

# DATA SHEET

## **TDA3615J** Multiple voltage regulator

Product specification  
Supersedes data of 1998 Jun 23

2004 Jan 12

## Multiple voltage regulator

## TDA3615J

### FEATURES

#### General

- Six voltage regulators
- Five microprocessor controlled regulators (regulators 2 to 6)
- Regulator 1 and reset operate during load dump and thermal shutdown
- Low reverse current of regulator 1
- Very low quiescent current when regulators 2 to 6 and power switches are switched off ( $V_{I(iq)} = 0\text{ V}$ )
- Reset output
- Adjustable display regulator
- High ripple rejection
- Three power switches
- Low noise for regulators 2 to 6.

#### Protections

- Reverse polarity safe (down to  $-18\text{ V}$  without high reverse current)
- Able to withstand voltages up to  $18\text{ V}$  at the output (supply line may be short-circuited)
- ESD protected on all pins
- Thermal protection
- Load dump protection
- Foldback current limit protection (except for regulator 2)
- The regulator outputs and the power switches are DC short-circuited safe to ground and  $V_{bat}$ .

### GENERAL DESCRIPTION

The TDA3615J is a multiple output voltage regulator with power switches, intended for use in car radios with or without a microprocessor. It contains:

- One fixed voltage regulator (regulator 1) intended to supply a microprocessor, that also operates during load dump and thermal shutdown
- 5 power regulators supplied by  $V_{I(iq)}$
- 3 power switches with protections
- 3 enable inputs for selecting regulators 2 to 6 and the three power switches
- Very low quiescent current of typical  $110\text{ }\mu\text{A}$ .

### ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TDA3615J	DBS17P	plastic DIL-bent-SIL power package; 17 leads (lead length 12 mm)	SOT243-1

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## QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Supply</b>						
$V_{bat/I(iig)}$	supply voltage					
	operating	regulators on	11	14.4	18	V
	operating	regulator 1 on	3.5	14.4	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
$I_q$	quiescent supply current	$V_{bat} = 14.4$ V; $V_{I(iig)} < 1$ V; note 1	–	110	250	$\mu$ A
		$V_{bat} = V_{I(iig)} = 14.4$ V; selector inputs 0,0,0 (state 3 in Table 1); note 1	–	125	–	$\mu$ A
<b>Voltage regulators</b>						
$V_{O(REG1)}$	output voltage regulator 1 (5 V standby)	$0.5 \text{ mA} \leq I_{REG1} \leq 50 \text{ mA}$	4.75	5.0	5.25	V
$V_{O(REG2)}$	output voltage regulator 2 (filament)	$0.5 \text{ mA} \leq I_{REG2} \leq 300 \text{ mA}$	2.7	2.85	3.0	V
$V_{O(REG3)}$	output voltage regulator 3 (5 V logic)	$0.5 \text{ mA} \leq I_{REG3} \leq 450 \text{ mA}$	4.75	5.0	5.25	V
$V_{O(REG4)}$	output voltage regulator 4 (synthesizer)	$0.5 \text{ mA} \leq I_{REG4} \leq 100 \text{ mA}$	9.0	9.5	10.0	V
$V_{O(REG5)}$	output voltage regulator 5 (AM)	$0.5 \text{ mA} \leq I_{REG5} \leq 150 \text{ mA}$	9.0	9.5	10.0	V
$V_{O(REG6)}$	output voltage regulator 6 (FM)	$0.5 \text{ mA} \leq I_{REG6} \leq 150 \text{ mA}$	9.0	9.5	10.0	V
<b>Power switches</b>						
$V_{drop(sw1)}$	drop-out voltage switch 1 (antenna)	$I_{SW1} = 0.55$ A	0.1	0.45	1.6	V
$I_{M(sw1)}$	peak current switch 1	$t < 1$ s	1.7	1.9	–	A
$V_{drop(sw2)}$	drop-out voltage switch 2 (media)	$I_{SW2} = 1$ A	–	0.5	1.0	V
$V_{clamp2}$	clamping voltage switch 2		–	15.0	16	V
$V_{drop(sw3)}$	drop-out voltage switch 3 (display)	$I_{SW3} = 0.35$ A	–	0.5	1.0	V
$V_{clamp3}$	clamping voltage switch 3		–	15.2	16	V

