AB43
Operational Amplifier (Adder / Scalar)

Operating Manual

Ver.1.1

An ISO 9001 : 2000 company

Innovative Technology Ecosystem
94-101, Electronic Complex Pardesipura,
Indore- 452010, India
Tel : 91-731- 2570301/02, 4211100
Fax: 91- 731- 2555643
e mail : info@scientech.bz
Website : www.scientech.bz
Toll free : 1800-103-5050

TÜV TÜV Rheinland Group

CERTIFICATE

The Certification Body for
Quality Management Systems
of TÜV Rheinland India Pvt. Ltd.

certifies in accordance with
TÜV Rheinland Group procedures that

Scientech Technologies Pvt. Ltd.

Unit-1: 94-101, Electronics Complex, Pardeshi Pura,
Indore – 452 010, Madhya Pradesh, India
Unit-2: 90-91, Electronics Complex, Pardeshi Pura,
Indore – 452 010, Madhya Pradesh, India

has established and applies a quality management system for

Design, Manufacture of Electronic Test & Measuring Instruments, Training Products for Electrical & Electronics Education and Providing Technology Training

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

DIN EN ISO 9001: 2000

are fulfilled.
The certificate is valid until 2010-11-20
Certificate Registration No. **85 100 001 07930**

TÜV NABCB QMS 010

Bangalore, 2007-11-21

The certification Body of
TÜV Rheinland India Pvt. Ltd.

The validity of this certificate is subject to timely completion of Surveillance audits as agreed in the Contract. The Validity of the Certificate can be verified under WWW.tuv.com with the Identification No. 9105027653

04/11/NABCB/00

www.tuv.com

Operational Amplifier (Adder / Scalar)

AB43

Table of Contents

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

AB43 is a compact, ready to use **Operational Amplifier (Adder / Scalar)** experimental Board. This is useful for students to study Op-amp as a Summing Amplifier and Scaling Amplifier with AC and DC inputs. It can be used as stand alone unit with external DC 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, and potentiometer.

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)
AB44	Operational Amplifier (Integrator/ Differentiator)
AB45	Schmitt Trigger and Comparator
AB49	K Derived Filter
AB51	Active filters (Low Pass and High Pass)
AB52	Active Band Pass Filter
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

Operational amplifier is a direct-coupled high-gain amplifier usually consisting of one or more differential amplifiers and usually followed by a level translator and an output stage. The output stage is generally a push-pull or push-pull complementary-symmetry pair. An operational amplifier is available as a single integrated circuit package.

The operational amplifier is a versatile device that can be used to amplify DC as well as AC input signals and was originally designed for performing mathematical operations such as addition, subtraction, multiplication, and integration. Thus the name operational amplifier stems from its original use for these mathematical operations and is abbreviated to op-amp. With the addition of suitable external feedback components, the modern day op-amp can be used for a variety of applications, such as AC and DC signal amplification, active filters, oscillators, comparators, regulator, regulators, and others.

The op-amp may be used as an Adder or Scalar in both inverting as well as non-inverting configuration figure 1 shows the inverting configuration with three inputs Input 1, Input 2 and Input 3. Depending on the relationship between the feedback resistor Rf and the input resistor Ra, Rb, and Rc, the circuit can be used as a summing amplifier (Adder) or a scaling amplifier. The circuit's function can be verified by examining the expression for the output voltage, Vout.

$$V_{out} = -[(R_F / R_a)V_a + (R_F / R_b)\ V_b + (R_F / R_c)\ V_c)] \ldots\ldots (1)$$

