DATA SHEET

TDA3604Q; TDA3604TH
Multiple voltage regulators with external reset delay and switch

Product specification
Supersedes data of 1997 Aug 21

2004 Feb 17

Multiple voltage regulators with external reset delay and switch

TDA3604Q; TDA3604TH

FEATURES

General

- One V_P-state controlled regulator (regulator 2)
- Regulator 2, reset and ignition buffer operate during load dump and thermal shutdown
- Separate control pins for switching regulator 1 and the power switch
- Supply voltage range of –18 to +50 V (operating from 9.75 V)
- Low reverse current of regulator 2
- Low quiescent current (when regulator 1, power switch and ignition buffer are switched off)
- Ignition input/output
- Reset output
- Adjustable reset delay time
- High ripple rejection
- Power switch
- Separate supply for the power switch.

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 protection
- Load dump protection
- Foldback current limit protection for regulators 1 and 2
- Delayed second current limit protection for the power switch
- The regulator outputs and the power switch are DC short-circuited safe to ground and V_P.

GENERAL DESCRIPTION

The TDA3604Q and TDA3604TH are multiple output voltage regulators with a power switch, intended for use in car radios with or without a microcontroller.

It contains one fixed voltage regulator with a foldback current protection (regulator 1) and one fixed voltage regulator (regulator 2), intended to supply a microcontroller, that also operates during load dump and thermal shutdown.

There is a power switch with protections, operated by an enable input.

The reset and ignition outputs can be used to interface by the microcontroller. The reset signal can be used to call up the microcontroller and the ignition output indicates ignition voltage available.

Both supply pins can withstand load dump pulses and negative supply voltages.

Regulator 2 will be switched on at a supply voltage >6.5 V and off at a voltage of regulator 2 <1.9 V.

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TDA3604Q	DBS13P	plastic DIL-bent-SIL power package; 13 leads (lead length 12 mm)	SOT141-6
TDA3604TH	HSOP20	plastic heat-dissipating small outline package; 20 leads; low stand-off	SOT418-3

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply						
V_P	supply voltage					
	operating		9.75	14.4	25	V
	regulator 2 on	note 1	2.4	14.4	25	V
	jump start	t ≤ 10 minutes	–	–	30	V
	load dump protection	during 50 ms; t_r ≥ 2.5 ms	–	–	50	V
I_q	total quiescent current	standby mode	–	400	500	µA
T_{vj}	virtual junction temperature		–	–	150	°C
Voltage regulators						
V_{REG1}	output voltage regulator 1	0.5 mA ≤ I_{REG1} ≤ 300 mA	8.65	9.0	9.35	V
V_{REG2}	output voltage regulator 2	0.5 mA ≤ I_{REG2} ≤ 50 mA; V_P = 14.4 V	4.8	5.0	5.2	V
V_{REGd1}	drop-out voltage regulator 1	I_{REG1} = 0.3 A; note 2	–	–	0.5	V
Power switch						
V_{swd}	drop-out voltage	I_{sw} = 0.5 A; note 3	–	–	1.4	V
I_{swM}	peak current	t ≤ 10 ms	1.4	–	–	A

Notes

1. Minimum operating voltage, only if V_P has exceeded 6.5 V.
2. The drop-out voltage of regulator 1 is measured between V_P and V_{REG1}.
3. The drop-out voltage of the power switch is measured between $V_{I(sw)}$ and $V_{O(sw)}$.

BLOCK DIAGRAM

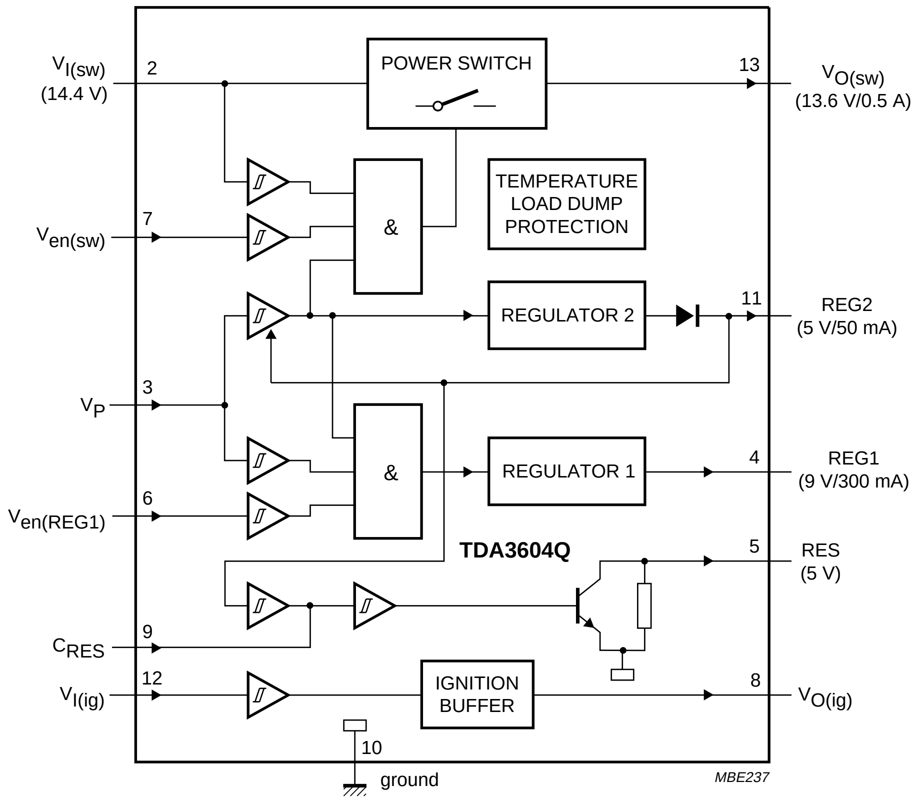


Fig.1 Block diagram (for DBS13P package; SOT141-6).