**Note**

1. The quiescent current is measured when  $R_L = \infty$ .

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BLOCK DIAGRAM

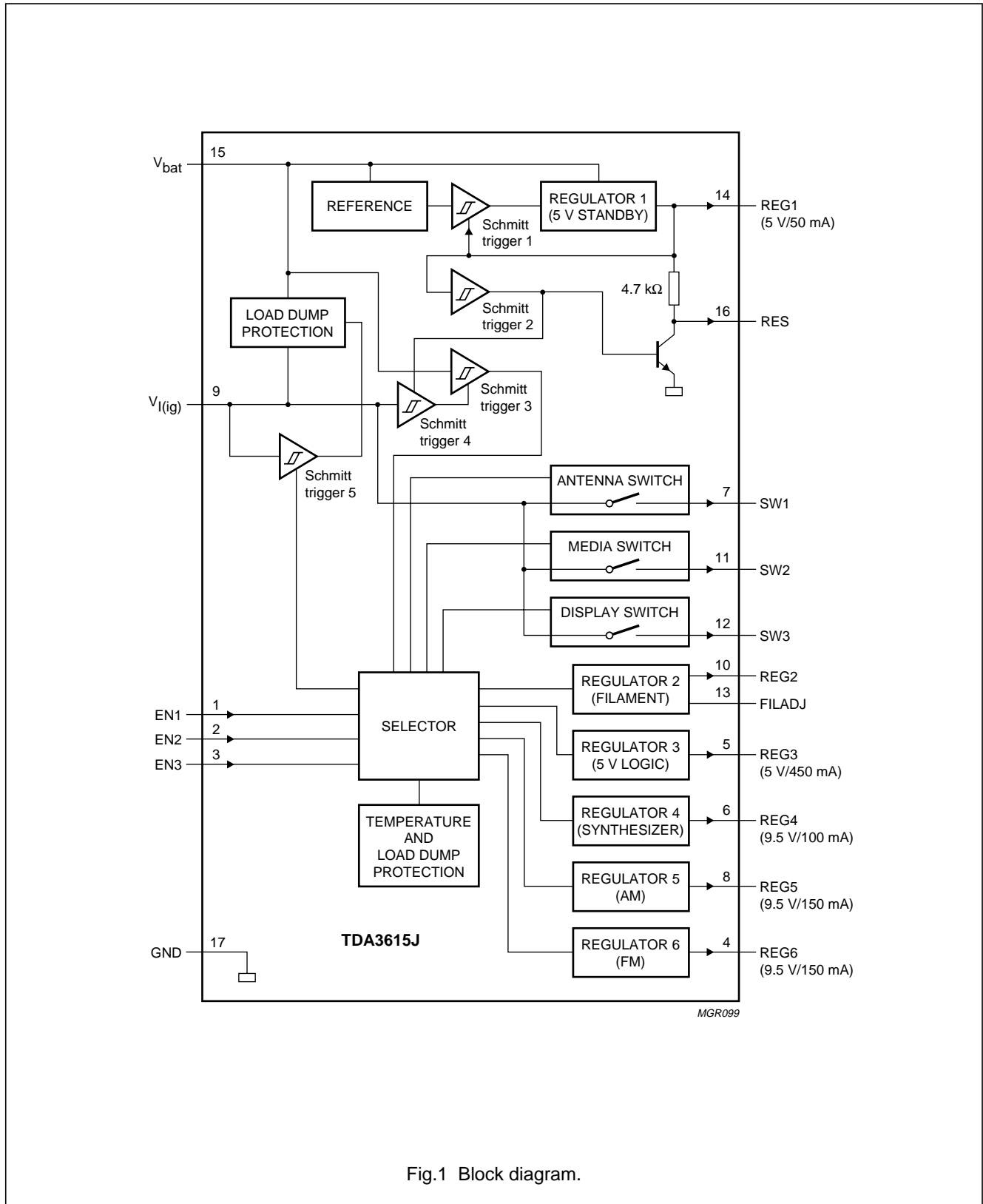


Fig.1 Block diagram.

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PINNING

SYMBOL	PIN	DESCRIPTION
EN1	1	enable input 1
EN2	2	enable input 2
EN3	3	enable input 3
REG6	4	regulator 6 output, FM
REG3	5	regulator 3 output, 5 V logic
REG4	6	regulator 4 output, synthesizer
SW1	7	switch 1 output, antenna
REG5	8	regulator 5 output, AM
$V_{I(ig)}$	9	ignition input voltage
REG2	10	regulator 2 output, filament
SW2	11	switch 2 output, media
SW3	12	switch 3 output, display
FILADJ	13	filament adjustment
REG1	14	regulator 1 output, 5 V standby
$V_{bat}$	15	battery input voltage
RES	16	reset output
GND	17	ground

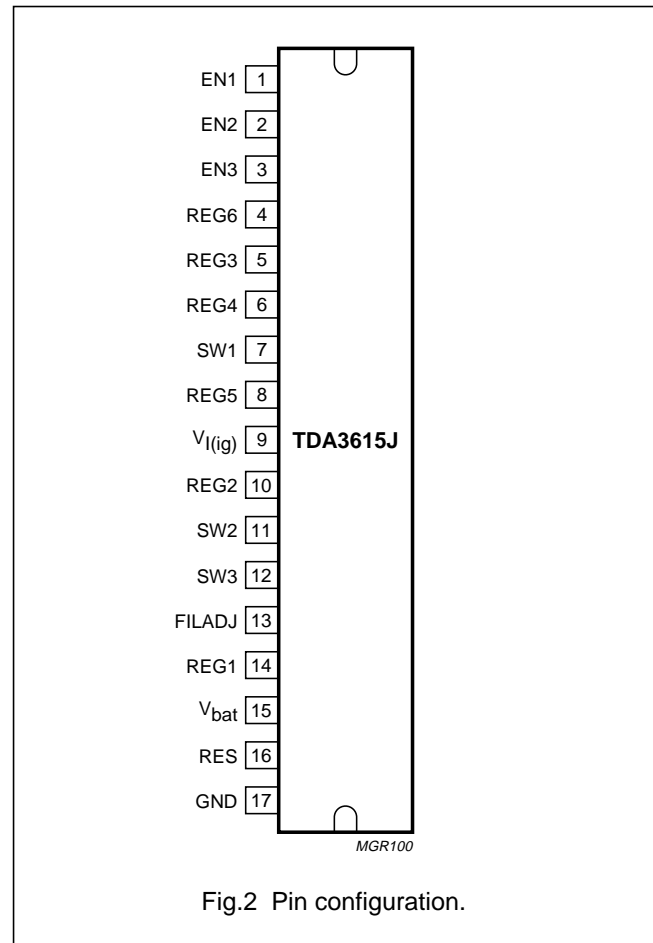


Fig.2 Pin configuration.

## Multiple voltage regulator

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**FUNCTIONAL DESCRIPTION**

The TDA3615J is a multiple voltage regulator intended to supply a microprocessor (e.g. in car radio applications). Because of low-voltage operation of the application, a low-voltage drop regulator is used in the TDA3615J.

Regulator 1 (5 V standby) will switch on when the supply voltage exceeds 7.2 V for the first time and will switch off again when the output voltage of the regulator drops below 3.5 V.

Reset is used to indicate that the regulator output voltage is within its voltage range. This start-up feature is built-in to secure a smooth start-up of the microprocessor at first connection, without uncontrolled switching of the standby regulator during the start-up sequence.

All other regulators and switches can be switched on and off by using the three control input pins. This is only possible when both supply voltages ( $V_{bat}$  and  $V_{I(ig)}$ ) are within their voltage range. Table 1 shows all possible states.

The filament regulator output voltage of the TDA3615J can be adjusted with pin FILADJ.

