

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.

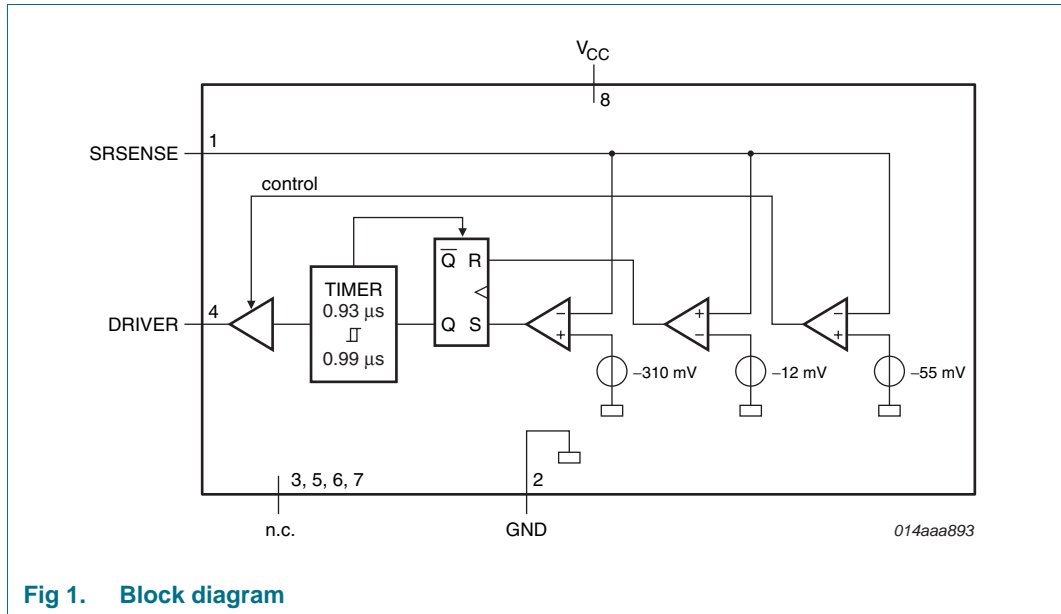
4. Ordering information

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 |

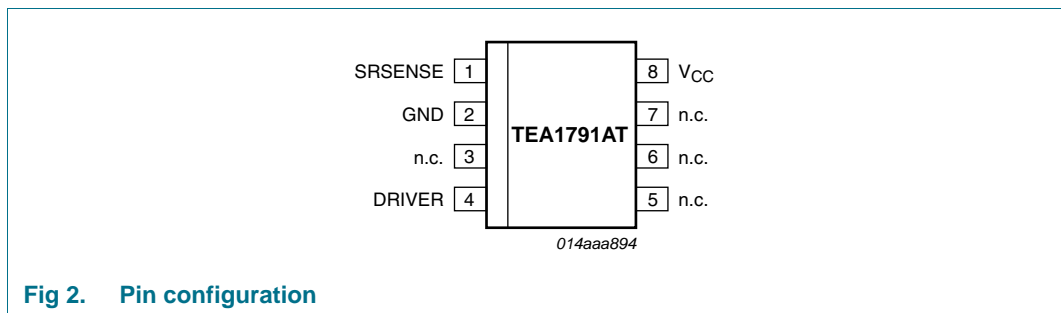


5. Block diagram



6. Pinning information

6.1 Pinning



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 μ s (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](#)).

