

**INTEGRATED CIRCUITS**

# DATA SHEET

## **TDA3607**

### **Multiple voltage regulator with switch**

Preliminary specification  
File under Integrated Circuits, IC01

1997 May 05

## Multiple voltage regulator with switch

## TDA3607

### FEATURES

- Three  $V_P$ -state controlled regulators (regulator 1, regulator 2 and regulator 3)
- Separate control pins for switching regulators 1, 2 and 3
- Supply voltage range from  $-18$  to  $+50$  V
- Low quiescent current (when regulators 1, 2 and 3 are switched off)
- High ripple rejection.

### GENERAL DESCRIPTION

The TDA3607 is a multiple output voltage regulator with three independent regulators. It contains:

1. Three fixed voltage regulators with foldback current protection (regulators 1, 2 and 3)
2. A supply pin which can withstand load dump pulses and negative supply voltages
3. Independent enable inputs for regulators 1, 2 and 3
4. Local temperature protection for regulator 3.

### 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, 2 and 3
- DC short-circuit safe to ground and  $V_P$  for all regulator outputs.

### QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Supply</b>						
$V_P$	supply voltage operating		11	14.4	18	V
	jump start	$t \leq 10$ minutes	–	–	30	V
	load dump protection	during 50 ms; $t_r \geq 2.5$ ms	–	–	50	V
$I_{q(tot)}$	total quiescent current	standby mode	–	1	40	$\mu$ A
$T_j$	junction temperature		–	–	150	$^{\circ}$ C
<b>Voltage regulators</b>						
$V_{REG1}$	output voltage regulator 1	$0.5 \text{ mA} \leq I_{REG1} \leq 1.3 \text{ A}$	8.55	9.0	9.45	V
$V_{REG2}$	output voltage 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
$V_{REG3}$	output voltage regulator 3	$0.5 \text{ mA} \leq I_{REG3} \leq 400 \text{ mA}$	4.75	5.0	5.25	V

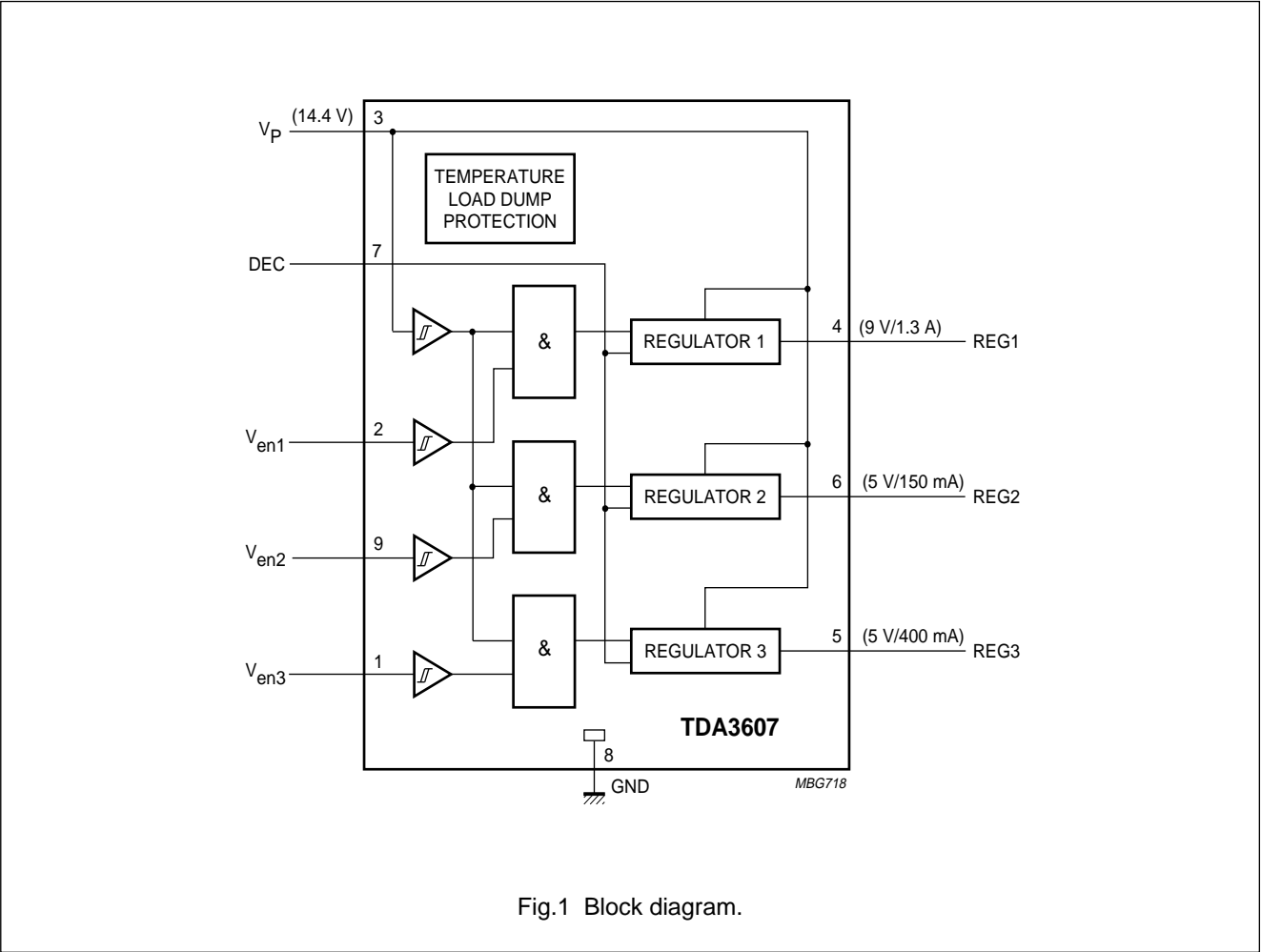
### ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TDA3607	SIL9P	plastic single in-line power package; 9 leads	SOT131-2

