FAIRCHILD SEMICONDUCTOR®

October 2013

# FSA8039
# Audio Jack Detection and Configuration Switch with Moisture Sensing

## Features

| | |
|---|---|
| **Detection** | Accessory Plug-In<br>3-Pole or 4-Pole Audio Jack<br>Send / End Key Pressed<br>Moisture |
| **Switch Type** | MIC |
| **$V_{DD}$** | 2.5 V to 4.5 V |
| **$V_{IO}$** | 1.6 to $V_{DD}$ |
| **THD (MIC)** | 0.01% Typical |
| **ESD (Air Gap)** | 15 kV |
| **Operating Temperature** | -40°C to 85°C |
| **Package** | 10-Lead UMLP,<br>1.4 mm × 1.8 mm × 0.5 mm,<br>0.4 mm Pitch |
| **Top Mark** | NF |
| **Ordering Information** | FSA8039UMSX_F106 |

## Applications

- 3.5 mm and 2.5 mm Audio Jacks
- Cellular Phones, Smart Phones
- MP3 and PMP

## Description

The FSA8039 is an audio jack detection switch for 3-pole and 4-pole accessories. The FSA8039 features moisture sensing, which prevents false positive detection of accessories in the audio jack. The FSA8039 also features an integrated MIC switch that allows a processor to configure attached accessories. The architecture is designed to allow common third-party headphones to be used for listening to music from mobile handsets, personal media players, and portable peripheral devices.

- Prevents False Detection of Accessories in the Audio Jack when Moisture is Present
- Removes Audio Jack Pop & Click Caused by MIC Bias
- Detects Audio Jack Accessories:
  - Standard Headphones
  - Send / End Button Presses
- Integrates a MIC Switch for 4-Pole Configuration

## Related Resources

- *FSA8039 Evaluation Board*
- *For samples and questions, please contact:* *Analog.Switch@fairchildsemi.com*

