Demo Note for the A8580 Evaluation Board

$4.0V_{IN}$ – $40V_{IN}$, $3.3V_{OUT}$, 2.5A, 425KHz Asynchronous Buck Regulator with Low IQ PFM Mode

December 18th, 2012

GENERAL SPECIFICATIONS

Specification	Min	Nom	Max	Units
Absolute Maximum Input Voltage	–0.3	–	40	Volts
Operating Input Voltage Range	4.0	12	35	Volts
V_{IN} **START** Threshold, V_{IN} rising	3.6	3.8	4.0	Volts
V_{IN} **STOP** Threshold, V_{IN} falling	3.2	3.4	3.6	Volts
Output Voltage (FB: 47K/147K, ±1%)	3.175	3.302	3.434	Volts
Steady-State Output Current ($12V_{IN}$)	–	2.5	–	A
Pulse-by-pulse Current Limit @ 30% duty	3.12	3.69	4.25	A
PWM/PFMn Input	–0.3	–	5.5	Volts

OPERATING INSTRUCTIONS

Input Power Connection:

Connect a 12V power supply from V_{IN} to GND that is capable of at least 2.5A. **Once operational, V_{IN} can fall as low as $3.4V_{TYP}$ ($3.6V_{MAX}$) before the A8580 is reset**.

PWM/PFMn Input and DIP switch SW1 (SLEEPn):

Connect an external voltage to the PWM/PFMn input and set SW1 (SLEEPn) to control the A8580's operating mode. The following table summarizes the A8580's operating modes based on SW1 (SLEEPn) and the PWM/PFMn input. Also, PWM/PFMn may be used to synchronize the A8580 PWM switching frequency by applying a square wave above 510KHz.

SW1 (SLEEPn)	PWM/PFMn	Operating Mode
OFF (SLEEPn<0.5V)	N/A	Low current SLEEP mode, no output voltage
ON (SLEEPn>2.1V)	< 0.8V	Low IQ PFM mode, supports up to $500mA_{TYP}$
	> 2.6V	Normal PWM mode at 425KHz, supports up to 2.5A
	CLK signal	Normal PWM mode, synchronized to external CLK

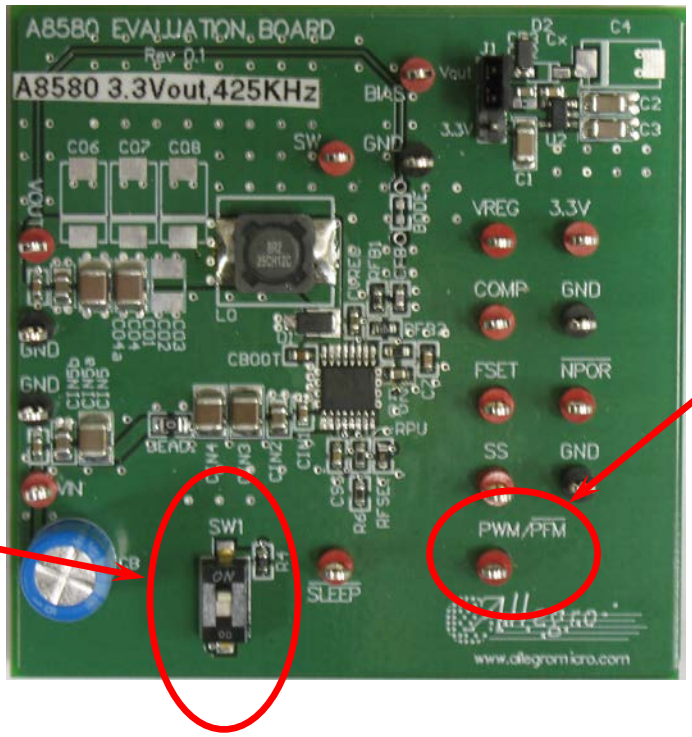
Note: Set SW1 to the "OFF" position before driving the SLEEPn test point by a pulse generator or an external power supply.

Note: Continuously applying more than 5.5V to the PWM/PFMn pin may damage the A8580.

Output Load Connections:

Connect a load from V_{OUT} to GND. The steady-state load current can be as high as 2.5A. Pulse-by-pulse current limit and/or thermal shutdown will occur if the load is greater than 3.7A.

DEMO BOARD PICTURE



PWM/PFMn Input
> 2.6V for PWM
< 0.8V for PFM

SW1
(SLEEPn)

MODIFYING THE DEMO BOARD TO PRODUCE V_{OUT} > 5.5V

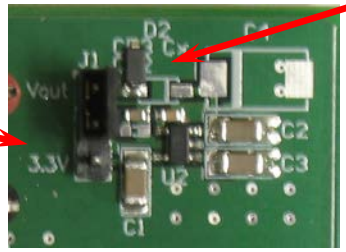
If the demo board is modified to produce more than 5.5Vout two changes must be made:

1) Jumper J1 must be set to the "lower" position (shown below) so the on-board 3.3V LDO (U2) will deliver the BIAS voltage to the A8580.

