Charger Detection Device with High Speed USB Switch Battery Charger Specification v1.2

Check for Samples: bq24392

FEATURES

- Charger Detection Device
  - USB BCv1.2 Compliant
  - VBUS Detection
  - Data Contact Detection
  - Primary & Secondary Detection
  - Dead Battery Provision (DBP) 32-min Timer
- Switch
  - USB 2.0 High Speed Switch
- Compatible Accessories
  - Dedicated Charging Port
  - Standard Charging Port
  - Charging Port
- Other Chargers Detected
  - Apple™ Charger
  - TomTom™ Charger
  - Non Compliant USB Charger

APPLICATIONS

- Cell Phones
- Smart-Phones
- Tablets
- Camera & GPS Systems

TYPICAL APPLICATION DIAGRAM

ORDERING INFORMATION(1)

<table>
<thead>
<tr>
<th>℃</th>
<th>PACKAGE(2)</th>
<th>ORDERABLE PART NUMBER</th>
<th>TOP-SIDE MARKING</th>
</tr>
</thead>
<tbody>
<tr>
<td>−40°C to 85°C</td>
<td>μQFN 0.5-mm pitch – RSE</td>
<td>BQ24392RSER</td>
<td>APH</td>
</tr>
</tbody>
</table>

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.

(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.

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DESCRIPTION
The bq24392 is a charger detection device with an integrated isolation switch for use with a micro/mini USB port. The device is compliant with USB Battery Charging specification v1.2. This device allows cell phones and tablets to be charged from different adapters including USB BCv1.2 compliant and non-standard USB chargers. These non-standard chargers include Apple, TomTom, and non-compliant USB chargers. The bq24392 conforms to Dead Battery Provision (DBP) specified in BCv1.2. This includes a 32-min timer that cannot exceed 45 mins.

The bq24392 has a USB 2.0 switch that supports high speed. In addition to a USB connector and host pins, bq24392 has one input and three output pins. This results in a minimum software workload for the system to interact with the device.

$V_{BUS}$ has 28V tolerance to avoid external protection. Power for this device is supplied through VBUS when accessory is attached.

BLOCK DIAGRAM

BQ24392

- Charger detection device
- USB2.0 High Speed Switch

Micro-USB Port
- ID_CONV: No connect

BQ24392 Logic
- Controls the state of SW_OPEN, CHG_AL_N & CHG_DET
- The state of the three output pins will follow the detection table included in the specification
<table>
<thead>
<tr>
<th>PIN NO.</th>
<th>NAME</th>
<th>I/O</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SW_OPEN</td>
<td>O</td>
<td>Open-drain output. 10kΩ external pull-up resistor. This pin indicates the status of the USB switch. SW_OPEN = LOW then switch is connected SW_OPEN = HIGH-Z then switch is not connected</td>
</tr>
<tr>
<td>2</td>
<td>DM_HOST</td>
<td>I/O</td>
<td>D– signal to transceiver</td>
</tr>
<tr>
<td>3</td>
<td>DP_HOST</td>
<td>I/O</td>
<td>D+ signal to transceiver</td>
</tr>
<tr>
<td>4</td>
<td>CHG_AL_N</td>
<td>O</td>
<td>Open-drain output add 10kΩ external pull-up resistor. This pin indicates when charging is allowed. CHG_AL_N = LOW then charging allowed CHG_AL_N = HIGH-Z then no charging</td>
</tr>
<tr>
<td>5</td>
<td>GOOD_BAT</td>
<td>I</td>
<td>Input from the system This pin indicates the status of the battery GOOD_BAT = LOW indicates a dead battery GOOD_BAT = HIGH indicates a good battery</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
<td></td>
<td>USB DM connected to USB receptacle</td>
</tr>
<tr>
<td>7</td>
<td>DP_CON</td>
<td>I/O</td>
<td>D+ signal from USB connector</td>
</tr>
<tr>
<td>8</td>
<td>DM_CON</td>
<td>I/O</td>
<td>D– signal from USB connector</td>
</tr>
<tr>
<td>9</td>
<td>VBUS</td>
<td>I</td>
<td>Supply pin from USB connector</td>
</tr>
<tr>
<td>10</td>
<td>CHG_DET</td>
<td>O</td>
<td>Push-pull output to the system This pin indicates if a charger is detected by the device CHG_DET = LOW indicates a charger is not detected CHG_DET = HIGH indicates a charger detected</td>
</tr>
</tbody>
</table>
SUMMARY OF TYPICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>USB Path (DP_CON and DM_CON)</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-state resistance ($r_{on}$)</td>
<td>8 Ω</td>
</tr>
<tr>
<td>On-state resistance match ($Δr_{on}$)</td>
<td>0.5 Ω</td>
</tr>
<tr>
<td>On-state resistance flatness ($f_{on/flat}$)</td>
<td>0.5 Ω</td>
</tr>
<tr>
<td>Bandwidth (BW)</td>
<td>920 MHz</td>
</tr>
<tr>
<td>Off isolation ($O_{ISO}$)</td>
<td>–26 dB at 250 MHz</td>
</tr>
<tr>
<td>Crosstalk ($X_{TALK}$)</td>
<td>–32 dB at 250 MHz</td>
</tr>
<tr>
<td>Leakage current ($I_{IO(ON)}$)</td>
<td>50 nA</td>
</tr>
</tbody>
</table>

