

General Description

The SLG55593/SLG55593A is a USB device that combines high speed USB switches with a USB host charger (dedicated charger) identification circuit. The device supports both the latest USB Battery Charging Specification Revision 1.2 including data contact detection and a set resistor bias for Apple* compliant devices as well as legacy USB D+/D- short detection using data line pull-up.

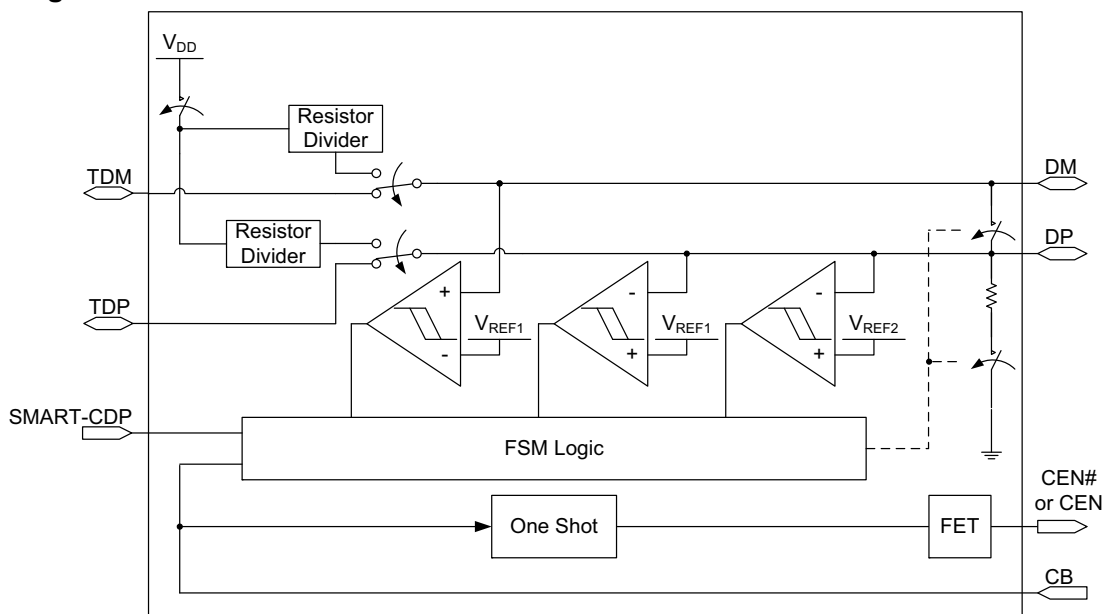
The SLG55593/SLG55593A can also support CDP mode (FAST charging and data communication available mode if smartphone can support CDP mode.)

The SLG55593/SLG55593A can also support low speed / full speed mouse/keyboard wake-up from S3 mode.

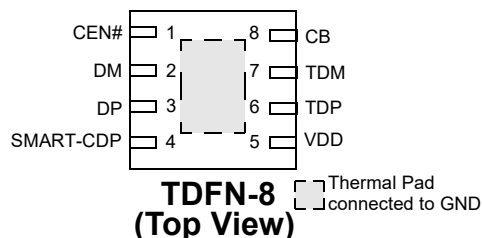
Features

- High Speed USB Switching
- Low 4.0pF (typ) On Capacitance
- Low 4.0Ω (typ) On Resistance
- Low 0.5Ω (typ) On Resistance Flatness
- 4.5V to 5.5V Supply Range
- Low Supply Current
- Automatic Current-Limit Switch Control
- Automatic USB Charger Identification Circuit
- CDP Support (active USB 2.0 data communication with 1.5A charging)
- Apple iPad* @ 2A charging current support
- Automatic CDP/SDP mode support with SMART-CDP=1 for "Always Data Communication"
- Chinese Telecom Standard YD/T 1591-2009 specification support
- Samsung Galaxy Tab** charge scheme support
- Pb-Free / RoHS Compliant / Halogen-Free
- TDFN-8 Package

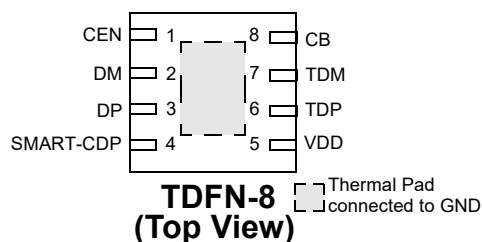
Block Diagram



Pin Configuration - SLG55593



Pin Configuration - SLG55593A



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** Samsung Galaxy Tab are trademarks of Samsung Electronics, registered in Korea and other countries.

