

# DATA SHEET

## **TDA3618AJR**

Multiple voltage regulator with  
switch and ignition buffers

Product specification  
Supersedes data of 2001 May 02  
File under Integrated Circuits, IC01

2002 Feb 12

## Multiple voltage regulator with switch and ignition buffers

## TDA3618AJR

### FEATURES

#### General

- Extremely low noise behaviour and good stability with very small output capacitors
- Two  $V_P$ -state controlled regulators 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 from  $-18$  to  $+50$  V
- Low reverse current of regulator 2
- Low quiescent current when regulator 1, regulator 3 and the power switch are switched off
- Hold output for low  $V_P$
- Hold output for regulators 1 and 3
- Hold output for foldback mode switch
- Hold output for load dump and temperature protection
- Reset (push-pull) and hold (open-collector) outputs
- Adjustable reset delay time
- High ripple rejection
- Backup capacitor for regulator 2
- Two independent ignition buffers, one inverted and with open-collector output.

#### Protection

- Reverse polarity safe, down to  $-18$  V
- 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-circuit safe to ground and  $V_P$ .

### GENERAL DESCRIPTION

The TDA3618AJR 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 foldback current protection (regulators 1 and 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 protection, operated by an enable input
- Reset and hold outputs that can be used to interface with the microcontroller; the reset signal can be used to wake up the microcontroller
- A supply pin that can withstand load dump pulses and negative supply voltages
- Regulator 2, which is switched on at a backup voltage greater than  $6.5$  V and off when the output voltage of regulator 2 drops below  $1.9$  V
- A provision for the 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<br>NUMBER | PACKAGE |   |          |
|----------------|---------|---|----------|
|                | NAME    | DESCRIPTION   | VERSION  |
| TDA3618AJR     | 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         |
|---------------------------|--------------------------------|---|------|------|------|--------------|
| <b>Supply</b>             |                                |   |      |      |      |              |
| $V_P$                     | 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;<br>$t_r \geq 2.5$ ms                  | –    | –    | 50   | V            |
| $I_{q(tot)}$              | total quiescent supply current | standby mode  | –    | 400  | 500  | $\mu$ A      |
| $T_j$                     | junction temperature           |   | –    | –    | 150  | $^{\circ}$ C |
| <b>Voltage regulators</b> |                                |   |      |      |      |              |
| $V_{O(REG1)}$             | output voltage of regulator 1  | $1 \text{ mA} \leq I_{REG1} \leq 600 \text{ mA}$                            | 8.5  | 9.0  | 9.5  | V            |
| $V_{O(REG2)}$             | output voltage of regulator 2  | $0.5 \text{ mA} \leq I_{REG2} \leq 150 \text{ mA}$ ; $V_P = 14.4 \text{ V}$ | 4.75 | 5.0  | 5.25 | V            |
| $V_{O(REG3)}$             | output voltage of regulator 3  | $1 \text{ mA} \leq I_{REG3} \leq 750 \text{ mA}$                            | 4.75 | 5.0  | 5.25 | V            |
| <b>Power switch</b>       |                                |   |      |      |      |              |
| $V_{drop}$                | drop-out voltage               | $I_{SW} = 1 \text{ A}$  | –    | 0.45 | 0.70 | V            |
|                           |                                | $I_{SW} = 1.8 \text{ A}$  | –    | 1.0  | 1.8  | V            |
| $I_M$                     | peak current                   |   | 3    | –    | –    | A            |

Multiple voltage regulator with  
switch and ignition buffers

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BLOCK DIAGRAM

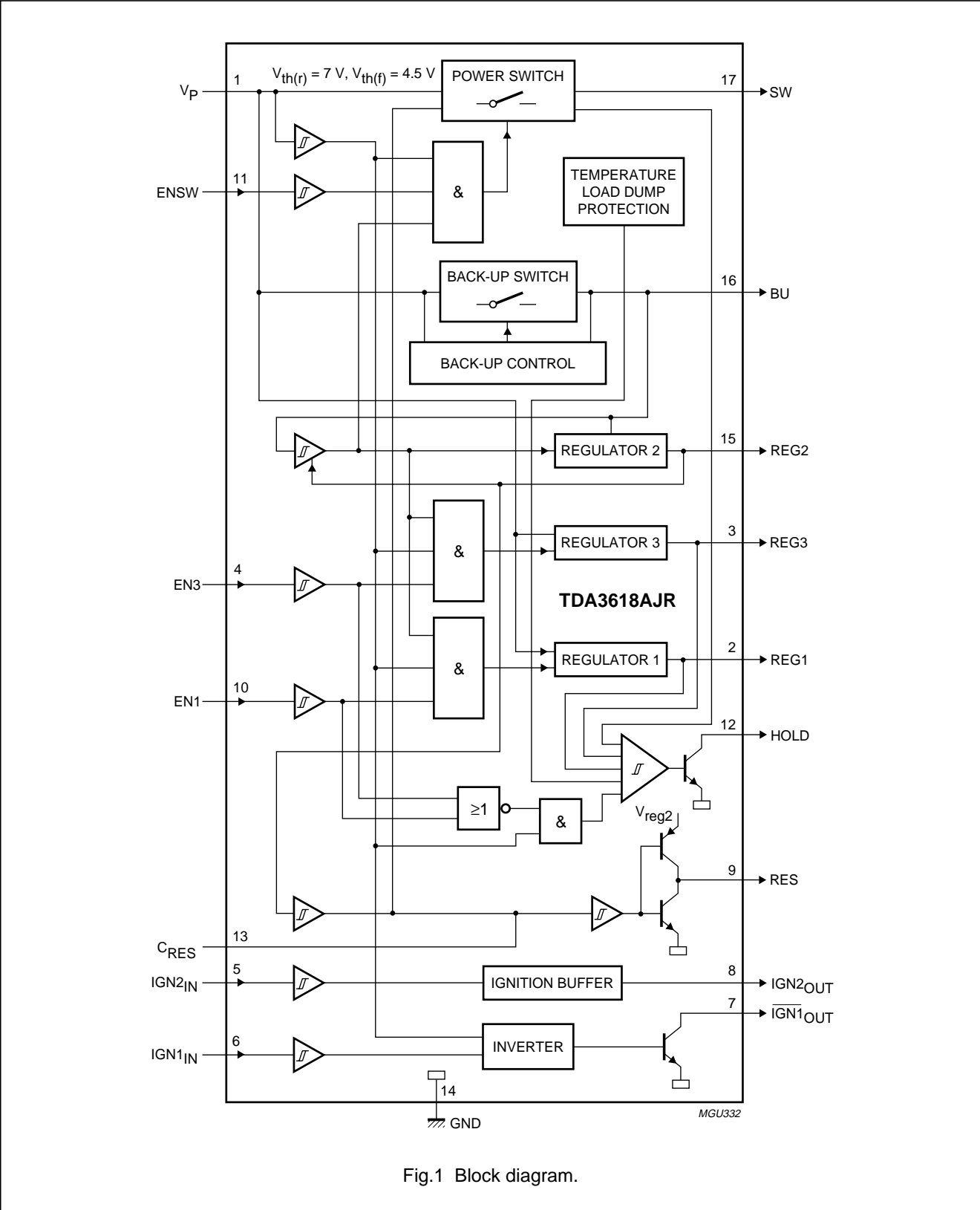


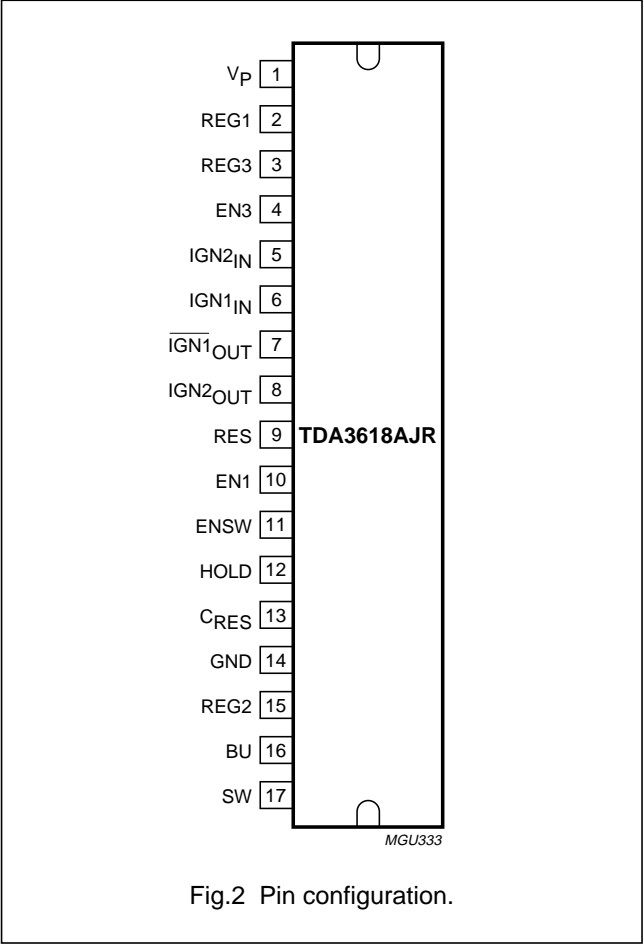
Fig.1 Block diagram.

