

## DESCRIPTION

The MPQ6400 is a microprocessor ( $\mu$ P) supervisory circuit which can monitor and provide a reset function for system voltages from 0.4V. When either the SENSE voltage falls below its threshold ( $V_{IT}$ ) or the voltage of manual reset ( $\overline{MR}$ ) is pulled to a logic low, the RESET signal will be asserted. Fixed voltage threshold options set by the factory are available for standard voltage rails between 0.9V and 5V, while the MPQ6400DG(J)-01 allows for an adjustable voltage threshold with an external resistor divider. When the SENSE voltage and  $\overline{MR}$  exceed their respective thresholds, RESET is pulled up to logic high after a user-programmable delay time.

The MPQ6400 has a very low quiescent current of 1.6 $\mu$ A typically, which makes it ideal suitable for battery-powered applications. The device features a precision reference to achieve  $\pm 1\%$  threshold accuracy. The reset delay time is set by an external capacitor connected between  $C_{DELAY}$  and GND, allowing the user to select any delay time between 2.1ms and 10s. The 380ms delay time is set by connecting the  $C_{DELAY}$  pin to  $V_{CC}$ . The 24ms delay time is set by floating the  $C_{DELAY}$  pin. The MPQ6400 is available in QFN-6 (2mmx2mm) and TSOT23-6 packages.

## FEATURES

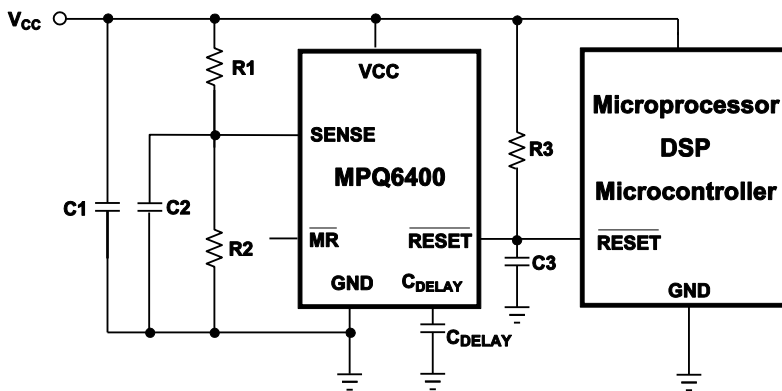
- Fixed Voltage Threshold from 0.9V to 5V
- Adjustable Voltage Threshold from 0.4V
- Low Quiescent Current: 1.6 $\mu$ A (Typ)
- Adjustable Reset Delay Time: 2.1ms to 10s
- High Threshold Accuracy:  $\pm 1\%$  (Typ)
- Manual Reset ( $\overline{MR}$ ) Input
- Open-Drain  $\overline{RESET}$  Output
- Immune to Short Negative SENSE Voltage
- Guaranteed Reset Valid to  $V_{CC}=0.8V$
- Available in QFN-6 (2mmx2mm) and TSOT23-6 Packages
- Available in AEC-Q100 Qualified

## APPLICATIONS

- Advanced Driver Assistance Systems (ADAS)
- Body Control Modules
- Infotainment Systems
- Low Quiescent Current Systems
- Electric Vehicles
- MCU/DSP/FPGA/ASIC Applications

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## TYPICAL APPLICATION



## ORDERING INFORMATION

| Part Number*      | Package       | T <sub>J</sub>  | Top Marking | MSL Rating*** |
|-------------------|---------------|-----------------|-------------|---------------|
| MPQ6400DG-33**    | QFN-6 (2x2mm) | -40°C to +125°C | See Below   | 1             |
| MPQ6400DG-33-AEC1 | QFN-6 (2x2mm) | -40°C to +125°C |             |               |
| MPQ6400DG-01      | QFN-6 (2x2mm) | -40°C to +125°C |             |               |
| MPQ6400DG-01-AEC1 | QFN-6 (2x2mm) | -40°C to +125°C |             |               |
| MPQ6400DJ-33-AEC1 | TSOT23-6      | -40°C to +125°C |             |               |
| MPQ6400DJ-01-AEC1 | TSOT23-6      | -40°C to +125°C |             |               |

\*For Tape & Reel, add suffix -Z (e.g. MPQ6400DG-XX-Z);  
For RoHS compliant packaging, add suffix -LF (e.g. MPQ6400DG-XX-LF-Z).

\*\* Check factory for availability in other options.

\*\*\* Moisture Sensitivity Level Rating

### TOP MARKING

**9RY**  
**LLL**

9R: Product code of MPQ6400DG-33/MPQ6400DG-33-AEC1  
Y: Year code  
LLL: Lot number

### TOP MARKING

**5BY**  
**LLL**

5B: Product code of MPQ6400DG-01/MPQ6400DG-01-AEC1  
Y: Year code  
LLL: Lot number

### TOP MARKING

**| 3SYW**

3S: Product code of MPQ6400DJ-33-AEC1  
Y: Year code  
W: week code

## TOP MARKING

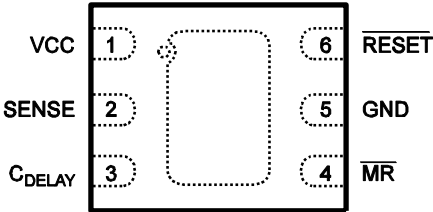
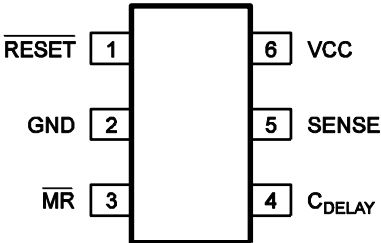
| 4BYW

4B: Product code of MPQ6400DJ-01-AEC1

Y: Year code

W: week code

## PACKAGE REFERENCE

|                                                                                                                                                                                                                |                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p style="text-align: center;"><b>TOP VIEW</b></p>  <p>VCC 1 6 RESET</p> <p>SENSE 2 5 GND</p> <p>C<sub>DELAY</sub> 3 4 MR</p> | <p style="text-align: center;"><b>TOP VIEW</b></p>  <p>RESET 1 6 VCC</p> <p>GND 2 5 SENSE</p> <p>MR 3 4 C<sub>DELAY</sub></p> |
| <p style="text-align: center;"><b>QFN-6 (2mmx2mm)</b></p>                                                                                                                                                      | <p style="text-align: center;"><b>TSOT23-6</b></p>                                                                                                                                                              |

