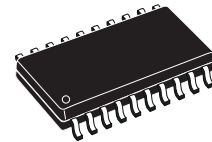




# L9337MD

## TRIPLE LOW SIDE DRIVER

- WIDE INPUT VOLTAGE RANGE FROM -24V UP TO +45V
- WIDE OPERATING SUPPLY VOLTAGE RANGE FROM 4.5V UP TO 32V
- REVERSE BIASING PROTECTED ( $V_S = -24V$ )
- VERY LOW STANDBY QUIESCENT CURRENT  $< 2\mu A$
- PROGRAMMABLE SIGNAL TRANSFER POLARITY
- TTL AND CMOS COMPATIBLE INPUTS
- DEFINED OUTPUT OFF STATE OFF FOR OPEN INPUTS
- THREE OPEN DRAIN DMOS OUTPUTS, WITH  $R_{DSon} = 1.5\ \Omega$  at 25°C and  $V_S > 6V$
- OUTPUT CURRENT LIMITATION
- CONTROLLED OUTPUT SLOPE FOR LOW EMI
- OVERTEMPERATURE SHUT-DOWN
- INTEGRATED OUTPUT CLAMPING FOR FAST INDUCTIVE RECIRCULATION  $V_{FB} > 45V$
- STATUS MONITORING FOR
  - OVERTEMPERATURE



SO20 (12+4+4)

