

## ISL88011, ISL88012, ISL88013, ISL88014, ISL88015

5 Ld Voltage Supervisors with Adjustable Power-On Reset, Dual Voltage Monitoring or Watchdog Timer Capability

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The ISL88011, ISL88012, ISL88013, ISL88014, ISL88015 family of devices offer both fixed and/or adjustable voltage-monitoring that combine popular functions such as Power-On reset control, watchdog timer, supply voltage supervision, and manual reset assertion in a small 5 Ld SOT-23 package.

Unique features on the ISL88013 and ISL88015 include a watchdog timer with a 51s start-up timeout and a 1.6s normal timeout duration. On the ISL88011 and ISL88014, users can increase the nominal 200ms Power-On reset timeout delay by adding an external capacitor to the  $C_{POR}$  pin. Both fixed and adjustable voltage monitors are provided by the ISL88012. Complementary active-low and active-high reset outputs are available on the ISL88011, ISL88012 and ISL88013 devices. All devices provide manual reset capability (see "Product Features Table" on page 5).

Seven preprogrammed reset threshold voltages accurate to  $\pm 1.5\%$  over temperature are offered (see "Ordering Information" on page 3). The ISL88012, ISL88014 and ISL88015 have a user-adjustable voltage input available for custom monitoring of any voltage down to 0.6V. All parts are specifically designed for low power consumption and high threshold accuracy.

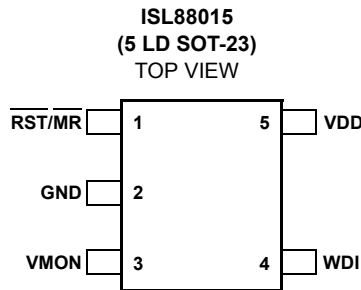
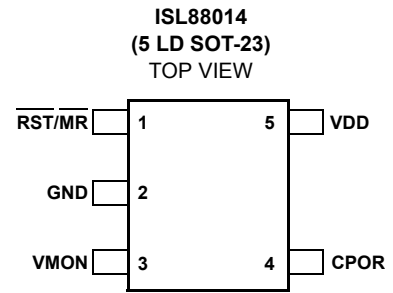
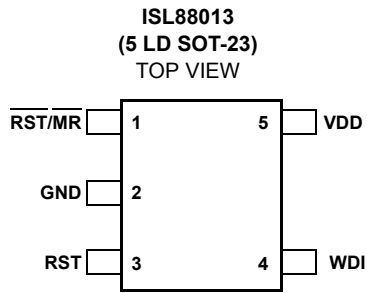
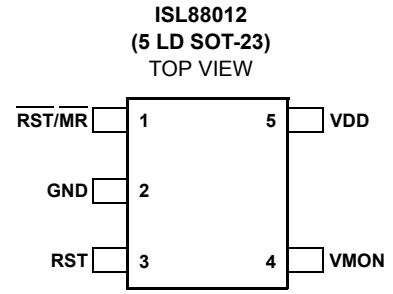
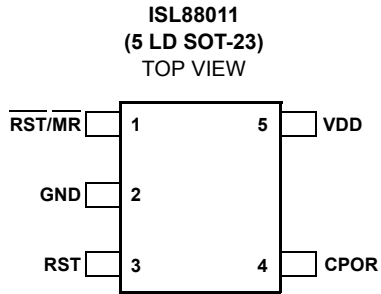
### Features

- Single/dual voltage monitoring supervisors
- Fixed-voltage options allow precise monitoring of +2.5V, +3.0V, +3.3V, and +5.0V power supplies
- Dual supervisor has one fixed voltage input and another that is user-adjustable down to 0.6V.
- Both RST and  $\overline{\text{RST}}$  outputs available
- Adjustable POR timeout delay options
- Watchdog timer with 1.6s normal and 51s start-up timeout durations
- Manual reset input on all devices
- Reset signal valid down to  $V_{DD} = 1V$
- Accurate  $\pm 1.5\%$  voltage threshold
- Immune to power-supply transients
- Ultra low 5.5 $\mu$ A supply current
- Small 5 Ld SOT-23 Pb-Free package
- Pb-Free (RoHS Compliant)

### Applications

- Process control systems
- Intelligent instruments
- Embedded control systems
- Computer systems
- Critical  $\mu$ P and  $\mu$ C power monitoring
- Portable/battery-powered equipment
- PDA and handheld PC devices

