Marvell Solutions

POWER MANAGEMENT

DSP Switcher™ Power Modules

88MG815/88MG816, 1A Rated Output Current
88MG830/88MG831, 2A Rated Output Current

Non Isolated, Step-Down Switching Regulator Module with AnyVoltage™ Technology. Single and Dual Output Voltage Versions

Preliminary Specifications, Patent Pending

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Advance Information	This document contains design specifications for initial product development. Specifications may change without notice. Contact Marvell Field Application Engineers for more information.
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88MG815/88MG816/88MG830/88MG831

Non Isolated, Step-Down Switching Regulator Module with AnyVoltage™ Technology. Single and Dual Output Voltage Versions

SIP Package

DIP Package (TBD)

SMT Package

FEATURES/BENEFITS

- True lead- free "plug-n-play" solution
- No external components required - except a single voltage programming resistor
- Tiny footprint, vertical and horizontal options
- Input voltage range: 3V to 5.5V
- Programmable output voltage: 0.72V to 3.63V
- 2% output voltage tolerance
- 1 MHz switching frequency
- 95% efficiency—no heatsink required
- 2.5V and 3.3V LDO Secondary Voltage Versions
- Ultra-fast transient response
- Low output ripple and noise
- AnyVoltage™ Technology provides 64 output selections and shortens design cycles
- Output voltage margining capability for easy system testing and qualification
- High reliability - lowest component count
- Works with any external capacitive load (low ESR, high ESR)
- Built-in undervoltage lockout, thermal protection, and current limit
- Control IC and passive kit components are available for high volume user

OVERVIEW

The 88MG815/88MG816/88MG830/88MG831 is a high-performance, non-isolated, DC-DC converter module for point-of-load (POL) applications. It functions as a synchronous step-down (buck) switching regulator in a small form factor. The module includes a proprietary Marvell® integrated regulator device. The switching frequency for the regulator is 1 MHz, and no external components are required (except one voltage programming resistor, see Section 2.1 "Output Voltage - AnyVoltage™ Technology" on page 14).

Ultra-high conversion efficiency (typically 95%) allows for the use of the 88MG815/88MG816/88MG830/88MG831 without any heatsink. Additionally, the 88MG815/88MG816/88MG830/88MG831 includes an innovative single resistor method[1] to program the output voltage. This voltage is defined by the user with an external resistor.

The 88MG815/88MG816/88MG830/88MG831 operates from an input voltage range of 3V to 5.5V, making the device well suited for portable applications. The output voltage range is 0.72V to 3.63V, supporting future devices down to 65 nm geometries.

Other key features include an internal current limit, an undervoltage lockout, a thermal shutdown, and an ambient temperature range of -40°C to 85°C

1. Patent Pending

APPLICATIONS

- Point-of-load power supplies
- Networking/Datacom systems
- Portable computing
- Workstation and Servers
- DSP power supplies
- LAN/WAN
- Enterprise Networks
- Industrial Controls

DEVICE FEATURE DIFFERENCES

Table below summarizes the feature differences between 88MG815/88MG816/88MG830/88MG831.

Features	**88MG815z-x**	**88MG816-x**	**88MG830z-x**	**88MG831-x**
Rated Output Current	1.0A	1.0A	2.0A	2.0A
Packages ("-x" package code options -S ->SIP -D ->DIP -T ->SMT)	• 8-Pin SIP • 7-Pin DIP • 7-Pin SMT	• 7-Pin SIP • 6-Pin DIP • 6-Pin SMT	• 8-Pin SIP • 7-Pin DIP • 7-Pin SMT	• 7-Pin SIP • 6-Pin DIP • 6-Pin SMT
LDO "z" voltage option	B = 3.3V E = 2.5V	No LDO	B = 3.3V E = 2.5V	No LDO

PRODUCT SELECTOR TABLE

Part Number	**Description**	**LDO Output Voltage**	**Rated Output Current[1]**	**Package**
88MG815B-S	SIP Module: 1A Rated Output Switching Reg. with LDO	3.3V	1.0A	9-pin SIP
88MG815E-S	SIP Module: 1A Rated Output Switching Reg. with LDO	2.5V	1.0A	9-pin SIP
88MG815B-D	DIP Module: 1A Rated Output Switching Reg. with LDO	3.3V	1.0A	7-pin DIP
88MG815E-D	DIP Module: 1A Rated Output Switching Reg. with LDO	2.5V	1.0A	7-pin DIP
88MG815B-T	SMT Module: 1A Rated Output Switching Reg. with LDO	3.3V	1.0A	7-pin SMT
88MG815E-T	SMT Module: 1A Rated Output Switching Reg. with LDO	2.5V	1.0A	7-pin SMT
88MG816-S	SIP Module: 1A Rated Output Switching Reg.	--	1.0A	8-pin SIP
88MG816-D	DIP Module: 1A Rated Output Switching Reg.	--	1.0A	6-pin DIP
88MG816-T	SMT Module: 1A Rated Output Switching Reg.	--	1.0A	6-pin SMT
88MG830B-S	SIP Module: 2A Rated Output Switching Reg. with LDO	3.3V	2.0A	9-pin SIP
88MG830E-S	SIP Module: 2A Rated Output Switching Reg. with LDO	2.5V	2.0A	9-pin SIP
88MG830B-D	DIP Module: 2A Rated Output Switching Reg. with LDO	3.3V	2.0A	7-pin DIP
88MG830E-D	DIP Module: 2A Rated Output Switching Reg. with LDO	2.5V	2.0A	7-pin DIP
88MG830B-T	SMT Module: 2A Rated Output Switching Reg. with LDO	3.3V	2.0A	7-pin SMT
88MG830E-T	SMT Module: 2A Rated Output Switching Reg. with LDO	2.5V	2.0A	7-pin SMT
88MG831-S	SIP Module: 2A Rated Output Switching Reg.	--	2.0A	8-pin SIP
88MG831-D	DIP Module: 2A Rated Output Switching Reg.	--	2.0A	6-pin DIP
88MG831-T	SMT Module: 2A Rated Output Switching Reg.	--	2.0A	6-pin SMT

1. The maximum continuous output current while maintaining output voltage regulation is determined by thermal constraints. Refer to the Output Current Temperature Derating Curves.

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Figure 1: 88MG815z & 88MG830z Package - Component View

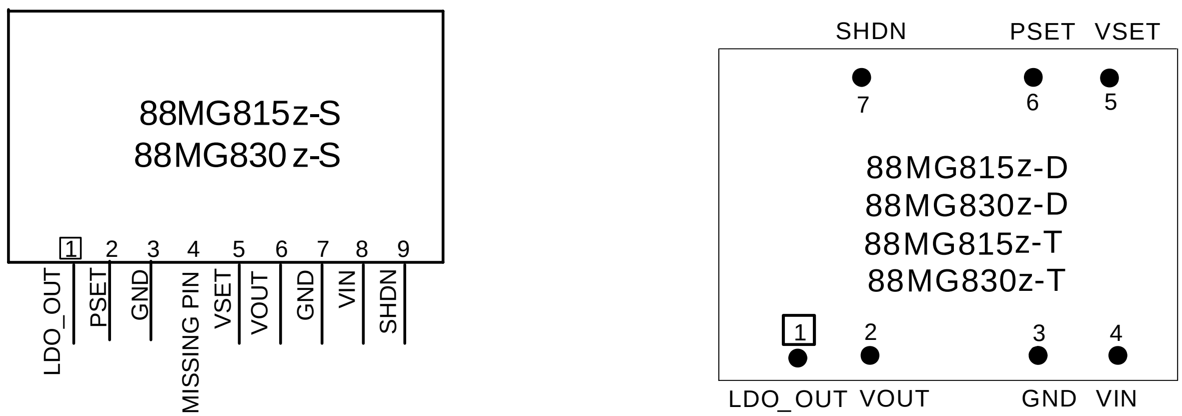
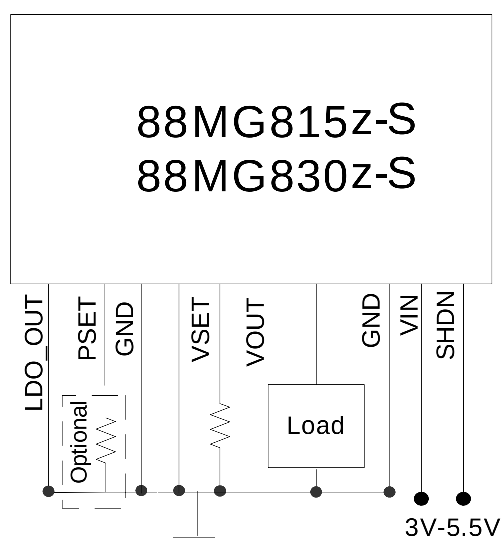
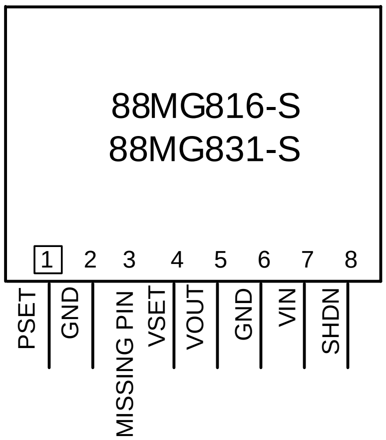


