AB65
Phase Shift Oscillator

Operating Manual

Ver.1.1

An ISO 9001 : 2000 company

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Innovative Technology Ecosystem

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The certificate is valid until 2010-11-20

Certificate Registration No. **85 100 001 07930**

TÜV NABCB QMS 010

Bangalore, 2007-11-21

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04/11/NABCB/00

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Phase Shift Oscillator

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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

AB65 is a compact, ready to use **Phase Shift Oscillator** experiment board. This is useful for students to understand functionality of phase shift oscillator. Student can also see phase shift introduced by different RC stages of a phase shift oscillator. 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
AB14	Darlington Pair
AB15	Common Emitter Amplifier
AB16	Common Collector Amplifier
AB17	Common Base Amplifier
AB18	RC-Coupled Amplifier
AB19	Cascode Amplifier
AB20	Direct Coupled Amplifier
AB21	Class A Amplifier
AB22	Class B Amplifier (push pull emitter follower)
AB23	Class C Tuned Amplifier
AB24	Transformer Coupled Amplifier
AB25	Phase Locked Loop (FM Demodulator & Frequency Divider / Multiplier)
AB26	FET Amplifier
AB27	Voltage Controlled Oscillator
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
AB37	DC Ammeter (0-2mA)
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)
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
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

Oscillators are circuits that produce periodic waveforms without input other than perhaps a trigger. They generally use some form of active device, lamp, or crystal, surrounded by passive devices such as resistors, capacitors, and inductors, to generate the output.

There are two main classes of oscillator : Relaxation and Sinusoidal. Relaxation oscillators generate the triangular, saw tooth and other non-sinusoidal waveforms. Sinusoidal oscillators consist of amplifiers with external components used to generate oscillation, or crystals that internally generate the oscillation. The focus here is on sine wave oscillators, created using operational amplifiers “Op-Amps”. Sine wave oscillators are used as references or test waveforms by many circuits.

An oscillator is a type of feedback amplifier in which part of the output is fedback to the input via a feedback circuit. If the signal fedback is of proper magnitude and phase, the circuit produces alternating currents or voltages. Two requirements for oscillation are :

1. The magnitude of the loop gain A_VB must be at least 1.

2. The total phase shift of the loop gain A_VB must be equal to 0° or 360°. If the amplifier causes a phase shift of 180°, the feedback circuit must provide an additional phase shift of 180° so that the total phase shift around the loop is 360°.

Figure 1 shows a phase shift oscillator, which consists of an op-amp as the amplifying stage and three RC cascaded networks as the feedback voltage from the output back to the input of the amplifier. The op-amp is used in the inverting mode; therefore, any signal that appears at the inverting terminal is shifted by 180° at the output. An additional 180° phase shift required for oscillation is provided by the cascaded RC networks. Thus the total phase shift around the loop is 360° (or 0°). At some specific frequency when the phase shift of the cascaded RC networks is exactly 180° and the gain of the amplifier is sufficiently large, the circuit will oscillate at that frequency. This frequency is called the frequency of oscillation, f_0, and it is given by