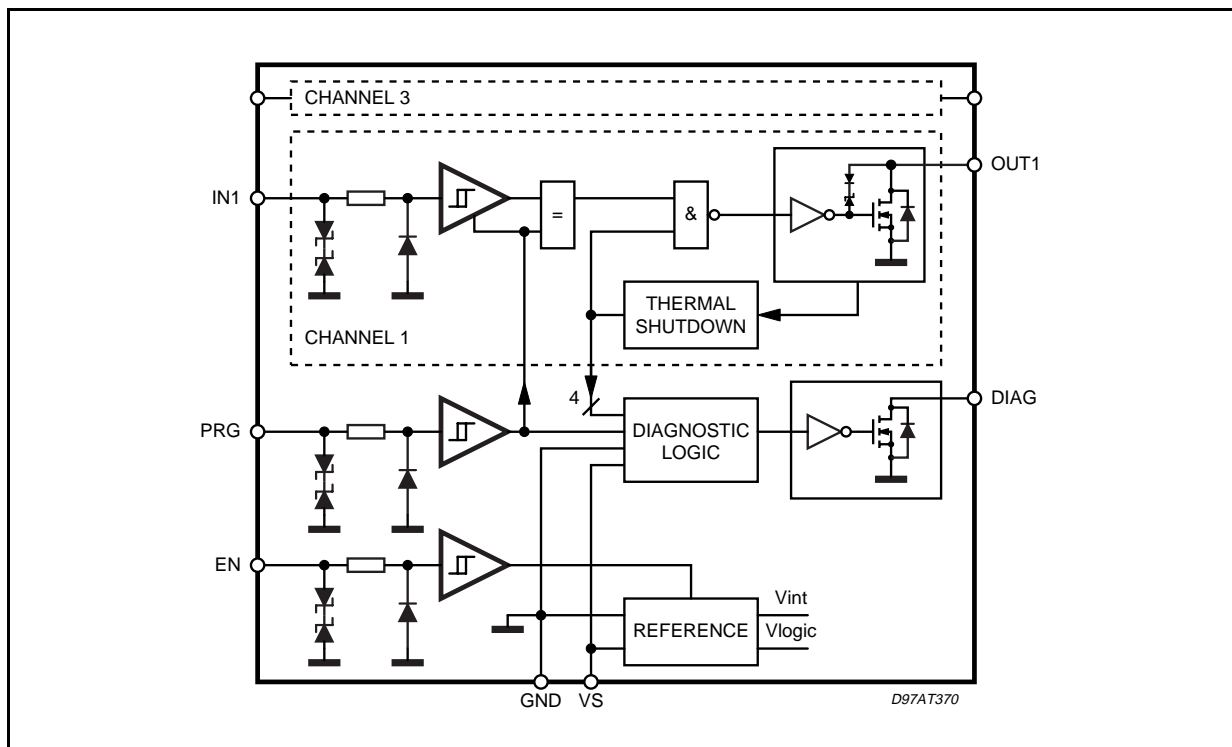
ORDERING NUMBER: L9337MD

- DISCONNECTED GROUND OR SUPPLY VOLTAGE
- ESD: ALL PINS ARE GUARANTEED TILL 2kV HUMAN BODY MODEL

### DESCRIPTION

The L9337MD is a monolithic integrated triple low side driver realized in advanced Multipower-BCD technology. It is intended to drive lines, lamps or relays in automotive or industrial applications.

### BLOCK DIAGRAM

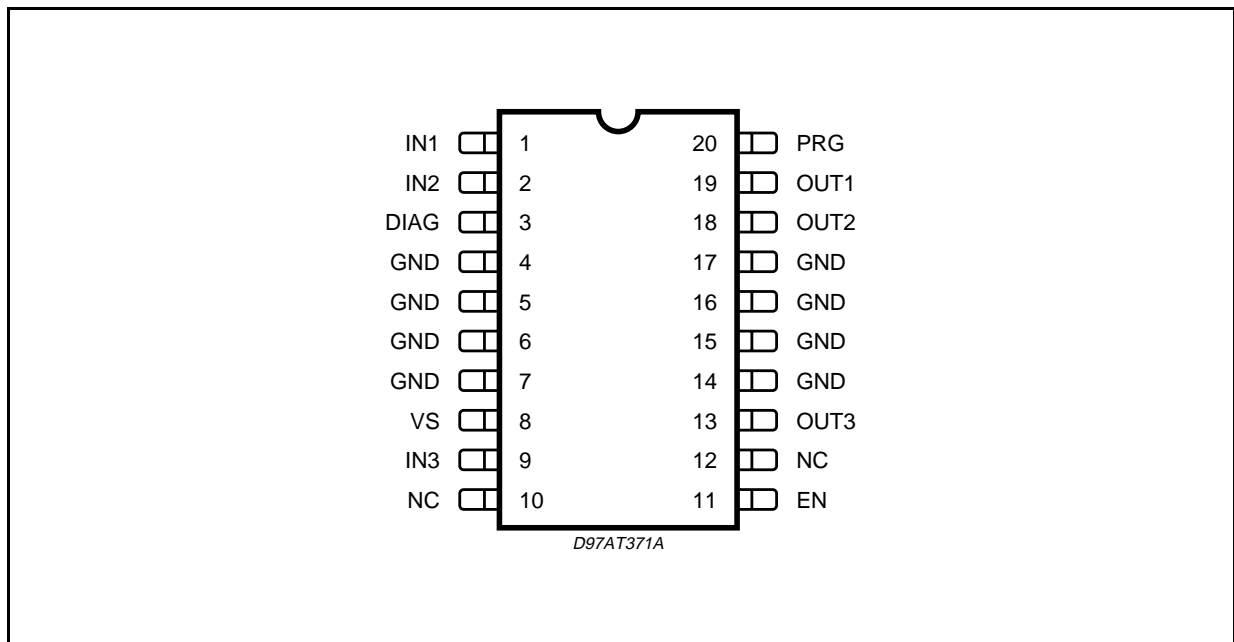


## L9337MD

### ABSOLUTE MAXIMUM RATINGS (no damage or latch)

| Symbol              | Parameter              | Value      | Unit |
|---------------------|------------------------|------------|------|
| $V_S$               | Supply voltage         | -24 to 45  | V    |
| <b>Pin voltages</b> |                        |            |      |
| $V_{IN}$            | Input, enable, program | -24 to 45  | V    |
| $V_{OUT}$           | Output                 | -0.3 to 45 | V    |
| $V_{DIAG}$          | Diagnostic output      | -0.3 to 45 | V    |