Multiple voltage regulator with switch

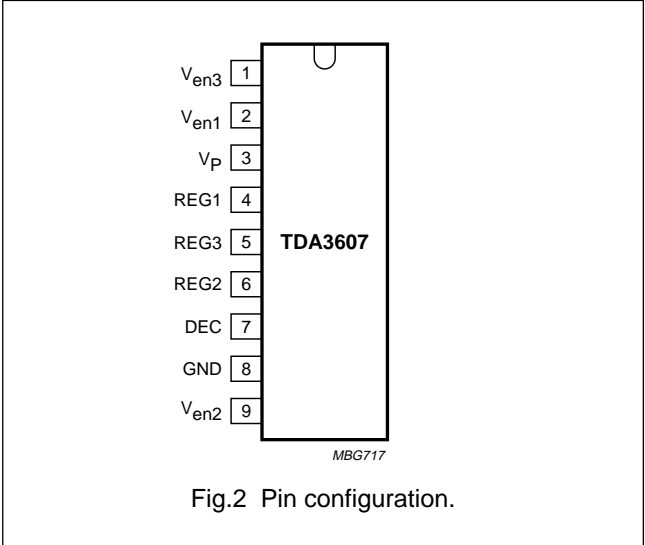
TDA3607

BLOCK DIAGRAM



PINNING

SYMBOL	PIN	DESCRIPTION
V <sub>en3</sub>	1	enable input regulator 3
V <sub>en1</sub>	2	enable input regulator 1
V <sub>P</sub>	3	supply voltage
REG1	4	regulator 1 output
REG3	5	regulator 3 output
REG2	6	regulator 2 output
DEC	7	decoupling capacitor
GND	8	ground
V <sub>en2</sub>	9	enable input regulator 2



## Multiple voltage regulator with switch

## TDA3607

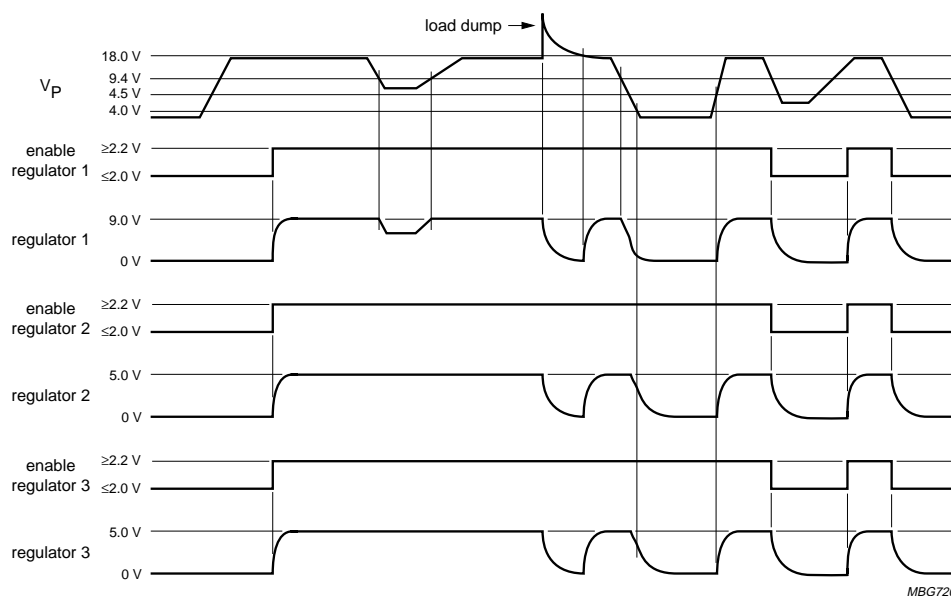
**FUNCTIONAL DESCRIPTION**

The TDA3607 is a multiple output voltage regulator with three independent switchable regulators. When the supply voltage ( $V_P > 4.5$  V) is available, regulators 1, 2 and 3 can be operated by means of 3 independent enable inputs.

Schmitt-trigger functions are included to switch-off the regulators at low battery voltage ( $V_P < 4$  V). A hysteresis is included to avoid random switching.

All output pins are fully protected. The regulators are protected against load dump (regulators will switch-off at supply voltages higher than 20 V) and short-circuit (foldback current protection).

The total timing of a semi on/off logic set is shown in Fig.3.



MBG720

Fig.3 Timing diagrams.

## Multiple voltage regulator with switch

## TDA3607

## LIMITING VALUES

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_P$	supply voltage				
	operating		–	18	V
	jump start	$t \leq 10$ minutes	–	30	V
	load dump protection	during 50 ms; $t_r \geq 2.5$ ms	–	50	V
$V_P$	reverse battery voltage	non-operating	–	–18	V
$P_{tot}$	total power dissipation		–	62	W
$T_{stg}$	storage temperature range	non-operating	–55	+150	°C
$T_{amb}$	ambient temperature range	operating	–40	+85	°C
$T_j$	junction temperature	operating	–	150	°C

## THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-c}$	thermal resistance from junction to case	regulator and switch-on	2	K/W
$R_{th\ j-a}$	thermal resistance from junction to ambient in free air		50	K/W

## QUALITY SPECIFICATION

In accordance with “SNW-FQ-611-E”. The number of the quality specification can be found in the “Quality Reference Handbook”. The handbook can be ordered using the code 9397 750 00192.