All output pins are fully protected. The regulators are protected against load dump and short-circuit (foldback current protection, except the filament regulator output). At load dump all regulator outputs will go LOW except the 5 V standby regulator output.

The antenna switch and the media switch can withstand 'loss of ground'. This means that the ground pin is disconnected and the switch output is connected to ground ( $V_{bat}$  and  $V_{I(ig)}$  are normally connected to the right pin).

**Selector settings**

**Table 1** Possible states of outputs depending on inputs

STATE	INPUTS					OUTPUTS								
	$V_{bat}$	$V_{I(ig)}$	EN1	EN2	EN3	REG1	REG2	REG3	REG4	REG5	REG6	SW1	SW2	SW3
1	0	X <sup>(1)</sup>	X <sup>(1)</sup>	X <sup>(1)</sup>	X <sup>(1)</sup>	0	0	0	0	0	0	0	0	0
2	1	0	X <sup>(1)</sup>	X <sup>(1)</sup>	X <sup>(1)</sup>	1	0	0	0	0	0	0	0	0
3	1	1	0	0	0	1	0	0	0	0	0	0	0	0
4	1	1	0	0	1	1	1	1	1	0	1	1	0	1
5	1	1	0	1	0	1	1	1	1	1	0	1	0	1
6	1	1	0	1	1	1	1	1	0	0	0	0	1	1
7	1	1	1	0	0	1	1	1	0	0	0	0	0	1
8	1	1	1	0	1	1	1	1	1	0	1	1	1	1
9	1	1	1	1	0	1	1	1	1	1	0	1	1	1
10	1	1	1	1	1	1	1	1	1	0	0	1	1	1

**Note**

1. X = don't care.

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**LIMITING VALUES**

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{bat/I(iig)}$	supply voltage	regulators on	–	18	V
	operating	$t \leq 10$ minutes	–	30	V
	jump start	$t \leq 50$ ms; $t_r \geq 2.5$ ms	–	50	V
$V_{rp}$	reverse polarity voltage	non-operating	–	–18	V
$P_{tot}$	total power dissipation	$T_{amb} = 25$ °C	–	62.5	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	40	K/W

**QUALITY SPECIFICATION**

Quality specification is in accordance with "SNW-FQ-611".

**CHARACTERISTICS** $V_{bat} = V_{I(iig)} = 14.4$  V;  $T_{amb} = 25$  °C; see Fig.4; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Supply</b>						
$V_{bat/I(iig)}$	supply voltage	regulators on	11	14.4	18	V
	operating	$t \leq 10$ minutes	–	–	30	V
	jump start	$t \leq 50$ ms; $t_r \geq 2.5$ ms	–	–	50	V
$I_q$	quiescent supply current	$V_{bat} = 14.4$ V; $V_{I(iig)} < 1$ V; note 1	–	110	250	µA
		$V_{bat} = V_{I(iig)} = 14.4$ V; selector inputs 0,0,0; note 1	–	125	–	µA
<b>Reset buffer</b>						
$I_{sink(L)}$	LOW-level sink current		2	15	–	mA
$R_{pu(int)}$	internal pull-up resistance		3.7	4.7	5.7	kΩ
<b>Selector control inputs</b>						
$V_{IL}$	LOW-level input voltage		–0.5	–	+0.8	V
$V_{IH}$	HIGH-level input voltage		2.0	–	–	V
$I_{IH}$	HIGH-level input current	$V_{IH} > 2$ V	–	–	1.0	mA
$I_{IL}$	LOW-level input current	$V_{IL} < 0.8$ V	–1.0	–	–	mA

