

Syllabus for the Course: SIGNAL CONDITIONING AND DATA ACQUISITION SYSTEM

Unit1-Signal conditioning circuits: Introduction to Operational amplifiers, input-output characteristics, frequency response, Slew rate. Op-Amp based signal conditioning circuits, Integrator, differentiator, log amplifier, Difference amplifier, Instrumentation amplifier, AD620.

Basic Bridge amplifier and its use with strain gauge and temperature sensors. DC Bridges, use of Wheatstone bridge for resistive transducers, voltage and current sensitivity of dc bridge. Active Filters in instrumentation circuits: High pass low pass, Band pass, Design of Butterworth and Chebyshev filters.

Unit 2- Data Acquisition Techniques: Analog and digital data acquisition, Sensor/Transducer interfacing, unipolar and bipolar transducers, Sample and hold circuits, Sampling and quantization, Interference, Grounding and Shielding. Analog to Digital convertors (ADC): ramp type and SAR, and Digital to Analog Convertors (DAC) R-2R based DAC, Multiplexer and de-multiplexer.

Unit 3 -Data Transfer Techniques: Serial data transmission methods and standards RS 232-C: specifications, connection and timing diagram, MAX232, RS422 and RS485, 4-20 mA current loop, HART protocol, Specification, connections and techniques of GPIB/IEEE-488, Universal Serial Bus (USB), Bluetooth protocols, IR receiver and transmitters for remote control applications.

Unit 4- Data Acquisition System (DAS): Basic building blocks of DAS, types and configurations. Single channel and multichannel, Design of data acquisition system, Data acquisition cards and Remote Terminal Units, PC-Based data acquisition system: LabVIEW based data acquisition. Supervisory Control and data acquisition system (SCADA).

Scheme

L	T	P	Cr
3	0	2	4.0

Evaluation Scheme

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	40
3	Sessional	35

Course Learning Outcomes (CLO)

1. Elucidate signal conditioning circuits
2. design basic signal conditioning circuits
3. explain various data transfer techniques
4. explain the elements of data acquisition techniques.
5. Elucidate the components of data acquisition system

