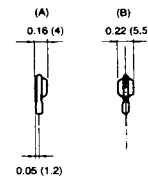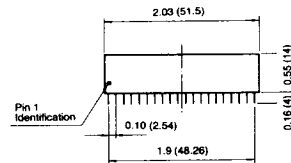# DATEL

FEATURES

- Small and thin size
- A variety of families
- Cutoff frequency fc is set by only two or four resistors
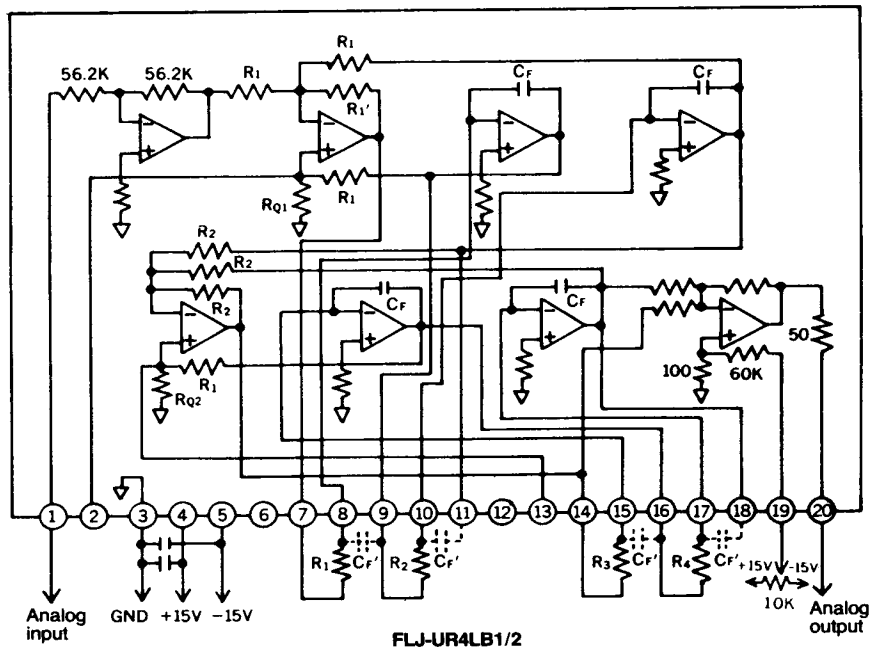- Light weight, low cost

GENERAL DESCRIPTION

The FLJ-UR series filters are single in-line package resistor tuneable filters. They are small in size and can reduce installation space on the printed circuit board. The cutoff frequency can be easily set by only two or four external resistors. The series has a variety of products, allowing system designers flexibility in selecting filters to suit their application.

MECHANICAL DIMENSIONS (Fig. 2)

INCHES (mm)

2.03 (51.5)
0.55 (14)
0.16 (4)
Pin 1 Identification
0.10 (2.54)
1.9 (48.26)

(A) 0.16 (4)
(B) 0.22 (5.5)

0.05 (1.2)

Pin cross section: 0.02×0.01 (0.5×0.25)

FLJ-UR4LB1/2

Analog input
GND +15V −15V
Analog output

SPECIFICATIONS

Typical at R=31.8 kΩ, 25°C and ±15V supply voltage unless otherwise specified.

COMMON SPECIFICATIONS TO ALL MODELS

ABSOLUTE RATINGS

Supply voltage (±Vs) .... ±18V
Input voltage .... ±Vs

FREQUENCY CHARACTERISTICS

fc accuracy .... ±3% max.
(with 0 dB gain at the frequency given in Note *2)

INPUT CHARACTERISTICS

Input Impedance .... 50 kΩ min.
Maximum Input Voltage ±10V

OUTPUT CHARACTERISTICS

Output Impedance .... 100Ω max.
Maximum Output Voltage ... ±10V min.
Load Resistance .... 10 kΩ min.
Noise (10~500 kHz) .... 140 μV max.
Offset Voltage .... ±30 mV max. zero adjustable

POWER SUPPLY AND ENVIRONMENTS

Supply Voltage .... ±15V
Supply Voltage,
Operating Range .... ±5V~±18V
Operating Temerature/
Humidity Range .... −20°C~70°C, 10~95%RH
Storage Temperature/
Humidity Range .... −30°C~80°C, 10~80%RH

SPECIFICATIONS 1 (4 POLE MODELS)