**Pinouts**



## Ordering Information

| PART NUMBER<br>(Notes 1, 2, 3)  | PART<br>MARKING<br>(Note 4) | V <sub>THVDD</sub><br>(V) | V <sub>THVMON</sub><br>(V) | TEMPERATURE<br>RANGE<br>(°C) | PACKAGE<br>TAPE AND REEL<br>(Pb-free) | PKG.<br>DWG. # |
|---|-----------------------------|---------------------------|----------------------------|------------------------------|---------------------------------------|----------------|
| ISL88011IH546Z-TK   | AGU                         | 4.64                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88011IH546Z-T7A  | AGU                         | 4.64                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88011IH544Z-TK   | AGV                         | 4.38                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88011IH544Z-T7A  | AGV                         | 4.38                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88011IH531Z-TK   | AGW                         | 3.09                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88011IH531Z-T7A  | AGW                         | 3.09                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88011IH529Z-TK   | AGX                         | 2.92                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88011IH529Z-T7A  | AGX                         | 2.92                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88011IH526Z-TK   | AGY                         | 2.63                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88011IH526Z-T7A  | AGY                         | 2.63                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88011IH523Z-TK   | AGZ                         | 2.32                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88011IH523Z-T7A  | AGZ                         | 2.32                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88011IH522Z-TK (No longer available, recommended replacement: ISL88013IH522Z-TK)   | AHE                         | 2.19                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88011IH522Z-T7A (No longer available, recommended replacement: ISL88013IH522Z-T7A) | AHE                         | 2.19                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88012IH546Z-TK (No longer available or supported)                                  | AHF                         | 4.64                      | 0.6 (Note 2)               | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88012IH546Z-T7A (No longer available or supported)                                 | AHF                         | 4.64                      | 0.6 (Note 2)               | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88012IH544Z-TK (No longer available or supported)                                  | AHG                         | 4.38                      | 0.6 (Note 2)               | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88012IH544Z-T7A (No longer available or supported)                                 | AHG                         | 4.38                      | 0.6 (Note 2)               | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88012IH531Z-TK (No longer available or supported)                                  | AHH                         | 3.09                      | 0.6 (Note 2)               | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88012IH531Z-T7A (No longer available or supported)                                 | AHH                         | 3.09                      | 0.6 (Note 2)               | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88012IH529Z-TK (No longer available or supported)                                  | AHI                         | 2.92                      | 0.6 (Note 2)               | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88012IH529Z-T7A (No longer available or supported)                                 | AHI                         | 2.92                      | 0.6 (Note 2)               | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88012IH526Z-TK (No longer available or supported)                                  | AHJ                         | 2.63                      | 0.6 (Note 2)               | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88012IH526Z-T7A (No longer available or supported)                                 | AHJ                         | 2.63                      | 0.6 (Note 2)               | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88012IH523Z-TK (No longer available or supported)                                  | AHK                         | 2.32                      | 0.6 (Note 2)               | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88012IH523Z-T7A (No longer available or supported)                                 | AHK                         | 2.32                      | 0.6 (Note 2)               | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88012IH522Z-TK (No longer available or supported)                                  | AHL                         | 2.19                      | 0.6 (Note 2)               | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88012IH522Z-T7A (No longer available or supported)                                 | AHL                         | 2.19                      | 0.6 (Note 2)               | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88013IH546Z-TK (No longer available, recommended replacement: ISL88011IH546Z-TK)   | AHM                         | 4.64                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88013IH546Z-T7A (No longer available, recommended replacement: ISL88011IH546Z-T7A) | AHM                         | 4.64                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88013IH544Z-TK   | AHN                         | 4.38                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88013IH544Z-T7A  | AHN                         | 4.38                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88013IH531Z-TK   | AHO                         | 3.09                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88013IH531Z-T7A  | AHO                         | 3.09                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88013IH529Z-TK   | AHP                         | 2.92                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |
| ISL88013IH529Z-T7A  | AHP                         | 2.92                      | N/A                        | -40 to +85                   | 5 Ld SOT-23                           | P5.064         |

**Ordering Information** (Continued)

| PART NUMBER<br>(Notes 1, 2, 3)  | PART MARKING<br>(Note 4) | V <sub>THVDD</sub><br>(V) | V <sub>THVMON</sub><br>(V) | TEMPERATURE RANGE<br>(°C) | PACKAGE TAPE AND REEL<br>(Pb-free) | PKG. DWG. # |
|---|--------------------------|---------------------------|----------------------------|---------------------------|------------------------------------|-------------|
| ISL88013IH526Z-TK   | AHQ                      | 2.63                      | N/A                        | -40 to +85                | 5 Ld SOT-23                        | P5.064      |
| ISL88013IH526Z-T7A  | AHQ                      | 2.63                      | N/A                        | -40 to +85                | 5 Ld SOT-23                        | P5.064      |
| ISL88013IH523Z-TK (No longer available, recommended replacement: ISL88011IH523Z-TK)   | AHR                      | 2.32                      | N/A                        | -40 to +85                | 5 Ld SOT-23                        | P5.064      |
| ISL88013IH523Z-T7A (No longer available, recommended replacement: ISL88011IH523Z-T7A) | AHR                      | 2.32                      | N/A                        | -40 to +85                | 5 Ld SOT-23                        | P5.064      |
| ISL88013IH522Z-TK   | AHS                      | 2.19                      | N/A                        | -40 to +85                | 5 Ld SOT-23                        | P5.064      |
| ISL88013IH522Z-T7A  | AHS                      | 2.19                      | N/A                        | -40 to +85                | 5 Ld SOT-23                        | P5.064      |
| ISL88014IH5Z-TK   | AHT                      | N/A                       | 0.6 (Note 2)               | -40 to +85                | 5 Ld SOT-23                        | P5.064      |
| ISL88014IH5Z-T7A  | AHT                      | N/A                       | 0.6 (Note 2)               | -40 to +85                | 5 Ld SOT-23                        | P5.064      |
| ISL88015IH5Z-TK (No longer available or supported)                                    | AHU                      | N/A                       | 0.6 (Note 2)               | -40 to +85                | 5 Ld SOT-23                        | P5.064      |
| ISL88015IH5Z-T7A (No longer available or supported)                                   | AHU                      | N/A                       | 0.6 (Note 2)               | -40 to +85                | 5 Ld SOT-23                        | P5.064      |
| ISL88011EVAL1Z  | ISL88011 Evaluation Card |                           |                            |                           |                                    |             |
| ISL88013EVAL1Z  | ISL88013 Evaluation Card |                           |                            |                           |                                    |             |
| ISL88014EVAL1Z  | ISL88014 Evaluation Card |                           |                            |                           |                                    |             |

