DATA SHEET

TDA3609JR

Multiple voltage regulator with switch and ignition buffers

Preliminary specification
File under Integrated Circuits, IC01

1997 Aug 15

Philips
Semiconductors

PHILIPS

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

TDA3609JR

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
$I_{q(tot)}$	total quiescent supply current	standby mode	–	500	600	µA
T_j	junction temperature		–	–	150	°C
Voltage regulators						
$V_{O(REG1)}$	output voltage regulator 1	1 mA $\leq I_{REG1} \leq 600$ mA	9.5	10.0	10.5	V
$V_{O(REG2)}$	output voltage regulator 2	0.5 mA $\leq I_{REG2} \leq 150$ mA; $V_P = 14.4$ V	4.75	5.0	5.25	V
$V_{O(REG3)}$	output voltage regulator 3	1 mA $\leq I_{REG3} \leq 500$ mA	4.75	5.0	5.25	V
Power switch						
V_d	drop-out voltage	$I_{sw} = 1$ A	–	0.45	0.7	V
		$I_{sw} = 1.8$ A	–	1	1.8	V
I_M	peak current		3	–	–	A

Multiple voltage regulator with switch and ignition buffers

TDA3609JR

BLOCK DIAGRAM
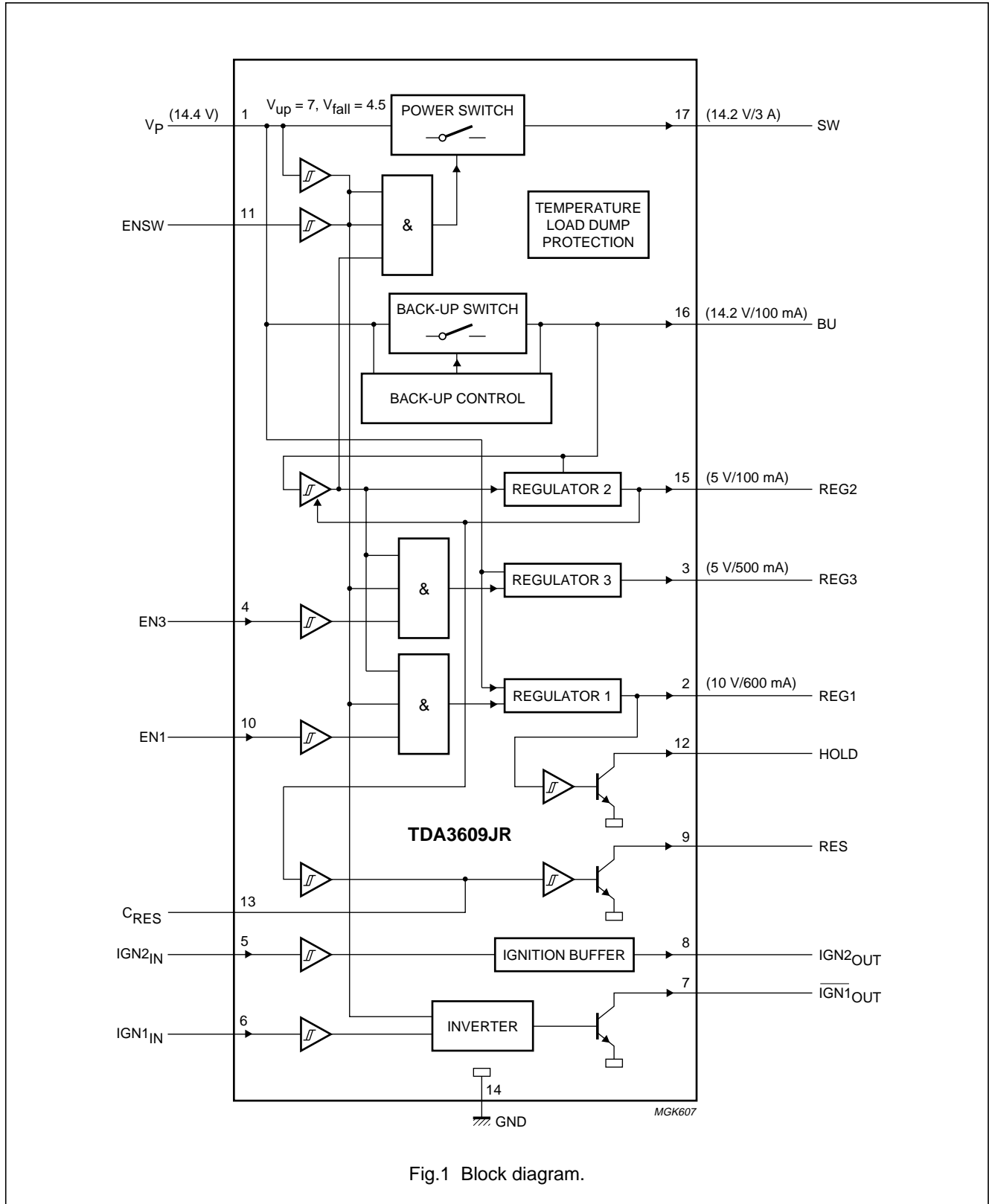
Fig.1 Block diagram.

