MP2188

Dual 3A, 5.5V, 1.2MHz, COT Synchronous Step Down Switchers With Auto Output Discharge

The Future of Analog IC Technology

DESCRIPTION

The MP2188 is a monolithic, step-down, switch-mode dual converter with internal power MOSFETs. It can achieve up to 3A continuous output current from a 2.5V–to-5.5V input voltage with excellent load and line regulation. The output voltages of two channels are 1.1V and 1.8V respectively.

The constant-on-time control scheme provides fast transient response and eases loop stabilization. Fault condition protections include cycle-by-cycle current limiting and thermal shutdown.

The MP2188 is available in small 2.2mmx2.6mm QFN-16 package and requires only a minimal number of readily available standard external components.

The MP2188 is ideal for a wide range of applications including high-performance DSPs, FPGAs, smartphones, portable instruments, and DVD drivers.

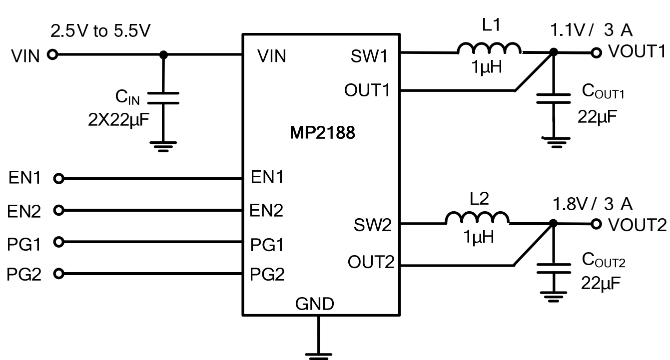
FEATURES

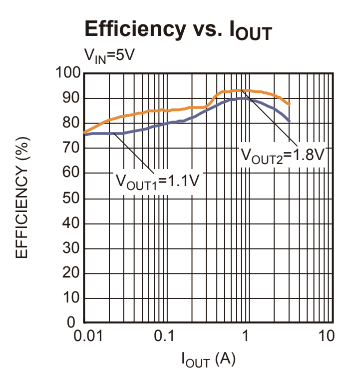
- Wide 2.5V-to-5.5V Operating Input Range
- Fixed Output Voltages: 1.1V & 1.8V
- Adjustable Output Voltage from 0.8V by external FB Resistor
- 100% Duty Cycle in Dropout
- Up to 3A Output Current
- Low IQ: 80μA
- 60mΩ and 30mΩ Internal Power MOSFET Switches
- Default 1.2MHz Switching Frequency
- EN and Power-Good for Power Sequencing
- Cycle-by-Cycle Over-Current Protection
- Auto Discharge at Power-Off
- Short-Circuit Protect with Hiccup Mode
- Stable with Low-ESR Output Ceramic Capacitors
- Available in a 2.2mm x 2.6mm QFN-16 Package

APPLICATIONS

- Solid State Drives(SSD)
- Low Voltage I/O System Power
- Handheld/Battery-powered Systems
- Wireless/Networking Cards

TYPICAL APPLICATION





ORDERING INFORMATION

Part Number*	Package	Top Marking
MP2188GQA	QFN-16(2.2mmx2.6mm)	*See Below*

* For Tape & Reel, add suffix –Z (e.g. MP2188GQA–Z);

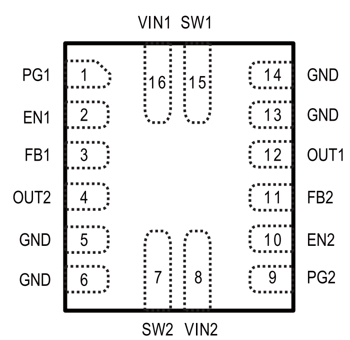
TOP MARKING

AKJ
YWW
LLL

AKJ: product code of MP2188GQA;
Y: year code;
WW: week code:
LLL: lot number;

