

DATA SHEET

TDA3609JR

Multiple voltage regulator with
switch and ignition buffers

Preliminary specification
File under Integrated Circuits, IC01

1997 Aug 15

Multiple voltage regulator with switch and ignition buffers

TDA3609JR

FEATURES

General

- Extreme low noise behaviour and good stability with very small output capacitors
- Two V_P -state controlled regulators (regulator 1 and regulator 3) and a power switch
- Regulator 2, reset and ignition buffer operate during load dump and thermal shutdown
- Separate control pins for switching regulator 1, regulator 3 and the power switch
- Supply voltage range of -18 to $+50$ V
- Low reverse current of regulator 2
- Low quiescent current (when regulator 1, regulator 3, and power switch are switched-off)
- Hold output (only valid when regulator 1 is switched-on)
- Reset and hold outputs (open collector outputs)
- Adjustable reset delay time
- High ripple rejection
- Back-up capacitor for regulator 2
- Two independent ignition buffers (one inverted and with open collector output).

Protections

- Reverse polarity safe (down to -18 V without high reverse current)
- Able to withstand voltages up to 18 V at the outputs (supply line may be short-circuited)
- ESD protected on all pins
- Thermal protections with hysteresis
- Load dump protection
- Foldback current limit protection for regulators 1, 2 and 3
- Delayed second current limit protection for the power switch (at short-circuit)
- The regulator outputs and the power switch are DC short-circuited safe to ground and V_P .

GENERAL DESCRIPTION

The TDA3609JR is a multiple output voltage regulator with a power switch and ignition buffers, intended for use in car radios with or without a microcontroller. It contains:

- Two fixed voltage regulators with a foldback current protection (regulator 1 and regulator 3) and one fixed voltage regulator (regulator 2), intended to supply a microcontroller, that also operates during load dump and thermal shutdown
- A power switch with protections, operated by an enable input
- Reset and hold outputs that can be used to interface by the microcontroller. The reset-signal can be used to call up the microcontroller and the hold output indicates regulator 1 voltage available and within range.
- A supply pin which can withstand load dump pulses and negative supply voltages.
- Regulator 2 that will be switched on at a back-up voltage greater than 6.5 V and off when the output voltage of regulator 2 drops below 1.9 V.
- A provision for use of a reserve supply capacitor that will hold enough energy for regulator 2 (5 V continuous) to allow a microcontroller to prepare for loss of voltage.
- An inverted ignition 1 input with open collector output stage.
- An ignition 2 input Schmitt trigger with push pull output stage.

ORDERING INFORMATION

| TYPE NUMBER | PACKAGE | | |
|-------------|---------|---------------------------------------------------------------------------------|----------|
| | NAME | DESCRIPTION | VERSION |
| TDA3609JR | DBS17P | plastic DIL-bent-SIL (special bent) power package; 17 leads (lead length 12 mm) | SOT475-1 |

Multiple voltage regulator with switch and
ignition buffers

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QUICK REFERENCE DATA

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---------------------------|--------------------------------|------------------------------------------------------------------------------------|------|------|------|--------------------|
| Supply | | | | | | |
| V_P | supply voltage operating | | 11 | 14.4 | 18 | V |
| | reverse polarity | non-operating | – | – | –18 | V |
| | regulator 2 on | | 2.4 | 14.4 | 50 | V |
| | jump start | $t \leq 10$ minutes | – | – | 30 | V |
| | load dump protection | $t \leq 50$ ms; $t_r \geq 2.5$ ms | – | – | 50 | V |
| $I_{q(\text{tot})}$ | total quiescent supply current | standby mode | – | 500 | 600 | μA |
| T_j | junction temperature | | – | – | 150 | $^{\circ}\text{C}$ |
| Voltage regulators | | | | | | |
| $V_{O(\text{REG}1)}$ | output voltage regulator 1 | $1 \text{ mA} \leq I_{\text{REG}1} \leq 600 \text{ mA}$ | 9.5 | 10.0 | 10.5 | V |
| $V_{O(\text{REG}2)}$ | output voltage regulator 2 | $0.5 \text{ mA} \leq I_{\text{REG}2} \leq 150 \text{ mA}$; $V_P = 14.4 \text{ V}$ | 4.75 | 5.0 | 5.25 | V |
| $V_{O(\text{REG}3)}$ | output voltage regulator 3 | $1 \text{ mA} \leq I_{\text{REG}3} \leq 500 \text{ mA}$ | 4.75 | 5.0 | 5.25 | V |
| Power switch | | | | | | |
| V_d | drop-out voltage | $I_{\text{sw}} = 1 \text{ A}$ | – | 0.45 | 0.7 | V |
| | | $I_{\text{sw}} = 1.8 \text{ A}$ | – | 1 | 1.8 | V |
| I_M | peak current | | 3 | – | – | A |

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BLOCK DIAGRAM

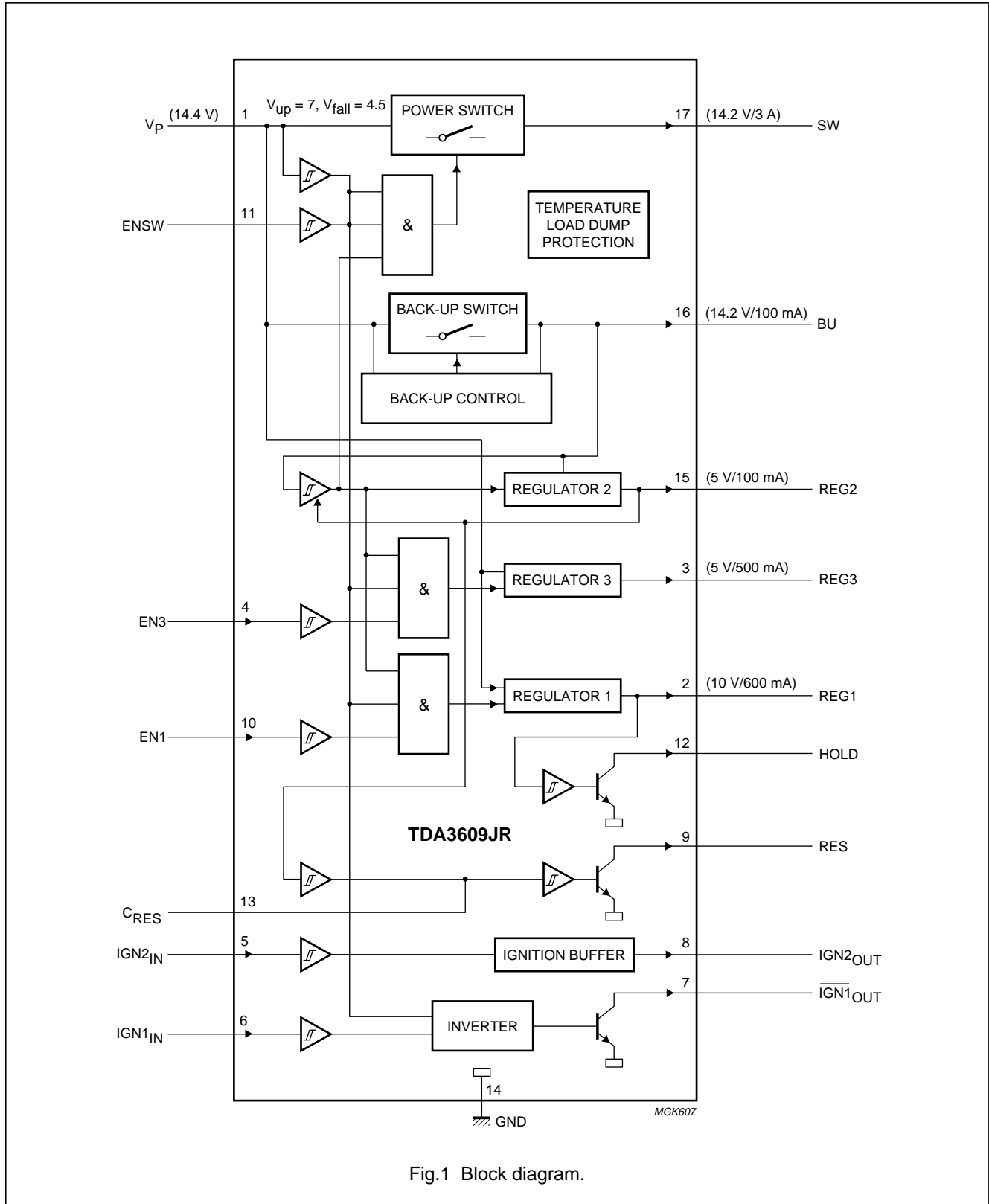


Fig.1 Block diagram.