Multiple voltage regulator with switch and ignition buffers

TDA3609JR

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
$\overline{IGN1}_{OUT}$	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
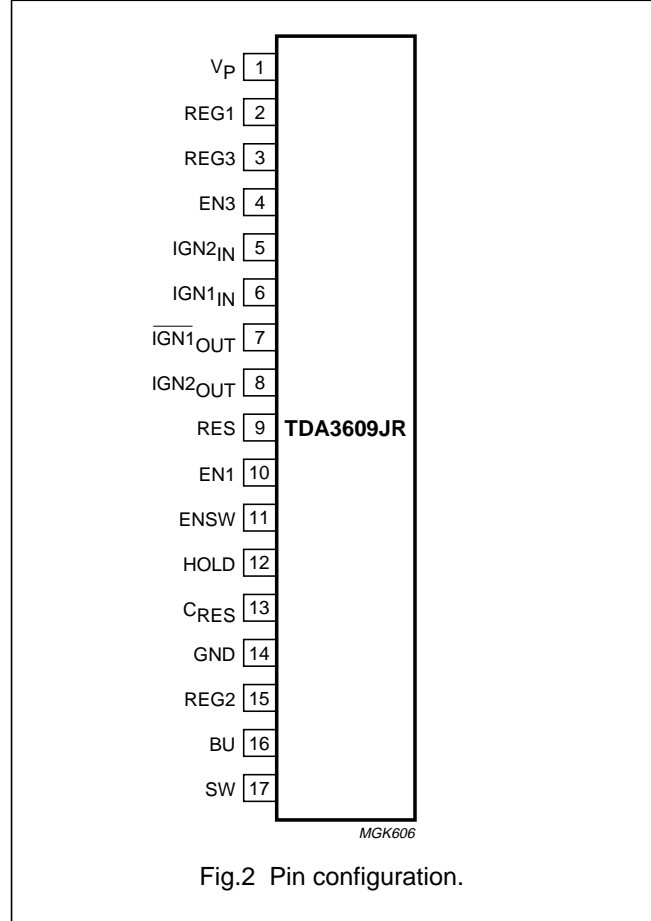
Fig.2 Pin configuration.

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 a 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).

Multiple voltage regulator with switch and
ignition buffers

TDA3609JR

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.

