

ZXF103

VARIABLE Q FILTER

DESCRIPTION

The ZXF103 is a versatile analog high Q bandpass filter. It can be configured to provide pass or notch characteristics.

The basic filter section requires 2 resistors and 2 capacitors to set the centre frequency. The frequency range is up to 600kHz. Two external resistors control filter Q Factor. The Q can be varied up to 50.

APPLICATIONS

Many filter applications including: -

- Sonar and Ultrasonic Systems
- Line frequency notch
- Signalling
- Motion detection
- Instrumentation
- Low frequency telemetry

FEATURES AND BENEFITS

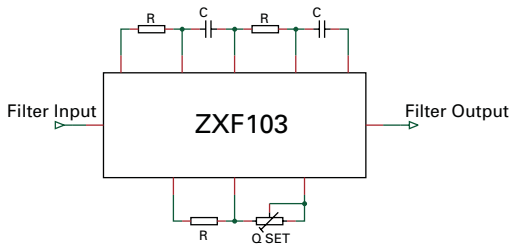
- Centre Frequency up to 1MHz
- Variable Q up to 50
- Low distortion
- Low noise
- Low power 25mW
- Devices easily cascaded
- Small QSOP16 package

ORDERING INFORMATION

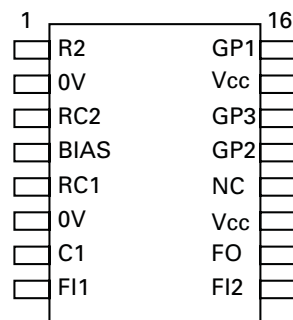
| PART NUMBER | PACKAGE | PART MARK |
|-------------|---------|-----------|
| ZXF103Q16 | QSOP16 | ZXF103 |

| PART NUMBER | CONTAINER | INCREMENT |
|-------------|----------------|-----------|
| ZXF103Q16TA | Reel 7" 178mm | 500 |
| ZXF103Q16TC | Reel 13" 330mm | 2500 |

SYSTEM DIAGRAM



PINOUT



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ABSOLUTE MAXIMUM RATINGS

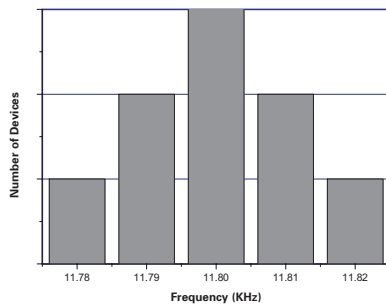
| | |
|-----------------------------|-----------------------|
| Voltage on any pin | 7.0V (relative to 0V) |
| Operating temperature range | 0 to 70°C |
| Storage temperature | -55 to 125°C |

ELECTRICAL CHARACTERISTICS

Test Conditions: Temperature = 25°C, V_{CC} = 5.00V, 0V = 0.00V, R_L = 10k, C_L = 10pF

| GENERAL CHARACTERISTICS | | | | | |
|--|--|------|---------|-------------|---------|
| Parameter | Conditions | Min. | Typical | Max. | Units |
| Operating current | | | 4.0 | 5.0 | mA |
| Max. operating frequency | V _{out} =1.6V p-p V _{out} =1.0V p-p | | | 600 1000 | kHz |
| Q usable range | | 0.5 | | 50 | |
| Centre Frequency temperature coefficient | Q=30, f _o = 1kHz | | 100 | | ppm/°C |
| Q temperature coefficient | Q=30, f _o = 1kHz | | 0.1 | | % /°C |
| Voltage noise | 1 – 100 kHz | | 20 | | nV/√ Hz |
| Input impedance | | 10 | 15 | 20 | kΩ |
| Linear Output Range | Output load = 10 kΩ | | 2 | | V pk-pk |
| Sink current | | | 450 | | μA |
| Source current | | | 450 | | μA |