Books

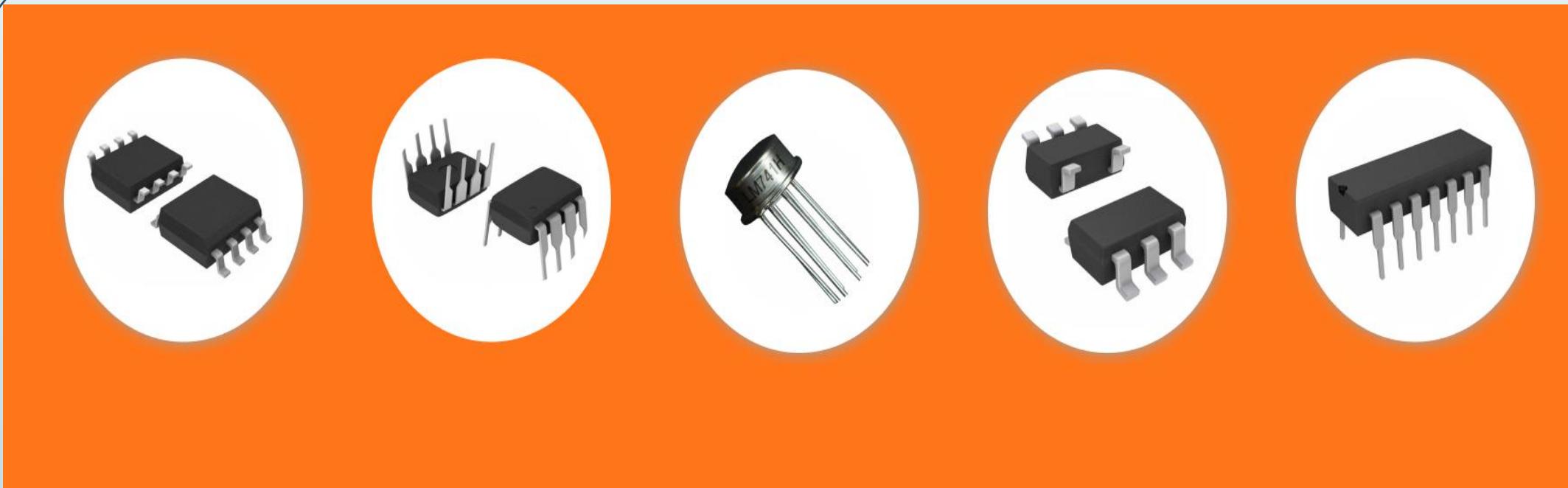
► ***Text Books***

1. Coughlin, R.F., *Operational Amplifiers and Linear Integrated Circuits*, Pearson Education (2006).
2. Kalsi, H.S., *Electronic Instrumentation*, Tata McGraw Hill (2002).
3. Gayakwad, R.A., *Op-Amp and Linear Integrated Circuits*, Pearson Education (2002).
4. Behzad Ehsani, *Data Acquisition Using LabVIEW*, Packt – 2016

Reference Books

1. Anand, M.M.S., *Electronic Instruments and Instrumentation Technology*, Prentice Hall of India Private Limited (2004).
2. A.K. Sawhney, *A Course in Electronic Measurements and Instrumentation*, Dhanpat Rai Publications

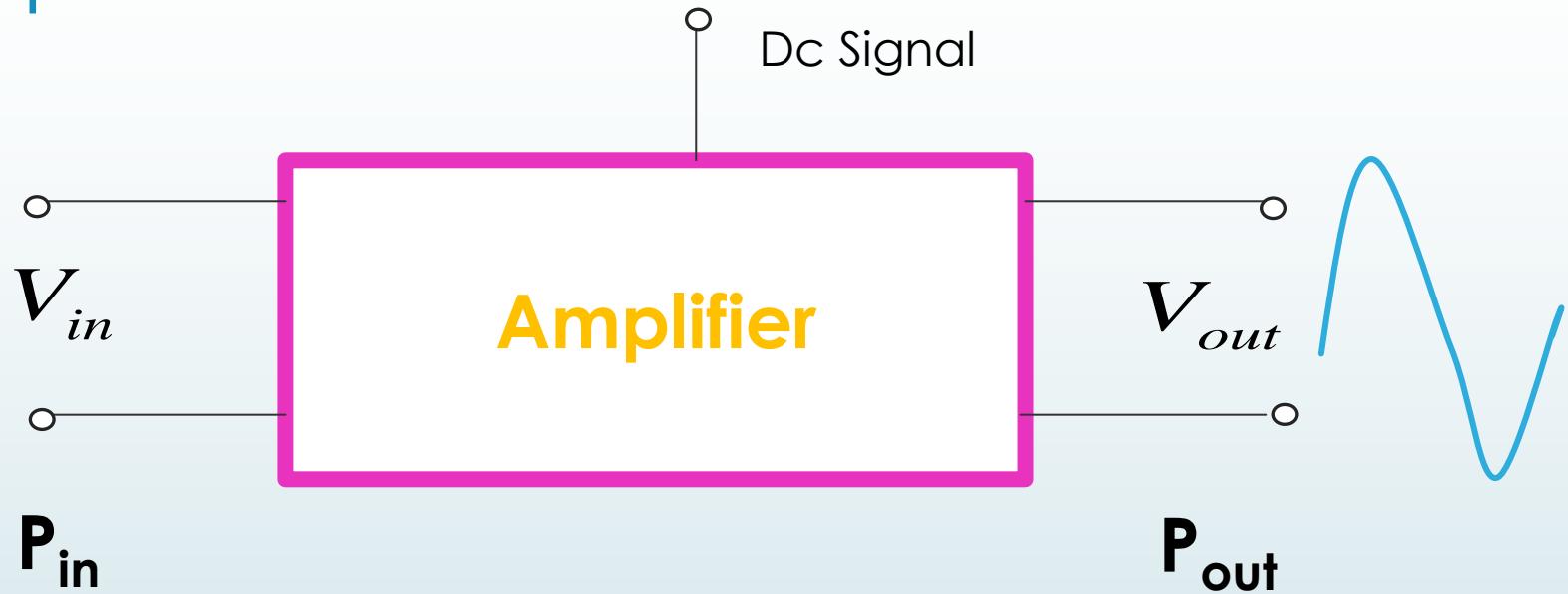
The Operational Amplifiers



Contents

- ▶ **Amplifier**
- ▶ **The Operational Amplifiers**
- ▶ **Operational Amplifier Terminals**
- ▶ **OP AMP CKT**
- ▶ **OP AMP Packages**
- ▶ **LM741 OP AMP**
- ▶ **Applications**
- ▶ **Identification of OP AMP**

