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FAN3988 USB/Charger and Over-Voltage Detection Device

Features

- Charger/USB Detection Device
- Charger/USB Device Detection Flag
- Over-/Under-Voltage Detection Flag
- V_{BUS} Supply: 2.7 V to 20 V
- C_{ON} of 1.5 pF
- 6-Lead MicroPak™ MLP Package

Applications

- Mobile Phones
- Handheld Devices

Description

The FAN3988 is a USB-connection-monitoring device used to determine if a standard USB device or a battery-charging device is connected.

The FAN3988 sets the FLAG1 pin to logic HIGH or LOW as an indicator to the system controller that a standard USB device or a charger is connected to the USB port. The FAN3988 also monitors the V_{BUS} for over- or under-voltage conditions. The FLAG2 pin is set LOW if V_{BUS} is less than 3.3 V or greater than 6.0 V.

The FAN3988 is packaged in a very small 6-lead MicroPak™ MLP package suitable for small board space applications, such as mobile phones.

Ordering Information

| Part Number | Operating Temperature Range | Package | Packing Method | Quantity |
|---------------------------------|-----------------------------|------------------------------|----------------|----------|
| FAN3988IL6X | -40°C to +85°C | 6-Lead MicroPak™ MLP Package | Reel | 5000 |
| FAN3988IL6X_F113 ⁽¹⁾ | | | | |

Note:

1. Legacy product number; please order FAN3988IL6X for new designs.

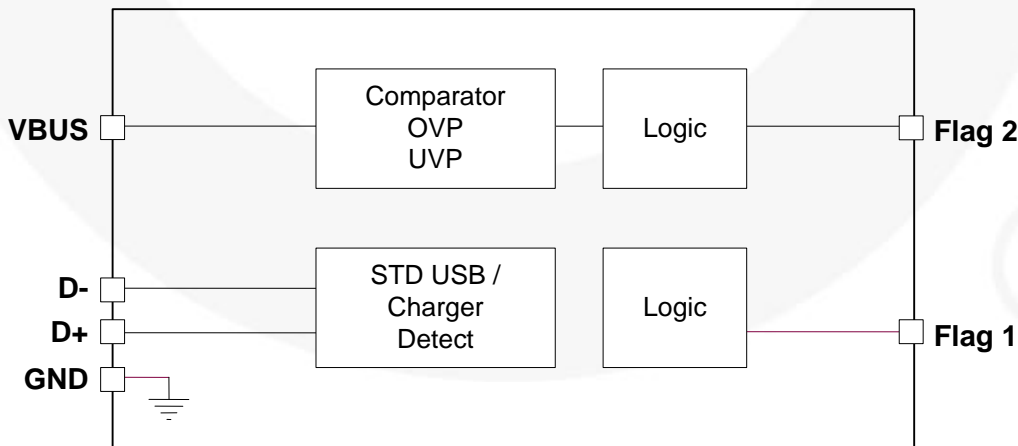


Figure 1. Block Diagram

Pin Configuration

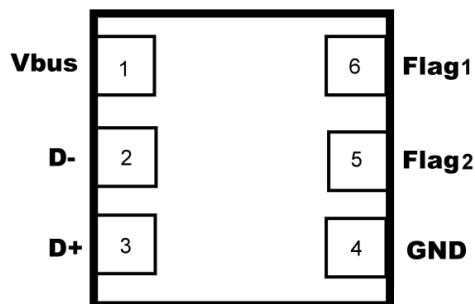


Figure 2. Pin Configuration (Top View)

Pin Definitions

| Pin# | Name | Type | Description |
|------|-------|--------|---|
| 1 | Vbus | Input | Power input from charger, USB device, or handheld battery |
| 2 | D- | Input | USB data input |
| 3 | D+ | Input | USB data input |
| 4 | Gnd | Input | Device ground |
| 5 | Flag2 | Output | Over/under-voltage flag output |
| 6 | Flag1 | Output | Charger/standard USB device detect flag |