NOTES:

- These Intersil Pb-free plastic packaged products employ special Pb-free material sets, molding compounds/die attach materials, and 100% matte tin plate plus anneal (e3 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations). Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.
- The voltage trip point can be adjusted to be greater than 0.6V using 2 external resistors. By default, the V<sub>THVMON</sub> trip point is 0.6V if no external resistors are used.
- For Moisture Sensitivity Level (MSL), please see device information page for [ISL88011](#), [ISL88012](#), [ISL88013](#), [ISL88014](#), [ISL88015](#). For more information on MSL please see techbrief [TB363](#).
- The part marking is located on the bottom of the part.

**Functional Block Diagrams**



**Product Features Table**

| FUNCTION                                      | ISL88011 | ISL88012 | ISL88013 | ISL88014 | ISL88015 |
|---|----------|----------|----------|----------|----------|
| Active-Low Reset ( $\overline{\text{RST}}$ )  | x        | x        | x        | x        | x        |
| Active-High Reset (RST)                       | x        | x        | x        |          |          |
| Watchdog Timer (WDI)                          |          |          | x        |          | x        |
| Dual Voltage Supervision                      |          | x        |          |          |          |
| Adjustable POR Timeout ( $C_{\text{POR}}$ )   | x        |          |          | x        |          |
| Manual Reset Input ( $\overline{\text{MR}}$ ) | x        | x        | x        | x        | x        |
| Fixed Trip Point Voltage                      | x        | x        | x        |          |          |
| Adjustable Trip Point Voltage                 |          | x        |          | x        | x        |

**Pin Descriptions**

| PIN      |          |          |          |          | NAME   | FUNCTION  |
|----------|----------|----------|----------|----------|--|---|
| ISL88011 | ISL88012 | ISL88013 | ISL88014 | ISL88015 |  |   |
| 1        | 1        | 1        | 1        | 1        | $\overline{\text{RST}}/\overline{\text{MR}}$ | Combined Active-Low Reset Output and Manual Reset Input |
| 2        | 2        | 2        | 2        | 2        | GND  | Ground  |
|          | 4        |          | 3        | 3        | VMON   | Adjustable Threshold Voltage Input                      |
| 3        | 3        | 3        |          |          | RST  | Active-High Reset Output                                |
| 4        |          |          | 4        |          | $C_{\text{POR}}$                             | Adjustable POR Timeout Delay Input                      |
|          |          | 4        |          | 4        | WDI  | Watchdog Timer Input                                    |
| 5        | 5        | 5        | 5        | 5        | $V_{\text{DD}}$                              | Supply Voltage and Monitored Input                      |

**Absolute Maximum Ratings**

|  |                 |
|--|-----------------|
| Temperature Under Bias                         | -40°C to +125°C |
| Storage Temperature                            | -65°C to +150°C |
| Voltage on any pin with respect to GND         | -1.0V to +7V    |
| DC Output Current                              | 5mA             |
| ESD Rating                                     |                 |
| Human Body Model (Tested per JESD22-A114)      | 2500V           |
| Charged Device Model (Tested per JESD22-C101E) | 1200V           |
| Machine Model (Tested per JESD22-A115)         | 250V            |

**Thermal Information**

|  |   |
|--|---|
| Thermal Resistance (Typical)                   | $\theta_{JA}$ (°C/W)  |
| 5 Ld SOT-23 (Note 5)                           | 190   |
| Maximum Junction Temperature (Plastic Package) | +125°C  |
| Maximum Storage Temperature Range              | -65°C to +150°C   |
| Pb-Free Reflow Profile                         | see link below  |
|  | <a href="http://www.intersil.com/pbfree/Pb-FreeReflow.asp">http://www.intersil.com/pbfree/Pb-FreeReflow.asp</a> |

**Recommended Operating Conditions**

|                                 |                              |
|---------------------------------|------------------------------|
| Temperature Range (Industrial)  | -40°C to +85°C               |
| Pull-up Resistance ( $R_{PU}$ ) | 5k $\Omega$ to 100k $\Omega$ |

**CAUTION:** Do not operate at or near the maximum ratings listed for extended periods of time. Exposure to such conditions may adversely impact product reliability and result in failures not covered by warranty.

## NOTE:

5.  $\theta_{JA}$  is measured with the component mounted on a high effective thermal conductivity test board in free air. See Tech Brief [TB379](#) for details.

