# SPY ROBOT

A project report submitted in partial fulfilment of the requirement for the award

Of the degree

**BACHELOR OF TECHNOLOGY**

IN

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FROM

## UNIVERSITY OF CALICUT

KERALA

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**Perinthalmanna – 679325**

# Department of Electronics and Communication Engineering

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## CERTIFICATE

Certified that the project work entitled **"SPY ROBOT"** carried out by **NISHAD NAZAR (CEAKEEC088) , NISHIL POTTAYIL (CEAKEEC089)** and **NITHIN K (CEAEEC090)** bona fide student of M.E.A ENGINEERING COLLEGE in partial fulfilment for the award of Bachelor of Technology in Electronics and Communication Engineering from University of Calicut, Kerala during the year 2012-2013.It is certified that all corrections/suggestions indicated for internal assessment have been incorporated in the report submitted in the department library. The project report has been approved as it satisfies the academic requirements in respect of project work prescribed for the said degree.

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# ABSTRACT

This project deals with the development of the device for the purpose of spying –'SPY ROBOT'. This project can be used for military activities, wireless surveillance etc. It is basically remote operated spy robot circuit which can be controlled by using a RF based remote controller. The Robot is attached with a wireless camera and it captures video and audio information from the surroundings and can be viewed on a laptop or TV. The Robot can be operated within the range of 100metres.The device uses the ASK for data transmission and reception. The Robot wheels driven by motor IC. The Robot can move forward, backward, left, and right directions. Thereby producing an efficient Spy Robot.

# ACKNOWLEDGEMENT

We take this opportunity to express our sincere thanks to **Dr. H. ABDUL RAUF,** our respected principal who gave the best facilities and atmosphere for the project work completion. We would like to thank **Mr RAJEEV N**, the Head of Department of electronics and communication Engineering, M.E.A Engineering College Perinthalmanna for providing permission and facilities to conduct the project in a systematic way. We are extremely grateful to **Mr JAMSEER N** , lecturer, Department Electronics and communication Engineering, M.E.A Engineering College Perinthalmanna, for the inspiring and sincere guidance throughout the project.

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Finally we thank **God** for his blessings.

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# LIST OF FIGURES

# LIST OF ABBREVIATIONS

| | |
|---|---|
| ASK | Amplitude Shift Keying |
| TX | Transmitter |
| RX | Receiver |
| V | Volt |
| $V_{cc}$ | Voltage Supply |
| O/P | Output |
| RF | Radio Frequency |

# CHAPTER 1

# INTRODUCTION

## 1.1 Problem definition

The Spy Robot is an ultimate device which can be used in several security measures. There are many situations where human beings cannot deal with tough problems like bomb detection, where humans cannot reach narrow place etc. . . . In these situations there is need to use Spy Robot application.

## 1.2 Objective study

- Study of RF transmission and reception.
- Study of motor driver – H bridge IC.
- Study of encoding and decoding of data.

## 1.3 Scope of study

This project provides a large scope in the wireless security and surveillance systems as a modern technology in this era.

## 1.4 Project motivation and contribution

The motivation of this project is to satisfy the need for spying especially in the field of military operations. This also helps in providing information from the place where humans cannot reach. Spy Robot will play a major role in the national defence.

## 1.5 Report organization

This report is organized in to 10 chapters

Chapter 1- It is just an introduction about the project. It includes problem definition, scope of study, project motivation & contribution, report organization.

Chapter 2-This Chapter contains block diagram and block diagram level description

Chapter 3-Chapter three contains circuit diagram, design &working

Chapter 4-Chapter four contains component description

Chapter 5-It consist of the advantages of the project

Chapter 6-It has the disadvantages of the project

Chapter 7-It contains applications and future scope of the project

Chapter 8-It contains the reference

Chapter 9-It contains appendix

# CHAPTER 2

# BLOCK DIAGRAM AND DESCRIPTION

## 2.1 Block Diagram

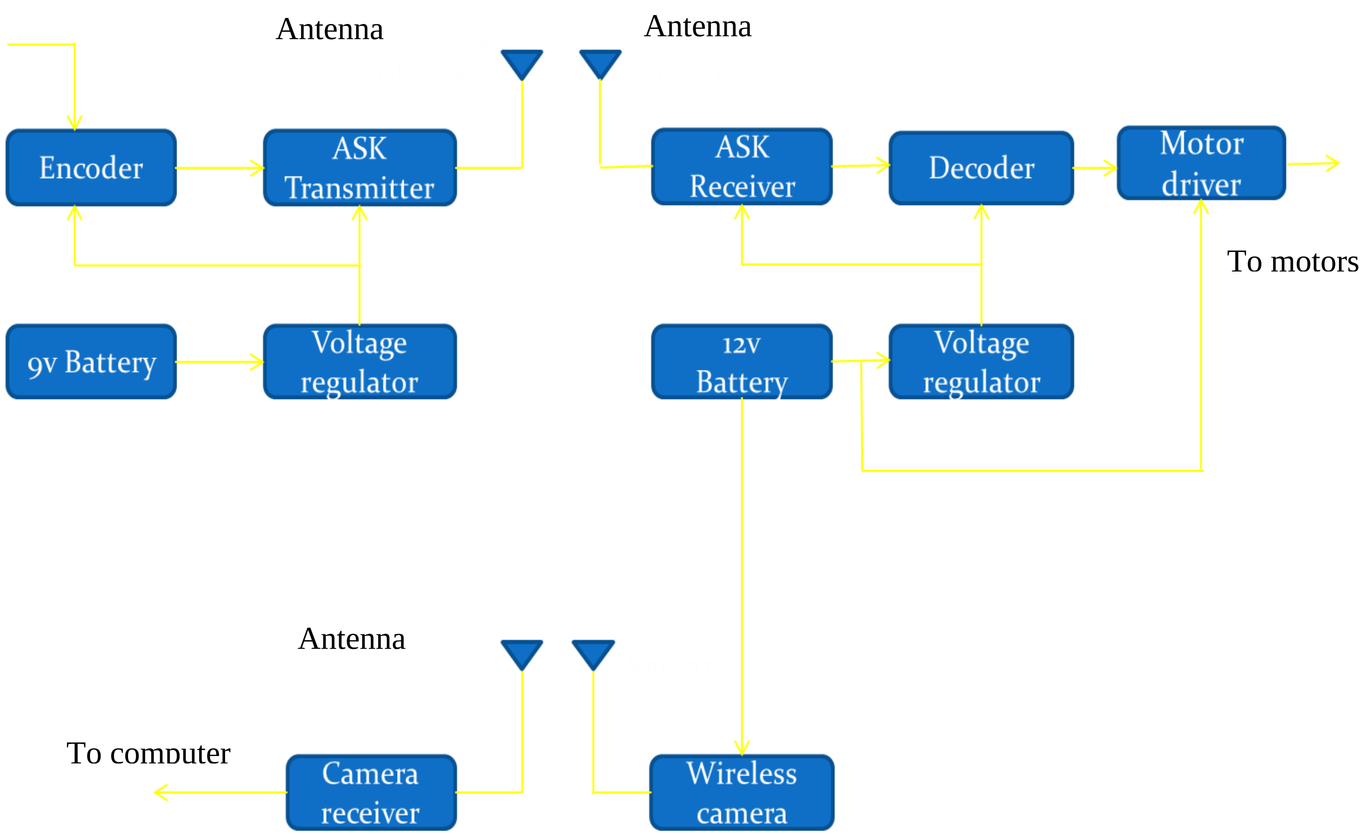



Figure 2.1 Block diagram

## 2.2 Block Diagram Description

The circuit consist of two sections- transmission and reception. The transmitter section consist of HT12E encoder, a transmitter, voltage regulator .The receiver consist of HT12D decoder, motor IC L293D and wireless camera.

The different blocks are described below:

### 2.2.1 Encoder

The IC HT12E is used as encoder for the circuit. The encoder converts the input pulse which is a parallel data into binary signals (serial data) and then it is transmitted.

### 2.2.2 Transmitter

RF transmitter used here is an amplitude shift key TX 434 which has a data transfer rate of 1 Kbps - 10Kbps .The serial wave of encoder is then modulated by ASK and then it is transmitted through RF.

### 2.2.2 Receiver

The RF receiver receives the transmitted data signal and the output is fed to a decoder. The receiver used here is RX 434 which is also a ASK modulation.

### 2.2.3 Decoder

The decoder used here is IC HT12D.It decodes the received data which is in binary (serial ) form to parallel data.Then this data is used to drive the motor driving IC L293D.

### 2.2.4 H-bridge

Here we use IC L293D as the H-Bridge. The output of decoder is fed as inputs into the H-Bridge. Then it is used to change the direction of the motor with respect to the input signal.

### 2.2.5 Voltage regulator

The voltage regulator IC regulates the output voltage as per required by the IC’s. We have used IC 7805, IC 7812 to regulate 5 V and 12 V supply respectively.

### 2.2.6 Wireless camera

We have used a 2.4 GHZ mini wireless camera with night vision as a spy camera .It can transmit audio and video signals in up to 100m distance without obstacle.