### PIN CONNECTIONS (Top view)



### PIN DESCRIPTION

| SO 12+4+4<br>No         | Pin Name | Function       |
|-------------------------|----------|----------------|
| 8                       | VS       | SUPPLY VOLTAGE |
| 4,5,6,7,14,<br>15,16,17 | GND      | GROUND         |
| 11                      | EN       | ENABLE         |
| 20                      | PRG      | PROGRAM        |
| 3                       | DIAG     | DIAGNOSTIC     |
| 1                       | IN1      | INPUT 1        |
| 2                       | IN2      | INPUT 2        |
| 9                       | IN3      | INPUT 3        |
| 19                      | OUT 1    | OUTPUT 1       |
| 18                      | OUT 2    | OUTPUT 2       |
| 13                      | OUT 3    | OUTPUT 3       |
| 10, 12                  | NC       | NOT CONNECTED  |

## THERMAL DATA

| Symbol           | Parameter  | SO20 (2) | SO(12+4+4) (1)           | Unit     |
|------------------|--|----------|--------------------------|----------|
| $R_{th(j-pins)}$ | Thermal resistance junction to pin                             | –        | 14 (Typ.)                | °C/W     |
| $R_{th(j-amb)}$  | Thermal resistance junction to ambient mounted on SMPCB2 board | 77 to 97 | –                        | °C/W     |
| $T_{jMon}$       | Temperature-monitoring<br>Switch-off-level<br>Switch-on-level  |          | 160 to 190<br>140 to 170 | °C<br>°C |

(1) See SGS-THOMSON Microelectronics databook: "Thermal Management in Surface Mount Technology"

(2) See SGS-THOMSON Microelectronics databook: "Thermal characteristics of SO20"

**OPERATING CONDITIONS** (The electrical characteristics are valid within the below defined operating ranges, unless otherwise specified. The function will be guaranteed by design until  $T_{jMON}$  switch-OFF-level.

| Symbol         | Parameter            | Value      | Unit |
|----------------|----------------------|------------|------|
| $V_S$          | Supply Voltage       | 4.5 to 32  | V    |
| $V_{IN}$       | Input pin voltage    | -24 to 45  | V    |
| $V_{EN}$       | Enable pin voltage   | -24 to 45  | V    |
| $V_{OUT}, V_D$ | Output pin voltage   | -0.3 to 45 | V    |
| $T_j$          | Junction temperature | -40 to 150 | °C   |