PINNING

SYMBOL	PIN		DESCRIPTION
	SOT141-6	SOT418-3	
n.c.	1	1, 2, 6, 9, 13, 18, 19 and 20	not connected
$V_{I(sw)}$	2	3	power switch input
V_P	3	4	supply voltage
REG1	4	5	regulator 1 output
RES	5	7	reset output (+5 V)
$V_{en(REG1)}$	6	8	regulator 1 enable input
$V_{en(sw)}$	7	10	power switch enable input
$V_{O(ig)}$	8	11	ignition output
C_{RES}	9	12	reset delay capacitor
GND	10	14	ground (0 V)
REG2	11	15	regulator 2 output
$V_{I(ig)}$	12	16	ignition input
$V_{O(sw)}$	13	17	power switch output

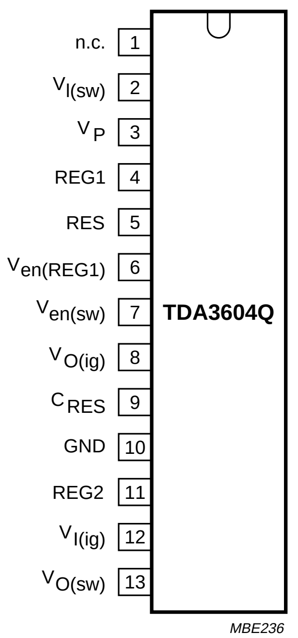


Fig.2 Pin configuration SOT141-6.

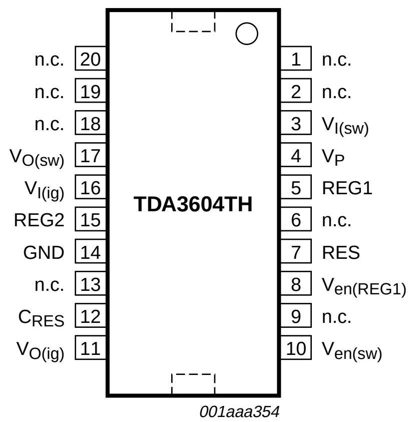


Fig.3 Pin configuration SOT418-3.

FUNCTIONAL DESCRIPTION

The TDA3604Q and TDA3604TH are multiple output voltage regulators 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.

Regulator 2 will switch on when the supply voltage exceeds 6.5 V for the first time and will switch off again when the output voltage of regulator 2 drops below 1.9 V (this is below an engine start). When regulator 2 is switched on and the output voltage of this regulator is within its voltage range, the reset output will be enabled (reset will go HIGH via a pull-up resistor) to generate a reset to the microcontroller. The reset cycles can be extended by an external capacitor at C_{RES} (pin of the reset delay capacitor). 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.

When both regulator 2 and the supply voltage ($V_P > 4.5$ V) are available, regulator 1 and the power switch can be operated by the enable inputs $V_{en(REG1)}$ and $V_{en(sw)}$ respectively.

All output pins are fully protected. The regulators are protected against load dump (regulator 1 will switch off at supply voltages higher than 25 V) and short-circuit (foldback current protection).
The power switch contains a current protection which is delayed for ≥10 ms (in short-circuit condition). During this time the current is limited to 1.4 A ($V_P \leq 18$ V).

At supply voltages over 16.9 V the power switch is clamped at 15.0 V (to avoid externally connected circuitry being damaged by an overvoltage) and the power switch will switch off at load dump.

Interfacing with the microcontroller can be accomplished by an ignition Schmitt trigger and ignition output buffer, (simple full/semi on/off logic applications).

The total timing of a semi on/off logic set is shown in Fig.4.

