

FAN1655

3A DDR Bus Termination Regulator

Features

- Sinks and sources 2.1A continuous, 3A peak
- 0 to +125°C operating temperature range
- 5mA Buffered VREFOUT = VDDQ/2
- Load regulation: $V_{TT} = V_{REFOUT} \pm 40\text{mV}$
- On-chip thermal limiting
- Low Cost SO-14, Power Enhanced eTSSOP or 8-pin 5x6mm MLP packages
- Low-Current Shutdown Mode
- Output Short Circuit Protection

Applications

- DDR Terminator VTT supply

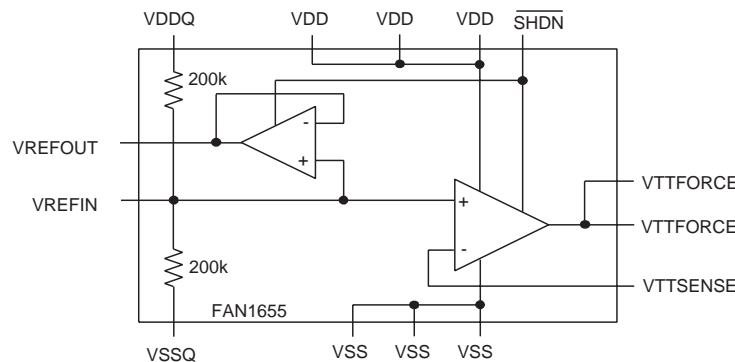
Description

The FAN1655 is a low-cost bi-directional LDO specifically designed for terminating DDR memory bus. It can both sink and source up to 2.1A continuous, 3A peak, providing enough current for most DDR applications. Load regulation meets the JEDEC spec, $V_{TT} = V_{REFOUT} \pm 40\text{mV}$.

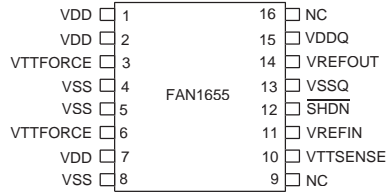
The FAN1655 includes a buffered reference voltage capable of supplying up to 5mA current. On-chip thermal limiting provides protection against a combination of power overload and ambient temperature that would create an excessive junction temperature. A shutdown input puts the FAN1655 into a low power mode.

The FAN1655 regulator is available in a power-enhanced eTSSOP™-16 package, and the standard SOIC-14

Block Diagram



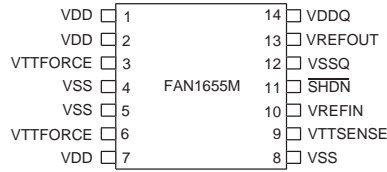
Pin Assignments



16-Lead Plastic eTSSOP-16

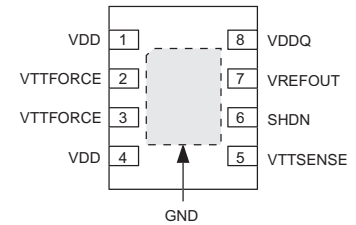
$$\theta_{JC} = 4^{\circ}\text{C/W}^*$$

*With package power slug soldered to 0.5 square inch copper area over backside ground plane of internal power plane



14-Lead Plastic SOIC

$$\theta_{JC} = 37^{\circ}\text{C/W}, \theta_{JA} = 88^{\circ}\text{C/W}$$



8-Lead MLP Package (5x6mm)

