TEA1762T

GreenChip synchronous rectifier controller

Rev. 02 — 25 April 2007 Product data sheet

1. General description

The TEA1762T is a member of the new generation of Synchronous Rectifier (SR) controller ICs for switched mode power supplies. Its high level of integration allows the design of a cost-effective power supply with a very low number of external components.

The TEA1762T is a controller IC dedicated for synchronous rectification on the secondary side of discontinuous conduction mode and quasi resonant flyback converters. Besides electronics for synchronous rectification, it also has integrated circuitry for output voltage and output current regulation.

The TEA1762T is fabricated in a Silicon On Insulator (SOI) process. This NXP SOI process makes possible a wide range of operation.

2. Features

2.1 Distinctive features

- Combined synchronous rectification and primary feedback control functionality
- Wide supply voltage range (8.6 V to 38 V)
- High level of integration, resulting in a very low external component count
- Wide opto output voltage range (3.5 V to 38 V)
- Accurate internal voltage reference for voltage control (within 1 %)
- Separate sense ground for accurate voltage sensing
- High driver output voltage of 10 V to drive all MOSFET brands to the lowest R_{DSon}
- Reference voltage output pin

2.2 Green features

- Low current consumption
- High system efficiency from no load to full load

2.3 Protection features

- Undervoltage protection
- Internal over-temperature protection
- General purpose protection input pin

3. Applications

- The TEA1762T is intended for adapters. The device can also be used in all other discontinuous conduction mode and quasi resonant flyback systems that demand a highly efficient and cost-effective solution.

4. Ordering information

Table 1. Ordering information

Type number	Package		
	Name	Description	Version
TEA1762T	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1