Pin Description - SLG55593

| Pin # | Pin Name | Type | Pin Description |
|-------|-------------|--------------|--|
| 1 | CEN# | Output | P-FET Open Drain Output. Current Limit Switch (CLS) Control Output. CB changes from 0 to 1 or 1 to 0. CEN# will be high for 2 seconds (typ) |
| 2 | DM | Input/Output | USB Connector D- |
| 3 | DP | Input/Output | USB Connector D+ |
| 4 | SMART-CDP | Input | Input Control logic (see truth table) |
| 5 | VDD | PWR | Power Supply. Connect a 0.1μF capacitor between VDD and GND as close as possible to the device. |
| 6 | TDP | Input/Output | Host USB Transceiver D+ Connection |
| 7 | TDM | Input/Output | Host USB Transceiver D- Connection |
| 8 | CB | Input | Switch Control Bit 0 = autodetection charger identification active 1 = charging downstream port with active USB2.0 data communication mode with 1.5A support |
| 9 | Thermal Pad | GND | Ground |

Pin Description - SLG55593A

| Pin # | Pin Name | Type | Pin Description |
|-------|-------------|--------------|--|
| 1 | CEN | Output | N-FET Open Drain Output. Current Limit Switch (CLS) Control Output. CB changes from 0 to 1 or 1 to 0. CEN will be low for 2 seconds (typ) |
| 2 | DM | Input/Output | USB Connector D- |
| 3 | DP | Input/Output | USB Connector D+ |
| 4 | SMART-CDP | Input | Input Control logic (see truth table) |
| 5 | VDD | PWR | Power Supply. Connect a 0.1μF capacitor between VDD and GND as close as possible to the device. |
| 6 | TDP | Input/Output | Host USB Transceiver D+ Connection |
| 7 | TDM | Input/Output | Host USB Transceiver D- Connection |
| 8 | CB | Input | Switch Control Bit 0 = autodetection charger identification active 1 = charging downstream port with active USB2.0 data communication mode with 1.5A support |
| 9 | Thermal Pad | GND | Ground |

Truth Table

| CB | SMART-CDP | Function |
|----|-----------|---|
| 0 | X | DCP autodetect with mouse/keyboard wakeup |
| 1 | 0 | S0 charging with SDP only |
| 1 | 1 | S0 charging with CDP or SDP only (depending on external device) And, when Non-CDP phone is plugged in, the CDP mode will be changed automatically to SDP mode during handshaking protocol for supporting data communication. |

Ordering Information

| Part Number | Type |
|--------------|------------------------|
| SLG55593V | TDFN-8 |
| SLG55593VTR | TDFN-8 - Tape and Reel |
| SLG55593AV | TDFN-8 |
| SLG55593AVTR | TDFN-8 - Tape and Reel |

Absolute Maximum Ratings

| Parameter | Min. | Max. | Unit |
|--------------------------------------|------|------|------|
| Supply Voltage | -0.3 | 6.0 | V |
| Continuous Current into any terminal | -30 | +30 | mA |
| Continuous Power Dissipation | -- | 954 | mW |
| Operating Temperature Range | -40 | 85 | °C |
| Junction Temperature | | 150 | °C |
| Storage Temperature Range | -65 | 150 | °C |
| Lead Temperature (Soldering, 10s) | | 260 | °C |

Note: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Electrical Characteristics - Power Supply

$V_{DD} = 4.5V$ to $5.5V$, $T_A = 25^\circ C$ (unless specified otherwise)

| Parameter | Description | Condition/Note | Min. | Typ. | Max. | Unit |
|-----------|---------------------------------|--|------|------|------|---------|
| V_{DD} | Power Supply Range | $V_{CB} > V_{IH}$ | 4.5 | 5.0 | 5.5 | V |
| | | $V_{CB} = 0V$ | 4.75 | -- | 5.25 | V |
| I_{DD} | Supply Current $V_{DD} = 5V$ | CB = LOW, SMART-CDP = X (autodetect with wakeup) | -- | 120 | 140 | μA |
| | | CB = HIGH, SMART- = LOW (SDP) | -- | 20 | 30 | μA |
| | | CB = HIGH, SMART- = HIGH (CDP) | -- | 40 | 70 | μA |