Multiple voltage regulator with  
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PINNING

| SYMBOL              | PIN | DESCRIPTION  |
|---------------------|-----|--|
| V <sub>P</sub>      | 1   | supply voltage   |
| REG1                | 2   | regulator 1 output                                       |
| REG3                | 3   | regulator 3 output                                       |
| EN3                 | 4   | enable input regulator 3                                 |
| IGN2 <sub>IN</sub>  | 5   | ignition 2 input   |
| IGN1 <sub>IN</sub>  | 6   | ignition 1 input   |
| IGN1 <sub>OUT</sub> | 7   | ignition 1 output (active LOW)                           |
| IGN2 <sub>OUT</sub> | 8   | ignition 2 output  |
| RES                 | 9   | reset output (push-pull)                                 |
| EN1                 | 10  | enable input regulator 1                                 |
| ENSW                | 11  | enable input power switch                                |
| HOLD                | 12  | hold output (active LOW)                                 |
| C <sub>RES</sub>    | 13  | reset delay capacitor                                    |
| GND                 | 14  | ground   |
| REG2                | 15  | regulator 2 output                                       |
| BU                  | 16  | backup output  |
| SW                  | 17  | power switch output                                      |
| heat tab            | —   | it is strongly recommended to connect this tab to ground |



## Multiple voltage regulator with switch and ignition buffers

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### FUNCTIONAL DESCRIPTION

The TDA3618AJR is a multiple output voltage regulator with a power switch, intended for use in car radios with or without a microcontroller. Because of the low-voltage operation of the car radio, low-voltage drop regulators are used in the TDA3618AJR.

Regulator 2 switches on when the backup voltage exceeds 6.5 V for the first time and switches off again when the output voltage of regulator 2 falls below 1.9 V (this is far below an engine start). When regulator 2 is switched on and its output voltage is within its voltage range, the reset output is enabled to generate a reset to the microcontroller. The reset cycle can be extended by an external capacitor at pin  $C_{RES}$ . This start-up feature is included 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 backup capacitor can be used to supply regulator 2 for a short period when the supply drops to 0 V (the time depends on the value of the storage capacitor).

The output stages of regulators 1 and 3 have an extremely low noise behaviour and good stability. These regulators are stabilized by using small output capacitors.

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 the enable inputs (pins EN1 and EN3 respectively).

Pin HOLD is normally HIGH and is active LOW. Pin HOLD is connected to an open-collector NPN transistor and must have an external pull-up resistor to operate. The HOLD output is controlled by a LOW-voltage detection circuit which, when activated, pulls the warning output LOW (enabled). The detection outputs of the regulators are connected to an OR gate inside the IC such that the hold is activated (goes LOW) when the regulator voltages of regulator 1 and/or regulator 3 are out of regulation for any reason. Each regulator enable input controls its own detection circuit, such that if a regulator is disabled or switched off, the detection circuit for that regulator is disabled.

The hold circuit is also controlled by the temperature and load dump protection. Activating the temperature or load dump protection causes a hold (LOW) during the time the protection is activated. When all regulators are switched off, pin HOLD is controlled by the battery line (pin  $V_P$ ), temperature protection and load dump protection.

The hold output is enabled (LOW) at low battery voltages. This indicates that it is not possible to get regulator 1 into regulation when switching it on. The hold function includes hysteresis to avoid oscillations when the regulator voltage crosses the hold threshold. Pin HOLD also becomes LOW when the switch is in foldback protection mode; see Fig.4 for a timing diagram. The hold circuit block diagram is given in Fig.3.

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

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

The switch contains a current protection. However, this protection is delayed at short-circuit by the reset delay capacitor. During this time, the output current is limited to a peak value of at least 3 and 2 A continuous ( $V_P \leq 18$  V).

In the normal situation, the voltage on the reset delay capacitor is approximately 3.5 V (depending on temperature). The switch output is approximately  $V_P - 0.4$  V. At operational temperature, the switch can deliver at least 3 A. At high temperature, the switch can deliver approximately 2 A. During an overload condition or short-circuit ( $V_{SW} < V_P - 3.7$  V), the voltage on the reset delay capacitor rises 0.6 V above the voltage of regulator 2. This rise time depends on the capacitor connected to pin  $C_{RES}$ . During this time, the switch can deliver more than 3 A. The charge current of the reset delay capacitor is typically 4  $\mu$ A and the voltage swing approximately 1.5 V. When regulator 2 is out of regulation and generates a reset, the switch can only deliver 2 A and will go into foldback protection without delay. At supply voltages  $>17$  V, the switch is clamped at 16 V maximum (to avoid externally connected circuits being damaged by an overvoltage) and the switch will switch off at load dump.

Interfacing with the microcontroller (simple full/semi on/off logic applications) can be realized with two independent ignition Schmitt triggers and ignition output buffers (one open-collector and one push-pull output). Ignition 1 output is inverted.

The total timing diagrams are shown in Figs 4 and 5.

Multiple voltage regulator with  
switch and ignition buffers

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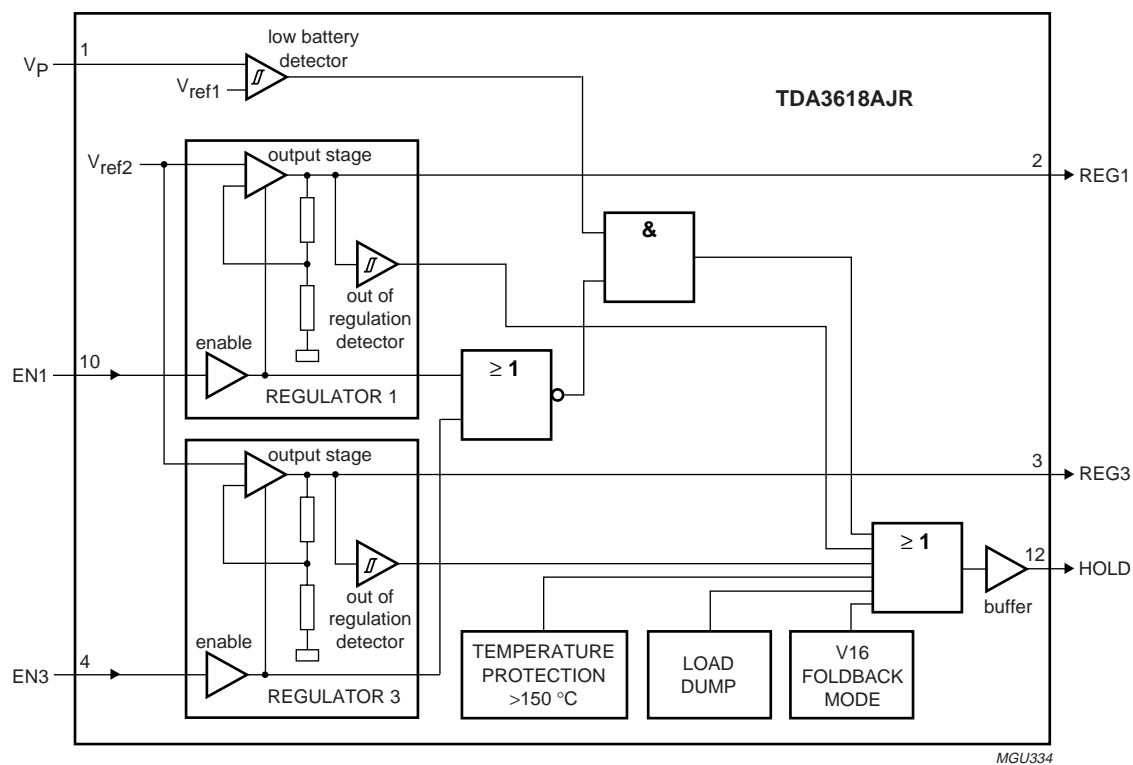


Fig.3 Block diagram of the hold circuit.