5. Block diagram

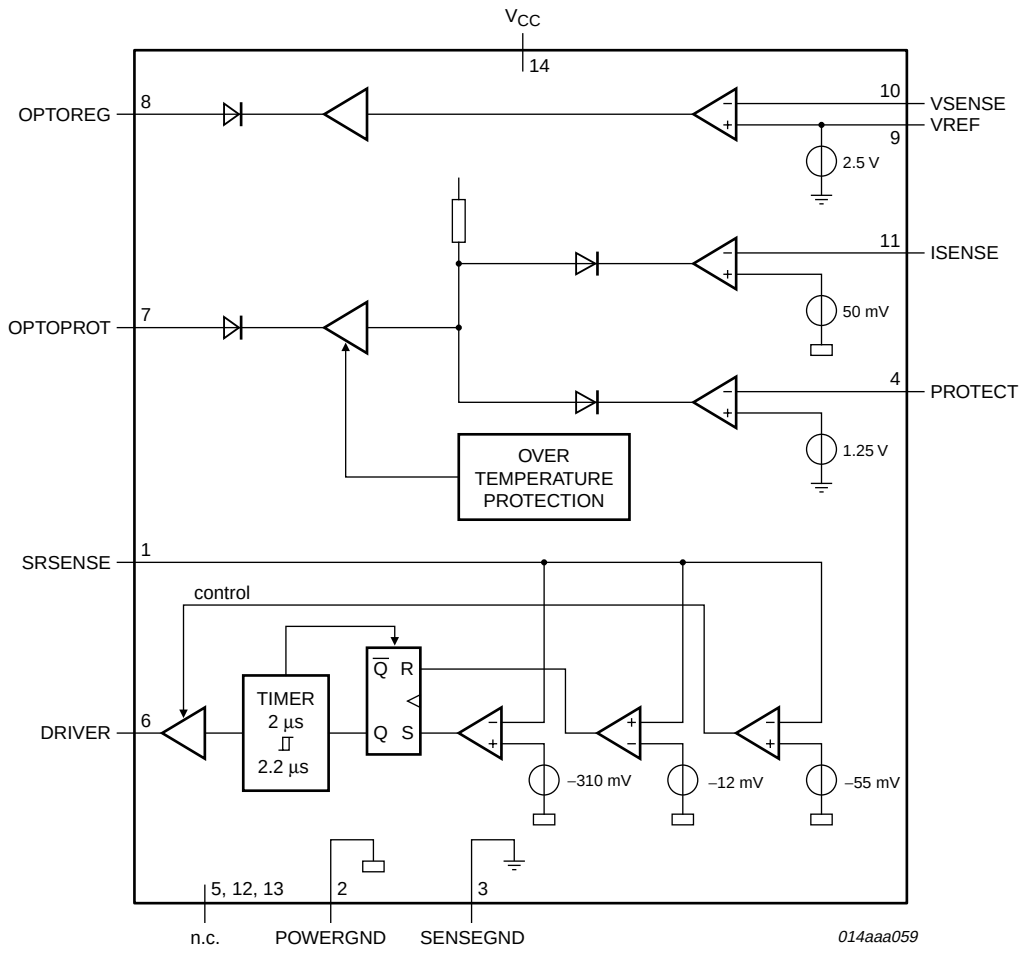


Fig 1. TEA1762T block diagram

6. Pinning information

6.1 Pinning

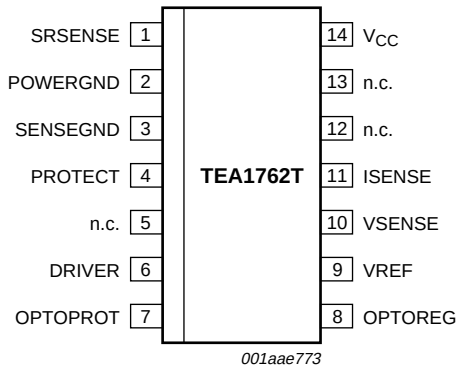


Fig 2. Pin configuration TEA1762T

6.2 Pin description

Table 2. Pin description for SO14

Symbol	Pin	Description
SRSENSE	1	synchronous timing input
POWERGND	2	power ground
SENSEGND	3	sense ground
PROTECT	4	general purpose protection input
n.c.	5	not connected
DRIVER	6	driver output for SR MOSFET
OPTOPROT	7	opto coupler driver output for current protection
OPTOREG	8	opto coupler driver output for voltage regulation
VREF	9	reference voltage output
VSENSE	10	sense input for voltage control
ISENSE	11	sense input for current control
n.c.	12	not connected
n.c.	13	not connected
V_{CC}	14	supply voltage

7. Functional description

The TEA1762T is the controller for synchronous rectification to be used in discontinuous conduction mode and quasi resonant flyback converters. Besides controlling the SR MOSFET, the TEA1762T contains the voltage reference and amplifiers to regulate and control the output voltage and output current of the power supply.

7.1 Start-up and undervoltage lock-out

The IC leaves the under-voltage lock-out state and activates the synchronous rectifier circuitry and also the voltage/current sense circuitry as soon as the voltage on the V_{CC} pin is above 8.6 V (typical). As soon as the voltage drops below 8.1 V (typical), the under-voltage lock-out state is re-entered and the SR driver output is actively kept low and also the opto driver outputs are disabled.

7.2 Synchronous rectification

After a negative voltage (–310 mV typical) is sensed on the SRSENSE pin, the driver output voltage is made high and the external MOSFET is switched on. As soon as the SRSENSE voltage rises to –55 mV, the driver output voltage is regulated to maintain the –55 mV on the SRSENSE pin. As soon as the SRSENSE voltage is above –12 mV, the driver output is pulled to ground. After switch-on of the SR MOSFET, the input signal on the SRSENSE pin is blanked for 2 µs (typical). This will eliminate false switch-off due to high frequency ringing at the start of the secondary stroke.

Because the driver output voltage is reduced as soon as the voltage on the SRSENSE pin is –55 mV, the external power switch can be switched off fast when the current through the switch reaches zero. With this zero-current switch off, no separate standby mode is needed to maintain high efficiency during no-load operation. The zero current is detected by sensing a –12 mV level on the SRSENSE pin. See Figure 3.