Amplifier



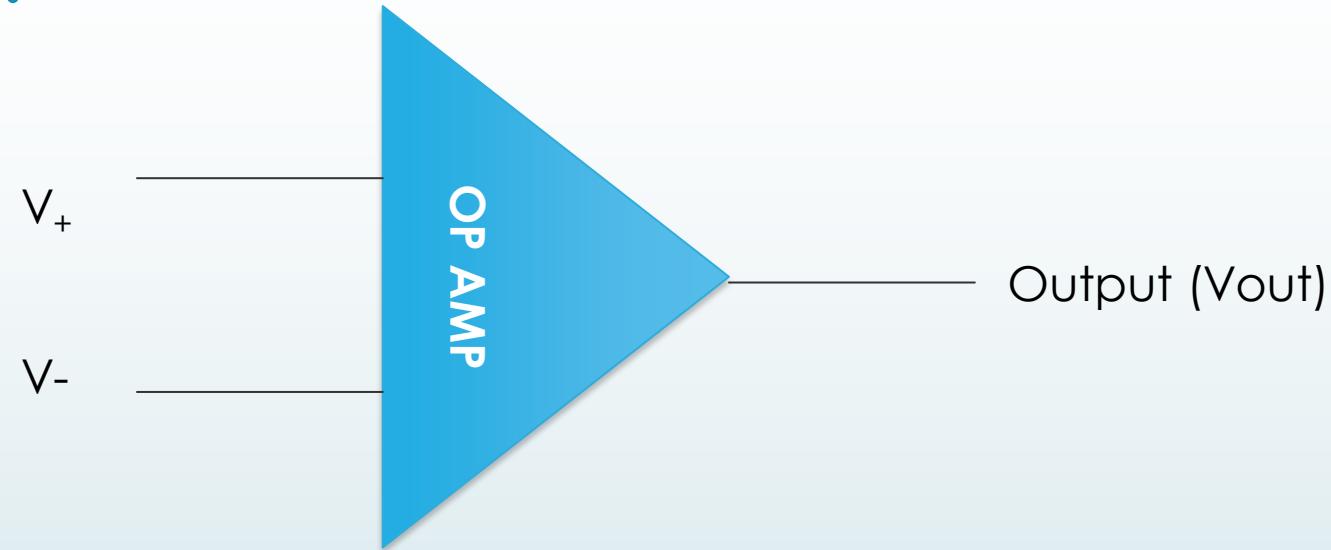
- The main aim of amplification is to increase the signal magnitude.
- The transistor based amplifier has only single input and single output.