PACKAGE REFERENCE

TOP VIEW



QFN-16

ABSOLUTE MAXIMUM RATINGS (1)

Supply Voltage V_{IN} 6V
V_{SW} .... (-3V for < 10ns & -5V for <5ns) to 6.5V (7V for <10ns & 9V for <5ns)
All Other Pins ....-0.3V to +6 V
Junction Temperature ....150°C
Lead Temperature ....260°C
Continuous Power Dissipation (T_A = 25°C) (2)
…………... .... 1.67W
Storage Temperature............... -65°C to +150°C

Recommended Operating Conditions (3)

Supply Voltage V_{IN} ....2.5V to 5.5V
Output Voltage V_{OUT}.................. 0.8V to D_{max}*V_{IN}
Operating Junction Temp. (T_J). -40°C to +125°C

Thermal Resistance (4) θ_{JA} θ_{JC}

QFN-16 (2.2mm x 2.6mm)...... 75 ...... 16... °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 will cause excessive die temperature, and the regulator will 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 JESD51-7, 4-layer PCB.

ELECTRICAL CHARACTERISTICS

V_{IN} = 5V, T_J=-40°C to +125°C, typical value is tested at T_J = 25°C, unless otherwise noted.

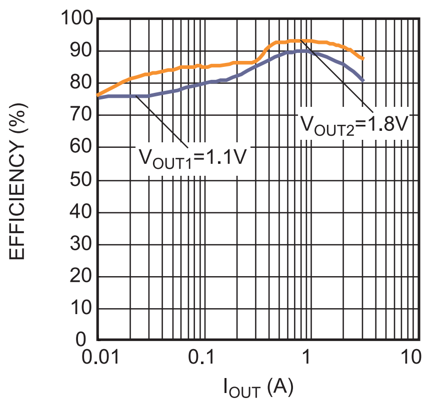
Parameter	Symbol	Condition	Min	Typ	Max	Units
Internal Feedback Voltage	V_{FB}	2.5V ≤ V_{IN} ≤ 5.5V, T_J=25°C	-1.5%	0.600	+1.5%	V/%
			-2%		+2%	
Fixed Output Voltage	Vo	1.1V rail, T_J=25°C	-1.5%	1.1	+1.5%	V/%
		1.8V rail, T_J=25°C	-1.5%	1.8	+1.5%	
PFET Switch ON Resistance	R_{DSON_P}			60		mΩ
NFET Switch ON Resistance	R_{DSON_N}			30		mΩ
Switch Leakage		$V_{EN1\ or\ 2}$ = 0V, V_{IN} = 5V $V_{SW1\ or\ 2}$ = 0V and 5V, T_J=25°C		0.1	2	μA
PFET Current Limit(5)			4.7	5.3		A
ON Time	t_{ON}	V_{IN}=5V, V_{OUT1} =1.1V		183		ns
		V_{IN}=5V, $V_{OUT\ 2}$=1.8V		300		
Switching frequency	f_s	V_{IN}=5V, V_{OUT1} =1.1V, I_{OUT1} =1A V_{IN}=5V, V_{OUT2} =1.8V, I_{OUT2} =1A, T_J=25°C	-20%	1200	+20%	kHz
Minimum OFF Time	$t_{MIN\text{-}OFF}$			50		ns
Soft-Start Time	$t_{SS\text{-}ON}$			1.3		ms
Soft-Stop Time	$t_{SS\text{-}OFF}$			1		ms
Power-Good Upper Trip Threshold	PG_H	FB voltage with respect to the regulation		+10%		%
Power-Good Lower Trip Threshold	PG_L			-10%		%
Power-Good Delay	PG_D			110		μs
Power-Good Sink Current Capability	$V_{PG\text{-}L}$	Sink 1mA			0.4	V
Power Good Logic High Voltage	$V_{PG\text{-}H}$	V_{IN}=5V	4.9			V
Power Good Internal Pull-Up Resistor	R_{PG}			500		kΩ
Under-Voltage Lockout Threshold Rising			2.0	2.2	2.4	V
Under-Voltage Lockout Threshold Hysteresis				150		mV
EN Input Logic Low Voltage					0.4	V
EN Input Logic High Voltage			1.2			V
EN Input Current		$V_{EN1\ or\ 2}$=2V		2		μA
		$V_{EN1\ or\ 2}$=0V		0.1		μA
Supply Current (Shutdown)		$V_{EN1\ or\ 2}$=0V		0.1		μA
Supply Current (Quiescent)		V_{EN}=2V, V_{IN}=3.6V, Both channel on		80		μA
Thermal Shutdown (6)				150		°C
Thermal Hysteresis (6)				30		°C

