MP8847

6A, 2.7V-6V, High-Efficiency, Synchronous, Step-Down Switcher with I²C Interface In 2x3mm QFN

The Future of Analog IC Technology

DESCRIPTION

The MP8847 is a highly integrated, high-frequency, synchronous, step-down switcher with an I²C control interface. The MP8847 can support up to 6A of load current over an input supply range from 2.7V to 6V with excellent load and line regulation.

Constant-frequency hysteretic mode provides an extremely fast transient response without loop compensation to achieve high efficiency easily under light-load condition.

The output voltage level can be controlled on-the-fly through a 3.4Mbps I²C serial interface. The voltage range can be adjusted from 0.6V to 1.235V in 5mV steps. The voltage slew rate, switching frequency, and power-saving mode are also selectable through the I²C interface.

Full protection features include internal soft start, over-current protection (OCP), and over-temperature protection (OTP).

The MP8847 requires a minimal number of readily available, standard, external components and is available in a compact QFN-14(2mmx3mm) package.

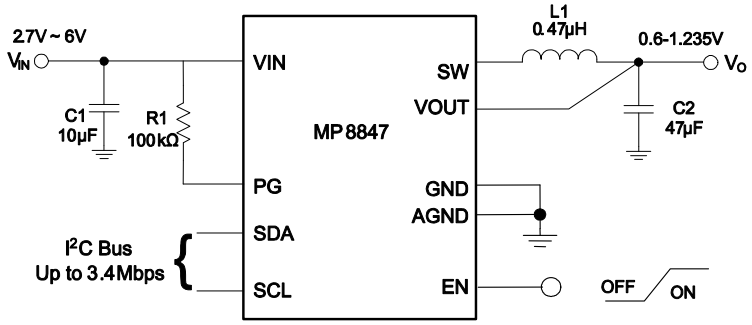
FEATURES

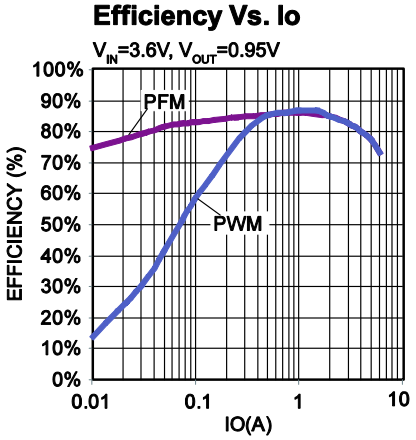
- I²C-Programmable Output Range from 0.6V to 1.235V in 5mV Steps
- 2.7V to 6V Input Voltage Range
- Up to 6A Load Current
- Internal 35mΩ High-Side and 15mΩ Low-Side Power MOSFETs
- I²C-Compatible Interface up to 3.4Mbps
- Factory Adjustable Switching Frequency from 0.85MHz to 2.2MHz
- Power-Saving Mode Selectable via I²C
- Internal 1ms Soft Start
- Power Good Indicator
- Current Overload and Thermal Shutdown Protection
- Available in 2mmx3mm QFN-14 Package

APPLICATIONS

- Processor Core Supplies
- Micro Converters

TYPICAL APPLICATION





ORDERING INFORMATION

Part Number	Package	Top Marking
MP8847GD*	QFN-14 (2mmx3mm)	*See Below*
EVKT-8847	8847 Evaluation Kit	

* For Tape & Reel, add suffix –Z (e.g. MP8847GD–Z)

TOP MARKING

AVEY
LLL

AVE: product code of MP8847GD
Y: year code
LLL: Lot number

EVALUATION KIT EVKT-8847

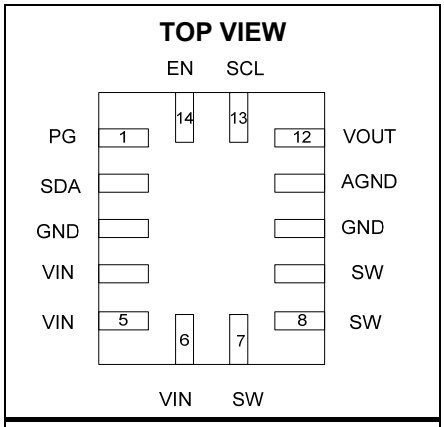
EVKT-8847 Kit contents: (Items below can be ordered separately).

#	Part Number	Item	Quantity
1	EV8847-D-00A	MP8847GD Evaluation Board	1
2	EVKT-USBI2C-02	Includes one USB to I2C Dongle, one USB Cable, and one Ribbon Cable	1
3	Tdrive-8847	USB Flash drive that stores the GUI installation file and supplemental documents	1

Order direct from MonolithicPower.com or our distributors.

Figure 1. EVKT-8847 Evaluation Kit Setup

PACKAGE REFERENCE



QFN-14 (2mmx3mm)

ABSOLUTE MAXIMUM RATINGS (1)

Supply voltage (VIN) ..... -0.3V to 7V
V_{SW} ..... -0.3V (-5V for <10ns) to 6.5V(8V for <10ns or 10V for <3ns)
All other pins ..... -0.3V to 6.5V
Junction temperature ..... 150°C
Lead temperature ..... 260°C
Continuous power dissipation(T_A = +25°C) (2)(4)
QFN 3.5W
Storage temperature ..... -65°C to 150°C

Recommended Operating Conditions (3)

Supply voltage (VIN) ..... 2.7V to 6V
Output voltage (VOUT) ..... 0.6V to 1.235V
Operating junction Temp (T_J) ... -40°C to +125°C

***Thermal Resistance*(4)**	***θ_{JA}***	***θ_{JC}***
QFN 2mmx3mm		
EV8847-D-00A(4)	35	8 ....°C/W
JESD51-7(5)	70	15 ...°C/W

NOTES:

1) Exceeding these ratings may damage the device.
2) The maximum allowable power dissipation is a function of the maximum junction temperature T_J (MAX), the junction-to-ambient thermal resistance θ_{JA}, and the ambient temperature T_A. The maximum allowable continuous power dissipation at any ambient temperature is calculated by P_D (MAX) = (T_J (MAX)-T_A)/θ_{JA}. Exceeding the maximum allowable power dissipation produces an excessive die temperature, causing the regulator to go into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage.
3) The device is not guaranteed to function outside of its operating conditions.
4) Measured on EV8847-D-00A, 4-layer PCB, 63mm x 63mm.
5) Measured on JESD51-7, 4-layer PCB.
   note 5) The value of θ_{JA} given in this table is only valid for comparison with other packages and cannot be used for design purposes. These values are calculated in accordance with JESD51-7, and simulated on a specified JEDEC board. They do not represent the performance obtained in an actual application.

