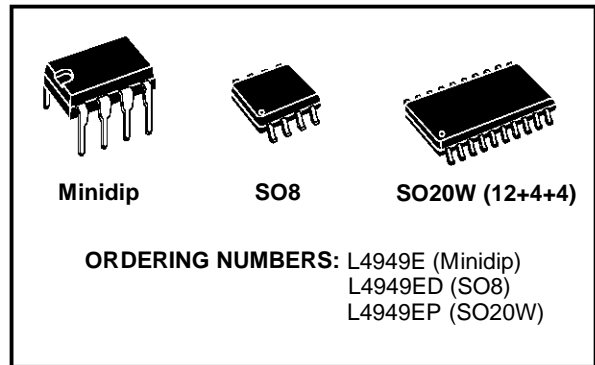


## MULTIFUNCTION VERY LOW DROP VOLTAGE REGULATOR

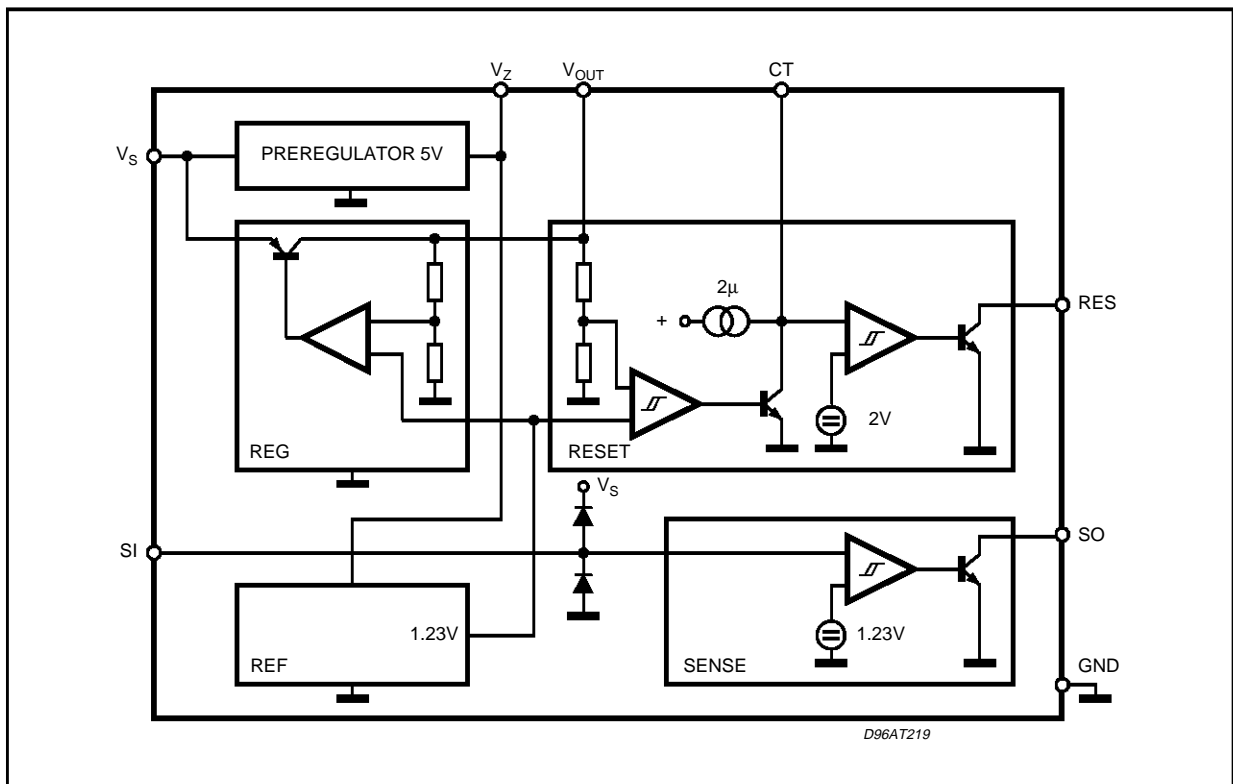
- OPERATING DC SUPPLY VOLTAGE RANGE 5V - 28V
- TRANSIENT SUPPLY VOLTAGE UP TO 40V
- EXTREMELY LOW QUIESCENT CURRENT IN STANDBY MODE
- HIGH PRECISION STANDBY OUTPUT VOLTAGE  $5V \pm 1\%$
- OUTPUT CURRENT CAPABILITY UP TO 100mA
- VERY LOW DROPOUT VOLTAGE LESS THAN 0.5V
- RESET CIRCUIT SENSING THE OUTPUT VOLTAGE
- PROGRAMMABLE RESET PULSE DELAY WITH EXTERNAL CAPACITOR
- VOLTAGE SENSE COMPARATOR
- THERMAL SHUTDOWN AND SHORT CIRCUIT PROTECTIONS



### DESCRIPTION

The L4949E is a monolithic integrated 5V voltage regulator with a very low dropout output and additional functions as power-on reset and input voltage sense. It is designed for supplying the micro-computer controlled systems especially in automotive applications.