## CHARACTERISTICS

$V_P = 14.4$  V;  $T_{amb} = 25$  °C; measured in test circuit of Fig.5; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supplies						
V <sub>P</sub>	supply voltage					
	operating		11	14.4	18	V
	REGn on	note 1	6	14.4	18	V
	jump start	t ≤ 10 minutes	–	–	30	V
	load dump protection	during 50 ms; t <sub>r</sub> ≥ 2.5 ms	–	–	50	V
I <sub>q</sub>	quiescent current	V <sub>P</sub> = 12.4 V; note 2	–	1	40	μA
		V <sub>P</sub> = 14.4 V; note 2	–	1	–	μA
Schmitt-trigger power supply for regulators 1, 2 and 3						
V <sub>thr</sub>	rising voltage threshold	V <sub>en</sub> = 3 V	–	4.5	–	V
V <sub>thf</sub>	falling voltage threshold	V <sub>en</sub> = 3 V	–	4.1	–	V
V <sub>hys</sub>	hysteresis		–	0.4	–	V

## Multiple voltage regulator with switch

## TDA3607

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Schmitt-trigger for enable input (regulators 1, 2 and 3)</b>						
$V_{thr}$	rising voltage threshold		1.7	2.2	2.7	V
$V_{thf}$	falling voltage threshold		1.5	2.0	2.5	V
$V_{hys}$	hysteresis		0.1	0.2	0.5	V
$I_{LI}$	input leakage current	$V_{en} = 5\text{ V}$	5	30	50	$\mu\text{A}$
<b>Regulator 1 (<math>I_{REG1} = 5\text{ mA}</math>)</b>						
$V_{REG1(off)}$	output voltage off		–	1	400	mV
$V_{REG1}$	output voltage	$1\text{ mA} \leq I_{REG1} \leq 1.3\text{ A}$	8.55	9.0	9.45	V
		$10.5\text{ V} \leq V_P \leq 18\text{ V}$	8.55	9.0	9.45	V
$\Delta V_{REG1}$	line regulation	$10.5\text{ V} \leq V_P \leq 18\text{ V}$	–	–	50	mV
$\Delta V_{REGL1}$	load regulation	$1\text{ mA} \leq I_{REG1} \leq 1.3\text{ A}$	–	–	100	mV
$I_{qREG1}$	quiescent current	$I_{REG1} = 1.3\text{ A}$	–	45	110	mA
SVRR1	supply voltage ripple rejection	$f = 3\text{ kHz}$ ; $V_{i(p-p)} = 2\text{ V}$	60	70	–	dB
$V_{REGd1}$	drop-out voltage	$I_{REG1} = 1.3\text{ A}$ ; note 3	–	0.5	1.3	V
$I_{REGm1}$	current limit	$V_{REG1} > 7.5\text{ V}$ ; note 4	1.3	–	–	A
$I_{REGsc1}$	short-circuit current	$R_L \leq 0.5\ \Omega$ ; note 5	250	900	–	mA
$\alpha_{ct}$	cross talk noise	note 6	–	25	150	$\mu\text{V}$
<b>Regulator 2 (<math>I_{REG2} = 5\text{ mA}</math>)</b>						
$V_{REG2(off)}$	output voltage off		–	1	400	mV
$V_{REG2}$	output voltage	$0.5\text{ mA} \leq I_{REG2} \leq 150\text{ mA}$	4.75	5.0	5.25	V
		$7\text{ V} \leq V_P \leq 18\text{ V}$	4.75	5.0	5.25	V
$\Delta V_{REG2}$	line regulation	$7\text{ V} \leq V_P \leq 18\text{ V}$	–	–	50	mV
$\Delta V_{REGL2}$	load regulation	$0.5\text{ mA} \leq I_{REG2} \leq 150\text{ mA}$	–	–	50	mV
$I_{qREG2}$	quiescent current	$I_{REG2} = 0.15\text{ A}$	–	5	15	mA
SVRR2	supply voltage ripple rejection	$f = 3\text{ kHz}$ ; $V_{i(p-p)} = 2\text{ V}$	60	70	–	dB
$V_{REGd2}$	drop-out voltage	$I_{REG2} = 100\text{ mA}$ ; $V_P = 5\text{ V}$ ; note 3	–	0.15	1.5	V
$I_{REGm2}$	current limit	$V_{REG2} > 4\text{ V}$ ; note 4	0.3	0.9	–	A
$I_{REGsc2}$	short-circuit current	$R_L \leq 0.5\ \Omega$ ; note 5	20	250	–	mA
$\alpha_{ct}$	cross talk noise	note 6	–	25	100	$\mu\text{V}$

