# TEA1791T

## GreenChip synchronous rectifier controller

Rev. 02 — 7 June 2010 Product data sheet

## 1. General description

The TEA1791T 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 TEA1791T is a controller IC dedicated to synchronous rectification on the secondary side of discontinuous conduction mode and quasi-resonant flyback converters.

The TEA1791T is fabricated in a Silicon On Insulator (SOI) process.

## 2. Features and benefits

### 2.1 Distinctive features

- Accurate synchronous rectification functionality
- Wide supply voltage range (8.5 V to 38 V)
- High level of integration, resulting in a very low external component count
- High driver output voltage of 10 V to drive all MOSFET brands to the lowest $R_{DSon}$

### 2.2 Green features

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

### 2.3 Protection features

- Undervoltage protection

## 3. Applications

- The TEA1791T is intended for adapters. The device can also be used in all other discontinuous conduction mode systems 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 |
| TEA1791T/N1 | SO8 | plastic small outline package; 8 leads; body width 3.9 mm | SOT96-1 |

# 5. Block diagram

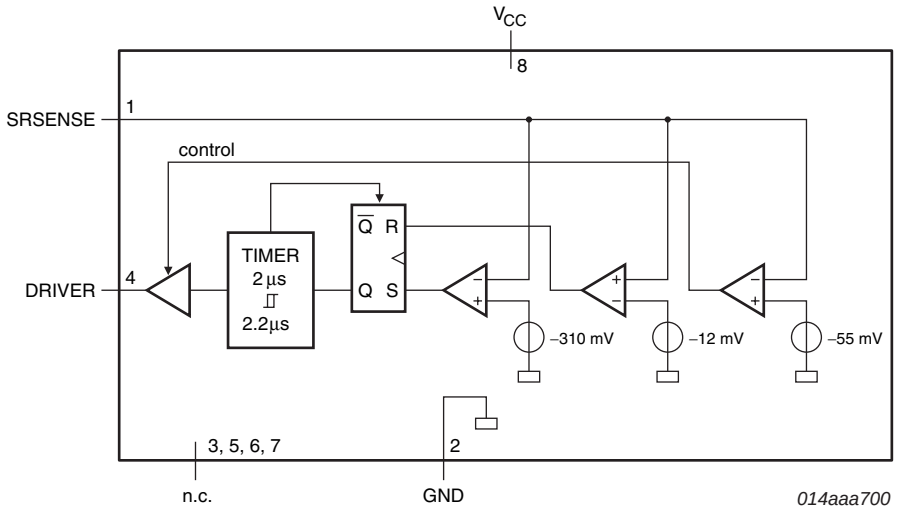



**Fig 1. Block diagram**

# 6. Pinning information

## 6.1 Pinning

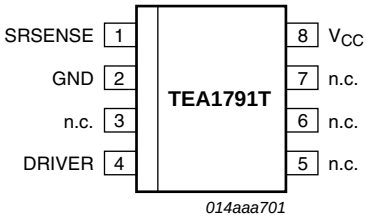



**Fig 2. Pin configuration**

## 6.2 Pin description

**Table 2. Pin description**

| Symbol | Pin | Description |
|---|---|---|
| SRSENSE | 1 | synchronous timing input |
| GND | 2 | ground |
| n.c. | 3 | not connected |
| DRIVER | 4 | driver output for SR MOSFET |
| n.c | 5 | not connected |
| n.c. | 6 | not connected |
| n.c. | 7 | not connected |
| $V_{CC}$ | 8 | supply voltage |

# 7. Functional description

## 7.1 Introduction

The TEA1791T is the controller for synchronous rectification to be used in discontinuous conduction mode and quasi-resonant flyback converters.

## 7.2 Start-up and UnderVoltage LockOut (UVLO)

The IC leaves the undervoltage lockout state and activates the synchronous rectifier circuitry as soon as the voltage on the $V_{CC}$ pin is above 8.5 V (typical). When the voltage drops below 8.0 V (typical), the undervoltage lockout state is reentered and the SR driver output is actively kept low.

