Programmable Filter

DT-212D, DT-212DC1, DT-212DC2

DT-212 series filters are regarded as universal filters capable of controlling frequencies with digital signal. The following three types of outputs are to be obtained simultaneously: low pass filter with 12dB/oct of rolloff, high pass filter with 12dB/oct of rolloff, and band pass filter with 6dB/oct of bandwidth. DT-212 series filters facilitate the settings of gain and Q through the adoption of the external resistors, besides the configuration of filters possessing various characteristics and high-order filters.
Frequency is controlled by BCD 3 digits (12 lines). The frequency range falls into three types: 1Hz to 1.599kHz (DT-212DC1), 100Hz to 159.9kHz (DT-212DC2), and a range to be designated with the external capacitors (DT-212D).

▼Filter characteristics

Type		Low pass, high pass, band pass
Order		2 (1-pole pair)
Rolloff		12dB/oct low pass, high pass 6dB/oct • BW band pass
Characteristics		Configuration of any high-order filters available. (with external resistors)
Frequency setting range (fc)		DT-212DC1 : 1Hz to 1.599kHz DT-212DC2 : 100Hz to 159.9kHz DT-212D : Range specified with the external capacitors
Q	**Range**	1/3 to 1 × 10^6/fc
	Setting	Set with external resistors.

▼Input characteristics

Impedance	Specified with a gain external resistor. (10kΩ/gain)
Maximum voltage	±10V/gain
Maximum voltage	Same as supply voltage

▼Output characteristics

Impedance	Max. 5Ω
Maximum voltage	±10V(≤100kHz)
Load resistance	Min. 2kΩ
Pass-band gain[*1]	Gained with external resistors.
Distortion[*2]	0.002%(typ)

Noise	Low pass : 35μVrms(typ) High pass : 100μVrms(typ) Band pass : 30μVrms(typ) (in the 10Hz to 500kHz bandwidth)
Offset voltage	±20mV(typ) Adjustable with an external trimmer potentiometer.
Offset voltage drift	5μV/°C(typ)

▼Cut-off frequency control characteristics

Code	BCD: 3 digits, positive logic (+5V)
Input circuit	CMOS4000 series, pulled down to GND (internal) at 100kΩ
Accuracy	±0.1%(typ)(212D), ±0.5%(typ)(212DC1/2)

▼Built-in operational amplifier

Input bias current	200nA(typ)
f_T	10MHz(typ)
Slew rate	8V/μs(typ)

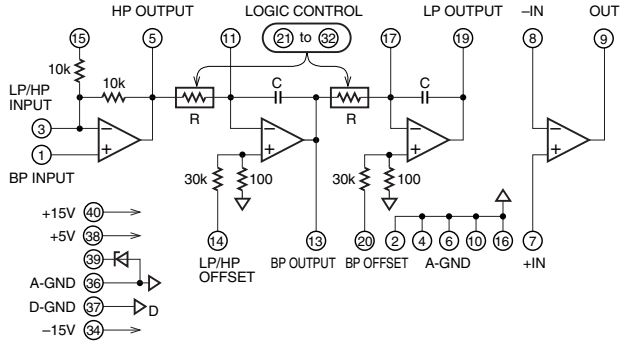
▼Others

Supply voltage		±15V±10% +5V±10%
Quiescent current		typ : +15mA/–18mA, +2.2mA max: +23mA/–27mA, +3.3mA
Temperature/ humidity range	**Operation**	–20°C to 70°C, 10 to 95%RH
	Storage	–30°C to 80°C, 10 to 80%RH
Dimensions		54.4 × 33.7 × 9.4mm, Type HA

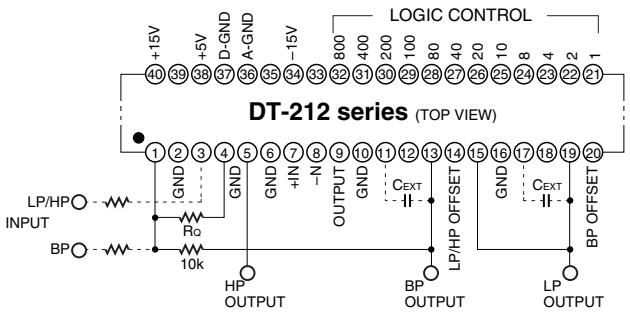
Note: The following specifications are applied unless otherwise specified:
Supply voltage: ±15V and +5V, Gain: 1, Q=0.707, Ambient temp.: 23±5°C

*1: Low pass outputs are DC-coupled. High frequency characteristics of high pass outputs: Max. 500kHz
*2: Measurement point: fc/2 (low pass), 2fc (high pass), fo (band pass)