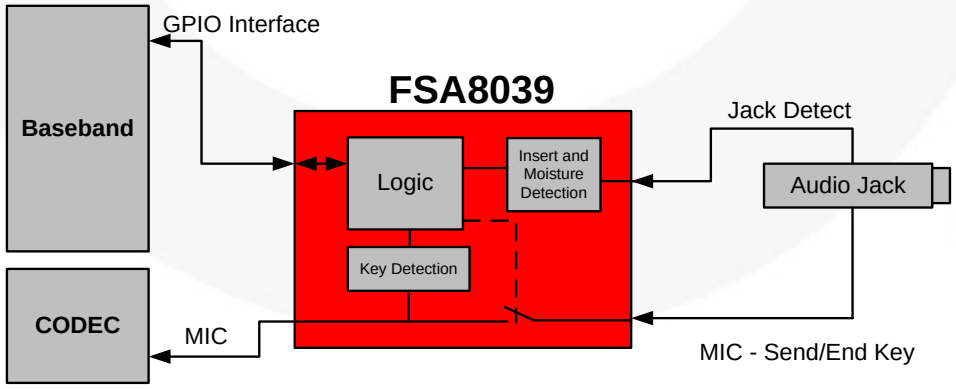



**Figure 1. System Diagram**

## Typical Application Diagram

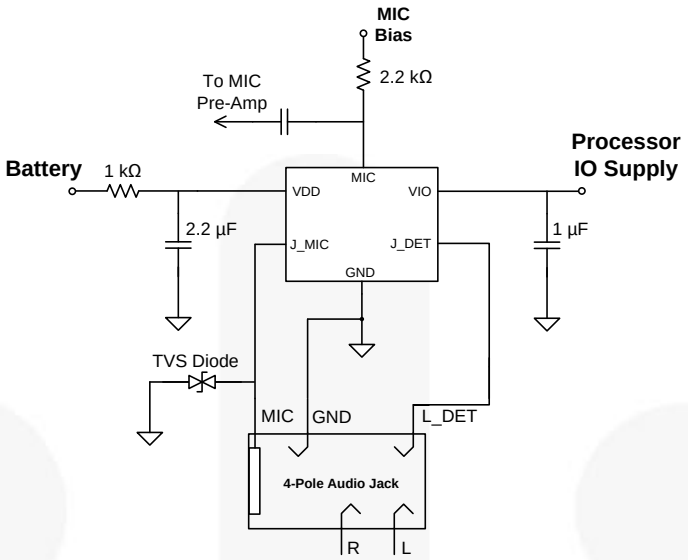



**Figure 2. Typical Application**

## Pin Configuration

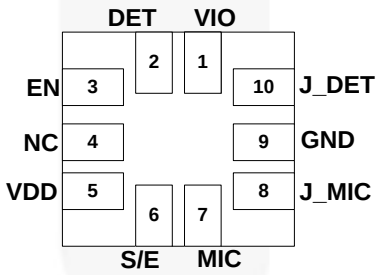



**Figure 3. Pin Assignment (Through View)**

## Pin Definitions

| Name | Pin # | Type | Description | |
|---|---|---|---|---|
| $V_{IO}$ | 1 | Power | Baseband I/O supply voltage | |
| DET | 2 | Output | De-bounced output of J_DET; Indicates if audio accessory is plugged in. | DET=L, Plugged |
| | | | | DET=H, Unplugged |
| EN | 3 | Input | Internal microphone switch control input | EN=L, Switch is Open |
| | | | | EN=H, Switch is Closed |
| NC | 4 | N/C | No connect; connect to ground for improved solder stability | |
| $V_{DD}$ | 5 | Power | Core supply voltage | |
| S/E | 6 | Output | De-bounced output for a connected 4-pole accessory; Indicates when an accessory key has been pressed | S/E=L, No Key Press |
| | | | | S/E=H, Key Press |
| MIC | 7 | Switch | System-side microphone switch pin | EN=L, Switch Open EN=H, Switch Closed |
| J_MIC | 8 | Switch | Accessory-side microphone switch pin | |
| GND | 9 | Ground | Ground for both the audio jack and PCB | |
| J_DET | 10 | Input | Input from the audio jack mechanical plug insert/removal detection pin. | J_DET=H, Unplugged |
| | | | | J_DET=L, Plugged |

**Note:**

1. L=LOW, H=HIGH.

## 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 |
|---|---|---|---|---|---|
| $V_{DD}$, $V_{IO}$ | DC Supply Voltages | | -0.5 | 6.0 | V |
| $V_{SW}$ | MIC Switch I/O Voltage and All Input Voltages Except J_DET | | -0.5 | $V_{DD}$+0.5 | V |
| $V_{JD}$ | Input Voltage for J_DET Input | | -1.5 | $V_{DD}$+0.5 | V |
| $I_{IK}$ | Input Clamp Diode Current | | -50 | | mA |
| $I_{SW}$ | Switch I/O Current (Continuous)[2] | | | 50 | mA |
| $T_{STG}$ | Storage Temperature Range | | -65 | +150 | °C |
| $T_J$ | Maximum Junction Temperature | | | +150 | °C |
| $T_L$ | Lead Temperature (Soldering, 10 Seconds) | | | +260 | °C |
| ESD | IEC 61000-4-2 System ESD | Air Gap | 15.0 | | kV |
| | | Contact | 8.0 | | |
| | Human Body Model, JEDEC JESD22-A114, | J_DET, J_MIC, $V_{DD}$, $V_{IO}$, GND | 13.0 | | |
| | | All Other Pins | 8.0 | | |
| | Charged Device Model, JEDEC JESD22-C101 | All Pins | 2.0 | | |