Figure 2: Connection Block Configuration Sample for 88MG815z & 88MG830z



1.2 Pin Diagram for 88MG816 & 88MG831

Figure 3: 88MG816 & 88MG831 Package - Component View



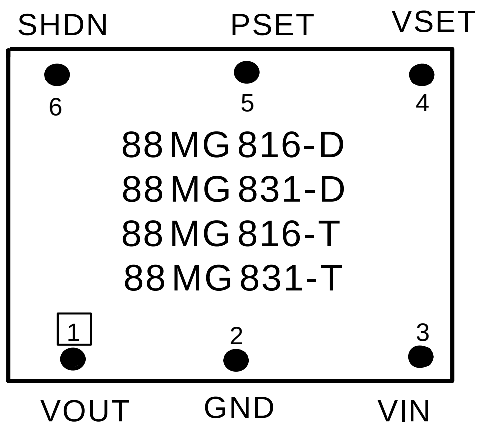
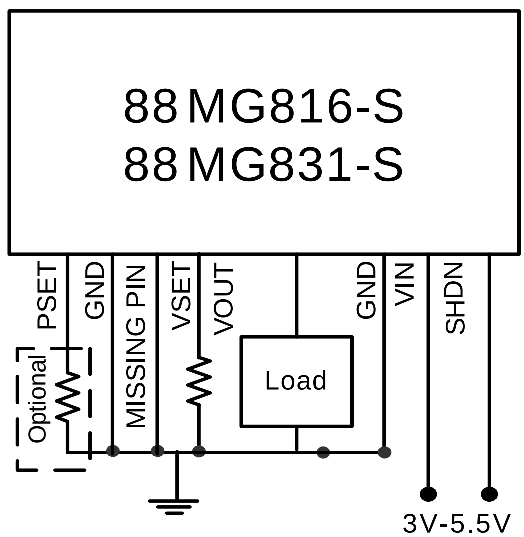


Figure 4: Connection Block Configuration Sample for 88MG816 & 88MG831



1.3 Pin Description

Name	Pin Description
LDO_OUT[1]	Secondary Output Voltage. Connect directly to load with a short wide PCB trace.
PSET	Percent Set. An external resistor is connected to the ground to trim the set voltage by the percentage value. See Table 1 in the Section 2.1 "Output Voltage - AnyVoltage™ Technology" on page 14 for resistor values and percentage options. A resistor with tolerance better than 5% can be used. The total capacitance between this pin and GND should be less than 25 pF. Shorting this pin to ground, floating this pin, or using R_{PSET} > 619K or R_{PSET} < 7.68K does not affect the set voltage. If this pin is not used, it should be tied to GND.
GND	Power ground. Connect all GND pins to a suitable low-impedance ground plane.
NC	Not connected. No pin.
VSET	Voltage set. An external resistor is connected to ground to set the output voltage of the switching regulator. See Table 1 in the Section 2.1 "Output Voltage - AnyVoltage™ Technology" on page 14 for resistor values and output voltage options. A resistor with tolerance better than 5% can be used. The total capacitance across this pin and GND should be less than 25 pF. Shorting this pin to ground, floating this pin, or using R_{VSET} > 619K or R_{VSET} < 7.68K disables the switching regulator.
VOUT	Switch Output Voltage. Connect directly to load with a short wide PCB trace.
LDO_OUT	LDO Output voltage. Connect directly to load with a wide, low impedance PCB trace.
VIN	3V - 5.5V Input voltage.
SHDN	Shutdown. Logic low (≤ 0.8V) enables the regulator. Logic high (≥ 2.0V) disables the regulator. The high signal has to be at least 20 µs long to disable the regulator.

1. This pin is present in 88MG815z & 88MG830z only.

1.4 Pin Assignment Table

Name	88MG815z-S 88MG830z-S	88MG815z-D/T 88MG830z-D/T	88MG816-S 88MG831-S	88MG816-D/T 88MG831-D/T
LDO_OUT	1	1	-	-
PSET	2	6	1	5
GND	3,7	3	2,6	2
MISSING PIN	4	-	3	-
VSET	5	5	4	4
VOUT	6	2	5	1
VIN	8	4	7	3
SHDN	9	7	8	6

Section 2. Functional Description

2.1 Output Voltage - AnyVoltage™ Technology

The output voltage of the 88MG815/88MG816/88MG830/88MG831 Series is programmed by using the look-up Table 1 or Table 2 to select the resistor value for the VSET and PSET pins. The VSET pin sets the output voltage, and the PSET pin trims the set voltage to a percentage value.

For example, Using Table 1 to program 2.25V output, a 165K resistor is selected for the VSET pin, and an 11K resistor is selected for the PSET pin. The 160K resistor sets the output voltage to 2.5V and the 11K resistor trims the set voltage off by 10% (or -10%). Using a resistor value greater than 619K or less than 7.68K for the VSET pin disables the switching regulator and sets the SW pin to high impedance. Using a resistor value greater than 619K or less than 7.68K for the PSET pin does not affect the set voltage. If not used, the PSET pin should be tied to ground. Using the VSET resistor's value greater than 619 kohm or less than 7.68 kohm disables the step-down switching regulator and sets the SW pin to high impedance. if the VSET resistor's value is outside the 5% tolerance, the output can be either higher or lower than the set voltage.

Using resistor value greater than 619 kohm or less than 7.68 kohm for the PSET pin does not affect the set voltage. When the PSET pin is not used, it must be connected to ground. Like the VSER resistor, the percent value can be either higher or lower if the PSER resistor's value is outside the 5% tolerance.

Table 1: Any Voltage Programming Table for 5% Resistors

		PSET								
		-10.0%	–7.5%	–5.0%	–2.5%	0%	2.5%	5.0%	7.5%	10.0%
		11k	18k	30k	51k	GND	100k	160k	270k	470k
VSET	11k	0.720	0.740	0.760	0.780	0.800	0.820	0.840	0.860	0.880
	18k	0.900	0.925	0.950	0.975	1.000	1.025	1.050	1.075	1.100
	30k	1.080	1.110	1.140	1.170	1.200	1.230	1.260	1.290	1.320
	51k	1.350	1.388	1.425	1.463	1.500	1.538	1.575	1.613	1.650
	100k	1.620	1.665	1.710	1.755	1.800	1.845	1.890	1.935	1.980
	160k	2.250	2.313	2.375	2.438	2.500	2.563	2.625	2.688	2.750
	270k	2.700	2.775	2.850	2.925	3.000	3.075	3.150	3.225	3.300
	470k	2.970	3.053	3.135	3.218	3.300	3.383	3.465	3.548	3.630

Table 2: AnyVoltage™ Programming Table for 1% Resistors

		PSET								
		-10.0%	**–7.5%**	**–5.0%**	**–2.5%**		**2.5%**	**5.0%**	**7.5%**	**10.0%**
		11k	**18.7k**	**31.6k**	**53.6k**	**Open /GND**	**97.6k**	**165k**	**280k**	**475k**
VSET	**GND**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	11k	0.720	0.740	0.760	0.780	0.800	0.820	0.840	0.860	0.880
	18.7k	0.900	0.925	0.950	0.975	1.000	1.025	1.050	1.075	1.100
	31.6k	1.080	1.110	1.140	1.170	1.200	1.230	1.260	1.290	1.320
	53.6k	1.350	1.388	1.425	1.463	1.500	1.538	1.575	1.613	1.650
	97.6k	1.620	1.665	1.710	1.755	1.800	1.845	1.890	1.935	1.980
	165k	2.250	2.313	2.375	2.438	2.500	2.563	2.625	2.688	2.750
	280k	2.700	2.775	2.850	2.925	3.000	3.075	3.150	3.225	3.300
	475k	2.970	3.053	3.135	3.218	3.300	3.383	3.465	3.548	3.630
	Open	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

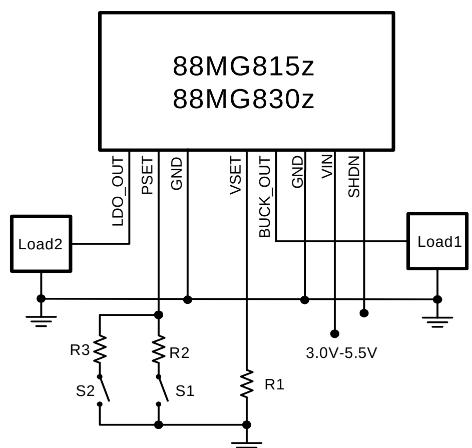
The VSET and PSET resistor are read once during start-up before the output voltage is turned on. After the output voltage is turned on, the VSET and PSET resisters are ignored.This ascertains that the output voltage tolerance is not dependant upon the tolerance or thermal characteristics of these resistors.