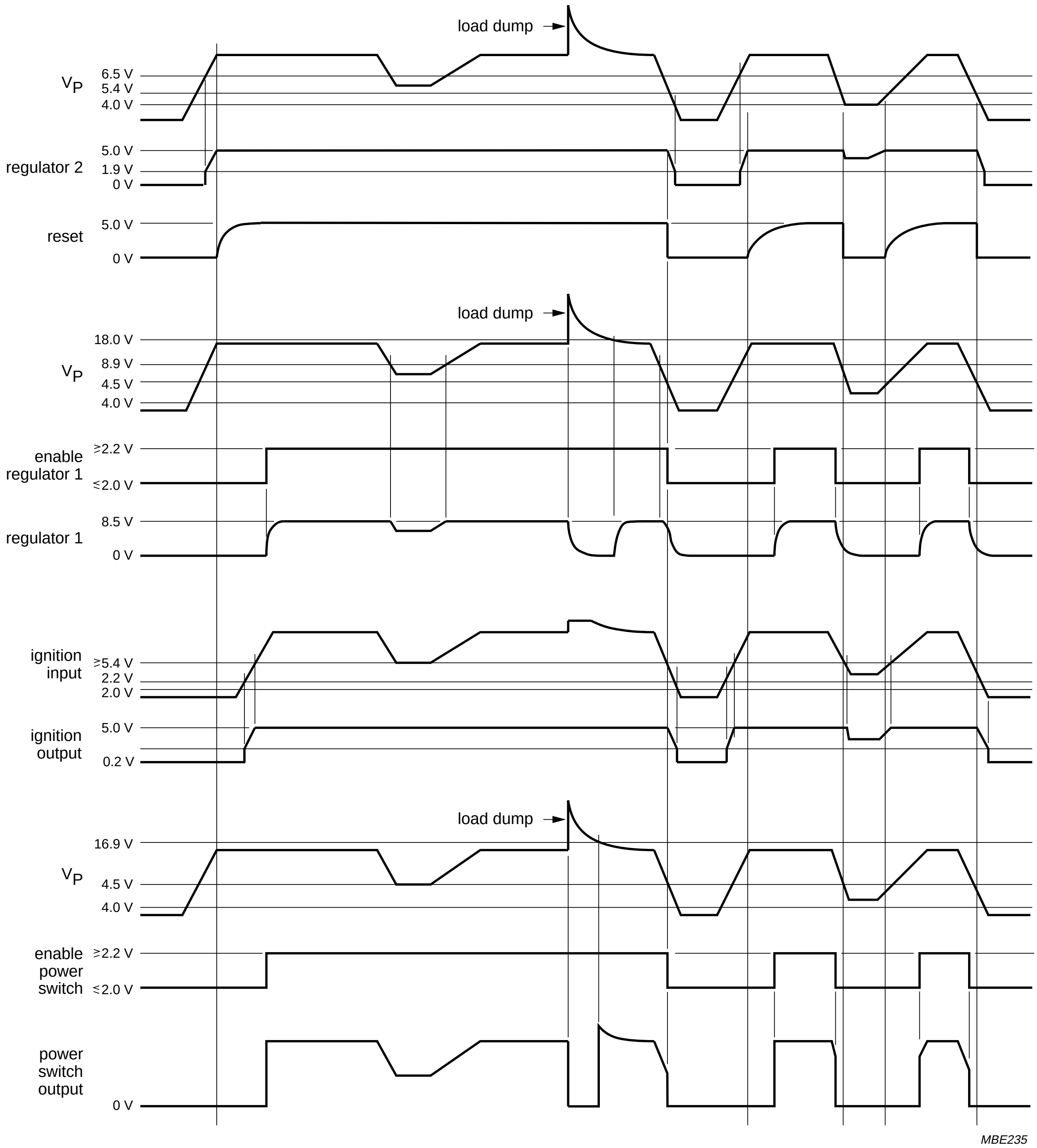


Fig.4 Timing diagrams.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_P	supply voltage				
	operating		–	25	V
	reverse polarity	non-operating	–	–18	V
	jump start	t ≤ 10 minutes	–	30	V
	load dump protection	during 50 ms; t_r ≥ 2.5 ms	–	50	V
V_{ppi}	positive pulse voltage at ignition buffer	V_P = 14.4 V; R_I = 1 kΩ	–	50	V
V_{npi}	negative pulse voltage at ignition buffer	V_P = 14.4 V; R_I = 1 kΩ	–	–100	V
T_{stg}	storage temperature	non-operating	–55	+150	°C
T_{vj}	virtual junction temperature		–40	+150	°C
P_{tot}	total power dissipation		–	15.6	W

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th(j-c)}$	thermal resistance from junction to case		8	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	50	K/W

