4 - CHANNEL INFRA RED REMOTE CONTROL

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CERTIFICATE

This is to certify that the work entitled , "4 – Channel IR remote control" submitted by Anil Yadav, Mrinal Rawat, Ashish Sharma and Rohan Sharma in partial fulfillment for the award of degree of Bachelor of Technology in Electronics and Communication Engineering of Jaypee University of Information Technology has been carried out under my supervision. This work has not been submitted partially or wholly to any other University or Institute for the award of this or any other degree or diploma.

Vivek Sehgal

Mr. Vivek Sehgal
[Project co-ordinator]

ACKNOWLEDGMENT

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We would like to express our gratitude and heartfelt thanks to ***Dr. Sunil Bhooshan***, Head of Department, Electronics and Communication Engineering, JUIT, Waknaghat for his constant support during the project.

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LIST OF ABBREVIATION

Transmitter Unit

Resistors

R1-R4	3k
R11,R6	180k
R5	43k
R7	4.7k
R8	10k
R9	1k
R10	.068k
P1	10k Preset

Capacitors

C4-C6	0.1MFD
C2	0.001MFD
C1,C3	0.01MFD

Semiconductors

IC1	MC145026
IC2	NE555
IC5	SN74ls132
T2	2N2222A
D2	IR LED

Receiver Unit

R1	170k
R2	330k
R3-R6	1k
R7-R11	330k

C1	0.01MFD
C2	0.1MFD

D1-D4	IN4148
D5-D9	IN4007
T1-T4	BC547
IC1	7400
IC2	MC145027
IC3	CD4049UBM
IC4,IC5	CD4013BM

ABSTRACT

Develop a smart home system.

To control the electrical appliances using remote control using motorolla encoder & decoder , a remote , TSOP-1738 IC, D – type flip flop , NE555 IC ,transistors and resistances.

Controlling appliances like fan, bulb ,tube etc. using a remote

MC145026 encoder is used in the remote along with NE555 and with SN74ls132 to transmit an IR signal at 40 kHz through an IR LED.

TSOP-1738 receives the IR signal and MC145027 decoder decodes the signal and drives the relay through an intermediate stage of D-type flip flops.

INTRODUCTION

The project is intended towards creating a smart home by controlling the electrical appliances using a remote control.

The basic diagram is as shown below:

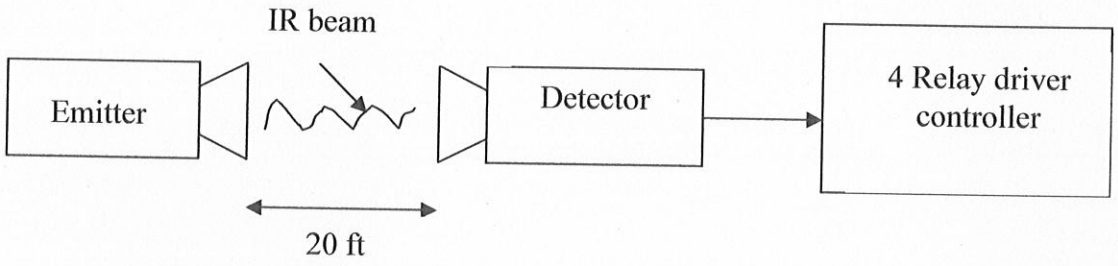


Figure 1

CHAPTER – I

The Emitter

The emitter is the remote section .The emitter consists of:

- Motorola MC145026 encoder IC
- NE 555 timer
- SN74ls132 Nand gate
- Infra Red LED
- 4-Switches
- Resistances and Capacitances of different values

Diagram of emitter

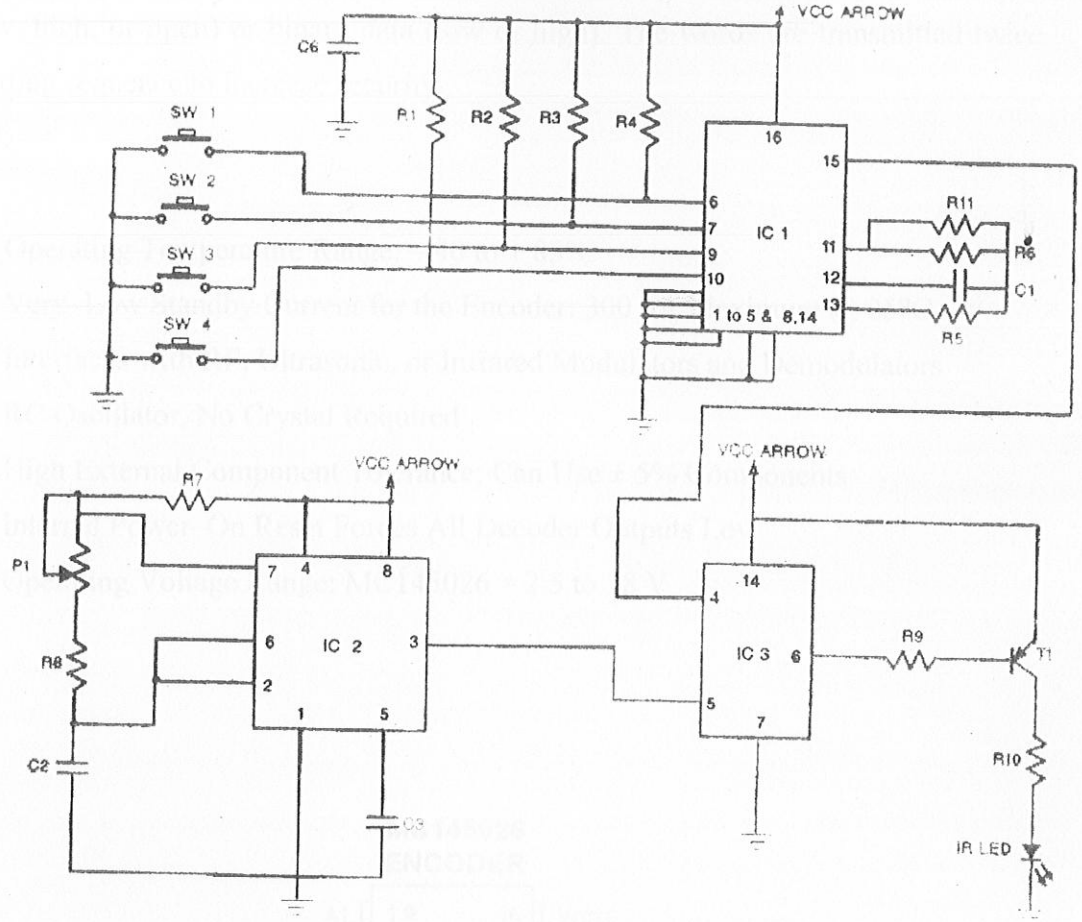


Figure 2

Description

When any of the four switches is pressed the corresponding pins (6, 7 ,9 ,10) goes high. The pull up resistor brings the pin to logic 1 . The encoder MC145026 encodes the data and transmits it serially through pin 15 . NE555 timer is used to generate a frequency of 40 kHz. The SN74ls132 takes the output of the encoder and the output of the timer and gives the combined signal of 40 kHz. This combined signal is transmitted through an IR LED. The description of the components used is as follows:-

MC145026

The MC145026 encodes nine lines of information and serially sends this information upon receipt of a transmit enable (TE) signal. The nine lines may be encoded with trinary data (low, high, or open) or binary data (low or high). The words are transmitted twice per encoding sequence to increase security.

