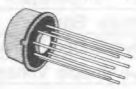
SGS-THOMSON MICROELECTRONICS

# LM111-LM211 LM311

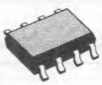
## VOLTAGE COMPARATORS

- MAXIMUM INPUT CURRENT : 150 nA
- MAXIMUM OFFSET CURRENT : 20 nA
- DIFFERENTIAL INPUT VOLTAGE RANGE : ± 30 V
- POWER CONSUMPTION : 135 mW AT ± 15 V
- SUPPLY VOLTAGE : + 5 V TO ± 15 V
- OUTPUT CURRENT : 50 mA



**H**
**TO-99**
(Metal Can)

**N**
**DIP8**
(Plastic Package)
**J**
**CERDIP8**
(Cerdip Package)



**D**
**SO8**
(Plastic Micropackage)

**GC**
**LCC20**
(Tricecop (LCC))

### DESCRIPTION

The LM111, LM211 and LM311 are voltage comparators that have low input currents.

They are also designed to operate over a wide range of supply voltages : from standard ± 15 V operational amplifier supplies down to the single + 5 V supply used for IC logic.

Their output is compatible with RTL-DTL and TTL as well as MOS circuits and can switch voltages up to + 50 V at output currents as high as 50 mA.

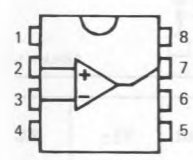
### ORDER CODES

| Part Number | Temperature Range | Package | | | | |
|---|---|---|---|---|---|---|
| | | H | N | J | D | GC |
| LM111 | – 55 to + 125 °C | • | | • | | • |
| LM211 | – 40 to + 105 °C | • | • | | • | |
| LM311 | 0 to + 70 °C | • | • | • | • | |

**Note** : Hi-Rel Versions Available
**Examples** LM111H. LM111J

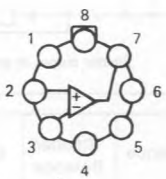
### PIN CONNECTIONS (top views)

**DIP8**
**CERDIP8**
**SO8**



1 - Ground
2 - Non-inverting input
3 - Inverting input
4 - $V_{CC}^-$

**TO-99**



5 - Balance
6 - Strobe/balance
7 - Output
8 - $V_{CC}^+$

**LCC20**

1 - NC
2 - Ground
3 - NC
4 - NC
5 - Non-inverting input
6 - NC
7 - Inverting input
8 - NC
9 - NC
10 - $V_{CC}^-$

11 - NC
12 - Balance
13 - NC
14 - NC
15 - Balance/Strobe
16 - NC
17 - Output
18 - NC
19 - NC
20 - $V_{CC}^+$

