AB52
Active Band Pass Filter

Operating Manual

Ver.1.1

An ISO 9001 : 2000 company

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TÜV TÜV Rheinland Group

CERTIFICATE

The Certification Body for
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Indore – 452 010, Madhya Pradesh, India

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An audit was performed, Report No. 07930
Proof has been furnished that the requirements according to

DIN EN ISO 9001: 2000

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The certificate is valid until 2010-11-20
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TÜV NABCB QMS 010

Bangalore, 2007-11-21

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RoHS Compliance

Scientech Products are RoHS Complied.

RoHS Directive concerns with the restrictive use of Hazardous substances (Pb, Cd, Cr, Hg, Br compounds) in electric and electronic equipments.

Scientech products are “Lead Free” and “Environment Friendly”.

It is mandatory that service engineers use lead free solder wire and use the soldering irons upto (25 W) that reach a temperature of 450°C at the tip as the melting temperature of the unleaded solder is higher than the leaded solder.

Introduction

AB52 is a compact ready to use **Active Band-Pass Filter** experiment board. It illustrates the functionality of Active Band-Pass Filter at adjustable High cutoff frequency (f_H) and Low cutoff frequency (f_L). It can be used as stand alone unit with external Power Supply or can be used with **Scientech Analog Lab ST2612** which has built-in DC Power Supply, AC Power Supply, function generator, modulation generator, continuity tester, toggle switches, potentiometers.

List of Boards :

Model	Name
AB01	Diode characteristics (Si, Zener, LED)
AB02	Transistor characteristics (CB NPN)
AB03	Transistor characteristics (CB PNP)
AB04	Transistor characteristics (CE NPN)
AB05	Transistor characteristics (CE PNP)
AB06	Transistor characteristics (CC NPN)
AB07	Transistor characteristics (CC PNP)
AB08	FET characteristics
AB09	Rectifier Circuits
AB10	Wheatstone Bridge
AB11	Maxwell's Bridge
AB12	De Sauty's Bridge
AB13	Schering Bridge
AB15	Common Emitter Amplifier
AB14	Darlington Pair
AB16	Common Collector Amplifier
AB17	Common Base Amplifier
AB18	Cascode Amplifier
AB19	RC-Coupled Amplifier
AB20	Direct Coupled Amplifier
AB21	Class A Amplifier
AB22	Class B Amplifier (push pull emitter follower)
AB23	Class C Tuned Amplifier
AB25	Phase Locked Loop (FM Demodulator & Frequency Divider / Multiplier)
AB28	Multivibrator (Mono stable / Astable)
AB29	F-V and V-F Converter
AB30	V-I and I-V Converter
AB31	Zener Voltage Regulator
AB32	Transistor Series Voltage Regulator
AB33	Transistor Shunt Voltage Regulator
AB35	DC Ammeter
AB39	Instrumentation Amplifier
AB41	Differential Amplifier (Transistorized)

AB42	Operational Amplifier (Inverting / Non-inverting / Differentiator)
AB43	Operational Amplifier (Adder/Scalar)
AB44	Operational Amplifier (Integrator/ Differentiator)
AB45	Schmitt Trigger and Comparator
AB49	K Derived Filter
AB51	Active filters (Low Pass and High Pass)
AB54	Tschebyscheff Filter
AB56	Fiber Optic Analog Link
AB57	Owen's Bridge
AB58	Anderson's Bridge
AB59	Maxwell's Inductance Bridge
AB64	RC – Coupled Amplifier with Feedback
AB65	Phase Shift Oscillator
AB66	Wien Bridge Oscillators
AB67	Colpitt Oscillator
AB68	Hartley Oscillator
AB80	RLC Series and RLC Parallel Resonance
AB82	Thevenin's and Maximum power Transfer Theorem
AB83	Reciprocity and Superposition Theorem
AB84	Tellegen's Theorem
AB85	Norton's theorem
AB88	Diode Clipper
AB89	Diode Clampers
AB90	Two port network parameter
AB91	Optical Transducer (Photovoltaic cell)
AB92	Optical Transducer (Photoconductive cell/LDR)
AB93	Optical Transducer (Phototransistor)
AB96	Temperature Transducer (RTD & IC335)
AB97	Temperature Transducer (Thermocouple)
AB101	DSB Modulator and Demodulator
AB102	SSB Modulator and Demodulator
AB106	FM Modulator and Demodulator

…… and many more

Theory

An electric filter is a frequency selective circuit that passes electric signals of specific band of frequencies and attenuates signal of frequencies outside this band. Depending on the type of elements used in their construction filters may be classified as passive or active filters. Elements used in passive filters are resistors, capacitors and inductors.