ABSOLUTE MAXIMUM RATINGS
over –40°C to 85°C temperature range (unless otherwise noted)

<table>
<thead>
<tr>
<th>Pin voltage range</th>
<th>VBUS</th>
<th>Pin voltage range</th>
<th>CHG_AL_N</th>
<th>All Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSOLUTE MAX</td>
<td>–2 to 28 V</td>
<td>ABSOLUTE MAX</td>
<td>–2 to 28 V</td>
<td>–0.3 to 7 V</td>
</tr>
<tr>
<td>UNIT</td>
<td>V</td>
<td>UNIT</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>HBM</td>
<td>4000 V</td>
<td>CDM</td>
<td>1500 V</td>
<td>IEC Contact Discharge (DP_CON, DM_CON to GND)</td>
</tr>
</tbody>
</table>

RECOMMENDED OPERATING CONDITIONS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>MIN</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>VBUS</td>
<td>4.75</td>
<td>5.25</td>
<td>V</td>
</tr>
</tbody>
</table>

THERMAL IMPEDANCE RATINGS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RSE PACKAGE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$θ_{JA}$</td>
<td>184</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

GENERAL ELECTRICAL SPECIFICATION
over –40°C to 85°C temperature range (unless otherwise noted)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{BUS_VALID}$</td>
<td>VBUS Valid threshold</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{CHG_DET}$</td>
<td>Rising VBUS threshold</td>
<td></td>
<td>3.5</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{CHG_AL_N}$</td>
<td>$I_{OH} = –2 \text{ mA}$</td>
<td>3.5</td>
<td>VBSU(1)</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{OL}$</td>
<td>$I_{OL} = 2 \text{ mA}$</td>
<td></td>
<td>0.4</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{IH}$</td>
<td>GOOD_BAT</td>
<td>1.1</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{IL}$</td>
<td>GOOD_BAT</td>
<td></td>
<td>0.5</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$R_{PD}$</td>
<td>Internal pull-down resistor</td>
<td>950</td>
<td></td>
<td></td>
<td>kΩ</td>
</tr>
<tr>
<td>$I_{Q_SWON}$</td>
<td>Current consumption</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$VBUS = 5\text{ V}; USB Switch ON;$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$GOOD_BAT VIH Min = 1.1 \text{ V}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$250 \mu A$</td>
<td></td>
<td></td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>$I_{Q_SWON}$</td>
<td>$VBUS = 5\text{ V}; USB Switch ON;$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$GOOD_BAT VIH Min = 2.5 \text{ V}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$80 \mu A$</td>
<td></td>
<td></td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>$I_{Q_SWOFF}$</td>
<td>$VBUS = 5\text{ V}; USB Switch OFF;$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$45 \mu A$</td>
<td></td>
<td></td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>$I_{DBP}$</td>
<td>Dead battery provision timer</td>
<td></td>
<td>32</td>
<td>45</td>
<td>Mins</td>
</tr>
</tbody>
</table>