## ABSOLUTE MAXIMUM RATINGS

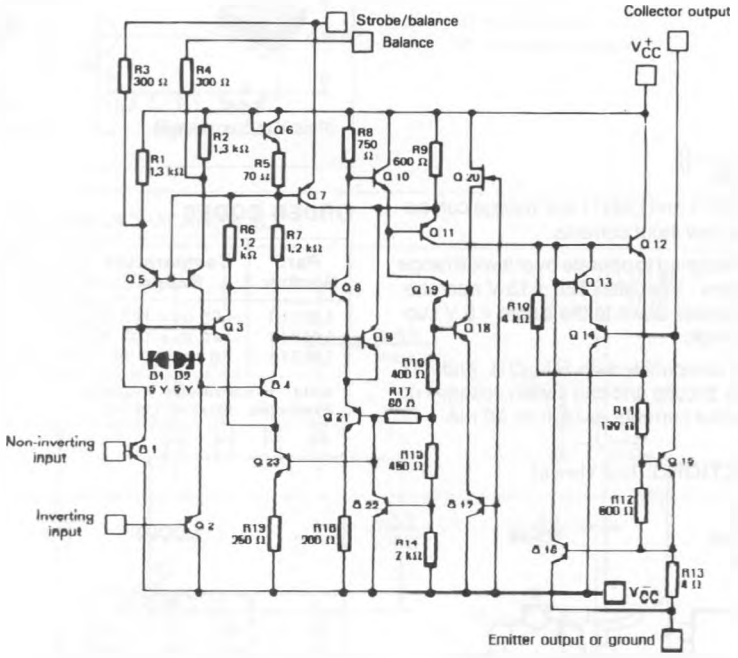
| Symbol | Parameter | LM111 | LM211 | LM311 | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | 36 | 36 | 36 | V |
| $V_{ID}$ | Differential Input Voltage | ± 30 | ± 30 | ± 30 | V |
| $V_I$ | Input Voltage – (note 1) | ± 15 | ± 15 | ± 15 | V |
| $P_{tot}$ | Power Dissipation<br>LM311D-LM211D<br>Other Versions | <br><br>500 | <br><br>500 | <br>300<br>500 | mW |
| $T_{oper}$ | Operating Free-air Temperature Range | – 55 to + 125 | – 40 to + 105 | 0 to + 70 | °C |
| $T_{stg}$ | Storage Temperature Range | – 65 to + 150 | – 65 to + 150 | – 65 to + 150 | °C |
| $V_{(1-4)}$ | Ground to Negative Supply Voltage | 30 | 30 | 30 | V |
| $V_{(7-4)}$ | Output to Negative Supply Voltage | 50 | 50 | 40 | V |

Output short-circuit duration : 10 s
Voltage at strobe pin : $V_{CC}$ – 5 V

Maximum junction temperature **LM111** : + 150 °C
**LM211** : + 150 °C
**LM311** : + 150 °C

**Note :** 1. This rating applies for ± 15 V supplies. The positive input voltage limit is 30 V above the negative. The negative input voltage limit is equal to the negative supply voltage or 30 V below the positive supply, whichever is less.

## SCHEMATIC DIAGRAM




| Case | GND | Non-Inverting Input | Inverting Input | $V_{CC}^-$ | Balance | Strobe/ Balance | Output | $V_{CC}^+$ | N.C. |
|---|---|---|---|---|---|---|---|---|---|
| TO–99 / DIP8<br>CERDIP8 / SO8 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| LCC20 | 2 | 5 | 7 | 10 | 12 | 15 | 17 | 20 | * |

* LCC20 : Other pins are not connected.

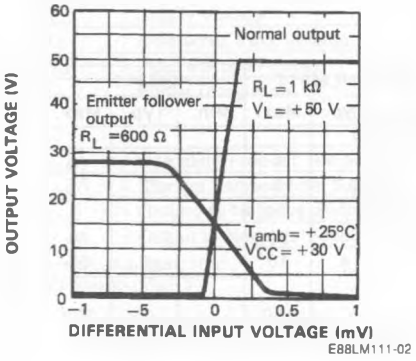
## ELECTRICAL CHARACTERISTICS

LM111: $-55\ °C \le T_{amb} \le +125\ °C$, $V_{CC} = \pm 15\ V$
LM211: $-40\ °C \le T_{amb} \le +105\ °C$, $V_{CC} = \pm 15\ V$
LM311: $0\ °C \le T_{amb} \le +70\ °C$, $V_{CC} = \pm 15\ V$
(unless otherwise specified)

