

Precision Quad Supply and Line Monitor

FEATURES

- Inputs for Monitoring Up to Four Supply Voltages
- Two Inputs Preset for -5V and -12V Monitoring, or Programmable Positive Levels
- Precision 2.5V Reference
- Separate Inputs for Over-Current and Line Fault Sensing
- Adjustable Under- to Over-Voltage Fault Windows
- Latched Over-Voltage and Over-Current Output
- Power Good and Power Warning Outputs
- Auto Restart Function with ON/OFF Control, and Programmable Delay
- Programmable Pwr On Reset Delay

DESCRIPTION

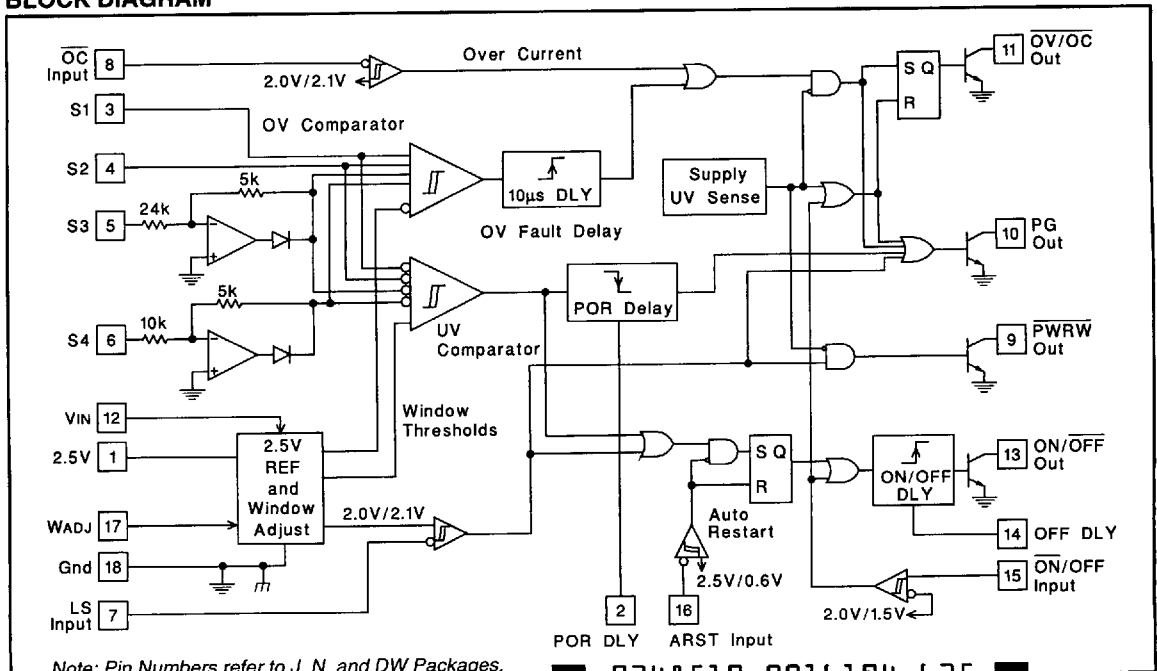
The UC1904 Quad Supply Monitor will respond to under- and over-voltage conditions on up to four continuously monitored voltage levels. Four independent positive voltages can be monitored or, alternatively, two of the sense inputs are preset to monitor -5V and -12V supplies. The device also monitors Over-Current and Line Sense inputs, both with precision input thresholds.

Four open collector outputs on the UC1904 give the following responses: 1. The $\overline{OV/OC}$ output is a latched over-voltage, or over-current response. 2. A Power Good signal responds low with any fault detection – on power-up a programmable delay is used to hold this output low for a system Power On Reset signal. 3. The PWRW output responds only to a Line Sense input, for early warning of power failures. 4. The last open collector, the $\overline{ON/OFF}$ output, generates a delayed supply OFF control signal in response to an OFF input command, under-voltage condition, or line fault detection.