**Electrical Specifications** Over the recommended operating conditions unless otherwise specified,  $R_{PU} = 10k\Omega$ .

| SYMBOL                    | PARAMETER                                       | TEST CONDITIONS                       | MIN             | TYP  | MAX  | UNITS   |
|---------------------------|---|---------------------------------------|-----------------|------|------|---------|
| $V_{DD}$                  | Supply Voltage Range                            |                                       | 2.0             |      | 5.5  | V       |
| $I_{DD}$                  | Supply Current for ISL88011, ISL88012, ISL88013 | $V_{DD} = 5.0V$                       |                 | 8    | 11.5 | $\mu A$ |
|                           |   | $V_{DD} = 3.3V$                       |                 | 7    | 10   | $\mu A$ |
|                           |   | $V_{DD} = 2.5V$                       |                 | 5.5  | 9    | $\mu A$ |
|                           |   | Supply Current for ISL88014, ISL88015 | $V_{DD} = 3.3V$ |      | 4.5  | 8       |
| $I_{LI}$                  | Input Leakage Current (VMON)                    |                                       |                 |      | 100  | nA      |
| $I_{LO}$                  | Output Leakage Current (VMON)                   |                                       |                 |      | 100  | nA      |
| <b>VOLTAGE THRESHOLDS</b> |   |                                       |                 |      |      |         |
| $V_{THVDD}$               | Fixed $V_{DD}$ Voltage Trip Point               | ISL88011, ISL88012, ISL88013IH546     | 4.57            | 4.64 | 4.71 | V       |
|                           |   | ISL88011, ISL88012, ISL88013IH544     | 4.31            | 4.38 | 4.45 | V       |
|                           |   | ISL88011, ISL88012, ISL88013IH531     | 3.04            | 3.09 | 3.14 | V       |
|                           |   | ISL88011, ISL88012, ISL88013IH529     | 2.88            | 2.92 | 2.96 | V       |
|                           |   | ISL88011, ISL88012, ISL88013IH526     | 2.59            | 2.63 | 2.67 | V       |
|                           |   | ISL88011, ISL88012, ISL88013IH523     | 2.29            | 2.32 | 2.35 | V       |
|                           |   | ISL88011, ISL88012, ISL88013IH522     | 2.16            | 2.19 | 2.22 | V       |
| $V_{THVDD}$<br>HYST       | Hysteresis at $V_{DD}$ Input                    | $V_{THVDD} = 4.64V$                   |                 | 46   |      | mV      |
|                           |   | $V_{THVDD} = 4.38V$                   |                 | 44   |      | mV      |
|                           |   | $V_{THVDD} = 3.09V$                   |                 | 31   |      | mV      |
|                           |   | $V_{THVDD} = 2.92V$                   |                 | 29   |      | mV      |
|                           |   | $V_{THVDD} = 2.63V$                   |                 | 26   |      | mV      |
|                           |   | $V_{THVDD} = 2.32V$                   |                 | 23   |      | mV      |
|                           |   | $V_{THVDD} = 2.19V$                   |                 | 22   |      | mV      |
| $V_{THVMON}$              | Adj. Reset Voltage Trip Point (Note 6)          | $V_{THVDD} = 4.64V$                   | 599             | 605  | 611  | mV      |
|                           |   | $V_{THVDD} = 4.38V$                   | 597             | 603  | 609  | mV      |
|                           |   | $V_{THVDD} = 3.09V$                   | 589             | 595  | 601  | mV      |
|                           |   | $V_{THVDD} = 2.92V$                   | 589             | 595  | 601  | mV      |
|                           |   | $V_{THVDD} = 2.63V$                   | 589             | 595  | 601  | mV      |
|                           |   | $V_{THVDD} = 2.32V$                   | 597             | 603  | 609  | mV      |
|                           |   | $V_{THVDD} = 2.19V$                   | 597             | 603  | 609  | mV      |

**Electrical Specifications** Over the recommended operating conditions unless otherwise specified,  $R_{PU} = 10k\Omega$ . (Continued)

| SYMBOL                         | PARAMETER                              | TEST CONDITIONS                          | MIN                  | TYP          | MAX                 | UNITS   |
|--------------------------------|--|--|----------------------|--------------|---------------------|---------|
| $V_{THVMON}$                   | Adj. Reset Voltage Trip Point (Note 7) |  | 594                  | 600          | 606                 | mV      |
| $V_{THVMON}$<br>$HYST$         | Hysteresis Voltage (Notes 6, 7)        |  |                      | 3            |                     | mV      |
| <b>RESET</b>                   |  |  |                      |              |                     |         |
| $V_{OL}$                       | Reset Output Voltage Low               | $V_{DD} \geq 3.3V$ , Sinking 0.5mA       |                      | 0.05         | 0.40                | V       |
|                                |  | $V_{DD} < 3.3V$ , Sinking 0.5mA          |                      | 0.05         | 0.40                | V       |
| $V_{OH}$                       | Reset Output Voltage High              | $V_{DD} \geq 3.3V$ , Sourcing 0.4mA      | $V_{DD}-0.6$         | $V_{DD}-0.4$ |                     | V       |
|                                |  | $V_{DD} < 3.3V$ , Sourcing 0.4mA         | $V_{DD}-0.6$         | $V_{DD}-0.4$ |                     | V       |
| $t_{RPD}$                      | $V_{TH}$ to Reset Asserted Delay       |  |                      | 60           |                     | $\mu s$ |
| $t_{POR}$                      | POR Timeout Delay                      | ISL88012, ISL88013, ISL88015             | 140                  | 200          | 260                 | ms      |
|                                |  | ISL88011, ISL88014 with $C_{POR} = OPEN$ | 200                  | 250          |                     | ms      |
| $C_{LOAD}$                     | Load Capacitance on Reset Pins         |  |                      | 5            |                     | pF      |
| <b>MANUAL RESET</b>            |  |  |                      |              |                     |         |
| $V_{MR}$                       | $\overline{MR}$ Input Voltage          |  | 0                    |              | 100                 | mV      |
| $t_{MR}$                       | $\overline{MR}$ Minimum Pulse Width    |  | 1                    |              |                     | $\mu s$ |
| <b>WATCHDOG TIMER (Note 8)</b> |  |  |                      |              |                     |         |
| Start $t_{WDT}$                | Start-up Watchdog Timeout Period       |  | 32                   | 51           | 64                  | sec     |
| $t_{WDT}$                      | Normal Watchdog Timeout Period         |  | 1.0                  | 1.6          | 2.0                 | sec     |
| $t_{WDPS}$                     | WDI Minimum Pulse Width                |  | 100                  |              |                     | ns      |
| $V_{IL}$                       | Watchdog Input Voltage Low             |  |                      |              | $0.3 \times V_{DD}$ | V       |
| $V_{IH}$                       | Watchdog Input Voltage High            |  | $0.85 \times V_{DD}$ |              |                     | V       |
| $I_{WDT}$                      | Watchdog Input Current                 |  |                      |              | 100                 | nA      |

