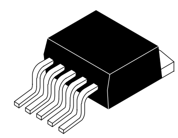
CMPWR280

Dual Input SmartOR™ Power Switch

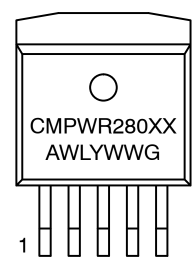
ON Semiconductor®

http://onsemi.com



TO−263
TO/TN SUFFIX
CASE 418AH

MARKING DIAGRAM



CMPWR280	= Specific Device Code
XX	= TO/TN
A	= Assembly Location
WL	= Wafer Lot
Y	= Year
WW	= Work Week
G	= Pb−Free Package

Product Description

The ON Semiconductor's SmartOR™ CMPWR280 is a fully protected Dual−Input low−dropout CMOS regulator that also provides the necessary control signal for driving an external auxiliary P−channel MOSFET switch. The SmartOR™ device automatically selects one of three possible inputs on a priority basis: V_{CC} (1.5 A), V_{SBY} (375 mA) or V_{AUX} via the drive signal used to control an external switch.

V_{CC} is given first priority. In the event of the V_{CC} supply being powered down, the device will automatically deselect the V_{CC} prior to regulator dropout and immediately select V_{SBY} (second priority) as its power source.

If neither V_{CC} nor V_{SBY} are present the drive control output will turn−on an external P−channel MOSFET switch from an auxiliary 3.3 V supply V_{AUX} to V_{OUT}.

All the necessary control circuitry needed to provide a smooth and automatic transition between all three supplies has been incorporated. This allows V_{CC} to be dynamically switched without loss of output voltage.

The CMPWR280 is internally protected against output short−circuits, current overload and thermal overload.

The CMPWR280 is housed in a standard, 5−lead TO−263 package and is available with optional lead−free finishing.

Features

- Selects from 3 Input Voltages and Provides 3.3 V Output
- Automatic Selection of V_{CC}, V_{SBY} or V_{AUX}
- Drive Control Signal for External V_{AUX} Switch
- Glitch−Free 3.3 V Output During Supply Transitions
- Built−In Hysteresis for Supply Selection
- V_{CC} Regulates Up to 1.5 A Output Current
- V_{SBY} Regulates Up to 375 mA Output Current
- Foldback Current Limiting
- Thermal Shutdown with Hysteresis
- Standard 5−lead TO−263 Package
- These Devices are Pb−Free and are RoHS Compliant

Applications

- Peripheral Component Interface (PCI) Adapter Cards
- Network Interface Cards (NICs)
- Multiple Powered Systems
- Systems with Standby Capabilities

ORDERING INFORMATION

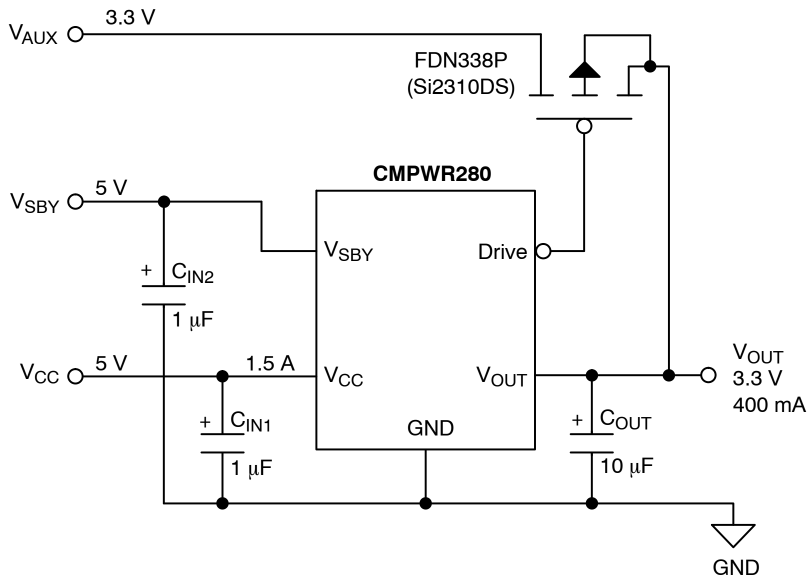
Device	Package	Shipping†
CMPWR280TO	TO−263 (Pb−Free)	750/Tape & Reel
CMPWR280TN	TO−263 (Pb−Free)	750/Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

