

LM3880/LM3880Q-1 Power Sequencer

 Check for Samples: [LM3880](#), [LM3880Q-1](#)

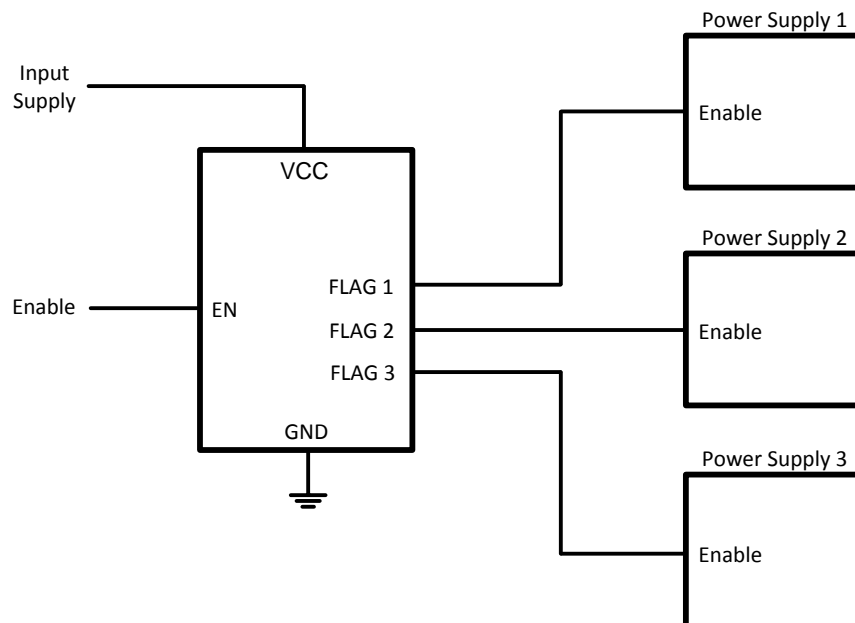
FEATURES

- Easiest Method to Sequence Rails
- Power Up and Power Down Control
- Input Voltage Range of 2.7V to 5.5V
- Small Footprint SOT-23-6
- Low Quiescent Current of 25 μ A
- Standard Timing Options Available
- Customization of Timing and Sequence Available through Factory Programmability
- LM3880Q is AEC-Q100 Grade 1 Qualified and is Manufactured on an Automotive Grade Flow

APPLICATIONS

- Multiple Supply Sequencing
- Microprocessor / Microcontroller Sequencing
- FPGA Sequencing
- Automotive

Typical Application Circuit



DESCRIPTION

The LM3880 Power Sequencer offers the easiest method to control power up and power down of multiple power supplies (switchers or linear regulators). By staggering the startup sequence, it is possible to avoid latch conditions or large in-rush currents that can affect the reliability of the system.

Available in a SOT-23-6 package, the Power Sequencer contains a precision enable pin and three open drain output flags. Upon enabling the LM3880 the three output flags will sequentially release, after individual time delays, permitting the connected power supplies to startup. The output flags will follow a reverse sequence during power down to avoid latch conditions.

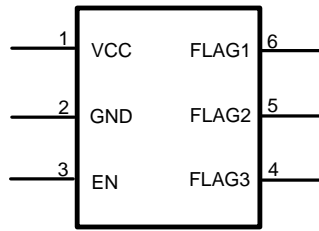
EPROM capability allows every delay and sequence to be fully adjustable. Contact Texas Instruments if a non-standard configuration is required.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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Connection Diagram



**Figure 1. Top View
SOT-23-6 Package**

PIN DESCRIPTIONS

| Pin # | Name | Function |
|-------|-------|----------------------|
| 1 | VCC | Input supply |
| 2 | GND | Ground |
| 3 | EN | Precision enable pin |
| 4 | FLAG3 | Open drain output #3 |
| 5 | FLAG2 | Open drain output #2 |
| 6 | FLAG1 | Open drain output #1 |

Table 1. Sequence Designator Table

| Sequence Number | Flag Order | |
|-----------------|------------|------------|
| | Power Up | Power Down |
| 1 | 1 - 2 - 3 | 3 - 2 - 1 |
| 2 | 1 - 2 - 3 | 3 - 1 - 2 |
| 3 | 1 - 2 - 3 | 2 - 3 - 1 |
| 4 | 1 - 2 - 3 | 2 - 1 - 3 |
| 5 | 1 - 2 - 3 | 1 - 3 - 2 |
| 6 | 1 - 2 - 3 | 1 - 2 - 3 |

Table 2. Timing Designator Table⁽¹⁾

| Timing Designator | t _{d1} | t _{d2} | t _{d3} | t _{d4} | t _{d5} | t _{d6} |
|-------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| AF | 16ms | 16ms | 16ms | 16ms | 16ms | 16ms |
| AE | 2ms | 2ms | 2ms | 2ms | 2ms | 2ms |
| AA | 10ms | 10ms | 10ms | 10ms | 10ms | 10ms |
| AB | 30ms | 30ms | 30ms | 30ms | 30ms | 30ms |
| AC | 60ms | 60ms | 60ms | 60ms | 60ms | 60ms |
| AD | 120ms | 120ms | 120ms | 120ms | 120ms | 120ms |

(1) See timing diagrams for more information



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings ^{(1) (2)}

| | |
|--------------------------------------|-----------------|
| VCC | -0.3V to +6.0V |
| EN, FLAG1, FLAG2, FLAG3 | -0.3V to 6.0V |
| Max Flag 'ON' Current | 50 mA |
| Storage Temperature Range | -65°C to +150°C |
| Junction Temperature | 150°C |
| Lead Temperature (Soldering, 5 sec.) | 260°C |
| Minimum ESD Rating | ±2 kV |

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but does not ensure specific performance limits. For ensured specifications and conditions, see the Electrical Characteristics.
- (2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/Distributors for availability and specifications.

Operating Ratings ⁽¹⁾

| | |
|-------------------------|---------------------------------|
| VCC to GND | 2.7V to 5.5V |
| EN, FLAG1, FLAG2, FLAG3 | -0.3V to V _{CC} + 0.3V |
| Junction Temperature | -40°C to +125°C |

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but does not ensure specific performance limits. For ensured specifications and conditions, see the Electrical Characteristics.

Electrical Characteristics

Specifications with standard typeface are for T_J = 25°C, and those in bold face type apply over the full Operating Temperature Range (T_J = -40°C to +125°C). Minimum and Maximum limits are specified through test, design or statistical correlation.