- Operating Temperature Range: – 40 to + 85°C
- Very–Low Standby Current for the Encoder: 300 nA Maximum @ 25°C
- Interfaces with RF, Ultrasonic, or Infrared Modulators and Demodulators
- RC Oscillator, No Crystal Required
- High External Component Tolerance; Can Use ± 5% Components
- Internal Power–On Reset Forces All Decoder Outputs Low
- Operating Voltage Range: MC145026 = 2.5 to 18 V

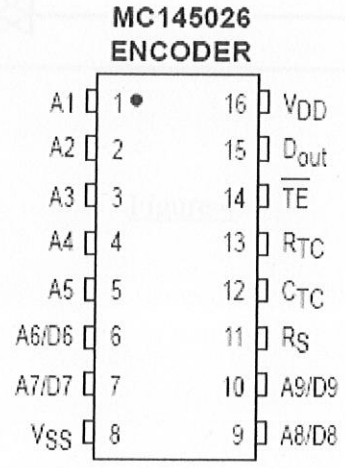


Figure 3

Block Diagram of MC145026

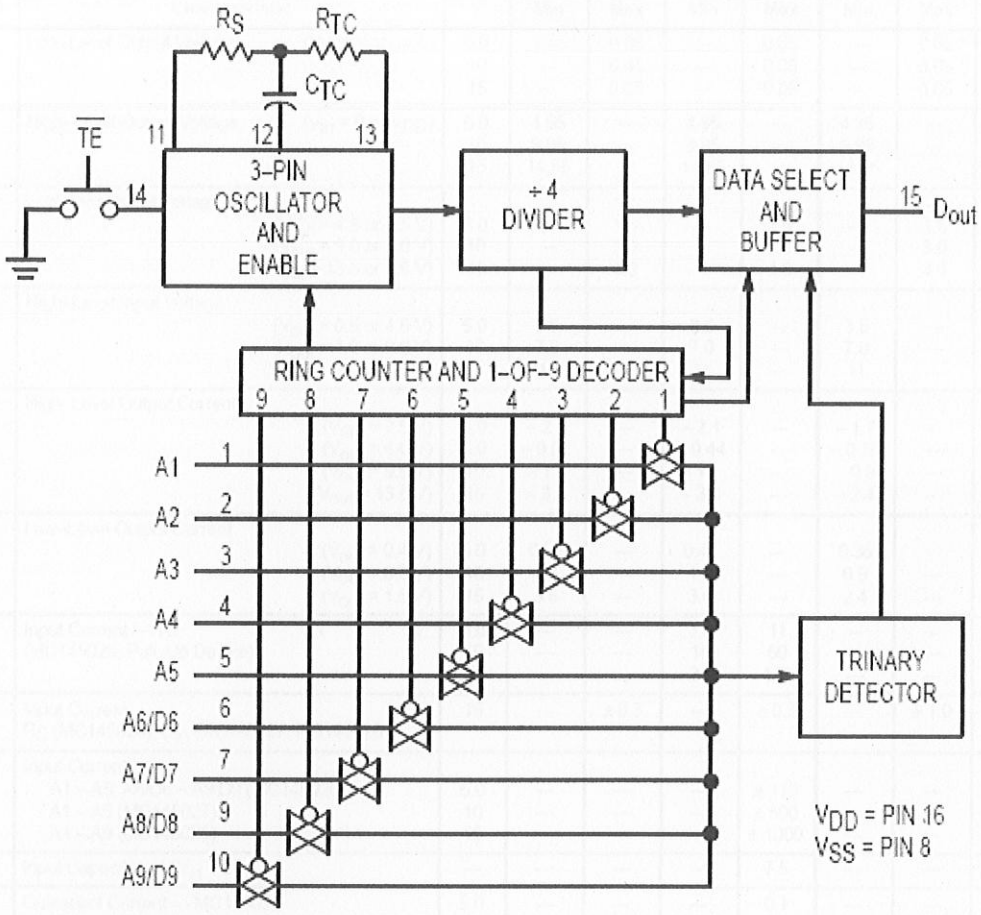


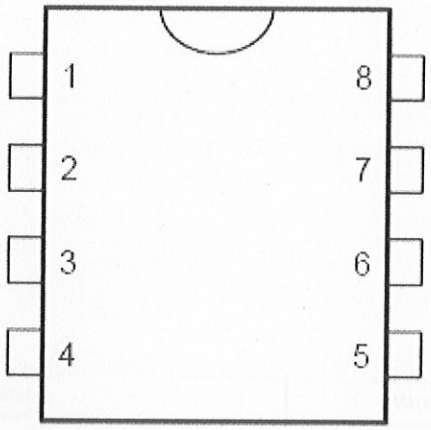
Figure 4

Electrical Characteristics

Symbol	Characteristic	V_{DD} V	Guaranteed Limit						Unit
			−40°C		25°C		85°C		
			Min	Max	Min	Max	Min	Max	
V_{OL}	Low–Level Output Voltage (V_{in} = V_{DD} or 0)	5.0	—	0.05	—	0.05	—	0.05	V
		10	—	0.05	—	0.05	—	0.05	
		15	—	0.05	—	0.05	—	0.05	
V_{OH}	High–Level Output Voltage (V_{in} = 0 or V_{DD})	5.0	4.95	—	4.95	—	4.95	—	V
		10	9.95	—	9.95	—	9.95	—	
		15	14.95	—	14.95	—	14.95	—	
V_{IL}	Low–Level Input Voltage								V
	(V_{out} = 4.5 or 0.5 V)	5.0	—	1.5	—	1.5	—	1.5	
	(V_{out} = 9.0 or 1.0 V)	10	—	3.0	—	3.0	—	3.0	
	(V_{out} = 13.5 or 1.5 V)	15	—	4.0	—	4.0	—	4.0	
V_{IH}	High–Level Input Voltage								V
	(V_{out} = 0.5 or 4.5 V)	5.0	3.5	—	3.5	—	3.5	—	
	(V_{out} = 1.0 or 9.0 V)	10	7.0	—	7.0	—	7.0	—	
	(V_{out} = 1.5 or 13.5 V)	15	11	—	11	—	11	—	
I_{OH}	High–Level Output Current								mA
	(V_{out} = 2.5 V)	5.0	−2.5	—	−2.1	—	−1.7	—	
	(V_{out} = 4.6 V)	5.0	−0.52	—	−0.44	—	−0.36	—	
	(V_{out} = 9.5 V)	10	−1.3	—	−1.1	—	−0.9	—	
	(V_{out} = 13.5 V)	15	−3.6	—	−3.0	—	−2.4	—	
I_{OL}	Low–Level Output Current								mA
	(V_{out} = 0.4 V)	5.0	0.52	—	0.44	—	0.36	—	
	(V_{out} = 0.5 V)	10	1.3	—	1.1	—	0.9	—	
	(V_{out} = 1.5 V)	15	3.6	—	3.0	—	2.4	—	
I_{in}	Input Current — TE (MC145026, Pull–Up Device)	5.0	—	—	3.0	11	—	—	µA
		10	—	—	16	60	—	—	
		15	—	—	35	120	—	—	
I_{in}	Input Current R_S (MC145026), D_{in} (MC145027, MC145028)	15	—	±0.3	—	±0.3	—	±1.0	µA
I_{in}	Input Current								µA
	A1 – A5, A6/D6 – A9/D9 (MC145026),	5.0	—	—	—	±110	—	—	
	A1 – A5 (MC145027),	10	—	—	—	±500	—	—	
	A1 – A9 (MC145028)	15	—	—	—	±1000	—	—	
C_{in}	Input Capacitance (V_{in} = 0)	—	—	—	—	7.5	—	—	pF
I_{DD}	Quiescent Current — MC145026	5.0	—	—	—	0.1	—	—	µA
		10	—	—	—	0.2	—	—	
		15	—	—	—	0.3	—	—	
I_{DD}	Quiescent Current — MC145027, MC145028	5.0	—	—	—	50	—	—	µA
		10	—	—	—	100	—	—	
		15	—	—	—	150	—	—	
I_{dd}	Dynamic Supply Current — MC145026 (f_c = 20 kHz)	5.0	—	—	—	200	—	—	µA
		10	—	—	—	400	—	—	
		15	—	—	—	600	—	—	
I_{dd}	Dynamic Supply Current — MC145027, MC145028 (f_c = 20 kHz)	5.0	—	—	—	400	—	—	µA
		10	—	—	—	800	—	—	
		15	—	—	—	1200	—	—	