### BLOCK DIAGRAM



**ABSOLUTE MAXIMUM RATINGS**

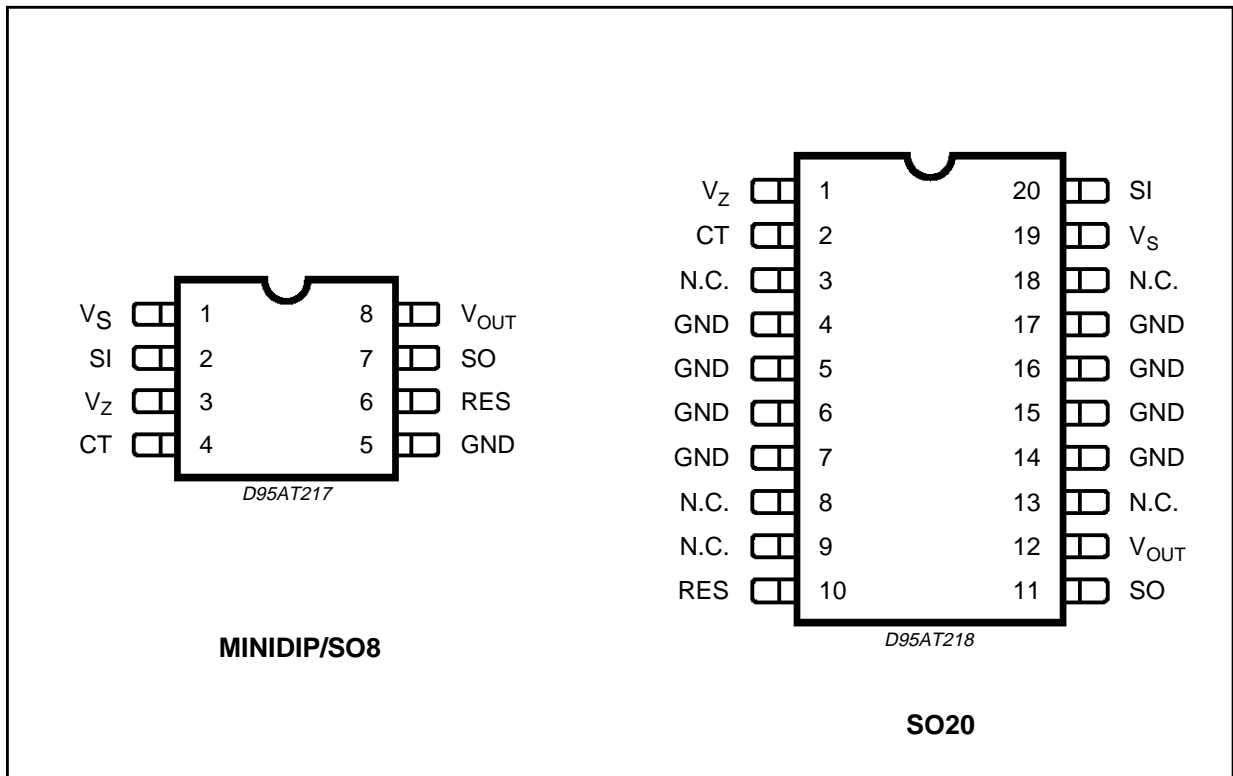
| Symbol                             | Parameter                         | Value              | Unit |
|------------------------------------|-----------------------------------|--------------------|------|
| V <sub>SDC</sub>                   | DC Operating Supply Voltage       | 28                 | V    |
| V <sub>STR</sub>                   | Transient Supply Voltage (T < 1s) | 40                 | V    |
| I <sub>O</sub>                     | Output Current                    | Internally Limited |      |
| V <sub>O</sub>                     | Output Voltage                    | 20                 | V    |
| V <sub>RES</sub> , V <sub>SO</sub> | Output Voltage                    | 20                 | V    |
| I <sub>RES</sub> , I <sub>SO</sub> | Output Current                    | 5                  | mA   |
| V <sub>Z</sub>                     | Preregulator Output Voltage       | 7                  | V    |
| I <sub>Z</sub>                     | Preregulator Output Current       | 5                  | mA   |
| T <sub>J</sub>                     | Junction Temperature              | -40 to +150        | °C   |
| T <sub>stg</sub>                   | Storage Temperature Range         | -55 to +150        | °C   |

Note: The circuit is ESD protected according to MIL-STD-883C

**THERMAL DATA**

| Symbol                 | Description                           | Max | Minidip | SO-8 | SO20L | Unit |
|------------------------|---------------------------------------|-----|---------|------|-------|------|
| R <sub>th j-amb</sub>  | Thermal Resistance Junction-ambient   | Max | 100     | 200  | 50    | °C/W |
| R <sub>th j-pins</sub> | Thermal Resistance Junction-pins      | Max |         |      | 15    | °C/W |
| T <sub>JSD</sub>       | Thermal Shutdown Junction temperature |     |         | 165  |       | °C   |