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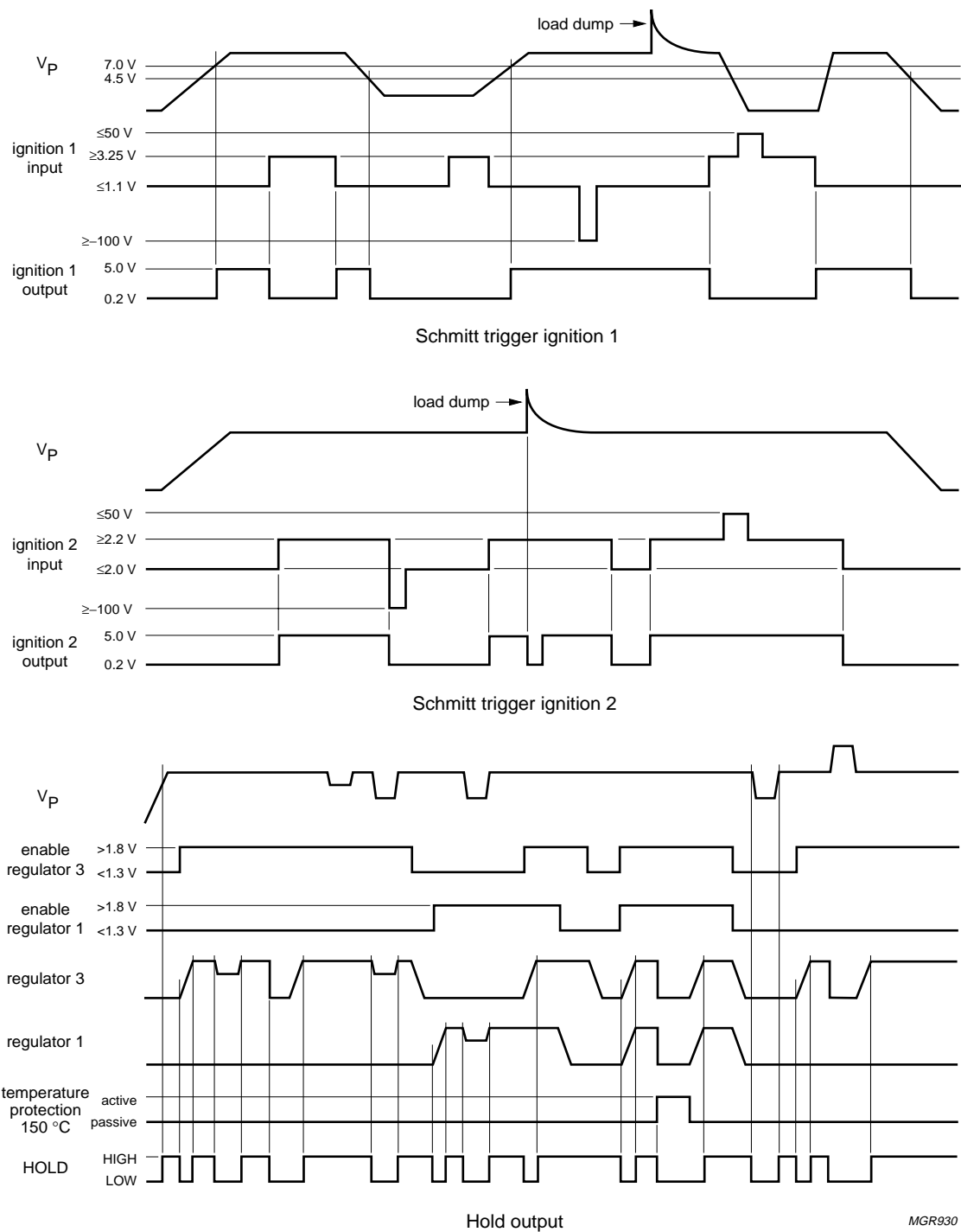


Fig.4 Timing diagram of ignition Schmitt triggers and HOLD.



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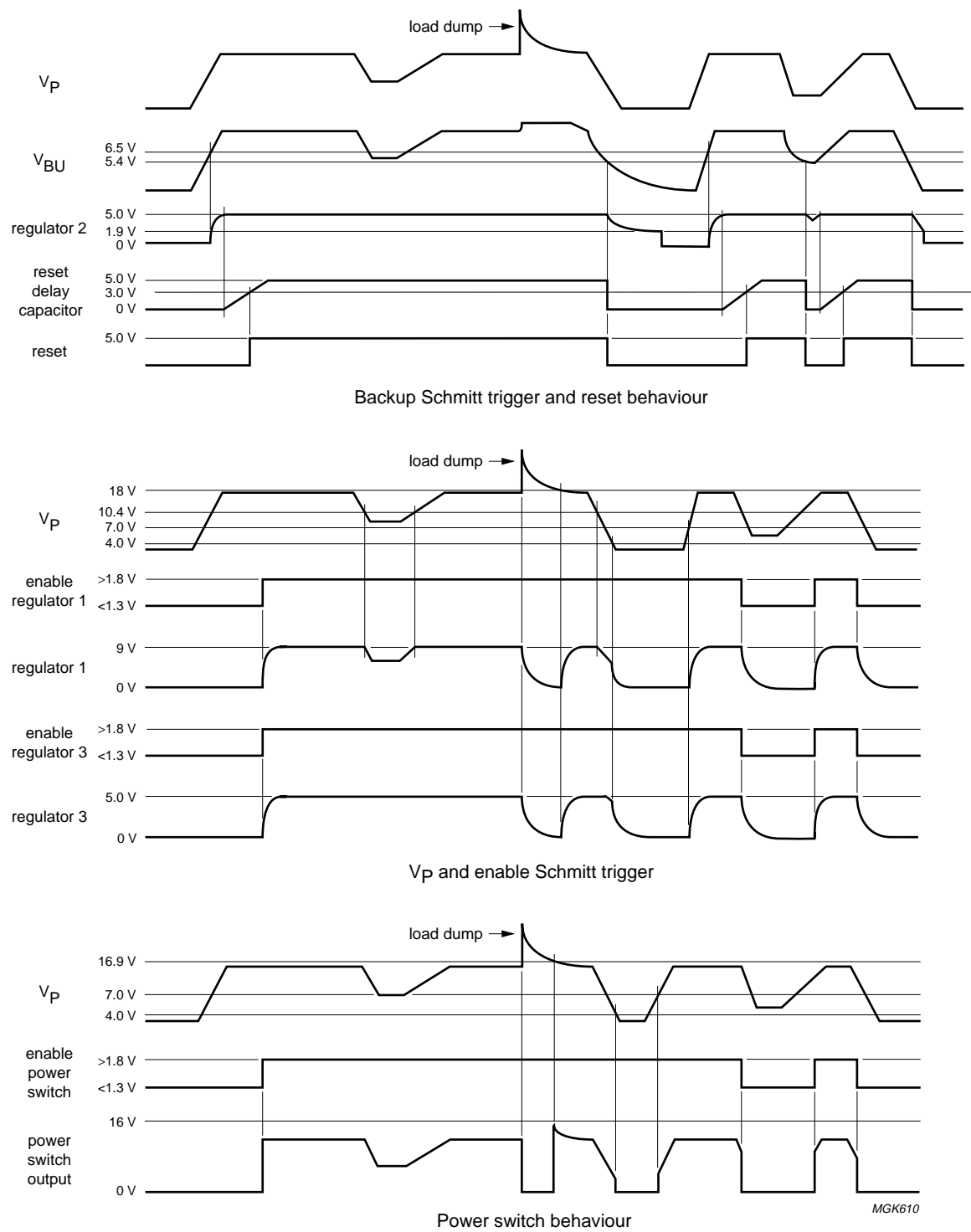


Fig.5 Timing diagram of regulators and power switch.