## ABSOLUTE MAXIMUM RATINGS <sup>(1)</sup>

|                                                                    |                          |
|--------------------------------------------------------------------|--------------------------|
| Supply voltage ( $V_{CC}$ )                                        | -0.3 to +6V              |
| $C_{DELAY}$ voltage ( $V_{CDELAY}$ )                               | -0.3V to $V_{CC} + 0.3V$ |
| SENSE voltage ( $V_{SENSE}$ )                                      | -0.3V to 6V              |
| All other pins                                                     | -0.3V to +6V             |
| RESET current ( $I_{RESET}$ )                                      | 5mA                      |
| Continuous power dissipation ( $T_A = 25^\circ C$ ) <sup>(2)</sup> |                          |
| QFN-6 (2mmx2mm)                                                    | 2.5W                     |
| TSOT23-6                                                           | 0.75W                    |
| Junction temperature                                               | 150°C                    |
| Lead temperature                                                   | 260°C                    |
| Storage temperature                                                | -65°C to +150°C          |

## ESD Ratings

Human body mode (HBM):

$C_{DELAY}$  to  $V_{CC}$ .....Class 1C <sup>(3)</sup>

All other pins..... Class 2 <sup>(3)</sup>

Charged device mode (CDM) .....Class C2b <sup>(4)</sup>

## Recommended Operating Conditions

Supply voltage ( $V_{CC}$ )..... 1.8V to 5.5V

Maximum junction temp ( $T_J$ ) ..... +125°C <sup>(5)</sup>

| Thermal Resistance <sup>(6)</sup> | $\theta_{JA}$ | $\theta_{JC}$ |
|-----------------------------------|---------------|---------------|
| QFN-6 (2mmx2mm)                   | 50            | 12 ... °C/W   |
| TSOT23-6                          | 220           | 110 .. °C/W   |

### Notes:

- 1) Exceeding these ratings may damage the device.
- 2) The maximum allowable power dissipation is a function of the maximum junction temperature,  $T_J$  (MAX), the junction-to-ambient thermal resistance,  $\theta_{JA}$ , and the ambient temperature,  $T_A$ . The maximum allowable continuous power dissipation at any ambient temperature is calculated by  $P_D(MAX) = (T_J(MAX) - T_A) / \theta_{JA}$ . Exceeding the maximum allowable power dissipation will cause excessive die temperature, and the regulator will go into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage.
- 3) Per AEC-Q100-002.
- 4) Per AEC-Q100-011.
- 5) Operating devices at junction temperatures greater than 125°C is possible, please contact MPS for details.
- 6) The value of  $\theta_{JA}$  given in this table is only valid for comparison with other packages and cannot be used for design purposes. These values were calculated in accordance with JEDEC51-7, and simulated on a specified JEDEC board. They do not represent the performance obtained in an actual application.

## ELECTRICAL CHARACTERISTICS

1.8V ≤ V<sub>CC</sub> ≤ 5.5V, R<sub>3</sub> = 100kΩ, C<sub>3</sub> = 47pF, T<sub>J</sub> = -40°C to +125°C, Typical values are at T<sub>J</sub> = +25°C, unless otherwise noted.

| Parameters                                                                            | Symbol             | Condition                                                                                                                                    | Min                | Typ  | Max                 | Units             |
|---------------------------------------------------------------------------------------|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------|---------------------|-------------------|
| Input Supply Range                                                                    | V <sub>CC</sub>    |                                                                                                                                              | 1.8                |      | 5.5                 | V                 |
| Supply Current<br>(current into V <sub>CC</sub> pin)                                  | I <sub>CC</sub>    | V <sub>CC</sub> = 3.3V, $\overline{\text{RESET}}$ not asserted, $\overline{\text{MR}}$ , $\overline{\text{RESET}}$ , C <sub>DELAY</sub> open |                    | 1.6  | 5                   | μA                |
|                                                                                       |                    | V <sub>CC</sub> = 5.5V, $\overline{\text{RESET}}$ not asserted, $\overline{\text{MR}}$ , $\overline{\text{RESET}}$ , C <sub>DELAY</sub> open |                    | 1.85 | 15                  | μA                |
| Low-level Output Voltage                                                              | V <sub>OL</sub>    | 1.3V ≤ V <sub>CC</sub> < 1.8V, I <sub>OL</sub> = 0.4mA                                                                                       |                    |      | 0.3                 | V                 |
|                                                                                       |                    | 1.8V ≤ V <sub>CC</sub> ≤ 5.5V, I <sub>OL</sub> = 1.0mA                                                                                       |                    |      | 0.4                 | V                 |
| Power-up Reset Voltage <sup>(7)</sup>                                                 |                    | V <sub>OL</sub> (max) = 0.2V, I <sub>RESET</sub> = 15μA, T <sub>rise</sub> (V <sub>CC</sub> ) ≥ 15μs/V                                       |                    |      | 0.8                 | V                 |
| Negative-going Input Threshold Accuracy <sup>(9)</sup>                                | V <sub>IT</sub>    |                                                                                                                                              | -3                 | 1    | 1.7                 | %                 |
| Hysteresis on V <sub>IT</sub> Pin                                                     | V <sub>HYS</sub>   |                                                                                                                                              |                    | 1.5  | 4                   | V <sub>IT</sub> % |
| $\overline{\text{MR}}$ Internal Pull-up Resistance                                    | R <sub>MR</sub>    |                                                                                                                                              | 50                 | 110  |                     | kΩ                |
| Input Current at SENSE Pin                                                            | I <sub>SENSE</sub> | MPQ6400-33, V <sub>SENSE</sub> = 6V                                                                                                          |                    | 2.4  |                     | μA                |
|                                                                                       |                    | MPQ6400-01, V <sub>SENSE</sub> = 6V                                                                                                          |                    |      | 100                 | nA                |
| $\overline{\text{RESET}}$ Leakage Current                                             |                    | V <sub>RESET</sub> = 5.5V, $\overline{\text{RESET}}$ not asserted                                                                            |                    |      | 2                   | μA                |
| $\overline{\text{MR}}$ Logic Low Input                                                | V <sub>IL</sub>    |                                                                                                                                              |                    |      | 0.25V <sub>CC</sub> | V                 |
| $\overline{\text{MR}}$ Logic High Input                                               | V <sub>IH</sub>    |                                                                                                                                              | 0.7V <sub>CC</sub> |      |                     | V                 |
| SENSE Maximum Transient Duration                                                      | t <sub>w</sub>     | V <sub>IH</sub> = 1.05 V <sub>IT</sub> , V <sub>IL</sub> = 0.95 V <sub>IT</sub>                                                              |                    | 17.5 |                     | μs                |
| $\overline{\text{RESET}}$ Delay Time                                                  | t <sub>d</sub>     | C <sub>DELAY</sub> = Open                                                                                                                    | 15                 | 24   | 34                  | ms                |
|                                                                                       |                    | C <sub>DELAY</sub> = V <sub>CC</sub> <sup>(8)</sup>                                                                                          | 230                | 380  | 530                 | ms                |
|                                                                                       |                    | C <sub>DELAY</sub> = 150pF                                                                                                                   | 1.3                | 2.1  | 3                   | ms                |
|                                                                                       |                    | C <sub>DELAY</sub> = 10nF <sup>(8)</sup>                                                                                                     | 61                 | 102  | 142                 | ms                |
| $\overline{\text{MR}}$ to $\overline{\text{RESET}}$ Propagation Delay                 | t <sub>pHL1</sub>  | V <sub>IH</sub> = 0.7 V <sub>CC</sub> , V <sub>IL</sub> = 0.25 V <sub>CC</sub>                                                               |                    | 160  |                     | ns                |
| High to Low Level $\overline{\text{RESET}}$ Delay, SENSE to $\overline{\text{RESET}}$ | t <sub>pHL2</sub>  | V <sub>IH</sub> = 1.05 V <sub>IT</sub> , V <sub>IL</sub> = 0.95 V <sub>IT</sub>                                                              |                    | 17.5 |                     | μs                |