$$f_0 = 1.732 / 2 \pi RC$$

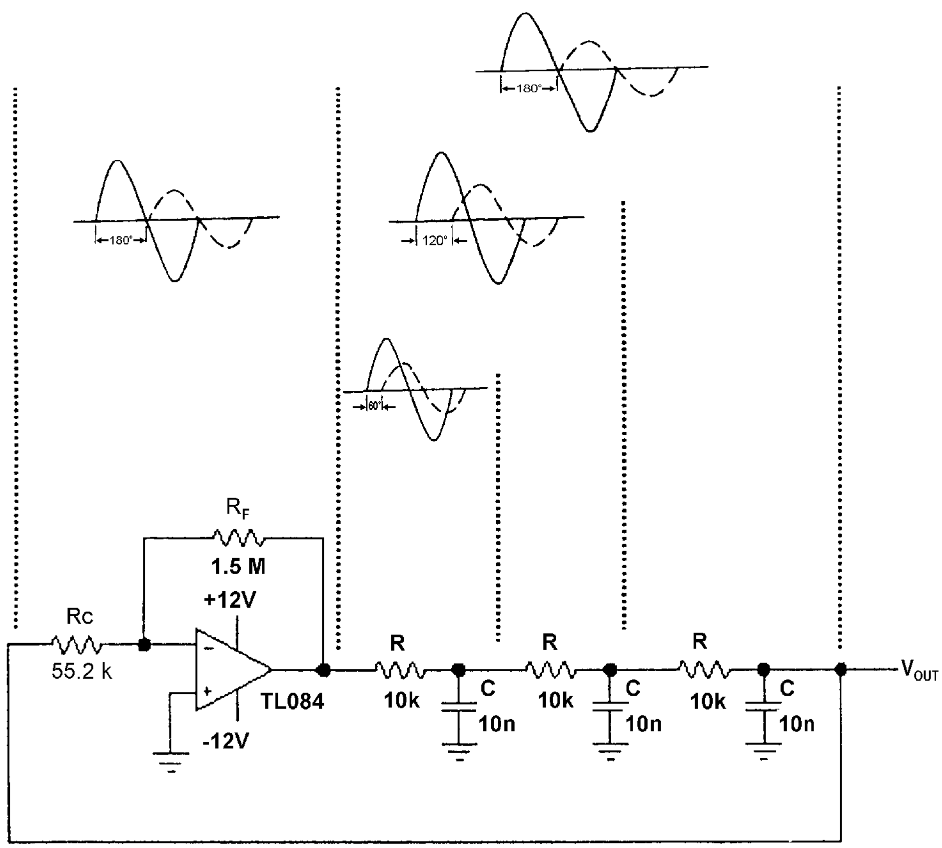


Figure 1

A phase-shift oscillator can be built with one Op-Amp is shown above the normal assumption is that the phase shift sections are independent of each other. Then Equation is written

$$AB = A\,[1 / RCs + 1]^3$$

The loop phase is -180° when the phase shift of each section is -60°, and this occurs when ω = 1.732 / 2πRC because the tangent of 60° = 1.732. The oscillation frequency with the component values shown in figure 1 is slightly different than the calculated oscillation frequency. These discrepancies are partially due to the component variations, but the biggest contributing factor is the incorrect assumption that the RC section does not load each other. This circuit configuration was very popular when active components were large and expensive, but now Op-Amps are inexpensive and small and come four in a package, so the single op-amp phase-shift oscillator is losing popularity.

Buffered Phase-Shift Oscillator :

The buffered phase shift oscillator shown in figure 2 oscillates very close to the calculated frequency.

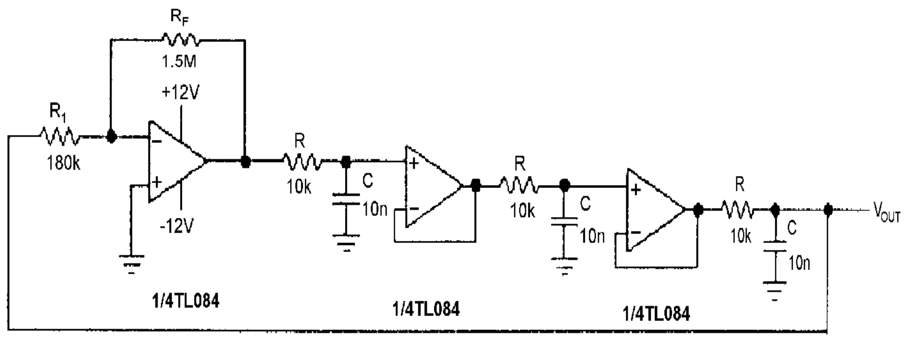


Figure 2

The buffer prevent the RC sections from loading each other, hence the buffered phase shift oscillator performs closer to the calculated frequency and gain. The gain setting resistor, R1, loads the third RC section, and if the fourth op-amp in a quad op amp buffers this RC section, the performance becomes idle. Low-distortion sine waves can be obtained from either phase-shift oscillator, but the purest sine wave is taken from the output of the last RC section.

This is a high-impedance node, so a high-impedance input is mandated to prevent loading and frequency shifting with load variations.

Experiment

Objective :

Study of Phase Shift Oscillator with and without buffer between RC sections

Equipments Needed :

1. Analog board, **AB65.**
2. DC power supplies -12V, +12V from external source or **ST2612 Analog Lab**.
3. 2 mm patch cords.