(1) CHG_DET Max value will be clamped at 7V when VBUS > 7V.
USB SWITCHING ELECTRICAL CHARACTERISTICS

$V_{BUS} = 4.5V$ to $5.5\, V$, $T_A = -40^\circ\, C$ to $85^\circ\, C$ (unless otherwise noted)\(^{(1)}\)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{USBIO}$</td>
<td>Analog signal range</td>
<td>0</td>
<td>3.6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$r_{ON}$</td>
<td>ON-state resistance</td>
<td>DM_CON, DP_CON, DM_HOST, DP_HOST</td>
<td>$V_I = 0, V$ to $3.6, V$, $I_O = -2, mA$</td>
<td>8</td>
<td>$\Omega$</td>
</tr>
<tr>
<td>$\Delta r_{ON}$</td>
<td>ON-state resistance match between channels</td>
<td>DM_CON, DP_CON, DM_HOST, DP_HOST</td>
<td>$V_I = 0.4, V$, $O = -2, mA$</td>
<td>0.5</td>
<td>$\Omega$</td>
</tr>
<tr>
<td>$r_{ON(\text{flat})}$</td>
<td>ON-state resistance flatness</td>
<td>DM_CON, DP_CON, DM_HOST, DP_HOST</td>
<td>$V_I = 0, V$ to $3.6, V$, $I_O = -2, mA$</td>
<td>1.1</td>
<td>$\Omega$</td>
</tr>
<tr>
<td>$I_{O(OFF)}$</td>
<td>VI or VO OFF leakage current</td>
<td>$V_I = 0.3, V$, $V_O = 2.7, V$ or $V_I = 2.7, V$, $V_O = 0.3, V$, Switch OFF</td>
<td>45</td>
<td>nA</td>
<td></td>
</tr>
<tr>
<td>$I_{O(ON)}$</td>
<td>VO ON leakage current</td>
<td>$V_I = \text{OPEN}$, $V_O = 0.3, V$ or $2.7, V$, Switch ON</td>
<td>50</td>
<td>nA</td>
<td></td>
</tr>
</tbody>
</table>

**DYNAMIC**

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_{I(OFF)}$</td>
<td>VI OFF capacitance</td>
<td>DC bias $= 0, V$ or $3.6, V$, $f = 10, MHz$, Switch OFF</td>
<td>2</td>
<td>pF</td>
<td></td>
</tr>
<tr>
<td>$C_{O(OFF)}$</td>
<td>VO OFF capacitance</td>
<td>DC bias $= 0, V$ or $3.6, V$, $f = 10, MHz$, Switch OFF</td>
<td>10</td>
<td>pF</td>
<td></td>
</tr>
<tr>
<td>$C_{I(ON)}$, $C_{O(ON)}$</td>
<td>VI, VO ON capacitance</td>
<td>DC bias $= 0, V$ or $3.6, V$, $f = 10, MHz$, Switch ON</td>
<td>11</td>
<td>pF</td>
<td></td>
</tr>
<tr>
<td>BW</td>
<td>Bandwidth</td>
<td>$R_L = 50, \Omega$, Switch ON</td>
<td>920</td>
<td>MHz</td>
<td></td>
</tr>
<tr>
<td>$O_{ISO}$</td>
<td>OFF Isolation</td>
<td>$f = 240, MHz$, $R_L = 50, \Omega$, Switch OFF</td>
<td>$-26$</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>$X_{TALK}$</td>
<td>Crosstalk</td>
<td>$f = 240, MHz$, $R_L = 50, \Omega$</td>
<td>$-30.5$</td>
<td>dB</td>
<td></td>
</tr>
</tbody>
</table>

\(^{(1)}\) $V_O$ is equal to the asserted voltage on DP\_CON, DM\_CON pins.

$V_I$ is equal to the asserted voltage on DP\_HOST and DM\_HOST pins.