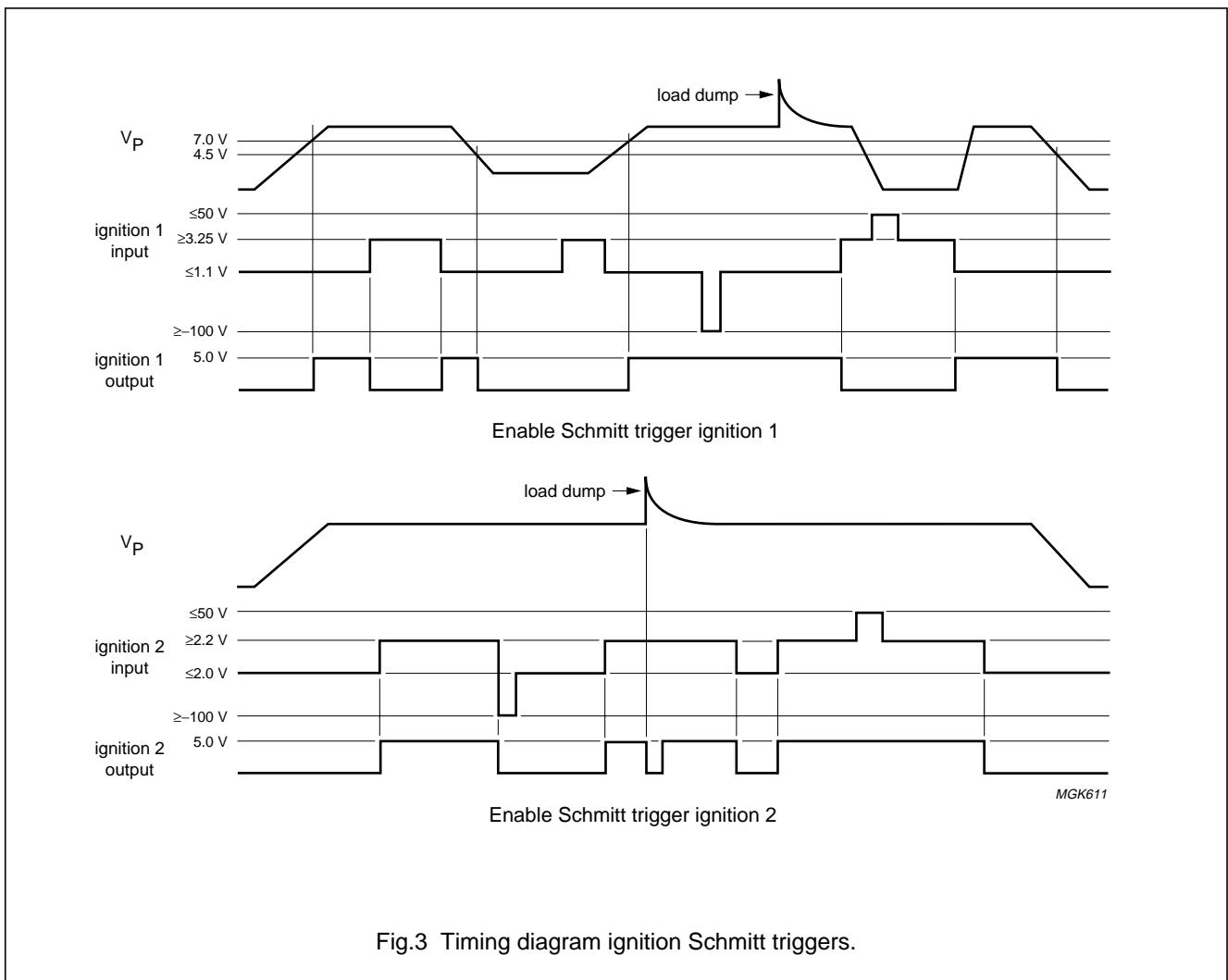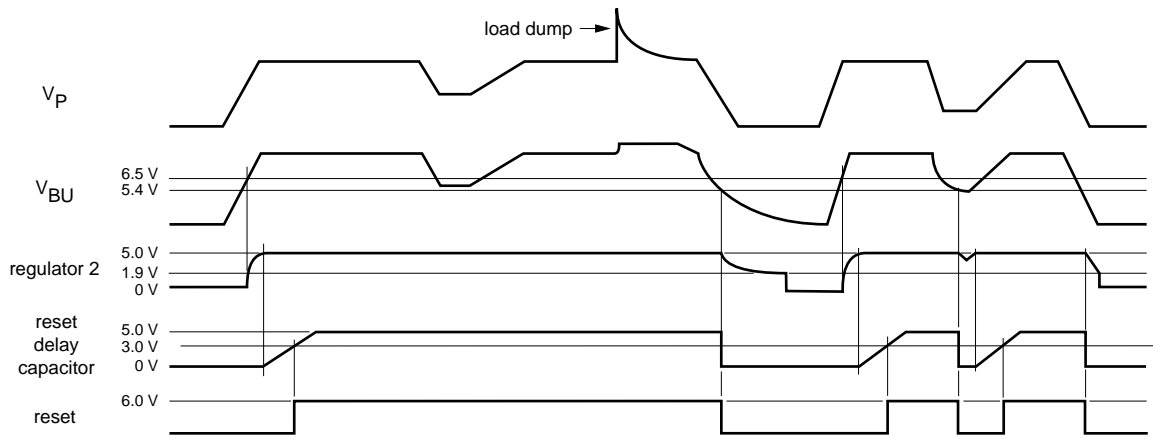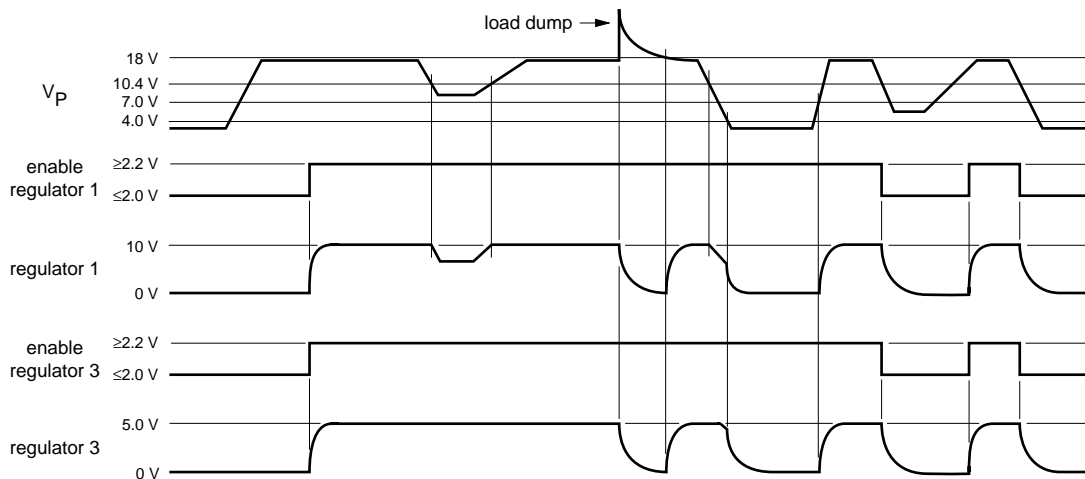The total timing diagrams are shown in Figs 3 and 4.

Fig.3 Timing diagram ignition Schmitt triggers.

