

# 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

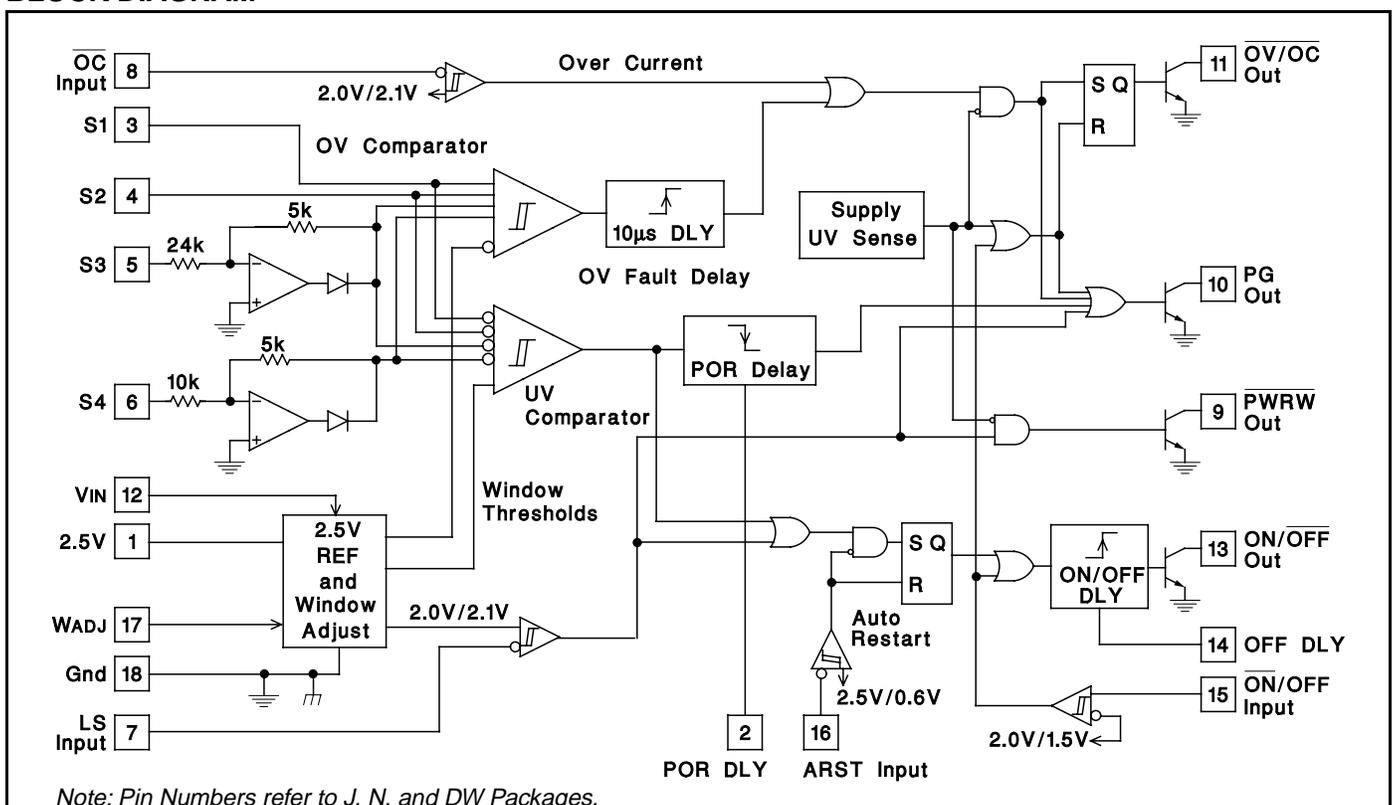
The UC1904 Quad Supply Monitor will respond to under- and over-voltage conditions on up to four continuously monitored voltage levels. Four independent positive voltages can be monitored or, alternatively, two of the sense inputs are preset to monitor -5V and -12V supplies. The device also monitors Over-Current 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  $\overline{PWRW}$  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