Truth Table

| Connection State | V _{BUS} (V) | D- | D+ | FLAG1 | FLAG2 |
|-------------------------------|----------------------|-------------|-------------|-------|-------|
| STD USB Device ⁽²⁾ | 0 | Open | Open | LOW | LOW |
| STD USB Device | 0 | R to GND | R to GND | LOW | LOW |
| STD USB Device | 5 | R to GND | R to GND | LOW | HIGH |
| USB Charger | 5 | Short to D+ | Short to D- | HIGH | HIGH |
| V _{BUS} > 6 V | > 6 | Short to D+ | Short to D- | HIGH | LOW |
| V _{BUS} < 3.3 V | < 3.3 | Short to D+ | Short to D- | HIGH | LOW |
| PC Data/Charger | 5 | Open | Open | LOW | HIGH |

Note:

2. See Figure 7.

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

| Symbol | Parameter | Min. | Max. | Unit |
|------------------|-------------------|------|------|------|
| V _{BUS} | DC Supply Voltage | -0.3 | 20.0 | V |

Reliability Information

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|------------------|--|------|------|------|------|
| T _J | Junction Temperature | | | +150 | °C |
| T _{STG} | Storage Temperature Range | -65 | | +150 | °C |
| θ _{JA} | Thermal Resistance, JEDEC Standard, Multi-layer Test Boards, Still Air | | 41 | | °C/W |

ESD Information

| Symbol | Parameter | | Max. | Unit |
|--------|-------------------------------------|-----------------------------------|------|------|
| ESD | Electrostatic Discharge Information | Human Body Model, JESD22-A114 | 5 | kV |
| | | Charged Device Model, JESD22-C101 | 2 | |

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to Absolute Maximum Ratings.

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|------------------|-----------------------------|------|------|------|------|
| T _A | Operating Temperature Range | -40 | | +85 | °C |
| V _{BUS} | Supply Voltage Range | 2.7 | 5.0 | 20.0 | V |

DC Electrical Characteristics

$T_A = 25^\circ\text{C}$ and $V_{BUS} = 5.0\text{ V}$, unless otherwise noted.

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Unit |
|-------------------------------|---------------------------------------|--|-------|-------|-------|---------------|
| Supply | | | | | | |
| V_{BUS} | Supply Voltage Range | V_{BUS} Range | 2.7 | 5.0 | 20.0 | V |
| I_{BUS} | Quiescent Supply Current | $V_{BUS} = +5.0\text{ V}$, D+ D- Shorted | | 1.2 | 2.0 | mA |
| t_{SUPPLY} | Power-Up Stabilization Time | $V_{BUS} = +5.0\text{ V}$, D+ D- Shorted | | 10 | | ms |
| Input Characteristics | | | | | | |
| C_{D+} | Input Capacitance | | | 1.5 | 2.0 | pF |
| C_{D-} | Input Capacitance | | | 1.5 | 2.0 | pF |
| $I_{off\ D+}$ | Off Leakage Current | $V_{BUS} = 0\text{ V}$ or 5 V V_{IN} on D+ = 5 V | | 1 | | μA |
| $I_{off\ D-}$ | Off Leakage Current | $V_{BUS} = 0\text{ V}$ or 5 V V_{IN} on D- = 5 V | | 1 | | μA |
| Output Characteristics | | | | | | |
| OV_{DETECT} | Over-Voltage Threshold Detect | $V_{BUS} = +5.0\text{ V}$, Flag2 = LOW | 5.8 | 6.0 | 6.5 | V |
| OV_{HYST} | Over-Voltage Hysteresis | Voltage Sweep through Upper and Lower Trip Points | | 100 | | mV |
| UV_{DETECT} | Under-Voltage Threshold Detect | $V_{BUS} = +5.0\text{ V}$, Flag2 = LOW | 3.0 | 3.3 | 3.6 | V |
| UV_{HYST} | Under-Voltage Hysteresis | Voltage Sweep through Upper and Lower Trip Points | | 100 | | mV |
| $V_{OH\ FLAG1/FLAG2}$ | Minimum HIGH Output Voltage | $V_{BUS} = +5.0\text{ V}$, $I_{OH} = -20\ \mu\text{A}$ | 2.4 | | 2.6 | V |
| $V_{OL\ FLAG1/FLAG2}$ | Maximum LOW Output Voltage | $V_{BUS} = +5.0\text{ V}$, $I_{OL} = 20\ \mu\text{A}$ | | | 0.3 | V |
| $I_{OH\ FLAG1/FLAG2}$ | Minimum HIGH Output Current | | -20 | | | μA |
| $I_{OL\ FLAG1/FLAG2}$ | Maximum HIGH Output Current | | | | 20 | μA |
| D+/D- Threshold | USB SDP (Standard Downstream Port) | D+ = 3V; D- = 0V-3V or 3V-0V D- = 3V; D+ = 0V-3V or 3V-0V | 1.025 | 1.300 | 1.365 | V |
| | USB DCP (Dedicated Charging Port) | D+/D- = 0V-3V, 3V-0V | | 1.450 | | V |
| t_{off} | Flag2 HIGH to LOW | 100 pF Load | | 10 | | ns |
| t_{on} | Flag2 LOW to HIGH | 100 pF Load | | 44 | | ns |