Notes:
5) Guaranteed by engineering sample characterization.
6) Guaranteed by design.

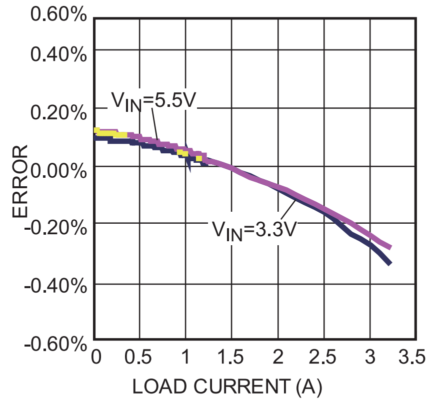
TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN} = 5V, V_{OUT1} = 1.1V, V_{OUT2} = 1.8V, L = 1.0µH, C_{OUT}=22µF, T_A = 25°C, unless otherwise noted.

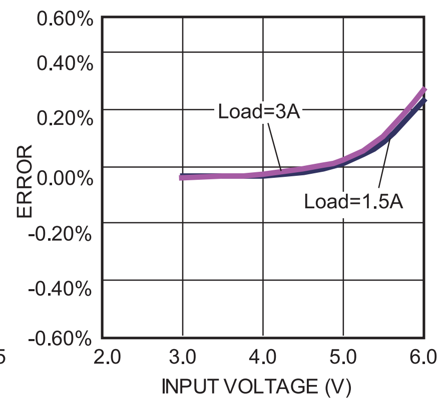
Efficiency vs. I_{OUT}



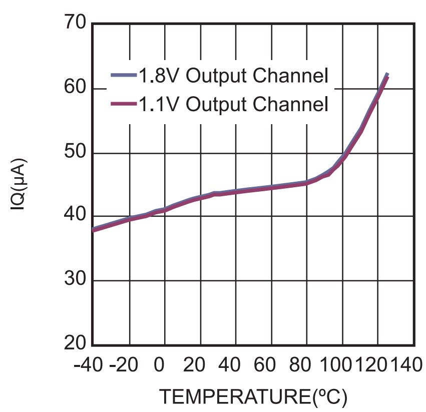
Load Regulation



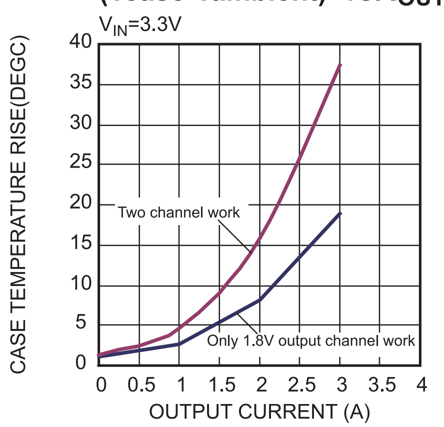
Line Regulation