Block diagram

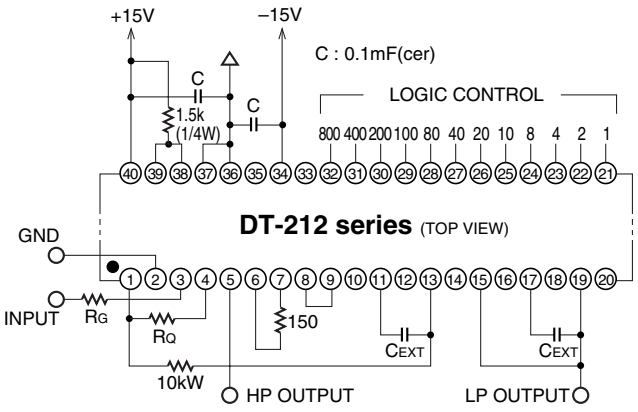


■Pinout diagram



Note *1: Do not connect an unused pin with other pins.
*2: Only external capacitors (CEXT) are available.
*3: A black circle (●) on the case top denotes Pin 1.

Basic connection diagram 2-pole low pass/high pass filters



Equation of gain $G_{LP} = G_{HP} = \frac{10}{R_G}$ (I/O phase inversion)

Equation of Q $Q = \frac{R_G}{R_Q}\,\frac{R_Q+10}{2R_G+10}$

$$RQ = \frac{10R_G}{(2R_G+10)\,Q - R_G}\ (k\Omega)$$

Units: R_G and R_Q in kΩ

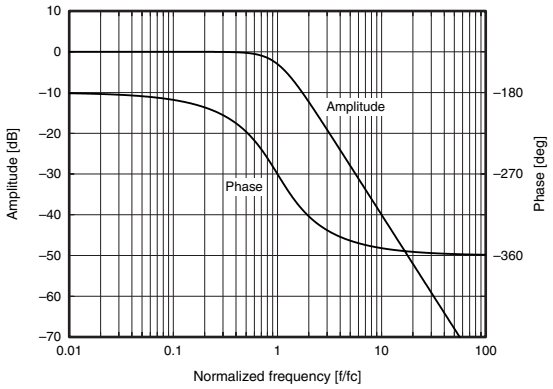
E.g.: Determine R_G and R_Q of Butterworth and Bessel characteristics.
(Gain = 2, a 12dB/oct low pass filter assigned)

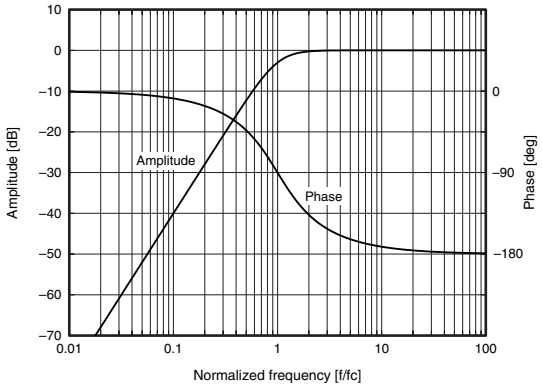
$$R_G = \frac{10}{G_{LP}} = 5k\Omega$$

$$R_Q = \frac{50}{20Q - 5}$$

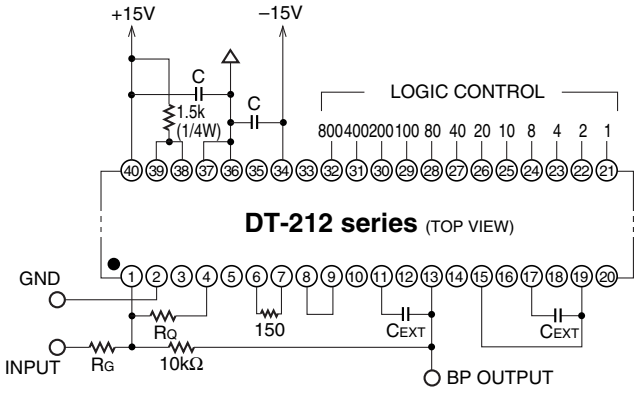
$= 5.469k\Omega$ (Q = 0.70711, Butterworth)

$= 7.637k\Omega$ (Q = 0.57735, Bessel)





Basic connection diagram 1-pole pair band pass filters



Equation of gain $G_{BP} = \frac{10}{R_G}$ (I/O phase inversion)