**PIN CONNECTIONS**



**ELECTRICAL CHARACTERISTICS** ( $V_S = 14V$ ;  $-40^\circ C < T_J < 125^\circ C$  unless otherwise specified)

| Symbol          | Parameter  | Test Condition   | Min.       | Typ.              | Max.               | Unit           |
|-----------------|--|--|------------|-------------------|--------------------|----------------|
| $V_O$           | Output Voltage   | $T_J = 25^\circ C$ ; $I_O = 1mA$   | 4.95       | 5                 | 5.05               | V              |
| $V_O$           | Output Voltage   | $6V < V_{IN} < 28V$ ; $1mA < I_O < 50mA$                                 | 4.90       | 5                 | 5.10               | V              |
| $V_O$           | Output Voltage   | $V_{IN} = 40V$ ;<br>$T < 1s$ $5mA < I_O < 100mA$                         | 4.75       |                   | 5.25               | V              |
| $V_{DP}$        | Dropout Voltage  | $I_O = 10mA$<br>$I_O = 50mA$<br>$I_O = 100mA$                            |            | 0.1<br>0.2<br>0.3 | 0.25<br>0.4<br>0.5 | V              |
| $V_{IO}$        | Input to Output Voltage Difference in Undervoltage Condition | $V_{IN} = 4V$ , $I_O = 35mA$   |            |                   | 0.4                | V              |
| $I_{outh}^{**}$ | Max Output Leakage   | $V_{IN} = 25V$ , $V_O = 5.5V$  | 20         | 50                | 80                 | $\mu A$        |
| $V_{OL}$        | Line Regulation  | $6V < V_{IN} < 28V$ ; $I_O = 1mA$  |            |                   | 20                 | mV             |
| $V_{OLO}$       | Load Regulation  | $1mA < I_O < 100mA$  |            |                   | 30                 | mV             |
| $I_{LIM}$       | Current Limit  | $V_O = 4.5V$<br>$V_O = 4.5V$ , $T_J = 25^\circ C$<br>$V_O = 0V$ (note 1) | 105<br>120 | 200<br>100        | 400<br>400         | mA<br>mA<br>mA |
| $I_{QSE}$       | Quiescent Current  | $I_O = 0.3mA$ ; $T_J < 100^\circ C$                                      |            | 200               | 300                | $\mu A$        |
| $I_Q$           | Quiescent Current  | $I_O = 100mA$  |            |                   | 5                  | mA             |

\*\* With this test we guarantee that with no output current the output voltage will not exceed 5.5V

**RESET**

|                |                                       |  |    |              |     |         |
|----------------|---------------------------------------|--|----|--------------|-----|---------|
| $V_{RT}$       | Reset Threshold Voltage               |  |    | $V_O - 0.5V$ |     | V       |
| $V_{RTH}$      | Reset Threshold Hysteresis            |  | 50 | 100          | 200 | mV      |
| $t_{RD}$       | Reset Pulse Delay                     | $C_T = 100nF$ ; $T_R \geq 100\mu s$            | 55 | 100          | 180 | ms      |
| $V_{RL}$       | Reset Output Low Voltage              | $R_{RES} = 10K\Omega$ to $V_O$ $V_S \geq 1.5V$ |    |              | 0.4 | V       |
| $I_{RH}$       | Reset Output High Leakage Current     | $V_{RES} = 5V$                                 |    |              | 1   | $\mu A$ |
| $V_{CTth}$     | Delay Comparator Threshold            |  |    | 2            |     | V       |
| $V_{CTth, hy}$ | Delay Comparator Threshold Hysteresis |  |    | 100          |     | mV      |

**SENSE**

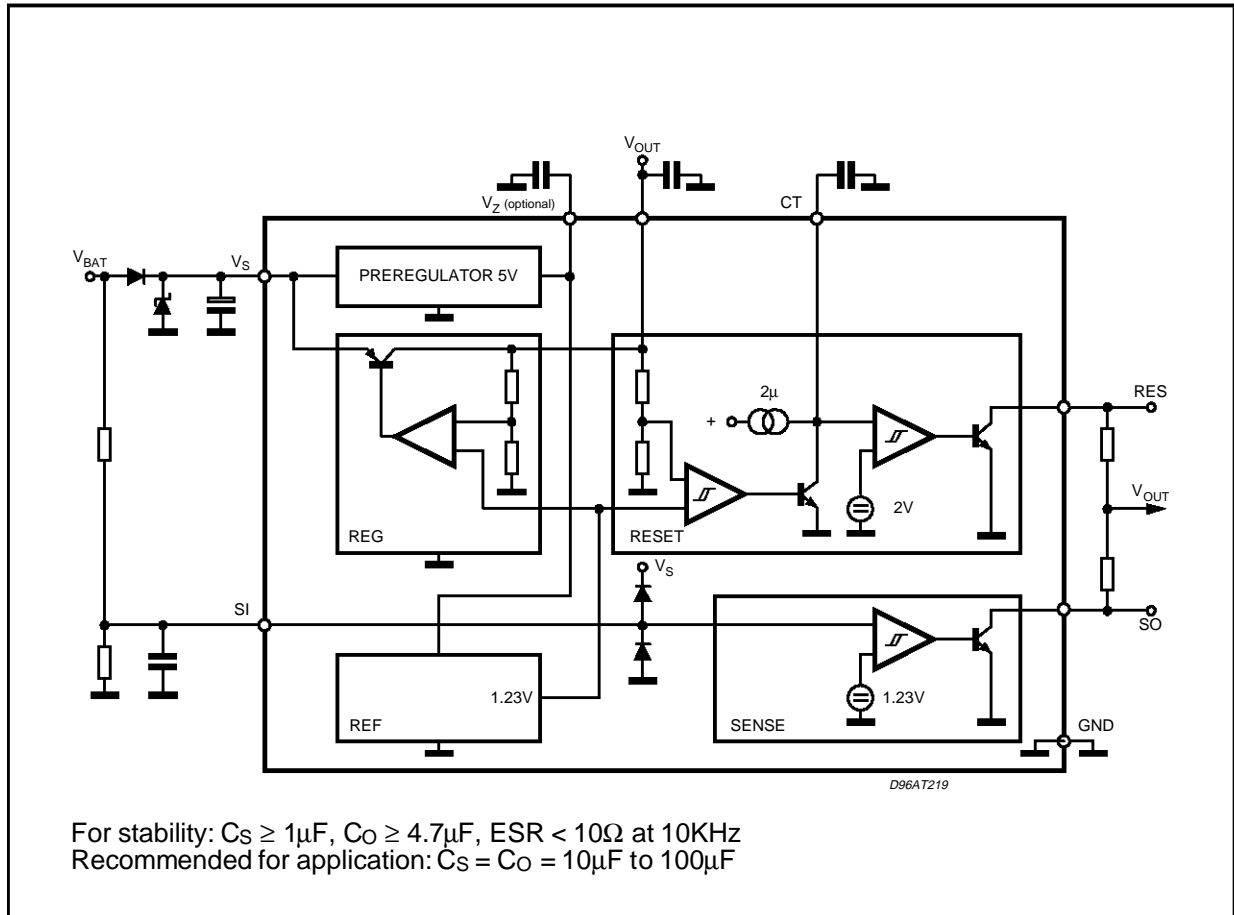
|           |                            |  |      |      |      |         |
|-----------|----------------------------|--|------|------|------|---------|
| $V_{st}$  | Sense Low Threshold        |  | 1.16 | 1.23 | 1.35 | V       |
| $V_{sth}$ | Sense Threshold Hysteresis |  | 20   | 100  | 200  | mV      |
| $V_{SL}$  | Sense Output Low Voltage   | $V_{SI} \leq 1.16V$ ; $V_S \geq 3V$<br>$R_{SO} = 10K\Omega$ to $V_O$ |      |      | 0.4  | V       |
| $I_{SH}$  | Sense Output Leakage       | $V_{SO} = 5V$ ; $V_{SI} \geq 1.5V$                                   |      |      | 1    | $\mu A$ |
| $I_{SI}$  | Sense Input Current        | $V_{SI} = 0$   | -20  | -8   | -3   | $\mu A$ |