The OV-UV fault window is adjustable with a programming input. The thresholds are centered around the precision 2.5V reference, with a scaled hysteresis for precise, glitch free operation. In the positive mode of operation, the fault windows at each of the sense inputs can be independently scaled using external resistors and the 2.5V reference output. An Auto Restart function couples with the under-voltage and line sensing circuits to allow controlled power supply start-up and shutdown.

This device will operate over a supply range of 4.75V to 18V. The device is available in a DIP, SOIC, or PLCC outline. This device is ESD protected on all pins.

BLOCK DIAGRAM



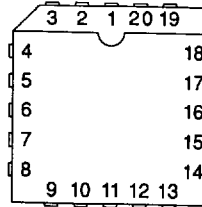
ABSOLUTE MAXIMUM RATINGS (Note 1)

| | |
|--|--------------------|
| Input Supply Voltage | 20V |
| Sense Inputs, S1 And S2, Other Analog And Logic Inputs | |
| Maximum Forced Voltage | -0.3V to 10V |
| Maximum Forced Current | ±10mA |
| Sense Input S3, (-12V Sense Input) | |
| Maximum Forced Voltage | -18V to 10V |
| Maximum Forced Current | ±10mA |
| Sense Input S4, (-5V Sense Input) | |
| Maximum Forced Voltage | -10V to 10V |
| Maximum Forced Current | ±10mA |
| Open Collector Outputs | |
| Maximum Voltage | 20V |
| Maximum Current | 50mA |
| Reference Output Current | Internally Limited |
| Operating Junction Temperature | -55°C to +150°C |
| Storage Temperature | -65°C to +150°C |

Note 1: Unless otherwise indicated, voltages are reference to ground and currents are positive into, negative out of, the specified terminals.

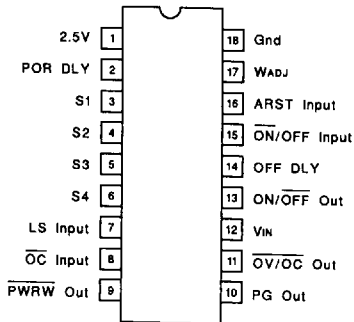
CONNECTION DIAGRAMS

**PLCC-20 (TOP VIEW)
Q PACKAGE**



| PACKAGE PIN FUNCTION | |
|----------------------|-----|
| FUNCTION | PIN |
| 2.5V | 1 |
| POR DLY | 2 |
| N.C. | 3 |
| S1 | 4 |
| S2 | 5 |
| S3 | 6 |
| S4 | 7 |
| N.C. | 8 |
| LS Input | 9 |
| OC Input | 10 |
| PWRW Out | 11 |
| PG Out | 12 |
| OV/OC Out | 13 |
| VIN | 14 |
| ON/OFF Out | 15 |
| OFF DLY | 16 |
| ON/OFF Input | 17 |
| ARST Input | 18 |
| WADJ | 19 |
| Gnd | 20 |

**DIL-18, SOIC-18 (TOP VIEW)
J or N PACKAGE, DW PACKAGE**



ELECTRICAL CHARACTERISTICS:

Unless otherwise stated, these specifications hold for TA = 0 to 70°C for the UC3904, -40 to +85°C for the UC2904, and -55 to +125°C for the UC1904, +VIN = 15V, WADJ = 0.5V, Sense Inputs 1-4, OC and LS Inputs = 2.5V. The ON/OFF Input and the ARST Input = 0V.

