

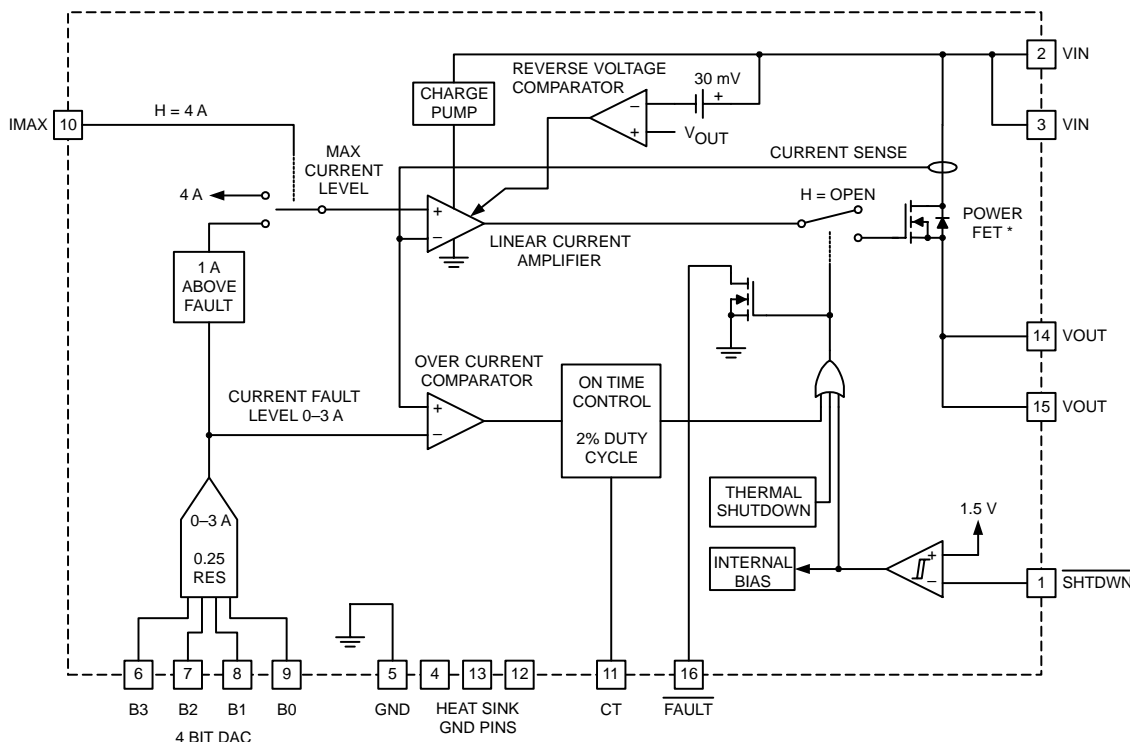
- Integrated 0.15-Ω Power MOSFET
- 7-V to 15-V Operation
- Digital-Programmable Current Limit from 0 A to 3 A
- 100-μA I_{CC} When Disabled
- Programmable On Time
- Programmable Start Delay
- Fixed 2% Duty Cycle
- Thermal Shutdown
- Fault-Output Indicator
- Maximum-Output Current Can Be Set to 1 A Above the Programmed-Fault Level or to a Full 4 A
- 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, C_T . 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 2% duty cycle ratio limits average output power.

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

block diagram



NOTE: Pin numbers refer to DIL-16 and SOIC-16 packages.



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.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2000, Texas Instruments Incorporated

UCC2915, UCC3915

15-V PROGRAMMABLE HOT SWAP POWER MANAGER

SLUS198C – FEBRUARY 2000 - REVISED - JUNE 2001

description (continued)

When the output current is below the fault level, the output MOSFET is switched on with a nominal ON resistance of $0.15\ \Omega$. 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 50 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 UCC3915 can be put into sleep mode, drawing only $100\ \mu\text{A}$ of supply current. Other features include an open-drain fault-output indicator, thermal shutdown, undervoltage lockout, 7-V to 15-V operation, and low-thermal resistance SOIC and TSSOP power packages.

