TEA1791AT

GreenChip synchronous rectifier controller

Rev. 01 — 7 June 2010 Product data sheet

1. General description

The TEA1791AT 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 TEA1791AT is a controller IC dedicated for synchronous rectification on the secondary side of discontinuous conduction mode and quasi-resonant flyback converters.

The TEA1791AT 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 TEA1791AT 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
TEA1791AT/N1	SO8	plastic small outline package; 8 leads; body width 3.9 mm	SOT96-1

5. Block diagram

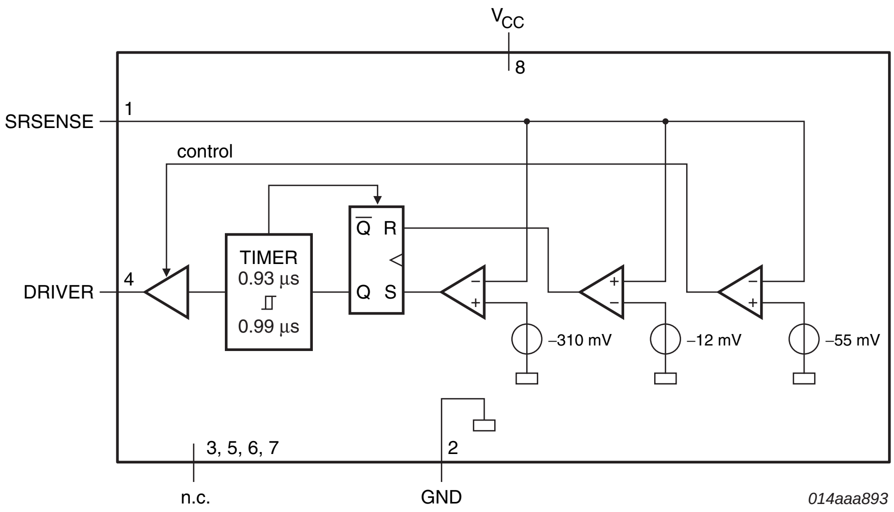


Fig 1. Block diagram

6. Pinning information

6.1 Pinning

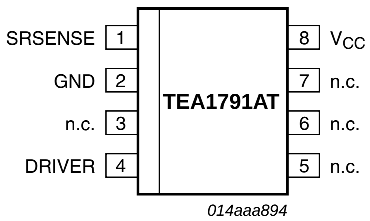


Fig 2. Pin configuration

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 TEA1791AT 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). As soon as 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. As soon as the SRSENSE voltage is above –12 mV, the driver output is pulled to ground.

When the SR MOSFET is switched on, the input signal on the SRSENSE pin is blanked for 0.93 μs (typical). This eliminates false switch-off due to high frequency 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 quickly 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 the no-load operation. The zero current is detected by sensing a –12 mV level on the SRSENSE pin (see Figure 3).