| Symbol | Parameter | LM111/LM211 | | | LM311 | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| $V_{IO}$ | Input Offset Voltage ($R_S \le 50\ k\Omega$) – (note 2) | | | | | | | mV |
| | $T_{min} \le T_{amb} \le T_{max}$ | | | 4 | | | 10 | |
| | $T_{amb} = +25\ °C$ | | 0.7 | 3 | | 2 | 7.5 | |
| $I_{IO}$ | Input Offset Current – (note 2) | | | | | | | nA |
| | $T_{min} \le T_{amb} \le T_{max}$ | | | 20 | | | 70 | |
| | $T_{amb} = +25\ °C$ | | 4 | 10 | | 6 | 50 | |
| $I_{IB}$ | Input Bias Current – (note 2) | | | | | | | nA |
| | $T_{min} \le T_{amb} \le T_{max}$ | | | 150 | | | 300 | |
| | $T_{amb} = +25\ °C$ | | 60 | 100 | | 100 | 250 | |
| $A_{VD}$ | Large Signal Voltage Gain ($T_{amb} = +25\ °C$) | 40 | 200 | | 40 | 200 | | V/mV |
| | Supply Currents ($T_{amb} = 25\ °C$) | | | | | | | mA |
| $I_{CC}^+$ | Positive | | 5.1 | 6 | | 5.1 | 7.5 | |
| $I_{CC}^-$ | Negative | | 4.1 | 5 | | 4.1 | 5 | |
| $V_I$ | Input Voltage Range | | ± 14 | | | ± 14 | | V |
| $V_{OL}$ | Low Level Output Voltage | | | | | | | V |
| | $T_{min} \le T_{amb} \le T_{max}$ | | | | | | | |
| | $V_{CC}^+ \ge +4.5\ V$, $V_{CC}^- = 0$, | | | | | | | |
| | $I_{sink} = 8\ mA$, $V_I \le -6\ mV$ | | 0.23 | 0.4 | | | | |
| | $V_I \le -10\ mV$ | | | | | 0.23 | 0.4 | |
| | $T_{amb} = +25\ °C$, $I_O = 50\ mA$, $V_I \le -5\ mV$ | | 0.75 | 1.5 | | | | |
| | $V_I \le -10\ mV$ | | | | | 0.75 | 1.5 | |
| $I_{OH}$ | High Level Output Current | | | | | | | |
| | $T_{min} \le T_{amb} \le T_{max}$, $V_I \ge +5\ mV$, $V_O = +35\ V$ | | 0.1 | 0.5 | | | | µA |
| | $T_{amb} = +25\ °C$, $V_I \ge +5\ mV$, $V_O = +35\ V$ | | 0.2 | 10 | | | | nA |
| | $V_I \ge +10\ mV$, $V_O = +35\ V$ | | | | | 0.2 | 50 | nA |
| $I_{strobe}$ | Strobe Current ($T_{amb} = +25\ °C$) | | 3 | | | 3 | | mA |
| $t_{rs}$ | Response Time ($T_{amb} = +25\ °C$) – (note 3) | | 200 | | | 200 | | ns |

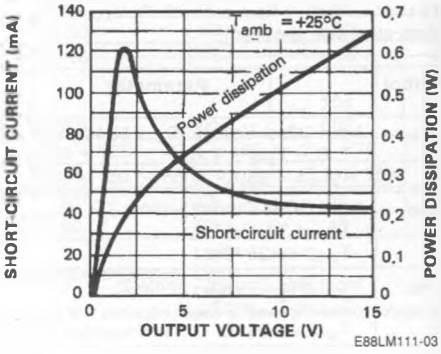
Notes: 2. The offset voltage, offset current and bias current specifications apply for any supply voltage from a single +5 V supply up to ±15 V supplies.
The offset voltages and offset currents given are the maximum values required to drive the output down to +1 V or up to +14 V with a 1 mA load current. Thus, these parameters define an error band and take into account the worst case of voltage gain and input impedance.
3. The response time specified (see definitions) is for a 100 mV input step with 5 mV overdrive.