Multiple voltage regulator with switch and ignition buffers

TDA3609JR

load dump →

V_P

V_{BU} — 6.5 V, 5.4 V

regulator 2 — 5.0 V, 1.9 V, 0 V

reset delay capacitor — 5.0 V, 3.0 V, 0 V

reset — 6.0 V

Back-up Schmitt trigger and reset behaviour

load dump →

V_P — 18 V, 10.4 V, 7.0 V, 4.0 V

enable regulator 1 — ≥2.2 V, ≤2.0 V

regulator 1 — 10 V, 0 V

enable regulator 3 — ≥2.2 V, ≤2.0 V

regulator 3 — 5.0 V, 0 V

V_P and enable Schmitt trigger

load dump →

V_P — 16.9 V, 7.0 V, 4.0 V

enable power switch — ≥2.2 V, ≤2.0 V

power switch output — 16 V, 0 V
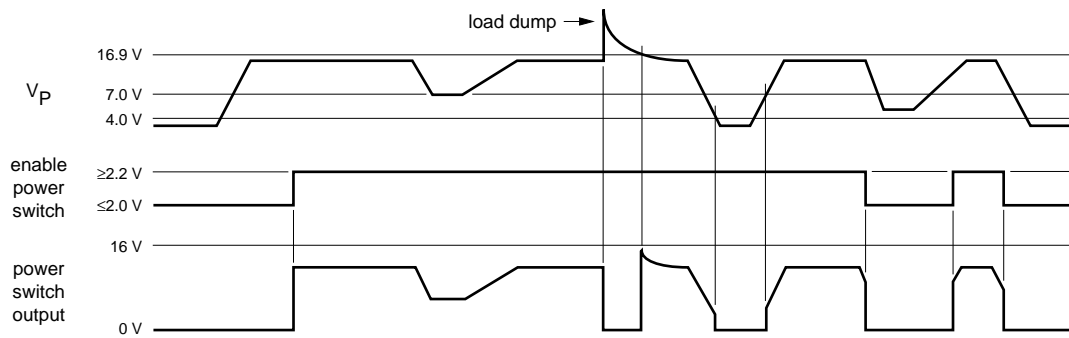
Power switch behaviour

MGK610

Fig.4 Timing diagram regulators and power switch.

Multiple voltage regulator with switch and ignition buffers

TDA3609JR

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	$t \leq 10$ minutes	–	30	V
	load dump protection	$t \leq 50$ ms; $t_r \geq 2.5$ 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

Multiple voltage regulator with switch and
ignition buffers

TDA3609JR

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply						
V_P	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	t ≤ 50 ms; t_r ≥ 2.5 ms	–	–	50	V
I_q	quiescent supply current	V_P = 12.4 V; note 2; I_{REG2} = 0.1 mA	–	500	600	µA
		V_P = 14.4 V; note 2; I_{REG2} = 0.1 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_{REG} = I_{sw} = 1 mA	0.1	0.2	0.5	V
I_{LI}	input leakage current	V_{en} = 5 V	1	5	10	µA
Reset trigger level						
V_{thr}	rising threshold voltage of regulator 2	V_P rising; I_{REG1} = 50 mA; note 3	4.5	V_{REG2} – 0.15	V_{REG2} – 0.1	V
Schmitt trigger for hold						
V_{thr}	rising threshold voltage of regulator 1	V_P rising; note 3	–	V_{REG1} – 0.15	V_{REG1} – 0.075	V
V_{thf}	falling threshold voltage of regulator 1	V_P falling; note 3	9.2	V_{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	$V_{RES/HOLD}$ ≤ 0.8 V	2	–	–	mA
I_{LO}	output leakage current	V_P = 14.4 V; $V_{RES/HOLD}$ = 5 V	–	0.1	5	µA
	rise time	note 4	–	7	50	µs
	fall time	note 4	–	1	50	µs

Multiple voltage regulator with switch and ignition buffers

TDA3609JR

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 nF; note 5	20	35	70	ms
Regulator 1 (I_{REG1} = 5 mA unless otherwise specified)						
$V_{O(off)}$	output voltage off		–	1	400	mV
$V_{O(REG1)}$	output voltage	1 mA ≤ I_{REG1} ≤ 600 mA	9.5	10.0	10.5	V
		12 V ≤ V_P ≤ 18 V	9.5	10.0	10.5	V
ΔV	line regulation	12 V ≤ V_P ≤ 18 V	–	2	75	mV
ΔV_L	load regulation	1 mA ≤ I_{REG1} ≤ 600 mA	–	20	100	mV
I_q	quiescent current	I_{R1} = 600 mA	–	25	60	mA
SVRR	supply voltage ripple rejection	f_i = 3 kHz; $V_{i(p-p)}$ = 2 V	60	70	–	dB
V_d	drop-out voltage	I_{REG1} = 550 mA; V_P = 9.5 V; note 6	–	0.4	0.7	V
I_{REGm1}	current limit	V_{REG1} > 8.5 V; note 7	0.65	1.2	–	A
I_{REGsc1}	short-circuit current	R_L ≤ 0.5 Ω; note 8	250	800	–	mA
Regulator 2 (I_{REG2} = 5 mA unless otherwise specified)						
$V_{O(REG2)}$	output voltage	0.5 mA ≤ I_{REG2} ≤ 150 mA	4.75	5.0	5.25	V
		I_{REG2} = 300 mA; note 9	4.75	5.0	5.25	V
		8 V ≤ V_P ≤ 18 V	4.75	5.0	5.25	V
		18 V ≤ V_P ≤ 50 V; I_{REG2} ≤ 150 mA	4.75	5.0	5.25	V
ΔV	line regulation	6 V ≤ V_P ≤ 18 V	–	2	50	mV
		6 V ≤ V_P ≤ 50 V	–	15	75	mV
ΔV_L	load regulation	1 mA ≤ I_{REG2} ≤ 150 mA	–	20	50	mV
		1 mA ≤ I_{REG2} ≤ 300 mA	–	–	100	mV
SVRR	supply voltage ripple rejection	f = 3 kHz; $V_{i(p-p)}$ = 2 V	60	70	–	dB
V_d	drop-out voltage	I_{REG2} = 100 mA; V_P = 4.75 V; note 6	–	0.4	0.6	V
		I_{REG2} = 200 mA; V_P = 5.75 V; note 6	–	0.8	1.2	V
		I_{REG2} = 100 mA; V_{bu} = 4.75 V; note 10	–	0.2	0.5	V
		I_{REG2} = 200 mA; V_{bu} = 5.75 V; note 10	–	0.8	1.0	V
I_{REGm2}	current limit	V_{REG2} > 4.5 V; note 7	0.32	0.37	–	A
I_{REGsc2}	short-circuit current	R_L ≤ 0.5 Ω; note 8	20	100	–	mA