2.2 Output Voltage Margining

A useful application of the Marvell® AnyVoltage™ technology is “output voltage margining”. Voltage margining is commonly used during system qualification to evaluate operation at “corner” conditions of voltage, temperature etc. Typically, output voltage will be offset up and down by some percentage (margin) of the nominal value. For the 88MG815/88MG816/88MG830/88MG831 Series the VSET pin/resistor controls the nominal voltage of the switching regulator output while the PSET pin/resistor controls the margin voltage. As can be seen in Table 1, the PSET pin allows the margin to be set as high as 10% above and as low as -10% below the nominal setpoint established by VSET. Depending on the value of the PSET resistor intermediate points of ±7.5%, ±5% and ±2.5% can also be accessed.

For example, if an application calls for a nominal output voltage of 1.5V then Table 1 prescribes a value of R1 for the VSET resistor. This selection is shown in Figure 6 connected to the VSET pin. To offset the voltage above and below the nominal value, the PSET pin can be used with resistor values again from Table 1. Additionally, switches S1 and S2 can be alternately closed to select from the two resistors - R3 and R2 (offset values) for PSET. If more offsets are required more switches and resistors may be used. As shown in the figures below, if S1 is closed and S2 opened a positive 5% offset would be added to the nominal 1.5V output yielding 1.575V. Conversely, if S1 is opened and S2 closed the output would be offset to -5% from 1.5V, or 1.425V. Finally with both S1 and S2 opened the output would return to the nominal 1.5V. Thus voltage margining can be simply and reliably implemented with a minimum of components and design effort.

Figure 5: Output Voltage Margining for 88MG815z & 88MG830z



2.3 LDO Versions

The 88MG815z and 88MG830z versions have a second output voltage regulated as a Low Dropout Linear regulator. This is identified by the LDO_OUT output. The LDO controller is part of the Marvell® power IC on the module. The linear pass element is a small P-Channel MOSFET.

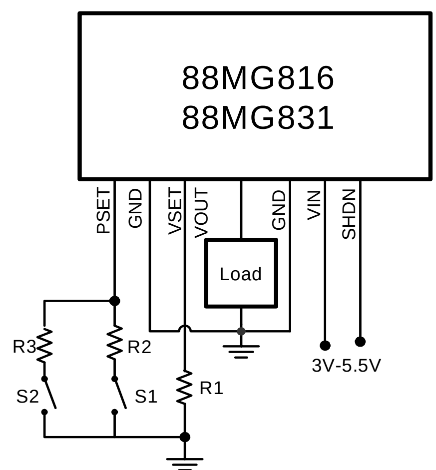
The LDO output is enabled immediately after the SHDN pin is pulled low.

2.3.1 LDO Output Voltage

The fixed output voltage of the LDO is either 3.3V or 2.5V, depending upon the selected version of the module.The “z” in the part number determines this. If z = B, then LDO_OUT = 3.3V, if z = E then LDO_OUT = 2.5V.

The LDO is short-circuit protected to a current of approximately 1A. The output current rating of the LDO is 450 mA continuous over the Industrial Temperature range. It is thermally limited because of the limited copper area available on the module for heat dissipation. The module can deliver peak currents of 800 mA for very brief times, such as 1 ms without damage.

Figure 6: Output Voltage Margining for 88MG816 & 88MG831

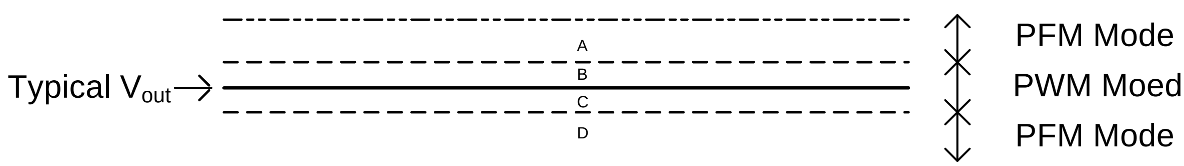


2.4 Regulation and Start-up

The step-down switching regulator uses Pulse Width Modulation (PWM) And Pulse Frequency Modulation (PFM) modes to regulate the output voltage using digital control. The mode of operation depends on the level of output current and the output voltage.

In steady states, the step-down switching regulator monitors the current flowing through the inductor to determine if the regulator is handling heavy or light load applications. For heavy load applications, the step-down regulator operates in the PWM mode (B and C) to minimize the ripple current for optimum efficiency and to minimize the ripple output voltage. The step-down regulator operates in the PFM and Discontinuous Conduction Mode (DCM) (A and D) to limit the switching action for optimum efficiency in light load applications. In this mode, the average output voltage is slightly higher than the average output voltage for heavy transient load applications.

Figure 7: Output Voltage Window



2.5 Digital Soft Start

During start-up, the 88MG815/88MG816, 1A Rated Output Current provides a soft start function. Soft start reduces surge currents from input voltage and provides a well-controlled output voltage rise characteristics. The rate of the output voltage start-up is limited by the value of the output capacitor and the internal current limit circuitry. This combination forces the output voltage to come up slowly, providing a soft-start characteristic.

During soft start, the 88MG815/88MG816, 1A Rated Output Current feeds a constant current to the output capacitor in several steps. Figure 4 of the MVPG15x/16 datasheet shows the inductor current waveform during startup. The current limit is ramped up in 7 steps beginning at approximately 40% of the current limit rating and ending at 100% at 25 µs per step. The buck regulator behaves like a current source during this time as the output ramps up slowly.

2.6 Undervoltage Lockout (UVLO)

The 88MG815/88MG816/88MG830/88MG831 Series incorporates undervoltage-lockout circuitry to disable the step-down regulator when the input voltage is below 2.75V (typical). The step-down regulator is enabled when the input voltage is above 2.85V (typical).

2.7 Thermal Shutdown

If the junction temperature of the Control IC on 88MG815/88MG816/88MG830/88MG831 Series exceeds 150°C (typical), the thermal shutdown circuitry disables the step-down regulator. The step-down regulator is enabled when the junction temperature falls to 120°C (typical).

Section 3. Electrical Specifications

3.1 Absolute Maximum Ratings

Table 3: Absolute Maximum Ratings

Stresses above those listed in Absolute Maximum Ratings may cause permanent device failure. Functionality at or above those limits is not implied. Exposure to absolute maximum ratings for extended periods may affect device reliability.

Parameter	Symbol	Range	Units
Input Voltage to GND	V_{IN}	-0.3 to 6.0	V
Voltage Set to GND	V_{SET}	-0.6 to (V_{IN} + 0.3)	V
Percentage Set Voltage to GND	V_{PSET}	-0.6 to (V_{IN} + 0.3)	V
Shutdown Voltage to GND	V_{SHDN}	-0.6 to (V_{IN} + 0.3)	V
Storage Temperature Range	T_{STOR}	-65 to +150	°C
Output Current (Peak Switch Current) for 88MG815z & 88MG816	I_{PEAK}	1.5	A
Output Current (Peak Switch Current) for 88MG830z & 88MG831	I_{PEAK}	3.0	A
Rated Output Current for 88MG815z & 88MG816	I_{OUT}	1	A
Rated Output Current for 88MG830z & 88MG831	I_{OUT}	2	A
LDO Current	I_{OUTLDO}	450	mA

3.2 Recommended Operating Conditions

Table 4: Recommended Operating Conditions[1]

Parameter	Symbol	Range	Units
Input Voltage	V_{IN}	3 to 5.5	V
Operating Temperature Range[2]	T_{OP}	-40 to +85	°C

1. This device is not guaranteed to function outside the specified operating range.
2. This device is guaranteed to meet the specifications from 0°C to 70°C. Any specifications that pertains to the operating temperature range -40°C to +85°C are assured by design, characterization, and correlation with statistical process controls.