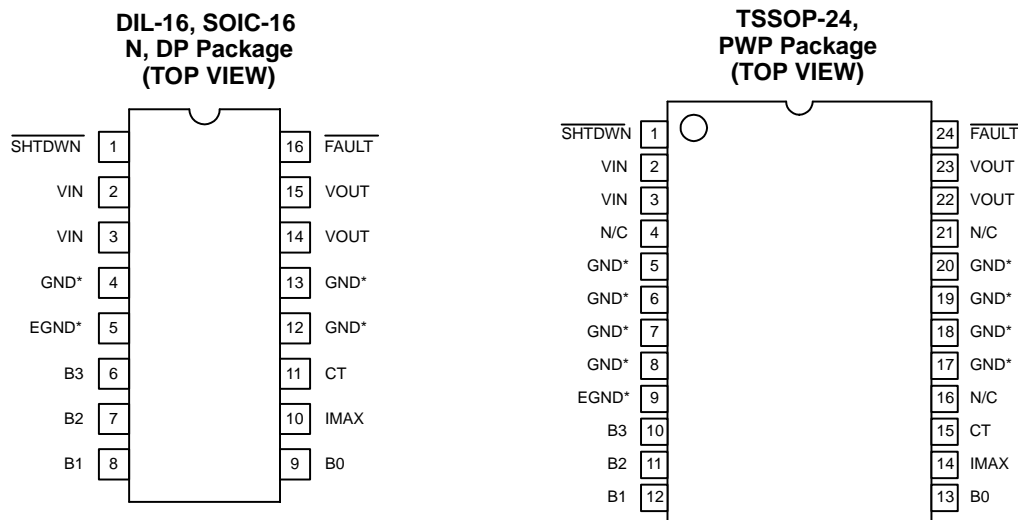
absolute maximum ratings over operating free-air temperature (unless otherwise noted)[†]

VIN	15.5 V
VOUT – VIN	0.3 V
FAULT sink current	50 mA
FAULT voltage	–0.3 V to 8 V
Output current	Self limiting
TTL input voltage	–0.3 to VIN
Storage temperature, T _{stg}	–65°C to 150°C
Junction temperature, T _J	–55°C to 150°C
Lead temperature (soldering, 10 sec.)	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.

[‡] Currents are positive into, negative out of the specified terminal. Consult Packaging Section of the *Interface Products Data Book* (TI Literature Number SLUD002) for thermal limitations and considerations of packages.

package information



*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.

*Pin 9 serves as lowest impedance to the electrical ground; other GND pins serve as heat sink/ground. These pins should be connected to large etch areas to help dissipate heat.

UCC2915, UCC3915 15-V PROGRAMMABLE HOT SWAP POWER MANAGER

SLUS198C – FEBRUARY 2000 - REVISED - JUNE 2001

electrical characteristics, these specifications apply for $T_A = -40^{\circ}\text{C}$ to 85°C for the UCC2915 and 0°C to 70°C for the UCC3915, $V_{IN} = 12\text{ V}$, $I_{MAX} = 0.4\text{ V}$, $SHTDWN = 2.4\text{ V}$, $T_A = T_J$, (unless otherwise stated)

supply

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Voltage input range		7.0		15.0	V
Supply current			1.0	2.0	mA
Sleep mode current	$\overline{SHTDWN} = 0.2\text{ V}$, no load		100	150	μA
Output leakage	$\overline{SHTDWN} = 0.2\text{ V}$			20	μA

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

output

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Voltage drop	$I_{OUT} = 1\text{ A}$ (10 V to 12 V)		0.15	0.3	V
	$I_{OUT} = 2\text{ A}$ (10 V to 12 V)		0.3	0.6	V
	$I_{OUT} = 3\text{ A}$ (10 V to 12 V)		0.45	0.9	V
	$I_{OUT} = 1\text{ A}$, $V_{IN} = 7\text{ V}$ and 15 V		0.2	0.4	V
	$I_{OUT} = 2\text{ A}$, $V_{IN} = 7\text{ V}$ and 15 V		0.4	0.8	V
	$I_{OUT} = 3\text{ A}$, $V_{IN} = 7\text{ V}$, 12 V MAX		0.6	1.2	V
Initial startup time	See Note 2		100		μs
Short circuit response	See Note 2		100		ns
Thermal shutdown	See Note 2		165		$^{\circ}\text{C}$
Thermal hysteresis	See Note 2		10		$^{\circ}\text{C}$

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

NOTE 2: Ensured by design. Not production tested.