# CHAPTER 3

# CIRCUIT DIAGRAM AND WORKING

## 3.1 Circuit of Transmitter

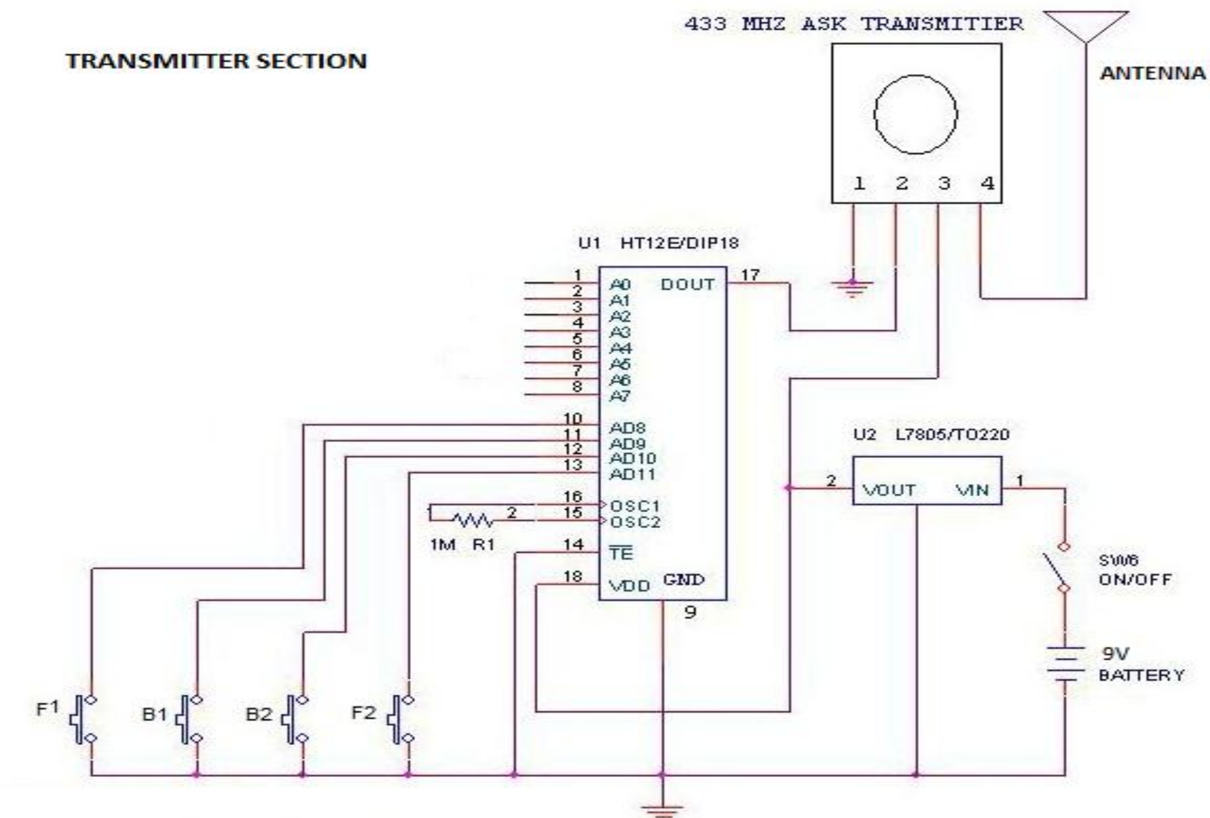



Figure 3.1 Transmitter

The transmitter section consist of encoder IC, an ASK transmitter, voltage regulators, four push button switches. The four switches provided as control signals to the pin 10- pin 13 of encoder IC .Each switch is assigned movements for the Robot .When a switch is closed, that pin is grounded. Thus a signal is produced and then this signal (parallel data) is fed into the encoder as input .The encoder IC receiver receives parallel data in the form of address bits and control bits. The control signals from remote switches along with 8 address bits constitute a set of 12 parallel signals. The encoder HT12E encodes these parallel signals into serial bits. Transmission is enabled by providing ground to pin 14 which is active low. The serial data is fed to RF transmitter through pin 17 of HT12E.Then the encoded data is modulated using Amplitude Shift Keying technique with ASK transmitter .Then the modulated data is transmitted wirelessly to the RF receiver.

## 3.2 Encoder


Figure 3.2 Encoder

HT12E is an encoder integrated circuit of $2^{12}$ series of encoders. They are paired with $2^{12}$ series of decoders for use in remote control system applications. It is mainly used in interfacing RF and infrared circuits. The chosen pair of encoder/decoder should have same number of addresses and data format.

Simply put, HT12E converts the parallel inputs into serial output. It encodes the 12 bit parallel data into serial for transmission through an RF transmitter. These 12 bits are divided into 8 address bits and 4 data bits.

HT12E has a transmission enable pin which is active low. When a trigger signal is received on TE pin, the programmed addresses/data are transmitted together with the header bits via an RF or an infrared transmission medium.HT12E begins a 4-word transmission cycle upon receipt of a transmission enable. This cycle is repeated as long as TE is kept low. As soon as TE returns to high, the encoder output completes its final cycle and then stops.

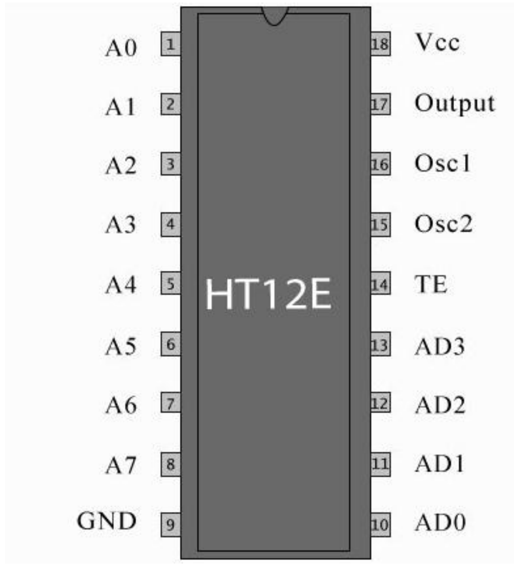



Figure 3.3 Pin out Encoder

## 3.3 RF modules: Transmitter and Receiver

The RF module, as the name suggests, operates at Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as Amplitude Shift Keying (ASK)

The encoded data bits from the MCT2E output is transmitted through ASK transmitter. Amplitude-shift-Keying (ASK) is a form of modulation that represents digital data as variations in the amplitude of a carrier wave. Any digital modulation scheme uses a finite number of distinct signals to represent digital data. ASK uses a finite number of amplitudes, each assigned a unique pattern of binary digits. Usually, each amplitude encodes an equal number of bits. Each pattern of bits forms the symbol that is represented by the particular amplitude.


Figure 3.4 ASK Transmitter

Figure 3.5 ASK Receiver

The demodulator, which is designed specifically for the symbol-set used by the modulator, determines the amplitude of the received signal and maps it back to the symbol it represents, thus recovering the original data. Frequency and phase of the carrier are kept constant. Thus the transmitted code is generated.

## 3.4 Voltage regulator


Figure 3.6 IC 7805

A Voltage regulator is used to produce a constant linear output voltage. It's generally used with AC to DC power supply.78xx series are designed for positive and 79xx series are for negative voltage regulator. Here we use IC 7805 to regulate 5 V DC.**7805** is a three terminal +5v voltage regulator IC from 78XX chips family. LM78XX series are from National Semiconductor. They are linear positive voltage regulator IC; used to produce a fixed linear stable output voltage.

## 3.5 Circuit of Receiver

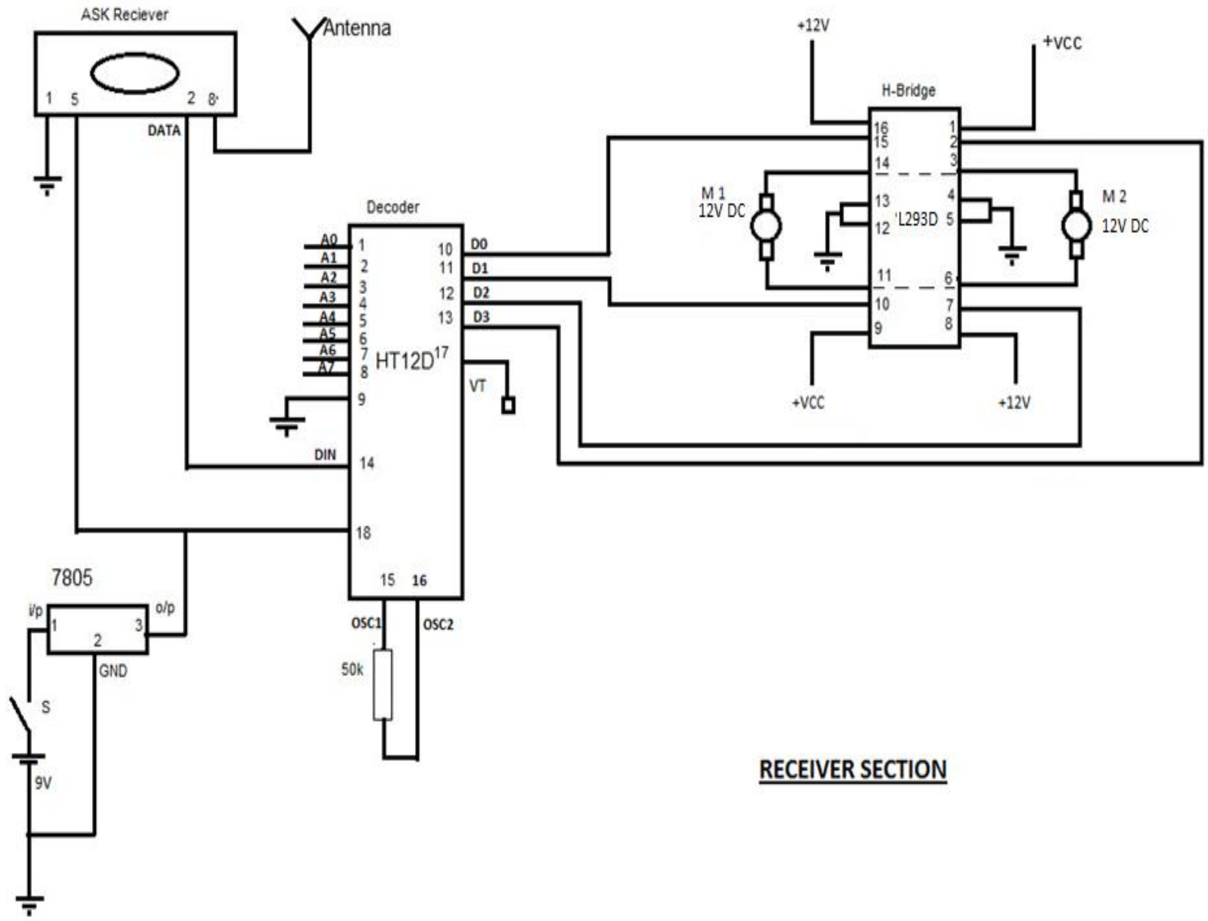



Figure 3.7 Receiver

In the receiver section, the elements are ASK receiver, HT12D decoder, L293D, 12 V DC motor. The signal is received and demodulated by the ASK receiver and this bin these signals, sends them to the decoder IC (HT12D) through pin2. The serial data is received at the data pin (DIN, pin14) of HT12D. The decoder then retrieves the original parallel format from the received serial data. Then the data is fed into the input of L293D. It is a motor driver IC to drive DC motors. The data as input corresponds to the control signals at the transmitter section. Then the IC drives the motor to the clockwise or anti-clockwise direction as per the control signals applied.

When no signal is received at data pin of HT12D, it remains in standby mode and consumes very less current (less than 1µA) for a voltage of 5V. When signal is received by receiver, it is given to DIN pin (pin14) of HT12D. On reception of signal, oscillator of HT12D gets activated. IC HT12D then decodes the serial data and checks the address bits three times. If these bits match with the local address pins (pins 1-8) of HT12D, then it puts the data bits on its data pins (pins 10-13) and makes the VT pin high. An LED is connected to VT pin (pin17) of the decoder. This LED works as an indicator to indicate a valid transmission. The corresponding output is thus generated at the data pins of decoder IC.

A signal is sent by lowering any or all the pins 10-13 of HT12E and corresponding signal is received at receiver's end (at HT12D). Address bits are configured by using the by using the first 8 pins of both encoder and decoder ICs. To send a particular signal, address bits must be same at encoder and decoder ICs. By configuring the address bits properly, a single RF transmitter can also be used to control different RF receivers of same frequency.