**Note:**

2. The input and output negative ratings may be exceeded if the input and output diode current ratings are observed.

## 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. | Max. | Unit |
|---|---|---|---|---|
| $V_{DD}$ | Battery Supply Voltage | 2.5 | 4.5 | V |
| $V_{IO}$ | Parallel I/O Supply Voltage | 1.6 | $V_{DD}$ | V |
| $T_A$ | Operating Temperature | -40 | +85 | ºC |

## DC Electrical Characteristics

All typical values are at $T_A$=25°C unless otherwise specified.

| Symbol | Parameter | $V_{DD}$ (V) | Condition | $T_A$=-40 to +85°C | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| **MIC Switch** | | | | | | | |
| $V_{IN}$ | Switch Input Voltage Range | 2.5 to 4.5 | | 0 | | $V_{DD}$ | V |
| $R_{ON}$ | MIC Switch On Resistance | 2.8 | $I_{OUT}$=30 mA, $V_{IN}$=2.2 V | | 0.85 | 2.00 | Ω |
| | | 3.0 | | | 0.70 | 2.00 | |
| | | 3.3 | | | 0.50 | 2.00 | |
| | | 3.8 | | | 0.40 | 2.00 | |
| $R_{FLAT(ON)}$ | On Resistance Flatness | 2.8 | $I_{OUT}$=30 mA, $V_{IN}$=1.6 to 2.8 V | | 0.45 | 1.50 | |
| | | 3.0 | | | 0.40 | 1.50 | |
| | | 3.3 | | | 0.35 | 1.50 | |
| | | 3.8 | | | 0.30 | 1.50 | |
| **J_DET** | | | | | | | |
| $J\_DET_{AudioV}$ | Audio Voltage on J_DET Pin | 2.5 to 4.5 | DET=LOW | -1 | | 1 | V |
| $J\_DET_{Audiof}$ | Audio Frequency on J_DET Pin | 2.5 to 4.5 | DET=LOW | 20 | | 20000 | Hz |
| $J\_DET_{RGND}$ | Detection Resistance to Ground | 2.5 to 4.5 | Audio Accessory Inserted | 0 | | 500 | kΩ |
| $J\_DET_{HYS}$ | Hysteresis of J_DET | | | | 200 | | mV |
| $J\_DET_{VIH}$ | J_DET Input High Voltage | | | 0.7 × $V_{DD}$ | | $V_{DD}$ | V |
| $J\_DET_{VIL}$ | J_DET Input Low Voltage | | | -1 | | 0.4 × $V_{DD}$ | V |
| **Parallel I/O** | | | | | | | |
| $V_{IH}$ | EN Input High Voltage | | | 0.7 × $V_{IO}$ | | $V_{IO}$ | V |
| $V_{IL}$ | EN Input Low Voltage | | | | | 0.3 × $V_{IO}$ | |
| $V_{OH}$ | DET, S/E Output High Voltage | | $I_{OH}$=-100 µA | 0.8 × $V_{IO}$ | | | |
| $V_{OL}$ | DET, S/E Output Low Voltage | | $I_{OL}$=+100 µA | | | 0.2 × $V_{IO}$ | |
| **Comparator** | | | | | | | |
| $V_{COMP\_S/E}$ | Comparator Threshold for SEND/END Sensing | 2.8 to 4.5 | J_DET, EN=LOW | | 780 | | mV |
| **Current** | | | | | | | |
| $I_{OFF}$ | Power-Off Leakage Current Through Switch | 0 | MIC=4.3 V | | | 1 | µA |
| $I_{IN}$ | Input Leakage Current | 0 | EN=4.3 V | | | 1 | µA |
| $I_{CC-SLNA}$ | $V_{DD}$ Supply Sleep Mode Current (No Accessory Attached) | 2.5 to 4.5 | EN=LOW | | 1.5 | 3.0 | µA |
| $I_{CC-SLWA}$ | $V_{DD}$ Supply Active Mode Current (Accessory Attached) | 2.5 to 4.5 | DET=LOW, EN=HIGH | | 20 | 27 | µA |