**PREREGULATOR**

|       |                             |                 |     |   |    |         |
|-------|-----------------------------|-----------------|-----|---|----|---------|
| $V_Z$ | Preregulator Output Voltage | $I_Z = 10\mu A$ | 4.5 | 5 | 6  | V       |
| $I_Z$ | Preregulator Output Current |                 |     |   | 10 | $\mu A$ |

Note 1: Foldback characteristic

APPLICATION CIRCUIT



APPLICATION INFORMATION  
 Supply Voltage Transient

High supply voltage transients can cause a reset output signal disturbance.

For supply voltages greater than 8V the circuit shows a high immunity of the reset output against supply transients of more than 100V/µs.

For supply voltages less than 8V supply transients of more than 0.4V/µs can cause a reset signal disturbance.

To improve the transient behaviour for supply voltages less than 8V a capacitor at pin 3 can be used.

A capacitor at pin 3 ( $C_3 \leq 1\mu F$ ) reduces also the output noise.

FUNCTIONAL DESCRIPTION

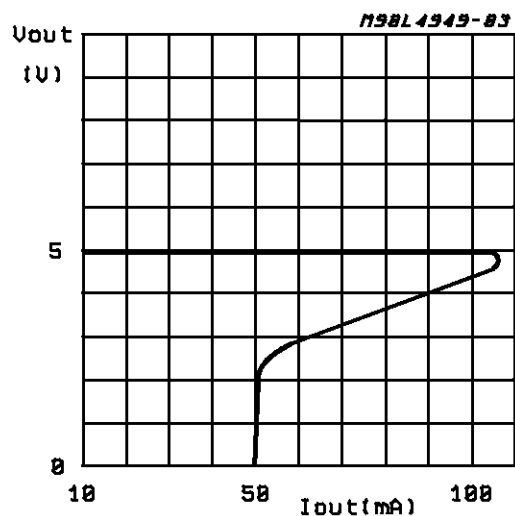
The L4949E is a monolithic integrated voltage regulator, based on the STM modular voltage regulator approach. Several outstanding features and auxiliary functions are implemented to meet the requirements of supplying microprocessor systems in automotive applications. Nevertheless, it is suitable also in other applications where the present functions are required. The modular ap-

proach of this device allows to get easily also other features and functions when required.

Voltage Regulator

The voltage regulator uses an Isolated Collector Vertical PNP transistor as a regulating element.

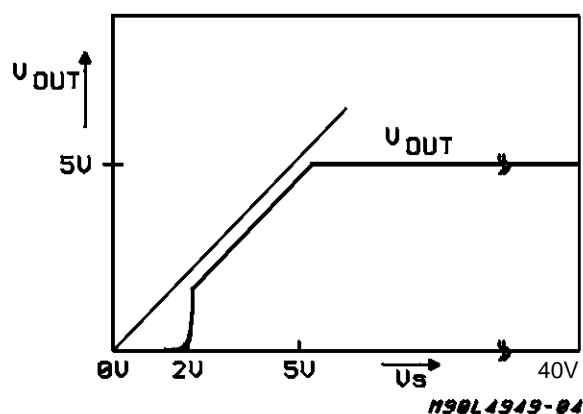
Figure 1: Foldback Characteristic of  $V_O$



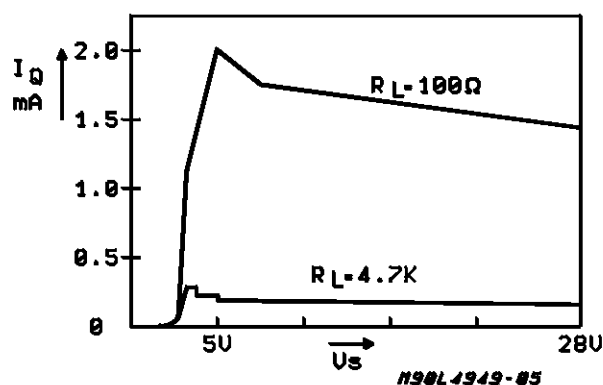
With this structure very low dropout voltage at currents up to 100mA is obtained. The dropout operation of the standby regulator is maintained down to 3V input supply voltage. The output voltage is regulated up to the transient input supply voltage of 40V. With this feature no functional interruption due to overvoltage pulses is generated. The typical curve showing the standby output voltage as a function of the input supply voltage is shown in Fig. 2. The current consumption of the device (quiescent current) is less than 300µA.