ELECTRICAL CHARACTERISTICS

VIN = 5V, T_J= -40°C to +125°C[6], typical value is tested at T_J= +25°C. The limit over temperature is guaranteed by characterization, unless otherwise noted.

Parameter	Symbol	Condition	Min	Typ	Max	Units
Input voltage range	V_{IN}		2.7		6	V
Quiescent current	I_Q	EN=1.8V, no switching, PFM mode		300		μA
Shutdown current	I_S	EN=GND, T_J=25°C			1	μA
Internal reference voltage	V_{REF}	T_J=25°C	0.591	0.600	0.609	V
		-40°C<T_J<125°C	0.585	0.600	0.615	V
Lowest output voltage	V_{LOW}	Register = 00h, T_J=25°C	0.591	0.600	0.609	V
		-40°C<T_J<125°C	0.585	0.600	0.615	V
Highest output voltage	V_{HIGH}	Register = 7Fh, T_J=25°C	1.216	1.235	1.254	V
		-40°C<T_J<125°C	1.204	1.235	1.266	V
Output voltage step	V_{STEP}			5		mV
High-side switch on resistance	R_{HSON}			35		mΩ
Low-side switch on resistance	R_{LSON}			15		mΩ
UVLO rising threshold	V_{UVLOR}			2.55	2.7	V
UVLO hysteretic	V_{UVLOHY}			150		mV
Switching frequency	F_{SW}		0.85		2.2	MHz
Frequency variation	F_{SW}				25%	
Minimum on time[7]	T_{MINON}			60		ns
Switch leakage	I_{SW}	V_{EN}=0V, VIN=5V, VSW=0V and 5V, T_J=25°C		0.1	1	μA
EN turn on delay[7]		EN to SW active		107		μs
EN rising threshold		T_J=25°C	1.38	1.55	1.72	V
EN hysteresis		T_J=25°C		0.697		V
Power good UV threshold rising	PGVth-Hi	Good		0.9		VOUT
Power good UV threshold falling	PGVth-Lo	Fault		0.85		VOUT
Power good OV threshold rising	PGVth-Hi	Fault		1.1		VOUT
Power good OV threshold falling	PGVth-Lo	Good		1.05		VOUT
Power good pull-down voltage	V_{PGL}	I_{SINK}=1mA			0.4	V
Power good deglitch time	T_{PGd}			50		μs
Power good leakage	I_{PGd}				1	μA
VOUT OVP threshold		Rising edge		+10%		V_{TARGET}

ELECTRICAL CHARACTERISTICS *(continued)*

VIN = 5V, T_J= -40°C to +125°C(6), typical value is tested at T_J= +25°C. The limit over temperature is guaranteed by characterization, unless otherwise noted.

Parameter	Symbol	Condition	Min	Typ	Max	Units
High-side switch peak current limit (source)	I_{peak}		7	9		A
High-side switch valley current limit(7)	I_{valley}			5.8		A
Low-side switch current limit (sink)		PFM mode		0		A
		PWM mode(7)		-5		A
Soft-start time	T_{SS-ON}	VOUT rises from 10% to 90%	0.4	1	1.6	ms
Discharge resistor				500		Ω
Thermal warning(7)				130		°C
Thermal shutdown(7)				150		°C
DAC resolution(7)				7		bits

NOTE:

6) Not tested in production, guaranteed by over-temperature correlation .
7) Data based on sample characterization.

I/O LEVEL CHARACTERISTICS

Parameter	Symbol	Condition	HS-Mode		LS-Mode		Units
			Min	Max	Min	Max	
Low-level input voltage	V_{IL}		-0.5	$0.3V_{CC}$	-0.5	0.3Vcc	V
High-level input voltage	V_{IH}		$0.7V_{CC}$	V_{CC}+0.5	$0.7V_{CC}$	V_{CC}+0.5	V
Hysteresis of Schmitt trigger inputs	V_{HYS}	V_{CC}>2V	$0.05V_{CC}$	-	$0.05V_{CC}$	-	V
		V_{CC}<2V	$0.1V_{CC}$	-	$0.1V_{CC}$	-	
Low-level output voltage(open drain) at 3mA sink current	V_{OL}	V_{CC}>2V	0	0.4	0	0.4	V
		V_{CC}<2V	0	$0.2V_{CC}$	0	0.2Vcc	
Low-level output current	I_{OL}		-	3	-	3	mA
Transfer gate on resistance for currents between SDA and SCAH, or SCL and SCLH	R_{onL}	VOL level, IOL=3mA	-	50	-	50	Ω
Transfer gate on resistance between SDA and SCAH, or SCL and SCLH	R_{onH}	Both signals (SDA and SDAH, or SCL and SCLH) at V_{CC} level	50	-	50	-	kΩ
Pull-up current of the SCLH current source	I_{cs}	SCLH output levels between $0.3V_{CC}$ and $0.7V_{CC}$	2	6	2	6	mA
Rise time of the SCLH or SCL signal	t_{rCL}	Output rise time (current source enabled) with an external pull-up current source of 3mA					
		Capacitive load from 10pF to 100pF	10	40			ns
		Capacitive load of 400pF	20	80			ns
Fall time of the SCLH or SCL signal	t_{fCL}	Output fall time (current source enabled) with an external pull-up current source of 3mA					
		Capacitive load from 10pF to 100pF	10	40			ns
		Capacitive load of 400pF	20	80	20	250	ns
Rise time of SDAH signal	t_{rDA}	Capacitive load from 10pF to 100pF	10	80	-	-	ns
		Capacitive load of 400pF	20	160	20	250	ns
Fall time of SDAH signal	t_{fDA}	Capacitive load from 10pF to 100pF	10	80	-	-	ns
		Capacitive load of 400pF	20	160	20	250	ns

I/O LEVEL CHARACTERISTICS*(continued)*

Parameter	Symbol	Condition	HS-Mode		LS-Mode		Units
			Min	Max	Min	Max	
Pulse width of spikes that must be suppressed by the input filter	t_{SP}		0	10	0	50	ns
Input current for each I/O pin	I_i	Input voltage between $0.1V_{CC}$ and $0.9V_{CC}$	-	10	-10	+10	µA
Capacitance for each I/O pin	C_i		-	10	-	10	pF