## AC Electrical Characteristics

All typical values are for $V_{CC}$=3.3 V at $T_A$=25°C unless otherwise specified.

| Symbol | Parameter | $V_{DD}$ (V) | Conditions | Typical | Unit |
|---|---|---|---|---|---|
| **MIC Switch** | | | | | |
| THD+N | Total Harmonic Distortion + Noise | 3.8 | $R_T$=600 Ω, f=20 Hz to 20 kHz, $V_{MIC}$=2.2 VDC + 0.5$V_{PP}$ Sine | 0.01 | % |
| $O_{IRR}$ | Off Isolation | 3.8 | f=20 Hz to 20 kHz, $R_S$=$R_T$=32 Ω, $C_L$=0 pF | -85 | dB |
| $C_{ON}$ | MIC and J_MIC Switch ON Capacitance | 3.8 | f=1 MHz | 60 | pF |
| $C_{OFF}$ | MIC and J_MIC Switch OFF Capacitance | 3.8 | f=1 MHz | 35 | pF |
| **Parallel I/O** | | | | | |
| $t_R$, $t_F$ | Output Edge Rates (DET, S/E) | 3.8 | $C_L$=5 pF, 20% to 80%, | 20 | ns |
| $t_{POLL}$ | On Time of MIC Switch for Sensing SEND/END Button Press | 2.5 to 4.5 | DET= LOW, EN= LOW | 1 | ms |
| $t_{WAIT}$ | Period of MIC Switching Time for Sensing SEND/END Button Press | 2.5 to 4.5 | DET= LOW, EN= LOW | 10 | ms |
| $t_{DET\_IN}$ | Debounce Time after J_DET Changes State from HIGH to LOW | 2.5 to 4.5 | | 70 | ms |
| $t_{DET\_REM}$ | Debounce Time after J_DET Changes State from LOW to HIGH | 2.5 to 4.5 | | 30 | µs |
| $t_{KBK}$ | SEND/END Button Press/Release Debounce Time | 2.5 to 4.5 | | 30 | ms |
| **Power** | | | | | |
| PSRR | Power Supply Rejection Ratio | 3.8 | Power Supply Noise 300 $mV_{PP}$, f=217 Hz | -90 | dB |

## Application Information

### Design/Layout Best Practices

System-level Electrostatic Discharge (ESD) events often occur in the audio path of a mobile device, typically when inserting or removing an accessory from the audio jack. The audio path from the audio jack to the audio codec or microphone pre-amplifier is typically designed for relatively low frequencies (<100 kHz). However, an ESD event is a high-frequency event with fast edge rates (<100 ns/V). Because of this, the audio signal paths represent a high-frequency transmission line to the ESD signal.

Use the following PCB design and layout best practices when designing a system audio path.

### Audio Path Layout Guidelines for ESD

For the MIC and ground signals between the audio jack and FSA8039, decrease the spacing between these traces to increase the inductive coupling of these signals. In effect, this creates a low-frequency band-pass filter that shunts ESD energy to ground before it reaches internal components. Where feasible, lay the MIC trace as a shielded stripline; an example is shown in Figure 4.

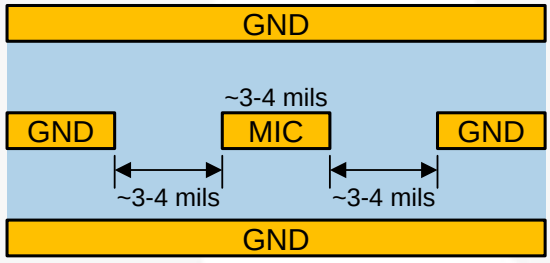



**Figure 4. MIC PCB Trace as Shielded Stripline**

### Ground Layout Guidelines

Ground layout for audio path devices should consider high-frequency effects. During an ESD event, parasitic inductance and resistance in the ground path reduces its ability to shunt the fast transient energy. Use the following techniques to improve grounding effectiveness:

- Use “star” ground connections (not daisy-chain).
- Use ground vias to minimize ground path impedance and ground loops.
- Stitch ground traces to the ground plane at the device, where possible *(see Figure 4)*.
- Flood ground, where possible *(see Figure 4)*.
- Avoid ground “islands” or “peninsulas” if possible.
- If using a modular audio jack assembly that is not soldered to the main PCB, use a ground pad on the jack with an ohmic connection to battery ground.