$$\theta_{JC} = 4^{\circ}\text{C/W}, \theta_{JA} = 34^{\circ}\text{C/W}$$

as measured on FAN1655MP Eval Board

Pin Definitions

| Pin | | | Pin Name | Pin Function Description |
|------|---------|---------|----------|--|
| MLP | eTSSOP | SOIC-14 | | |
| 1, 4 | 1, 2, 7 | 1, 2, 7 | VDD | Input power for the LDO. |
| 2, 3 | 3, 6 | 3, 6 | VTTFORCE | The VTT output voltage. |
| PAD | 4, 5, 8 | 4, 5, 8 | VSS | IC Ground. |
| 5 | 10 | 9 | VTTSENSE | Feedback for remote sense of the VTT voltage. |
| | 11 | 10 | VREFIN | Alternative input for direct control of VTTOUT and VREFOUT. |
| 6 | 12 | 11 | SHDN | Shutdown. This active low shutdown turns off both VTT and VREFOUT. This pin has an internal pull-down, and must be externally driven high for the IC to be on. |
| | 13 | 12 | VSSQ | Signal Ground. |
| 7 | 14 | 13 | VREFOUT | Buffered Voltage Reference Output. |
| 8 | 15 | 14 | VDDQ | VDDQ Input. Attach this pin to the VDDQ supply to generate VTT and VREFOUT. |
| | 9, 16 | | NC | No Internal Connection |

Typical Application

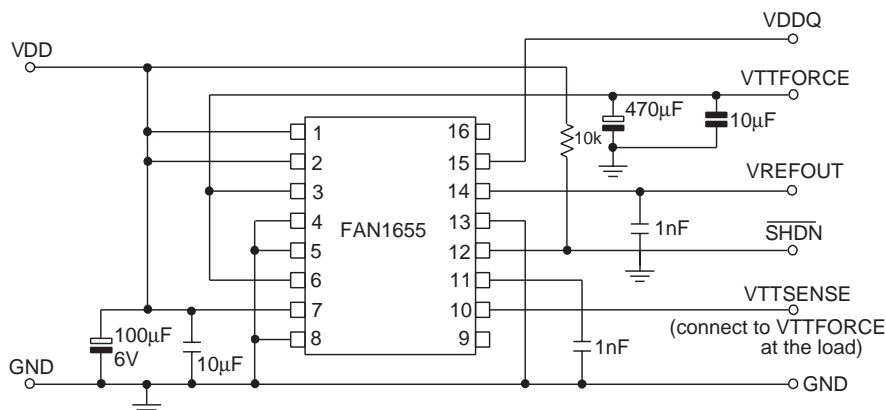


Figure 1. (eTSSOP pinout shown)