## NOTES:

6. Applies to ISL88012.
7. Applies to ISL88014 and ISL88015.
8. Applies to ISL88013 and ISL88015.

## Pin Description

### RST

The push-pull RST output is set to  $V_{DD}$  (HIGH) listed in the following:

1. The device is first powered up.
2. Either  $V_{DD}$  or the voltage on VMON falls below their respective minimum voltage sense levels.
3.  $\overline{MR}$  is asserted.
4. The watchdog timeout expires.

### RST/MR

This pin functions as both a reset output and a manual reset input. The  $\overline{RST}$  output functions identically to the complementary RST output but is an open drain output that is pulled to GND (LOW) when reset is asserted. The  $\overline{MR}$  input is an active-low debounced input to which a user can connect a push-button to add manual reset capability or drive with active low signal from a controller.

### $V_{DD}$

The  $V_{DD}$  pin is the power supply terminal. It is monitored by the ISL88011, ISL88012 and ISL88013. For these devices, the voltage at this pin is compared against an internal factory-programmed voltage trip point,  $V_{THVDD}$ . A reset is first asserted when the device is initially powered up to

ensure that the power supply has stabilized. Thereafter, reset is again asserted whenever  $V_{DD}$  falls below  $V_{THVDD}$ . The device is designed with hysteresis to help prevent chattering due to noise.

### VMON

The VMON pin on the ISL88012, ISL88014 and ISL88015 is a monitored input voltage that is user-adjustable. The voltage at this pin is compared against an internal 600mV reference voltage ( $V_{THVMON}$ ) and a reset is asserted whenever the monitored voltage falls below this trip point.

### WDI

The Watchdog Input takes an input from a microprocessor and ensures that it periodically toggles the WDI pin, otherwise the internal watchdog timer runs out and reset is asserted. The internal Watchdog Timer is cleared whenever the WDI input pin sees a rising or falling edge or the device is manually reset.

### CPOR

The CPOR input pin lets users increase the Power-On Reset timeout delay ( $t_{POR}$ ) by connecting a capacitor between CPOR and ground. (See Figure 3)