## Multiple voltage regulator with switch

## TDA3607

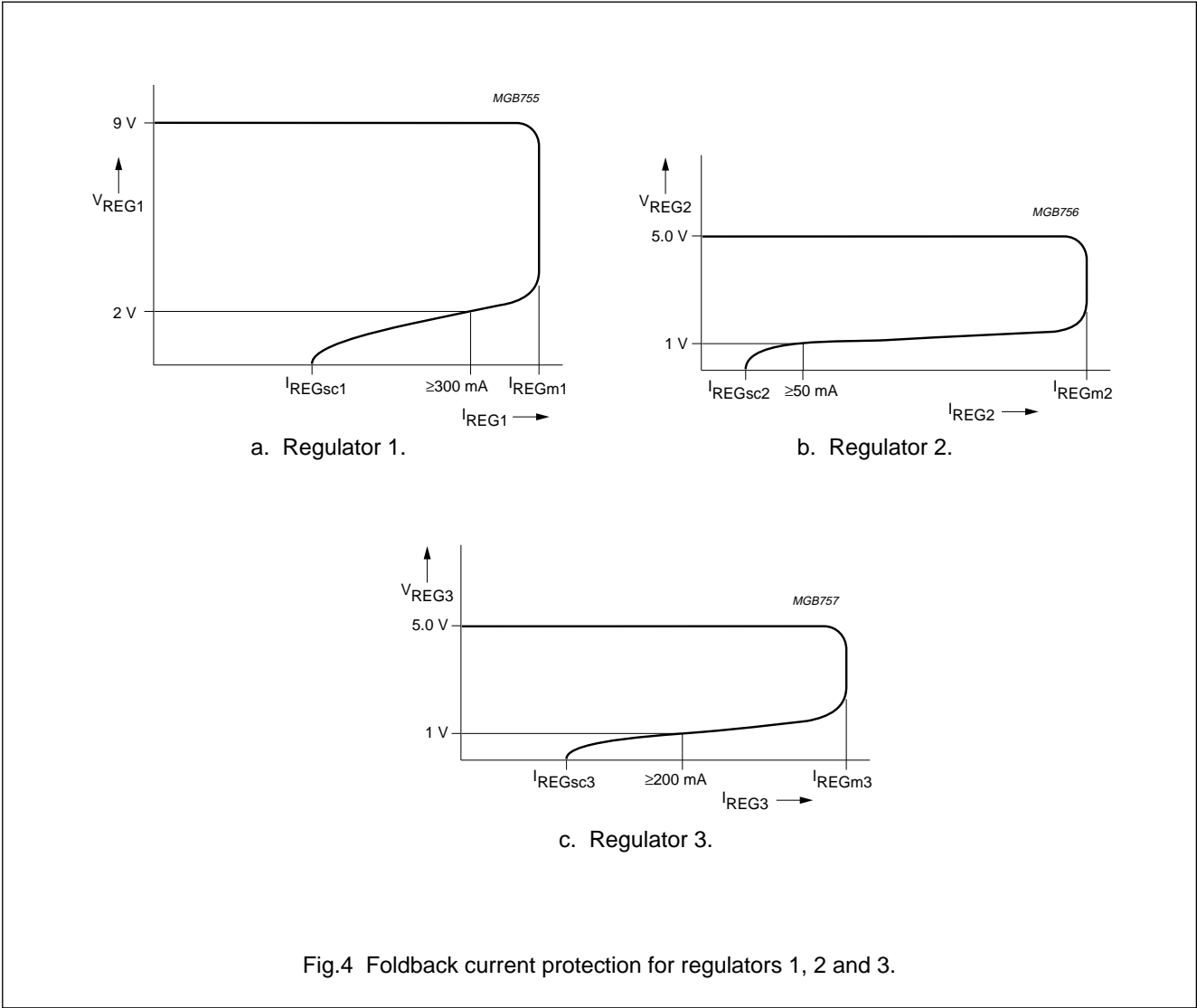
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Regulator 3 (<math>I_{REG3} = 5 \text{ mA}</math>)</b>						
$V_{REG3(off)}$	output voltage off		–	1	400	mV
$V_{REG3}$	output voltage	$1 \text{ mA} \leq I_{REG3} \leq 400 \text{ mA}$	4.75	5.0	5.25	V
		$7 \text{ V} \leq V_P \leq 18 \text{ V}$	4.75	5.0	5.25	V
$\Delta V_{REG3}$	line regulation	$7 \text{ V} \leq V_P \leq 18 \text{ V}$	–	–	50	mV
$\Delta V_{REGL3}$	load regulation	$1 \text{ mA} \leq I_{REG3} \leq 400 \text{ mA}$	–	20	50	mV
$I_{qREG3}$	quiescent current	$I_{REG3} = 0.4 \text{ A}$	–	10	40	mA
SVRR3	supply voltage ripple rejection	$f = 3 \text{ kHz}; V_{i(p-p)} = 2 \text{ V}$	60	70	–	dB
$V_{REGd3}$	drop-out voltage	$I_{REG3} = 400 \text{ mA}; V_P = 9 \text{ V};$ note 3	–	0.45	1.5	V
$I_{REGm3}$	current limit	$V_{REG3} > 4 \text{ V};$ note 4	0.45	0.9	–	A
$I_{REGsc3}$	short circuit current	$R_L \leq 0.5 \Omega;$ note 5	100	300	–	mA
$\alpha_{ct}$	cross talk noise	note 6	–	25	100	$\mu\text{V}$

**Notes**

1. Minimum operating voltage, only if  $V_P$  has exceeded 4.5 V.
2. The quiescent current is measured in the standby mode. So, the enable inputs of regulator 1, 2 and 3 are LOW ( $V_{en} < 1 \text{ V}$ ).
3. The drop-out voltage of regulators 1, 2 and 3 is measured between  $V_P$  and  $V_{REGn}$ .
4. At current limit,  $I_{REGmn}$  is held constant (see Fig.4 for behaviour of  $I_{REGmn}$ ).
5. The foldback current protection limits the dissipated power at short-circuit (see Fig.4).
6. Perform the load regulation test with sine wave load of 10 kHz on the regulator output under test. Measure the RMS ripple voltage on each of the remaining regulator outputs, using a 80 kHz low-pass filter.