CHARACTERISTICS

$V_P = V_{I(sw)} = 14.4$ V; $T_{amb} = 25$ °C; see Fig.7; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply						
V_P	supply voltage					
	operating		9.75	14.4	25	V
	regulator 2 on	note 1	2.4	14.4	25	V
	jump start	t ≤ 10 minutes	–	–	30	V
	load dump protection	during 50 ms; t_r ≥ 2.5 ms	–	–	50	V
I_q	quiescent supply current	V_P = 12.4 V; note 2	–	400	500	µA
		V_P = 14.4 V; note 2	–	420	–	µA
Schmitt trigger power supply for the power switch						
V_{thr}	rising threshold voltage		4.0	4.5	5.0	V
V_{thf}	falling threshold voltage		3.5	4.0	4.5	V
V_{hys}	hysteresis voltage		–	0.5	–	V
Schmitt trigger power supply for regulator 1						
V_{thr}	rising threshold voltage		4.0	4.5	5.0	V
V_{thf}	falling threshold voltage		3.5	4.0	4.5	V
V_{hys}	hysteresis voltage		–	0.5	–	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		–	4.7	–	V
Schmitt trigger for enable input (of regulator 1 and power 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		–	0.2	–	V
Schmitt trigger for reset buffer						
$V_{r(REG2)}$	rising voltage of regulator 2	note 3	–	V_{REG2} – 0.15	–	V
$V_{f(REG2)}$	falling voltage of regulator 2	note 3	–	V_{REG2} – 0.25	–	V
V_{spread}	voltage spread on tracking	note 4	–	10	–	mV
Schmitt trigger for ignition buffer						
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		–	0.2	–	V
Reset buffer						
I_{sink}	LOW-level sink current	V_{RES} ≤ 0.8 V	15	20	–	mA
I_{leak}	leakage current	V_P = 14.4 V; V_{RES} = 5 V	25	50	100	µA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Ignition buffer						
V_{OL}	LOW-level output voltage	$I_{OL} = 0$	0	0.2	0.8	V
V_{OH}	HIGH-level output voltage	note 5	–	5.0	5.2	V
I_{OL}	LOW-level output current	$V_{OL} \leq 0.8$ V	0.3	0.8	–	mA
I_{OH}	HIGH-level output current	$V_{OH} \geq 3$ V	0.3	2.0	–	mA
Regulator 1; note 6						
V_{REG1}	output voltage off		–	1	400	mV
V_{REG1}	output voltage	0.5 mA $\leq I_{REG1} \leq$ 300 mA	8.65	9.0	9.35	V
		10 V $\leq V_P \leq$ 18 V	8.65	9.0	9.35	V
ΔV_{REG1}	line regulation	10 V $\leq V_P \leq$ 18 V	–	–	50	mV
ΔV_{REGL1}	load regulation	0.5 mA $\leq I_{REG1} \leq$ 300 mA	–	–	70	mV
SVRR1	supply voltage ripple rejection	f_i = 200 Hz; V_I = 2 V (p-p)	60	–	–	dB
V_{REGd1}	drop-out voltage	I_{REG1} = 300 mA; note 7	–	0.4	0.5	V
I_{REGm1}	current limit	V_{REG1} > 7 V; note 8	0.45	–	1.2	A
I_{REGsc1}	short-circuit current	$R_L \leq 0.5\ \Omega$; note 9	50	300	–	mA
α_{ct}	cross talk	note 10	–	50	–	dB
Regulator 2; note 11						
V_{REG2}	output voltage	0.5 mA $\leq I_{REG2} \leq$ 50 mA	4.8	5.0	5.2	V
		7 V $\leq V_P \leq$ 18 V	4.8	5.0	5.2	V
		18 V $\leq V_P \leq$ 50 V	4.75	5.0	5.25	V
ΔV_{REG2}	line regulation	7 V $\leq V_P \leq$ 18 V	–	–	50	mV
ΔV_{REGL2}	load regulation	0.5 mA $\leq I_{REG1} \leq$ 30 mA	–	–	50	mV
SVRR2	supply voltage ripple rejection	f_i = 200 Hz; V_I = 2 V (p-p)	60	–	–	dB
V_{REGd2}	drop-out voltage	I_{REG2} = 30 mA; note 12	–	0.3	0.4	V
I_{REGm2}	current limit	V_{REG2} > 4.5 V; note 8	0.1	–	0.5	A
I_{REGsc2}	short-circuit current	$R_L \leq 0.5\ \Omega$; note 9	20	50	–	mA
α_{ct}	cross talk	note 13	–	50	–	dB
Power switch						
V_{swd}	drop-out voltage	I_{sw} = 0.5 A; note 14	–	0.8	1.4	V
I_{swcc}	continuous current		0.5	–	–	A
V_{swcl}	clamping voltage	$V_P \geq$ 16.9 V	–	15.0	16.2	V
I_{swM}	peak current	t $\leq$ 10 ms	1.4	–	–	A
V_{swfb}	fly back voltage behaviour	I_{sw} = –200 mA; V_P = 9 V	–	–	20	V
$I_{lim(sw)}$	current limit	V_P = 14.4 V; V_{sw} < 1.5 V; note 8	0.6	0.9	–	A
Reset delay						
I_O	output current		–	3	–	μA
V_{thr}	rising threshold voltage		2.7	3.0	3.3	V
t_d	delay time	C_I = 47 nF; note 15	25	50	100	ms

Notes to the characteristics

1. Minimum operating voltage, only if V_P has exceeded 6.5 V.
2. Enable inputs of regulator 1, ignition and power switch are low. Regulator 2 is unloaded.
3. Voltage drop due to load condition.
4. The spread on tracking is one sigma value.
5. Ignition output voltage will be less than or equal to the output voltage of regulator 2.
6. I_{REG1} = 5 mA unless otherwise specified.
7. The drop-out voltage of regulator 1 is measured between V_P and V_{REG1}.
8. At current limit, I_{REGm} is held constant (see Fig.5).
9. The foldback current protection limits the dissipated power at short-circuit (see Figs 5 and 6).
10. The cross talk of regulator 1 is measured with an I_{REG2} = 0.5 mA up to 30 mA and input frequency of f_i = 100 kHz.
11. I_{REG2} = 5 mA unless otherwise specified.
12. The drop-out voltage of regulator 2 is measured between V_P and V_{REG2}.
13. The cross talk of regulator 2 is measured with an I_{REG1} = 0.5 mA up to 100 mA and input frequency of f_i = 100 kHz.
14. The drop-out voltage of the power switch is measured between $V_{I(sw)}$ and $V_{O(sw)}$.
15. The delay time depends on the value of the capacitor: $t_d = \frac{C}{I} \times V_{thrC} = C \times 2.5 \times 10^6$

