Ultrasonic Distance Meter

Project Work

Submitted in partial fulfilment of the
requirements for the award of
Degree of Bachelor of Engineering
in Electrical and Electronics Engineering
of the Bharathiar University
Coimbatore - 641 046

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1993- 1994

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Certificate

This is to certify that the project entitled
"Ultrasonic Distance Meter"
has been submitted by

Mr. ....

in partial fulfilment of the requirements
for the award of the degree of
BACHELOR OF ENGINEERING in
ELECTRICAL AND ELECTRONICS ENGINEERING
branch of the Bharathiar University, Coimbatore - 641 046.
during the academic year 1993 - 94

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Faculty Guide

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Head of the Department

Certified that the candidate was examined by us in the project work viva-voce examination held on ....
and the university Register Number was ....

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External Examiner

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Last, but not the least, we extend our gratitude to all other staff members of Electrical and Electronics Engineering Department and our friends who helped us directly or indirectly resulting the completion of our project work.

SYNOPSIS

In this project, it is proposed to fabricate a good, efficient and yet a compact measuring meter for distance measurement. Though the principle of ultrasonics has been used for more than 4 decades, it finds application only in large industrial and medical fields.

Hence it is believed that this project will mirror the usage of the ultrasonic waves for measurement of distance.

Ultrasonic distance meter measures distance with the help of sound waves emitted from a transducer and collected by a receiving element. A piezoelectric crystal in the sender unit transmits sound waves at a frequency of 40 KHz. These waves get reflected when they fall on an object. The reflected waves are picked up by a receiving unit. The distance is measured by a counter and displayed on the LCD screen.

CONTENTS

CHAPTER - I

INTRODUCTION

There are different methods available to measure distance. The various devices used to measure displacement are the potentiometer device, resistance strain gauge, differential transformer and the most commonly used distance tape.

The potentiometer device to measure displacement is based on the positioning of the slides by an external force which varies the resistance in a potentiometer or a bridge circuit. The chief disadvantage of using a linear potentiometer is that they require a large force to move their sliding contacts.

In the resistance strain gauge device, the resistance of a wire or a semi conductor is changed by elongation or compression due to externally applied stress.

The chief disadvantages of this are they are very sensitive to changes in temperature and linearity of the strain gauge is poor. They are also very expensive.

In differential transformer device, the differential voltage of two secondary windings of a transformer is varied by positioning the magnetic core through an externally applied force.

The disadvantages of this are they are sensitive to stray magnetic fields. Many a time the transducer performance is affected by vibrations. Temperature affects the performance of the transducer.

The last one and the most common one to measure displacement is distance tape. Two persons are required to measure the distance and there is a chance of errors creeping in. For uneven surface it is difficult to use the tape. Accuracy is limited.

In the field of electronics, there has been fast developments in the various applications and it plays a significant role in all the areas of our need. In our project ultrasonic distance meter distance is measured with the help of sound waves emitted from the transducer and collected by the receiving element. A clock pulse generated is utilized which runs the counter at a frequency synchronous to the signal transmitted by the tranduction element. At the instant of transmission the counter is activated by a clock pulse of frequency 17.05 KHZ.

This electronic device to measure distance is very compact and needs only one person to operate. Just by pressing a computer switch, the distance between the transducer and the reflecting object is displayed almost instantaneously on the LCD screen. The measurement by this meter is found to be very accurate.

CHAPTER - II

FUNCTIONAL BLOCK DIAGRAM

Fig. 2.1 shows the complete Block Diagram of the meter.

2.1 HARDWARE DESCRIPTION

2.1.1 Power Supply Unit

The circuit of the power supply unit is shown in Fig. 2.2. A 9 volt battery is utilized to power the circuitry. The power is fed to one of the terminals of the voltage regulator chip 78L 05. The output of the chip is a constant voltage of 5 volts. This 5 volts is fed to a buffer amplifier designated as A4. The buffer amplifier is used so as to reduce the input impedance.

The buffier amplifier is a unit gain non-inverting amplifier. Thus the output of the buffer will be the same 5 volts. This desired sampled voltage is supplied to the non-inverting terminal of the comparator op-amp A2. The power input to the circuitry should never fall below 7 volts.

Thus the battery, after a long period, will naturally become weak. Once this happens the voltage supplied by it will become low and failure of the battery is at once indicated by the LCD display. Once this happens the battery should be replaced.

2.1.2 Voltage Levelling Circuit

The voltage levelling circuit shown in Fig. 2.3 mainly comprises of an operational amplifier which acts as a comparator. The voltage levelling circuit is utilized for the operators information sake. It is this circuit that enables the LOW-BAT signal light on the LCD screen to glow when the power from the battery has dropped below requisite value thus indicating the necessary for a replacement in the battery.

The operation of this is simple as it takes into account the principle of comparison. The non-inverting terminal of the op-amp is connected to the outputof the voltage regulator whichis a constant 5 volts. The inverting terminal of the op-amp is connected to the supply voltage of 9V. A voltage divider circuit comprising resistors R16 and R17 are present which drop the input voltage from 9V to 5V. Thus the 2 inputs of the comparator A2 are 5 volts and hence naturally the output of comparator will be zero. The input supply voltage is allowed to decrease upto a maximum value of 7 volts after which the low bat indication on the screen will glow. This is because the output of the comparator is fed to LCD screen through Nand gate which will have an output high only when both its inputs are high. As one input is from the 5 V supply and the other is from comparator, the desired effect occurs only when the comparator output is high, even this happens only when the input voltage from the battery falls from its value of 9 V but drop upto 7 V is accepted after which the output goes high and hence enables the Nand gate resulting and the low-bat to start glowing.

2.1.3 Ultrasonic Wave Generator

The main component of the sender unit is the transmitter element itself. A piezo-electric crystal has the property such that whenever electrical pulses are applied to them they get stimulated. Due to this stimulation the crystal starts vibrating and produces sound like an ordinary loudspeaker. But the vibrations are such that the sound produced is of very high frequency in the order of a few KHz to as high as MHz.

When the frequency of the sound waves are above 20 KHz the sound waves are known as ultrasonic. These ultrasonic waves are highly penetrative in a medium and are reflected by any material not belonging to that medium. This is the basic function of the ultrasonic wave generator. The circuit arrangement is shown in Fig. 2.4.

2.1.4. Sender Unit

As shown in circuit diagram in Fig. 2.5 the sender unit comprises of a schmitt trigger circuit, a wave shaping circuit which are used along with the piezo-electric crystal so as to produce a wave of desired frequency. A comparator op-amp designated by A6 is used to whose non-inverting terminal the positive on going schmitt trigger is connected. To the inverting terminal, the input signal is applied. Hence the op-amp compares these signals and produces the desired wave whose frequency is fixed by the design parameters of P1, which is a preset whose range is 2K and capacitor C2 designed to 1

The potentiometer is hence a variable quantity and this factor is utilized in order to attain the signal of value 40 KHz. This value of frequency is desired for the signal so that the transduction element will also oscillate at this frequency and hence will produce the ultrasonic waves of frequency 40 KHz. This circuit acts as the oscillator circuit. The schmitt trigger is operated at its threshold voltage. The LTP points of the schmitt trigger are varied by the use of the preset. This is done so as to attain the resonant frequency.

This signal shaping circuitry is made up of buffer amplifiers. It consists of 4 paired CMOS buffers. The output stage is actually a full bridge which causes the doubling of the effective voltage across the element. The capacitor C1 designed to 220 nf is used to block the DC component of the output signal during pauses in emission. To obtain bursts of signal by the tranducer at maximum energy, IC 4049 is connected directly to the 9V battery. The remainder of the circuit is connected to the output of the regulator and hence operates at 5 V.

The transduction element as stated previously is a tranducer made of a pieze-electric crystal. The input to the transduction element is a pulsating signal. The crystal hence undergoes contraction and rarifaction at a period similar to the input applied to it. Thus the sound waves produced are of ultrasonic waves.

2.1.5 Drive Amplifier

With reference to the Fig. 2.6 inverters N1....N6 are playing the role of drive amplifier. The input to this circuit is 40 KHz pulse.

The impulse pulse is branched between two paths (ie) one inverted and other non inverted. N1 and N2 are placed parallel in one path and N5 and N6 are placed parallel in other path. This is done to reduce the resistance in the path of the pulse to the transmitter.

For each input pulse, we are giving two pulses to the transmitter. Because we are reducing the path resistance and also we are giving two pulses simultaneously to the transmitter there will be two fold current amplification of the input pulse. Capacitor C1 is therefore used to avoid the DC signals entering the transmitter.

2.1.6. Receiver Unit

The sensing unit shown in Fig. 2.7 or the receiver unit consits of pieze-electric transducer and an amplifier designated as A3. The sensing transducer is similar to the transmiting transducer in construction, but the working of it is converse to that of the transmitting transducer. Here once the ultrasound waves transmitted by the transmitter are reflected by the object, they come into contact and are hence picked up by the receiver transducer.