## 7.3 Synchronous rectification

After a negative voltage (−310 mV typical) is sensed on the SRSENSE pin, the driver output voltage is driven 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. When 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 eliminates false switch-off due to high frequency ringing at the start of the secondary stroke.

Because the driver output voltage is reduced when the voltage on the SRSENSE pin is −55 mV, the external power switch can be switched off quickly when the current through the switch reaches zero. The zero current switch-off removes the need for a separate Standby mode to maintain high efficiency during the no-load operation. The zero current is detected by sensing a −12 mV level on the SRSENSE pin (see Figure 3).

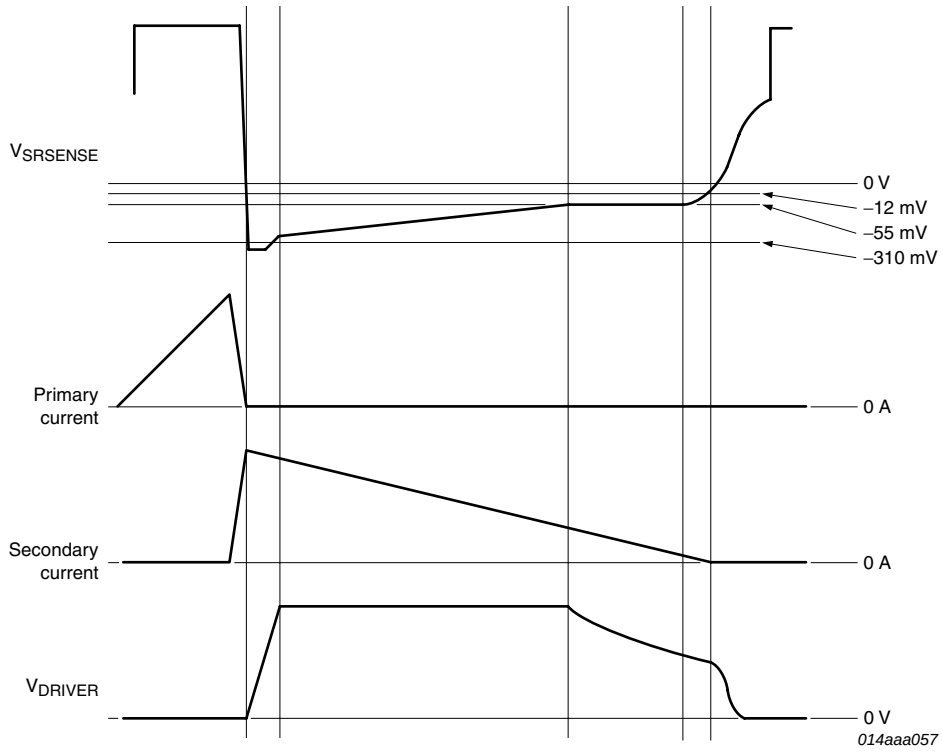



**Fig 3. Synchronous rectification signals**

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.

## 7.4 Supply management

All internal reference voltages are derived from a temperature compensated, on-chip band gap circuit.

## 7.5 Driver

The driver circuit to the gate of the external power MOSFET has a typical source capability of 250 mA and a typical sink capability of 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 lockout the driver output voltage is actively pulled low.

# 8. Limiting values

**Table 3. Limiting values**

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

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| **Voltages** | | | | | | |
| $V_{CC}$ | supply voltage | continuous | | –0.4 | +38 | V |
| $V_{SRSENSE}$ | voltage on pin SRSENSE | continuous | | - | 120 | V |
| **Currents** | | | | | | |
| $I_{DRIVER}$ | current on pin DRIVER | duty cycle < 10 % | | –0.8 | +3 | A |
| $I_{SRSENSE}$ | current on pin SRSENSE | | | –3 | - | mA |
| **General** | | | | | | |
| $P_{tot}$ | total power dissipation | $T_{amb}$ < 80 °C | | - | 0.45 | W |
| $T_{stg}$ | storage temperature | | | –55 | +150 | °C |
| $T_j$ | junction temperature | | | –40 | +150 | °C |
| $V_{ESD}$ | electrostatic discharge voltage | class 2 | | | | |
| | | human body model | [1] | - | 2000 | V |
| | | machine model | [2] | - | 200 | V |
| | | charged device model | | - | 500 | V |