Typical values represent the most likely parametric norm at T_J = 25°C and are provided for reference purposes only. V_{CC} = 3.3V, and limits apply to all timing options, unless otherwise specified.

| Symbol | Parameter | Conditions | Min (1) | Typ (2) | Max (1) | Unit |
|----------------------------|-----------------------------|----------------------------|------------|------------|------------|------|
| I _Q | Operating Quiescent current | | | 25 | 80 | μA |
| Open Drain Flags | | | | | | |
| I _{FLAG} | FLAGx Leakage Current | V _{FLAGx} = 3.3V | | 1 | 20 | nA |
| V _{OL} | FLAGx Output Voltage Low | I _{FLAGx} = 1.2mA | | | 0.4 | V |
| Power Up Sequence | | | | | | |
| t _{d1} | Timer delay 1 accuracy | | -15 | | 15 | % |
| | | 2ms Timing Option | -20 | | 20 | |
| t _{d2} | Timer delay 2 accuracy | | -15 | | 15 | % |
| | | 2ms Timing Option | -20 | | 20 | |
| t _{d3} | Timer delay 3 accuracy | | -15 | | 15 | % |
| | | 2ms Timing Option | -20 | | 20 | |
| Power Down Sequence | | | | | | |
| t _{d4} | Timer delay 4 accuracy | | -15 | | 15 | % |
| | | 2ms Timing Option | -20 | | 20 | |
| t _{d5} | Timer delay 5 accuracy | | -15 | | 15 | % |
| | | 2ms Timing Option | -20 | | 20 | |
| t _{d6} | Timer delay 6 accuracy | | -15 | | 15 | % |
| | | 2ms Timing Option | -20 | | 20 | |

- (1) Limits are 100% production tested at 25°. Limits over the operating temperature range are ensured through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate TI's Average Outgoing Quality Level (AOQL).
- (2) Typical numbers are at 25°C and represent the most likely parametric norm.

Electrical Characteristics (continued)

Specifications with standard typeface are for $T_J = 25^\circ\text{C}$, and those in bold face type apply over the full Operating Temperature Range ($T_J = -40^\circ\text{C}$ to $+125^\circ\text{C}$). Minimum and Maximum limits are specified through test, design or statistical correlation.

Typical values represent the most likely parametric norm at $T_J = 25^\circ\text{C}$ and are provided for reference purposes only. $V_{CC} = 3.3\text{V}$, and limits apply to all timing options, unless otherwise specified.

| Symbol | Parameter | Conditions | Min (1) | Typ (2) | Max (1) | Unit |
|---|------------------------|----------------------------|------------|------------|------------|---------------|
| Timing Delay Error | | | | | | |
| $(t_{d(x)} - 400 \mu\text{s}) / t_{d(x+1)}$ | Ratio of timing delays | For x = 1 or 4 | 95 | | 105 | % |
| | | For x = 1 or 4, 2ms option | 90 | | 110 | |
| $t_{d(x)} / t_{d(x+1)}$ | Ratio of timing delays | For x = 2 or 5 | 95 | | 105 | % |
| | | For x = 2 or 5, 2ms option | 90 | | 110 | |
| ENABLE Pin | | | | | | |
| V_{EN} | EN pin threshold | | 1.0 | 1.25 | 1.4 | V |
| I_{EN} | EN pin pull-up current | $V_{EN} = 0\text{V}$ | | 7 | | μA |

Typical Performance Characteristics

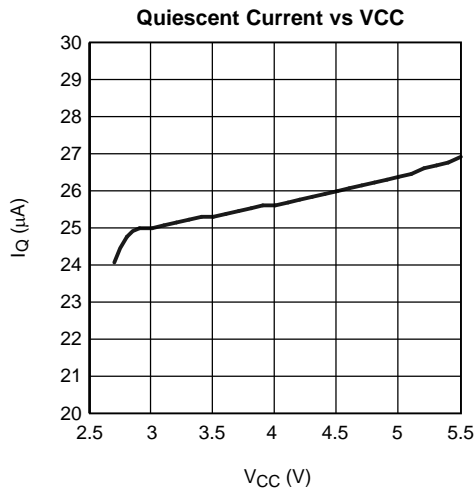


Figure 2.

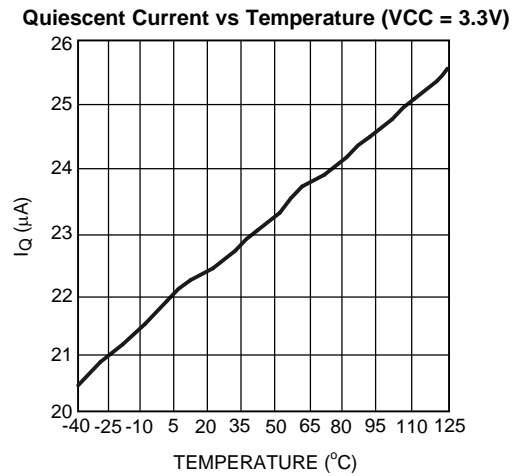


Figure 3.

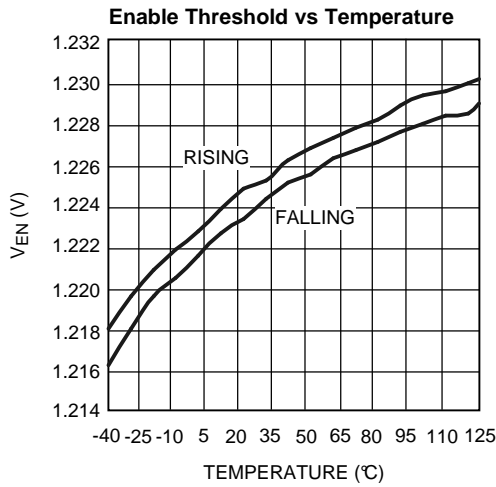


Figure 4.

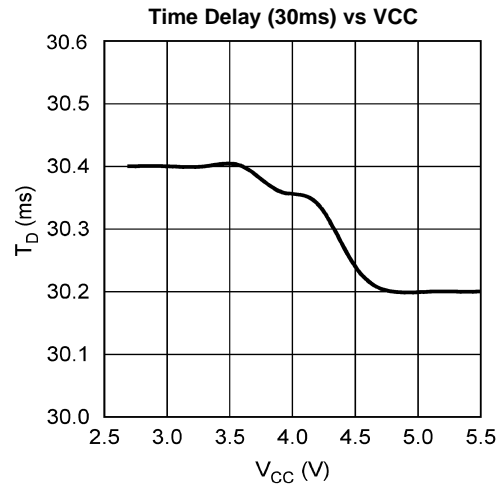


Figure 5.