NE555

The NE555 monolithic timing circuit is a highly stable controller capable of producing accurate time delays or oscillation. In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For a stable operation as an oscillator, the free running frequency and the duty cycle are both accurately controlled with two external resistors and one capacitor. The circuit may be triggered and reset on falling waveforms, and the output structure can source or sink up to 200mA.



1 - GND
2 - Trigger
3 - Output
4 - Reset
5 - Control voltage
6 - Threshold
7 - Discharge
8 - Vcc

Figure 5

Block Diagram

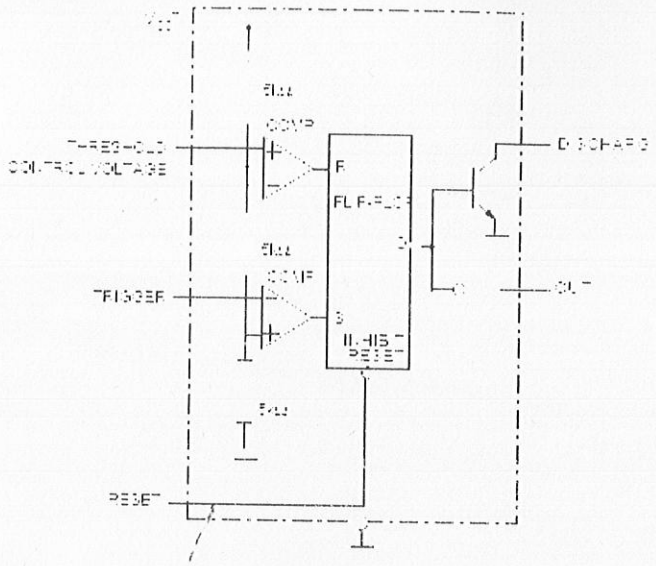


Figure 6

Operating Condition

- Vcc = 4.5 to 16 Volts

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
Vcc	Supply Voltage	16	V
T	Junction Temperature	150	°C
Tstg	Storage Temperature Range	-65 to 150	°C

Electrical Characteristics

Symbol	Parameter	SE555			NE555 - SA555			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
I_{CC}	Supply Current (R_L = ∞) - note [1] Low State V_{CC} = +5V V_{CC} = +15V High State V_{CC} = 5V		3 10 2	5 12		3 10 2	6 15	mA
	Timing Error (monostable) (R_A = 2kΩ to 100kΩ, C = 0.1µF) Initial Accuracy - note [2] Drift with Temperature Drift with Supply Voltage		0.5 30 0.05	2 100 0.2		- 50 0.1	3 0.5	% ppm/°C %/V
	Timing Error (astable) (R_A, R_B = 1kΩ to 100kΩ, C = 0.1µF, V_{CC} = +15V) Initial Accuracy - see note 2 Drift with Temperature Drift with Supply Voltage		1.5 90 0.15			2.25 150 0.3		% ppm/°C %/V
V_{CL}	Control Voltage Level V_{CC} = +15V V_{CC} = +5V	9.6 2.9	10 3.33	10.4 3.8	9 2.6	10 3.33	11 4	V
V_{th}	Threshold Voltage V_{CC} = +15V V_{CC} = +5V	9.4 2.7	10 3.33	10.6 4	8.8 2.4	10 3.33	11.2 4.2	V
I_{th}	Threshold Current - note [3]		0.1	0.25		0.1	0.25	µA
V_{trig}	Trigger Voltage V_{CC} = +15V V_{CC} = +5V	4.8 1.45	5 1.67	5.2 1.9	4.5 1.1	5 1.67	5.6 2.2	V
I_{trig}	Trigger Current (V_{trig} = 0V)		0.5	0.9		0.5	2.0	µA
V_{reset}	Reset Voltage [4]	0.4	0.7	1	0.4	0.7	-	V
I_{reset}	Reset Current V_{reset} = +0.4V V_{reset} = 0V		0.1 0.4	0.4 1		0.1 0.4	0.4 1.5	mA
V_{OL}	Low Level Output Voltage V_{CC} = +15V $I_{O(sink)}$ = 10mA $I_{O(sink)}$ = 50mA $I_{O(sink)}$ = 100mA $I_{O(sink)}$ = 200mA V_{CC} = +5V $I_{O(sink)}$ = 8mA $I_{O(sink)}$ = 5mA		0.1 0.4 2 2.5 0.1 0.05	0.15 0.5 2.2 0.25 0.2		0.1 0.4 2 2.5 0.3 0.25	0.25 0.75 2.5 0.4 0.35	V
V_{CH}	High Level Output Voltage V_{CC} = +15V $I_{O(sink)}$ = 200mA $I_{O(sink)}$ = 100mA V_{CC} = +5V $I_{O(sink)}$ = 100mA	13 3	12.5 13.3 3.3		12.75 2.75	12.5 13.3 3.3		V
$I_{d(off)}$	Discharge Pin Leakage Current (output high) (V_{ds} = 10V)		20	100		20	100	nA
$V_{dis(sat)}$	Discharge pin Saturation Voltage (output low) - note [5] V_{CC} = +15V, I_{dis} = 15mA V_{CC} = +5V, I_{dis} = 4.5mA		180 80	480 200		180 80	480 200	mV
t_r t_f	Output rise Time Output Fall Time		100 100	200 200		100 100	300 300	ns
t_{off}	Turn off Time - note [6] (V_{reset} = V_{CC})		0.5			0.5		µs

NE555 timer is operatimg in Astable mode in the circuit. In this mode circuit is connected as shown in figure (pin 2 and 6 connected) it triggers itself and free runs as a multi vibrator. The external capacitor charges through R1 and R2 and discharges through R2 only. Thus the duty cycle may be precisely set by the ratio of these two resistors. In the astable mode of operation, C1 charges and discharges between 1/3 VCC and 2/3 VCC.

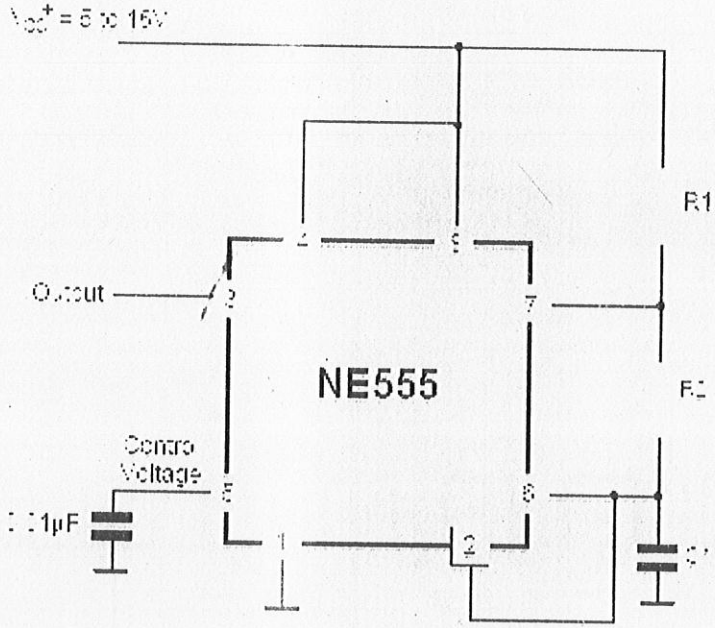


Figure 7

The frequency of oscillation is :

$$f = 1/T$$

$$= 1.44/(R1 + 2R2)\ C1$$

SN74ls132

The SN74LS132 contains four 2-Input NAND Gates which accept standard TTL input signals and provide standard TTL output levels. They are capable of transforming slowly changing input signals into sharply defined, jitter-free output signals. Additionally, they have greater noise margin than conventional NAND Gates.