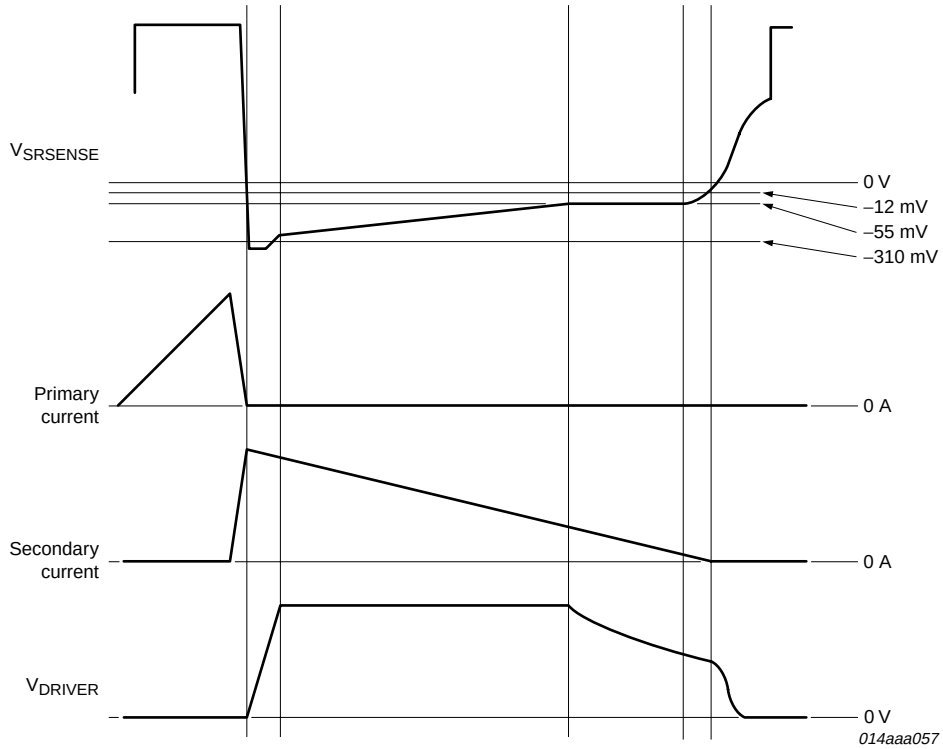


Fig 3. Synchronous rectification

If the secondary stroke of the flyback converter is shorter than 2 µs (typical), the driver output is disabled. This will guarantee stable operation for very low duty cycles. When the secondary stroke increases above 2.2 µs (typical), the driver output is again enabled.

7.3 SMPS output voltage and current regulation

The output voltage of the flyback Switched Mode Power Supply (SMPS) can be controlled by sensing the output voltage via the VSENSE pin. The feedback loop via the primary controller can regulate the output voltage of the switched mode power supply by regulating the voltage on the VSENSE pin to 2.5 V above the voltage on pin SENSEGND.

Also the output current of the flyback SMPS can be controlled or limited. The voltage on the ISENSE pin is regulated or limited to 50 mV above the voltage on pin POWERGND.

7.4 Opto outputs

The opto output is intended to drive an opto coupler (see Figure 5). The opto outputs have an open drain output configuration. The maximum sink current is internally limited to 5 mA (typical). The outputs are linearly controlled via the VSENSE and ISENSE input pins. An over-temperature situation will switch the protection opto output (OPTOPROT) to its maximum sink current.

During start-up ($V_{CC} < V_{startup}$) and undervoltage lock-out the outputs are disabled.

7.5 Protection input

The PROTECT pin is a general purpose input pin which can be used for additional protection of the switched mode power supply. With a Negative Temperature Coefficient (NTC) thermistor external temperature protection can be provided, e.g. the external power switches and transformer can be protected against high temperatures. With a Zener diode a secondary overvoltage protection can be made.

7.6 Reference voltage output

The reference voltage output pin can be used for supplying external circuitry. The maximum output current must be limited to 1 mA.

The reference voltage is activated as soon as the start-up voltage is reached on the V_{CC} pin and switched off again after the V_{CC} pin voltage drops below the V_{CC} stop level.

7.7 Supply management

All (internal) reference voltages are derived from a temperature compensated, on-chip band gap circuit. The reference voltage is trimmed to an accuracy within 1 %.

7.8 OverTemperature Protection (OTP)

The IC provides an accurate internal overtemperature protection of 150 °C (typical). The IC will maximize the current of pin OPTOPROT as soon as the internal temperature limit is reached. The opto signal can be used on the primary side of the flyback controller to activate the SMPS protection or limit the output power. As soon as the overtemperature condition is solved, normal operation will resume.

7.9 Driver

The driver circuit to the gate of the external power MOSFET has a source capability of typically 250 mA and a sink capability of typically 2.7 A. This permits fast turn-on and turn-off of the power MOSFET for efficient operation. The output voltage of the driver is limited to 10 V (typical). This high output voltage will drive all MOSFET brands to the minimum on-state resistance.

During start-up conditions ($V_{CC} < V_{startup}$) and undervoltage lock-out the driver output voltage is actively pulled low.