Typical Performance Characteristics

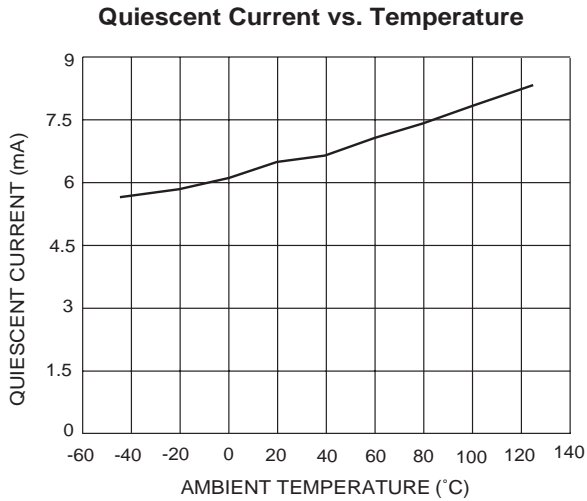


Figure 2. Quiescent Current vs. Ambient Temperature

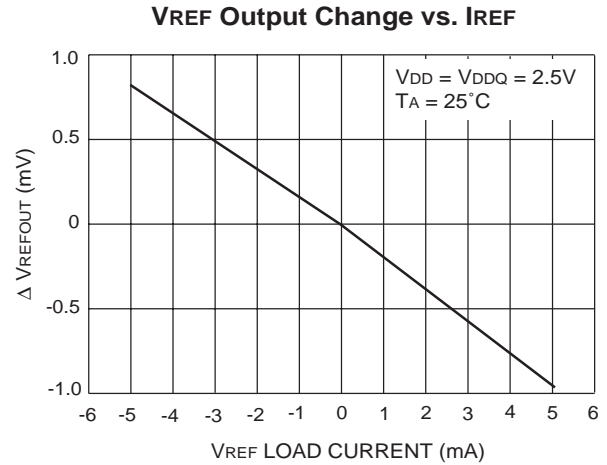


Figure 3. Reference Output Load Regulation

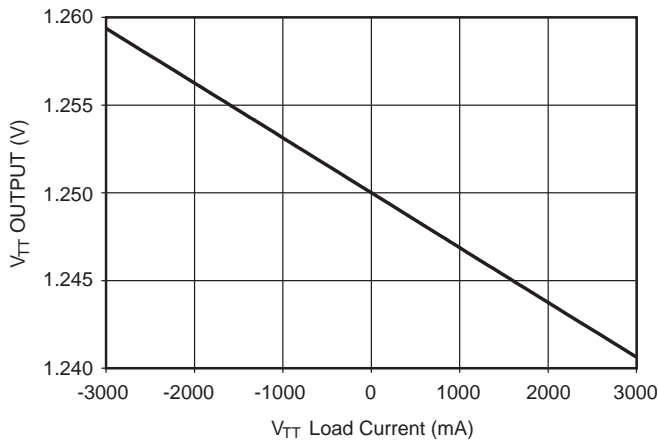


Figure 4. VTT Load Regulation

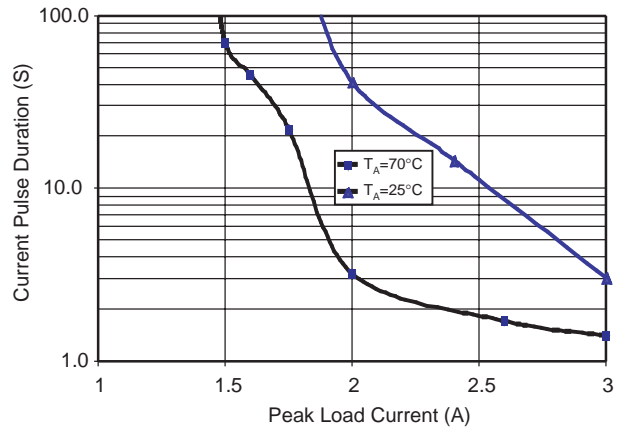


Figure 5. Maximum Non-Repetitive Output Current vs. Pulse Width (FAN1655M SO-14 Package)

Absolute Maximum Ratings

| | | |
|--|----------------------|--------------------------------------|
| Supply Voltage VDD, VDDQ | | 6V |
| Junction Temperature, T _J | | 150°C |
| Storage Temperature | | -65 to 150°C |
| Lead Soldering Temperature, 10 seconds | | 300°C |
| Power Dissipation, P _D | FAN1655M (SOIC-14) | 1.4W |
| | FAN1655MTF (e-TSSOP) | See "Power Dissipation and Derating" |
| | FAN1655MP (MLP) | |

Recommended Operating Conditions

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|-------------------------------|------------|------|------|------|-------|
| Supply Voltage VDD | | 2.3 | 2.5 | 3.6 | V |
| Supply Voltage VDDQ | | 2.2 | 2.5 | 3.0 | V |
| Ambient Operating Temperature | | 0 | | 125 | °C |
| VREFIN | | 1.1 | 1.25 | 1.5 | V |

Electrical Characteristics

(VDD = VDDQ = 2.5V ± 0.2V, and T_A = 25°C using circuit in Figure 1, unless otherwise noted.)

The • denotes specifications which apply over the specified operating temperature range.