Each circuit contains a 2-input Schmitt trigger followed by a Darlington level shifter and a phase splitter driving a TTL totem pole output. The Schmitt trigger uses positive feedback to effectively speed-up slow input transitions, and provide different input threshold voltages for positive and negative-going transitions.

Logic and Connection Diagram

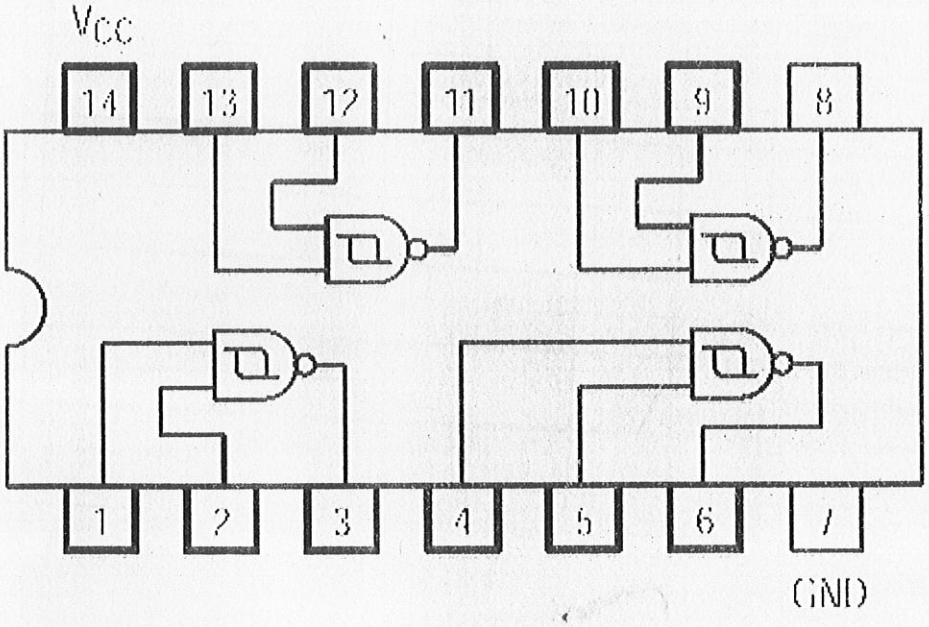


Figure 8

Operating Conditions

- Vcc = 4.25 to 5.25 volts

DC Characteristics

Symbol	Parameter	Limits			Unit	Test Conditions
		Min	Typ	Max		
V−+	Positive-Going Threshold Voltage	1.6		2.0	V	Vcc = 5.0 V
V−−	Negative-Going Threshold Voltage	0.6		1.1	V	Vcc = 5.0 V
V−+ − V−−	Hysteresis	0.4	0.9		V	Vcc = 5.0 V
VIK	Input Clamp Diode Voltage		−0.65	−1.5	V	Vcc = MIN, IIN = −18 mA
VOH	Output HIGH Voltage	2.7	3.4		V	Vcc = MIN, IOH = −400 µA, VIN = VIL
VOL	Output LOW Voltage		0.25	0.4	V	Vcc = MIN, IOL = 4.0 mA, VIN = 2.0 V
			0.35	0.5	V	Vcc = MIN, IOL = 8.0 mA, VIN = 2.0 V
I−+	Input Current at Positive-Going Threshold		−0.14		mA	Vcc = 5.0 V, VIN = V−+
I−−	Input Current at Negative-Going Threshold		−0.15		mA	Vcc = 5.0 V, VIN = V−−
IIH	Input HIGH Current			20	µA	Vcc = MAX, VIN = 2.7 V
				0.1	mA	Vcc = MAX, VIN = 7.0 V
IIL	Input LOW Current			−0.2	mA	Vcc = MAX, VIN = 0.4 V
IOS	Output Short Circuit Current (Note 1)	−20		−100	mA	Vcc = MAX, VOUT = 0 V
ICC	Power Supply Current Total, Output HIGH		5.9	11	mA	Vcc = MAX, VIN = 0 V
	Total, Output LOW		6.2	14	mA	Vcc = MAX, VIN = 4.5 V

CHAPTER - II

The Detector

The Detector is the receiver section .The Detector consists of:

- Motorola MC145027 decoder IC
- CD4049UBM Hex Inverter
- CD4013BM D-Type flip flop
- TSOP-1738 Receiver
- 4-Relays
- Resistances and capacitances of different values