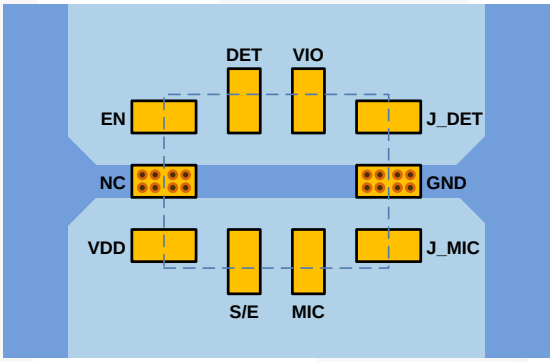
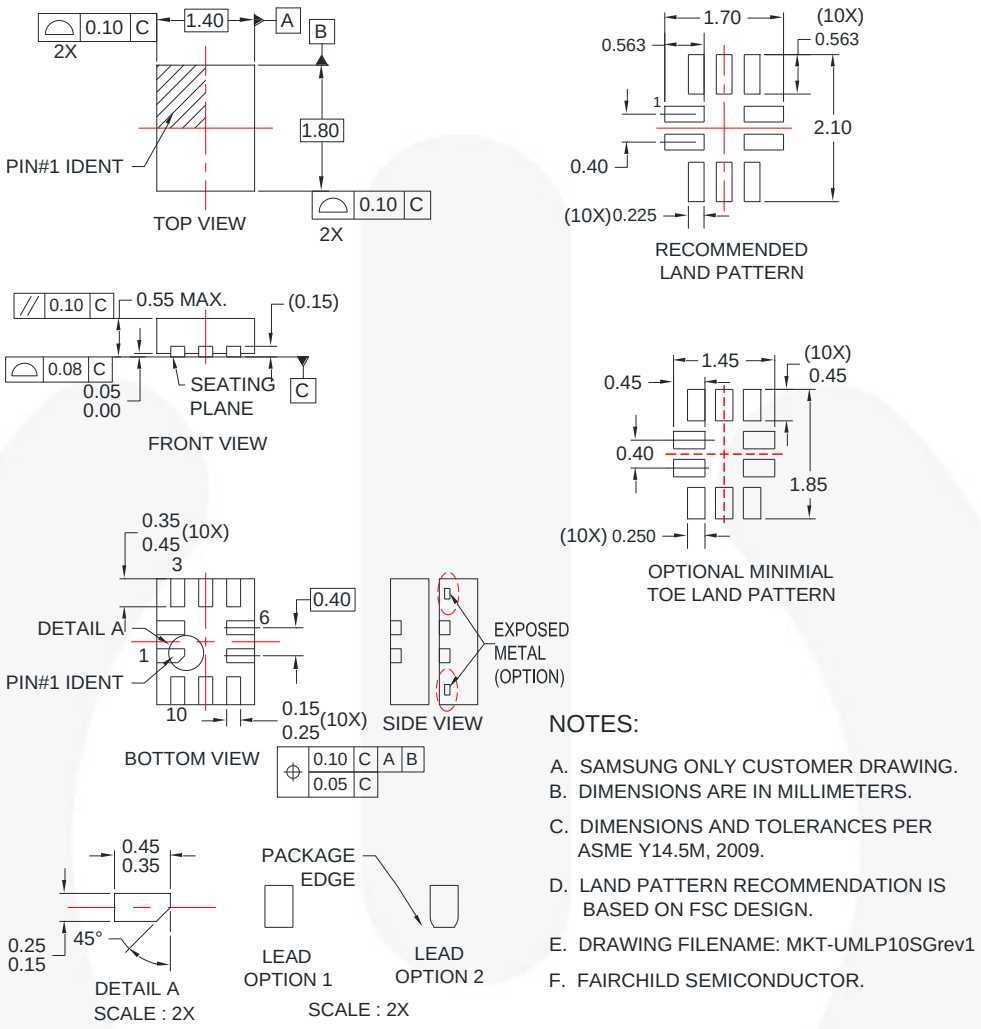