**Histogram of Centre Frequency
(F_o = 11.80KHz Q = 25)**



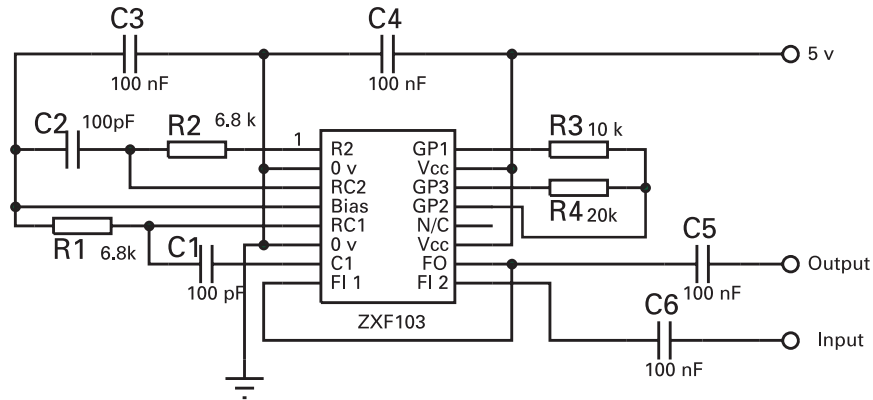
| Pin | Name | Function |
|-----|-----------------|------------------------------|
| 1 | R2 | Phase retard node |
| 2 | 0V | 0 Volts |
| 3 | RC2 | Phase retard node |
| 4 | BIAS | Internal bias generator |
| 5 | RC1 | Phase advance node |
| 6 | 0V | 0 Volts |
| 7 | C1 | Phase advance node |
| 8 | FI1 | Filter input mode dependent |
| 9 | FI2 | Filter input, mode dependent |
| 10 | FO | Filter output for all modes |
| 11 | V _{CC} | +5 Volt supply |
| 12 | N/C | No connection |
| 13 | GP2 | Loop gain node |
| 14 | GP3 | Loop gain node |
| 15 | V _{CC} | +5 Volt supply |
| 16 | GP1 | Loop gain node |



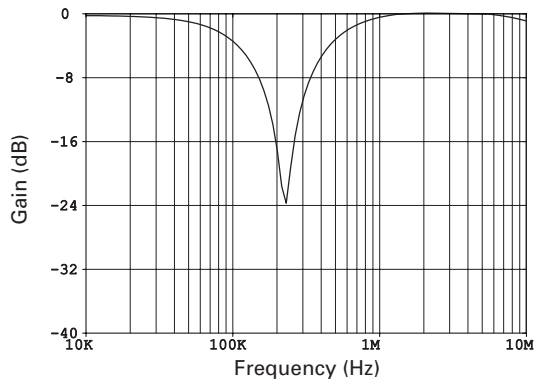
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Filter Configurations and Responses Notch Filter