Diagram of detector

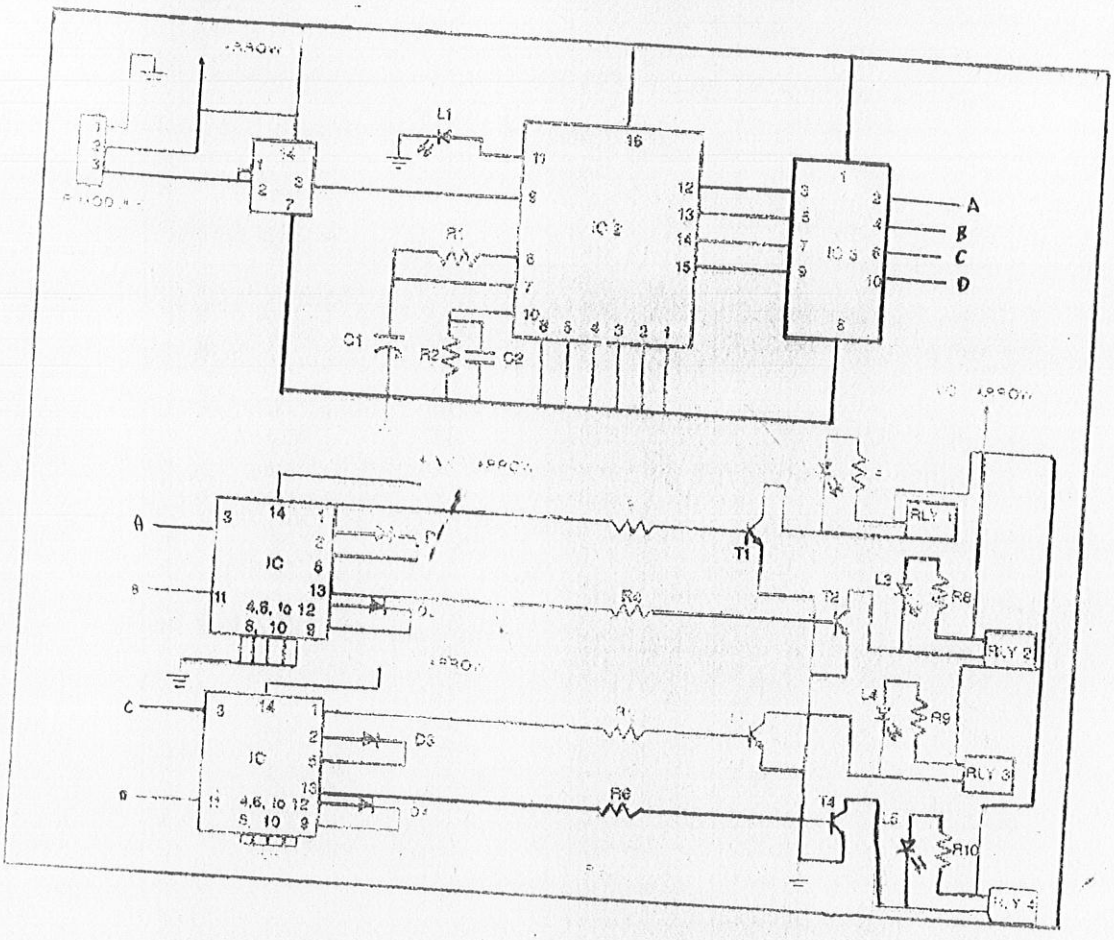


Figure 9

Description

The IR signal at 40 kHz is received by TSOP-1738 i.e the IR module. The signal is weak so it is amplified and send to pin 9 of the MC145027 decoder chip. The decoder then verifies the signal and set any of the pin 12,13,14,15. If at transmitter SW1 is pressed then the pin 12 is set, if SW2 is pressed then pin 13 is set and so on. The output is then connected to pin 3,5,7,9 respectively of the CD4049UBM IC which is the inverter.

The output of the inverter is then connected to the flip flops. The output if the flip flop is connected to the base of the transistor which when high drives the relay. Flip flop is used so that it latches on to the logic until the same switch is pressed again which in turns compliments the output of the flip flop. The electrical appliances is connected to the relay and thus can be controlled by the remote. The description of the components is as follows:

MC145027

The MC145027 decoder receives the serial stream and interprets five of the trinary digits as an address code. Thus, 243 addresses are possible. If binary data is used at the encoder, 32 addresses are possible. The remaining serial information is interpreted as four bits of binary data. The valid transmission (VT) output goes high on the MC145027 when two conditions are met. First, two addresses must be consecutively received (in one encoding sequence) which both match the local address. Second, the 4 bits of data must match the last valid data received. The active VT indicates that the information at the Data output pins has been updated.

- Operating Temperature Range: – 40 to + 85°C
- Very–Low Standby Current for the Encoder: 300 nA Maximum @ 25°C
- Interfaces with RF, Ultrasonic, or Infrared Modulators and Demodulators
- RC Oscillator, No Crystal Required
- High External Component Tolerance; Can Use ± 5% Components
- Internal Power–On Reset Forces All Decoder Outputs Low
- Operating Voltage Range MC145027 = 4.5 to 18 V