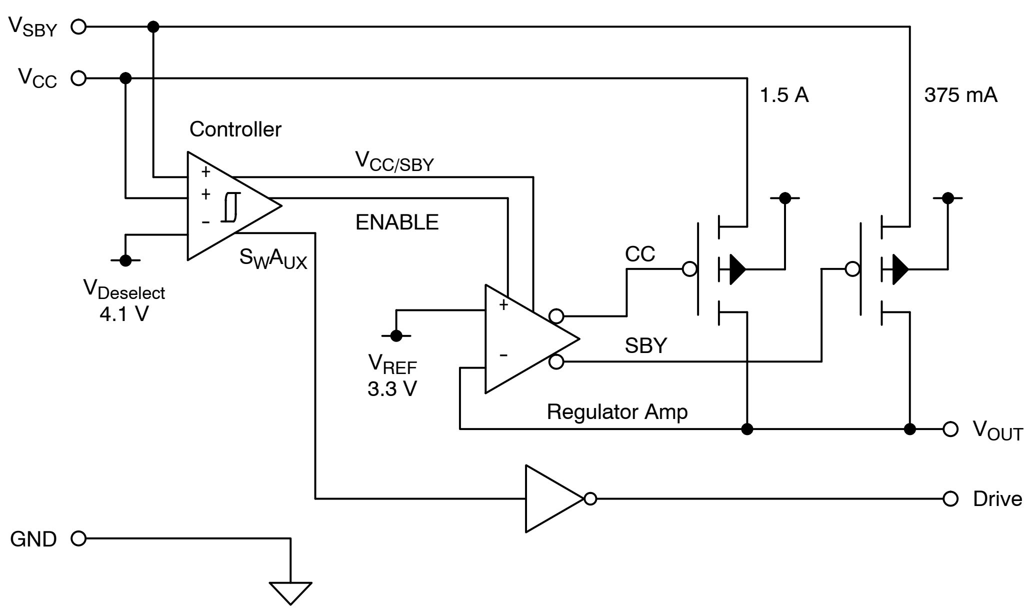
April, 2011 − Rev. 3

Publication Order Number:
CMPWR280/D

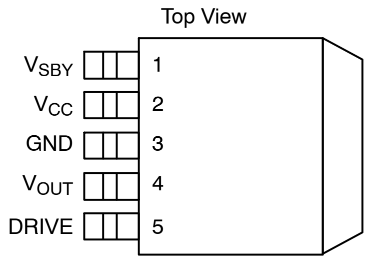
TYPICAL APPLICATION CIRCUIT



SIMPLIFIED ELECTRICAL SCHEMATIC



PACKAGE / PINOUT DIAGRAM



5−Pin TO−263
CMPWR280TO/TN

Table 1. PIN DESCRIPTIONS

Pin(s)	Name	Description
1	V_{SBY}	V_{SBY} is the standby 5 V supply power source, which is only selected on when V_{CC} < V_{CCDES}. If V_{SBY} is selected, the regulator can deliver a maximum of 375 mA load current. Whenever V_{SBY} exceeds both V_{CC} and V_{OUT}, it will be used to provide all the internal bias currents and any necessary regulator current.
2	V_{CC}	V_{CC} is the primary 5 V power supply for the internal regulator. Whenever V_{CC} exceeds V_{CCSEL} (4.5 V), the internal regulator (up to 1500 mA) will be enabled and deliver a fixed 3.3 V at V_{OUT}. When V_{CC} falls below V_{CCDES} (4.1 V typically) the regulator will be disabled. Internal loading on this pin is typically 1.5 mA when the regulator is enabled, which reduces to 0.2 mA whenever the regulator is disabled. If V_{CC} falls below either the V_{SBY} or V_{OUT} voltage, the loading on V_{CC} will reduce to only a few microamperes. During a V_{CC} power up sequence, there will be an effective step increase in V_{CC} line current when the regulator is enabled. The amplitude of this step increase will depend on the dc load current and any current required for charging/discharging the load capacitance. This line current transient will cause a voltage disturbance at the V_{CC} pin proportional to the effective power supply source impedance being delivered to the V_{CC} input. To prevent chatter during Select and Deselect transitions, a built−in hysteresis voltage of 400 mV has been incorporated. It is recommended that the power supply connected to the V_{CC} input should have a source impedance of less than 0.15 Ω to minimize the chatter during the enabling/disabling of the regulator.
3	GND	GND is the negative reference for all voltages. The current that flows in the ground connection is very low (typically 2.0 mA) and has minimal variation over all load conditions.
4	V_{OUT}	V_{OUT} is the regulator output voltage connection used to power the load. An output capacitor of ten microfarads is used to provide the necessary phase compensation, thereby preventing oscillation. The capacitor also helps to minimize the peak output disturbance during power supply changeover. When both V_{CC} and V_{SBY} falls below V_{OUT}, then V_{OUT} will be used to provide the necessary quiescent current for the internal reference circuits. This ensures excellent start−up characteristics for the regulator.
5	DRIVE	Drive is an active LOW logic output intended to be used as the control signal for driving an external P−channel MOSFET switch whenever the regulator is disabled. This will allow the voltage at V_{OUT} to be powered from an auxiliary supply voltage (3.3 V). The Drive pin is pulled HIGH to V_{CC} whenever the regulator is enabled, thus ensuring that the auxiliary supply remains isolated during normal regulator operation.

SPECIFICATIONS

Table 2. STANDARD OPERATING CONDITIONS

Parameter	Rating	Units
V_{CC}, V_{SBY} Input Voltage	4.75 to 5.25	V
Ambient Operating Temperature Range	0 to +70	°C
C_{EXT}	10 ±10%	μF

SPECIFICATIONS (Cont'd)

Table 3. ABSOLUTE MAXIMUM RATINGS

Parameter	Rating	Units
ESD Protection (HBM)	±2000	V
Pin Voltages V_{CC}, V_{SBY} ,V_{OUT} DRIVE	 [GND − 0.5] to [+6.0] [GND − 0.5] to [V_{CC} (V_{SBY}) + 0.5]	V
Storage Temperature Range	−40 to +150	°C
Operating Temperature Range Ambient Junction	 0 to +70 0 to +125	°C
Power Dissipation TO−263 (Note 1)	 Internally Limited	W

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. The maximum power dissipation of this device is internally limited by thermal shutdown circuitry. To achieve a power dissipation of 3.0 watts, a case−to−ambient thermal resistance of 25°C/W must be provided. This will typically require dedicated heatsinking ability of the printed circuit board. For more details, please see the Typical Thermal Characteristics section.