I²C PORT SIGNAL CHARACTERISTICS

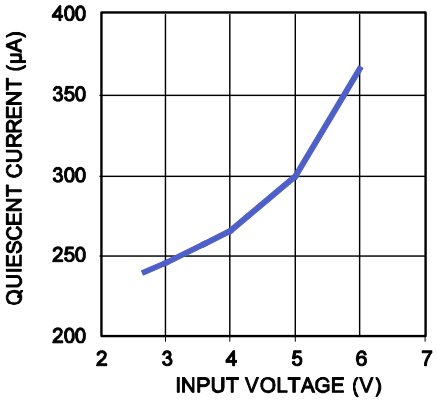
Parameter	Symbol	Condition	Cb=100pF		Cb=400pF		Units
			Min	Max	Min	Max	
SCLH and SCL clock frequency	f_{SCHL}		0	3.4	0	0.4	MHz
Set-up time for a repeated START condition	$T_{SU;STA}$		160	-	600	-	ns
Hold time (repeated) START condition	$T_{HD;STA}$		160	-	600	-	ns
Low period of the SCL clock	t_{LOW}		160	-	1300	-	ns
High period of the SCL clock	t_{HIGH}		60	-	600	-	ns
Data set-up time	$T_{SU:DAT}$		10	-	100	-	ns
Data hold time	$T_{HD;DAT}$		0	70	0	-	ns
Rise time of SCLH signal	t_{rCL}		10	40	20*0.1Cb	300	ns
Rise time of SCLH signal after a repeated START condition and after an acknowledge bit	t_{fCL1}		10	80	20*0.1Cb	300	ns
Fall time of SCLH signal	T_{fCL}		10	40	20*0.1Cb	300	ns
Rise time of SDAH signal	t_{fDA}		10	80	20*0.1Cb	300	ns
Fall time of SDAH signal	T_{fDA}		10	80	20*0.1Cb	300	ns
Set-up time for a stop condition	$T_{SU;STO}$		160	-	600	-	ns
Bus free time between a stop and start condition	T_{BUF}		160	-	1300	-	ns
Data valid time	$T_{VD;DAT}$		-	16	-	90	ns
Data valid acknowledge time	$T_{VD;ACK}$		-	160	-	900	ns
Capacitive load for each bus line	C_b	SDAH and SCLH line	-	100	-	400	pF
		SDAH+SDA line and SCLH+SCL line	-	400	-	400	pF
Noise margin at the low level	V_{nL}	For each connected device	-	$0.1V_{CC}$	$0.1V_{CC}$	-	V
Noise margin at the high level	V_{nH}	For each connected device	-	$0.2V_{CC}$	$0.2V_{CC}$	-	V

NOTE: V_{CC} is the I²C bus voltage, 1.5V to 3.3V range.

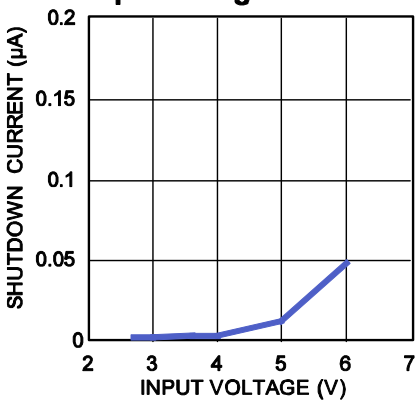
TYPICAL CHARACTERISTICS

VIN = 5V, VOUT = 0.95V, L = 0.47µH, T_A = 25°C, PWM, unless otherwise noted.

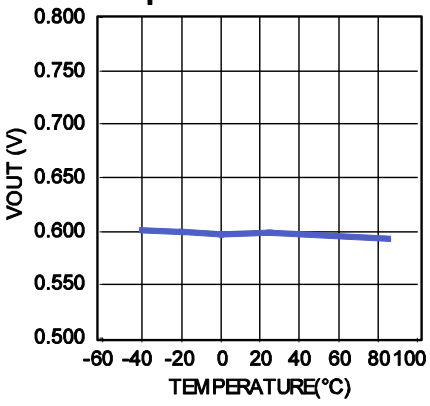
Quiescent Current vs. Input Voltage



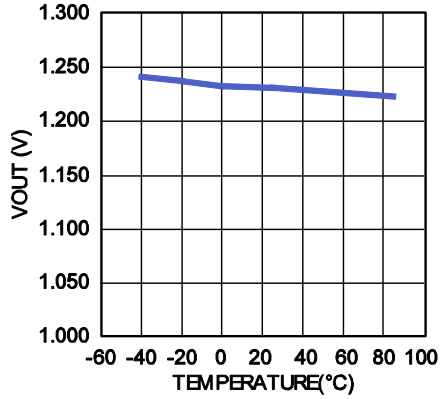
Shutdown Current vs. Input Voltage



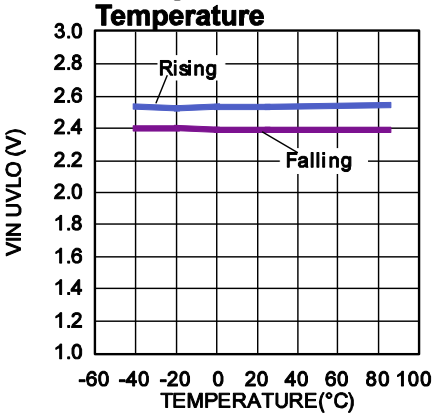
Lowest VOUT vs. Temperature



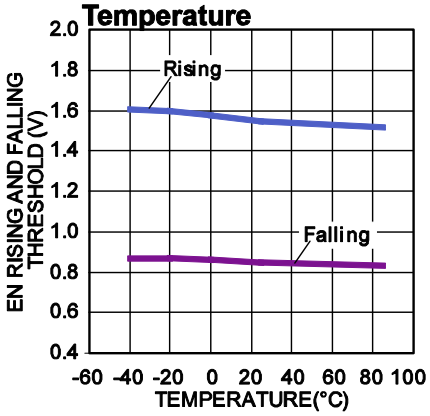
Highest VOUT vs. Temperature



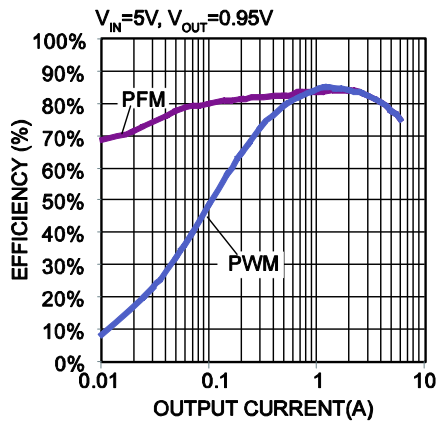
VIN UVLO Rising and Falling Threshold vs. Temperature