$$P_{out} > P_{in}$$

The Operational Amplifiers

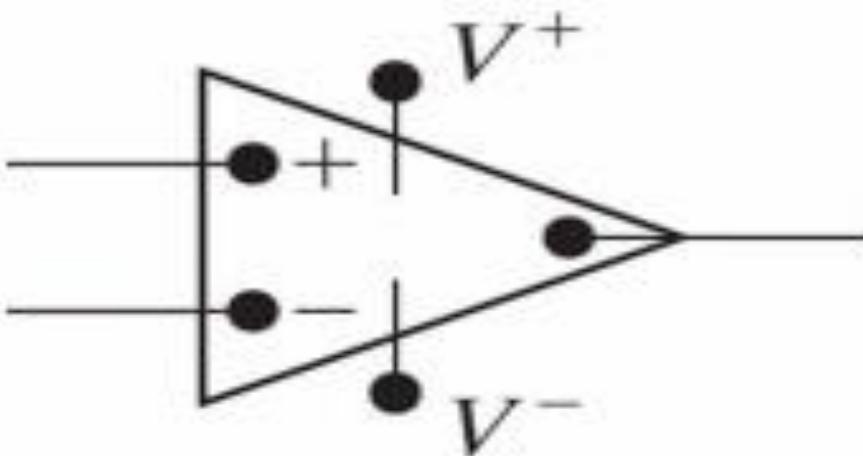
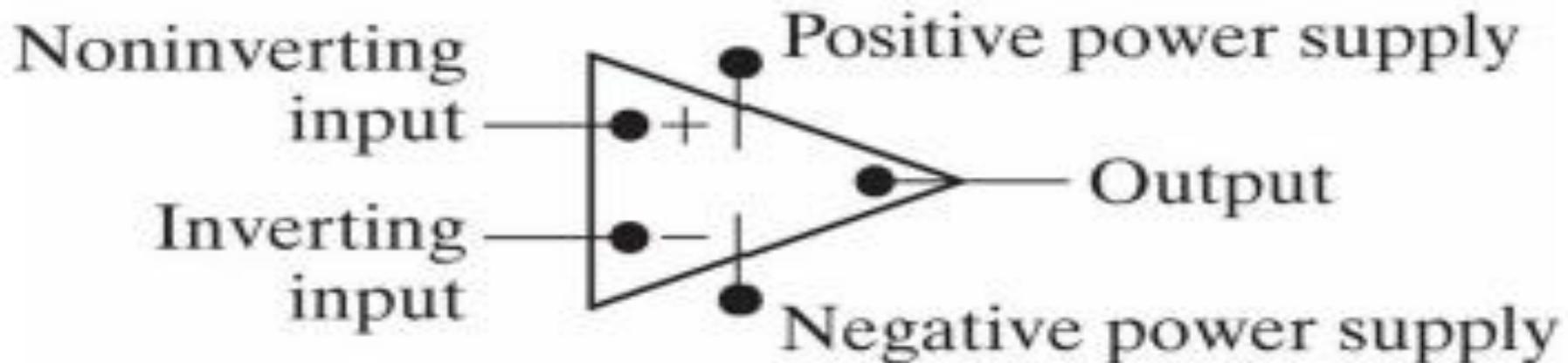
- ▶ First developed by John R. Ragazzine in 1947.
- ▶ FAIRCHILD introduces the op-amp that was to become the industry standard in 1968.
- ▶ The name “operational amplifier” comes from the fact that they were originally used to perform mathematical operations such as addition, subtraction, integration and differentiation.