### Note:

- 7) The lowest supply voltage (V<sub>CC</sub>) at which  $\overline{\text{RESET}}$  becomes active.  
8) Not tested in production and guaranteed by design and characterization.  
9) V<sub>SENSE</sub> Falling Slowly

## ORDERING INFORMATION

| Product      | Package  | Top Marking | Nominal Supply Voltage | Threshold Voltage (V <sub>IT</sub> ) |
|--------------|----------|-------------|------------------------|--------------------------------------|
| MPQ6400DG-33 | QFN      | 9R          | 3.3V                   | 3.07V                                |
| MPQ6400DG-01 | QFN      | 5B          | 3.3V                   | Adjustable                           |
| MPQ6400DJ-33 | TSOT23-6 | 3S          | 3.3V                   | 3.07V                                |
| MPQ6400DJ-01 | TSOT23-6 | 4B          | 3.3V                   | Adjustable                           |

## PIN FUNCTIONS

| Pin # |          | Name                      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------|----------|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| QFN-6 | TSOT23-6 |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 1     | 6        | V <sub>CC</sub>           | Supply voltage. A 0.1uF decoupling ceramic capacitor should be put close to this pin.                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 2     | 5        | SENSE                     | SENSE pin is connected to the monitored system voltage. When the monitored voltage is below desired threshold, $\overline{\text{RESET}}$ is asserted.                                                                                                                                                                                                                                                                                                                                                  |
| 3     | 4        | C <sub>DELAY</sub>        | Programmable reset delay time pin. When C <sub>DELAY</sub> connected to V <sub>CC</sub> through a resistor between 50kΩ and 200kΩ, a 380ms delay time is selected. When C <sub>DELAY</sub> floated, the delay time is 24ms. A capacitor bigger than 150pF connected C <sub>DELAY</sub> to GND could be used to get the user's programmable time from 2.1ms to 10s.                                                                                                                                     |
| 4     | 3        | $\overline{\text{MR}}$    | The manual reset ( $\overline{\text{MR}}$ ) can introduce another logic signal to control the $\overline{\text{RESET}}$ . It is internally connected to V <sub>CC</sub> through a 90kΩ resistor.                                                                                                                                                                                                                                                                                                       |
| 5     | 2        | GND                       | Ground.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 6     | 1        | $\overline{\text{RESET}}$ | $\overline{\text{RESET}}$ is an open drain signal which will be asserted when the SENSE voltage drops below a preset threshold or when the manual reset ( $\overline{\text{MR}}$ ) pin drops to a logic low. The $\overline{\text{RESET}}$ delay time is programmable from 2.1ms to 10s by using external capacitors. A pull-up resistor bigger than 10k should be connected this pin to supply line, and the $\overline{\text{RESET}}$ outputting a higher voltage than V <sub>CC</sub> is allowable. |

## DETAIL DESCRIPTION

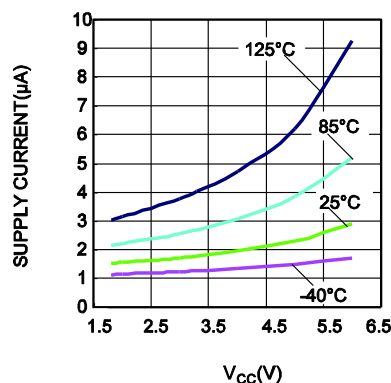
The MPQ6400 product family asserts a  $\overline{\text{RESET}}$  signal when either the SENSE pin voltage is lower than V<sub>IT</sub> or the manual reset ( $\overline{\text{MR}}$ ) is driven low. The MPQ6400-XX family, other than the MPQ6400DG(J)-01, can monitor a fixed voltage from 0.9V to 5.0V. The MPQ6400DG(J)-01 can monitor any voltage above 0.4V by adjusting the external resistor divider. After both the manual reset ( $\overline{\text{MR}}$ ) and SENSE voltages exceed their thresholds, the

$\overline{\text{RESET}}$  output remains asserted for a user's programmable delay time. Two fixed  $\overline{\text{RESET}}$  delay times are user-selectable: 380ms delay time by connecting the C<sub>DELAY</sub> pin to V<sub>CC</sub>, and 24ms delay time by leaving the C<sub>DELAY</sub> pin float. Any delay time from 2.1ms to 10s could be gotten by connecting a capacitor between C<sub>DELAY</sub> and GND. The wide monitor voltage and programmable reset delay time make MPQ6400 product family suitable for a broad array of applications.

