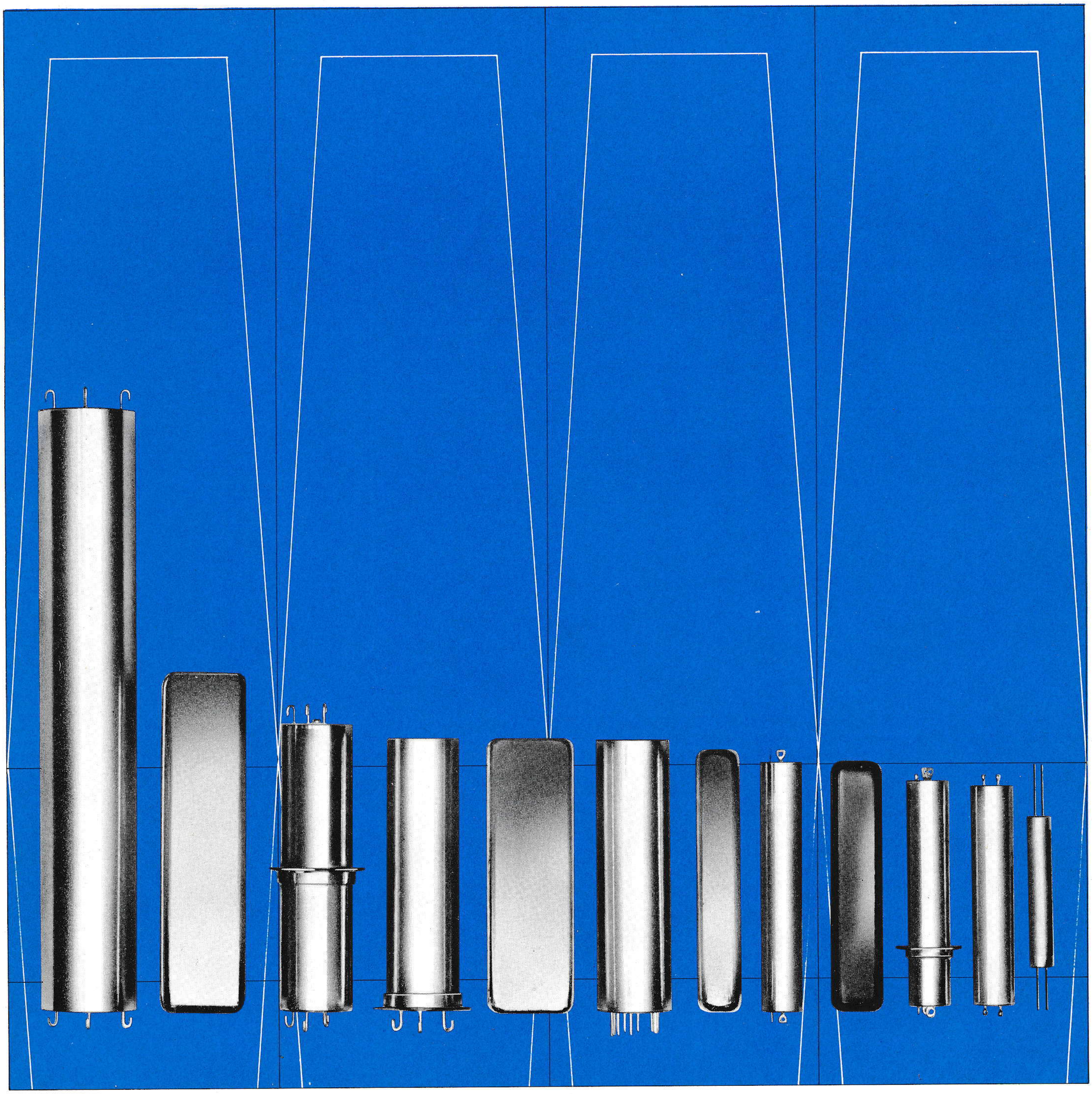
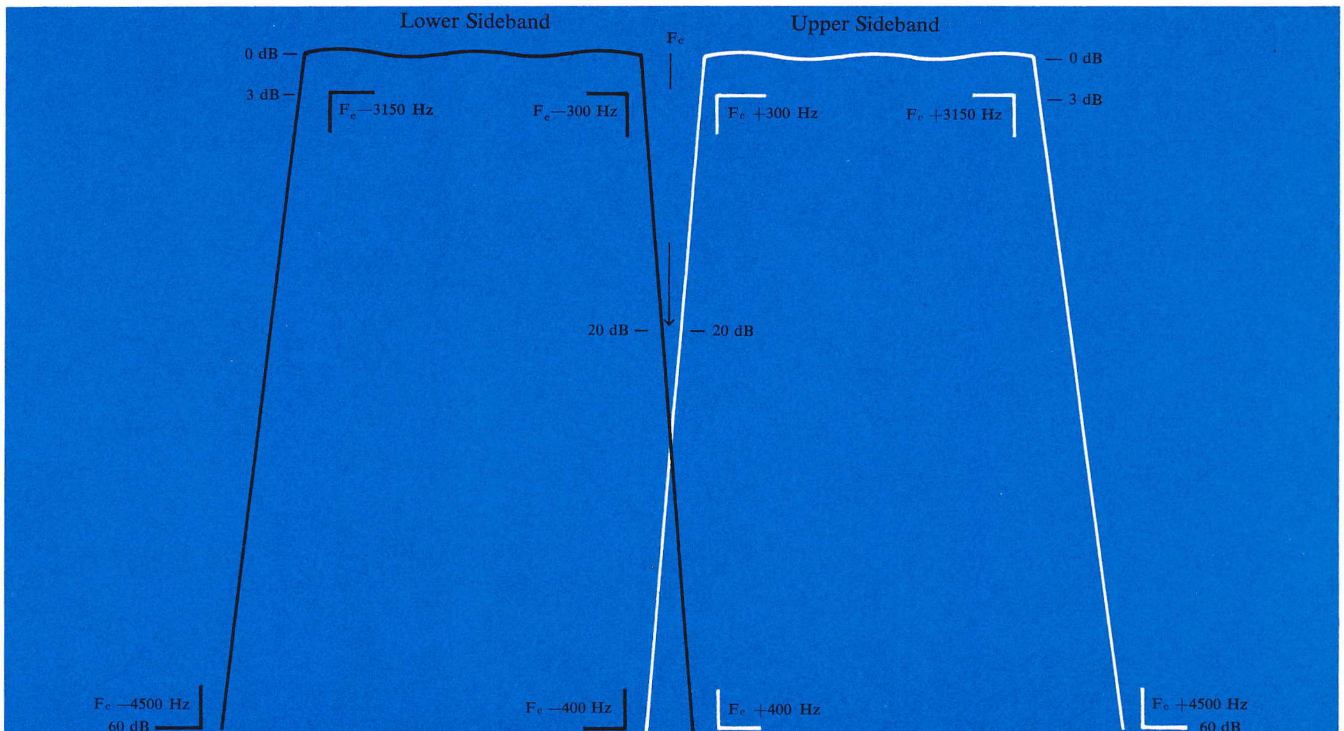
Collins Mechanical Filters Catalog

COLLINS





Frequency Response Worst-Case Limits

New: State-of-the-art SSB Mechanical Filters

Collins new F455Z-23C, -24C and F500Z-22C and -23C single sideband filters offer standard line prices with state-of-the-art performance. The new filters are highly selective, have low insertion loss and require no tuning. The freqeuncy response plots above are the worst case limits.

The new designs incorporate concepts in the mechanical filter field which provide improvements not previously attainable. One of these is the realization of attenuation peaks on both sides of the filter passband. This was accomplished through the use of "double bridging wire" techniques recently patented by Collins Radio Company. Employment of the techniques results in high selectivity with a minimum of disc resonators.

Another innovation is the use of a piezoelectric transducer replacing the magnetostrictive transducer. This design technique lowers the insertion loss to a point where it is no greater than a crystal filter. The use of piezoelectric transducers also reduces magnetic susceptibility in the filter and improves intermodulation distortion characteristics. The filters are designed with input and output transformers internally tuned, eliminating all requirements for external tuning. The filters are listed on page 8. Dimensions of the brass cartridge case, Style V, are presented on page 14.

SPECIFICATIONS	*Limits*	*Nominal Values*
Carrier Frequency (F_c)	455 kHz or 500 kHz	—
Carrier Rejection	20 db minimum	25 dB
Frequency Response	See curves above	—
3 dB bandwidth	2850 Hz minimum	3100 Hz
60 dB bandwidth	4900 Hz maximum	4100 Hz
Passband Ripple	2.5 dB maximum	1.5 dB
Insertion Loss	5 dB maximum	3 dB
Source and Load Impedance	2000 ohms	—
Operating Temperature Range	−20°C to +65°C	—

How to use this Catalog

This catalog lists the standard production Mechanical Filters available from stock. The listing is divided into three categories: Symmetrical Bandpass (page 5), Single Sideband (page 7), and Voice Multiplex Sideband (page 8). Standard case styles are described on pages 13 and 14. A general description of Mechanical Filters is presented on pages 3 and 4, and a brief design and application discussion appears on pages 10, 11 and 12. Design of Mechanical Filters for applications requiring special characteristics are performed by Collins engineering staff. Price quotations are furnished on request from your nearest Collins Engineering Sales Representative or from Collins Radio Company, Components Marketing, Newport Beach, Calif. 92663. Phone 714-833-0600.

Collins Mechanical Filters/General Information

Collins Mechanical Filters provide excellent discrimination against unwanted signals by steep-skirted selectivity while achieving a flat-topped frequency response. Electrically and mechanically stable, the filters tolerate extreme temperature changes with minor frequency shift, and give continuous service without aging or breakdowns. The filters are sealed in molded-phenolic cases or hermetically-sealed metal cases. Values of frequency stability with temperature vary from 2 to 10 PPM/°C between −40°C and +85°C for various filter types. In general, they may be operated over wider temperature ranges with slight degradation of characteristics. Figure 1 defines the MF frequency vs percent bandwidth spectrum.

The Collins Mechanical Filter is a mechanically resonant device which receives an electrical signal, converts this signal into mechanical vibrations, rejects unwanted frequencies within the mechanical structure, and then converts the mechanical vibration back into electrical energy. The filter consists of three basic elements: (1) transducers which convert electrical signals into mechanical vibrations, (2) high Q mechanically resonant metal discs, and (3) disc coupling wires. The transducers may be the magnetostrictive type, which until recently have been used exclusively in Collins Mechanical Filters, or they may be the newer piezoelectric ceramic type.

Figure 3 shows an electrical signal applied to the input coil of a magnetostrictive transducer. This produces an alternating magnetic field that passes through the magnetostrictive rod attached to the first disc. Since a magnetostrictive material changes its dimensions when subjected to a magnetic field, the rod when biased properly, will vibrate at the frequency of the impressed signal. The rod, in turn, drives the first disc which, by means of the short coupling wires connecting the discs, drives the next disc and so on until the signal reaches the output transducer. Strains developed in the output magnetostrictive rod produce an alternating magnetic field, which induces a voltage across the output coil. Filters using piezoelectric ceramic transducers operate in a manner similar to that described above. However, the coil, biasing magnet, and magnetostrictive rod of Figure 3 are replaced by the piezoelectric ceramic rod, and the coil inductance and resonating capacity of the equivalent circuit of Figure 3 are replaced by the transducer static capacitance and the resonating inductance respectively. A voltage across the input piezoelectric transducer produces an alternating electric field in the transducer which causes it to vibrate. These vibrations, as described above, are again transmitted through the

Figure 1. Mechanical Filter Percent Bandwidth vs Frequency Spectrum.