- ▶ They are the basic components used to build analog circuits.
- ▶ Other operations include buffering and amplification of DC and AC signals.
- ▶ In feedback configuration, the output of op amp is fed back to the input.
- ▶ By proper selection of its external components, could be configured for a variety of operations.

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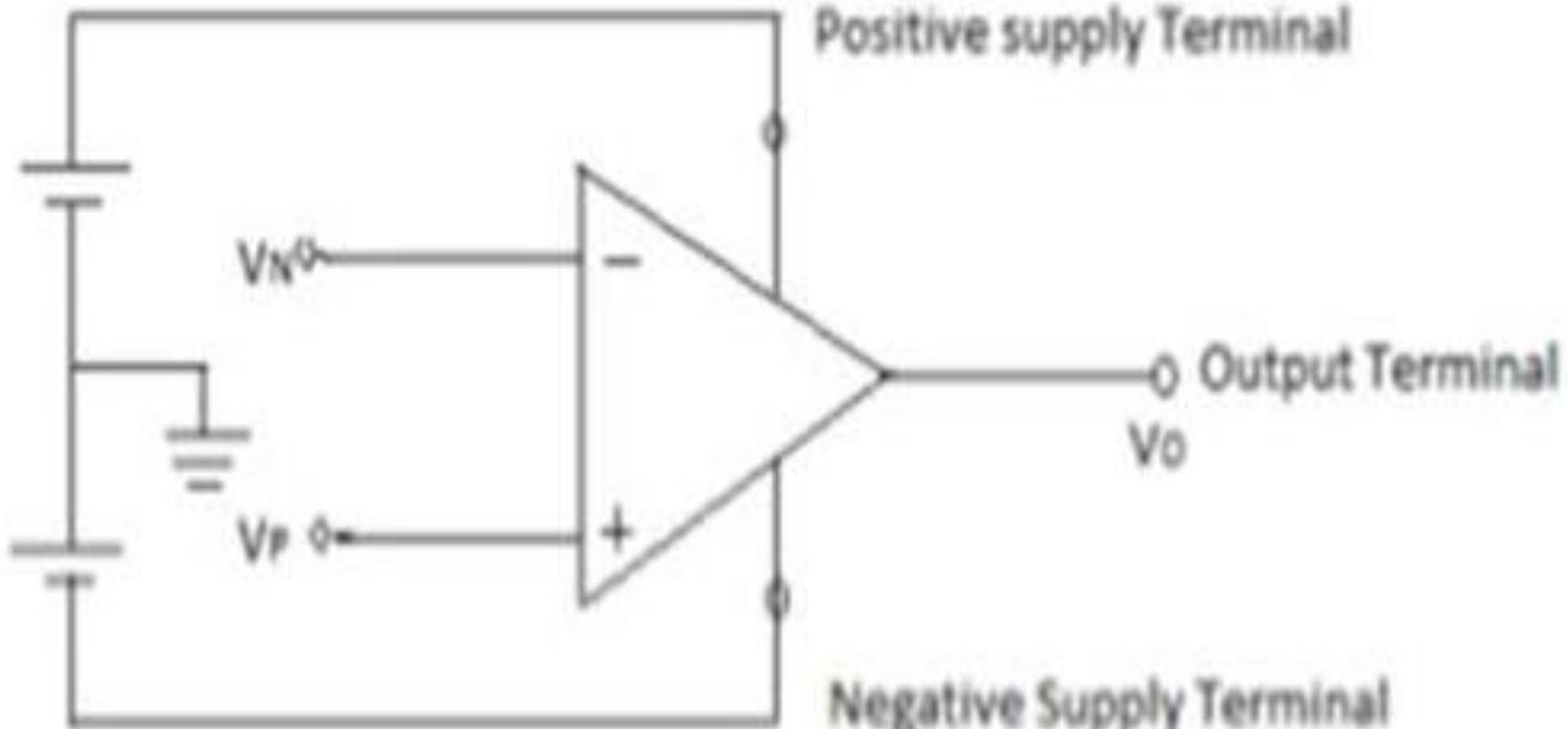