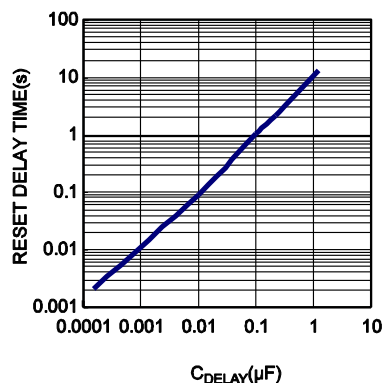
## TYPICAL PERFORMANCE CHARACTERISTICS

$V_{CC}=3.3V$ ,  $R_3 = 100k\Omega$ ,  $C_3 = 47pF$ ,  $T_A = -40^\circ C$  to  $+125^\circ C$ , Typical values are at  $T_A=+25^\circ C$ , unless otherwise noted.

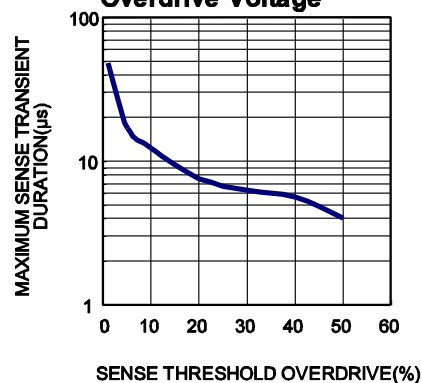
**Supply Current vs.  $V_{CC}$**



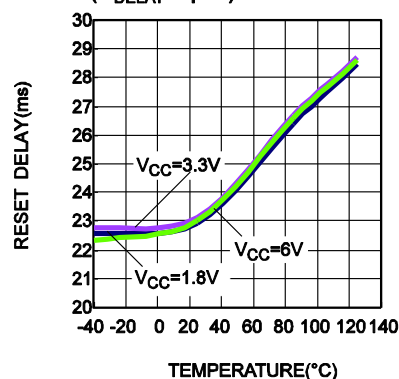
**Reset Delay Time vs.  $C_{DELAY}$**



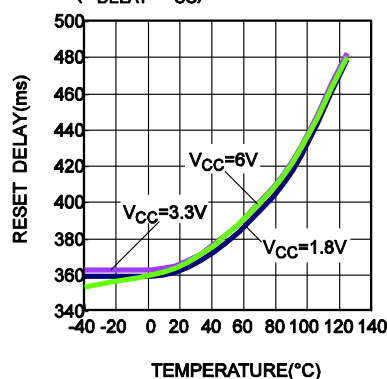
**Maximum SENSE Transient Duration vs. SENSE Threshold Overdrive Voltage**



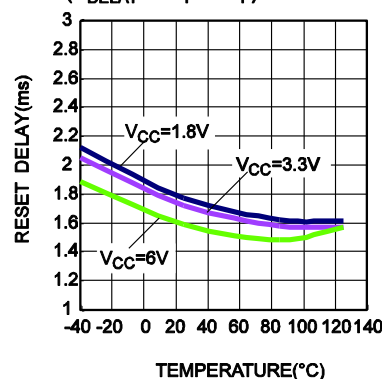
**Reset Delay vs. Temperature ( $C_{DELAY}=open$ )**



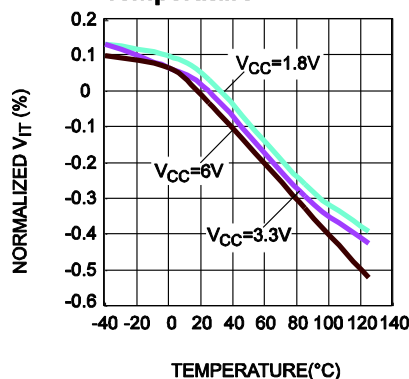
**Reset Delay vs. Temperature ( $C_{DELAY}=V_{CC}$ )**



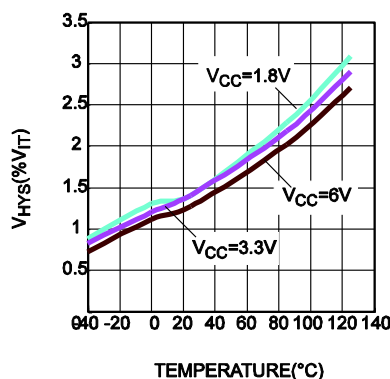
**Reset Delay vs. Temperature ( $C_{DELAY}=150pF$  Cap)**



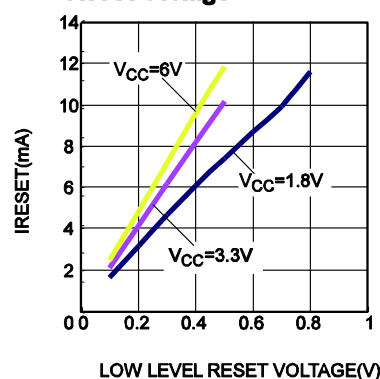
**Normalized  $V_{IT}$  vs. Temperature**



