

## **3A Sink/Source Bus Termination Regulator**

### ❖ GENERAL DESCRIPTION

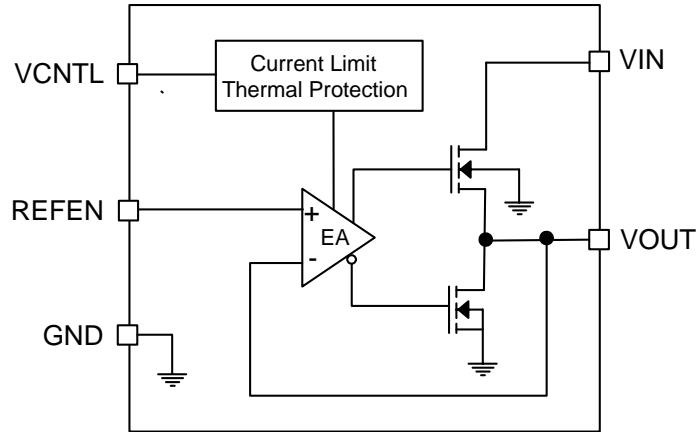
AX1250GH is a linear regulator designed as a cost-effective solution for active termination of DDR SDRAM. The converting voltage range is from 1.6V to 6V into a desired output voltage, which is adjusted by two external resistors. The current sourcing and sinking capability of the regulator is up to 3A while the output voltage within 3%.

This device provides on-chip thermal shutdown and current limit functions for circuit tolerance of the output fault conditions. TO252-5L package is available for all commercial and industrial surface mount applications.

### ❖ FEATURES

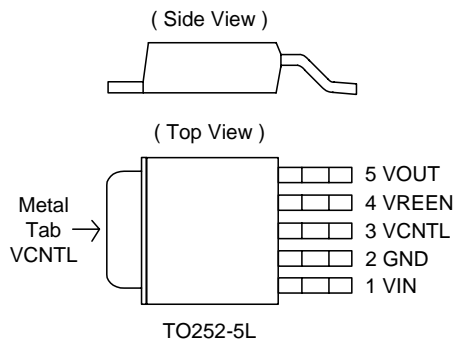
- Ideal for DDR-I and DDR-II applications
- Capable of sourcing and sinking current 3A
- Integrated power MOSFETs
- Current-shoot-through protection
- Current limiting protection
- Thermal shutdown protection
- High accuracy output voltage at full load
- Output adjustment by external resistors
- Minimum external components
- Shutdown for standby or suspend mode operation with high-impedance output
- TO252-5L Pb-Free Package.

## ❖ Block Diagram



## ❖ PIN ASSIGNMENT

The package of AX1250GH is TO252-5L; the pin assignment is given by:



| Name  | Description                             |
|-------|---|
| VIN   | IC power supply pin                     |
| GND   | Ground pin                              |
| REFEN | Reference voltage input and chip enable |
| VOUT  | Output Voltage pin                      |
| VCNTL | Gate drive voltage                      |

## ❖ ORDER INFORMATION

| Order Information  | Top Marking   |
|--|---|
| <p><b>AX1250GH X X</b></p> <p>Package Type<br/>D5: TO252-5L</p> <p>Packing<br/>Blank: Tube<br/>A: Taping</p> | <p>1250GHP → Part number</p> <p>YWWSS → Package Code</p> <p>YWWSS → Date Code</p> <p>Y: Last Digit of the year</p> <p>WW: Week</p> <p>SSS: Sequence</p> |

## ❖ Absolute Maximum Ratings (Ta=25°C)

| Characteristics                             | Symbol            | Rating             | Unit |
|---|-------------------|--------------------|------|
| VIN Supply Voltage                          | V <sub>IN</sub>   | 6                  | V    |
| Control Voltage                             | V <sub>CNTL</sub> | 6                  | V    |
| Power Dissipation                           | PD                | Internally Limited | W    |
| Storage Temperature Range                   | T <sub>ST</sub>   | -55 to +150        | °C   |
| Operating Ambient Temperature               | T <sub>A</sub>    | -40 to +85         | °C   |
| Operating Junction Temperature              | T <sub>J</sub>    | -40 to +125        | °C   |
| Thermal Resistance from Junction to case    | θ <sub>JC</sub>   | 10                 | °C/W |
| Thermal Resistance from Junction to ambient | θ <sub>JA</sub>   | 45                 | °C/W |

Note: θ<sub>JA</sub> is measured with the PCB copper area (need connect to all VCNTL pins) of approximately 1.5 in<sup>2</sup> (Multi-layer).