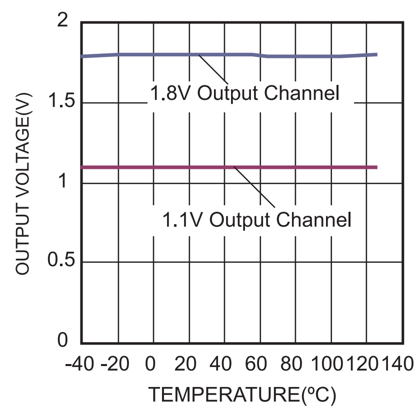
Quiescent Current vs. Temperature



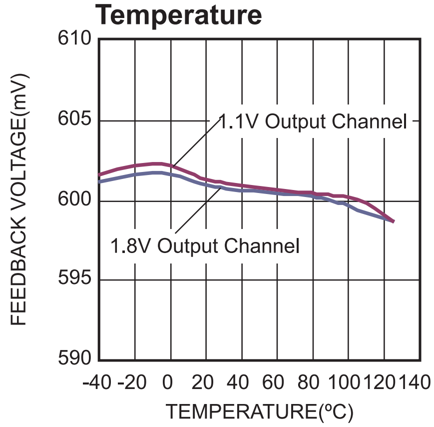
Case Temperature Rise (Tcase-Tambient) vs. I_{OUT}



Output Voltage vs. Temperature



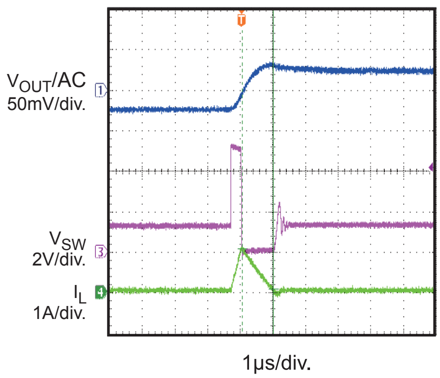
Feedback Voltage vs. Temperature



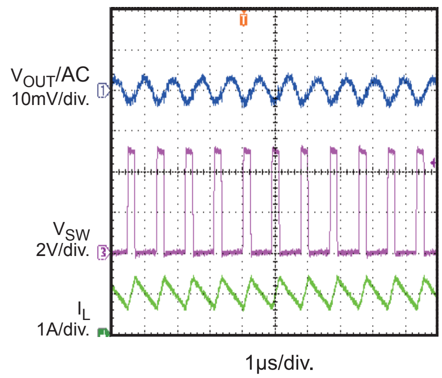
TYPICAL PERFORMANCE CHARACTERISTICS *(continued)*

V_{IN} = 5V, V_{OUT1} = 1.1V, V_{OUT2} = 1.8V, L = 1.0µH, C_{OUT}=22µF, T_A = 25°C, unless otherwise noted.