## 3.6 Decoder


Figure 3.8 Decoder HT12D

HT12D IC comes from HolTek Company. HT12D is a decoder integrated circuit that belongs to $2^{12}$ series of decoders. This series of decoders are mainly used for remote control system applications, like burglar alarm, car door controller, security system etc. It is mainly provided to interface RF and infrared circuits. They are paired with $2^{12}$ series of encoders. The chosen pair of encoder/decoder should have same number of addresses and data format.

In simple terms, HT12D converts the serial input into parallel outputs. It decodes the serial addresses and data received by, say, an RF receiver, into parallel data and sends them to output data pins. The serial input data is compared with the local addresses three times continuously. The input data code is decoded when no error or unmatched codes are found. A valid transmission in indicated by a high signal at VT pin.

HT12D is capable of decoding 12 bits, of which 8 are address bits and 4 are data bits. The data on 4 bit latch type output pins remain unchanged until new is received.

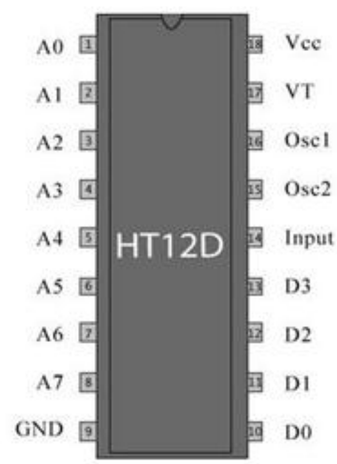



Figure 3.9 Pin out Decoder

# 3.7 L293D – H Bridge


Figure 3.10 L293D H-Bridges

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.

L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.

Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance state.

# 3.8 DC Motors

Figure 3.11 DC motor

The robot is driven by 100 rpm, 12 V DC motor. The motor has torque of 1.5 kg .cm. The motor has clockwise and anti-clockwise movement. These movements are made according to the control signals remotely given.

# 3.9 Wireless camera


Figure 3.12 Wireless camera and receiver

This is a 2.4GHZ wireless camera is with night vision facility .It is easily installed on the robot, and can transmit audio and video signals in up to 100m distance without block. It works with a 2.4GHZ wireless receiver.

This is a great wireless monitoring system and it can connect to TV monitor/Laptop through AV cable. The camera has built-in **12 Infra-Red**

**LED** with **8-10m Night Vision** function which can make spy work convenient at night. The cameras are connected to a 9V DC source.

## 3.9 Voltage regulator (7812)

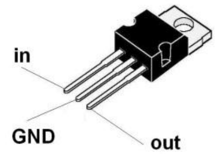



Figure 3.13 IC 7812

In reception we use IC 7812 to regulate 12 V DC to drive the 12 V DC motors with L293D Chit belongs to 78xx series chip family.

## Chapter 4

# ADVANTAGES

- They can perform tasks faster than humans and much more consistently and accurately.
- Captures views human can’t reach and stay camouflage.
- Giving us information that humans can't acquire.
- Development cost is low.

## Chapter 5

# DISADVANTAGES

- It needs maintenance to keep it running.
- Performance depends on the battery life.
- Robot can only be controlled up to the RF range.

## Chapter 6

# APPLICATION

- For observing Military Activities.
- Wireless security and surveillance in hot spots.
- Search and rescue operation.
- To inspect the defects in the centralized AC duct tubes.

# PRECAUTIONS

- Transmitter and receiver must be in specific range.
- Should maintain a clean circuit to avoid heating of IC L293D.

# FUTURE SCOPE AND CONCLUSION

The device has a large variety of future scope and possibilities

- Spy Robot can be controlled from anywhere in the world with GPS Navigation system.
- USB Connectivity.
- Data acquired can be accessed from anywhere in the world through cloud computing.

As the humans are becoming more and more dependent on machines, the scope of this field will only increase in the future. As humans are constantly keen in discovering and researching new areas, the robots will be a great help in those fields.

Spy robots will be a helpful device in the field of military operations. They can be used to detect bomb, reach anywhere humans cannot reach. They can be a great security tool for camera surveillance. We conclude here that this project has a great importance in many security measures and it plays a vital role in the national defence. Much other technology can be implemented onto the spy robot and can be made into a powerfultool.

# REFERENCES


- Digital communication By Simon haykin.
- Antenna Wave propagation by K D Prasad.
- Basics electronics engineering by Dr R K Singh.

# APPENDIX

HOLTEK

## HT12D/HT12F
## $2^{12}$ Series of Decoders

### Features

- Operating voltage: 2.4V~12V
- Low power and high noise immunity CMOS technology
- Low standby current
- Capable of decoding 12 bits of information
- Binary address setting
- Received codes are checked 3 times
- Address/Data number combination
  - HT12D: 8 address bits and 4 data bits
  - HT12F: 12 address bits only
- Built-in oscillator needs only 5% resistor
- Valid transmission indicator
- Easy interface with an RF or an infrared transmission medium
- Minimal external components
- Pair with Holtek's $2^{12}$ series of encoders
- 18-pin DIP, 20-pin SOP package

### Applications

- Burglar alarm system
- Smoke and fire alarm system
- Garage door controllers
- Car door controllers
- Car alarm system
- Security system
- Cordless telephones
- Other remote control systems

### General Description

The $2^{12}$ decoders are a series of CMOS LSIs for remote control system applications. They are paired with Holtek's $2^{12}$ series of encoders (refer to the encoder/decoder cross reference table). For proper operation, a pair of encoder/decoder with the same number of addresses and data format should be chosen.

The decoders receive serial addresses and data from a programmed $2^{12}$ series of encoders that are transmitted by a carrier using an RF or an IR transmission medium. They compare the serial input data three times continuously with their local addresses. If no error or unmatched codes are found, the input data codes are decoded and then transferred to the output pins. The VT pin also goes high to indicate a valid transmission.

The $2^{12}$ series of decoders are capable of decoding informations that consist of N bits of address and 12–N bits of data. Of this series, the HT12D is arranged to provide 8 address bits and 4 data bits, and HT12F is used to decode 12 bits of address information.

### Selection Table

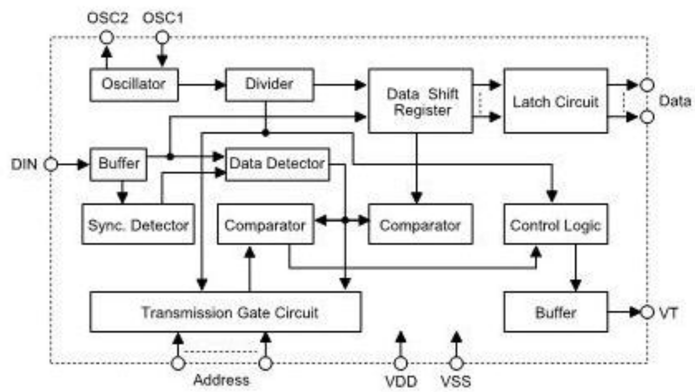
| Function / Part No. | Address No. | Data No. | Data Type | VT | Oscillator | Trigger | Package |
|---|---|---|---|---|---|---|---|
| HT12D | 8 | 4 | L | √ | RC oscillator | DIN active "Hi" | 18DIP, 20SOP |
| HT12F | 12 | 0 | — | √ | RC oscillator | DIN active "Hi" | 18DIP, 20SOP |

Notes: Data type: L stands for latch type data output.

VT can be used as a momentary data output.

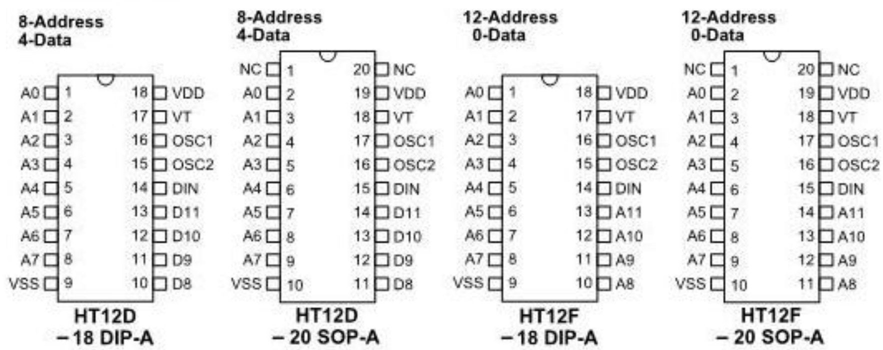
HOLTEK **HT12D/HT12F**

**Block Diagram**




Note: The address/data pins are available in various combinations (see the address/data table).

**Pin Assignment**

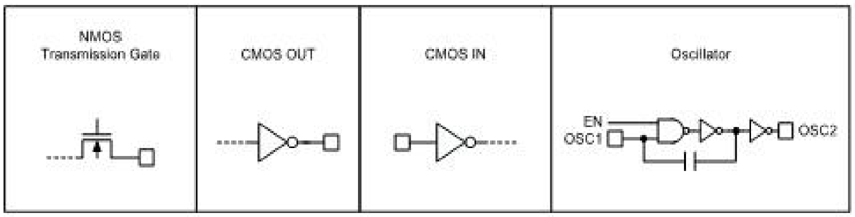



**Pin Description**

| Pin Name | I/O | Internal Connection | Description |
|---|---|---|---|
| A0~A11 (HT12F) | I | NMOS Transmission Gate | Input pins for address A0~A11 setting<br>These pins can be externally set to VSS or left open. |
| A0~A7 (HT12D) | I | NMOS Transmission Gate | Input pins for address A0~A7 setting<br>These pins can be externally set to VSS or left open. |
| D8~D11 (HT12D) | O | CMOS OUT | Output data pins, power-on state is low. |
| DIN | I | CMOS IN | Serial data input pin |
| VT | O | CMOS OUT | Valid transmission, active high |
| OSC1 | I | Oscillator | Oscillator input pin |
| OSC2 | O | Oscillator | Oscillator output pin |
| VSS | — | — | Negative power supply, ground |
| VDD | — | — | Positive power supply |

HOLTEK **HT12D/HT12F**

**Approximate internal connection circuits**




## Absolute Maximum Ratings

Supply Voltage ..........................................–0.3V to 13V

Input Voltage ................................$V_{SS}$–0.3 to $V_{DD}$+0.3V

Storage Temperature ............................–50°C to 125°C

Operating Temperature ...........................–20°C to 75°C

Note: These are stress ratings only. Stresses exceeding the range specified under "Absolute Maximum Ratings" may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

## Electrical Characteristics

Ta=25°C

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| | | $V_{DD}$ | Conditions | | | | |
| $V_{DD}$ | Operating Voltage | — | — | 2.4 | 5 | 12 | V |
| $I_{STB}$ | Standby Current | 5V | Oscillator stops | — | 0.1 | 1 | μA |
| | | 12V | | — | 2 | 4 | μA |
| $I_{DD}$ | Operating Current | 5V | No load, $f_{OSC}$=150kHz | — | 200 | 400 | μA |
| $I_O$ | Data Output Source Current (D8~D11) | 5V | $V_{OH}$=4.5V | –1 | –1.6 | — | mA |
| | Data Output Sink Current (D8~D11) | 5V | $V_{OL}$=0.5V | 1 | 1.6 | — | mA |
| $I_{VT}$ | VT Output Source Current | 5V | $V_{OH}$=4.5V | –1 | –1.6 | — | mA |
| | VT Output Sink Current | | $V_{OL}$=0.5V | 1 | 1.6 | — | mA |
| $V_{IH}$ | "H" Input Voltage | 5V | — | 3.5 | — | 5 | V |
| $V_{IL}$ | "L" Input Voltage | 5V | — | 0 | — | 1 | V |
| $f_{OSC}$ | Oscillator Frequency | 5V | $R_{OSC}$=51kΩ | — | 150 | — | kHz |

## Functional Description

### Operation

The $2^{12}$ series of decoders provides various combinations of addresses and data pins in different packages so as to pair with the $2^{12}$ series of encoders.