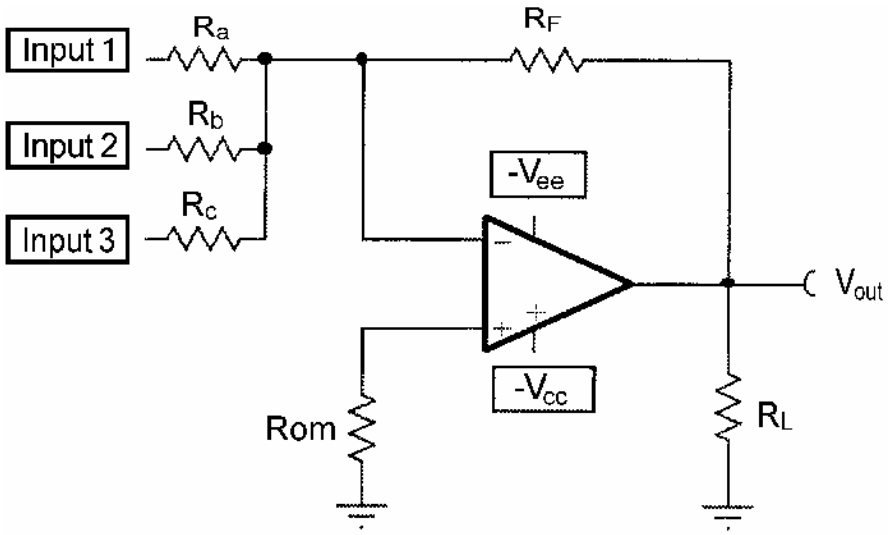


Figure 1

Summing Amplifier :

If in the circuit of figure 1, $R_a = R_b = R_c = R$, then equation 1 can be rewritten as :

$$V_{out} = -(R_F / R) * (V_a + V_b + V_c) \quad \text{..... (2)}$$

This means that the output voltage is equals to the negative sum of all the inputs times the gain of the circuit R_F / R; hence the circuit is called a Summing amplifier, obviously, when the gain of the circuit is 1, that is $R_a = R_b = R_c = R_F$, the output voltage is equal to the negative sum of all input voltages. Thus :

$$V_{out} = -(V_a + V_b + V_c) \quad \text{..... (3)}$$

Scaling or Weighted amplifier :

If each input voltage is amplified by a different factor, in other words, weighted differently at the output, the circuit in figure 1 is then called a scaling or weighted amplifier. This condition can be accomplished if R_a, R_b, and R_c are different in values. Thus the output voltage of the scaling amplifier is :

$$V_{out} = -[(R_F / R_a) V_a + (R_F / R_b) V_b + (R_f / R_c) V_c] \quad \text{..... (4)}$$

Where $R_F/R_a \neq R_F/R_b \neq R_F/R_c$

Experiment 1

Objective :
Study of Operational Amplifier as a Summing Amplifier

Equipments Needed :

1. Analog board of **AB43.**
2. DC power supplies +12V, 12V and +5V from external source or **ST2612 Analog Lab**.
3. Oscilloscope
4. Digital multi-meter.
5. 2 mm. patch cords.

Circuit diagram :

Circuit used to study Summing amplifier circuit is shown in figure 2.