## ❖ Electrical Characteristics

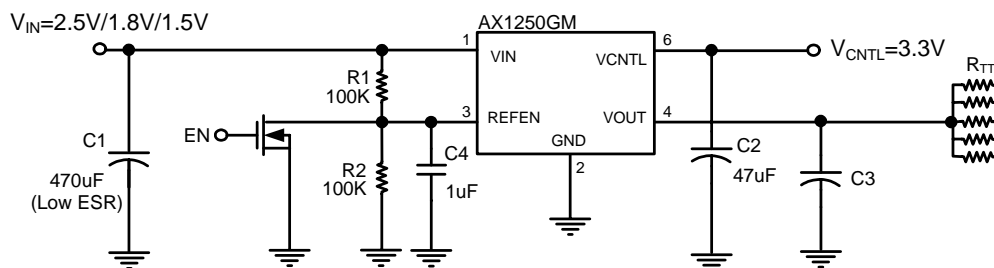
\*V<sub>IN</sub>=2.5V, V<sub>CNTL</sub>=3.3V, V<sub>REFEN</sub>=1.25V, C<sub>OUT</sub>=10μF (Ceramic), T<sub>A</sub>=25°C, unless otherwise specified

| Characteristics                | Symbol             | Conditions   | Min | Typ     | Max | Units |
|--------------------------------|--------------------|--|-----|---------|-----|-------|
| Input Voltage Range (DDR I/II) | V <sub>IN</sub>    | V <sub>CNTL</sub> ≥ V <sub>IN</sub> (Note1)                      | 1.6 | 1.5/1.8 | -   | V     |
| Gate Drive Voltage Range       | V <sub>CNTL</sub>  | V <sub>CNTL</sub> ≥ V <sub>IN</sub> (Note1)                      | -   | 3.3     | 6   | V     |
| Quiescent Current              | I <sub>CNTL</sub>  | I <sub>OUT</sub> =0A   | -   | 1       | 3   | mA    |
| Standby Current                | I <sub>STBY</sub>  | V <sub>REFEN</sub> < 0.2V (Shutdown)<br>R <sub>LOAD</sub> = 180Ω | -   | 10      | 90  | uA    |
| Output Offset Voltage          | V <sub>OS</sub>    | I <sub>OUT</sub> =0A (Note2)                                     | -20 | -5      | +20 | mV    |
| Load Regulation                | ΔV <sub>Load</sub> | I <sub>OUT</sub> =+1.5A  | -   | +0.5    | +2  | %     |
|                                |                    | I <sub>OUT</sub> =-1.5A  | -   | -0.5    | -2  |       |
| Shutdown Threshold             | V <sub>IH</sub>    | Enable   | 0.8 | -       | -   | V     |
|                                | V <sub>IL</sub>    | Shutdown   | -   | -       | 0.2 | V     |
| Current Limit                  | CL                 |  | -   | 3       | -   | A     |
| Thermal Shutdown               | TSD                | 3.3V ≤ V <sub>CNTL</sub> ≤ 5V                                    | -   | 140     | -   | °C    |

Note 1: Keep V<sub>CNTL</sub> ≥ V<sub>IN</sub> at power on/off sequences.

Note 2: V<sub>OS</sub> offset is the voltage measurement defined as V<sub>OUT</sub> subtracted from V<sub>REFEN</sub>.

## ❖ Application Circuit



$$R_{TT}=50\Omega/33\Omega/25\Omega$$

C3=10uF(Ceramic) + 1000uF under the worst case testing condition

## ❖ Application Information

### Input Capacitor and Layout Consideration

Place the input bypass capacitor as close as possible to the AX1250GH. A low ESR capacitor larger than 470uF is recommended for the input capacitor. Use short and wide traces to minimize parasitic resistance and inductance. Inappropriate layout may result in large parasitic inductance and cause undesired oscillation between AX1250GH and the preceding power converter.