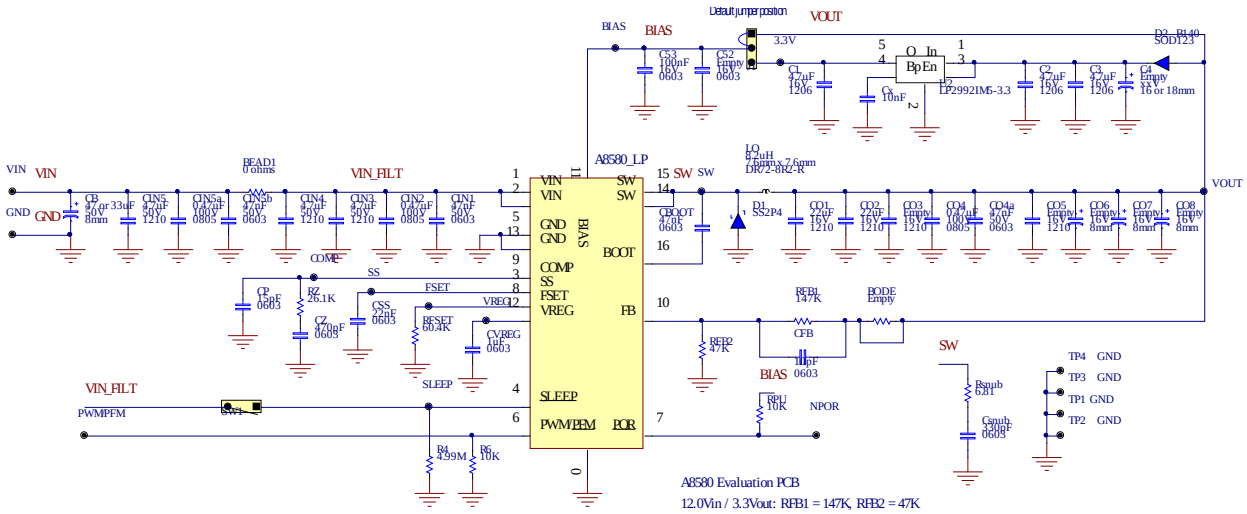
2) Diode D2 must be rotated 90° clockwise so it is "in circuit" and the 3.3V LDO (U2) will operate. If U2 is operational, the Low IQ current of the EVB will increase.

Rotate D2 90° so it connects to this pad

Move J1 to the "lower" position



DEMO BOARD SCHEMATIC

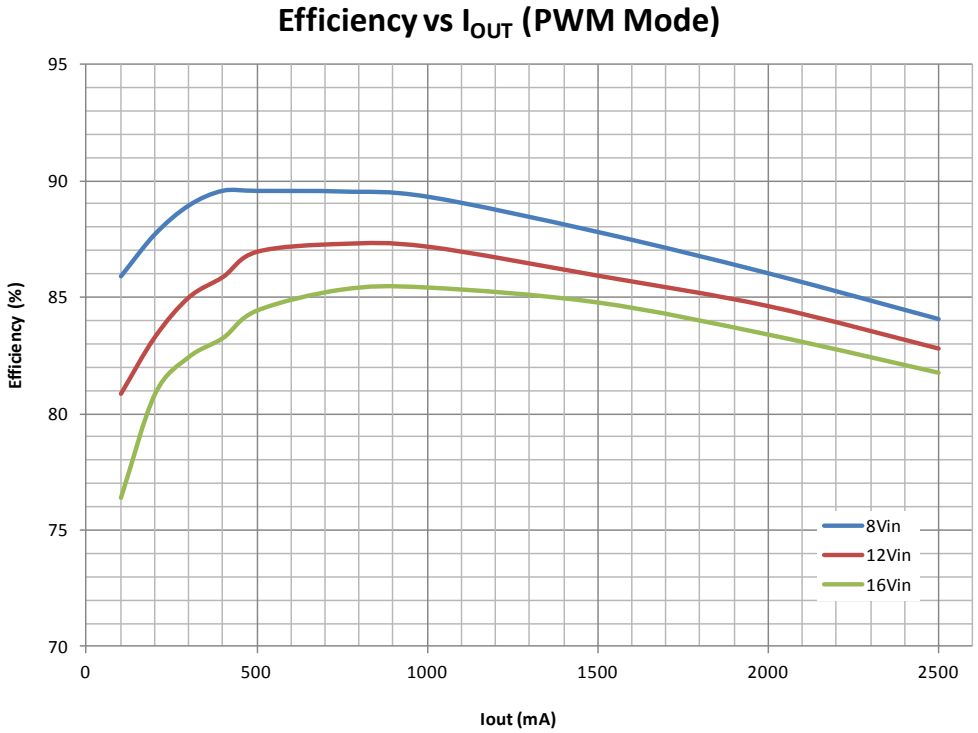


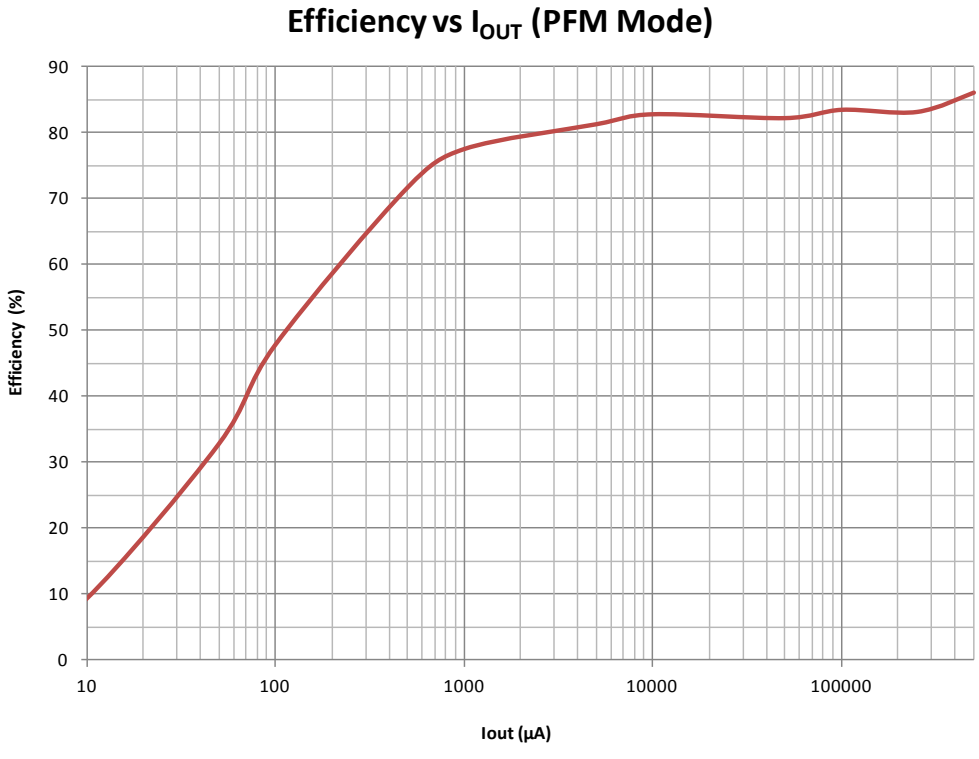
Note: CB is an optional, bulk, electrolytic capacitor for general supply filtering