7.10 Power ground and sense ground

The TEA1762T has two ground connections. The sense ground ensures an increased accuracy of the output voltage of the switched mode power supply and can also be used to compensate for cable losses on the output of the converter. The grounds are internally connected via two anti-parallel diodes.

8. Limiting values

Table 3. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). All voltages are measured with respect to power ground (pin 2); positive currents flow into the chip. The voltage ratings are valid provided other ratings are not violated; current ratings are valid provided the maximum power rating is not violated.

Symbol	Parameter	Conditions		Min	Max	Unit
Voltages						
V_{CC}	supply voltage	continuous		–0.4	+38	V
$V_{OPTOREG}$	voltage on pin OPTOREG	continuous		–0.4	+38	V
$V_{OPTOPROT}$	voltage on pin OPTOPROT	continuous		–0.4	+38	V
$V_{SRSENSE}$	voltage on pin SRSENSE	continuous		-	+120	V
V_{VSENSE}	voltage on pin VSENSE	continuous		–0.4	+5	V
V_{ISENSE}	voltage on pin ISENSE			–0.4	+5	V
$V_{PROTECT}$	voltage on pin PROTECT			–0.4	+5	V
$V_{SENSEGND}$	voltage on pin SENSEGND		[1]	–0.4	+0.4	V
Currents						
$I_{OPTOREG}$	current on pin OPTOREG			-	+6	mA
$I_{OPTOPROT}$	current on pin OPTOPROT			-	+6	mA
I_{DRIVER}	current on pin DRIVER	duty cycle < 10 %		–0.8	+3	A
I_{VREF}	current on pin VREF			–2	-	mA
$I_{SRSENSE}$	current on pin SRSENSE			–3	-	mA
General						
P_{tot}	total power dissipation	$T_{amb} < 80$ °C		-	0.65	W
T_{stg}	storage temperature			–55	+150	°C
T_j	junction temperature			–20	+150	°C

Table 3. Limiting values *...continued*

In accordance with the Absolute Maximum Rating System (IEC 60134). All voltages are measured with respect to power ground (pin 2); positive currents flow into the chip. The voltage ratings are valid provided other ratings are not violated; current ratings are valid provided the maximum power rating is not violated.

Symbol	Parameter	Conditions		Min	Max	Unit
ESD						
V_{ESD}	electrostatic discharge voltage	class 2				
		human body model	[2]	-	2000	V
		machine model	[3]	-	200	V
		charged device model		-	500	V

[1] Voltages on pin SENSEGND less than +1.0 V will not damage the IC when the duration is limited to 100 µs, but voltages on pin SENSEGND larger than +0.4 V may lead to disturbed IC operation.

[2] Equivalent to discharging a 100 pF capacitor through a 1.5 kΩ series resistor.

[3] Equivalent to discharging a 200 pF capacitor through a 0.75 µH coil and a 10 Ω resistor.

9. Thermal characteristics

Table 4. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	100	K/W

The graph in Figure 4 shows the relationship between junction temperature and VSENSE voltage.