The receiver transducer which is also a piezo-electric crystal utilizes the converse principle namely that when external signal, usually in the form of rarifications and contractions, acts on it, the transducer generates an electric signal whose value corresponds to the incident pressure wave in the form of the sound waves.

The principle is similar to that of a microphone, only that this transducer picks up signals of frequency in the ultrasonic range. The sensing transducer has a time dependent sensitivity. That is, to say, that as time elapses after the system has been operated, the sensitivity of the receiving transducer increases.

Those signals which arrive at the receiver unit at the shortest interval will be received by the sensing element with minimum sensitivity. But the power of the signal will be high as it has not travelled much of a distance to have grown weaker in strength. The received signal which is a pulsating D.C. is applied to the op-amp designated as A3. This receiver amplifier has a gain of 33 db derived from the relation.

$$\text{Gain} = 20 \log (R8/R9) \text{ db} \tag{2.1}$$

where the designed value of R8 is 100 KΩ and R9 is 7.2 KΩ. This amplifier is AC coupled as it has been seen that the transducer has a very high D.C. resistance. Thus the applied input voltage does not get amplified when the receiver is not functioning, as it is blocked off by the transducer.

The resistor R14 (100 Kr) serves to minimize the offset voltage caused by the input bias current. A minimum offset voltage at the output is necessary as it along with the input offset voltage of A5 determines the sensitivity of the transducer which has been already explained to be a time dependent quantity.

The sensitivity of the transducer is matched to the ambient conditions by adjusting the potentiometer designed as 1 M . The output of the sensing amplifier is fed to the bistable unit which sets and resets the counter by which the distance measurement is achieved.

2.1.7 Central Timing Unit

The Fig. 2.8 shows the central timing unit which is the heart of the whole system. It is at this region the clock pulses to drive the counter and the trigger or toggling pulses are produced which are utilised to enable the counter into functioning. The reference timing unit is built up of two sections namely

(i) Binary clock circuit

(ii) Bistable unit

These divisions will be explained in detail separately.

2.1.8 Binary Clock Circuit

The reference timing unit is stimulated that is to say excited by the pressing the switch S1 which is a push-to-make button switch. Once the triggering takes place the clock pulse generator is excited. This unit comprises of a preset P2. This being a variable quantity is adjusted so as to attain the desired clock pulse. The signal namely clock pulse of desired frequency is fed to the count pins of the counter. Thus the counter counts at the frequency of the clock pulse generated by this unit.

2.1.9. Bistable Unit

The output of Q12 goes high twice in a second when the switch S1 is pressed. When this Q12 goes high it gives a high on one terminal of the op-amp. A1 is the input voltage. The output of the comparator is the difference value. This value is used to toggle the bistable stage. To prevent toggling at other stages by the input signal we make use of the R6-C8 connection. This drops the voltage so that the output of A1 is only taken to consideration. The Bistable state will start the counter when the sound waves are transmitted and when the receiver picks up the waves on the return the counter is stopped.

2.1.10 Internal Clock Pulse Generator

Fig. 2.9 shows the circuit diagram. This unit is the region where the clock pulse necessary for the counter to perform in synchronism with the frequency of the signal being transmitted by the transducer. The binary clock circuit comprises of the chip 4060 along with a resistor, capacitor set up. The resistor used is a preset. The rheostat is so adjusted that the frequency generated is of the value 17.05 KHz.

As the capacitor is a constant value the frequency is varied by adjusting the rheostat so as to obtain the desired value of frequency. This signal clock pulse has a time period of 0.3 ns and hence on pressing the switch due to this period manipulating of the clock there will be a burst of twelve pulses in the duration of 0.3 ns of frequency designed as 40 KHz.

Hence the output Q 12 of the binary circuit is found to go high twice every second.

When Q12 goes high it will be seen that the output of the capacitor will be of requisite value which is applied to one terminal of the Amplifier A5.

The inverting terminal of the same is the signal picked up by the receiving transducer and amplified by the amplifier A3. During emission the output of A1 is high which via D1, causes the threshold of comparator A5 to be raised to a level that makes triggering by cross talk impossible.

2.1.11 Bistable Latch Circuitry

This circuit shown in Fig. 2.10 forms one block of the reference timing unit. The bistable circuit is comprised of NAND gates along with an amplifier comparator, which compares the received signal after amplification with the clock pulse reference signal.

At the start of emission, bistable N9 and N10 is set. This disables the count inhibit input of IC8, which there upon commences counting the 17.05 KHz pulses applied to the Pin 32 of the counter.

The receiver input amplifier has a gain of about 33dB. The amplifier is AC coupled, because the sensing element has a virtually infinitely big DC resistance. The input offset voltage is hence not amplified further (more R14) reduces the offset voltage to a minimum value which is anyway necessary as it along with the offset voltage of amplifier A1 determines the sensitivity of the transducer which is a time dependent quantity. This is realised by A1 lowering of the trigger level of A5 via time constant R6-C8. The maximum sensitivity may be matched to the ambient conditions by preset P3.

When an echo is received, the output of A5 goes low, which causes the bistable to be reset, and this in turn disables the clock of IC8. At the same time a short negative pulse is applied via R13-C12 and N11 to pins 34 ie., STORE, which results in the transfer of the counter state to the output latch of IC8. Gate G11 merely buffer the low impedance store input. When the Q12 output of IC4 goes low, the counter in IC8 is reset, and the circuit is ready for the next measurement. If Q12 goes low in the absence of an echo, the counter is still reset, as is the bistable unit (Via D3). The display will then read 0.00 to indicate an abortive measurement. Hence another pulse will have to be sent in order to measure the distance of the desired object.

2.1.12 Counters

Fig. 2.11 shows the ICM 7224. The ICM 7224 device constitute a family of high performance CMOS 4½ digit counters including decoders, output latches, display drivers, count inhibit leading zero blanking and reset circuitry.

The counter section provides direct static counting, guaranteed from DC to 15 MHZ, USING A 5V + or - 10% supply over the operating temperature range. At normal ambient temperatures, the devices will typically count upto 25 MHz. The count input is provided with a schmitt trigger to allow operation in noisy environments and correct counting with slowly changing inputs. These devices also provide count inhibit, store and reset circutry, which allow a direct interface with an ICM 7207/A to implement a low cost, low power frequency counter with a minimum component count.

These devices also corporate several features intended to simplify cascading 4 digit blocks. The carry output allows the counter to be cascaded, while the leading zero blanking input and output allows correct leading zero blanking between four decade blocks. The back plane driver of the LCD devices may be disabled, allowing the segments to be slaved to another back plane signal necessary when using an 8 or 13 digit single back plane display.

2.1.13 Liquid Crystal Display

The LCD has a distinct advantage of having a lower power requirement than the LED. It is typical in the order of microwatt compared to the milliwatts for LEDs. It does however require an external or internal light source, and are limited to a temperature range of 0° to 60°C.

A liquid crystal is a material that will flow like a liquid but whose molecular structure has some properties normally associated with solids. The greatest interest is in pneumatic liquid crystal. The individual molecules have a rod like appearance. The indium oxide conducting surface is transparent and the incident light will simply pass through the crystal and hence appear clear. If a voltage usually between 6 and 20 V is applied across the conducting surfaces the molecular arrangements is disturbed with the result that regions will be established with different indices of refraction. The incident light is therefore reflected in different directions at the interface between regions of different indices of refraction with the result that the scattered light has a forsted glass appearance.

A digit on LCD display may have the segmented appearance. The black area is actually a cleared conducting surface connected to the terminals below for external control. If a number 2 were required, the terminals 8, 7, 3, 4 and 5 would be energised and only those regions would be forsted while the other areas will remain clear.

The field effect twisted pneumatic LCD has the same segment appearance and thin layer of encapsulated liquid crystal, but its mode of operation is very different. Similar to the dynamic scattering LCD, the field effect can be operated in the reflective or transmissive mode with an interval source. The interval light source is on the right and the viewer is on the left. Only the vertical component of the entering light on the right can pass through the vertical light polarizer on the right. In the field effect LCD, either the clear conducting surface to the right is chemically etched or an organic film is applied to orient the molecules in the liquid crystal in the vertical plane, parallel to the cell wall. The opposite conducting surface is also treated to ensure that the molecules are 90° out of phase in the direction shown (horizontal) but still parallel to the cell wall. In between the two walls of the crystal there is a general drift from one polarization to the other. The left hand light polarizer is also such that it permits the passage of only the vertically polarized incident light. When a threshold voltage is applied the rod like molecules align themselves with the field and the light passes directly through without any shift.

Field effect LCDs are normally used when a source of energy is a prime factor since they absorb considerably less power than the light scattering types. The cost is typically higher for field effect units, and their height is limited to about 2" while light scattering units are available upto 8" in height. There is a great range of colour choice in LCD units unlike LEDs.

