

# CHY100 ChiPhy™ Family

## Charger Interface Physical Layer IC

### Product Highlights

- Fully supports Quick Charge 2.0 specification
  - Class A: 5 V, 9 V, and 12 V output voltage
  - Class B: 5 V, 9 V, 12 V, and 20 V output voltage
- USB battery charging specification revision 1.2 compatible
  - Automatic USB DCP shorting D+ to D- line
  - Default 5 V mode operation
- Supports TOPSwitch and TinySwitch
- Very low power consumption
  - Below 1 mW at 5 V output
- Fail safe operation
  - Adjacent pin-to-pin short-circuit fault
  - Open circuit pin fault

### Typical Applications

- Battery chargers for smart phones, tablets, netbooks, digital cameras, and bluetooth accessories
- USB power output ports

### Description

CHY100 is a low-cost USB high-voltage dedicated charging port (HVDCP) interface IC for the Quick Charge 2.0 specification. It incorporates all necessary functions to add Quick Charge 2.0 capability to Power Integrations' switcher ICs such as TOPSwitch or TinySwitch and other solutions employing traditional feedback schemes.

CHY100 supports the full output voltage range of either Class A or Class B. Optionally Class B can be inhibited for protecting the battery charger from accidental damage.

CHY100 automatically detects whether a connected Powered Device (PD) is Quick Charge 2.0 capable before enabling output voltage adjustment. If a PD not compliant to Quick Charge 2.0 is detected the CHY100 disables output voltage adjustment to ensure safe operation with legacy 5 V only USB PDs.

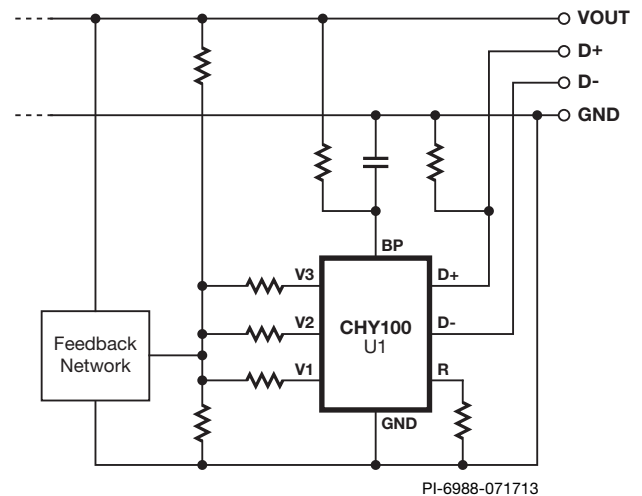
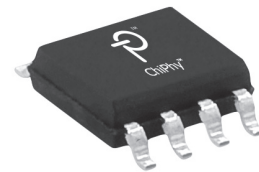
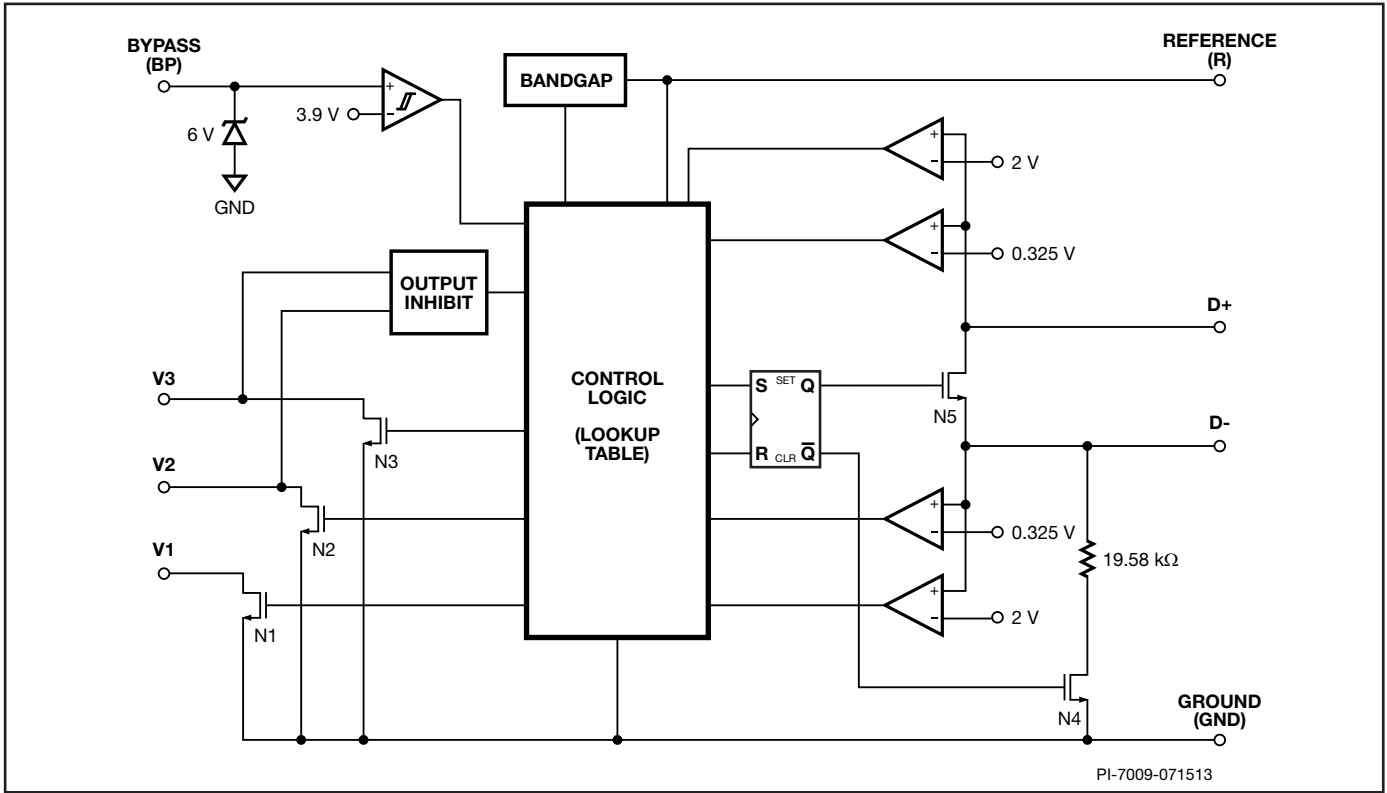