Multiple voltage regulator with switch and ignition buffers

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PINNING

| SYMBOL | PIN | DESCRIPTION |
|---------------------|-----|--------------------------------|
| V _P | 1 | supply voltage |
| REG1 | 2 | regulator 1 output |
| REG3 | 3 | regulator 3 output |
| EN3 | 4 | enable input regulator 3 |
| IGN2 _{IN} | 5 | ignition 2 input |
| IGN1 _{IN} | 6 | ignition 1 input |
| IGN1 _{OUT} | 7 | ignition 1 output (active LOW) |
| IGN2 _{OUT} | 8 | ignition 2 output |
| RES | 9 | reset output |
| EN1 | 10 | enable input regulator 1 |
| ENSW | 11 | enable input power switch |
| HOLD | 12 | hold output |
| C _{RES} | 13 | reset delay capacitor |
| GND | 14 | ground |
| REG2 | 15 | regulator 2 output |
| BU | 16 | back-up |
| SW | 17 | power switch output |

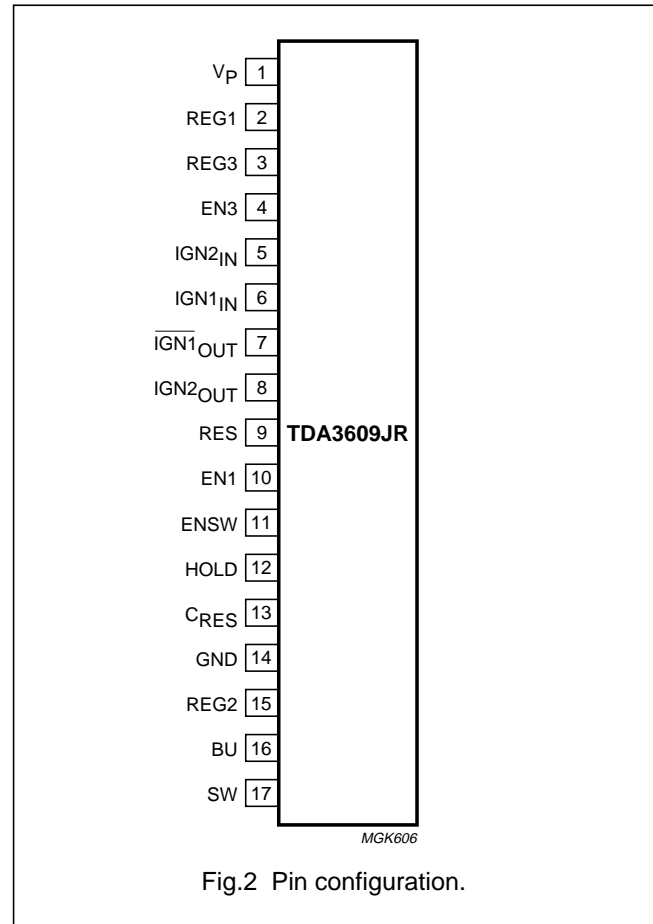


Fig.2 Pin configuration.

FUNCTIONAL DESCRIPTION

The TDA3609JR is a multiple output voltage regulator with a power switch, intended for use in car radios with or without a microcontroller. Because of low-voltage operation of the car radio, low-voltage drop regulators are used in the TDA3609JR.

Regulator 2 will switch on when the back-up voltage exceeds 6.5 V for the first time and will switch off again when the output voltage of regulator 2 is below 1.9 V (this is far below an engine start). When regulator 2 is switched on and the output voltage of this regulator is within its voltage range, the reset output will be enabled (reset will go HIGH via a pull-up resistor) to generate a reset to the microcontroller. The reset cycles can be extended by an external capacitor at pin 13. The above mentioned start-up feature is built-in to secure a smooth start-up of the microcontroller at first connection, without uncontrolled switching of regulator 2 during the start-up sequence.

The charge of the back-up capacitor can be used to supply regulator 2 for a short period when the supply falls down to 0 V (time depends on value of storage capacitor).

The output stages (regulator 1 and 3) of this regulator have extreme low noise behaviour and good stability. Using small output capacitors regulator 1 and 3 are made stable.

When both regulator 2 and the supply voltage ($V_P > 4.5$ V) are available, regulators 1 and 3 can be operated by means of enable inputs (pins 10 and 4 respectively).

Regulator 1 has a hold output (open collector) indicating that the output voltage of this regulator is settled (held HIGH by external pull-up resistor). When the output voltage of this regulator drops out of regulation (because of supply voltage drop or high load) the hold output will go LOW. The hold output signal is only valid when regulator 1 is enabled by its enable input (pin 10).

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The power switch can also be controlled by means of a separate enable input (pin 11).

All output pins are fully protected. The regulators are protected against load dump (regulator 1 and 3 will switch off at supply voltages >18 V) and short-circuit (foldback current protection).

The switch contains a current protection, but this protection is delayed at short-circuit condition for at least 10 ms. During this time the output current is limited to a peak value of at least 3 A and 2 A continuous ($V_P \leq 18 V$).

At supply voltages >17 V the switch is clamped at maximum 16 V (to avoid external connected circuitry being damaged by an overvoltage) and the switch will switch off at load dump.

By means of two independent ignition Schmitt triggers and ignition output buffers (one open collector and one push-pull output), interfacing with the microcontroller can be accomplished (simple full/semi on/off logic applications). The ignition 1 output is inverted.

The total timing diagrams are shown in Figs 3 and 4.