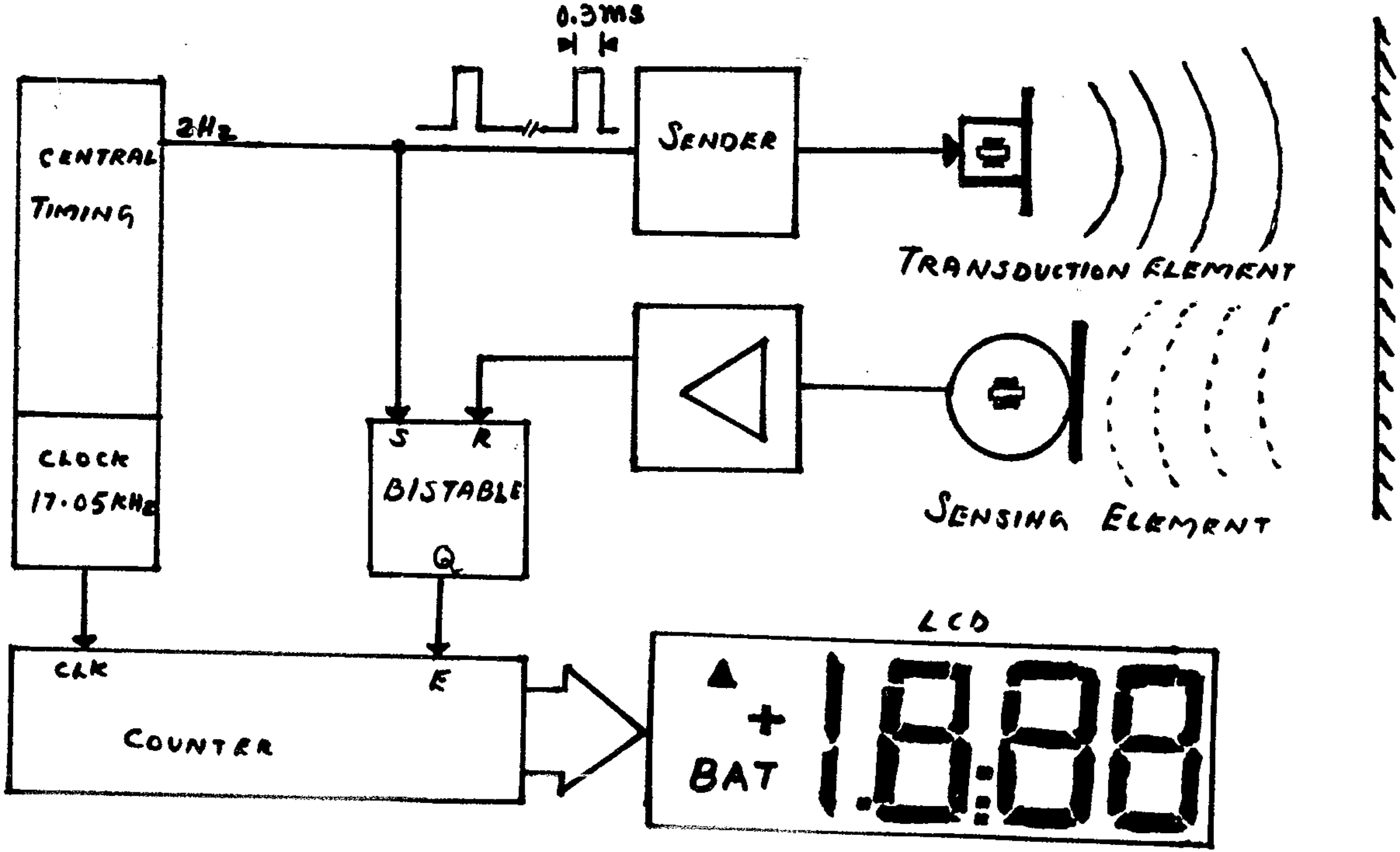
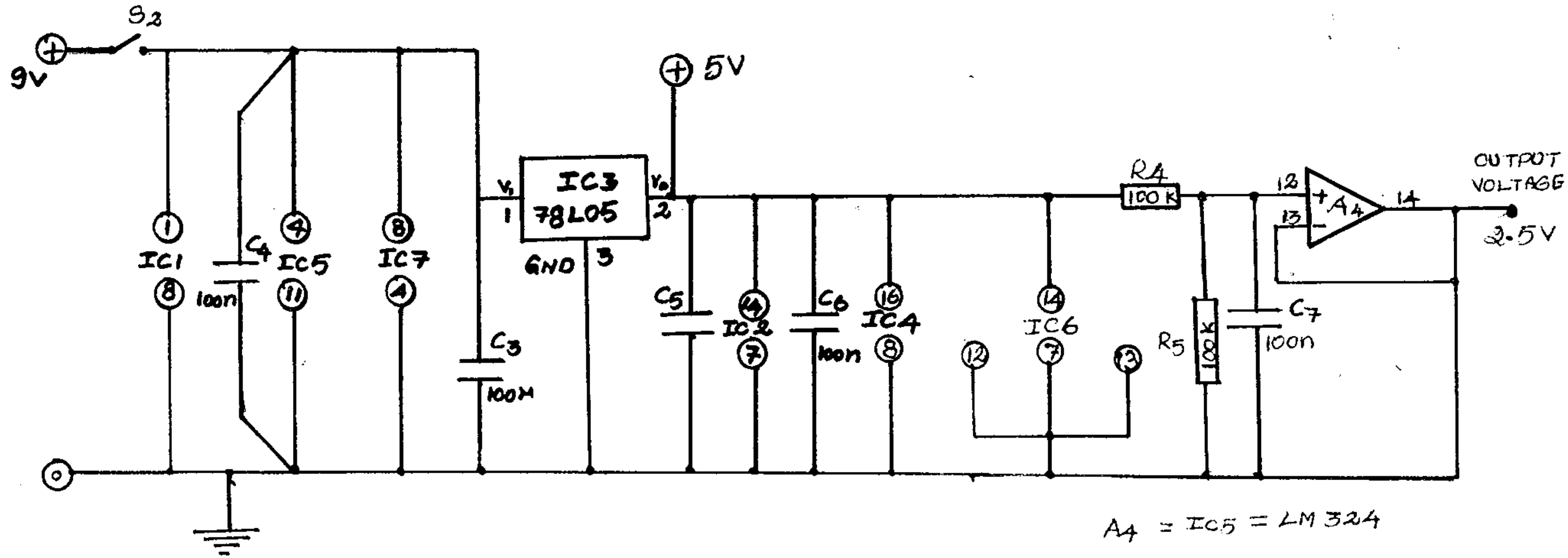
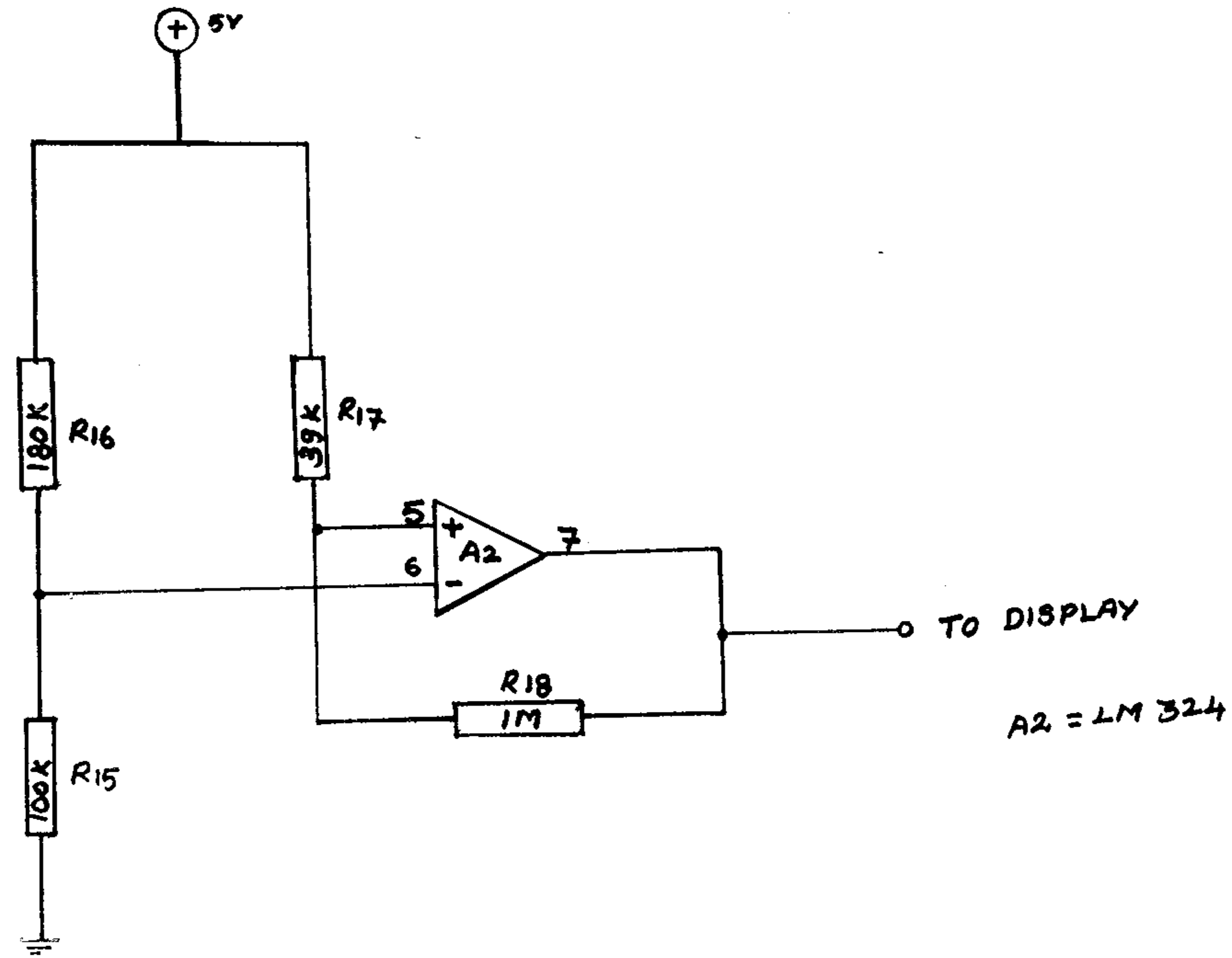