Typical Performance Characteristics

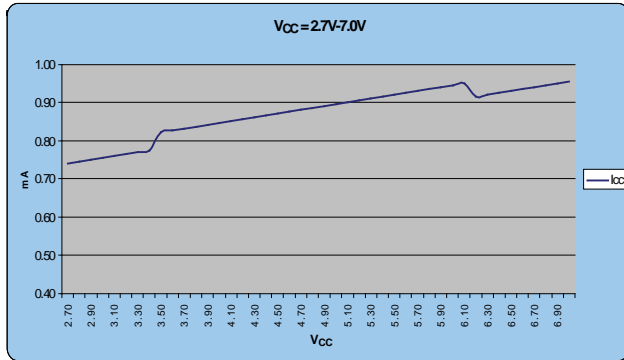


Figure 3. I_{Bus} vs. V_{Bus} (2.7 V-7.0 V) No Load

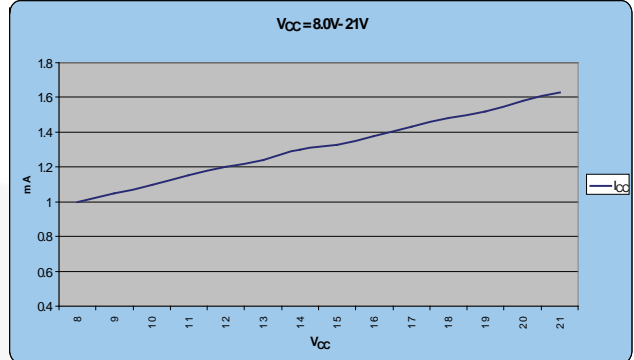


Figure 4. I_{Bus} vs. V_{Bus} (8.0V-21 V) No Load

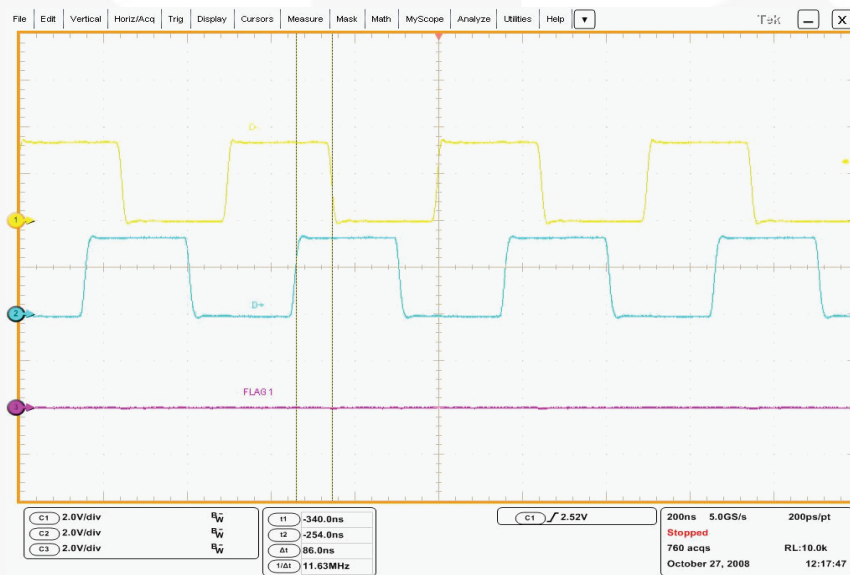


Figure 5. No Fault on Flag 1, Skew=65 ns

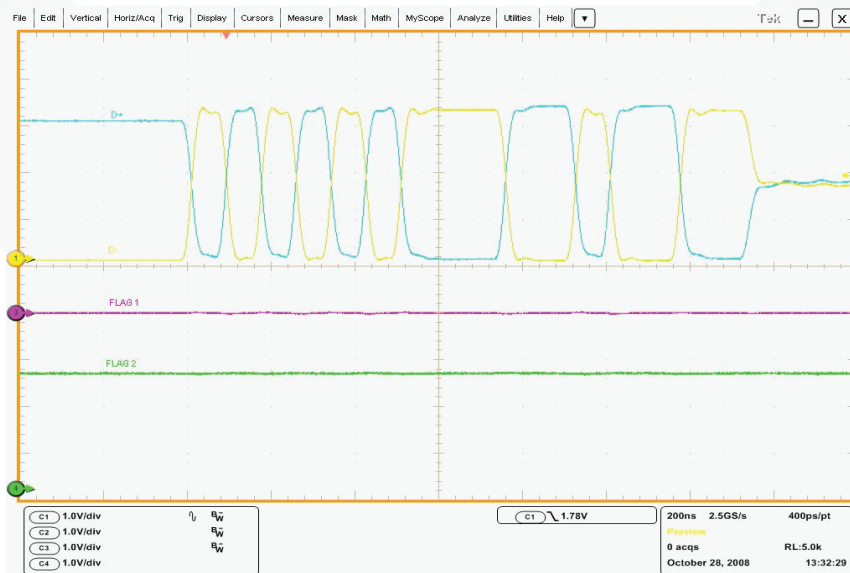


Figure 6. PC Data Running D+/D- (Flag 1 and Flag 2 at Correct Levels)