- The op-amp has two inputs and one output.
- Op-Amp is a very high gain differential amplifier with a high input impedance and low output impedance .
- Integrated circuit fabrication techniques have made high-performance operational amplifiers very inexpensive in comparison to older discrete devices.

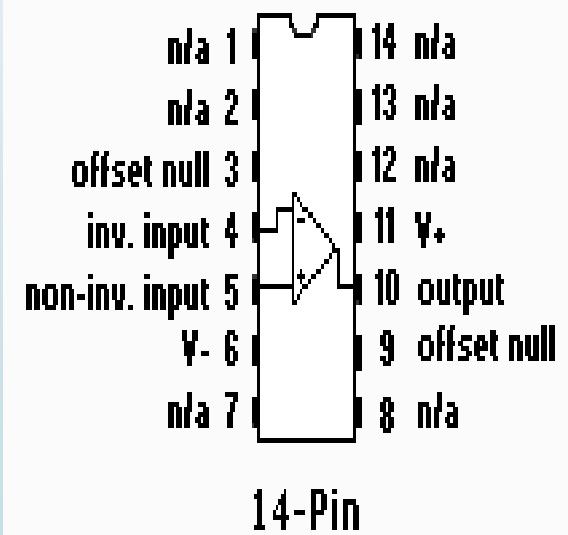
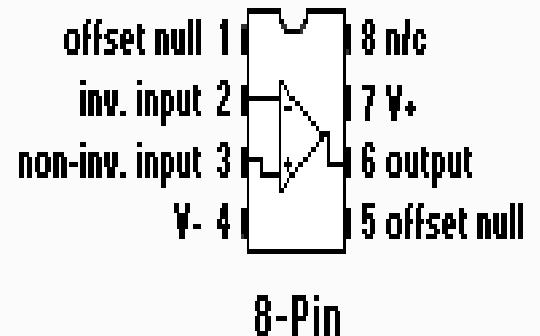
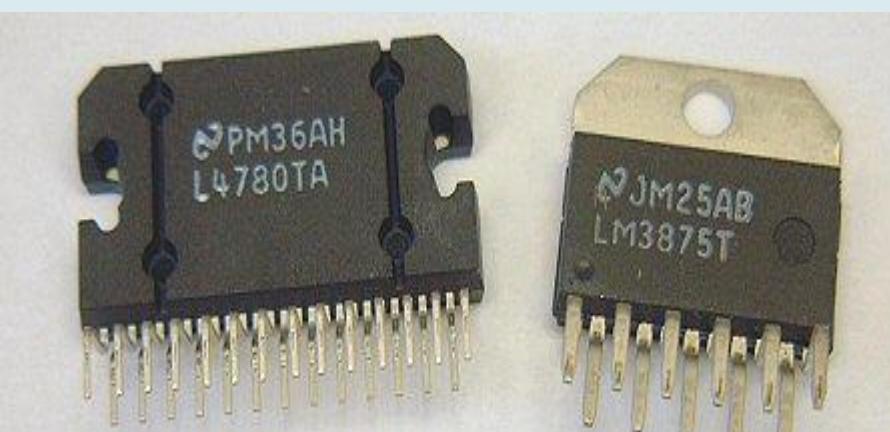
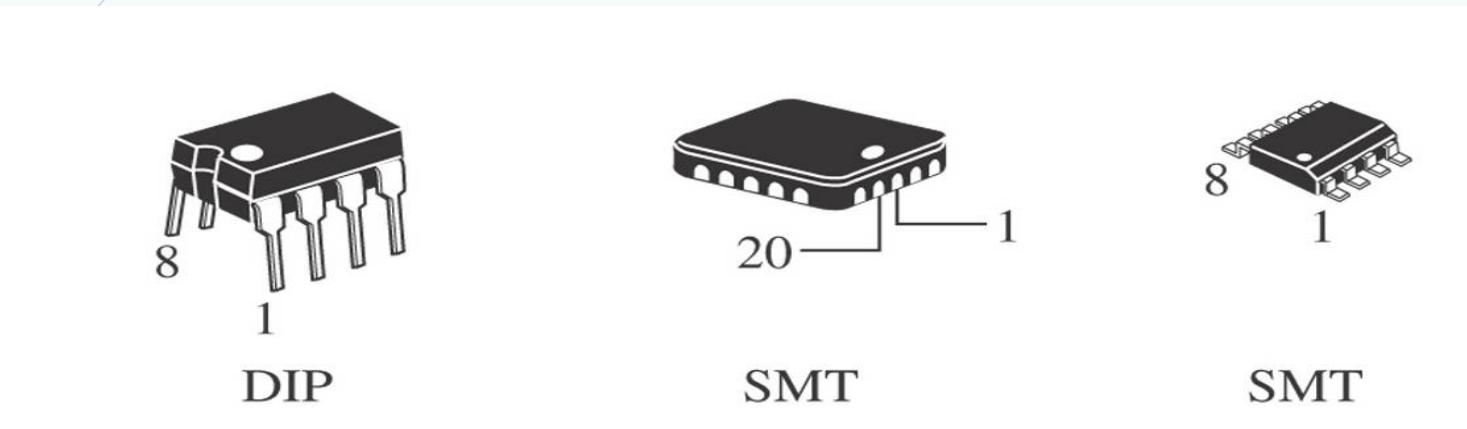
Operational Amplifier Terminals