Table 4. ELECTRICAL OPERATING CHARACTERISTICS (Note 2)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{OUT}	Regulator Output Voltage	0 mA < I_{LOAD} < 1500 mA (V_{CC}) 0 mA < I_{LOAD} < 375 mA (V_{SBY})	3.135	3.300	3.465	V
V_{CCSEL}	Select Voltage	V_{CC} Regulator Enabled		4.50	4.70	V
V_{CCDES}	V_{CC} Deselect Voltage	V_{CC} Regulator Disabled	3.90	4.10		V
V_{CCHYST}	Hysteresis Voltage	V_{CC} Hysteresis (Note 3)		0.40		V
I_{OUT}	Regulator Output Current	V_{CC} Selected V_{SBY} Selected	1500 375	2500 750		mA
I_{SC}	Short−circuit Output Current	V_{CC} Selected V_{SBY} Selected		800 200		mA
I_{RCC}	V_{CC} Pin Reverse Leakage	V_{SBY} = 5.0 V, V_{CC} = 0 V		10	100	μA
I_{RSBY}	V_{SBY} Pin Reverse Leakage	V_{SBY} = 0 V, V_{CC} = 5.0 V		10	100	μA
$V_{R\ LOAD}$	V_{CC} Load Regulation	V_{CC} Selected, I_{LOAD} = 15 mA to 1500 mA		30		mV
	V_{SBY} Load Regulation	V_{SBY} Selected, I_{LOAD} = 5 mA to 375 mA		30		
$V_{R\ LINE}$	Line Regulation	V_{CC} = 4.5 to 5.5 V, I_{LOAD} = 5 mA		5		mV
I_{CC}	V_{CC} Supply Current	V_{CC} Selected, I_{OUT} = 0 mA V_{CCDES} > V_{CC} > V_{AUX} or V_{OUT}		1.5 0.1	3.0 0.2	mA
I_{SBY}	V_{SBY} Supply Current	V_{SBY} Selected, I_{OUT} = 0 mA		1.5	3.0	mA
I_{GND}	Ground Pin Current (Note 4)	Regulator Disabled (only V_{OUT} Present) Regulator Selected, I_{LOAD} = 5 mA Regulator Selected = 5 V, I_{LOAD} = 500 mA		0.2 1.5 1.8	0.3 3.0 3.5	mA
R_{OH}	Drive R_{DS} High	R_{DS} to V_{CC}, V_{CC} > V_{CCSEL}		5	10	kΩ
R_{OL}	Drive R_{DS} Low	R_{DS} to GND, V_{CCDES} > V_{CC}		0.5	1.0	kΩ
t_{DH}	Drive High Delay	C_{DRIVE} = 1 nF, V_{CC} t_{RISE} < 100 ns		5.0		μs
t_{DL}	Drive Low Delay	C_{DRIVE} = 1 nF, V_{CC} t_{FALL} < 100 ns		0.5		μs
$T_{DISABLE}$	Shutdown Temperature			165		°C
T_{HYST}	Thermal Hysteresis			30		°C

2. Operating Characteristics are over Standard Operating Conditions unless otherwise specified.
3. The hysteresis defines the maximum level of acceptable disturbance on V_{CC} during switching. It is recommended that the V_{CC} source impedance be kept below 0.15 Ω to ensure the switching disturbance remains below the hysteresis during select/deselect transitions.
4. Ground pin current consists of controller current (0.2 mA) and regulator current when selected.

TYPICAL DC CHARACTERISTICS

Unless stated otherwise, all DC characteristics were measured at room temperature with a nominal V_{CC} supply voltage of 5.0 V and an output capacitance of 10 μF.

V_{CC} Line Regulation, as shown in V, is measured while forcing the deselect threshold to an artificial low level for loads of 100 mA, 500 mA and 1.5 A. At the maximum rated load of 1.5 A, a drop in line regulation occurs when the V_{CC} supply voltage drops below 3.8 V. For light load conditions (100 mA), regulation is maintained as low as 3.2 V

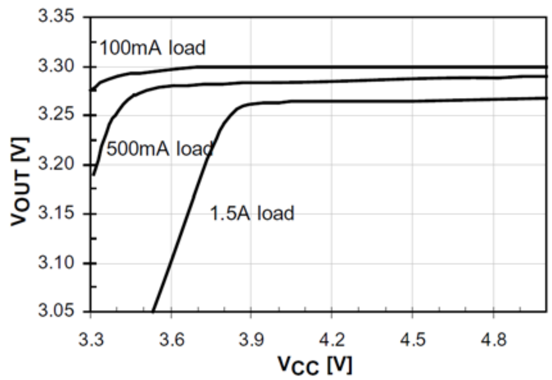


Figure 1. V_{CC} Line Regulation

V_{CC} Load Regulation (pulse condition) performance is shown up to and beyond the rated load. A change in load from 10% to 100% of rated current (150 mA to 1500 mA) results in an output voltage change of about 20 mV. This translates into an effective output impedance of less than 15 MΩ.