Pin Diagram

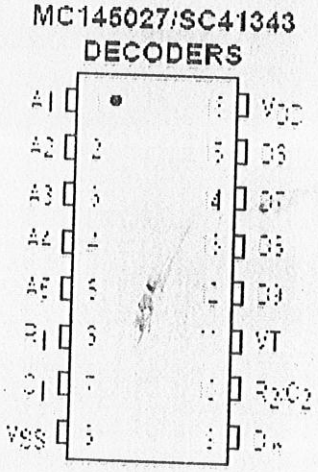


Figure 10

Block Diagram

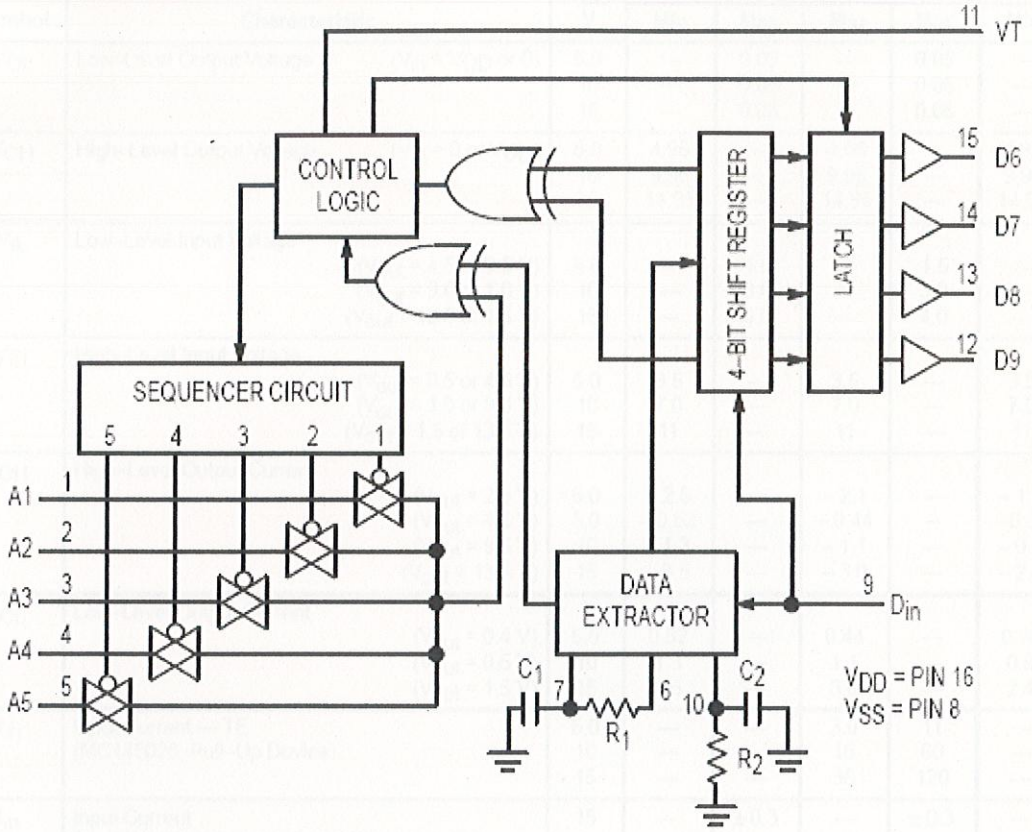


Figure 11

Electrical Characteristics

Symbol	Characteristic	V_{DD} V	Guaranteed Limit						Unit
			−40°C		25°C		85°C		
			Min	Max	Min	Max	Min	Max	
V_{OL}	Low–Level Output Voltage (V_{in} = V_{DD} or 0)	5.0	—	0.05	—	0.05	—	0.05	V
		10	—	0.05	—	0.05	—	0.05	
		15	—	0.05	—	0.05	—	0.05	
V_{OH}	High–Level Output Voltage (V_{in} = 0 or V_{DD})	5.0	4.95	—	4.95	—	4.95	—	V
		10	9.95	—	9.95	—	9.95	—	
		15	14.95	—	14.95	—	14.95	—	
V_{IL}	Low–Level Input Voltage								V
	(V_{out} = 4.5 or 0.5 V)	5.0	—	1.5	—	1.5	—	1.5	
	(V_{out} = 9.0 or 1.0 V)	10	—	3.0	—	3.0	—	3.0	
	(V_{out} = 13.5 or 1.5 V)	15	—	4.0	—	4.0	—	4.0	
V_{IH}	High–Level Input Voltage								V
	(V_{out} = 0.5 or 4.5 V)	5.0	3.5	—	3.5	—	3.5	—	
	(V_{out} = 1.0 or 9.0 V)	10	7.0	—	7.0	—	7.0	—	
	(V_{out} = 1.5 or 13.5 V)	15	11	—	11	—	11	—	
I_{OH}	High–Level Output Current								mA
	(V_{out} = 2.5 V)	5.0	−2.5	—	−2.1	—	−1.7	—	
	(V_{out} = 4.6 V)	5.0	−0.52	—	−0.44	—	−0.36	—	
	(V_{out} = 9.5 V)	10	−1.3	—	−1.1	—	−0.9	—	
	(V_{out} = 13.5 V)	15	−3.6	—	−3.0	—	−2.4	—	
I_{OL}	Low–Level Output Current								mA
	(V_{out} = 0.4 V)	5.0	0.52	—	0.44	—	0.36	—	
	(V_{out} = 0.5 V)	10	1.3	—	1.1	—	0.9	—	
	(V_{out} = 1.5 V)	15	3.6	—	3.0	—	2.4	—	
I_{in}	Input Current — TE (MC145026, Pull–Up Device)	5.0	—	—	3.0	11	—	—	µA
		10	—	—	16	60	—	—	
		15	—	—	35	120	—	—	
I_{in}	Input Current R_S (MC145026), D_{in} (MC145027, MC145028)	15	—	±0.3	—	±0.3	—	±1.0	µA
I_{in}	Input Current								µA
	A1 – A5, A6/D6 – A9/D9 (MC145026),	5.0	—	—	—	±110	—	—	
	A1 – A5 (MC145027),	10	—	—	—	±500	—	—	
	A1 – A9 (MC145028)	15	—	—	—	±1000	—	—	
C_{in}	Input Capacitance (V_{in} = 0)	—	—	—	—	7.5	—	—	pF
I_{DD}	Quiescent Current — MC145026	5.0	—	—	—	0.1	—	—	µA
		10	—	—	—	0.2	—	—	
		15	—	—	—	0.3	—	—	
I_{DD}	Quiescent Current — MC145027, MC145028	5.0	—	—	—	50	—	—	µA
		10	—	—	—	100	—	—	
		15	—	—	—	150	—	—	
I_{dd}	Dynamic Supply Current — MC145026 (f_c = 20 kHz)	5.0	—	—	—	200	—	—	µA
		10	—	—	—	400	—	—	
		15	—	—	—	600	—	—	
I_{dd}	Dynamic Supply Current — MC145027, MC145028 (f_c = 20 kHz)	5.0	—	—	—	400	—	—	µA
		10	—	—	—	800	—	—	
		15	—	—	—	1200	—	—	

TSOP

The TSOP17.. – series are miniaturized receivers for infrared remote control systems. PIN diode and preamplifier are assembled on lead frame, the epoxy package is designed as IR filter.The demodulated output signal can directly be decoded by a microprocessor. TSOP17.. is the standard IR remote control receiver series, supporting all major transmission codes.

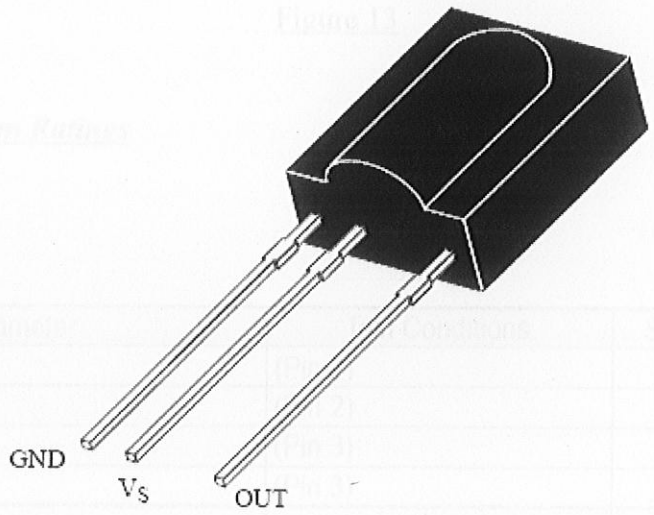


Figure 12

Block Diagram

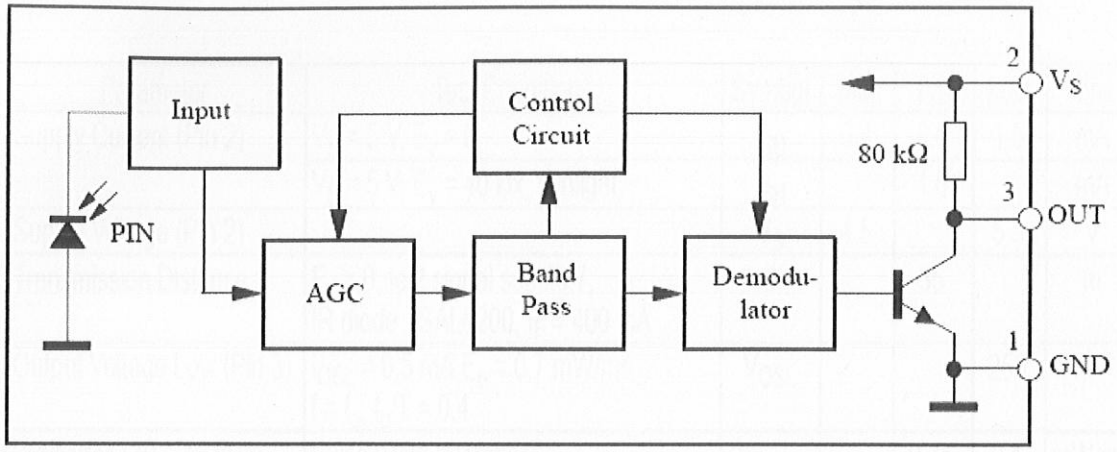


Figure 13

Absolute Maximum Ratings

T_{amb} = 25°C

Parameter	Test Conditions	Symbol	Value	Unit
Supply Voltage	(Pin 2)	V_S	–0.3...6.0	V
Supply Current	(Pin 2)	I_S	5	mA
Output Voltage	(Pin 3)	V_O	–0.3...6.0	V
Output Current	(Pin 3)	I_O	5	mA
Junction Temperature		T_j	100	°C
Storage Temperature Range		T_{stg}	–25...+85	°C
Operating Temperature Range		T_{amb}	–25...+85	°C
Power Consumption	($T_{amb} \leqq 85$ °C)	P_{tot}	50	mW
Soldering Temperature	t ≦ 10 s, 1 mm from case	T_{sd}	260	°C

Basic Characteristic

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
Supply Current (Pin 2)	V_S = 5 V, E_v = 0	I_{SD}	0.4	0.6	1.5	mA
	V_S = 5 V, E_v = 40 klx, sunlight	I_{SH}		1.0		mA
Supply Voltage (Pin 2)		V_S	4.5		5.5	V
Transmission Distance	E_v = 0, test signal see fig.7, IR diode TSAL6200, I_F = 400 mA	d		35		m
Output Voltage Low (Pin 3)	I_{OSL} = 0.5 mA, E_e = 0.7 mW/m^2, f = f_o, t_p/T = 0.4	V_{OSL}			250	mV
Irradiance (30 – 40 kHz)	Pulse width tolerance: $t_{pi} - 5/f_o < t_{po} < t_{pi} + 6/f_o$, test signal (see fig.7)	$E_{e\,min}$		0.35	0.5	mW/m^2
Irradiance (56 kHz)	Pulse width tolerance: $t_{pi} - 5/f_o < t_{po} < t_{pi} + 6/f_o$, test signal (see fig.7)	$E_{e\,min}$		0.4	0.6	mW/m^2
Irradiance	$t_{pi} - 5/f_o < t_{po} < t_{pi} + 6/f_o$	$E_{e\,max}$	30			W/m^2
Directivity	Angle of half transmission distance	$\varphi_{1/2}$		±45		deg

CD4049UBM

General Description

These hex buffers are monolithic complementary MOS (CMOS) integrated circuits constructed with N- and P-channel enhancement mode transistors. These devices feature logic level conversion using only one supply voltage (VDD). The input signal high level (VIH) can exceed the VDD supply voltage when these devices are used for logic level conversions.These devices are intended for use as hex buffers, CMOS to DTL/TTL converters, or as CMOS current drivers, and at VDD e 5.0V, they can drive directly two DTL/TTL loads over the full operating temperature range.