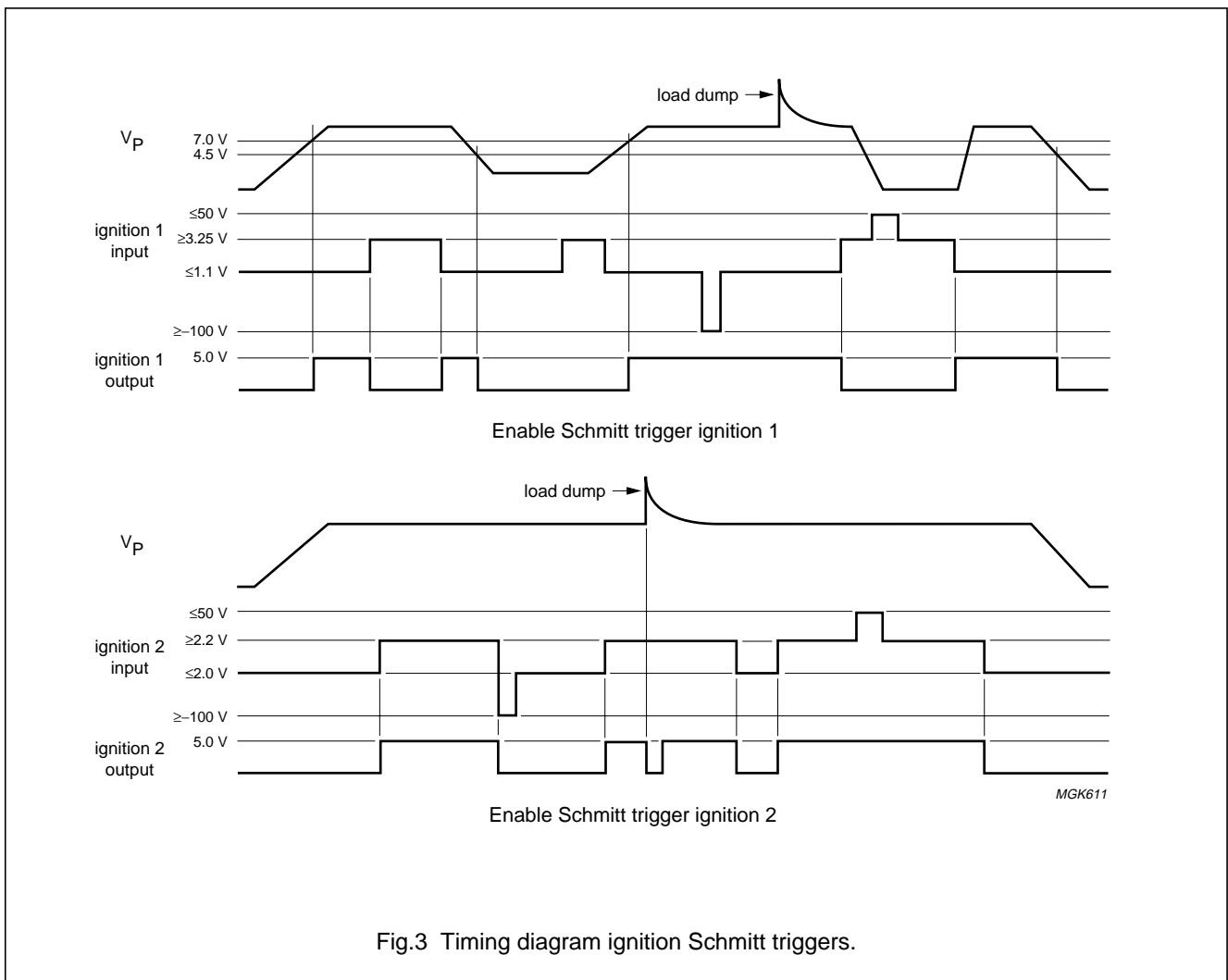
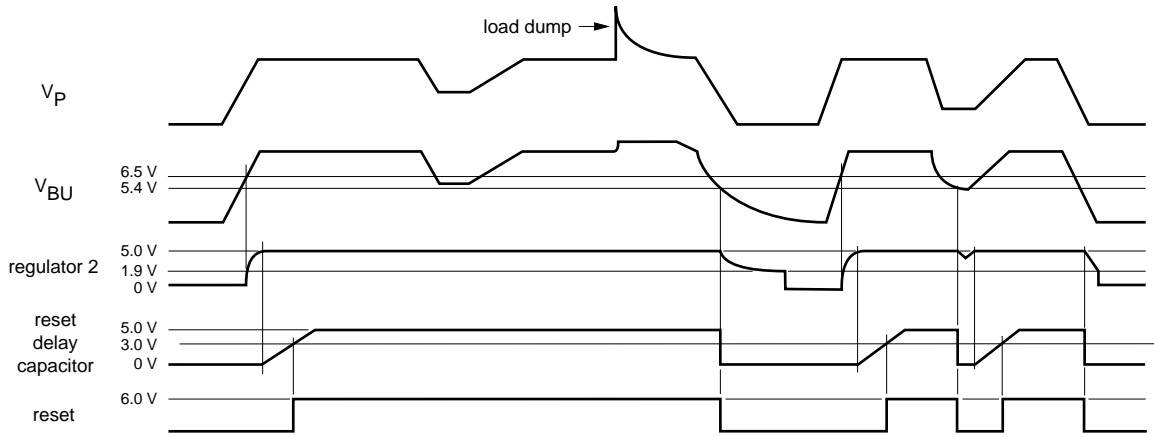


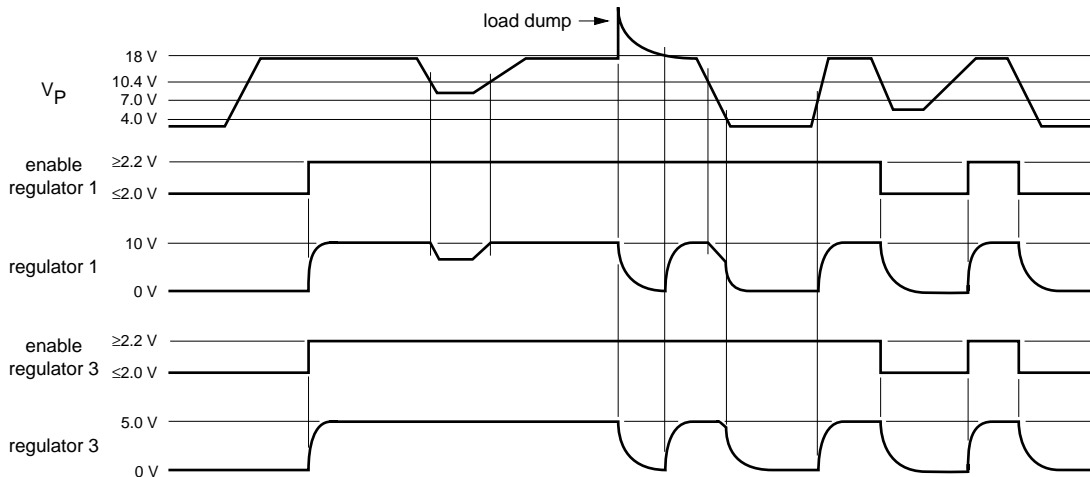
Fig.3 Timing diagram ignition Schmitt triggers.

Multiple voltage regulator with switch and ignition buffers

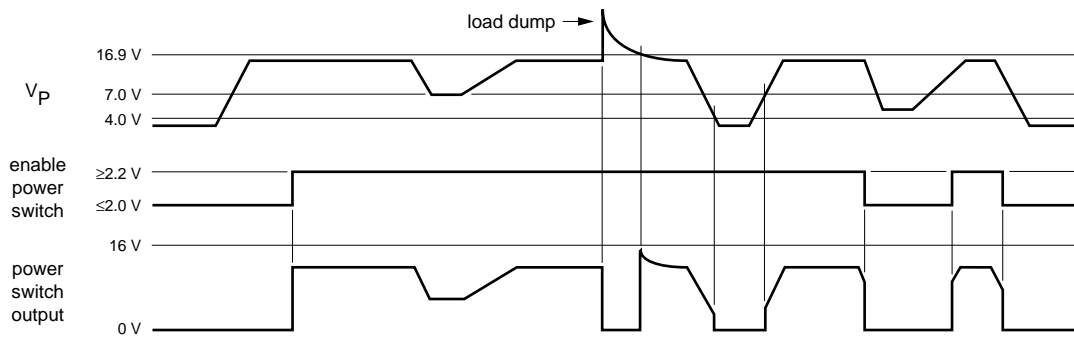
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Back-up Schmitt trigger and reset behaviour



V_P and enable Schmitt trigger



Power switch behaviour

MGK610

Fig.4 Timing diagram regulators and power switch.