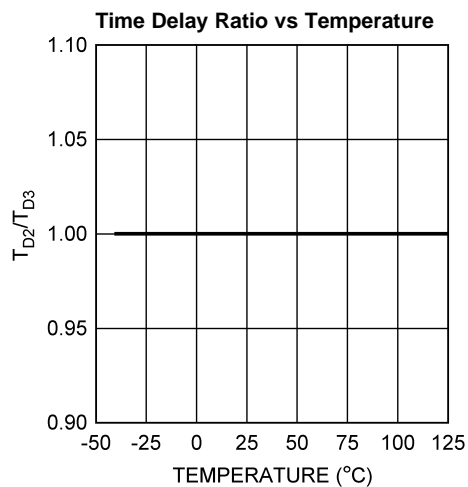


Figure 6.

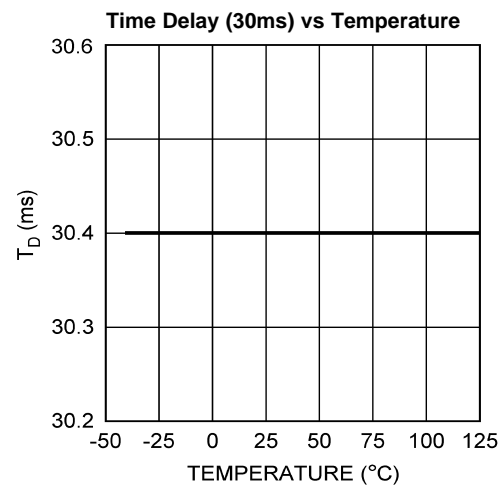


Figure 7.

Typical Performance Characteristics (continued)

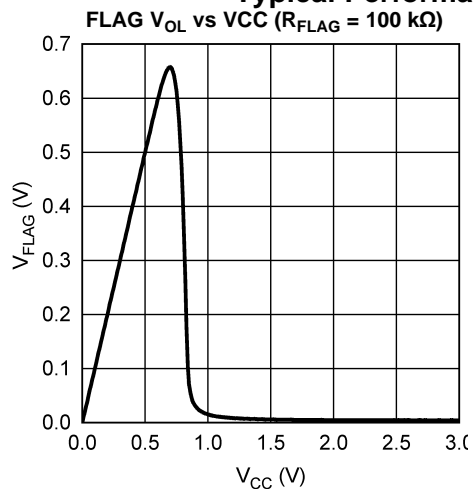


Figure 8.

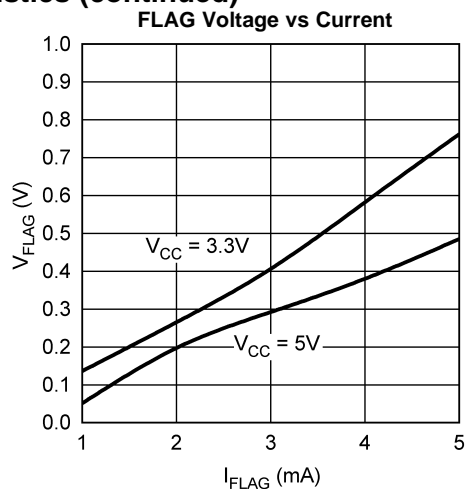


Figure 9.

Block Diagram

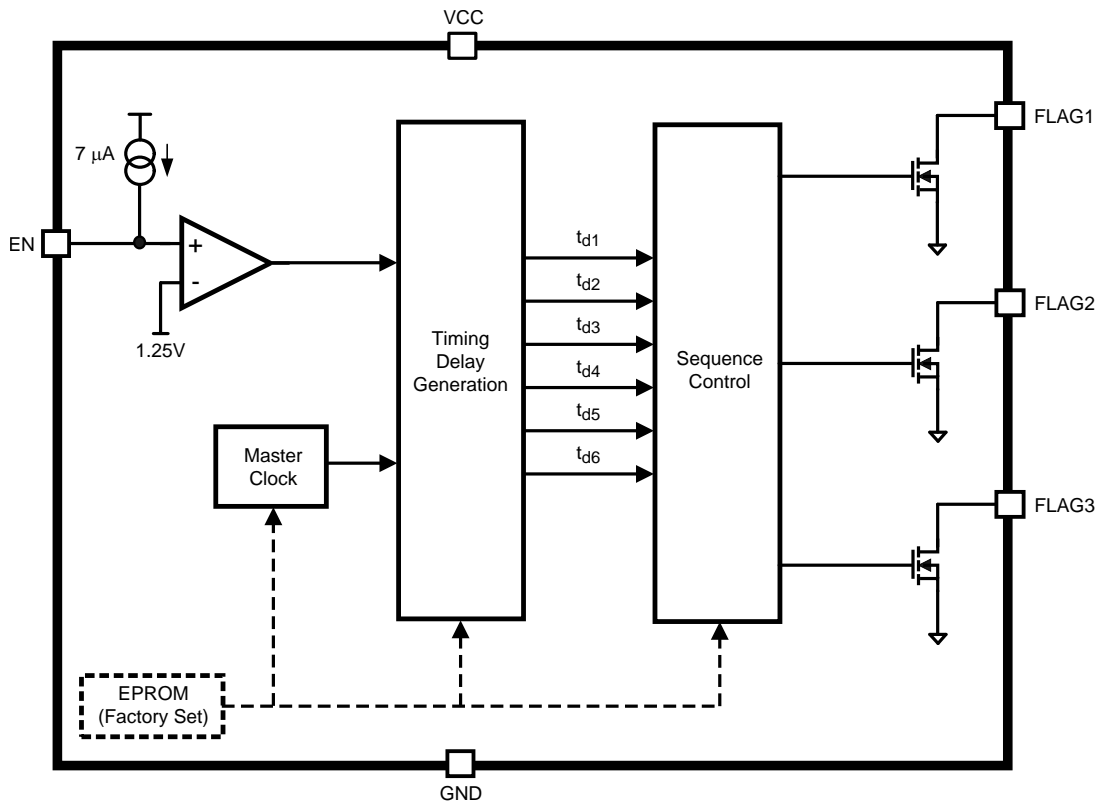


Figure 10. Block Diagram

Timing Diagrams (Sequence 1)

All standard options use this sequence for output flags rise and fall order.