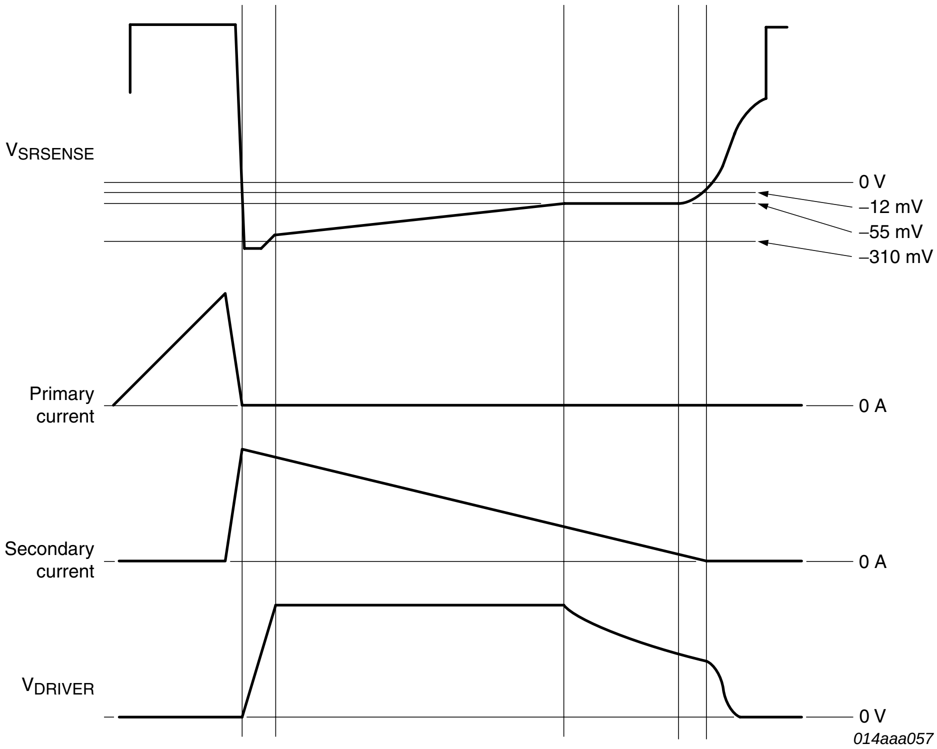


Fig 3. Synchronous rectification signals

If the secondary stroke of the flyback converter is shorter than 0.93 μs (typical), the driver output is disabled. This will guarantee stable operation for very low duty cycles. When the secondary stroke increases above 0.99 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 source stage is coupled to the timer (see Figure 1). When the timer has finished, the source capability is reduced to a small current (typical 5 mA) capable of keeping the driver output voltage at its level. Typically, the time the driver source stage delivers the 250 mA is 100 ns shorter than the minimum synchronous rectification active time ($t_{act(sr)(min)}$).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 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		0.7	0.93	1.16	μs
		Long time		0.75	0.99	1.23	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 TEA1791AT 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 stage. This MOSFET is controlled by the TEA1791AT.

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 TEA1791AT from excessive voltages. The $R_{SRSENSE}$ resistor should typically be 1 kΩ. Higher values might impair correct timing and lower values may not provide sufficient protection.