TRANSFER CHARACTERISTICS



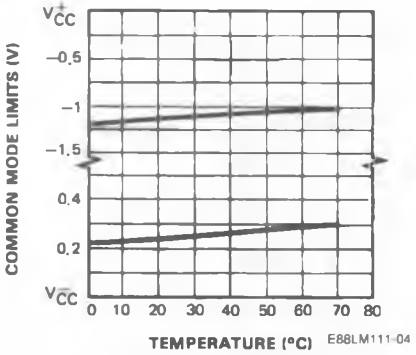

E88LM111-02

OUTPUT LIMITING CHARACTERISTICS



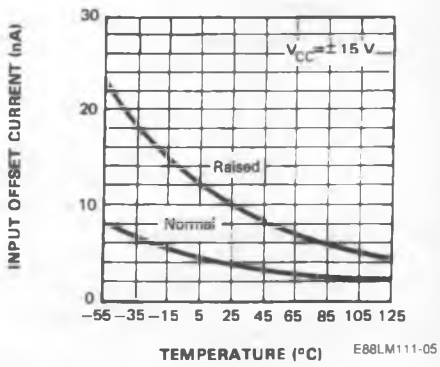

E88LM111-03

COMMON MODE LIMITS



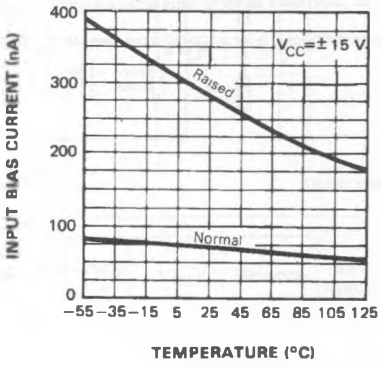

E88LM111-04

INPUT OFFSET CURRENT



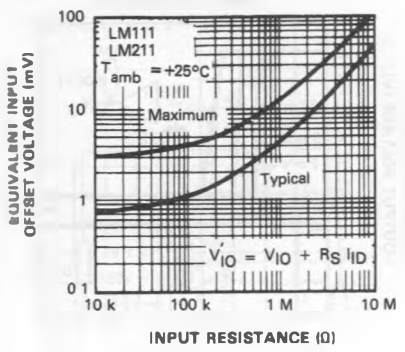

E88LM111-05

INPUT BIAS CURRENT



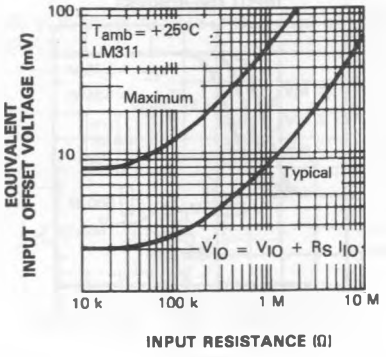

E88LM111-06

EQUIVALENT INPUT OFFSET ERROR



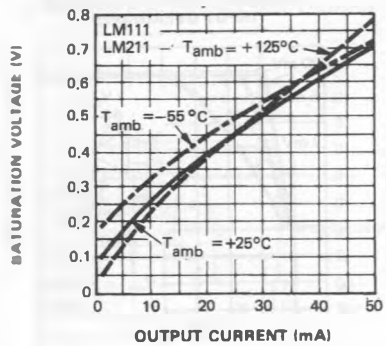

E88LM111-07

EQUIVALENT INPUT OFFSET ERROR



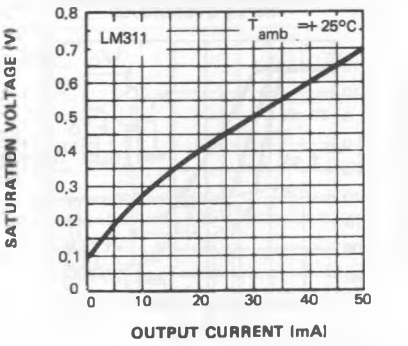

E88LM111-08

LOW LEVEL OUTPUT SATURATION VOLTAGE