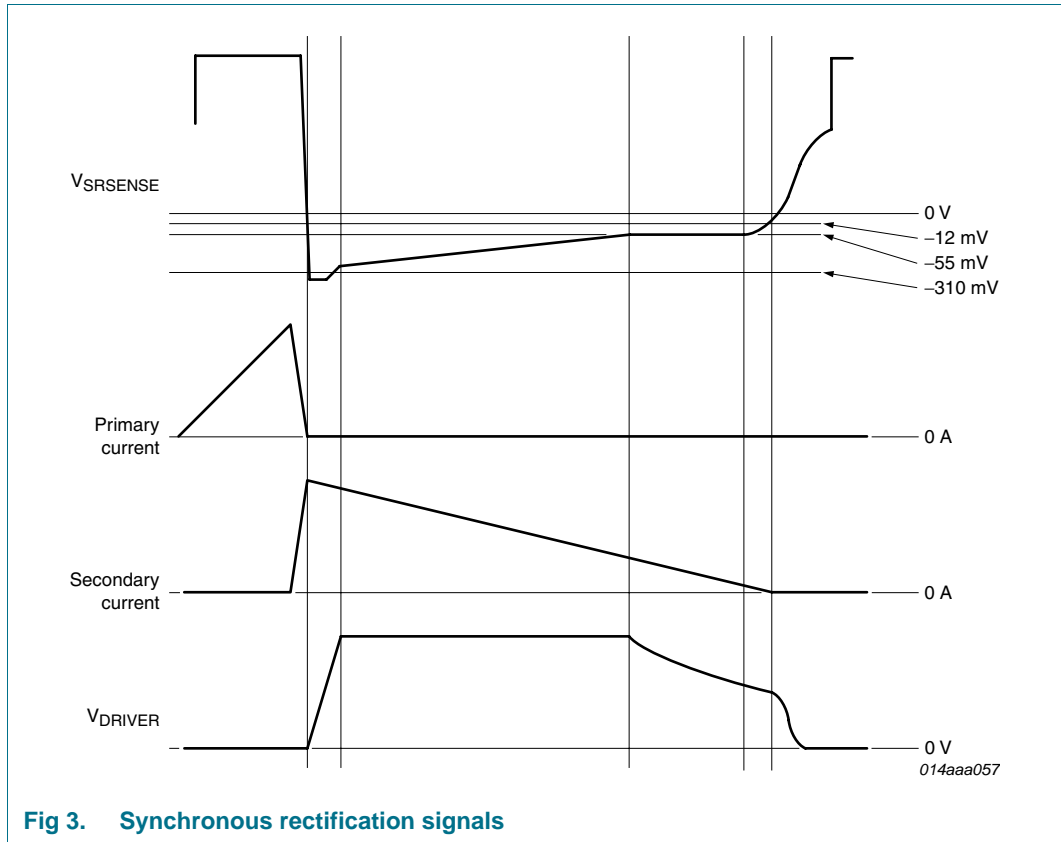


Fig 3. Synchronous rectification signals

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 ($V_{CC} < V_{start-up}$) 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 | $T_{amb} < 80\text{ °C}$ | - | 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 k Ω series resistor.

[2] Equivalent to discharging a 200 pF capacitor through a 0.75 μ H 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

$T_{amb} = 25\text{ }^{\circ}\text{C}$; $V_{CC} = 20\text{ V}$; 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 | $V_{CC} = 8\text{ V}$ ($V_{CC} < V_{startup}$) | - | 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 | $V_{CC} = 15\text{ V}$; voltage on pin DRIVER = 2 V | -0.3 | -0.25 | -0.2 | A |
| I_{sink} | sink current | $V_{CC} = 15\text{ V}$ | | | | |
| | | 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 | $V_{CC} = 15\text{ V}$ | - | 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 k Ω . Higher values might impair correct timing and lower values may not provide sufficient protection.