Electrical Characteristics - Analog Switch

$V_{DD} = 4.5V$ to $5.5V$, $T_A = 25^\circ C$ (unless specified otherwise)

| Parameter | Description | Condition/Note | Min. | Typ. | Max. | Unit |
|--------------------------|---|--|------|------|----------|----------|
| V_{DP}, V_{DM} | Analog signal Range | | 0 | -- | V_{DD} | V |
| R_{ON} | On Resistance TDP/TDM Switch | $V_{DD} = -0.4V$ to $0.4V$, $I = 10mA$ | -- | 3.5 | -- | Ω |
| | | $V_{DP} = V_{DM} = 0V$ to $3.3V$ $V_{DD} = 5V$ | -- | 4.0 | 7 | Ω |
| ΔR_{ON} | On Resistance Match between channels TDP/TDM Switch | $V_{DD} = 5.0V$ $V_{DP} = V_{DM} = 400mV$ $I_{DP} = I_{DM} = 10mA$ | -- | 0.1 | -- | Ω |
| R_{FLAT} | On Resistance flatness TDP/TDM Switch | $V_{DD} = 5.0V$ $V_{DP} = V_{DM} = 0V$ to V_{DD} $I_{DP} = I_{DM} = 10mA$ | -- | 0.5 | -- | Ω |
| R_{SHORT} | On Resistance of TDP/TDM Short | $V_{CB} = 0V$ $V_{DP} = 1V$ $I_{DP} = I_{DM} = 10mA$ | -- | 50 | 70 | Ω |
| I_{TDPOFF}, I_{TDMOFF} | Off-Leakage Current | $V_{DD} = 3.6V$ $V_{DP} = V_{DM} = 0.3V$ to $3.3V$ $V_{TDP} = V_{TDM} = 3.3V$ to $0.3V$ $V_{CB} = 0V$ | -250 | -- | 250 | nA |
| I_{DPON}, I_{DMON} | Off-Leakage Current | $V_{DD} = 3.6V$ $V_{DP} = V_{DM} = 3.3V$ to $0.3V$ $V_{CB} = V_{DD}$ | -250 | -- | 250 | nA |

Electrical Characteristics - Dynamic Performance

$V_{DD} = 4.5V$ to $5.5V$, $T_A = 25^\circ C$ (unless specified otherwise)

| Parameter | Description | Condition/Note | Min. | Typ. | Max. | Unit |
|-----------------------|----------------------------------|--|-----------------|------|------|---------|
| T_{ON} | Turn On Time | V_{TDP} or $V_{TDM} = 1.5V$ $R_L = 300\Omega$ $C_L = 35pF$ | -- ¹ | 20 | 100 | μs |
| T_{OFF} | Turn Off Time | V_{TDP} or $V_{TDM} = 1.5V$ $R_L = 300\Omega$ $C_L = 35pF$ | -- ¹ | 1 | 5 | μs |
| T_{PLH} , T_{PHL} | TDP/TDM Switch Propagation Delay | $R_L = R_S = 50\Omega$ | -- | 60 | -- | ps |
| T_{SKEW} | Output Skew | Skew between DP and DM when connected to TDP and TDM $R_L = R_S = 50\Omega$ | -- | 40 | -- | ps |
| C_{OFF} | TDP/TDM Off-Capacitance | $f = 1MHz$ | -- ¹ | 2.0 | -- | pF |
| C_{ON} | DP/DM On-Capacitance | $f = 240MHz$ | -- ¹ | 4.0 | 5.5 | pF |
| BW | -3dB Bandwidth | $R_L = R_S = 50\Omega$ | -- | 1000 | -- | MHz |
| V_{ISO} | Off-Isolation | V_{TDP} , $V_{DP} = 0dBm$ $R_L = R_S = 50\Omega$ $f = 250MHz$ | -- | -20 | -- | dB |
| V_{CT} | Crosstalk | V_{TDP} , $V_{DP} = 0dBm$ $R_L = R_S = 50\Omega$ $f = 250MHz$ | -- | -25 | -- | dB |