Fig. 2.1: BLOCK SCHEMATIC OF THE DISTANCE METER

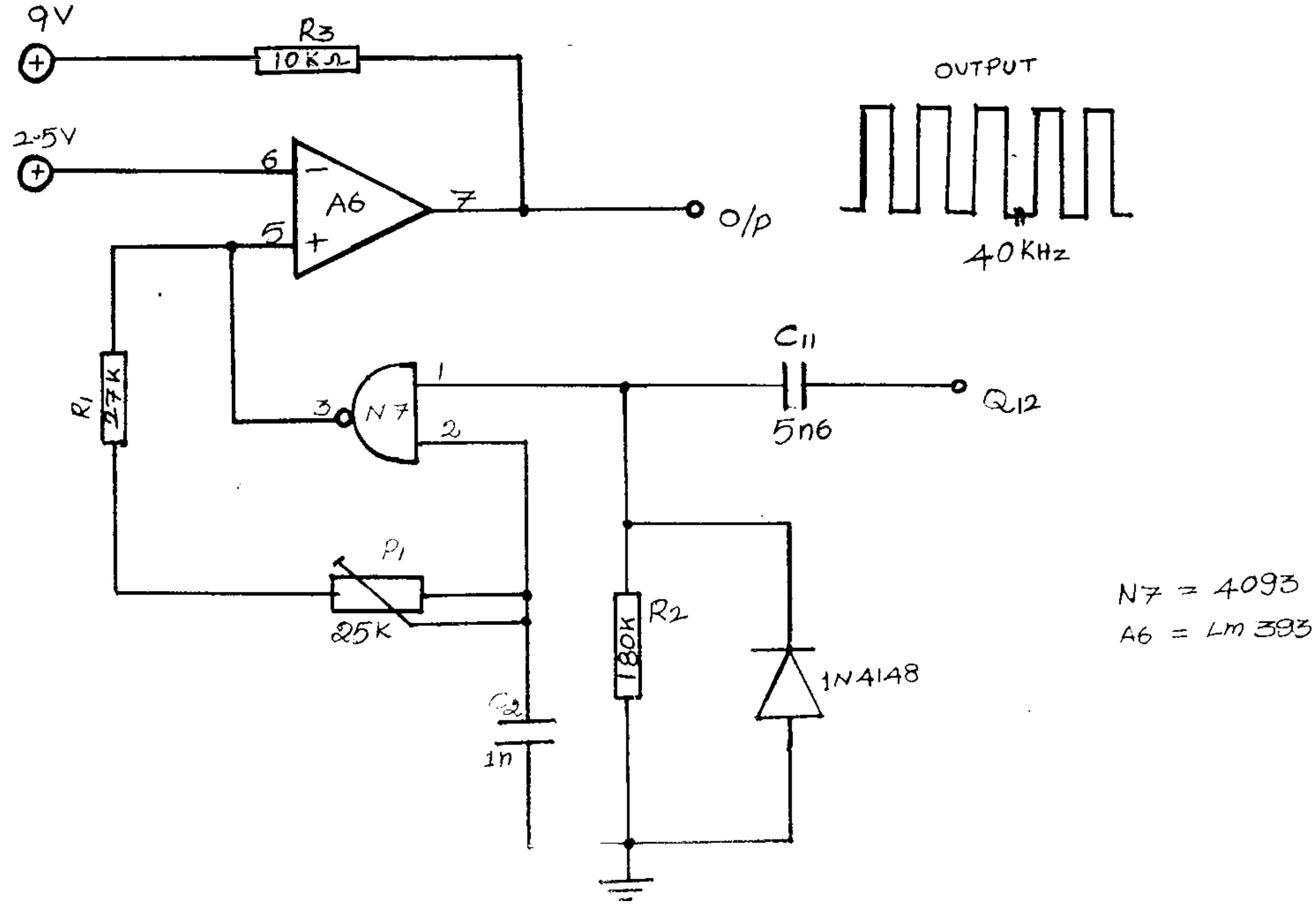


A4 = IC5 = LM 324
IC1 = 4049
IC2 = 4093
IC4 = 4060
IC5 = LM 324
IC6 = 4030
IC7 = LM 393

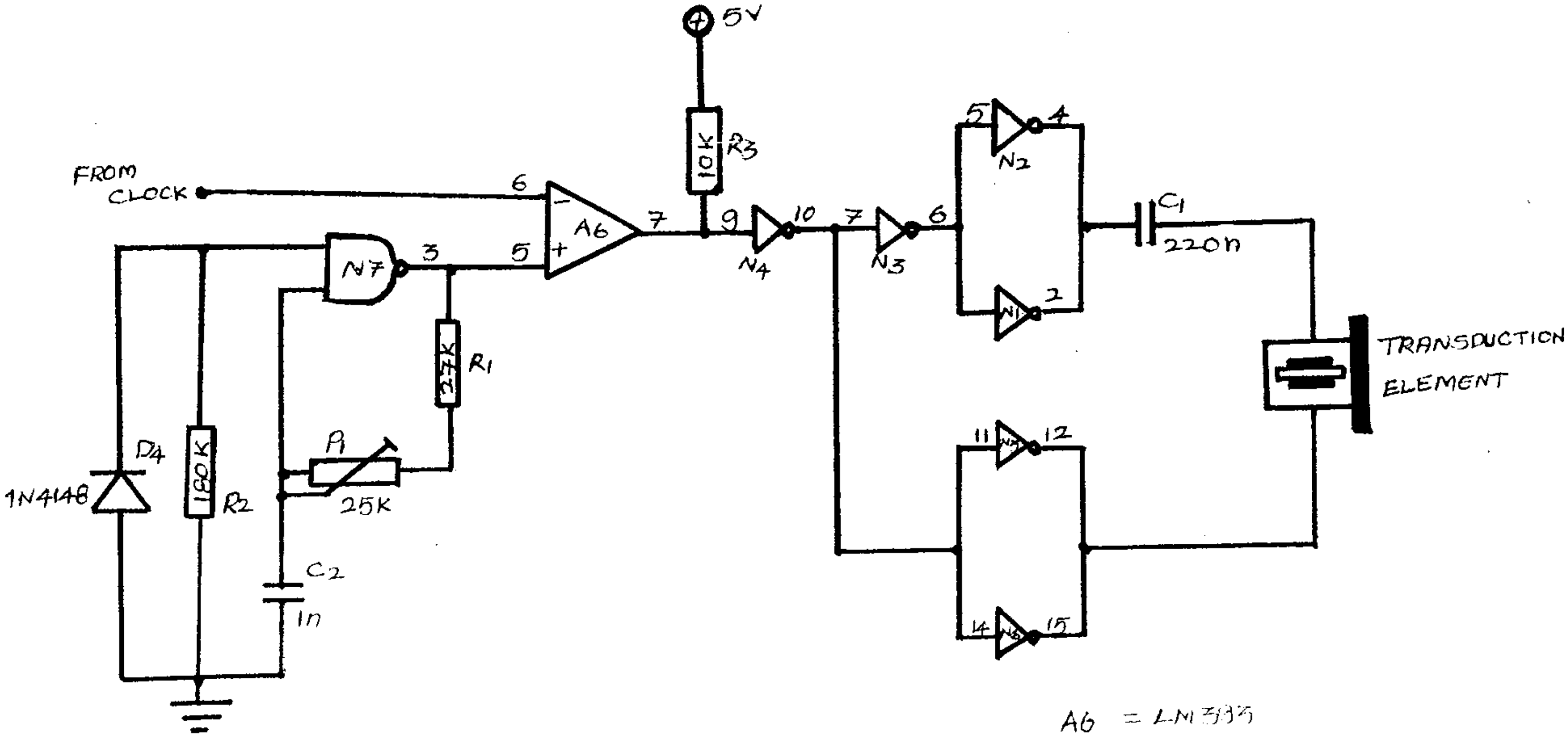
[2.2] Fig: POWER SUPPLY UNIT



[2.3] Fig: VOLTAGE LEVELLING CIRCUIT



[2.4] Fig: ULTRASONIC WAVE GENERATOR