DEMO BOARD BILL-OF-MATERIALS

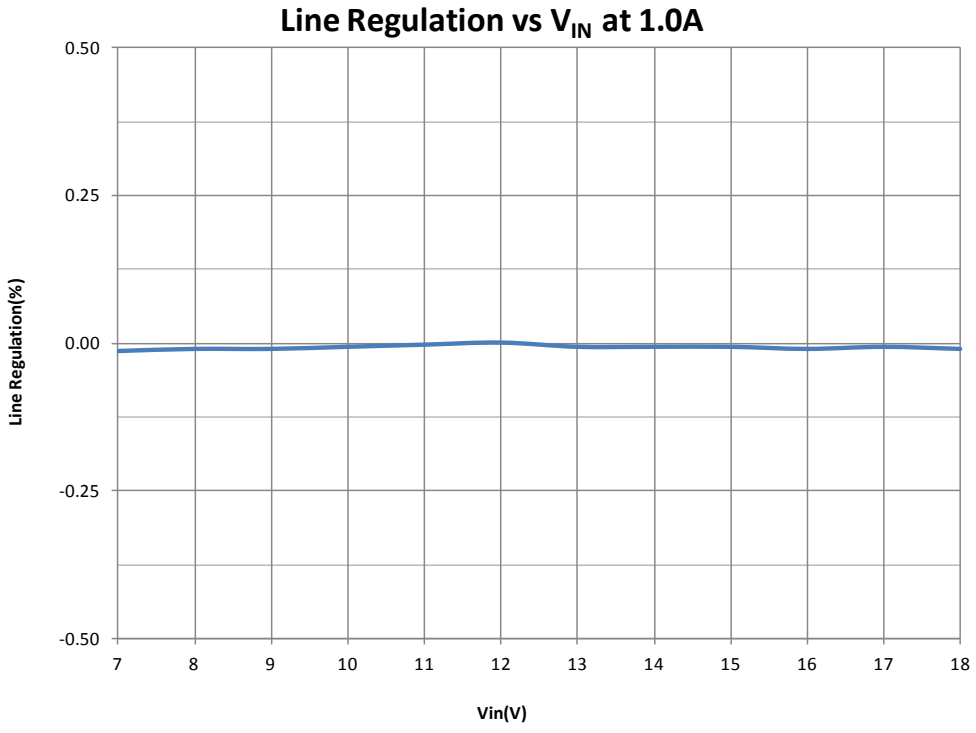
REFERENCE DESIGNATORS	DESCRIPTION	FOOTPRINT	QTY.	MANUFACTURER	MANUFACTURER P/N	SOURCE	PURCHASE P/N
PCB	A8580 PCB for eTSSOP16, **Rev 0.1**	N/A	1	Allegro MicroSystems		4pcb.com	
U1	A8580, 2A Buck Regulator	eTSSOP-16	1	Allegro MicroSystems	A8580		
U2	Regulator, LDO, 3.3V/250mA	SOT23-5	1	National Semi	LP2992IM5-3.3	Digikey	LP2992IM5-3.3CT-ND
R4	Resistor, 4.99MΩ, 1/10W, 1%	0603	1				
R6, RPU	Resistor, 10KΩ, 1/10W, 1%	0603	2				
RFB1	Resistor, 147KΩ, 1/10W, 1%	0603	1				
RFB2	Resistor, 47KΩ, 1/10W, 1%	0603	1				
RFSET	Resistor, 60.4KΩ, 1/10W, 1%	0603	1				
Rsnub	Resistor, 6.81Ω, 1/4W, 1%	1206	1				
RZ	Resistor, 26.1KΩ, 1/10W, 1%	0603	1				
BEAD1	Resistor, 0Ω, 0805	0805	1				
C1, C2, C3	Capacitor, Ceramic, 4.7µF, 16V, X7R	1206	3				
C53	Capacitor, Ceramic, 100nF, 25V, X7R	0603	1				
CB	Capacitor, Electrolytic, 33µF or 47µF, 50V, <0.5Ω, -40°C to 125°C	Thru Hole 8mm x 11.5mm	1	Nichicon Nichicon Nichicon	UBW1H330MPD UBT1H330MPD UBT1H470MPD	DigiKey Mouser Mouser	UBW1H330MPD-ND 647-UBT1H330MPD 647-UBT1H470MPD
CIN1, CIN5b, CO4a, CBOOT	Capacitor, Ceramic, 47nF, 50V, 10%, X7R, -55°C to 125°C	0603	4	Murata	GRM188R71H473KA61D	Digikey	490-3287-1-ND
CIN2, CIN5a, CO4	Capacitor, Ceramic, 0.47uF, 100V, 10%, X7R, -55°C to 125°C	0805	3	Murata	GRM21BR72A474KA73L	Digikey	490-3326-1-ND
CIN3, CIN4, CIN5	Capacitor, Ceramic, 4.7µF, 50V, X7R	1210	3	TDK	C3225X7R1H475K C3225X7R1H475M	Digikey	445-7726-1-ND 445-7727-1-ND
CFB	Capacitor, Ceramic, 10pF, 50V, COG	0603	1				
CO1, CO2	Capacitor, Ceramic, 22µF, 16V, X7R	1210	2	TDK	C3225X7R1C226K	Digikey	445-3945-2-ND
Csnub	Capacitor, Ceramic, 330pF, 50V, X7R	0603	1				
CSS	Capacitor, Ceramic, 22nF, 50V, X7R	0603	1				
CVREG	Capacitor, Ceramic, 1µF, 50V, X7R	0603	1				
CZ	Capacitor, Ceramic, 560pF, 50V, X7R	0603	1				
CP	Capacitor, Ceramic, 15pF, 50V, C0G	0603	1				
Cx	Capacitor, Ceramic, 10nF, 50V, X7R	0603	1				
BODE, C4, C52, CIN4, CO3, CO4, CO5, CO6, CO7, CO8	Empty	Various	0				
D1	Schottky Diode, 40V, 2A	SMP	1	Vishay	SS2P4-M3/84A	Digikey Mouser	SS2P4-M3/84AGICT-ND 625-SS2P4-M3/84A
D2	Schottky Diode, 40V, 1A, SOD123	SOD123	1	Diodes, Inc Diodes, Inc	B140HW-7 B140HW-7	Digikey Mouser	B140HWDICT-ND 621-B140HW-7
LO	Inductor, 8.2uH, 3.17A_{SAT} @ 25C, 40mΩ	7.6mm x 7.6mm 4.35mm thick	1	Cooper Bussmann	DRA74-8R2-R	Digikey Mouser	283-3644-1-ND 704-DRA74-8R2-R
3.3V, BIAS, COMP, FSET, NPOR, PWM/PFM, SLEEP, SS, SW, VIN, VOUT, VREG,	Test Points, Red, 0.063" diameter	0.063"	12	Keystone	5010	Digikey	5010K-ND
GND	Test Points, Black, 0.063" diameter	0.063"	5	Keystone	5011	Digikey	5011K-ND
J1	Header, 3-pins, 0.1" spacing (Note: P/N is for a 36-pin strip)		1	Sullins	PEC36SAAN	Digikey	S1012E-36-ND
SW1	DIP Switch, 1 position	SMT	1	C & K Components	SDA01H0SBR	Digikey	CKN9490CT-ND
Rubber Feet	Self stick rubber feet	Clear	4	3M	SJ-5303 (CLEAR)	Digikey	SJ5303-7-ND