To reduce the quiescent current peak in the undervoltage region and to improve the transient response in this region, the dropout voltage is controlled, the quiescent current as a function of the supply input voltage is shown in Fig. 3.

**Figure 2:** Output Voltage vs. Input Voltage



**Figure 3:** Quiescent Current vs. Supply Voltage



### Preregulator

To improve the transient immunity a preregulator stabilized the internal supply voltage to 5V. This internal voltage is present at Pin 3 (V<sub>Z</sub>). This voltage should not be used as an output because the output capability is very small ( $\leq 10\mu\text{A}$ ).

This output may be used as an option when a better transient behaviour for supply voltages less than 8V is required (see also application note).

In this case a capacitor (100nF - 1µF) must be connected between Pin 3 and GND. If this feature is not used Pin 3 must be left open.

### Reset Circuit

The block circuit diagram of the reset circuit is shown in Fig. 4. The reset circuit supervises the output voltage.

The reset threshold of 4.5V is defined with the internal reference voltage and standby output divider.

The reset pulse delay time  $t_{RD}$ , is defined with the charge time of an external capacitor  $C_T$ :

$$t_{RD} = \frac{C_T \cdot 2V}{2\mu\text{A}}$$

The reaction time of the reset circuit originates from the discharge time limitation of the reset capacitor  $C_T$  and is proportional to the value of  $C_T$ .

The reaction time of the reset circuit increases the noise immunity. Standby output voltage drops below the reset threshold only a bit longer than the reaction time results in a shorter reset delay time.

The nominal reset delay time will be generated for standby output voltage drops longer than approximately 50µs.

The typical reset output waveforms are shown in Fig. 5.

### Sense Comparator

The sense comparator compares an input signal with an internal voltage reference of typical 1.23V. The use of an external voltage divider makes this comparator very flexible in the application.

It can be used to supervise the input voltage either before or after the protection diode and to give additional informations to the microprocessor like low voltage warnings.