Multiple voltage regulator with switch

TDA3607



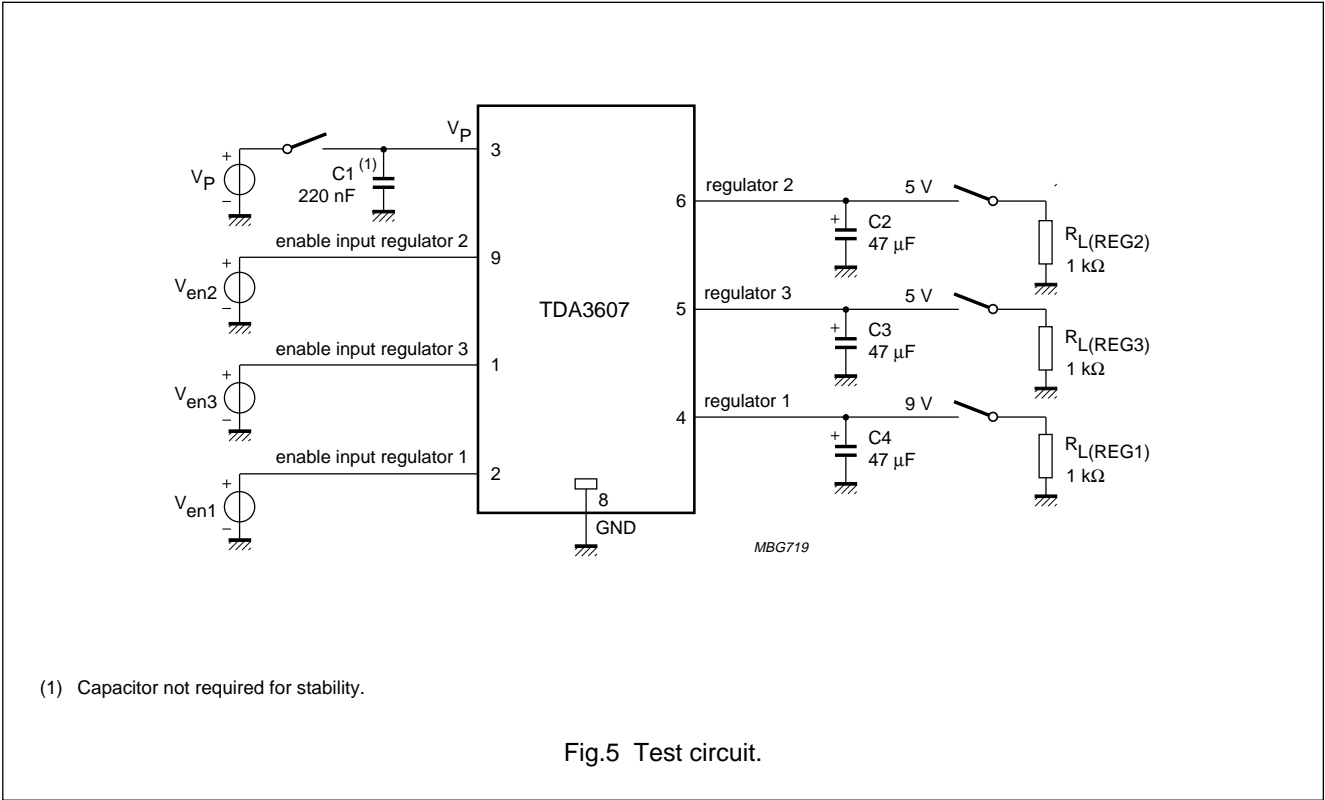


Multiple voltage regulator with switch

TDA3607

TEST AND APPLICATION INFORMATION

Test information



Application information

NOISE

Table 1 Noise figures

REGULATOR	NOISE FIGURE ( $\mu\text{V}$ ) <sup>(1)</sup>		
	at OUTPUT CAPACITOR ( $\mu\text{F}$ )		
	10	47	100
1	—	150	—
2	—	150	—
3	—	200	—

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  $\mu\text{F}$  is connected directly to pins 3 and 8 (supply and ground) the noise is minimal.

STABILITY

The regulators are made stable with the externally connected output capacitors. The value of the output capacitors can be selected by referring to the graphs illustrated in Figs 6 and 7.

When an electrolytic capacitor is used the temperature behaviour of this output capacitor can cause oscillations at cold temperature.

The following two examples explain how an output capacitor value is selected.

