



# AP1128

## 3A Bus Terminator Regulator

### ■ Features

- Ideal for DDR-I and DDR-II applications
- Capable of sourcing and sinking current 1.5A/3A
- Current limiting protection
- Thermal protection
- Current-shoot-through protection
- High accuracy output voltage at full load
- Minimum external components
- Adjustable VOUT by external resistors
- Shutdown for standby or suspend mode operation with high-impedance output
- TO252-5 and SOP-8 **Pb-free** Package

### ■ Applications

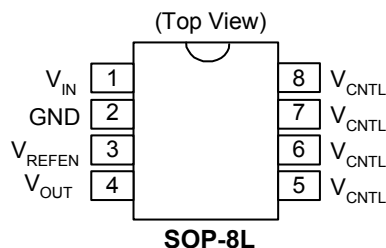
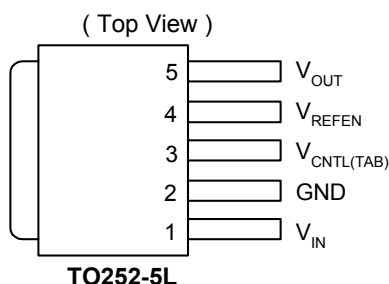
- Mother Board DDR-SDRAM Termination
- Mother Board DDR-II Termination
- Game / Play Station
- Set Top Box
- PCI / AGP Graphics
- IPC
- SCSI-III Bus Termination

### ■ General Description

AP1128 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 1.5A/3A while the output voltage within 2%/3%.

This device provides on-chip thermal shutdown and current limit functions for circuit tolerance of the output fault conditions. SO-8 and TO-252-5L packages are available for all commercial and industrial surface mount applications.

### ■ Pin Assignment

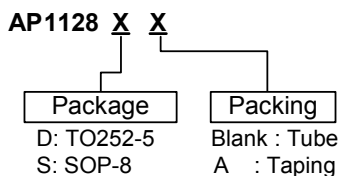


### ■ Pin Descriptions

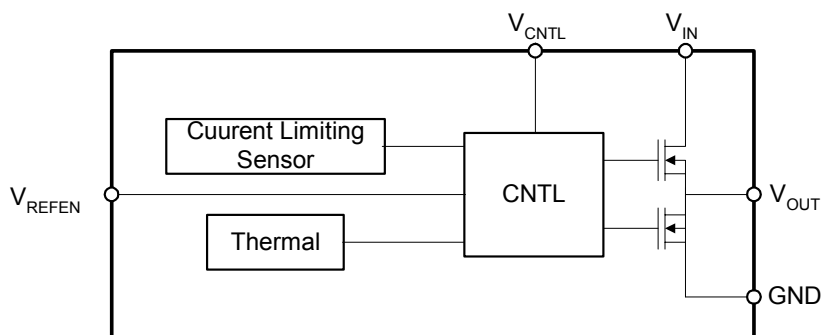
| Pin Name           | Descriptions                            |
|--------------------|-----------------------------------------|
| V <sub>IN</sub>    | Power Input                             |
| V <sub>CNTL</sub>  | Gate Drive Voltage                      |
| V <sub>REFEN</sub> | Reference Voltage Input and Chip Enable |
| GND                | Ground                                  |
| V <sub>OUT</sub>   | Output Voltage                          |