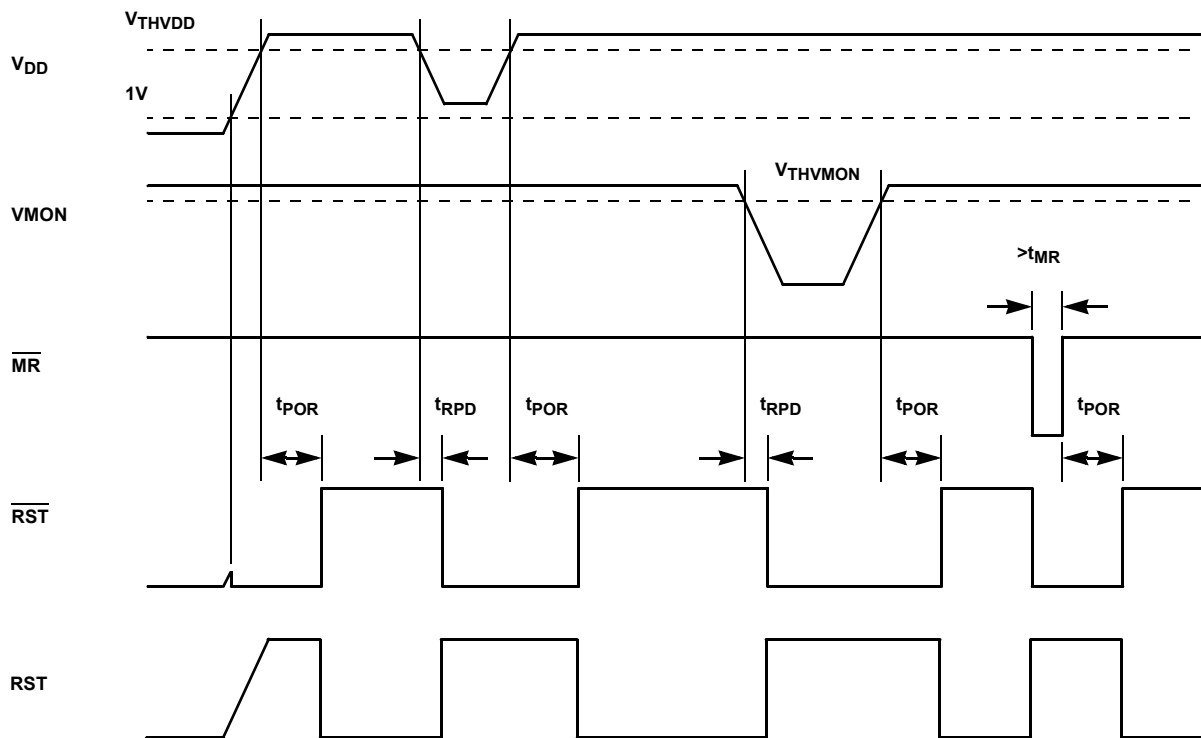


FIGURE 1. VOLTAGE MONITORING TIMING DIAGRAM



## Principles of Operation

The ISL88011, ISL88012, ISL88013, ISL88014, ISL88015 devices provide those functions needed for critical voltage monitoring. These features include Power-On Reset control, customizable supply voltage supervision, Watchdog Timer capability, and manual reset assertion. By integrating all of these features into a small 5 Ld SOT-23 package and using only 5.5µA of supply current, the ISL88011, ISL88012, ISL88013, ISL88014, ISL88015 devices can assist in lowering system cost, reducing board space requirements, and increasing the reliability of a system.

### Low Voltage Monitoring

During normal operation, these supervisors monitor both the voltage level of V<sub>DD</sub> (ISL88011, ISL88012, ISL88013) and/or V<sub>MON</sub> (ISL88012, ISL88014, ISL88015). The device asserts a reset if any of these voltages falls below their respective trip points. The reset signal effectively prevents the system from operating during a power failure or brownout condition. This reset signal remains asserted until V<sub>DD</sub> and the voltage on V<sub>MON</sub> exceed their voltage threshold setting for the reset time delay period t<sub>POR</sub> of 200ms (See Figure 1)

The ISL88012, ISL88014 and ISL88015 allow users to customize the minimum voltage sense level on the V<sub>MON</sub> input pin. To do this, connect an external resistor divider network to the V<sub>MON</sub> pin in order to set the trip point to some voltage above 600mV according to the following Equation 1 (See Figure 2).

$$V_{INTRIP} = 0.6 \times \frac{(R_1 + R_2)}{R_2} \quad (\text{EQ. 1})$$



FIGURE 2. USING V<sub>MON</sub> TO MONITOR V<sub>IN</sub> VIA RESISTORS

### Power-On Reset (POR)

Applying at least 1V to the V<sub>DD</sub> pin activates a POR circuit which asserts reset (i.e., RST goes HIGH while  $\overline{\text{RST}}$  goes LOW). The reset signals remain asserted until the voltage at V<sub>DD</sub> and/or V<sub>MON</sub> rise above the minimum voltage sense level for time period t<sub>POR</sub>. This ensures that the voltages have stabilized.

These reset signals provide several benefits:

- It prevents the system microprocessor from starting to operate with insufficient voltage.
- It prevents the processor from operating prior to stabilization of the oscillator.
- It ensures that the monitored device is held out of operation until internal registers are properly loaded.
- It allows time for an FPGA to download its configuration prior to initialization of the circuit.

### Adjusting POR Timeout via C<sub>POR</sub> Pin

On the ISL88011 and ISL88014, users can adjust the Power-On Reset timeout delay (t<sub>POR</sub>) up to many times the normal t<sub>POR</sub> of 250ms. To do this, connect a capacitor between C<sub>POR</sub> and ground (see Figure 3). For example, connecting a 30pF capacitor to C<sub>POR</sub> will increase t<sub>POR</sub> from a typical 250ms to about 2.5s. **NOTE:** Care should be taken in PCB layout and capacitor placement in order to reduce stray capacitance as much as possible, which lengthens the t<sub>POR</sub> timeout period.

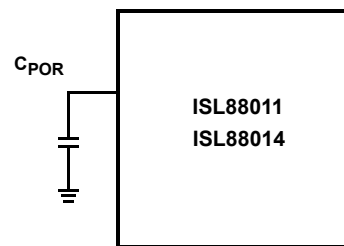


FIGURE 3. ADJUSTING t<sub>POR</sub> WITH A CAPACITOR

### Manual Reset

The manual reset input ( $\overline{MR}$ ) allows the user to trigger a reset by using a push-button switch. The  $\overline{MR}$  input is an active-low debounced input. By connecting a push-button directly from  $\overline{MR}$  to ground, the designer adds manual system reset capability (see Figure 4). Reset is asserted if the  $\overline{MR}$  pin is pulled low to less than 100mV for 1 $\mu$ s or longer while the push-button is closed. After  $\overline{MR}$  is released, the reset outputs remain asserted for  $t_{POR}$  (200ms) and then released.