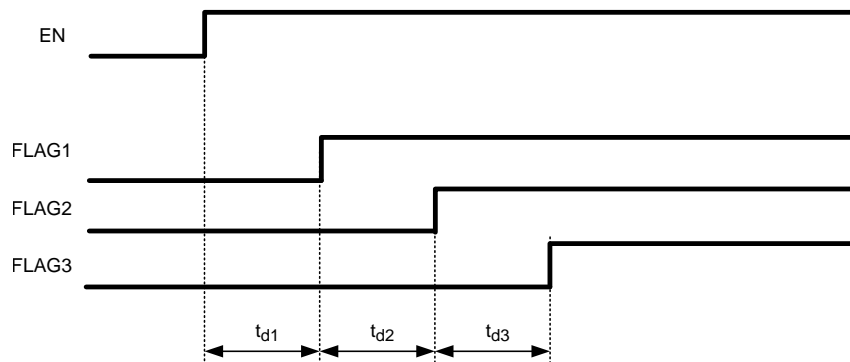


Figure 11. Power Up Sequence

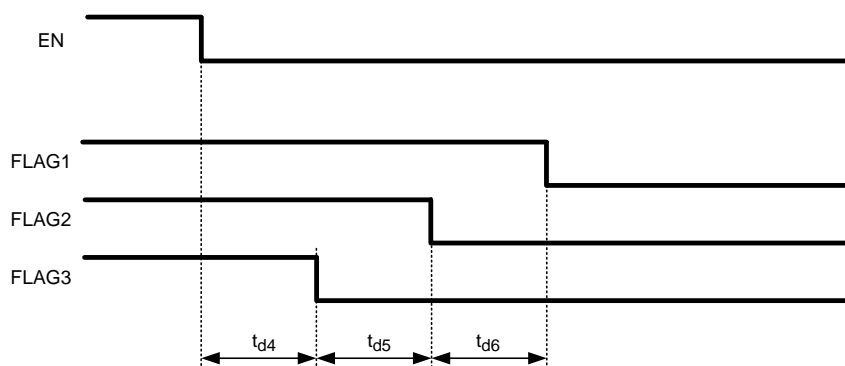


Figure 12. Power Down Sequence

APPLICATION INFORMATION

OVERVIEW

The LM3880 Power Sequencer provides an easy solution for sequencing multiple rails in a controlled manner. Six independent timers are integrated to control the timing sequence (power up and power down) of three open drain output flags. These flags permit connection to either a shutdown / enable pin of linear regulators and switchers to control the power supplies' operation. This allows a complete power system to be designed without worrying about large in-rush currents or latch-up conditions that can occur.

The timing sequence of the LM3880 is controlled entirely by the enable (EN) pin. Upon power up, all the flags are held low until this precision enable is pulled high. After the EN pin is asserted, the power up sequence will commence. An internal counter will delay the first flag (FLAG1) from rising until a fixed time period has expired. Upon the release of the first flag another timer will begin to delay the release of the second flag (FLAG2). This process repeats until all three flags have sequentially been released. The three timers that control the delays are all independent of each other and can be individually programmed if needed. (See [CUSTOM SEQUENCER](#) section).

The power down sequence is the same as power-up, but in reverse. When EN pin is de-asserted a timer will begin that delays the third flag (FLAG3) from pulling low. The second and first flag will then follow in a sequential manner after their appropriate delays. The three timers that are used to control the power down scheme can also be individually programmed and are completely independent of the power up timers.

Additional sequence patterns are also available in addition to customizable timers. For more information see the [CUSTOM SEQUENCER](#) section.

PART OPERATION

The timing sequence of the LM3880 is controlled by the assertion of the enable signal. The enable pin is designed with an internal comparator, referenced to a bandgap voltage (1.25V), to provide a precision threshold. This allows a delayed timing to be externally set using a capacitor or to start the sequencing based on a certain event, such as a line voltage reaching 90% of nominal. For an additional delayed sequence from the rail powering VCC, simply attach a capacitor to the EN pin as shown below.

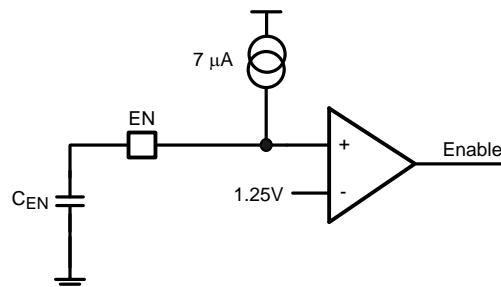


Figure 13. Cap Timing

Using the internal pull-up current source to charge the external capacitor (C_{EN}) the enable pin delay can be calculated by the equation below:

$$t_{enable_delay} = \frac{1.25V \times C_{EN}}{7 \mu A} \quad (1)$$

A resistor divider can also be used to enable the LM3880 based on a certain voltage threshold. Care needs to be taken when sizing the resistor divider to include the effects of the internal current source.

One of the features of the enable pin is that it provides glitch free operation. The first timer will start counting at a rising threshold, but will always reset if the enable pin is de-asserted before the first output flag is released. This can be shown in the timing diagram below:

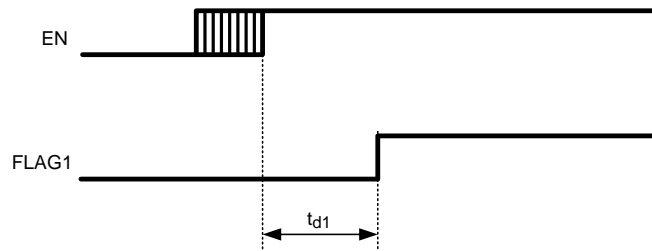


Figure 14. EN Glitch

If the enable signal remains high for the entire power-up sequence, then the part will operate as shown in the standard timing diagrams. However, if the enable signal is de-asserted before the power-up sequence is completed the part will enter a controlled shutdown. This allows the system to walk through a controlled power cycling, preventing any latch conditions from occurring. This state only occurs if the enable pin is de-asserted after the completion of timer 1, but before the entire power-up sequence is completed.