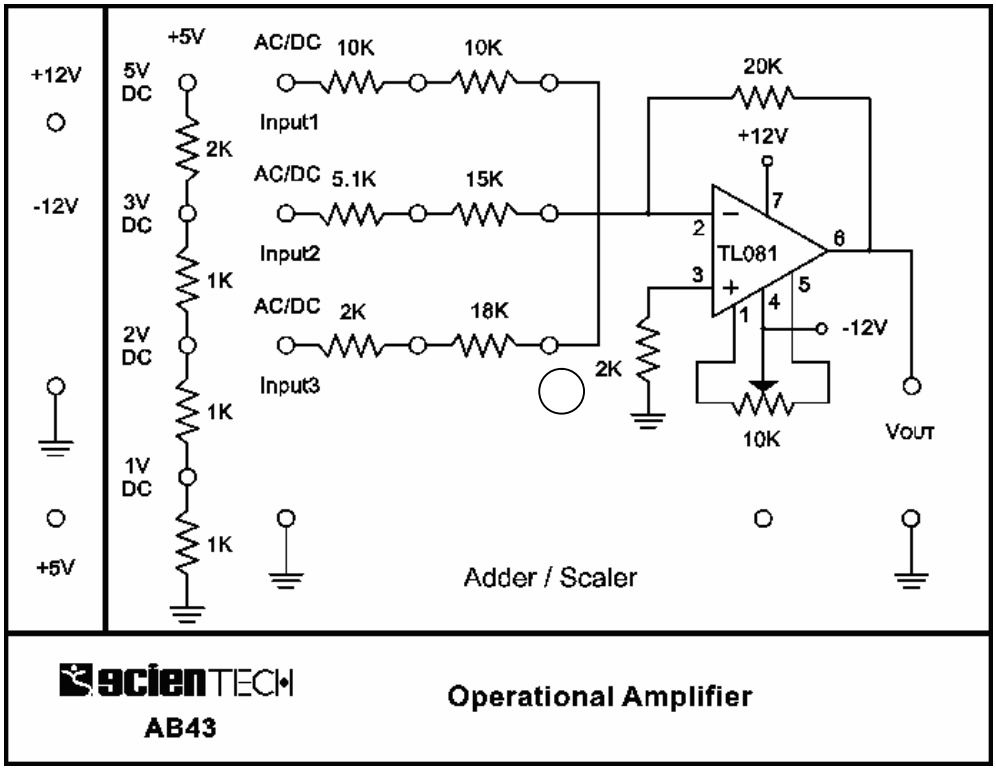


Figure 2

Procedure :

- Connect +12V, -12V, +5V DC power supplies at their indicated position from external source or **ST2612 Analog Lab**.

1. Connect any of the test point going to the pin 2 of IC TL081 with the ground.

2. Observe output voltage i.e. offset voltage at the test point V_{out} with respect to ground.

3. Rotate 10K potentiometer to nullify output offset voltage, if any.

4. Connect a patch cord between test point 1V DC & Input 1, 2V DC & Input 2, 3V DC & Input 3.

5. Measure the output voltage at the test point V_{out} and verify the result as per eq. (2).

6. Repeat the above procedure for different sets of DC / AC voltage and AC / DC inputs.

Experiment 2

Objective :
Study of Operational Amplifier as a Scaling Amplifier

Equipments Needed :

1. Analog board of **AB43.**
2. DC power supplies +12V, -12 and +5 from external source or **ST2612 Analog Lab**.
3. Oscilloscope
4. Digital multi-meter.
5. 2 mm. patch cords.

Circuit diagram :

Circuit used to study Scaling amplifier circuit is shown in figure 2.

