

# LTC1563-2 and LTC1563-3 Fourth Order Active RC Filter ICs

## DESCRIPTION

Demonstration circuit DC338B-A is for the evaluation of filter circuits using an LTC<sup>®</sup>1563-2 and DC338B-B for an LTC1563-3. LTC1563-2 and LTC1563-3 are dual 2nd order active RC filter building blocks with precision  $\pm 1.5\%$  capacitors. The LTC1563-2 uses six equal value resistors to implement a 4th order Butterworth lowpass filter, and the LTC1563-3 uses six equal value resistors to implement a 4th order Bessel lowpass filter. The lowpass cutoff frequency ( $f_c$ ) range of an LTC1563-X filter is 256Hz to 256kHz.

For testing and evaluation, the DC338B-A is configured as a single 4th order, 25.6kHz Butterworth lowpass filter; and the DC338B-B is configured as a single 4th order, 25.6kHz Bessel lowpass filter.

For other LTC1563-X configurations, the DC338B has unused pads for 0805 surface mount resistors and capacitors preconfigured with PCB traces to allow for the following LTC1563-X filter circuits:

1. 4th order lowpass filter
2. 5th order lowpass filter
3. 4th order narrow bandpass filter
4. 4th order wide bandpass filter

Refer to the LTC1563-X data sheet for additional information about filter circuit configurations.

**Design files for this circuit board are available at <http://www.linear.com/demo/DC338B>**

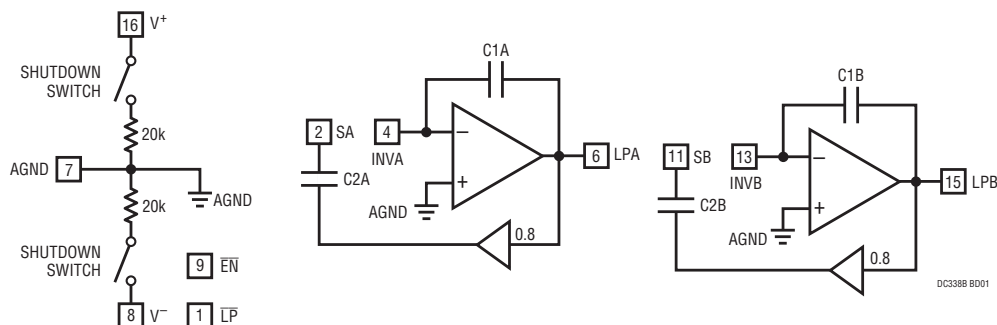
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## ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range, otherwise specifications are  $T_A = 25^\circ\text{C}$

| PARAMETER                        | CONDITIONS                      |   | MIN   | TYP                 | MAX     | UNITS |
|----------------------------------|---------------------------------|---|-------|---------------------|---------|-------|
| Total Supply Voltage             |                                 | ● | 2.7   |                     | 11      | V     |
| Supply Current                   | $V_S = 2.7\text{V}$ , LP MODE   | ● |       | 1                   | 1.8     | mA    |
|                                  | $V_S = \pm 5\text{V}$ , HS MODE | ● |       | 15                  | 23      | mA    |
| Lowpass Cutoff Frequency Range   | LP MODE                         |   | 0.256 |                     | 25.6    | kHz   |
| Lowpass Cutoff Frequency Range   | HS MODE                         |   | 0.256 |                     | 256     | kHz   |
| Bandpass Center Frequency Range  | LP MODE                         |   | 0.4   |                     | 10      | kHz   |
| Bandpass Center Frequency Range  | HS MODE                         |   | 0.4   |                     | 50      | kHz   |
| Output Voltage High, LPA and LPB | $R_L = 10\text{k}$              |   |       | $V^+ - 50\text{mV}$ |         | V     |
| Output Voltage Low, LPA and LPB  | $R_L = 10\text{k}$              |   |       | $V^- + 50\text{mV}$ |         | V     |
| DC Voltage Offset                | $V_S = 2.7\text{V}$ , LP MODE   | ● |       |                     | 6 $\pm$ | mV    |
|                                  | $V_S = \pm 5\text{V}$ , HS MODE | ● |       |                     | 3 $\pm$ | mV    |
| LTC1563-X OP AMP GBW             | $V_S = 2.7\text{V}$ , LP MODE   |   |       | 1.5                 |         | MHz   |
|                                  | $V_S = 4.75\text{V}$ , LP MODE  |   |       | 1.8                 |         | MHz   |
|                                  | $V_S = 2.7\text{V}$ , HS MODE   |   |       | 8                   |         | MHz   |
|                                  | $V_S = 4.75\text{V}$ , HS MODE  |   |       | 9                   |         | MHz   |
|                                  | $V_S = \pm 5\text{V}$ , HS MODE |   |       | 11                  |         | MHz   |