# Multiple voltage regulator with switch and ignition buffers

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## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 60134).

| SYMBOL           | PARAMETER               | CONDITIONS   | MIN. | MAX. | UNIT |
|------------------|-------------------------|--|------|------|------|
| V <sub>P</sub>   | 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 <sub>r</sub> ≥ 2.5 ms | –    | 50   | V    |
| P <sub>tot</sub> | total power dissipation |  | –    | 62   | W    |
| T <sub>stg</sub> | storage temperature     | non-operating  | –55  | +150 | °C   |
| T <sub>amb</sub> | ambient temperature     | operating  | –40  | +85  | °C   |
| T <sub>j</sub>   | junction temperature    | operating  | –40  | +150 | °C   |

## THERMAL CHARACTERISTICS

| SYMBOL               | PARAMETER                                   | CONDITIONS  | VALUE | UNIT |
|----------------------|---|-------------|-------|------|
| R <sub>th(j-c)</sub> | thermal resistance from junction to case    |             | 2     | K/W  |
| R <sub>th(j-a)</sub> | 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.8; unless otherwise specified.

| SYMBOL  | PARAMETER                                | CONDITIONS  | MIN. | TYP.                        | MAX.                         | UNIT |
|---|--|---|------|-----------------------------|------------------------------|------|
| Supplies  |  |   |      |                             |                              |      |
| V <sub>P</sub>  | supply voltage                           | operating   | 11   | 14.4                        | 18                           | V    |
|   |  | regulator 2 on; note 1                                      | 2.4  | 14.4                        | 18                           | V    |
|   |  | jump start; t ≤ 10 minutes                                  | –    | –                           | 30                           | V    |
|   |  | load dump protection;<br>t ≤ 50 ms; t <sub>r</sub> ≥ 2.5 ms | –    | –                           | 50                           | V    |
| I <sub>q</sub>  | quiescent supply current                 | V <sub>P</sub> = 12.4 V; note 2                             | –    | 390                         | 500                          | μA   |
|   |  | V <sub>P</sub> = 14.4 V; note 2                             | –    | 400                         | –                            | μA   |
| Schmitt trigger for regulator 1, regulator 3 and the power switch                 |  |   |      |                             |                              |      |
| V <sub>th(r)</sub>  | rising threshold voltage                 |   | 6.5  | 7.0                         | 7.5                          | V    |
| V <sub>th(f)</sub>  | falling threshold voltage                |   | 4.0  | 4.5                         | 5.0                          | V    |
| V <sub>hys</sub>  | hysteresis voltage                       |   | –    | 2.5                         | –                            | V    |
| Schmitt trigger for regulator 2   |  |   |      |                             |                              |      |
| V <sub>th(r)</sub>  | rising threshold voltage                 |   | 6.0  | 6.5                         | 7.1                          | V    |
| V <sub>th(f)</sub>  | falling threshold voltage                |   | 1.7  | 1.9                         | 2.3                          | V    |
| V <sub>hys</sub>  | hysteresis voltage                       |   | –    | 4.6                         | –                            | V    |
| Schmitt trigger for enable inputs (regulator 1, regulator 3 and the power switch) |  |   |      |                             |                              |      |
| V <sub>th(r)</sub>  | rising threshold voltage                 |   | 1.4  | 1.8                         | 2.4                          | V    |
| V <sub>th(f)</sub>  | falling threshold voltage                |   | 0.9  | 1.3                         | 1.9                          | V    |
| V <sub>hys</sub>  | hysteresis voltage                       | I <sub>REG</sub> = I <sub>SW</sub> = 1 mA                   | –    | 0.5                         | –                            | V    |
| I <sub>LI</sub>   | input leakage current                    | V <sub>EN</sub> = 5 V                                       | 1    | 5                           | 10                           | μA   |
| Reset trigger level of regulator 2  |  |   |      |                             |                              |      |
| V <sub>th(r)</sub>  | rising threshold voltage                 | V <sub>P</sub> rising; I <sub>REG1</sub> = 50 mA; note 3    | 4.43 | V <sub>O(REG2)</sub> – 0.15 | V <sub>O(REG2)</sub> – 0.1   | V    |
| V <sub>th(f)</sub>  | falling threshold voltage                | V <sub>P</sub> falling; I <sub>REG1</sub> = 50 mA; note 3   | 4.4  | V <sub>O(REG2)</sub> – 0.20 | V <sub>O(REG2)</sub> – 0.15  | V    |
| Schmitt triggers for HOLD output  |  |   |      |                             |                              |      |
| V <sub>th(r)(REG1)</sub>  | rising threshold voltage of regulator 1  | V <sub>P</sub> rising; note 3                               | –    | V <sub>O(REG1)</sub> – 0.15 | V <sub>O(REG1)</sub> – 0.075 | V    |
| V <sub>th(f)(REG1)</sub>  | falling threshold voltage of regulator 1 | V <sub>P</sub> falling; note 3                              | 8.1  | V <sub>O(REG1)</sub> – 0.35 | –                            | V    |
| V <sub>hys(REG1)</sub>  | hysteresis voltage due to regulator 1    |   | –    | 0.2                         | –                            | V    |
| V <sub>th(r)(REG3)</sub>  | rising threshold voltage of regulator 3  | V <sub>P</sub> rising; note 3                               | –    | V <sub>O(REG3)</sub> – 0.15 | V <sub>O(REG3)</sub> – 0.075 | V    |
| V <sub>th(f)(REG3)</sub>  | falling threshold voltage of regulator 3 | V <sub>P</sub> falling; note 3                              | 4.1  | V <sub>O(REG3)</sub> – 0.35 | –                            | V    |
| V <sub>hys(REG3)</sub>  | hysteresis voltage due to regulator 3    |   | –    | 0.2                         | –                            | V    |

# Multiple voltage regulator with switch and ignition buffers

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| SYMBOL  | PARAMETER   | CONDITIONS   | MIN. | TYP.          | MAX. | UNIT          |
|---|---|--|------|---------------|------|---------------|
| $V_{th(r)(VP)}$   | rising threshold voltage of supply voltage          | $V_{EN} = 0\text{ V}$  | 9.1  | 9.7           | 10.3 | V             |
| $V_{th(f)(VP)}$   | falling threshold voltage of supply voltage         | $V_{EN} = 0\text{ V}$  | 9.0  | 9.4           | 9.8  | V             |
| $V_{hys(VP)}$   | hysteresis voltage of supply voltage                | $V_{EN} = 0\text{ V}$  | –    | 0.3           | –    | V             |
| <b>Reset and hold buffer</b>  |   |  |      |               |      |               |
| $I_{sink(L)}$   | LOW-level sink current                              | $V_{RES} \leq 0.8\text{ V};$<br>$V_{HOLD} \leq 0.8\text{ V};$<br>$V_{CRES} < 1.0\text{ V}$ | 2    | –             | –    | mA            |
| $I_{LO}$  | HOLD output leakage current                         | $V_P = 14.4\text{ V}; V_{HOLD} = 5\text{ V}$   | –    | 0.1           | 5    | $\mu\text{A}$ |
| $I_{source(H)}$   | HIGH-level source current                           | $V_P = 14.4\text{ V}; V_{RES} = 4.5\text{ V};$<br>$V_{CRES} > 3.5\text{ V}$                | 240  | 400           | 900  | $\mu\text{A}$ |
| $t_r$   | rise time   | note 4   | –    | 7             | 50   | $\mu\text{s}$ |
| $t_f$   | fall time   | note 4   | –    | 1             | 50   | $\mu\text{s}$ |
| <b>Reset delay</b>  |   |  |      |               |      |               |
| $I_{ch}$  | charge current                                      |  | 2    | 4             | 8    | $\mu\text{A}$ |
| $I_{dch}$   | discharge current                                   |  | 500  | 800           | –    | $\mu\text{A}$ |
| $V_{th(r)(RES)}$  | rising voltage threshold reset signal               |  | 2.5  | 3.0           | 3.5  | V             |
| $t_{d(RES)}$  | delay time reset signal                             | $C = 47\text{ nF};$ note 5   | 20   | 35            | 70   | ms            |
| $V_{th(r)(SW)}$   | rising voltage threshold switch foldback protection |  | –    | $V_{O(REG2)}$ | –    | V             |
| $t_{d(SW)}$   | delay time switch foldback protection               | $C = 47\text{ nF};$ note 6   | 8    | 17.6          | 40   | ms            |
| <b>Regulator 1 (<math>I_{REG1} = 5\text{ mA}</math> unless otherwise specified)</b> |   |  |      |               |      |               |
| $V_{O(off)}$  | output voltage off                                  |  | –    | 1             | 400  | mV            |
| $V_{O(REG1)}$   | output voltage                                      | $1\text{ mA} \leq I_{REG1} \leq 600\text{ mA}$   | 8.5  | 9.0           | 9.5  | V             |
|   |   | $12\text{ V} \leq V_P \leq 18\text{ V}$  | 8.5  | 9.0           | 9.5  | V             |
| $\Delta V_{line}$   | line regulation                                     | $12\text{ V} \leq V_P \leq 18\text{ V}$  | –    | 2             | 75   | mV            |
| $\Delta V_{load}$   | load regulation                                     | $1\text{ mA} \leq I_{REG1} \leq 600\text{ mA}$   | –    | 20            | 100  | mV            |
| $I_q$   | quiescent current                                   | $I_{REG1} = 600\text{ mA}$   | –    | 25            | 60   | mA            |
| SVRR  | supply voltage ripple rejection                     | $f_i = 3\text{ kHz}; V_{i(p-p)} = 2\text{ V}$  | 60   | 70            | –    | dB            |
| $V_{drop}$  | drop-out voltage                                    | $I_{REG1} = 550\text{ mA};$<br>$V_P = 9.5\text{ V};$ note 7                                | –    | 0.4           | 0.7  | V             |
| $I_{lim}$   | current limit                                       | $V_{O(REG1)} > 8.5\text{ V};$ note 8   | 0.65 | 1.2           | –    | A             |
| $I_{sc}$  | short-circuit current                               | $R_L \leq 0.5\text{ }\Omega;$ note 9   | 250  | 800           | –    | mA            |