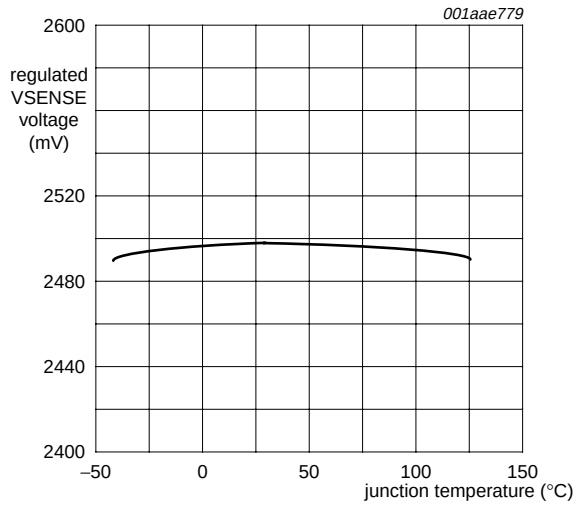


Fig 4. Typical regulated VSENSE voltage versus junction temperature

10. Characteristics

Table 5. Characteristics

T_{amb} = 25 °C; V_{CC} = 20 V; all voltages are measured with respect to sense ground (pin 3); currents are positive when flowing into the IC; unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Supply voltage management (pin V_{CC})							
$V_{startup}$	start-up voltage			8.35	8.6	8.85	V
V_{hys}	hysteresis voltage		[1]	-	0.5	-	V
$I_{CC(oper)}$	operating supply current	V_{CC} = 8 V; V_{CC} < $V_{startup}$		-	1	-	mA
		under normal operation; no load on pin DRIVER		-	1.4	-	mA
Synchronous rectification sense input (pin SRSENSE)							
$V_{act(drv)}$	driver activation voltage	w.r.t. power ground		–340	–310	–280	mV
$V_{reg(drv)}$	driver regulation voltage	w.r.t. power ground		–65	–55	–45	mV
$V_{deact(drv)}$	driver deactivation voltage	w.r.t. power ground			–12		mV
$t_{d(act)(drv)}$	driver activation delay time				125		ns
$t_{act(sr)(min)}$	minimum synchronous rectification active time	Short time		1.5	2	2.5	µs
		Long time		1.7	2.2	2.7	µs
Driver (pin DRIVER)							
I_{source}	source current	V_{CC} = 15 V; voltage on pin DRIVER = 2 V		–0.3	–0.25	–0.2	A
I_{sink}	sink current	V_{CC} = 15 V					
		voltage on pin DRIVER = 2 V		1	1.4	-	A
		voltage on pin DRIVER = 9.5 V		2.2	2.7	-	A
$V_{o(max)}$	maximum output voltage	V_{CC} = 15 V		-	10	12	V
Opto output (pin OPTOREG and OPTOPROT)							
$I_{O(max)}$	maximum output current	V_{OPTO} > 5 V		4	5	6	mA
$V_{O(min)}$	minimum output voltage	I_{OPTO} = 4 mA				3.5	V
Voltage sense (pin VSENSE)							
$V_{reg(VSENSE)}$	regulation voltage on pin VSENSE	See Figure 4		2.475	2.5	2.525	V
$I_{I(VSENSE)}$	input current on pin VSENSE	V_{VSENSE} = $V_{reg(VSENSE)}$		–100	0	+100	nA
g_m	transconductance	V_{VSENSE} to $I_{OPTOREG}$			40		A/V
GB	gain bandwidth product	R_L = 1 kΩ		1			MHz
Reference voltage (pin VREF)							
V_{VREF}	voltage on pin VREF			2.465	2.5	2.535	V
I_{VREF}	current on pin VREF			–1			mA
$C_{VREF(max)}$	maximum capacitance on pin VREF					40	pF
Current sense (pin ISENSE)							
$V_{reg(ISENSE)}$	regulation voltage on pin ISENSE	w.r.t. power ground; $V_{POWERGND}$ > –0.4 V		46	50	54	mV
$I_{I(reg)(ISENSE)}$	regulation input current on pin ISENSE	V_{ISENSE} = $V_{reg(ISENSE)}$		–200	–100	0	nA
g_m	transconductance	V_{ISENSE} to $I_{OPTOPROT}$			8		A/V

Table 5. Characteristics *...continued*

T_{amb} = 25 °C; V_{CC} = 20 V; all voltages are measured with respect to sense ground (pin 3); currents are positive when flowing into the IC; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
GB	gain bandwidth product	R_L = 1 kΩ	1			MHz
Protection input (pin PROTECT)						
$V_{th(PROTECT)}$	threshold voltage on pin PROTECT		1.15	1.25	1.35	V
V_{hys}	hysteresis voltage		15	30	45	mV
$I_{I(PROTECT)}$	input current on pin PROTECT	$V_{PROTECT} = V_{th(PROTECT)}$	–100	–50	–5	nA
Temperature protection						
$T_{pl(max)}$	maximum protection level temperature		140	150	-	°C
$T_{pl(hys)}$	protection level hysteresis temperature		-	12	-	°C

[1] The V_{CC} stop voltage is $V_{startup} - V_{hys}$.

11. Application information

A switched mode power supply with the TEA1762T consists of a primary side discontinuous conduction mode flyback controller, a transformer, and an output stage with a feedback circuit. In the output stage a MOSFET (Qsec) is used for low conduction losses. The MOSFET is controlled by the TEA1762T. The output voltage and/or current is also controlled by the TEA1762T via the opto coupler connection to the primary side. See Figure 5.

