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November 2015

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.

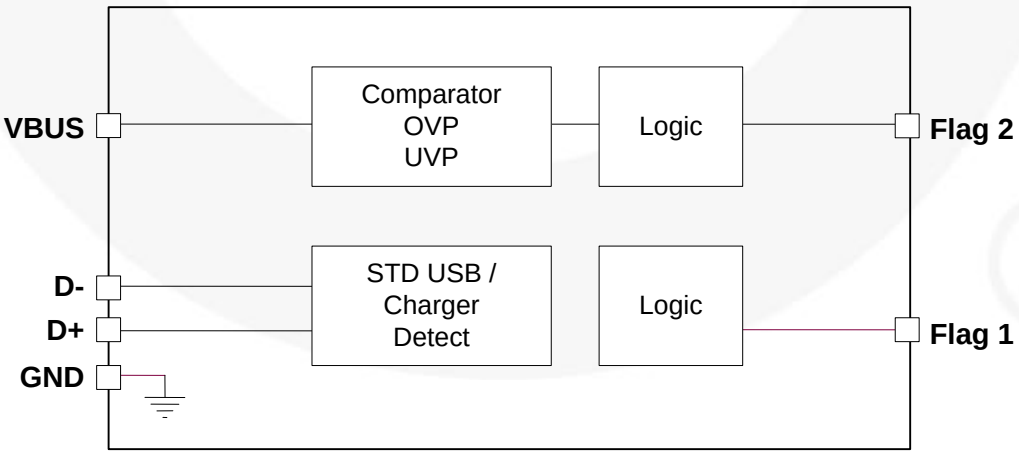

Figure 1. Block Diagram

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Pin Configuration

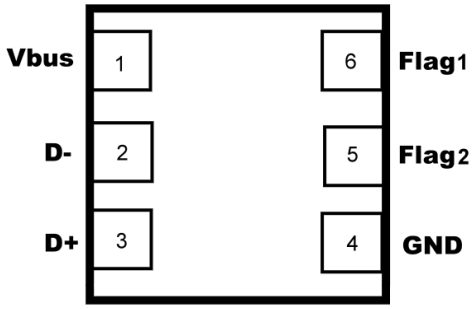

Figure 2. Pin Configuration (Top View)

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.*

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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

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DC Electrical Characteristics

T_A = 25°C and V_{BUS} = 5.0 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 V, D+ D- Shorted		1.2	2.0	mA
t_{SUPPLY}	Power-Up Stabilization Time	V_{BUS} = +5.0 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 V or 5 V V_{IN} on D+ = 5 V		1		µA
I_{off} D-	Off Leakage Current	V_{BUS} = 0 V or 5 V V_{IN} on D- = 5 V		1		µA
Output Characteristics						
OV_{DETECT}	Over-Voltage Threshold Detect	V_{BUS} = +5.0 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 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 V, I_{OH} = -20 µA	2.4		2.6	V
V_{OL} FLAG1/ FLAG2	Maximum LOW Output Voltage	V_{BUS} = +5.0 V, I_{OL} = 20 µA			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

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Typical Performance Characteristics