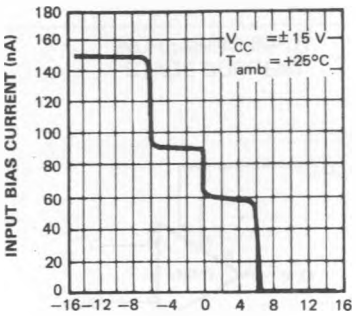

E88LM111-09

LOW LEVEL OUTPUT SATURATION VOLTAGE



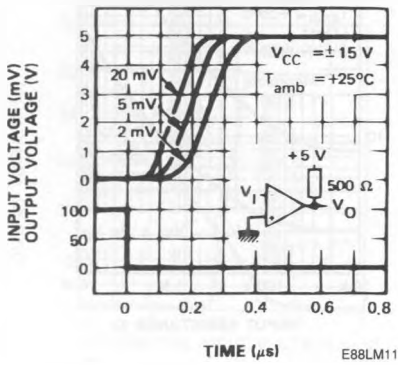

E88LM111-10

INPUT CHARACTERISTICS



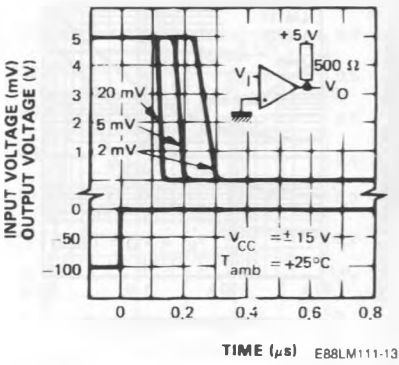

E88LM111-11

RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES



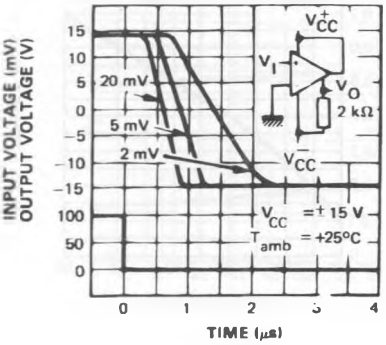

E88LM111-12

RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES



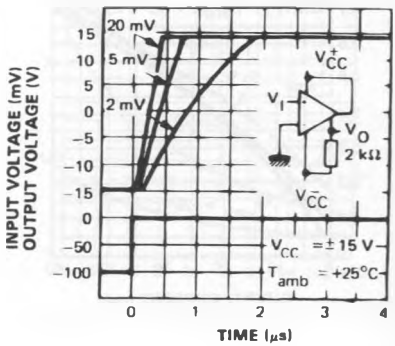

E88LM111-13

RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES




E88LM111-14

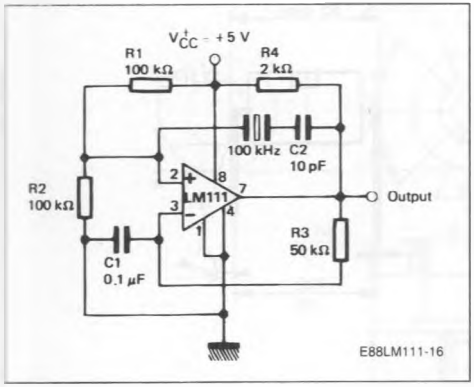
RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES



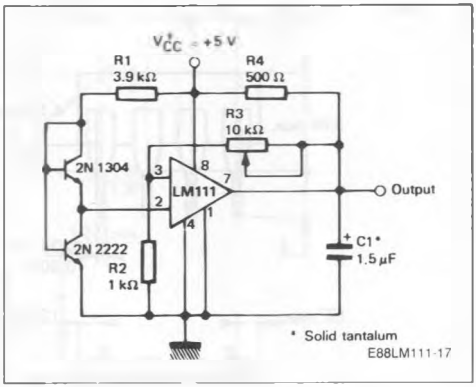

E88LM111-15

## TYPICAL APPLICATIONS

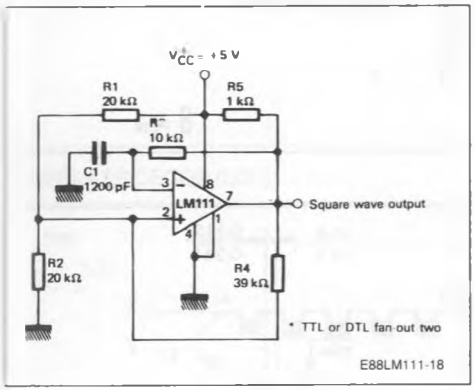
### CRYSTAL OSCILLATOR



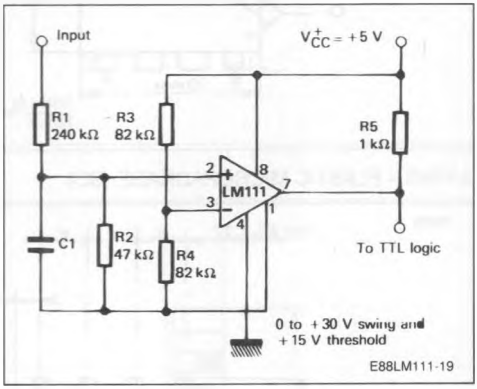

### LOW VOLTAGE ADJUSTABLE REFERENCE SUPPLY




### 500 kHz FREE RUNNING MULTIVIBRATOR

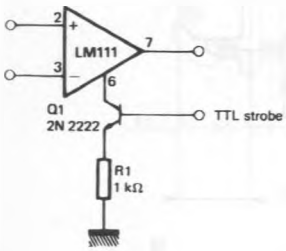



### TTL INTERFACE WITH HIGH LEVEL LOGIC

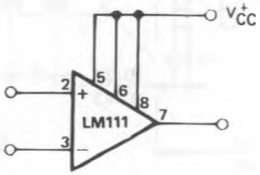