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LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|------------------|-------------------------|------------------------------------|------|------|------|
| V _P | supply voltage | | | | |
| | operating | | – | 18 | V |
| | reverse polarity | non-operating | – | –18 | V |
| | jump start | t ≤ 10 minutes | – | 30 | V |
| | load dump protection | t ≤ 50 ms; t _r ≥ 2.5 ms | – | 50 | V |
| P _{tot} | total power dissipation | | – | 62 | W |
| T _{stg} | storage temperature | non-operating | –55 | +150 | °C |
| T _{amb} | ambient temperature | operating | –40 | +85 | °C |
| T _j | junction temperature | operating | –40 | +150 | °C |

THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITIONS | VALUE | UNIT |
|----------------------|---------------------------------------------|-------------|-------|------|
| R _{th(j-c)} | thermal resistance from junction to case | | 2 | K/W |
| R _{th(j-a)} | thermal resistance from junction to ambient | in free air | 50 | K/W |

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CHARACTERISTICS

$V_P = 14.4\text{ V}$; $T_{\text{amb}} = 25\text{ °C}$; see Fig.7; unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|-------------------------------------------------------------------------------|------------------------------------------|----------------------------------------------------------------------|------|--------------------------|---------------------------|---------------|
| Supply | | | | | | |
| V_P | supply voltage | | 11 | 14.4 | 18 | V |
| | operating regulator 2 on | note 1 | 2.4 | 14.4 | 18 | V |
| | jump start | $t \leq 10$ minutes | – | – | 30 | V |
| | load dump protection | $t \leq 50\text{ ms}$; $t_r \geq 2.5\text{ ms}$ | – | – | 50 | V |
| I_q | quiescent supply current | $V_P = 12.4\text{ V}$; note 2; $I_{\text{REG2}} = 0.1\text{ mA}$ | – | 500 | 600 | μA |
| | | $V_P = 14.4\text{ V}$; note 2; $I_{\text{REG2}} = 0.1\text{ mA}$ | – | 520 | – | μA |
| Schmitt trigger power supply for switch, regulator 1 and regulator 3 | | | | | | |
| V_{thr} | rising threshold voltage | | 6.5 | 7.0 | 7.5 | V |
| V_{thf} | falling threshold voltage | | 4.0 | 4.5 | 5.0 | V |
| V_{hys} | hysteresis voltage | | 2.1 | 2.5 | 3.3 | V |
| Schmitt trigger for regulator 2 | | | | | | |
| V_{thr} | rising threshold voltage | | 6.0 | 6.5 | 7.1 | V |
| V_{thf} | falling threshold voltage | | 1.7 | 1.9 | 2.2 | V |
| V_{hys} | hysteresis voltage | | – | 4.6 | – | V |
| Schmitt trigger for enable input (regulator 1, regulator 3 and switch) | | | | | | |
| V_{thr} | rising threshold voltage | | 1.7 | 2.2 | 2.7 | V |
| V_{thf} | falling threshold voltage | | 1.5 | 2.0 | 2.5 | V |
| V_{hys} | hysteresis voltage | $I_{\text{REG}} = I_{\text{sw}} = 1\text{ mA}$ | 0.1 | 0.2 | 0.5 | V |
| I_{LI} | input leakage current | $V_{\text{en}} = 5\text{ V}$ | 1 | 5 | 10 | μA |
| Reset trigger level | | | | | | |
| V_{thr} | rising threshold voltage of regulator 2 | V_P rising; $I_{\text{REG1}} = 50\text{ mA}$; note 3 | 4.5 | $V_{\text{REG2}} - 0.15$ | $V_{\text{REG2}} - 0.1$ | V |
| Schmitt trigger for hold | | | | | | |
| V_{thr} | rising threshold voltage of regulator 1 | V_P rising; note 3 | – | $V_{\text{REG1}} - 0.15$ | $V_{\text{REG1}} - 0.075$ | V |
| V_{thf} | falling threshold voltage of regulator 1 | V_P falling; note 3 | 9.2 | $V_{\text{REG1}} - 0.35$ | – | V |
| V_{hys} | hysteresis voltage | | 0.1 | 0.2 | 0.3 | V |
| Reset and hold buffer | | | | | | |
| I_{sinkL} | LOW-level sink current | $V_{\text{RES/HOLD}} \leq 0.8\text{ V}$ | 2 | – | – | mA |
| I_{LO} | output leakage current | $V_P = 14.4\text{ V}$; $V_{\text{RES/HOLD}} = 5\text{ V}$ | – | 0.1 | 5 | μA |
| | rise time | note 4 | – | 7 | 50 | μs |
| | fall time | note 4 | – | 1 | 50 | μs |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--------------------------------------------------------------------------------------|---------------------------------|-------------------------------------------------------------------------------|------|------|------|---------------|
| Reset delay | | | | | | |
| I_{ch} | charge current | | 2 | 4 | 8 | μA |
| I_{dch} | discharge current | | 500 | 800 | – | μA |
| V_{thr} | rising voltage threshold | | 2.5 | 3.0 | 3.5 | V |
| t_d | delay time | $C = 47 \text{ nF}$; note 5 | 20 | 35 | 70 | ms |
| Regulator 1 ($I_{REG1} = 5 \text{ mA}$ unless otherwise specified) | | | | | | |
| $V_{O(off)}$ | output voltage off | | – | 1 | 400 | mV |
| $V_{O(REG1)}$ | output voltage | $1 \text{ mA} \leq I_{REG1} \leq 600 \text{ mA}$ | 9.5 | 10.0 | 10.5 | V |
| | | $12 \text{ V} \leq V_P \leq 18 \text{ V}$ | 9.5 | 10.0 | 10.5 | V |
| ΔV | line regulation | $12 \text{ V} \leq V_P \leq 18 \text{ V}$ | – | 2 | 75 | mV |
| ΔV_L | load regulation | $1 \text{ mA} \leq I_{REG1} \leq 600 \text{ mA}$ | – | 20 | 100 | mV |
| I_q | quiescent current | $I_{R1} = 600 \text{ mA}$ | – | 25 | 60 | mA |
| SVRR | supply voltage ripple rejection | $f_i = 3 \text{ kHz}$; $V_{i(p-p)} = 2 \text{ V}$ | 60 | 70 | – | dB |
| V_d | drop-out voltage | $I_{REG1} = 550 \text{ mA}$; $V_P = 9.5 \text{ V}$; note 6 | – | 0.4 | 0.7 | V |
| I_{REGm1} | current limit | $V_{REG1} > 8.5 \text{ V}$; note 7 | 0.65 | 1.2 | – | A |
| I_{REGsc1} | short-circuit current | $R_L \leq 0.5 \Omega$; note 8 | 250 | 800 | – | mA |
| Regulator 2 ($I_{REG2} = 5 \text{ mA}$ unless otherwise specified) | | | | | | |
| $V_{O(REG2)}$ | output voltage | $0.5 \text{ mA} \leq I_{REG2} \leq 150 \text{ mA}$ | 4.75 | 5.0 | 5.25 | V |
| | | $I_{REG2} = 300 \text{ mA}$; note 9 | 4.75 | 5.0 | 5.25 | V |
| | | $8 \text{ V} \leq V_P \leq 18 \text{ V}$ | 4.75 | 5.0 | 5.25 | V |
| | | $18 \text{ V} \leq V_P \leq 50 \text{ V}$; $I_{REG2} \leq 150 \text{ mA}$ | 4.75 | 5.0 | 5.25 | V |
| ΔV | line regulation | $6 \text{ V} \leq V_P \leq 18 \text{ V}$ | – | 2 | 50 | mV |
| | | $6 \text{ V} \leq V_P \leq 50 \text{ V}$ | – | 15 | 75 | mV |
| ΔV_L | load regulation | $1 \text{ mA} \leq I_{REG2} \leq 150 \text{ mA}$ | – | 20 | 50 | mV |
| | | $1 \text{ mA} \leq I_{REG2} \leq 300 \text{ mA}$ | – | – | 100 | mV |
| SVRR | supply voltage ripple rejection | $f = 3 \text{ kHz}$; $V_{i(p-p)} = 2 \text{ V}$ | 60 | 70 | – | dB |
| V_d | drop-out voltage | $I_{REG2} = 100 \text{ mA}$; $V_P = 4.75 \text{ V}$; note 6 | – | 0.4 | 0.6 | V |
| | | $I_{REG2} = 200 \text{ mA}$; $V_P = 5.75 \text{ V}$; note 6 | – | 0.8 | 1.2 | V |
| | | $I_{REG2} = 100 \text{ mA}$; $V_{bu} = 4.75 \text{ V}$; note 10 | – | 0.2 | 0.5 | V |
| | | $I_{REG2} = 200 \text{ mA}$; $V_{bu} = 5.75 \text{ V}$; note 10 | – | 0.8 | 1.0 | V |
| I_{REGm2} | current limit | $V_{REG2} > 4.5 \text{ V}$; note 7 | 0.32 | 0.37 | – | A |
| I_{REGsc2} | short-circuit current | $R_L \leq 0.5 \Omega$; note 8 | 20 | 100 | – | mA |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------|-------|-----------|------|---------------|
| Regulator 3 ($I_{REG3} = 5 \text{ mA}$ unless otherwise specified) | | | | | | |
| $V_{O(off)}$ | output voltage off | | – | 1 | 400 | mV |
| $V_{O(REG3)}$ | output voltage | $1 \text{ mA} \leq I_{REG3} \leq 500 \text{ mA}$ | 4.75 | 5.0 | 5.25 | V |
| | | $7 \text{ V} \leq V_P \leq 18 \text{ V}$ | 4.75 | 5.0 | 5.25 | V |
| ΔV | line regulation | $7 \text{ V} \leq V_P \leq 18 \text{ V}$ | – | 2 | 50 | mV |
| ΔV_L | load regulation | $1 \text{ mA} \leq I_{REG3} \leq 500 \text{ mA}$ | – | 20 | 75 | mV |
| I_q | quiescent current | $I_{R3} = 500 \text{ mA}$ | – | 19 | 45 | mA |
| SVRR | supply voltage ripple rejection | $f_i = 3 \text{ kHz}$; $V_{i(p-p)} = 2 \text{ V}$ | 60 | 70 | – | dB |
| V_d | drop-out voltage | $I_{REG3} = 500 \text{ mA}$; $V_P = 5.75 \text{ V}$; note 6 | – | 1 | 1.5 | V |
| I_{REGm3} | current limit | $V_{REG3} > 4.5 \text{ V}$; note 7 | 0.60 | 0.80 | – | A |
| I_{REGsc3} | short-circuit current | $R_L \leq 0.5 \Omega$; note 8 | 100 | 400 | – | mA |
| Power switch | | | | | | |
| V_d | drop-out voltage | $I_{sw} = 1 \text{ A}$; $V_P = 13.5 \text{ V}$; note 11 | – | 0.6 | 0.85 | V |
| | | $I_{sw} = 1.8 \text{ A}$; $V_P = 13.5 \text{ V}$; note 11 | – | 1.4 | 1.9 | V |
| I_{dc} | continuous current | $V_P = 16 \text{ V}$; $V_{sw} = 13.5 \text{ V}$ | 1.8 | 2.0 | – | A |
| V_{cl} | clamping voltage | $V_P \geq 17 \text{ V}$ | 13.5 | 15.0 | 16.0 | V |
| I_M | peak current | $V_P = 17 \text{ V}$; notes 12 and 13 | 3 | – | – | A |
| V_{fb} | fly back voltage behaviour | $I_{sw} = -100 \text{ mA}$ | – | $V_P + 3$ | 22 | V |
| I_{sc} | short-circuit current | $V_P = 14.4 \text{ V}$; $V_{sw} < 1.2 \text{ V}$; note 13 | – | 0.8 | – | A |
| Back-up switch | | | | | | |
| I_{dc} | continuous current | | 0.3 | 0.35 | – | A |
| V_{cl} | clamping voltage | $V_P \geq 16.7 \text{ V}$ | – | – | 16 | V |
| I_r | reverse current | $V_P = 0 \text{ V}$; $V_{bu} = 12.4 \text{ V}$ | – | – | 900 | mA |
| Schmitt trigger for enable input of ignition 1 | | | | | | |
| V_{thr} | rising threshold voltage of ignition 1 input | | 2.75 | 3.25 | 3.75 | V |
| V_{thf} | falling threshold voltage of ignition 1 input | | 0.8 | – | 1.3 | V |
| V_{hys} | hysteresis voltage | | 1.5 | – | – | V |
| I_{LI} | input leakage current | $V_{IGN1in} = 5 \text{ V}$ | – | – | 1.0 | μA |
| $I_{I(clamp)}$ | input clamping current | $V_{IGN1in} > 50 \text{ V}$ | – | – | 50 | mA |
| $V_{IH(clamp)}$ | HIGH-level input clamping voltage | | V_P | – | 50 | V |
| $V_{IL(clamp)}$ | LOW-level input clamping voltage | | –0.6 | – | 0 | V |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|-------------------------------------------------------|-----------------------------------------------|-------------------------------------------|-------|------|------|---------|
| Schmitt trigger power supply for ignition 1 | | | | | | |
| V_{thr} | rising threshold voltage | | 6.5 | 7.0 | 7.5 | V |
| V_{thf} | falling threshold voltage | note 14 | 4.0 | 4.5 | 5.0 | V |
| Ignition 1 buffer | | | | | | |
| V_{OL} | LOW-level output voltage | $I_{IGN1out} = 0$ mA | 0 | 0.2 | 0.8 | V |
| I_{OL} | LOW-level output current | $V_{IGN1out} \leq 0.8$ V | 0.45 | 0.8 | – | mA |
| I_{LO} | output leakage current | $V_{IGN1out} = 5$ V; $V_{IGN1in} = 0$ V | – | – | 1.0 | μ A |
| t_{PLH} | LOW-to-HIGH propagation time | V_{IGN1in} rising from 0.8 V to 3.75 V | – | – | 500 | μ s |
| t_{PHL} | HIGH-to-LOW propagation time | V_{IGN1in} falling from 3.75 V to 0.8 V | – | – | 500 | μ s |
| Schmitt trigger for enable input of ignition 2 | | | | | | |
| V_{thr} | rising threshold voltage of ignition 2 input | $V_P > 3.5$ V | 1.9 | 2.2 | 2.5 | V |
| V_{thf} | falling threshold voltage of ignition 2 input | $V_P > 3.5$ V | 1.7 | 2.0 | 2.3 | V |
| V_{hys} | hysteresis voltage | $V_P > 3.5$ V | 0.1 | 0.2 | 0.5 | V |
| I_{LI} | input leakage current | $V_{IGN2in} = 5$ V | – | – | 1.0 | μ A |
| $I_{I(clamp)}$ | input clamp current | $V_{IGN2in} > 50$ V | – | – | 50 | mA |
| $V_{IH(clamp)}$ | HIGH-level input clamping voltage | | V_P | – | 50 | V |
| $V_{IL(clamp)}$ | LOW-level input clamping voltage | | –0.6 | – | 0 | V |