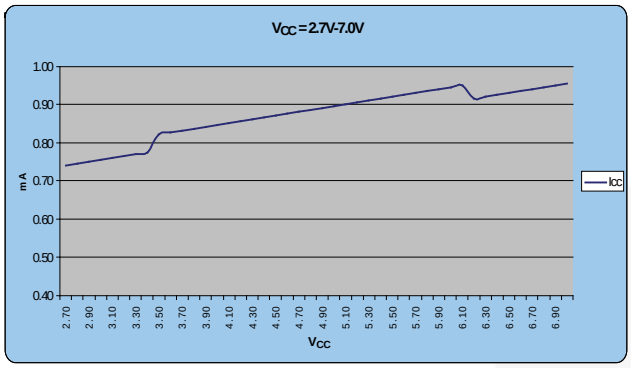

Figure 3. I_{BUS} vs. V_{BUS} (2.7 V-7.0 V) No Load

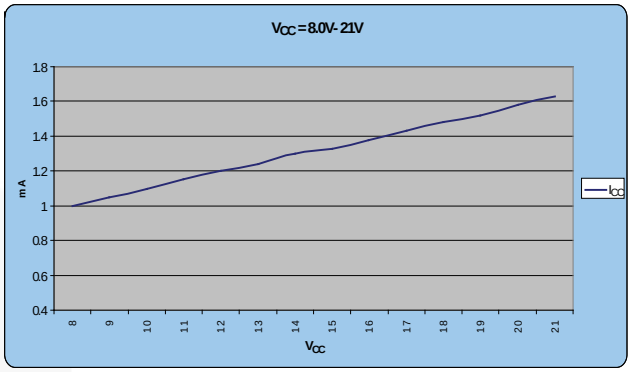

Figure 4. I_{BUS} vs. V_{BUS} (8.0V-21 V) No Load

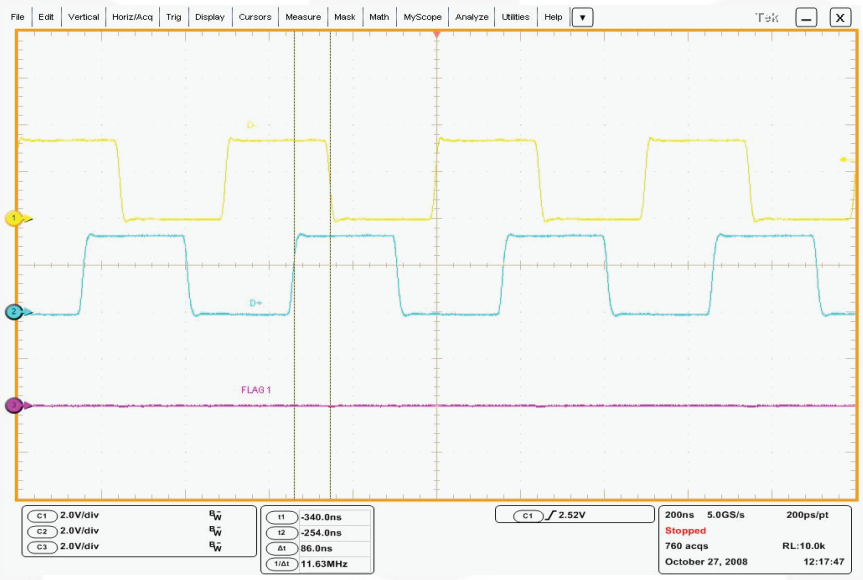

Figure 5. No Fault on Flag 1, Skew=65 ns

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

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Application Information

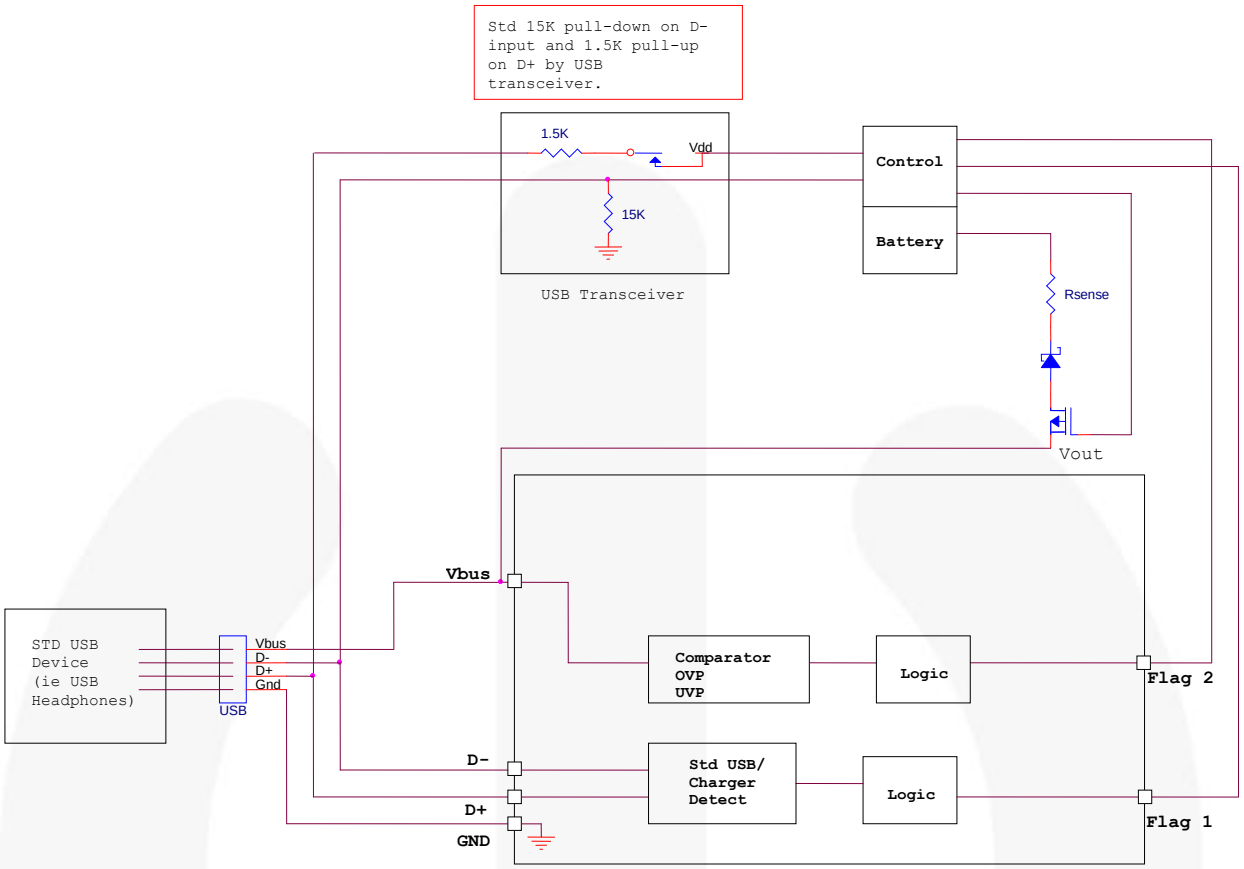

Figure 7. Typical Application System with USB Transceiver

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 kΩ 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.

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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 MΩ pull-down on the D- line and a 1 MΩ pull-up to V_{DD} (system supply) 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 MΩ and 5 MΩ 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 kΩ on a USB transceiver with a parallel R value of 1.497 kΩ. The D- input is connected to a 15 kΩ pull-down by the USB device and in parallel with 5 MΩ with a parallel R value of 14.955 kΩ. 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.