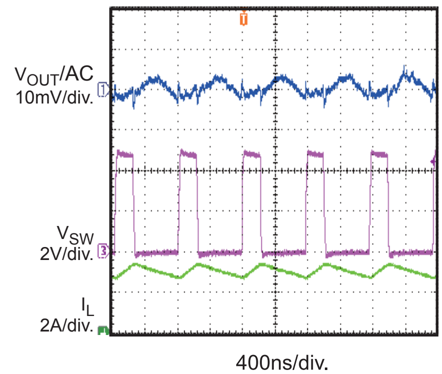
Output Ripple
I_{OUT}=0A



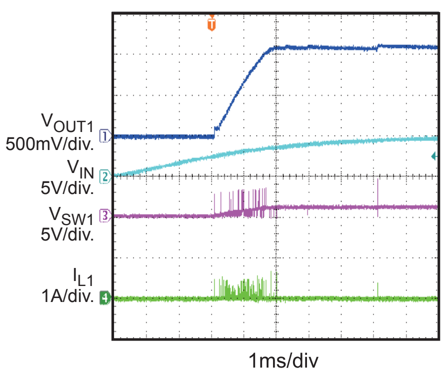
Output Ripple
I_{OUT}=1A



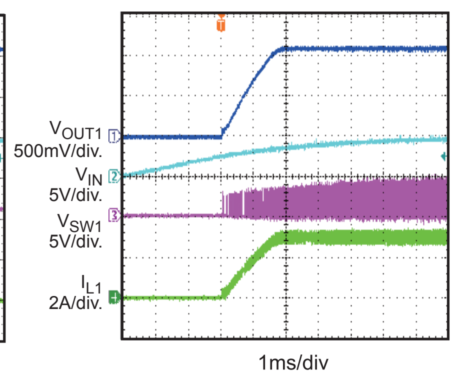
Output Ripple
I_{OUT}=3A



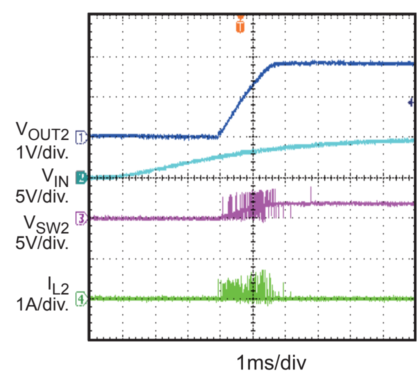
VIN Power On
V_{OUT1}=1.1V, I_{OUT1}=0A



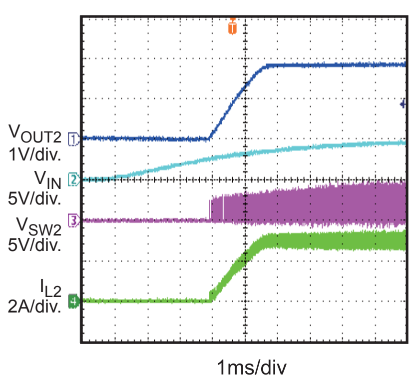
VIN Power On
V_{OUT1}=1.1V, I_{OUT1}=3A



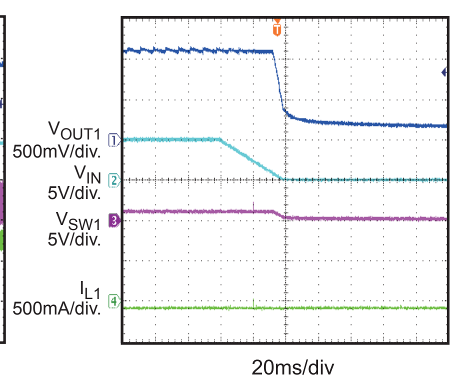
VIN Power On
V_{OUT2}=1.8V, I_{OUT2}=0A



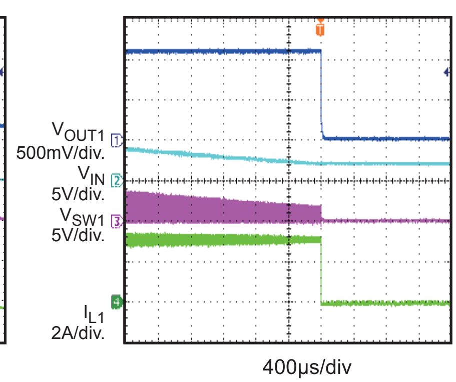
VIN Power On
V_{OUT2}=1.8V, I_{OUT2}=3A



VIN Power Off
V_{OUT1}=1.1V, I_{OUT1}=0A



VIN Power Off
V_{OUT1}=1.1V, I_{OUT1}=3A

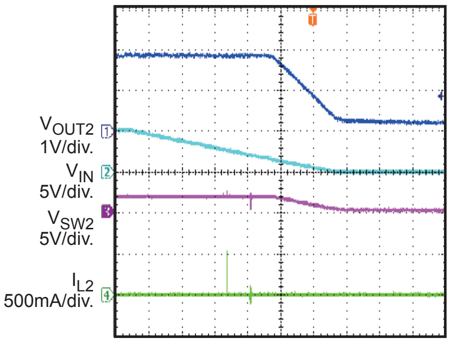


TYPICAL PERFORMANCE CHARACTERISTICS *(continued)*

V_{IN} = 5V, V_{OUT1} = 1.1V, V_{OUT2} = 1.8V, L = 1.0µH, C_{OUT}=22µF, T_A = 25°C, unless otherwise noted.