| Parameter | Conditions | Min. | Typ. | Max. | Units | |
|-----------------------------|---|-------------------|-------|-------|-------|---|
| VTT Output Voltage | I _{OUT} = 0A, VREFIN = open | VDDQ = 2.3V • | 1.135 | 1.150 | 1.165 | V |
| | | VDDQ = 2.5V • | 1.235 | 1.250 | 1.265 | V |
| | | VDDQ = 2.7V • | 1.335 | 1.350 | 1.365 | V |
| | I _{OUT} = ±2.1A, VREFIN = open | VDDQ = 2.3V | 1.110 | 1.150 | 1.190 | V |
| | | VDDQ = 2.5V | 1.210 | 1.250 | 1.290 | V |
| | | VDDQ = 2.7V | 1.310 | 1.350 | 1.390 | V |
| VTT Output Slew Rate | Cload = 10μF | | 0.3 | | V/μS | |
| VTT Leakage Current | SHDN = 0V | • | -50 | 50 | μA | |
| VTT Current Limit | | | ±3.1 | | A | |
| VREFIN Input Impedance | | | 100 | | KΩ | |
| VREFOUT Output Voltage | No load | VREFIN = 1.150V • | 1.145 | 1.150 | 1.155 | V |
| | | VREFIN = 1.250V • | 1.245 | 1.250 | 1.255 | V |
| | | VREFIN = 1.350V • | 1.345 | 1.350 | 1.355 | V |
| VREFOUT Output Current | VDDQ = 2.3V | • | -5 | 5 | mA | |
| VREFOUT Leakage Current | SHDN = 0V | • | -10 | 10 | μA | |
| SHDN Logic High | | • | 1.667 | | V | |
| SHDN Logic Low | | • | | 0.800 | V | |
| IDD Supply Current | No load, SHDN = 2.7V | • | 7.5 | 20 | mA | |
| VDDQ Leakage Current | SHDN = 0V | • | 6 | 10 | μA | |
| VDD Leakage Current | SHDN = 0V | • | 3 | 50 | μA | |
| SHDN Input Current | SHDN = 2.7V | • | 50 | 75 | μA | |
| Over-Temperature Shutdown | | | 155 | | °C | |
| Over-Temperature Hysteresis | | | 30 | | °C | |

Applications Information

Output Capacitor selection

The JEDEC specification for DDR termination requires that VTT stay within $\pm 40\text{mV}$ of VREF, which must track VDDQ/2 within 1%. During the initial load transient, the output capacitor keeps the output within spec. To stay within the 40mV window, the “load step” due to the load transient current dropping across the output capacitor’s ESR should be kept to around 25mV: where $\text{ESR} < \frac{25}{\Delta I}$ is given in m Ω , and ΔI is the maximum load current.

For example, to handle a 3A maximum load transient, the ESR should be no greater than 8m Ω . Furthermore, the output capacitor must be able to hold the load in spec while the regulator recovers (about 15 μS). A minimum value of 470 μF is recommended.

These requirements can be achieved by a combination of capacitors. FAN1655 requires a minimum of 5m Ω of ESR in the output and is not stable with all-ceramic output capacitors.

Power Dissipation and Derating

The maximum output current (sink or source) for a 1.25V output is:

$$I_{\text{OUT(MAX)}} = \frac{P_{\text{D(MAX)}}}{1.25} \quad (1)$$

where $P_{\text{D(MAX)}}$ is the maximum power dissipation which is:

$$P_{\text{D(MAX)}} = \frac{T_{\text{J(MAX)}} - T_{\text{A}}}{\theta_{\text{JA}}} \quad (2)$$