Equation of Q $Q = 0.5 + \frac{5}{R_G} + \frac{5}{R_Q}$

$$R_Q = \frac{10}{2Q - 1 - G_{BP}}\ (k\Omega)$$

Units: R_G and R_Q in kΩ

E.g.: Determine R_G and R_Q when Q is set at 2, 5, and 10.
(Gain = 5, a 1-pole pair band pass filter assigned)

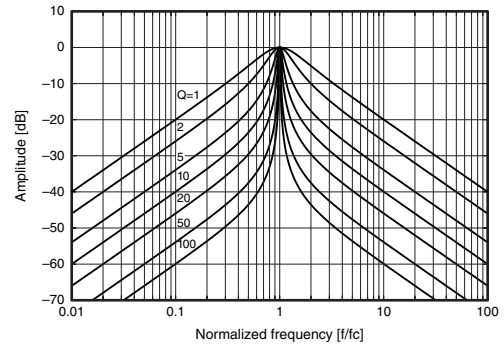
$$R_G = \frac{10}{G_{BP}} = 2k\Omega$$

$$R_G = \frac{10}{2Q - 1 - 5}$$

$= -5k\Omega$ (Q = 2)*

$= 2.5k\Omega$ (Q = 5)

$= 0.71k\Omega$ (Q = 10)



* The following specifications should be satisfied:
Q≥3 is obtained if a gain is "5", and the maximum gain is "3" if Q is set at 2.

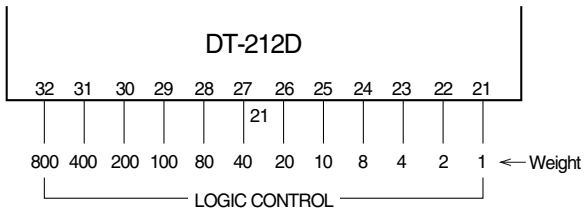
Filters

■Frequency setting

DT-212 series filters allow frequency setting through external contacts or digital signal. The frequency setting (BCD: 3 digits) is completed by assigning weights to the relevant input pins, as shown below. Internal logic reaches "Hi" if +5V is placed to the input pin (bit) and "Lo" if the input pin is set at 0V or open. The sum of bit weights (Hi) denotes frequency, and the frequency (fc) - sum (N) relationship is represented in the following equations.

DT-212DC1 fc = N (Hz)
DT-212DC2 fc = 100N (Hz)
DT-212D $fc = \frac{N}{20 \cdot C_{EXT}}$ (Hz)
(C_{EXT} : μF)

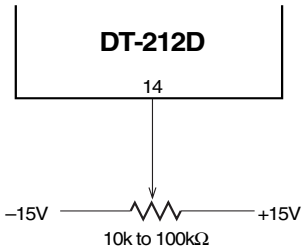
DT-212DC1 built-in capacitor: 50000pF
DT-212DC2 built-in capacitor: 500pF



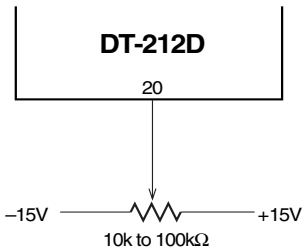
Operation in TTL level requires a voltage of +3.5 or more and a power of +5 or less when Hi level is placed. If the voltage does not attain +3.5V, connect a proper pull-up resistor to TTL output.

■Offset voltage adjustment

• When low pass or high pass output is used



• When band pass output is used

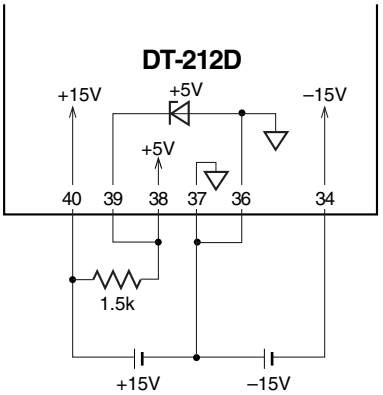


■Supply power and GND connection

DT-212 series filters are powered by ±15V and +5V, and also allow a power of +5V to be diverted from +15V.

• When only ±15V is supplied

A power of +5V is derived from the connection shown in the following diagram. The Hi level of the logic input signal should be +5.3V at the maximum due to fluctuations in Zener voltage.
The quiescent current for ±15V obtains 22mA (typ) after an increase of 7mA.



• When ±15V and +5V are supplied

The connection of Pins ㊱ and ㊲ requires caution to prevent the return current from flowing into the analog circuit from +5V of logic power. Pins ㊱ and ㊲ are to be connected on the power side as shown below.
Be sure to use a power of +5V that is small in ripple and pulse noise as with ±15V. The method with the use of only ±15V is adopted if a proper power of +5V fails to be obtained.