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

[2] Equivalent to discharging a 200 pF capacitor through a 0.75 μH coil and a 10 Ω series 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 | 150 | K/W |
| $R_{th(j-c)}$ | thermal resistance from junction to case | | 95 | K/W |

# 10. Characteristics

**Table 5. Characteristics**

*$T_{amb}$ = 25 °C; $V_{CC}$ = 20 V; all voltages are measured with respect to ground (pin 2); 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 | | 8.2 | 8.5 | 8.8 | V |
| $V_{hys}$ | hysteresis voltage | [1] | - | 0.5 | - | V |
| $I_{CC(oper)}$ | operating supply current | $V_{CC}$ = 8 V ($V_{CC}$ < $V_{startup}$) | - | 0.65 | - | mA |
| | | under normal operation; no load on pin DRIVER | - | 0.95 | - | mA |
| **Synchronous rectification sense input (pin SRSENSE)** | | | | | | |
| $V_{act(drv)}$ | driver activation voltage | | –340 | –310 | –280 | mV |
| $V_{reg(drv)}$ | driver regulation voltage | | –65 | –55 | –45 | mV |
| $V_{deact(drv)}$ | driver deactivation voltage | | - | –12 | - | mV |
| $t_{d(act)(drv)}$ | driver activation delay time | | - | 125 | - | ns |
| $t_{act(sr)(min)}$ | minimum synchronous rectification | Short time | 1.5 | 2.0 | 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 |

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

## 11. Application information

A switched mode power supply with the TEA1791T consists of a primary side discontinuous conduction mode flyback controller, a transformer, and an output stage with a feedback circuit. A MOSFET ($Q_{sec}$) is used for low conduction losses in the output state. This MOSFET is controlled by the TEA1791T.

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 TEA1791T from excessive voltages. The $R_{SRSENSE}$ resistor should typically be 1 kΩ. Higher values might impair correct timing, lower values may not provide sufficient protection.

