

15V Programmable Hot Swap Power Manager

FEATURES

- Integrated 0.15 Ohm Power MOSFET
- 7V to 15V Operation
- Digital Programmable Current Limit from 0 to 3A
- 100µA ICC when Disabled
- Programmable ON Time
- Programmable Start Delay
- Fixed 2% Duty Cycle
- Thermal Shutdown
- Fault Output Indicator
- Maximum Output Current can be set to 1A above the Programmed Fault Level or to a full 4A
- Power SOIC and TSSOP, Low Thermal Resistance Packaging

DESCRIPTION

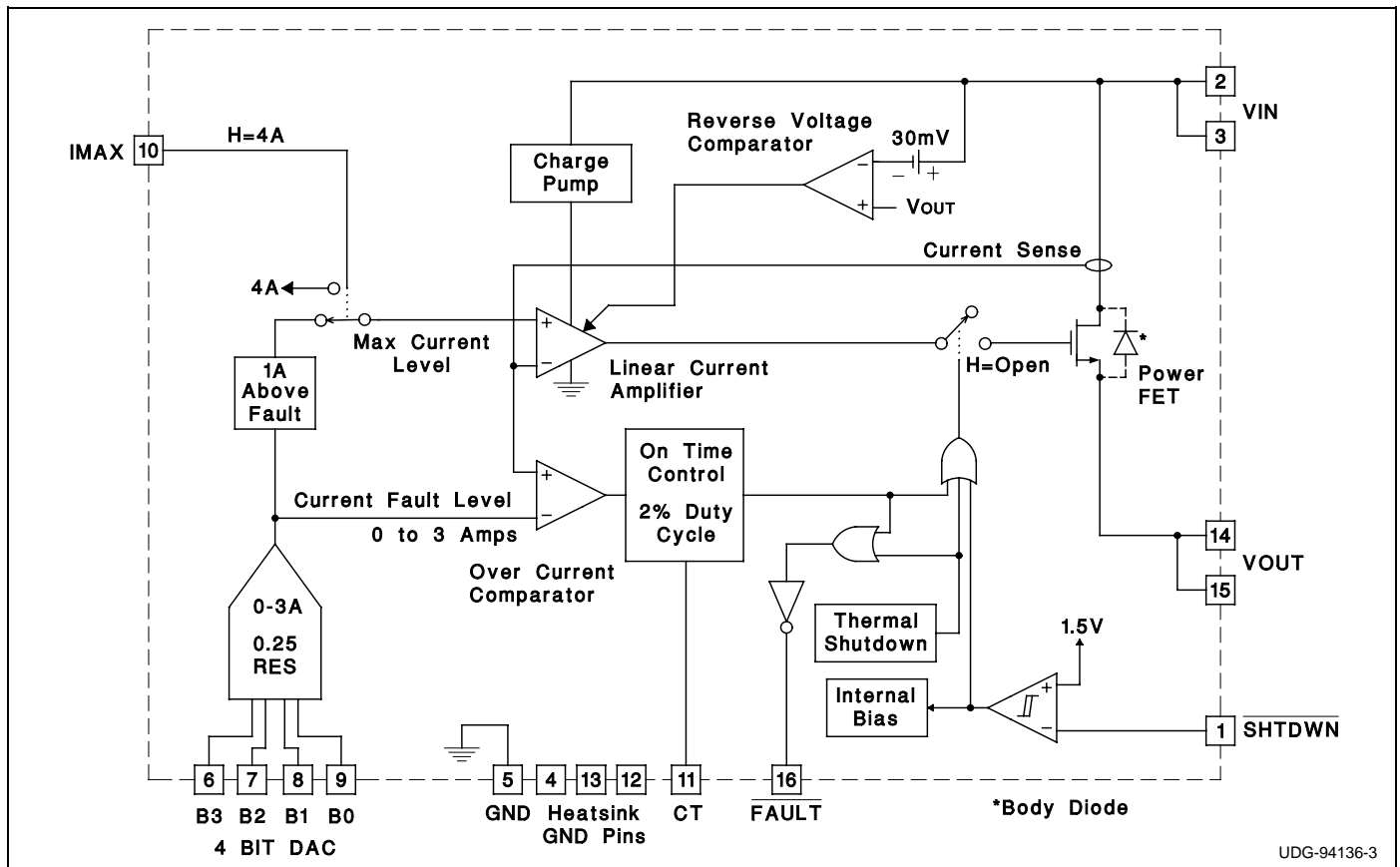
The UCC3915 Programmable Hot Swap Power Manager provides complete power management, hot swap capability, and circuit breaker functions. The only external component required to operate the device, other than power supply bypassing, is the fault timing capacitor, CT. All control and house-keeping functions are integrated, and externally programmable. These include the fault current level, maximum output sourcing current, maximum fault time, and startup delay. In the event of a constant fault, the Internal fixed 2% duty cycle ratio limits average output power.