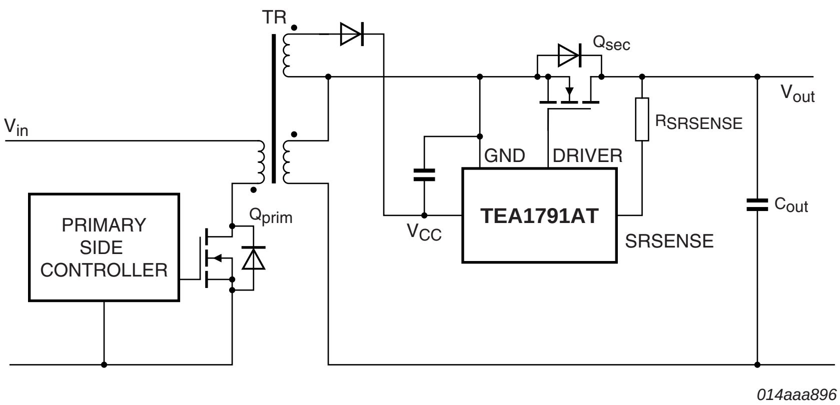


Fig 4. Application diagram high side rectification

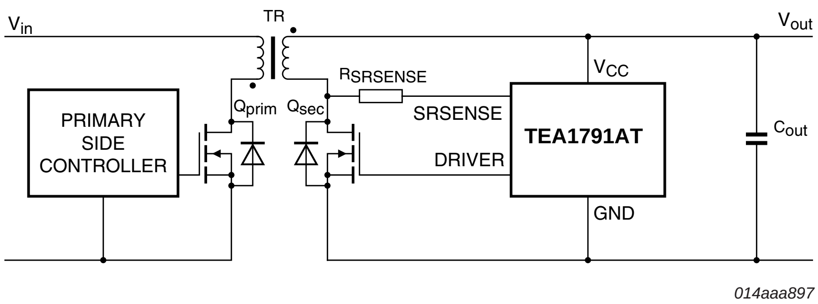


Fig 5. Application diagram low side rectification

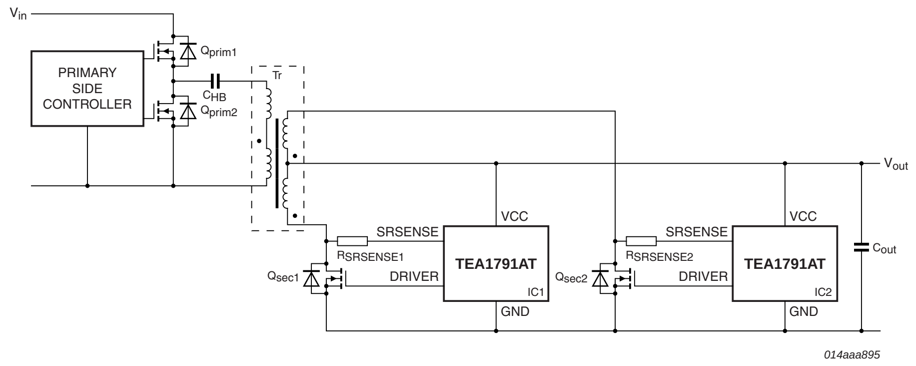
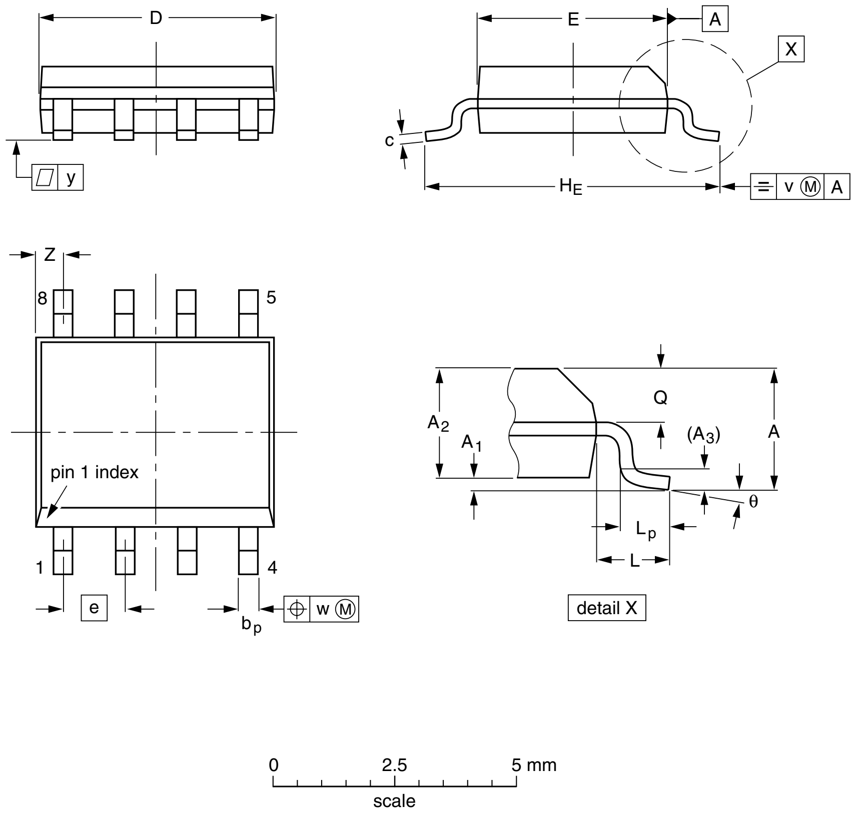


Fig 6. Application diagram resonant application

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 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	5.0 4.8	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° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.20 0.19	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	

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~~ 03-02-18

Fig 7. Package outline SOT96-1 (SO8)

13. Revision history

Table 6. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
TEA1791AT v.1	20100607	Product data sheet	-	-

14. Legal information

14.1 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".

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16. Contents

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