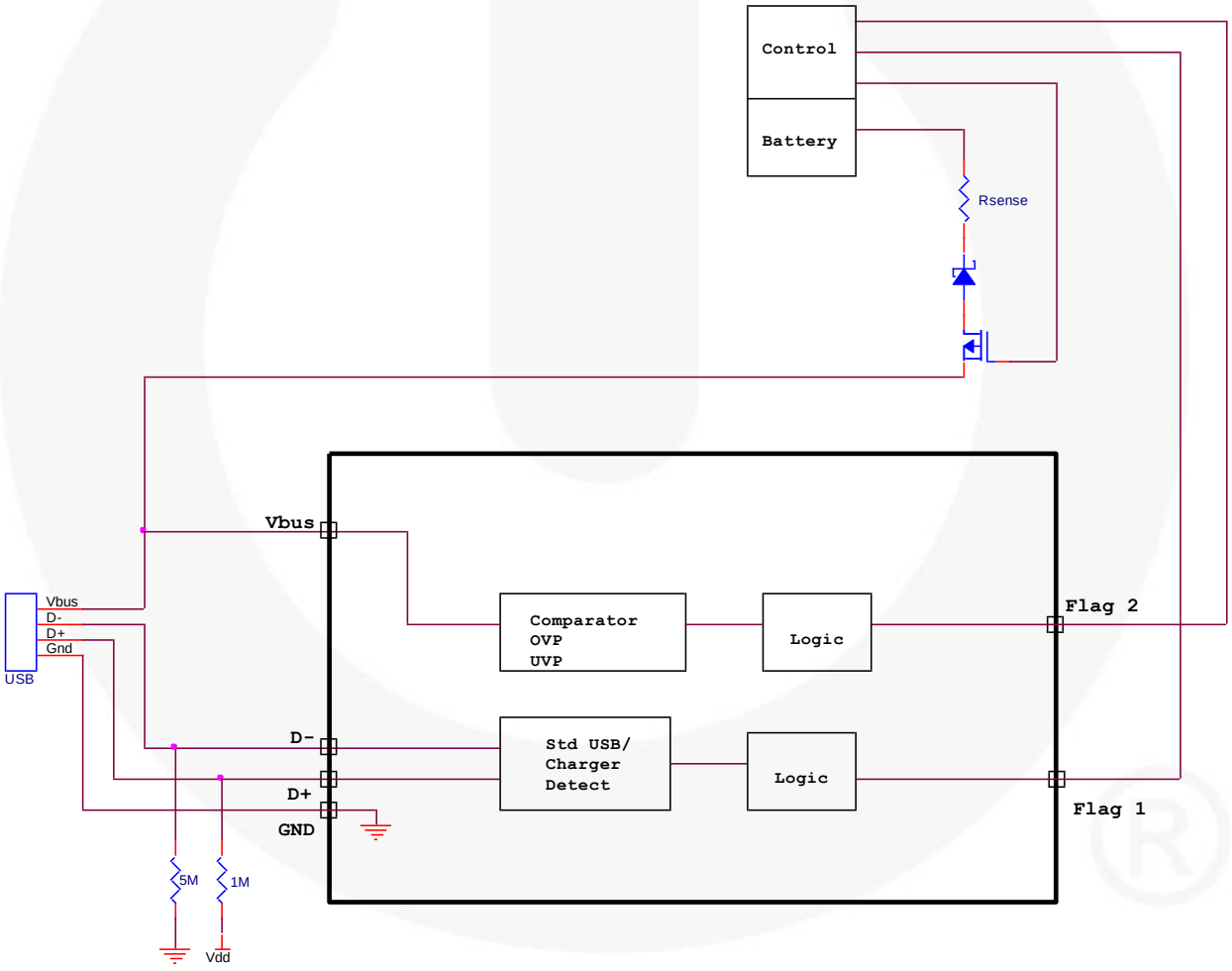

Figure 8. Typical System Application without USB Transceiver

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