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNITS |
|--|--|-------|-----|-------|-------|
| Input Supply | | | | | |
| VIN Supply Current | VIN = 15V | | 3.2 | 4.5 | mA |
| VIN UVLO Threshold | Low to High | | 4.5 | 4.75 | V |
| UVLO Threshold Hysteresis | | | 50 | | mV |
| Minimum VIN to Enable PG Out | | 0.8 | 1.5 | | V |
| Reference | | | | | |
| Output Voltage(VREF) | TJ = 25°C | 2.475 | 2.5 | 2.525 | V |
| | Over Temperature, UC3904 | 2.47 | | 2.53 | V |
| | Over Temperature, UC2904 & UC1904 | 2.465 | | 2.535 | V |
| Load Regulation | IOUT = 0 to 4mA | | | 6 | mV |
| Line Regulation | VIN = 4.75 to 18V | | | 5 | mV |
| Short Circuit Current | VREF = 0V | | 17 | | mA |
| OV UV Window, LS Input, OC Input, ARST Input, and ON/OFF Input Thresholds | | | | | |
| Over-Voltage Thresholds S1, S2 | WADJ = 0.25V, Offset from VREF, Input L to H | 110 | 125 | 140 | mV |
| | WADJ = 0.5V, Offset from VREF, Input L to H | 230 | 250 | 270 | mV |
| | WADJ = 1V, Offset from VREF, Input L to H | 460 | 500 | 540 | mV |
| Over-Voltage Thresholds S3, S4 Positive Mode | WADJ = 0.25V, Offset from VREF, Input L to H | 110 | 125 | 145 | mV |
| | WADJ = 0.5V, Offset from VREF, Input L to H | 230 | 250 | 280 | mV |
| | WADJ = 1V, Offset from VREF, Input L to H | 460 | 500 | 550 | mV |



ELECTRICAL CHARACTERISTICS (cont):

Unless otherwise stated, these specifications hold for $T_A = 0$ to 70°C for the UC3904, -40 to $+85^\circ\text{C}$ for the UC2904, and -55 to $+125^\circ\text{C}$ for the UC1904, $V_{IN} = 15\text{V}$, $W_{ADJ} = 0.5\text{V}$, Sense Inputs 1-4, OC and LS Inputs = 2.5V . The ON/OFF Input and the ARST Input = 0V .

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNITS |
|--|--|--------|-------|--------|-------------------|
| OV UV Window, LS Input, OC Input, ARST Input, and ON/OFF Input Thresholds (cont.) | | | | | |
| Under-Voltage Thresholds S1, S2 | WADJ = 0.25V, Offset from VREF, Input H to L | -140 | -125 | -110 | mV |
| | WADJ = 0.5V, Offset from VREF, Input H to L | -270 | -250 | -230 | mV |
| | WADJ = 1V, Offset from VREF, Input H to L | -540 | -500 | -460 | mV |
| Under-Voltage Thresholds S3, S4 Positive Mode | WADJ = 0.25V, Offset from VREF, Input H to L | -150 | -125 | -110 | mV |
| | WADJ = 0.5V, Offset from VREF, Input H to L | -285 | -250 | -230 | mV |
| | WADJ = 1V, Offset from VREF, Input H to L | -555 | -500 | -460 | mV |
| OV and UV Threshold Hysteresis | As a Function of WADJ | 30 | 50 | 70 | mV/V |
| S3 Negative Mode Thresholds | Over-Voltage, WADJ = 0.5V, Input H to L | -13.52 | -13.2 | -12.88 | V |
| | Under-Voltage, WADJ = 0.5V, Input L to H | -11.06 | -10.8 | -10.54 | V |
| | Hysteresis, WADJ = 0.5V | 80 | 120 | 160 | mV |
| S4 Negative Mode Thresholds | Over-Voltage, WADJ = 0.5V, Input H to L | -5.63 | -5.5 | -5.37 | V |
| | Under-Voltage, WADJ = 0.5V, Input L to H | -4.61 | -4.5 | -4.39 | V |
| | Hysteresis, WADJ = 0.5V | 30 | 50 | 70 | mV |
| WADJ Input Bias Current | $0.25\text{V} < W_{ADJ} < 1.0\text{V}$ | -5 | | 5 | $\mu\text{A/V}$ |
| LS Threshold | Input = H to L | 1.96 | 2 | 2.04 | V |
| | Threshold hysteresis | 65 | 100 | 125 | mV |
| OC Threshold | Input = H to L | 1.9 | 2 | 2.1 | V |
| | Threshold hysteresis | 50 | 100 | 150 | mV |
| ARST Input Threshold | Input = L to H | 2.25 | 2.5 | 2.75 | V |
| | Input = H to L | 0.56 | 0.625 | 0.69 | V |
| ON/OFF Input Threshold | Input high level | | 1.74 | 2.4 | V |
| | Input low level | 0.6 | 1.35 | | V |
| Sense and Logic Input Bias Currents | | | | | |
| Sense 1-4, Positive Mode | Input = 2.8V | | 250 | 800 | nA |
| | Input = 2.2V | -1000 | -250 | | nA |
| Sense 3 Negative Mode | Input = -12V | -700 | -500 | -300 | μA |
| Sense 4 Negative Mode | Input = -5V | -700 | -500 | -300 | μA |
| Line, and OC Inputs | Input = 2.2V | | 300 | 1000 | nA |
| ON/OFF Input | Input = 2.5V | | 150 | 600 | nA |
| ARST Input | Input = 0.5 | -2000 | -700 | | nA |
| Open Collector Outputs (OV/OC Out, PG Out, PWRW Out, ON/OFF Out) | | | | | |
| Saturation Voltage | $I_{OUT} = 10\text{mA}$ | | 0.2 | 0.4 | V |
| Leakage current | $V_{OUT} = 20\text{V}$ | | | 5 | μA |
| POR Delay | | | | | |
| Delay | | 160 | 250 | 350 | ms/ μF |
| Internal Pullup Current | | | 9 | | μA |
| Threshold Low to High | | | 2.25 | | V |
| OFF Delay | | | | | |
| Delay | | 120 | 185 | 250 | ms/ μF |
| Internal Pullup current | | | 12 | | μA |
| Threshold Low to High | | | 2.25 | | V |
| OV Fault Delay | | | | | |
| Delay | | 10 | 20 | 50 | μs |