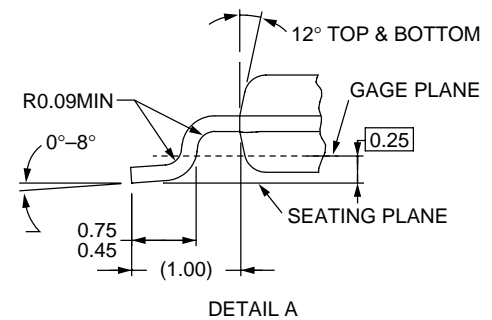
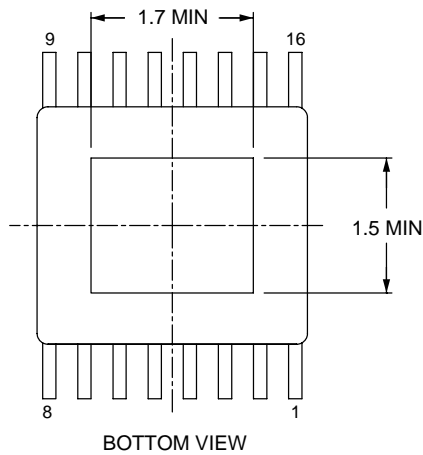
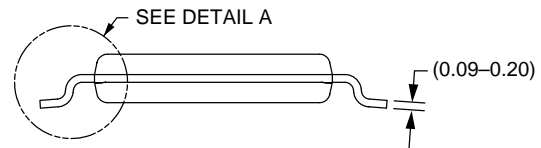
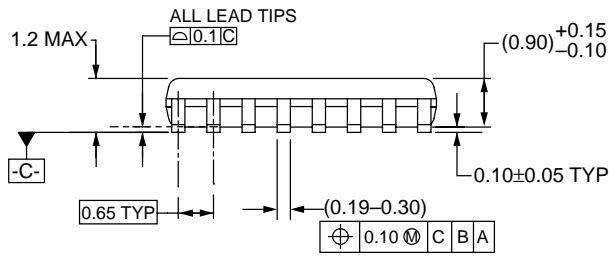
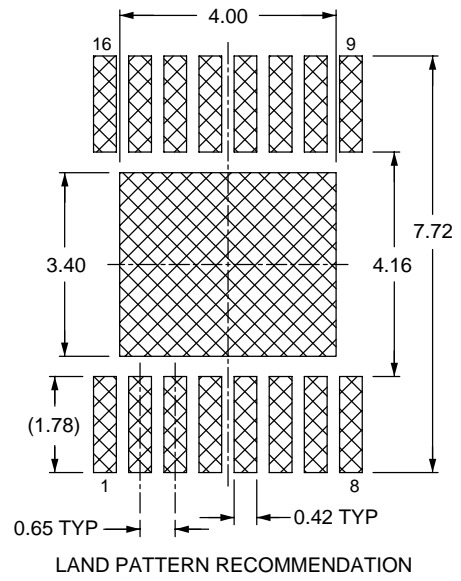
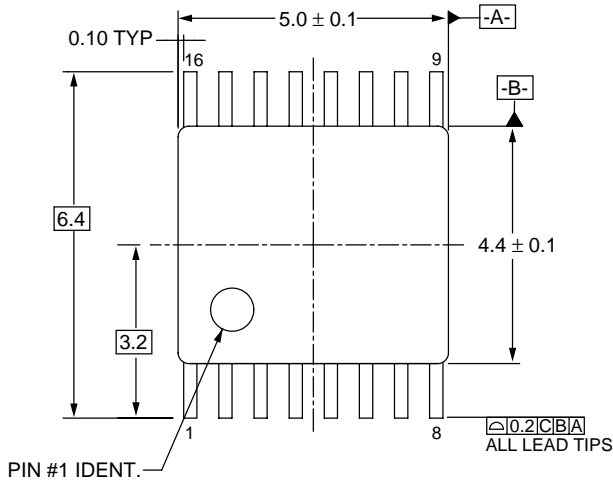
where $T_{\text{J(MAX)}}$ is the maximum die temperature of the IC and T_{A} is the operating ambient temperature.

FAN1655 has an internal thermal limit at 150°C, which defines $T_{\text{J(MAX)}}$. For the SOIC-14 package, θ_{JA} is given at 88°C/W. Using equation 2, the maximum dissipation at $T_{\text{A}} = 25^\circ\text{C}$ is 1.4W, which is its rated maximum dissipation.

The e-TSSOP or MLP package, however, use the PCB copper to cool the IC through the thermal pad on the package bottom. For maximum dissipation, this pad should be soldered to the PCB copper, with as much copper area as possible surrounding it to cool the package. Thermal vias should be placed as close to the thermal pad as possible to transfer heat to other layers of copper on the PCB. With large areas of PCB copper for heat sinking, a θ_{JA} of under 40°C/W can easily be achieved.