DAC

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Trip current	Code = 0000–0011 (device off)				
	Code = 0100	0.07	0.25	0.45	A
	Code = 0101	0.32	0.50	0.70	A
	Code = 0110	0.50	0.75	0.98	A
	Code = 0111	0.75	1.00	1.3	A
	Code = 1000	1.0	1.25	1.6	A
	Code = 1001	1.25	1.50	1.85	A
	Code = 1010	1.5	1.75	2.15	A
	Code = 1011	1.70	2.00	2.4	A
	Code = 1100	1.90	2.25	2.7	A
	Code = 1101	2.1	2.50	2.95	A

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



UCC2915, UCC3915

15-V PROGRAMMABLE HOT SWAP POWER MANAGER

SLUS198C – FEBRUARY 2000 - REVISED - JUNE 2001

electrical characteristics, these specifications apply for $T_A = -40^{\circ}\text{C}$ to 85°C for the UCC2915 and 0°C to 70°C for the UCC3915, $V_{IN} = 12\text{ V}$, $I_{MAX} = 0.4\text{ V}$, $SHTDWN = 2.4\text{ V}$, $T_A = T_J$, (unless otherwise stated)

DAC (continued)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Trip current	Code = 1110	2.30	2.75	3.25	A
	Code = 1111	2.50	3.0	3.50	A
Max output current over trip (current source mode)	Code = 0100 to 1111, $I_{MAX} = 0\text{ V}$	0.35	1.0	1.65	A
Max output current (current source mode)	Code = 0100 to 1111, $I_{MAX} = 2.4\text{ V}$	3.0	4.0	5.2	A

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

fault timer

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
CT charge current	$V_{CT} = 1.0\text{ V}$	-83	-62	-47	μA
CT discharge current	$V_{CT} = 1.0\text{ V}$	0.8	1.2	1.8	μA
Output duty cycle	$V_{OUT} = 0\text{ V}$	1.0%	1.9%	3.3%	
CT fault threshold		1.2	1.5	1.7	V
CT reset threshold		0.4	0.5	0.6	V

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

shutdown

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Shutdown threshold		1.1	1.5	1.9	V
Shutdown hysteresis			150		mV
Input current			100	500	nA

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

open drain output ($\overline{\text{FAULT}}$)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
High level output current	$\overline{\text{FAULT}} = 5\text{ V}$			250	μA
Low level output voltage	$I_{OUT} = 5\text{ mA}$		0.2	0.8	V

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

TTL input dc characteristics

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
TTL input voltage high		2.0			V
TTL input voltage low				0.8	V
TTL input high current	$V_{IH} = 2.4\text{ V}$		3	10	μA
TTL input low current	$V_{IL} = 0.4\text{ V}$			1	μA

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



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 $T_{\text{FAULT}} = 16.1 \times 10^3 \times C_T$. Once the fault time is reached the output will shutdown for a time given by $T_{\text{SD}} = 833 \times 10^3 \times C_T$, this equates to a 1.9% duty cycle.

FAULT: Open-drain output, which pulls low upon any fault or interrupt condition, or thermal shutdown.

IMAX: When this pin is set to a logic low, the maximum-sourcing current will always be 1 A above the programmed-fault level. When set to a logic high, the maximum-sourcing current will be a constant 4 A 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 100 μA 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 V to 15 V. Both VIN pins should be connected together and connected to the 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 $V_{\text{IN}} - (0.15 \Omega \times I_{\text{OUT}})$. VOUT must not exceed VIN by greater than 0.3 V.