Figure 1. Typical Application Schematic.



SO-8 (D Package)

Figure 2. Package Option.



PI-7009-071513

Figure 3. Functional Block Diagram.

## Pin Functional Description

### GROUND (GND) Pin

Ground.

### V1 Pin

Open Drain input of output voltage adjustment switch. Active for 9 V, 12 V, and 20 V output setting.

### V2 Pin

Open Drain input of output voltage adjustment switch. Active for 12 V, and 20 V output setting.

### V3 Pin

Open Drain input of output voltage adjustment switch. Active for 20 V output setting.

### BYPASS (BP) Pin

Connection point for an external bypass capacitor for the internally generated supply voltage.

### REFERENCE (R) Pin

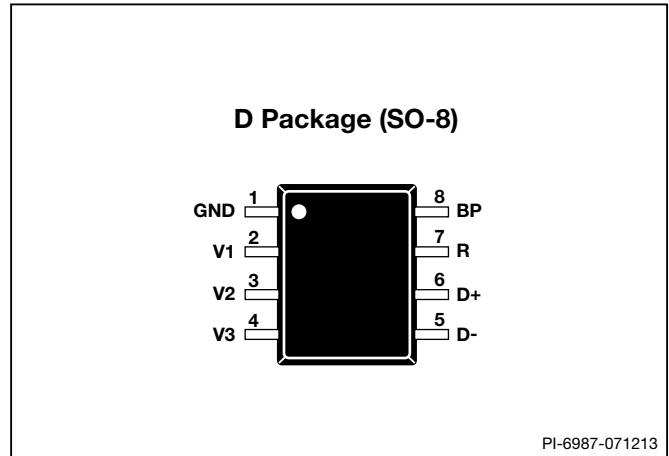
Connected to internal band-gap reference. Provides reference current through connected resistor.

### DATA LINE D+ Pin

USB D+ data line input.

### DATA LINE D- Pin

USB D- data line input.