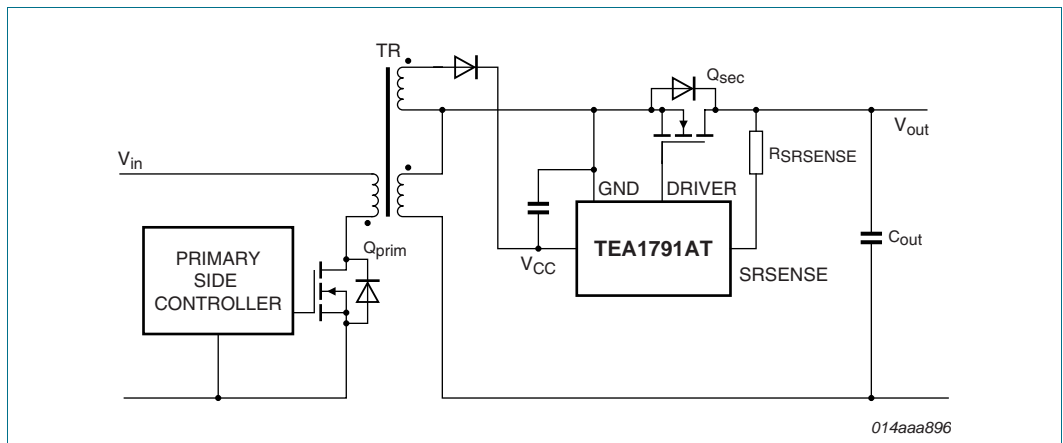


Fig 4. Application diagram high side rectification

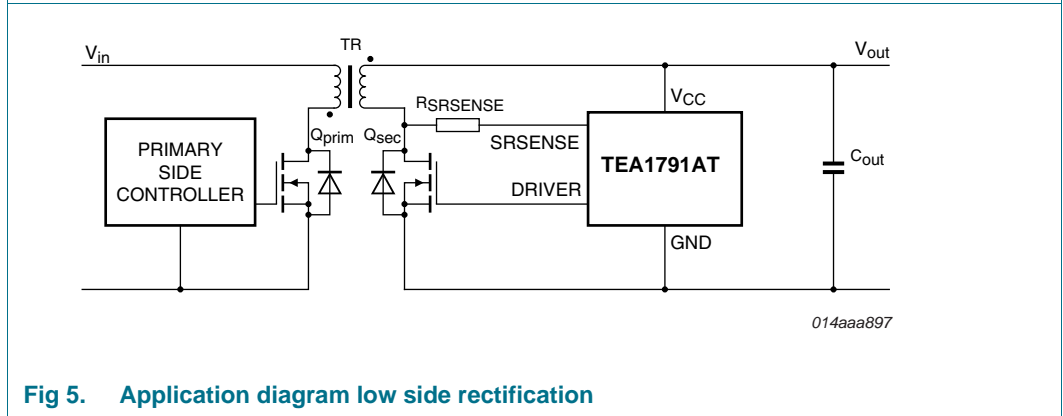
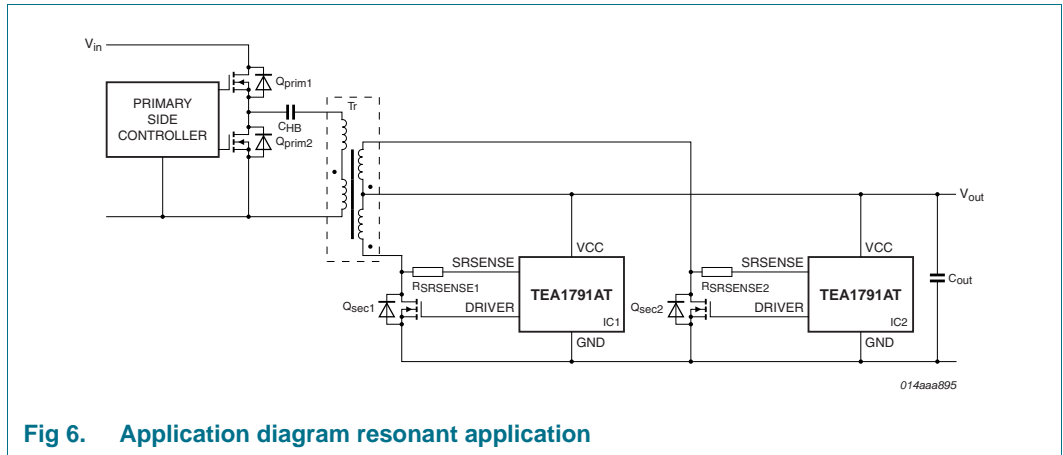