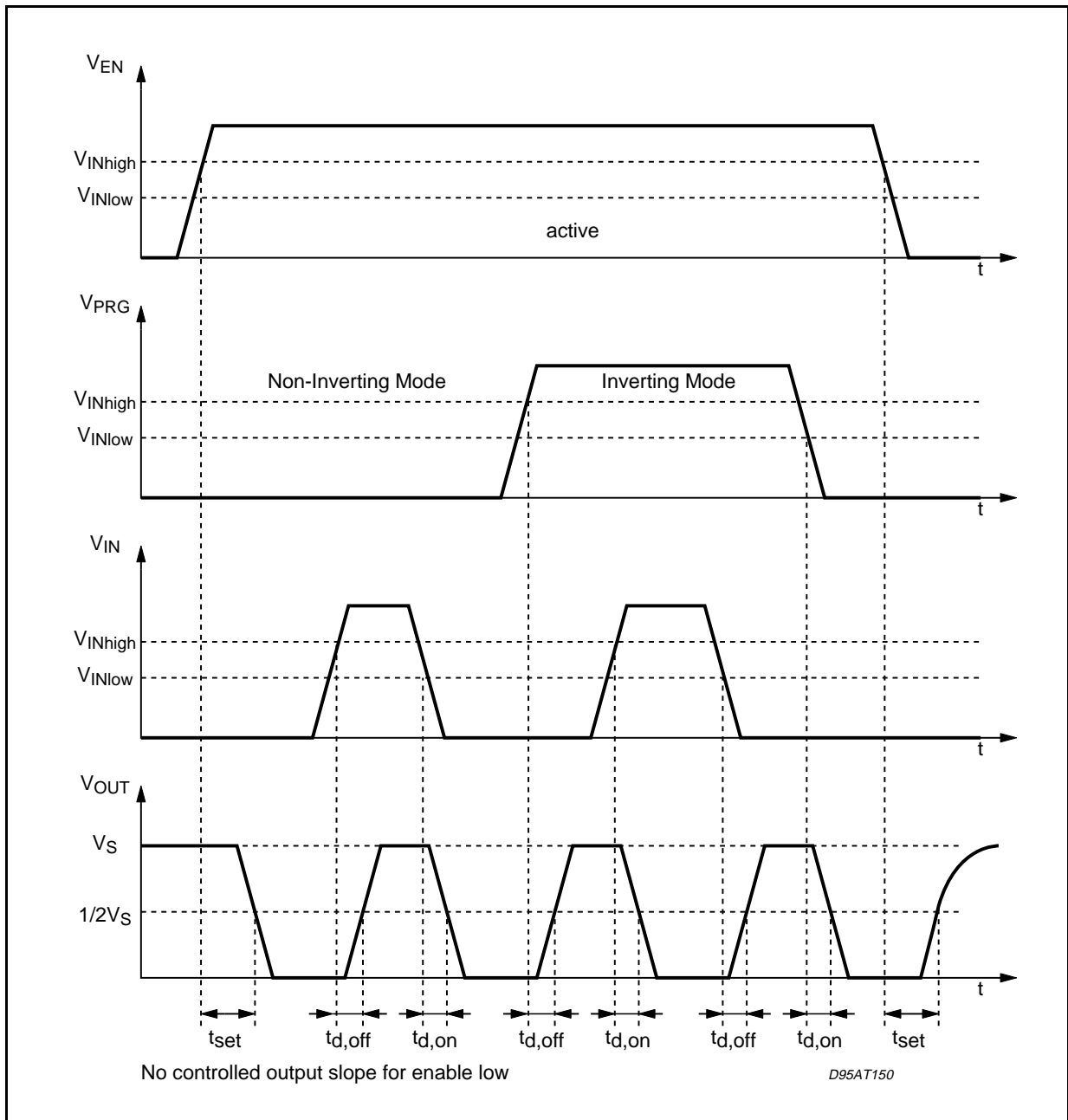
## ELECTRICAL CHARACTERISTICS (Refer to the test circuit, unless otherwise specified.)

| Symbol                        | Parameter                      | Test Condition  | Min. | Typ.       | Max.       | Unit                 |
|-------------------------------|--------------------------------|---|------|------------|------------|----------------------|
| $I_Q$                         | Quiescent current              | $-0.3V \leq V_{EN} \leq 0.5V$ ;<br>$V_S = 14V$ ; $T_j = 85^\circ C$       |      | <2         | 10         | $\mu A$              |
|                               |                                | EN = high; $V_S \leq 14V$   |      | 1.5        | 2          | mA                   |
| <b>Inputs IN1 - IN3, PRG</b>  |                                |   |      |            |            |                      |
| $V_{INlow}$                   | Input voltage LOW              |   | -24  |            | 2.0        | V                    |
| $V_{INhigh}$                  | Input voltage HIGH             |   | 2.8  |            | 45         | V                    |
| $I_{IN}$                      | Input current                  | $-24V \leq V_i \leq 10V$  | -10  |            | 15         | $\mu A$              |
| <b>Enable Input EN</b>        |                                |   |      |            |            |                      |
| $V_{ENlow}$                   | Input voltage LOW              |   | -24  |            | 1          | V                    |
| $V_{ENhigh}$                  | Input voltage HIGH             |   | 3.2  |            | VS         | V                    |
| $R_{EN}$                      | Input impedance                | $-24V < V_i < 2.5V$   | 10   |            |            | K $\Omega$           |
| $I_{EN}$                      | Input current                  | $2.5V \leq V_i \leq 25V$  |      | 20         | 50         | $\mu A$              |
| <b>Outputs OUT1-OUT3</b>      |                                |   |      |            |            |                      |
| $R_{DSon}$                    | Output ON-resistor to ground   | $V_S \geq 6V$ , $I_O = 0.3A$<br>$T_j = 25^\circ C$<br>$T_j = 125^\circ C$ |      | 1.7        | 2.3<br>3.5 | $\Omega$<br>$\Omega$ |
| $I_{OLeak}$                   | Leakage current                | $V_O = V_S = 14V$ ; $T_j = 85^\circ C$                                    |      | $\leq 1$   | 5          | $\mu A$              |
| $V_{OClamp}$                  | Output voltage during clamping | time < 200 $\mu s$ ; $10mA \leq I_O \leq 0.3A$                            | 45   | 52         | 60         | V                    |
| $I_{OSC}$                     | Short-circuit current          |   | 400  | 700        | 1200       | mA                   |
| $C_O$                         | Internal output capacities     | $V_O \geq 4.5V$   |      |            | 100        | pF                   |
| <b>Diagnostic output DIAG</b> |                                |   |      |            |            |                      |
| $V_{Dlow}$                    | Output voltage LOW             | $I_{DL} \leq 1mA$   |      | 0.3        | 0.5        | V                    |
| $I_{Dmax}$                    | Max. Output current            | Internal current limitation   | 1    | 5          | 15         | mA                   |
| $I_{Dleak}$                   | Leakage current                | $V_S = 14V$ ; $T_j = 85^\circ C$  |      | $\leq 0.1$ | 1          | $\mu A$              |