VIN Power Off

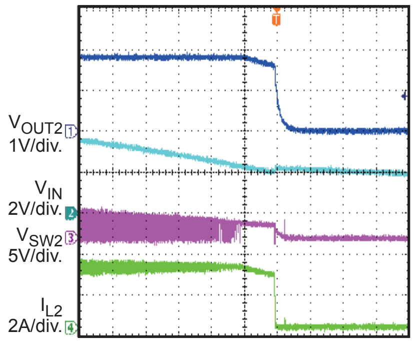
V_{OUT2}=1.8V, I_{OUT2}=0A



20ms/div.

VIN Power Off

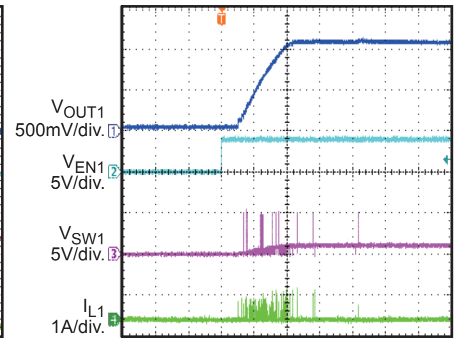
V_{OUT2}=1.8V, I_{OUT2}=3A



100µs/div.

EN ON

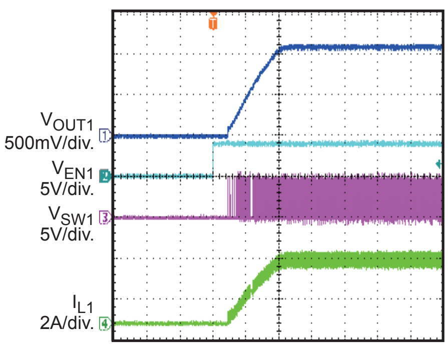
V_{OUT1}=1.1V, I_{OUT1}=0A



1ms/div.

