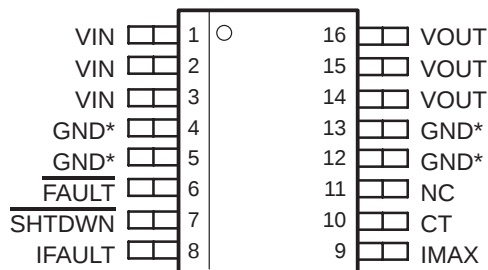


- Integrated 0.075-Ω Power MOSFET
- 3 V to 6 V Operation
- External Analog Control of Fault Current From 0 A to 4 A
- Independent Analog Control of Current Limit up to 5 A
- Fast Overload Protection
- Unidirectional Switch
- Minimal External Components
- 1-μA I_{CC} When Disabled
- Programmable On Time
- Programmable Start Delay
- Fixed 3% Duty Cycle

DP PACKAGE
(TOP VIEW)

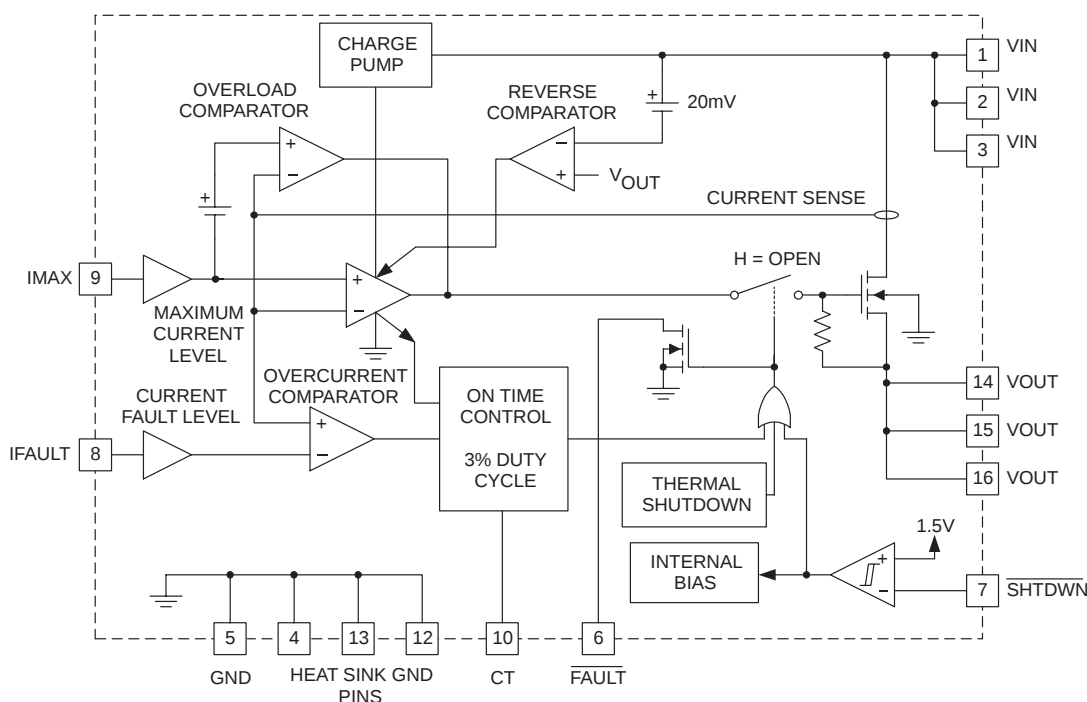


Pin 5 serves as the lowest impedance to the electrical ground. Pins 4, 12, and 13, serve as heat sink/ground. These pins should be connected to large etch PCB areas to help dissipate heat.

description

The UCC2918 low on-resistance hot swap power manager provides complete power management, hot swap capability, and circuit breaker functions. The only components needed to operate the device, other than supply bypassing, are a timing capacitor and two programming resistors. All control and housekeeping 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 3% duty cycle ratio limits the average output power. The IFAULT pin allows linear programming of the fault level current from 0 A to 4 A.

functional block diagram



UDG-00101

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.