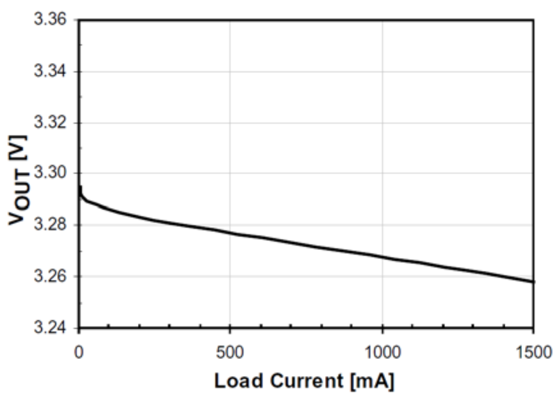


Figure 2. V_{CC} Load Regulation

V_{SBY} Load Regulation (pulse condition) performance is shown up to and beyond the rated load. A change in load from 10% to 100% of rated (50 mA to 500 mA) results in an output voltage change of about 20 mV. This translates into an effective output impedance of less than 50 MΩ.

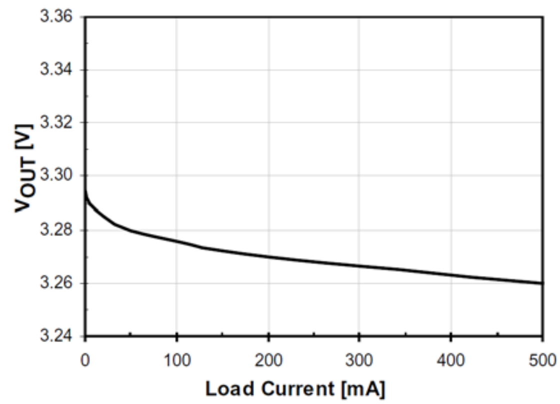


Figure 3. V_{SBY} Load Regulation

Ground Current is shown across the entire range of load conditions in Ground Current. The ground current of 2 mA has minimal variation across the range of load conditions and shows only a slight increase at maximum load. This slight increase at rated load is due to the current limit protection circuitry becoming active.

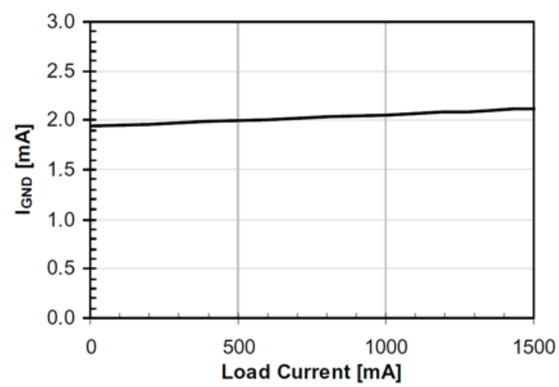


Figure 4. Ground Current

V_{CC} Supply Current of the device is shown across the entire V_{CC} range in V.

In the absence of V_{AUX}, the supply current remains fixed at approximately 0.15 mA until V_{CC} reaches the Select voltage threshold of 4.35 V. At this point the regulator is enabled and a supply current of 1.0 mA is conducted.

When V_{AUX} is present, the V_{CC} supply current is less than 10 μA until V_{CC} exceeds V_{AUX}, at which point V_{CC} then powers the controller (0.15 mA). When V_{CC} reaches V_{SELECT}, the regulator is enabled.

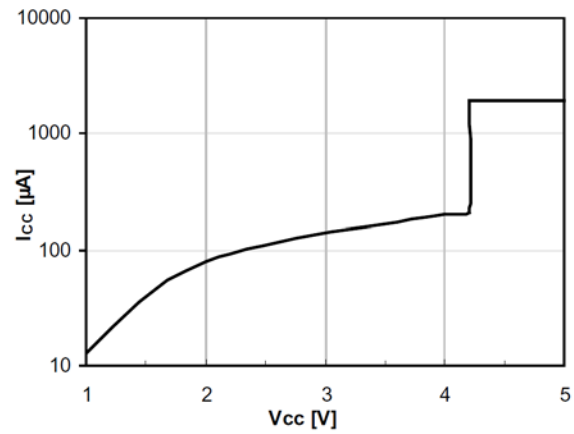


Figure 5. V_{CC} Supply Current (No Load)

TYPICAL TRANSIENT CHARACTERISTICS

The transient characterization test set−up shown in Transient Performance Test Set−up includes the effective source impedance of the V_{CC} supply (R_S). This was measured to be approximately 0.1 Ω. It is recommended that this effective source impedance be no greater than 0.15 Ω to ensure precise switching is maintained during V_{CC} selection and deselection.

Both the rise and fall times during V_{CC} power−up/down sequencing were controlled at a 10 millisecond duration. This is considered to represent worst case conditions for most application circuits.