AC Filter Performance

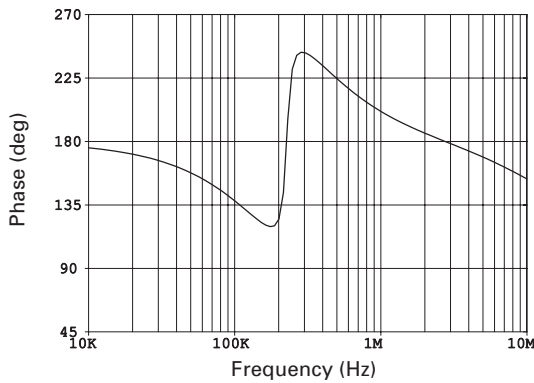


$$F_o = \frac{1}{2\pi RC}$$

where $R=R_1=R_2$
and $C=C_1=C_2$

$$Q \propto \frac{R_4}{R_3}$$

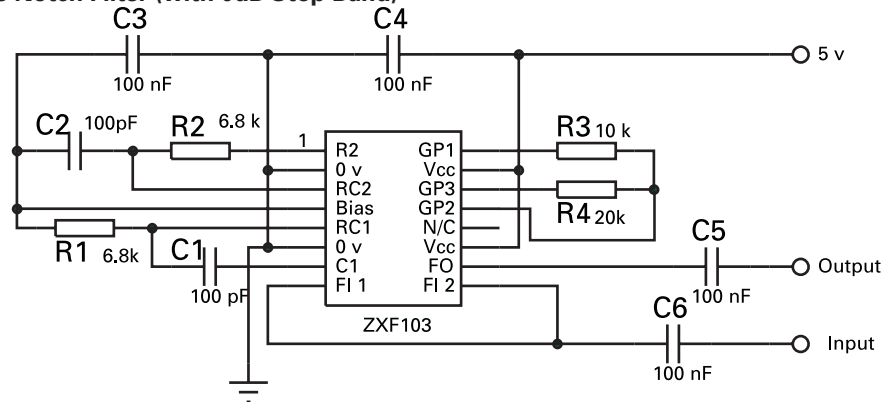
where R_1, R_2, R_3 and $R_4 \geq 2k\Omega$
and C_1 and $C_2 \geq 50pF$



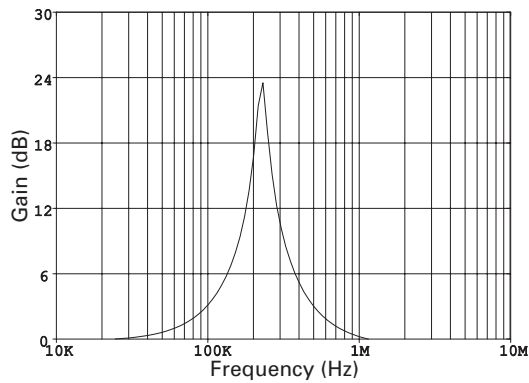
See "Designing for a value of Q"
for more details.

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Filter Configurations and Responses (Continued) Inverse Notch Filter (with 0dB Stop Band)