UCC2918/81510
LOW ON-RESISTANCE HOT SWAP POWER MANAGER

SLUS457C – JULY 2000 - REVISED APRIL 2001

description (continued)

Fast overload protection is accomplished by an additional overload comparator. Its threshold is internally set above the maximum sourcing current limit setting. In the event of a short circuit or extreme current condition, this comparator is tripped, shutting down the output. This function is needed since the maximum sourcing current limit loop has a finite bandwidth.

When the output current is below the fault level, the output MOSFET is switched on with a nominal resistance of 0.075 Ω. When the output current exceeds the fault level or the maximum sourcing level, the output remains on, but the fault timer starts charging a capacitor connected to the CT pin (CT). Once CT charges to a preset threshold, the switch is turned off, and remains off for 30 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.

The UCC2918 is designed for unidirectional current flow, emulating an ideal diode in series with the power switch. This feature is particularly attractive in applications where many devices are powering a common bus, such as with SCSI termination power (Termpwr). The UCC2918 can also be put into the sleep mode, drawing only 1 µA of supply current.

Other features include an open-drain fault output indicator, thermal shutdown, undervoltage lockout, 3 V to 6 V operation, and a low thermal resistance small-outline power package.

absolute maximum ratings over operating free-air temperature (unless otherwise noted)†‡

Table with 2 columns: Parameter and Rating. Rows include: Input voltage (8 V), SOIC power dissipation (2.5 W), Fault output sink current (50 mA), Fault output voltage (VIN), Output current (dc) (Internally Limited), Input voltage SHTDWN, IFAULT, IMAX (-0.3 V to VIN), Storage temperature range, Tstg (-65°C to 150°C), Operating virtual junction temperature, TJ (-55°C to 150°C), Lead temperature (soldering, 10 seconds) (300°C).

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

‡ Unless otherwise indicated, voltages are reference to ground and currents are positive into, negative out of the specified terminal. Pulsed is defined as a less than 10% duty cycle with a maximum duration of 500 µs. Consult Packaging Section of Databook for thermal limitations and considerations of package.

UCC2918/81510

LOW ON-RESISTANCE HOT SWAP POWER MANAGER

SLUS457C – JULY 2000 - REVISED APRIL 2001

electrical characteristics at $T_A = -40^{\circ}\text{C}$ to 85°C , $V_{IN} = 5\text{ V}$, $R_{I\text{MAX}} = 42.2\text{ k}\Omega$, $R_{I\text{FAULT}} = 52.3\text{ k}\Omega$, $\text{SHTDWN} = 2.4\text{ V}$, $C_T = 0.1\text{ }\mu\text{F}$, $T_A = T_J$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Supply Section					
Voltage input range, V_{IN}		3	5	6	V
VDD supply current	No load		1	2	mA
Sleep mode current	$\text{SHTDWN} = 0.2\text{ V}$		0.5	5	μA
Output Section					
$R_{DS(on)}$	$I_{OUT} = 1\text{ A to }4\text{ A}$, $V_{IN} = 5\text{ V}$, $T_A = 25^{\circ}\text{C}$		0.075	0.095	Ω
	$I_{OUT} = 1\text{ A to }4\text{ A}$, $V_{IN} = 3\text{ V}$, $T_A = 25^{\circ}\text{C}$		0.09	0.116	Ω
	$I_{OUT} = 1\text{ A to }4\text{ A}$, $V_{IN} = 5\text{ V}$		0.075	0.125	Ω
	$I_{OUT} = 1\text{ A to }4\text{ A}$, $V_{IN} = 3\text{ V}$		0.09	0.154	Ω
Reverse leakage current	$\text{SHTDWN} = 0\text{ V}$, $V_{IN} = 0\text{ V}$, $V_{OUT} = 5\text{ V}$			20	μA
Initial start-up time	See Note 1		100		μs
Thermal shutdown	See Note 1		170		$^{\circ}\text{C}$
Thermal hysteresis	See Note 1		10		$^{\circ}\text{C}$
Output leakage	$\text{SHTDWN} = 0.2\text{ V}$			20	μA
Trip current	$R_{I\text{FAULT}} = 105\text{ k}\Omega$	0.75	1	1.25	A
	$R_{I\text{FAULT}} = 52.3\text{ k}\Omega$	1.7	2	2.3	A
	$R_{I\text{FAULT}} = 34.8\text{ k}\Omega$	2.5	3	3.5	A
	$R_{I\text{FAULT}} = 25.5\text{ k}\Omega$	3.3	4	4.7	A
Maximum output current	$R_{I\text{MAX}} = 118\text{ k}\Omega$	0.3	1	1.7	A
	$R_{I\text{MAX}} = 60.4\text{ k}\Omega$	1	2	3	A
	$R_{I\text{MAX}} = 42.2\text{ k}\Omega$	2	3	4	A
	$R_{I\text{MAX}} = 33.2\text{ k}\Omega$	2.5	3.8	5.1	A
	$R_{I\text{MAX}} = 27.4\text{ k}\Omega$	3.0	4.6	6.2	A
Fault Section					
C_T charge current	$V_{CT} = 1\text{ V}$	-50	-36	-22	μA
C_T discharge current	$V_{CT} = 1\text{ V}$	0.5	1.2	2.0	μA
Output duty cycle	$V_{OUT} = 0\text{ V}$	1.5	3	6	%
C_T fault threshold		0.8	1.3	1.8	V
C_T reset threshold		0.25	0.5	0.75	V
Shutdown Section					
Shutdown threshold		1.1	1.5	2.0	V
Shutdown hysteresis			100		mV
Input low current	$\text{SHTDWN} = 0\text{ V}$	-500	0	500	nA
Input high current	$\text{SHTDWN} = 2\text{ V}$	-2	-1	-0.5	μA
Open Drain Fault Output Section					
High level output current				1	μA
Low level output voltage	$I_{OUT} = 1\text{ mA}$		0.4	0.9	V