DEMO BOARD PERFORMANCE

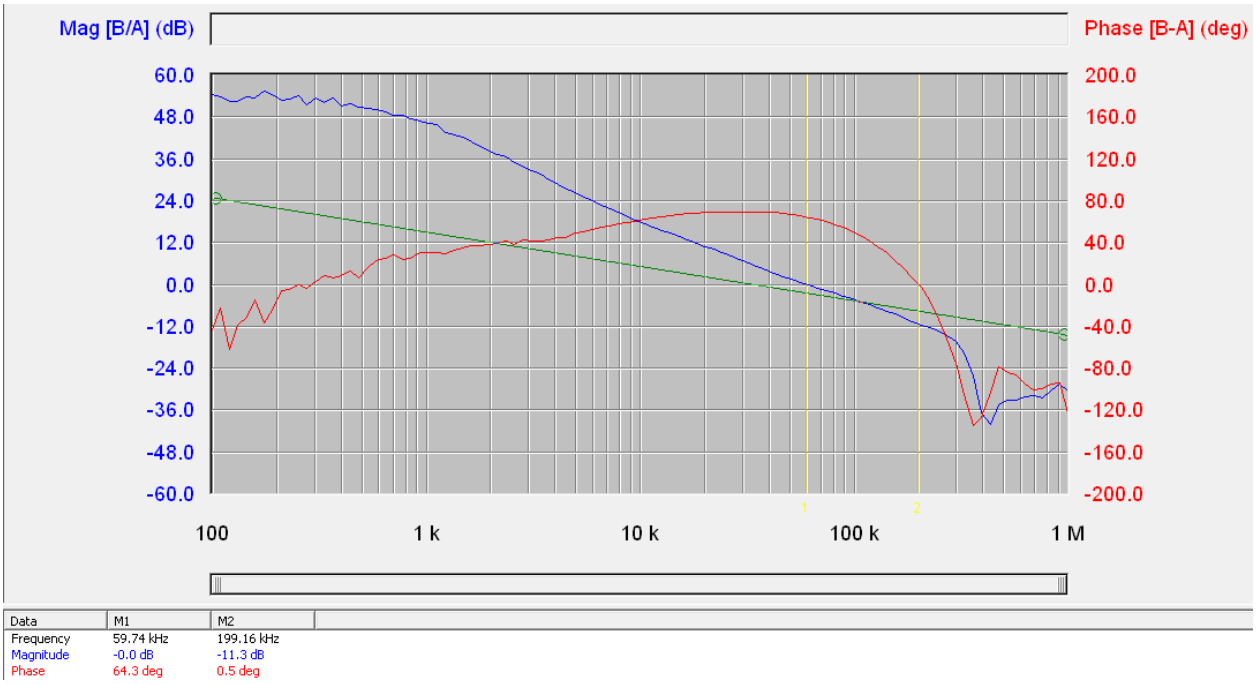




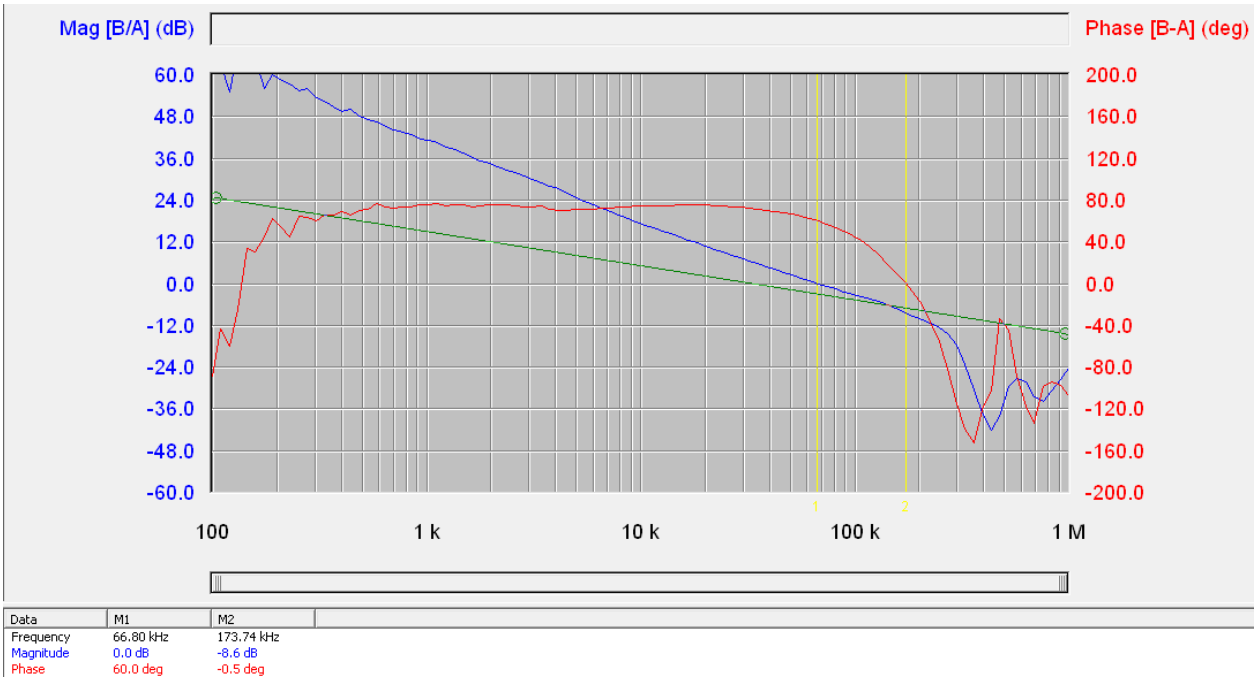
DEMO BOARD PERFORMANCE



DEMO BOARD PERFORMANCE

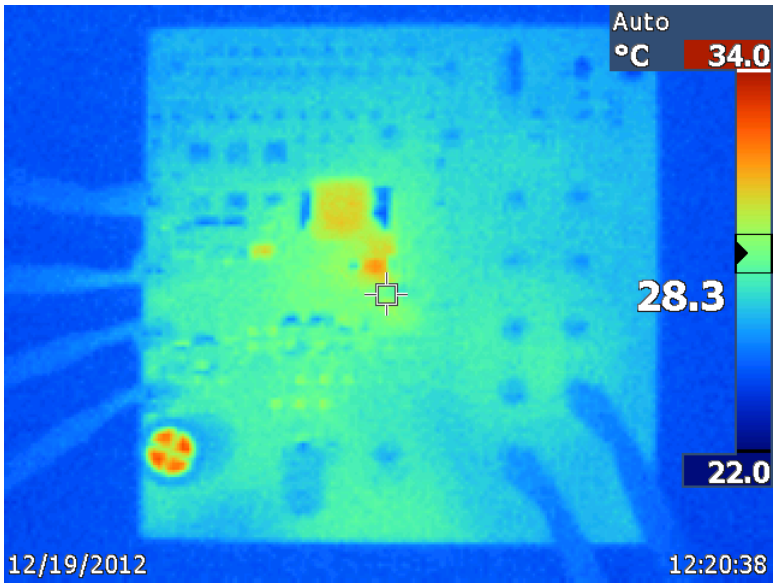


Bode Plot: $12V_{IN}$, 330mA Load: 0dB at 59.7KHz, PM=64.3deg, GM=11.3dB