AC Filter Performance

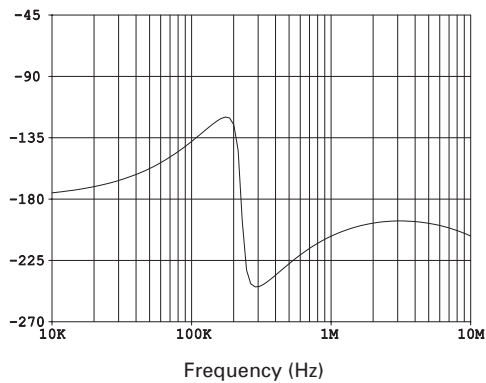


$$F_o = \frac{1}{2\pi RC}$$

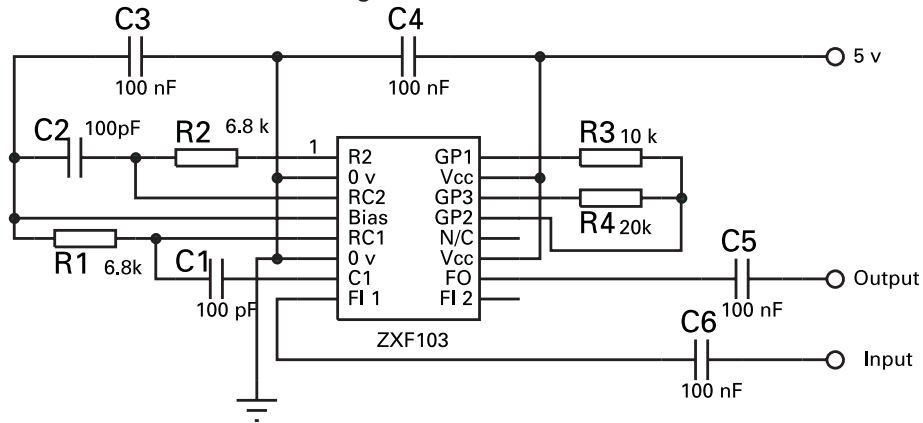
where $R=R_1=R_2$
and $C=C_1=C_2$

$$Q \propto \frac{R_4}{R_3}$$

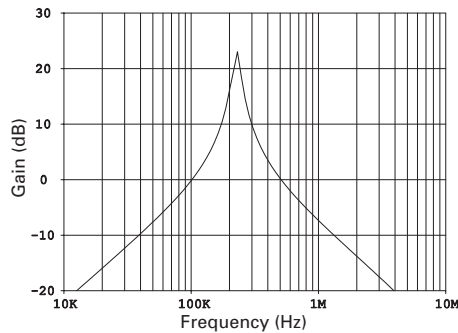
where R_1, R_2, R_3 and $R_4 \geq 2k\Omega$
and C_1 and $C_2 \geq 50pF$



Filter Configurations and Responses (Continued) Inverse Notch Filter (with attenuating skirts)



AC Filter Performance

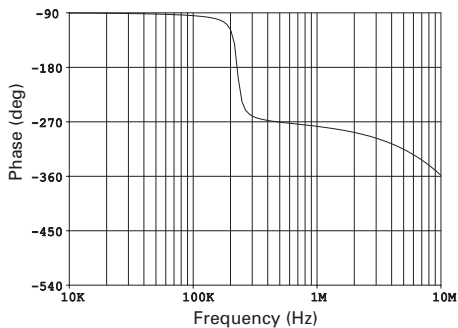


$$F_0 = \frac{1}{2\pi RC}$$

where $R=R_1=R_2$
and $C=C_1=C_2$

$$Q \propto \frac{R_4}{R_3}$$

where R_1, R_2, R_3 and $R_4 \geq 2k\Omega$
and C_1 and $C_2 \geq 50pF$



See "Designing for a value of Q" for more details.

The skirt 'roll off' away from the peak is -20dB/Decade regardless of chosen Q.

Typical responses from the circuit with component values derived from the diagram.

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Designing for a value of Q

As mentioned on the configuration pages, there is a proportional relationship between the ratio of R4 and R3, and Q.

$$Q \propto \frac{R4}{R3}$$

These resistors define the gain of an inverting amplifier that determines the peak value of gain and therefore the Q of the filter, as Q is described as;

$$Q = \frac{Fo}{-3dB\text{Bandwidth}}$$

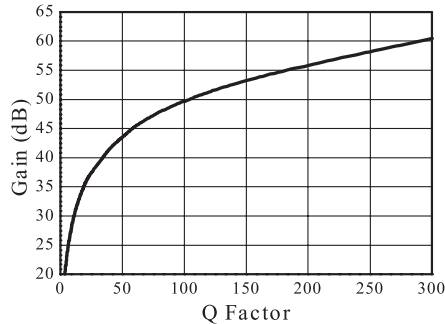
This value of required gain is quite critical. As the maximum value of Q is approached, too much gain will cause the filter to oscillate at the centre frequency Fo. A small reduction of gain will cause the value of Q to fall significantly. Therefore, for high values of Q factor or tight tolerances of lower values of Q, the resistor ratio must be trimmed.

Frequency dependant effects must be accounted for in determining the appropriate gain. As the frequency increases, the effective circuit gain reduces. The required gain is nominally two but at higher frequencies it will need to be slightly greater than two in order to compensate for loss of gain and internal phase shifts.

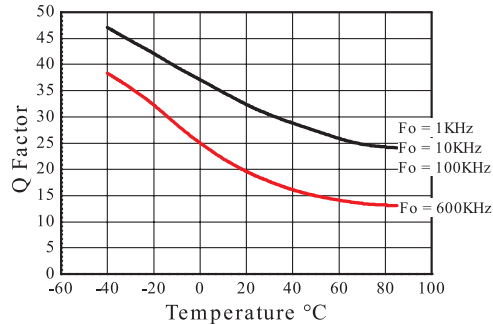
This is not really a problem for circuits where the desired Fo remains constant, as the phase shifts are accounted for permanently. For designs where Q is high and Fo is to be 'swept', care must be taken that a gain appropriate at the highest frequency does not cause oscillation at the lowest.

Variation in Q increases from device to device, as the value of Q increases, due to internal gain spreads.