$I_O$ is equal to the current on the DP\_CON, DM\_CON.

$I_I$ is equal to the current on the DP\_HOST and DM\_HOST pins.
GENERAL OPERATION

The bq24392 is designed to interface a micro/mini USB connector to external peripherals.

The device will automatically detect different types of chargers through the mini/micro USB pin connector. The bq24392 has a high speed USB 2.0 switch that can be automatically opened and closed based on the accessory detected.

DETECTION SEQUENCE

After accessory insertion, once VBUS voltage is greater than $V_{BUS\_VALID}$ threshold, the device proceeds onto data contact detection. This state has a 600ms timeout feature specified in BCDv1.2. Depending on the result, the next step is primary detection or non-compatible USB charger detection. In the case of former, the next step is detecting a Standard Downstream Port (SDP), Dedicated Charging Port (DCP), or Charging Downstream Port (CDP). In the case of latter, the next step is detecting an Apple, TomTom, or Non-compliant Charger.

The USB 2.0 switches are automatically closed to enable data transfer if either SDP or CDP is detected and the GOOD_BAT input is HIGH.

Once a charger has been detected, and if the GOOD_BAT input is LOW, a Dead Battery timer is initiated. If the GOOD_BAT continues to be LOW for 30 minutes (maximum of 45 minutes), charging is disabled. Toggling GOOD_BAT HIGH after DBP timer expires will re-start detection.

The following flow-chart shows the detection sequence used in the bq24392.
Flow Chart of Detection Sequence

POWERUP

VBUS > VBUS_UV

IDLE

VBUS > VBUS_VALID

GOOD_BAT = 1

DATA CONTACT DETECTION
600ms Timeout Feature

USB COMPLIANT

PRIMARY DETECTION

USB NON COMPLIANT

CHECK VOLTAGE LEVEL ON DP_CON & DM_CON

SDP

CHARGER

Standard Downstream Port

GOOD_BAT=1

GOOD_BAT=0

USB SWITCH ON

USB SWITCH OFF

SECONDARY DETECTION

Apple Charger

TomTom Charger

No Charger

GOOD_BAT=1

GOOD_BAT=0

Dedicated Charging Port

Charging Downstream Port

GOOD_BAT=1

GOOD_BAT=0

USB SWITCH ON

USB SWITCH OFF

Start DBP Timer

32 Mins Expire

Disable Charging
Detection Table

The table below lists the configurations of the DP_CON (D+) and DM_CON (D–) that are internal to the various device types.