Electrical Characteristics - Internal Resistors

$V_{DD} = 4.5V$ to $5.5V$, $T_A = 25^\circ C$ (unless specified otherwise)

| Parameter | Description | Condition/Note | Min. | Typ. | Max. | Unit |
|-----------|-----------------------|----------------|--------|-------|--------|-----------|
| R_{PD} | DP/DM Short Pull-down | | 350 | 500 | 700 | $k\Omega$ |
| RT_{RP} | RP1/RP2 Ratio | | 0.8544 | 0.863 | 0.872 | Ratio |
| R_{RP} | RP1 + RP2 Resistance | | 69.75 | 93.0 | 115.18 | $k\Omega$ |
| RT_{RM} | RM1/RM2 Ratio | | 1.485 | 1.5 | 1.515 | Ratio |
| R_{RM} | RM1 + RM2 Resistance | | 93.75 | 125.0 | 156.25 | $k\Omega$ |

Electrical Characteristics - Logic Input CB

$V_{DD} = 4.5V$ to $5.5V$, $T_A = 25^\circ C$ (unless specified otherwise)

| Parameter | Description | Condition/Note | Min. | Typ. | Max. | Unit |
|-----------|--------------------------|--|------|------|------|---------|
| V_{IH} | CB Input Logic High | | 1.4 | -- | -- | V |
| V_{IL} | CB Input Logic Low | | -- | -- | 0.4 | V |
| I_{IN} | CB Input Leakage Current | $V_{DD} = 5.5V$ $0 \leq V_{CB} \leq V_{IL}$ or $V_{IH} \leq V_{CB} \leq V_{DD}$ | -1 | -- | 1 | μA |

Electrical Characteristics - Logic Input SMART-CDP

$V_{DD} = 4.5V$ to $5.5V$, $T_A = 25^\circ C$ (unless specified otherwise)

| Parameter | Description | Condition/Note | Min. | Typ. | Max. | Unit |
|-----------|---------------------------------|--|------|------|------|---------|
| V_{IH} | SMART-CDP input Logic High | | 3.0 | -- | -- | V |
| V_{IL} | SMART-CDP input Logic Low | | -- | -- | 0.8 | V |
| I_{IN} | SMART-CDP Input Leakage Current | $V_{DD} = 5.5V$ $0V < V_{SMART-CDP} < V_{IL}$ or $V_{IH} < V_{SMART-CDP} < V_{DD}$ | -1 | -- | 1 | μA |

Electrical Characteristics - CEN#/CEN Outputs

$V_{DD} = 4.5V$ to $5.5V$, $T_A = 25^\circ C$ (unless specified otherwise)

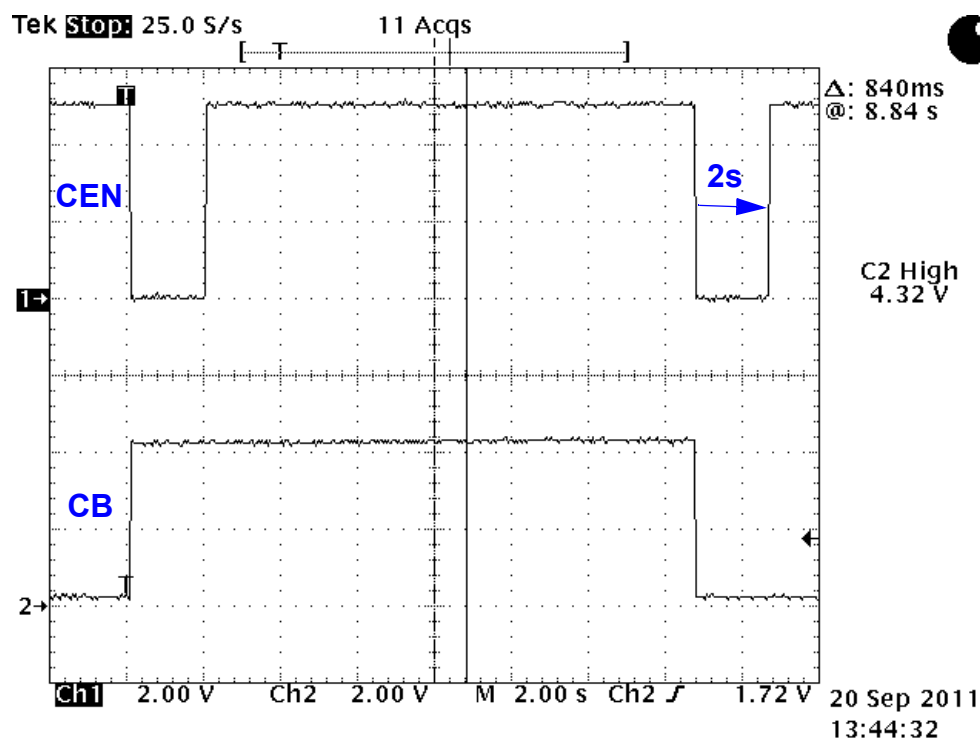
| Parameter | Description | Condition/Note | Min. | Typ. | Max. | Unit |
|------------------|--------------------------------|--|---------------|------|------|---------|
| T_{VBT} | V_{BUS} Toggle Time | CB = Logic 0 to Logic 1 or Logic 1 to Logic 0 | 1.5 | 2.0 | 2.5 | s |
| $V_{OH_CEN\#}$ | CEN# Output Logic High Voltage | CB = Logic 0 to Logic 1 $I_{SOURCE} = 2mA$ | $V_{DD}-0.4V$ | -- | -- | V |
| $I_{OUT_CEN\#}$ | CEN# Output Leakage Current | $V_{DD} = 5.5V$ $V_{CEN\#} = 0V$ or CEN# deasserted | -- | -- | 1 | μA |
| V_{OL_CEN} | CEN Output Logic Low Voltage | CB = Logic 0 to Logic 1 $I_{SINK} = 2mA$ | -- | -- | 0.4V | V |
| I_{OUT_CEN} | CEN Output Leakage Current | $V_{DD} = 5.5V$ $V_{CEN} = 5.5V$ or CEN deasserted | -- | -- | 1 | μA |