APPLICATION INFORMATION

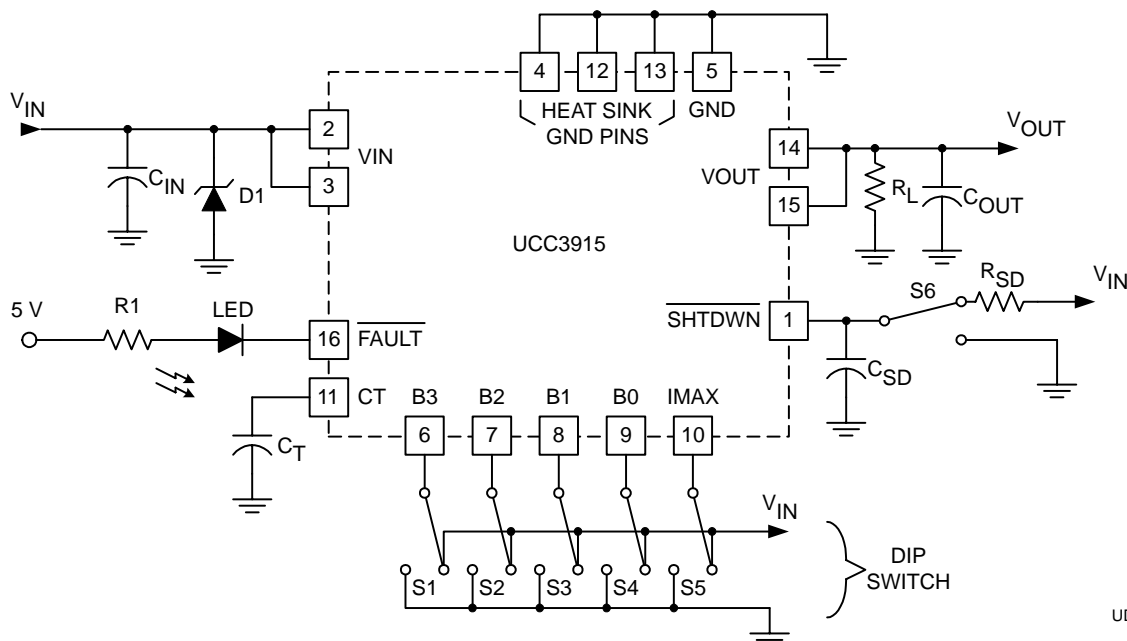


Figure 1. Evaluation Circuit

UCC2915, UCC3915 15-V PROGRAMMABLE HOT SWAP POWER MANAGER

SLUS198C – FEBRUARY 2000 - REVISED - JUNE 2001

APPLICATION INFORMATION

protecting the UCC3915 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 UCC3915. It is important to limit the peak of this spike to less than 15 V to prevent damage to the UCC3915. 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 UCC3915 or use PCB power and ground planes).
- Decoupling V_{IN} with a capacitor, C_{IN} (refer to Figure 1), located close to the V_{IN} pins. This capacitor is typically 1 μ F or less to limit the inrush current.
- Clamping the voltage at V_{IN} below 15 V with a Zener diode, D1 (refer to Figure 1), located close to the V_{IN} pins.

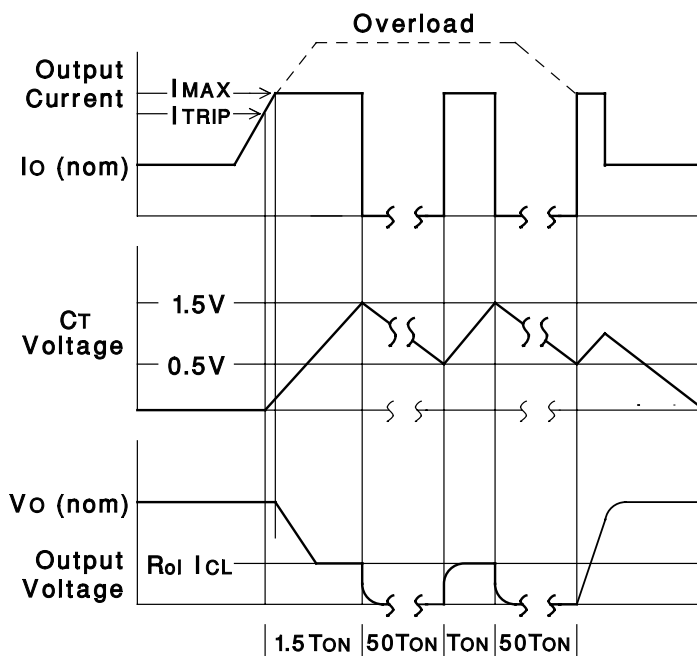


Figure 2. Load Current, Timing-Capacitor Voltage, and Output Voltage of the UCC3915 Under Fault Conditions

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 ensure 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 C_T .