When this event occurs, the falling edge of enable pin resets the current timer and will allow the remaining power-up cycle to complete before beginning the power down sequence. The power down sequence starts approximately 120ms after the final power-up flag. This allows output voltages in the system to stabilize before everything is shutdown. An example of this operation can be seen below:

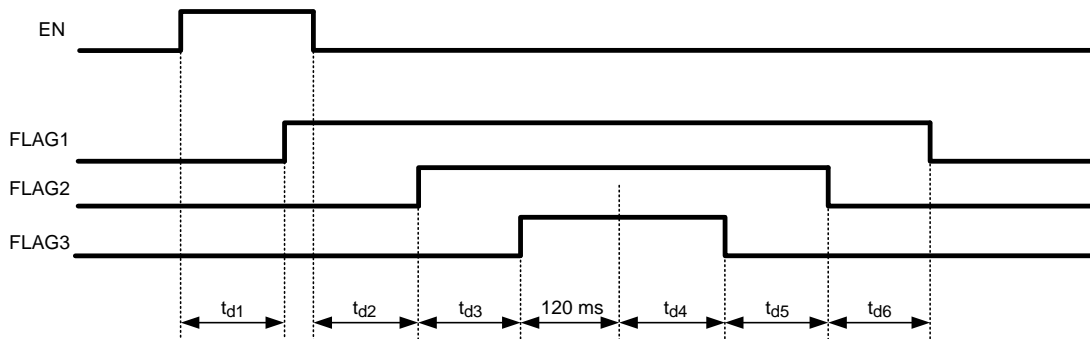


Figure 15. Incomplete Sequence

All the internal timers are generated by a master clock that has an extremely low tempco. This allows for tight accuracy across temperature and a consistent ratio between the individual timers. There is a slight additional delay of approximately 400 μ s to timers 1 and 4 which is a result of the EPROM refresh. This refresh time is in addition to the programmed delay time and will be almost insignificant to all but the shortest of timer delays.

CUSTOM SEQUENCER

The LM3880 Power Sequencer is based on a CMOS process utilizing an EPROM that has the capability to be custom programmed at the factory. Approximately 500,000,000 different options are available allowing even the most complex system to be simply sequenced. Because of the vast options that are possible, customization is limited to orders of a certain quantity. Please contact Texas Instruments for more information.

The variables that can be programmed include the six delay timers and the reverse sequence order. For the timers, each can be individually selected from one of the timer selector columns in the table shown below. However, all six time delays must be from the same column.

| Timer Options 1 ⁽¹⁾ | Timer Options 2 ⁽¹⁾ | Timer Options 3 ⁽¹⁾ | Timer Options 4 ⁽¹⁾ |
|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 0 | 0 | 0 | 0 |
| 2 | 4 | 6 | 8 |
| 4 | 8 | 12 | 16 |
| 6 | 12 | 18 | 24 |
| 8 | 16 | 24 | 32 |
| 10 | 20 | 30 | 40 |
| 12 | 24 | 36 | 48 |
| 14 | 28 | 42 | 56 |
| 16 | 32 | 48 | 64 |
| 18 | 36 | 54 | 72 |
| 20 | 40 | 60 | 80 |
| 22 | 44 | 66 | 88 |
| 24 | 48 | 72 | 96 |
| 26 | 52 | 78 | 104 |
| 28 | 56 | 84 | 112 |
| 30 | 60 | 90 | 120 |

(1) All times listed are in milliseconds

The sequencing order for power up is always controlled by layout. The flag number translates directly into the sequence order during power up (ie FLAG1 will always be first). However, for some systems a different power down order could be required. To allow flexibility for this aspect in a design, the Power Sequencer incorporates six different options for controlling the power down sequence. These options can be seen in the timing diagrams on the next page. This ability can be programmed in addition to the custom timers.

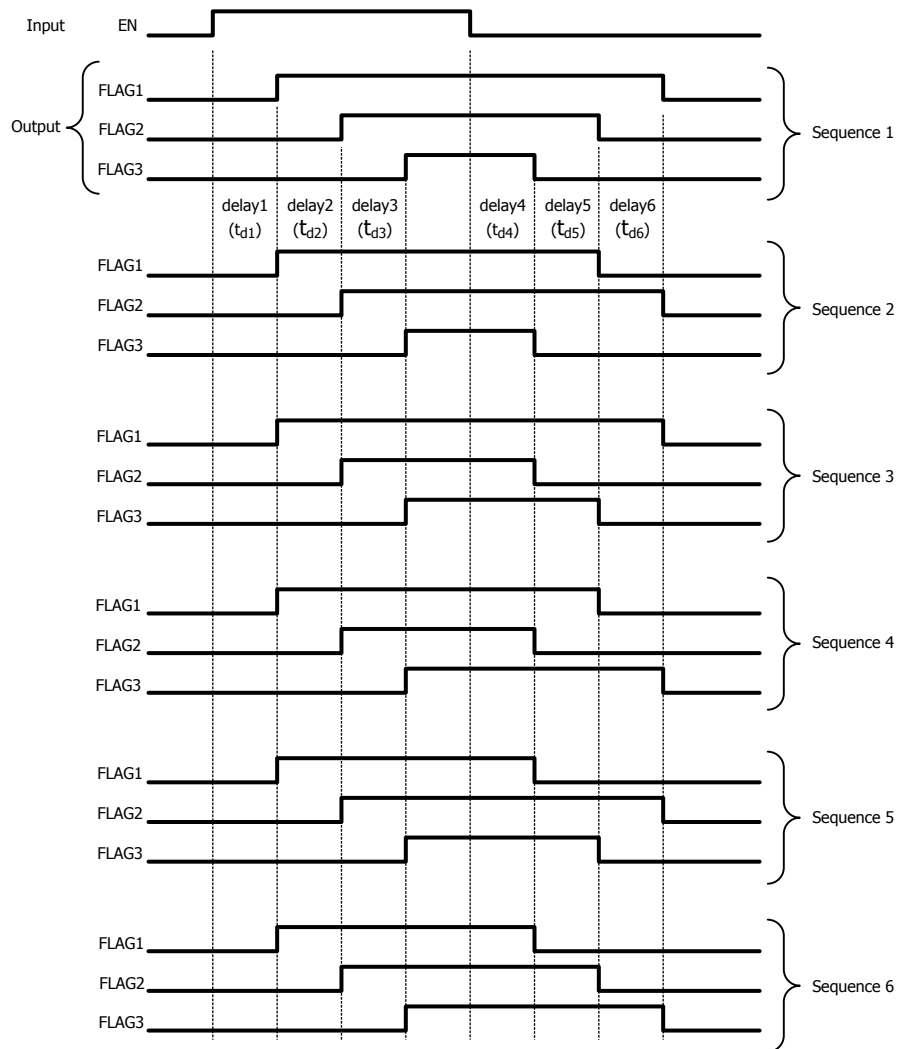


Figure 16. Power Down Sequence Options



REVISION HISTORY

| Changes from Revision H (March 2013) to Revision I | Page |
|--|--------------------------|
| <hr/> <ul style="list-style-type: none">• Changed layout of National Data Sheet to TI format | <hr/> 12 |