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| SYMBOL  | PARAMETER                       | CONDITIONS  | MIN. | TYP. | MAX. | UNIT |
|---|---------------------------------|---|------|------|------|------|
| <b>Regulator 2 (<math>I_{REG2} = 5\text{ mA}</math> unless otherwise specified)</b> |                                 |   |      |      |      |      |
| $V_{O(REG2)}$   | output voltage                  | $0.5\text{ mA} \leq I_{REG2} \leq 300\text{ mA}$                          | 4.75 | 5.0  | 5.25 | V    |
|   |                                 | $8\text{ V} \leq V_P \leq 18\text{ V}$                                    | 4.75 | 5.0  | 5.25 | V    |
|   |                                 | $18\text{ V} \leq V_P \leq 50\text{ V};$<br>$I_{REG2} \leq 150\text{ mA}$ | 4.75 | 5.0  | 5.25 | V    |
| $\Delta V_{line}$   | 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   |
| $\Delta V_{load}$   | 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 | $f_i = 3\text{ kHz}; V_{i(p-p)} = 2\text{ V}$                             | 60   | 70   | –    | dB   |
| $V_{drop}$  | drop-out voltage                | $I_{REG2} = 100\text{ mA};$<br>$V_P = 4.75\text{ V};$ note 7              | –    | 0.4  | 0.6  | V    |
|   |                                 | $I_{REG2} = 200\text{ mA};$<br>$V_P = 5.75\text{ V};$ note 7              | –    | 0.8  | 1.2  | V    |
|   |                                 | $I_{REG2} = 100\text{ mA};$<br>$V_{BU} = 4.75\text{ V};$ note 10          | –    | 0.2  | 0.5  | V    |
|   |                                 | $I_{REG2} = 200\text{ mA};$<br>$V_{BU} = 5.75\text{ V};$ note 10          | –    | 0.8  | 1.0  | V    |
| $I_{lim}$   | current limit                   | $V_{O(REG2)} > 4.5\text{ V};$ note 8                                      | 0.32 | 0.37 | –    | A    |
| $I_{sc}$  | short-circuit current           | $R_L \leq 0.5\ \Omega;$ note 9  | 20   | 100  | –    | mA   |
| <b>Regulator 3 (<math>I_{REG3} = 5\text{ mA}</math> unless otherwise specified)</b> |                                 |   |      |      |      |      |
| $V_{O(off)}$  | output voltage off              |   | –    | 1    | 400  | mV   |
| $V_{O(REG3)}$   | output voltage                  | $1\text{ mA} \leq I_{REG3} \leq 750\text{ mA}$                            | 4.75 | 5.0  | 5.25 | V    |
|   |                                 | $7\text{ V} \leq V_P \leq 18\text{ V}$                                    | 4.75 | 5.0  | 5.25 | V    |
| $\Delta V_{line}$   | line regulation                 | $7\text{ V} \leq V_P \leq 18\text{ V}$                                    | –    | 2    | 50   | mV   |
| $\Delta V_{load}$   | load regulation                 | $1\text{ mA} \leq I_{REG3} \leq 750\text{ mA}$                            | –    | 20   | 100  | mV   |
| $I_q$   | quiescent current               | $I_{REG3} = 750\text{ mA}$  | –    | 19   | 45   | mA   |
| SVRR  | supply voltage ripple rejection | $f_i = 3\text{ kHz}; V_{i(p-p)} = 2\text{ V}$                             | 60   | 70   | –    | dB   |
| $V_{drop}$  | drop-out voltage                | $I_{REG3} = 500\text{ mA};$<br>$V_P = 5.75\text{ V};$ note 7              | –    | 1    | 1.5  | V    |
| $I_{lim}$   | current limit                   | $V_{O(REG3)} > 4.5\text{ V};$ note 8                                      | 0.80 | 0.90 | –    | A    |
| $I_{sc}$  | short-circuit current           | $R_L \leq 0.5\ \Omega;$ note 9  | 100  | 400  | –    | mA   |
| <b>Power switch</b>   |                                 |   |      |      |      |      |
| $V_{drop}$  | drop-out voltage                | $I_{SW} = 1\text{ A}; V_P = 13.5\text{ V};$<br>note 11                    | –    | 0.45 | 0.70 | V    |
|   |                                 | $I_{SW} = 1.8\text{ A}; V_P = 13.5\text{ V};$<br>note 11                  | –    | 1.0  | 1.8  | V    |
| $I_{dc}$  | continuous current              | $V_P = 16\text{ V}; V_{SW} = 13.5\text{ V}$                               | 1.8  | 2.0  | –    | A    |
| $V_{clamp}$   | clamping voltage                | $V_P \geq 17\text{ V}$  | 13.5 | 15.0 | 16.0 | V    |

# Multiple voltage regulator with switch and ignition buffers

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| SYMBOL  | PARAMETER                                     | CONDITIONS   | MIN.  | TYP.      | MAX. | UNIT          |
|---|---|--|-------|-----------|------|---------------|
| $I_M$   | peak current                                  | $V_P = 17\text{ V}$ ;<br>notes 6, 12, 13                     | 3     | –         | –    | A             |
| $V_{fb}$  | flyback voltage behaviour                     | $I_{SW} = -100\text{ mA}$                                    | –     | $V_P + 3$ | 22   | V             |
| $I_{sc}$  | short-circuit current                         | $V_P = 14.4\text{ V}$ ;<br>$V_{SW} < 1.2\text{ V}$ ; note 13 | –     | 0.8       | –    | A             |
| <b>Backup switch</b>                                  |   |  |       |           |      |               |
| $I_{dc}$  | continuous current                            |  | 0.3   | 0.35      | –    | A             |
| $V_{clamp}$   | 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 | $\mu\text{A}$ |
| <b>Schmitt trigger for enable input of ignition 1</b> |   |  |       |           |      |               |
| $V_{th(r)}$   | rising threshold voltage of ignition 1 input  |  | 2.75  | 3.25      | 3.75 | V             |
| $V_{th(f)}$   | 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  | $\mu\text{A}$ |
| $I_{I(clamp)}$  | 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             |
| <b>Schmitt trigger for power supply of ignition 1</b> |   |  |       |           |      |               |
| $V_{th(r)}$   | rising threshold voltage                      |  | 6.5   | 7.0       | 7.5  | V             |
| $V_{th(f)}$   | falling threshold voltage                     | note 14  | 4.0   | 4.5       | 5.0  | V             |
| <b>Ignition 1 buffer</b>                              |   |  |       |           |      |               |
| $V_{OL}$  | LOW-level output voltage                      | $I_{IGN1OUT} = 0\text{ mA}$                                  | 0     | 0.2       | 0.8  | V             |
| $V_{OH}$  | HIGH-level output voltage                     | $I_{IGN1OUT} = 0\text{ mA}$                                  | 4.5   | 5.0       | 5.25 | V             |
| $I_{OL}$  | LOW-level output current                      | $V_{IGN1OUT} \leq 0.8\text{ V}$                              | 0.45  | 0.8       | –    | mA            |
| $I_{LO}$  | output leakage current                        | $V_{IGN1OUT} = 5\text{ V}$ ;<br>$V_{IGN1IN} = 0\text{ V}$    | –     | –         | 1.0  | $\mu\text{A}$ |
| $t_{PLH}$   | LOW-to-HIGH propagation time                  | $V_{IGN1IN}$ falling from 3.75 to 0.8 V                      | –     | –         | 500  | $\mu\text{s}$ |
| $t_{PHL}$   | HIGH-to-LOW propagation time                  | $V_{IGN1IN}$ rising from 0.8 to 3.75 V                       | –     | –         | 500  | $\mu\text{s}$ |
| <b>Schmitt trigger for enable input of ignition 2</b> |   |  |       |           |      |               |
| $V_{th(r)}$   | rising threshold voltage of ignition 2 input  | $V_P > 3.5\text{ V}$   | 1.9   | 2.2       | 2.5  | V             |
| $V_{th(f)}$   | falling threshold voltage of ignition 2 input | $V_P > 3.5\text{ V}$   | 1.7   | 2.0       | 2.3  | V             |
| $V_{hys}$   | hysteresis voltage                            | $V_P > 3.5\text{ V}$   | 0.1   | 0.2       | 0.5  | V             |
| $I_{LI}$  | input leakage current                         | $V_{IGN2IN} = 5\text{ V}$                                    | –     | –         | 1.0  | $\mu\text{A}$ |
| $I_{I(clamp)}$  | input clamp current                           | $V_{IGN2IN} > 50\text{ V}$                                   | –     | –         | 50   | mA            |