The internal 4 bit DAC allows programming of the fault level current from 0 to 3A with 0.25A resolution. The IMAX control pin sets the maximum sourcing current to 1A above the trip level and to a full 4A of output current for fast output capacitor charging.

When the output current is below the fault level, the output MOSFET is switched ON with a nominal ON resistance of 0.15 ohms. When the output current exceeds the fault level, but is less than the maximum sourcing level, the output remains switched ON, but the fault timer starts, charging CT. Once CT charges to a preset threshold, the switch is turned OFF, and remains OFF for 60 times the programmed fault time. When the output current reaches the maximum sourcing level, the MOSFET transitions from a switch to a constant current source.

continued

BLOCK DIAGRAM



UDG-94136-3

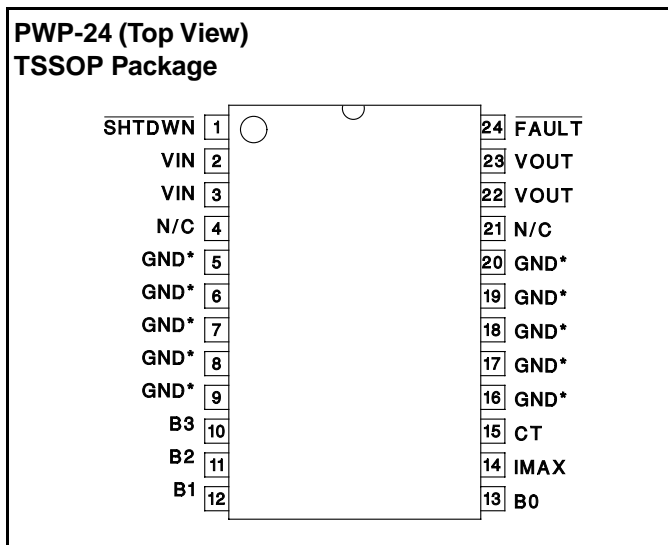
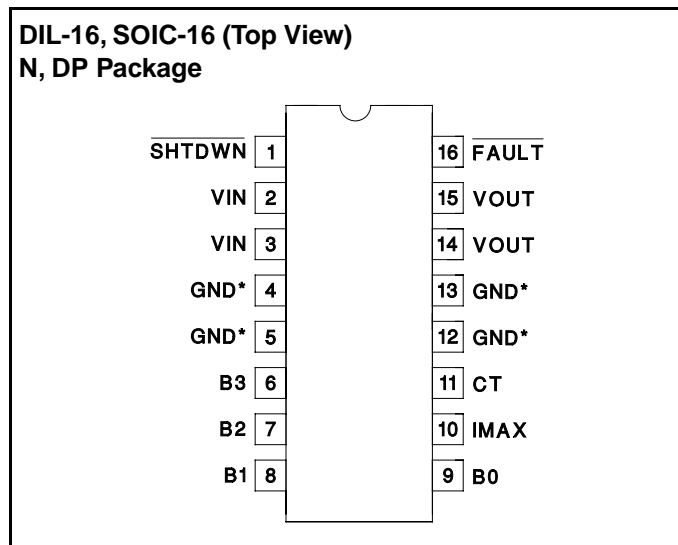
DESCRIPTION (cont.)