Application Information

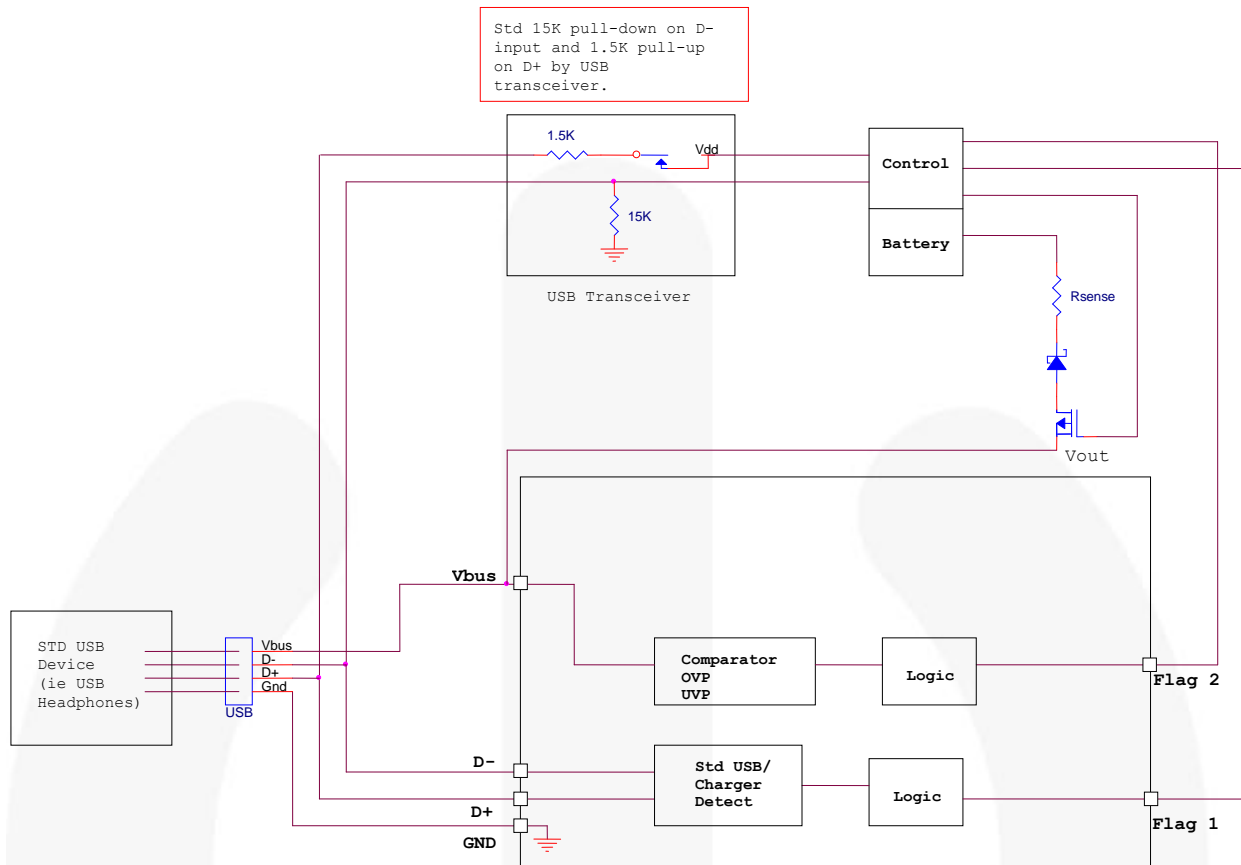


Figure 7. Typical Application System with USB Transceiver

With USB Transceiver (Figure 7)

The FAN3988 sets the FLAG1 pin to logic HIGH or LOW as an indicator to the system controller that a standard USB device or a charger is connected to the USB port. The FAN3988 also monitors the V_{BUS} for over- or under-voltage conditions. The FLAG2 pin is set LOW if V_{BUS} is less than 3.3 V or greater than 6.0 V.

In a standard USB configuration, there is a switch in the USB transceiver that is always ON in the full-speed mode. It is ON during the transition from full-speed mode to high-speed mode and is turned off after enumeration is complete.

In a condition where D+ and D- are shorted when a charger is plugged into the USB port, the USB switch is ON and pulled to V_{DD} , which is about 3.3 V, making both D+ and D- HIGH and flag1 set HIGH – indicating that a charging device is connected to the port.

In a condition where D+ and D- are connected to a standard USB device, the D+ is pulled to V_{DD} and D- is set LOW (due to the 15 k Ω pull-down in the USB transceiver) and flag1 is LOW.

If D+ and D- are open (floating), D+ is pulled to V_{DD} and D- floats LOW, which makes flag1 LOW.

Without USB Transceiver (Figure 8)

The FAN3988 sets the FLAG1 pin to logic HIGH or LOW as an indicator to the system controller that a standard USB device or a charger is connected to the USB port. The FAN3988 also monitors the V_{BUS} for over- or under-voltage conditions. The FLAG2 pin is set LOW if V_{BUS} is less than 3.3 V or greater than 6.0 V.

In a condition where a USB transceiver is not incorporated or there is a switch between the USB port and the FAN3988, external resistors must be used to set the correct input logic states on the D+ D- inputs. A 5 M Ω pull-down on the D- line and a 1 M Ω pull-up on the D+ line are recommended.

When a condition exists where a charger is plugged into the USB port (D+ D- shorted), the voltage divider of 1 M Ω and 5 M Ω puts a voltage of 2.75 V on the D+ D- inputs and flag1 is HIGH, indicating a charger is connected to port.

In a condition where the USB port is connected to a standard USB device, the D+ input is pulled up to V_{DD} (system supply) in parallel with the 1.5 k Ω on a USB transceiver with a parallel R value of 1.497 k Ω . The D- input is connected to a 15 k Ω pull-down by the USB device and in parallel with 5 M Ω with a parallel R value of 14.955 k Ω . This condition makes flag1 LOW.