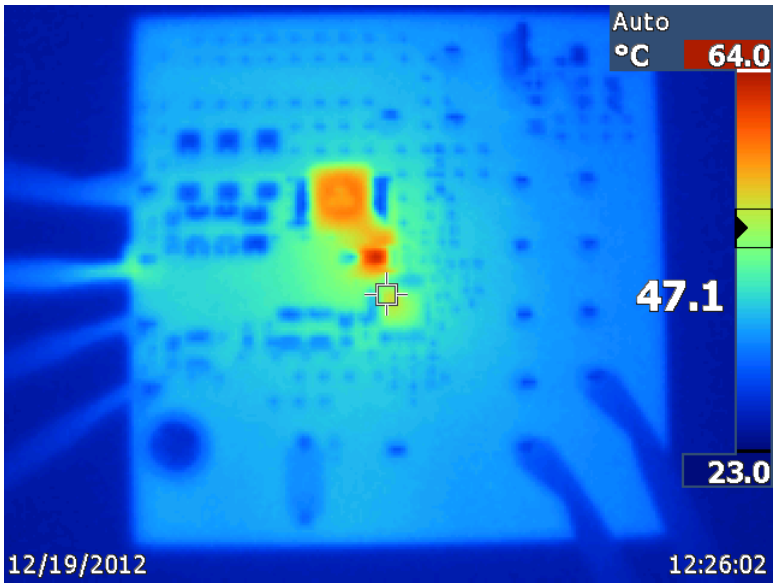


Bode Plot: $12V_{IN}$, 2.5A Load: 0dB at 66.8KHz, PM=60deg, GM=8.6dB

DEMO BOARD PERFORMANCE

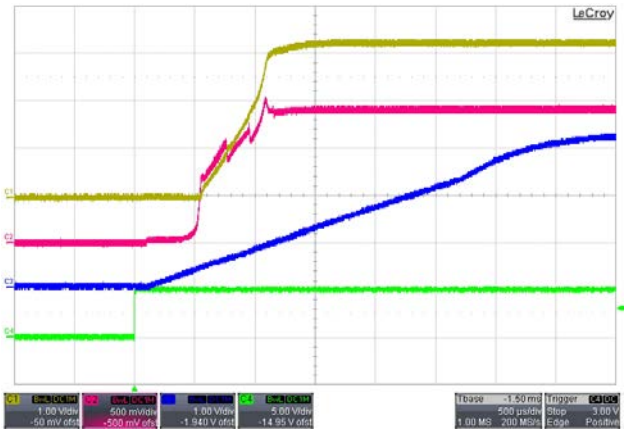


Component Temperatures: $12V_{IN}$, $3.3V_{OUT}$, 500mA Load, T_{AMB}=25°C
No Airflow (still air)