# Multiple voltage regulator with switch and ignition buffers

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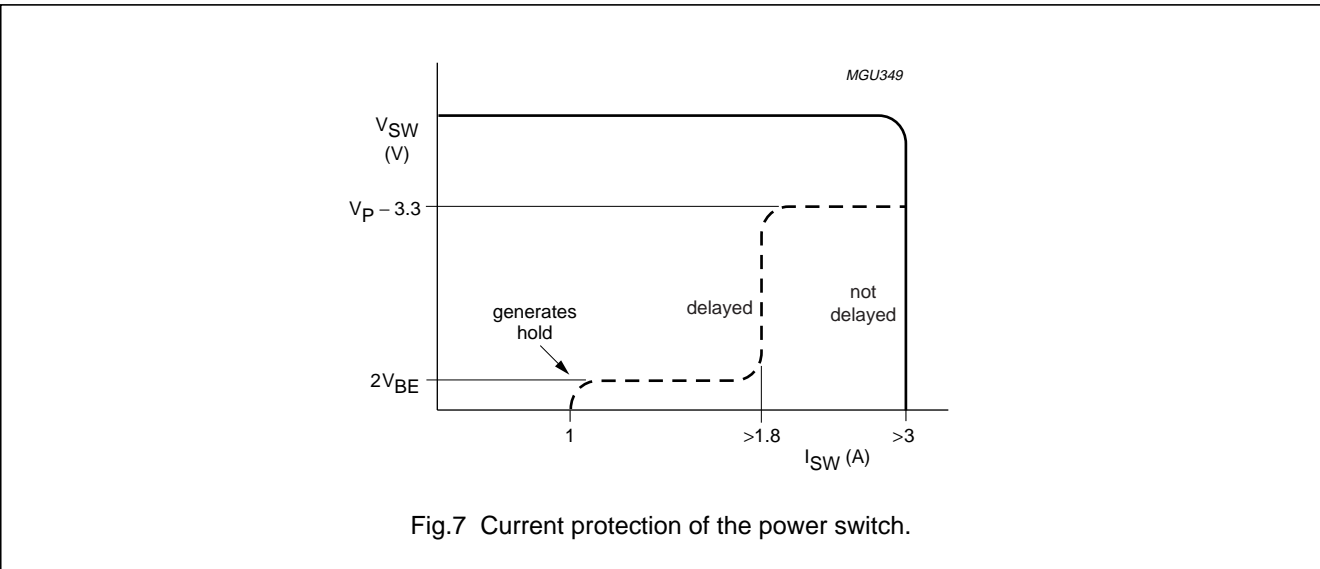
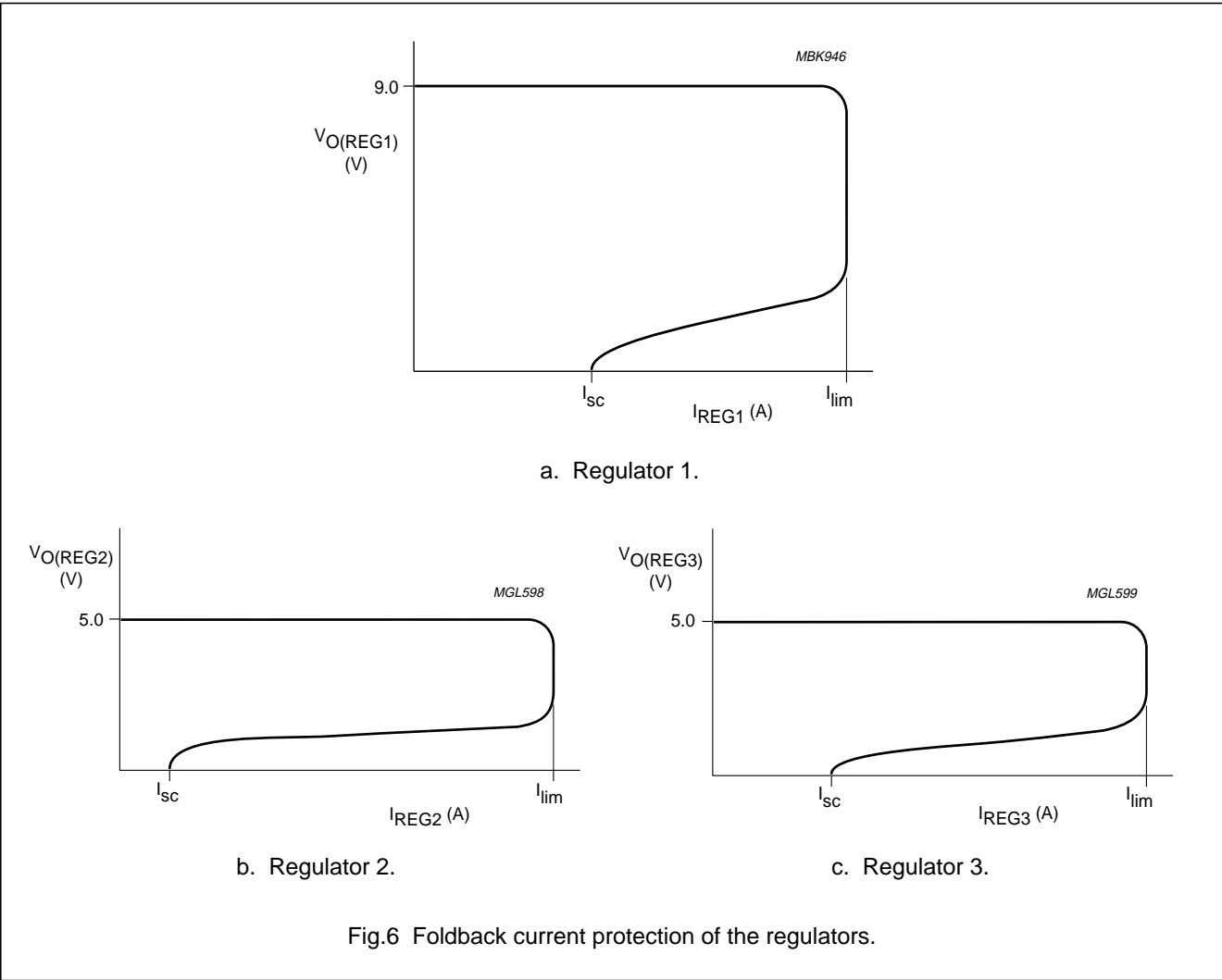
| SYMBOL                   | PARAMETER                         | CONDITIONS   | MIN.  | TYP. | MAX. | UNIT          |
|--------------------------|-----------------------------------|--|-------|------|------|---------------|
| $V_{IH(clamp)}$          | HIGH-level input clamping voltage |  | $V_P$ | –    | 50   | V             |
| $V_{IL(clamp)}$          | LOW-level input clamping voltage  |  | –0.6  | –    | 0    | V             |
| <b>Ignition 2 buffer</b> |                                   |  |       |      |      |               |
| $V_{OL}$                 | LOW-level output voltage          | $I_{IGN2OUT} = 0 \text{ mA}$                               | 0     | 0.2  | 0.8  | V             |
| $V_{OH}$                 | HIGH-level output voltage         | $I_{IGN2OUT} = 0 \text{ mA}$                               | 4.5   | 5.0  | 5.25 | V             |
| $I_{OL}$                 | LOW-level output current          | $V_{IGN2OUT} \leq 0.8 \text{ V}$                           | 0.45  | 0.8  | –    | mA            |
| $I_{OH}$                 | HIGH-level output current         | $V_{IGN2OUT} \geq 4.5 \text{ V}$                           | –0.45 | –2.0 | –    | mA            |
| $I_{LO}$                 | output leakage current (source)   | $V_{IGN2OUT} = 5 \text{ V};$<br>$V_{IGN2IN} = 5 \text{ V}$ | –     | –    | 1.0  | $\mu\text{A}$ |
| $t_{PLH}$                | LOW-to-HIGH propagation time      | $V_{IGN2IN}$ rising from 1.7 to 2.5 V                      | –     | –    | 500  | $\mu\text{s}$ |
| $t_{PHL}$                | HIGH-to-LOW propagation time      | $V_{IGN2IN}$ falling from 2.5 to 1.7 V                     | –     | –    | 500  | $\mu\text{s}$ |