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|--------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM3880MF-1AA | NRND | SOT-23 | DBV | 6 | 1000 | TBD | Call TI | Call TI | -40 to 125 | F20A | |
| LM3880MF-1AA/NOPB | ACTIVE | SOT-23 | DBV | 6 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F20A | Samples |
| LM3880MF-1AB/NOPB | ACTIVE | SOT-23 | DBV | 6 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F21A | Samples |
| LM3880MF-1AC/NOPB | ACTIVE | SOT-23 | DBV | 6 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F22A | Samples |
| LM3880MF-1AD/NOPB | ACTIVE | SOT-23 | DBV | 6 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F23A | Samples |
| LM3880MF-1AE/NOPB | ACTIVE | SOT-23 | DBV | 6 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | | F25A | Samples |
| LM3880MF-1AF/NOPB | ACTIVE | SOT-23 | DBV | 6 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | | F31A | Samples |
| LM3880MFE-1AA/NOPB | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | | F20A | Samples |
| LM3880MFE-1AB/NOPB | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | | F21A | Samples |
| LM3880MFE-1AC/NOPB | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | | F22A | Samples |
| LM3880MFE-1AD/NOPB | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | | F23A | Samples |
| LM3880MFE-1AE/NOPB | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | | F25A | Samples |
| LM3880MFE-1AF/NOPB | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | | F31A | Samples |
| LM3880MFX-1AA/NOPB | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F20A | Samples |
| LM3880MFX-1AB/NOPB | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F21A | Samples |
| LM3880MFX-1AC/NOPB | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F22A | Samples |
| LM3880MFX-1AD/NOPB | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F23A | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM3880MFX-1AE/NOPB | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | | F25A | Samples |
| LM3880MFX-1AF/NOPB | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | | F31A | Samples |
| LM3880QMF-1AA/NOPB | ACTIVE | SOT-23 | DBV | 6 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F27A | Samples |
| LM3880QMF-1AB/NOPB | ACTIVE | SOT-23 | DBV | 6 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F28A | Samples |
| LM3880QMF-1AC/NOPB | ACTIVE | SOT-23 | DBV | 6 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F29A | Samples |
| LM3880QMF-1AD/NOPB | ACTIVE | SOT-23 | DBV | 6 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F30A | Samples |
| LM3880QMF-1AE/NOPB | ACTIVE | SOT-23 | DBV | 6 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F24A | Samples |
| LM3880QMF-1AF/NOPB | ACTIVE | SOT-23 | DBV | 6 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F32A | Samples |
| LM3880QMFE-1AA/NOPB | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F27A | Samples |
| LM3880QMFE-1AB/NOPB | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F28A | Samples |
| LM3880QMFE-1AC/NOPB | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F29A | Samples |
| LM3880QMFE-1AD/NOPB | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F30A | Samples |
| LM3880QMFE-1AE/NOPB | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F24A | Samples |
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| LM3880QMF-1AA/NOPB | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F27A | Samples |
| LM3880QMF-1AB/NOPB | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F28A | Samples |
| LM3880QMF-1AC/NOPB | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F29A | Samples |
| LM3880QMF-1AD/NOPB | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F30A | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|---|
| LM3880QMFx-1AE/NOPB | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F24A |  |
| LM3880QMFx-1AF/NOPB | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | F32A |  |

(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.

OBSELETE: 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> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(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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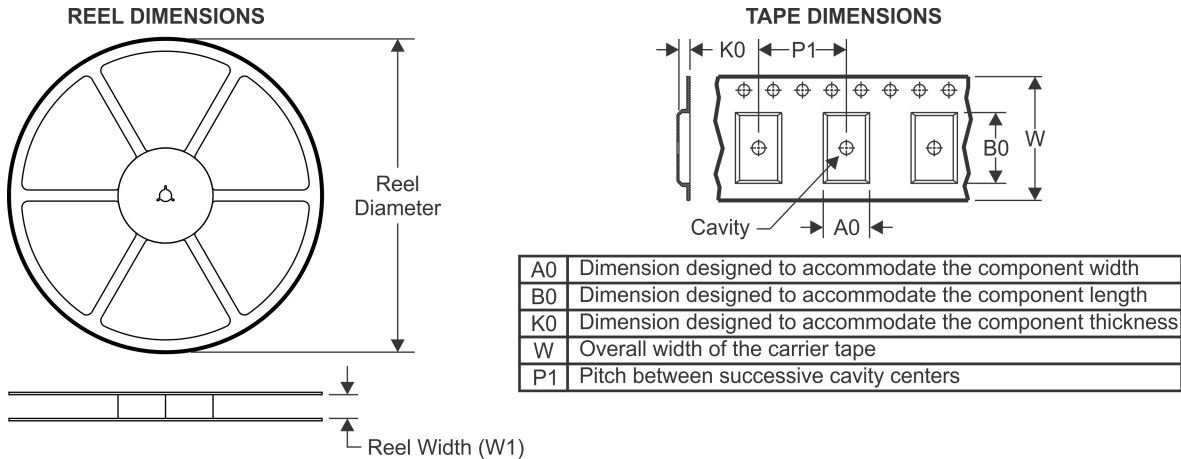
OTHER QUALIFIED VERSIONS OF LM3880, LM3880-Q1 :

- Catalog: [LM3880](#)
- Automotive: [LM3880-Q1](#)

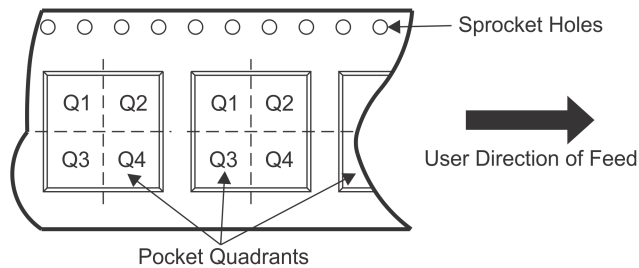
NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