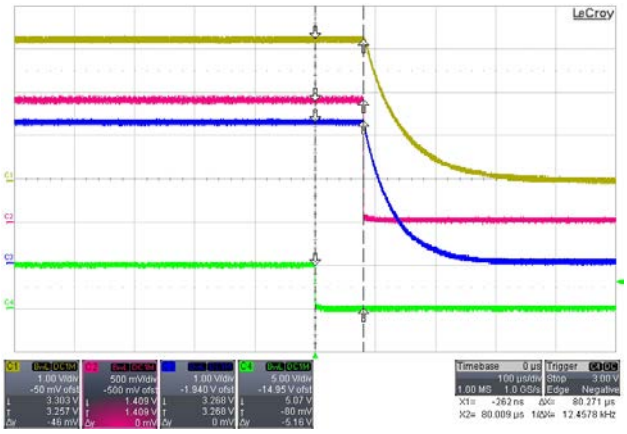


Component Temperatures: $12V_{IN}$, $3.3V_{OUT}$, 2.5A Load, T_{AMB}=25°C
No Airflow (still air)

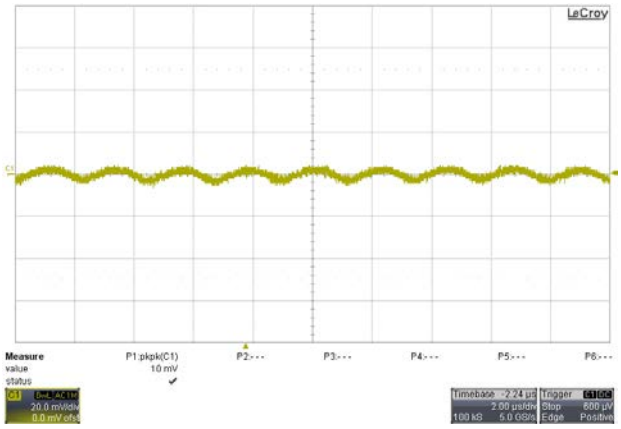
DEMO BOARD PERFORMANCE



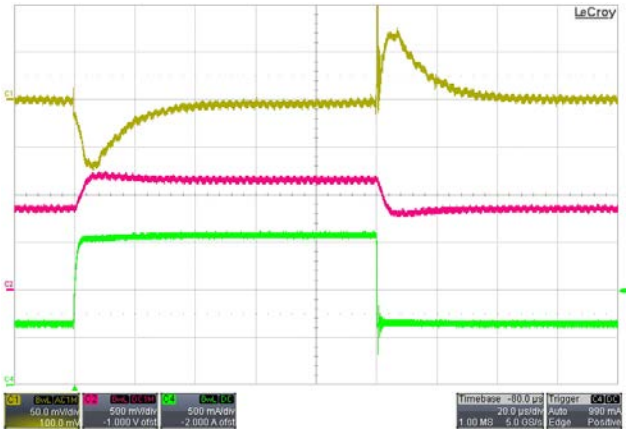
PWM Startup
$12V_{IN}$, 2.5A (1.3Ω) load, PWM/PFMn=1
CH1=V_{OUT}, CH2=COMP, CH3=SS, CH4=SLEEPn



PWM Shutdown
$12V_{IN}$, 2.5A (1.3Ω) load, PWM/PFMn=1
CH1=V_{OUT}, CH2=COMP, CH3=SS, CH4=SLEEPn

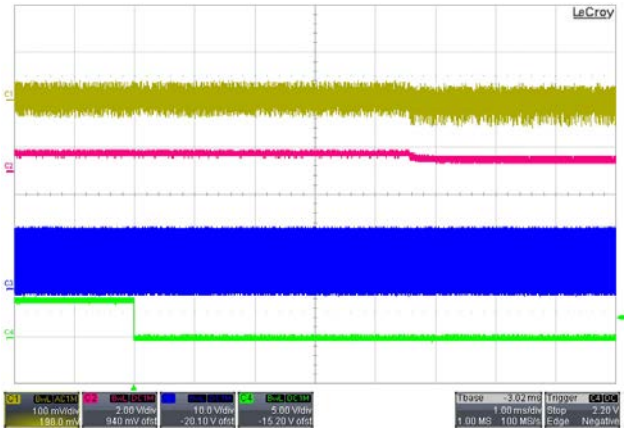


PWM Output Voltage Ripple
$12V_{IN}$, 2.5A (1.3Ω) load, PWM/PFMn=1,
CH1=V_{OUT}

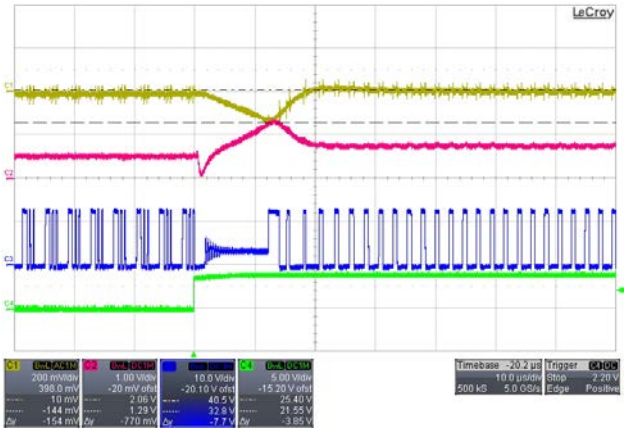


PWM Transient Response
$12V_{IN}$, 1A load step up/down,
PWM/PFMn=1
CH1=V_{OUT}, CH2=COMP, CH4=I_{OUT}