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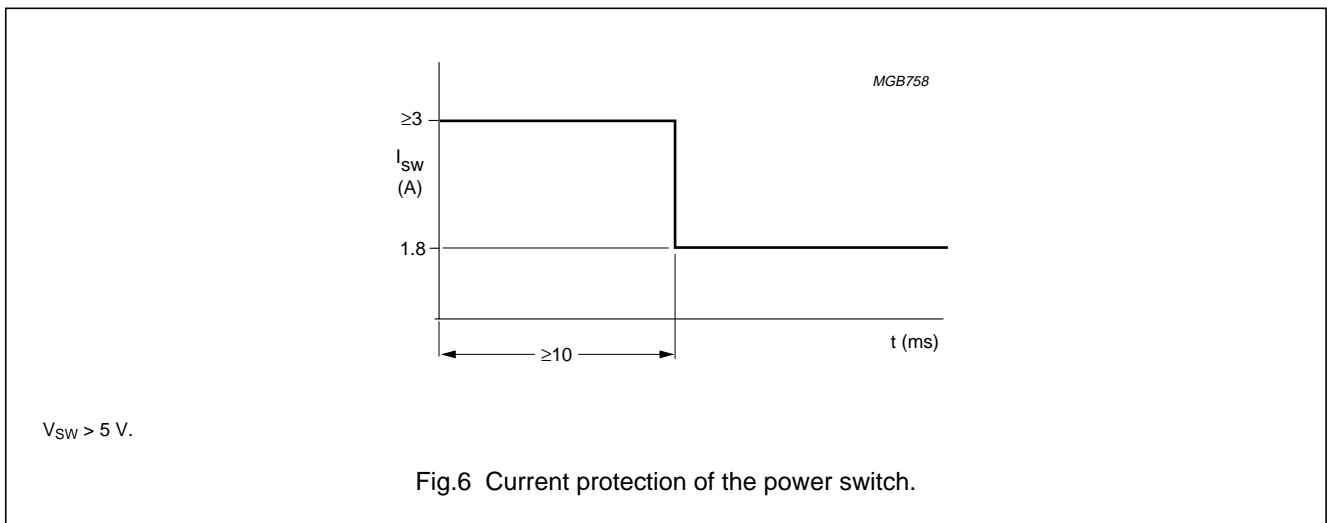
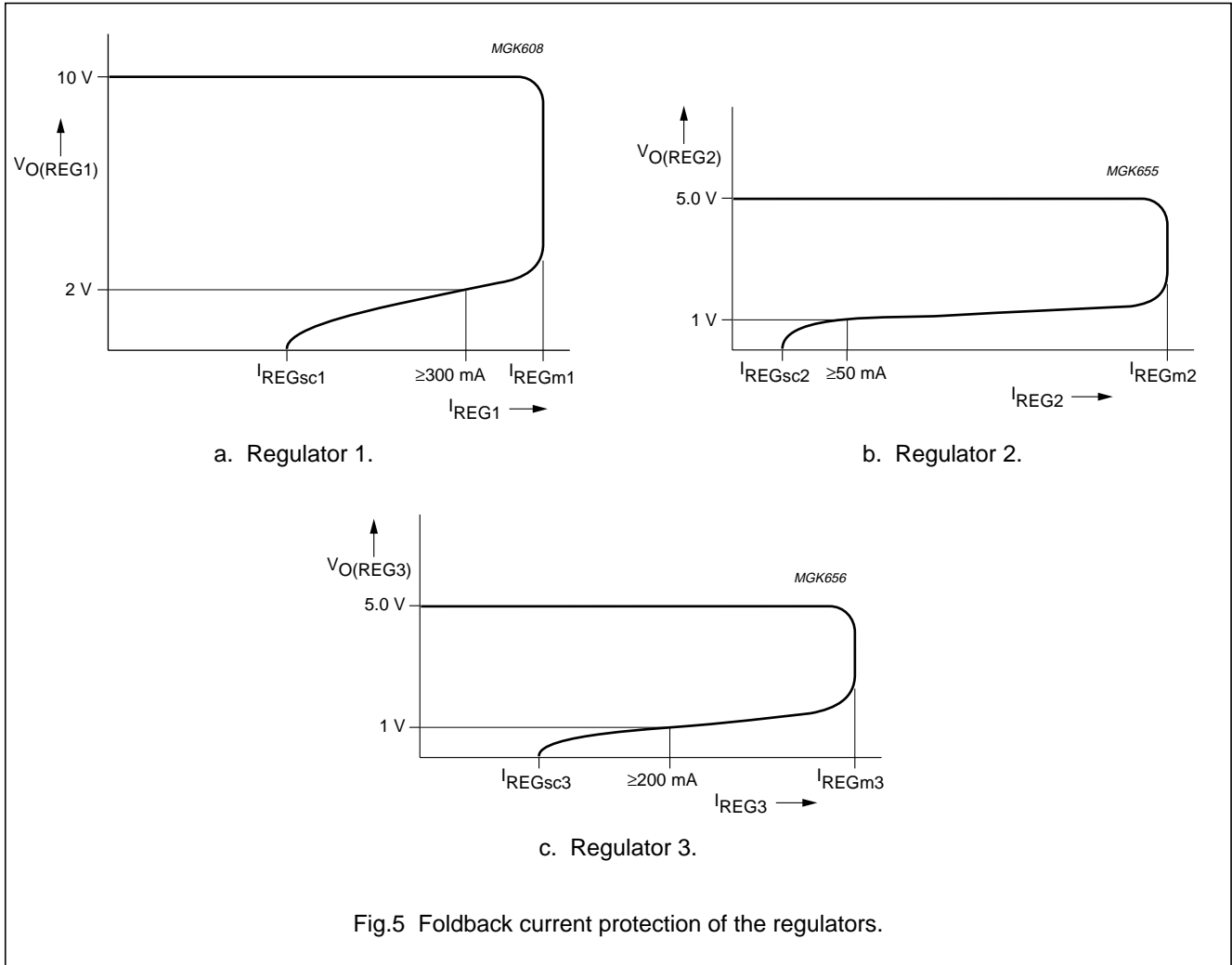
| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--------------------------|---------------------------------|-------------------------------------------------------|-------|------|------|------|
| Ignition 2 buffer | | | | | | |
| V _{OL} | LOW-level output voltage | I _{IGN2out} = 0 mA | 0 | 0.2 | 0.8 | V |
| V _{OH} | HIGH-level output voltage | I _{IGN2out} = 0 mA | 4.5 | 5.0 | 5.25 | V |
| I _{OL} | LOW-level output current | V _{IGN2out} ≤ 0.8 V | 0.45 | 0.8 | – | mA |
| I _{OH} | HIGH-level output current | V _{IGN2out} ≥ 4.5 V | –0.45 | –2.0 | – | mA |
| I _{LO} | output leakage current (source) | V _{IGN1out} = 5 V; V _{IGN1in} = 0 V | – | – | 1.0 | μA |
| t _{PLH} | LOW-to-HIGH propagation time | V _{IGN2in} rising from 1.7 V to 2.5 V | – | – | 500 | μs |
| t _{PHL} | HIGH-to-LOW propagation time | V _{IGN2in} falling from 2.5 V to 1.7 V | – | – | 500 | μs |