## LTC1563-X BLOCK DIAGRAM



### Capacitor Values:

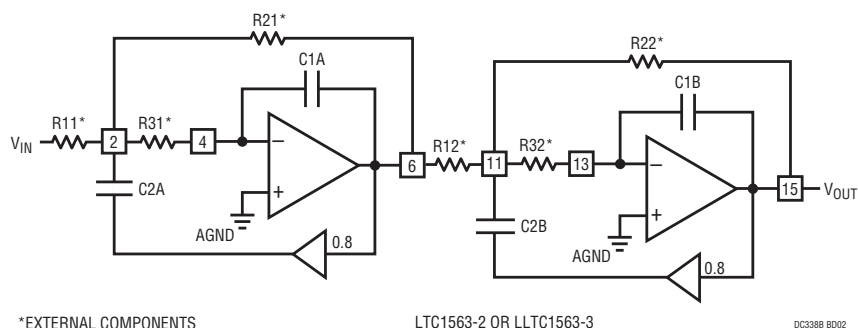
LTC1563-2, SIDE A  $C1A = 53.8\text{pF}$ ,  $C2A = 64.2\text{pF}$ . SIDE B  $C1B = 39.1\text{pF}$ ,  $C2B = 87.9\text{pF}$ .

LTC1563-3, SIDE A  $C1A = 34.9\text{pF}$ ,  $C2A = 38.8\text{pF}$ . SIDE B  $C1B = 26.8\text{pF}$ ,  $C2B = 40.3\text{pF}$ .

### Typical Capacitor Specifications:

Side A to Side B capacitor mismatch  $\pm 1.5\%$ , part to part capacitor variation  $\pm 2\%$ . Note: There is a stray 5pF capacitor from SA and SB node to ground.

## LTC1563-X 4TH ORDER LOWPASS FILTER

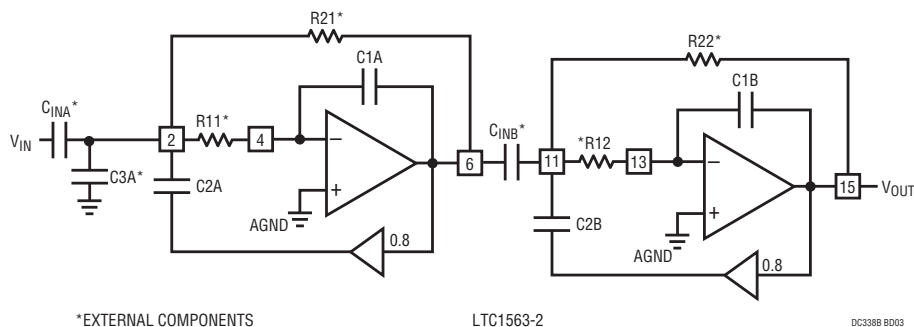


\*EXTERNAL COMPONENTS

LTC1563-2 OR LLTC1563-3

DC338B BD02

## LTC1563-X 4TH ORDER BANDPASS FILTER (NARROW PASSBAND)



\*EXTERNAL COMPONENTS

LTC1563-2

DC338B BD03

## QUICK START PROCEDURE

See Figure 1 for proper measurement equipment setup and follow the procedure below.