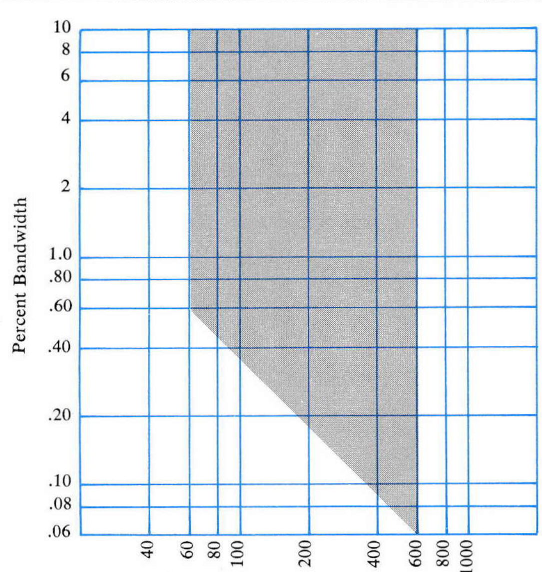


Figure 2. Frequency Response Characteristics of a Typical Voice Channel Filter.

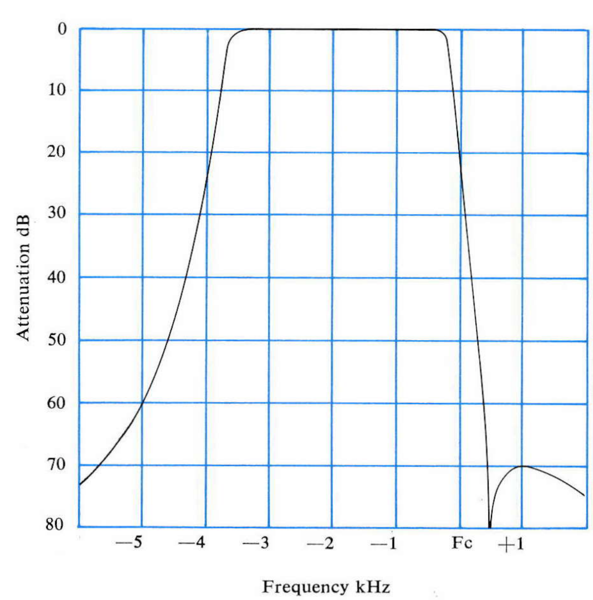


Figure 3. Mechanical Filter Electrical Analogy.

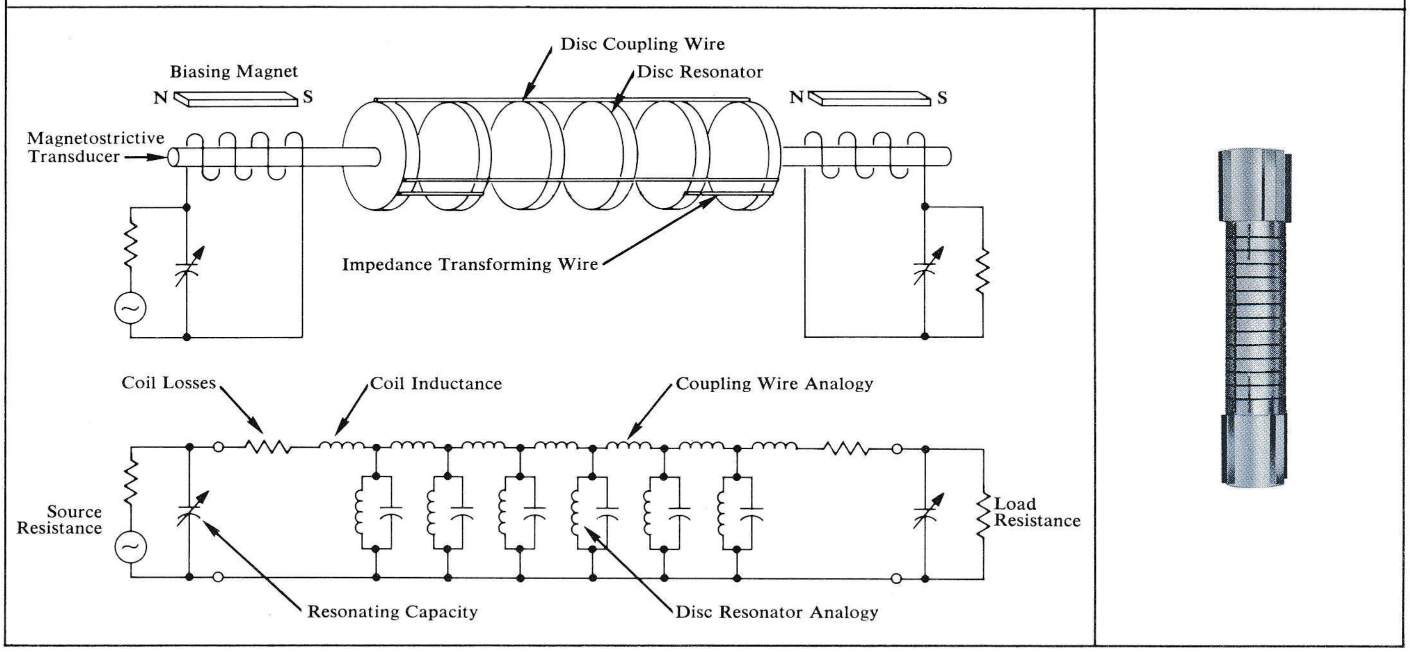
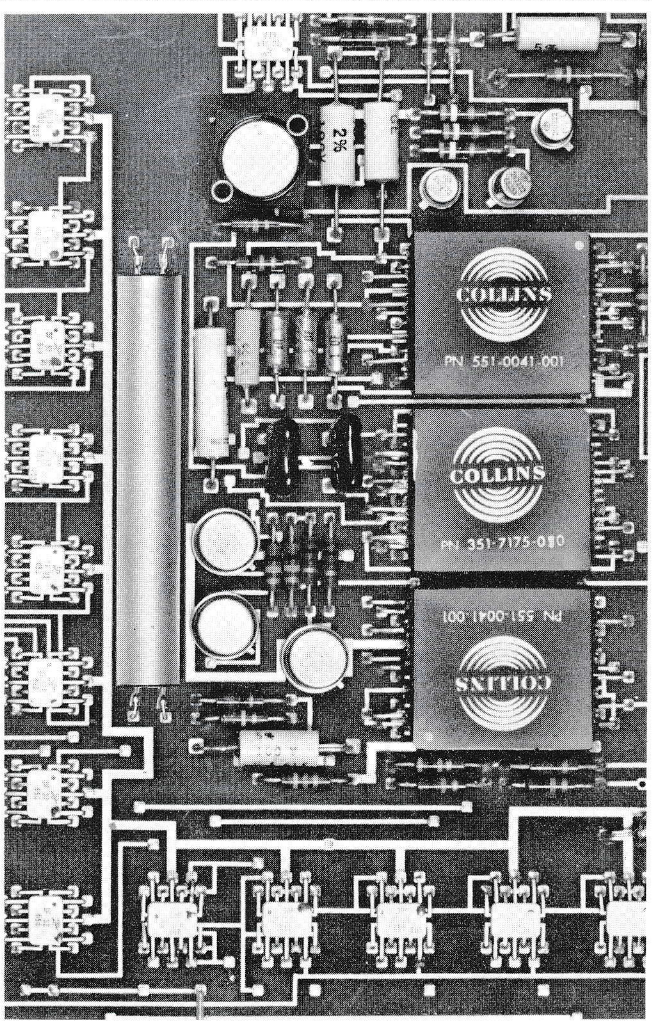


Figure 4. Typical installation of a Collins Mechanical Filter on a circuit board. Flat packs are Collins hybrid thin film circuits.



disc-wire assembly to the output transducer which converts the vibrations to a voltage at the filter output.

The transducers not only convert energy from one form to another, but also reflect the source and load resistances into the mechanical circuit. The reflected impedances provide a termination for the filter.

The multi-element filter in the electrical analogy *(Figure 3)* illustrates how the center frequency of the filter is determined by the metal discs. Each disc is represented by a parallel resonant circuit. Increasing the number of discs increases the skirt selectivity of the filter. Skirt selectivity is specified as shape factor which is the ratio of 60 dB to 6 dB bandwidth. Shape factors are as low as 1.2 to 1.

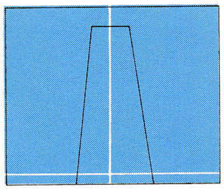
The coupling inductors represent the wires which couple the discs. By varying the mechanical coupling between the discs, that is, making the coupling wires larger or smaller, the bandwidth of the filter is varied. Because the bandwidth varies approximately as the total cross-sectional area of the coupling wires, the bandwidth can be increased by either using larger diameter wires or a greater number of coupling wires. Standard available bandwidths range from 500 Hz to 50 kHz. Special units are built with bandwidths outside these nominal limits. By bridging one or more discs with a coupling wire of proper dimensions, it is possible to achieve a cancellation of signals at the output of the Mechanical Filter. This results in attenuation poles in either the upper or lower filter stopbands, or both. Filters utilizing these attenuation poles provide steeper skirt selectivity with fewer disc resonators than filters without them.

The frequency response characteristics of a typical voice channel filter are shown in Figure 2. The attenuation pole is at a frequency above the filter passband. The passband ripple is low. The envelope delay is smooth and fairly flat; therefore, the filter delay characteristic can easily be equalized.

Applications for the wide range of standard filters include single sideband, high performance transmitting and receiving equipment, multiplexing equipment, missile guidance systems, frequency synthesizers, doppler radar, data transmission systems, precision navigation equipment, spectrum analyzers, FM communications receivers, CB transceivers, and others.

Collins Mechanical Filters

Collins Radio Company offers a wide selection of Mechanical Filters in three basic types: Symmetrical Bandpass, Single Sideband, and Voice Multiplex Sideband.



Symmetrical Bandpass

This table lists Collins *standard* symmetrical bandpass Mechanical Filter designs. Case styles are described on pages 13-14. For special designs to your specifications, contact your nearest Collins Engineering Sales Representative or Collins Radio Company, Newport Beach, Calif. 92663. Phone 714-833-0600.