Notes

- Minimum operating voltage, only if V_P has exceeded 6.5 V.
- The quiescent current is measured in the standby mode. So, the enable inputs of regulator 1, 3 and the power switch are grounded and R_{L(REG2)} = ∞ (see Fig.7).
- The voltage of the regulator sinks as a result of a V_P drop.
- The rise and fall time is measured with a 10 kΩ pull-up resistor and a 50 pF load capacitor.
- The delay time depends on the value of the capacitor: $t_d = \frac{C}{I_{ch}} \times V_{C(th)} = C \times (750 \times 10^3)$ (ms)
- The drop-out voltage of regulators 1, 2 and 3 is measured between V_P and REGn.
- At current limit, I_{REGmn} is held constant (see Fig.5 for behaviour of I_{REGmn}).
- The foldback current protection limits the dissipated power at short-circuit (see Fig.5).
- The peak current of 300 mA can only be applied for short periods (t < 100 ms).
- The drop-out voltage measured between BU and REG2.
- The drop-out voltage of the power switch is measured between V_P and SW.
- The maximum output current of the switch is limited to 1.8 A when the supply voltage exceeds 18 V. A test-mode is built-in. The delay time of the switch will be disabled when a voltage of V_P + 1 V is applied to the switch-enable input.
- At short-circuit, I_{sc} of the power switch is held constant to a lower value than the continuous current after a delay of at least 10 ms. A test-mode is built-in. The delay time of the switch will be disabled when a voltage of V_P + 1 V is applied to the switch-enable input.
- V_{IGN1out} = LOW for V_{IGN1out} > 1.2 V or V_{EN1} > 1.3 V or V_{EN3} > 1.3 V or V_{ENSW} > 1.3 V.