The UCC3915 can be put into sleep mode, drawing only 100µA of supply current. Other features include an open drain Fault Output Indicator, Thermal Shutdown, Under-voltage Lockout, 7V to 15V operation, and low thermal resistance SOIC and TSSOP Power Packages.

ABSOLUTE MAXIMUM RATINGS

VIN +15.5 Volts
 VOUT – VIN 0.3V
 FAULT Sink Current 50mA
 FAULT Voltage –0.3 to 8V
 Output Current Self Limiting
 TTL Input Voltage –0.3 to VIN
 Storage Temperature –65°C to +150°C
 Junction Temperature –55°C to +150°C
 Lead Temperature (Soldering, 10 sec.) +300°C
Currents are positive into, negative out of the specified terminal. Consult Packaging Section of Databook for thermal limitations and considerations of packages.

CONNECTION DIAGRAMS



**Pin 5 serves as lowest impedance to the electrical ground; Pins 4, 12, and 13 serve as heat sink/ground. These pins should be connected to large etch areas to help dissipate heat. For N Package, pins 4, 12, and 13 are N/C.*

ELECTRICAL CHARACTERISTICS Unless otherwise stated, these specifications apply for TA = –40°C to +85°C for the UCC2915 and 0°C to 70°C for the UCC3915, VIN = 12V, IMAX = 0.4V, SHTDWN = 2.4V, TA = Tj.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Supply Section					
Voltage Input Range		7.0		15.0	V
Supply Current			1.0	2.0	mA
Sleep Mode Current	SHTDWN = 0.2V		100	150	µA
Output Section					
Voltage Drop	IOUT = 1A (10V to 12V)		0.15	0.3	V
	IOUT = 2A (10V to 12V)		0.3	0.6	V
	IOUT = 3A (10V to 12V)		0.45	0.9	V
	IOUT = 1A, VIN = 7V and 15V		0.2	0.4	V
	IOUT = 2A, VIN = 7V and 15V		0.4	0.8	V
	IOUT = 3A, VIN = 7V, 12V Max.		0.6	1.2	V
Initial Startup Time	Note 2		100		µs
Short Circuit Response	Note 2		100		ns
Thermal Shutdown	Note 2		165		°C
Thermal Hysteresis	Note 2		10		°C

ELECTRICAL CHARACTERISTICS (cont.) Unless otherwise stated, these specifications apply for TA = -40°C to +85°C for the UCC2915 and 0°C to 70°C for the UCC3915, VIN = 12V, I_{MAX} = 0.4V, SHTDWN = 2.4V, TA = TJ.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
DAC Section					
Trip Current	Code = 0000-0011 (Device Off)				
	Code = 0100	0.15	0.25	0.35	A
	Code = 0101	0.35	0.50	0.65	A
	Code = 0110	0.60	0.75	0.90	A
	Code = 0111	0.85	1.00	1.15	A
	Code = 1000	1.0	1.25	1.5	A
	Code = 1001	1.25	1.50	1.75	A
	Code = 1010	1.5	1.75	2.0	A
	Code = 1011	1.70	2.00	2.3	A
	Code = 1100	1.90	2.25	2.58	A
	Code = 1101	2.1	2.50	2.90	A
	Code = 1110	2.30	2.75	3.20	A
	Code = 1111	2.50	3.0	3.50	A
Max Output Current	Code = 0000 to 0011			0.02	mA
Max Output Current Over Trip (Current Source Mode)	Code = 0100 to 1111, I _{MAX} = 0V	0.5	1.0	1.8	A
Max Output Current (Current Source Mode)	Code = 0100 to 1111, I _{MAX} = 2.4V	3.0	4.0	5.2	A
Fault Output Section					
CT Charge Current	V _{CT} = 1.0V	-77	-62	-47	μA
CT Discharge Current	V _{CT} = 1.0V	0.8	1.2	1.6	μA
Output Duty Cycle	V _{OUT} = 0V	1.0	1.9	3.3	%
CT Fault Threshold		1.3	1.5	1.7	V
CT Reset Threshold		0.4	0.5	0.6	V
Shutdown Section					
Shutdown Threshold		1.1	1.5	1.9	V
Shutdown Hysteresis			150		mV
Input Current			100	500	nA
Open Drain Output Section					
High Level Output Current	$\overline{\text{FAULT}} = 5V$			250	μA
Low Level Output Voltage	I _{OUT} = 10mA		0.2	0.8	V
TTL Input DC Characteristics Section					
TTL Input Voltage High		2.0			V
TTL Input Voltage Low				0.8	V
TTL Input High Current	V _{IH} = 2.4V		3	10	μA