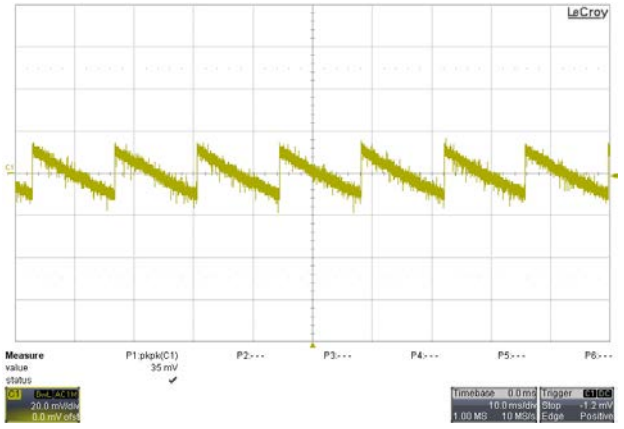
DEMO BOARD PERFORMANCE



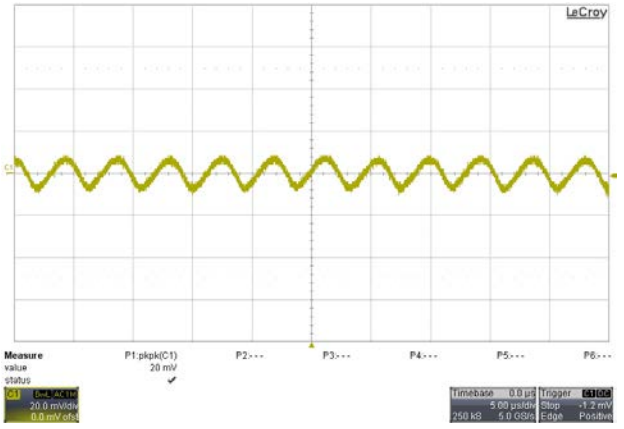
PWM to PFM Transition
$12V_{IN}$, 470mA (7Ω) load
CH1=V_{OUT}, CH2=COMP, CH3=SW, CH4=PWM/PFMn



PFM to PWM Transition
$12V_{IN}$, 470mA (7Ω) load
CH1=V_{OUT}, CH2=COMP, CH3=SW, CH4=PWM/PFMn

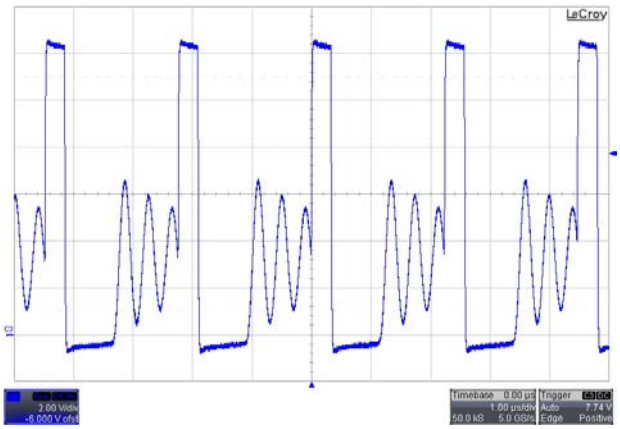


PFM Output Voltage Ripple
$12V_{IN}$, 1mA (3.3KΩ) load
CH1=V_{OUT}

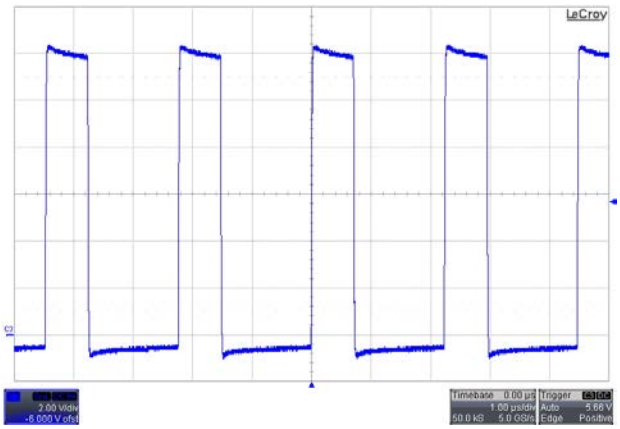


PFM Output Voltage Ripple
$12V_{IN}$, 400mA (8Ω) load
CH1=V_{OUT}

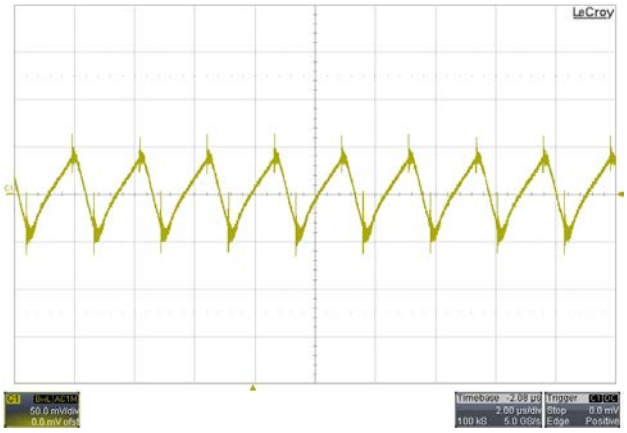
DEMO BOARD PERFORMANCE



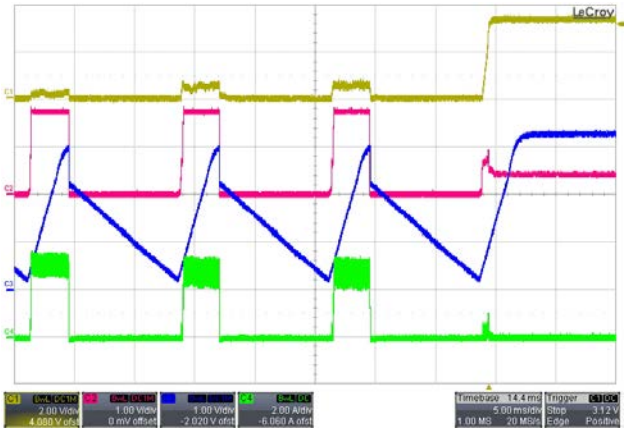
SW Voltage at $12V_{IN}$, 100mA load, PWM/PFMn=1
CH3=SW



