

# Electronic Component Data Sheet

Lesson 9  
EET 150



## Lesson Objectives

**In this presentation you will learn:**

what information electronic component manufacturers' data sheets contain

how to read the specifications on manufacturers' data sheets

how to convert a design from a schematic to a practical design

see designs based on commonly used integrated circuits

to read and interpret the data sheets of commonly used integrated circuits



## Manufacturer's Data Sheets

- Documentation published by electronic component manufacturers that designers use when constructing circuits.
  - Data Sheet Information
    - General Description
    - Device Features
    - Typical Applications
    - Equivalent Circuits of IC's
    - Device Connection diagrams (pinouts)
    - Maximum Ratings and Electrical Characteristics
    - Timing Diagrams for digital circuits
    - Design formulas
    - Typical Application Circuits



## Typical Data Sheet Information Example

LM555 Timer IC Manufactured by National Semiconductor (and others)

### LM555 Timer

#### General Description

The LM555 is a highly stable device for generating accurate time delays or oscillation. Additional terminals are provided for triggering or resetting if desired. In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For astable operation as an oscillator, the free running frequency and duty cycle are accurately controlled with two external resistors and one capacitor. The circuit may be triggered and reset on falling waveforms, and the output circuit can source or sink up to 200mA or drive TTL circuits.

Explains the device function

#### Features

- Direct replacement for SE555/NE555
- Timing from microseconds through hours
- Operates in both astable and monostable modes
- Adjustable duty cycle
- Output can source or sink 200 mA
- Output and supply TTL compatible
- Temperature stability better than 0.005% per °C
- Normally on and normally off output
- Available in 8-pin MSOP package

Summary of key features

#### Applications

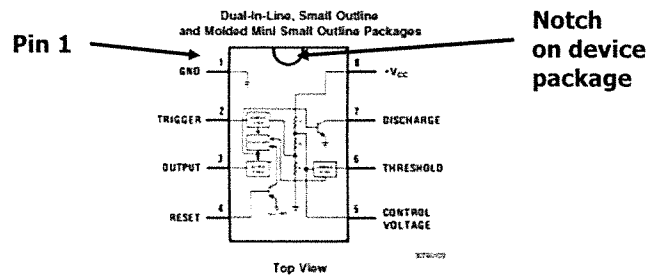
- Precision timing
- Pulse generation
- Sequential timing
- Time delay generation
- Pulse width modulation
- Pulse position modulation
- Linear ramp generator

Typical applications



## Typical Data Sheet Example Connection Diagram

Relates the IC input and output leads from schematic to pins on package. Shows package orientation. (Where is pin 1?)



## Typical Data Sheet Example Maximum Ratings Electrical Characteristics

Note supply voltage limits and power dissipation

**Absolute Maximum Ratings** (Note 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage	+18V	←
Power Dissipation (Note 3)		
LM555CM, LM555CN	1190 mW	
LM555CMM	613 mW	←
Operating Temperature Ranges		
LM555C	0°C to +70°C	
Storage Temperature Range	-65°C to +150°C	

**Electrical Characteristics**  
gives details of other electrical properties

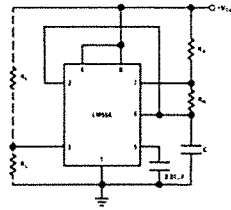
**Electrical Characteristics** (Notes 1, 2)  
( $T_A = 25^\circ\text{C}$ ,  $V_{CC} = -5\text{V to }+15\text{V}$ , unless otherwise specified)

Parameter	Conditions	Limits			Units
		LM555C			
		Min	Typ	Max	
Supply Voltage		4.5		18	V
Supply Current	$V_{CC} = 5\text{V}$ , $I_L = -$ $V_{CC} = 15\text{V}$ , $I_L = -$ (Low State) (Note 4)		3 10	6 15	mA

## Typical Data Sheet Example Design Formulas and Circuit Examples

**ASTABLE OPERATION**

If the circuit is connected as shown in Figure 4 (pins 2 and 6 connected) it will trigger itself and free run as a multivibrator. The external capacitor charges through  $R_A + R_B$  and discharges through  $R_B$ . Thus the duty cycle may be precisely set by the ratio of these two resistors.



**FIGURE 4. Astable**

In this mode of operation, the capacitor charges and discharges between  $1/3 V_{CC}$  and  $2/3 V_{CC}$ . As in the triggered mode, the charge and discharge times, and therefore the frequency are independent of the supply voltage.

Application Circuit Design

The charge time (output high) is given by:

$$t_1 = 0.693 (R_A + R_B) C$$

And the discharge time (output low) by:

$$t_2 = 0.693 (R_B) C$$

Thus the total period is:

$$T = t_1 + t_2 = 0.693 (R_A + 2R_B) C$$

The frequency of oscillation is:

$$f = \frac{1}{T} = \frac{1.44}{(R_A + 2R_B) C}$$

Figure 6 may be used for quick determination of these RC values.

The DUTY CYCLE IS:

$$D = \frac{R_B}{R_A + 2R_B}$$

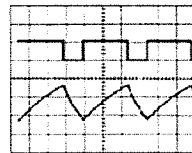
**Design formulas**

Data sheets may also include external component range limits for device operation

## Typical Data Sheet Example Other Information

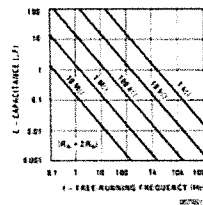
**Typical Waveforms**

Figure 5 shows the waveforms generated in this mode of operation.



