123/.116	.225/.215	.020/.010
#8-32 UNC-2A	.260/.240	.073/.063	.169/.165	.288/.278	.023/.013
#12-32 UNEF-2A	.260/.240	.073/.063	.231/.221	.406/.394	.027/.017
1/4-28 UNF-2A	.332/.302	.098/.088	.267/.256	.408/.396	.022/.012
5/16-24 UNF-2A	.448/.428	.135/.115	.324/.314	.435/.425	.027/.017
5/8-24 UNEF-2A	.740/.760	.135/.115	.659/.640	1.07/1.05	.040/.050
3/4-20 UNEF-2A	1.05/1.07	.135/.115	.769/.795	1.22/1.25	.045/.055
1 1/8-18 UNEF-2A	1.68/1.63	.184/.190	1.17/1.14	1.83/1.80	.057/.067