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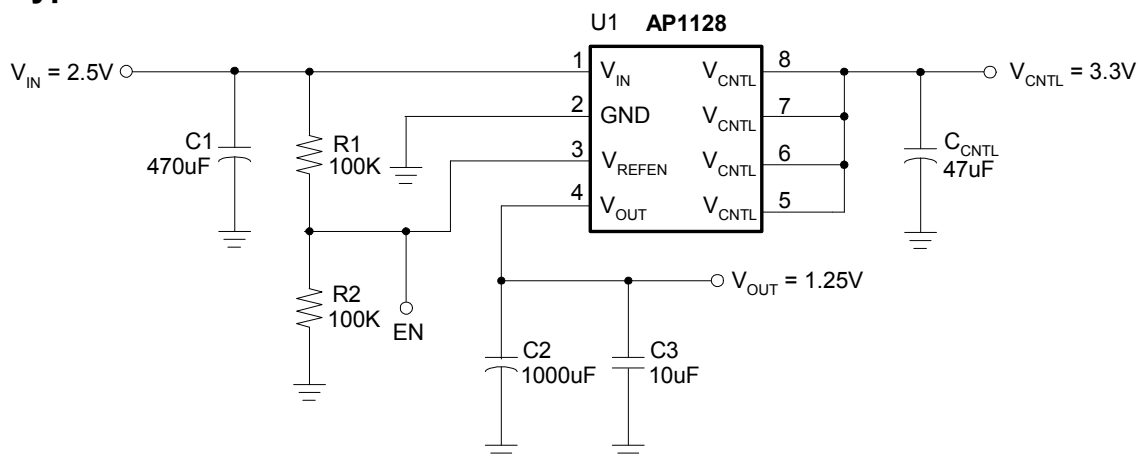
### ■ Ordering Information



### ■ Block Diagram



### ■ Typical Circuit



### ■ Absolute Maximum Ratings

| Symbol        | Parameter                          |                | Rating           | Unit |
|---------------|------------------------------------|----------------|------------------|------|
| $V_{IN}$      | Power Input Voltage                |                | 6                | V    |
| $P_D$         | Power Dissipation                  |                | internal limited |      |
|               | HBM ESD Rating                     |                | 3                | KV   |
| $T_{STG}$     | Storage Temperature                |                | -55 to 150       | °C   |
| $T_{Lead}$    | Lead Temperature (Soldering 5 sec) |                | 260              | °C   |
| $\theta_{JC}$ | Thermal Resistance                 | SOP-8 (Note 3) | 20               | °C/W |
|               |                                    | TO252-5        | 6                |      |
| $\theta_{JA}$ | Thermal Resistance                 | SOP-8          | 80               | °C/W |
|               |                                    | TO252-5        | 40               |      |



## 3A Bus Terminator Regulator

### ■ Electrical Characteristics

$V_{IN} = +2.5V$ ,  $V_{CNTL} = +3.3V$ ,  $V_{REFEN} = +1.25V$ ,  $C_{OUT} = 10\mu F$  (Ceramic)

| Symbol                      | Parameter                              | Conditions                                         | Min. | Typ.    | Max. | Unit |
|-----------------------------|----------------------------------------|----------------------------------------------------|------|---------|------|------|
| V <sub>OS</sub>             | Output Offset Voltage (Note 1)         | I <sub>OUT</sub> =0A                               | -20  | -5      | 20   | mV   |
| ΔV <sub>LOAD</sub>          | Load Regulation                        | I <sub>L</sub> : 0A --> 1.5A                       | -    | 0.5     | 2    | %    |
|                             |                                        | I <sub>L</sub> : 0A --> -1.5A                      | -    | 0.5     | 2    |      |
| V <sub>IN</sub>             | Input Voltage Range (DDR I/II) (Note2) | V <sub>CNTL</sub> ≥ V <sub>IN</sub>                | 1.6  | 2.5/1.8 | -    | V    |
| V <sub>CNTL</sub>           | Gate Drive Voltage Range (Note2)       | V <sub>CNTL</sub> ≥ V <sub>IN</sub>                | -    | 3.3     | 6    | V    |
| I <sub>CNTL</sub>           | Operation Current of V <sub>CNTL</sub> | I <sub>OUT</sub> = 0A                              | -    | 3       | 6    | mA   |
| I <sub>SHDN</sub>           | Current in Shutdown                    | V <sub>REFEN</sub> < 0.2V,<br>R <sub>L</sub> =180Ω | -    | 10      | 90   | uA   |
| I <sub>Q</sub>              | Quiescent Current                      | I <sub>OUT</sub> =0A                               | -    | 1       | 3    | mA   |
| Short Circuit Protection    |                                        |                                                    |      |         |      |      |
| I <sub>LIMIT</sub>          | Current Limit                          | SOP-8                                              | -    | 2       | -    | A    |
|                             |                                        | TO-252                                             | -    | 3       | -    |      |
| Over Temperature Protection |                                        |                                                    |      |         |      |      |
| T <sub>OS</sub>             | Thermal Shutdown Temperature           | 3.3V ≤ V <sub>CNTL</sub> ≤ 5V                      | -    | 140     | -    | °C   |
| Shutdown Function           |                                        |                                                    |      |         |      |      |
|                             | Shutdown Threshold Trigger             | Output = High                                      | 0.8  | -       | -    | V    |
|                             | Shutdown Threshold Trigger             | Output = Low                                       | -    | -       | 0.2  |      |