1. Place jumpers in the following positions: JP4 to DUAL SUPPLY, JP3 to ACTIVE, JP5 to HIGH SPEED.
2. With power off, connect a dual 5V power supply to +V and -V.
3. Connect a 10kHz, 1V<sub>P-P</sub>, sine wave generator to V<sub>IN</sub> and GND turrets.
4. Set the scaling of an oscilloscope to 1V/100μs per division.
5. Connect an oscilloscope probe from V<sub>OUT</sub> and GND to oscilloscope channel 1.
6. Power up the system and the oscilloscope should show a 10kHz 1V<sub>P-P</sub> sine wave.
7. To test stopband attenuation, set the input frequency to 100kHz and the output voltage drops to less than 5mV<sub>P-P</sub> and 25mV for the DC338B-A and DC338B-B, respectively.

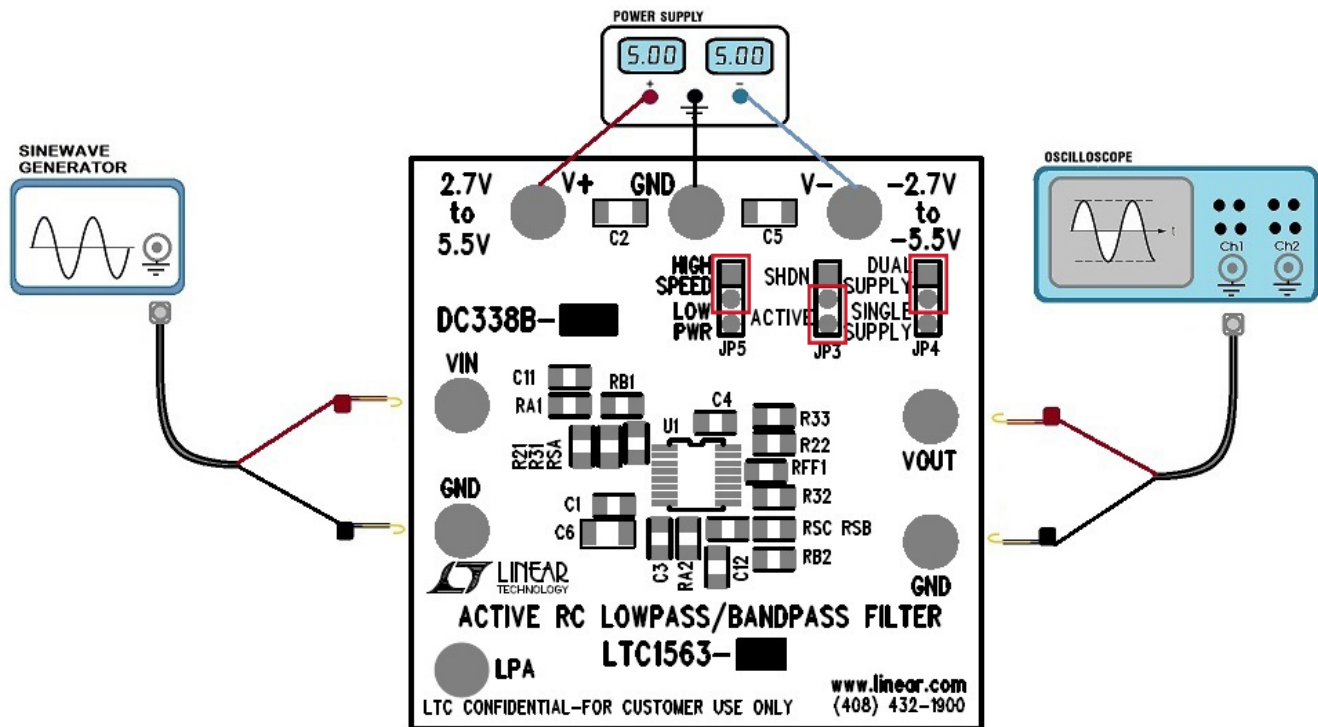


Figure 1. Quick Start Test Equipment Setup

## QUICK START PROCEDURE

### DC338B Default Configuration

For testing and evaluation, the DC338B-A is configured as a single 4th order, 25.6kHz Butterworth lowpass filter (the Figure 2 circuit) and the DC338B-B is configured as a single 4th order, 25.6kHz Bessel lowpass filter (the Figure 3 circuit).