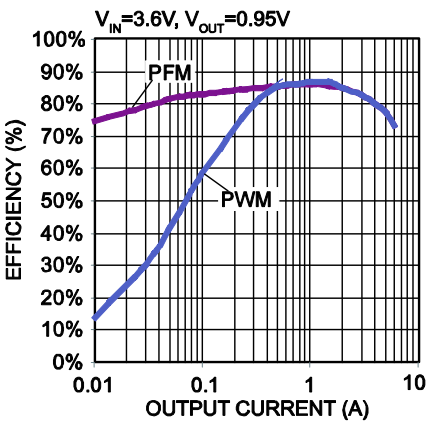
EN Rising and Falling Threshold vs. Temperature



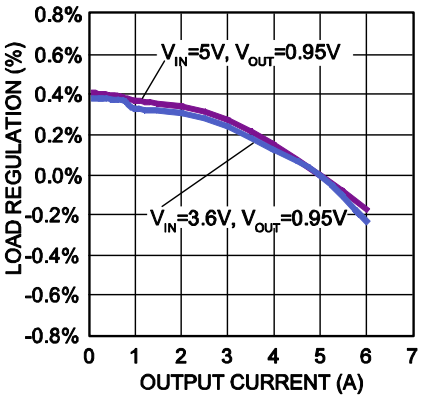
Efficiency vs. Io



Efficiency vs. Io



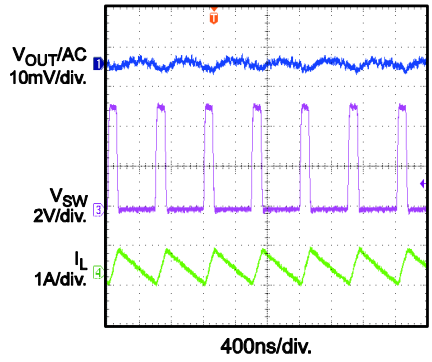
Load Regulation vs. Io



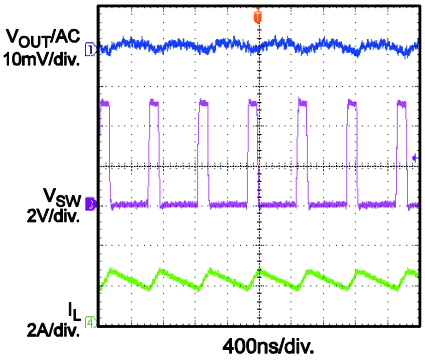
TYPICAL CHARACTERISTICS*(continued)*

VIN = 5V, VOUT = 0.95V, L = 0.47µH, T_A = 25°C, PWM, unless otherwise noted.

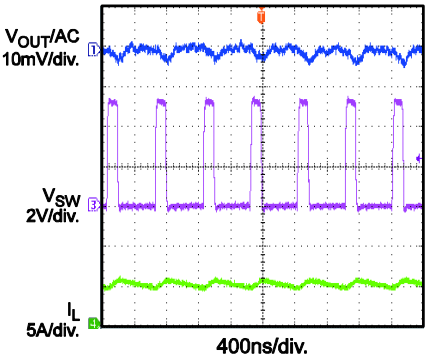
Output Ripple
I_{OUT} = 0A



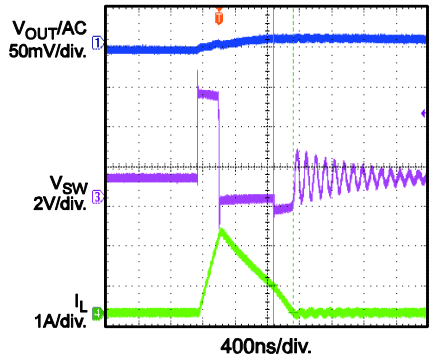
Output Ripple
I_{OUT} = 2A



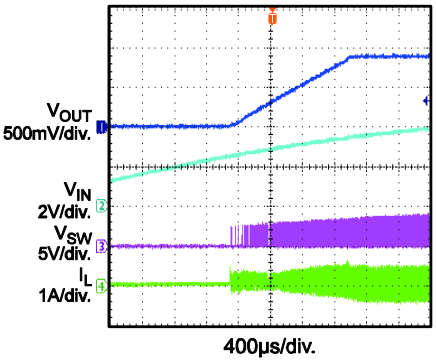
Output Ripple
I_{OUT} = 5A



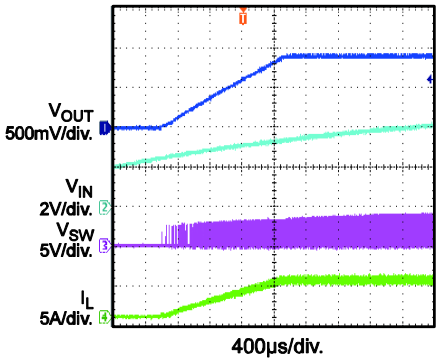
Output Ripple
PFM Mode



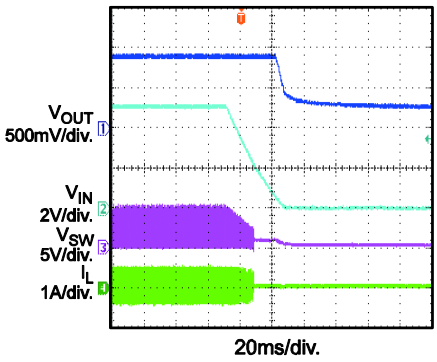
VIN Power Up
I_{OUT} = 0A



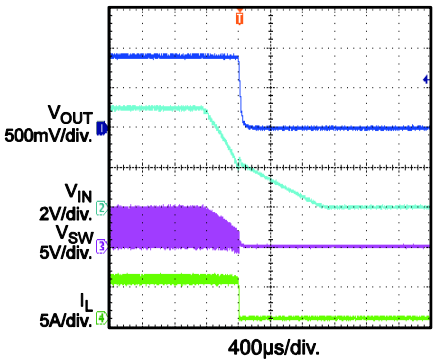
VIN Power Up
I_{OUT} = 5A



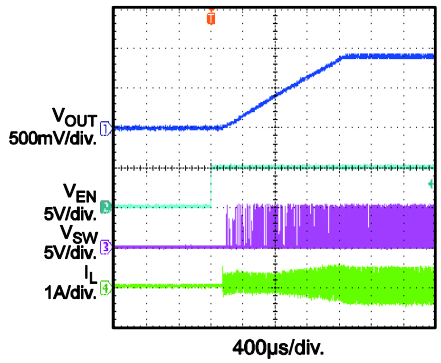
VIN Power Down
I_{OUT} = 0A



VIN Power Down
I_{OUT} = 5A



EN On
I_{OUT} = 0A

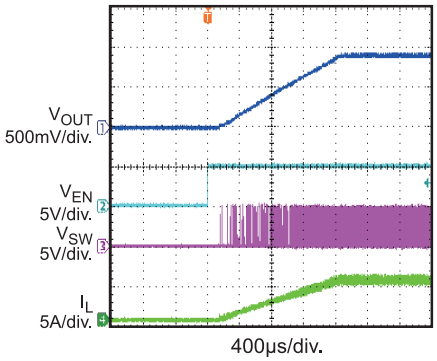


TYPICAL CHARACTERISTICS*(continued)*

VIN = 5V, VOUT = 0.95V, L = 0.47µH, T_A = 25°C, unless otherwise noted.