**$V_{HYS}$  vs. Temperature**



**$I_{RESET}$  vs. Low Level Reset Voltage**



## FUNCTIONAL BLOCK DIAGRAM

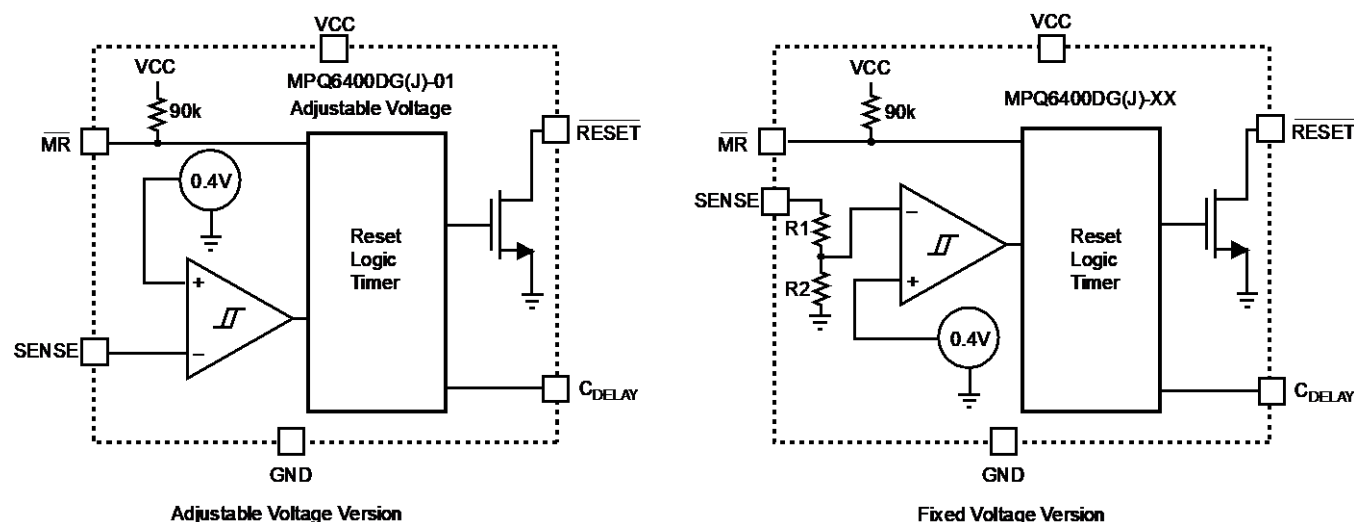


Figure 1—Functional Block Diagram

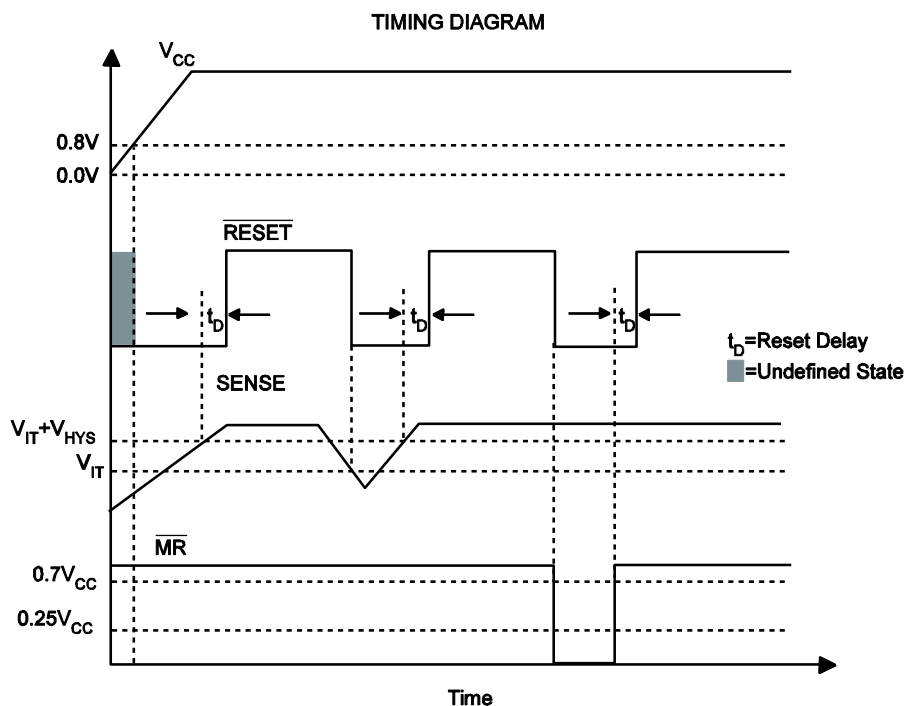


Figure 2—MPQ6400 Timing Diagram

TRUTH TABLE

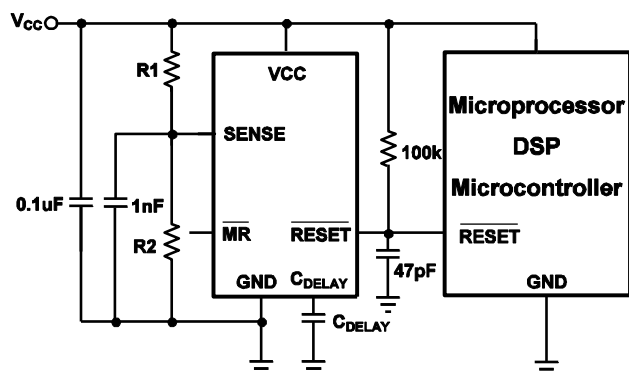
| MR | SENSE > V <sub>IT</sub> | RESET |
|----|-------------------------|-------|
| L  | 0                       | L     |
| L  | 1                       | L     |
| H  | 0                       | L     |
| H  | 1                       | H     |



## APPLICATION INFORMATION

### Reset Output Function

The MPQ6400  $\overline{\text{RESET}}$  output is typically connected to the  $\overline{\text{RESET}}$  input of a microprocessor, as shown in Figure 3. When  $\overline{\text{RESET}}$  is not asserted, a pull up resistor must be connected to hold this signal high. The voltage of reset signal is allowed to be higher than  $V_{CC}$  (up to 6V) through a resistor pulling up from supply line. If the voltage is below 0.8V,  $\overline{\text{RESET}}$  output is undefined. This condition can be ignored generally because that most microprocessors do not function at this state. When both SENSE and  $\overline{\text{MR}}$  are higher than their threshold voltage,  $\overline{\text{RESET}}$  output holds logic high. Once either of the two drops below their threshold,  $\overline{\text{RESET}}$  will be asserted.



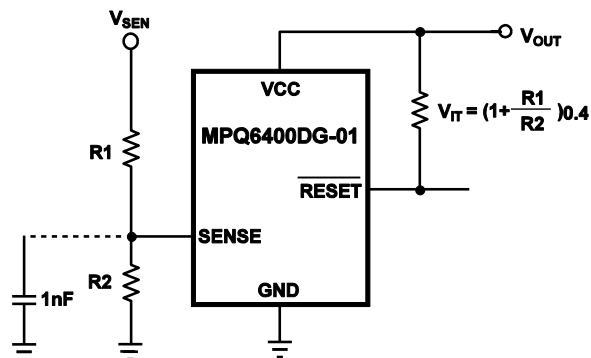
**Figure 3—Typical Application of MPQ6400 with Microprocessor**

From the point that  $\overline{\text{MR}}$  is again logic high and SENSE is above  $V_{IT} + V_{HYS}$  (the threshold hysteresis),  $\overline{\text{RESET}}$  will be driven to a logic high after a reset delay time. The reset delay time is programmable by  $C_{DELAY}$  pin. Due to the finite impedance of  $\overline{\text{RESET}}$  pin, the pull up resistor should be bigger than 10k $\Omega$ .