Multiple voltage regulator with switch

TDA3607

Example 1

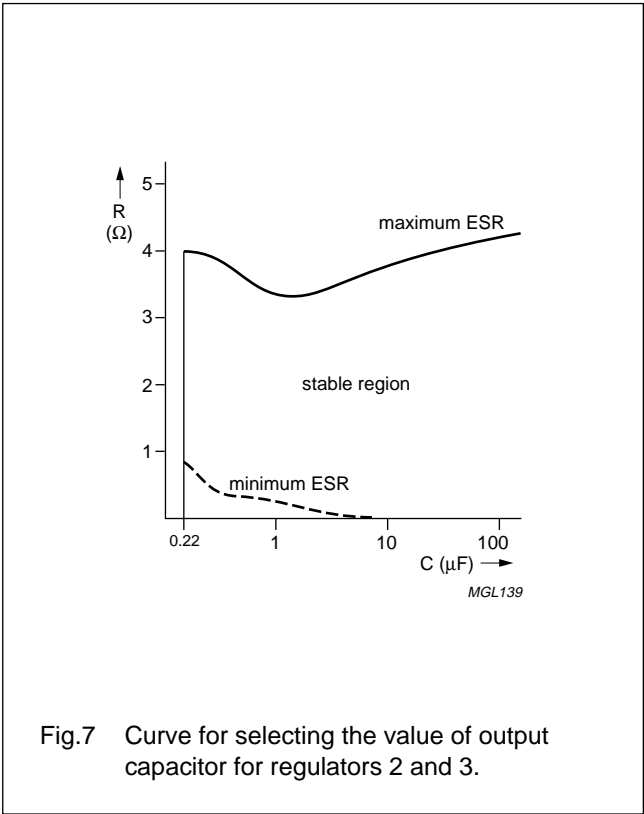
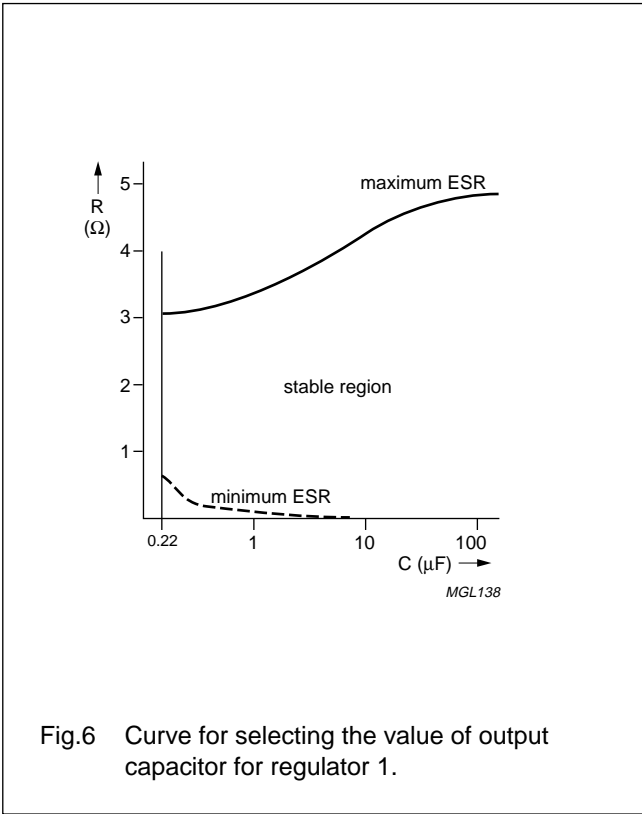
Regulator 1 is made stable with an electrolytic output capacitor of 68  $\mu\text{F}$  ( $\text{ESR} = 0.5 \Omega$ ), at  $-30^\circ\text{C}$  the capacitor value is decreased to 22  $\mu\text{F}$  and the ESR is increased to 3.5  $\Omega$ . The regulator will remain stable at  $-30^\circ\text{C}$ .

Example 2

Regulator 2 is made stable with a 10  $\mu\text{F}$  electrolytic capacitor ( $\text{ESR} = 3.3 \Omega$ ), at  $-30^\circ\text{C}$  the capacitor value is decreased to 3  $\mu\text{F}$  and the ESR is increased to 23.1  $\Omega$ . The regulator will be unstable at  $-30^\circ\text{C}$  (see Fig.7).

Solution

Use a tantalum capacitor of 10  $\mu\text{F}$  or a large electrolytic capacitor. The use tantalum capacitors is recommended to avoid problems with stability at cold temperatures.