PI-6987-071213

Figure 4. Pin Configuration.

## Functional Description

CHY100 is a low-cost USB high-voltage dedicated charging port (HVDCP) interface IC for the Quick Charge 2.0 specification. It incorporates all necessary functions to add Quick Charge 2.0 capability to Power Integrations' integrated switcher ICs such as TOPSwitch or TinySwitch.

CHY100 also supports other solutions with traditional feedback schemes like optocoupler and secondary reference regulator TL431 as depicted in Figure 5.

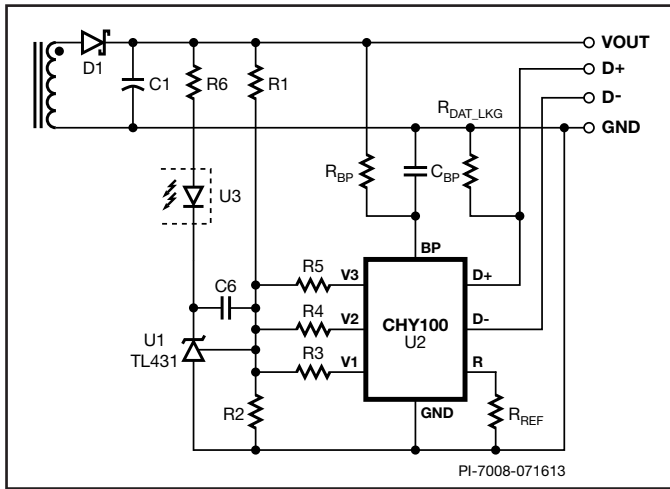


Figure 5. CHY100 with Traditional Output Regulation (CV Only).

CHY100 supports the full output voltage range of Quick Charge 2.0 Class A (5 V, 9 V, or 12 V) or Class B (5 V, 9 V, 12 V, or 20 V). It automatically detects either Quick Charge 2.0 capable powered devices (PD) or legacy PDs compliant with the USB Battery Charging Specification revision 1.2 and only enables output voltage adjustment accordingly.

### Shunt Regulator

The internal shunt regulator clamps the BYPASS pin at 6 V when current is provided through an external resistor ( $R_{BP}$  in Figure 5). This facilitates powering of CHY100 externally over the wide power supply output voltage range of 5 V to 20 V. Recommended values are  $R_{BP} = 4.53 \text{ k}\Omega$  and  $C_{BP} = 220 \text{ nF}$ .

### BYPASS Pin Undervoltage

The BYPASS pin undervoltage circuitry resets the CHY100 when the BYPASS pin voltage drops below 3.9 V. Once the BYPASS pin voltage drops below 3.9 V it must rise back to 4 V to enable correct operation.

### Reference Input

Resistor  $R_{REF}$  at the REFERENCE pin is connected to an internal band gap reference and provides an accurate reference current for internal timing circuits. The recommended value is  $R_{REF} = 127 \text{ k}\Omega$ .

## Quick Charge 2.0 Interface

At power-up CHY100 turns on switch N5 (see Figure 3) in 20 ms or less after the BYPASS pin voltage has reached 4 V. Switch N4 and output switches N1 to N3 remain off. This sets the default 5 V output voltage level. With D+ and D- short-circuited the normal handshake between the AC-DC adapter (DCP) and powered devices (PD) as described in the USB Battery Charging Specification 1.2 can commence. After switch N5 has been turned on CHY100 starts monitoring the voltage level at D+. If it continuously stays above  $V_{DAT(REF)}$  (typ. 0.325 V) and below  $V_{SEL(REF)}$  (typ. 2 V) for at least 1.25 seconds CHY100 will enter Quick Charge 2.0 operation mode. If the voltage at D+ drops any time below 0.325 V CHY100 resets the 1.25 seconds timer and stays in USB Battery Charging Specification 1.2 compatibility mode with a default output voltage of 5 V.