Circuit diagram :

Circuit used to plot different characteristics of transistor is as shown in figure 3

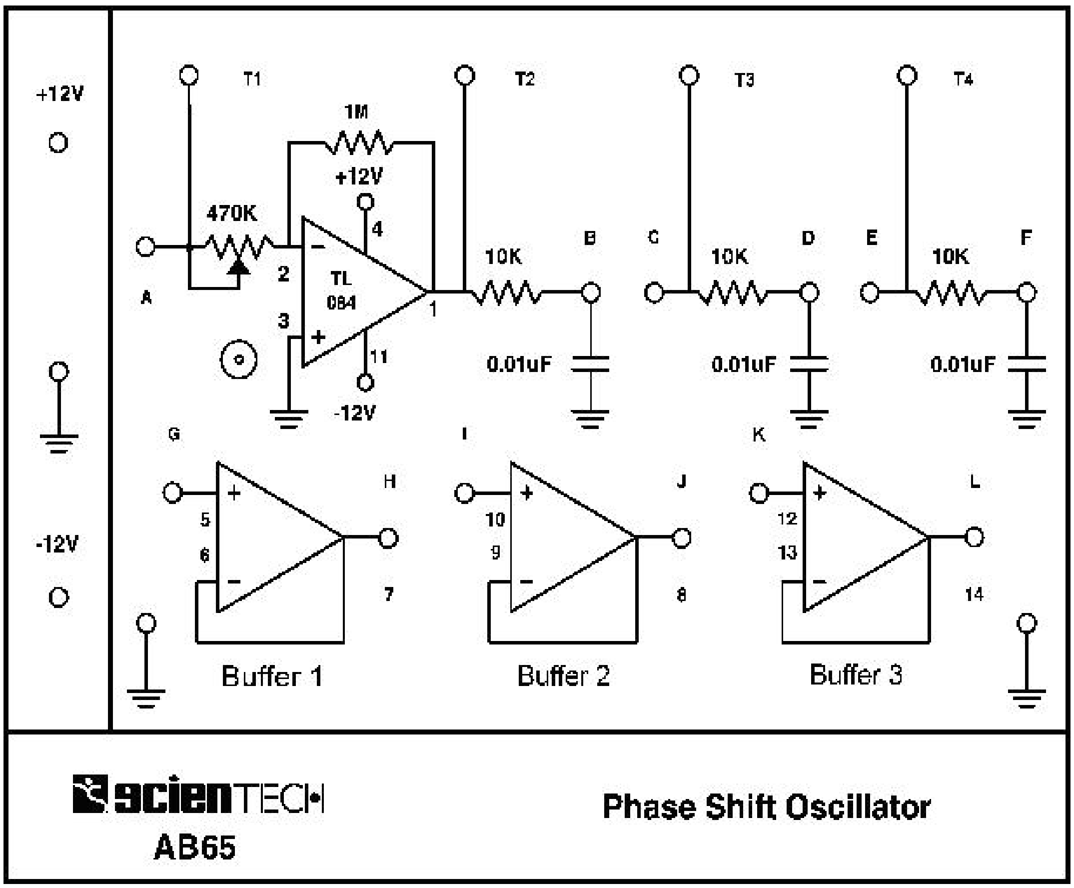


Figure 3

Procedure :

- To study phase shift oscillator without buffer between RC sections proceed as follows :

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

2. Connect a 2mm patch cord between test point B & C, D & E, F & A

3. Switch ‘On’ the Power Supply.

4. Measure frequency at any test points T1, T2, T3, T4 using CRO.

5. Compare measured frequency with the theoretically calculated value.

6. Measure phase difference between test points Tl & T2, T2 & T3, T3 & T4, and T4 & T1 with the help of dual channel CRO.

7. Vary gain Potentiometer of 470K to adjust gain of the amplifier in case of clipped waveform.

Results :

1. Theoretical value of output frequency = ____________

2. Practical value of output frequency = ____________

3. Phase shift between Test Point T1 & T2 = ____________

4. Phase shift between Test Point T2 & T3 = ____________

5. Phase shift between Test Point T3 & T4 = ____________

6. Phase shift between Test Point T4 & T1 = ____________

- To study phase shift oscillator with buffer between RC sections proceed as follows :

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

2. Connect a 2 mm patch cord between Test Point B & G, C & H, D & I, E & J, F & K, L & A.

3. Switch ‘On’ the Power Supply.

4. Measure frequency at any test points T1, T2, T3, T4 using CRO.

5. Compare measured frequency with the theoretically calculated value.

7. Measure phase difference between test points T1 & T2, T2 & T3, T3 & T4, T4 and T1 with the help of dual channel CRO.

8. Vary gain Potentiometer of 470K to adjust gain of the amplifier in case of clipped waveform.

Results :