## AUXILIARY CIRCUITS

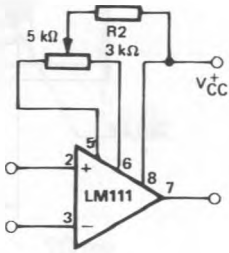
### STROBE




### INCREASING INPUT STAGE CURRENT

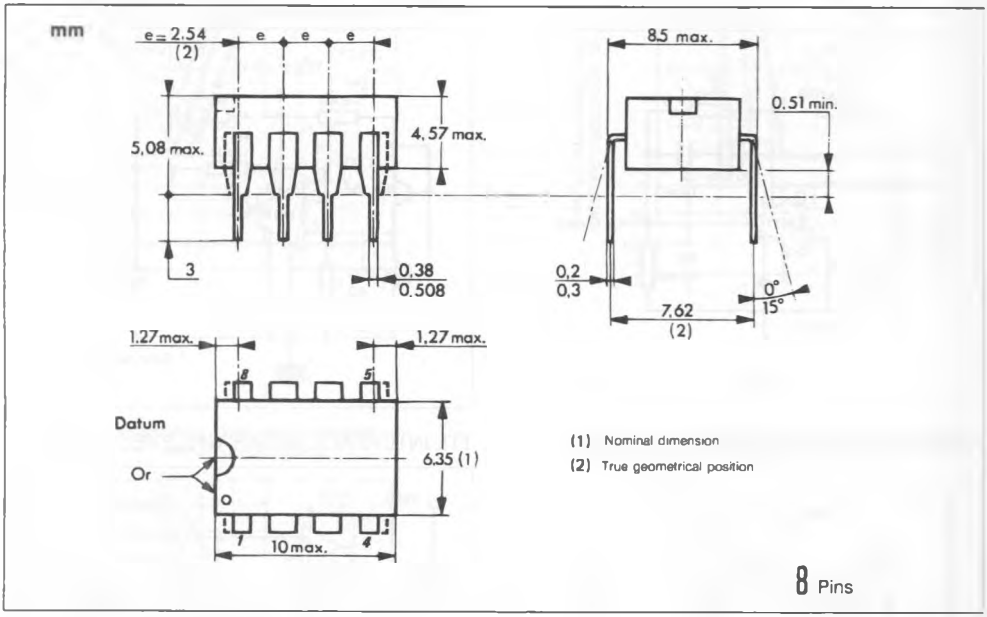



### OFFSET BALANCING

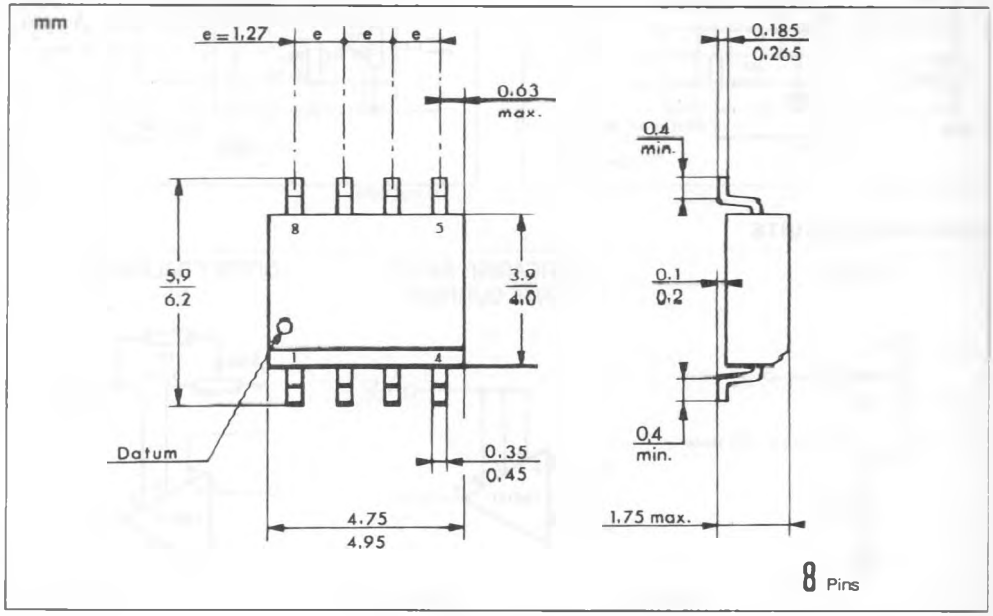


## PACKAGE MECHANICAL DATA

8 PINS – PLASTIC DIP OR CERDIP

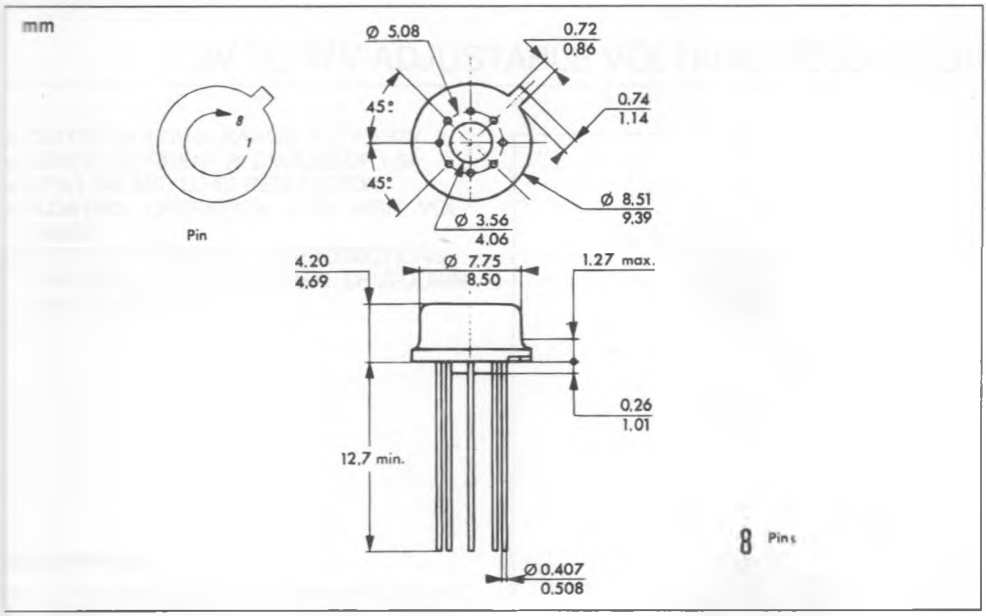



8 PINS – PLASTIC MICROPACKAGE (SO)



## PACKAGE MECHANICAL DATA (continued)

8 PINS – METAL CAN TO99




20 PINS – TRICECOP (LCC)