3.3 Electrical Characteristics

Table 5: Electrical Characteristics

The following applies unless otherwise noted: V_{IN} = 5.0V. T_A = 25°C. **Bold values indicate –40°C ≤ T_A ≤ 85°C.**

Parameter	Symbol	Condition	Min	Typ	Max	Units
Input Voltage Range	V_{IN}		**3.0**		**5.5**	V
Total Quiescent Current (No Load)	I_{IN}			1.3		mA
Shutdown Supply Current	I_{IN}	V_{SHDN} = V_{IN} = 5.5V		1	10	µA
Undervoltage Lockout	V_{UVLO}	High threshold, V_{IN} increasing		2.85	**3.00**	V
		Low threshold, V_{IN} decreasing	**2.65**	2.75		V
Shutdown Input Voltage Logic	V_{SHDN}	Enable regulator			**0.8**	V
		Disable regulator	**2.0**			V
Shutdown Input Current	I_{SHDN}	V_{SHDN} = GND or 5.5V			±1	µA
Over-Temperature Thermal Shutdown	T_{OTS}	T_J increasing (disable regulator)		150		°C
		T_J decreasing (enable regulator)		120		°C
Switching Frequency	f_{SW}			1		MHz
Electrical Material Rating						
Flammability Rating		UL94V-0				
Material Type		TBD				

Table 6: 88MG815/88MG816, 1A Rated Output Current Electrical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Units
Line Regulation		I_{OUT} = 1A V_{IN} = 3.0V to 5.5V		0.2		%
Load Regulation		I_{OUT} = 0.2A to 2.0A		0.5		%
Line Regulation LDO		I_{OUT} = 800 mA V_{IN} = 4.0V to 5.5V		0.2		%
Load Regulation LDO		I_{OUT} = 10 mA to 800 mA		0.5		%
Input Current Ripple	I_{IN} ripple	V_{OUT} = 0.8V I_{OUT} = 1A (without external filter)		15		mA pk-pk
Input Voltage Ripple	V_{IN} ripple			50		mV pk-pk
Output Voltage Accuracy					±2	%
Output Voltage Noise		I_{OUT} = 2.0A V_{OUT} = 1.8V		8.0		mV RMS

Table 7: 88MG830/88MG831, 2A Rated Output Current Electrical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Units
Line Regulation		I_{OUT} = 2A V_{IN} = 3.0V to 5.5V		0.2		%
Load Regulation		I_{OUT} = 0.2A to 2.0A		0.5		%
Line Regulation LDO		I_{OUT} = 800 mA V_{IN} = 4.0V to 5.5V		0.2		%
Load Regulation LDO		I_{OUT} = 10 mA to 800 mA		0.5		%
Input Current Ripple	I_{IN} ripple	V_{OUT} = 0.8V I_{OUT} = 2A (without external filter)		15		mA pk-pk
Input Voltage Ripple	V_{IN} ripple			50		mV pk-pk
Output Voltage Accuracy					±2	%
Output Voltage Noise		I_{OUT} = 2.0A V_{OUT} = 1.8V		8.0		mV RMS

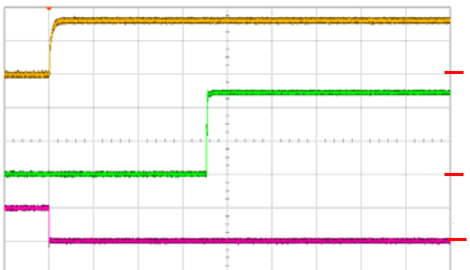
Table 8: LDO Output Electrical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Units
Line Regulation		I_{OUT} = 1A V_{IN} = 3.0V to 5.5V		0.2		%
Load Regulation		I_{OUT} = 0.25A to 1.0A		0.5		%
Output Voltage Accuracy					±2	%

Section 4. Functional Characteristics

4.1 Startup Waveforms

Start-up Using the Shutdown Pin



V_{IN} = 5.0V

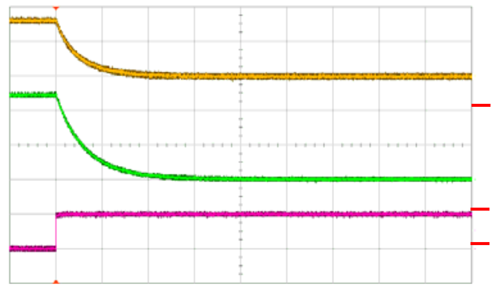
t_{DLY} ~ 3.5 ms

V_{LDO} = 3.3V

V_{BUCK} = 1.2V

I_{LOAD} = No Load

Turn Off Using the Shutdown Pin



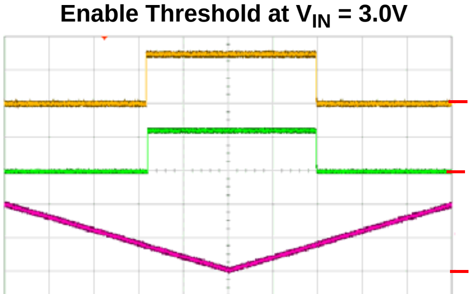
V_{IN} = 5.0V

V_{LDO} = 3.3V

V_{BUCK} = 1.2V

I_{LOAD} = No Load

Enable Threshold at V_{IN} = 3.0V



V_{IN} = 5.0V

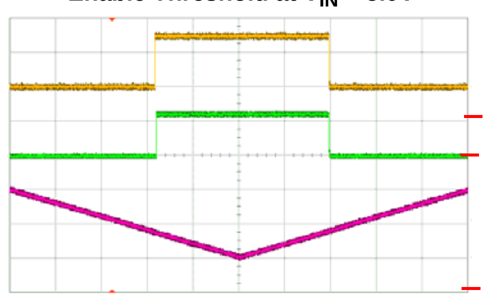
V_{TH} = 0.7V (Note)

V_{LDO} = 3.3V

V_{BUCK} = 1.2V

I_{LOAD} = 10 mA

Enable Threshold at V_{IN} = 5.0V



V_{IN} = 5.0V

V_{TH} = 0.9V (Note)

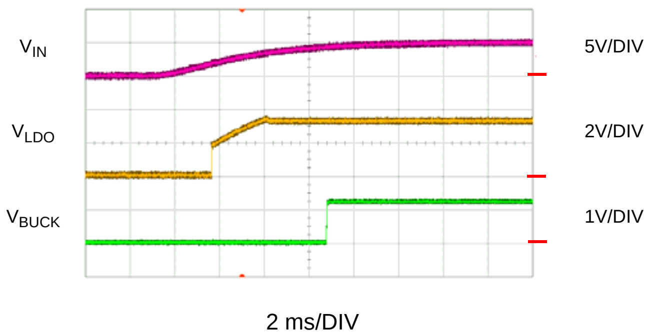
V_{LDO} = 3.3V

V_{BUCK} = 1.2V

I_{LOAD} = 10 mA

NOTE: There is a delay (3.5 ms typ) before the output voltage turns on. The actual threshold is before delay.

VIN Soft Start



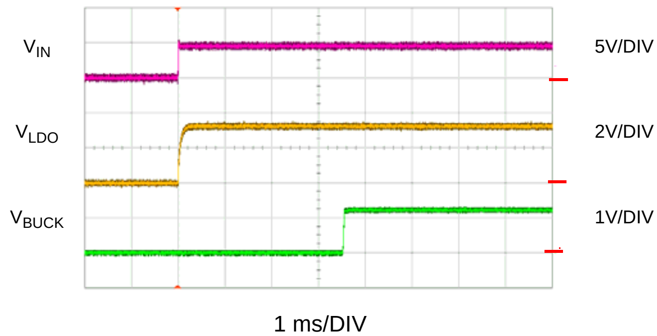
V_{IN} = 5.0V

V_{LDO} = 3.3V

V_{BUCK} = 1.2V

I_{LOAD} = No Load

VIN Hot Plug



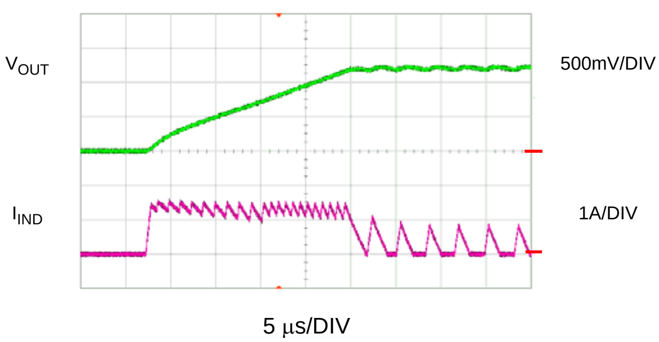
V_{IN} = 5.0V

V_{LDO} = 3.3V

V_{BUCK} = 1.2V

I_{LOAD} = No Load

88MG830 Step-down Output Rise Time

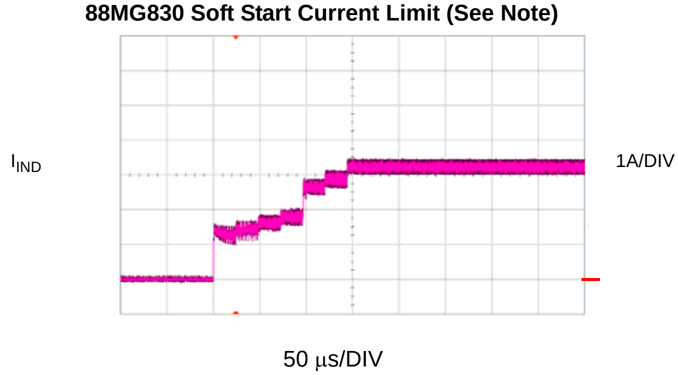


V_{IN} = 5.0V

V_{OUT}= 1.2V

I_{LOAD} = 500 mA

88MG830 Soft Start Current Limit (See Note)