Center Frequency (kHz)	*Type*	*Part Number*	*Nominal Bandwidth (kHz)*	*Maximum Bandwidth (kHz @ 60 dB)*	*Case Style*
142	F142Y-15	526-9566-001	1.5 @ 6 dB	3.75	Y-3
200	F200A-10/30	526-9098-000	1.0 @ 6 dB 3.0 @ 6 dB	3.00 6.90	(Special Dual)
200	F200L-10	526-9409-000	1.0 @ 6 dB	3.0	K (special)
200	F200L-10A	526-9520-001	1.0 @ 6 dB	3.0	K (special)
200	F200Y-23	526-9567-001	2.0 @ 3 dB	4.8	Y-2.8
200	F200Y-60	526-9487-000	6.0 @ 6 dB	13.0	Y (long)
205	F205Y-23	526-9568-001	2.0 @ 3 dB	4.8	Y-2.8
235	F235Y-80R	526-9557-001	8.0 @ 3 dB	20.0 (@ 40 dB)	F
245.0	F245Q-1	526-9345-000	0.5 @ 3 dB	1.5 (@ 50 dB)	H (special)
245.5	F245Q-2	526-9346-000	0.5 @ 3 dB	1.5 (@ 50 dB)	H (special)
250	F250Q-1	526-9347-000	0.5 @ 3 dB	1.5 (@ 50 dB)	H (special)
250	F250Q-07	526-9484-000	0.7 @ 6 dB	2.5	H (special)
250	F250A-20	526-9012-00	2.0 @ 6 dB	4.3	C
250	F250C-27	526-9514-001	2.7 @ 6 dB	4.5 (@ 40 dB)	C
250	F250Z-3	526-9080-000	2.7 @ 6 dB	4.5 (@ 40 dB)	K (special)
250	F250X-4	526-9218-000	2.85 @ 3 dB	6.0 (@ 65 dB)	L-3⅞
250	F250A-67	526-9039-000	6.7 @ 6 dB	14.0	C
250	F250F-80R	526-9558-001	8.0 @ 3 dB	20.0 (@ 40 dB)	F
250	F205A-85	526-9049-000	8.5 @ 6 dB	18.0	C
250	F250F-100	526-9410-000	10.0 @ 6 dB	20.0 (@ 40 dB)	F
265	F265F-80R	526-9559-001	8.0 @ 3 dB	20.0 (@ 40 dB)	F
300	F300K-05	526-9589-010	0.5 @ 6 dB	1.1	K
300	F300C-68	526-9477-00	6.5 @ 6 dB	10.8	C
300	F300X-68	526-9307-00	6.5 @ 6 dB	10.8	L (special)
450	F450Y-60	526-9643-010	6.0 @ 6 dB	26.0	Y
452	F452FA-21	526-9628-010	2.1 @ 6 dB	5.3	FA
453	F453Q-06	526-9627-010	0.7 @ 12 dB	N/A	Y-3¼
455	F455E-05	526-9321-00	0.5 @ 6 dB	2.5	E
455	F455F-05	526-9318-00	0.5 @ 6 dB	2.5	F
455	F455FA-05	526-9494-00	0.5 @ 6 dB	2.5	FA
455	F455H-05	526-9229-00	0.5 @ 3 dB	2.5	H
455	F455J-05	526-9154-00	0.5 @ 3 dB	2.5	J
455	F455K-05	526-9228-00	0.5 @ 3 dB	2.5	K
455	F455M-05	526-9614-010	0.54 @ 3 dB	3.4	M
455	F455Q-5	526-9367-00	0.5 @ 6 dB	2.5	L-2-29/32
455	F455Q-8	526-9393-00	0.5 @ 6 dB	2.5	J
455	F455Y-05	526-9521-001	0.5 @ 6 dB	3.0	Y (long)
455	F455FB-05	526-9530-001	0.54 @ 3 dB	3.1	FA
455	F455F-08	526-9085-00	0.8 @ 6 dB	2.0	F
455	F455FA-08	526-9446-00	0.8 @ 6 dB	4.0	FA
455	F455J-08	526-9090-00	0.8 @ 6 dB	2.6	J
455	F455F-085	526-9610-010	0.850 @ 6 dB	4.5	F
455	F455E-15	526-9370-00	1.5 @ 6 dB	3.5	E
455	F455E-15S	526-9571-010	1.5 @ 6 dB	18.0	E
455	F455F-15	526-9227-00	1.5 @ 6 dB	3.5	F
455	F455FA-15	526-9495-00	1.5 @ 6 dB	3.5	FA
455	F455H-15	526-9170-00	1.5 @ 6 dB	3.5	H
455	F455J-15	526-9155-00	1.5 @ 6 dB	3.5	J
455	F455K-15	526-9168-00	1.5 @ 6 dB	3.5	K
455	F455Q-6	526-9379-00	1.5 @ 6 dB	3.5	J (short)
455	F455Y-15F	526-9638-010	1.5 @ 6 dB	3.5	Y
455	F455NL-20	526-9562-001	2.2 @ 6 dB	11.5	K (special)
455	F455Q-2	526-9309-00	2.0 @ 6 dB	5.6	Y
455	F455E-21	526-9322-00	2.1 @ 6 dB	5.3	E

(continued)

Symmetrical Bandpass

Center Frequency (kHz)	*Type*	*Part Number*	*Nominal Bandwidth (kHz)*	*Maximum Bandwidth (kHz @ 60 dB)*	*Case Style*
455	F455F-21	526-9323-00	2.1 @ 6 dB	5.3	F
455	F455FA-21	526-9427-00	2.1 @ 6 dB	5.3	FA
455	F455FC-21	526-9564-001	2.0 @ 6 dB	7.5 (@ 50 dB)	FA
455	F455H-21	526-9313-00	2.1 @ 6 dB	5.3	H
455	F455J-21	526-9156-00	2.1 @ 6 dB	5.3	J
455	F455K-21	526-9317-00	2.1 @ 6 dB	5.3	K
455	F455N-20	526-9163-00	2.1 @ 6 dB	5.3	K (special)
455	F455Y-21	526-9337-00	2.1 @ 6 dB	5.3	Y
455	F455FA-27	526-9500-00	2.9 @ 6 dB	6.5	FA
455	F455E-31	526-9074-00	3.1 @ 6 dB	6.5	E
455	F455F-31	526-9075-00	3.1 @ 6 dB	6.5	F
455	F455FA-31	526-9496-00	3.1 @ 6 dB	6.5	FA
455	F455H-31	526-9093-00	3.1 @ 6 dB	6.5	H
455	F455J-31	526-9089-00	3.1 @ 6 dB	6.5	J
455	F455K-31	526-9338-00	3.1 @ 6 dB	6.5	K
455	F455Q-7	526-9380-00	3.1 @ 6 dB	6.5	J
455	F455Y-31	526-9338-00	3.1 @ 6 dB	6.5	Y
455	F455E-40	526-9324-00	4.0 @ 6 dB	8.5	E
455	F455F-40	526-9325-00	4.0 @ 6 dB	8.5	F
455	F455FA-40	526-9497-00	4.0 @ 6 dB	8.5	FA
455	F455H-40	526-9326-00	4.0 @ 6 dB	8.5	H
455	F455J-40	526-9327-00	4.0 @ 6 dB	8.5	J
455	F455K-40	526-9303-00	4.0 @ 6 dB	8.5	K
455	F455N-40	526-9160-00	4.0 @ 6 dB	8.5	K (special)
455	F455Y-40	526-9339-00	4.0 @ 6 dB	8.5	Y
455	F455Y-40F	526-9639-010	4.0 @ 6 dB	8.5	Y
455	F455E-60	526-9084-00	6.0 @ 6 dB	12.6	E
455	F455F-60	526-9087-00	6.0 @ 6 dB	12.6	F
455	F455FA-60	526-9498-00	6.0 @ 6 dB	12.6	FA
455	F455FC-60	526-9522-001	6.0 @ 6 dB	25.9	FA
455	F455H-60	526-9094-00	6.0 @ 6 dB	12.6	H
455	F455J-60	526-9091-00	6.0 @ 6 dB	12.6	J
455	F455K-60	526-9159-00	6.0 @ 6 dB	12.6	K
455	F455Y-60	526-9340-00	6.0 @ 6 dB	12.6	Y
455	F455E-80	526-9332-00	8.0 @ 6 dB	18.5	E
455	F455E-80S	526-9569-010	8.0 @ 6 dB	20.0	E
455	F455F-80	526-9331-00	8.0 @ 6 dB	18.5	F
455	F455H-80	526-9330-00	8.0 @ 6 dB	18.5	H
455	F455J-80	526-9329-00	8.0 @ 6 dB	18.5	J
455	F455K-80	526-9328-00	8.0 @ 6 dB	18.5	K
455	F455N-80	526-9161-00	8.0 @ 6 dB	18.5	K (special)
455	F455Y-80	526-9341-00	8.0 @ 6 dB	18.5	Y
455	F455E-120	526-9336-00	12.0 @ 6 dB	23.0	E
455	F455F-120	526-9173-00	12.0 @ 6 dB	23.0	F
455	F455FA-120	526-9563-001	12.0 @ 6 dB	30.0	FA
455	F455H-120	526-9171-00	12.0 @ 6 dB	23.0	H
455	F455J-120	526-9333-00	12.0 @ 6 dB	23.0	J
455	F455K-120	526-9316-00	12.0 @ 6 dB	23.0	K
455	F455Y-120	526-9342-00	12.0 @ 6 dB	23.0	Y
455	F455YA-120A	526-9489-001	12.0 @ 6 dB	30.0	Y
455	F455YA-120B	526-9629-010	12.0 @ 6 dB	30.0	Y
455	F455T-150A	526-9667-010	15.0 @ 6 dB	30.0	T

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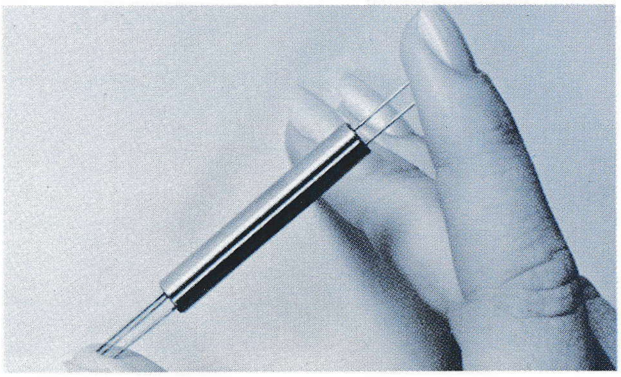
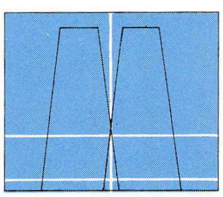


New: Collins F455T-150A Symmetrical Bandpass Minifilters

Available in a cylindrical brass case less than 0.1 cubic inch in volume (1½ inch long, ¼ inch diameter). Center frequency: 455 kHz nominal. Frequency response: bandwidth, 6 dB attenuation, 15 kHz nominal; bandwidth 60 dB attenuation, 30 kHz maximum. Source and load impedance: 70,000 ohms. Passband ripple: 2 dB maximum. Operating temperature range: −10°C to +60°C.