Mechanical Dimensions

16 Lead eTSSOP



NOTES:

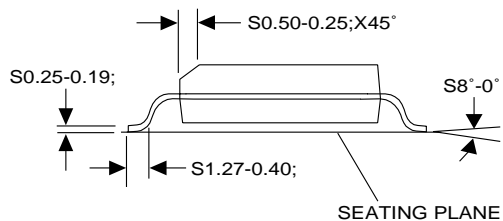
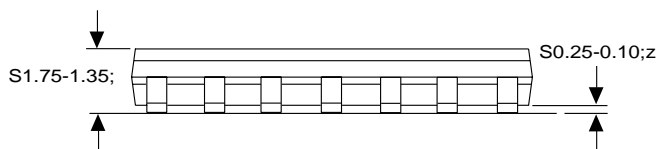
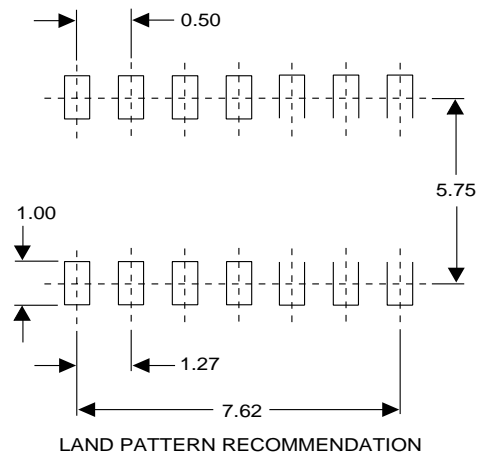
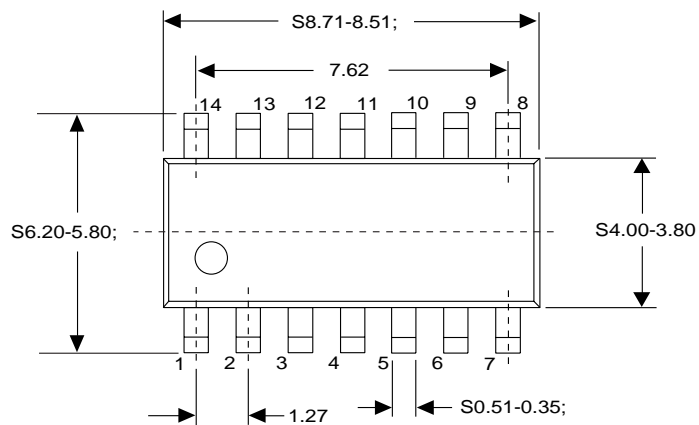
- A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION ABT, DATED 10/97.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND THE BAR EXTENSIONS.
- D. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.