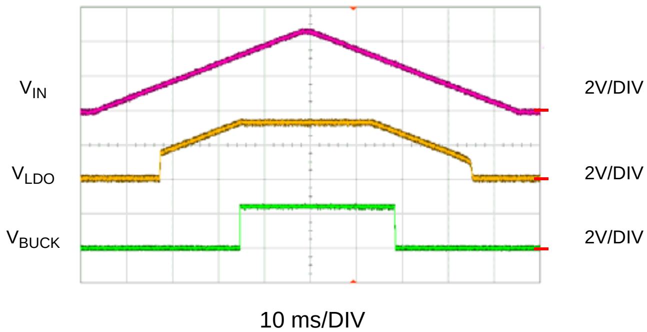


V_{IN} = 5.0V

V_{OUT} = 3.3V

NOTE: Graph shows the full range of Soft Start Current Limit. This test was conducted under an output overload condition and the output voltage is not in regulation. Realistically, this condition would result in thermal shutdown in a short time.

UVLO Thresholds



V_{IN} = 5.0V

V_{LDO} = 3.3V

V_{BUCK} = 1.2V

I_{LOAD} = 10 mA

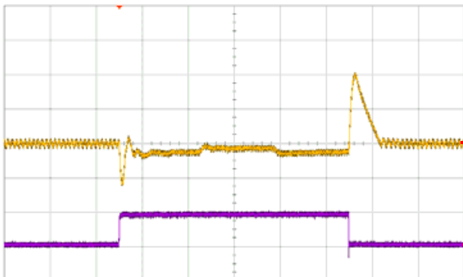
V_{HTH} = 2.966V

V_{LTH} = 2.767V

4.2 Load Transient Response Waveforms

4.2.1 88MG830 Step-Down Regulator

Load Transient Response



V_{IN} = 5.0V

V_{BUCK} = 1.2V

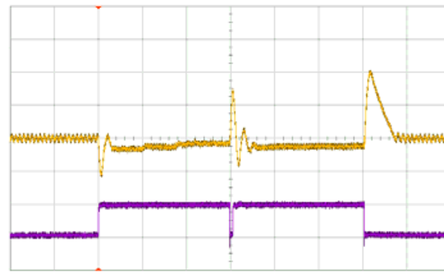
C_{OUT} = 22 µF

I_{LOAD} = 0.2A to 2A

t_{RISE} = 6A/µs

t_{FALL} = 129A/µs

Double-Pulsed Load Response



V_{IN} = 5.0V

V_{BUCK} = 1.2V

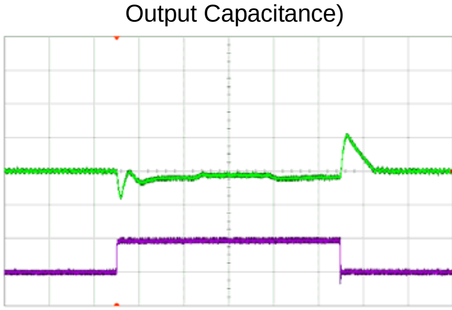
C_{OUT} = 22 µF

I_{LOAD} = 0.2A to 2A

t_{RISE} = 6A/µs

t_{FALL} = 129A/µs

Load Transient Response (Additional Output Capacitance)



V_{IN} = 5.0V

V_{BUCK} = 1.2V

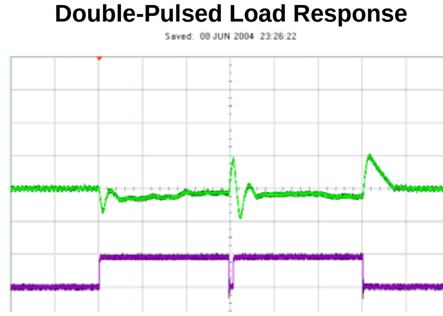
Additional C_{OUT} = 22 µF

I_{LOAD} = 0.2A to 2A

t_{RISE} ~ 6A/µS

t_{FALL} ~ 129A/µS

Double-Pulsed Load Response



V_{IN} = 5.0V

V_{BUCK} = 1.2V

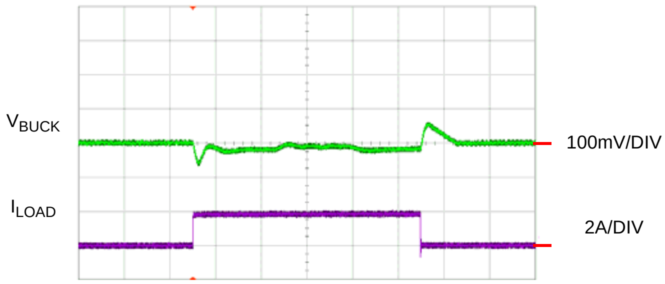
Additional C_{OUT} = 22 µF

I_{LOAD} = 0.2A to 2A

t_{RISE} ~ 6A/µS

t_{FALL} ~ 129A/µS

Load Transient Response (2 x Additional Output Capacitance)