APPLICATION INFORMATION

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

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

Where V_{OUT} is the output voltage.

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

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

Long C_T 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.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
UCC2915DP	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	UCC2915DP	Samples
UCC2915DPG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	UCC2915DP	Samples
UCC2915DPTR	OBSOLETE	SOIC	D	16		TBD	Call TI	Call TI	-40 to 85	UCC2915DP	
UCC2915DPTRG4	OBSOLETE	SOIC	D	16		TBD	Call TI	Call TI	-40 to 85		
UCC3915DP	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	0 to 70	UCC3915DP	Samples
UCC3915DPG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	0 to 70	UCC3915DP	Samples
UCC3915DPTR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	0 to 70	UCC3915DP	Samples
UCC3915DPTRG4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	0 to 70	UCC3915DP	Samples
UCC3915N	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI	0 to 70	UCC3915N	
UCC3915NG4	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI	0 to 70		
UCC3915PWP	ACTIVE	TSSOP	PW	24	60	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	0 to 70	UCC3915PWP	Samples
UCC3915PWPG4	ACTIVE	TSSOP	PW	24	60	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	0 to 70	UCC3915PWP	Samples
UCC3915PWPTR	ACTIVE	TSSOP	PW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	0 to 70	UCC3915PWP	Samples
UCC3915PWPTRG4	ACTIVE	TSSOP	PW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	0 to 70	UCC3915PWP	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

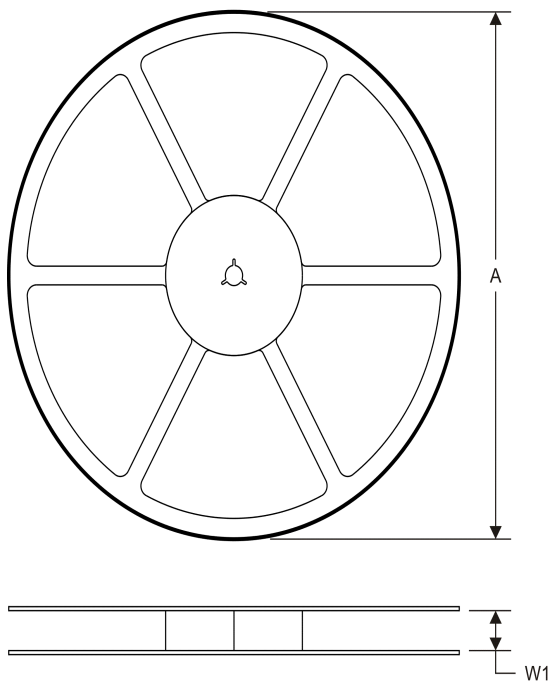
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

⁽⁴⁾ Only one of markings shown within the brackets will appear on the physical device.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION
REEL DIMENSIONS

TAPE DIMENSIONS


A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

TAPE AND REEL INFORMATION

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
UCC3915DPTR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
UCC3915PWPTR	TSSOP	PW	24	2000	330.0	16.4	6.95	8.3	1.6	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
UCC3915DPTR	SOIC	D	16	2500	367.0	367.0	38.0
UCC3915PWPTR	TSSOP	PW	24	2000	367.0	367.0	38.0

N (R-PDIP-T**)

16 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



PINS ** DIM	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS-001 VARIATION	AA	BB	AC	AD



4040049/E 12/2002

NOTES:

- A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
-  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R-PDSO-G16)