ELECTRICAL CHARACTERISTICS (Continued)

| Symbol                     | Parameter                       | Test conditions  | Min. | Typ. | Max. | Unit      |
|----------------------------|---------------------------------|--|------|------|------|-----------|
| <b>Timing</b> (see Fig. 1) |                                 |  |      |      |      |           |
| $t_{d,on}$                 | On delay time                   | $V_S = 14V, C_{ext} = 0pF$<br>$10mA \leq I_o \leq 200mA$ |      | 2.5  | 3.5  | $\mu s$   |
| $t_{d,off}$                | Off delay time                  |  |      | 3    | 4.5  | $\mu s$   |
| $t_{set}$                  | Enable settling time            |  |      |      | 10   | $\mu s$   |
| $t_{d,DIAG}$               | On or Off diagnostic delay time |  |      |      | 10   | $\mu s$   |
| $S_{out}$                  | Output slopes                   |  | 2.5  | 9    | 16   | $V/\mu s$ |

Figure 1



## CIRCUIT DESCRIPTION

The L9337 is a triple low side driver for lines, lamps or inductive loads in automotive and industrial applications.

All Inputs are TTL or CMOS compatible. This allows the device to be driven directly by a micro-controller. For the noise immunity, all inputs have a Schmitt-trigger with a hysteresis of typ. 100mV. Each input stage has an input voltage protection from -24V to 10V. The device can be activated with a 'high' signal on ENable input. ENable 'low' switches the device into the sleep mode. In this mode the quiescent current is less than 10 $\mu$ A. A high signal on PRoGramming input changes the signal transfer polarity from noninverting into the inverting mode. Normally this pin is connected to V<sub>S</sub> or GND. These pins (PRG and EN) are internally fixed at low status by open input condition. Independent of the PRoGramming input, the OUTput switches off, if the signal INput pin is not connected.

Each output driver has a current limitation of min 0.4A and a separate thermal shut-down. The thermal shut-down deactivates that output which ex-

ceeds Temperature switch off level. About 20K below this temperature threshold the output will be activated again. This means, that each output is able to sink continuously 285mA without activating thermal shut-down at 85°C ambient temperature (SO20). The slew rate of the output is limited to max. 14V/ $\mu$ s to reduce the electromagnetic interference, but not for the enable transfer characteristic (see fig. 1). An integrated active fly-back voltage limitation clamps the output voltage during the flyback phase of inductive loads to typ. 50V. The power DMOS switches ON, if the device is enabled and the OUTput swings below ground. This protection avoids the activation of parasitics inside the power DMOS.

The DIAGnostic is an open drain output. The logic status depends on the PRoGramming pin. If the PRG pin is 'low' the DIAG output becomes low, if the device works correctly.