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Regulator 1 for 5 V standby (<math>I_{REG1} = 1 \text{ mA}</math> unless otherwise specified)</b>						
$V_{O(REG1)}$	output voltage	$0.5 \text{ mA} \leq I_{REG1} \leq 50 \text{ mA}$	4.75	5.0	5.25	V
		$6.5 \text{ V} \leq V_{bat} \leq 18 \text{ V}$ ; note 2	4.75	5.0	5.25	V
		$18 \text{ V} \leq V_{bat} \leq 50 \text{ V}$ ; load dump; $I_{REG1} = 30 \text{ mA}$	4.75	5.0	5.25	V
$\Delta V_{LN1}$	line voltage regulation	$7 \text{ V} \leq V_{bat} \leq 18 \text{ V}$	–	3	50	mV
$\Delta V_{L1}$	load voltage regulation	$0.5 \text{ mA} \leq I_{REG1} \leq 50 \text{ mA}$	–	–	60	mV
SVRR1	supply voltage ripple rejection	$f_i = 120 \text{ Hz}$ ; $V_{i(p-p)} = 2 \text{ V}$	60	72	–	dB
$V_{drop1}$	drop-out voltage	$V_{bat} = 5 \text{ V}$ ; note 3	–	0.27	1	V
$I_{l1}$	current limit	$V_{REG1} > 4.5 \text{ V}$	60	170	–	mA
$I_{sc1}$	short-circuit current	$R_L \leq 0.5 \Omega$ ; note 4	15	60	–	mA
<b>Regulator 2 for filament (<math>I_{REG2} = 5 \text{ mA}</math> unless otherwise specified)</b>						
$V_{O(REG2)}$	output voltage	$0.5 \text{ mA} \leq I_{REG2} \leq 300 \text{ mA}$	2.7	2.85	3.0	V
		$7.5 \text{ V} \leq V_{bat} \leq 16.9 \text{ V}$	2.7	2.85	3.0	V
		adjust control	1.1	adjust	$V_{I(ig)}$	V
$\Delta V_{LN2}$	line voltage regulation	$7.5 \text{ V} \leq V_{bat} \leq 16.9 \text{ V}$	–	–	50	mV
$\Delta V_{L2}$	load voltage regulation	$5 \text{ mA} \leq I_{REG2} \leq 300 \text{ mA}$	–	–	70	mV
SVRR2	supply voltage ripple rejection	$f_i = 120 \text{ Hz}$ ; $V_{i(p-p)} = 2 \text{ V}$	60	80	–	dB
$I_{sc2}$	short-circuit current	$R_L \leq 0.5 \Omega$	0.35	0.66	–	A
<b>Regulator 3 for 5 V logic (<math>I_{REG3} = 5 \text{ mA}</math> unless otherwise specified)</b>						
$V_{O(REG3)}$	output voltage	$0.5 \text{ mA} \leq I_{REG3} \leq 450 \text{ mA}$	4.75	5.0	5.25	V
		$7.5 \text{ V} \leq V_{bat} \leq 16.9 \text{ V}$	4.75	5.0	5.25	V
$\Delta V_{LN3}$	line voltage regulation	$7.5 \text{ V} \leq V_{bat} \leq 16.9 \text{ V}$	–	–	50	mV
$\Delta V_{L3}$	load voltage regulation	$5 \text{ mA} \leq I_{REG3} \leq 450 \text{ mA}$	–	–	60	mV
SVRR3	supply voltage ripple rejection	$f_i = 120 \text{ Hz}$ ; $V_{i(p-p)} = 2 \text{ V}$	60	80	–	dB
$I_{l3}$	current limit	$V_{REG3} > 3.5 \text{ V}$	0.5	0.85	–	A
$I_{sc3}$	short-circuit current	$R_L \leq 0.5 \Omega$ ; note 4	20	125	–	mA
<b>Regulator 4 for synthesizer (<math>I_{REG4} = 5 \text{ mA}</math> unless otherwise specified)</b>						
$V_{O(REG4)}$	output voltage	$0.5 \text{ mA} \leq I_{REG4} \leq 100 \text{ mA}$	9.0	9.5	10.0	V
		$10.75 \text{ V} \leq V_{bat} \leq 16.9 \text{ V}$	9.0	9.5	10.0	V
$\Delta V_{LN4}$	line voltage regulation	$10.75 \text{ V} \leq V_{bat} \leq 16.9 \text{ V}$	–	–	50	mV
$\Delta V_{L4}$	load voltage regulation	$5 \text{ mA} \leq I_{REG4} \leq 100 \text{ mA}$	–	–	70	mV
SVRR4	supply voltage ripple rejection	$f_i = 120 \text{ Hz}$ ; $V_{i(p-p)} = 2 \text{ V}$	60	70	–	dB
$V_{drop4}$	drop-out voltage	$I_{REG4} = 0.1 \text{ A}$ ; $V_{bat} = 9 \text{ V}$ ; note 5	–	0.18	0.5	V
$I_{l4}$	current limit	$V_{REG4} > 7 \text{ V}$	0.35	0.57	–	A
$I_{sc4}$	short-circuit current	$R_L \leq 0.5 \Omega$ ; note 4	20	160	–	mA



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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Regulator 5 for AM (<math>I_{REG5} = 5 \text{ mA}</math> unless otherwise specified)</b>						
$V_{O(REG5)}$	output voltage	$0.5 \text{ mA} \leq I_{REG5} \leq 150 \text{ mA}$	9.0	9.5	10.0	V
		$10.75 \text{ V} \leq V_{bat} \leq 16.9 \text{ V}$	9.0	9.5	10.0	V
$\Delta V_{LN5}$	line voltage regulation	$10.75 \text{ V} \leq V_{bat} \leq 16.9 \text{ V}$	–	–	50	mV
$\Delta V_{L5}$	load voltage regulation	$5 \text{ mA} \leq I_{REG5} \leq 150 \text{ mA}$	–	–	70	mV
SVRR5	supply voltage ripple rejection	$f_i = 120 \text{ Hz}; V_{i(p-p)} = 2 \text{ V}$	60	70	–	dB
$V_{drop5}$	drop-out voltage	$I_{REG5} = 0.15 \text{ A}; V_{bat} = 9 \text{ V}; \text{note 5}$	–	0.35	1	V
$I_{l5}$	current limit	$V_{REG5} > 7 \text{ V}$	0.2	0.37	–	A
$I_{sc5}$	short-circuit current	$R_L \leq 0.5 \Omega; \text{note 4}$	50	130	–	mA
<b>Regulator 6 for FM (<math>I_{REG6} = 5 \text{ mA}</math> unless otherwise specified)</b>						
$V_{O(REG6)}$	output voltage	$0.5 \text{ mA} \leq I_{REG6} \leq 150 \text{ mA}$	9.0	9.5	10.0	V
		$10.75 \text{ V} \leq V_{bat} \leq 16.9 \text{ V}$	9.0	9.5	10.0	V
$\Delta V_{LN6}$	line voltage regulation	$10.75 \text{ V} \leq V_{bat} \leq 16.9 \text{ V}$	–	–	50	mV
$\Delta V_{L6}$	load voltage regulation	$5 \text{ mA} \leq I_{REG6} \leq 150 \text{ mA}$	–	–	70	mV
SVRR6	supply voltage ripple rejection	$f_i = 120 \text{ Hz}; V_{i(p-p)} = 2 \text{ V}$	60	70	–	dB
$V_{drop6}$	drop-out voltage	$I_{REG6} = 0.15 \text{ A}; V_{bat} = 9 \text{ V}; \text{note 5}$	–	0.4	1	V
$I_{l6}$	current limit	$V_{REG6} > 7 \text{ V}$	0.2	0.37	–	A
$I_{sc6}$	short-circuit current	$R_L \leq 0.5 \Omega; \text{note 4}$	50	125	–	mA
<b>Power switch 1 (antenna)</b>						
$V_{drop(sw1)}$	drop-out voltage	$I_{SW1} = 0.55 \text{ A}; \text{note 5}$	0.1	0.45	1.6	V
$V_{clamp1}$	clamping voltage		–	15.2	16	V
$I_{M1}$	peak current	$t < 1 \text{ s}$	1.7	1.9	–	A
<b>Power switch 2 (media)</b>						
$V_{drop(sw2)}$	drop-out voltage	$I_{SW2} = 1 \text{ A}; \text{note 5}$	–	0.5	1.0	V
$V_{clamp2}$	clamping voltage		–	15.0	16	V
<b>Power switch 3 (display)</b>						
$V_{drop(sw3)}$	drop-out voltage	$I_{SW3} = 0.35 \text{ A}; \text{note 5}$	–	0.5	1.0	V
$V_{clamp3}$	clamping voltage		–	15.2	16	V
<b>Schmitt trigger 1 for regulator</b>						
$V_{thr1}$	rising threshold voltage	selector inputs 0,0,0 (state 3 in Table 1); $I_{REG1} = 10 \text{ mA}$	6.2	7.2	7.8	V
$V_{thf1}$	falling threshold voltage	selector inputs 0,0,0 (state 3 in Table 1); $I_{REG1} = 10 \text{ mA}$	3.2	3.5	3.7	V
$V_{hys1}$	hysteresis voltage		–	3.7	–	V
<b>Schmitt trigger 2 for reset; note 6</b>						
$V_{thr2}$	rising threshold voltage	$I_{REG1} = 10 \text{ mA}$	4.28	4.45	4.73	V
$V_{thf2}$	falling threshold voltage	$I_{REG1} = 10 \text{ mA}$	4.2	4.35	4.5	V
$V_{hys2}$	hysteresis voltage		–	0.1	–	V