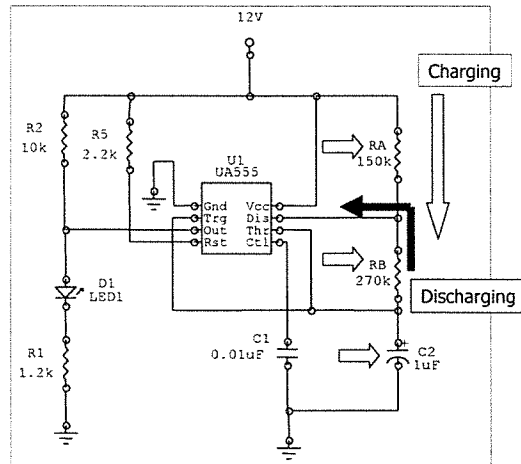
$V_{CC} = 5V$   
 TIME = 20µs/div  
 $R_A = 3.9k\Omega$   
 $R_B = 2k\Omega$   
 $C = 0.01\mu F$

**Graphical Design Tools  
(nomographs)**



**FIGURE 6. Free Running Frequency**

## LM555 Flasher Circuit



This circuit flashes an LED twice a second.

RA, RB and C2 set Flash rate

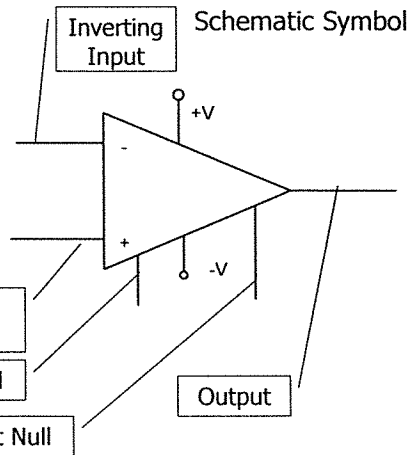
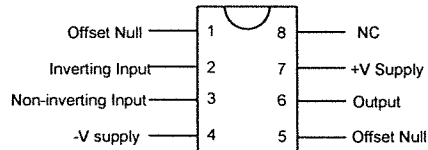
Charging path through RA and RB

Discharging path through RB only

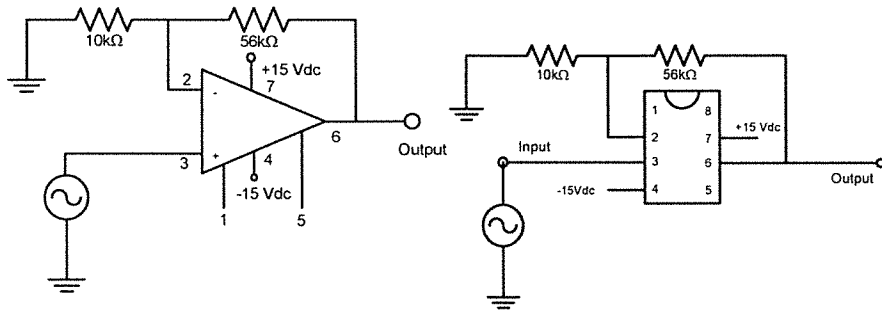
## Other Common Devices The Operation Amplifier

### OP AMP'S

LM741 Connection Diagram



## Non-Inverting Amplifier Design LM741

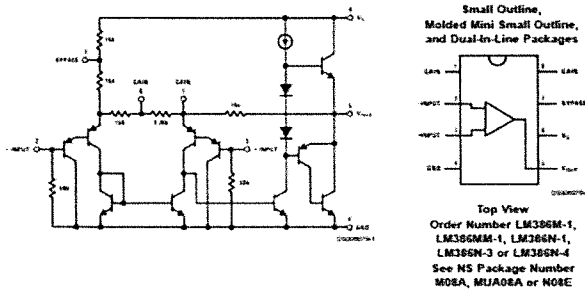


Schematic Diagram

Connection Diagram

## Audio Amplifier LM386

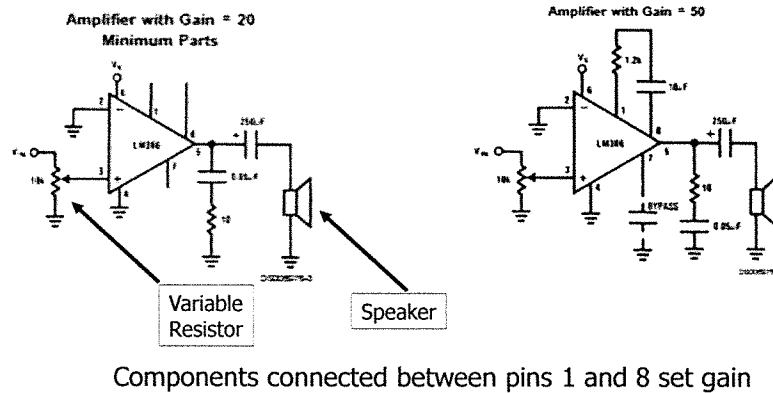
Equivalent Schematic and Connection Diagrams



Adjustable Gain 20-200

# Audio Amplifier LM386

Typical Circuit Application for the Data Sheet



End Lesson 9 EET150

Coming Next: Ac Waveforms and Their  
Measurement

**ELECTRONIC COMPONENT  
DATA SHEETS**