Active filter consists of active components such as Op-amp, transistors with passive elements.

Most commonly used filters are:

1. Low Pass Filter

2. High Pass Filter

3. Band-Pass Filter

Band-Pass Filter :

It is a frequency selective circuit, which passes signals of particular band of frequencies lies between its low cut off frequency (f_L) and high cut off frequency (f_h) and attenuates signals of frequencies having above and below its cutoff frequencies. i.e. the Band-Pass Filter has a pass band between two cutoff frequencies f_H and f_L where $f_H > f_L$ and two stop bands: $0 < f < f_L$ and $f > f_H$. The 3-db band width of filter is f_H-f_L.

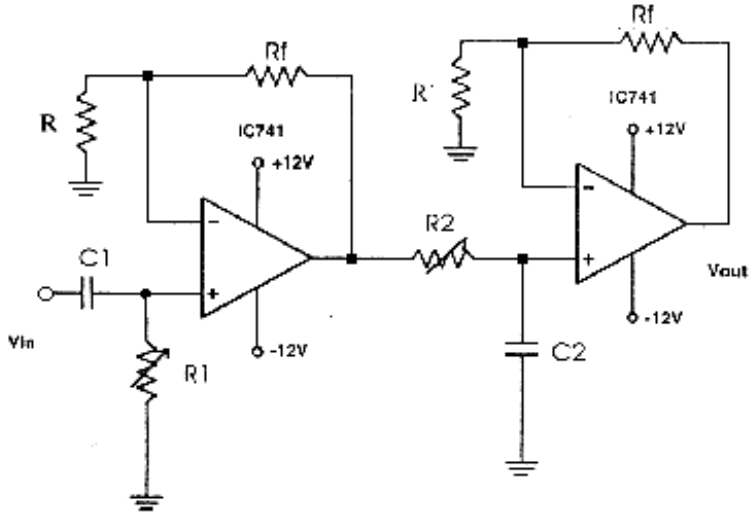


Figure 1

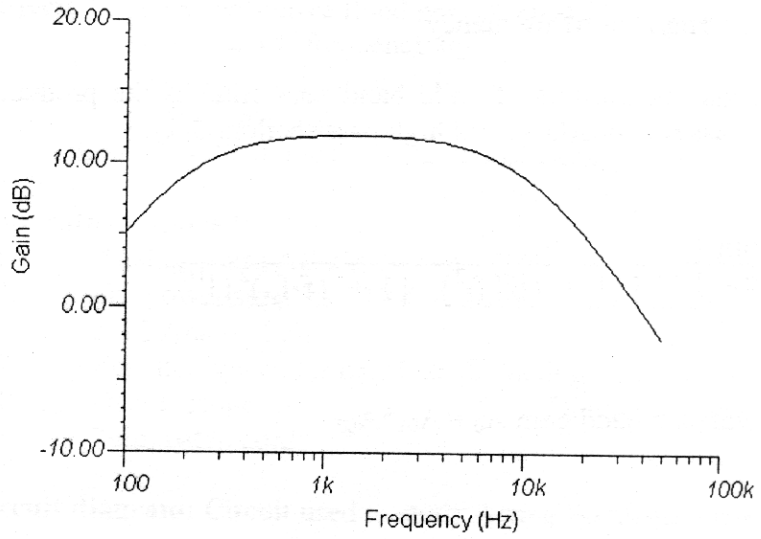


Figure 2

A Wide Band-Pass Filter is formed by cascading a High Pass Filter and Low Pass Filter.

If the High-Pass Filter and Low-Pass Filter are of the first order then the Band-Pass Filter will have a roll off rate of -20db/decade.

