Electronic Component Data Sheet

ET 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

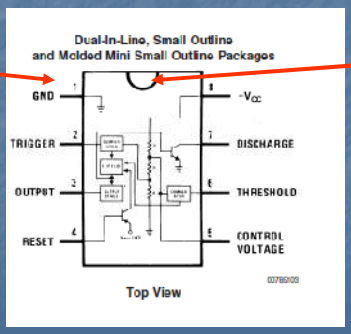
- Precision timing
- Pulse generation
- Sequential timing
- Time delay generation
- Pulse width modulation
- Pulse position modulation
- Linear ramp generator

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?)

Pin 1



Notch on device package

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	1180 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°C, V_{CC} = +5V to +15V, unless otherwise specified)

Parameter	Conditions	Limits			Units
		LM555C			
		Min	Typ	Max	
Supply Voltage		4.5		16	V
Supply Current	V_{CC} = 5V, R_L = ∞ V_{CC} = 15V, R_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.

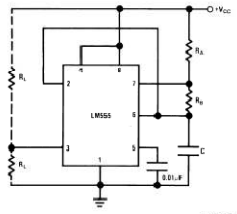


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FIGURE 4. Astable

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:

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

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

The duty cycle is:

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

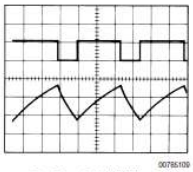
Design formulas

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.



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V_{CC} = 5V
TIME = 20µs/DIV.
R_A = 3.9kΩ
R_B = 3kΩ
C = 0.01µF

Top Trace: Output 5V/Div.
Bottom Trace: Capacitor Voltage 1V/Div.

Graphical Design Tools (nomographs)

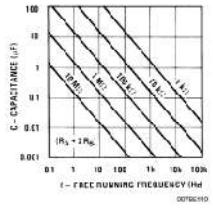

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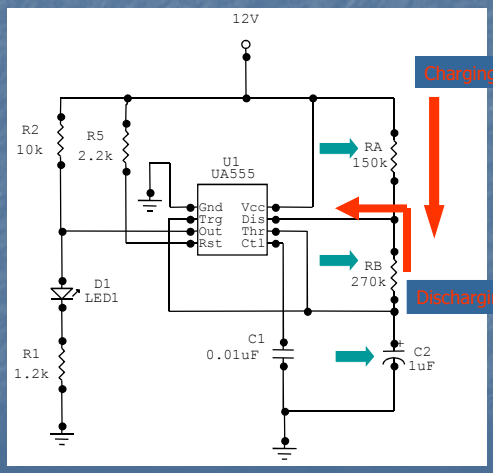
FIGURE 6. Free Running Frequency

LM555 Flasher Circuit



This circuit flashes an LED twice a second.

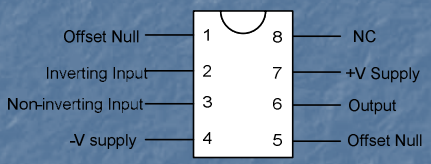
RA, RB and C2 set Flash rate

Charging path through RA and RB

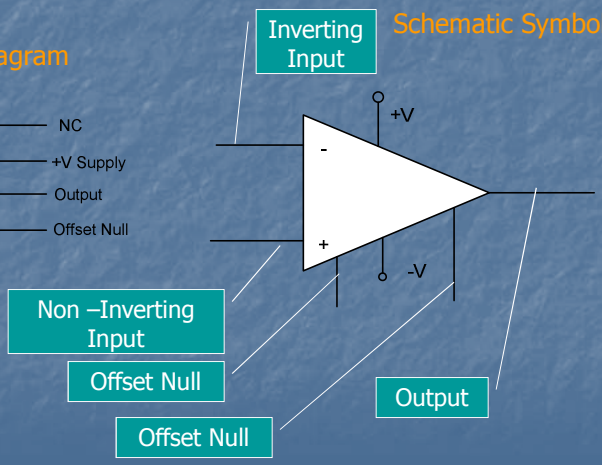
Discharging path through RB only

Other Common Devices
The Operation Amplifier
OP AMP's

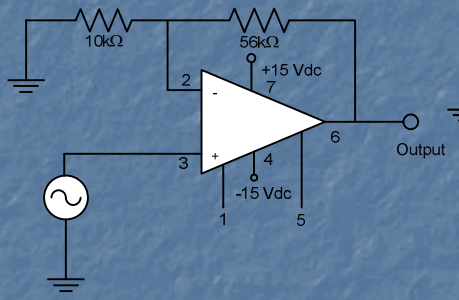
LM741 Connection Diagram



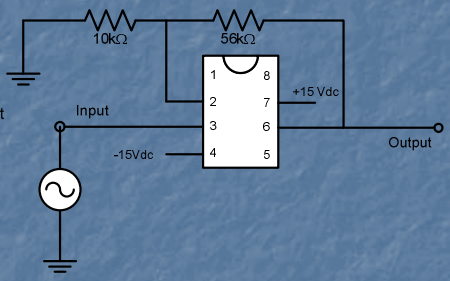
Schematic Symbol



Non-Inverting Amplifier Design LM741

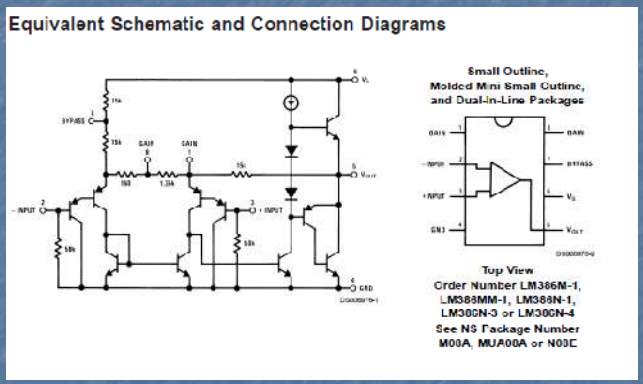


Schematic Diagram



Connection Diagram

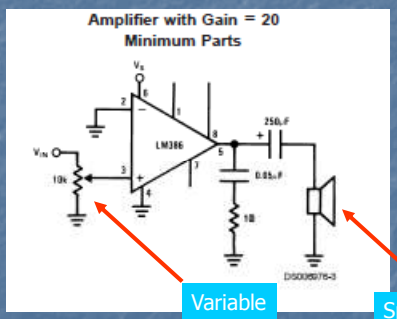
Audio Amplifier LM386

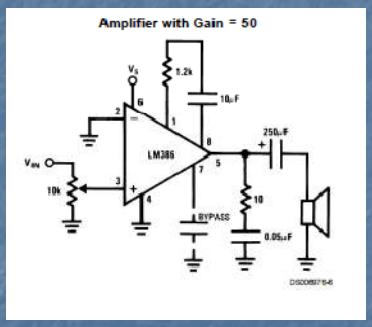


Adjustable Gain 20-200

Audio Amplifier
LM386

Typical Circuit Application for the Data Sheet





Variable Resistor

Speaker

Components connected between pins 1 and 8 set gain

ET150

Coming Next: Ac Waveforms and Their Measurement

ELECTRONIC COMPONENT DATA SHEETS