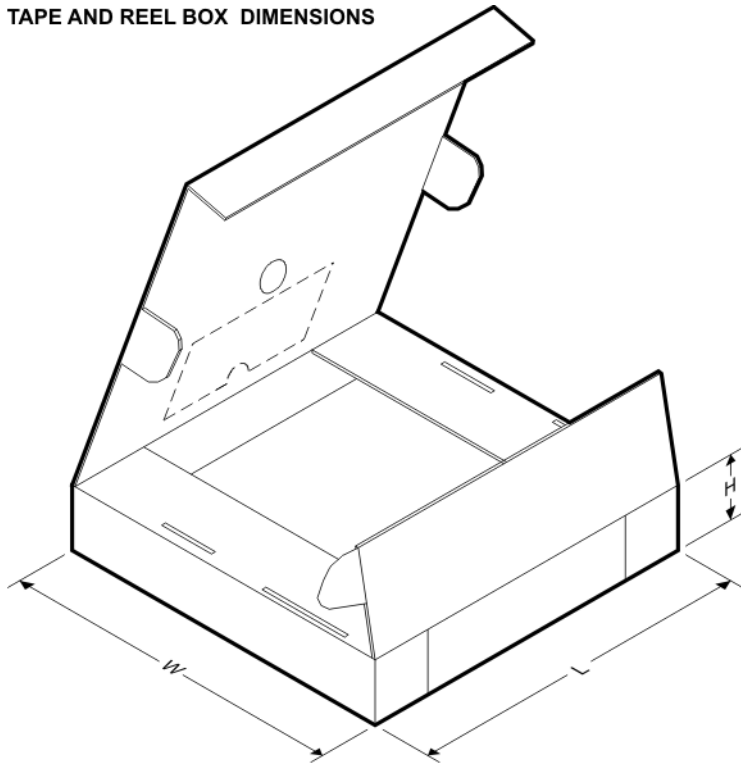


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|--------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM3880MF-1AA | SOT-23 | DBV | 6 | 1000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880MF-1AB/NOPB | SOT-23 | DBV | 6 | 1000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880MF-1AC/NOPB | SOT-23 | DBV | 6 | 1000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880MF-1AD/NOPB | SOT-23 | DBV | 6 | 1000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880MF-1AE/NOPB | SOT-23 | DBV | 6 | 1000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880MF-1AF/NOPB | SOT-23 | DBV | 6 | 1000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880MFE-1AA/NOPB | SOT-23 | DBV | 6 | 250 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880MFE-1AB/NOPB | SOT-23 | DBV | 6 | 250 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880MFE-1AC/NOPB | SOT-23 | DBV | 6 | 250 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880MFE-1AD/NOPB | SOT-23 | DBV | 6 | 250 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880MFE-1AE/NOPB | SOT-23 | DBV | 6 | 250 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880MFE-1AF/NOPB | SOT-23 | DBV | 6 | 250 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880MFX-1AB/NOPB | SOT-23 | DBV | 6 | 3000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880MFX-1AC/NOPB | SOT-23 | DBV | 6 | 3000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880MFX-1AD/NOPB | SOT-23 | DBV | 6 | 3000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880MFX-1AE/NOPB | SOT-23 | DBV | 6 | 3000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880MFX-1AF/NOPB | SOT-23 | DBV | 6 | 3000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880QMF-1AA/NOPB | SOT-23 | DBV | 6 | 1000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM3880QMF-1AB/NOPB | SOT-23 | DBV | 6 | 1000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880QMF-1AC/NOPB | SOT-23 | DBV | 6 | 1000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880QMF-1AD/NOPB | SOT-23 | DBV | 6 | 1000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880QMF-1AE/NOPB | SOT-23 | DBV | 6 | 1000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880QMF-1AF/NOPB | SOT-23 | DBV | 6 | 1000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880QMFE-1AA/NOPB | SOT-23 | DBV | 6 | 250 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880QMFE-1AB/NOPB | SOT-23 | DBV | 6 | 250 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880QMFE-1AC/NOPB | SOT-23 | DBV | 6 | 250 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880QMFE-1AD/NOPB | SOT-23 | DBV | 6 | 250 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880QMFE-1AE/NOPB | SOT-23 | DBV | 6 | 250 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880QMFE-1AF/NOPB | SOT-23 | DBV | 6 | 250 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880QMF-1AA/NOPB | SOT-23 | DBV | 6 | 3000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880QMF-1AB/NOPB | SOT-23 | DBV | 6 | 3000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880QMF-1AC/NOPB | SOT-23 | DBV | 6 | 3000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880QMF-1AD/NOPB | SOT-23 | DBV | 6 | 3000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880QMF-1AE/NOPB | SOT-23 | DBV | 6 | 3000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LM3880QMF-1AF/NOPB | SOT-23 | DBV | 6 | 3000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |

TAPE AND REEL BOX DIMENSIONS



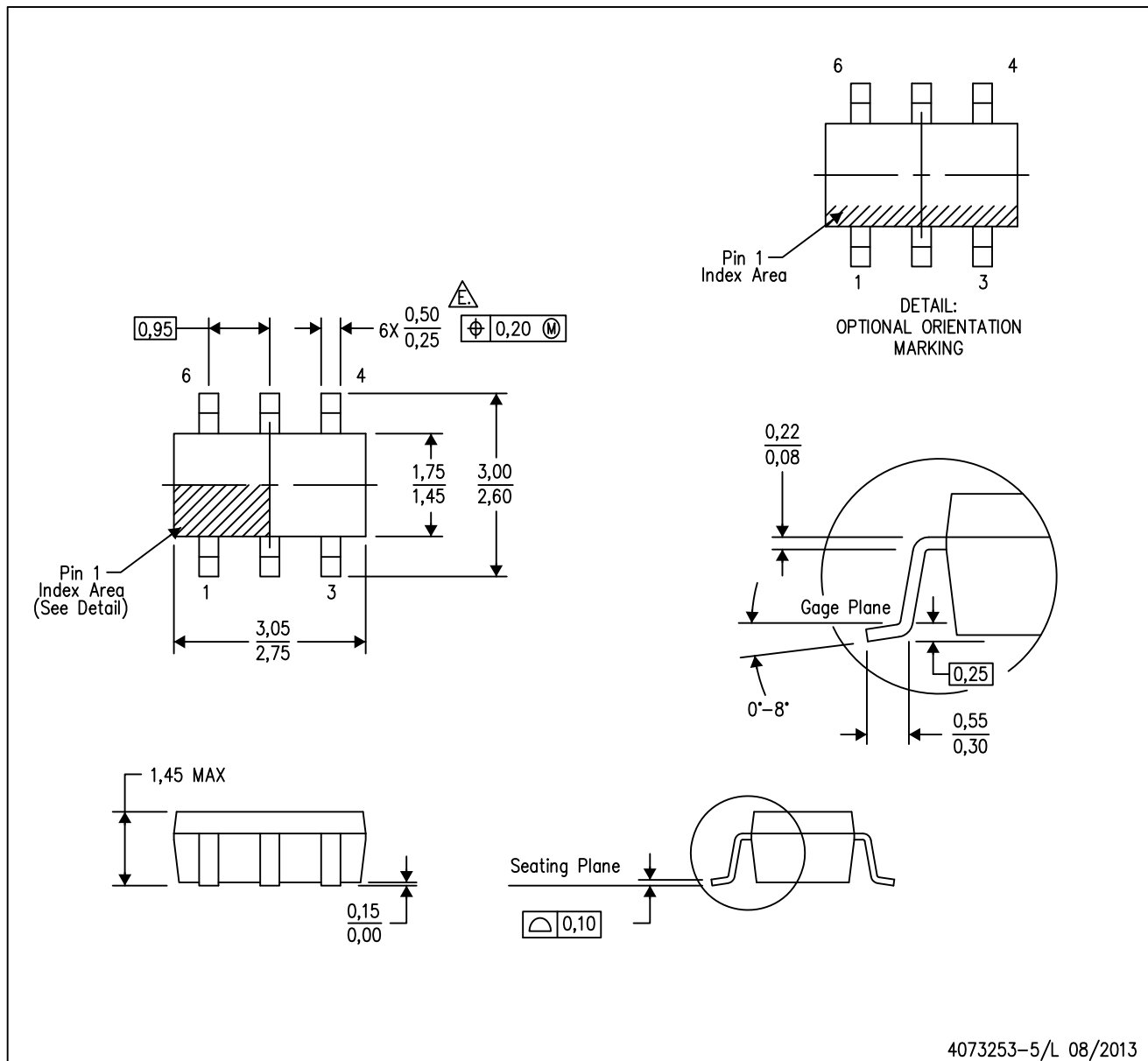
*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM3880MF-1AA | SOT-23 | DBV | 6 | 1000 | 210.0 | 185.0 | 35.0 |
| LM3880MF-1AB/NOPB | SOT-23 | DBV | 6 | 1000 | 210.0 | 185.0 | 35.0 |
| LM3880MF-1AC/NOPB | SOT-23 | DBV | 6 | 1000 | 210.0 | 185.0 | 35.0 |
| LM3880MF-1AD/NOPB | SOT-23 | DBV | 6 | 1000 | 210.0 | 185.0 | 35.0 |
| LM3880MF-1AE/NOPB | SOT-23 | DBV | 6 | 1000 | 210.0 | 185.0 | 35.0 |
| LM3880MF-1AF/NOPB | SOT-23 | DBV | 6 | 1000 | 210.0 | 185.0 | 35.0 |
| LM3880MFE-1AA/NOPB | SOT-23 | DBV | 6 | 250 | 210.0 | 185.0 | 35.0 |
| LM3880MFE-1AB/NOPB | SOT-23 | DBV | 6 | 250 | 210.0 | 185.0 | 35.0 |
| LM3880MFE-1AC/NOPB | SOT-23 | DBV | 6 | 250 | 210.0 | 185.0 | 35.0 |
| LM3880MFE-1AD/NOPB | SOT-23 | DBV | 6 | 250 | 210.0 | 185.0 | 35.0 |
| LM3880MFE-1AE/NOPB | SOT-23 | DBV | 6 | 250 | 210.0 | 185.0 | 35.0 |
| LM3880MFE-1AF/NOPB | SOT-23 | DBV | 6 | 250 | 210.0 | 185.0 | 35.0 |
| LM3880MFX-1AB/NOPB | SOT-23 | DBV | 6 | 3000 | 210.0 | 185.0 | 35.0 |
| LM3880MFX-1AC/NOPB | SOT-23 | DBV | 6 | 3000 | 210.0 | 185.0 | 35.0 |
| LM3880MFX-1AD/NOPB | SOT-23 | DBV | 6 | 3000 | 210.0 | 185.0 | 35.0 |
| LM3880MFX-1AE/NOPB | SOT-23 | DBV | 6 | 3000 | 210.0 | 185.0 | 35.0 |
| LM3880MFX-1AF/NOPB | SOT-23 | DBV | 6 | 3000 | 210.0 | 185.0 | 35.0 |
| LM3880QMF-1AA/NOPB | SOT-23 | DBV | 6 | 1000 | 210.0 | 185.0 | 35.0 |
| LM3880QMF-1AB/NOPB | SOT-23 | DBV | 6 | 1000 | 210.0 | 185.0 | 35.0 |
| LM3880QMF-1AC/NOPB | SOT-23 | DBV | 6 | 1000 | 210.0 | 185.0 | 35.0 |
| LM3880QMF-1AD/NOPB | SOT-23 | DBV | 6 | 1000 | 210.0 | 185.0 | 35.0 |
| LM3880QMF-1AE/NOPB | SOT-23 | DBV | 6 | 1000 | 210.0 | 185.0 | 35.0 |
| LM3880QMF-1AF/NOPB | SOT-23 | DBV | 6 | 1000 | 210.0 | 185.0 | 35.0 |
| LM3880QMFE-1AA/NOPB | SOT-23 | DBV | 6 | 250 | 210.0 | 185.0 | 35.0 |
| LM3880QMFE-1AB/NOPB | SOT-23 | DBV | 6 | 250 | 210.0 | 185.0 | 35.0 |
| LM3880QMFE-1AC/NOPB | SOT-23 | DBV | 6 | 250 | 210.0 | 185.0 | 35.0 |
| LM3880QMFE-1AD/NOPB | SOT-23 | DBV | 6 | 250 | 210.0 | 185.0 | 35.0 |
| LM3880QMFE-1AE/NOPB | SOT-23 | DBV | 6 | 250 | 210.0 | 185.0 | 35.0 |
| LM3880QMFE-1AF/NOPB | SOT-23 | DBV | 6 | 250 | 210.0 | 185.0 | 35.0 |
| LM3880QMFX-1AA/NOPB | SOT-23 | DBV | 6 | 3000 | 210.0 | 185.0 | 35.0 |
| LM3880QMFX-1AB/NOPB | SOT-23 | DBV | 6 | 3000 | 210.0 | 185.0 | 35.0 |
| LM3880QMFX-1AC/NOPB | SOT-23 | DBV | 6 | 3000 | 210.0 | 185.0 | 35.0 |
| LM3880QMFX-1AD/NOPB | SOT-23 | DBV | 6 | 3000 | 210.0 | 185.0 | 35.0 |
| LM3880QMFX-1AE/NOPB | SOT-23 | DBV | 6 | 3000 | 210.0 | 185.0 | 35.0 |
| LM3880QMFX-1AF/NOPB | SOT-23 | DBV | 6 | 3000 | 210.0 | 185.0 | 35.0 |

MECHANICAL DATA

DBV (R-PDSO-G6)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
 - Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
- \triangle Falls within JEDEC MO-178 Variation AB, except minimum lead width.

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