Electrical Characteristics - ESD Protection

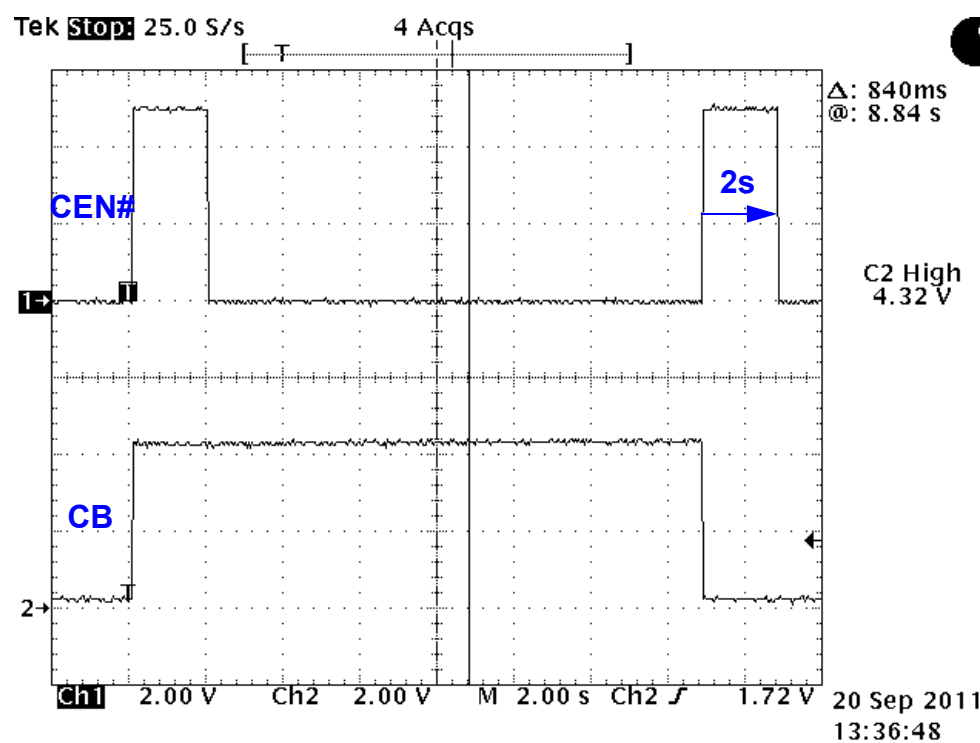
$V_{DD} = 4.5V$ to $5.5V$, $T_A = 25^\circ C$ (unless specified otherwise)

| Parameter | Description | Condition/Note | Min. | Typ. | Max. | Unit |
|-----------|---------------------------------------|------------------|------|---------|------|------|
| V_{ESD} | ESD Protection Level (DP and DM Only) | Human Body Model | -- | ± 8 | -- | kV |
| V_{ESD} | ESD Protection Level (All other pins) | Human Body Model | -- | ± 2 | -- | kV |