### Thermal Considerations

The AX1250GH series can deliver a current of up to 3A over the full operating junction temperature range. However, the maximum output current must be dated at higher ambient temperature to ensure the junction temperature does not exceed 125°C. With all possible conditions, the junction temperature must be within the range specified under operating conditions. Power dissipation can be calculated based on the output current and the voltage drop across regulator.

$$PD = (V_{IN} - V_{OUT}) \times I_{OUT} + V_{IN} \times I_Q$$

The final operating junction temperature for any set of conditions can be estimated by the following thermal equation:

$$PD (MAX) = (T_{J (MAX)} - T_A) / \theta_{JA}$$

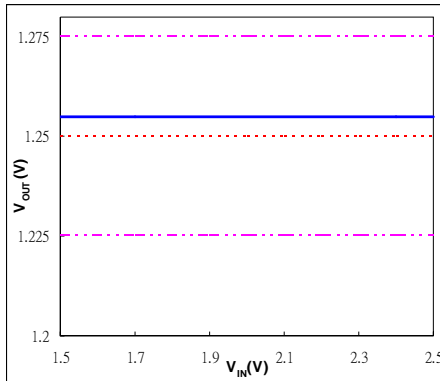
Where  $T_{J (MAX)}$  is the maximum junction temperature of the die (125° C) and  $T_A$  is the maximum ambient temperature. The junction to ambient thermal resistance ( $\theta_{JA}$ ) for TO252-5L package at recommended minimum footprint is 45°C/W on 1.5 in<sup>2</sup> and Multi-layer PCB layout. The maximum power dissipation at  $T_A = 25^\circ\text{C}$  can be calculated by following formula:

$$PD (MAX) = (125^\circ\text{C} - 25^\circ\text{C}) / 45^\circ\text{C/W} = 2.22\text{W}$$

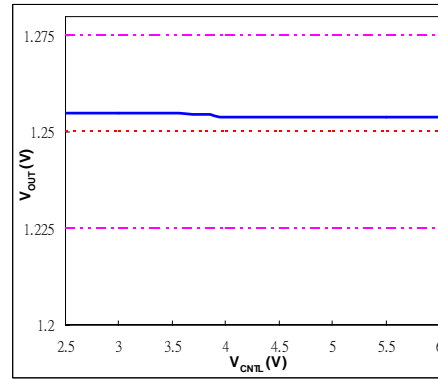
The thermal resistance  $\theta_{JA}$  of TO252-5L is determined by the package design and the PCB design. However, the package design has been decided. If possible, it's useful to increase thermal performance by the PCB design. The thermal resistance can be decreased by adding wide copper to tap (VCNTL) pin. We have to consider the copper couldn't stretch infinitely and avoid the tin overflow.

## ❖ Typical Characteristics

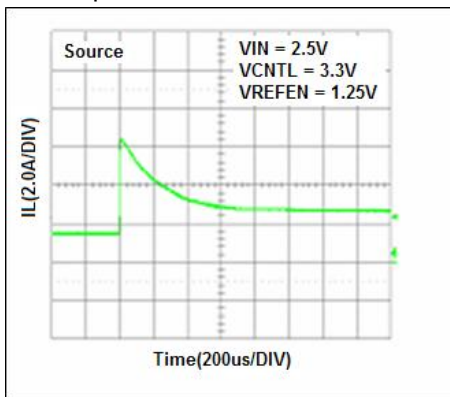
Line Regulation(  $V_{IN}$  vs.  $V_{OUT}$  )



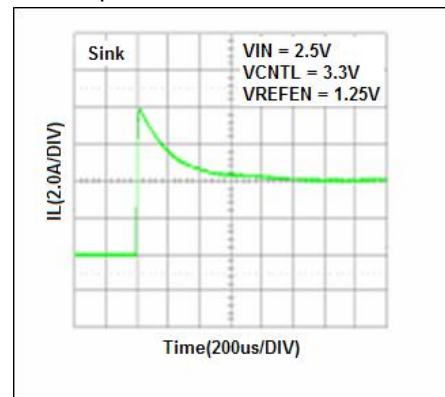
Line Regulation(  $V_{CNTL}$  vs.  $V_{OUT}$  )