No. of poles/characteristics		4-pole lowpass	4-pole lowpass	4-pole highpass	4-pole highpass
Type		Butterworth	Chebyshev	Butterworth	Chebyshev
Model		FLJ-UR4LA	FLJ-UR4LB	FLJ-UR4HA	FLJ-UR4HB
fc (−3 dB) characteristics					
Range[1]	Suffix 1 model	40 Hz~1.6 kHz	*Same as left	*Same as left	*Same as left
	Suffix 2 model	400 Hz~20 kHz	•	400 Hz~5 kHz	•
Setting		by 4 external resistors	•	•	•
Pass band characteristics					
Gain[2]		0 dB±0.3 dB	•	0 dB±1 dB	•
Ripple		—	0.28 dBp-p	—	0.28 dBp-p
Upper-limit frequency (small signal)		—	—	50 kHz±1 dB max.[3]	•
Rolloff characteristics					
Rolloff		24 dB/oct	42 dB/oct or equivalent	24 dB/oct	42 dB/oct or equivalent
Attenuation volume (1/2 fc or 2 fc)		24 dB	55 dB	24 dB	55 dB
Minimum attenuation		—	46 dB	—	46 dB
Attenuation at 1 MHz		70 dB min.	—	—	—
Output characteristics					
Offset drift		30 μV/°C	•	15 μV/°C	•
Distortion rate[2]		0.01%	•	0.1%	•
Slew rate		—	—	2V/μsec	•
Quiescent current/package					
Quiescent current (@±15V)		±12 mA	±16 mA	±8 mA	±16 mA
Package		20 pins SIP (A)	•	•	•

SPECIFICATIONS 2 (2 POLE AND 1 POLE PAIR MODELS)

No. of poles/characteristics		2-pole high lowpass	1-pole pair bandpass	2-pole pair bandpass	2-pole pair band elimination
Type		Butterworth	Butterworth	Butterworth	Butterworth
Model		FLJ-UR2LH	FLJ-UR1BA	FLJ-UR2BA	FLJ-UR2EA
fc (−3 dB) characteristics					
Range[1]	Suffix 1 model	40 Hz~1.6 kHz	*Same as left	*Same as left	*Same as left
	Suffix 2 model	400 Hz~20 kHz	400 Hz~10 kHz	•	•
Setting		by 2 external resistors	•	by 4 external resistors	•
Pass band characteristics					
Gain[2]		0 dB±0.3 dB	0 dB±1 dB	•	0 dB±0.3 dB
Upper-limit frequency (small signal)[3]		100 kHz±1 dB HPF	—	—	50 kHz±1 dB max.
Rolloff characteristics					
Rolloff		12 dB/oct	—	—	—
Q		—	5[4]	5	5
Attenuation volume (1/2 fc or 2 fc)		12 dB	17.5 dB	35 dB	—
Attenuation at 1 MHz		−70 dB min. LPF	•	•	—
Maximum attenuation (f₀)		—	—	—	60 dB
Output characteristics					
Offset drift		15 μV/°C	•	•	30 μV/°C
Distortion rate[2]		0.1%	0.01%	•	•
Slew rate		2V/μsec HPF	—	—	2V/μsec
Quiescent current/package					
Quiescent current (@±15V)		±8 mA	•	±12 mA	±20 mA
Package		20 pins SIP (A)	•	•	20 pins SIP (B)

*1. Addition of 2 or 4 external capacitors allow extension to lower band
*2. FLJ-UR4LA, 4LB; fc/10. FLJ-UR4HA; 3.3 fc. FLJ-UR4HB; 10 fc (fc≦3 kHz), 3.3 fc (fc>3 kHz)
  FLJ-UR2LH; fc/10 (LPF), 10 fc (HPF)
*3. Gain of 0 dB at above stated frequencies. (See *2)
*4. Connection of a specified pin to GND allow 10, 20, 30, 40 and 50. External resistors allow a range of 1.81≦Q≦50

TECHNICAL NOTES

1. Do not use a switching regulator. Use a well regulated ±15V power supply. Install 0.01 µF bypass capacitors as close to the filter as possible.

2. Use metal film resistors of 1% tolerance for fc setting. When making a higher-order filter, use more accurate resistors.

3. Connect external resistors with short leads as close to the filter as possible.

4. Use external capacitors with good stability and high dielectric resistance. It is recommended to use multilayer ceramic capacitors or plastic film capacitors.

5. Regulate output offset voltage by using an external trimmer (10 KΩ to 50 KΩ).

6. The FLJ-UR series filters are packaged single inline and are compact in size. Installation at high-density may cause temperature rises between elements. Installation with 0.8" or more of space between filters can eliminate the problem.