Figure 4

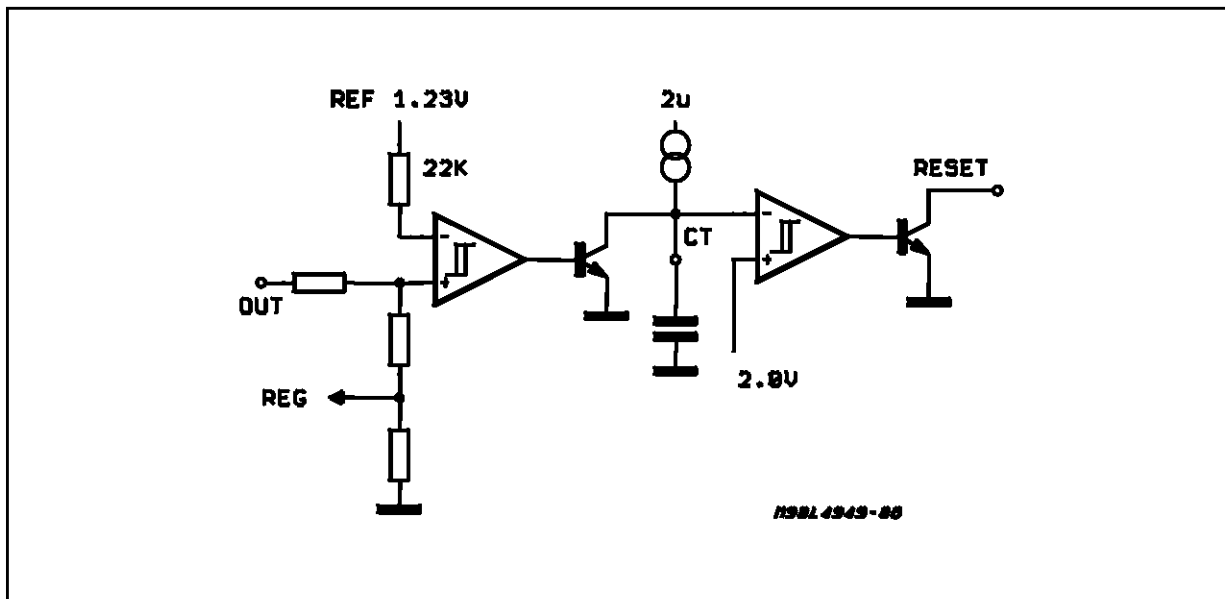
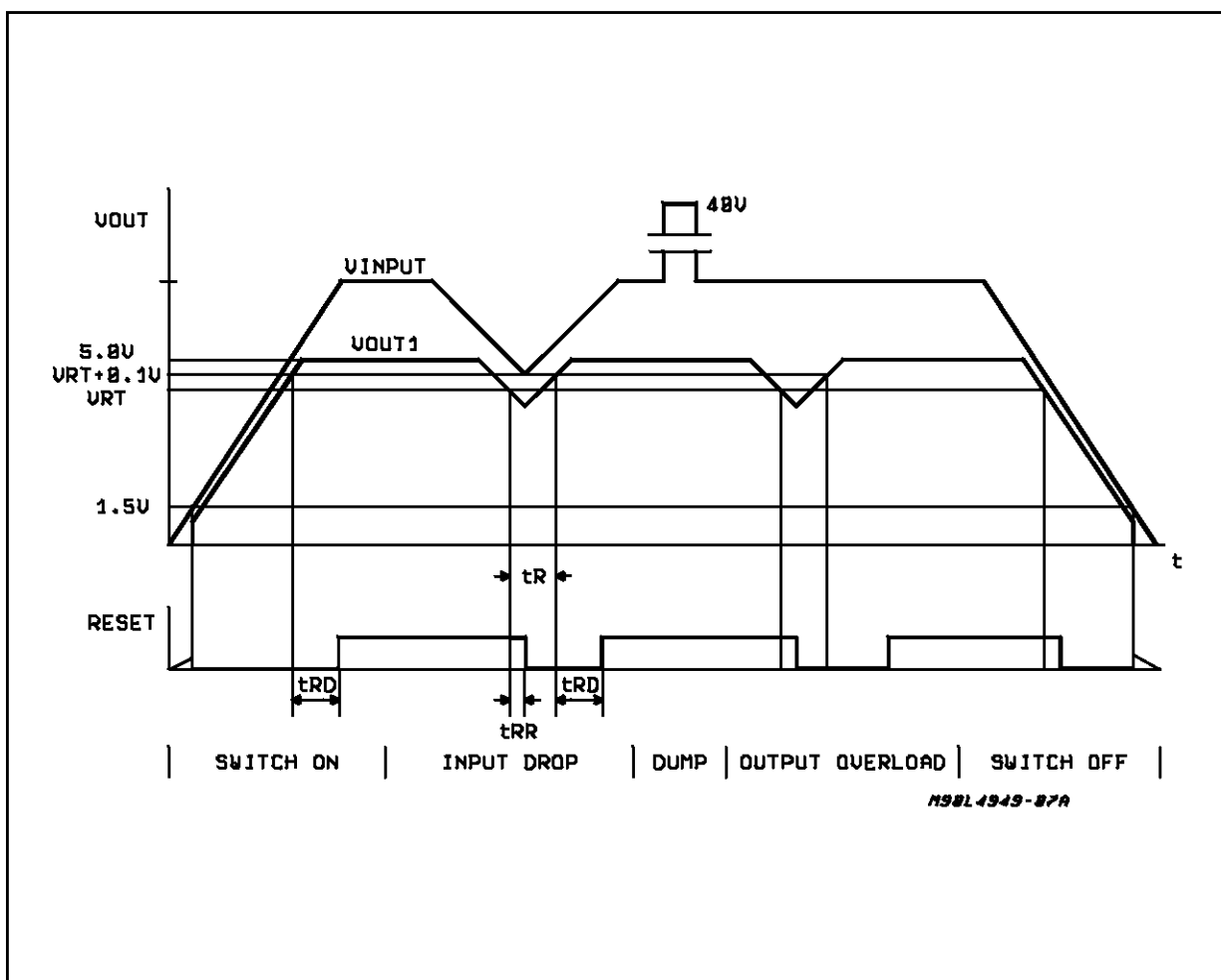
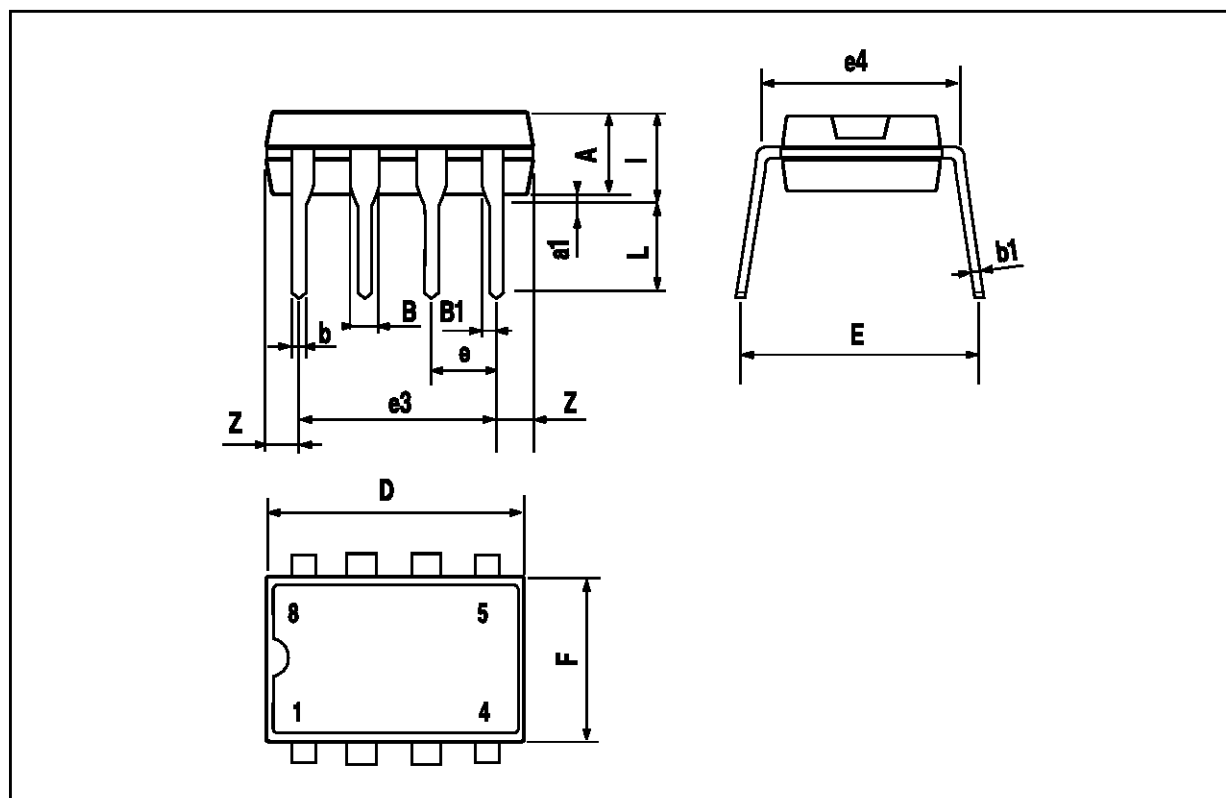