Symmetrical Bandpass

Center Frequency (kHz)	*Type*	*Part Number*	*Nominal Bandwidth (kHz)*	*Maximum Bandwidth (kHz @ 60 dB)*	*Case Style*
455	F455E-160	526-9320-00	16.0 @ 6 dB	27.5	E
455	F455F-160	526-9335-00	16.0 @ 6 dB	27.5	F
455	F455H-160	526-9314-00	16.0 @ 6 dB	27.5	H
455	F455J-160	526-9334-00	16.0 @ 6 dB	27.5	J
455	F455K-160	526-9315-00	16.0 @ 6 dB	27.5	K
455	F455N-160	526-9162-00	16.0 @ 6 dB	38.0	K (special)
455	F455Y-160	526-9343-00	16.0 @ 6 dB	27.5	Y
455	F455T-300	526-9655-010	30.0 @ 3 dB	55.0	T
455	F455Y-330	526-9607-00	33.0 @ 6 dB	60.0	Y
455	F455E-350	526-9371-00	35.0 @ 6 dB	62.0	E
455	F455F-350	526-9180-00	35.0 @ 6 dB	62.0	F
455	F455H-350	526-9302-00	35.0 @ 6 dB	62.0	H
455	F455J-350	526-9300-00	35.0 @ 6 dB	62.0	J
455	F455K-350	526-9186-00	35.0 @ 6 dB	62.0	K
455	F455Y-350	526-9344-00	35.0 @ 6 dB	62.0	Y
455	F455Y-350A	526-9582-010	35.0 @ 6 dB	60.0	Y
455	F455Q-3	526-9310-00	40.0 @ 6 dB	140.0	Y
455.7	F455Q-05	526-9305-00	0.5 @ 6 dB	2.1	H, J, or K
500	F500Y-01S	526-9556-001	0.15 @ 2 dB	8.0 (@ 40 dB)	Y
500	F500B-08	526-9007-00	0.8 @ 6 dB	3.5	E
500	F500Y-08CW	526-9588-010	0.8 @ 3 dB	3.0	Y
500	F500B-14	526-9030-00	1.4 @ 6 dB	3.8	E
500	F500F-14	526-9215-00	1.4 @ 6 dB	3.5	F
500	F500B-31	526-9008-00	3.1 @ 6 dB	7.5	E
500	F500F-31	526-9408-00	2.2 @ 3 dB	8.0	F
500	F500Y-31	526-9426-00	3.1 @ 6 dB	8.0	Y
500	F500Y-31S	526-9453-00	3.1 @ 6 dB	8.0	Y
500	F500B-60	526-9009-00	6.0 @ 6 dB	14.0	E
500	F500F-60	526-9319-00	6.0 @ 6 dB	19.0	F
500	F500M-60	526-9621-010	6.0 @ 6 dB	14.0	M
500	F500MI-60	526-9617-010	6.0 @ 3 dB	14.0	M
500	F500Y-60	526-9378-00	6.0 @ 6 dB	13.2	Y
500	F500Y-70	526-9421-00	7.0 @ 6 dB	19.0	Y (flange)
500	F500Y-80F	526-9646-010	8.0 @ 3 dB	20.0	V
500	F500E-94	526-9472-00	9.4 @ 6 dB	19.0	E
500	F500F-94	526-9216-00	9.4 @ 6 dB	19.0	F
500	F500Y-94S	526-9468-00	9.4 @ 6 dB	19.0	Y
500	F500Y-120	526-9575-00	12.0 @ 6 dB	26.0	Y
500	F500Y-500	526-9418-00	50.0 @ 6 dB	86.0	Y
501	F501Y-05F	526-9647-010	0.5 @ 6 dB	5.5	V



Single Sideband

This table lists the Collins *standard* single sideband Mechanical Filter designs. Case styles are described on pages 13-14. For special designs to your specifications, contact your nearest Collins Engineering Sales Representative or Collins Radio Company, Newport Beach, California 92663. Telephone 714-833-0600.

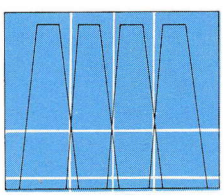
Carrier Frequency (kHz)	*Type*	*Part Number*	*Sideband*	*Nominal Bandwidth (kHz)*	*Case Style*
220	F220Z-30	526-9580-010	lower	3.0 @ 6 dB	Y3
250	F250Z-4	526-9130-00	upper	2.85 @ 3 dB	C
250	F250Z-4	526-9130-021	upper	2.90 @ 3 dB	C
250	F250Z-4	526-9130-031	upper	3.40 @ 3 dB	C
250	F250Z-5	526-9131-00	lower	2.85 @ 3 dB	C
300	F300Z-4	526-9312-00	upper	2.65 @ 2.5 dB	L (special)
300	F300Z-5	526-9311-00	lower	2.65 @ 2.5 dB	L (special)
300	F300Z-6	526-9363-00	upper	5.65 @ 2.5 dB	L (special)
300	F300Z-7	526-9362-00	lower	5.65 @ 2.5 dB	L (special)
300	F300Z-8	526-9416-00	upper	2.55 @ 3 dB	L (special)
300	F300Z-9	526-9417-00	lower	2.55 @ 3 dB	L (special)
300	F300Z-10	526-9428-00	upper	2.7 @ 1.5 dB	L (special)
300	F300Z-11	526-9429-00	lower	2.7 @ 1.5 dB	L (special)
450	F450Z-1C	526-9634-010	upper	2.7 @ 2.0 dB	V
450	F450Z-2C	526-9652-010	lower	2.7 @ 2.0 dB	V
455	F455Z-2	526-9096-00	lower	2.7 @ 3 dB	H
455	F455Z-4	526-9364-00	upper	2.7 @ 3 dB	Y (long)
455	F455Z-4	526-9364-011	upper	2.7 @ 3 dB	F
455	F455Z-4	526-9364-021	upper	2.6 @ 3 dB	Y (long)

(continued)

Single Sideband

Carrier Frequency (kHz)	Type	Part Number	Sideband	Nominal Bandwidth (kHz)	Case Style
455	F455Z-4	526-9364-031	upper	3.4 @ 3 dB	Y (long)
455	F455Z-4	526-9364-041	upper	2.7 @ 3 dB	E
455	F455Z-5	526-9365-00	lower	2.7 @ 3 dB	Y (long)
455	F455Z-5	526-9365-011	lower	2.7 @ 3 dB	F
455	F455Z-5	526-9365-021	lower	3.4 @ 3 dB	Y (long)
455	F455Z-5	526-9365-031	lower	3.1 @ 3 dB	Y (long)
455	F455Z-5	526-9365-041	lower	2.7 @ 3 dB	E
455	F455Z-5B	526-9578-010	lower	2.7 @ 3 dB	Y (long)
455	F455Z-6	526-9368-00	upper	1.7 @ 3 dB	Y (long)
455	F455Z-10	526-9445-00	upper	3.3 @ 3 dB	Y
455	F455Z-12	526-9486-00	upper	1.2 @ 3 dB	Y
455	F455Z-14	526-9527-001	upper	5.46 @ 3 dB	F
455	F455Z-15	526-9528-001	lower	5.46 @ 3 dB	F
455	F455Z-16	526-9605-010	upper	1.7 @ 3 dB	FA
455	F455Z-16	526-9605-020	upper	1.7 @ 3 dB	FA (special)
455	F455Z-17	526-9606-010	lower	1.7 @ 3 dB	FA
455	F455Z-17	526-9606-020	lower	1.7 @ 3 dB	FA (special)
455	F455Z-18L	526-9625-010	lower	1.7 @ 3 dB	Y (long)
455	F455Z-19F	526-9630-010	lower	2.8 @ 2 dB	Y (long)
455	F455Z-20F	526-9640-010	lower	2.1 @ 2 dB	Y (long)
455	F455Z-21F	526-9641-010	upper	2.1 @ 2 dB	Y (long)
455	F455Z-22F	526-9648-010	upper	2.8 @ 1.5 dB	Y (special)
455	F455Z-23C	526-9665-010	upper	3.0 @ 3 dB	V
455	F455Z-24C	526-9666-010	lower	3.0 @ 3 dB	V
500	F500Z-4	526-9377-00	upper	2.7 @ 3 dB	Y
500	F500Z-4C	526-9579-010	upper	3.0 @ 3 dB	Y
500	F500Z-5	526-9376-00	lower	2.7 @ 3 dB	Y
500	F500Z-6	526-9412-00	upper	2.75 @ 1.5 dB	Y
500	F500Z-7	526-9413-00	lower	2.75 @ 1.5 dB	Y
500	F500Z-8	526-9414-00	upper	2.4 @ 3 dB	Y
500	F500Z-9	526-9415-00	lower	2.4 @ 3 dB	Y
500	F500Z-10	526-9420-00	upper	3.2 @ 3 dB	Y (flanged)
500	F500Z-11	526-9419-00	lower	3.2 @ 3 dB	Y (flanged)
500	F500Z-12	526-9422-00	upper	2.75 @ 3 dB	Y
500	F500Z-13	526-9423-00	lower	2.75 @ 3 dB	Y
500	F500Z-14	526-9424-00	upper	2.4 @ 4 dB	Y
500	F500Z-15	526-9425-00	lower	2.4 @ 4 dB	Y
500	F500Z-16	526-9481-00	upper	8.0 @ 3 dB	Y
500	F500Z-17	526-9480-00	lower	8.0 @ 3 dB	Y
500	F500Z-18F	526-9644-010	upper	3.0 @ 3 dB	V
500	F500Z-19F	526-9645-010	lower	3.0 @ 3 dB	V
500	F500Z-20F	526-9663-010	upper	2.4 @ 6 dB	Y (long)
500	F500Z-21F	526-9664-010	lower	2.4 @ 6 dB	Y (long)
500	F500Z-22C	526-9668-010	upper	3.0 @ 3 dB	V
500	F500Z-23C	526-9669-010	lower	3.0 @ 3 dB	V

New SSB designs (See description on inside front cover).



Voice Multiplex Sideband

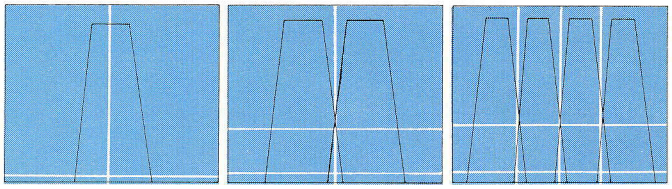
This table lists the Collins *standard* voice multiplex Mechanical Filter sideband designs. These filters are designed for 4-kHz spacing and operate as lower sideband selectors from 64 kHz to 108 kHz. Case styles are described on pp. 13-14. For special designs to your specifications, contact your nearest Collins representative or Collins Radio Company, Newport Beach, California 92663. Telephone 714-833-0600.

Carrier Frequency (kHz)	Type	Part Number	Sideband	Nominal Bandwidth (kHz)	Case Style
64	F64Z-7	526-9396-000	lower	2.9 @ 1.5 dB	L
68	F68Z-7	526-9397-000	lower	2.9 @ 1.5 dB	L
72	F72Z-7	526-9398-000	lower	2.9 @ 1.5 dB	L
76	F76Z-7	526-9399-000	lower	2.9 @ 1.5 dB	L
80	F80Z-7	526-9400-000	lower	2.9 @ 1.5 dB	L
84	F84Z-7	526-9401-000	lower	2.9 @ 1.5 dB	L
88	F88Z-7	526-9402-000	lower	2.9 @ 1.5 dB	L
92	F92Z-7	526-9403-000	lower	2.9 @ 1.5 dB	L
96	F96Z-7	526-9404-000	lower	2.9 @ 1.5 dB	L
100	F100Z-7	526-9405-000	lower	2.9 @ 1.5 dB	L
104	F104Z-7	526-9406-000	lower	2.9 @ 1.5 dB	L
108	F108Z-7	526-9407-000	lower	2.9 @ 1.5 dB	L
64	F64Z-7A	526-9631-010	lower	2.4 @ 0.25 dB	L

(continued)