Note 1: All voltages are with respect to Ground. Current is positive into and negative out of the specified terminal.

Note 2: Guaranteed by design. Not 100% tested in production.

PIN DESCRIPTIONS

B0 - B3: These pins provide digital input to the DAC, which sets the fault current threshold. They can be used to provide a digital soft-start and adaptive current limiting.

CT: A capacitor connected to ground sets the maximum fault time. The maximum fault time must be more than the time required to charge the external capacitance in one cycle. The maximum fault time is defined as $T_{FAULT} = 16.1 \cdot 10^3 \cdot CT$. Once the fault time is reached the output will shutdown for a time given by $TSD = 833 \cdot 10^3 \cdot CT$, this equates to a 1.9% duty cycle.

FAULT: Open drain output, which pulls low upon any fault or interrupt condition, Fault, or Thermal Shutdown.

IMAX: When this pin is set to a logic low, the maximum sourcing current will always be 1A above the programmed fault level. When set to a logic high, the maximum sour-

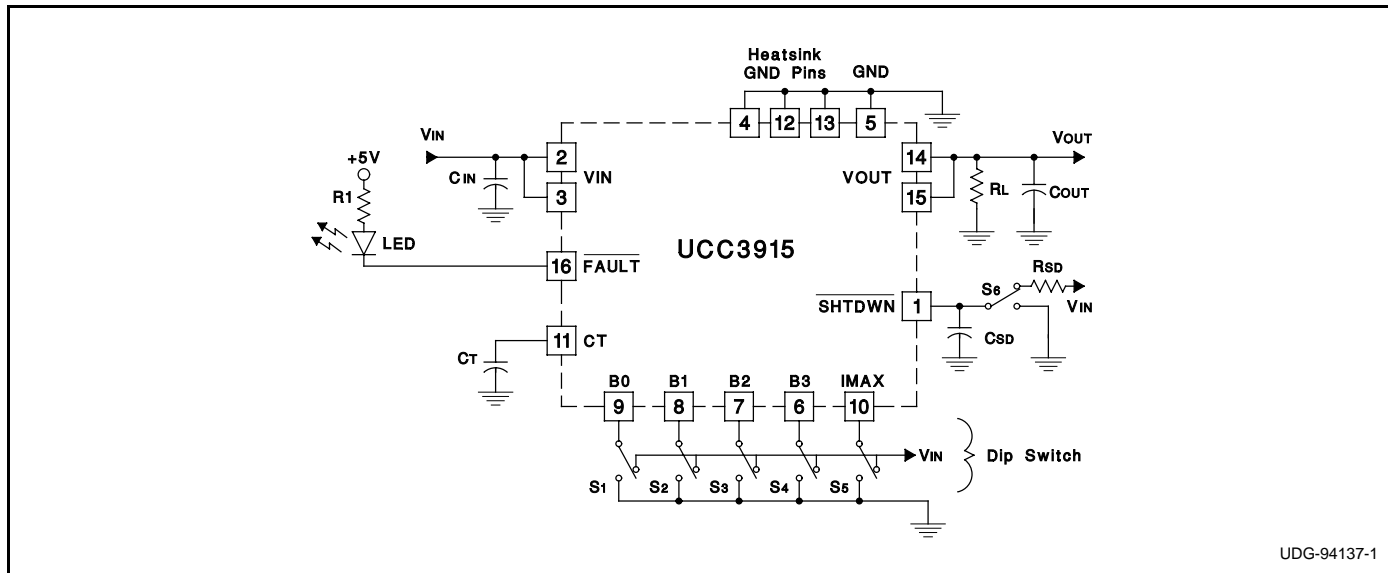
cing current will be a constant 4A for applications which require fast charging of load capacitance.