The decoders receive data that are transmitted by an encoder and interpret the first N bits of code period as addresses and the last 12–N bits as data, where N is the address code number. A signal on the DIN pin activates the oscillator which in turn decodes the incoming address and data. The decoders will then check the received address three times continuously. If the received address codes all match the contents of the decoder's local address, the 12–N bits of data are decoded to activate the output pins and the VT pin is set high to indicate a valid transmission. This will last unless the address code is incorrect or no signal is received.

The output of the VT pin is high only when the transmission is valid. Otherwise it is always low.

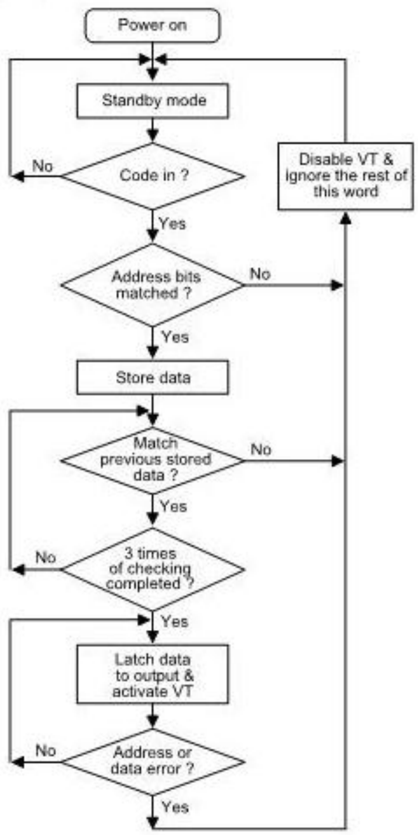
### Output type

Of the $2^{12}$ series of decoders, the HT12F has no data output pin but its VT pin can be used as a momentary data output. The HT12D, on the other hand, provides 4 latch type data pins whose data remain unchanged until new data are received.

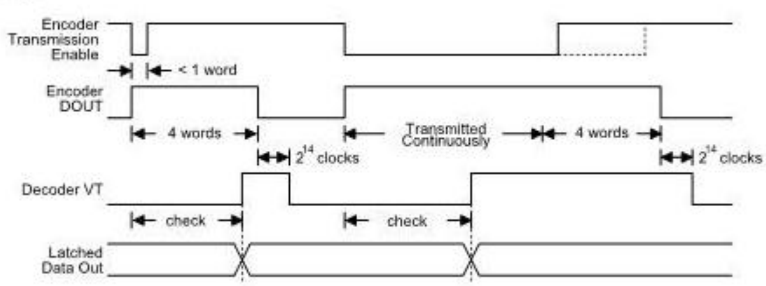
| Part No. | Data Pins | Address Pins | Output Type | Operating Voltage |
|---|---|---|---|---|
| HT12D | 4 | 8 | Latch | 2.4V~12V |
| HT12F | 0 | 12 | — | 2.4V~12V |

### Flowchart

The oscillator is disabled in the standby state and activated when a logic "high" signal applies to the DIN pin. That is to say, the DIN should be kept low if there is no signal input.




### Decoder timing



HOLTEK **HT12D/HT12F**

**Encoder/Decoder cross reference table**

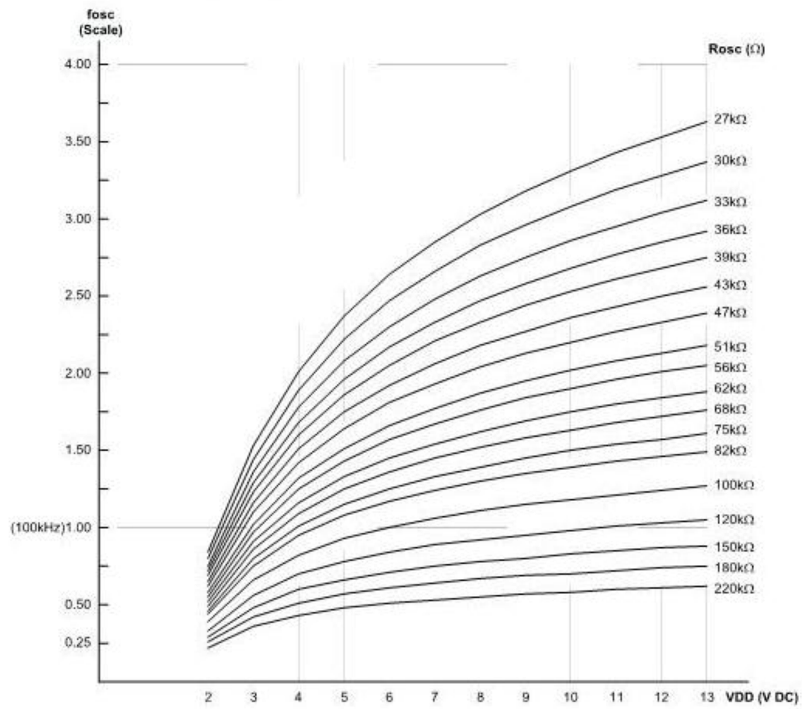
| Decoders Part No. | Data Pins | Address Pins | VT | Pair Encoder | Package | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Encoder | | Decoder | |
| | | | | | DIP | SOP | DIP | SOP |
| HT12D | 4 | 8 | √ | HT12A<br>HT12E | 18 | 20 | 18 | 20 |
| HT12F | 0 | 12 | √ | HT12A<br>HT12E | 18 | 20 | 18 | 20 |

**Address/Data sequence**

The following table provides address/data sequence for various models of the $2^{12}$ series of decoders.

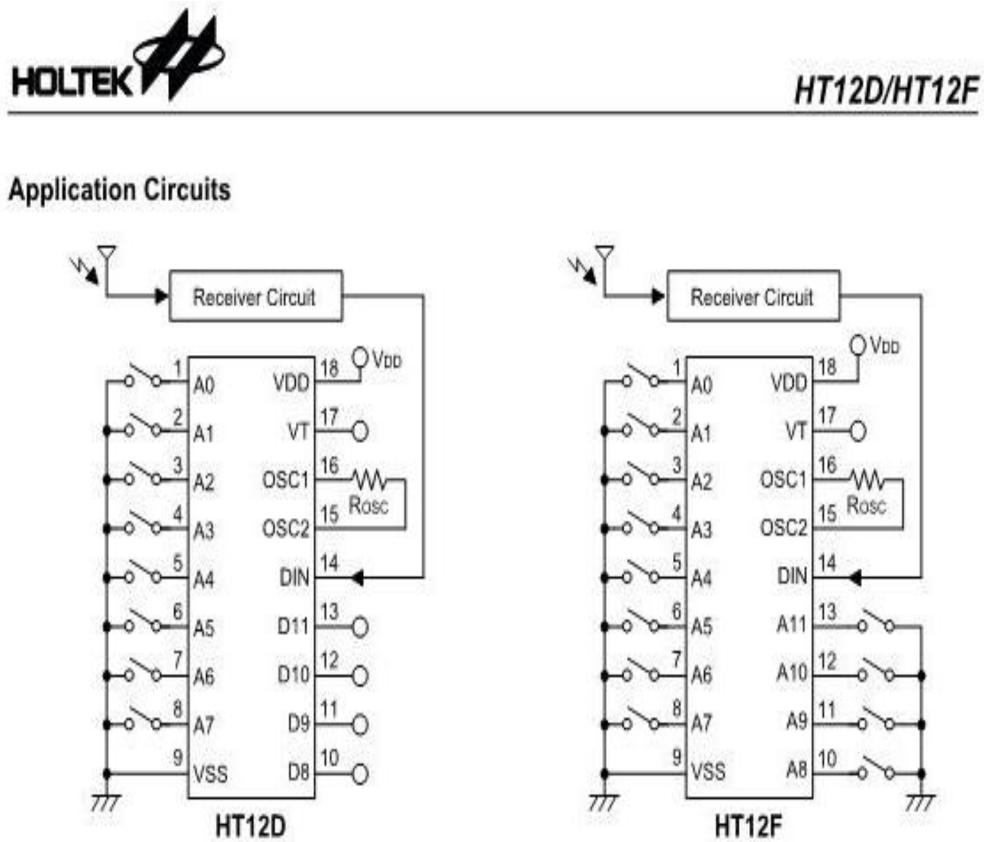
| Part No. | Address/Data Bits | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| HT12D | A0 | A1 | A2 | A3 | A4 | A5 | A6 | A7 | D8 | D9 | D10 | D11 |
| HT12F | A0 | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | A11 |

**Oscillator frequency vs supply voltage**




Note: The recommended oscillator frequency is $f_{OSCD}$ (decoder) $\cong 50\ f_{OSCE}$ (HT12E encoder)

$\cong \frac{1}{3} f_{OSCE}$ (HT12A encoder).


HOLTEK
HT12D/HT12F
Application Circuits
Receiver Circuit
A0
A1
A2
A3
A4
A5
A6
A7
VSS
VDD
VT
OSC1
OSC2
DIN
D11
D10
D9
D8
Rosc
VDD
HT12D
Receiver Circuit
A11
A10
A9
A8
HT12F

HOLTEK

# HT12A/HT12E
# $2^{12}$ Series of Encoders

## Features

- Operating voltage
  - 2.4V~5V for the HT12A
  - 2.4V~12V for the HT12E
- Low power and high noise immunity CMOS technology
- Low standby current: 0.1μA (typ.) at $V_{DD}$=5V
- HT12A with a 38kHz carrier for infrared transmission medium
- Minimum transmission word
  - Four words for the HT12E
  - One word for the HT12A
- Built-in oscillator needs only 5% resistor
- Data code has positive polarity
- Minimal external components
- HT12A/E: 18-pin DIP/20-pin SOP package

## Applications

- Burglar alarm system
- Smoke and fire alarm system
- Garage door controllers
- Car door controllers
- Car alarm system
- Security system
- Cordless telephones
- Other remote control systems

## General Description

The $2^{12}$ encoders are a series of CMOS LSIs for remote control system applications. They are capable of encoding information which consists of N address bits and 12–N data bits. Each address/data input can be set to one of the two logic states. The programmed addresses/data are transmitted together with the header bits via an RF or an infrared transmission medium upon receipt of a trigger signal. The capability to select a $\overline{TE}$ trigger on the HT12E or a DATA trigger on the HT12A further enhances the application flexibility of the $2^{12}$ series of encoders. The HT12A additionally provides a 38kHz carrier for infrared systems.