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Schmitt trigger 3 for battery sense</b>						
$V_{thr3}$	rising threshold voltage	$V_{I(ig)} = 14.4 \text{ V}; R_L = 1 \text{ k}\Omega$	6.8	7.35	7.9	V
$V_{thf3}$	falling threshold voltage	$V_{I(ig)} = 14.4 \text{ V}; R_L = 1 \text{ k}\Omega$	5.5	5.95	6.4	V
$V_{hys3}$	hysteresis voltage		–	1.4	–	V
<b>Schmitt trigger 4 for ignition sense</b>						
$V_{thr4}$	rising threshold voltage	$V_{bat} = 14.4 \text{ V}; R_L = 100 \Omega$	7.2	7.6	8.0	V
$V_{thf4}$	falling threshold voltage	$V_{bat} = 14.4 \text{ V}; R_L = 100 \Omega$	6.0	6.3	6.8	V
$V_{hys4}$	hysteresis voltage		–	1.3	–	V
<b>Schmitt trigger 5 for load dump</b>						
$V_{thr5}$	rising threshold voltage	selector inputs 1,0,1 (state 8 in Table 1); note 7	17.5	18.5	19.5	V
$V_{thf5}$	falling threshold voltage	selector inputs 1,0,1 (state 8 in Table 1); note 7	17	$V_{thr} - 0.3$	$V_{thr} - 0.1$	V

**Notes**

1. The quiescent current is measured when  $R_L = \infty$ .
2. Only if  $V_{bat}$  has exceeded 7.2 V.
3. The drop-out voltage of regulator 1 is measured between  $V_{bat}$  and  $V_{REGx}$ .
4. The foldback current protection limits the dissipation power at short-circuit.
5. The drop-out voltage of regulators 2 to 6 and power switches 1, 2 and 3 are measured between  $V_{I(ig)}$  and  $V_{REGx}$  or between  $V_{I(ig)}$  and  $V_{SWx}$ .
6. The voltage of regulator 1 sinks as a result of a supply voltage drop.
7. Only when one of the control pins is HIGH.

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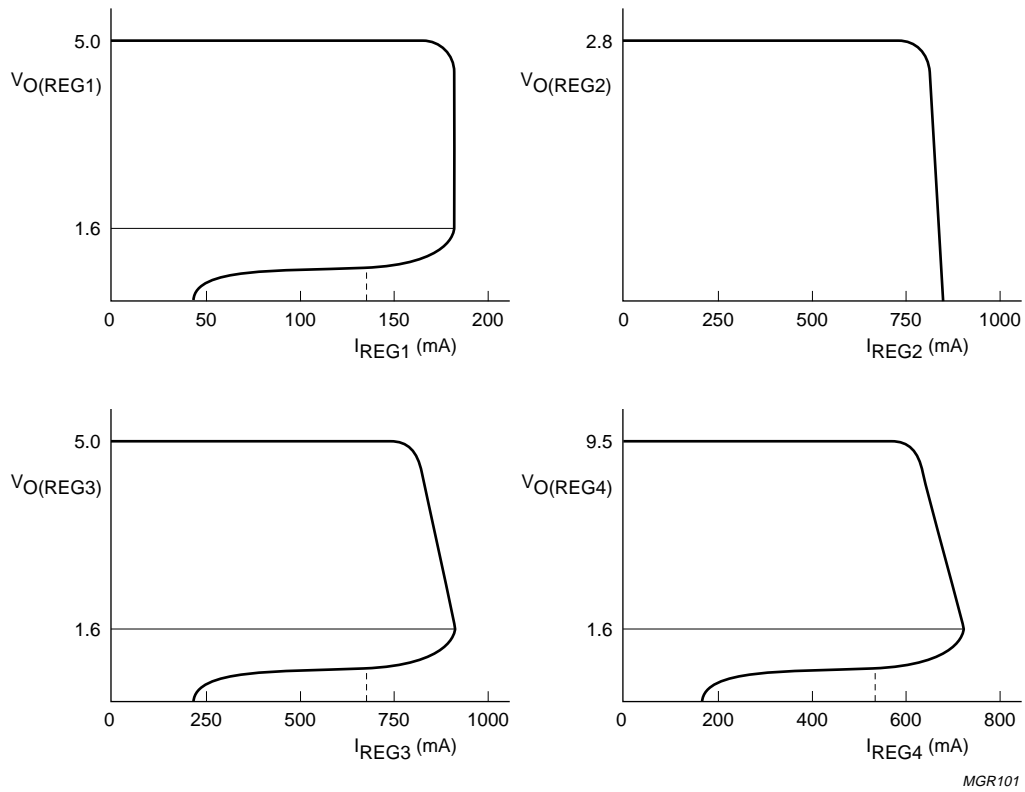


Fig.3 Typical foldback current protection behaviour.