**Figure 5. PCB Layout/Grounding**

In addition to ESD robustness, these techniques can improve audio signal performance by reducing audio cross-talk and echo due to resistive voltage drops in the audio ground path.

## Physical Dimensions




NOTES:

A. SAMSUNG ONLY CUSTOMER DRAWING.
B. DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 2009.
D. LAND PATTERN RECOMMENDATION IS BASED ON FSC DESIGN.
E. DRAWING FILENAME: MKT-UMLP10SGrev1
F. FAIRCHILD SEMICONDUCTOR.

**Figure 6. 10-Lead, Quad Ultrathin MLP (UMLP), 1.4 × 1.8 mm Body**

**Table 1. Nominal Values**

| JEDEC Symbol | Description | Nominal Values (mm) |
|---|---|---|
| A | Overall Height | 0.5 |
| A1 | Package Standoff | 0.026 |
| A3 | Lead Thickness | 0.152 |
| b | Lead Width | 0.2 |
| L | Lead Length | 0.4 |
| e | Lead Pitch | 0.4 |
| D | Body Length (Y) | 1.8 |
| E | Body Width (X) | 1.4 |

*Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.*

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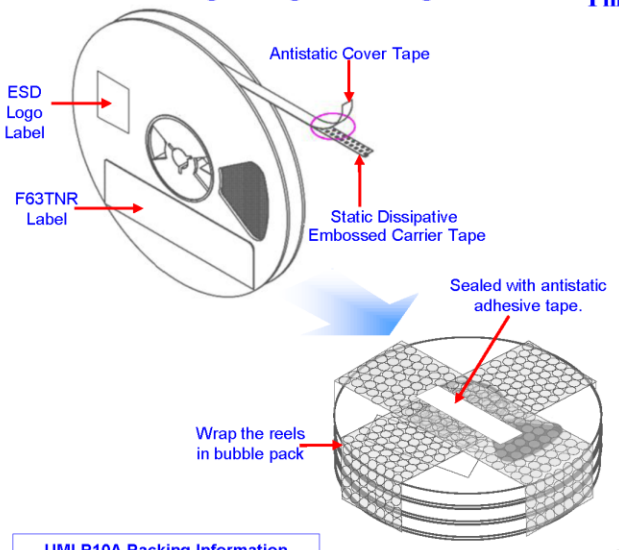
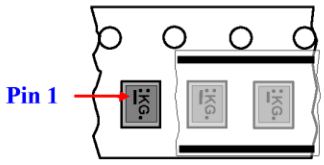
*http://www.fairchildsemi.com/dwg/UM/UMLP10SG.pdf.*

## Packing Specifications

### UMLP10A Packing Configuration: Figure 1.0



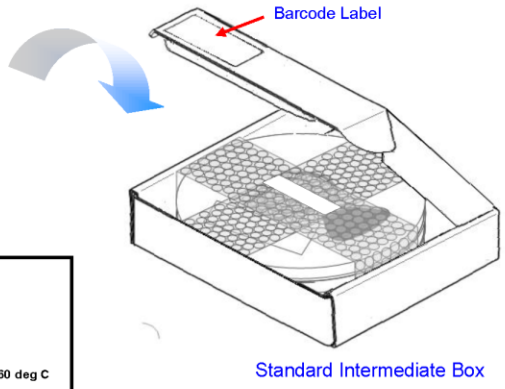

**Packing Description:**

UMLP 10 pins products are classified under Moisture Sensitive Level 1 at 260°C peak package body temperature.