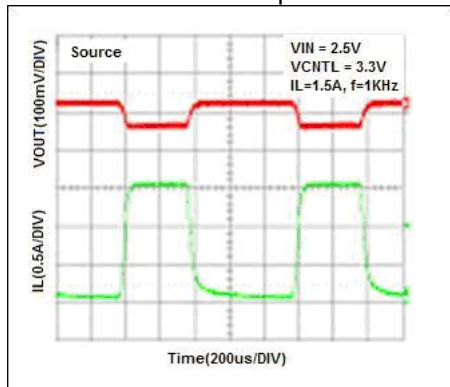
Output Short-Circuit Protection



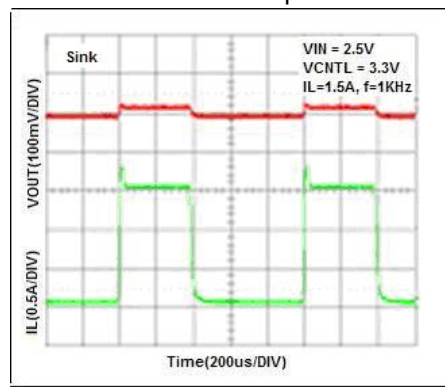
Output Short-Circuit Protection



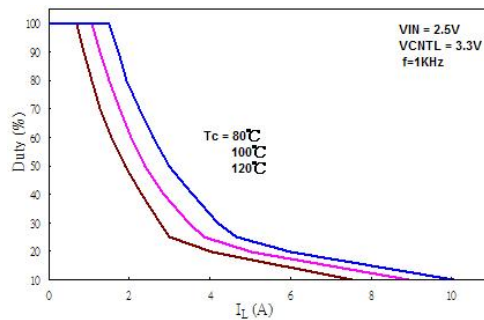
Transient Response



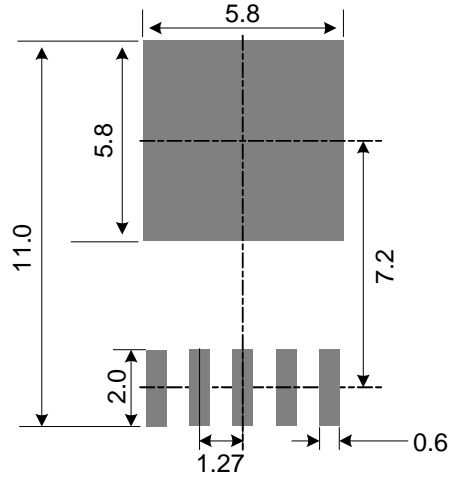
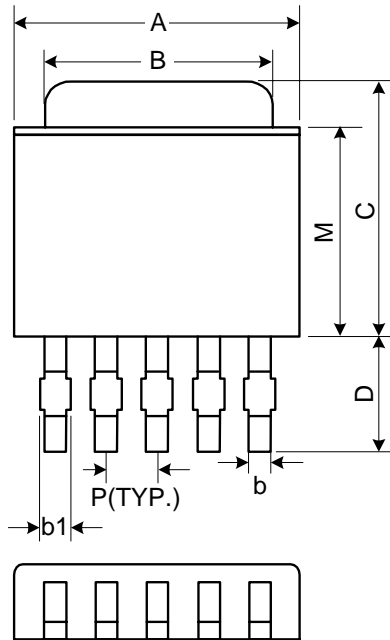
Transient Response



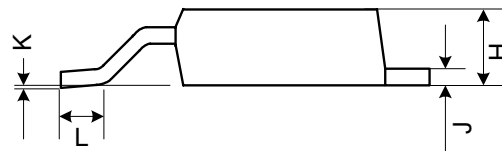
Safe Operating Area



❖ Package Outlines



Land Pattern Recommendation (Unit: mm)



| Symbol | Dimensions In Millimeters |      |      | Dimensions In Inches |       |       |
|--------|---------------------------|------|------|----------------------|-------|-------|
|        | Min.                      | Nom. | Max. | Min.                 | Nom.  | Max.  |
| A      | 6.35                      | 6.60 | 6.85 | 0.250                | 0.260 | 0.270 |
| B      | 5.20                      | 5.35 | 5.50 | 0.205                | 0.211 | 0.217 |
| C      | 6.80                      | 7.00 | 7.30 | 0.268                | 0.276 | 0.287 |
| D      | 2.20                      | 2.50 | 2.80 | 0.087                | 0.098 | 0.110 |
| P      | 1.27 REF.                 |      |      | 0.050 REF.           |       |       |
| H      | 2.20                      | 2.30 | 2.40 | 0.087                | 0.091 | 0.094 |
| J      | 0.45                      | 0.52 | 0.58 | 0.018                | 0.020 | 0.023 |
| K      | 0.00                      | 0.08 | 0.15 | 0.000                | 0.003 | 0.006 |
| L      | 0.90                      | 1.20 | 1.63 | 0.035                | 0.047 | 0.064 |
| M      | 5.40                      | 5.80 | 6.20 | 0.213                | 0.228 | 0.244 |
| b      | 0.50                      | 0.65 | 0.80 | 0.020                | 0.026 | 0.031 |
| b1     | 0.40                      | 0.50 | 0.63 | 0.016                | 0.020 | 0.025 |