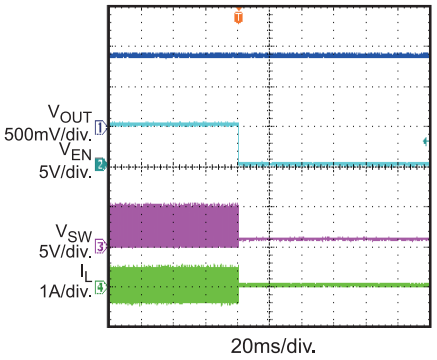
EN On

I_{OUT} = 5A



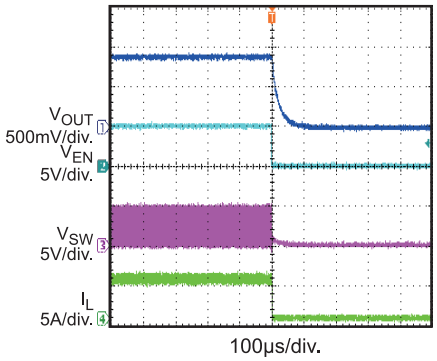
EN Down

I_{OUT} = 0A



EN Down

I_{OUT} = 5A



PIN FUNCTIONS

Package Pin #	Name	Description
1	PG	**Power good output.**
2	SDA	**I²C serial data.**
3, 10	GND	**Power ground.**
4, 5, 6	VIN	**Input supply voltage.**
7, 8, 9	SW	**Switch note.**
11	AGND	**Analog ground.**
12	VOUT	**Output voltage sensing.**
13	SCL	**I²C serial clock.**
14	EN	**On and off control.**

REGISTERSAND DESCRIPTION

Register Map

ADD	NAME	R/W	D7	D6	D5	D4	D3	D2	D1	D0
00	Status	R	ILIM	UVLO	OVP	VoOV	VoUV	PGOOD	OTW	EN stat
01	VSEL	R/W	EN	Output reference						
02	SysCntlreg1	R/W	Switching frequency			Transient response		Pglohi	Vinovp	Mode
03	SysCntlreg2	R/W	Reserved		Go	Out-dis	Gl_filt	Slew rate	PG control	PG set
04	ID1	R	Vendor ID			Die ID				
05	ID2	R	Reserved			Die rev				

NOTE: Theburst write cannot be on Reg.03.

Default Value of Registers

ADD	NAME	R/W	D7	D6	D5	D4	D3	D2	D1	D0
00	Status	R	NA	NA	NA	NA	NA	NA	NA	NA
01	VSEL	R/W	1	1	0	0	0	1	1	0
02	SysCntlreg1	R/W	1	0	0	0	1	1	0	0
03	SysCntlreg2	R/W	0	0	0	0	0	0	0	1
04	ID1	R	0	0	0	1	0	0	0	1
05	ID2	R	0	0	0	0	0	0	0	0

Register Description

1. Reg00 Status

NAME	BITS	DESCRIPTION
ILIM	D7	When the bit is high, IC is in the current limit.
UVLO	D6	When the bit is high,VIN is less than the UVLO threshold.
OVP	D5	When the bit is high,VIN is greater than the OVP threshold.
VoOV	D4	When the bit is high, a voltage higher than 110% of the regulation voltage is presented.
VoUV	D3	When the bit is high, a voltage lower than 90% of the regulation voltage is presented.
PGOOD	D2	When the bit is high, the output is in regulation; otherwise, the output voltage is out of the ±10% regulation window.
OTW	D1	When the junction temperature is higher than 130°C, the bit is high; otherwise, the bit is low.
En stat	D0	When the bit is high, the SMPS is enabled; when the bit is low, the SMPS is disabled.

2. Reg01 VSEL

NAME	BITS	DESCRIPTION
EN	D7	I²C controlled enable. When EN is low, the converter is off. When EN is high, the EN bit takes over.
Output Reference	D[6:0]	Sets the output voltage from 0.6V to 1.235V (see Table 1).

Table 1: Output Voltage Chart

D[6:0]	VOUT	D[6:0]	VOUT	D[6:0]	VOUT	D[6:0]	VOUT
000 0000	0.600	010 0000	0.760	100 0000	0.920	110 0000	1.080
000 0001	0.605	010 0001	0.765	100 0001	0.925	110 0001	1.085
000 0010	0.610	010 0010	0.770	100 0010	0.930	110 0010	1.090
000 0011	0.615	010 0011	0.775	100 0011	0.935	110 0011	1.095
000 0100	0.620	010 0100	0.780	100 0100	0.940	110 0100	1.100
000 0101	0.625	010 0101	0.785	100 0101	0.945	110 0101	1.105
000 0110	0.630	010 0110	0.790	100 0110	0.950	110 0110	1.110
000 0111	0.635	010 0111	0.795	100 0111	0.955	110 0111	1.115
000 1000	0.640	010 1000	0.800	100 1000	0.960	110 1000	1.120
000 1001	0.645	010 1001	0.805	100 1001	0.965	110 1001	1.125
000 1010	0.650	010 1010	0.810	100 1010	0.970	110 1010	1.130
000 1011	0.655	010 1011	0.815	100 1011	0.975	110 1011	1.135
000 1100	0.660	010 1100	0.820	100 1100	0.980	110 1100	1.140
000 1101	0.665	010 1101	0.825	100 1101	0.985	110 1101	1.145
000 1110	0.670	010 1110	0.830	100 1110	0.990	110 1110	1.150
000 1111	0.675	010 1111	0.835	100 1111	0.995	110 1111	1.155
001 0000	0.680	011 0000	0.840	101 0000	1.000	111 0000	1.160
001 0001	0.685	011 0001	0.845	101 0001	1.005	111 0001	1.165
001 0010	0.690	011 0010	0.850	101 0010	1.010	111 0010	1.170
001 0011	0.695	011 0011	0.855	101 0011	1.015	111 0011	1.175
001 0100	0.700	011 0100	0.860	101 0100	1.020	111 0100	1.180
001 0101	0.705	011 0101	0.865	101 0101	1.025	111 0101	1.185
001 0110	0.710	011 0110	0.870	101 0110	1.030	111 0110	1.190
001 0111	0.715	011 0111	0.875	101 0111	1.035	111 0111	1.195
001 1000	0.720	011 1000	0.880	101 1000	1.040	111 1000	1.200
001 1001	0.725	011 1001	0.885	101 1001	1.045	111 1001	1.205
001 1010	0.730	011 1010	0.890	101 1010	1.050	111 1010	1.210
001 1011	0.735	011 1011	0.895	101 1011	1.055	111 1011	1.215
001 1100	0.740	011 1100	0.900	101 1100	1.060	111 1100	1.220
001 1101	0.745	011 1101	0.905	101 1101	1.065	111 1101	1.225
001 1110	0.750	011 1110	0.910	101 1110	1.070	111 1110	1.230
001 1111	0.755	011 1111	0.915	101 1111	1.075	111 1111	1.235