EN ON

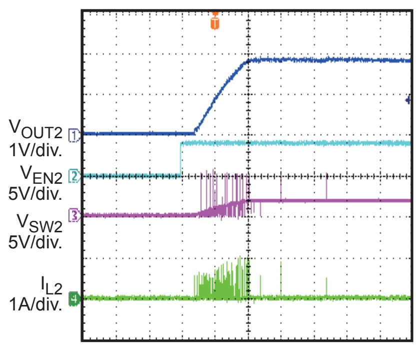
V_{OUT1}=1.1V, I_{OUT1}=3A



1ms/div

EN ON

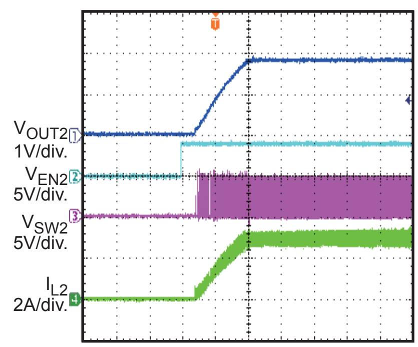
V_{OUT2}=1.8V, I_{OUT2}=0A



1ms/div

EN ON

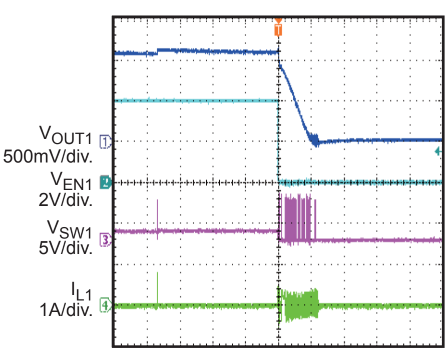
V_{OUT2}=1.8V, I_{OUT2}=3A



1ms/div

EN OFF

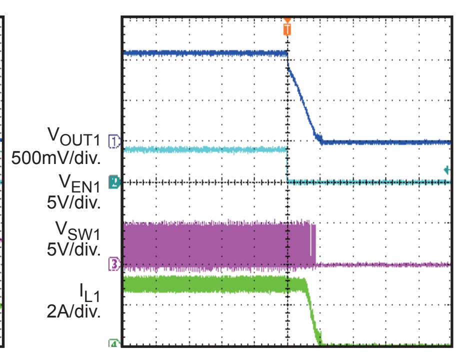
V_{OUT1}=1.1V, I_{OUT1}=0A



1ms/div

EN OFF

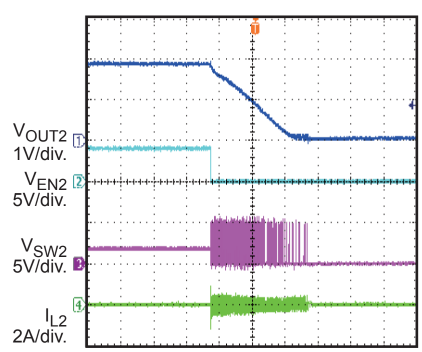
V_{OUT1}=1.1V, I_{OUT1}=3A



1ms/div

EN OFF

V_{OUT2}=1.8V, I_{OUT2}=0A



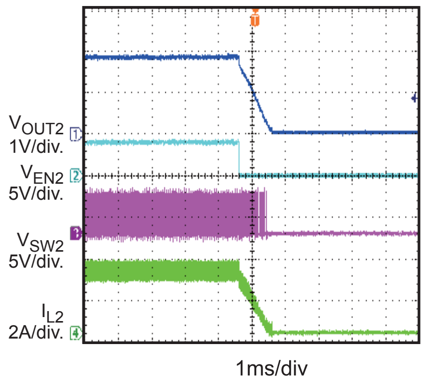
400µs/div

TYPICAL PERFORMANCE CHARACTERISTICS *(continued)*

V_{IN} = 5V, V_{OUT1} = 1.1V, V_{OUT2} = 1.8V, L = 1.0µH, C_{OUT}=22µF, T_A = 25°C, unless otherwise noted.

EN OFF

V_{OUT2}=1.8V, I_{OUT2}=3A



PIN FUNCTION

QFN16 Pin #	Name	Description
1	PG1	Power Good Indicator of channel 1. The output of this pin is an open drain with an internal pull up resistor to VIN1. PG1 is pulled up to VIN1 when the FB1 voltage is within 10% of the regulation level. If the FB1 voltage is out of that regulation range, it is LOW.
2	EN1	On/Off Control of channel 1.
3	FB1	Internal FB point of channel 1. Floating FB1 PIN will get pre-set fixed output voltage.
4	OUT2	Input Sense of channel 2. For output voltage sense.
5, 6, 13, 14	GND	Power Ground.
7	SW2	Switch Output of channel 2.
8	VIN2	Supply Voltage of channel 2. The MP2188 operates from a +2.5V-to-+5.5V unregulated input.
9	PG2	Power Good Indicator of channel 2. The output of this pin is an open drain with an internal pull up resistor to VIN2. PG2 is pulled up to VIN2 when the FB2 voltage is within 10% of the regulation level. If the FB2 voltage is out of that regulation range, it is LOW.
10	EN2	On/Off Control of channel 2.
11	FB2	Internal FB point of channel 2. Floating FB2 PIN will get pre-set fixed output voltage.
12	OUT1	Input Sense of channel 1. For output voltage sense.
15	SW1	Switch Output of channel 1.
16	VIN1	Supply Voltage of channel 1. The MP2188 operates from a +2.5V-to-+5.5V unregulated input.