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TEST AND APPLICATION INFORMATION

Test information

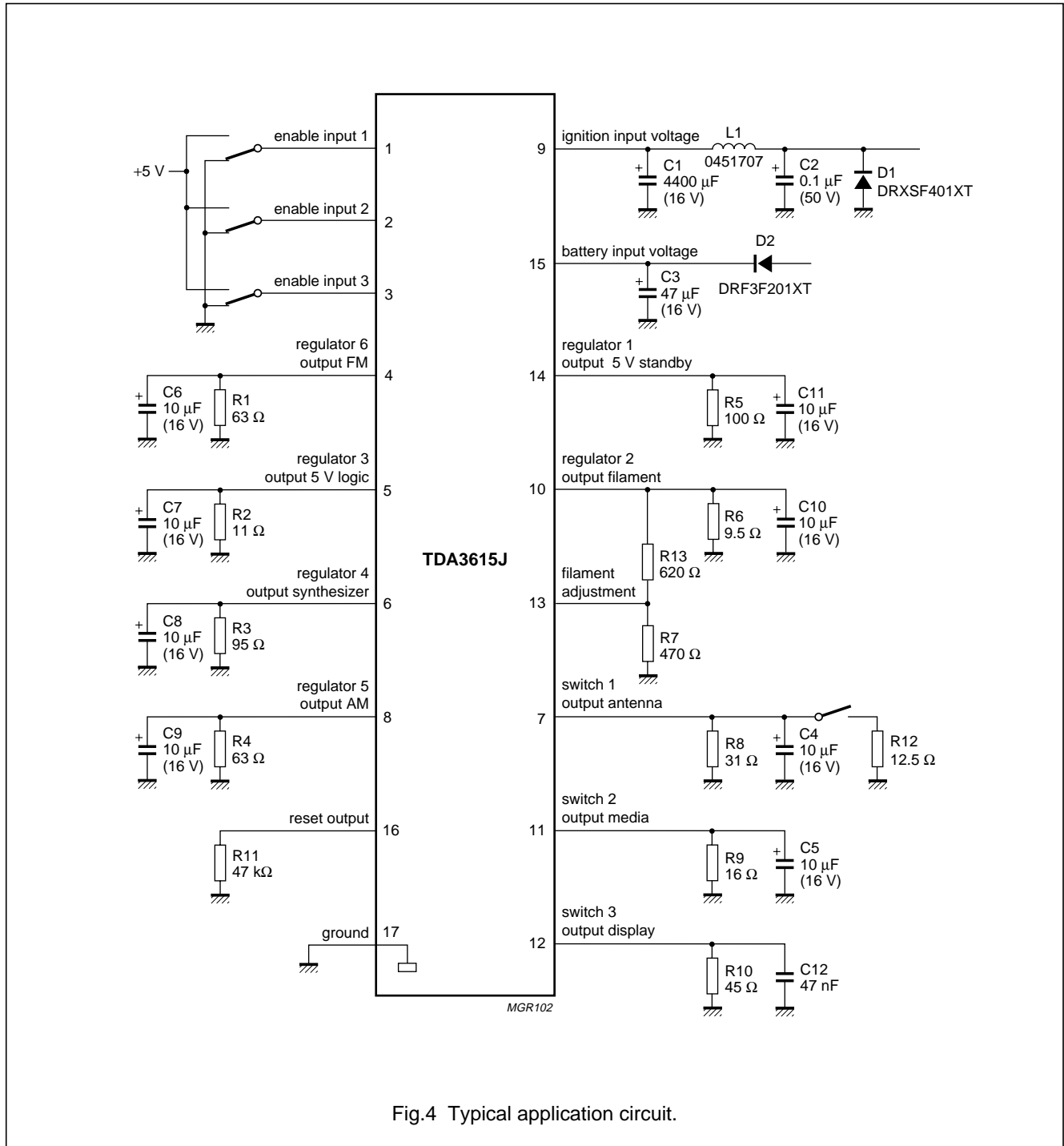


Fig.4 Typical application circuit.

# Multiple voltage regulator

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## Application information

### NOISE

**Table 2** Noise figures

REGULATOR	NOISE FIGURE ( $\mu V$ ) <sup>(1)</sup>		
	$C_o = 10 \mu F$	$C_o = 47 \mu F$	$C_o = 100 \mu F$
1	175	145	100
2	125	98	85
3	180	150	125
4	290	260	190
5	290	260	190
6	290	260	190

### Note

1. Measured at a bandwidth of 1 MHz.

The regulator outputs for regulators 2 to 6 are designed in such a way that the noise is very low and the stability is very good. The noise output voltages are depending on the output capacitors. Table 2 describes the influence of the output capacitors on the output noise.

### STABILITY

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

With almost any output capacitor, stability can be guaranteed; see Figs 5, 6 and 7.

When only an electrolytic capacitor is used, the temperature behaviour of this output capacitor can cause oscillations at extreme low temperature. The next 2 examples show how an output capacitor value is selected. Oscillation problems can be avoided by adding a 47 nF capacitor in parallel with the electrolytic capacitor.

#### Example 1 (regulator 1)

Regulator 1 is made stable with an electrolytic output capacitor of 10  $\mu F$  (ESR = 3.1  $\Omega$ ). At -30 °C the capacitor value is decreased to 3  $\mu F$  and the ESR is increased to 22  $\Omega$ . The regulator will remain stable at -30 °C; see Fig.5.

#### Example 2 (regulator 5)

Regulator 5 is made stable with a 2.2  $\mu F$  electrolytic capacitor (ESR = 8  $\Omega$ ). At -30 °C the capacitor value is decreased to 0.8  $\mu F$  and the ESR is increased to 56  $\Omega$ . Using Fig.6, the regulator will be instable at -30 °C.

Even when only a small MKT capacitor of 47 nF is used as output capacitor, regulator 5 will remain stable over all temperatures.