## Selection Table

| Function / Part No. | Address No. | Address/ Data No. | Data No. | Oscillator | Trigger | Package | Carrier Output | Negative Polarity |
|---|---|---|---|---|---|---|---|---|
| HT12A | 8 | 0 | 4 | 455kHz resonator | D8~D11 | 18 DIP<br>20 SOP | 38kHz | No |
| HT12E | 8 | 4 | 0 | RC oscillator | $\overline{TE}$ | 18 DIP<br>20 SOP | No | No |

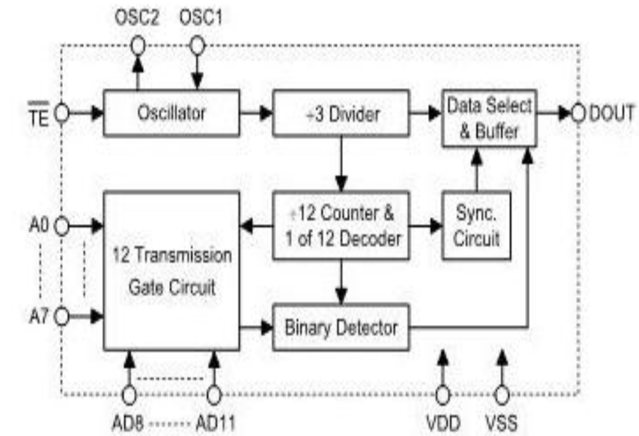
Note: Address/Data represents pins that can be address or data according to the decoder requirement.

HOLTEK **HT12A/HT12E**

## Block Diagram

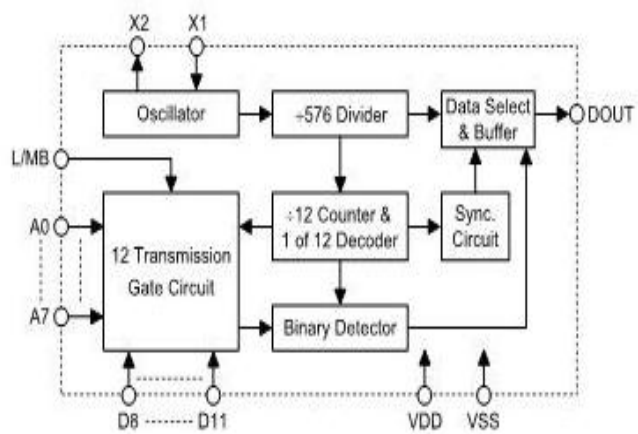
### $\overline{TE}$ trigger

HT12E




### DATA trigger

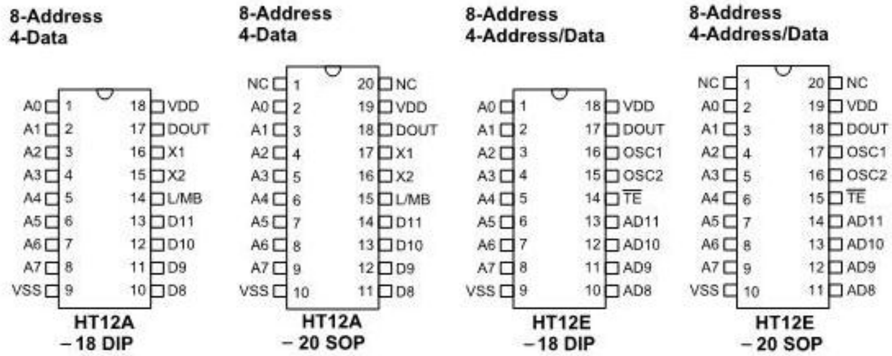
HT12A




Note: The address data pins are available in various combinations (refer to the address/data table).

HOLTEK HT12A/HT12E

## Pin Assignment




## Pin Description

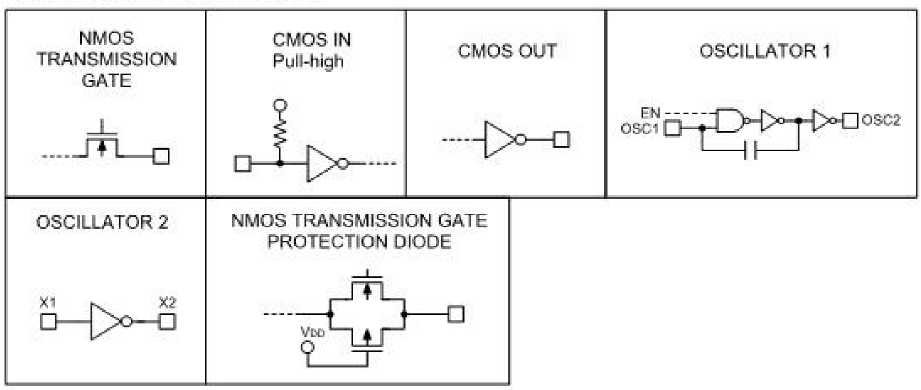
| Pin Name | I/O | Internal Connection | Description |
|---|---|---|---|
| A0~A7 | I | CMOS IN Pull-high (HT12A)<br>NMOS TRANSMISSION GATE PROTECTION DIODE (HT12E) | Input pins for address A0~A7 setting<br>These pins can be externally set to VSS or left open |
| AD8~AD11 | I | NMOS TRANSMISSION GATE PROTECTION DIODE (HT12E) | Input pins for address/data AD8~AD11 setting<br>These pins can be externally set to VSS or left open |
| D8~D11 | I | CMOS IN Pull-high | Input pins for data D8~D11 setting and transmission enable, active low<br>These pins should be externally set to VSS or left open (see Note) |
| DOUT | O | CMOS OUT | Encoder data serial transmission output |
| L/MB | I | CMOS IN Pull-high | Latch/Momentary transmission format selection pin:<br>Latch: Floating or VDD<br>Momentary: VSS |

HOLTEK HT12A/HT12E

| Pin Name | I/O | Internal Connection | Description |
|---|---|---|---|
| $\overline{TE}$ | I | CMOS IN Pull-high | Transmission enable, active low (see Note) |
| OSC1 | I | OSCILLATOR 1 | Oscillator input pin |
| OSC2 | O | OSCILLATOR 1 | Oscillator output pin |
| X1 | I | OSCILLATOR 2 | 455kHz resonator oscillator input |
| X2 | O | OSCILLATOR 2 | 455kHz resonator oscillator output |
| VSS | I | — | Negative power supply, grounds |
| VDD | I | — | Positive power supply |

Note: D8~D11 are all data input and transmission enable pins of the HT12A.
$\overline{TE}$ is a transmission enable pin of the HT12E.

**Approximate internal connections**




## Absolute Maximum Ratings

Supply Voltage (HT12A) ..............–0.3V to 5.5V

Input Voltage....................$V_{SS}$–0.3 to $V_{DD}$+0.3V

Operating Temperature...............–20°C to 75°C

Supply Voltage (HT12E) ...............–0.3V to 13V

Storage Temperature.................–50°C to 125°C

Note: These are stress ratings only. Stresses exceeding the range specified under "Absolute Maximum Ratings" may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

HOLTEK HT12A/HT12E

## Electrical Characteristics

**HT12A** Ta=25°C

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| | | $V_{DD}$ | Conditions | | | | |
| $V_{DD}$ | Operating Voltage | — | — | 2.4 | 3 | 5 | V |
| $I_{STB}$ | Standby Current | 3V | Oscillator stops | — | 0.1 | 1 | μA |
| | | 5V | | — | 0.1 | 1 | μA |
| $I_{DD}$ | Operating Current | 3V | No load $f_{OSC}$=455kHz | — | 200 | 400 | μA |
| | | 5V | | — | 400 | 800 | μA |
| $I_{DOUT}$ | Output Drive Current | 5V | $V_{OH}=0.9V_{DD}$ (Source) | –1 | –1.6 | — | mA |
| | | | $V_{OL}=0.1V_{DD}$ (Sink) | 2 | 3.2 | — | mA |
| $V_{IH}$ | "H" Input Voltage | — | — | $0.8V_{DD}$ | — | $V_{DD}$ | V |
| $V_{IL}$ | "L" Input Voltage | — | — | 0 | — | $0.2V_{DD}$ | V |
| $R_{DATA}$ | D8~D11 Pull-high Resistance | 5V | $V_{DATA}$=0V | — | 150 | 300 | kΩ |

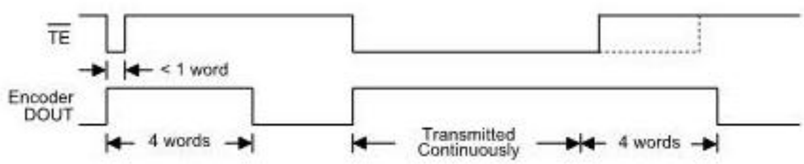
**HT12E** Ta=25°C

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| | | $V_{DD}$ | Conditions | | | | |
| $V_{DD}$ | Operating Voltage | — | — | 2.4 | 5 | 12 | V |
| $I_{STB}$ | Standby Current | 3V | Oscillator stops | — | 0.1 | 1 | μA |
| | | 12V | | — | 2 | 4 | μA |
| $I_{DD}$ | Operating Current | 3V | No load $f_{OSC}$=3kHz | — | 40 | 80 | μA |
| | | 12V | | — | 150 | 300 | μA |
| $I_{DOUT}$ | Output Drive Current | 5V | $V_{OH}=0.9V_{DD}$ (Source) | –1 | –1.6 | — | mA |
| | | | $V_{OL}=0.1V_{DD}$ (Sink) | 1 | 1.6 | — | mA |
| $V_{IH}$ | "H" Input Voltage | — | — | $0.8V_{DD}$ | — | $V_{DD}$ | V |
| $V_{IL}$ | "L" Input Voltage | — | — | 0 | — | $0.2V_{DD}$ | V |
| $f_{OSC}$ | Oscillator Frequency | 5V | $R_{OSC}$=1.1MΩ | — | 3 | — | kHz |
| $R_{\overline{TE}}$ | $\overline{TE}$ Pull-high Resistance | 5V | $V_{\overline{TE}}$=0V | — | 1.5 | 3 | MΩ |

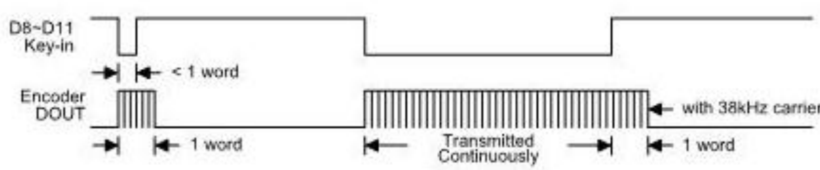
## Functional Description

### Operation

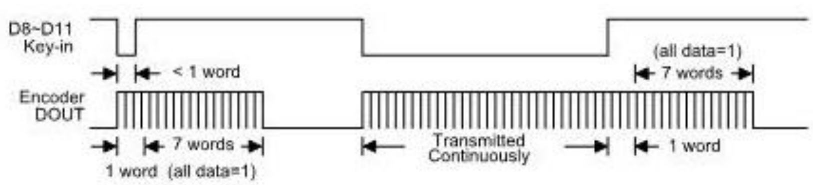
The $2^{12}$ series of encoders begin a 4-word transmission cycle upon receipt of a transmission enable ($\overline{TE}$ for the HT12E or D8~D11 for the HT12A, active low). This cycle will repeat itself as long as the transmission enable ($\overline{TE}$ or D8~D11) is held low. Once the transmission enable returns high the encoder output completes its final cycle and then stops as shown below.