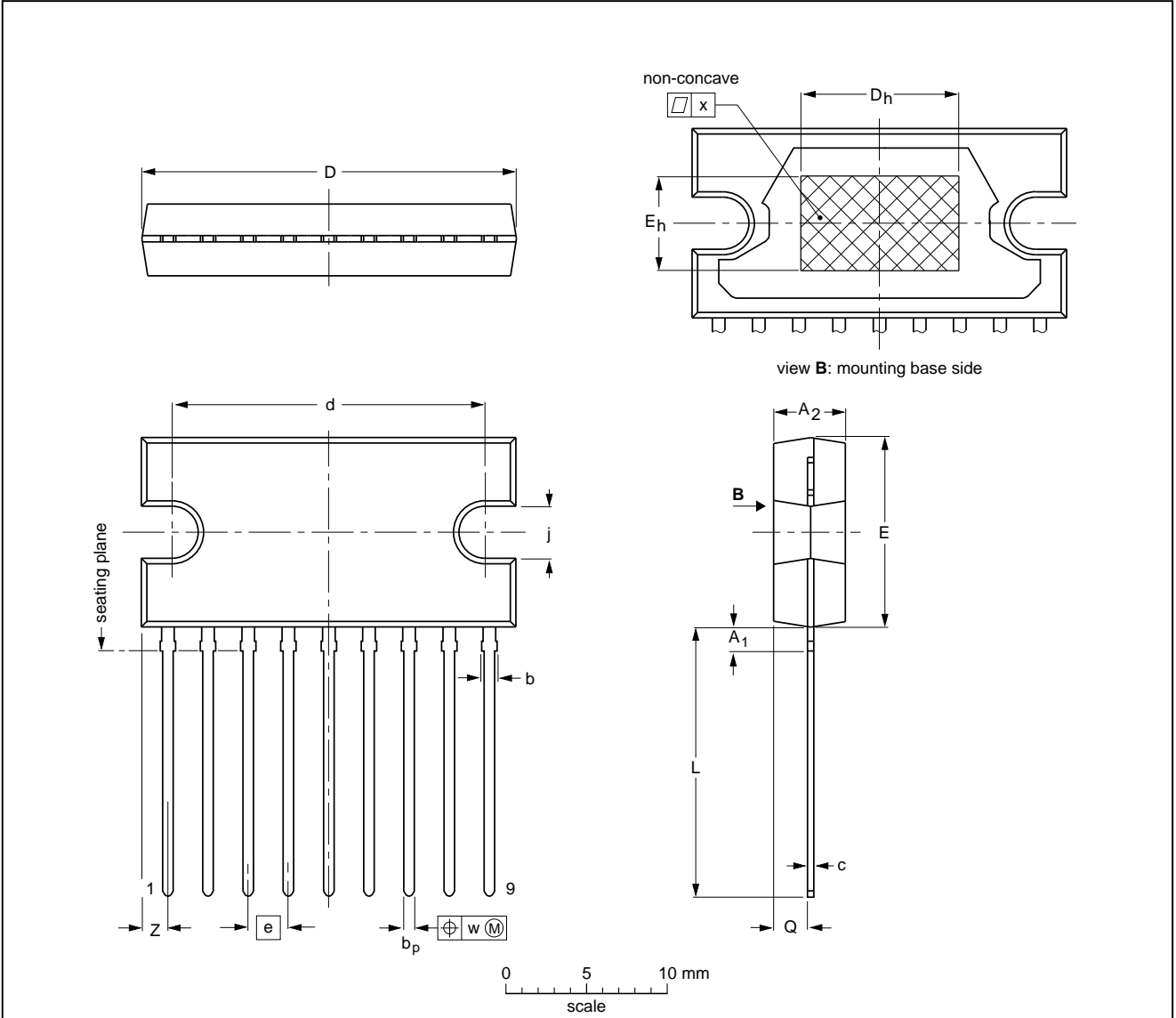
Multiple voltage regulator with switch

TDA3607

PACKAGE OUTLINE

SIL9P: plastic single in-line power package; 9 leads

SOT131-2



DIMENSIONS (mm are the original dimensions)

UNIT	A <sub>1</sub> max.	A <sub>2</sub>	b max.	b <sub>p</sub>	c	D <sup>(1)</sup>	d	D <sub>h</sub>	E <sup>(1)</sup>	e	E <sub>h</sub>	j	L	Q	w	x	Z <sup>(1)</sup>
mm	2.0	4.6 4.2	1.1	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	2.54	6	3.4 3.1	17.2 16.5	2.1 1.8	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	EIAJ			
SOT131-2						92-11-17 95-03-11

## Multiple voltage regulator with switch

## TDA3607

### 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.	

### LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

---

Multiple voltage regulator with switch

TDA3607

---

**NOTES**

Multiple voltage regulator with switch

TDA3607

---

**NOTES**

---

Multiple voltage regulator with switch

TDA3607

---

**NOTES**

# Philips Semiconductors – a worldwide company

**Argentina:** see South America

**Australia:** 34 Waterloo Road, NORTH RYDE, NSW 2113,  
Tel. +61 2 9805 4455, Fax. +61 2 9805 4466

**Austria:** Computerstr. 6, A-1101 WIEN, P.O. Box 213,  
Tel. +43 1 60 101, Fax. +43 1 60 101 1210

**Belarus:** Hotel Minsk Business Center, Bld. 3, r. 1211, Volodarski Str. 6,  
220050 MINSK, Tel. +375 172 200 733, Fax. +375 172 200 773

**Belgium:** see The Netherlands

**Brazil:** see South America

**Bulgaria:** Philips Bulgaria Ltd., Energoprojekt, 15th floor,  
51 James Bourchier Blvd., 1407 SOFIA,  
Tel. +359 2 689 211, Fax. +359 2 689 102

**Canada:** PHILIPS SEMICONDUCTORS/COMPONENTS,  
Tel. +1 800 234 7381

**China/Hong Kong:** 501 Hong Kong Industrial Technology Centre,  
72 Tat Chee Avenue, Kowloon Tong, HONG KONG,  
Tel. +852 2319 7888, Fax. +852 2319 7700

**Colombia:** see South America

**Czech Republic:** see Austria

**Denmark:** Prags Boulevard 80, PB 1919, DK-2300 COPENHAGEN S,  
Tel. +45 32 88 2636, Fax. +45 31 57 0044

**Finland:** Sinikalliontie 3, FIN-02630 ESPOO,  
Tel. +358 9 615800, Fax. +358 9 61580920

**France:** 4 Rue du Port-aux-Vins, BP317, 92156 SURESNES Cedex,  
Tel. +33 1 40 99 6161, Fax. +33 1 40 99 6427

**Germany:** Hammerbrookstraße 69, D-20097 HAMBURG,  
Tel. +49 40 23 53 60, Fax. +49 40 23 536 300

**Greece:** No. 15, 25th March Street, GR 17778 TAVROS/ATHENS,  
Tel. +30 1 4894 339/239, Fax. +30 1 4814 240

**Hungary:** see Austria

**India:** Philips INDIA Ltd, Shivsagar Estate, A Block, Dr. Annie Besant Rd.  
Worli, MUMBAI 400 018, Tel. +91 22 4938 541, Fax. +91 22 4938 722