Fig 5. Application diagram low side rectification



12. Package outline

SO8: plastic small outline package; 8 leads; body width 3.9 mm

SOT96-1

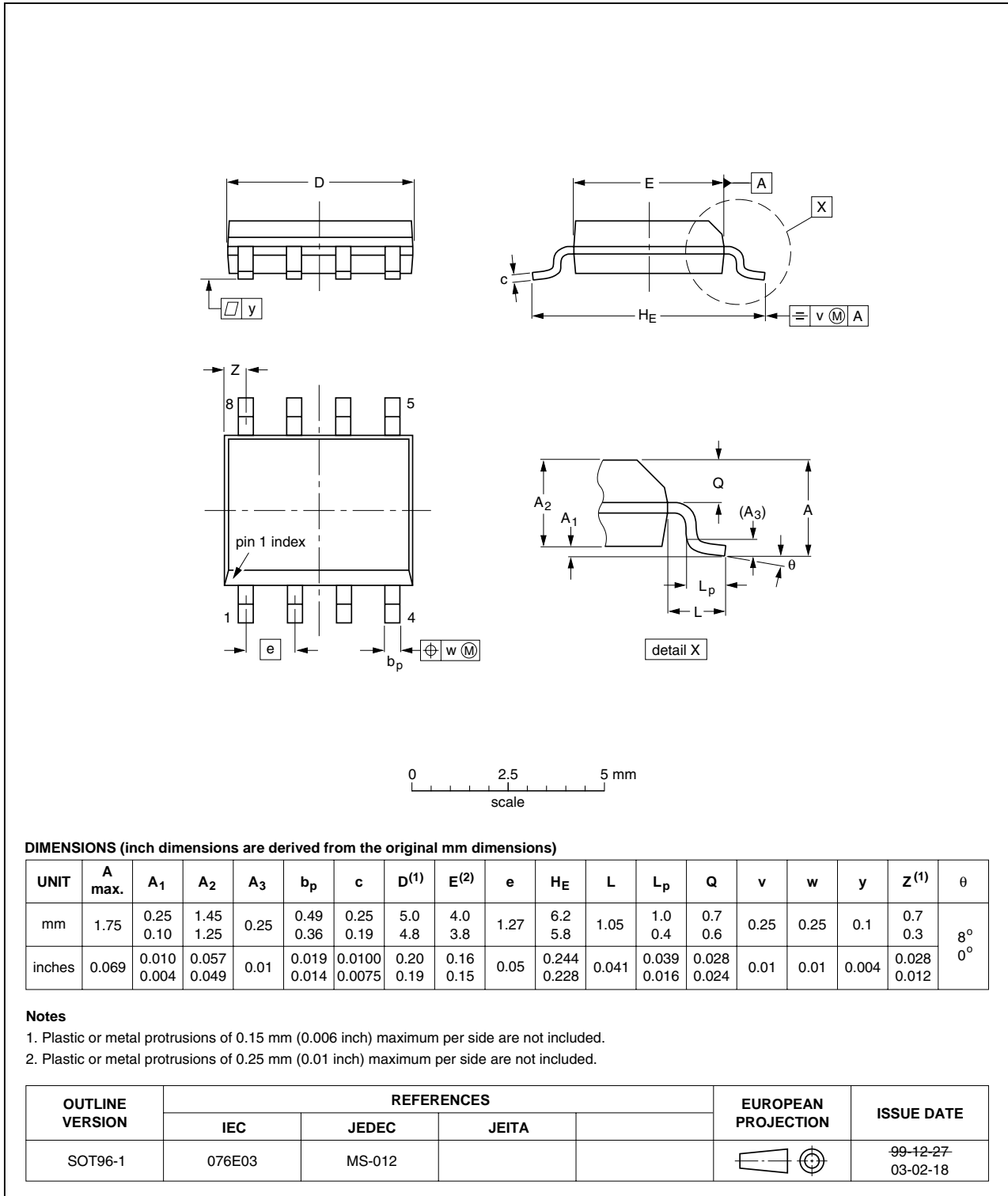


Fig 7. Package outline SOT96-1 (SO8)

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

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