Transmission timing for the HT12E




Transmission timing for the HT12A (L/MB=Floating or VDD)

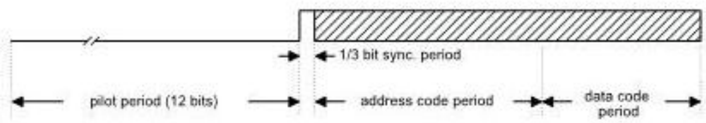



Transmission timing for the HT12A (L/MB=VSS)

### Information word

If L/MB=1 the device is in the latch mode (for use with the latch type of data decoders). When the transmission enable is removed during a transmission, the DOUT pin outputs a complete word and then stops. On the other hand, if L/MB=0 the device is in the momentary mode (for use with the momentary type of data decoders). When the transmission enable is removed during a transmission, the DOUT outputs a complete word and then adds 7 words all with the "1" data code.

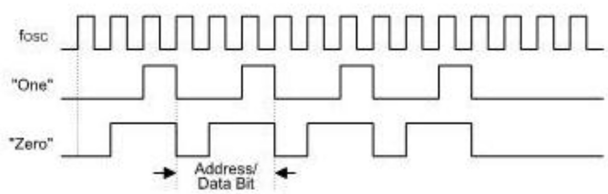
An information word consists of 4 periods as illustrated below.



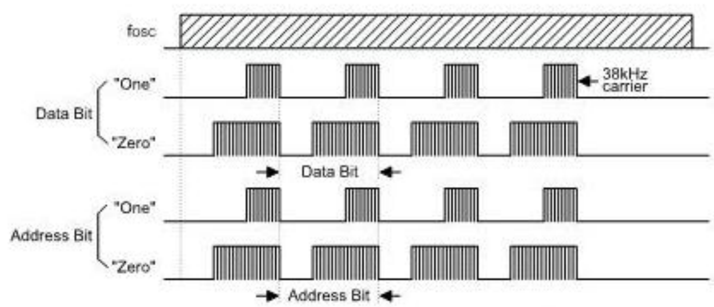

Composition of information

### Address/data waveform

Each programmable address/data pin can be externally set to one of the following two logic states as shown below.




Address/Data bit waveform for the HT12E




Address/Data bit waveform for the HT12A

The address/data bits of the HT12A are transmitted with a 38kHz carrier for infrared remote controller flexibility.

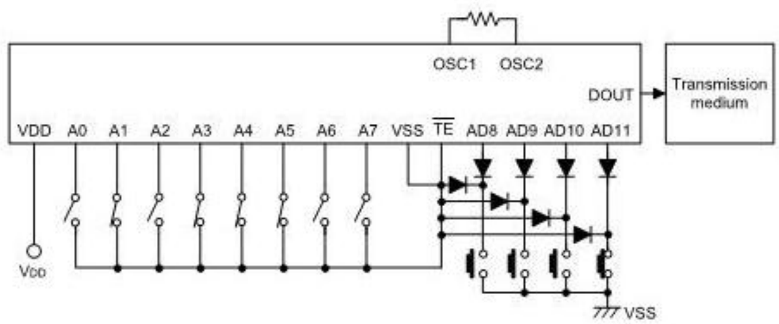
### Address/data programming (preset)

The status of each address/data pin can be individually pre-set to logic "high" or "low". If a transmission-enable signal is applied, the encoder scans and transmits the status of the 12 bits of address/data serially in the order A0 to AD11 for the HT12E encoder and A0 to D11 for the HT12A encoder.

During information transmission these bits are transmitted with a preceding synchronization bit. If the trigger signal is not applied, the chip enters the standby mode and consumes a reduced current of less than 1μA for a supply voltage of 5V.

Usual applications preset the address pins with individual security codes using DIP switches or PCB wiring, while the data is selected by push buttons or electronic switches.

The following figure shows an application using the HT12E:




The transmitted information is as shown:

| Pilot & Sync. | A0 | A1 | A2 | A3 | A4 | A5 | A6 | A7 | AD8 | AD9 | AD10 | AD11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |

### Address/Data sequence

The following provides the address/data sequence table for various models of the $2^{12}$ series of encoders. The correct device should be selected according to the individual address and data requirements.

| Part No. | Address/Data Bits | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| HT12A | A0 | A1 | A2 | A3 | A4 | A5 | A6 | A7 | D8 | D9 | D10 | D11 |
| HT12E | A0 | A1 | A2 | A3 | A4 | A5 | A6 | A7 | AD8 | AD9 | AD10 | AD11 |

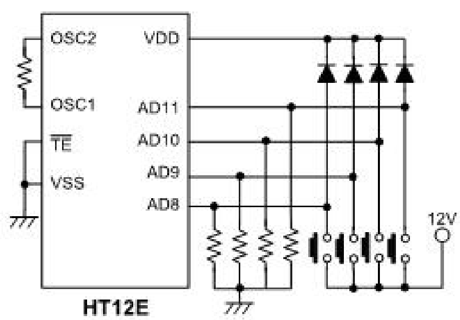
### Transmission enable

For the HT12E encoders, transmission is enabled by applying a low signal to the $\overline{TE}$ pin. For the HT12A encoders, transmission is enabled by applying a low signal to one of the data pins D8~D11.

### Two erroneous HT12E application circuits

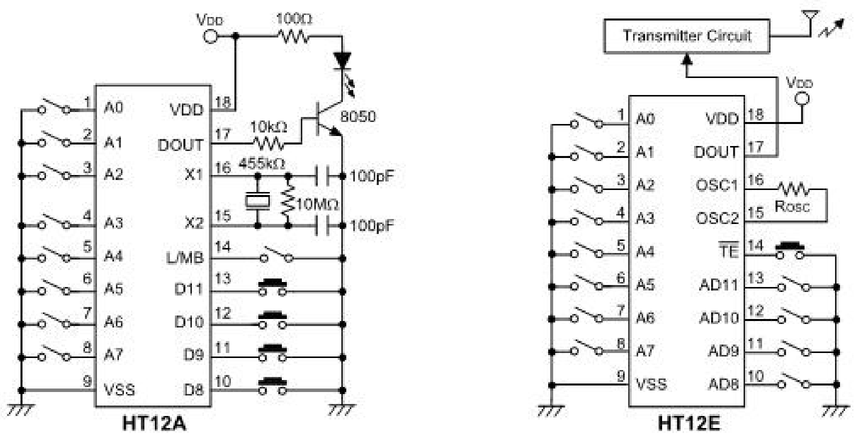
The HT12E must follow closely the application circuits provided by Holtek (see the "Application circuits").

- Error: AD8~AD11 pins input voltage > $V_{DD}$+0.3V



HOLTEK **HT12A/HT12E**

## Application Circuits



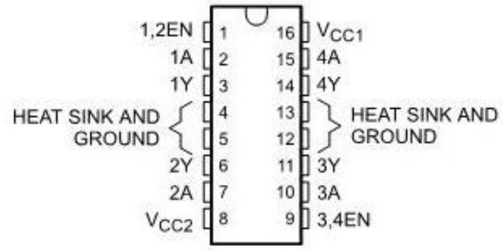

Note: Typical infrared diode: EL-1L2 (KODENSHI CORP.)
Typical RF transmitter: JR-220 (JUWA CORP.)

**L293, L293D**
**QUADRUPLE HALF-H DRIVERS**

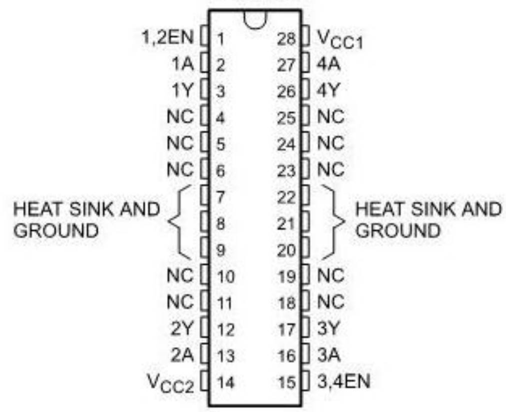
SLRS008B – SEPTEMBER 1986 – REVISED JUNE 2002

- **Featuring Unitrode L293 and L293D Products Now From Texas Instruments**
- **Wide Supply-Voltage Range: 4.5 V to 36 V**
- **Separate Input-Logic Supply**
- **Internal ESD Protection**
- **Thermal Shutdown**
- **High-Noise-Immunity Inputs**
- **Functional Replacements for SGS L293 and SGS L293D**
- **Output Current 1 A Per Channel (600 mA for L293D)**
- **Peak Output Current 2 A Per Channel (1.2 A for L293D)**
- **Output Clamp Diodes for Inductive Transient Suppression (L293D)**

**N, NE PACKAGE**
**(TOP VIEW)**




**DWP PACKAGE**
**(TOP VIEW)**




## description

The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications.

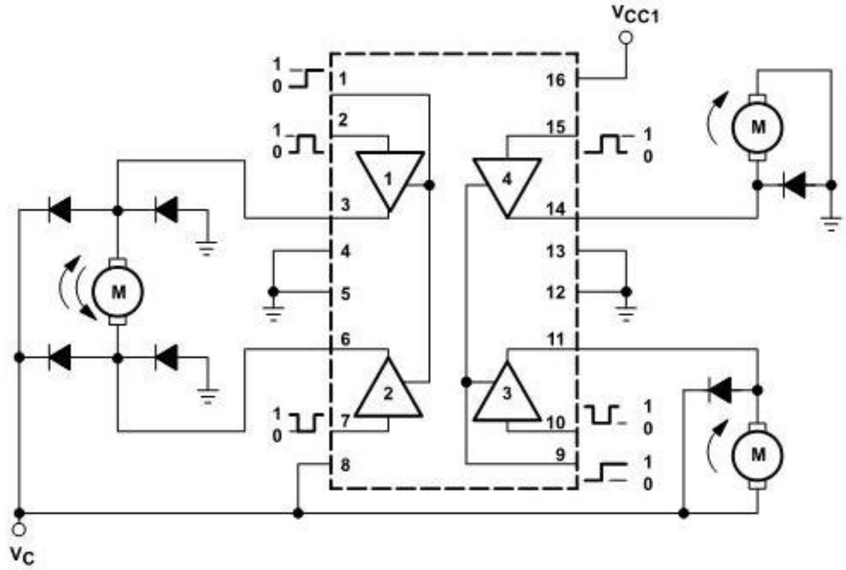
All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enable input is high, the associated drivers are enabled and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications.