Figure 5



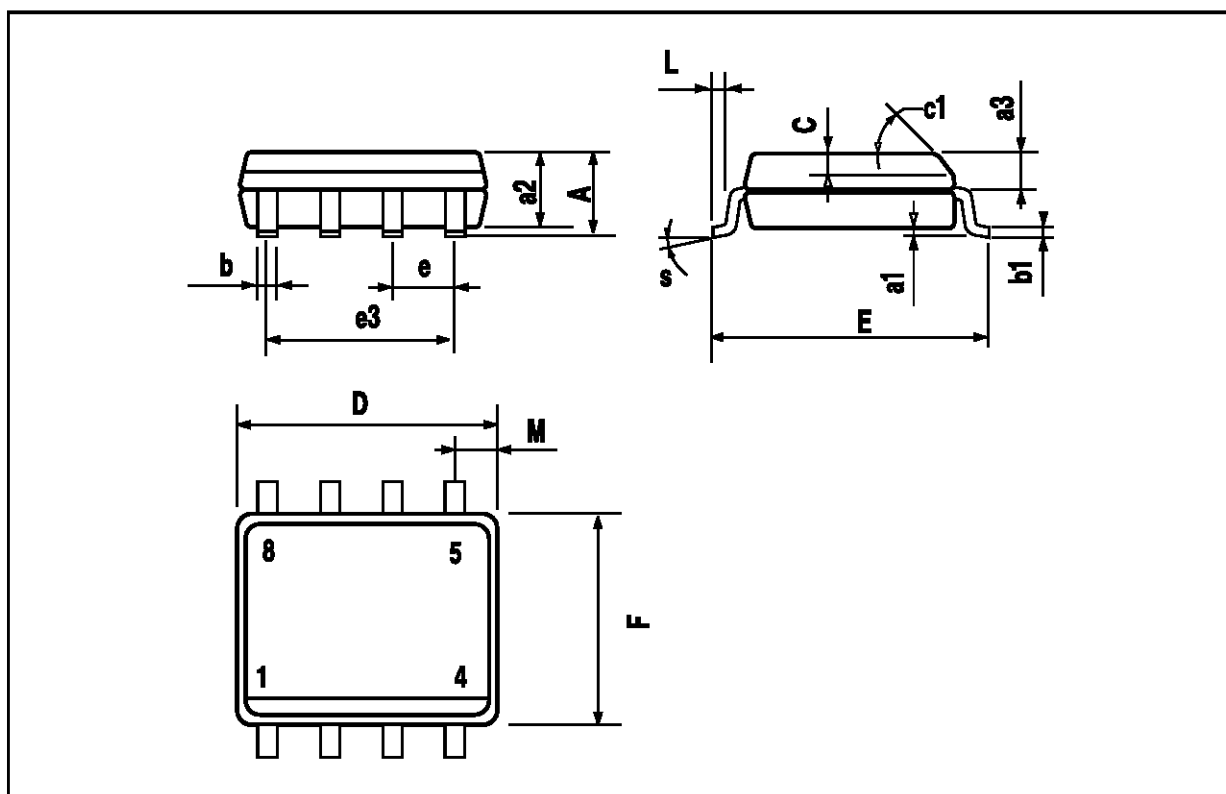
## MINIDIP PACKAGE MECHANICAL DATA

| DIM. | mm   |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN  | TYP  | MAX  | MIN   | TYP   | MAX   |
| A    |      | 3.3  |      |       | 0.130 |       |
| a1   | 0.7  |      |      | 0.028 |       |       |
| B    | 1.39 |      | 1.65 | 0.055 |       | 0.065 |
| B1   | 0.91 |      | 1.04 | 0.036 |       | 0.041 |
| b    |      | 0.5  |      |       | 0.020 |       |
| b1   | 0.38 |      | 0.5  | 0.015 |       | 0.020 |
| C    |      |      |      |       |       |       |
| D    |      |      | 9.8  |       |       | 0.386 |
| D1   |      |      |      |       |       |       |
| E    |      | 8.8  |      |       | 0.346 |       |
| e    |      | 2.54 |      |       | 0.100 |       |
| e3   |      | 7.62 |      |       | 0.300 |       |
| e4   |      |      |      |       |       |       |
| F    |      |      | 7.1  |       |       | 0.280 |
| I    |      |      | 4.8  |       |       | 0.189 |
| L    |      | 3.3  |      |       | 0.130 |       |
| N    |      |      |      |       |       |       |
| Z    | 0.44 |      | 1.6  | 0.017 |       | 0.063 |