Voice Multiplex Sideband

Carrier Frequency (kHz)	Type	Part Number	Sideband	Nominal Bandwidth (kHz)	Case Style
68	F68Z-7A	526-9631-020	lower	2.4 @ 0.25 dB	L
72	F72Z-7A	526-9631-030	lower	2.4 @ 0.25 dB	L
76	F76Z-7A	526-9631-040	lower	2.4 @ 0.25 dB	L
80	F80Z-7A	526-9631-050	lower	2.4 @ 0.25 dB	L
84	F84Z-7A	526-9631-060	lower	2.4 @ 0.25 dB	L
88	F88Z-7A	526-9631-070	lower	2.4 @ 0.25 dB	L
92	F92Z-7A	526-9631-080	lower	2.4 @ 0.25 dB	L
96	F96Z-7A	526-9631-090	lower	2.4 @ 0.25 dB	L
100	F100Z-7A	526-9631-100	lower	2.4 @ 0.25 dB	L
104	F104Z-7A	526-9631-110	lower	2.4 @ 0.25 dB	L
108	F108Z-7A	526-9631-120	lower	2.4 @ 0.25 dB	L
64	F64Z-7B	526-9631-130	lower	3.1 @ 0.5 dB	L
68	F68Z-7B	526-9631-140	lower	3.1 @ 0.5 dB	L
72	F72Z-7B	526-9631-150	lower	3.1 @ 0.5 dB	L
76	F76Z-7B	526-9631-160	lower	3.1 @ 0.5 dB	L
80	F80Z-7B	526-9631-170	lower	3.1 @ 0.5 dB	L
84	F84Z-7B	526-9631-180	lower	3.1 @ 0.5 dB	L
88	F88Z-7B	526-9631-190	lower	3.1 @ 0.5 dB	L
92	F92Z-7B	526-9631-200	lower	3.1 @ 0.5 dB	L
96	F96Z-7B	526-9631-210	lower	3.1 @ 0.5 dB	L
100	F100Z-7B	526-9631-220	lower	3.1 @ 0.5 dB	L
104	F104Z-7B	526-9631-230	lower	3.1 @ 0.5 dB	L
108	F108Z-7B	526-9631-240	lower	3.1 @ 0.5 dB	L
64	F64Z-7C	526-9631-250	lower	2.9 @ 1.0 dB	L
68	F68Z-7C	526-9631-260	lower	2.9 @ 1.0 dB	L
72	F72Z-7C	526-9631-270	lower	2.9 @ 1.0 dB	L
76	F76Z-7C	526-9631-280	lower	2.9 @ 1.0 dB	L
80	F80Z-7C	526-9631-290	lower	2.9 @ 1.0 dB	L
84	F84Z-7C	526-9631-300	lower	2.9 @ 1.0 dB	L
88	F88Z-7C	526-9631-310	lower	2.9 @ 1.0 dB	L
92	F92Z-7C	526-9631-320	lower	2.9 @ 1.0 dB	L
96	F96Z-7C	526-9631-330	lower	2.9 @ 1.0 dB	L
100	F100Z-7C	526-9631-340	lower	2.9 @ 1.0 dB	L
104	F104Z-7C	526-9631-350	lower	2.9 @ 1.0 dB	L
108	F108Z-7C	526-9631-360	lower	2.9 @ 1.0 dB	L
64	F64Z-8A	526-9454-000	lower	2.4 @ 0.5 dB	L
68	F68Z-8A	526-9455-000	lower	2.4 @ 0.5 dB	L
72	F72Z-8A	526-9456-000	lower	2.4 @ 0.5 dB	L
76	F76Z-8A	526-9457-000	lower	2.4 @ 0.5 dB	L
80	F80Z-8A	526-9458-000	lower	2.4 @ 0.5 dB	L
84	F84Z-8A	526-9459-000	lower	2.4 @ 0.5 dB	L
88	F88Z-8A	526-9460-000	lower	2.4 @ 0.5 dB	L
92	F92Z-8A	526-9461-000	lower	2.4 @ 0.5 dB	L
96	F96Z-8A	526-9462-000	lower	2.4 @ 0.5 dB	L
100	F100Z-8A	526-9463-000	lower	2.4 @ 0.5 dB	L
104	F104Z-8A	526-9464-000	lower	2.4 @ 0.5 dB	L
108	F108Z-8A	526-9465-000	lower	2.4 @ 0.5 dB	L
64	F64Z-12	526-9632-010	lower	3.1 @ 0.5 dB	L
68	F68Z-12	526-9632-020	lower	3.1 @ 0.5 dB	L
72	F72Z-12	526-9632-030	lower	3.1 @ 0.5 dB	L
76	F76Z-12	526-9632-040	lower	3.1 @ 0.5 dB	L
80	F80Z-12	526-9632-050	lower	3.1 @ 0.5 dB	L
84	F84Z-12	526-9632-060	lower	3.1 @ 0.5 dB	L
88	F88Z-12	526-9632-070	lower	3.1 @ 0.5 dB	L
92	F92Z-12	526-9632-080	lower	3.1 @ 0.5 dB	L
96	F96Z-12	526-9632-090	lower	3.1 @ 0.5 dB	L
100	F100Z-12	526-9632-100	lower	3.1 @ 0.5 dB	L
104	F104Z-12	526-9632-110	lower	3.1 @ 0.5 dB	L
108	F108Z-12	526-9632-120	lower	3.1 @ 0.5 dB	L
64	F64Z-14	526-9633-010	lower	3.1 @ 0.7 dB	L
68	F68Z-14	526-9633-020	lower	3.1 @ 0.7 dB	L
72	F72Z-14	526-9633-030	lower	3.1 @ 0.7 dB	L
76	F76Z-14	526-9633-040	lower	3.1 @ 0.7 dB	L
80	F80Z-14	526-9633-050	lower	3.1 @ 0.7 dB	L
84	F84Z-14	526-9633-060	lower	3.1 @ 0.7 dB	L
88	F88Z-14	526-9633-070	lower	3.1 @ 0.7 dB	L
92	F92Z-14	526-9633-080	lower	3.1 @ 0.7 dB	L
96	F96Z-14	526-9633-090	lower	3.1 @ 0.7 dB	L
100	F100Z-14	526-9633-100	lower	3.1 @ 0.7 dB	L
104	F104Z-14	526-9633-110	lower	3.1 @ 0.7 dB	L
108	F108Z-14	526-9633-120	lower	3.1 @ 0.7 dB	L



Mechanical Filters/Application Guidelines

Collins Mechanical Filters are built with two basic types of transducers: (1) magnetostrictive transducers or (2) piezoelectric transducers. Magnetostrictive transducers are further divided into two types: (a) wire transducers and (b) ferrite transducers. The type of transducer incorporated in the filter determines the application technique to be followed.

Both magnetostrictive wire and ferrite transducers require that the input and output transducer coils be capacitively "resonated." The care required to resonate them will depend on the filter itself, the desired response variation level, and the loss. Many Mechancial Filters in many applications may be resonated by a fixed, standard capacitor whose value will be dependent on the particular filter type and the external/stray capacity presented to the filter by the application circuit.

As the performance requirements for the filter become more stringent, greater care must be exercised in resonating the transducer coils. For example, if a Mechanical Filter is to be used in the receiver of a Citizen's Band transceiver, the nominal value of resonating capacitance defined in the filter specification probably will give satisfactory results. If, however, the filter is being used in a single sideband radio which requires a low value of response variation in the passband and more precise frequency response characteristics, it is best to use variable capacitors to peak the filter during the equipment design stage. Then, having once determined the proper capacity value for that filter type and that application circuit, fixed capacitors may be used in production. In those applications where the ultimate performance is required from the filter, for example, the very low ripple values required in voice multiplexing and telecommunications systems, it is advisable to have tunable, variable capacitors installed in the production equipment.

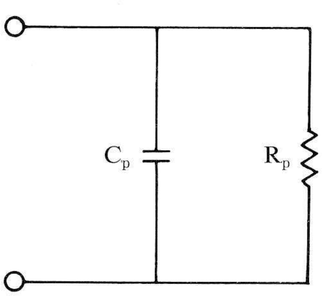
In all cases, properly resonating the transducer coils insures minimum response variation in the passband, and also minimizes the loss through the filter.

To determine the proper value of capacity for resonance in a particular circuit, the simplest way to begin is to set the signal input to the filter at the center frequency of the filter, then adjust the capacitors for maximum output amplitude from the filter. Many applications require no more tuning effort. If the application requires that you realize the absolute minimum value of response variation in the passband, further adjustment may be necessary. If so, continue by sweeping the frequency of the input signal across the passband of the filter while adjusting the capacitors for minimum ripple. The variation in capacity from the "fixed" value will not be large, but it usually results in lower ripple values.

In addition to resonating the transducer coils, the circuit must provide the proper values of source and load resistance, as with any other filter type. In the case of the wire transducers, the filters are essentially self-terminated, and the filters require a very high value of terminating resistance when the transducer coils are parallel resonated, or a very low value of terminating resistance when the transducer coils are series resonated. In other words, when operated parallel resonant, the terminating resistance can be any value higher than 100K ohms, and when operated series resonant, the terminating resistance can be any value lower than 100 ohms. For many applications, those limiting values can be changed to 50K ohms and 200 ohms, but for terminating resistances between 50K ohms and 200 ohms a capacity divider should be used.

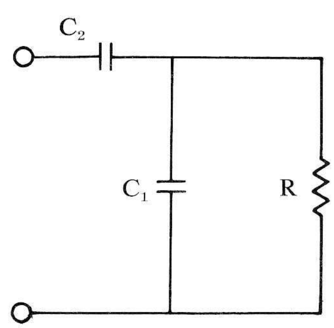
The filters using ferrite transducers need to be terminated with specific resistance values, and these values are defined in the filter specification. Again, if it is not possible to terminate the filter with that specific resistance, a capacity divider should be used. As an example, let us assume that a Mechanical Filter

Figure 1. Specified Termination (20 K ohms).



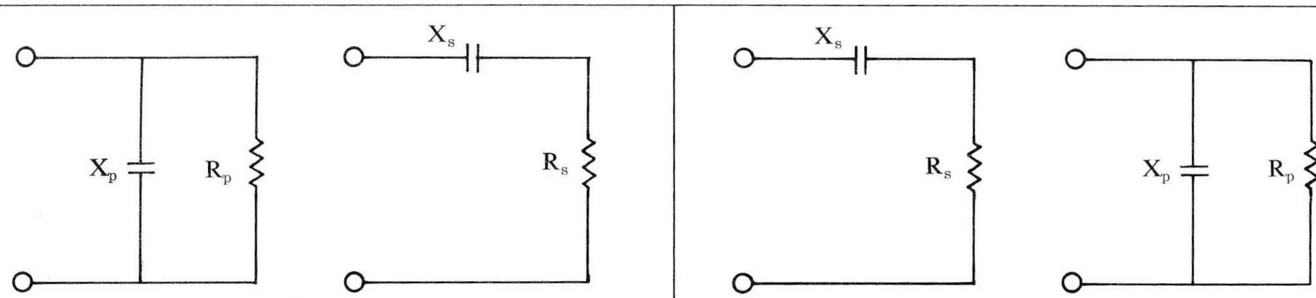
$$C_p = 130 \text{ pf}$$
$$R_p = 20{,}000 \text{ ohms}$$

Figure 2. Alternate Configuration (10 K ohms).



$$C_1 = \sqrt{\frac{R_p}{R}}(C_p)$$
$$C_2 = \frac{C_1\, C_p}{C_1 - C_p}$$

Figure 3. Parallel-to-series (left) and Series-to-parallel (right) Conversions.



$$R_s = \frac{\frac{1}{R_p}}{\left(\frac{1}{R_p}\right)^2 + \left(\frac{1}{X_p}\right)^2}$$

$$X_s = \frac{\frac{1}{X_p}}{\left(\frac{1}{R_p}\right)^2 + \left(\frac{1}{X_p}\right)^2}$$

$$R_p = R_s + \frac{X_s^{\,2}}{R_s}$$

$$X_p = X_s + \frac{R_s^{\,2}}{X_s}$$

with ferrite transducers has been designed to operate parallel tuned with 130 pf of capacity and a terminating resistance of 20K ohms, but it is more convenient for the designer to provide a terminating resistance of 10K ohms. The specified termination is shown in Figure 1, and the alternate configuration is shown in Figure 2.