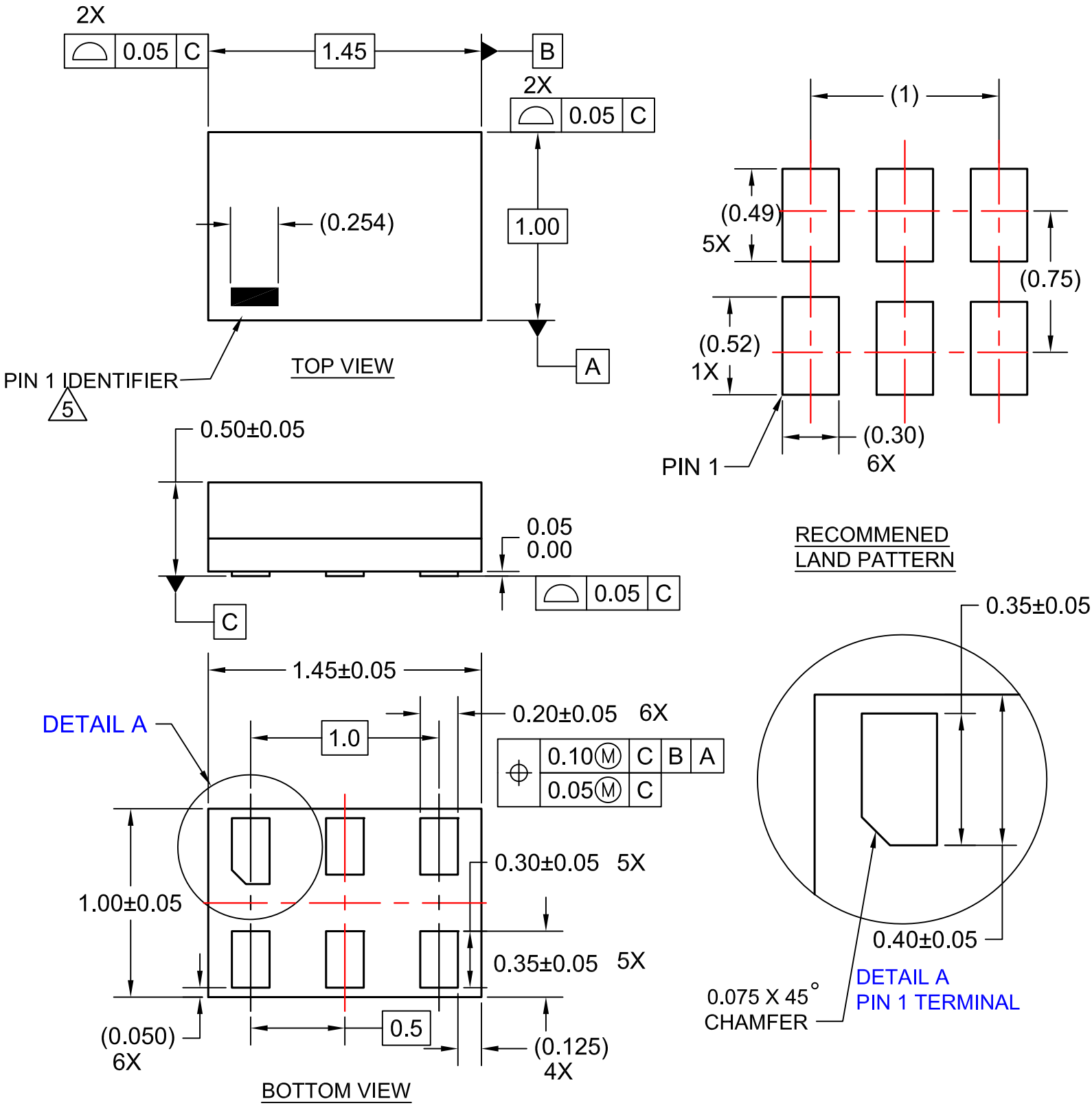

NOTES:

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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