3. Reg02 SysCntlreg1

NAME	BITS	DESCRIPTION			
Switching Frequency	D[7:5]	D[7:5]	Switching Frequency	D[7:5]	Switching Frequency
		000	2.2MHz	100	1.25MHz(default)
		001	2MHz	101	1.11MHz
		010	1.67MHz	110	0.85MHz
		011	--	111	--
Transient Response	D[4:3]	D[4:3]	Response Speed	D[4:3]	Response Speed
		00	Ultra-fast	01	Fast(default)
		10	Normal	11	Slow
PG_LOHI	D2	A “0” here sets PGOOD to sense only a negative voltage excursion of VO from the reference. A “1” (default) sets PGOOD to detect both a positive and negative excursion of VO from the reference.			
VIN_OVP	D1	A “1” disables the VIN OVP function. The converter continues operating. A “0” (default)turns off the converter when VIN reaches VIN MAX.			
Mode	D0	A “0” enables PFM mode; a high disables PFM mode.			

4.Reg03 SysCntlreg2

NAME	BITS	DESCRIPTION			
Reserved	D[7:6]	Reserved.			
Go	D5	Writing to this bit starts a VOUT transition regardless of its initial value.			
Output Discharge	D4	A “0” disables the output discharge. The output voltage must be discharged by the load. A high enables the internal pull-down.			
Gl_filt	D3	A “0” disables PGOOD delay.			
Slew Rate	D2	D2	Slew rate	D2	Slew rate
		0	32mV/μs	1	8mV/μs
PG Control	D1	A“0”enable the PG function. A“1” disables the PG function, and then the PG voltage is set by the PG Set bit.			
PG Set	D0	When the PG Control bit=1, the PG voltage is pulled high if PG Set=0; otherwise, the PG voltage is pulled low.			

5. Reg04 ID1

NAME	BITS	DESCRIPTION
Vendor ID	D[7:4]	Vendor ID.
Die ID	D[3:0]	IC type.

6.Reg05 ID2

NAME	BITS	DESCRIPTION
Reserved	D[7:4]	Reserved.
Die Rev	D[3:0]	Die revision.

Operation Status

CONDITION	PG	REGULATION	LATCH-OFF	STATUS BIT
VIN over-voltage	Low	Off	No	OVP
VIN under-voltage	Low	Off	N/A	UVLO
Thermal warning	Low	On	No	OTW
Thermal shutdown	Low	Off	Yes	N/A
Current limit	High	On	No	ILIM
Output under-voltage	Low	Off	Yes	VoUV
Output over-voltage (>110% of target output)	Low	On	No	VoOV

BLOCKDIAGRAM

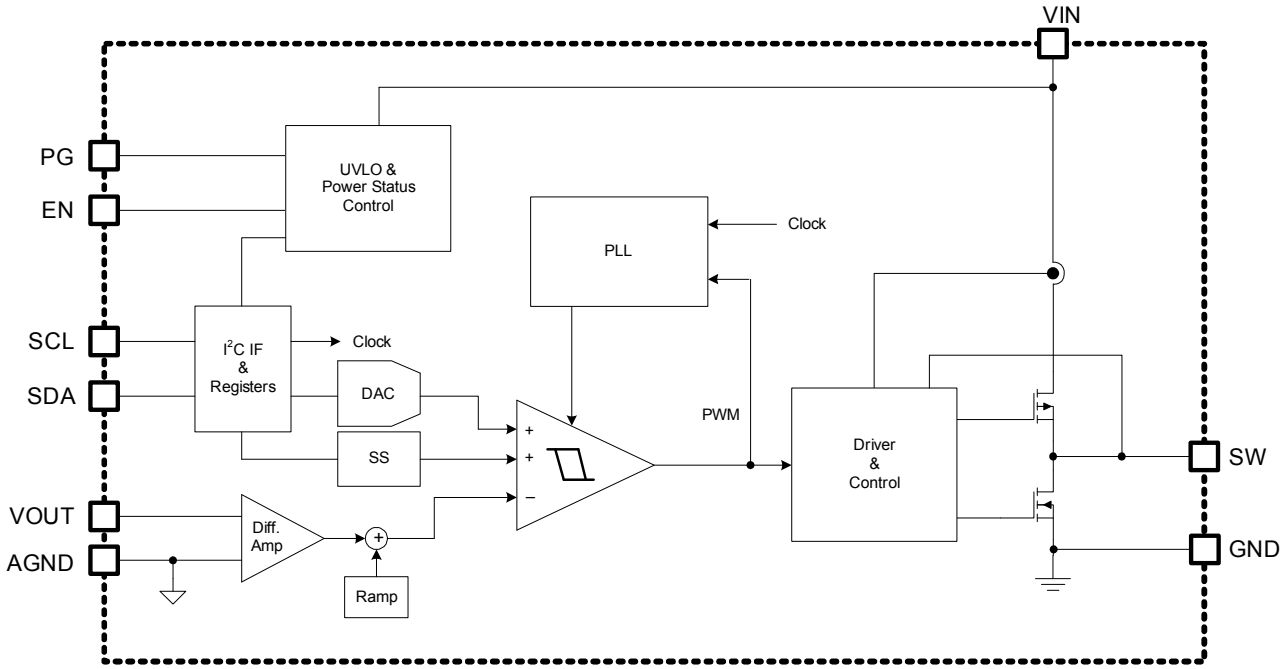


Figure 2: Functional Block Diagram

OPERATION

The MP8847 is a low-voltage, 6A, synchronous, step-down converter with a controllable I²C interface. The MP8847 applies MPS's patented constant-frequency hysteretic control to utilize fast transient response of the hysteretic control and keep the switching frequency constant. No compensation is required, which simplifies the design procedure.