Multiple voltage regulator with switch and
ignition buffers

TDA3609JR

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

Multiple voltage regulator with switch and
ignition buffers

TDA3609JR

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	$I_{\overline{IGN1}out} = 0$ mA	0	0.2	0.8	V
I_{OL}	LOW-level output current	$V_{\overline{IGN1}out} \leq 0.8$ V	0.45	0.8	–	mA
I_{LO}	output leakage current	$V_{\overline{IGN1}out} = 5$ V; $V_{IGN1in} = 0$ V	–	–	1.0	µA
t_{PLH}	LOW-to-HIGH propagation time	V_{IGN1in} rising from 0.8 V to 3.75 V	–	–	500	µs
t_{PHL}	HIGH-to-LOW propagation time	V_{IGN1in} falling from 3.75 V to 0.8 V	–	–	500	µs
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	µA
$I_{I(clamp)}$	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

Multiple voltage regulator with switch and ignition buffers
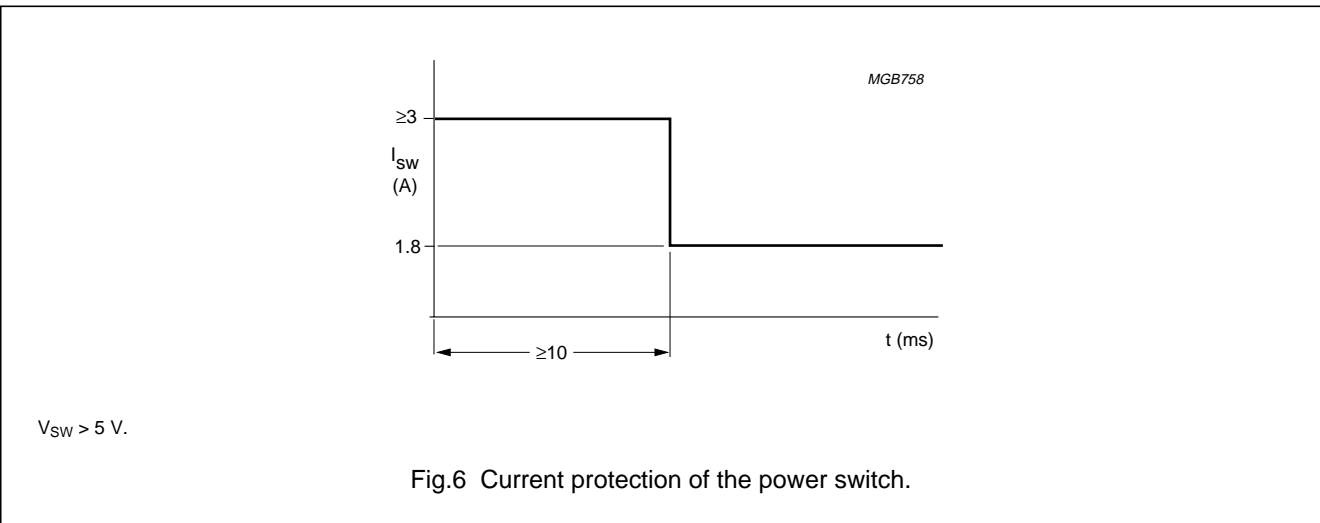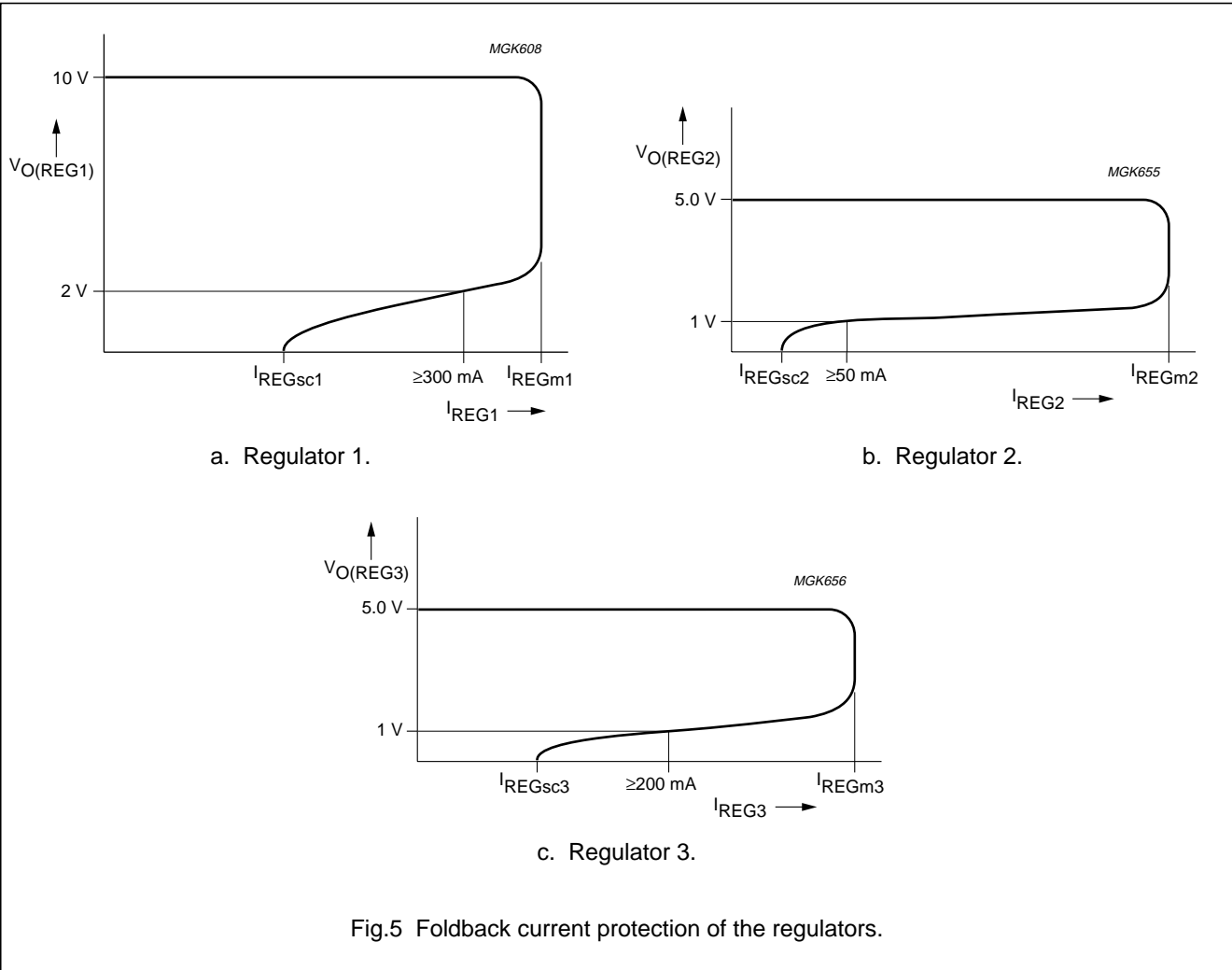
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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Ignition 2 buffer						
V_{OL}	LOW-level output voltage	$I_{IGN2out} = 0$ mA	0	0.2	0.8	V
V_{OH}	HIGH-level output voltage	$I_{IGN2out} = 0$ mA	4.5	5.0	5.25	V
I_{OL}	LOW-level output current	$V_{IGN2out} \leq 0.8$ V	0.45	0.8	–	mA
I_{OH}	HIGH-level output current	$V_{IGN2out} \geq 4.5$ V	−0.45	−2.0	–	mA
I_{LO}	output leakage current (source)	$V_{\overline{IGN1}out} = 5$ 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