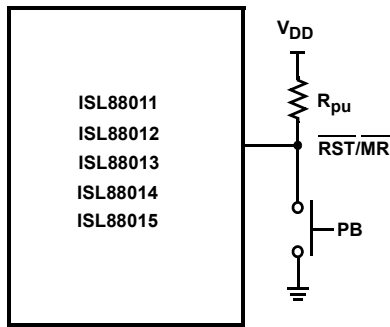


FIGURE 4. CONNECTING A MANUAL RESET PUSH-BUTTON

### Watchdog Timer

The Watchdog Timer circuit checks microprocessor activity by monitoring the WDI input pin. The microprocessor must periodically toggle the WDI pin within  $t_{WDT}$  (1.6s nominal), otherwise the reset signal is asserted (see Figure 5). Internally, the 1.6s timer is cleared by either a reset or by toggling the WDI input.

Besides the 1.6s default timeout during normal operation, these devices also have a longer 51s timeout for start-up. During this time, a reset cannot be asserted due to the WDI not being toggled. The longer delay at power-on allows an operating system to boot, an FPGA to initialize, or the system software to initialize without the burden of dealing with the Watchdog.

### Symbol Table

| WAVEFORM | INPUTS                      | OUTPUTS                       |
|----------|-----------------------------|-------------------------------|
|          | Must be steady              | Will be steady                |
|          | May change from LOW to HIGH | Will change from LOW to HIGH  |
|          | May change from HIGH to LOW | Will change from HIGH to LOW  |
|          | Don't Care: Changes Allowed | Changing: State Not Known     |
|          | N/A                         | Center Line is High Impedance |