SO8 PACKAGE MECHANICAL DATA

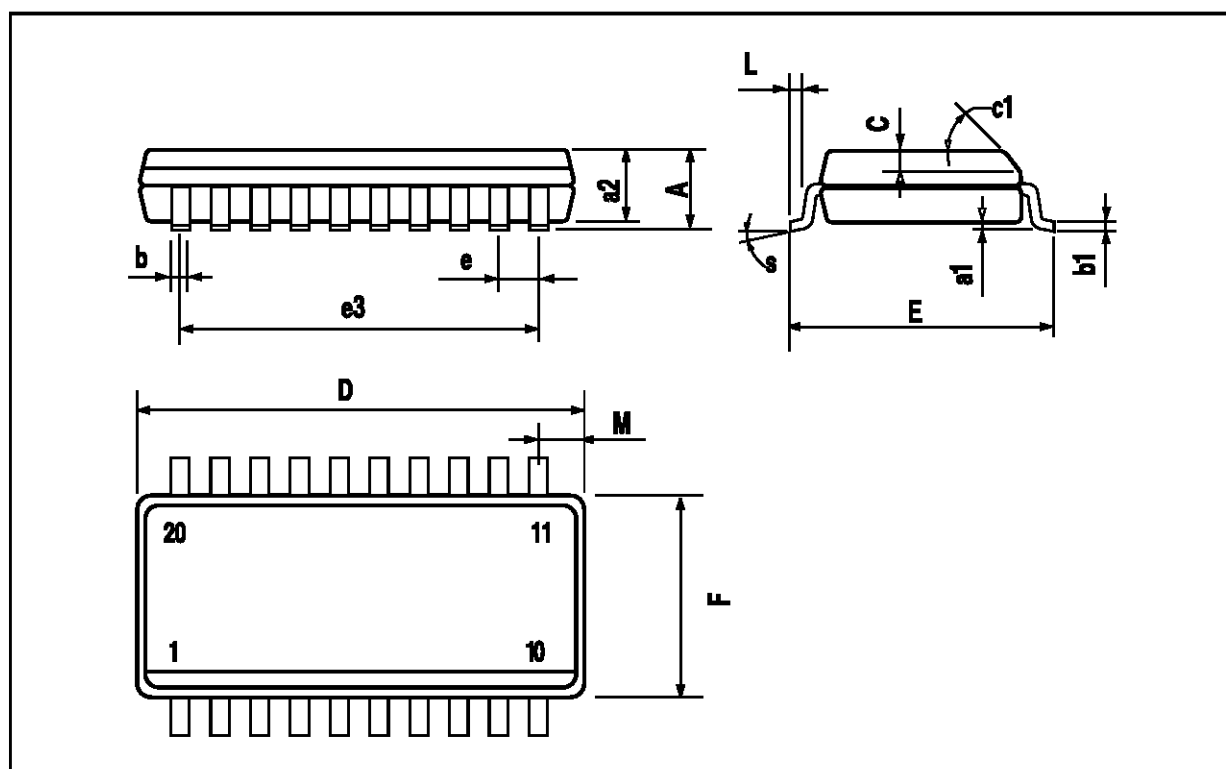
| DIM. | mm   |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN  | TYP  | MAX  | MIN   | TYP   | MAX   |
| A    |      |      | 1.75 |       |       | 0.069 |
| a1   | 0.1  |      | 0.25 | 0.004 |       | 0.010 |
| a2   |      |      | 1.65 |       |       | 0.065 |
| a3   | 0.65 |      | 0.85 | 0.026 |       | 0.033 |
| b    | 0.35 |      | 0.48 | 0.014 |       | 0.019 |
| b1   | 0.19 |      | 0.25 | 0.007 |       | 0.010 |
| C    | 0.25 |      | 0.5  | 0.010 |       | 0.020 |
| c1   |      | 45   |      |       | 1.772 |       |
| D    |      | 1    | 4.8  |       | 0.039 | 0.189 |
| E    | 5.8  |      | 6.2  | 0.228 |       | 0.244 |
| e    |      | 1.27 |      |       | 0.050 |       |
| e3   |      | 3.81 |      |       | 0.150 |       |
| F    |      | 1    | 3.8  |       | 0.039 | 0.150 |
| G    |      |      |      |       |       |       |
| L    | 0.4  |      | 1.27 | 0.016 |       | 0.050 |
| M    |      |      | 0.6  |       |       | 0.024 |
| S    |      |      | 8    |       |       | 0.315 |





## SO20 PACKAGE MECHANICAL DATA

| DIM. | mm         |       |       | inch  |       |       |
|------|------------|-------|-------|-------|-------|-------|
|      | MIN.       | TYP.  | MAX.  | MIN.  | TYP.  | MAX.  |
| A    |            |       | 2.65  |       |       | 0.104 |
| a1   | 0.1        |       | 0.3   | 0.004 |       | 0.012 |
| a2   |            |       | 2.45  |       |       | 0.096 |
| b    | 0.35       |       | 0.49  | 0.014 |       | 0.019 |
| b1   | 0.23       |       | 0.32  | 0.009 |       | 0.013 |
| C    |            | 0.5   |       |       | 0.020 |       |
| c1   | 45° (typ.) |       |       |       |       |       |
| D    | 12.6       |       | 13.0  | 0.496 |       | 0.512 |
| E    | 10         |       | 10.65 | 0.394 |       | 0.419 |
| e    |            | 1.27  |       |       | 0.050 |       |
| e3   |            | 11.43 |       |       | 0.450 |       |
| F    | 7.4        |       | 7.6   | 0.291 |       | 0.299 |
| L    | 0.5        |       | 1.27  | 0.020 |       | 0.050 |
| M    |            |       | 0.75  |       |       | 0.030 |
| S    | 8° (max.)  |       |       |       |       |       |



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