If D+ and D- are open (floating), D+ is pulled to V_{DD} (system supply) and D- floats LOW, which makes flag1 LOW.

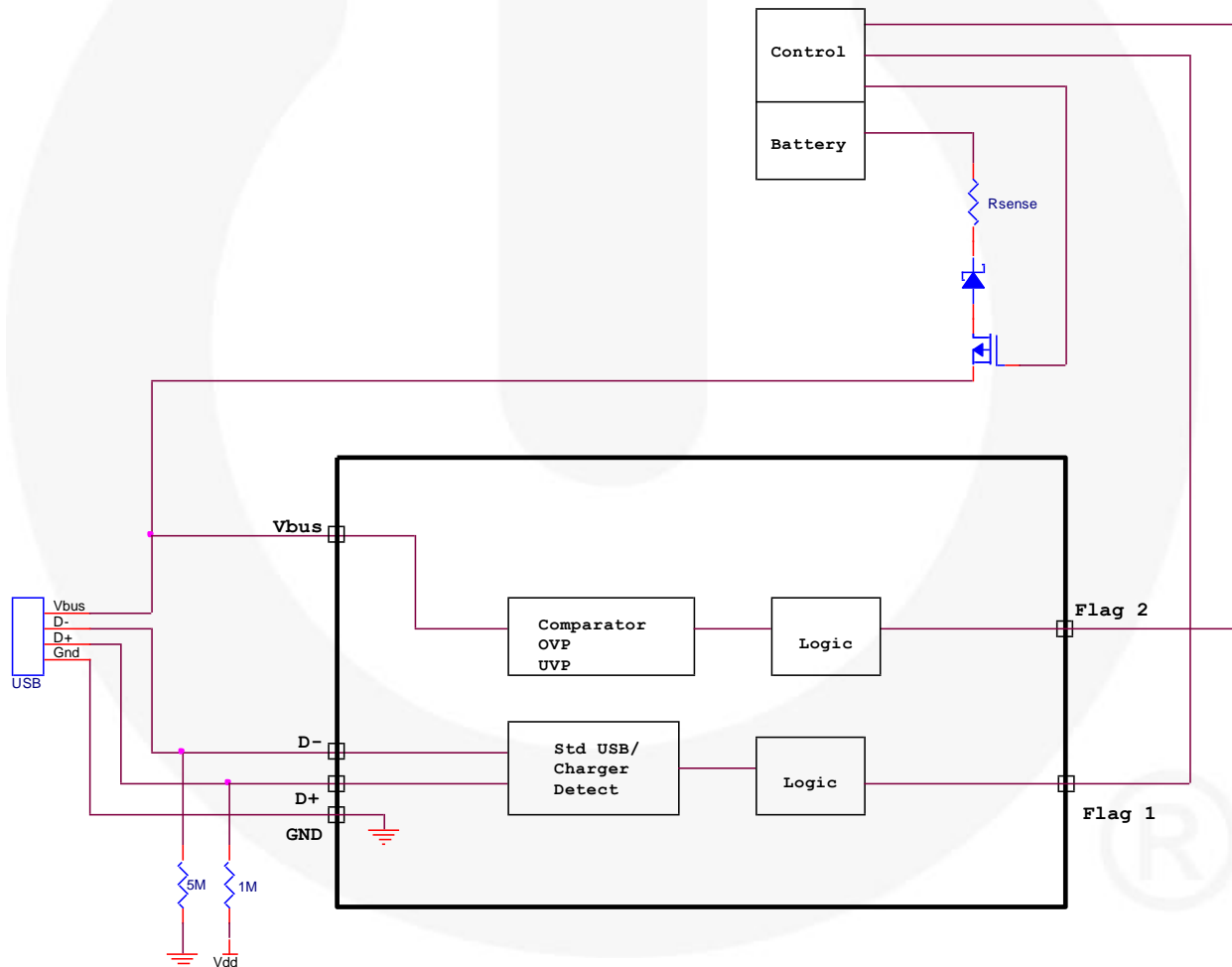
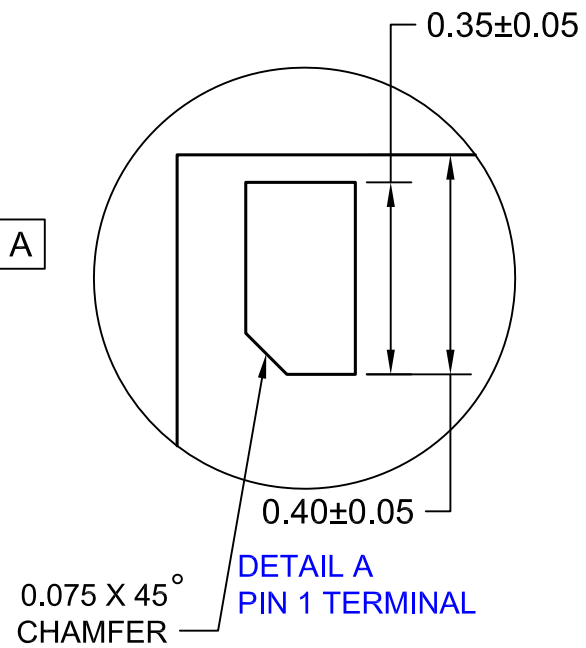
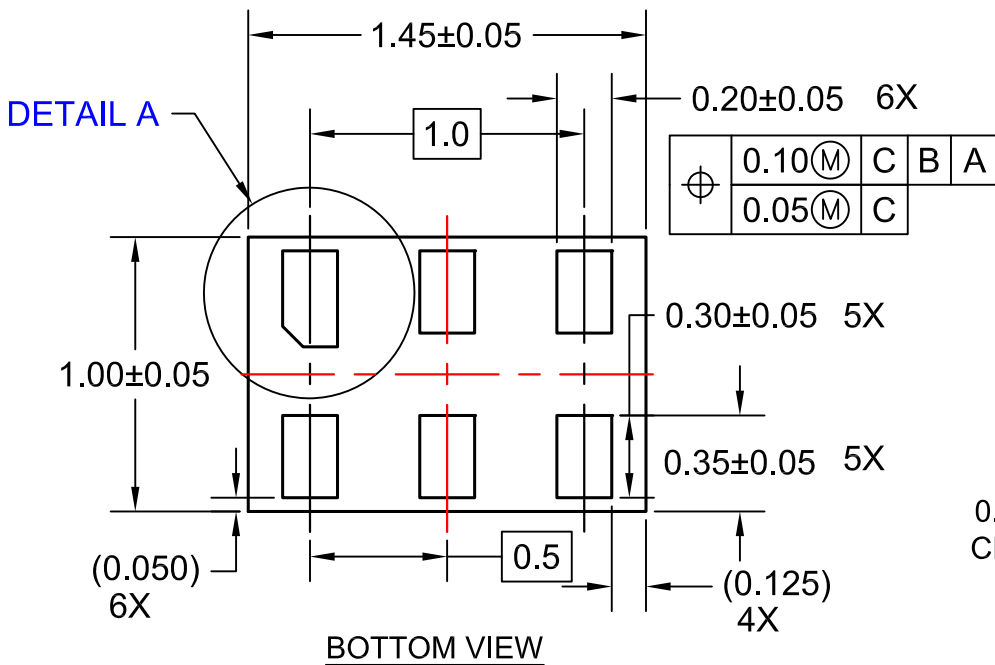