### Monitor a Voltage

The SENSE input pin is connected to the monitored system voltage directly or through a resistor network (on MPQ6400DG-01). When the voltage on the pin is below  $V_{IT}$ ,  $\overline{\text{RESET}}$  is asserted. A threshold hysteresis will prevent the chip from responding perturbation on SENSE pin. A 1nF to 10nF bypass capacitor should be put on this pin to increase its immunity to noise. A typical application of the MPQ6400DG-01 is shown in Figure 4. Two external resistors form a voltage

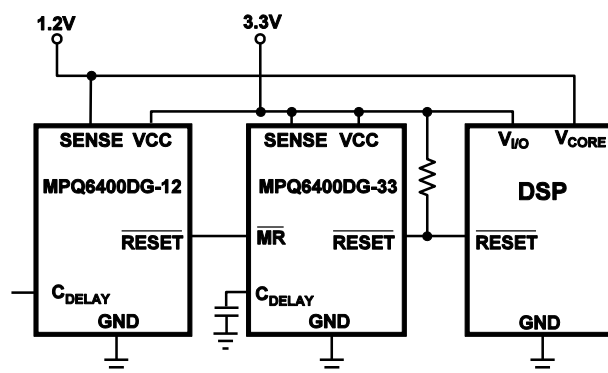
divider from monitored voltage to GND. Its tap connects to the SENSE pin. The circuit can be used to monitor any voltage higher than 0.4V.



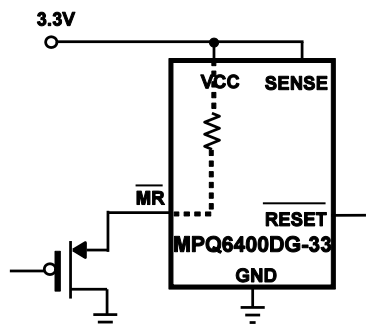
**Figure 4—MPQ6400DG-01 Monitoring a User-Defined Voltage**

### Monitor Multiple System Voltages

The manual reset ( $\overline{\text{MR}}$ ) can introduce another logic signal to control the  $\overline{\text{RESET}}$ . When  $\overline{\text{MR}}$  is a logic low ( $0.25V_{CC}$ ),  $\overline{\text{RESET}}$  will be asserted. After both SENSE and  $\overline{\text{MR}}$  are above their thresholds,  $\overline{\text{RESET}}$  will be driven to a logic high after a reset delay time. The  $\overline{\text{MR}}$  is internally connected to  $V_{CC}$  through a 90k $\Omega$  resistor so this pin can float. See how multiple system voltages are monitored by  $\overline{\text{MR}}$  in Figure 5. If the signal on  $\overline{\text{MR}}$  isn't up to  $V_{CC}$ , there will be an additional current through internal 90k $\Omega$  pull up resistor. A logic-level FET can be used to minimize the leakage, as shown in Figure 6.



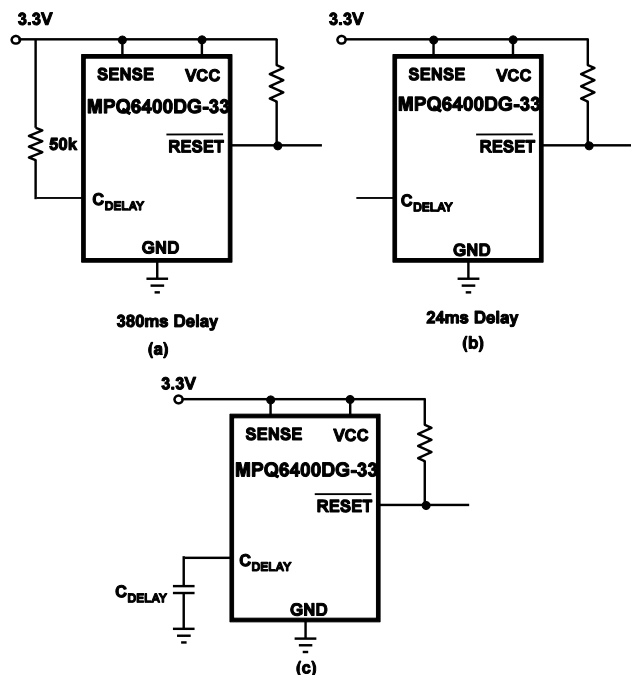
**Figure 5—MPQ6400 Family Monitoring Multiple System Voltages**



**Figure 6—Minimizing  $I_{CC}$  When  $\overline{MR}$  Signal isn't over  $V_{CC}$  by External MOSFET**

### Programmable Reset Delay Time

The reset delay time can be programmed by  $C_{DELAY}$  configure. When  $C_{DELAY}$  is connected to  $V_{CC}$  through a resistor between 50kΩ and 200kΩ, the delay time is 380ms. When  $C_{DELAY}$  floated, the delay time is 24ms. In addition, a capacitor connected  $C_{DELAY}$  to GND could be used to get the user's programmable delay time from 2.1ms to 10s. The three configures can be found in Figure 7(a)(b)(c).



**Figure 7—Programmable Configurations to the Reset Delay Time**

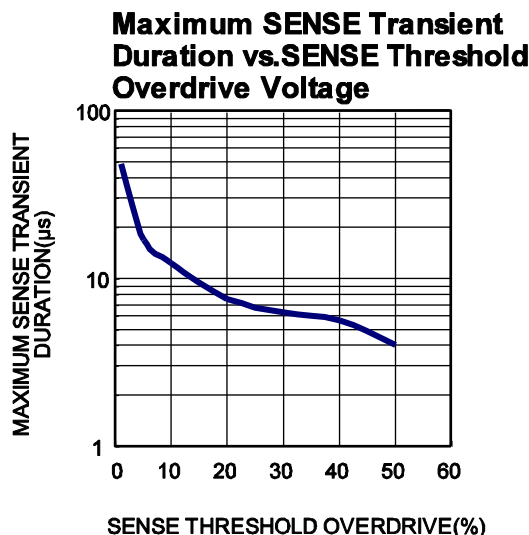
The external capacitor  $C_{DELAY}$  must be larger than 150pF. For a given delay time, the capacitor value can be calculated using the following equation:

$$C_{DELAY}(\text{nF}) = [t_D(\text{s}) - 4.99 \times 10^{-4}(\text{s})] \times 107$$

The reset delay time is determined by the charge time of external capacitor. While SENSE is above  $V_{IT}$  and  $\overline{MR}$  is a logic high, the internal 140nA current source is enabled and starts to charge the capacitor to set the delay time. When the capacitor voltage rises to 1.13V, the  $\overline{RESET}$  is de-asserted. The capacitor will be discharged when the  $\overline{RESET}$  is again asserted. Stray capacitance may cause errors of the delay time. A ceramic capacitor with low leakage is strongly recommended.