During a selection or deselection transition, the DC load current is switching from V_{AUX} to V_{CC} and vice versa. In addition to the normal load current, there may also be an in−rush current for charging/discharging the load capacitor.

The total current pulse being applied to either V_{AUX} or V_{CC} is equal to the sum of the DC load and the corresponding in−rush current. Transient currents in excess of 1.0 amps can readily occur for brief intervals when either supply commences to power the load.

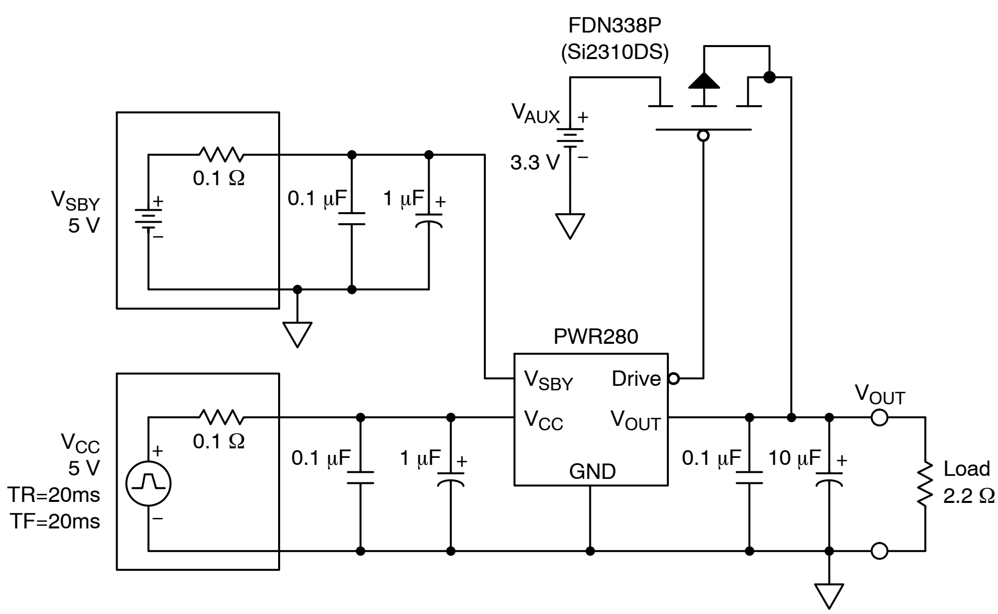


Figure 6. Transient Characterization Test Set−up

V_{CC} **Load Transient Response** is shown in V for a step load from 15 mA to 1500 mA. An overshoot of approximately 300 mV is observed, before settling within 3 µs.

V_{SBY} **Load Transient Response** is shown in V is shown for a step load from 5 mA to 375 mA. An overshoot of approximately 100 mV is observed, before settling within 1 µs.