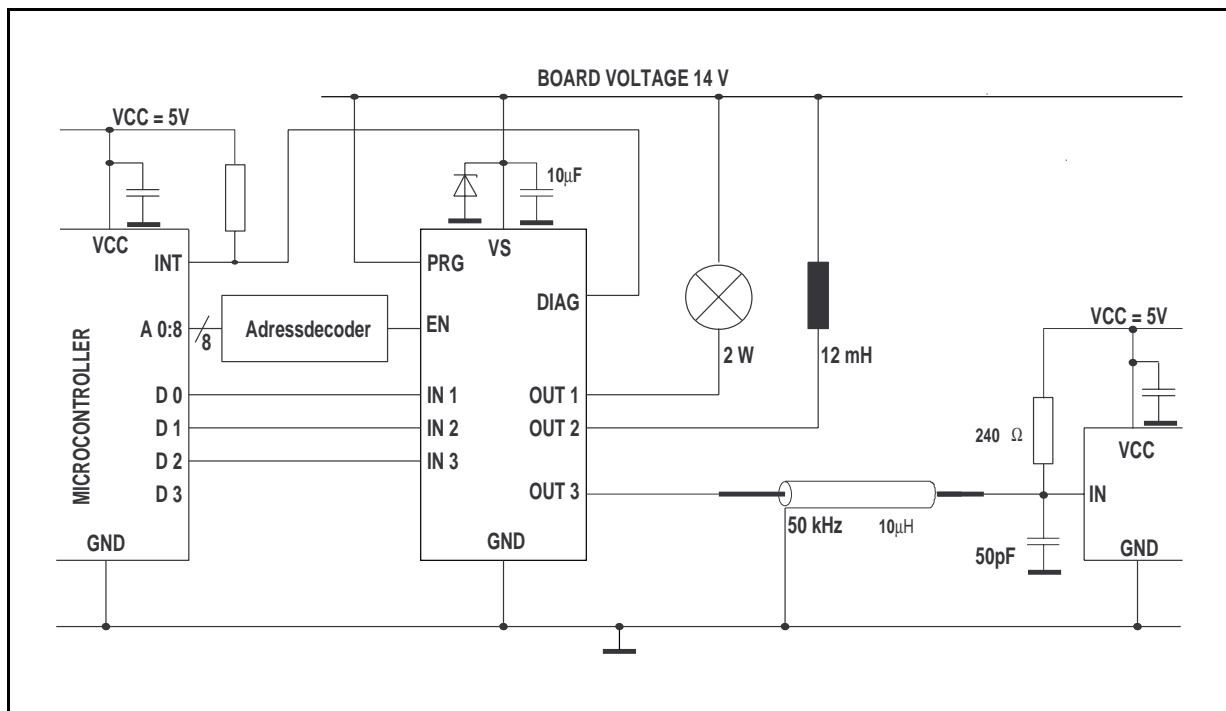
At thermal shut-down of one channel, disconnected ground or supply voltage the DIAGnostic output becomes high. If the PRG pin is 'high' this output is switched off at normal function and switched on at overtemperature.

## DIAGNOSTIC TABLE

| Pins   | EN | PRG | IN | OUT       | DIAG    |
|--|----|-----|----|-----------|---------|
| Normal function  | H  | L   | L  | L (on)    | L (on)  |
|  | H  | L   | H  | H (off)   | L (on)  |
|  | H  | H   | L  | H (off)   | H(off)  |
|  | H  | H   | H  | L (on)    | H(off)  |
|  | L  | X   | X  | H (off)   | H(off)  |
| Overtemperature, disconnected ground or supply voltage | H  | L   | X  | H (off) * | H (off) |
| Overtemperature  | H  | H   | X  | H (off) * | L (on)  |

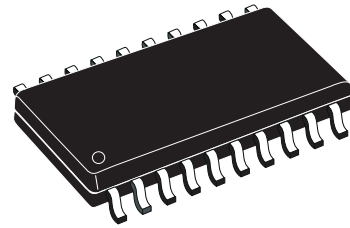
X = not relevant \* selective for each channel at overtemperature

Figure 2: Application circuit for inverting transfer polarity.