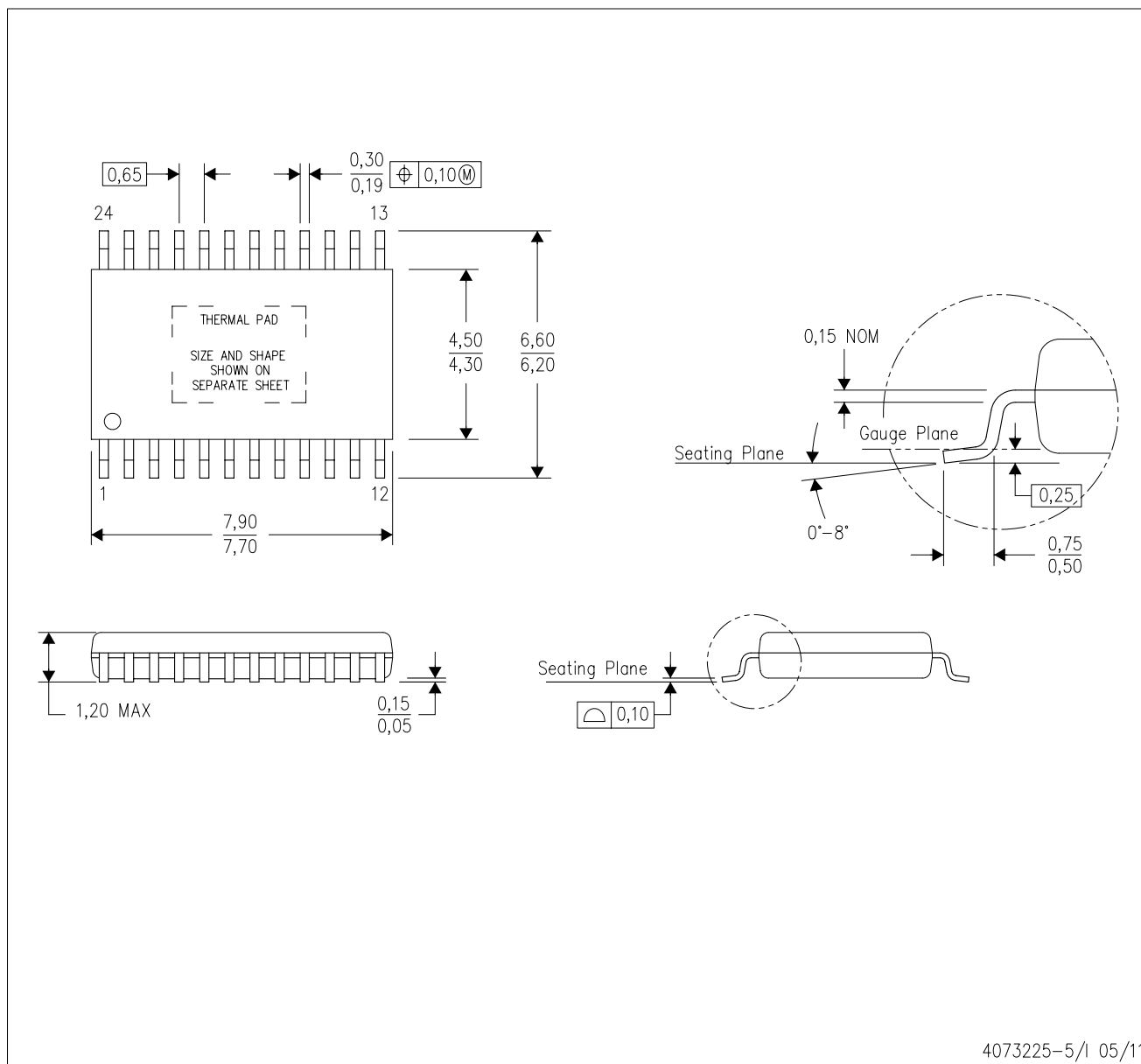
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - $\triangle D$ Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AC.

PWP (R-PDSO-G24)

PowerPAD™ PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusions. Mold flash and protrusion shall not exceed 0.15 per side.
 - D. This package is designed to be soldered to a thermal pad on the board. Refer to Technical Brief, PowerPad Thermally Enhanced Package, Texas Instruments Literature No. SLMA002 for information regarding recommended board layout. This document is available at www.ti.com <<http://www.ti.com>>.
 - E. See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
 - E. Falls within JEDEC MO-153

PowerPAD is a trademark of Texas Instruments.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

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

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license 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 significant portions 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. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
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
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com