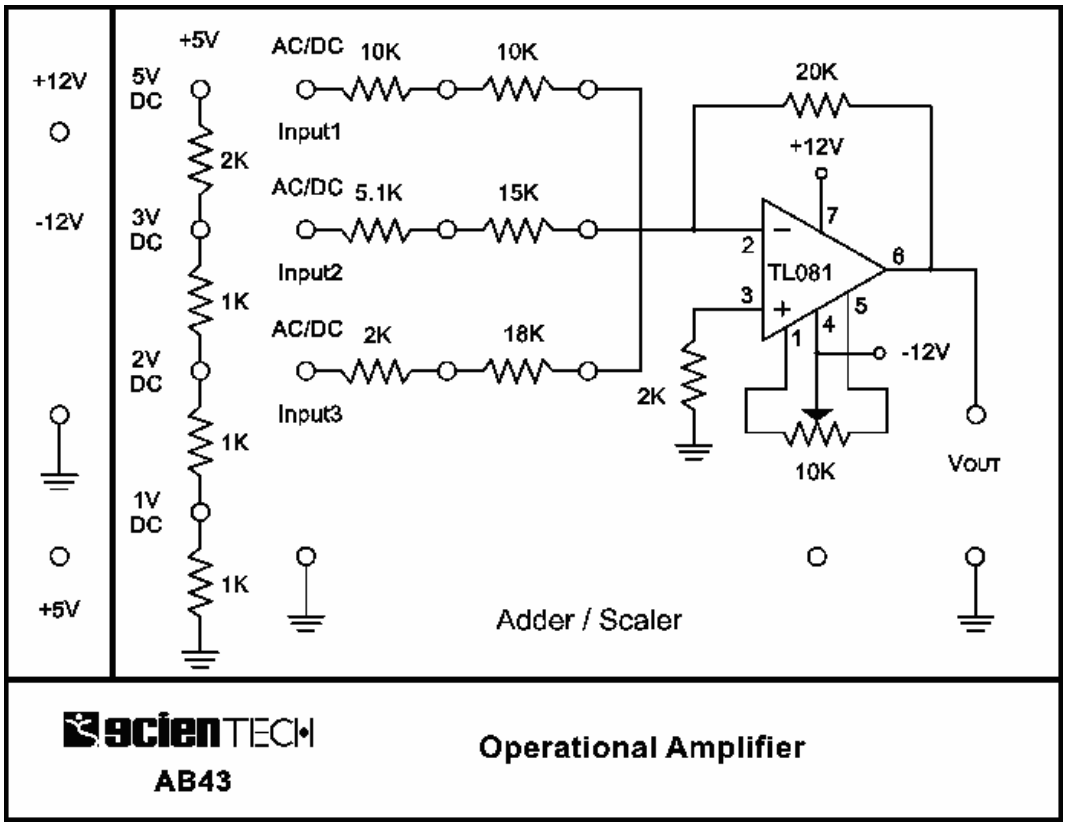


Figure 2

Procedure :

- Connect +12V, -12V, +5V DC power supplies at their indicated position from external source or **ST2612 Analog Lab**.

1. Connect any of the test point going to the pin 2 of IC TL081 with the ground.

2. Observe output voltage i.e. offset voltage at the test point V_{out} with respect to ground.

3. Rotate 10K potentiometer to nullify output offset voltage, if any.

4. Connect a patch cord between test point 1V DC, 2V DC, 3V DC & the left test point of 10K, 15K, 18K so that it will satisfied the condition $R_a \neq R_b \neq R_c \neq R_F$.

5. Measure the output voltage at the test point V_{out} and verify the result as per eq. (4).

6. Repeat the above procedure for different sets of DC / AC voltage and resistance inputs.

Note : All the three AC inputs applied in both of the cases should be in phase.

Data Sheet

TL081, TL081A, TL081B, TL082, TL082A, TL082B
TL082Y, TL084, TL084A, TL084B, TL084Y
JFET-INPUT OPERATIONAL AMPLIFIERS

SLOS081E – FEBRUARY 1977 – REVISED FEBRUARY 1999

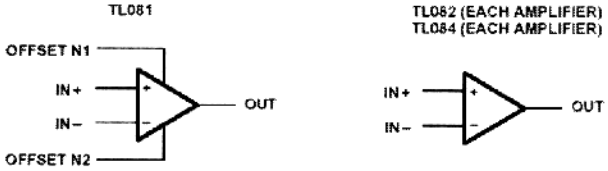
- Low Power Consumption
- Wide Common-Mode and Differential Voltage Ranges
- Low Input Bias and Offset Currents
- Output Short-Circuit Protection
- Low Total Harmonic Distortion . . . 0.003% Typ
- High Input Impedance . . . JFET-Input Stage
- Latch-Up-Free Operation
- High Slew Rate . . . 13 V/μs Typ
- Common-Mode Input Voltage Range Includes V_{CC+}

description

The TL08x JFET-input operational amplifier family is designed to offer a wider selection than any previously developed operational amplifier family. Each of these JFET-input operational amplifiers incorporates well-matched, high-voltage JFET and bipolar transistors in a monolithic integrated circuit. The devices feature high slew rates, low input bias and offset currents, and low offset voltage temperature coefficient. Offset adjustment and external compensation options are available within the TL08x family.

The C-suffix devices are characterized for operation from 0°C to 70°C. The I-suffix devices are characterized for operation from –40°C to 85°C. The Q-suffix devices are characterized for operation from –40°C to 125°C. The M-suffix devices are characterized for operation over the full military temperature range of –55°C to 125°C.