Features

- Wide supply voltage range 3.0V to 15V
- Direct drive to 2 TTL loads at 5.0V over full temperature range
- High source and sink current capability
- Special input protection permits input voltages greater than VDD

Connection Diagram

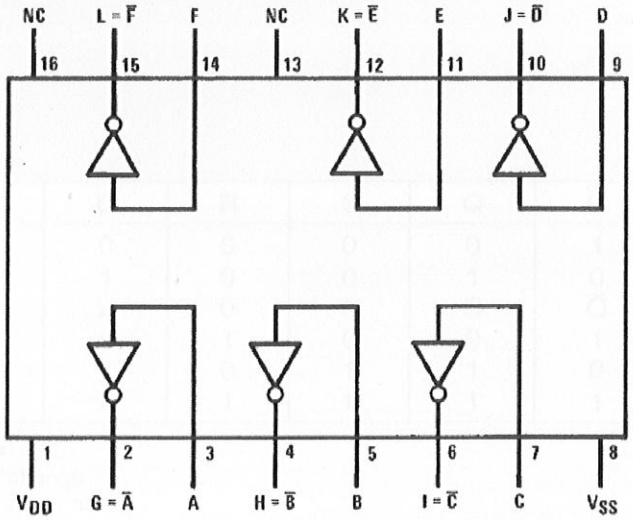


Figure 14

Operating Conditions

- Supply Voltage (VDD) 3V to 15V
- Input Voltage (VIN) 0V to 15V
- Voltage at Any Output Pin (VOUT) 0 to VDD

CD4013BM

General Description

The CD4013B dual D flip-flop is a monolithic complementary MOS (CMOS) integrated circuit constructed with N- and P-channel enhancement mode transistors. Each flip-flop has independent data, set, reset, and clock inputs and ``Q" and ``Q" outputs. These devices can be used for shift register applications, and by connecting ``Q" output to the data input, for counter and toggle applications. The logic level present at the ``D" input is transferred to the Q output during the positive-going transition of the clock pulse. Setting or resetting is independent of the clock and is accomplished by a high level on the set or reset line respectively.

Truth Tabel

CL†	D	R	S	Q	$\overline{Q}$
⌐	0	0	0	0	1
⌐	1	0	0	1	0
¬	x	0	0	Q	$\overline{Q}$
x	x	1	0	0	1
x	x	0	1	1	0
x	x	1	1	1	1

No change
† = Level change
x = Don't care case

Connection Diagram

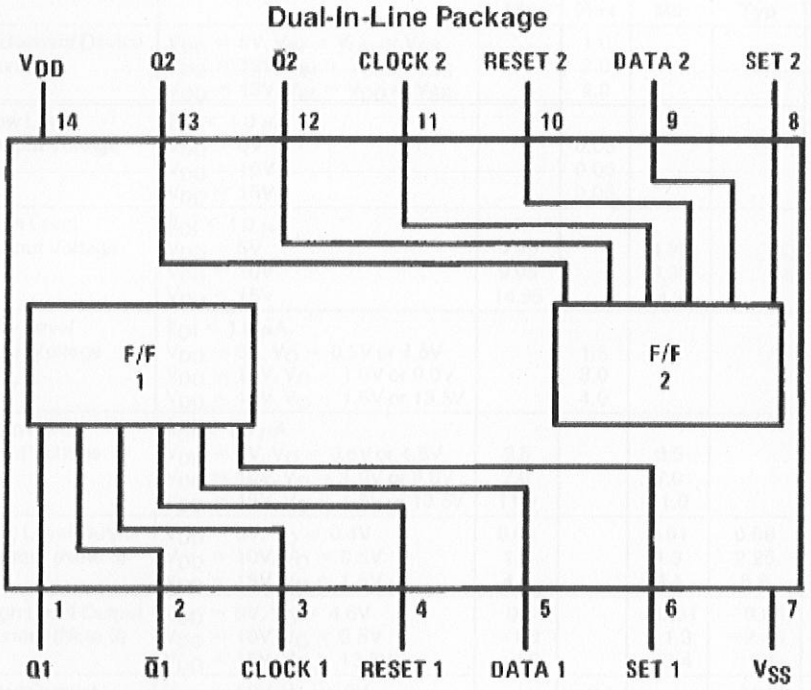


Figure 15

DC Electrical Characteristic

Symbol	Parameter	Conditions	−55°C		+25°C			+125°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I_{DD}	Quiescent Device Current	V_{DD} = 5V, V_{IN} = V_{DD} or V_{SS}		1.0			1.0		30	μA
		V_{DD} = 10V, V_{IN} = V_{DD} or V_{SS}		2.0			2.0		60	μA
		V_{DD} = 15V, V_{IN} = V_{DD} or V_{SS}		4.0			4.0		120	μA
V_{OL}	Low Level Output Voltage	$\|I_O\|$ < 1.0 μA								
		V_{DD} = 5V		0.05			0.05		0.05	V
		V_{DD} = 10V		0.05			0.05		0.05	V
		V_{DD} = 15V		0.05			0.05		0.05	V
V_{OH}	High Level Output Voltage	$\|I_O\|$ < 1.0 μA								
		V_{DD} = 5V	4.95		4.95			4.95		V
		V_{DD} = 10V	9.95		9.95			9.95		V
		V_{DD} = 15V	14.95		14.95			14.95		V
V_{IL}	Low Level Input Voltage	$\|I_O\|$ < 1.0 μA								
		V_{DD} = 5V, V_O = 0.5V or 4.5V		1.5			1.5		1.5	V
		V_{DD} = 10V, V_O = 1.0V or 9.0V		3.0			3.0		3.0	V
		V_{DD} = 15V, V_O = 1.5V or 13.5V		4.0			4.0		4.0	V
V_{IH}	High Level Input Voltage	$\|I_O\|$ < 1.0 μA								
		V_{DD} = 5V, V_O = 0.5V or 4.5V	3.5		3.5			3.5		V
		V_{DD} = 10V, V_O = 1.0V or 9.0V	7.0		7.0			7.0		V
		V_{DD} = 15V, V_O = 1.5V or 13.5V	11.0		11.0			11.0		V
I_{OL}	Low Level Output Current (Note 3)	V_{DD} = 5V, V_O = 0.4V	0.64		0.51	0.88		0.36		mA
		V_{DD} = 10V, V_O = 0.5V	1.6		1.3	2.25		0.9		mA
		V_{DD} = 15V, V_O = 1.5V	4.2		3.4	8.8		2.4		mA
I_{OH}	High Level Output Current (Note 3)	V_{DD} = 5V, V_O = 4.6V	−0.64		−0.51	−0.88		−0.36		mA
		V_{DD} = 10V, V_O = 9.5V	−1.6		−1.3	−2.25		−0.9		mA
		V_{DD} = 15V, V_O = 13.5V	−4.2		−3.4	−8.8		−2.4		mA
I_{IN}	Input Current	V_{DD} = 15V, V_{IN} = 0V		−0.1		-10^{-5}	−0.1		−1.0	μA
		V_{DD} = 15V, V_{IN} = 15V		0.1		10^{-5}	0.1		1.0	μA