**Note 1:**  $V_{OS}$  is the voltage measurement  $V_{OUT}$  subtracted from  $V_{REFEN}$ .

**Note 2:** Keep  $V_{CNTL} \geq V_{IN}$  at power on/off sequences.

**Note 3:** Surface mounted on 1 in<sup>2</sup> copper pad of FR4 board

### ■ Typical Performance Characteristics

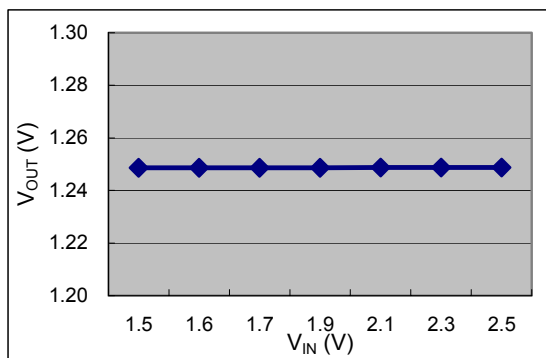


Fig 1. Line Regulation ( $V_{IN}$  v.s.  $V_{OUT}$ )

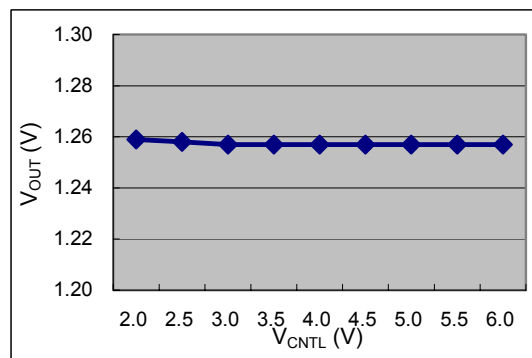


Fig 2. Line Regulation ( $V_{CNTL}$  v.s.  $V_{OUT}$ )

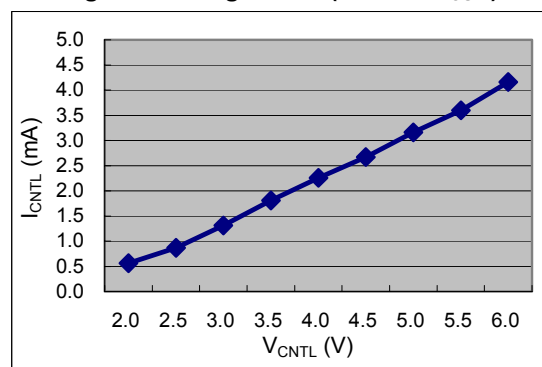


Fig 3. Line Regulation ( $V_{CNTL}$  v.s.  $I_{CNTL}$ )