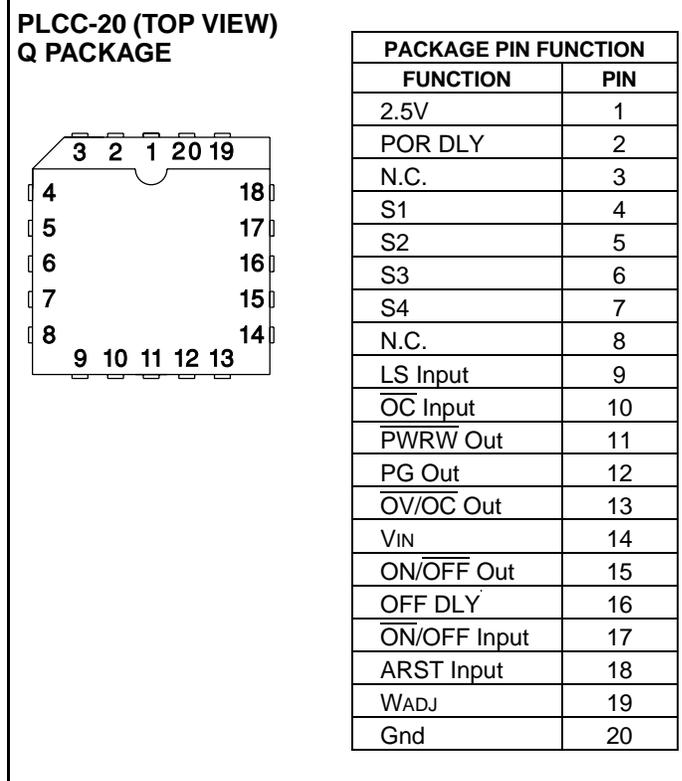
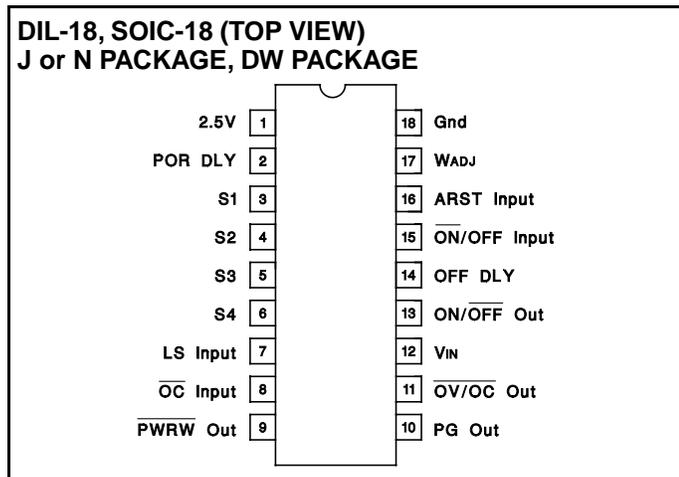


**ABSOLUTE MAXIMUM RATINGS (Note 1)**

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**



**ELECTRICAL CHARACTERISTICS:** Unless otherwise stated, these specifications hold for  $T_A = 0$  to  $70^\circ\text{C}$  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 =  $2.5\text{V}$ . The ON/OFF Input and the ARST Input =  $0\text{V}$ .

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
<b>Input Supply</b>					
$V_{IN}$ Supply Current	$V_{IN} = 15\text{V}$		3.2	4.5	mA
$V_{IN}$ UVLO Threshold	Low to High		4.5	4.75	V
UVLO Threshold Hysteresis			50		mV
Minimum $V_{IN}$ to Enable PG Out			0.8	1.5	V
<b>Reference</b>					
Output Voltage( $V_{REF}$ )	$T_J = 25^\circ\text{C}$	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	$I_{OUT} = 0$ to $4\text{mA}$			6	mV
Line Regulation	$V_{IN} = 4.75$ to $18\text{V}$			5	mV
Short Circuit Current	$V_{REF} = 0\text{V}$		17		mA
<b>OV UV Window, LS Input, OC Input, ARST Input, and ON/OFF Input Thresholds</b>					
Over-Voltage Thresholds S1, S2	$W_{ADJ} = 0.25\text{V}$ , Offset from $V_{REF}$ , Input L to H	110	125	140	mV
	$W_{ADJ} = 0.5\text{V}$ , Offset from $V_{REF}$ , Input L to H	230	250	270	mV
	$W_{ADJ} = 1\text{V}$ , Offset from $V_{REF}$ , Input L to H	460	500	540	mV
Over-Voltage Thresholds S3, S4 Positive Mode	$W_{ADJ} = 0.25\text{V}$ , Offset from $V_{REF}$ , Input L to H	110	125	145	mV
	$W_{ADJ} = 0.5\text{V}$ , Offset from $V_{REF}$ , Input L to H	230	250	280	mV
	$W_{ADJ} = 1\text{V}$ , Offset from $V_{REF}$ , Input L to H	460	500	550	mV

**ELECTRICAL CHARACTERISTICS (cont):**

Unless otherwise stated, these specifications hold for  $T_A = 0$  to  $70^\circ\text{C}$  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,  $\overline{\text{OC}}$  and LS Inputs =  $2.5\text{V}$ . The  $\overline{\text{ON/OFF}}$  Input and the ARST Input =  $0\text{V}$ .