NOTE 1: Ensured by design. Not production tested.



UCC2918/81510

LOW ON-RESISTANCE HOT SWAP POWER MANAGER

SLUS457C – JULY 2000 - REVISED APRIL 2001

pin descriptions

CT: A capacitor connected to this pin sets the maximum fault time. The maximum time must be greater than the time to charge external load capacitance. The nominal fault time is defined as:

$$T_{\text{FAULT}} = 22.2 \times 10^3 \times C_T \quad (1)$$

Once the fault time is reached, the output shuts down for a time given by:

$$T_{\text{SD}} = 0.667 \times 10^6 \times C_T \quad (2)$$

This equates to a 3% duty cycle. The recommended minimum value for the C_T capacitor is 0.1 μF .

FAULT: Open-drain output, which pulls low on any condition that causes the output to open; fault, thermal shutdown, shutdown, and maximum sourcing current greater than the fault time.

GND: This is the most negative voltage in the circuit. All 4 ground pins should be used, and properly heat sunk on the PCB.

IFault: A resistor connected from this pin to ground sets the fault threshold. The resistor versus fault current is set by the formula:

$$R_{\text{FAULT}} = \frac{105 \text{ k}\Omega}{I_{\text{TRIP}}} \quad (3)$$

IMAX: A resistor connected from this pin to ground sets the maximum sourcing current. The resistor vs the output sourcing current is set by the formula:

$$R_{\text{IMAX}} = \frac{126 \text{ k}\Omega}{\text{Maximum Sourcing Current}} \quad (4)$$

SHTDWN: When this pin is brought low, the IC is put into sleep mode. The input threshold is hysteretic, allowing the user to program a startup delay with an external RC circuit.