In the example chosen:

$$C_1 = \sqrt{\frac{20{,}000}{10{,}000}}\,(130) = 184\text{ pf}$$

$$C_2 = \frac{(184)\ (130)}{184 - 130} = 443\text{ pf}$$

If the designer wanted to operate at a much lower impedance level, he could convert the terminating circuitry to series resonate the coil. Again let us assume the filter is designed to operate parallel tuned with 130 pf and a resistance of 20K ohms. The conversions shown in Figure 3 are satisfactory at a single frequency to convert either from parallel to series or vice versa when you know only one terminating condition. Note that you must use the capacitive reactance in the calculation, not the value of capacity in picofarads.

In our example, let us assume an operating frequency of 455 kHz. The reactance of 130 pf at 455 kHz is:

$$\frac{1}{2\pi\,(455{,}000)\ (130 \times 10^{-12})} = 2700\text{ ohms}$$

then:

$$R_S = \frac{\frac{1}{20{,}000}}{\left(\frac{1}{20{,}000}\right)^2 + \left(\frac{1}{2700}\right)^2} = 359\text{ ohms}$$

$$X_S = \frac{\frac{1}{2700}}{\left(\frac{1}{20{,}000}\right)^2 + \left(\frac{1}{2700}\right)^2} = 2650\text{ ohms}$$

and:

$$C_S = \frac{1}{2\pi\,(455{,}000)\ (2650)} = 132\text{ pf}$$

Therefore, the equivalent series circuit at 455 kHz is 359 ohms resistance in series with 132 pf of capacity.

Let us continue with our example and discuss a fourth possibility. We have looked at the cases where we use: (1) parallel tuning, (2) series tuning, and (3) a capacity divider and a resistive termination somewhat less than the 20K ohms needed for parallel tuning. Now assume that we want to use a terminating resistance significantly nearer the 359 ohms which is needed for series tuning. In this range of terminating resistances, it is better to use a capacity divider as shown in Figure 4.

Assume the desired value for R is 1000 ohms. We know from a previous calculation that R_S is 359 ohms and C_S is 132 pf.

Then:

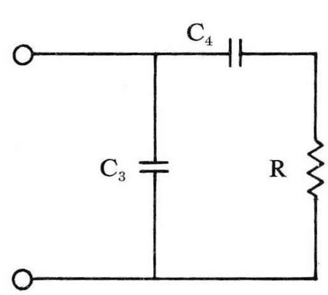
$$C_4 = \sqrt{\frac{359}{1000}}\,(132) = 79\text{ pf}$$

$$C_3 = 132 - 79 = 53\text{ pf}$$

All of the examples use approximations and neglect stray capacities. As a result, some adjustments in values may be required in the final application circuit. However it is a simple, easy-to-use approach, and should provide the circuit designer with a good starting point for his design. It is also apparent that there is some choice of approach in the "middle" range of terminations between the limiting values of 20K ohms and 359 ohms.

The filters using ceramic transducers are usually tuned inter-

Figure 4. Alternate Capacity Divider.



$$C_4 = \sqrt{\frac{R_s}{R}}\,(C_s)$$

$$C_3 = C_s - C_4$$

nally and need to be terminated with a specific resistance normally shunted by a specific value of capacitance. The filter could be internally tuned so that the external value of capacitance required is zero, but as a practical matter, there are always stray capacitances present in the external circuitry. Therefore the filters are designed to see some convenient value of capacitance which is defined in the filter specification.

Signal levels into the filters should not be so high that a slight increase in level would change the bandpass characteristics of the filter. The specification for the filter defines a maximum input level. As a general rule, levels around −20 dBm to −10 dBm are acceptable. Permanent damage to the filter is not likely to occur unless levels are considerably higher, but some deterioration of the response characteristics may occur when the filter is "over-driven." The filters will operate satisfactorily with input levels as low as −100 dBm.

Most Mechanical Filters are capable of providing stopband rejection greater than 90 dB. To take full advantage of this capability, reasonable care in physical layouts and good design practices should be observed. For example, physical separation and/or shielding between input and output should be provided. If wiring is used, keep leads short and provide good grounds. Do not provide "leakage" paths around the filter in any way. If stopband levels are not greater than 90 dB, it is likely to be a circuit problem rather than a filter problem.

All of the preceding comments are intended as basic guidelines. Experience and experimentation with Mechanical Filters will provide you with acceptable deviations for specific applications.

Figures 5 and 6 are two generalized application circuits. They, of course, are not limiting but are supplied simply as starting points for the design engineer.

Figure 5. Transistor Amplifiers.

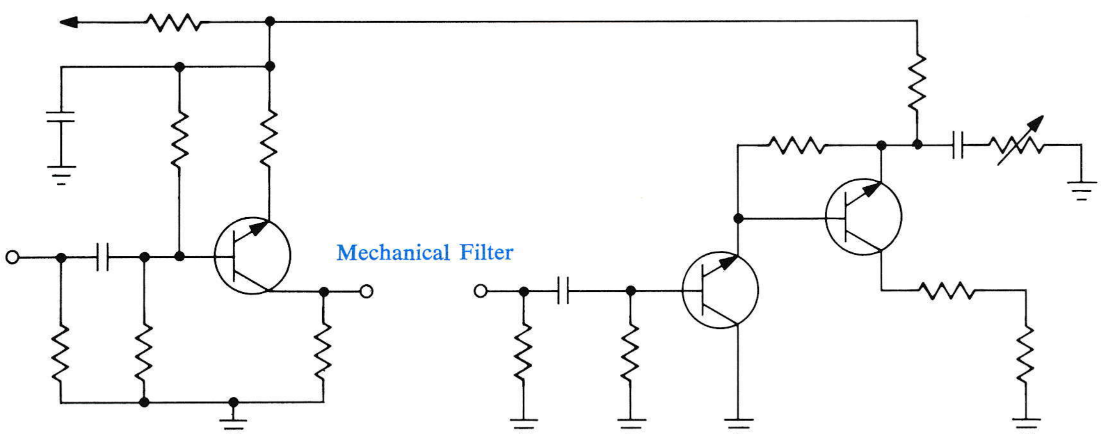
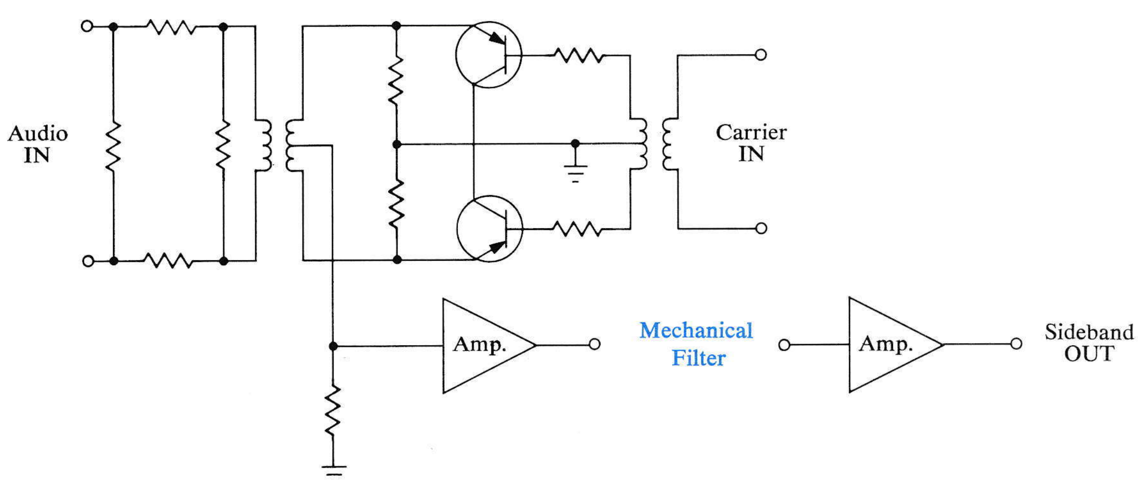


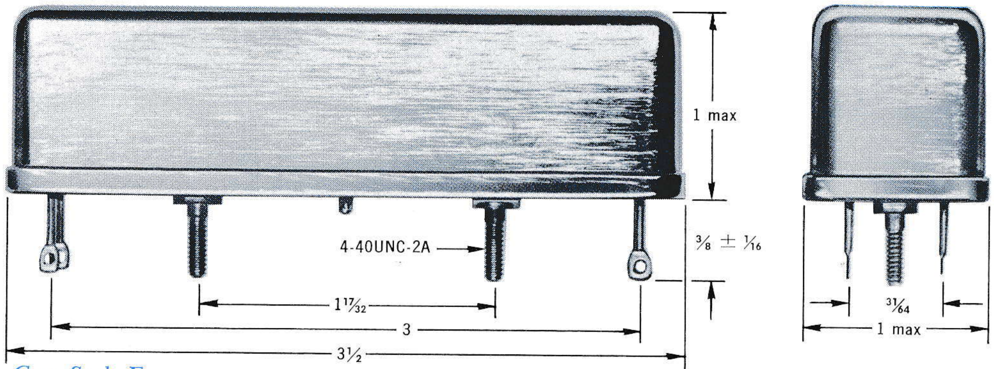
Figure 6. Balanced Modulator.



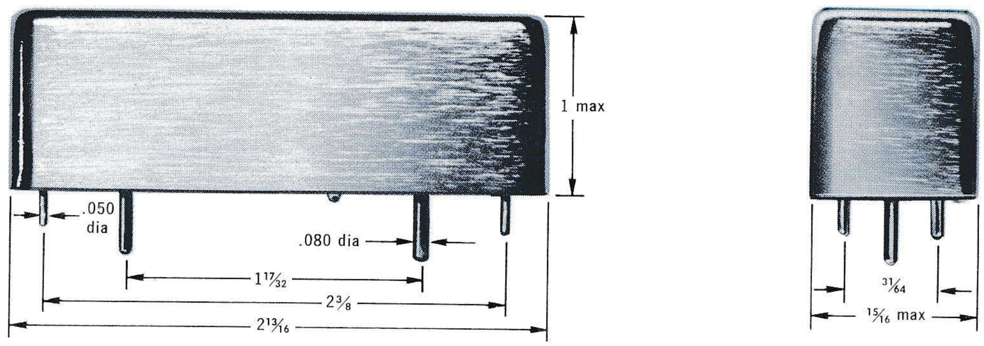
Mechanical Filters/Case Styles

Mechanical Filters are available in a wide variety of case and mounting styles.
The basic designs are shown on these pages. Call us if you have special case configuration requirements.

