Low Pass, Continuous Time Filter Module with Programmable Cut-off Frequency and Gain.

Single 8th Order Continuous Time Elliptic Type.

This module, shown in fig. 1, is based on the Linear Technology Corporation LTC1564. This chip implements a digitally controlled low-pass filter and a 4-Bit Programmable Gain Amplifier (PGA). The filter is an 8th order low-pass elliptic type.

By rotating a 16-position switch, the user can select f_{CUTOFF} between 10kHz to 150kHz, in 10kHz steps. A second 16-position switch allows the user to adjust the filter gain between 1 and 16, in 1v/v steps. No other analogue components are required to implement a programmable filter with this module.

See www.linear.com for a full datasheet on the LTC1564. We strongly recommend reading this datasheet in addition to the data on our module as the LTC1564 datasheet may contain additional information necessary for your application.

Features

- Single, 8th Order Elliptic Type Lowpass Filter with user selectable gain and cutoff frequency.
  - f_{CUTOFF} adjustable from 0kHz to 150kHz in 10kHz Steps (0kHz position puts filter into a low-power "off" with It's output going high impedance).
- Filter has a switch selectable gain (G) facility
  - G = 1 to 16 in 1v/v steps
- 2.7v to 10v Operation (Single or Split Supplies)
- Rail-to-Rail Input and Output Range
- Operating Temperature range 0 to 70˚C

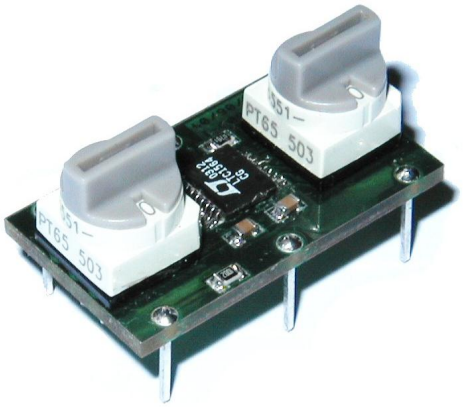

Figure 1: *Tirna Electronics Digitally Controlled Continuous Time Analogue Filter Module.*

APPLICATIONS

- Anti-aliasing or reconstruction filter for a switched capacitor filter (SCF) such as the Tirna Electronics SCF module.
- Anti-aliasing filtering prior to analogue-to-digital converter (ADC) or reconstruction filtering following a digital-to-analogue converter (DAC) or Pulse Width Modulator (PWM) output.
- Baseband signal band-limiting prior to up-conversion or signal conditioning following down conversion in a communications system. The latter application may require a passive "roofing" filter before this module to shield it from high frequency product terms beyond the capability of this active filter module.

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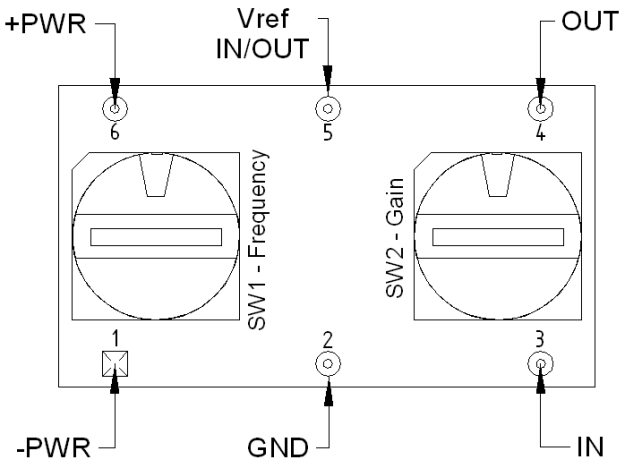
Low Pass, Continuous Time Filter Module with Programmable Cut-off Frequency and Gain

Pin layout



Pin 1: -1.35v to -5.25v (dual supply mode). Connect to pin 2 when using a single sided supply.

Pin 2: Ground. Connect to your system analogue ground.

Pin 3: Input Signal. Must remain between +PWR and -PWR.

Pin 4: Output Signal. Will drive 5kΩ in parallel with 50pF. Higher loading means more distortion. Higher capacitive loads should be isolated with 500Ω to preserve AC stability. Beware the capacitive load represented by many even quite short cables. Always check their capacitance/metre from the catalogue.

Pin 5: Output Signal centred on this voltage (see set-up notes).

Pin 6: +1.35v to +5v.