On the L293, external high-speed output clamp diodes should be used for inductive transient suppression.

A $V_{CC1}$ terminal, separate from $V_{CC2}$, is provided for the logic inputs to minimize device power dissipation.

The L293and L293D are characterized for operation from 0°C to 70°C.

**block diagram**




NOTE: Output diodes are internal in L293D.

TEXAS INSTRUMENTS
AVAILABLE OPTIONS

| $T_A$ | PACKAGE PLASTIC DIP (NE) |
|---|---|
| 0)C to 70)C | L293NE<br>L293DNE |

Unitrode Products
from Texas Instruments

AVAILABLE OPTIONS

| $T_A$ | PACKAGED DEVICES | |
|---|---|---|
| | SMALL OUTLINE (DWP) | PLASTIC DIP (N) |
| 0)C to 70)C | L293DWP<br>L293DDWP | L293N<br>L293DN |

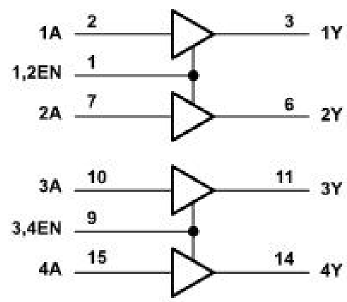
The DWP package is available taped and reeled. Add the suffix TR to device type (e.g., L293DWPTR).

**FUNCTION TABLE**
**(each driver)**

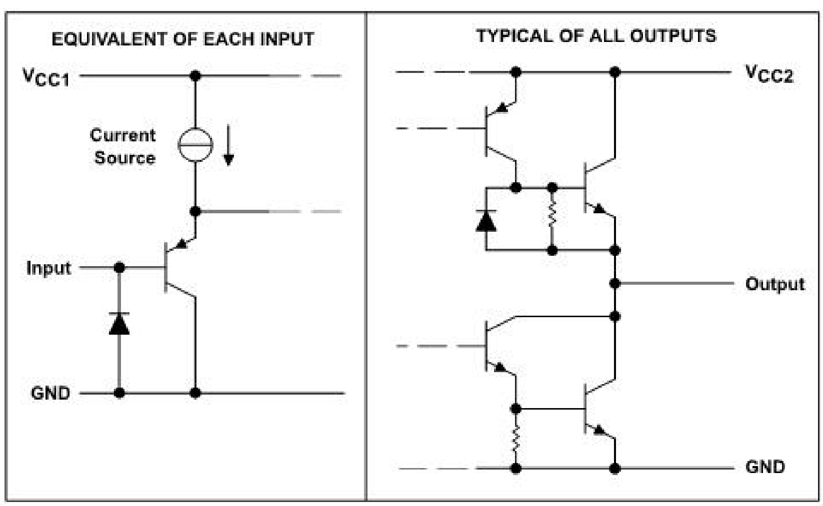
| INPUTS† | | OUTPUT |
|---|---|---|
| A | EN | Y |
| H | H | H |
| L | H | L |
| X | L | Z |

H = high level, L = low level, X = irrelevant,
Z = high impedance (off)
† In the thermal shutdown mode, the output is in the high-impedance state, regardless of the input levels.

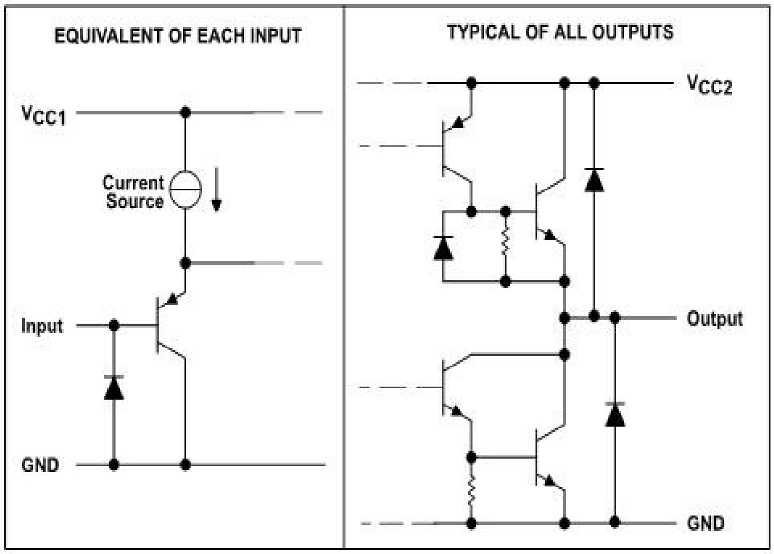
**logic diagram**




**schematics of inputs and outputs (L293)**



**schematics of inputs and outputs (L293D)**




**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†**

| | |
|---|---|
| Supply voltage, $V_{CC1}$ (see Note 1) | 36 V |
| Output supply voltage, $V_{CC2}$ | 36 V |
| Input voltage, $V_I$ | 7 V |
| Output voltage range, $V_O$ | –3 V to $V_{CC2}$ + 3 V |
| Peak output current, $I_O$ (nonrepetitive, t 5 ms): L293 | ±2 A |
| Peak output current, $I_O$ (nonrepetitive, t 100 µs): L293D | ±1.2 A |
| Continuous output current, $I_O$: L293 | ±1 A |
| Continuous output current, $I_O$: L293D | ±600 mA |
| Continuous total dissipation at (or below) 25°C free-air temperature (see Notes 2 and 3) | 2075 mW |
| Continuous total dissipation at 80°C case temperature (see Note 3) | 5000 mW |
| Maximum junction temperature, $T_J$ | 150°C |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds | 260°C |
| Storage temperature range, $T_{stg}$ | –65°C to 150°C |

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES:
1. All voltage values are with respect to the network ground terminal.
2. For operation above 25°C free-air temperature, derate linearly at the rate of 16.6 mW/°C.
3. For operation above 25°C case temperature, derate linearly at the rate of 71.4 mW/°C. Due to variations in individual device electrical characteristics and thermal resistance, the built-in thermal overload protection may be activated at power levels slightly above or below the rated dissipation.

### recommended operating conditions

| | | | MIN | MAX | UNIT |
|---|---|---|---|---|---|
| | Supply voltage | $V_{CC1}$ | 4.5 | 7 | V |
| | | $V_{CC2}$ | $V_{CC1}$ | 36 | |
| $V_{IH}$ | High-level input voltage | $V_{CC1}$ 7 V | 2.3 | $V_{CC1}$ | V |
| | | $V_{CC1}$ 7 V | 2.3 | 7 | V |
| $V_{IL}$ | Low-level output voltage | | –0.3† | 1.5 | V |
| $T_A$ | Operating free-air temperature | | 0 | 70 | °C |

† The algebraic convention, in which the least positive (most negative) designated minimum, is used in this data sheet for logic voltage levels.

### electrical characteristics, $V_{CC1}$ = 5 V, $V_{CC2}$ = 24 V, $T_A$ = 25°C

| PARAMETER | | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{OH}$ | High-level output voltage | | L293: $I_{OH}$ = –1 A<br>L293D: $I_{OH}$ = –0.6 A | | $V_{CC2}$–1.8 | $V_{CC2}$–1.4 | | V |
| $V_{OL}$ | Low-level output voltage | | L293: $I_{OL}$ = 1 A<br>L293D: $I_{OL}$ = 0.6 A | | | 1.2 | 1.8 | V |
| $V_{OKH}$ | High-level output clamp voltage | | L293D: $I_{OK}$ = –0.6 A | | | $V_{CC2}$ + 1.3 | | V |
| $V_{OKL}$ | Low-level output clamp voltage | | L293D: $I_{OK}$ = 0.6 A | | | 1.3 | | V |
| $I_{IH}$ | High-level input current | A | $V_I$ = 7 V | | | 0.2 | 100 | μA |
| | | EN | | | | 0.2 | 10 | |
| $I_{IL}$ | Low-level input current | A | $V_I$ = 0 | | | –3 | –10 | μA |
| | | EN | | | | –2 | –100 | |
| $I_{CC1}$ | Logic supply current | | $I_O$ = 0 | All outputs at high level | | 13 | 22 | mA |
| | | | | All outputs at low level | | 35 | 60 | |
| | | | | All outputs at high impedance | | 8 | 24 | |
| $I_{CC2}$ | Output supply current | | $I_O$ = 0 | All outputs at high level | | 14 | 24 | mA |
| | | | | All outputs at low level | | 2 | 6 | |
| | | | | All outputs at high impedance | | 2 | 4 | |

### switching characteristics, $V_{CC1}$ = 5 V, $V_{CC2}$ = 24 V, $T_A$ = 25°C

| PARAMETER | | TEST CONDITIONS | L293NE, L293DNE | | | UNIT |
|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | |
| $t_{PLH}$ | Propagation delay time, low-to-high-level output from A input | $C_L$ = 30 pF, See Figure 1 | | 800 | | ns |
| $t_{PHL}$ | Propagation delay time, high-to-low-level output from A input | | | 400 | | ns |
| $t_{TLH}$ | Transition time, low-to-high-level output | | | 300 | | ns |
| $t_{THL}$ | Transition time, high-to-low-level output | | | 300 | | ns |

### switching characteristics, $V_{CC1}$ = 5 V, $V_{CC2}$ = 24 V, $T_A$ = 25°C

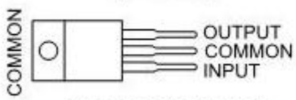
| PARAMETER | | TEST CONDITIONS | L293DWP, L293N<br>L293DDWP, L293DN | | | UNIT |
|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | |
| $t_{PLH}$ | Propagation delay time, low-to-high-level output from A input | $C_L$ = 30 pF, See Figure 1 | | 750 | | ns |
| $t_{PHL}$ | Propagation delay time, high-to-low-level output from A input | | | 200 | | ns |
| $t_{TLH}$ | Transition time, low-to-high-level output | | | 100 | | ns |
| $t_{THL}$ | Transition time, high-to-low-level output | | | 350 | | ns |

**∝A7800 SERIES**
**POSITIVE-VOLTAGE REGULATORS**

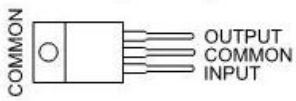
SLVS056J – MAY 1976 – REVISED MAY 2003

- **3-Terminal Regulators**
- **Output Current up to 1.5 A**
- **Internal Thermal-Overload Protection**
- **High Power-Dissipation Capability**
- **Internal Short-Circuit Current Limiting**
- **Output Transistor Safe-Area Compensation**

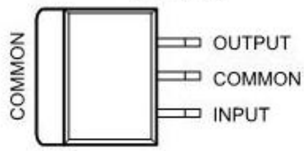
**KC (TO-220) PACKAGE**
**(TOP VIEW)**




**KCS (TO-220) PACKAGE**
**(TOP VIEW)**




**KTE PACKAGE**
**(TOP VIEW)**




## description/ordering information

This series of fixed-voltage integrated-circuit voltage regulators is designed for a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation. Each of these regulators can deliver up to 1.5 A of output current. The internal current-limiting and thermal-shutdown features of these regulators essentially make them immune to overload. In addition to use as fixed-voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents, and also can be used as the power-pass element in precision regulators.