### Reconfiguring the DC338B

Removing the default passive components (RA1, RB1 RSA, R31, R21, RA2, RB2 RSB, R32 and R22), the DC338B can be configured for variety of lowpass or bandpass filter circuits. Figures 2 thru 6 highlight easy to design and simulate with LTspice®<sup>1</sup> LTC1563 filter circuits.

Note: The LTC1563-X LTspice models only, the high speed mode (HP) with op amps at the maximum GBW (listed under Electrical Characteristics). The GBW limit must be considered when simulating LTspice circuits. For example, if an LTC1563 circuit operates in low power mode then the maximum lowpass cutoff frequency is 25.6kHz and an LTspice simulation showing a typical frequency response at cutoff frequencies greater than 25.6kHz is overly optimistic.

<sup>1</sup>LTspice is a high performance simulator, schematic capture and waveform viewer available for free download at [www.linear.com/LTspice](http://www.linear.com/LTspice).

## QUICK START PROCEDURE

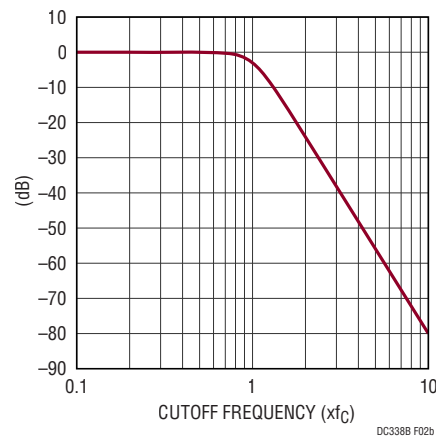
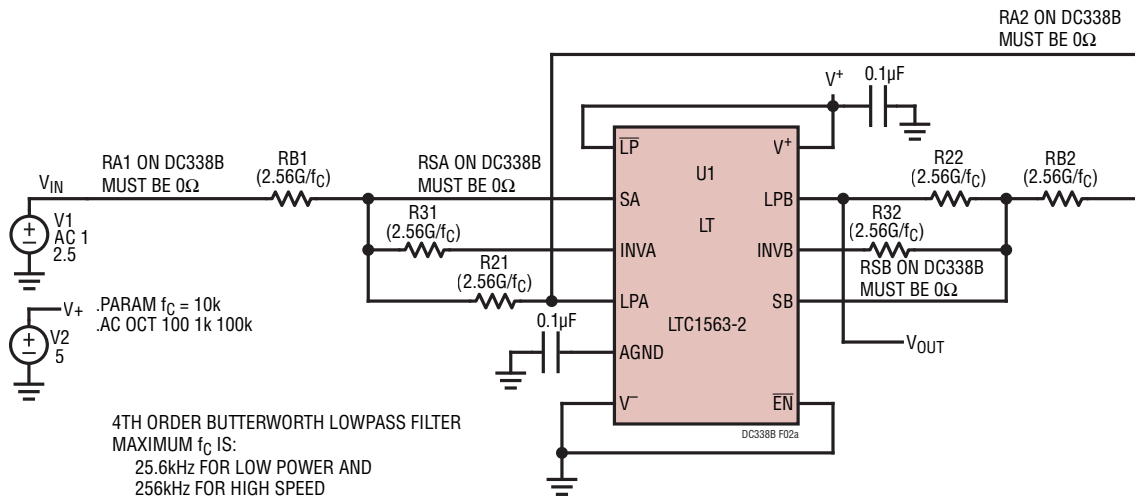
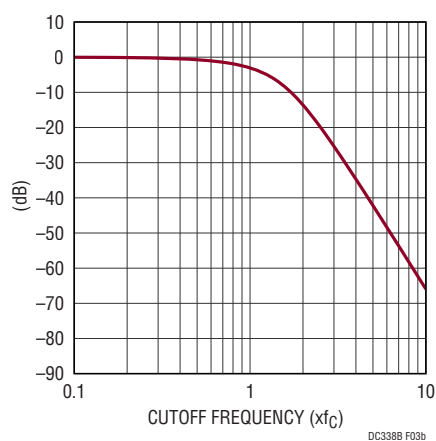