<table>
<thead>
<tr>
<th>Device Type</th>
<th>VBUS</th>
<th>DP_CON (D+)</th>
<th>DM_CON (D–)</th>
<th>GOOD_BAT (Input)</th>
<th>CHG_AL_N (Output)</th>
<th>CHG_DET (Output)</th>
<th>SW_OPEN (Output)</th>
<th>Switch Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Downstream Port</td>
<td>&gt;3.5V</td>
<td>Pull-down R to GND</td>
<td>Pull-down R to GND</td>
<td>HIGH</td>
<td>LOW</td>
<td>LOW</td>
<td>LOW</td>
<td>Connected</td>
</tr>
<tr>
<td>Charging Downstream Port</td>
<td>&gt;3.5V</td>
<td>Pull-down R to GND</td>
<td>$V_{DM, SRC}$</td>
<td>HIGH</td>
<td>LOW</td>
<td>HIGH</td>
<td>LOW</td>
<td>Connected</td>
</tr>
<tr>
<td>Dedicated Charging Port</td>
<td>&gt;3.5V</td>
<td>Short to D–</td>
<td>Short to D+</td>
<td>HIGH</td>
<td>LOW</td>
<td>HIGH</td>
<td>Hi-Z</td>
<td>Not Connected</td>
</tr>
<tr>
<td>Apple Charger</td>
<td>&gt;3.5V</td>
<td>$2.0 &lt; V_{DP} &lt; 2.8$</td>
<td>$2.0 &lt; V_{DM} &lt; 2.8$</td>
<td>HIGH</td>
<td>LOW</td>
<td>HIGH</td>
<td>Hi-Z</td>
<td>Not Connected</td>
</tr>
<tr>
<td>TomTom Charger</td>
<td>&gt;3.5V</td>
<td>$2.0 &lt; V_{DP} &lt; 3.1$</td>
<td>$2.0 &lt; V_{DM} &lt; 3.1$</td>
<td>HIGH</td>
<td>LOW</td>
<td>HIGH</td>
<td>Hi-Z</td>
<td>Not Connected</td>
</tr>
<tr>
<td>PS/2 Charger</td>
<td>&gt;3.5V</td>
<td>Pull-up R to VBUS</td>
<td>Pull-up R to VBUS</td>
<td>X</td>
<td>LOW</td>
<td>LOW</td>
<td>Hi-Z</td>
<td>Not Connected</td>
</tr>
<tr>
<td>Non-compliant USB Charger</td>
<td>&gt;3.5V</td>
<td>Open</td>
<td>Open</td>
<td>X</td>
<td>LOW</td>
<td>LOW</td>
<td>Hi-Z</td>
<td>Not Connected</td>
</tr>
<tr>
<td>Any Device</td>
<td>&lt;3.5V</td>
<td>Open</td>
<td>Open</td>
<td>X</td>
<td>Hi-Z</td>
<td>LOW</td>
<td>Hi-Z</td>
<td>Not Connected</td>
</tr>
<tr>
<td>Any Device</td>
<td>&gt;3.5V</td>
<td>X</td>
<td>X</td>
<td>LOW</td>
<td>Hi-Z</td>
<td>LOW</td>
<td>Hi-Z</td>
<td>Not Connected</td>
</tr>
</tbody>
</table>
USB 2.0 EYE DIAGRAM

Figure 1. 480-Mbps USB 2.0 Eye Diagram with No Device

Figure 2. 480-Mbps USB 2.0 Eye Diagram with USB Switch
Table 1. Critical Components

<table>
<thead>
<tr>
<th>PIN</th>
<th>NUMBER</th>
<th>CRITICAL COMPONENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>NUMBER</td>
<td>CRITICAL COMPONENT</td>
</tr>
<tr>
<td>VBUS</td>
<td>9</td>
<td>1µF~10µF ESD Protection Diode</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.2Ω ESD Protection Diode</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.1µF ESD Protection Diode</td>
</tr>
<tr>
<td>SW_OPEN</td>
<td>1</td>
<td>10kΩ</td>
</tr>
<tr>
<td>CHG_AL_N</td>
<td>4</td>
<td>10kΩ</td>
</tr>
<tr>
<td>DM_CON</td>
<td>14</td>
<td>2.2Ω</td>
</tr>
<tr>
<td>DP_CON</td>
<td>15</td>
<td>2.2Ω</td>
</tr>
</tbody>
</table>

(System & Charger)

USB HOST

DP_HOST

DM_HOST

CHG_DET

BQ24392

CHG_AL_N

GOOD_BAT

(System Status)

VBUS

DM_CON

DP_CON

GND

0.1µF

2.2Ω

1µF~10µF

ESD

USB PORT

1pF

R2

100 kΩ

3.3V

ESD

1pF

10pF

ESD

1pF

10pF

ESD

1pF

10pF

ESD

1pF

10pF

ESD

1pF

10pF

ESD

1pF

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Schematic Guidelines

1. V_{BUS} requires 1µF~10µF and 0.1µF decoupling capacitors to reduce noise from circuit elements. The capacitors act as a shunt to block off the noise. The 0.1µF capacitor smooths out high frequencies and has a lower series inductance. The 1µF~10µF capacitor smooths out the lower frequencies and has a much higher series inductance. Using both capacitors will provide better load regulation across the frequency spectrum.

2. SW\_OPEN and CHG\_AL\_N are open-drain outputs that require a 10kΩ pull-up resistor to VDDIO.

3. V_{BUS}, DM\_CON, and DP\_CON are recommended to have an external resistor of 2.2Ω to provide extra ballasting to protect the chip and internal circuitry.