**ORDERING INFORMATION**

| $T_J$ | $V_{O(NOM)}$ (V) | PACKAGE† | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---|---|---|---|---|---|
| 0ϒC to 125ϒC | 5 | POWER-FLEX (KTE) | Reel of 2000 | ∝A7805CKTER | ∝A7805C |
| | | TO-220 (KC) | Tube of 50 | ∝A7805CKC | ∝A7805C |
| | | TO-220, short shoulder (KCS) | Tube of 20 | ∝A7805CKCS | |
| | 8 | POWER-FLEX (KTE) | Reel of 2000 | ∝A7808CKTER | ∝A7808C |
| | | TO-220 (KC) | Tube of 50 | ∝A7808CKC | ∝A7808C |
| | | TO-220, short shoulder (KCS) | Tube of 20 | ∝A7808CKCS | |
| | 10 | POWER-FLEX (KTE) | Reel of 2000 | ∝A7810CKTER | ∝A7810C |
| | | TO-220 (KC) | Tube of 50 | ∝A7810CKC | ∝A7810C |
| | 12 | POWER-FLEX (KTE) | Reel of 2000 | ∝A7812CKTER | ∝A7812C |
| | | TO-220 (KC) | Tube of 50 | ∝A7812CKC | ∝A7812C |
| | | TO-220, short shoulder (KCS) | Tube of 20 | ∝A7812CKCS | |
| | 15 | POWER-FLEX (KTE) | Reel of 2000 | ∝A7815CKTER | ∝A7815C |
| | | TO-220 (KC) | Tube of 50 | ∝A7815CKC | ∝A7815C |
| | | TO-220, short shoulder (KCS) | Tube of 20 | ∝A7815CKCS | |
| | 24 | POWER-FLEX (KTE) | Reel of 2000 | ∝A7824CKTER | ∝A7824C |
| | | TO-220 (KC) | Tube of 50 | ∝A7824CKC | ∝A7824C |

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

## ∝A7800 SERIES
## POSITIVE-VOLTAGE REGULATORS

SLVS056J – MAY 1976 – REVISED MAY 2003

### recommended operating conditions

| | | | MIN | MAX | UNIT |
|---|---|---|---|---|---|
| $V_I$ | Input voltage | ∝A7805C | 7 | 25 | V |
| | | ∝A7808C | 10.5 | 25 | |
| | | ∝A7810C | 12.5 | 28 | |
| | | ∝A7812C | 14.5 | 30 | |
| | | ∝A7815C | 17.5 | 30 | |
| | | ∝A7824C | 27 | 38 | |
| $I_O$ | Output current | | | 1.5 | A |
| $T_J$ | Operating virtual junction temperature | ∝A7800C series | 0 | 125 | )C |

### electrical characteristics at specified virtual junction temperature, $V_I$ = 10 V, $I_O$ = 500 mA (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | $T_J$† | ∝A7805C MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Output voltage | $I_O$ = 5 mA to 1 A, $V_I$ = 7 V to 20 V, $P_D$ 15 W | 25)C | 4.8 | 5 | 5.2 | V |
| | | 0)C to 125)C | 4.75 | | 5.25 | |
| Input voltage regulation | $V_I$ = 7 V to 25 V | 25)C | | 3 | 100 | mV |
| | $V_I$ = 8 V to 12 V | | | 1 | 50 | |
| Ripple rejection | $V_I$ = 8 V to 18 V, f = 120 Hz | 0)C to 125)C | 62 | 78 | | dB |
| Output voltage regulation | $I_O$ = 5 mA to 1.5 A | 25)C | | 15 | 100 | mV |
| | $I_O$ = 250 mA to 750 mA | | | 5 | 50 | |
| Output resistance | f = 1 kHz | 0)C to 125)C | | 0.017 | | |
| Temperature coefficient of output voltage | $I_O$ = 5 mA | 0)C to 125)C | | –1.1 | | mV/)C |
| Output noise voltage | f = 10 Hz to 100 kHz | 25)C | | 40 | | ∝V |
| Dropout voltage | $I_O$ = 1 A | 25)C | | 2 | | V |
| Bias current | | 25)C | | 4.2 | 8 | mA |
| Bias current change | $V_I$ = 7 V to 25 V | 0)C to 125)C | | | 1.3 | mA |
| | $I_O$ = 5 mA to 1 A | | | | 0.5 | |
| Short-circuit output current | | 25)C | | 750 | | mA |
| Peak output current | | 25)C | | 2.2 | | A |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-∝F capacitor across the input and a 0.1-∝F capacitor across the output.

**∝A7800 SERIES**
**POSITIVE-VOLTAGE REGULATORS**

SLVS056J – MAY 1976 – REVISED MAY 2003

**electrical characteristics at specified virtual junction temperature, $V_I$ = 19 V, $I_O$ = 500 mA (unless otherwise noted)**

| PARAMETER | TEST CONDITIONS | $T_J$† | ∝A7812C MIN | ∝A7812C TYP | ∝A7812C MAX | UNIT |
|---|---|---|---|---|---|---|
| Output voltage | $I_O$ = 5 mA to 1 A, $V_I$ = 14.5 V to 27 V, $P_D$ 15 W | 25ÌC | 11.5 | 12 | 12.5 | V |
| | | 0ÌC to 125ÌC | 11.4 | | 12.6 | |
| Input voltage regulation | $V_I$ = 14.5 V to 30 V | 25ÌC | | 10 | 240 | mV |
| | $V_I$ = 16 V to 22 V | | | 3 | 120 | |
| Ripple rejection | $V_I$ = 15 V to 25 V, f = 120 Hz | 0ÌC to 125ÌC | 55 | 71 | | dB |
| Output voltage regulation | $I_O$ = 5 mA to 1.5 A | 25ÌC | | 12 | 240 | mV |
| | $I_O$ = 250 mA to 750 mA | | | 4 | 120 | |
| Output resistance | f = 1 kHz | 0ÌC to 125ÌC | | 0.018 | | |
| Temperature coefficient of output voltage | $I_O$ = 5 mA | 0ÌC to 125ÌC | | –1 | | mV/ÌC |
| Output noise voltage | f = 10 Hz to 100 kHz | 25ÌC | | 75 | | ∝V |
| Dropout voltage | $I_O$ = 1 A | 25ÌC | | 2 | | V |
| Bias current | | 25ÌC | | 4.3 | 8 | mA |
| Bias current change | $V_I$ = 14.5 V to 30 V | 0ÌC to 125ÌC | | | 1 | mA |
| | $I_O$ = 5 mA to 1 A | | | | 0.5 | |
| Short-circuit output current | | 25ÌC | | 350 | | mA |
| Peak output current | | 25ÌC | | 2.2 | | A |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-∝F capacitor across the input and a 0.1-∝F capacitor across the output.

## APPLICATION INFORMATION

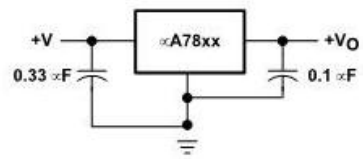



**Figure 1. Fixed-Output Regulator**

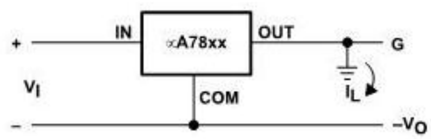
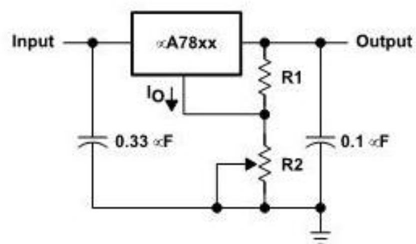


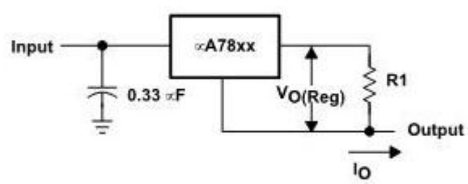

**Figure 2. Positive Regulator in Negative Configuration ($V_I$ Must Float)**




NOTE A: The following formula is used when $V_{xx}$ is the nominal output voltage (output to common) of the fixed regulator:

$$V_O = V_{xx} + \left(\frac{V_{xx}}{R1} + I_Q\right)R2$$

**Figure 3. Adjustable-Output Regulator**




$I_O = (V_O/R1) + I_O$ Bias Current

**Figure 4. Current Regulator**

### Wireless camera with night vision:

## Camera:

| | |
|---|---|
| Frequency | CH1: 2414 MHz, CH2: 2432 MHz, CH3: 2450 MHz, CH4: 2468 MHz |
| Imaging Sensor | 1/3 inch OMNI-VISION Colour CMOS |
| Night Vision | **12 infrared LED** with **8 ~ 10 m IR nigh vision** range |
| Horizontal Resolution | **380 TV Line** |
| CMOS Total Pixels | 628 x 582 (PAL) / 510 x 492 (NTSC) |
| View Angles | 48-52 degrees |
| Minimum Illumination | 1 Lux / 0 Lux with IR |
| Gain Control | Automatic |
| Transmission Power | 10 mW |
| Consumption Current | 180 mA MAX |
| Modulation Mode | FM |
| Bandwidth | 18 M |
| Operating Range | 30 m / 100 m (Obstructed / Unobstructed) |
| DC Power by Battery Connector | 1 x 9V PP3 Battery |
| AC Power by Adapter | DC 8V |
| Operating Temperature | -10 ~ 40 °C |
| Operating Humidity | 85% R.H. |
| Dimension | 44 (L) x 44 (W) x 66 (D) mm |

# Receiver:

| | |
|---|---|
| Frequency | ISM 2400 ~ 2483 MHz |
| Antenna | Omni-directional antenna |
| Channel | 1-4 (Flip-type switch) |
| Intermediate Frequency | 480 MHz |
| Frequency Stabilization | ± 100 kHz |
| Demodulation Mode | FM |
| Receiving Sensitivity | -85 dB |
| Video Output | 1Vp-p@75 Ohm, S/N>38dB |
| Audio Output | 1Vp-p@600 Ohm |
| Power | DC 9V |
| Operating Temperature | -10 ~ 40 °C |
| Operating Humidity | 85% R.H. |
| Dimension | 130 (L) x 80 (W) x 22 (D) mm |