## Notes

- Minimum operating voltage, only if  $V_P$  has exceeded 6.5 V.
- The quiescent current is measured in the standby mode with pins EN1, EN2 and ENSW connected to ground and  $R_{L(REG2)} = \infty$  (see Fig.8).
- The voltage of the regulator drops as a result of a  $V_P$  drop.
- The rise and fall times are measured with a 10 k $\Omega$  pull-up resistor and a 50 pF load capacitor.
- The delay time depends on the value of the capacitor connected to pin C<sub>RES</sub>:
 
$$t_{d(RES)} = \frac{C}{I_{ch}} \times V_{th(r)(RES)} = C \times (750 \times 10^3) \text{ [s]}$$
- The delay time depends on the value of the capacitor connected to pin C<sub>RES</sub>:
 
$$t_{d(RES)} = \frac{C}{I_{ch}} \times (V_{O(REG2)} - 3.5) = C \times (375 \times 10^3) \text{ [s]}$$
- The drop-out voltage of regulators 1, 2 and 3 is measured between pins  $V_P$  and REGn.
- At current limit,  $I_{lim}$  is held constant (see Fig.6 for the behaviour of  $I_{lim}$ ).
- The foldback current protection limits the dissipated power at short-circuit (see Fig.6).
- The drop-out voltage is measured between pins BU and REG2.
- The drop-out voltage of the power switch is measured between pins  $V_P$  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 is disabled when a voltage of  $V_P + 1 \text{ V}$  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 is disabled when a voltage of  $V_P + 1 \text{ V}$  is applied to the switch-enable input.
- $V_{IGN1OUT} = \text{LOW}$  for  $V_{IGN1IN} > 1.2 \text{ V}$  or  $V_{EN1} > 1.3 \text{ V}$  or  $V_{EN3} > 1.3 \text{ V}$  or  $V_{ENSW} > 1.3 \text{ V}$ .

Multiple voltage regulator with  
switch and ignition buffers

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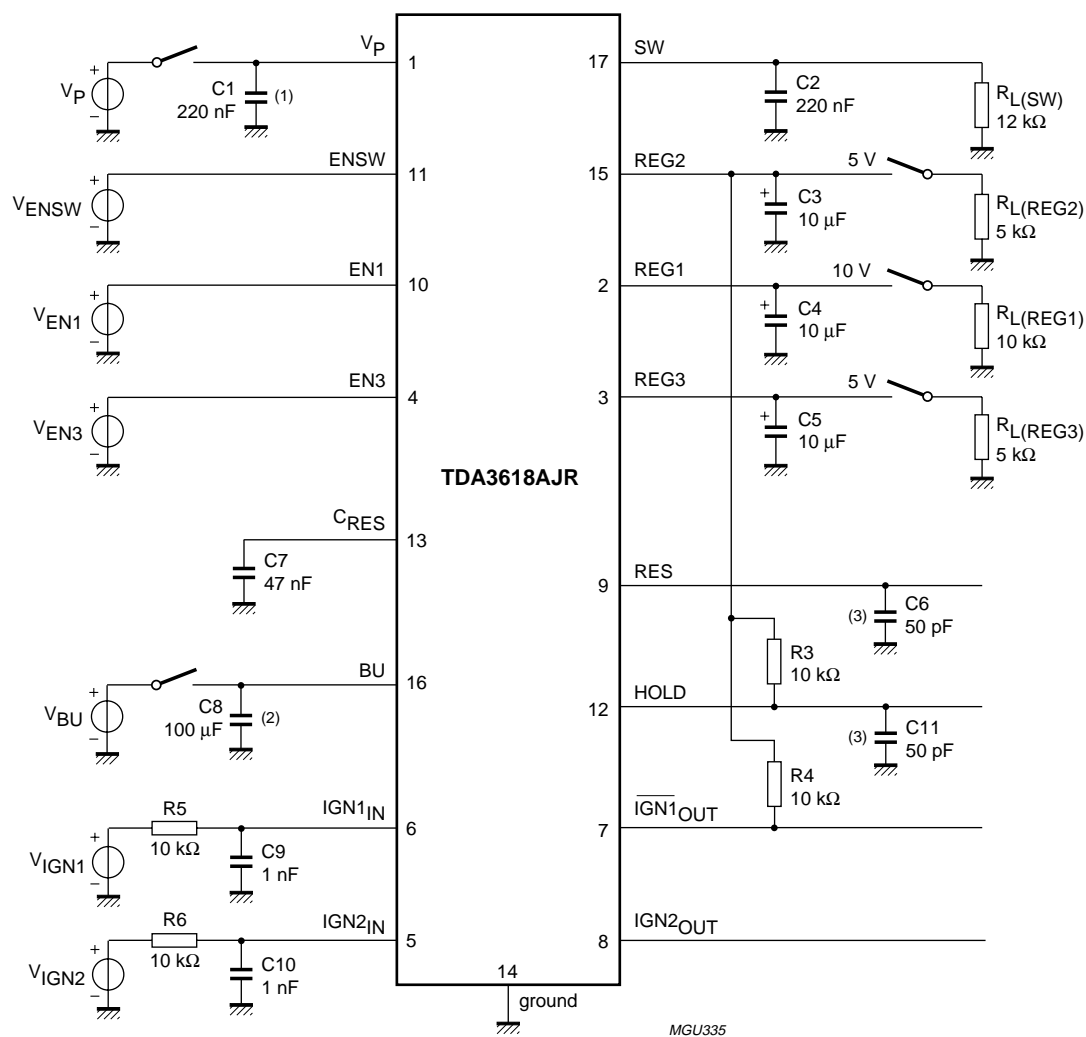


# Multiple voltage regulator with switch and ignition buffers

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### TEST AND APPLICATION INFORMATION

#### Test information



- (1) A minimum supply line capacitor of 220 nF on  $V_P$  is required for stability.
- (2) A minimum backup capacitance of 1  $\mu$ F is required for stability.
- (3) Capacitors represent typical input capacitance of CMOS logic connected to reset and hold outputs.

Fig.8 Test circuit.

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Application information

NOISE

Table 1 Noise figures

| REGULATOR | NOISE FIGURE (μV) <sup>(1)</sup> |                        |                         |
|-----------|----------------------------------|------------------------|-------------------------|
|           | C <sub>o</sub> = 10 μF           | C <sub>o</sub> = 47 μF | C <sub>o</sub> = 100 μF |
| 1         | 170                              | 130                    | 110                     |
| 2         | 180                              | 120                    | 100                     |
| 3         | 100                              | 70                     | 65                      |

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 (the output noise of the regulators is translated to a current noise by 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 stabilized with the externally connected output capacitors.

The output capacitors can be selected by using the graphs of Figs 9 and 10. When an electrolytic capacitor is used, the temperature behaviour of this output capacitor can cause oscillations at a low temperature. The two examples below show how an output capacitor value is selected.