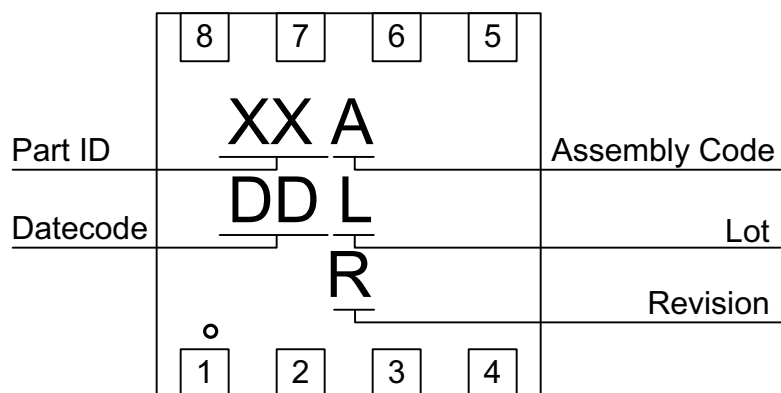
CEN Function Waveform



CEN# Function Waveform



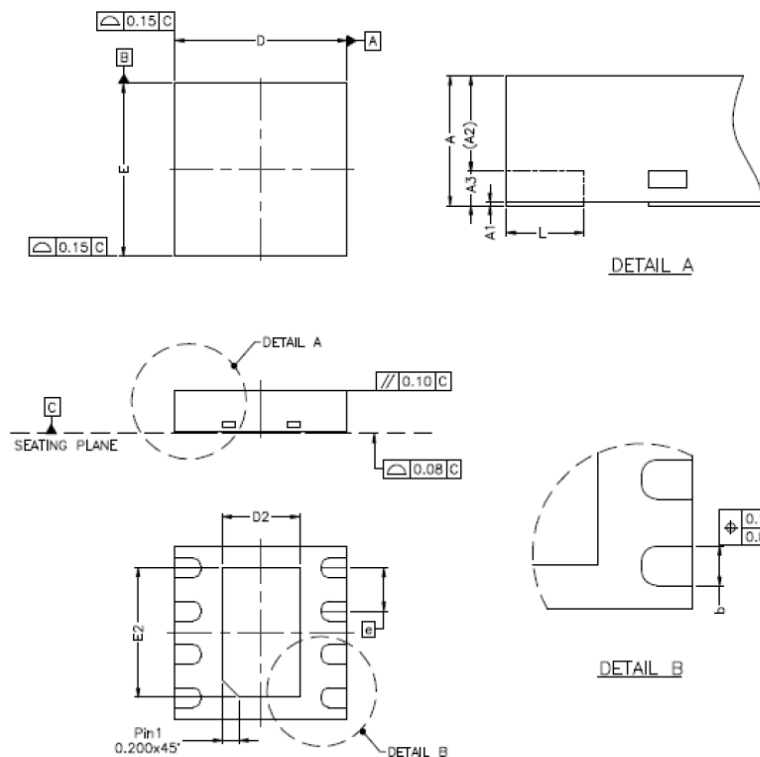
Package Top Marking System Definition



- XX – Part ID Field: identifies the specific device configuration
- A – Assembly Code Field: Assembly Location of the device.
- DD – Date Code Field: Coded date of manufacture
- L – Lot Code: Designates Lot #
- R – Revision Code: Device Revision

Package Drawing and Dimensions

8 Lead TDFN Package
JEDEC MO-229, Variation WCCD



| SYMBOL | DIMENSION (MM) | | | DIMENSION (MIL) | | |
|--------|----------------|------|------|-----------------|------|------|
| | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| A | 0.70 | 0.75 | 0.80 | 28 | 30 | 31 |
| A1 | 0.00 | 0.02 | 0.05 | 0 | 1 | 2 |
| A2 | 0 | 0.55 | 0.80 | 0 | 22 | 31 |
| A3 | — | 0.20 | — | — | 8 | — |
| b | 0.18 | 0.25 | 0.30 | 7 | 10 | 12 |
| D | 1.90 | 2.00 | 2.10 | 74 | 79 | 83 |
| D1 | — | | | — | | |
| D2 | 0.75 | 0.90 | 1.05 | 30 | 35 | 41 |
| E | 1.90 | 2.00 | 2.10 | 75 | 79 | 83 |
| E1 | — | | | — | | |
| E2 | 1.50 | 1.65 | 1.70 | 53 | 59 | 65 |
| e | 0.50 BSC | | | 20 BSC | | |
| L | 0.25 | 0.30 | 0.35 | 10 | 12 | 14 |