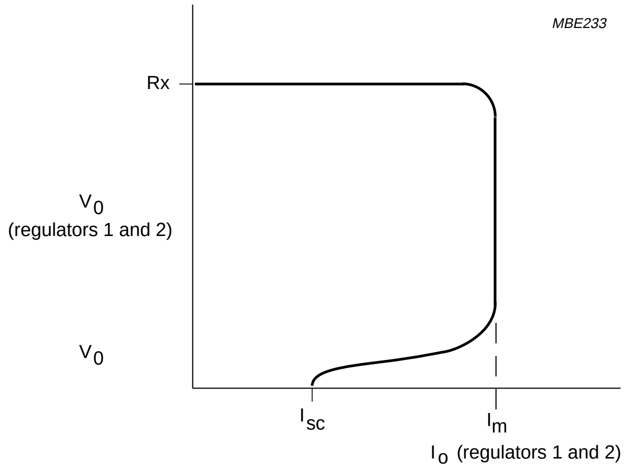


Fig.5 Foldback current protection of the regulators.

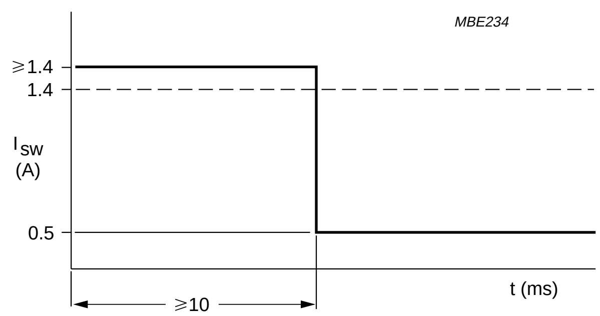
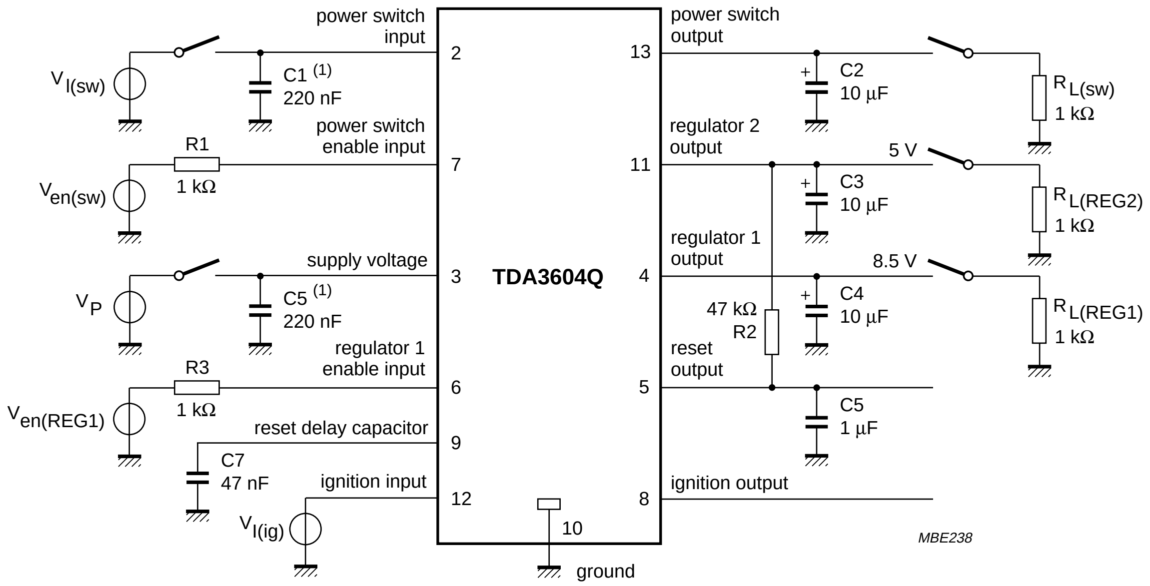


Fig.6 Foldback current protection of the power switch.

TEST AND APPLICATION INFORMATION



(1) Capacitor not required for stability.

Fig.7 Test circuit (for DBS13P package; SOT141-6).

Noise information

The noise at the output of the regulators depends on the bandwidth of the regulators, which can be adjusted by the output capacitors. Table 1 shows the noise figures.

Although stability is guaranteed when C_L is higher than 10 µF (over temperature range) with tan (ϕ) = 1 in the frequency range 1 to 10 kHz, however, for low noise, a 47 µF load capacitor is required.

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 the output capacitors). When a high frequency capacitor of 220 nF with an electrolytic capacitor of 100 µF in parallel is placed directly over V_P and GND (pins of supply voltage and ground) the noise is minimized.

Table 1 Noise figures

REGULATOR	NOISE (µV)(1)	OUTPUT CAPACITOR (µF)
1	180	10
	100	47
	80	100
2	120	10
	70	47
	70	100

Note

1. Bandwidth of 100 kHz.

SHORT CIRCUIT BEHAVIOUR OF POWER SWITCH

The short circuit behaviour of the switch with large inductive loads (switch output goes out of the radio) can be improved by replacing C2 (see Fig.7) by a larger electrolytic capacitor of 10 μF/16 V. When the temperature protection of the switch becomes active, due to a short circuit of the switch, the behaviour will be improved.

When the switch is clamped an minimum output capacitor of 10 μF is needed.

The power switch is not protected against ‘loss of ground’ condition (= short of the switch to ground with floating ground pin of the TDA3604 itself). A ‘loss of ground’ situation can in practice only occur when the switch output goes outside the car-radio box.