7. Relation between fc and external resistor/capacitor: With the FLJ-UR series, a cutoff or center frequency can be set by 2 or 4 external resistors. The values of R of 2 or 4 external resistors for normal use can be calculated as;

$$R = \frac{15.9 \times 10^6}{fc\ (Hz)}\ (\Omega) \quad \text{Suffix 1 model}$$

$$R = \frac{159 \times 10^6}{fc\ (Hz)}\ (\Omega) \quad \text{Suffix 2 model}$$

Note: $R_1 = R_2 = R_3 = R_4$

In certain applications the resistance of each of 2 or 4 resistors may be changed. R_1 to R_4 shown in the block diagrams are the external resistors explained here. In standard use, the fc can be set to a minimum of 40 Hz. This is because the values of R have to be increased to about 400K according to the relation between R and fc. The fc setting range can be expanded to lower band by adding 2 or 4 external capacitors.

$$R = \frac{159 \times 10^3}{(Cext + 0.01)\ fc}\ (\Omega) \quad \text{Suffix 1 model}$$

$$R = \frac{159 \times 10^3}{(Cext + 0.001)\ fc}\ (\Omega) \quad \text{Suffix 2 model}$$

where Cext is measured in µF and Fc in Hz.

In the applications in which the output offset, time drift, or output noise must be minimal, use the above external capacitors if the values of external resistors exceed 100 kΩ each.

8. How to tune fc
   As shown in the specifications, the fc setting accuracy is 3% depending on the accuracy of elements used. There is no practical problem in tuning when they are used as lowpass or highpass filters. However, bandpass filters and band elimination filters may require sharp tuning. Such filters can be tuned with external trimmers as shown in Fig. 10. R_1, R_2 and VR_1 are not used with the FLJ-UR1BA1/2.
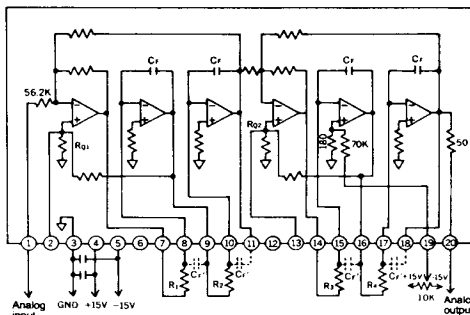
   a. FLJ-UR1BA1/2
      - An input signal of oscillating frequency fc is given.
      - I/O signals are monitored with a phase measuring instrument such as an oscilloscope.
      - Tune VR_2 until the phase difference between I/O signals can be reduced to 0°.
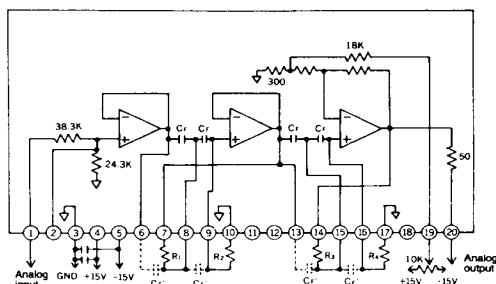
b. FLJ-UR2BA1/2
   - An input frequency of 1.0734×fc is provided.
   - Tune VR_1 until the phase difference between the input signal and the output signal at pin 9 reaches at 180° looking at a phase measuring instrument such as an oscilloscope.
   - An input signal of frequency fc is given.
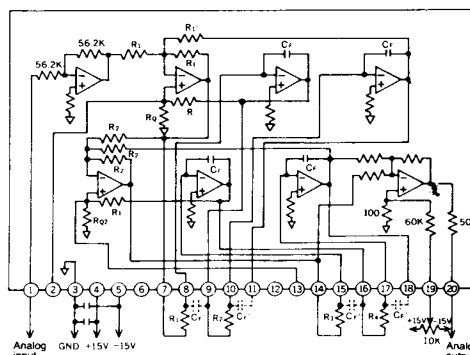   - Tune VR2 until the phase difference between the input signal and the output signal at pin 20 is set at 0°.