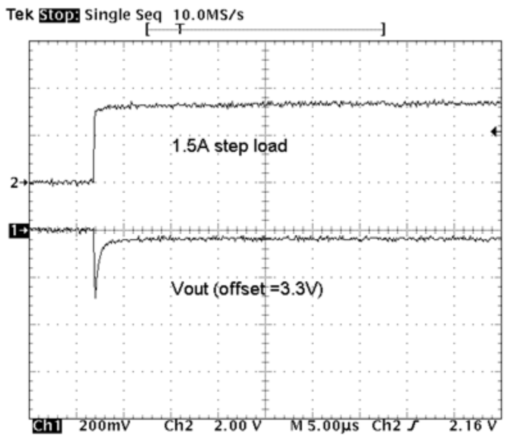


Figure 7. V_{CC} Load Transient Response

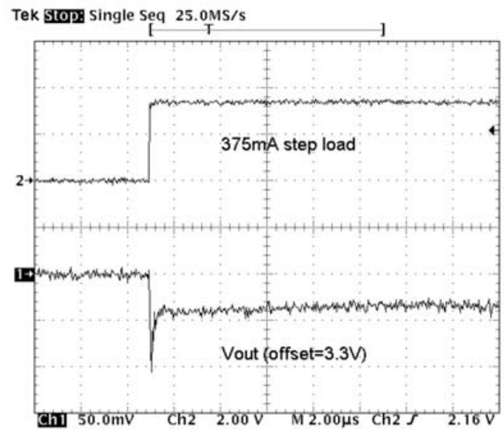


Figure 8. V_{SBY} Load Transient Response

Cold Start and Full Power Down Modes

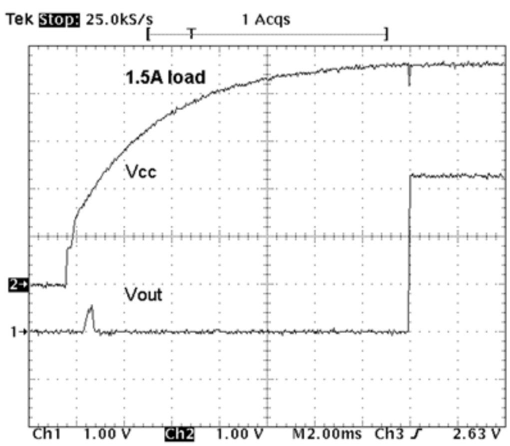


Figure 9. V_{CC} Cold Start

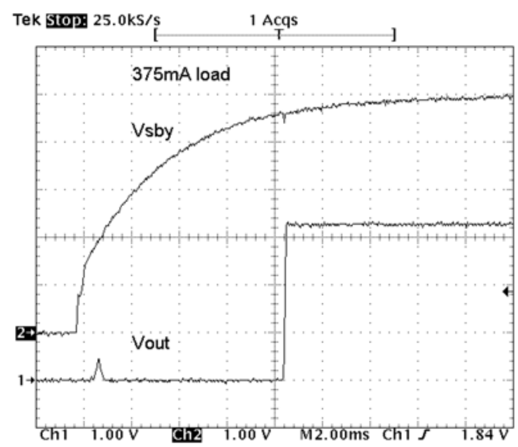


Figure 10. V_{CC} Full Power−Down

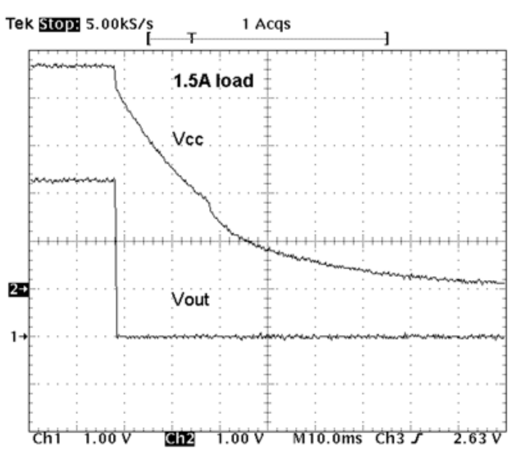


Figure 11. V_{SBY} Cold Start

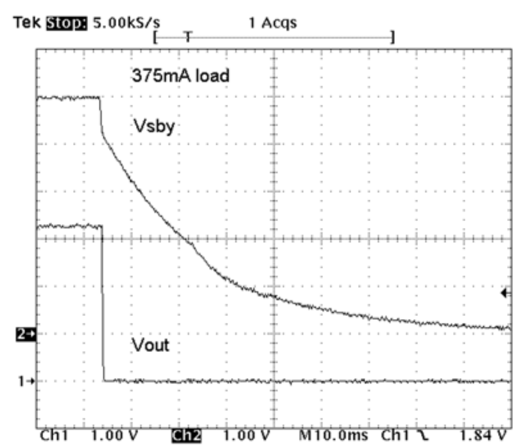


Figure 12. V_{SBY} Full Power−Down

VCC Power Changeover Modes

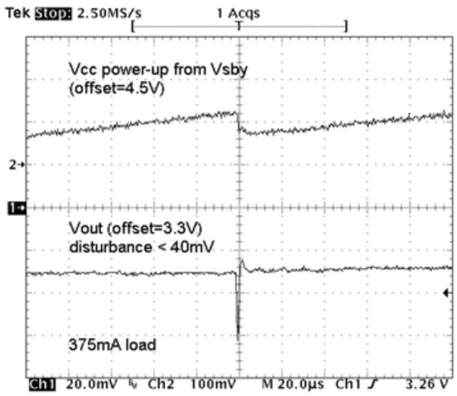


Figure 13. V_{CC} Power Up (V_{SBY} = 5 V)

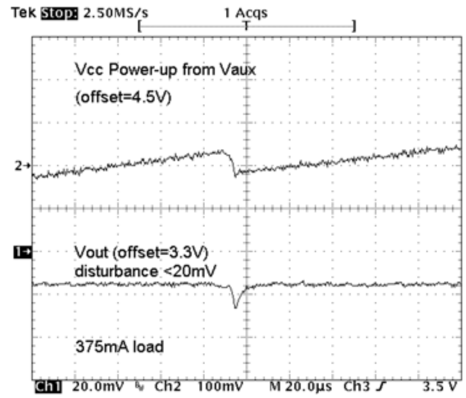


Figure 14. V_{CC} Power Up (V_{AUX} = 3.3 V)

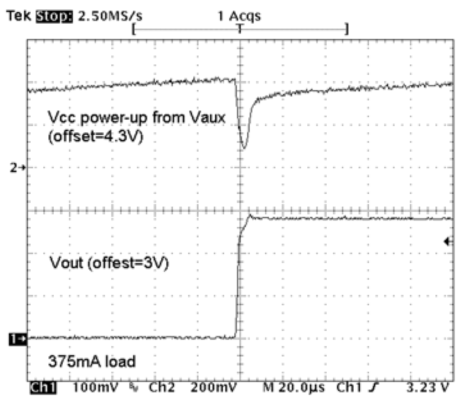


Figure 15. V_{CC} Power Up (V_{AUX} = 3.0 V)

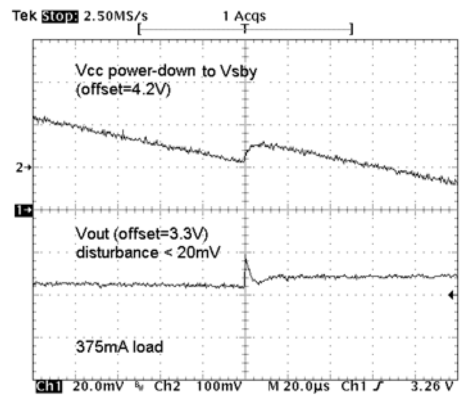


Figure 16. V_{CC} Power Down (V_{SBY} = 5 V)