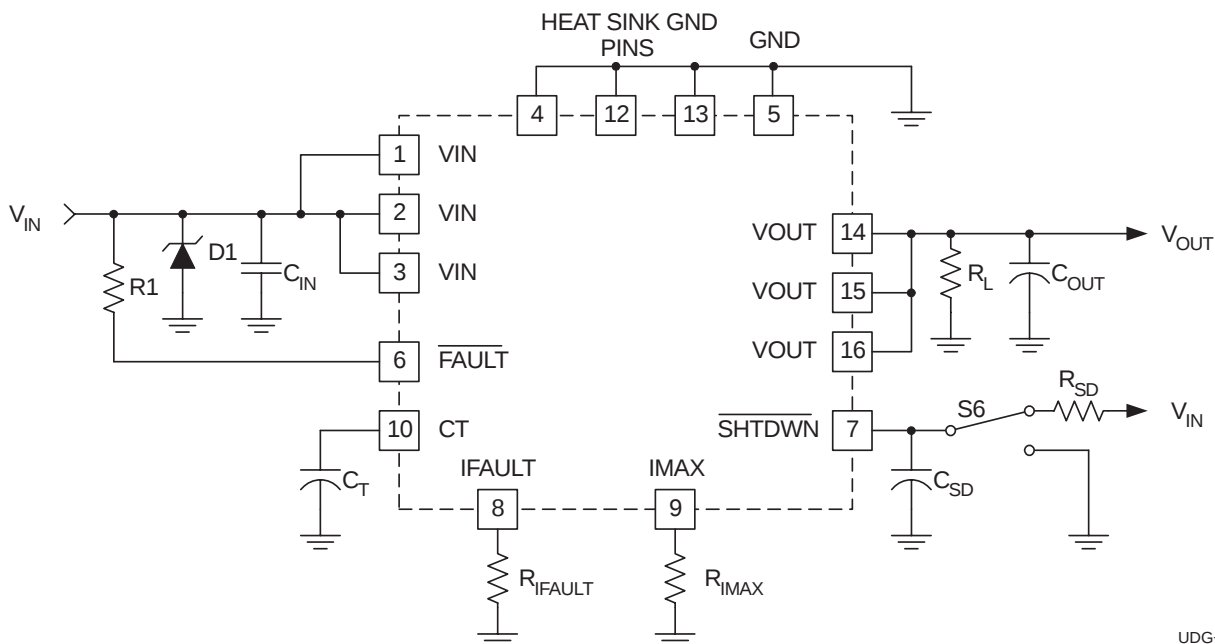
VIN: This is the input voltage to the UCC2918. The recommended operating voltage range is 3V to 6V. All VIN pins should be connected together and to the power source.

VOU: Output voltage for the circuit breaker. When switched the output voltage will be approximately:

$$V_{\text{OUT}} = V_{\text{IN}} - 0.075 \Omega \times I_{\text{OUT}} \quad (5)$$

All VOU pins should be connected together and to the load.

APPLICATION INFORMATION



UDG-00102

Figure 1. Typical Application

protecting the UCC2918 from voltage transients

The parasitic inductance associated with the power distribution can cause a voltage spike at V_{IN} if the load current is suddenly interrupted by the UCC2918. *It is important to limit the peak of this spike to less than 6 V to prevent damage to the UCC2918.* This voltage spike can be minimized by:

- Reducing the power distribution inductance (e.g., twist the positive + and negative – leads of the power supply feeding V_{IN} , locate the power supply close to the UCC2918 or use a PCB ground plane).
- Decoupling V_{IN} with a capacitor, C_{IN} (refer to Figure 1), located close to the V_{IN} pin. This capacitor is typically less than 1 μF to limit the inrush current.
- Clamping the voltage at V_{IN} below 6 V with a Zener diode, D1 (refer to Figure 1), located close to the V_{IN} pin.

estimating maximum load capacitance

For circuit breaker 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 circuit breaker, the output comes up if the load requires less than the maximum available short-circuit current.

To ensure recovery of a duty-cycle of the current-limited circuit breaker from a short-circuited load condition, there is a maximum total output capacitance that 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 C_T .

APPLICATION INFORMATION

estimating maximum load capacitance

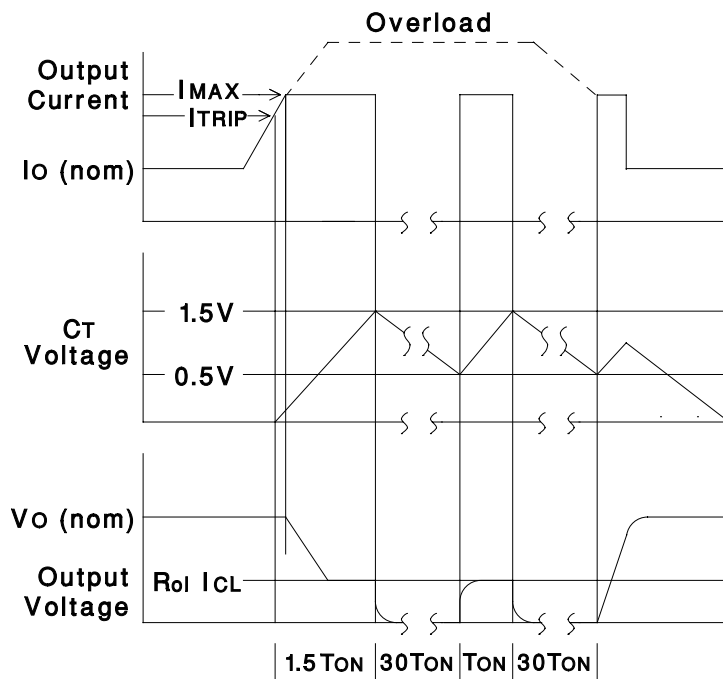
For worst-case constant-current load of value just less than the trip limit, $C_{OUT(max)}$ can be estimated from:

$$C_{OUT(max)} \approx (I_{MAX} - I_{LOAD}) \left(\frac{22 \times 10^3 \times C_T}{V_{OUT}} \right) \quad (6)$$

Where V_{OUT} is the output voltage and I_{MAX} is the maximum sourcing current.

For a resistive load of value R_{LOAD} , the value of $C_{OUT(max)}$ can be estimated from:

$$C_{OUT(max)} \approx \left[\frac{22 \times 10^3 \times C_T}{R_{LOAD} \times \ln \left[\frac{1}{1 - \frac{V_{OUT}}{I_{MAX} \times R_{LOAD}}} \right]} \right] \quad (7)$$



UDG-00103

Figure 2. Load Current, Timing Capacitor Voltage, and Output Voltage of the UCC2918 Under Fault

TYPICAL CHARACTERISTICS

**REVERSE VOLTAGE COMPARATOR
RESPONSE TIME**

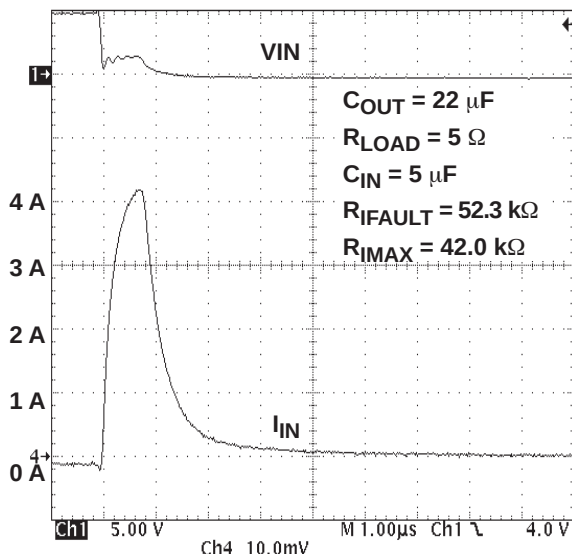


Figure 3

FAULT TIMING WAVEFORMS

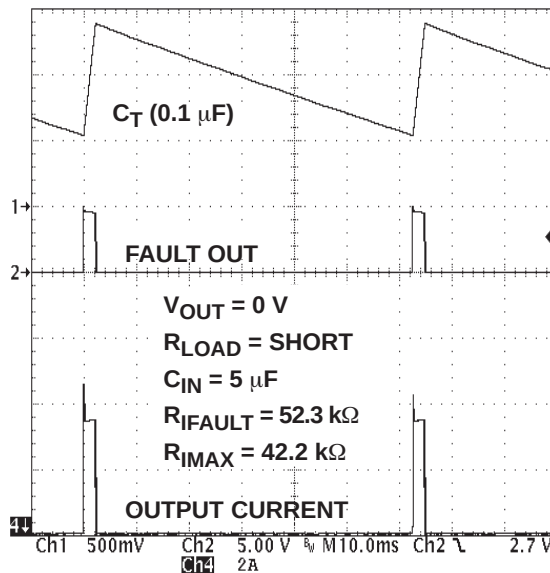


Figure 4

NOTE: In Figure 3 the input driven with a pulse generator shows C_{OUT} discharging through R_L and conducting through UCC81510 FET in the reverse direction.