Once CHY100 has entered Quick Charge 2.0 operation mode switch N5 will be turned off. Additionally switch N4 is turned on connecting a 19.53 k $\Omega$  pull-down resistor to D-. As soon as the voltage at D- has dropped low (<0.325 V) for at least 1 ms CHY100 starts accepting requests for different AC-DC adapter output voltages by means of applied voltage levels at data lines D+ and D- through the powered device. Table 1 summarizes the output voltage lookup table, corresponding AC-DC adapter output voltages and status of switches N1 to N3.

| D+    | D-    | Output        | Switch Status          |
|-------|-------|---------------|------------------------|
| 0.6 V | 0.6 V | 12 V          | N1 = N2 = On, N3 = Off |
| 3.3 V | 0.6 V | 9 V           | N1 = On, N2 = N3 = Off |
| 3.3 V | 3.3 V | 20 V          | N1 = N2 = N3 = On      |
| 0.6 V | GND   | 5 V (default) | N1 = N2 = N3 = Off     |

Table 1. Output Voltage Lookup Table.

For Quick Charge 2.0 Class A support only, the V3 pin has to be connected to the BYPASS pin (directly or through a resistor up to 100 k $\Omega$ ). This will inhibit any requests for setting a 20 V output.

At USB cable disconnect the voltage level at D+ is pulled down by resistor  $R_{DAT(LKG)}$  (see Figure 5). Once it drops below 0.325 V CHY100 will turn on switch N5 (thereby short-circuiting D+ and D-) and turns off switches N1 to N4. This sets the default output voltage of 5 V. The recommended value for  $R_{DAT(LKG)} = 390 \text{ k}\Omega$ .

## Absolute Maximum Ratings

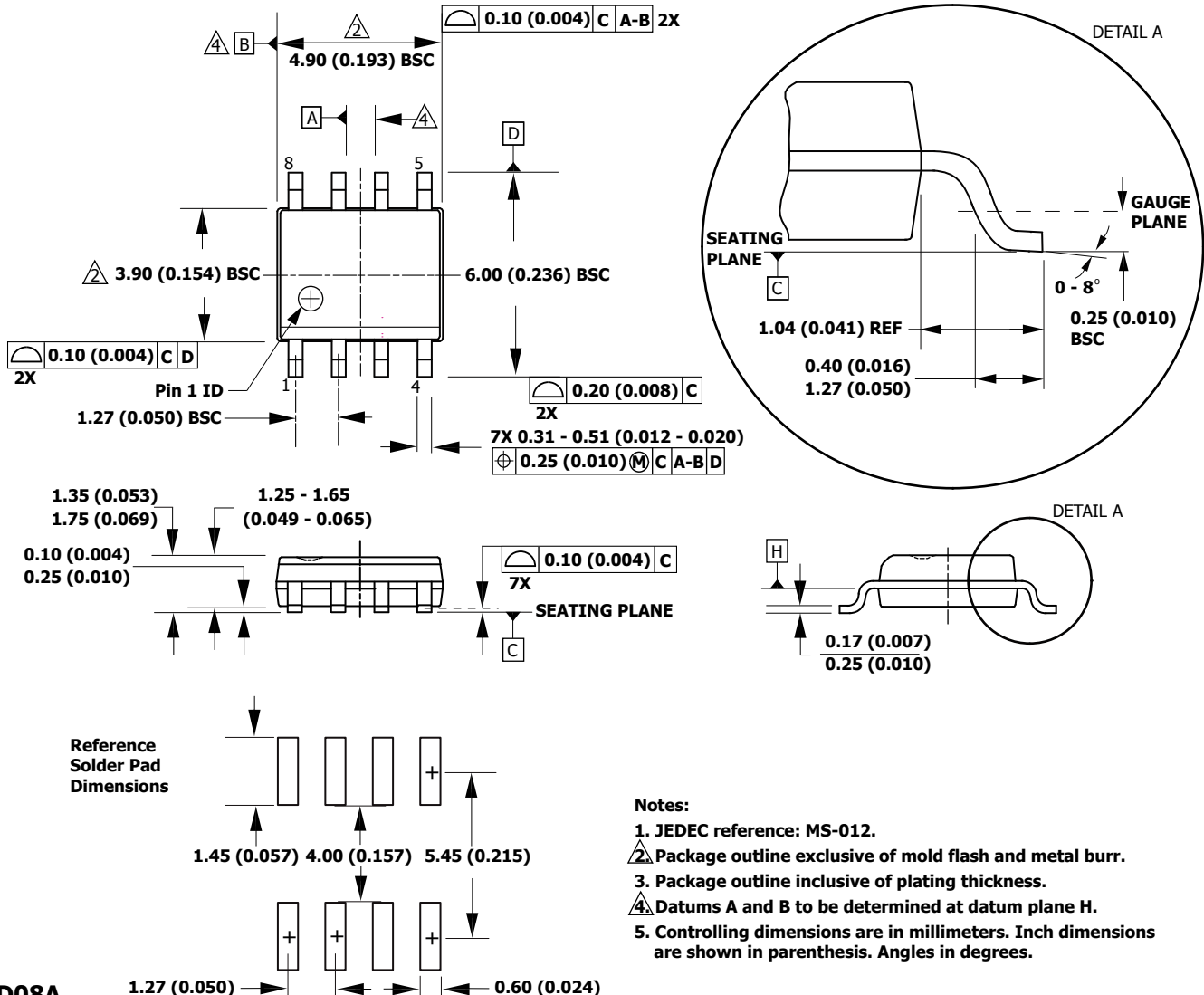
|                             |             |                                       |                   |
|-----------------------------|-------------|---------------------------------------|-------------------|
| BYPASS Pin Voltage .....    | -0.3 to 9 V | Operating Junction Temperature.....   | -40 °C to +150 °C |
| REFERENCE Pin Voltage ..... | -0.3 to 9 V | Operating Ambient Temperature.....    | -40 °C to 105 °C  |
| V1/V2/V3 Pin Voltage .....  | -0.3 to 9 V | Storage Temperature .....             | -65 °C to 150 °C  |
| D+/D- Pin Voltage .....     | -0.3 to 5 V | Lead Temperature <sup>(1)</sup> ..... | 260 °C            |
| BYPASS Pin Current .....    | 25 mA       | Notes:                                |                   |
| V1/V2/V3 Pin Current .....  | 0.5 mA      | 1. 1/16 in. from case for 5 seconds.  |                   |
| D+/D- Pin Current .....     | 1 mA        |                                       |                   |