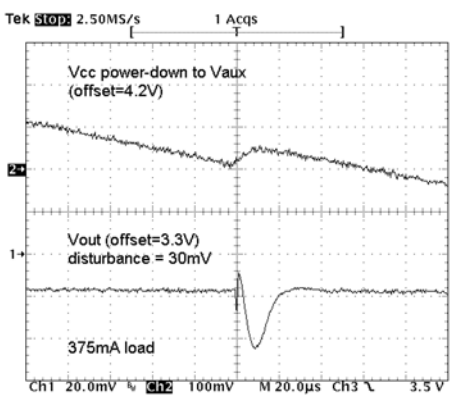


Figure 17. V_{CC} Power Down (V_{AUX} = 3.3 V)

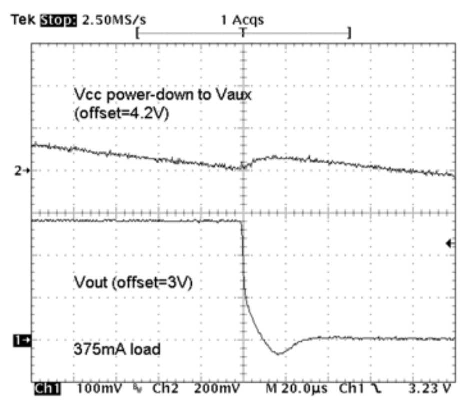


Figure 18. V_{CC} Power Down (V_{AUX} = 3.0 V)

TYPICAL THERMAL CHARACTERISTICS

Thermal dissipation of junction heat consists primarily of two paths in series. The first path is the junction to the case (θ_{JC}) thermal resistance which is defined by the package style, and the second path is the case to ambient (θ_{CA}) thermal resistance, which is dependent on board layout.

The overall junction to ambient (θ_{JA}) thermal resistance is equal to:

$$\theta_{JA} = \theta_{JC} + \theta_{CA}$$

For a given package style and board layout, the operating junction temperature is a function of junction power dissipation P_{JUNC}, and the ambient temperature, resulting in the following thermal equation:

$$\begin{aligned} T_{JUNC} &= T_{AMB} + P_{JUNC}(\theta_{JC}) + P_{JUNC}(\theta_{CA}) \\ &= T_{AMB} + P_{JUNC}(\theta_{JA}) \end{aligned}$$

The CMPWR280TO is housed in a TO−263 5−lead package, which provides a θ_{JC} of 3°C/W. The ground tab is soldered down to the PCB. When the device is mounted on a double−sided printed circuit board with two square inches of copper allocated for “heat spreading”, the resulting θ_{JA} is 25°C/W.

Based on a maximum power dissipation of 2.85 W (1.9 V x 1.5 A) with an ambient of 70°C the resulting junction temperature will be:

$$\begin{aligned} T_{JUNC} &= T_{AMB} + P_{JUNC}(\theta_{JA}) \\ &= 70^\circ C + 2.85\,W\,(25^\circ C/W) \\ &= 70^\circ C + 71^\circ C = 141^\circ C \end{aligned}$$

All thermal characteristics of the CMPWR280TO were measured using a double−sided board with two square inches of copper area connected to the GND pins for “heat spreading”.

Measurements showing performance up to junction temperature of 125°C were performed under light load conditions (5 mA). This allows the ambient temperature to be representative of the internal junction temperature.

NOTE: The use of multi−layer board construction with power planes will further enhance the thermal performance of the package. In the event of no copper area being dedicated for heat spreading, a multi−layer board construction will typically provide the CMPWR280TO with an overall θ_{JA} of 25°C/W which allows up to 2.5 W to be safely dissipated.

Output Voltage vs. Temperature. Output Voltage vs. Temperature shows the regulator V_{OUT} performance up to the maximum rated junction temperature. The overall 125°C variation in junction temperature causes an output voltage change of about 25 mV.

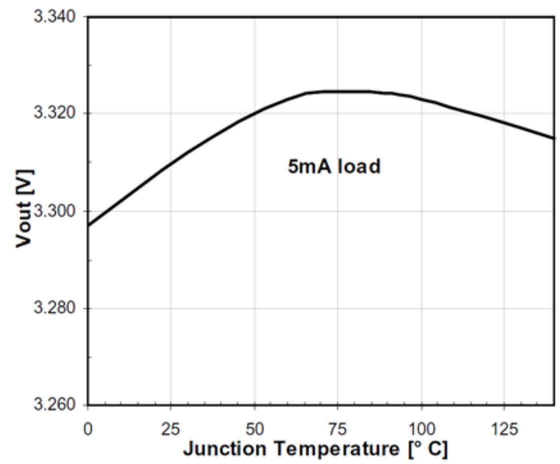


Figure 19. Output Voltage vs. Temperature

Output Voltage (Rated) vs. Temperature. Output Voltage (Rated) vs. Temperature shows the regulator steady state performance when fully loaded (1.5 A) in an ambient temperature up to the rated maximum of 70°C. The output variation at maximum load is approximately 13 mV across the normal temperature range.