For the high pass section the magnitude of gain is given by

$$|G_{HP}| = \frac{A_{01} * (f / f_L)}{1 + j(f/f_L)} \qquad |G_{HP}| = \frac{A_{01}(f / f_L)}{\{1 + (f/f_L)^2\}^{1/2}}$$

$A_{01} = 1 + R_F / R$ = Pass band gain of High pass section
f = frequency of input signal
$f_L = 1/2 \pi R_1C_1$ = Low cut off frequency

For the Low pass section the magnitude of gain is given by

$$|G_{LP}| = \frac{A_{02}}{1 + j(f/f_H)} \qquad |G_{LP}| = \frac{A_{02}}{\{1 + (f/f_H)^2\}^{1/2}}$$

$A_{02} = 1 + R_F / R$ = pass band gain of Low pass section

f = frequency of input signal

$f_H = 1/2 \pi R_2C_2$ = High cutoff frequency

The voltage gain magnitude of wide Band Pass Filter is the product of gains of low pass sections (G_{LP}) and High Pass section (G_{HP})

$$\left|\frac{Vout}{Vin}\right| = \frac{A_0(f/f_L)}{[\{1 + (f/f_L)^2\} \{1 + (f/f_H)^2\}]^{1/2}}$$

Where the total pass band gain $A_0 = A_{01} * A_{02}$

Experiment

Objective :

Study of the Active Band Pass Filter and to evaluate

1. **Low cutoff frequency f_L.**
2. **High cutoff frequency f_H.**
3. **3 db Bandwidth.**
4. **Plot the frequency response of Band-Pass Filter.**

Equipment Needed :

1. Analog board of **AB52.**
2. DC power supplies +12V, –12V from external source or **ST2612 Analog Lab**.
3. Function generator or **ST2612 Analog Lab**.
4. Oscilloscope Caddo 802 or equivalent
5. Digital Multimeter
6. 2 mm Patch Cords.

Circuit diagram :

Circuit used to study Active Band Pass Filter shown in figure 3.

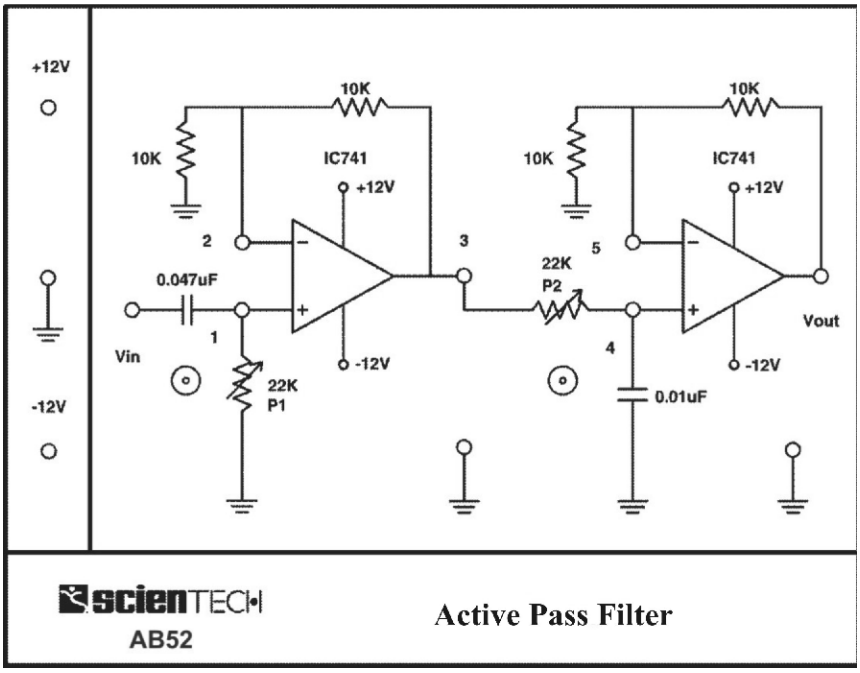


Figure 3

Procedure :

1. Connect Ohmmeter between Test Point 1 and Gnd. Adjust resistance value to approximately 17K by varying the potentiometer P1 to set the Low cutoff frequency (f_L) at 200Hz.
2. Connect Ohmmeter between Test Point 3 and Test Point 4. Adjust resistance value to approximately 800 ohms by varying the potentiometer P2 to set the High cutoff frequency (f_H) at 20 KHz.
3. Connect +12V and −12V DC power supplies at there indicated position from external source or **ST2612** Analog Lab.
4. Switch 'On' the Power Supply.
5. Connect a sinusoidal signal of amplitude 1V (p-p) of frequency 1 KHz to the Test Point Vin of Band-Pass Filter from external source or **ST2612** Analog Lab.
6. Observe output on Oscilloscope by connecting Test Point Vout to Oscilloscope.
7. Increase the frequency of input signal step by step and observe the effect on output Vout on Oscilloscope.
8. Decrease the frequency of input signal step by step and observe the effect on output Vout on Oscilloscope.
9. Tabulate values of Vout, gain, gain (db) at different values of input frequency shown in Observation Table.
10. Plot the frequency response of Band-Pass Filter using the data obtained at different input frequencies.
11. Perform the same procedure at different Cutoff frequencies shown below.