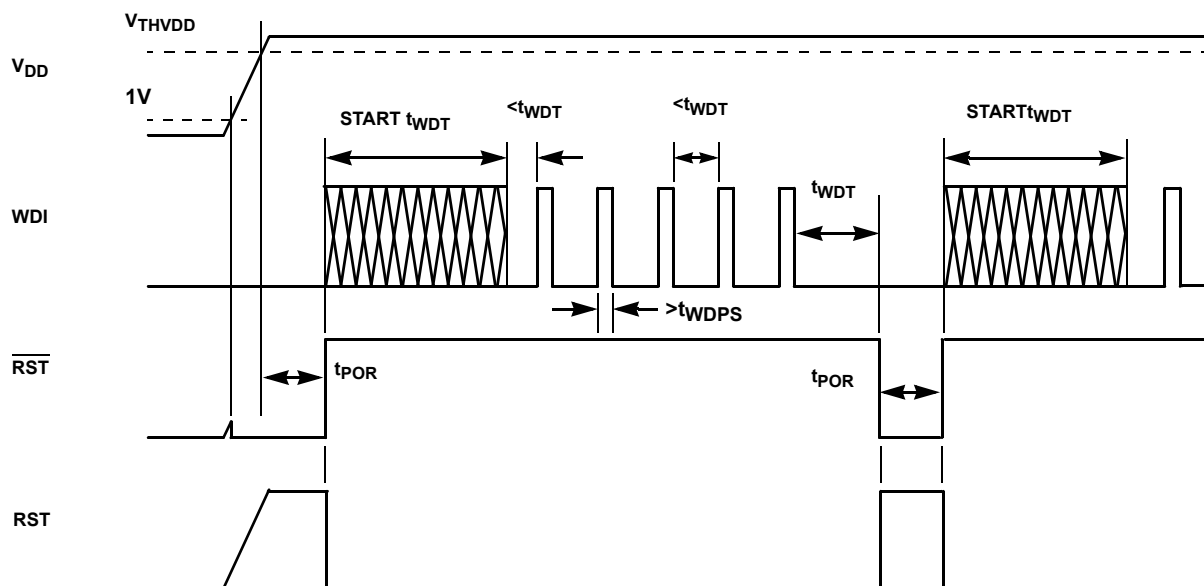


FIGURE 5. WATCHDOG TIMING DIAGRAM

## Typical Parametric Performance Curves

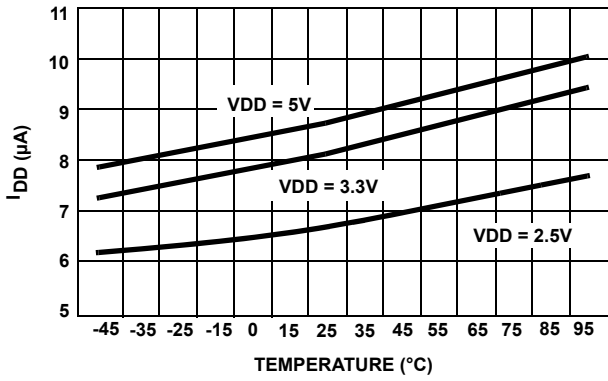


FIGURE 6. I<sub>DD</sub> (ISL88011, ISL88012, ISL88013) vs TEMPERATURE

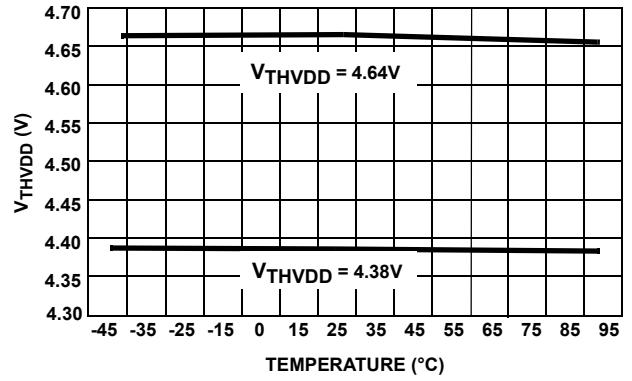


FIGURE 7. V<sub>THVDD</sub>, V<sub>DD</sub> = 5V vs TEMPERATURE

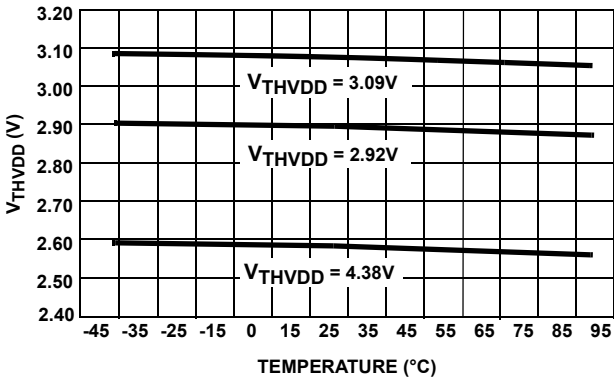


FIGURE 8. V<sub>THVDD</sub>, V<sub>DD</sub> = 3.3V vs TEMPERATURE



FIGURE 9. V<sub>THVDD</sub>, V<sub>DD</sub> = 2.5V vs TEMPERATURE

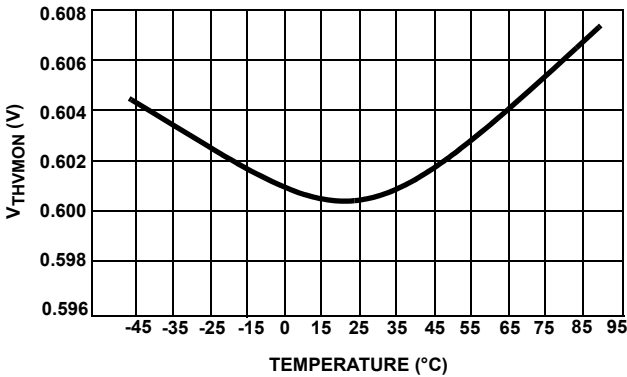


FIGURE 10. V<sub>THVMON</sub> vs TEMPERATURE



FIGURE 11. t<sub>POR</sub> (C<sub>POR</sub> OPEN) vs TEMPERATURE

## Typical Application Circuits



FIGURE 12. HIGH ACCURACY 12V SUPPLY MONITOR



FIGURE 13. 12V SUPPLY PGOOD or PGOOD

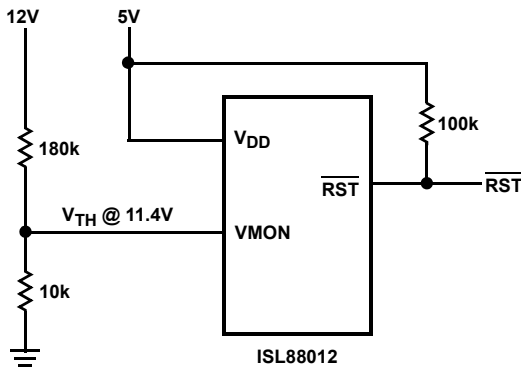
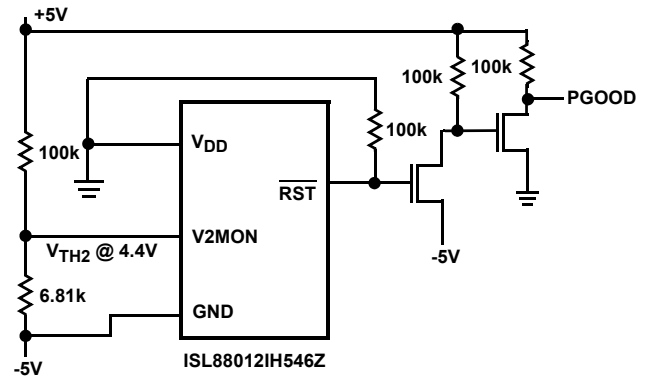


FIGURE 14. MONITOR 5V AND 12V SUPPLIES



PGOOD = HIGH IF  $-V < -4.6V$  AND  $-V + +V > 9.4$  (abs)

FIGURE 15. +5V AND -5V MONITOR



VOLTAGE OUT OF RANGE = PGOOD LOW

FIGURE 16. OVER/UNDERVOLTAGE MONITOR



## Revision History

The revision history provided is for informational purposes only and is believed to be accurate, but not warranted. Please go to the web to make sure that you have the latest revision.

| DATE             | REVISION | CHANGE  |
|------------------|----------|---|
| December 4, 2015 | FN8093.5 | Updated Ordering Information Table on page 3 and page 4.<br>Added Revision History and About Intersil sections. |

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# Package Outline Drawing

## P5.064

### 5 LEAD SMALL OUTLINE TRANSISTOR PLASTIC PACKAGE

Rev 3, 4/11



**NOTES:**

1. Dimensioning and tolerance per ASME Y14.5M-1994.
2. Package conforms to EIAJ SC-74 and JEDEC MO178AA.
3. Package length and width are exclusive of mold flash, protrusions, or gate burrs.
4. Footlength measured at reference to gauge plane.
5. Lead thickness applies to the flat section of the lead between 0.08mm and 0.15mm from the lead tip.
6. Controlling dimension: MILLIMETER.  
Dimensions in ( ) for reference only.

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