NOTE :

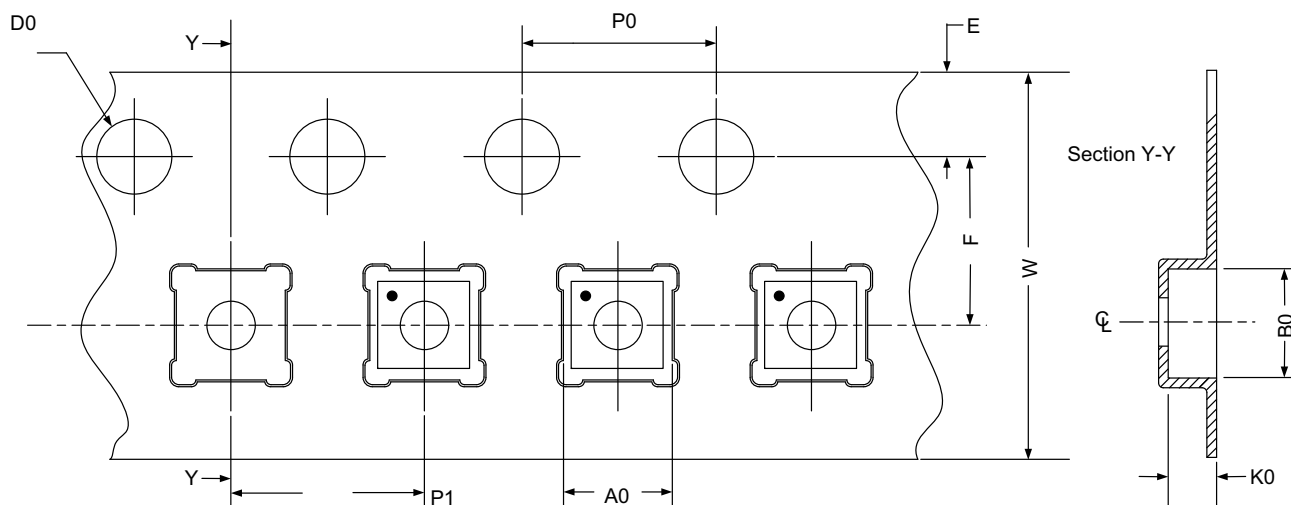
1. REFER TO JEDEC STD: MO-229.
2. DIMENSION "b" APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15MM AND 0.30MM FROM THE TERMINAL TIP. IF THE TERMINAL HAS OPTIONAL RADIUS ON THE OTHER END OF THE TERMINAL, THE DIMENSION "b" SHOULD NOT BE MEASURED IN THAT RADIUS AREA.

Tape and Reel Specifications

| Package Type | # of Pins | Nominal Package Size [mm] | Max Units | | Reel & Hub Size [mm] | Leader (min) | | Trailer (min) | | Tape Width [mm] | Part Pitch [mm] |
|---------------|-----------|---------------------------|-----------|---------|----------------------|--------------|-------------|---------------|-------------|-----------------|-----------------|
| | | | per Reel | per Box | | Pockets | Length [mm] | Pockets | Length [mm] | | |
| TDFN 8L Green | 8 | 2 x 2 x 0.75 | 3,000 | 3,000 | 178 / 60 | 100 | 400 | 100 | 400 | 8 | 4 |

Carrier Tape Drawing and Dimensions

| Package Type | Pocket BTM Length | Pocket BTM Width | Pocket Depth | Index Hole Pitch | Pocket Pitch | Index Hole Diameter | Index Hole to Tape Edge | Index Hole to Pocket Center | Tape Width |
|---------------|-------------------|------------------|--------------|------------------|--------------|---------------------|-------------------------|-----------------------------|------------|
| | A0 | B0 | K0 | P0 | P1 | D0 | E | F | W |
| TDFN 8L Green | 2.3 | 2.3 | 1.05 | 4 | 4 | 1.55 | 1.75 | 3.5 | 8 |



Refer to EIA-481 specification

Recommended Reflow Soldering Profile

Please see IPC/JEDEC J-STD-020: latest revision for reflow profile based on package volume of 3.00 mm³ (nominal). More information can be found at www.jedec.org.

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