20 µs/DIV

V_{IN} = 5.0V

I_{LOAD} = 0.2A to 2A

V_{BUCK} = 1.2V

Additional C_{OUT} = 2X22 µF

Double-Pulsed Load Response

20 µs/DIV

V_{IN} = 5.0V

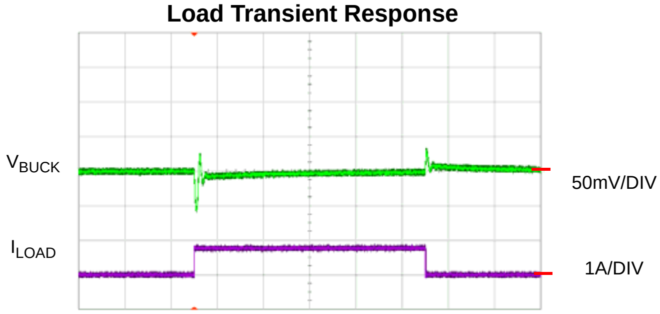
I_{LOAD} = 0.2A to 2A

V_{BUCK} = 1.2V

Additional C_{OUT} = 2X22 µF

4.2.2 LDO Regulator

Load Transient Response



20 µs/DIV

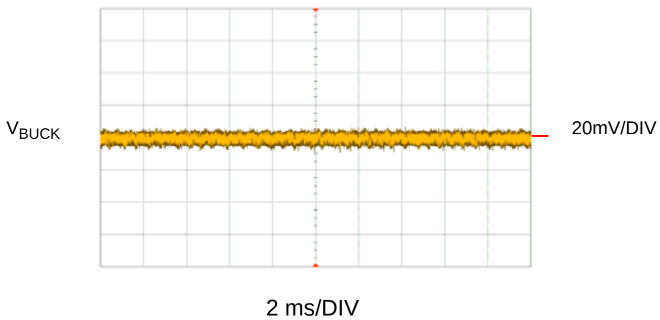
V_{IN} = 5.0V

I_{LOAD} = 0.2A to 0.8A

V_{LDO} = 3.3V

4.3 Switching Waveforms

PWM Output Ripple Voltage



V_{IN} = 5.0V

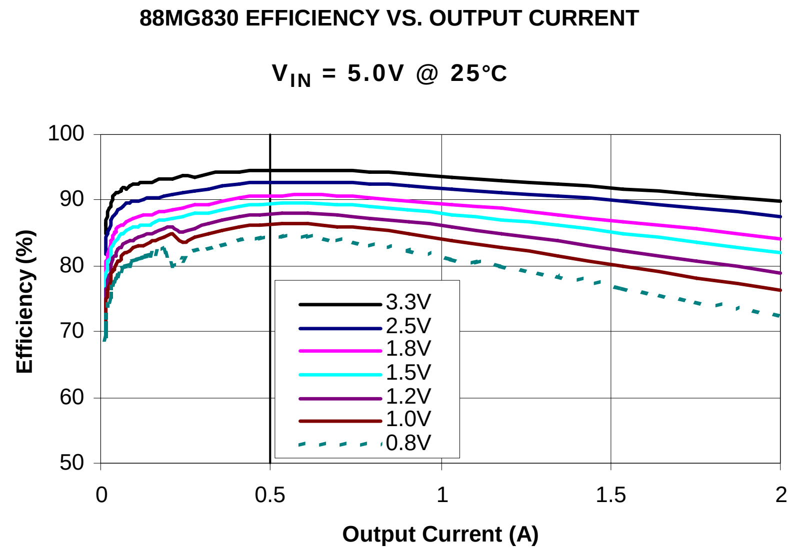
V_{BUCK} = 1.2V

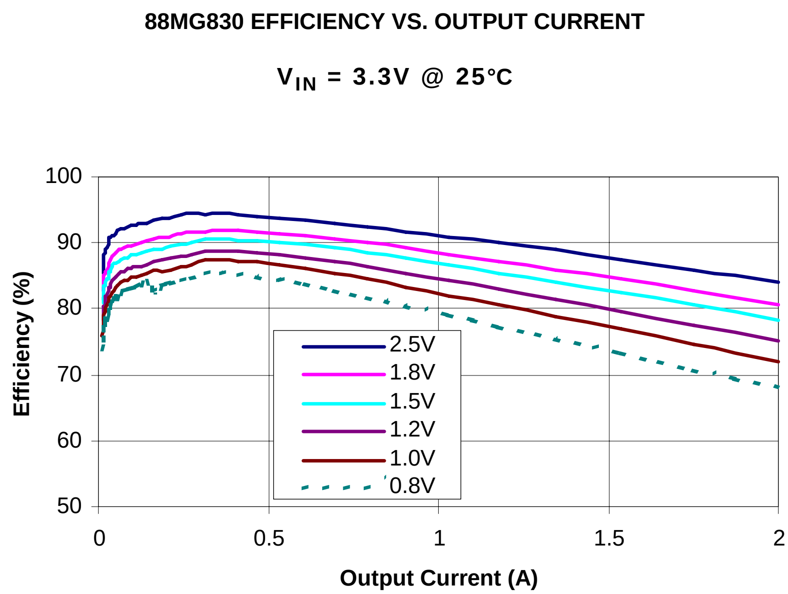
I_{OUT} = 2A

$V_{OUT(P-P)}$ = 15.7 mV (Note)

NOTE: For repeatability of measuring output ripple ($V_{OUT(P-P)}$), the test procedure is to set the scope bandwidth to 20MHz and uses a coax cable with very short leads terminated into 50Ω. The coax leads must be routed away from the switching node as much as possible.

4.4 Efficiency





4.5 Considerations for Bench Testing and Hot Plug Applications

These power modules have an Absolute Maximum input voltage rating of 6V. This means you must be careful when bench testing or with applications that require “Hot Plugging” of VIN to the system. Hot Plug applications are those that instantly apply voltage to a power module from a long cable. Common examples of this are: Bench top power supplies that supply power to the module through long banana plug cords and power obtained from “wall wart” linear supplies. It turns out that long cables or wires can act as “transmission cables” and when the power is applied to the module input, the result is a reflected transient wave that can almost DOUBLE the input voltage. This can have the consequence of destroying the power module because its maximum input voltage rating has been exceeded. This is not a power module “problem”, but an application environment problem that can be overcome.

4.5.1 Hot Plug Solution

The input voltage ringing on a long power cord occurs because the cable sees an AC short-circuit at the input of the power module. This is because the input capacitor to the module is a ceramic capacitor with extremely low ESR. To minimize or eliminate the amplitude of the ringing voltage it is necessary to add external capacitors in parallel to the module input capacitors. However, these capacitors need to have noticeable ESR – which is what dampens the ringing.

When bench testing or working on a “hot plug” application, Marvell recommends the following practice:

4.5.2 Hot Plug Protection for bench testing and Wall Wart Applications

- Add a 22uF – 100uF Tantalum capacitor located near the input connector of your system. The measurable ESR of the Tantalum capacitor will help dissipate any potential ringing expected from the input line.

The additional capacitance and use of capacitors with measurable ESR results in keeping any voltage overshoot less than 6V.