1. Minimum operating voltage, only if V_P has exceeded 6.5 V.

2. The quiescent current is measured in the standby mode. So, the enable inputs of regulator 1, 3 and the power switch are grounded and $R_{L(REG2)} = \infty$ (see Fig.7).

3. The voltage of the regulator sinks as a result of a V_P drop.

4. The rise and fall time is measured with a 10 kΩ pull-up resistor and a 50 pF load capacitor.

5. The delay time depends on the value of the capacitor: $t_d = \dfrac{C}{I_{ch}} \times V_{C(th)} = C \times \left(750 \times 10^3 \right) (ms)$

6. The drop-out voltage of regulators 1, 2 and 3 is measured between V_P and REGn.

7. At current limit, I_{REGmn} is held constant (see Fig.5 for behaviour of I_{REGmn}).

8. The foldback current protection limits the dissipated power at short-circuit (see Fig.5).

9. The peak current of 300 mA can only be applied for short periods (t < 100 ms).

10. The drop-out voltage measured between BU and REG2.

11. The drop-out voltage of the power switch is measured between V_P and SW.

12. 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.

13. 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.

14. $V_{\overline{IGN1}out}$ = 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.

a. Regulator 1.

b. Regulator 2.

c. Regulator 3.

Fig.5 Foldback current protection of the regulators.

$V_{SW} > 5$ V.

Fig.6 Current protection of the power switch.