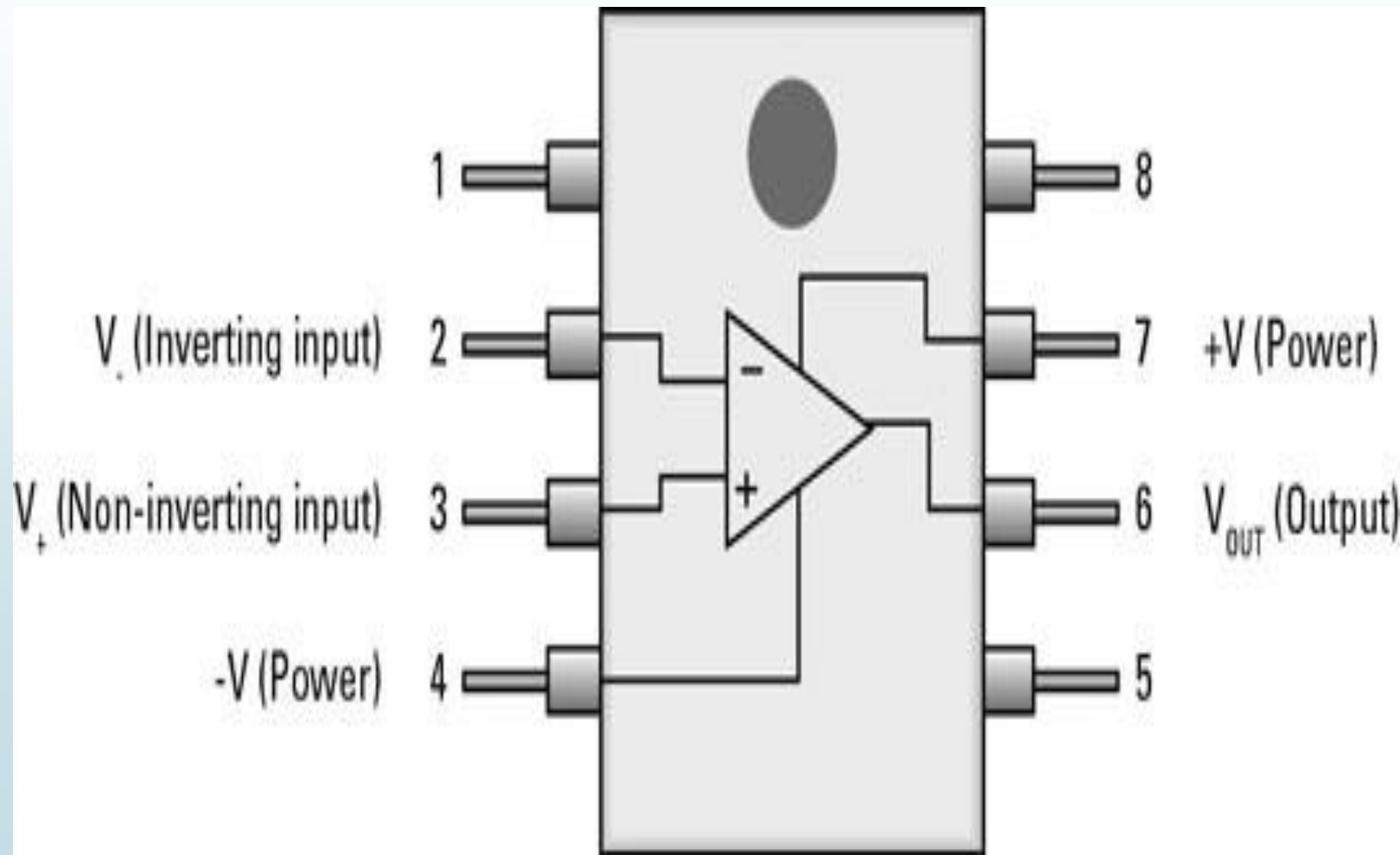
OP AMP CKT TERMINALS



OP AMP Packages



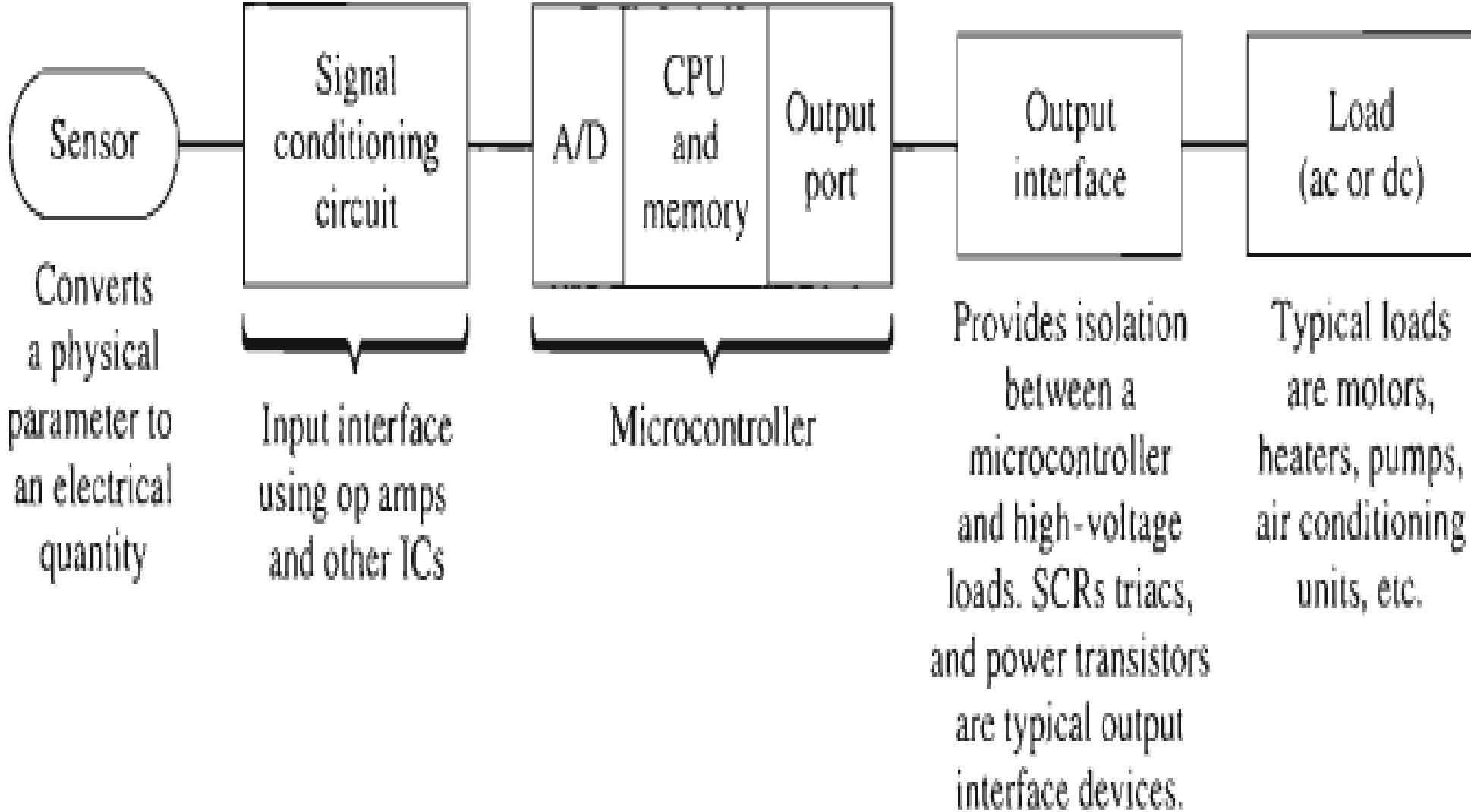
LM741 OP AMP





Applications

- ▶ As Inverting Amplifiers
- ▶ Non Inverting Amplifiers
- ▶ As a Buffer
- ▶ As a Phase Shifter
- ▶ Adder or Summing Amplifier
- ▶ As a Differential Amplifier
- ▶ As Voltage to Current Converter
- ▶ As a Voltage Comparator



OP Amp Manufacturer

- ▶ [Advanced Linear Devices](#) {Rail to Rail, CMOS, JFET, Micropower Operational Amplifier ICs}
- ▶ [Analog Devices](#) {Op Amps, Comparators}
- ▶ [Fairchild Semiconductor, Corp.](#) {Op Amp IC Manufacturer}
- ▶ [Maxim Integrated Products](#) {Op Amp - Comparator IC Manufacturer}
- ▶ [Microchip](#) {Linear Op Amps; Chopper Stabilized, Auto-zero Linear Op Amps, Programmable Gain Amplifiers, Selectable Gain Amps, Comparators}
- ▶ [Micrel Semiconductor](#) {Operational Amplifier - Comparators}
- ▶ [Micropac Industries Inc.](#) {High Temp Instrumentation Amplifier}
- ▶ [Renesas Technology Corp](#) {CMOS OP Amp - High RF Noise Immunity or Low Power operation}
- ▶ [ROHM](#) {OpAmps-Comparator IC Manufacturer}
- ▶ [STMicroelectronics](#) {Op Amps - Comparators}
- ▶ [TI](#) {Instrumentation Amps, Operational Amps}

Identification of OP AMP IC's

- ▶ LM339C
- ▶ The first symbol is used for identifying the manufacturer.
- ▶ 339 is the IC
- ▶ The 3rd part specifies the op amp is used for commercial applications.
 - ▶ C: commercial applications 0 to 70 °C.
 - ▶ I: Industrial applications -25 °C to 85 °C
 - ▶ M:military applications -55 °C to 125 °C.

References

- ▶ **Coughlin, R.F., Operational Amplifiers and Linear Integrated Circuits, Pearson Education (2006).**
- ▶ **Gayakwad, R.A., Op-Amp and Linear Integrated Circuits, Pearson Education (2002).**
- ▶ **Franco, S., Design with Operational Amplifier and Analog Integrated circuit, McGraw Hill (2016).**
- ▶ **Terrell, D., Op Amps Design Application and Troubleshooting, Newness (1996).**