Section 5. Mechanical Drawings

5.1 Mechanical Dimensions for 88MG815z & 88MG830z

Figure 8: 88MG815z & 88MG830z SIP Series Mechanical Dimensions

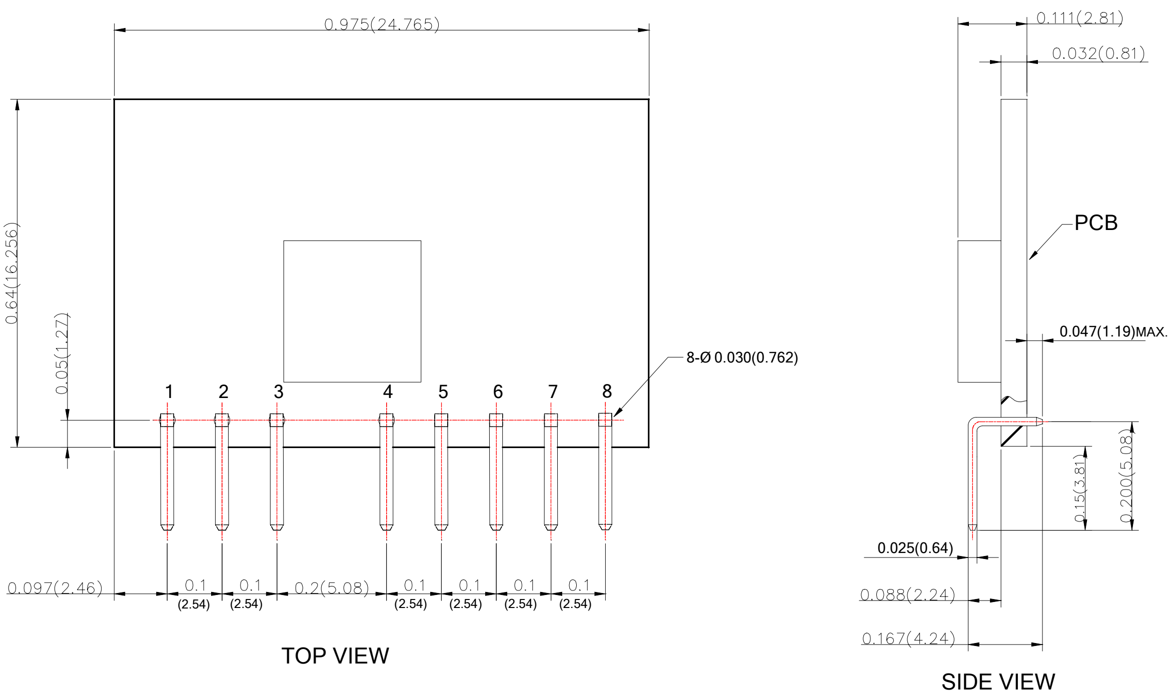


Figure 9: 88MG815z & 88MG830z DIP Series Mechanical Dimensions

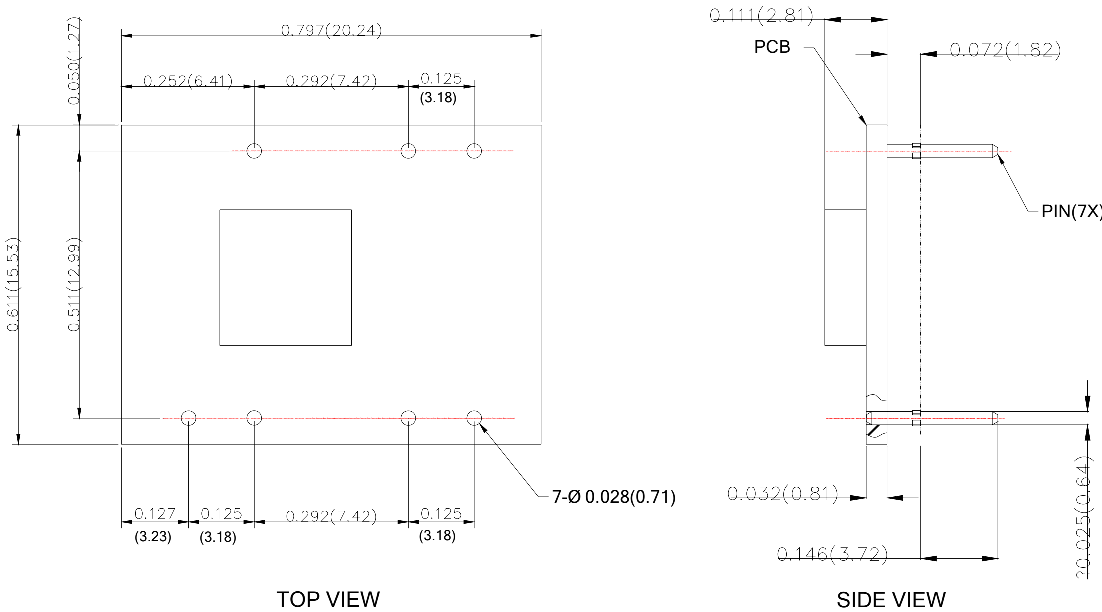
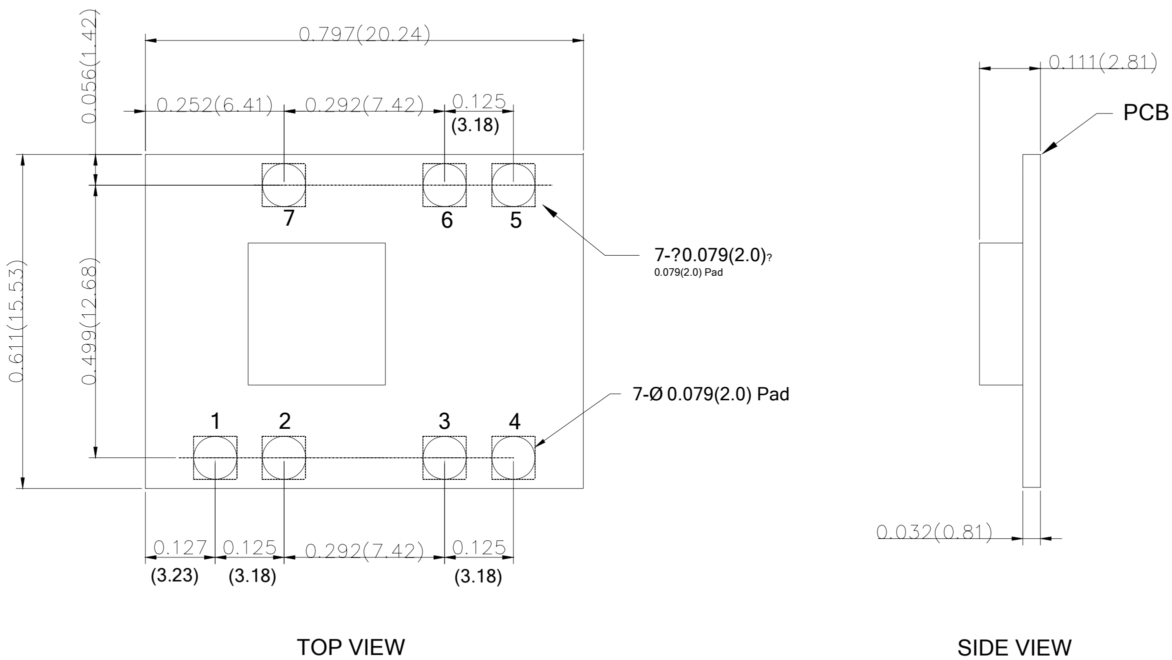