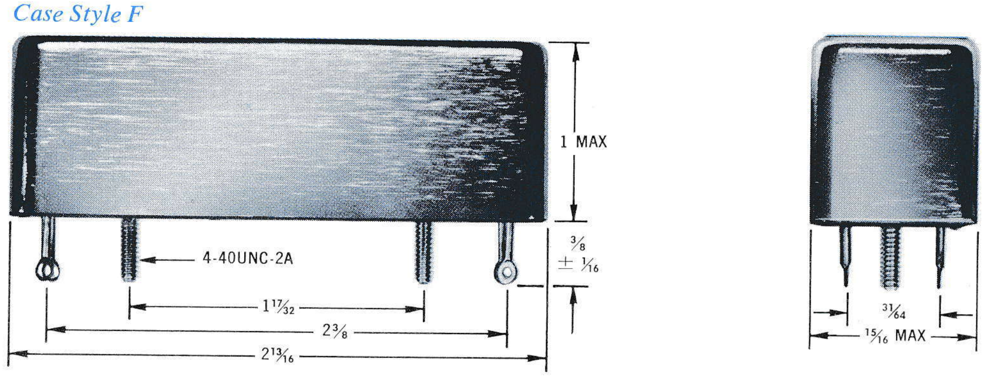
Case Style C



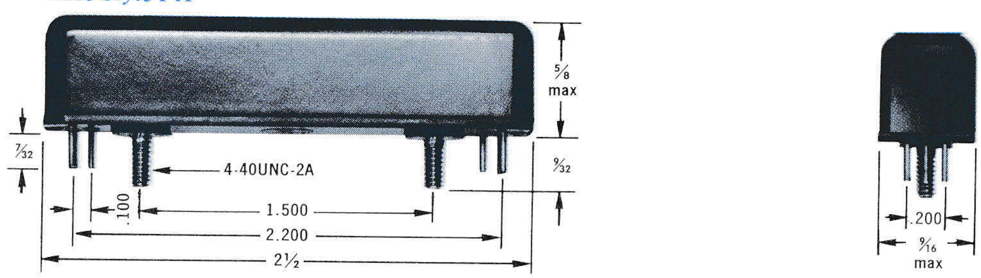
Case Style E



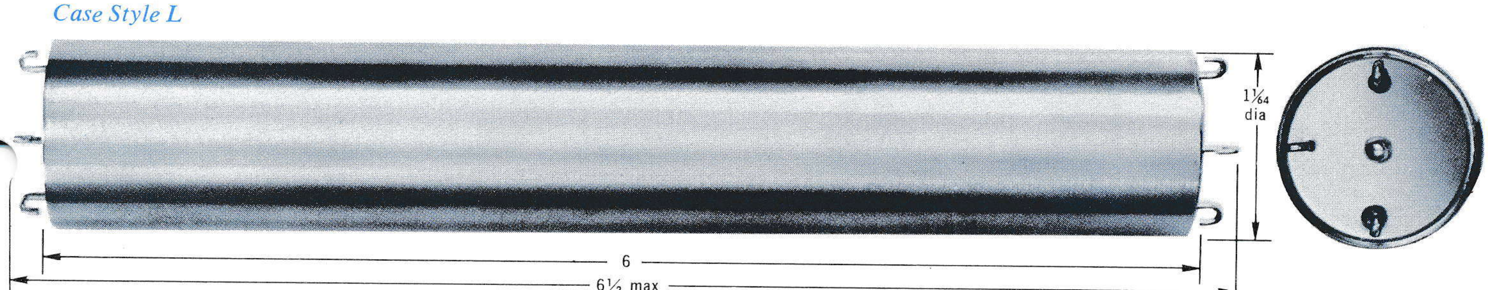
Case Style F



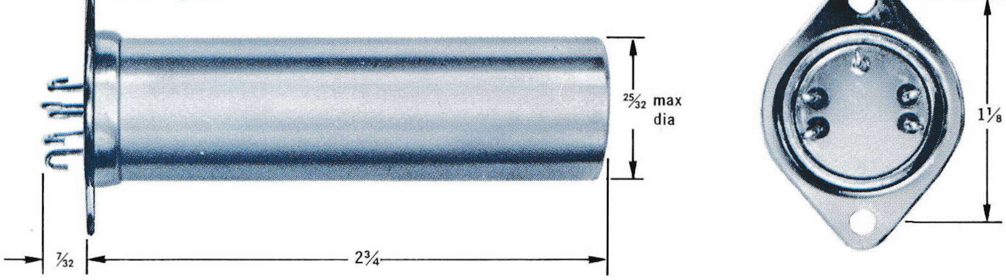
Case Style FA



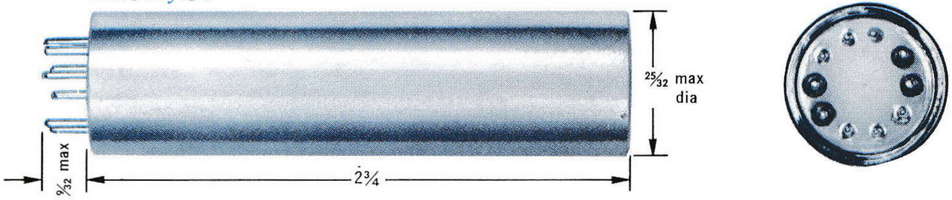
Case Style L



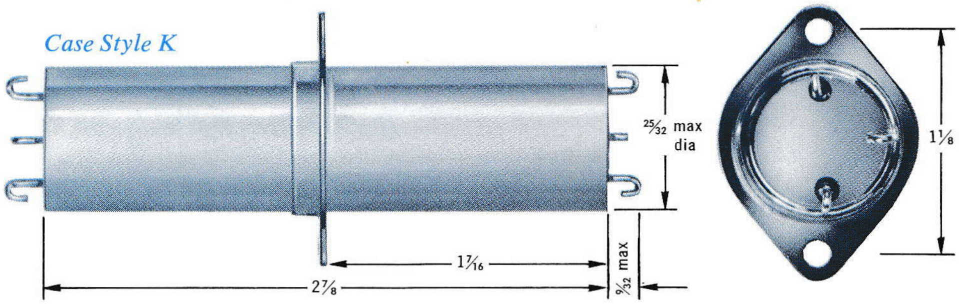
Case Style H



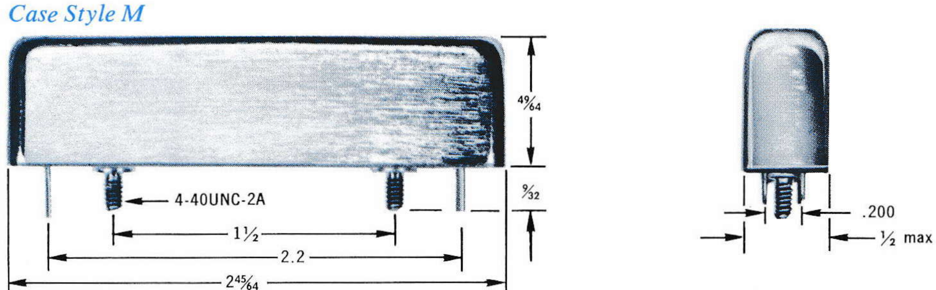
Case Style J



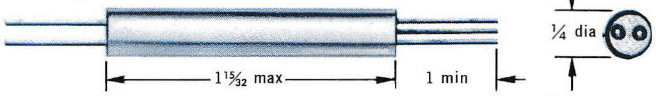
Case Style K



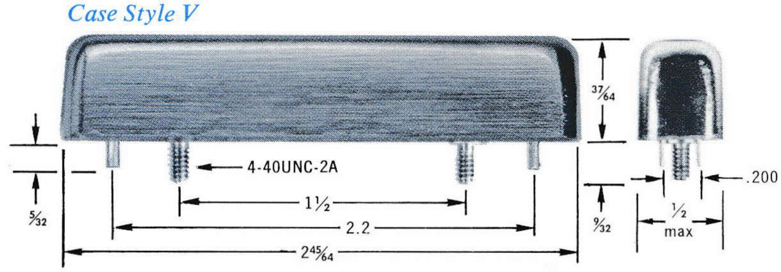
Case Style M



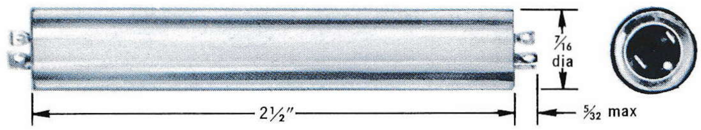
Case Style T



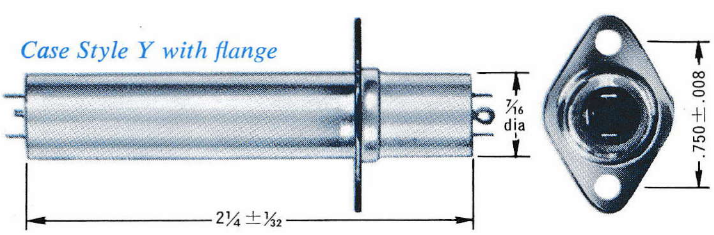
Case Style V



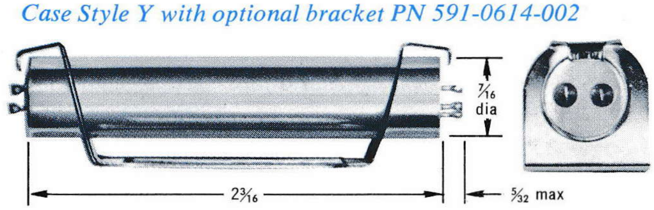
Case Style Y long

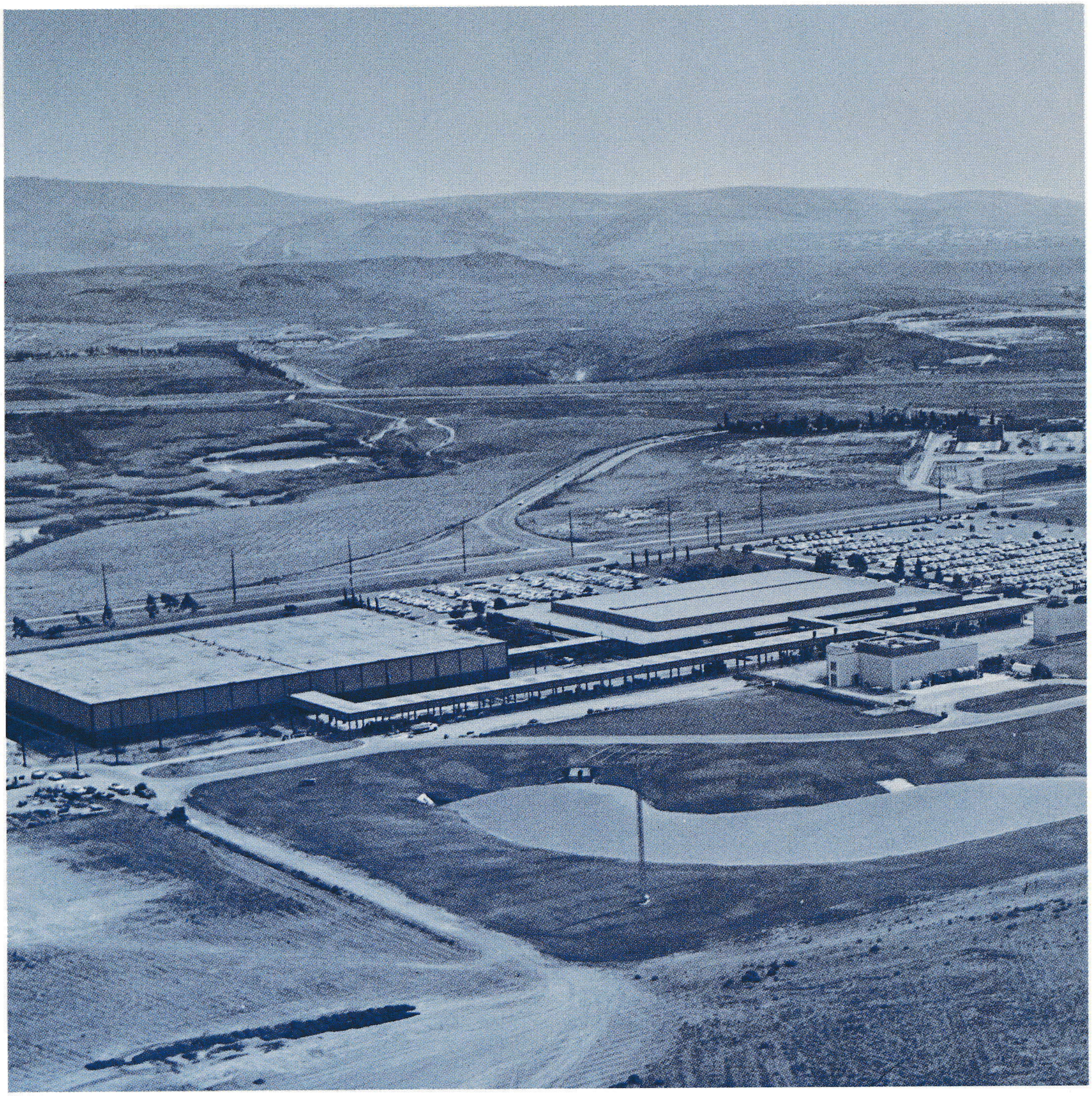


Case Style Y with flange



Case Style Y with optional bracket PN 591-0614-002





New multimillion-dollar structure (building at left) houses component production at Collins facility near Newport Beach, California. The new building is two-level and contains 240,000 square feet of floor space with ultra-modern microelectronic environment and equipment. Communication and data facilities for automated design and fabrication link with centers at Dallas, Texas; Cedar Rapids, Iowa, and Toronto, Canada plants, as well as with service offices in major cities.