PIN FUNCTIONAL DESCRIPTION

2.5V: This is the output of the precision 2.5V reference.

ARST Input: This input, with a 4:1 hysteretic threshold, is used to sequence a power system through the **Auto ReStarT** cycle. A delayed representation of a supply output voltage is used at this pin to provide adequate startup time for the power system, and a minimum power-off period.

Gnd: Reference point for the internal reference and all thresholds, as well as the return for the remainder of the device.

LS Input: The **Line Sense** input is used to monitor a voltage that varies with the input line voltage to a system. The input is compared to a precision 2.0V level and is used to activate the **PWRW** and **PG** outputs, as well as triggering the **Auto Restart** sequence.

OC Input: The **Over-Current** input can be used to respond to an inverted over-current signal. A low level signal at this input latches in a fault indication at the **OV/OC** output.

OFF DLY: This pin functions similarly to the **POR DLY** pin to delay the turn-on of the **ON/OFF** output transistor. The charging current and upper threshold are 12 μ A and 2.1V.

ON/OFF Input: With a high level at this input the **ON/OFF Out** pin is activated after a user-programmable delay. A high level also activates the **PG Out** pin, and resets the **OV/OC** fault latch.

On/Off Out: This output is an open collector output that is activated by the **ON/OFF Input**, or the **Auto Restart** circuitry. Saturation voltage on this and all the open collector outputs is rated at 10mA of current.

OV/OC Out: In response to either an **Over-Voltage** or **Over-Current** situation this output is latched active low. There is nominal 20 μ s delay in the **OV** path to the fault latch, providing rejection to transient overshooting on the monitored voltages. The low condition is cleared when

the fault latch is reset by the **ON/OFF Input**, or a **UVLO** condition on the device.

POR DLY: This pin is used, with an external capacitor, to program a **Power-On-Reset** delay. This delay is reset whenever there is a **UV** condition at one of the **S1-S4** inputs, and then triggered upon the clearing of the **UV** condition. When reset, the voltage across the capacitor is quickly discharged to near zero volts, and the **PG Out** pin goes active low. Once triggered the capacitor is charged by a 9 μ A current source. The **PG Out** pin remains active low until the delay capacitor voltage reaches a 2.1V threshold.