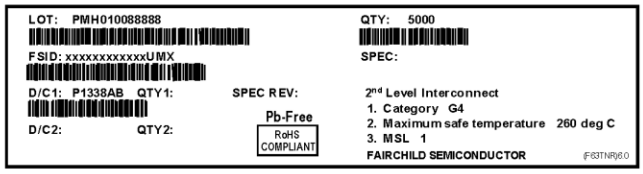
The carrier tape is made from dissipative polystyrene or polycarbonate resin. The cover tape is a multilayer film primarily composed of polyester film, adhesive layer, heat activated sealant, and anti-static sprayed agent. These reeled parts in standard option are shipped with 5000 units per 178 mm diameter reel. Up to three reels are packed in each intermediate box. The reels is made of polystyrene plastic (anti-static coated or intrinsic).

These full reels are individually barcode labeled and placed inside a pizza box made of recyclable corrugated brown paper with a Fairchild logo printing. These pizza boxes are placed inside a barcode labeled shipping box which comes in different sizes depending on the number of parts shipped.

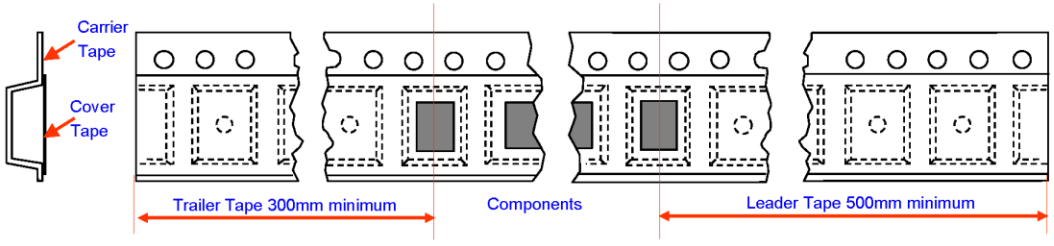
| UMLP10A Packing Information | |
|---|---|
| Packaging Option | Standard (no flow code) |
| Packaging type | TNR |
| Qty per Reel | 5000 |
| Reel Size | 7" Dia |
| Box Dimension (mm) | 193X183X80 |
| Max qty per Box | 15,000 |




### F63TNR Label Sample




### UMLP10A Tape Leader and Trailer Configuration: Figure 2.0

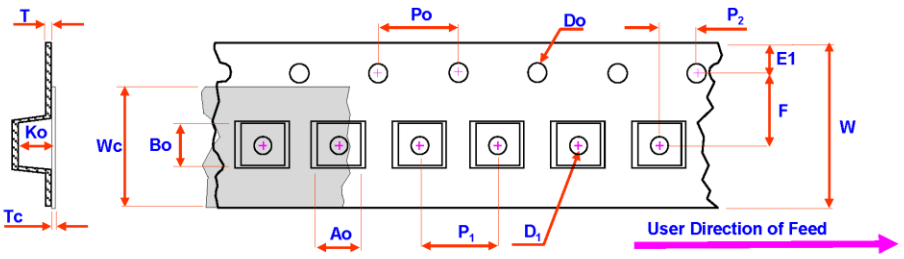



NOTES:
A : ALL DIMENSION ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED
B : DRAWING FILE NAME : PKG-UMLP10AREV2
C : PLASTIC REEL W1 DIMENSION CONTROL LIMIT OF:
8MM REEL=±1.0MM AND 12MM REEL AND ABOVE =±1.5MM