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

## 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 $\mu$ 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 $\mu$ 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 $\mu$ A current source. The **PG Out** pin remains active low until the delay capacitor voltage reaches a 2.1V threshold.

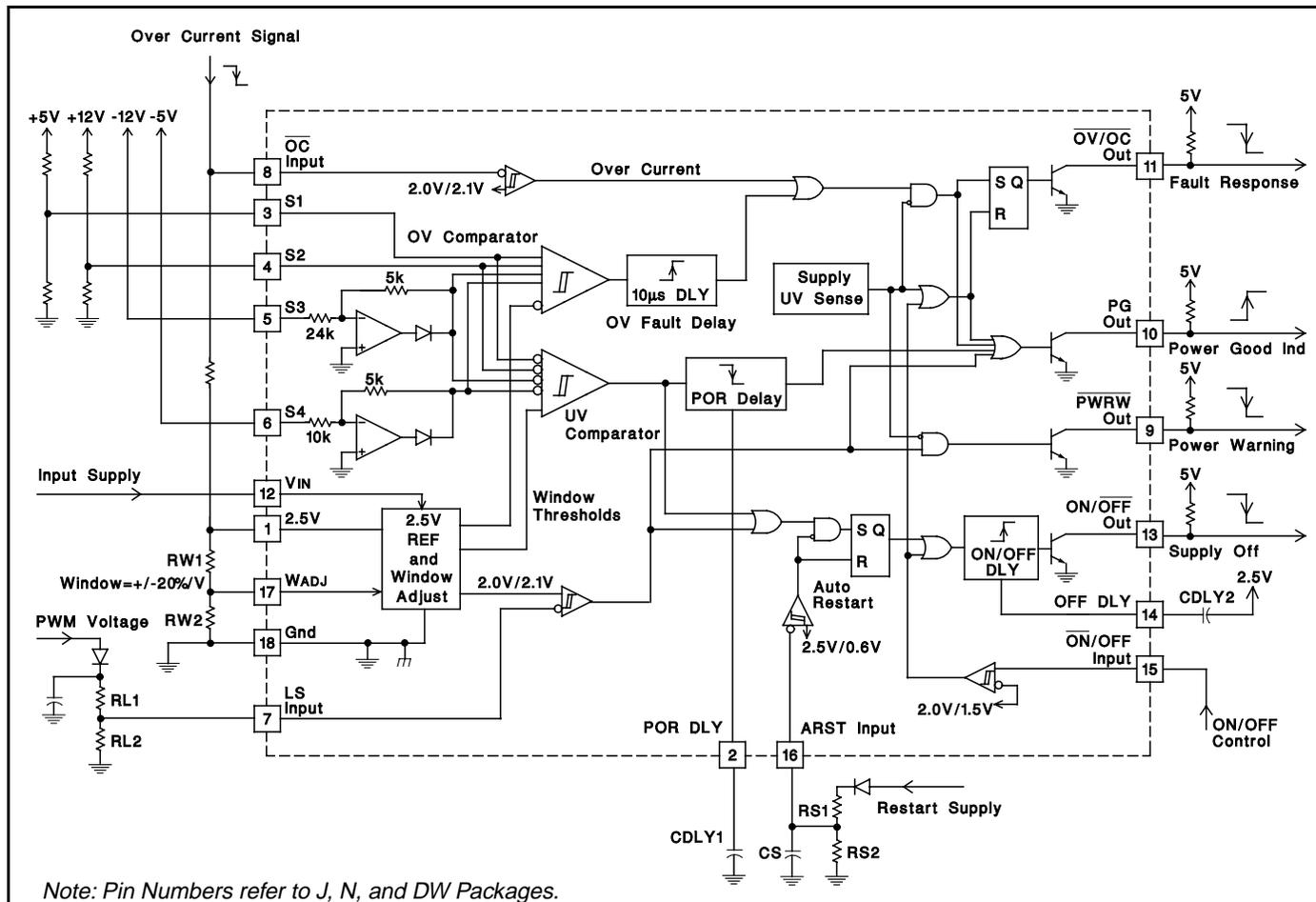
**PG Out:** During any fault, under-voltage, or UVLO condition this output is low. A **Power Good** indication (output off) is given when all supply conditions are within defined operating limits. During power-up the **PG** signal is delayed by a programmable **Power On Reset** delay. During **UVLO**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



## IMPORTANT NOTICE

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