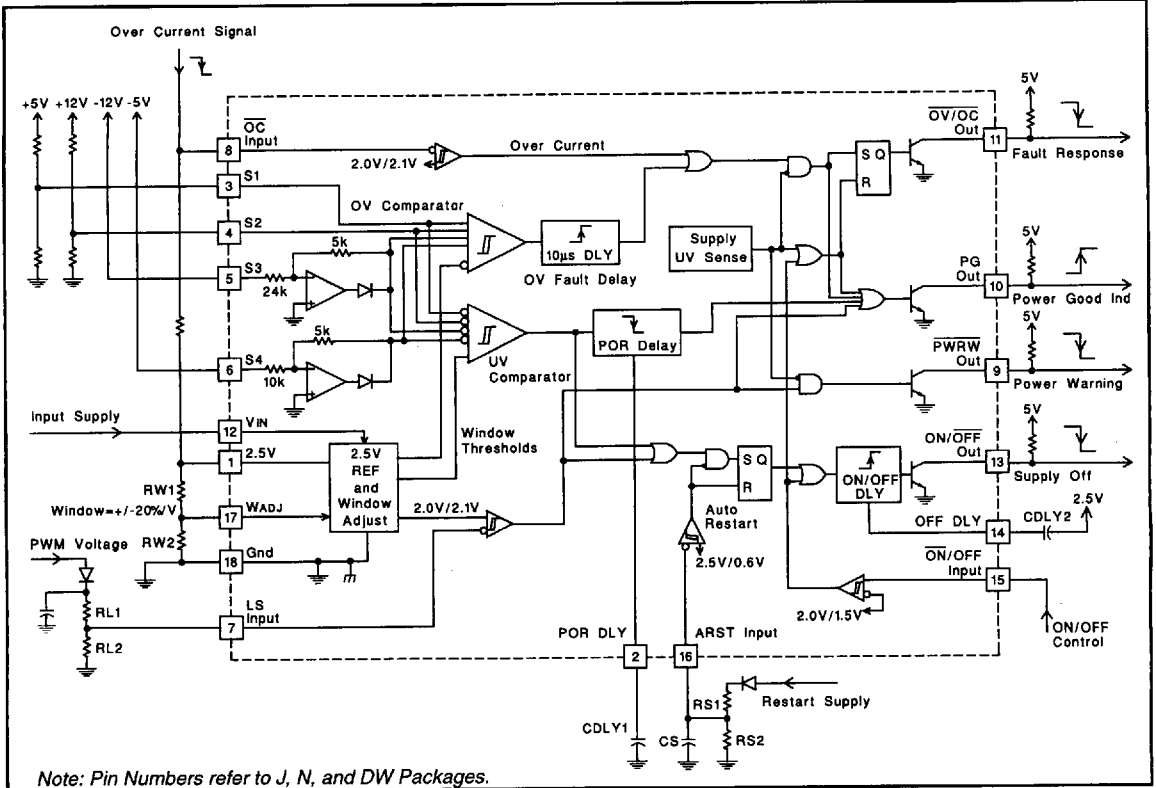
PG Out: During any fault, under-voltage, or **UVLO** condition this output is low. A **Power Good** indication (output off) is given when all supply conditions are within defined operating limits. During power-up the **PG** signal is delayed by a programmable **Power On Reset** delay. During **UVLO** the output is active low as long as the input supply, **Vin**, is above approximately 1.0V.

PWRW Out: When a low line condition is sensed by the **LS Input** this output goes low. This output is disabled (off) during a **UVLO** condition.

S1-S4: These are the sense inputs for **OV** and **UV** monitoring of external voltages. All four inputs can be used to sense positive voltages with a simple divider to scale the voltage level to the 2.5V centered window. The **S3** and **S4** inputs can also be used to sense -12V and -5V supplies respectively with no external components. This is done with internal precision resistor dividers and two source only op-amps that are disabled when the pins are used in the positive mode.

Vin: Input supply for the UC1904. The device is operational with 4.75V to 18V on this pin.

WADJ: The **WADJ** input is used to program the **OV** and **UV** window thresholds. The **OV-UV** window is centered around the 2.5V reference and is nominally $\pm 20\%$ per volt on the **WADJ** input pin.



Note: Pin Numbers refer to J, N, and DW Packages.