### ■ Typical Performance Characteristics (Continued)

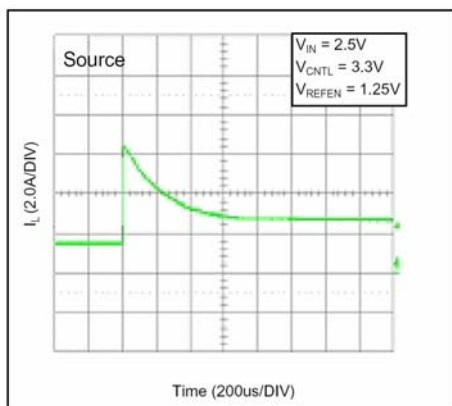


Fig 4. Output Short-Circuit Protection

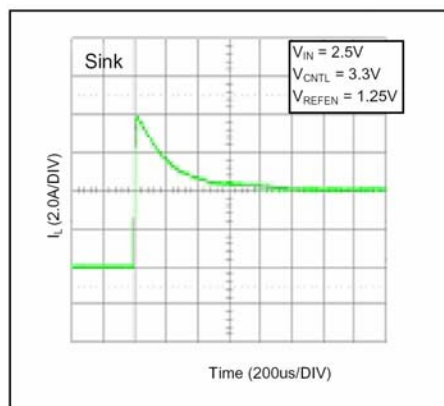


Fig 5. Output Short-Circuit Protection

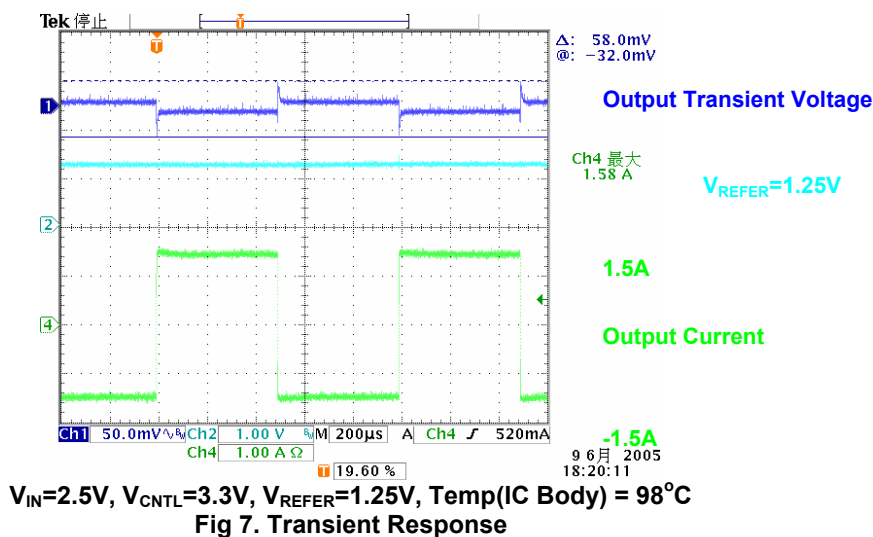