### SENSE Voltage Transients Immunity

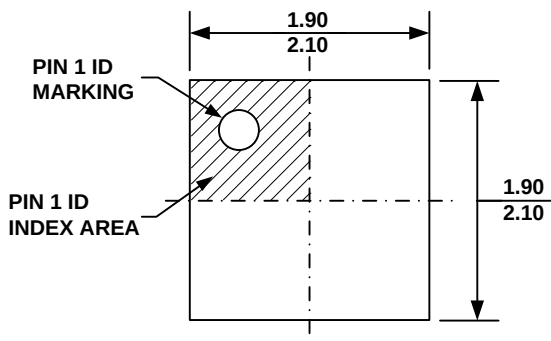
The MPQ6400 can be immune to SENSE pin short negative transient. The maximum immune duration is 17us while overdrive is 5%. A shorter negative transient can not assert the  $\overline{RESET}$  output. The effective duration is relative to the threshold overdrive, as shown in Figure 8.



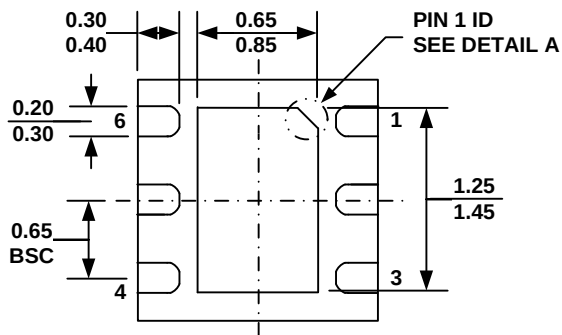
**Figure 8—Maximum Transient Duration vs. Sense Threshold Overdrive Voltage**

## PACKAGE INFORMATION

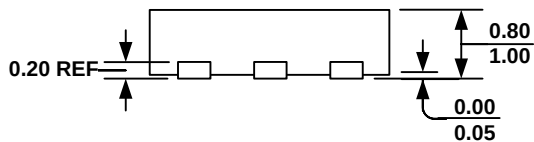
**QFN-6 (2mmx2mm)**



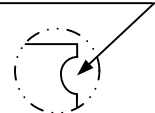
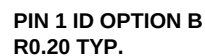
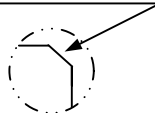
**TOP VIEW**



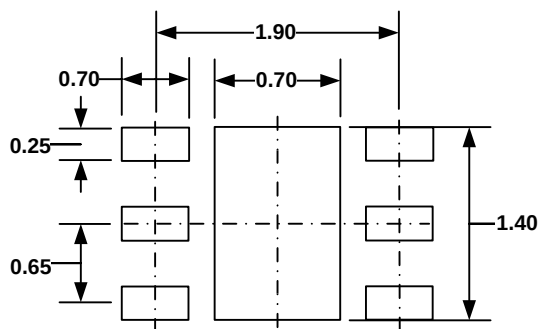
**BOTTOM VIEW**



### SIDE VIEW



### DETAIL A



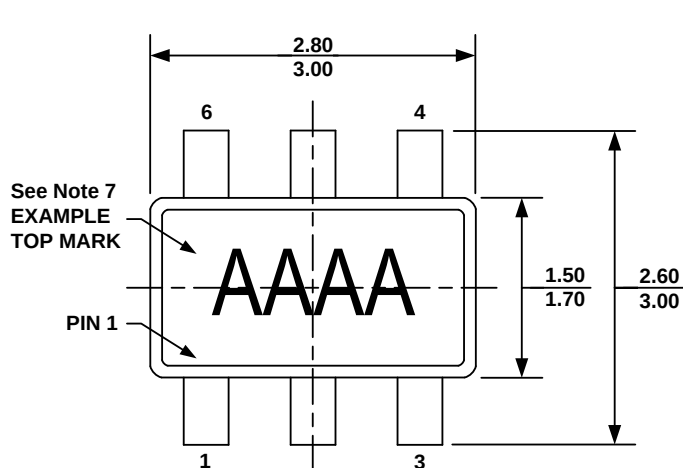
## RECOMMENDED LAND PATTERN

**NOTE:**

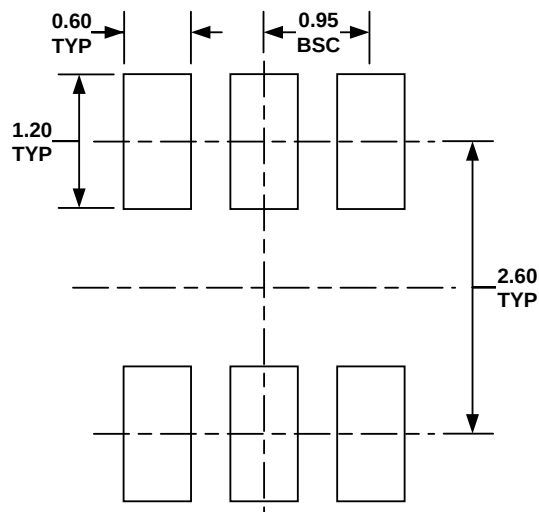
- 1) ALL DIMENSIONS ARE IN MILLIMETERS.
- 2) EXPOSED PADDLE SIZE DOES NOT INCLUDE MOLD FLASH.
- 3) LEAD COPLANARITY SHALL BE 0.10 MILLIMETER MAX.
- 4) JEDEC REFERENCE IS MO-229, VARIATION VCCC.
- 5) DRAWING IS NOT TO SCALE.