**Figure 7. 10-Lead, Quad Ultrathin MLP (UMLP), Packing Specification, Page 1**

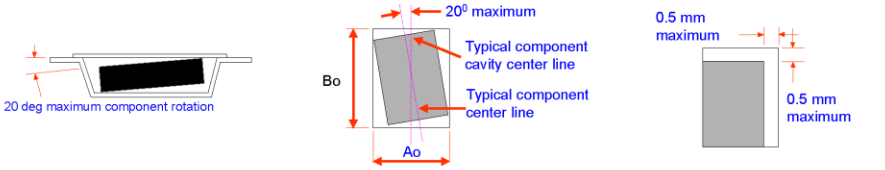
## Packing Specifications

**Embossed Carrier Tape Configuration: Figure 3.0**

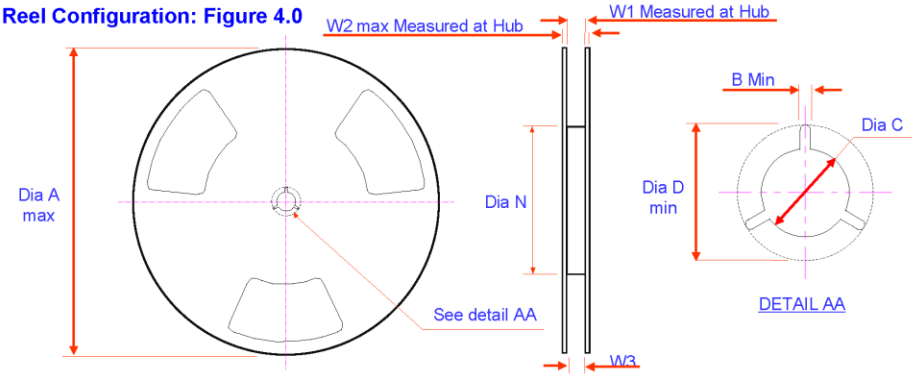



| Dimensions are in millimeters | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Package | Ao ±0.05 | Bo ±0.05 | Do ±0.10 | D1 Min | E1 ±0.10 | F ±0.10 | Ko ±0.05 | P1 TYP | Po TYP | P2 ±0.05 | T TYP | Tc ±0.05 | W ±0.30 | Wc TYP |
| UMLP1.4x1.8 | 1.60 | 2.00 | 1.50 | 0.5 | 1.75 | 3.5 | 0.70 | 4.0 | 4.0 | 2.0 | 0.254 | 0.06 | 8.0 | 5.3 |

Notes: Ao, Bo, and Ko dimensions are determined with respect to the EIA /Jedec RS-481 rotational and lateral movement requirements (see sketches A, B, and C).




**Reel Configuration: Figure 4.0**




| Dimensions are in millimeters | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Tape Width | Reel Option | Dia A max | Dia B min | Dia C +0.5/-0.2 | Dia D min | Dim N min | Dim W1 +2/-0 | Dim W2 Max | Dim W3 (LSL-USL) |
| 8 mm | 7" Dia | 178.0 | 1.5 | 13.0 | 20.2 | 55.0 | 8.4 | 14.4 | 7.9~10.9 |

NOTES:
A : ALL DIMENSION ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED
B : DRAWING FILE NAME : PKG-UMLP10AREV2
C : PLASTIC REEL W1 DIMENSION CONTROL LIMIT OF:
8MM REEL=±1.0MM AND 12MM REEL AND ABOVE =±1.5MM

**Figure 8. 10-Lead, Quad Ultrathin MLP (UMLP), Packing Specification, Page 2**

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As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

## ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, www.fairchildsemi.com, under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed applications, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address any warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

## PRODUCT STATUS DEFINITIONS

**Definition of Terms**

| Datasheet Identification | Product Status | Definition |
|---|---|---|
| Advance Information | Formative / In Design | Datasheet contains the design specifications for product development. Specifications may change in any manner without notice. |
| Preliminary | First Production | Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
| No Identification Needed | Full Production | Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design. |
| Obsolete | Not In Production | Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only. |

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