Multiple voltage regulator with switch and
ignition buffers

TDA3609JR

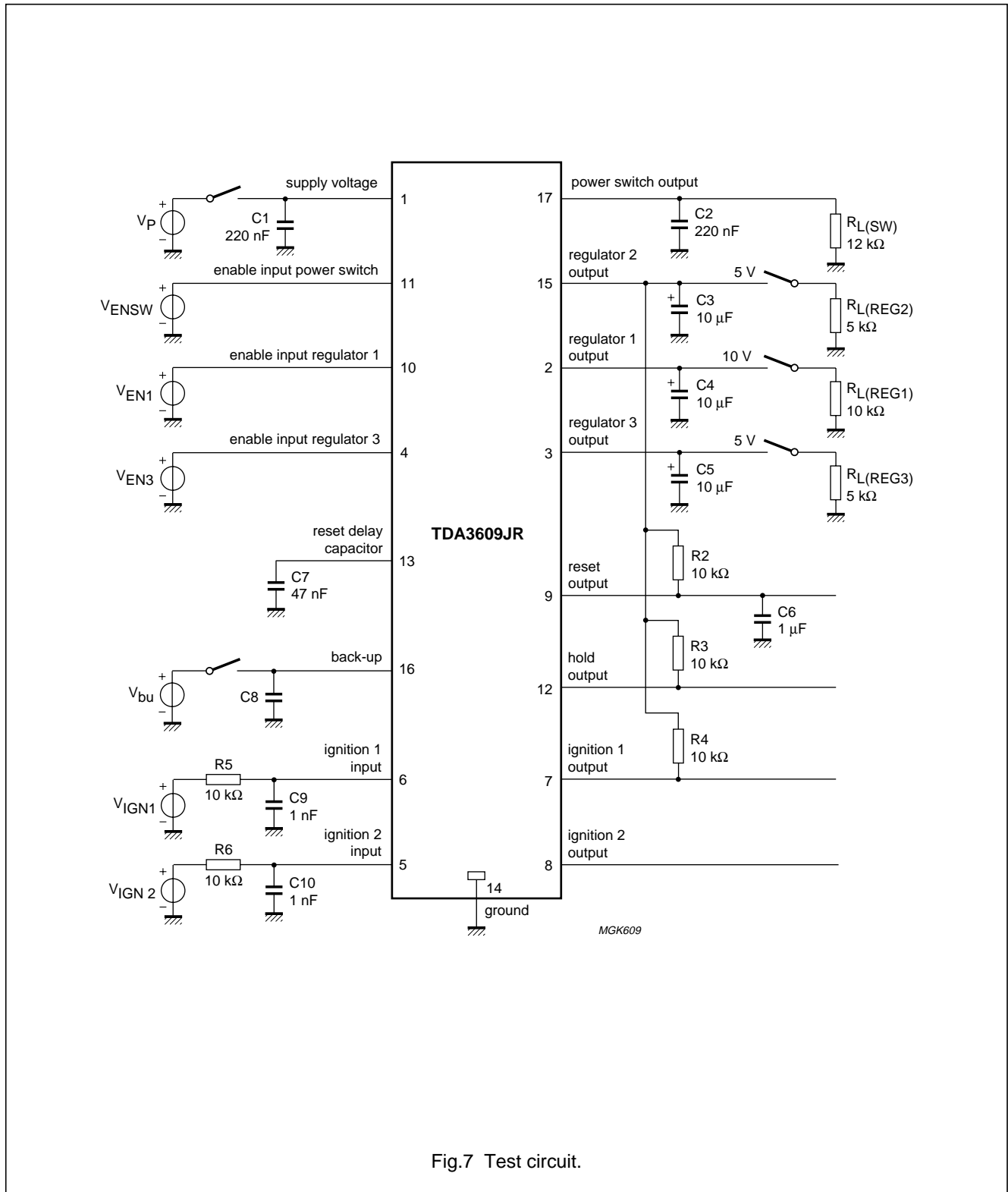**TEST AND APPLICATION INFORMATION**

Test information

Fig.7 Test circuit.

Multiple voltage regulator with switch and ignition buffers

TDA3609JR

Application information

NOISE

Table 1 Noise figures

REGULATOR	NOISE FIGURE (μV)[1]		
	$C_O = 10\ \mu F$	$C_O = 47\ \mu F$	$C_O = 100\ \mu F$
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 $-30\ ^\circ$C the capacitor value is decreased to 73 μF and the ESR is increased to 1.1 Ω. The regulator will remain stable at $-30\ ^\circ$C.

Example 2

Regulator 2 is made stable with a 10 μF electrolytic capacitor (ESR = 3 Ω). At $-30\ ^\circ$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 $-30\ ^\circ$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.
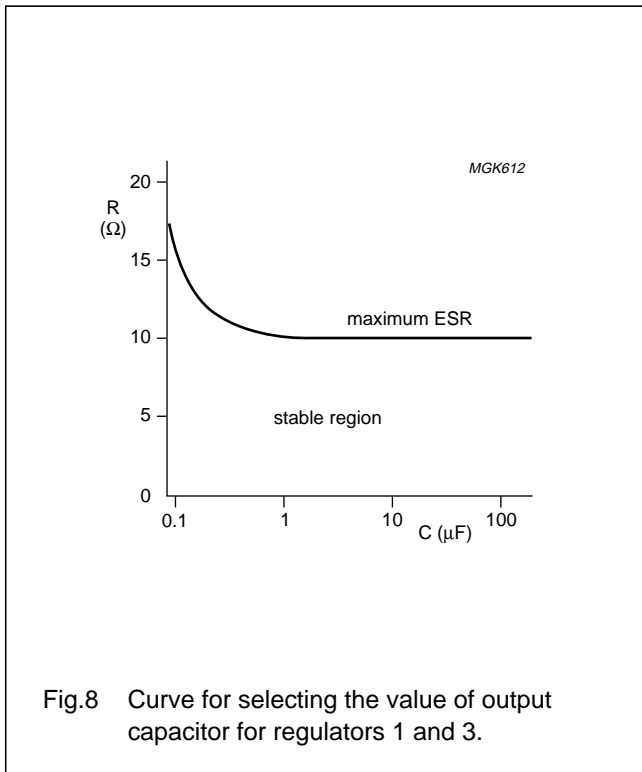