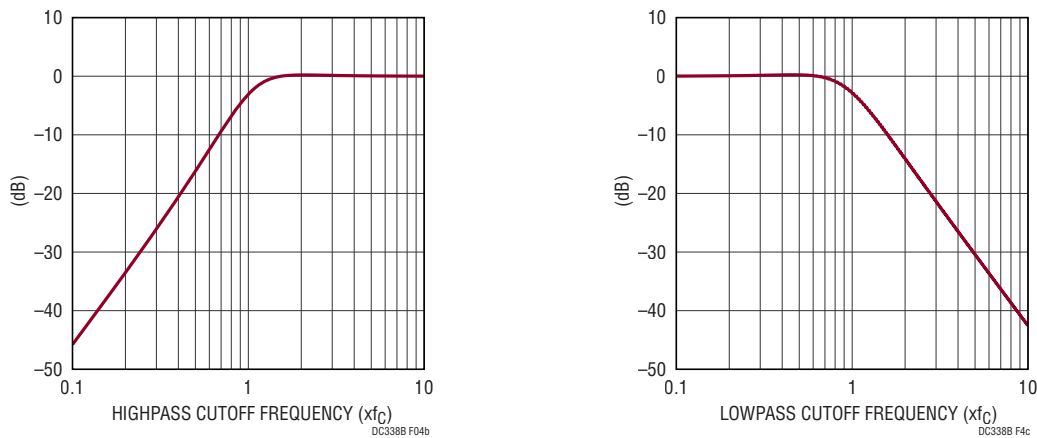
Figure 2. 4th Order Butterworth Lowpass Filter (DC338A-A Default Configuration)

The LTspice file for this circuit is available at [www.linear.com/demo/DC338B](http://www.linear.com/demo/DC338B).

## QUICK START PROCEDURE

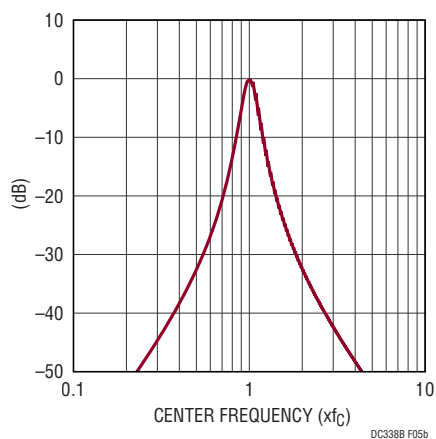


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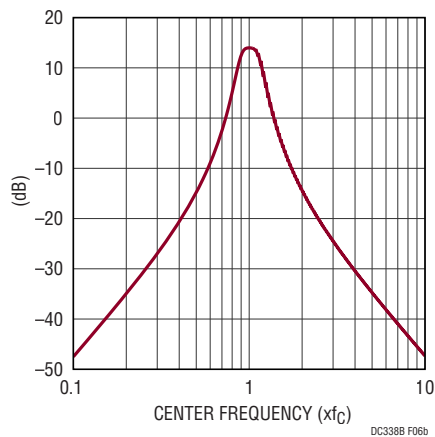
The LTspice file for this circuit is available at [www.linear.com/demo/DC338B](http://www.linear.com/demo/DC338B).

## QUICK START PROCEDURE



### Figure 5. 4th Order Narrow Bandpass Filter

The LTspice file for this circuit is available at [www.linear.com/demo/DC338B](http://www.linear.com/demo/DC338B).



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# DEMO MANUAL DC338B

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