The MP8847 integrates an I²C-compatible interface that allows transfers up to 3.4Mbps. This communication interface can be used for dynamic voltage scaling with voltage steps down to 5mV with the output voltage from 0.6V to 1.235V. The voltage transition slew rate can be controlled as well.

Light-Load Operation

In light-load condition, the MP8847uses a proprietary control scheme to save power and improve efficiency. The MP8847 turns off the low-side switch when the inductor current begins reversing. The MP8847then works in discontinuous conduction mode (DCM) operation.

Enable(EN)

When the input voltage is greater than the under-voltage lockout (UVLO) threshold (typically 2.55V), the MP8847 can be enabled by pulling EN above 1.55V(typical value). Pull EN down to ground to disable the MP8847. The IC can also be disabled by floating EN. There is an internal 1MΩ resistor from EN to ground.

Soft Start (SS)

The MP8847 has a built-in soft start that ramps up the output voltage at a controlled slew rate, preventing inrush current and output voltage overshoot at start-up. The soft-start time is about 1ms.

Power Good (PG) Indictor

The MP8847 has an open drain output for power good (PG) indication. When the output voltage is within ±10% of the regulation voltage, PG is pulled up to VIN by the external resistor.

Current Limit

The MP8847 has a typical 9A current limit for the high-side switch. When the high-side switch reaches the current limit, the MP8847expands the minimum off time until the current drops to 5.8A before the high-side switch is turned on for the next switching cycle. This prevents the inductor current from continuing to build up and damaging the components.

Thermal Protection

The MP8847employs thermal shutdown by monitoring the junction temperature of the IC internally. If the junction temperature exceeds the thermal warning threshold (around 130°C), OTW is set. If there is no action or response from the system, the junction temperature continues rising until it exceeds the thermal shutdown threshold (typically 150°C). After thermal shutdown, a new power start-up cycle is needed to turn on the MP8847 again.

I²C INTERFACE

The MP8847 can communicate with the core and the I²C for smart design. MPS has a GUI control interface (see Figure 3). The installation process and usage can be found in the MP884x Family Software Guide.

I²C Address

The I²C slave address of the MP8847 is 0xC0H / 0xC1H internally (see Table 2).

Table 2: I²C Slave Address

Hex	A7	A6	A5	A4	A3	A2	A1	A0
W 0xC0 R 0xC1	1	1	0	0	0	0	0	R/W
Address	0x60							

I²CEnable

The MP8847's EN pin can start up and shutdown the converter, and the I²C Enable pin can control the converter as well. The Reg01 VSEL D7 bit is I²C-controlled enabled. When writing D7=0, the converter is off. When writing D7=1, the converter is on. Both the external EN and I²C EN can control the converter. The converter works only when both EN pins are high.

Output Voltage Selection

The MP8847 output voltage is I²C-programmable. There is no need to set feedback resistors to achieve different output voltages. The default output voltage is 0.95V but can be set from 0.6V to 1.235V in 5mV steps via the I²C. To change the output voltage, write the Go bit (Reg03 Syscntlreg2 [D5]) to 1. This action means that the output voltage can be set to another value that is not the default Vo voltage. Then write the Output reference bit (Reg01 VSEL [D6:D0]). The output voltage can be changed according to Table 1.

To guarantee a normal output voltage, the input voltage is suggested to be 1.5V higher than the pre-set output voltage.

Switching Frequency

The default switching frequency of the MP8847 is 1.25MHz. However, the frequency can be changed based on the application. By writing the switching frequency bits (Reg02 SysCntlreg1 [D7:D5], the switching frequency can be programmed to one of six possible values. Their corresponding data can be found in Reg02 SysCntlreg1.

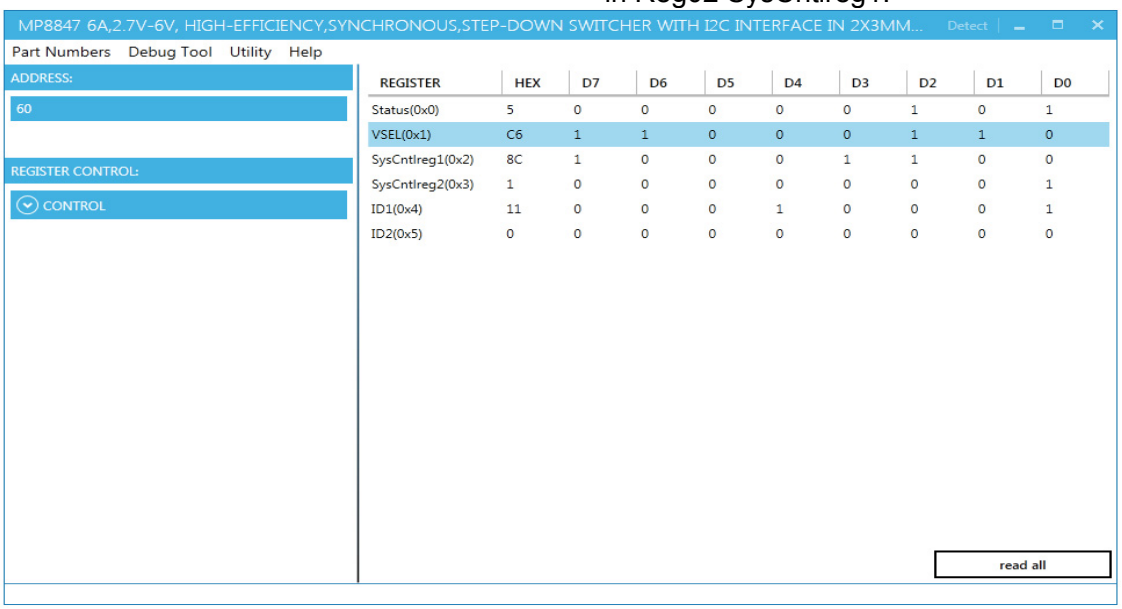


Figure 3: MP8847 Control Interface

PGOOD Configuration

The MP8847 has an option to use the PG_LOHI function. This function can be written in the Pglohi bit (Reg02 Syscntlreg1 [D2]). The default value is 1, where PGOOD senses both a positive and negative excursion of Vo from the reference. If writing this bit to 0, PGOOD only senses a negative voltage excursion of Vo from the reference.