There is an application solution to protect against ‘loss of ground’ (see Fig.8).

It is advisable to limit the dissipation at short circuit condition by monitoring the output of the power switch. The microprocessor can switch of the power switch when the switch was enabled and the switch output remains low due to a short circuit condition.

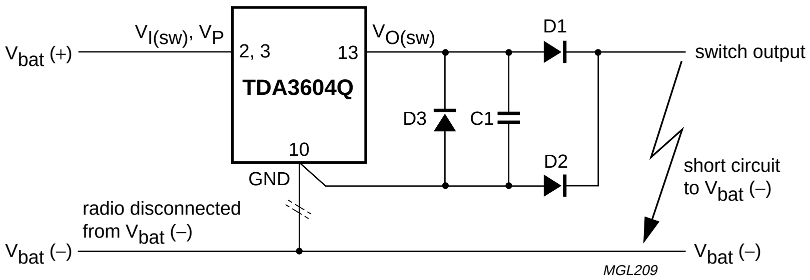
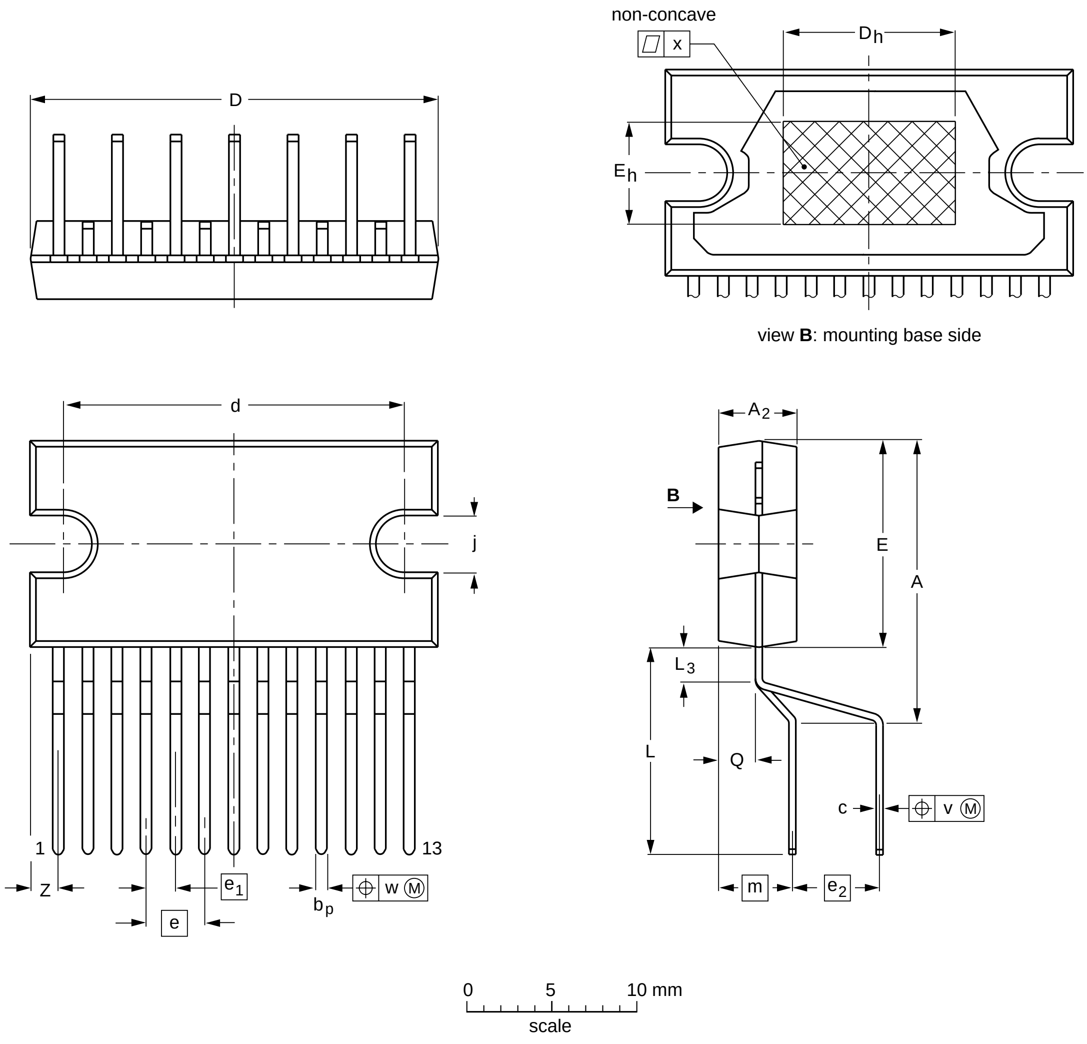


Fig.8 ‘Loss of ground’ protection.