1. Theoretical value of output frequency ________ =
2. Practical value of output frequency = _________
3. Phase shift between Test Point T1 & T2 _____ =
4. Phase shift between Test Point T2 & T3 _____ =
5. Phase shift between Test Point T3 & T4 _____ =
6. Phase shift between Test Point T4 & T1 _____ =

Data Sheet

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

SLOS081E – FEBRUARY 1977 – REVISED FEBRUARY 1999

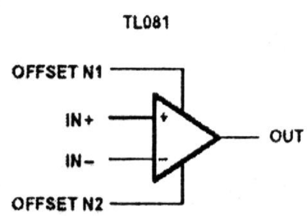
- Low Power Consumption
- Wide Common-Mode and Differential Voltage Ranges
- Low Input Bias and Offset Currents
- Output Short-Circuit Protection
- Low Total Harmonic Distortion . . . 0.003% Typ
- High Input Impedance . . . JFET-Input Stage
- Latch-Up-Free Operation
- High Slew Rate . . . 13 V/μs Typ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

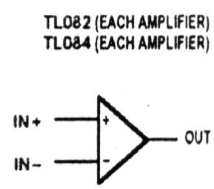
description

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



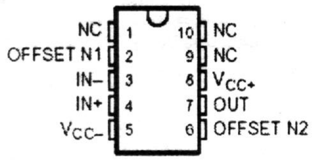


AVAILABLE OPTIONS

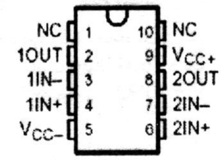
T_A	V_{IO}max AT 25°C	PACKAGED DEVICES										CHIP FORM (Y)
		SMALL OUTLINE (D008)	SMALL OUTLINE (D014)	CHIP CARRIER (FK)	CERAMIC DIP (J)	CERAMIC DIP (JG)	PLASTIC DIP (N)	PLASTIC DIP (P)	TSSOP (PW)	FLAT PACK (U)	FLAT PACK (W)	
0°C to 70°C	15 mV 6 mV 3 mV	TL081CD TL081ACD TL081BCD	—	—	—	—	—	TL081CP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

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

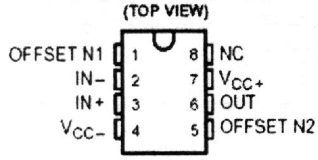
TL081M
U PACKAGE
(TOP VIEW)



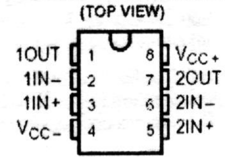
TL082M
U PACKAGE
(TOP VIEW)



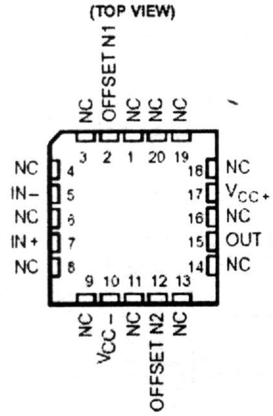
TL081, TL081A, TL081B
D, JG, P, OR PW PACKAGE
(TOP VIEW)



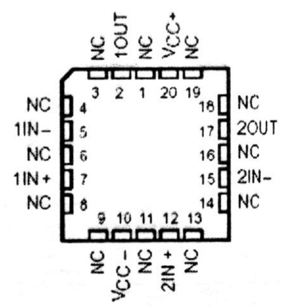
TL082, TL082A, TL082B
D, JG, P, OR PW PACKAGE
(TOP VIEW)



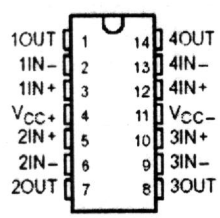
TL081M . . . FK PACKAGE
(TOP VIEW)



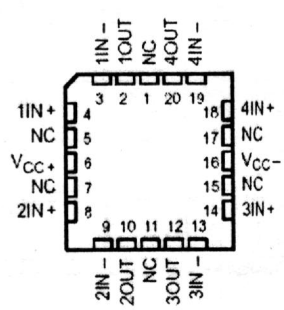
TL082M . . . FK PACKAGE
(TOP VIEW)



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



TL084M . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

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. 2 mm Patch Cords (Red) .... 2 Nos.
2. 2 mm Patch Cord (Blue) .... 7 Nos.
3. 2 mm Patch Cord (Black) .... 3 Nos.
4. e-Manual...1 No.

Updated 27-03-2009