| Parameter   | Symbol                            | Conditions<br>SOURCE = 0 V; T <sub>J</sub> = -20 °C to +85 °C<br>(Unless Otherwise Specified) | Min                   | Typ   | Max  | Units |
|---|-----------------------------------|---|-----------------------|-------|------|-------|
| <b>Supply, Reference and Protection Functions</b> |                                   |   |                       |       |      |       |
| <b>BYPASS Pin Voltage</b>                         | V <sub>BP</sub>                   |   | 4                     | 5     | 6    | V     |
| <b>Power-Up Reset Threshold Voltage</b>           | V <sub>BP(RESET)</sub>            |   | 2.0                   |       | 3.9  | V     |
| <b>BYPASS Pin Source Current</b>                  | I <sub>BPSC</sub>                 | V <sub>BP</sub> = 4.3 V, T <sub>J</sub> = 25 °C<br>N1 = N2 = N3 = Off                         |                       |       | 135  | μA    |
| <b>BYPASS Pin Shunt Voltage</b>                   | V <sub>BP(SHUNT)</sub>            | I <sub>BP</sub> = 3 mA  | 5.7                   | 6     | 6.3  | V     |
| <b>REFERENCE Pin Voltage</b>                      | V <sub>R</sub>                    |   | 1.18                  | 1.23  | 1.28 | V     |
| <b>HVDCP Functions</b>                            |                                   |   |                       |       |      |       |
| <b>Data Detect Voltage</b>                        | V <sub>DAT(REF)</sub>             |   | 0.25                  | 0.325 | 0.4  | V     |
| <b>Output Voltage Selection Reference</b>         | V <sub>SEL(REF)</sub>             |   | 1.8                   | 2     | 2.2  | V     |
| <b>12 V / 20 V Output Inhibit Threshold</b>       | V <sub>INH</sub>                  |   | V <sub>BP</sub> - 0.6 |       |      | V     |
| <b>Data Lines Short-Circuit Delay</b>             | T <sub>DAT(SHORT)</sub>           | V <sub>OUT</sub> ≥ 0.8 V<br>See Figure 5  |                       | 10    | 20   | ms    |
| <b>D+ High Glitch Filter Time</b>                 | T <sub>GLITCH(BC)<br/>DONE</sub>  |   | 1000                  | 1250  | 1500 | ms    |
| <b>Output Voltage Glitch Filter Time</b>          | T <sub>GLITCH(V)<br/>CHANGE</sub> |   | 20                    | 40    | 60   | ms    |
| <b>D- Pull-Down Resistance</b>                    | R <sub>DM(DWN)</sub>              |   | 14.25                 | 19.53 | 24.5 | kΩ    |
| <b>Switch N1 On-Resistance</b>                    | R <sub>DS(ON)N1</sub>             | I <sub>N1</sub> = 200 μA  |                       |       | 300  | Ω     |
| <b>Switch N2 On-Resistance</b>                    | R <sub>DS(ON)N2</sub>             | I <sub>N2</sub> = 200 μA  |                       |       | 300  | Ω     |
| <b>Switch N3 On-Resistance</b>                    | R <sub>DS(ON)N3</sub>             | I <sub>N3</sub> = 200 μA  |                       |       | 300  | Ω     |
| <b>Switch N4 On-Resistance</b>                    | R <sub>DS(ON)N4</sub>             | I <sub>N4</sub> = 200 μA  |                       |       | 300  | Ω     |
| <b>Switch N5 On-Resistance</b>                    | R <sub>DS(ON)N5</sub>             | I <sub>N5</sub> = 200 μA, V <sub>(D+)</sub> ≤ 3.6 V   |                       | 20    | 40   | Ω     |
| <b>Data Line Capacitance</b>                      | C <sub>DCP(PWR)</sub>             | See Note A  |                       |       | 1    | nF    |