Input Over-Voltage Protection (OVP)

The MP8847 has an option to use the VIN_OVP function. This function can be written in the VIN_OVP bit (Reg02 Syscntlreg1 [D1]). The default value is 0, where the VIN OVP function is enabled. When VIN is higher than 6.3V, the converter is disabled. After VIN recovers to 6.2V, the converter restarts. If the VIN_OVP bit is set to 1, VIN OVP is disable. The converter will not stop, even if VIN exceeds its safe range.

Forced Continuous Conduction Mode (CCM)

The MP8847 has auto-pulse-frequency modulation (PFM) mode and forced CCM. This function can be written in the Mode bit (Reg02 Syscntlreg1 [D0]). The default value is 0, where auto-PFM mode is selected. Considering a smaller Vo ripple and regulation for a full load range, forced CCM is recommended. Set this bit to 1 to disable PFM mode.

Output Discharge

The MP8847 has an output discharge function. Writing the Out-dis bit (Reg03 SysCntlreg2 [D4]) can change the output discharge mode. The default value is 0, and Vo can be discharged by its load when EN is low. Writing D4=1 can enable the function, and then the output voltage can be discharged by the internal pull-down resistance.

Output Voltage Transition Slew Rate

When the output voltage switches from low to high or from high to low, the transition slew rate can be different. There are two possible values for selection. Through writing the Slew Rate bits (Reg02 Syscntlreg1[D4: D3]), the transition slew rate can be set at one possible value based on the application. The internal reference follows the set slew rate, but the output voltage slew rate does not always follow the internal reference. Considering the output capacitor and inductor, the actual output voltage slew rate should be a little slower.

PG Multi-Use

The MP8847 PG pin has multi-usage. When the PG Control bit (Reg03 SysCntlreg2 D1) is 0, PG indicates the Vo status, such as Vo over-voltage or under-voltage. When the PG Control bit (Reg03 sysCntlrge2 D1) is 1, the PG voltage is controlled by the PG Set bit (Reg03 sysCntlrge2 D0).The PG voltage is high if D0=0; otherwise, the PG voltage is low (see Table 3).

Table 3: PG Multi-Use

D1	D0	PG
0	0	PG indicator
0	1	
1	0	PG forced to 1
1	1	PG forced to 0

I²C Register Hold On

The MP8847 has a special function: the I²C register can hold on after EN changes low. The updated register can be held for later application conditions, even if the external EN pulls low.

TYPICAL APPLICATION CIRCUIT

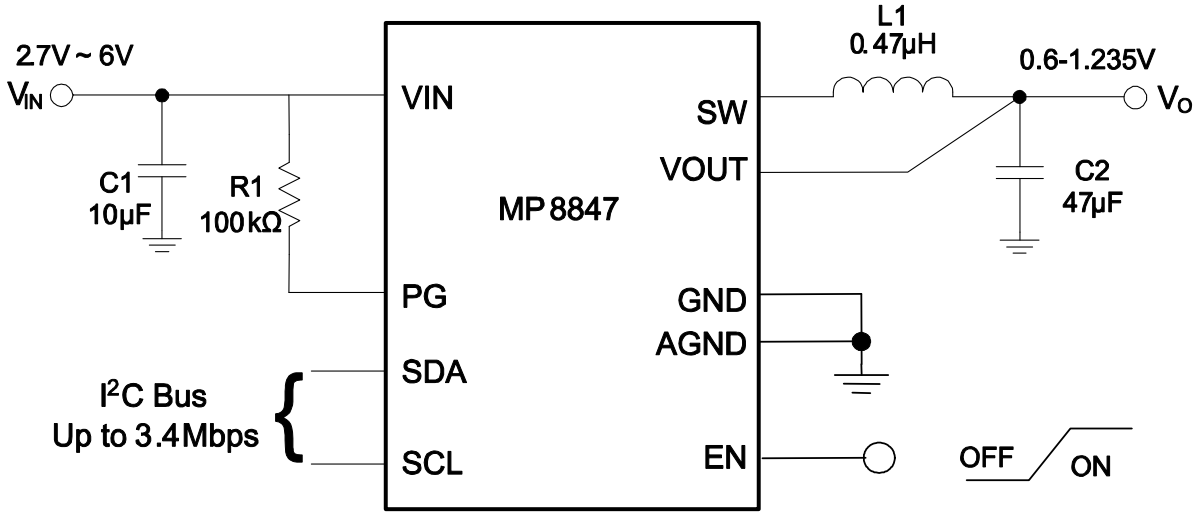
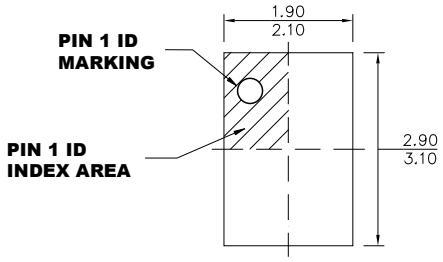


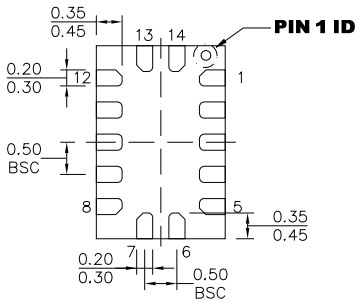
Figure 4: Application Circuit

PACKAGE INFORMATION

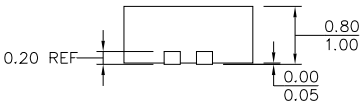
QFN-14 (2mmx3mm)



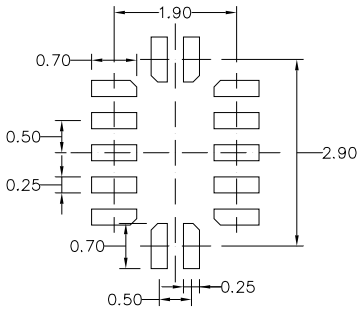
TOP VIEW



BOTTOM VIEW



SIDE VIEW



RECOMMENDED LAND PATTERN

NOTE:

1) ALL DIMENSIONS ARE IN MILLIMETERS.
2) EXPOSED PADDLE SIZE DOES NOT INCLUDE MOLD FLASH.
3) LEAD COPLANARITY SHALL BE 0.10 MILLIMETERS MAX.
4) JEDEC REFERENCE IS MO-220.
5) DRAWING IS NOT TO SCALE.

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