SHTDWN: When this pin is brought to a logic low, the IC is put into a sleep mode drawing typically less than 100µA of I_{CC} . The input threshold is hysteretic, allowing the user to program a startup delay with an external RC circuit.

VIN: Input voltage to the UCC3915. The recommended voltage range is 7 to 15 volts. Both VIN pins should be connected together and connected to power source.

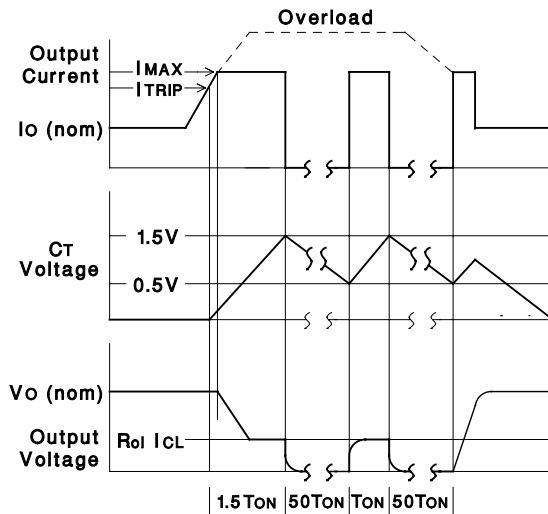
VOUT: Output voltage from the UCC3915. Both VOUT pins should be connected together and connected to the load. When switched the output voltage will be approximately $V_{IN} - (0.15\Omega \cdot I_{OUT})$. VOUT must not exceed V_{IN} by greater than 0.3V.

Evaluation Circuit



UDG-94137-1

Load Current, Timing Capacitor Voltage, and Output Voltage of the UCC3915 under Fault Conditions.



UDG-94138

Estimating Maximum Load Capacitance

For hot swap applications, the rate at which the total output capacitance can be charged depends on the maximum output current available and the nature of the load. For a constant-current, current-limited application, the output will come up if the load asks for less than the maximum available short-circuit current.

To guarantee recovery of a duty-cycle from a short-circuited load condition, there is a maximum total output capacitance which can be charged for a given unit ON time (Fault time). The design value of ON or Fault time can be adjusted by changing the timing capacitor CT.

For worst-case constant-current load of value just less than the trip limit; COUT(max) can be estimated from:

$$C_{OUT(max)} \approx (I_{MAX} - I_{LOAD}) \cdot \left(\frac{16.1 \cdot 10^3 \cdot C_T}{V_{OUT}} \right)$$

Where VOUT is the output voltage.

For a resistive load of value RL, the value of COUT(max) can be estimated from:

$$C_{OUT(max)} \approx \left(\frac{16.1 \cdot 10^3 \cdot C_T}{R_L \cdot \ln \left[\frac{1}{1 - \frac{V_{OUT}}{I_{MAX} \cdot R_L}} \right]} \right)$$

Long CT times must consider the maximum temperature. Thermal shutdown protection may be the limiting Fault time.

Safety Recommendations

Although the UCC3915 is designed to provide system protection for all fault conditions, all integrated circuits can ultimately fail short. For this reason, if the UCC3915 is intended for use in safety critical applications where UL or some other safety rating is required, a redundant

safety device such as a fuse should be placed in series with the device. The UCC3915 will prevent the fuse from blowing for virtually all fault conditions, increasing system reliability and reducing maintenance cost, in addition to providing the hot swap benefits of the device.