Resistance P1(W)	**Capacitance C_1(mF)**	**f_L (Hz)**	**Resistance P2 (W)**	**Capacitance C_2 (mF)**	**f_H (Hz)**
17K	0.047	200	800	0.01	20K
6.7K	0.047	500	3184	0.01	5K
3.38K	0.047	1K	1.59K	0.01	10K

Observation Table :

Sr. No.	Input freq. (Hz)	Vout	|V out / Vin|= gain	Gain (db) = 20 log |vout / vin|
1.	50			
2.	100			
3.	200(f_L)			
4.	500			
5.	1K			
6.	2K			
7.	5K			
8.	10K(f_H)			
9.	15K			
10.	20K			
11.	30K			

Theoretical Calculations :

1. Pass band gain of Band Pass Filter $A_0 = A_{01} * A_{02}$

2. Pass band gain (db) 20 log |Vout / Vin|

3. High cutoff frequency $f_H = 1/2\pi R_2C_2$

4. Low cutoff frequency $f_L = 1/2\ \pi\ R_1C_1$

5. 3 db Bandwidth = $f_H - f_L$

Results :

	Theoretical	Practical
Pass band gain A_0		
Pass band gain (db)		
High cutoff frequency f_H		
Low cutoff frequency f_L		
3 db Bandwidth		

Data Sheet

mA741

UA741

GENERAL PURPOSE SINGLE OPERATIONAL AMPLIFIER

- LARGE INPUT VOLTAGE RANGE
- NO LATCH-UP
- HIGH GAIN
- SHORT-CIRCUIT PROTECTION
- NO FREQUENCY COMPENSATION
- REQUIRED
- SAME PIN CONFIGURATION AS THE UA709

N
DIP8
(Plastic Package)

D
SO8
(Plastic Micropackage)

DESCRIPTION

The UA741 is a high performance monolithic operational amplifier constructed on a single silicon chip. It is intented for a wide range of analog applications.

- Summing amplifier
- Voltage follower
- Integrator
- Active filter
- Function generator

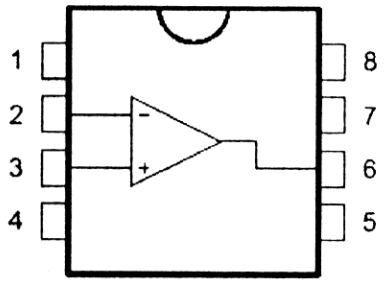
The high gain and wide range of operating voltages provide superior performances in integrator, summing amplifier and general feedback applications. The internal compensation network (6dB/octave) insures stability in closed loop circuits.

ORDER CODE

Part Number	Temperature Range	Package	
		N	D
UA741C	0°C, +70°C	•	•
UA741I	-40°C, +105°C	•	•
UA741M	-55°C, +125°C	•	•
Example : UA741CN			

N = Dual in Line Package (DIP)
D = Small Outline Package (SO) - also available in Tape & Reel (DT)

PIN CONNECTIONS (top view)



1 - Offset null 1
2 - Inverting input
3 - Non-inverting input
4 - V_{CC}^-
5 - Offset null 2
6 - Output
7 - V_{CC}^+
8 - N.C.

Warranty

1. We guarantee the product against all manufacturing defects for 24 months from the date of sale by us or through our dealers. Consumables like dry cell etc. are not covered under warranty.

2. The guarantee will become void, if

a) The product is not operated as per the instruction given in the operating manual.

b) The agreed payment terms and other conditions of sale are not followed.

c) The customer resells the instrument to another party.

d) Any attempt is made to service and modify the instrument.

3. The non-working of the product is to be communicated to us immediately giving full details of the complaints and defects noticed specifically mentioning the type, serial number of the product and date of purchase etc.

4. The repair work will be carried out, provided the product is dispatched securely packed and insured. The transportation charges shall be borne by the customer.

For any Technical Problem Please Contact us at **service@scientech.bz**

List of Accessories

1. 2mm Patch Cord 16" (Red) ..... 2 Nos.

2. 2mm Patch Cord 16" (Black) ..... 2 Nos.

3. 2mm Patch Cord 16" (Blue) ..... 2 Nos.

4. e-Manual.....1 No.

Updated 26-06-2009