Multiple voltage regulator with switch and ignition buffers

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TEST AND APPLICATION INFORMATION

Test information

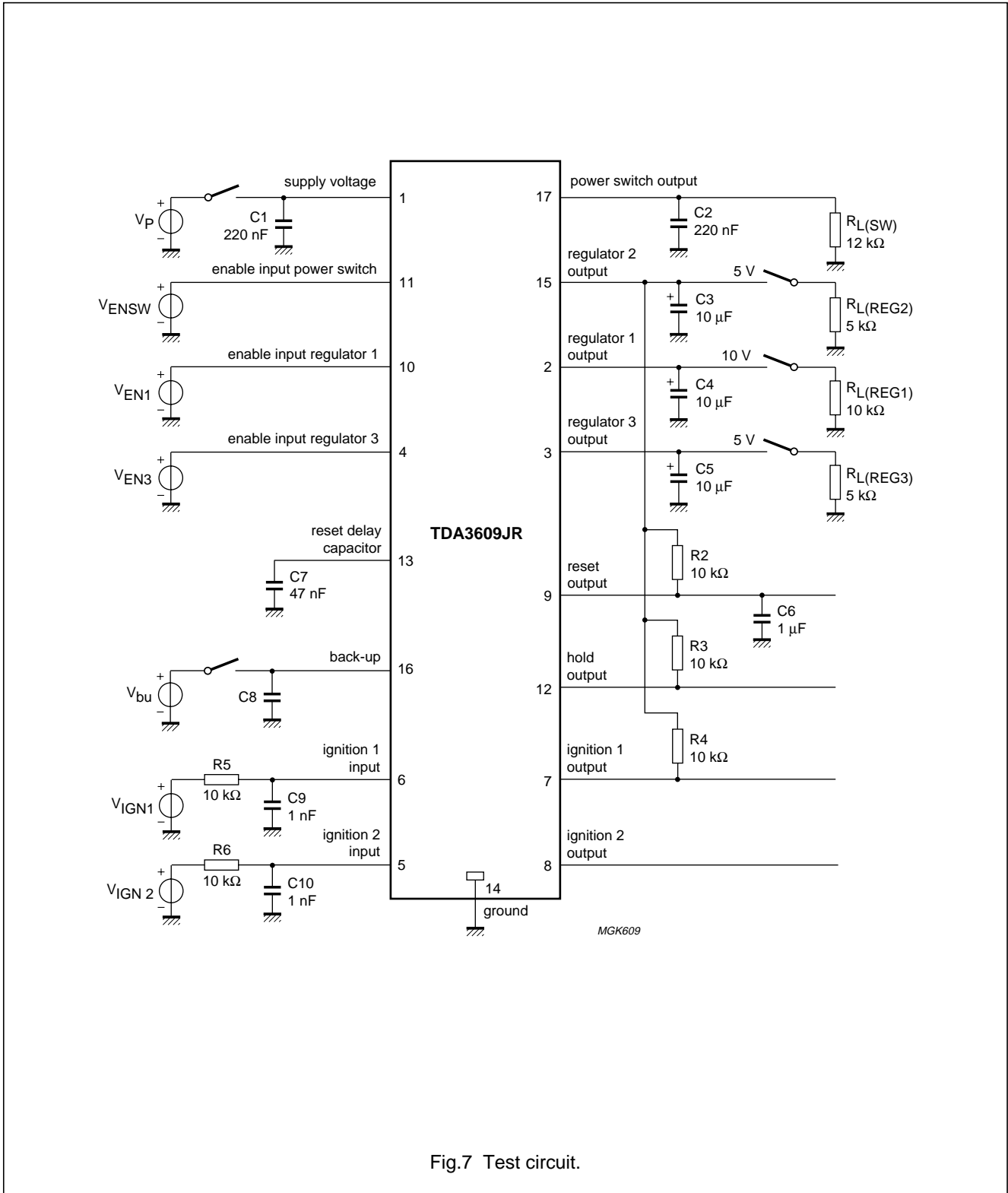


Fig.7 Test circuit.

Multiple voltage regulator with switch and ignition buffers

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Application information

NOISE

Table 1 Noise figures

| REGULATOR | NOISE FIGURE (μV) ⁽¹⁾ | | |
|-----------|-----------------------------------------------|------------------------|-------------------------|
| | $C_O = 10 \mu\text{F}$ | $C_O = 47 \mu\text{F}$ | $C_O = 100 \mu\text{F}$ |
| 1 | tbf | 150 | tbf |
| 2 | tbf | 150 | tbf |
| 3 | tbf | 200 | tbf |

Note

1. Measured at a bandwidth of 200 kHz.

The noise on the supply line depends on the value of the supply capacitor and is caused by a current noise (output noise of the regulators is translated into a current noise by means of the output capacitors). When a high frequency capacitor of 220 nF in parallel with an electrolytic capacitor of 100 μF is connected directly to pins 1 and 14 (supply and ground) the noise is minimal.

STABILITY

The regulators are made stable with the external connected output capacitors.

The output capacitors can be selected using the graphs of Figs 8 and 9. When an electrolytic capacitor is used, the temperature behaviour of this output capacitor can cause oscillations at a low temperature. The next 2 examples show how an output capacitor value is selected.

Example 1

Regulators 1 and 3 are made stable with an electrolytic output capacitor of 220 μF (ESR = 0.15 Ω). At -30°C the capacitor value is decreased to 73 μF and the ESR is increased to 1.1 Ω . The regulator will remain stable at -30°C .

Example 2

Regulator 2 is made stable with a 10 μF electrolytic capacitor (ESR = 3 Ω). At -30°C the capacitor value is decreased to 3 μF and the ESR is increased to 23.1 Ω . Using Fig.9, the regulator will be instable at -30°C .

Solution

Use a tantalum capacitor of 10 μF or a larger electrolytic capacitor. To avoid problems with stability at low temperatures, the use of tantalum capacitors is recommended.

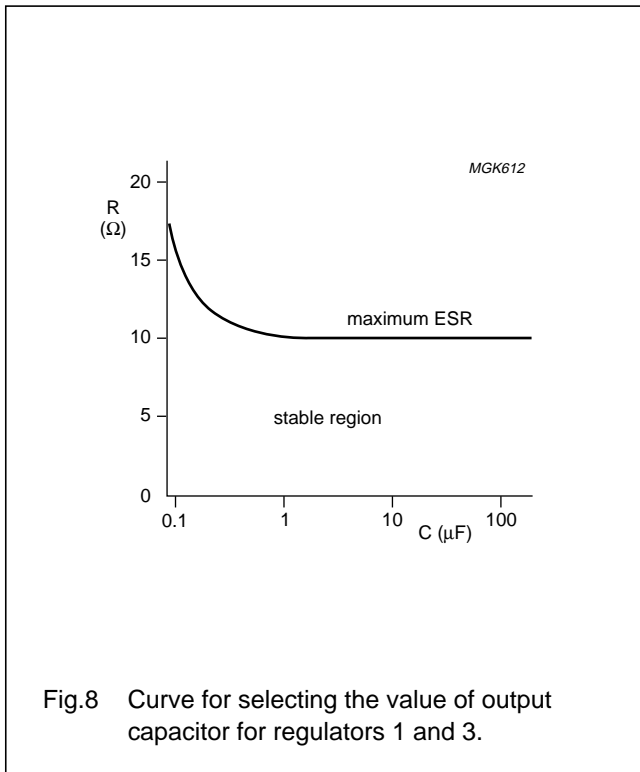


Fig.8 Curve for selecting the value of output capacitor for regulators 1 and 3.