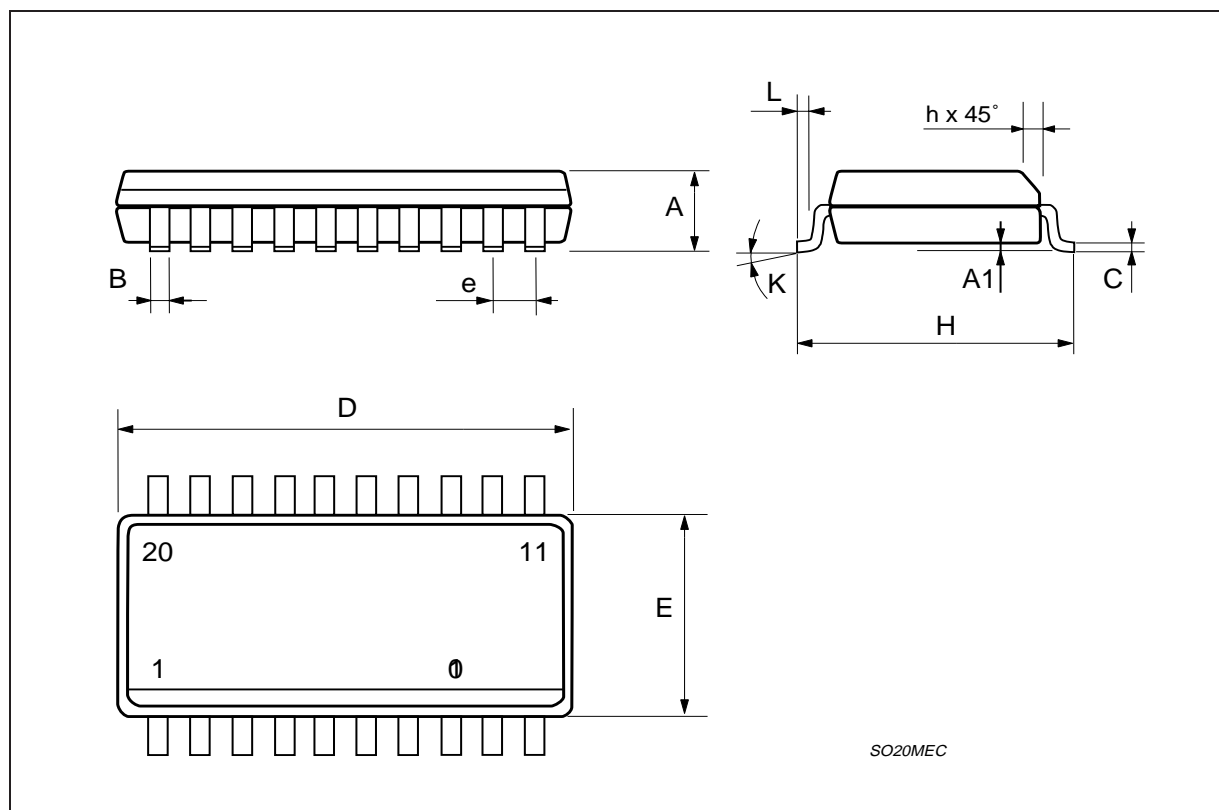


| DIM. | mm                 |      |       | inch  |       |       |
|------|--------------------|------|-------|-------|-------|-------|
|      | MIN.               | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 2.35               |      | 2.65  | 0.093 |       | 0.104 |
| A1   | 0.1                |      | 0.3   | 0.004 |       | 0.012 |
| B    | 0.33               |      | 0.51  | 0.013 |       | 0.020 |
| C    | 0.23               |      | 0.32  | 0.009 |       | 0.013 |
| D    | 12.6               |      | 13    | 0.496 |       | 0.512 |
| E    | 7.4                |      | 7.6   | 0.291 |       | 0.299 |
| e    |                    | 1.27 |       |       | 0.050 |       |
| H    | 10                 |      | 10.65 | 0.394 |       | 0.419 |
| h    | 0.25               |      | 0.75  | 0.010 |       | 0.030 |
| L    | 0.4                |      | 1.27  | 0.016 |       | 0.050 |
| K    | 0° (min.)8° (max.) |      |       |       |       |       |

## OUTLINE AND MECHANICAL DATA



**SO20**



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