INRUSH CURRENT LIMITING

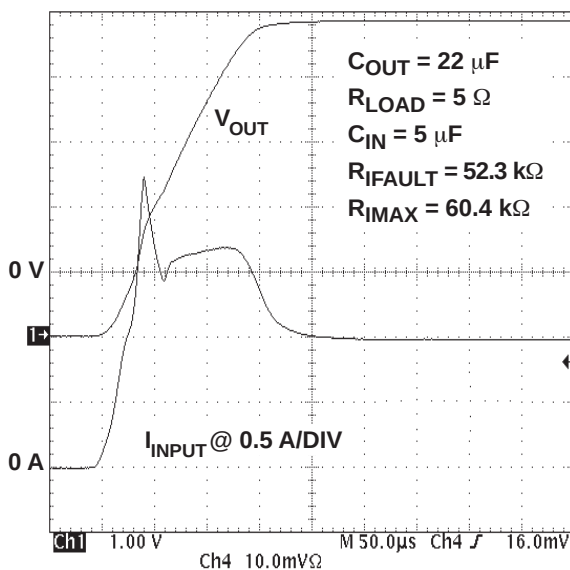


Figure 5

**FAULT AND OUTPUT TURN-OFF
DELAY FROM C_T FAULT
THRESHOLD**

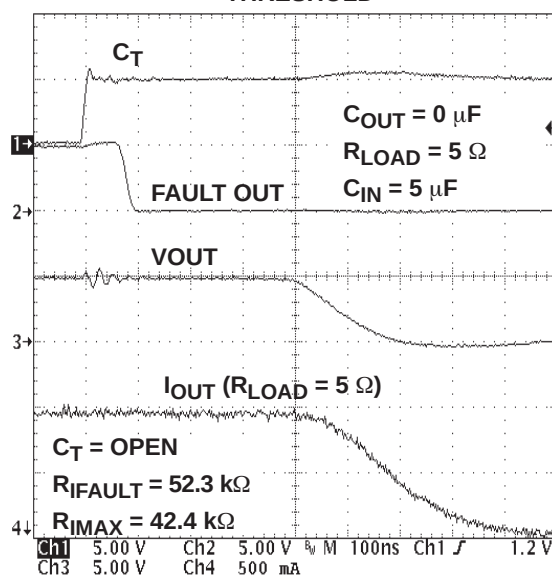


Figure 6

NOTE: In Figure 5 the input is switched on through the external FET. V_{OUT} shows I_{MAX} linear amplifier limiting the changing current to C_{OUT} .