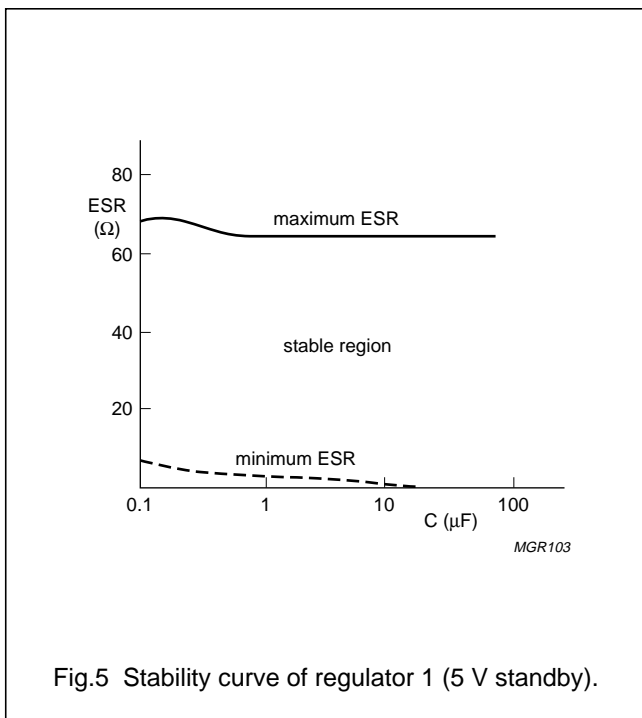


Fig.5 Stability curve of regulator 1 (5 V standby).

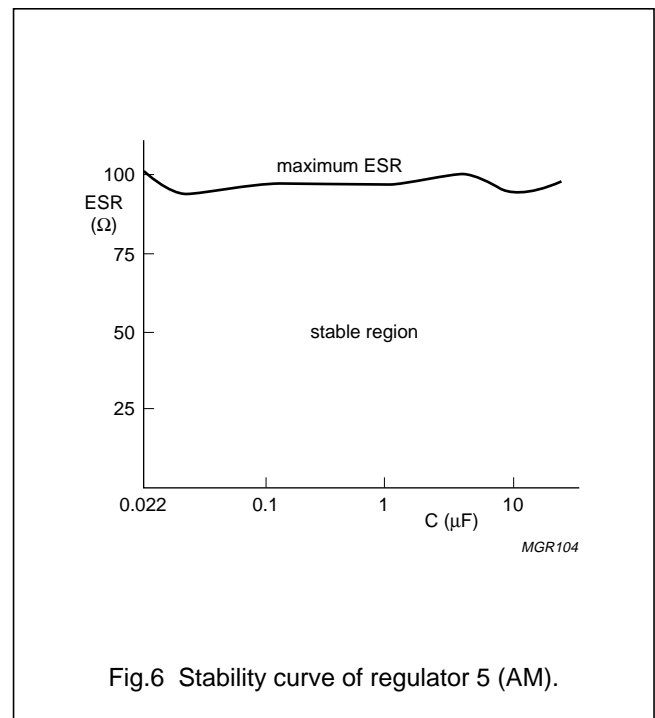
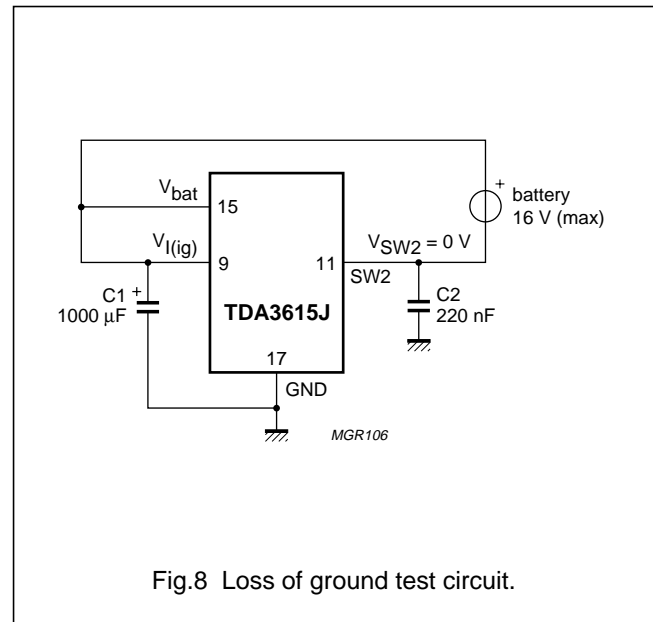
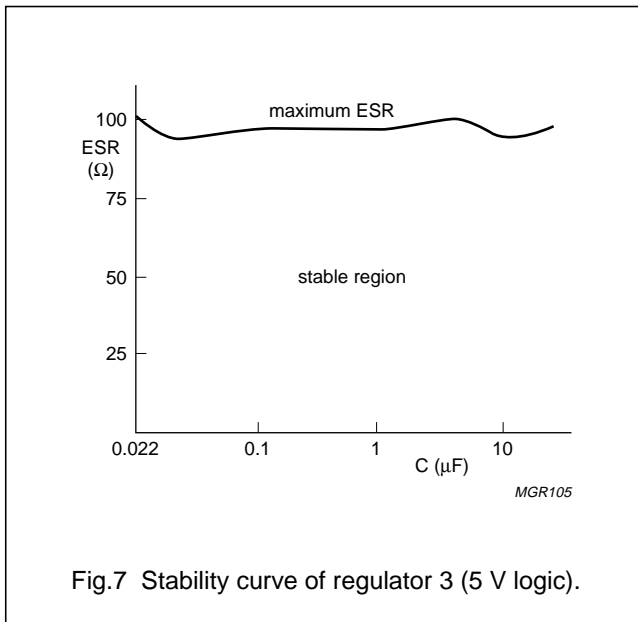


Fig.6 Stability curve of regulator 5 (AM).

## Multiple voltage regulator

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## LOSS OF GROUND PROTECTION

Two power switches (media and antenna) are protected for loss of ground. The loss of ground situation is depicted in Fig.8. The ground terminal of the battery is connected to the output of the media switch. Two problems occur:

1. At first connection a high charge current will flow through C1 to the ground terminal (pin 17) of the TDA3615J and out of the switch output (pin 11). The media and antenna switches are protected to limit this current.
2. When the switch is enabled, a short-circuit current will flow out of the power switch output (pin 11) because the output of the switch is shortened below substrate potential.