**Indonesia:** see Singapore

**Ireland:** Newstead, Clonskeagh, DUBLIN 14,  
Tel. +353 1 7640 000, Fax. +353 1 7640 200

**Israel:** RAPAC Electronics, 7 Kehilat Saloniki St, PO Box 18053,  
TEL AVIV 61180, Tel. +972 3 645 0444, Fax. +972 3 649 1007

**Italy:** PHILIPS SEMICONDUCTORS, Piazza IV Novembre 3,  
20124 MILANO, Tel. +39 2 6752 2531, Fax. +39 2 6752 2557

**Japan:** Philips Bldg 13-37, Kohnan 2-chome, Minato-ku, TOKYO 108,  
Tel. +81 3 3740 5130, Fax. +81 3 3740 5077

**Korea:** Philips House, 260-199 Itaewon-dong, Yongsan-ku, SEOUL,  
Tel. +82 2 709 1412, Fax. +82 2 709 1415

**Malaysia:** No. 76 Jalan Universiti, 46200 PETALING JAYA, SELANGOR,  
Tel. +60 3 750 5214, Fax. +60 3 757 4880

**Mexico:** 5900 Gateway East, Suite 200, EL PASO, TEXAS 79905,  
Tel. +9-5 800 234 7381

**Middle East:** see Italy

**Netherlands:** Postbus 90050, 5600 PB EINDHOVEN, Bldg. VB,  
Tel. +31 40 27 82785, Fax. +31 40 27 88399

**New Zealand:** 2 Wagener Place, C.P.O. Box 1041, AUCKLAND,  
Tel. +64 9 849 4160, Fax. +64 9 849 7811

**Norway:** Box 1, Manglerud 0612, OSLO,  
Tel. +47 22 74 8000, Fax. +47 22 74 8341

**Philippines:** Philips Semiconductors Philippines Inc.,  
106 Valero St. Salcedo Village, P.O. Box 2108 MCC, MAKATI,  
Metro MANILA, Tel. +63 2 816 6380, Fax. +63 2 817 3474

**Poland:** Ul. Lukiska 10, PL 04-123 WARSZAWA,  
Tel. +48 22 612 2831, Fax. +48 22 612 2327

**Portugal:** see Spain

**Romania:** see Italy

**Russia:** Philips Russia, Ul. Usatcheva 35A, 119048 MOSCOW,  
Tel. +7 095 755 6918, Fax. +7 095 755 6919

**Singapore:** Lorong 1, Toa Payoh, SINGAPORE 1231,  
Tel. +65 350 2538, Fax. +65 251 6500

**Slovakia:** see Austria

**Slovenia:** see Italy

**South Africa:** S.A. PHILIPS Pty Ltd., 195-215 Main Road Martindale,  
2092 JOHANNESBURG, P.O. Box 7430 Johannesburg 2000,  
Tel. +27 11 470 5911, Fax. +27 11 470 5494

**South America:** Rua do Rocio 220, 5th floor, Suite 51,  
04552-903 São Paulo, SÃO PAULO - SP, Brazil,  
Tel. +55 11 821 2333, Fax. +55 11 829 1849

**Spain:** Balmes 22, 08007 BARCELONA,  
Tel. +34 3 301 6312, Fax. +34 3 301 4107

**Sweden:** Kottbygatan 7, Akalla, S-16485 STOCKHOLM,  
Tel. +46 8 632 2000, Fax. +46 8 632 2745

**Switzerland:** Allmendstrasse 140, CH-8027 ZÜRICH,  
Tel. +41 1 488 2686, Fax. +41 1 481 7730

**Taiwan:** Philips Semiconductors, 6F, No. 96, Chien Kuo N. Rd., Sec. 1,  
TAIPEI, Taiwan Tel. +886 2 2134 2865, Fax. +886 2 2134 2874

**Thailand:** PHILIPS ELECTRONICS (THAILAND) Ltd.,  
209/2 Sanpavuth-Bangna Road Prakanong, BANGKOK 10260,  
Tel. +66 2 745 4090, Fax. +66 2 398 0793

**Turkey:** Talatpasa Cad. No. 5, 80640 GÜLTEPE/ISTANBUL,  
Tel. +90 212 279 2770, Fax. +90 212 282 6707

**Ukraine:** PHILIPS UKRAINE, 4 Patrice Lumumba str., Building B, Floor 7,  
252042 KIEV, Tel. +380 44 264 2776, Fax. +380 44 268 0461

**United Kingdom:** Philips Semiconductors Ltd., 276 Bath Road, Hayes,  
MIDDLESEX UB3 5BX, Tel. +44 181 730 5000, Fax. +44 181 754 8421

**United States:** 811 East Arques Avenue, SUNNYVALE, CA 94088-3409,  
Tel. +1 800 234 7381

**Uruguay:** see South America

**Vietnam:** see Singapore

**Yugoslavia:** PHILIPS, Trg N. Pasica 5/v, 11000 BEOGRAD,  
Tel. +381 11 625 344, Fax. +381 11 635 777

**For all other countries apply to:** Philips Semiconductors, Marketing & Sales Communications,  
Building BE-p, P.O. Box 218, 5600 MD EINDHOVEN, The Netherlands, Fax. +31 40 27 24825

**Internet:** <http://www.semiconductors.philips.com>

© Philips Electronics N.V. 1997

SCA54

All rights are reserved. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner.

The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice. No liability will be accepted by the publisher for any consequence of its use. Publication thereof does not convey nor imply any license under patent- or other industrial or intellectual property rights.

Printed in The Netherlands

547027/1200/01/pp16

Date of release: 1997 May 05

Document order number: 9397 750 02272

*Let's make things better.*