UCC2918/81510

LOW ON-RESISTANCE HOT SWAP POWER MANAGER

SLUS457C – JULY 2000 - REVISED APRIL 2001

TYPICAL CHARACTERISTICS

PROPAGATION DELAY
SHUTDOWN TO FAULT AND
OUTPUT RAMP-DOWN

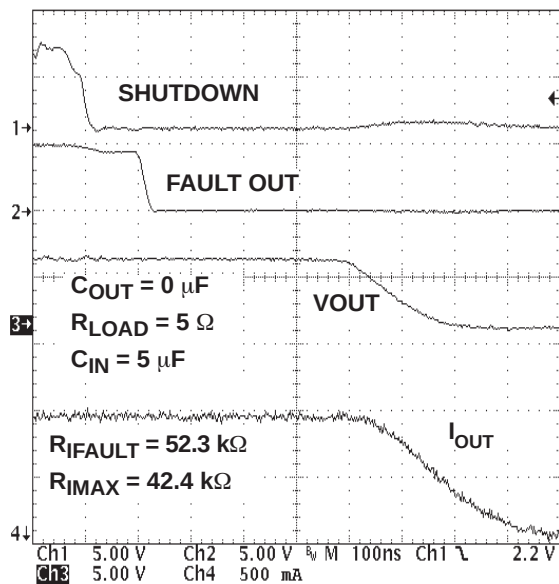


Figure 7

PROPAGATION DELAY
ENABLE TO FAULT AND
OUTPUT RAMP-UP

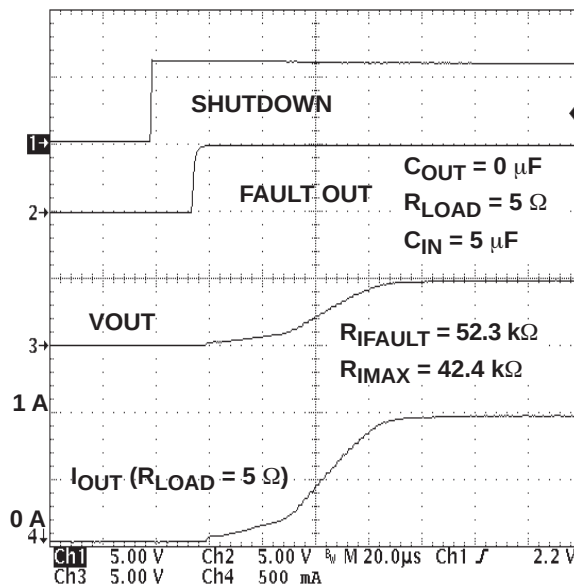


Figure 8

ON-STATE RESISTANCE
vs
OUTPUT CURRENT

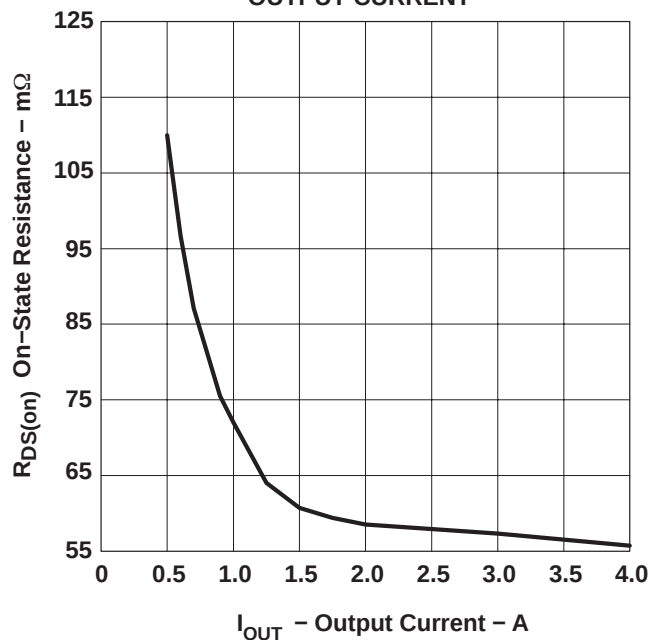


Figure 9

ON-STATE RESISTANCE
vs
TEMPERATURE

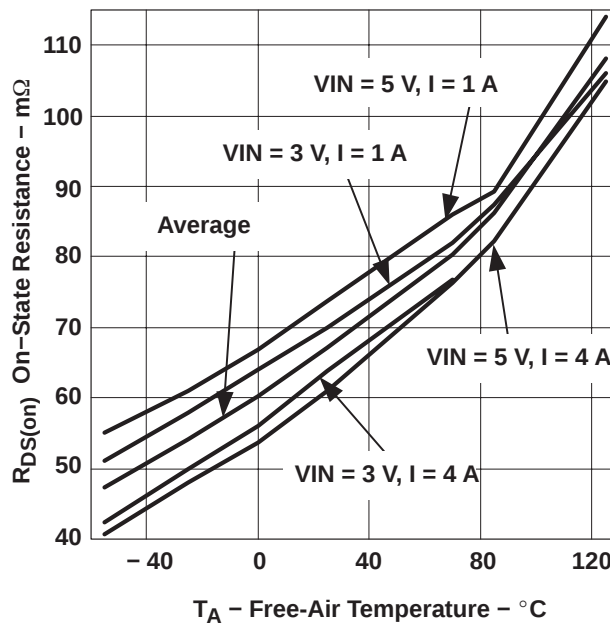


Figure 10

APPLICATION INFORMATION

safety considerations

Although the UCC2918 is designed to provide system protection for all fault conditions, all integrated circuits can ultimately fall short. For this reason, if the UCC2918 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 power device. The UCC2918 prevents 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.



IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
RF/IF and ZigBee® Solutions	www.ti.com/lprf

Applications

Audio	www.ti.com/audio
Automotive	www.ti.com/automotive
Broadband	www.ti.com/broadband
Digital Control	www.ti.com/digitalcontrol
Medical	www.ti.com/medical
Military	www.ti.com/military
Optical Networking	www.ti.com/opticalnetwork
Security	www.ti.com/security
Telephony	www.ti.com/telephony
Video & Imaging	www.ti.com/video
Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2009, Texas Instruments Incorporated