symbols



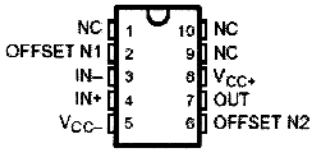
AVAILABLE OPTIONS

T_A	V_{IO}max AT 25°C	PACKAGED DEVICES										CHIP FORM (Y)
		SMALL OUTLINE (D008)	SMALL OUTLINE (D014)	CHIP CARRIER (FK)	CERAMIC DIP (J)	CERAMIC DIP (JG)	PLASTIC DIP (N)	PLASTIC DIP (P)	TSSOP (PW)	FLAT PACK (U)	FLAT PACK (W)	
0°C to 70°C	15 mV	TL081CD	—	—	—	—	—	TL081CP	TL081CPW	—	—	—
	6 mV	TL081ACD						TL081ACP				
	3 mV	TL081BCD						TL081BCP				
	15 mV	TL082CD	—	—	—	—	—	TL082CP	TL082CPW	—	—	TL082Y
	6 mV	TL082ACD						TL082ACP				
	3 mV	TL082BCD						TL082BCP				
	15 mV	—	TL084CD	—	—	—	TL084CN	—	TL084CPW	—	—	TL084Y
	6 mV		TL084ACD				TL084ACN					
	3 mV		TL084BCD				TL084BCN					
–40°C to 85°C	6 mV	TL081ID		—	—	—		TL081IP	—	—	—	—
	6 mV	TL082ID						TL082IP				
	6 mV	TL084ID	TL084ID				TL084IN					
–40°C to 125°C	9 mV	—	TL084QD	—	—	—	—	—	—	—	—	—
–55°C to 125°C	6 mV	—	—	TL081MFK		TL081MJG	—	—	—	TL081MU		—
	6 mV			TL082MFK		TL082MJG				TL082MU		
	9 mV			TL084MFK	TL084MJ						TL084MW	

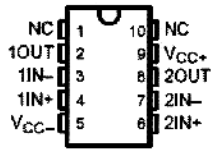
The D package is available taped and reeled. Add R suffix to the device type (e.g., TL081CDR).

TL081, TL081A, TL081B, TL082, TL082A, TL082B
TL082Y, TL084, TL084A, TL084B, TL084Y
JFET-INPUT OPERATIONAL AMPLIFIERS
SLOS081E – FEBRUARY 1977 – REVISED FEBRUARY 1999

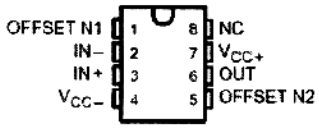
TL081M
U PACKAGE
(TOP VIEW)



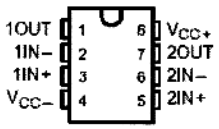
TL082M
U PACKAGE
(TOP VIEW)



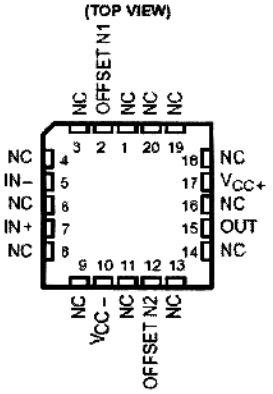
TL081, TL081A, TL081B
D, JG, P, OR PW PACKAGE
(TOP VIEW)



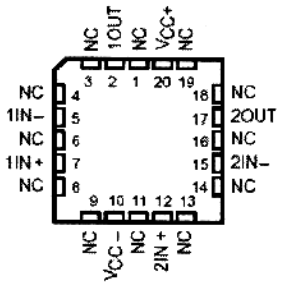
TL082, TL082A, TL082B
D, JG, P, OR PW PACKAGE
(TOP VIEW)



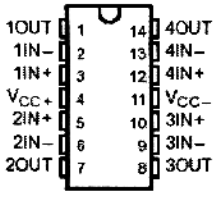
TL081M . . . FK PACKAGE
(TOP VIEW)



TL082M . . . FK PACKAGE
(TOP VIEW)

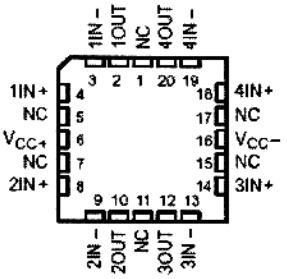


TL084, TL084A, TL084B
D, J, N, PW, OR W PACKAGE
(TOP VIEW)



NC – No internal connection

TL084M . . . FK PACKAGE
(TOP VIEW)



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 (Red) 16”..... 2 Nos.

2. 2mm Patch Cord (Blue) 16”.....1 No.

3. 2mm Patch Cord (Black) 16” ..... 2 Nos.

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

Updated 26-06-2009