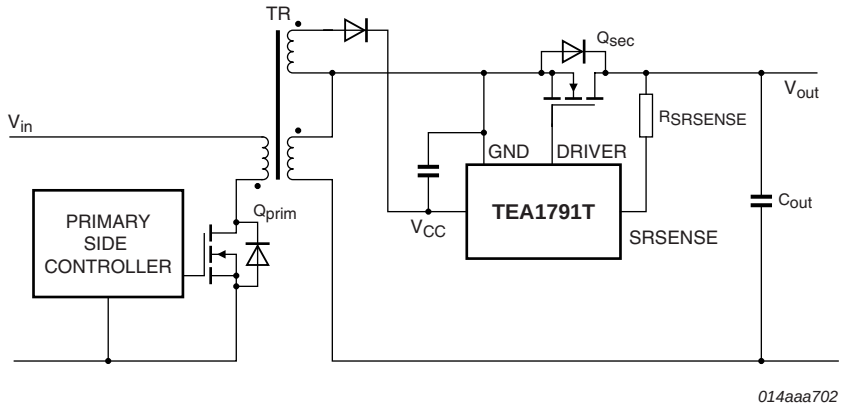



**Fig 4. Application diagram high side rectification**

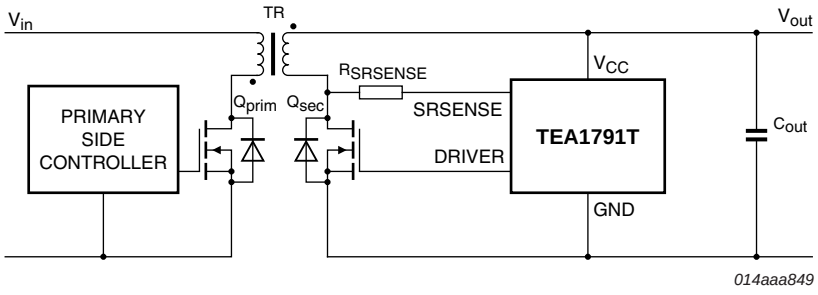
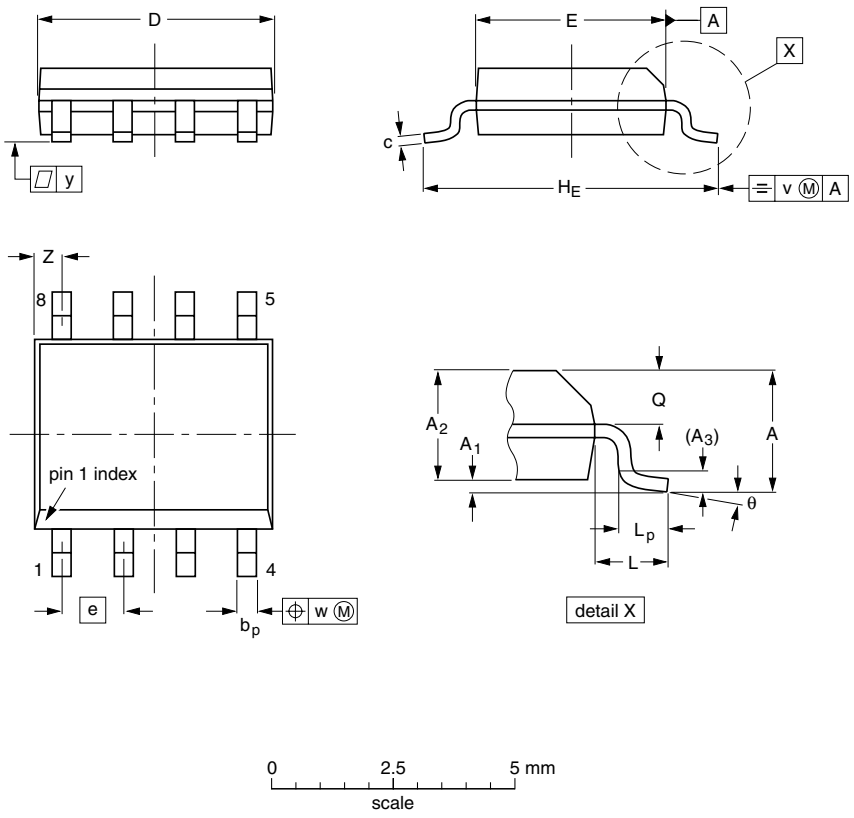



**Fig 5. Application diagram low side rectification**

## 12. Package outline

**SO8: plastic small outline package; 8 leads; body width 3.9 mm** **SOT96-1**




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

| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | $D^{(1)}$ | $E^{(2)}$ | e | $H_E$ | L | $L_p$ | Q | v | w | y | $Z^{(1)}$ | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.75 | 0.25<br>0.10 | 1.45<br>1.25 | 0.25 | 0.49<br>0.36 | 0.25<br>0.19 | 5.0<br>4.8 | 4.0<br>3.8 | 1.27 | 6.2<br>5.8 | 1.05 | 1.0<br>0.4 | 0.7<br>0.6 | 0.25 | 0.25 | 0.1 | 0.7<br>0.3 | $8^o$<br>$0^o$ |
| inches | 0.069 | 0.010<br>0.004 | 0.057<br>0.049 | 0.01 | 0.019<br>0.014 | 0.0100<br>0.0075 | 0.20<br>0.19 | 0.16<br>0.15 | 0.05 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.024 | 0.01 | 0.01 | 0.004 | 0.028<br>0.012 | |

**Notes**

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT96-1 | 076E03 | MS-012 | | | | ~~99-12-27~~<br>03-02-18 |

**Fig 6. Package outline SOT96-1 (SO8)**

## 13. Revision history

**Table 6. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| TEA1791T v.2 | 20100607 | Product data sheet | - | TEA1791T_1 |
| Modifications: | • $R_{th(j-c)}$ added to Table 4.<br>• Figure 5 “Application diagram low side rectification”, added.<br>• Minimum value junction temperature changed in Table 3. | | | |
| TEA1791T_1 | 20090203 | Product data sheet | - | - |

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| 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. |

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

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## 16. Contents





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