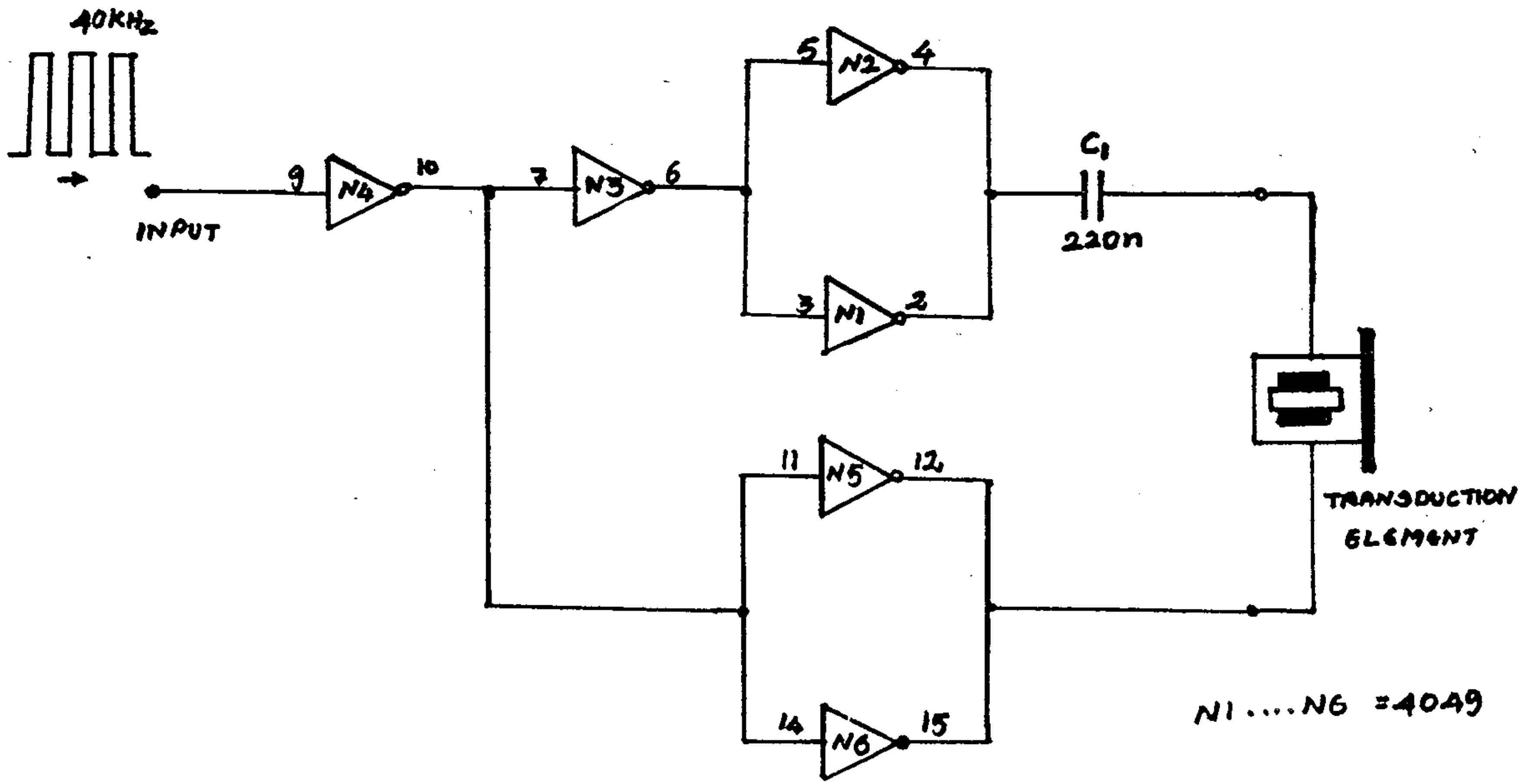


A6 = LM333

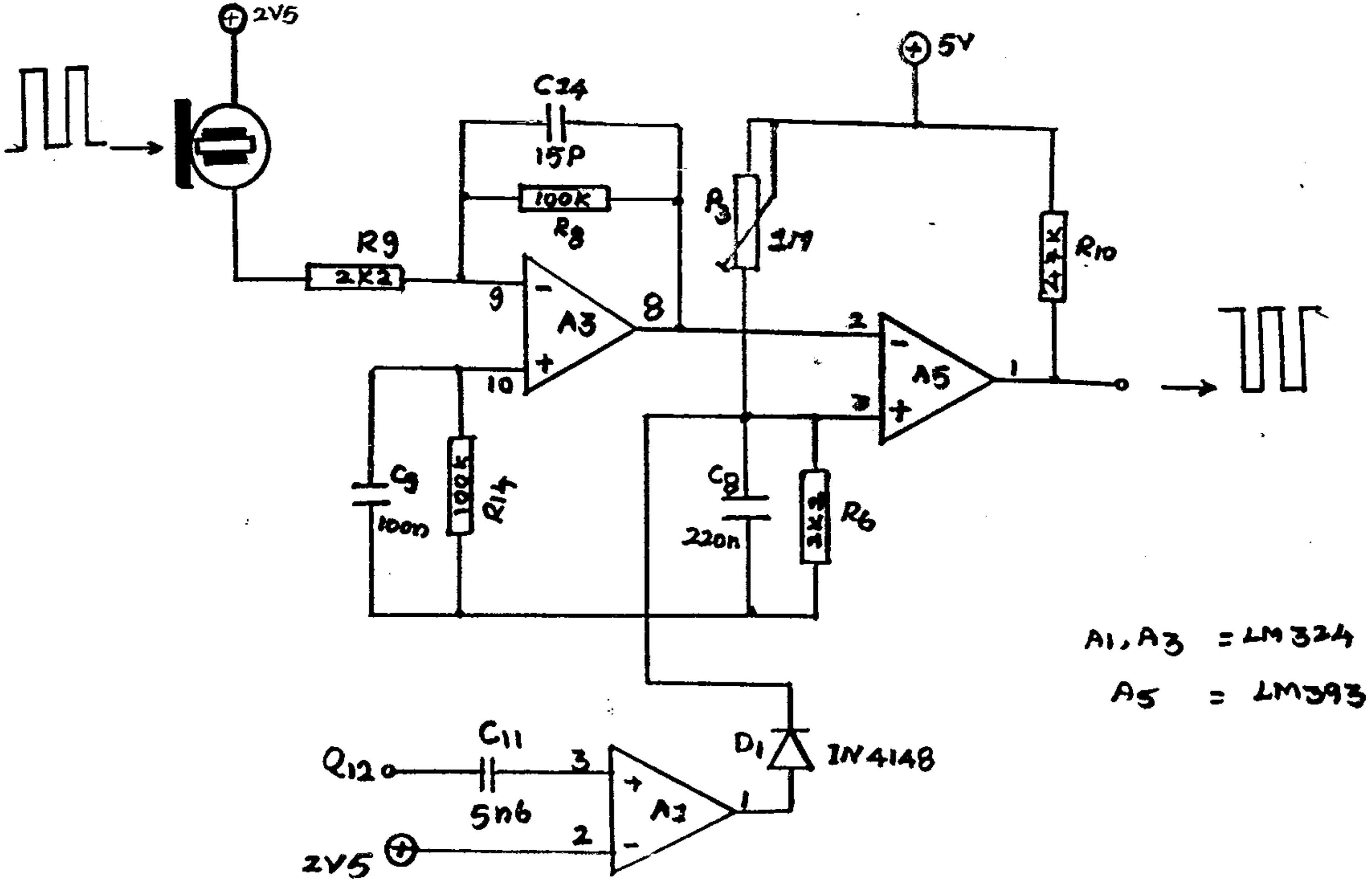
N1.... N6 = 4093

N7 = 4093

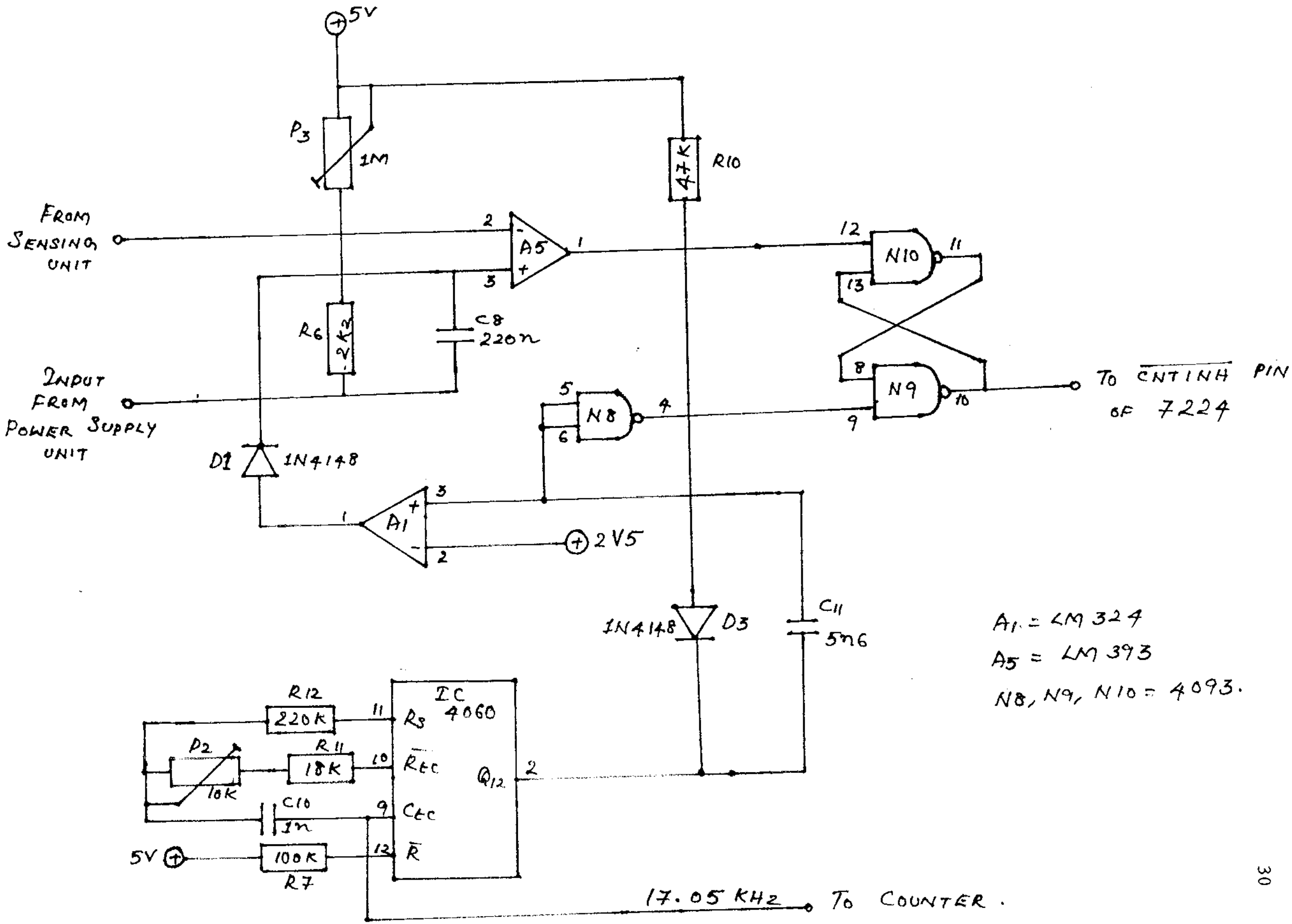
[2.5] Fig : SENDER UNIT

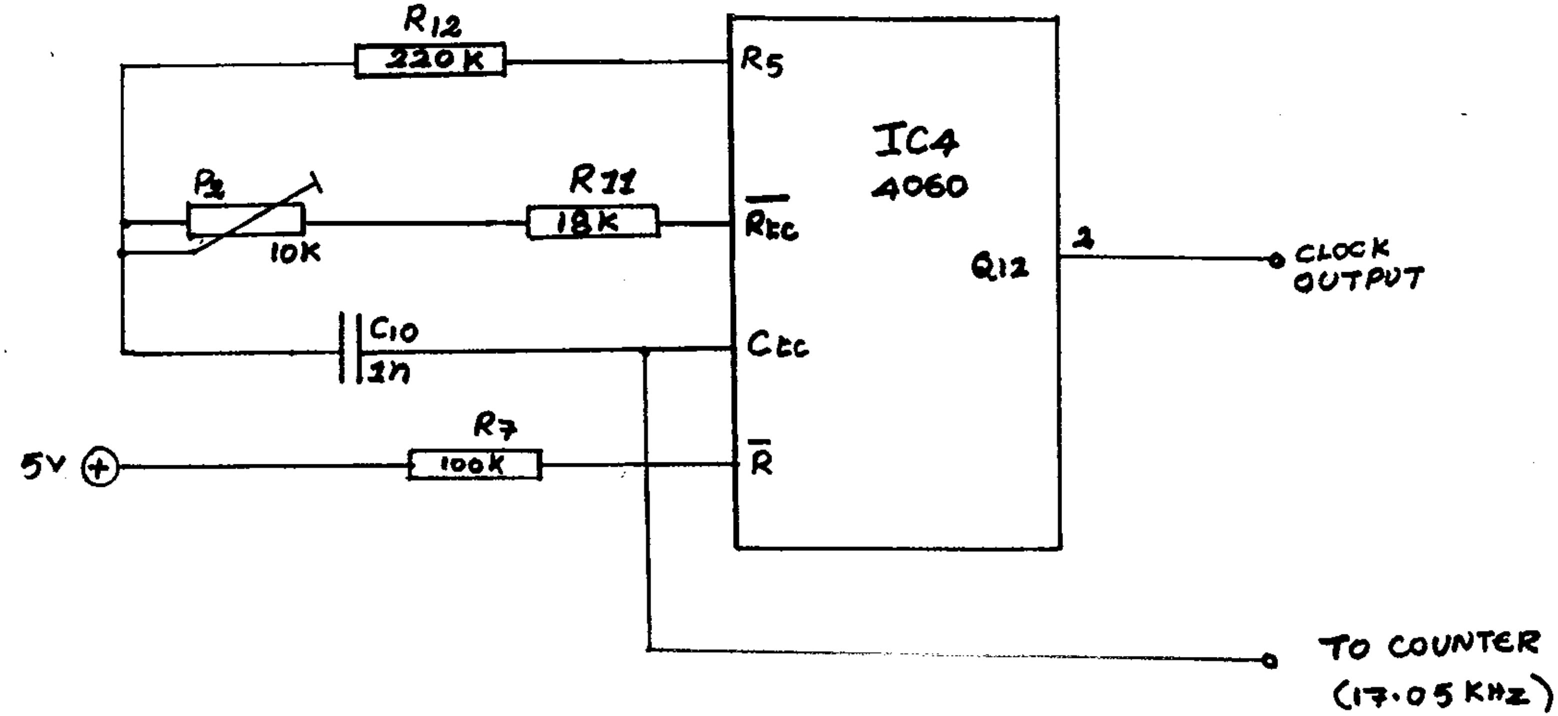


[2.6] Fig: DRIVE AMPLIFIER AND TRANSMITTER.



[2.7] Fig : RECEIVER UNIT


5V
P3
1M
47K
R10
FROM SENSING UNIT
A5
N10
N9
N8
R6
2k2
C8
220n
INPUT FROM POWER SUPPLY UNIT
D1
1N4148
A1
2V5
TO CNTINH PIN OF 7224
1N4148
D3
C11
5n6
R12
220K
IC 4060
P2
R11
18K
10K
C10
1n
5V
100K
R7
Rs
Rtc
Ctc
Q12
R
17.05 KHz
TO COUNTER.
A1 = LM 324
A5 = LM 393
N8, N9, N10 = 4093.



[2.9] Fig: INTERNAL CLOCK PULSE GENERATOR.