## PACKAGE INFORMATION (continued)

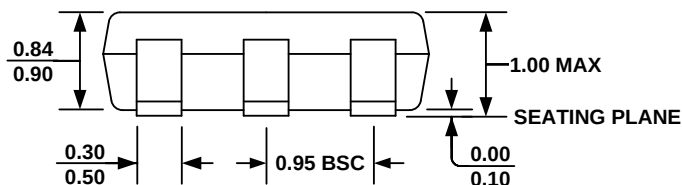
### TSOT23-6



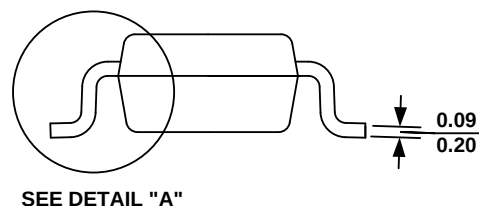
**TOP VIEW**



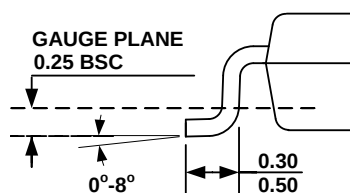
**RECOMMENDED LAND PATTERN**



**FRONT VIEW**



**SIDE VIEW**

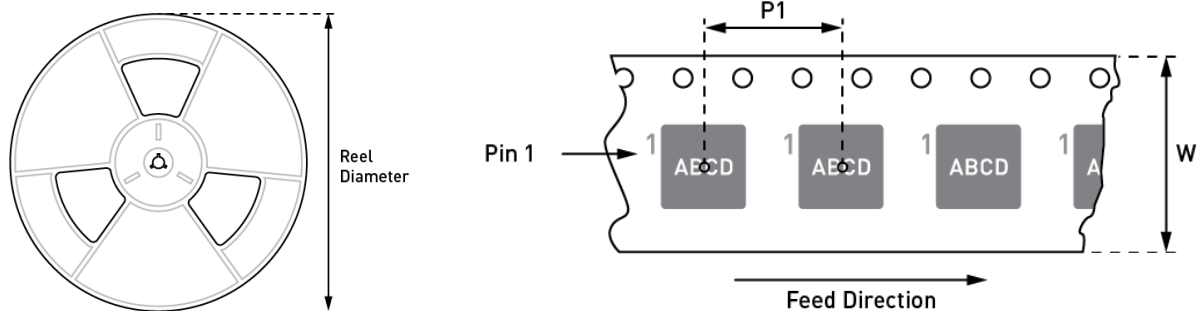


**DETAIL "A"**

#### NOTE:

- 1) ALL DIMENSIONS ARE IN MILLIMETERS.
- 2) PACKAGE LENGTH DOES NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURR.
- 3) PACKAGE WIDTH DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION.
- 4) LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.10 MILLIMETERS MAX.
- 5) DRAWING CONFORMS TO JEDEC MO-193, VARIATION AB.
- 6) DRAWING IS NOT TO SCALE.
- 7) PIN 1 IS LOWER LEFT PIN WHEN READING TOP MARK FROM LEFT TO RIGHT, (SEE EXAMPLE TOP MARK)

## CARRIER INFORMATION



| Part Number         | Package Description | Quantity /Reel | Reel Diameter | Carrier Tape Width | Carrier Tape Pitch |
|---------------------|---------------------|----------------|---------------|--------------------|--------------------|
| MPQ6400DG-33-Z      | QFN-6<br>(2mmx2mm)  | 5000           | 13in          | 12mm               | 8mm                |
| MPQ6400DG-33-AEC1-Z |                     |                |               |                    |                    |
| MPQ6400DG-01-Z      |                     |                |               |                    |                    |
| MPQ6400DG-01-AEC1-Z |                     |                |               |                    |                    |
| MPQ6400DJ-33-AEC1-Z | TSOT23-6            | 3000           | 7in           | 8mm                | 4mm                |
| MPQ6400DJ-01-AEC1-Z |                     |                |               |                    |                    |

## REVERISON HISTORY

| Revision # | Revision Date | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Pages Updated |
|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 1.0        | 12/5/2011     | Initial                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | -             |
| 1.11       | 5/8/2018      | Add MPQ6400-01 ordering information with under qualification note and top marking information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2             |
| 1.12       | 11/4/2019     | Add MSL information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 2             |
|            |               | Add ESD information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 3             |
|            |               | Updated EC according to ATE result<br>a) Negative-going input threshold accuracy<br>b) Input current at SENSE pin<br>c) RESET leakage current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 5             |
|            |               | Added Carrier information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 11            |
|            |               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |
| 1.2        | 10/23/2023    | <ul style="list-style-type: none"> <li>Updated the Description section <ul style="list-style-type: none"> <li>Grammar and formatting updates</li> <li>Added the TSOT23-6 package</li> </ul> </li> <li>Updated the Features section: <ul style="list-style-type: none"> <li>Deleted “Guaranteed Industrial/Automotive Temp Range Limits”</li> <li>Updated “Power-On Reset Generator with Adjustable Delay Time” to “Adjustable Reset Delay Time”</li> <li>Updated the Fixed Voltage Threshold and Adjustable Voltage Threshold bullet points</li> <li>Added package information</li> </ul> </li> <li>Grammar and formatting updates</li> <li>Deleted “(ADAS)”</li> <li>Updated the Applications section</li> </ul> | 1             |
|            |               | Updated “MPQ6400DG-01” to “MPQ6400DG(J)-01”                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1, 6          |
|            |               | Updated “-Z” to “-Z”, “-LF” to “-LF”, and “-XX” to “-XX”                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2             |
|            |               | Added the MPQ6400DJ ordering information, top marking, and package reference                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2, 3          |
|            |               | Added the TSOT23-6 line in the Absolute Maximum Ratings section; added the ESD Ratings section; added the TSOT23-6 line in the Thermal Resistance section; added note 3 and note 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 4             |
|            |               | Updated note numbers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 5             |
|            |               | Added the MPQ6400DJ ordering information and pin function information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 6             |
|            |               | Updated “MPQ6400DG-01” to “MPQ6400DG(J)-01” and “MPQ6400DG-XX” to “MPQ6400DG(J)-XX” in Figure 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 8             |
|            |               | Added the MPQ6400DJ package information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 12            |
|            |               | Add the MPQ6400DJ carrier information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 13            |
|            |               | Updated “Supervisory Circuit” to “Voltage Supervisor” in headers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | All           |

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