Example 1

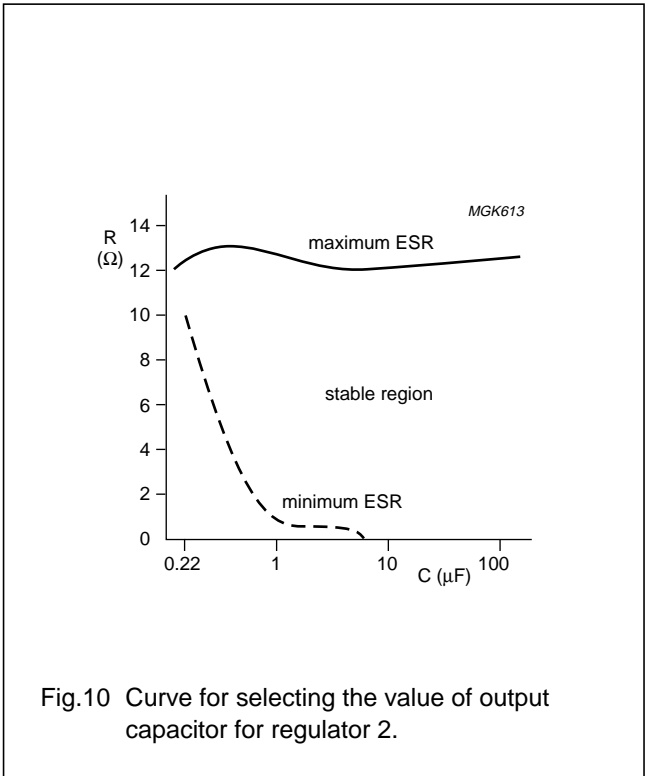
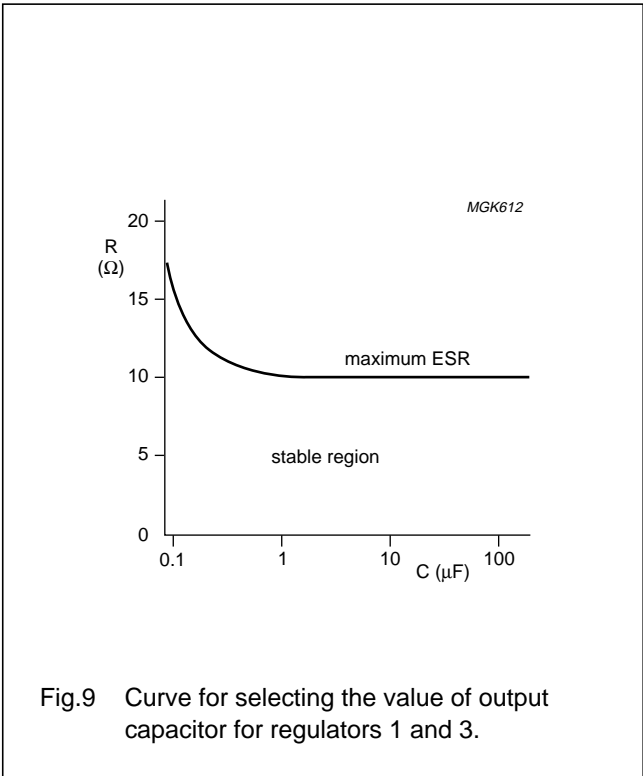
Regulators 1 and 3 are stabilized with an electrolytic output capacitor of 220 μF (ESR = 0.15 Ω). At T<sub>amb</sub> = −30 °C, the capacitor value is decreased to 73 μF and the ESR is increased to 1.1 Ω. The regulator remains stable at T<sub>amb</sub> = −30 °C.

Example 2

Regulator 2 is stabilized with a 10 μF electrolytic capacitor (ESR = 3 Ω). At T<sub>amb</sub> = −30 °C, the capacitor value is decreased to 3 μF and the ESR is increased to 23.1 Ω. Using Fig.10, the regulator will be unstable at T<sub>amb</sub> = −30 °C.

Solution

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



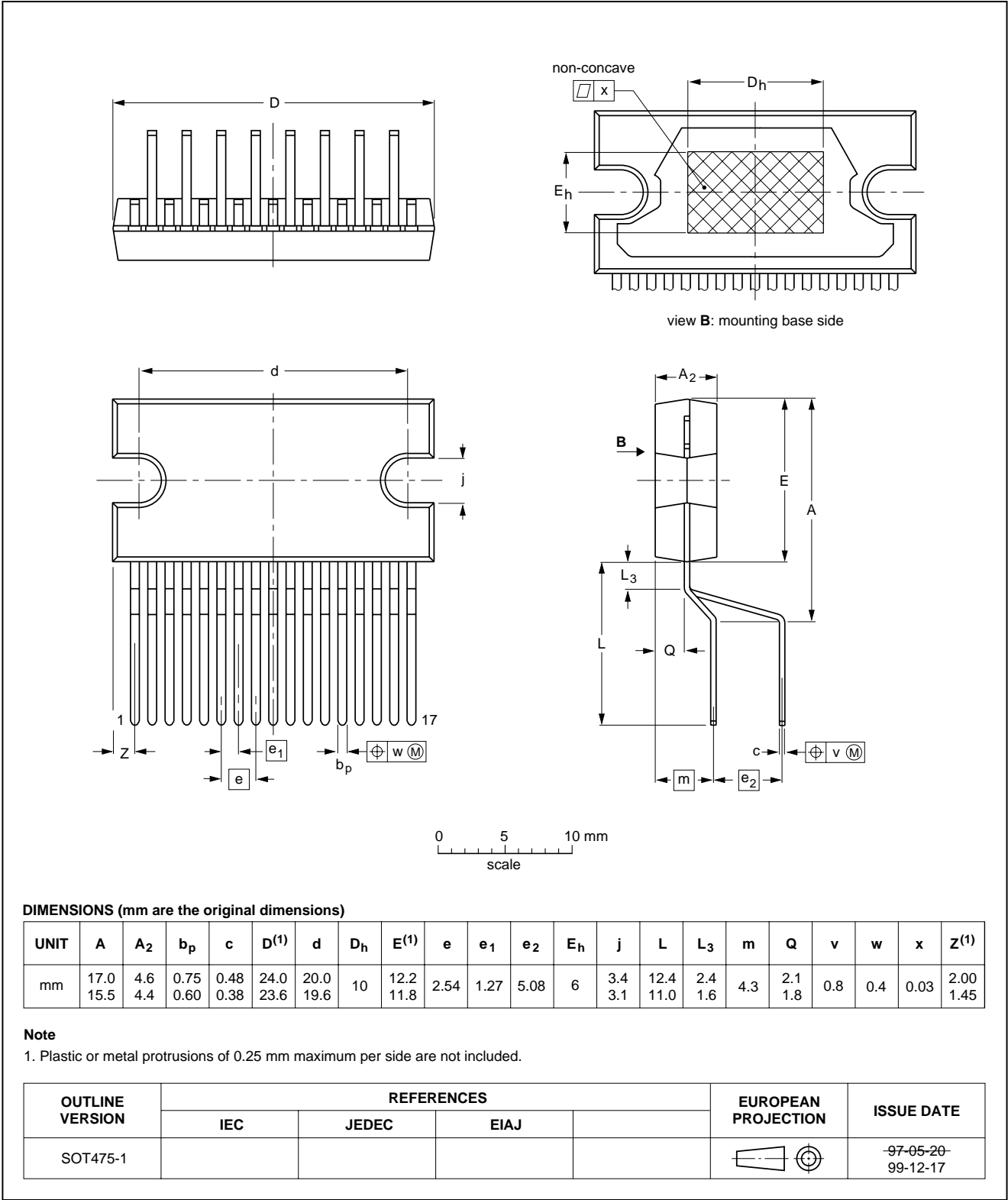
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PACKAGE OUTLINE

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

SOT475-1



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SOLDERING

Introduction to soldering through-hole mount packages

This text gives a brief insight to wave, dip and manual soldering. A more in-depth account of soldering ICs can be found in our *“Data Handbook IC26; Integrated Circuit Packages”* (document order number 9398 652 90011).

Wave soldering is the preferred method for mounting of through-hole mount IC packages on a printed-circuit board.

Soldering by dipping or by solder wave

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

Manual soldering

Apply the soldering iron (24 V or less) to the lead(s) of the package, either 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.

Suitability of through-hole mount IC packages for dipping and wave soldering methods

| PACKAGE                   | SOLDERING METHOD |                         |
|---------------------------|------------------|-------------------------|
|                           | DIPPING          | WAVE                    |
| DBS, DIP, HDIP, SDIP, SIL | suitable         | suitable <sup>(1)</sup> |

Note

1. For SDIP packages, the longitudinal axis must be parallel to the transport direction of the printed-circuit board.

# Multiple voltage regulator with switch and ignition buffers

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## DATA SHEET STATUS

| DATA SHEET STATUS <sup>(1)</sup> | PRODUCT STATUS <sup>(2)</sup> | DEFINITIONS  |
|----------------------------------|-------------------------------|--|
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## Notes

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**NOTES**

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**NOTES**

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## **Contact information**

For additional information please visit **<http://www.semiconductors.philips.com>**. Fax: **+31 40 27 24825**

For sales offices addresses send e-mail to: **[sales.addresses@www.semiconductors.philips.com](mailto:sales.addresses@www.semiconductors.philips.com)**.

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