4. DM\_CON and DP\_CON are recommended to have a 1pF external ESD Protection Diode rated for 8kV IEC protection to prevent failure in case of an 8kV IEC contact discharge.

5. V_{BUS\_IN} is recommended to have a 1pF ~ 10pF external ESD Protection Diode rated for 8kV IEC protection to prevent failure in case of an 8kV IEC contact discharge.

6. CHG\_DET is a push-pull output pin. An external pull-up and Diode are shown to depict a typical 3.3V system. The pull-up resistor and diode are optional. The pull-up range on the CHG\_DET pin is from 3.5V to VBUS. When VBUS > 7V, CHG\_DET will be clamped to 7V.
Table 1: Packaging Information

<table>
<thead>
<tr>
<th>Orderable Device</th>
<th>Status (1)</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>Package Qty</th>
<th>Eco Plan (2)</th>
<th>Lead/Ball Finish (6)</th>
<th>MSL Peak Temp (3)</th>
<th>Op Temp (°C)</th>
<th>Device Marking (4/5)</th>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>BQ24392RSER</td>
<td>ACTIVE</td>
<td>UQFN</td>
<td>RSE</td>
<td>10</td>
<td>3000</td>
<td>Green (RoHS &amp; no Sb/Br)</td>
<td>CU NIPDAUAG</td>
<td>Level-1-260C-UNLIM</td>
<td>-40 to 85</td>
<td>APH</td>
<td></td>
</tr>
</tbody>
</table>

(1) The marketing status values are defined as follows:
- ACTIVE: Product device recommended for new designs.
- LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
- NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
- PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
- OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check [http://www.ti.com/productcontent](http://www.ti.com/productcontent) for the latest availability information and additional product content details.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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## TAPE AND REEL INFORMATION

### REEL DIMENSIONS

![Reel Dimensions Diagram]

<table>
<thead>
<tr>
<th>Device</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>SPQ</th>
<th>Reel Diameter (mm)</th>
<th>Reel Width W1 (mm)</th>
<th>A0 (mm)</th>
<th>B0 (mm)</th>
<th>K0 (mm)</th>
<th>P1 (mm)</th>
<th>W (mm)</th>
<th>Pin1 Quadrant</th>
</tr>
</thead>
<tbody>
<tr>
<td>BQ24392RSER</td>
<td>UQFN</td>
<td>RSE</td>
<td>10</td>
<td>3000</td>
<td>180.0</td>
<td>8.4</td>
<td>1.68</td>
<td>2.13</td>
<td>0.76</td>
<td>4.0</td>
<td>8.0</td>
<td>Q1</td>
</tr>
</tbody>
</table>

*All dimensions are nominal.*

**Dimensions Notes:**
- A0: Dimension designed to accommodate the component width
- B0: Dimension designed to accommodate the component length
- K0: Dimension designed to accommodate the component thickness
- W: Overall width of the carrier tape
- P1: Pitch between successive cavity centers
### TAPE AND REEL BOX DIMENSIONS

<table>
<thead>
<tr>
<th>Device</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>SPQ</th>
<th>Length (mm)</th>
<th>Width (mm)</th>
<th>Height (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BQ24392RSER</td>
<td>UQFN</td>
<td>RSE</td>
<td>10</td>
<td>3000</td>
<td>202.0</td>
<td>201.0</td>
<td>28.0</td>
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</tbody>
</table>

*All dimensions are nominal*
RSE (R-PUQFN-N10) PLASTIC QUAD FLATPACK NO-LEAD

NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
B. This drawing is subject to change without notice.
C. QFN (Quad Flatpack No-Lead) package configuration.
D. This package compiles to JEDEC MO-268 variation UEF D.
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC-7351 is recommended for alternate designs.
D. Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads.
E. Maximum stencil thickness 0.127 mm (5 mils). All linear dimensions are in millimeters.
F. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.
G. Side aperture dimensions over-print land for acceptable area ratio > 0.66. Customer may reduce side aperture dimensions if stencil manufacturing process allows for sufficient release at smaller opening.
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