FLJ-UR4LA1/2 Block Diagram (Fig. 3)
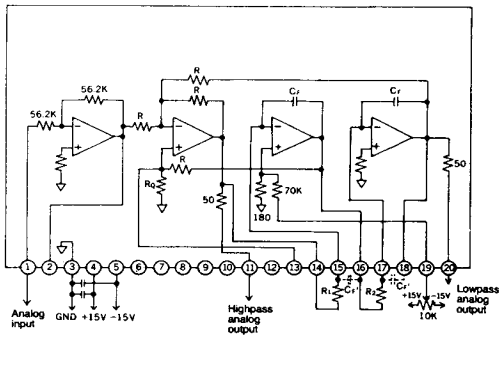

FLJ-UR4HA1/2 Block Diagram (Fig. 4)

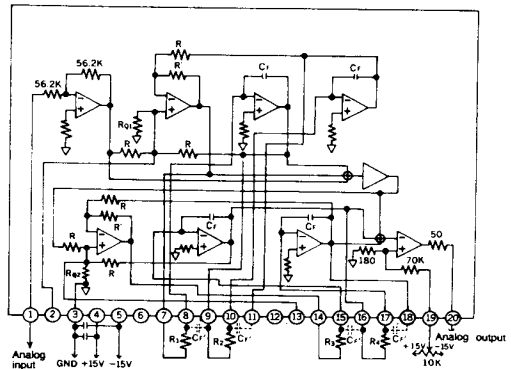### FLJ-UR4HB1/2 Block Diagram (Fig. 5)

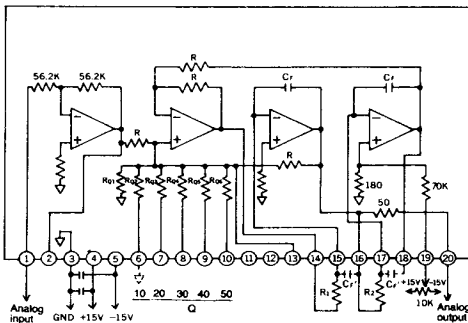Cf in each figure is 10000 pF for suffix 1 model and 1000 pF for suffix 2 model.
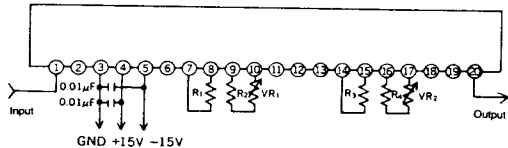
FLJ-UR2LH1/2 Block Diagram (Fig. 6)

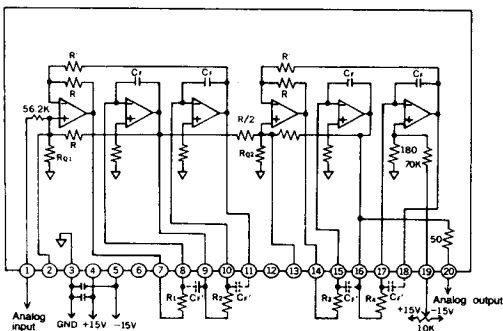### FLJ-UR2EA1/2 Block Diagram (Fig. 9)

FLJ-UR1BA1/2 Block Diagram (Fig. 7)

fc tuning method (Fig. 10)

FLJ-UR2BA1/2 Block Diagram (Fig. 8)

Cf in each figure is 10000 pF for suffix 1 model and 1000 pF for suffix 2 model.

ORDERING INFORMATION

LOW CUTOFF FREQUENCY TYPE (40 Hz~1.6 kHz)

FLJ-UR4LA1: 4-pole lowpass, Butterworth
FLJ-UR4LB1: 4-pole lowpass, Chebyshev
FLJ-UR4HA1: 4-pole highpass, Butterworth
FLJ-UR4HB1: 4-pole highpass, Chebyshev
FLJ-UR2LH1: 2-pole lowpass/highpass, Butterworth
FLJ-UR1BA1: 1-pole pair bandpass, Butterworth
FLJ-UR2BA1: 2-pole pair bandpass, Butterworth
FLJ-UR2EA1: 2-pole pair band elimination, Butterworth

HIGH CUTOFF FREQUENCY TYPE (400 Hz~5 k/10 k/20 kHz)

FLJ-UR4LA2: 4-pole lowpass, Butterworth
FLJ-UR4LB2: 4-pole lowpass, Chebyshev
FLJ-UR4HA2: 4-pole highpass, Butterworth
FLJ-UR4HB2: 4-pole highpass, Chebyshev
FLJ-UR2LH2: 2-pole highpass/lowpass, Butterworth
FLJ-UR1BA2: 1-pole pair bandpass, Butterworth
FLJ-UR2BA2: 2-pole pair bandpass, Butterworth
FLJ-UR2EA2: 2-pole pair band elimination, Butterworth