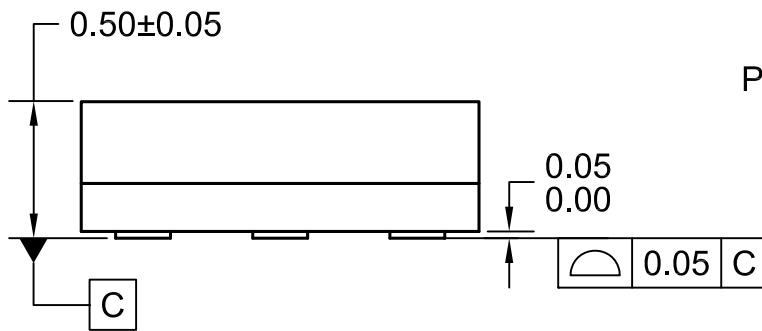
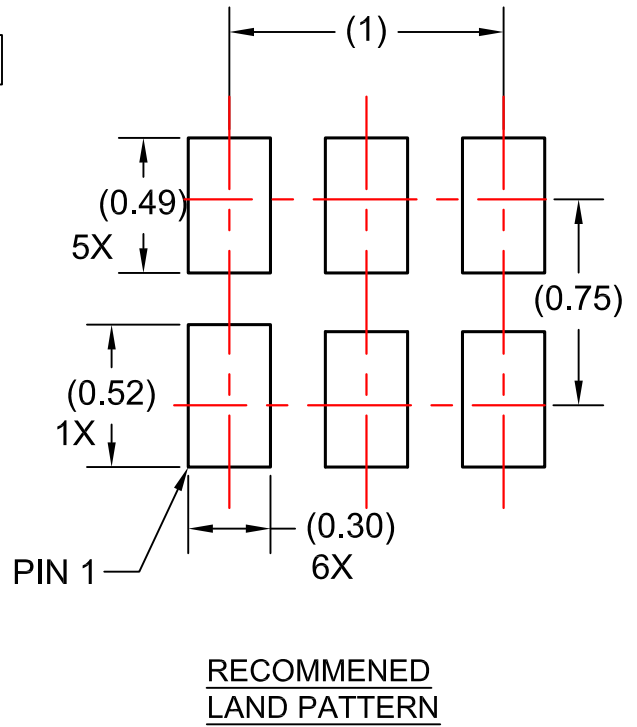
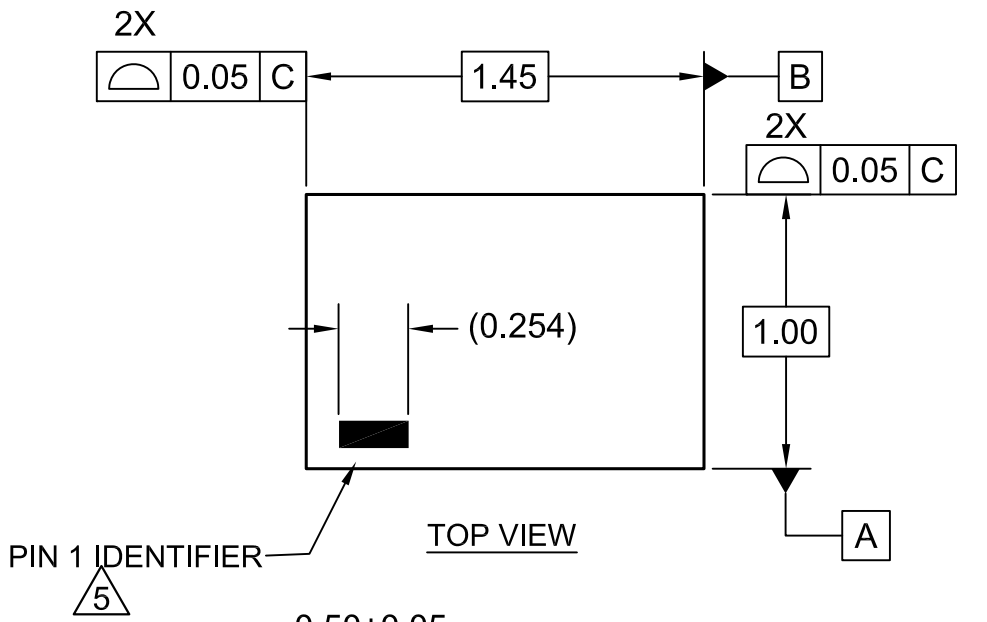


Figure 8. Typical System Application without USB Transceiver



NOTES:

1. CONFORMS TO JEDEC STANDARD MO-252 VARIATION UAAD
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y14.5M-2009
4. LANDPATTERN RECOMMENDATION PER FSC
5. PIN ONE IDENTIFIER IS 2X LENGTH OF ANY OTHER LINE IN THE MARK CODE LAYOUT.
6. FILENAME AND REVISION: MAC06AREV6



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