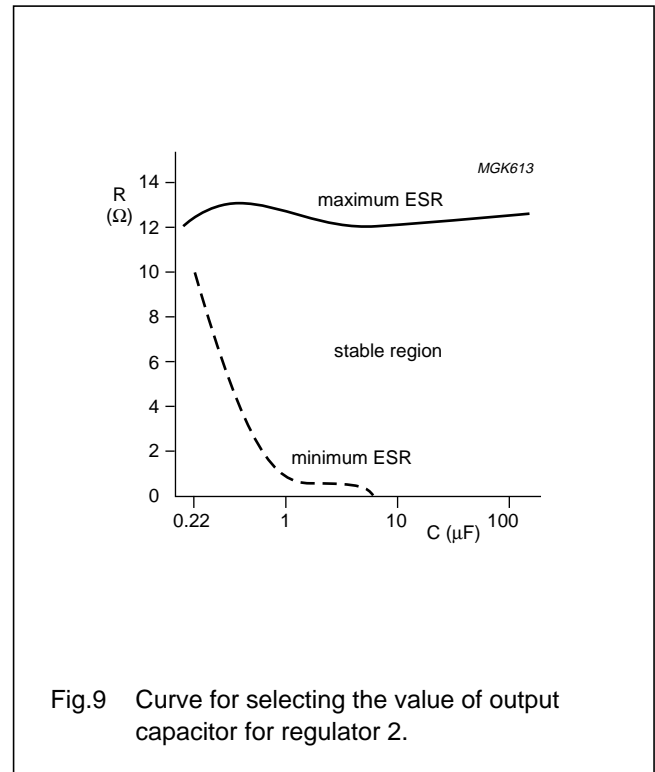


Fig.9 Curve for selecting the value of output capacitor for regulator 2.

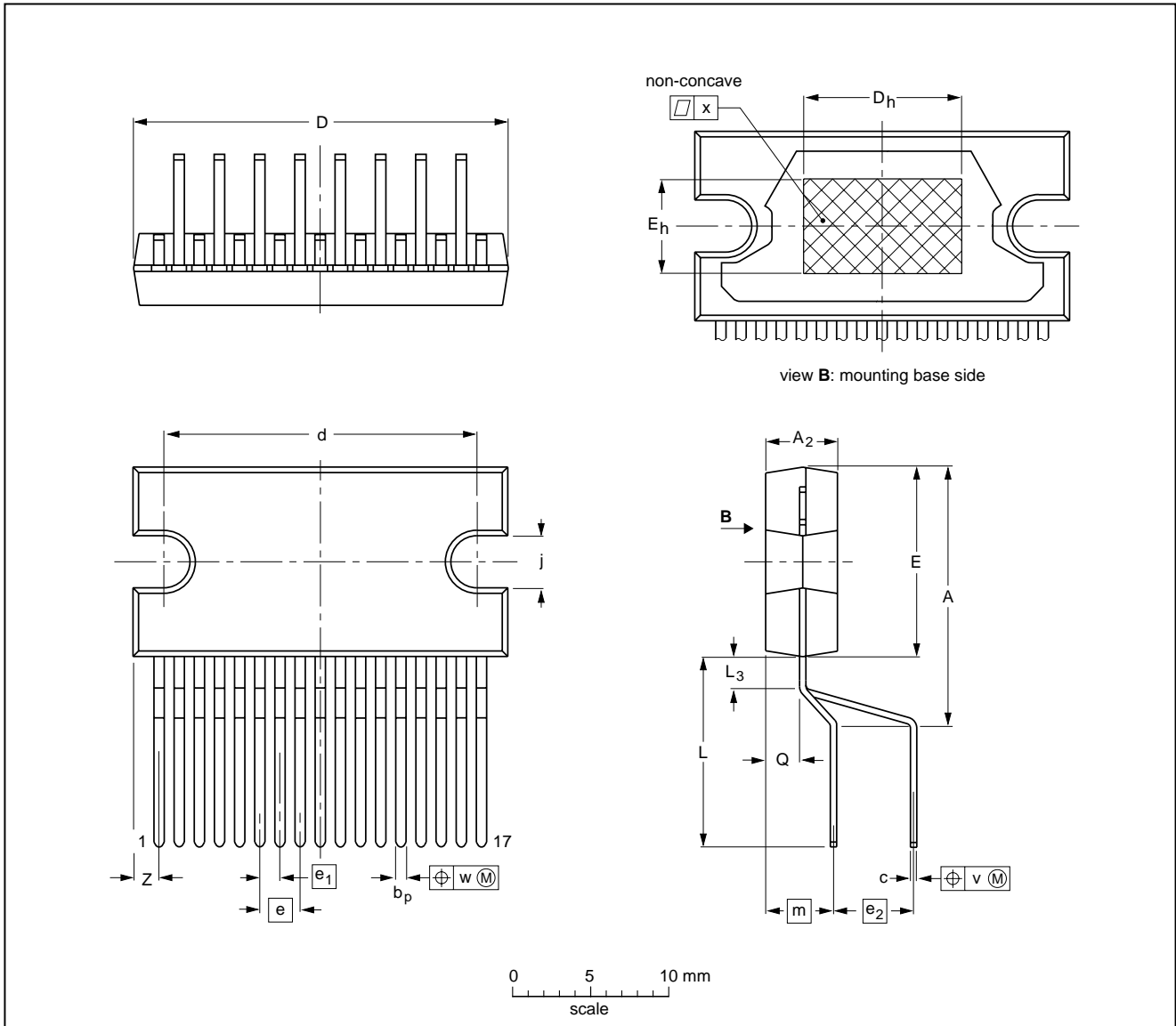
Multiple voltage regulator with switch and ignition buffers

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PACKAGE OUTLINE

DBS17P: plastic DIL-bent-SIL (special bent) power package; 17 leads (lead length 12 mm)

SOT475-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A | A ₂ | b _p | c | D ⁽¹⁾ | d | D _h | E ⁽¹⁾ | e | e ₁ | e ₂ | E _h | j | L | L ₃ | m | Q | v | w | x | z ⁽¹⁾ |
|------|--------------|----------------|----------------|--------------|------------------|--------------|----------------|------------------|------|----------------|----------------|----------------|------------|--------------|----------------|-----|------------|-----|-----|------|------------------|
| mm | 17.0 15.5 | 4.6 4.2 | 0.75 0.60 | 0.48 0.38 | 24.0 23.6 | 20.0 19.6 | 10 | 12.2 11.8 | 2.54 | 1.27 | 5.08 | 6 | 3.4 3.1 | 12.4 11.0 | 2.4 1.6 | 4.3 | 2.1 1.8 | 0.8 | 0.4 | 0.03 | 2.00 1.45 |

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|-------|------|---------------------|------------|
| | IEC | JEDEC | EIAJ | | |
| SOT475-1 | | | | | 97-05-20 |

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SOLDERING

Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our "IC Package Databook" (order code 9398 652 90011).

Soldering by dipping or by wave

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact

with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature ($T_{stg\ max}$). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

Repairing soldered joints

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

DEFINITIONS

| Data sheet status | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Objective specification | This data sheet contains target or goal specifications for product development. |
| Preliminary specification | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification | This data sheet contains final product specifications. |
| Limiting values | |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability. | |
| Application information | |
| Where application information is given, it is advisory and does not form part of the specification. | |

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Printed in The Netherlands

547027/1200/01/pp20

Date of release: 1997 Aug 15

Document order number: 9397 750 02248

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