Figure 10: 88MG815z & 88MG830z SMT Series Mechanical Dimensions



5.2 Mechanical Dimensions for 88MG816 & 88MG831

Figure 11: 88MG816 & 88MG831 SIP Series Mechanical Dimensions

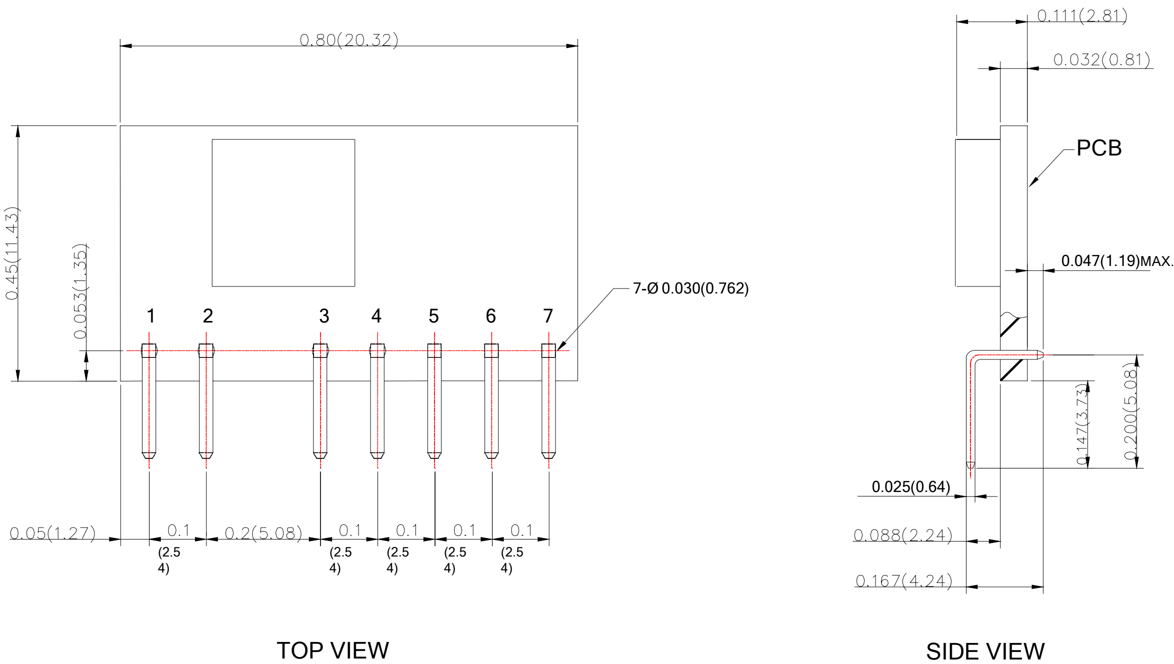


Figure 12: 88MG816 & 88MG831 DIP Series Mechanical Dimensions

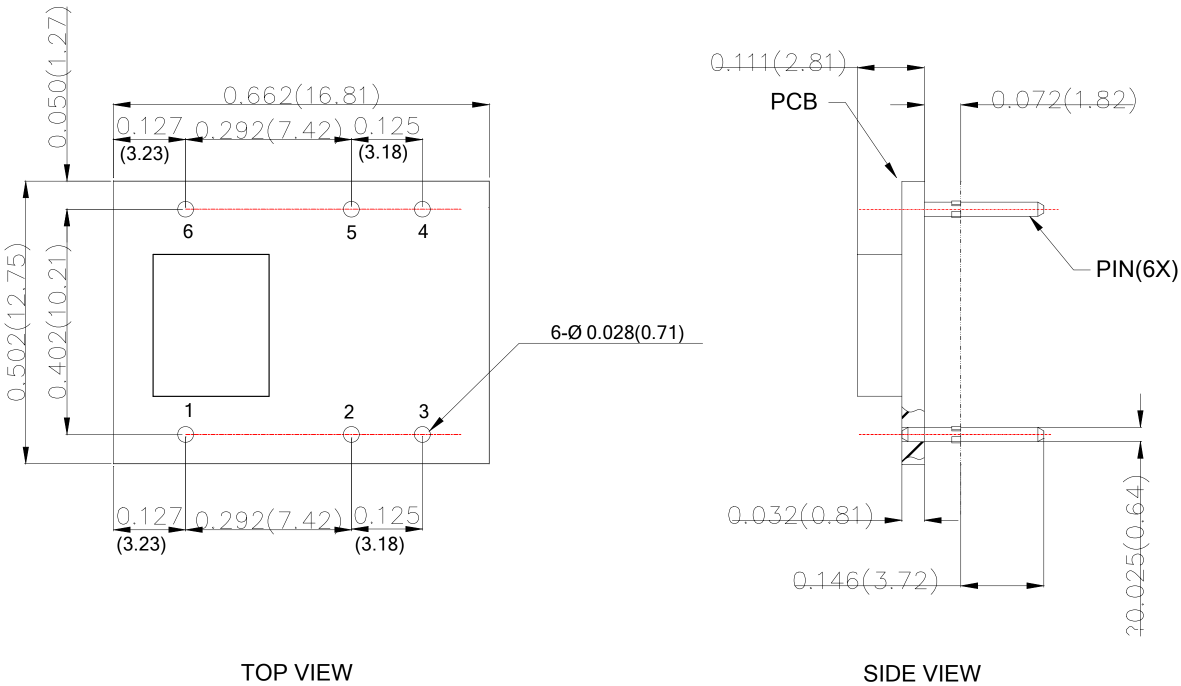
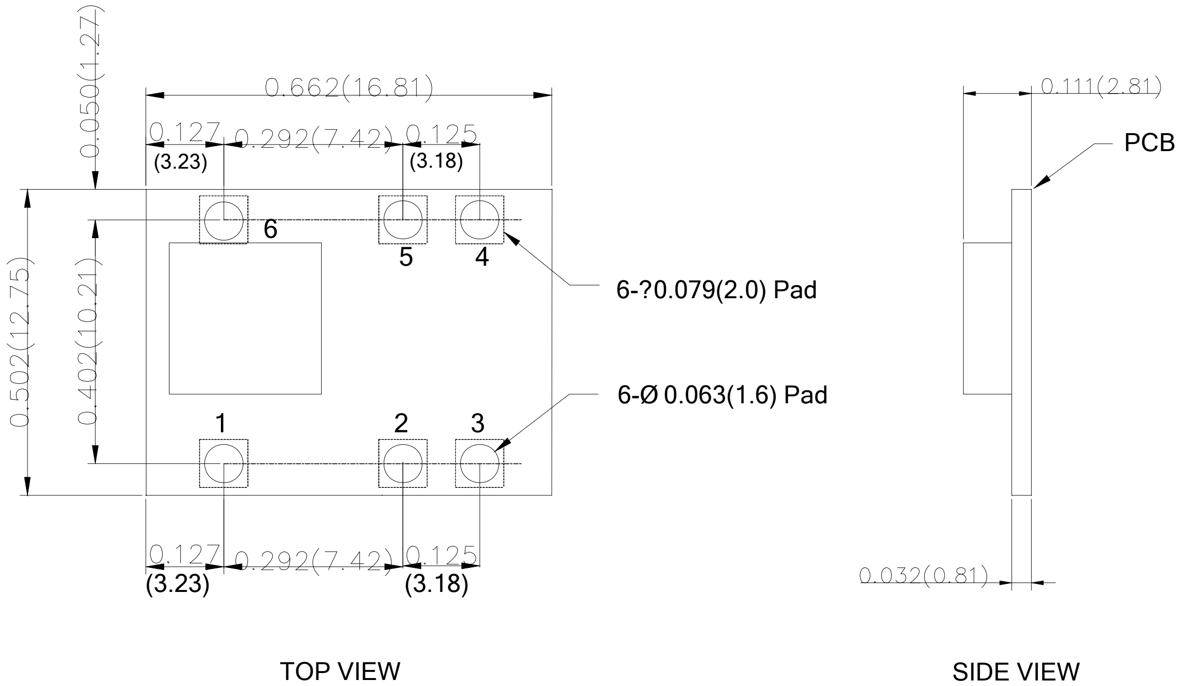


Figure 13: 88MG816 & 88MG831 SMT Series Mechanical Dimensions



Section 6. Ordering Information

6.1 Ordering Part Numbers and Package Markings

Figure 14 shows the ordering part numbering scheme for the 88MG815z & 88MG830z devices. Contact Marvell® FAEs or sales representatives for complete ordering information.

Figure 14: 88MG815z & 88MG830z Part Number

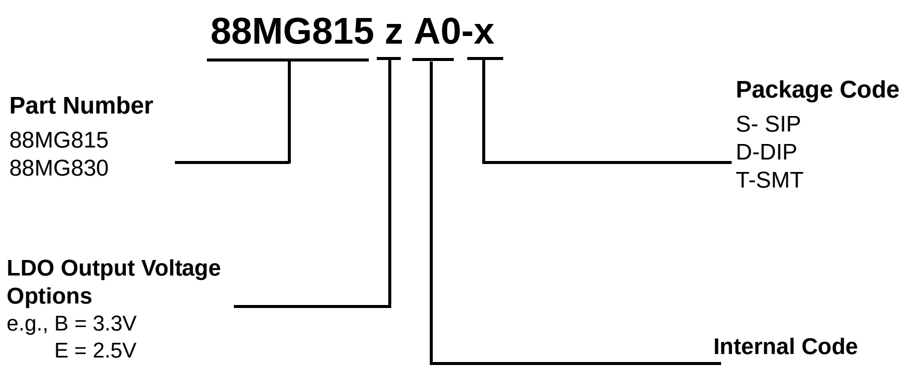
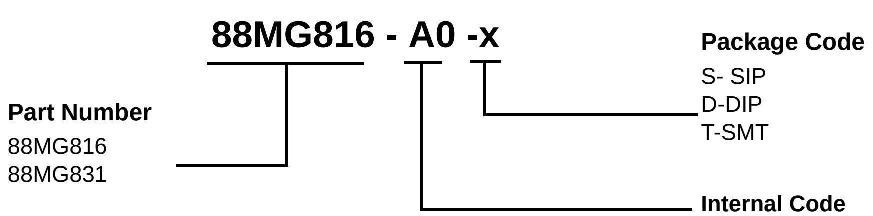


Figure 15: 88MG816 & 88MG831 Part Number



6.2 Sample Ordering Part Number

The standard ordering part numbers for the respective solutions are as follows:

Table 9: Ordering Part Numbers

Part Number	Switcher Output Voltage	LDO Output Voltage	Output Current	Ambient Temperature Range[1]	Package
88MG815B -S	Programmable	3.3V	1.0A	-40°C to 85°C	9-pin SIP
88MG815E-S	Programmable	2.5V	1.0A	-40°C to 85°C	9-pin SIP
88MG815B-D	Programmable	3.3V	1.0A	-40°C to 85°C	7-pin DIP
88MG815E-D	Programmable	2.5V	1.0A	-40°C to 85°C	7-pin DIP
88MG815B-T	Programmable	3.3V	1.0A	-40°C to 85°C	7-pin SMT
88MG815E-T	Programmable	2.5V	1.0A	-40°C to 85°C	7-pin SMT
88MG816-S	Programmable	--	1.0A	-40°C to 85°C	8-pin SIP
88MG816-D	Programmable	--	1.0A	-40°C to 85°C	6-pin DIP
88MG816-T	Programmable	--	1.0A	-40°C to 85°C	6-pin SMT
88MG830B-S	Programmable	3.3V	2.0A	-40°C to 85°C	9-pin SIP
88MG830E-S	Programmable	2.5V	2.0A	-40°C to 85°C	9-pin SIP
88MG830B-D	Programmable	3.3V	2.0A	-40°C to 85°C	7-pin DIP
88MG830E-D	Programmable	2.5V	2.0A	-40°C to 85°C	7-pin DIP
88MG830B-T	Programmable	3.3V	2.0A	-40°C to 85°C	7-pin SMT
88MG830E-T	Programmable	2.5V	2.0A	-40°C to 85°C	7-pin SMT
88MG831-S	Programmable	--	2.0A	-40°C to 85°C	8-pin SIP
88MG831-D	Programmable	--	2.0A	-40°C to 85°C	6-pin DIP
88MG831-T	Programmable	--	2.0A	-40°C to 85°C	6-pin SMT

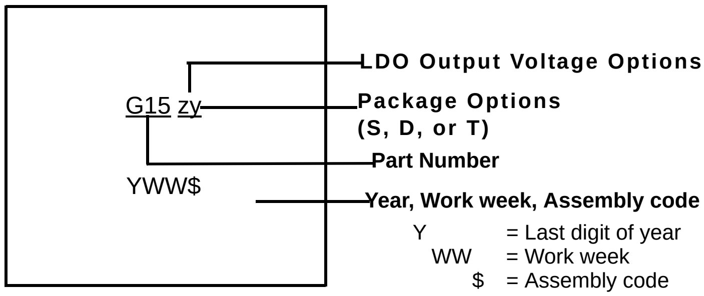
1. Any specifications that pertains to the operating temperature range -40°C to 85°C are assured by design, characterization, and correlation with statistical process controls.

6.3 Package Marking

6.3.1 88MG815z Package Marking

Figure 16 is an example of the package marking for the 88MG815z part. Markings for the other variants are similar.

Figure 16: 88MG815z Package Marking



Note: The above example is not drawn to scale. Locations of markings are approximate.

Table 10: Marking Specification Table

Part Number	Abbreviations
88MG815B-S	G15BS
88MG815E-S	G15ES
88MG815B-D	G15BD
88MG815E-D	G15ED
88MG815B-T	G15BT
88MG815E-T	G15ET
88MG816-S	G16-S
88MG816-D	G16-D
88MG816-T	G16-T
88MG830B-S	G30BS
88MG830E-S	G30ES
88MG830B-D	G30BD
88MG830E-D	G30ED
88MG830B-T	G30BT
88MG830E-T	G30ET
88MG831-S	G31-S
88MG831-D	G31-D
88MG831-T	G31-T

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