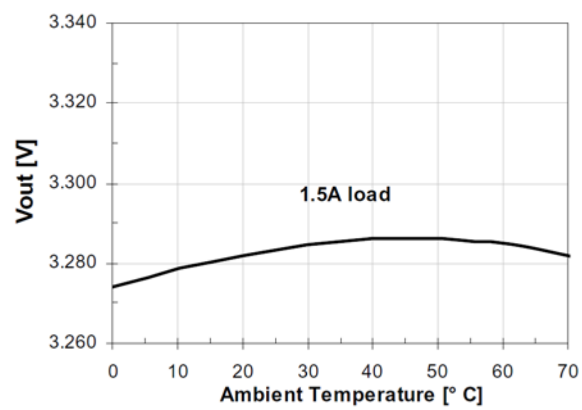


Figure 20. Output Voltage (Rated) vs. Temperature

Thresholds vs. Temperature. Threshold vs. Temperature shows the regulator select/deselect threshold variation up to the maximum rated junction temperature. The overall 125°C change in junction temperature causes a 30 mV variation in the select threshold voltage (regulator enable). The deselect threshold level varies about 30 mV over the 125°C change in junction temperature. This results in the built−in hysteresis having minimal variation over the entire operating junction temperature range.

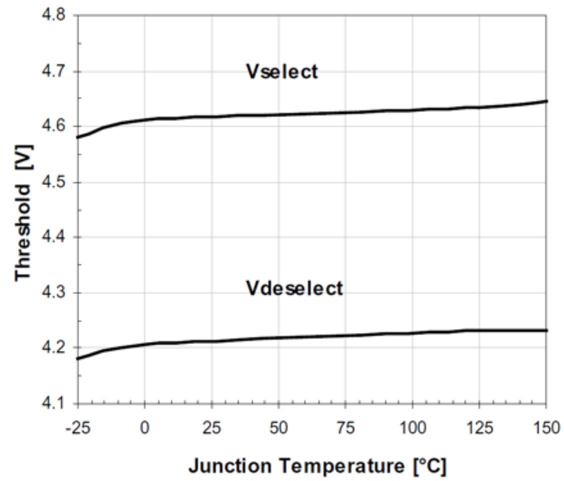
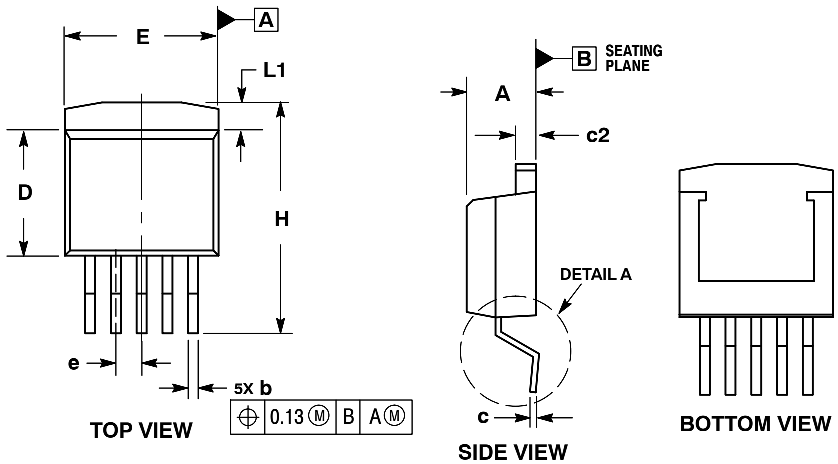


Figure 21. Threshold vs. Temperature

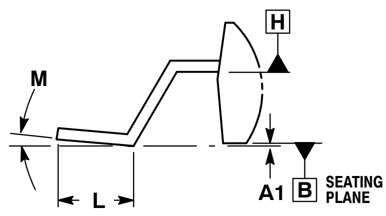
PACKAGE DIMENSIONS

D2PAK−5 (TO−263, 5 LEAD)
CASE 418AH−01
ISSUE A



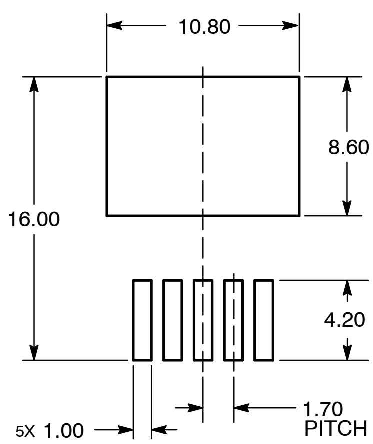
NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH AND GATE PROTRUSIONS. MOLD FLASH AND GATE PROTRUSIONS NOT TO EXCEED 0.13 MAXIMUM PER SIDE. THESE DIMENSIONS TO BE MEASURED AT DATUM H.

	MILLIMETERS	
DIM	MIN	MAX
A	4.06	4.82
A1	0.00	0.25
b	0.51	0.99
c	0.33	0.74
c2	1.14	1.65
D	8.38	9.65
E	9.65	10.67
e	1.70 BSC	
H	14.61	15.88
L	1.78	2.79
L1	−−−	1.68
M	0 °	8 °



DETAIL A

RECOMMENDED SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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