SW Voltage at $12V_{IN}$, 2.5A load, PWM/PFMn=1
CH3=SW

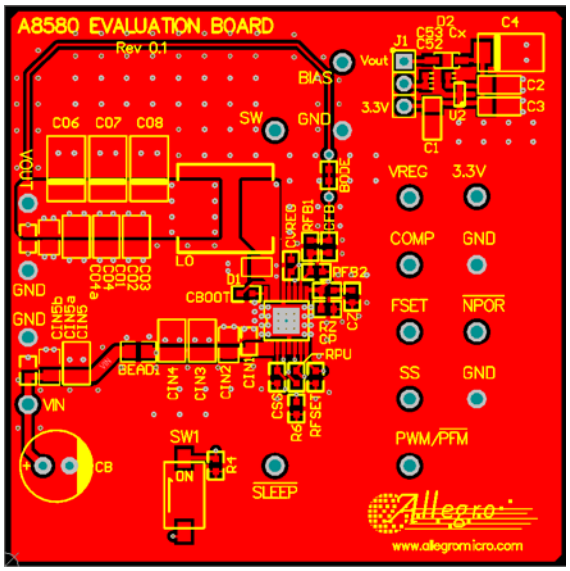


Input Voltage Ripple at $12V_{IN}$, 2.5A load, PWM/PFMn=1
CH1=V_{IN}

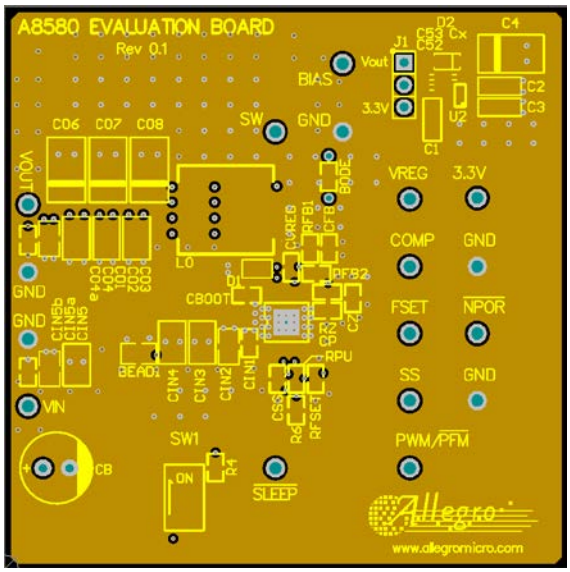


Output Shorted, Hiccup Mode Operation, PWM/PFMn=1
CH1=V_{OUT}, CH2=COMP, CH3=SS, CH4=I_L

DEMO PCB LAYOUT

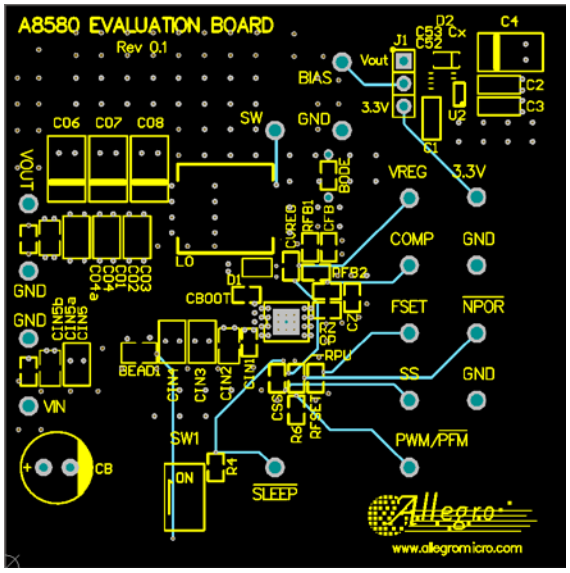


Top Layer and Top Silk

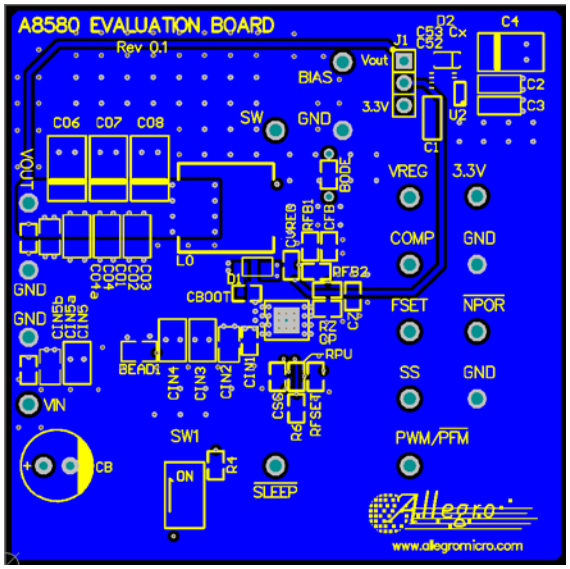


Layer 2 and Top Silk

DEMO PCB LAYOUT



Layer 3 and Top Silk



Bottom Layer and Bottom Silk