NOTES:

A. Guaranteed by design. Not tested in production.

SO-8 (D Package)

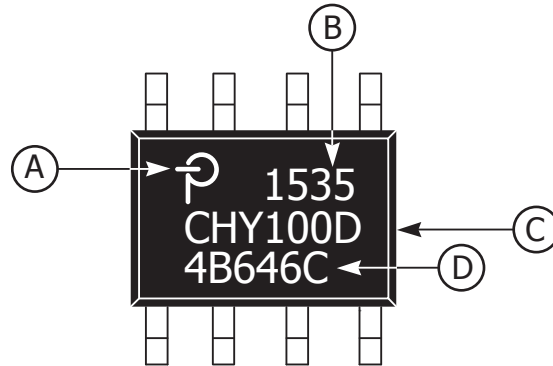


D08A

PI-5615-020515

**PACKAGE MARKING**

**SO-8 Package Marking**



- A. Power Integrations Registered Trademark
- B. Assembly Date Code (last two digits of year followed by 2-digit work week)
- C. Product Identification (Part #/Package Type)
- D. Lot Identification Code

PI-8059-083016

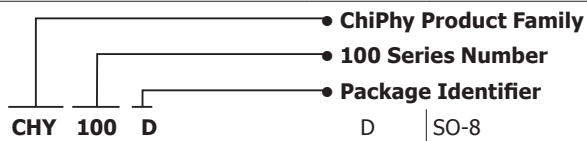
**MSL Table**

| Part Number | MSL Rating |
|-------------|------------|
| CHY100D     | 1          |

**ESD and Latch-Up Table**

| Test                 | Conditions                  | Results                                |
|----------------------|-----------------------------|--|
| Latch-up at 125 °C   | JESD78D                     | > ±100 mA or > 1.5 V (max) on all pins |
| Human Body Model ESD | ANSI/ESDA/JEDEC JS-001-2014 | > ±2000 V on all pins                  |
| Machine Model ESD    | JESD22-A115C                | > ±200 V on all pins                   |

**Part Ordering Information**



| Revision | Notes   | Date  |
|----------|---|-------|
| A        | Initial Release.  | 07/13 |
| B        | Extended Ambient Temperature to -40 °C.                   | 01/14 |
| C        | Added Note for Class A Charger on page 3.                 | 03/14 |
| D        | Updated with new Brand Style.                             | 06/15 |
| E        | Added Package Marking, MSL Table, ESD and Latch-Up Table. | 08/16 |

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