PACKAGE OUTLINES

DBS13P: plastic DIL-bent-SIL power package; 13 leads (lead length 12 mm) **SOT141-6**



DIMENSIONS (mm are the original dimensions)

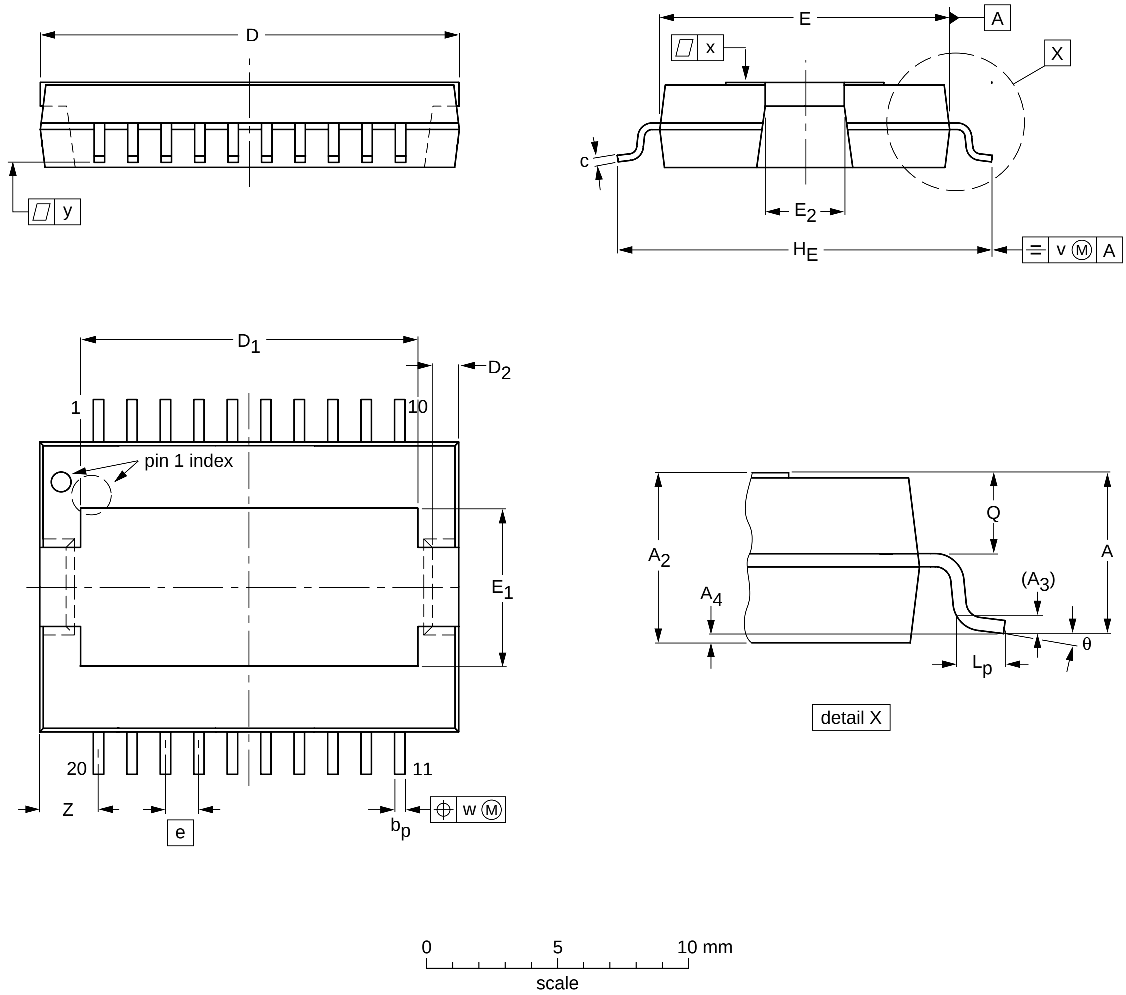
UNIT	A	A_2	b_p	c	D(1)	d	D_h	E(1)	e	e_1	e_2	E_h	j	L	L_3	m	Q	v	w	x	Z(1)
mm	17.0 15.5	4.6 4.4	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	3.4	1.7	5.08	6	3.4 3.1	12.4 11.0	2.4 1.6	4.3	2.1 1.8	0.8	0.25	0.03	2.00 1.45

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	JEITA			
SOT141-6						~~99-12-17~~ 03-03-12

HSOP20: plastic, heatsink small outline package; 20 leads; low stand-off height **SOT418-3**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_2	A_3	$A_4^{(1)}$	b_p	c	$D^{(2)}$	D_1	D_2	$E^{(2)}$	E_1	E_2	e	H_E	L_p	Q	v	w	x	y	Z	θ
mm	3.5	3.5 3.2	0.35	+0.08 −0.04	0.53 0.40	0.32 0.23	16.0 15.8	13.0 12.6	1.1 0.9	11.1 10.9	6.2 5.8	2.9 2.5	1.27	14.5 13.9	1.1 0.8	1.7 1.5	0.25	0.25	0.03	0.07	2.5 2.0	8° 0°

Notes

1. Limits per individual lead.
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT418-3						~~02-02-12~~ 03-07-23

SOLDERING

Introduction

This text gives a very brief insight to a complex technology. 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).

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mount components are mixed on one printed-circuit board. Wave soldering can still be used for certain surface mount ICs, but it is not suitable for fine pitch SMDs. In these situations reflow soldering is recommended. Driven by legislation and environmental forces the worldwide use of lead-free solder pastes is increasing.

Through-hole mount packages

SOLDERING BY DIPPING OR BY SOLDER WAVE

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.

Surface mount packages

REFLOW SOLDERING

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several methods exist for reflowing; for example, convection or convection/infrared heating in a conveyor type oven. Throughput times (preheating, soldering and cooling) vary between 100 and 200 seconds depending on heating method.