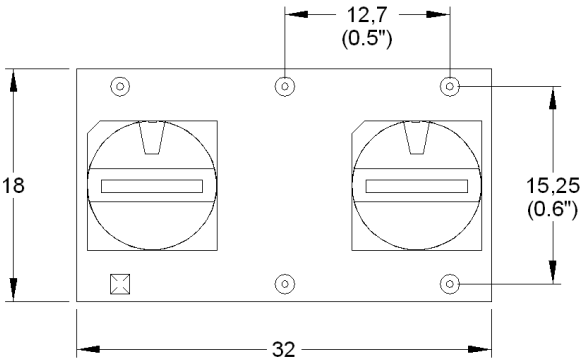
Electrical Specs

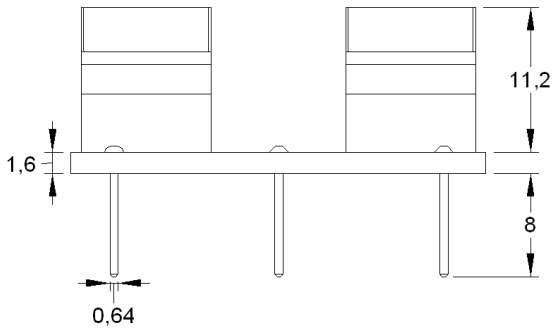
Absolute Maximum Ratings

Total Supply Voltage	(V^+ to V^-): 11v
Input Voltage	V^+ + 0.3v to V^- - 0.3V
Output short circuit Duration	Indefinite
Operating Temp. Range	0° to 70°C

Dimensions

Dimensions are shown in millimetres unless otherwise stated.





Board:

Dimensions	32 x 18 mm
Material	FR4
Thickness	1.6mm
Copper Thickness	35µm (1oz)
Finish	Green Soldermask

Pins:

Material	Phosphor Bronze
Finish	Tin on Nickel
Length (below board)	≈8.00mm
Height (above board)	≈0.5mm
Diameter	0.635mm
Cross-section	Square

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Switch Settings

Frequency Select - SW1

Switch Position (SW1)	Nominal Cut-off Frequency
0	0 (Filter Gain = 0)
1	10kHz
2	20kHz
3	30kHz
4	40kHz
5	50kHz
6	60kHz
7	70kHz
8	80kHz
9	90kHz
A	100kHz
B	110kHz
C	120kHz
D	130kHz
E	140kHz
F	150kHz

Gain Select - SW2

Switch Position (SW2)	Nominal Passband Gain		Maximum Input Signal Level (Volts peak-to-peak)			Nominal Input Impedance
	(V/V)	(dB)	Dual 5V	Single 5V	Single 3V	kΩ
0	1	0	10	5.0	3.0	10
1	2	6.0	5	2.5	1.5	5
2	3	9.5	3.33	1.67	1.0	3.33
3	4	12	2.5	1.25	0.75	2.5
4	5	14.0	2	1	0.6	2
5	6	15.6	1.67	0.83	0.5	1.67
6	7	16.9	1.43	0.71	0.43	1.43
7	8	18.1	1.25	0.63	0.38	1.25
8	9	19.1	1.1	0.56	0.33	1.11
9	10	20.0	1.0	0.50	0.3	1.0
A	11	20.8	0.91	0.45	0.27	0.91
B	12	21.6	0.83	0.42	0.25	0.83
C	13	22.3	0.77	0.38	0.23	0.77
D	14	22.9	0.71	0.36	0.21	0.71
E	15	23.5	0.67	0.33	0.20	0.66
F	16	24.1	0.63	0.31	0.19	0.63

How to Set-up the Module

This module may be run from double sided or single sided power supplies. Double sided supplies from ±1.35v to ±5.25v and single sided supplies from 2.7v to 10.5v may be used.

Left unconnected, pin 5 will act as an output and will source a voltage half way between +PWR (pin 8) and -PWR (pin 1) from an impedance of 7kΩ. The filter output is referenced to the voltage on pin 5, which means that if no input is supplied to a filter its output will sit at this voltage. A reference level external to the module can be used for the filter outputs, in which case pin 5 should be regarded as an input and tied to the desired reference level. For example, when using double sided supplies, pin 5 may be connected to system 0v (or 0v analogue), thus causing the filter outputs to sit at 0v in the absence of an input signal.

If a single sided power supply is used, (0v and +PWR), pin 5 will sit at +PWR/2 volts and this internally generated voltage may be used as a reference level for signals at the filter output by leaving pin 5 unconnected. With a single sided supply pin 5 should never be tied to 0v, but it could be tied to any appropriate external reference voltage which needs to be establish at the filter output in the absence of an input signal.

Elliptic Type Response

An elliptic filter is very similar to a Chebyshev filter in that is has a sharp cut-off (narrow transition band between pass-band and stop-band). In addition to the filtering qualities of the Chebyshev filter, the elliptic filter adds zeros of transmission (notches) in the stop-band.

In the case of the LTC1564, there are two zeros of transmission in the stop-band at about 2.5Fc and 3.3 Fc respectively. These stop-band notches further narrow the transition band compared with the corresponding order Chebyshev filter.

With these LTC1564 chips, as the cut-off frequency of the filter is increased, the depth of the notches decreases.

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