Fig 7. Transient Response

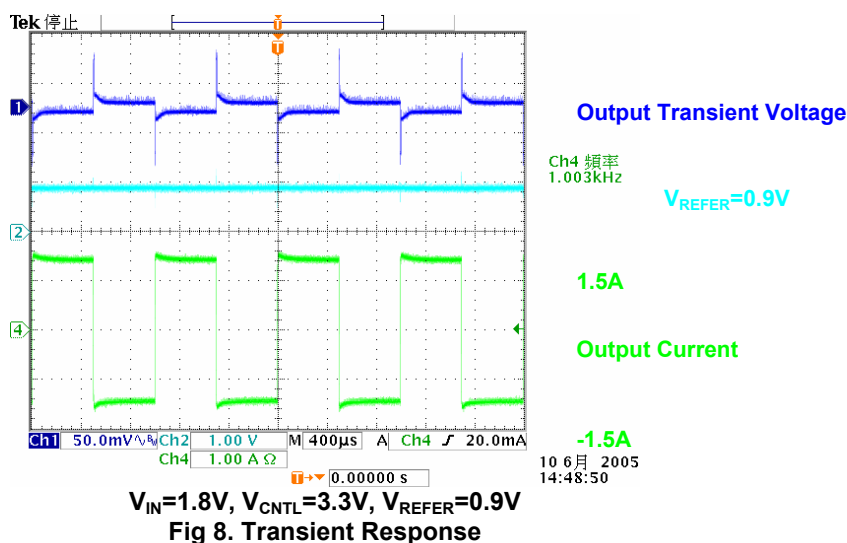


Fig 8. Transient Response

### ■ Typical Performance Characteristics (Continued)

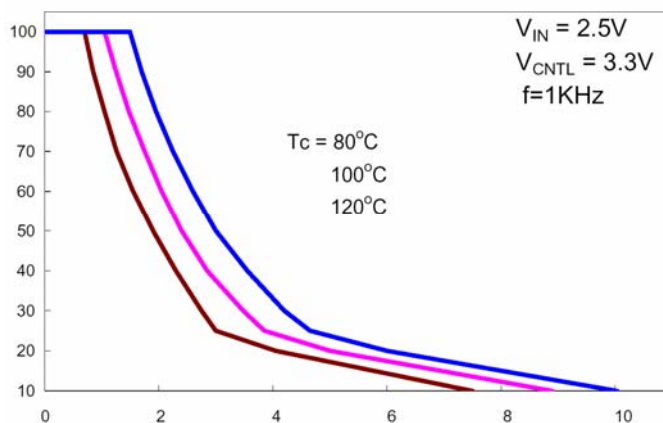
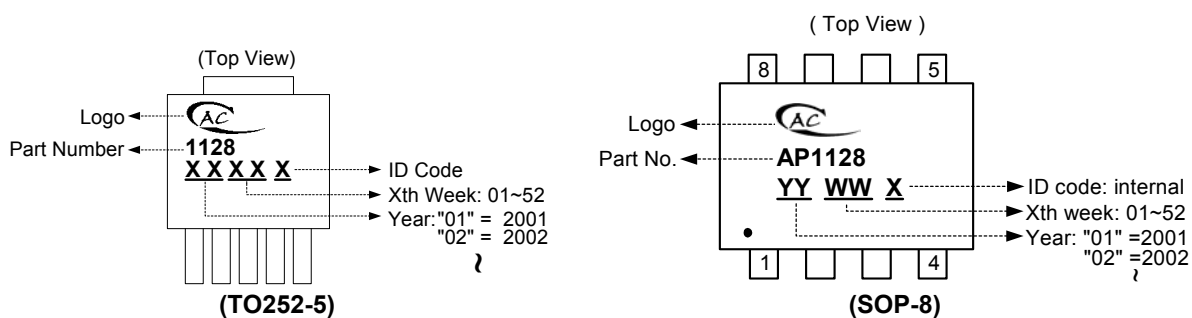