Typical reflow peak temperatures range from 215 to 270 °C depending on solder paste material. The top-surface temperature of the packages should preferably be kept:

- below 225 °C (SnPb process) or below 245 °C (Pb-free process)
  - for all the BGA, HTSSON..T and SSOP-T packages
  - for packages with a thickness ≥ 2.5 mm
  - for packages with a thickness < 2.5 mm and a volume ≥ 350 mm^3 so called thick/large packages.
- below 240 °C (SnPb process) or below 260 °C (Pb-free process) for packages with a thickness < 2.5 mm and a volume < 350 mm^3 so called small/thin packages.

Moisture sensitivity precautions, as indicated on packing, must be respected at all times.

WAVE SOLDERING

Conventional single wave soldering is not recommended for surface mount devices (SMDs) or printed-circuit boards with a high component density, as solder bridging and non-wetting can present major problems.

To overcome these problems the double-wave soldering method was specifically developed.

If wave soldering is used the following conditions must be observed for optimal results:

- Use a double-wave soldering method comprising a turbulent wave with high upward pressure followed by a smooth laminar wave.
- For packages with leads on two sides and a pitch (e):
  - larger than or equal to 1.27 mm, the footprint longitudinal axis is **preferred** to be parallel to the transport direction of the printed-circuit board;
  - smaller than 1.27 mm, the footprint longitudinal axis **must** be parallel to the transport direction of the printed-circuit board.

  The footprint must incorporate solder thieves at the downstream end.
- For packages with leads on four sides, the footprint must be placed at a 45° angle to the transport direction of the printed-circuit board. The footprint must incorporate solder thieves downstream and at the side corners.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

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.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

MANUAL SOLDERING

Fix the component by first soldering two diagonally-opposite end leads. Use a low voltage (24 V or less) soldering iron applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

Suitability of IC packages for wave, reflow and dipping soldering methods

MOUNTING	PACKAGE[1]	SOLDERING METHOD		
		WAVE	REFLOW[2]	DIPPING
Through-hole mount	CPGA, HCPGA	suitable	–	suitable
	DBS, DIP, HDIP, RDBS, SDIP, SIL	suitable[3]	–	–
Through-hole-surface mount	PMFP[4]	not suitable	not suitable	–
Surface mount	BGA, HTSSON..T[5], LBGA, LFBGA, SQFP, SSOP-T[5], TFBGA, USON, VFBGA	not suitable	suitable	–
	DHVQFN, HBCC, HBGA, HLQFP, HSO, HSOP, HSQFP, HSSON, HTQFP, HTSSOP, HVQFN, HVSON, SMS	not suitable[6]	suitable	–
	PLCC[7], SO, SOJ	suitable	suitable	–
	LQFP, QFP, TQFP	not recommended[7][8]	suitable	–
	SSOP, TSSOP, VSO, VSSOP	not recommended[9]	suitable	–
	CWQCCN..L[11], PMFP[10], WQCCN32L[11]	not suitable	not suitable	–

Notes

1. For more detailed information on the BGA packages refer to the *“(LF)BGA Application Note*” (AN01026); order a copy from your Philips Semiconductors sales office.
2. All surface mount (SMD) packages are moisture sensitive. Depending upon the moisture content, the maximum temperature (with respect to time) and body size of the package, there is a risk that internal or external package cracks may occur due to vaporization of the moisture in them (the so called popcorn effect). For details, refer to the Drypack information in the *“Data Handbook IC26; Integrated Circuit Packages; Section: Packing Methods”*.
3. For SDIP packages, the longitudinal axis must be parallel to the transport direction of the printed-circuit board.
4. Hot bar soldering or manual soldering is suitable for PMFP packages.
5. These transparent plastic packages are extremely sensitive to reflow soldering conditions and must on no account be processed through more than one soldering cycle or subjected to infrared reflow soldering with peak temperature exceeding 217 °C ± 10 °C measured in the atmosphere of the reflow oven. The package body peak temperature must be kept as low as possible.
6. These packages are not suitable for wave soldering. On versions with the heatsink on the bottom side, the solder cannot penetrate between the printed-circuit board and the heatsink. On versions with the heatsink on the top side, the solder might be deposited on the heatsink surface.
7. If wave soldering is considered, then the package must be placed at a 45° angle to the solder wave direction. The package footprint must incorporate solder thieves downstream and at the side corners.
8. Wave soldering is suitable for LQFP, QFP and TQFP packages with a pitch (e) larger than 0.8 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.65 mm.
9. Wave soldering is suitable for SSOP, TSSOP, VSO and VSSOP packages with a pitch (e) equal to or larger than 0.65 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.5 mm.
10. Hot bar or manual soldering is suitable for PMFP packages.
11. Image sensor packages in principle should not be soldered. They are mounted in sockets or delivered pre-mounted on flex foil. However, the image sensor package can be mounted by the client on a flex foil by using a hot bar soldering process. The appropriate soldering profile can be provided on request.

DATA SHEET STATUS

LEVEL	DATA SHEET STATUS[1]	PRODUCT STATUS[2][3]	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).

Notes

1. Please consult the most recently issued data sheet before initiating or completing a design.
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.
3. For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

DEFINITIONS

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

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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