Typical Gain at Fo V Q Factor (Fo = 140KHz)

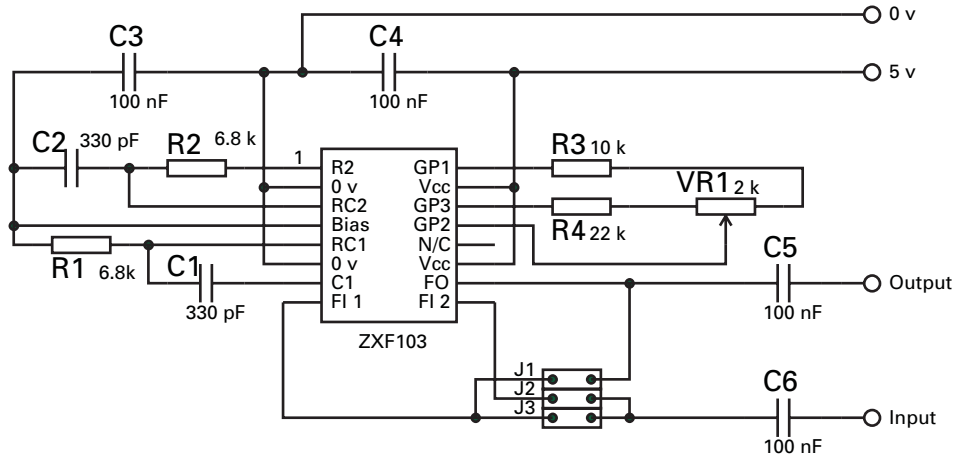


Q Factor V Temperature



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Evaluation Board Schematic

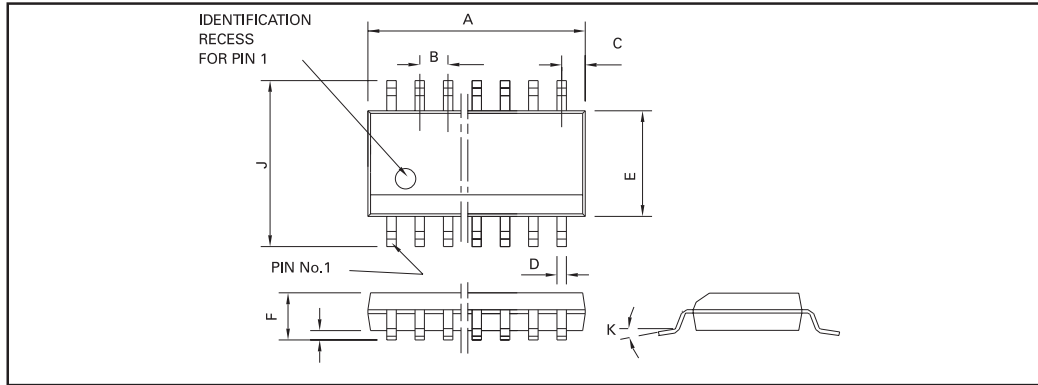


The evaluation board is designed for operation at 70kHz.

| | |
|--------------|------------------------------|
| Notch | J1 and J2 |
| Notch Pass 1 | J2 and J3 (0dB Stop Band) |
| Notch Pass 2 | J3 only (Attenuating skirts) |

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QSOP16

| DIM | Millimetres | | Inches | |
|-----|-------------|------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 4.80 | 4.98 | 0.189 | 0.196 |
| B | 0.635 | | 0.025 NOM | |
| C | 0.23 REF | | 0.009 REF | |
| D | 0.20 | 0.30 | 0.008 | 0.012 |
| E | 3.81 | 3.99 | 0.15 | 0.157 |
| F | 1.35 | 1.75 | 0.053 | 0.069 |
| G | 0.10 | 0.25 | 0.004 | 0.01 |
| J | 5.79 | 6.20 | 0.228 | 0.244 |
| K | 0° | 8° | 0° | 8° |

Conforms to JEDEC MO-137AB Iss A

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