Fig.8   Curve for selecting the value of output capacitor for regulators 1 and 3.
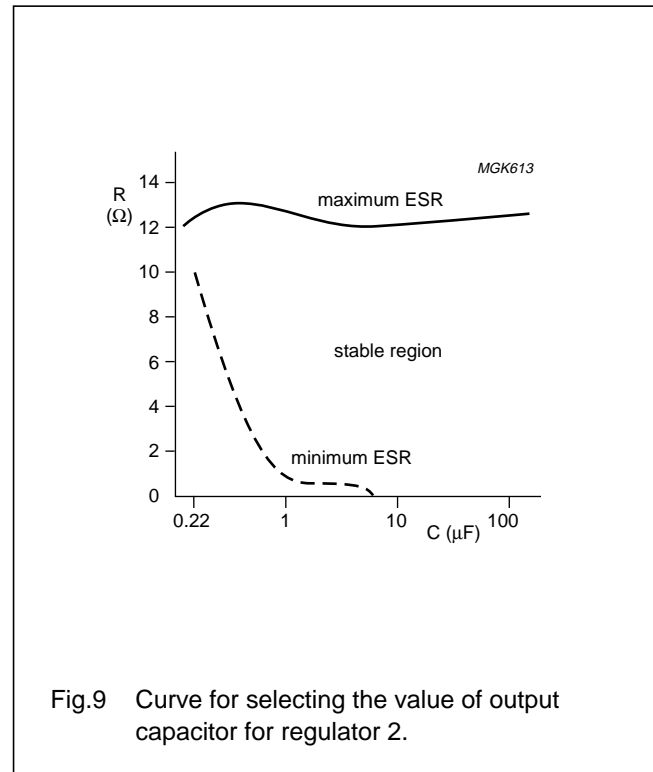

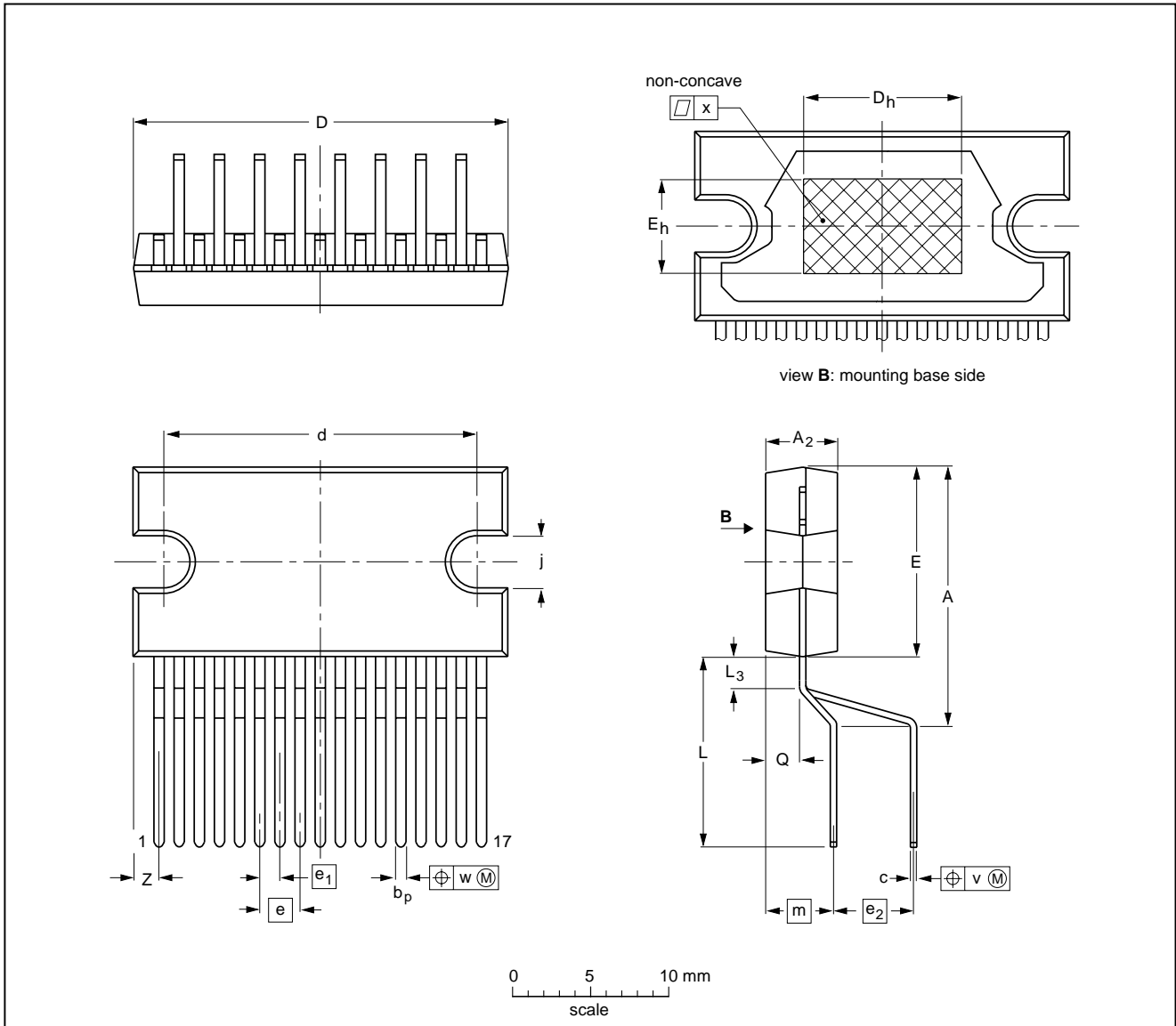Fig.9   Curve for selecting the value of output capacitor for regulator 2.

Multiple voltage regulator with switch and ignition buffers

TDA3609JR

PACKAGE OUTLINE

DBS17P: plastic DIL-bent-SIL (special bent) power package; 17 leads (lead length 12 mm)   **SOT475-1**

view **B**: mounting base side

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

Multiple voltage regulator with switch and ignition buffers

TDA3609JR

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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