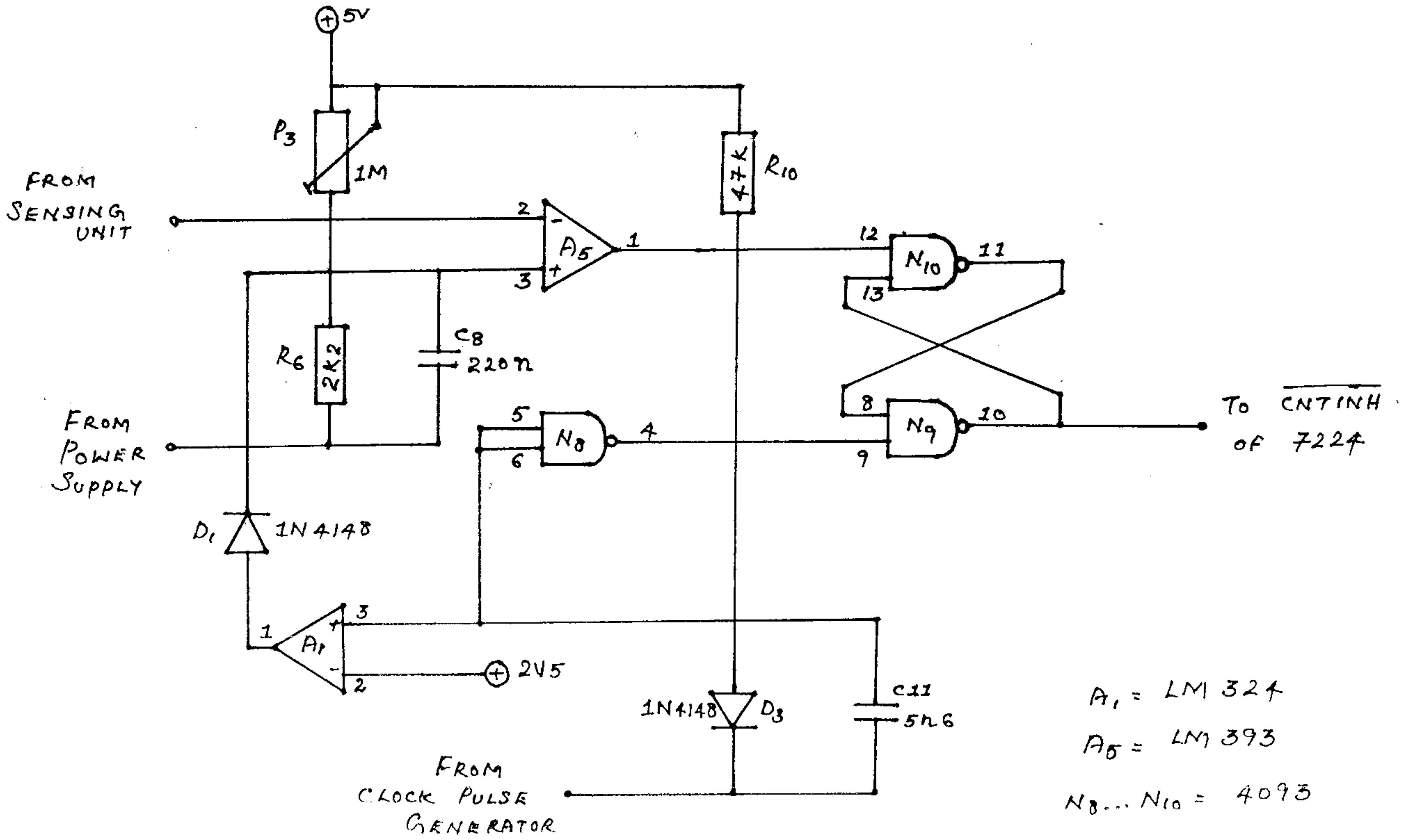


Fig. 2.10: BISTABLE LATCH CIRCUITRY

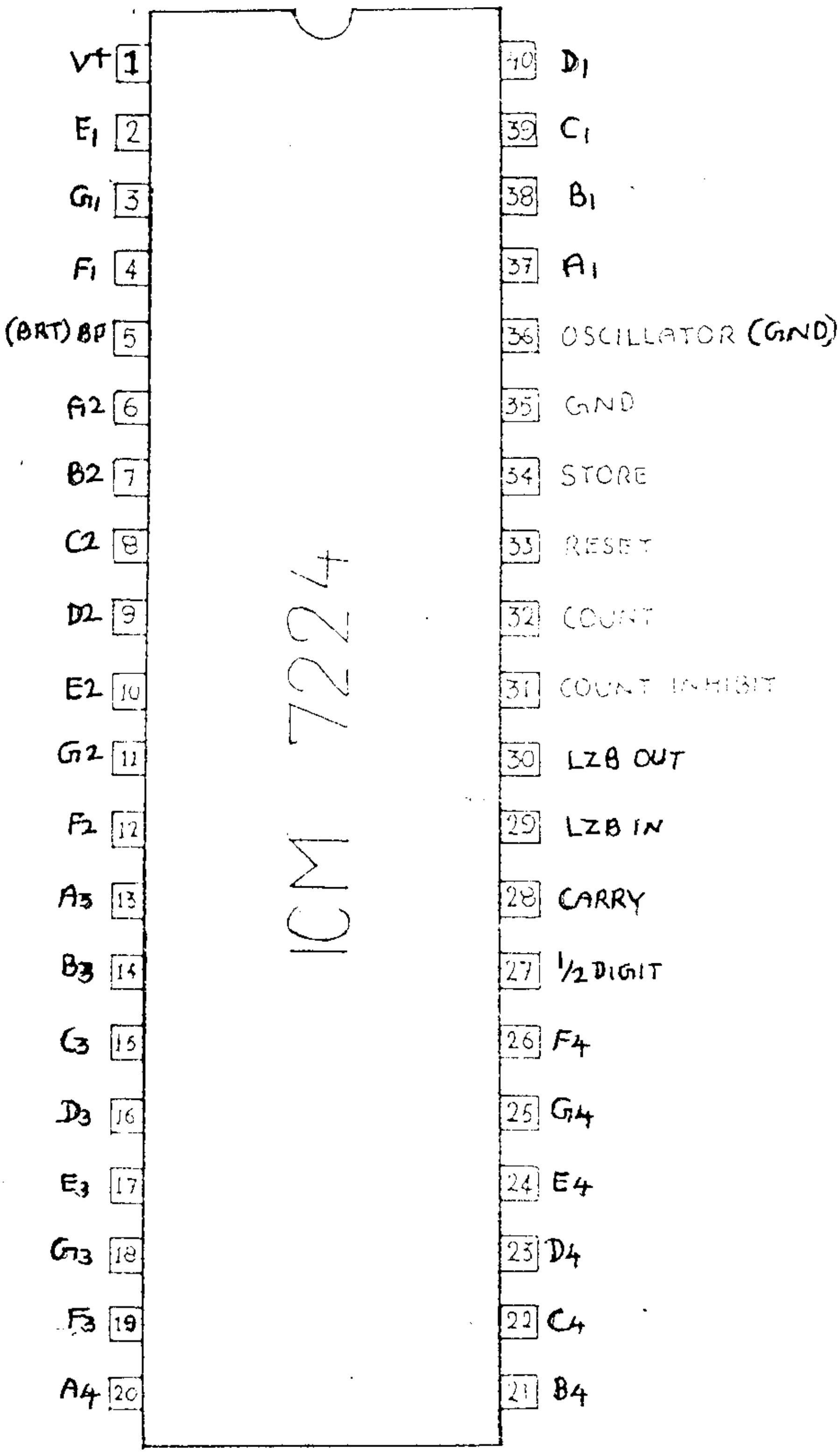

ICM 7224
V+ 1
E1 2
G1 3
F1 4
(BRT) BP 5
A2 6
B2 7
C2 8
D2 9
E2 10
G2 11
F2 12
A3 13
B3 14
C3 15
D3 16
E3 17
G3 18
F3 19
A4 20
40 D1
39 C1
38 B1
37 A1
36 OSCILLATOR (GND)
35 GND
34 STORE
33 RESET
32 COUNT
31 COUNT INHIBIT
30 LZB OUT
29 LZB IN
28 CARRY
27 1/2 DIGIT
26 F4
25 G4
24 E4
23 D4
22 C4
21 B4

Fig. 2.11

CHAPTER - 3

OPERATION OF THE METER

3.1 PRINCIPLE OF OPERATION

The ultra sonic range finder presented here is suitable for measuring distances between 25 cm and 4 meters. The result is shown on a $3\frac{1}{2}$ digit LCD display unit. A 'LO-BAT' indication on the LCD screen indicates that the battery should be replaced (9 V battery).

The transduction element emits bursts of 12 pulses at a frequency of about 40 KHz. This frequency is roughly identical with the resonance frequency of the two transducers so that some sort of selectivity is obtained at the sensing element. As soon as the first burst is emitted, a bistable is actuated which enables the counter.

Immediately after the burst has been emitted, the unit is switched to reception. The sensitivity of the receiver is a function of time. During and immediately after emission of the burst, the sensitivity is low. If an echo is received very soon after lessation of the emitted burst, it will be sufficiently strong to be processed by the receiver inspite of the very low sensitivity. An echo that takes a longer time to reach the sensing element will be weaker, but by then the sensitivity of the receiver has become higher.

At the instant the echo is sensed, the bistable is reset and the counter state transferred to the output latch.

Since the clock frequency is 17.05 KHz and the velocity of sound under normal atmospheric conditions may be taken as 341 ms^{-1}, the period of the clock is equal to the time taken by the burst to travel 2 cm. This means that the number of clock pulses counted between the onset of emission of the burst and the sensing of the echo is equal to the number of centimeters between the transducers and the reflecting surface. Fig. 3.1 shows the timing diagram.