A special protection is built-in to avoid the media and antenna switches from being damaged during a loss of ground condition.

In practice, this condition can occur when the ground terminal of the total application is connected to the switch output due to a bad wiring.

## CAPACITIVE LOADS ON POWER SWITCHES

Power switches can deliver a large current to the connected loads. When a supply voltage ripple is applied, large load currents will flow when capacitive loads are used in parallel with normal loads.

When the output of a power switch is forced above  $V_{l(ig)}$  an internal protection is activated to switch off the switch as long as the fault is present.

The display switch in particular is sensitive to capacitive loads.

We therefore strongly advise:

- Use only a 47 nF output capacitor on the display switch
- Use a 10  $\mu$ F capacitor on the outputs of the antenna and media switch.

On the outputs of regulators 2 to 6 a capacitor of 47 nF can be used; larger values are possible but not necessary to guarantee stability; see Figs 4, 6 and 7.

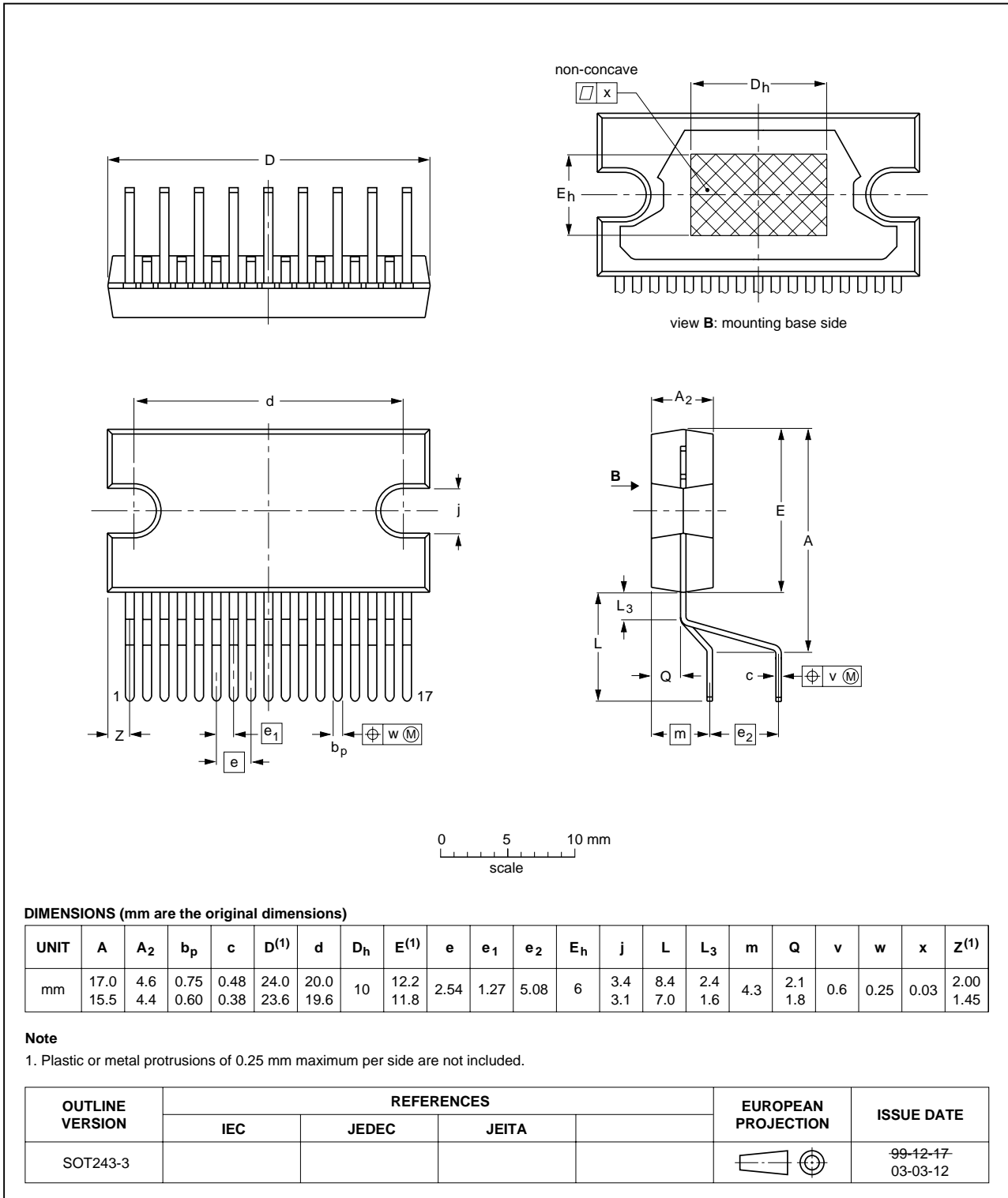
# Multiple voltage regulator

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## PACKAGE OUTLINE

DBS17P: plastic DIL-bent-SIL power package; 17 leads (lead length 7.7 mm)

SOT243-3



## Multiple voltage regulator

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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**

Driven by legislation and environmental forces the worldwide use of lead-free solder pastes is increasing. Typical dwell time of the leads in the wave ranges from 3 to 4 seconds at 250 °C or 265 °C, depending on solder material applied, SnPb or Pb-free respectively.

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
CPGA, HCPGA	–	suitable
DBS, DIP, HDIP, RDBS, SDIP, SIL	suitable	suitable <sup>(1)</sup>
PMFP <sup>(2)</sup>	–	not suitable

**Notes**

1. For SDIP packages, the longitudinal axis must be parallel to the transport direction of the printed-circuit board.
2. For PMFP packages hot bar soldering or manual soldering is suitable.



## Multiple voltage regulator

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## DATA SHEET STATUS

LEVEL	DATA SHEET STATUS <sup>(1)</sup>	PRODUCT STATUS <sup>(2)(3)</sup>	DEFINITION
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
II	Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
III	Product data	Production	This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN).

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2. The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.
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**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). 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.

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