The output voltage is set by resistors R_{fb1} and R_{fb2}. The output current is controlled by the resistor R_{isense}. The timing for the synchronous rectifier switch is derived from the voltage sensed on the SRSENSE pin. The resistor in the SRSENSE connection is needed to protect the TEA1762T from excessive voltages. The SRSENSE resistor should typically be 1 kΩ. Higher values might impair correct timing, lower values may not provide sufficient protection.

During output short circuit or load connection, the limiting values on pin SENSEGND must not be exceeded.

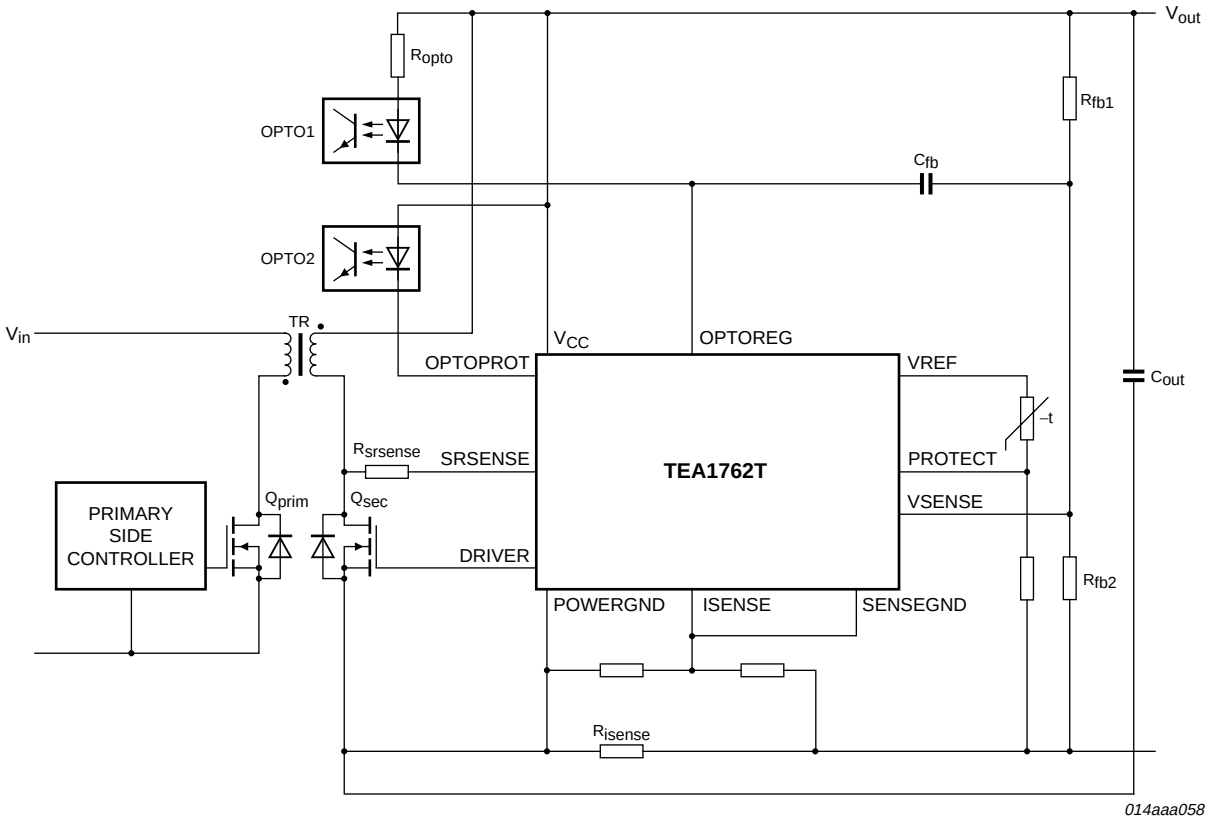


Fig 5. Application example TEA1762T

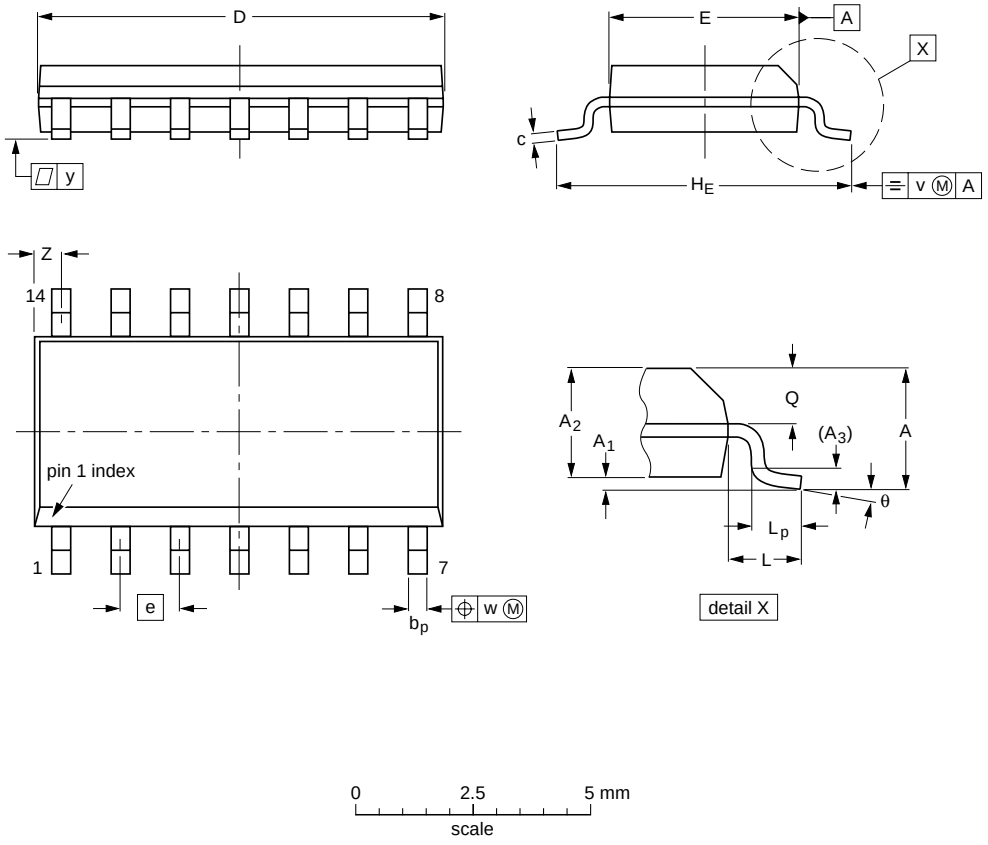
12. Test information

12.1 Quality information

The *General Quality Specification for Integrated Circuits, SNW-FQ-611* is applicable.

13. Package outline

SO14: plastic small outline package; 14 leads; body width 3.9 mm **SOT108-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	8.75 8.55	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8^o 0^o
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.35 0.34	0.16 0.15	0.05	0.244 0.228	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

Note

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT108-1	076E06	MS-012				~~99-12-27~~ 03-02-19

Fig 6. Package outline SOT108-1 (SO14)

14. Revision history

Table 6. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
TEA1762T_2	20070425	Product data sheet	-	TEA1762T_1
Modifications:	• Updated limiting values for $I_{SRSENSE}$ in Table 3. • Updated characteristic values for I_{source}, I_{sink}, GB (voltage and current sense) and $T_{pl(max)}$ in Table 5. • Soldering section removed. • The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Legal texts have been adapted to the new company name where appropriate.			
TEA1762T_1	20060331	Objective data sheet	-	-

15. Legal information

15.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

15.2 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

15.3 Disclaimers

General — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in medical, military, aircraft, space or life support equipment, nor in applications where failure or malfunction of a NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors accepts no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) may cause permanent damage to the device. Limiting values are stress ratings only and operation of the device at these or any other conditions above those given in the Characteristics sections of this document is not implied. Exposure to limiting values for extended periods may affect device reliability.

Terms and conditions of sale — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at http://www.nxp.com/profile/terms, including those pertaining to warranty, intellectual property rights infringement and limitation of liability, unless explicitly otherwise agreed to in writing by NXP Semiconductors. In case of any inconsistency or conflict between information in this document and such terms and conditions, the latter will prevail.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

15.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

GreenChip — is a trademark of NXP B.V.

16. Contact information

For additional information, please visit: **http://www.nxp.com**

For sales office addresses, send an email to: **salesaddresses@nxp.com**

17. Contents

For more information, please visit: http://www.nxp.com
For sales office addresses, please send an email to: salesaddresses@nxp.com

Date of release: 25 April 2007
Document identifier: TEA1762T_2

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

NXP:

TEA1762T/N2,118 TEA1762T/N2/DG,118