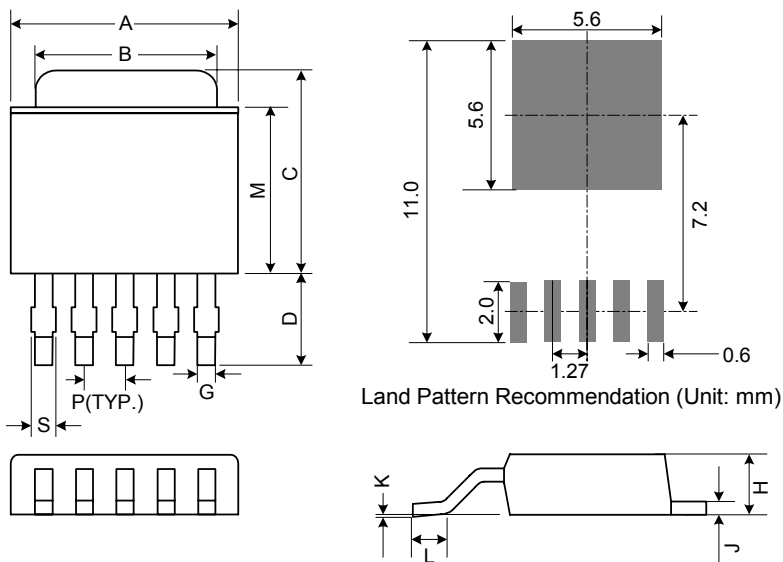
Fig 9. Safe Operating Area

### ■ Marking Information



### ■ Package Information

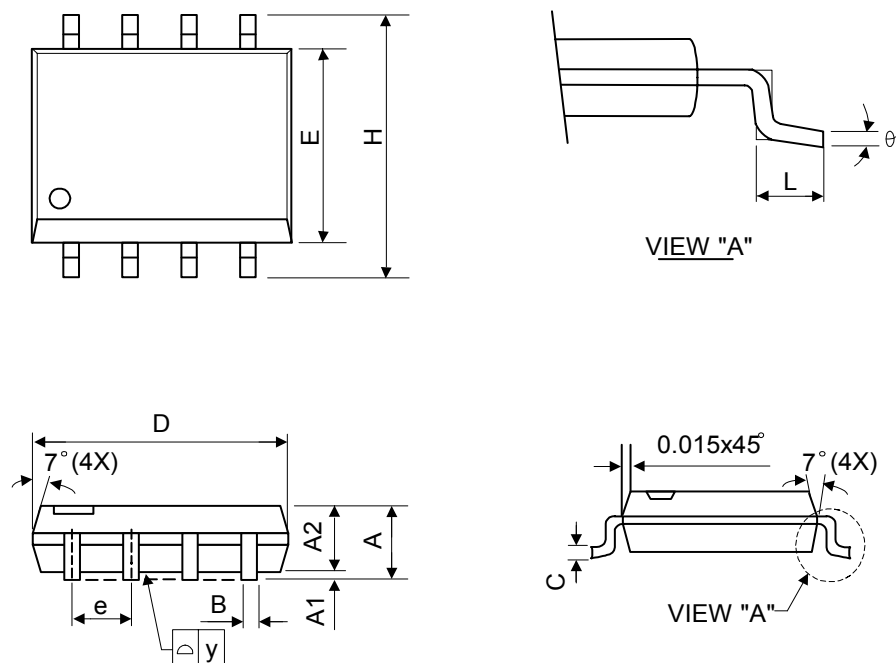
(1) Package Type: TO252-5



| 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.           |       |       |
| S      | 0.50                      | 0.65 | 0.80 | 0.020                | 0.026 | 0.031 |
| G      | 0.40                      | 0.50 | 0.63 | 0.016                | 0.020 | 0.025 |
| 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 |

### ■ Package Information (Continued)

(2) Package Type: SOP-8



| Symbol | Dimensions In Millimeters |      |      | Dimensions In Inches |       |       |
|--------|---------------------------|------|------|----------------------|-------|-------|
|        | Min.                      | Nom. | Max. | Min.                 | Nom.  | Max.  |
| A      | 1.40                      | 1.60 | 1.75 | 0.055                | 0.063 | 0.069 |
| A1     | 0.10                      | -    | 0.25 | 0.040                | -     | 0.100 |
| A2     | 1.30                      | 1.45 | 1.50 | 0.051                | 0.057 | 0.059 |
| B      | 0.33                      | 0.41 | 0.51 | 0.013                | 0.016 | 0.020 |
| C      | 0.19                      | 0.20 | 0.25 | 0.0075               | 0.008 | 0.010 |
| D      | 4.80                      | 5.05 | 5.30 | 0.189                | 0.199 | 0.209 |
| E      | 3.70                      | 3.90 | 4.10 | 0.146                | 0.154 | 0.161 |
| e      | -                         | 1.27 | -    | -                    | 0.050 | -     |
| H      | 5.79                      | 5.99 | 6.20 | 0.228                | 0.236 | 0.244 |
| L      | 0.38                      | 0.71 | 1.27 | 0.015                | 0.028 | 0.050 |
| y      | -                         | -    | 0.10 | -                    | -     | 0.004 |
| θ      | 0°                        | -    | 8°   | 0°                   | -     | 8°    |