Conclusion

The system designed here is commercially viable. This design is very simple to use and can be used in day to day life. This project is very practical in nature and can be used in a house to control the electrical appliances like fan, bulb, tube etc. through a remote. Moreover the concept can be used in various applications where there is a need of a system controlled by remote like in industries, offices etc. The system is also very potable. The snap shot of the remote and the receiver is shown below:

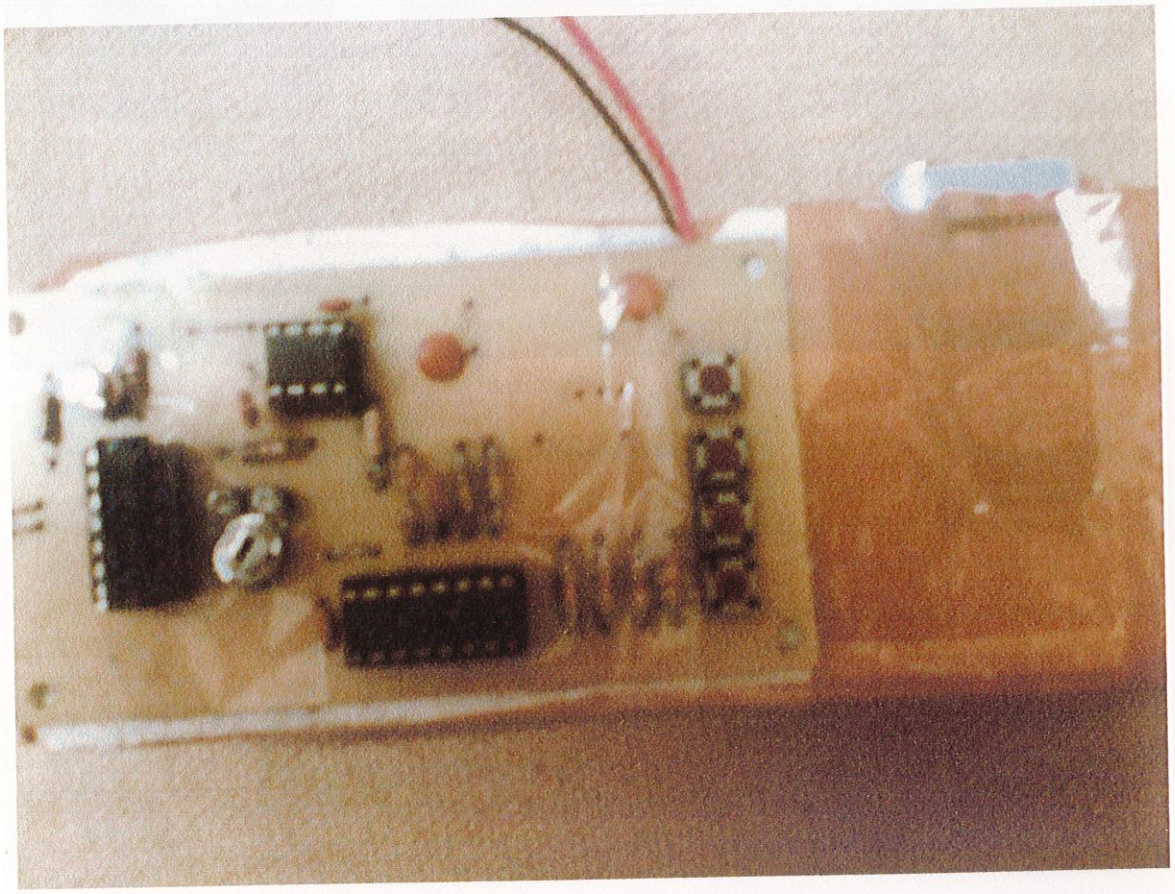


Figure 16 (Transmitter unit)

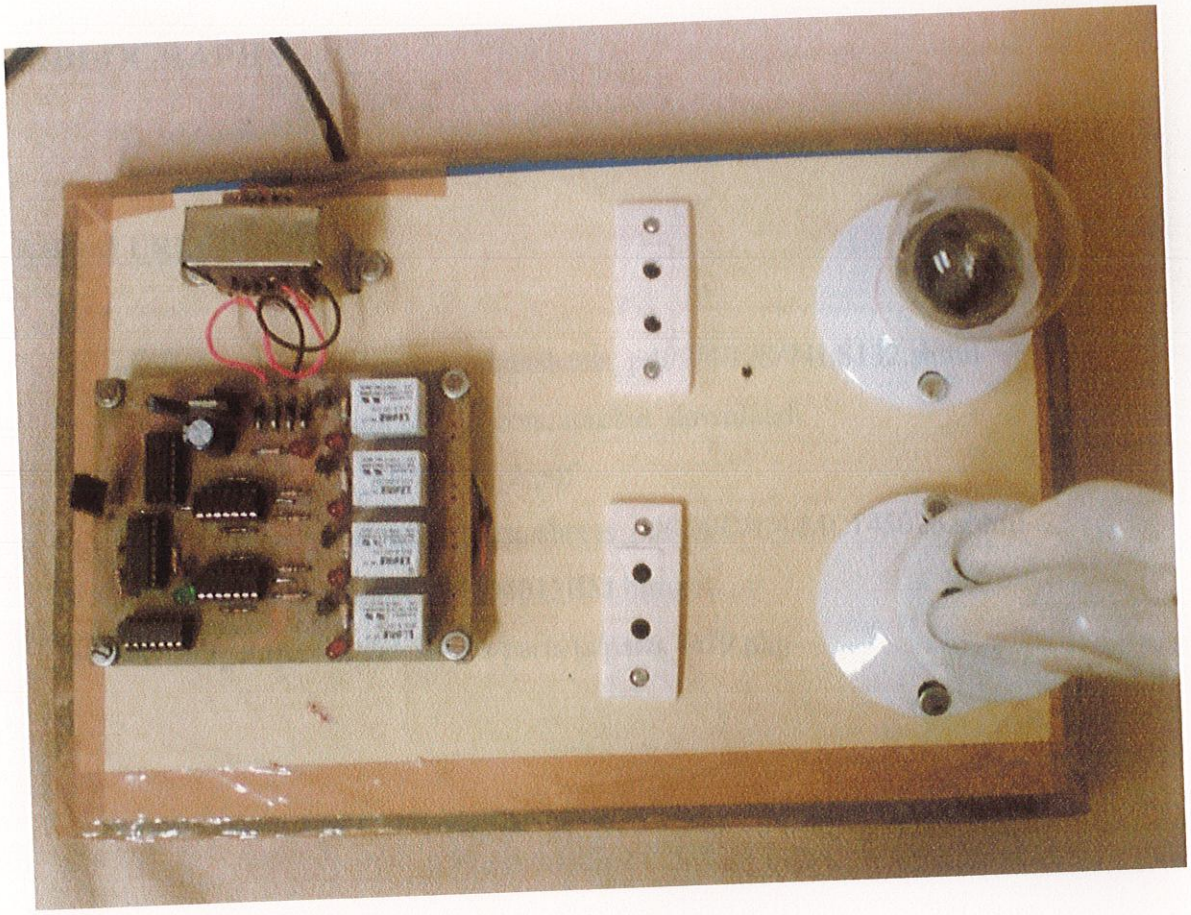


Figure 17(Receiver unit)

BIBLOGRAPHY

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