Mechanical Dimensions

14-Lead SOIC

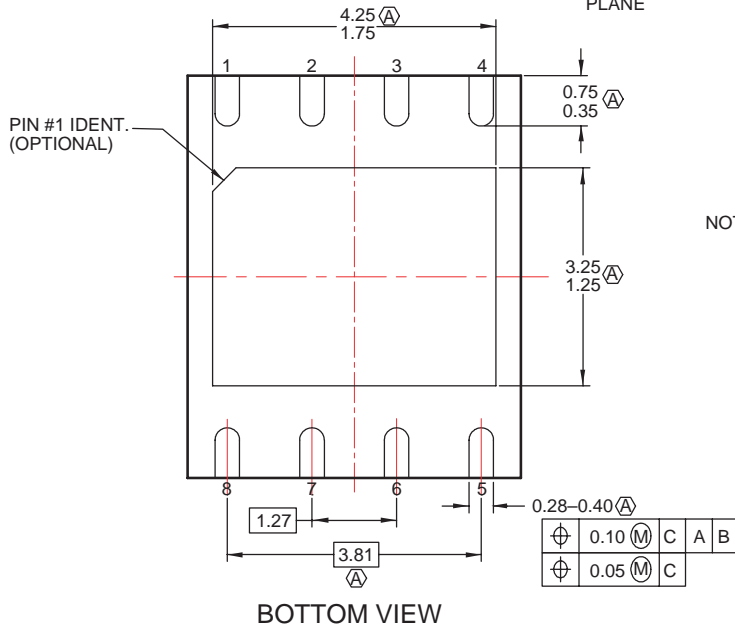
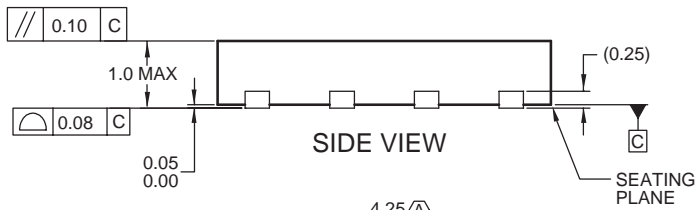
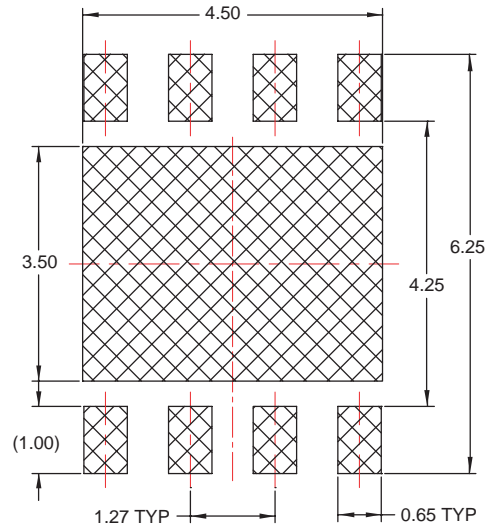
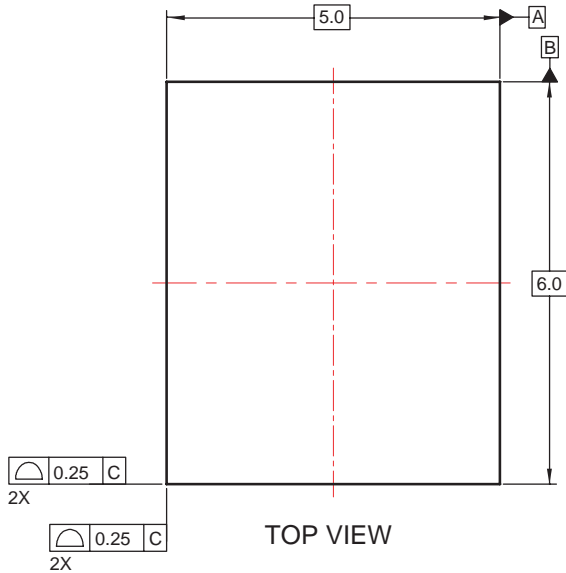
NOTES:

1. This package conforms to JEDEC MS-012, variation AB, ISSUEC dated May, 1990.
2. All dimensions are in millimeters
3. Standard lead finished
 200 microinches / 5.08 microns min.
 Lead/Tin (solder) on copper



Mechanical Dimensions

5mmX6mm 8-Lead MLP



- NOTES:
- A) DOES NOT FULLY CONFORM TO JEDEC REGISTRATION MO-229, DATED 11/2001.
 - B) DIMENSIONS ARE IN MILLIMETERS.
 - C) DIMENSIONING AND TOLERANCES PER ASME Y14.5-1994.

Ordering Information

| Part Number | Temperature Range | Package | Packing |
|-------------|-------------------|-----------|---------------|
| FAN1655M | 0°C to 125°C | SOIC-14 | Rails |
| FAN1655MX | 0°C to 125°C | SOIC-14 | Tape and Reel |
| FAN1655MTF | 0°C to 125°C | eTSSOP-16 | Rails |
| FAN1655MTFX | 0°C to 125°C | eTSSOP-16 | Tape and Reel |
| FAN1655MPX | 0°C to 125°C | MLP-08 | Tape and Reel |

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