3.2 CIRCUIT DESCRIPTION

Fig. 3.2 gives the complete circuit diagram of the unit. The transduction element is driven by four paired CMOS buffers. The output stage is actually a full bridge which causes a doubling of the effective voltage across the element. Capacitor C1 blocks the DC component of the output signal during pauses in emission. To obtain bursts at maximum energy, IC1 is connected directly to the 9V battery. The remainder of the circuit operates from 5 V.

The 40 KHz oscillator is tuned to the resonance frequency of the transducers with the aid of P1. The regulated supply voltage ensures adequate frequency stability. Comparator A6 matches the logic levels of the oscillator and the output circuit.

The 5 V supply is regulated by a 78 L 05. This type of regulator requires only a small bias current at low output currents and thus helps to keep the overall current drawn by the circuit low.

When S1 is pressed, output Q12 goes high twice a second. Network R2-C11 enables the 40 KHz oscillator for about 0.3 ms, so that the emitted burst contains 12 periods of the 40 KHz signal. During emission, the output of A1 is high which, via D1 causes the threshold of comparator A5 to be raised to a level that makes triggering by cross talk impossible.

At the start of an emission, bistable N9-N10 is set. This disables the count inhibit input of IC8, which thereupon commenses counting the 17.05 KHz pulses applied to Pin 32 by IC4.

When an echo is received, the output of A5 goes low, which causes the bistable to be reset and this in turn disables the clock to IC8. At the same time, a short negative pulse is applied via R13 - C12 and N11 to pin 34 ($\overline{\text{Store}}$) which results in the transfer of the counter state to the output latch of IC8. Gate N11 merely buffers the low-impedance store input. When the Q 12 output of IC4 goes low, the counter in IC8 is reset and the circuit is ready for the next measurement.

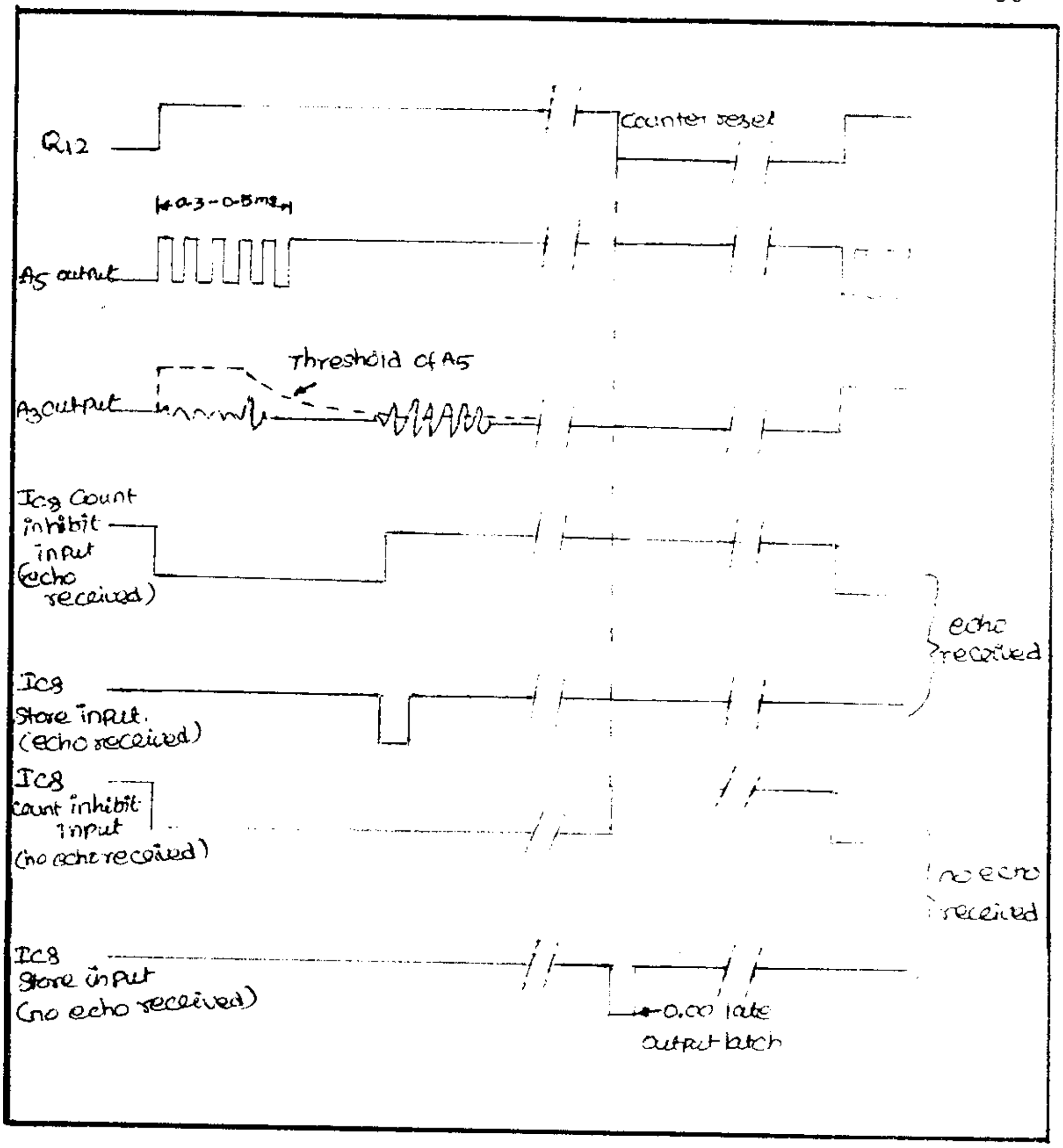


Fig.3.1: Timing diagram of the measuring process.

CHAPTER - 4

TESTING AND CALIBRATION

4.1 ACCURACY

The accuracy of the measurement depends on the precision with which time is measured and on the ambient conditions. The speed of sound depends on the atmospheric pressure, the temperature and the air density.

Larger errors caused by unit are mainly due to the incorrect triggering of the receiver. Partly because of the Q factor of the sending element, it takes a finite time (Upto a few periods of the 40 KHz signal) before the received signal attain maximum amplitude and the receiver in triggered and a delayed period causes a measuring error of about half a centimeter. None the less, under normal conditions, measurements made with this prototype upto a distance will be found to be accurate to within 2% ie., 2 cm/metre.

4.2 CALIBRATION

A multimeter an oscilloscipe and/or frequency meter are needed for calibration.

The frequency of the 40 KHz oscillator must be matched to the resonance frequency of the transducers. Connect temporary wire link between pins 1 and 14 of IC2 ; this will cause a transduction element to operate continuously. Turn P1 fully anti-clockwise. Measure the current drawn from the battery with the multimeter and turn P1 slowly clockwise until the current is maximum (about 16 mA). The oscillator is then set to the correct frequency. Note that when P1 is turned further there is a second current peak, but that is NOT the required point. This is all assuming that the 4093 used in the IC2 position is of SGS or RCA manufacture. The motorola version has a smaller hysteresis and this may necessitate an increase in the value of C2 to 2n2. The National Semiconductor version, on the other hand, has a higher hysteresis, so that the value of C2 may have to be reduced to 470

Remove the wire link from pins 1 and 14 of IC2. Press S1 and make sure that the transduction element produces a short click twice a second.

Next, P2 must be adjusted until the oscillator in IC4 operates at 17.05 KHz (measured with a frequency meter at pin 9 of the IC). In the absence of a frequency meter, place the unit in a position where the distance between the front of the transducers and a good reflecting surface (a wall or window plane) is exactly one metre (measured with a tape rule or similar). Press S1 and trun P2 until the display reads 1.00. If the reading is not stable or just 0.00, turn P3 slightly until a correct, stable reading is obtained.

Adjustment of P3 (sensitivity) depends largely on the circumstances of use. In quite surroundings, the control may be set fully anticlockwise (maximum sensitivity). If, however, the display gives spurious readings, like 128, 256 or 512, the sensitivity is too high : the meter then detects its own clock. This is obviated by turning P3 slightly clock wise.

If the unit is used in noisy surroundings, reduce the sensitivity even further, so that it does not respond to spurious sounds. Note, however, that the maximum measurable distance is then reduced. It should be borne that absorbent surfaces such as furniture, dressed people, and so on cannot be reliably be detected. This is because the echo from them is too weak to trigger the receiver. The sensitivity of the receiver may be increased by reducing the value of R6. Further more, the time dependency of the sensitivity may be altered by changing the value of time constant R6-C8. Reducing that value makes the meter more sensitive over shorter distances.

CHAPTER – V

CONCLUSION

An ultrasonic distance meter to measure distance has been designed, fabricated and tested. This meter can be used to measure a distance accurately upto 4 meters. The range of measurement can be increased by increasing the gain of the transducer and the supply voltage.

The meter is compact and handy. It is easily portable and cheaper. It finds applications in Civil Engineering works, air crafts, and in glass industries. The distance is directly displayed on the LCD screen and the accuracy is improved.

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