For additional information call or write
Components Marketing, Collins Radio Company,
Newport Beach, California 92663. Phone 714-833-0600.

COLLINS

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New F455Z-23C/24C & F500Z-22C/23C SSB Mechanical Filters

COLLINS

Collins new F455Z-23C/24C and F500Z-22C/23C single sideband filter pairs offer product line prices with state-of-the-art performance. The new filters are highly selective, have low insertion loss and require no tuning.

Advances in design and construction techniques are combined in the new 455 kHz and 500 kHz sideband filter pairs. A recently-patented design feature utilizes "double-bridging" wires to achieve attenuation poles or "infinite points" on both sides of the filter passband. The result is steeper skirt cut-off without the addition of disk resonators. To the equipment designer of a radio for independent sideband operation, this means:

(1) a minimum of 20 dB carrier suppression,

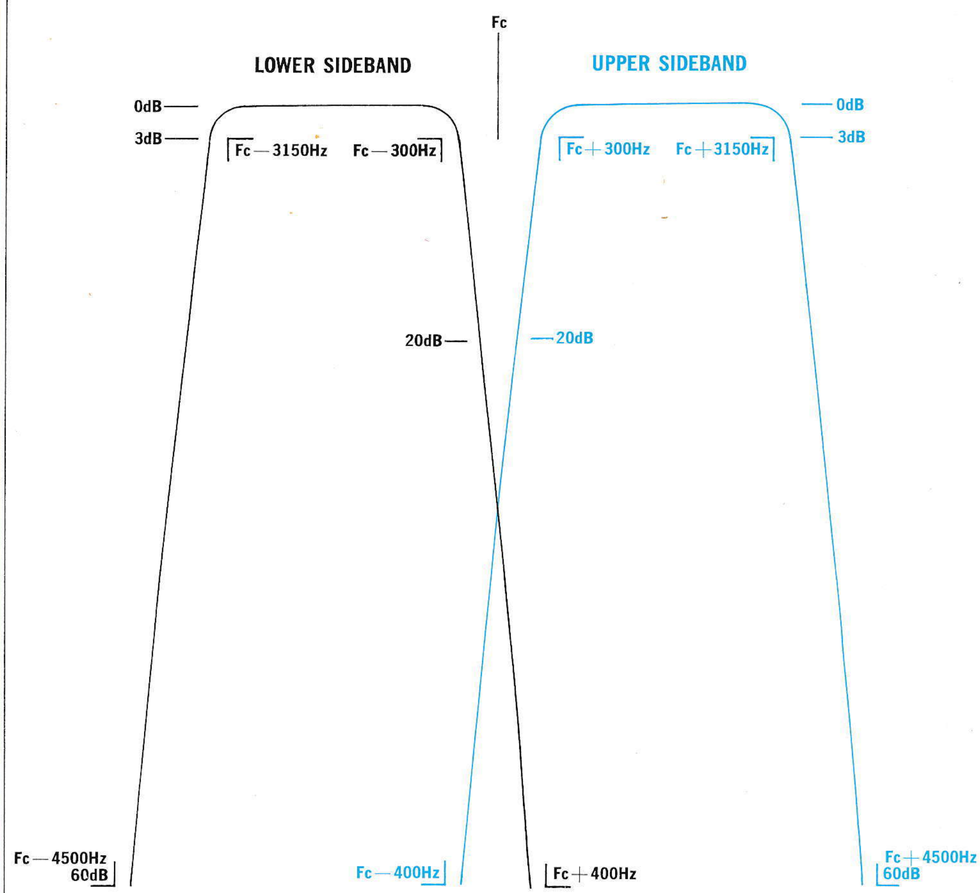
(2) guaranteed audio response over a minimum frequency range of 300 Hz to 3150 Hz,

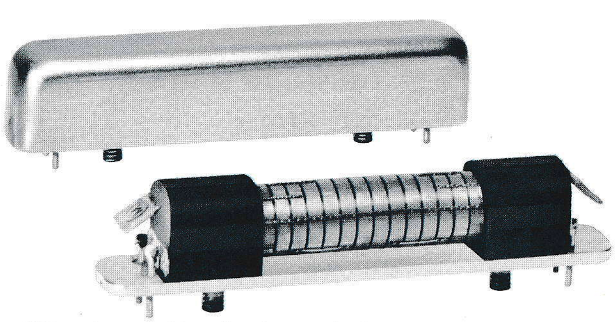
(3) nominal 60 dB to 3 dB bandwidth ratio of 1.3 to 1, which results in efficient, noise-free, adjacent-channel-interference-free operation,

(4) envelope delay characteristics smooth enough and flat enough for the transmission of high speed data without equalization.

Another new design feature of these filters is the piezoelectric ceramic transducer used in place of the conventional magnetostrictive ferrite transducer. To the equipment designer, this means: *(overleaf)*

Frequency Response Worst Case Limits





SSB pairs are 11-pole, 4-zero designs.

Specifications

	Limits	*Nominal Values*
Carrier frequency (F_c)	455 or 500 kHz	....
Carrier rejection	20 dB min	25 dB
Frequency response:	See curves	....
3 dB bandwidth	2850 Hz min	3100 Hz
60 dB bandwidth	4900 Hz max	4100 Hz
Passband ripple	2.5 dB max	1.5 dB
Insertion loss	5 dB max	3 dB
Source, load impedance	2000 ohms	....
Operating temp range	−20 to +65°C	....

(1) lower insertion loss, typically 3 dB,
(2) improved third order intermodulation distortion characteristics, typically −62 dB with −20 dBm input, and
(3) low passband ripple: 2.5 dB maximum over an operating temperature range of −20°C to +65°C.
While ceramics of this general type have been available for many years, it is only recently that their temperature shift characteristics have become good enough to permit their consideration for use as transducers in mechanical filters. Although they are now suitable as transducers, their low "Q" and relatively poor temperature shift characteristics do not allow them to be used as resonators.

A third basic refinement in these filters is another step in the improvement of the already excellent frequency shift versus temperature characteristics of Collins Mechanical Filters. Collins has had a longstanding program to achieve better control of the chemistry and processing of the raw material used to make the disk resonators. As a result, it is now possible to manufacture these filters with a total frequency shift as low as 10 Hz over the specified operating temperature range of −20°C to +65°C.

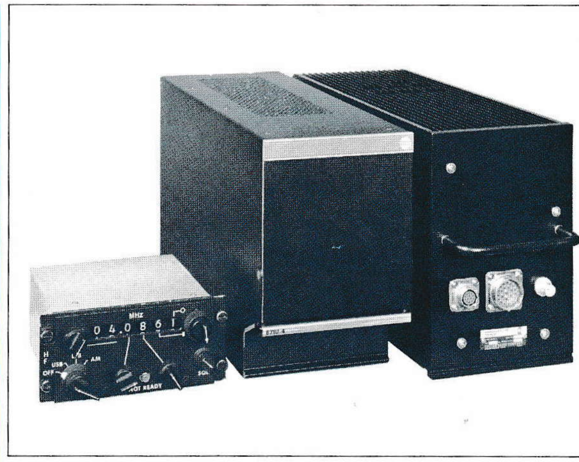
The benefits to the equipment designer are apparent when the "Frequency Response Worst Case Limits" curves *(see front)* are examined. The caption means literally what it says: for any number of filters, exposed to any temperature within the specified operating temperature range, the performance of the worst filter in the group will be equal to or better than the limits shown. A designer can then count on any one filter to be better than almost all the limits shown at any time or temperature in the specified range.

It is necessary with precision filters of this type, whether they are mechanical or crystal, to provide proper terminations to realize their specified performance. The termination is normally specified in terms of a resistive and a reactive component. It has been customary with mechanical filters to specify a fixed resistance value and a series or shunt capacitor which had to be adjusted within a limited range of values to optimize the performance of the filter. With this new set of filters, the user simply terminates them with a fixed resistance and a fixed value of shunt capacity, thus eliminating the need for any tuning or adjustment of capacity, but still realizing the excellent characteristics inherent in the designs.

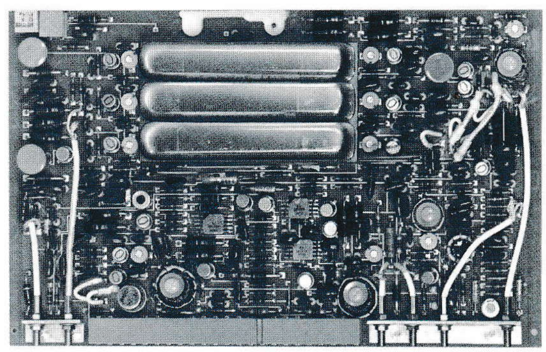
This new set of filters are all 11-pole, 4-zero designs. In spite of the complexity and high performance of such a design, the filters are packaged in an hermetically sealed, plated brass case with a total volume of only three-fourths of a cubic inch. The package provides its own stud mounting for ease of application in equipment design (see right).

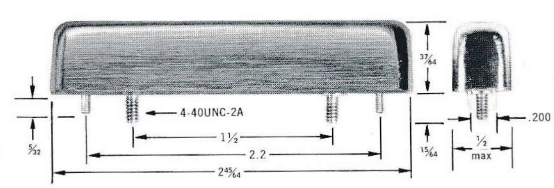
Type and part numbers for the filters are:
F455Z-23C, USB, PN 526-9665-010.
F455Z-24C, LSB, PN 526-9666-010.
F500Z-22C, USB, PN 526-9668-010.
F500Z-23C, LSB, PN 526-9669-010.

For additional information call or write Collins Radio Company, Components Marketing, Dept. 600, Newport Beach, California 92663. Phone 714-833-0600.



New HF airborne transceiver is part of Collins state-of-the-art 718U communication equipments, operates on any of 280,000 channels in USB, LSB, AME and CW modes. Below is a printed circuit board, showing three of the new mechanical filters, used in the equipments.





The new filters are packaged in an hermetically-sealed, plated brass case. Provides own studs for mounting.

COLLINS

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