3-42Vin, 5Vout at 3A Buck-Boost Reference Design Optimized for Automotive Cold Crank Test Report

PMP10681

05/22/2015

Description

This is a modified LM5118 2 switch buck-boost single inductor evaluation module (EVM). It is designed to provide 15W (5V, 3A) of output power with an input voltage range of 3V to 42V. Note that that in order to startup the input voltage must be 5V or higher. Once this is achieved operation will continue down to an input voltage of 3V.

This design is focused at maintaining regulation through an automotive battery cold crank event. Modeled after the ISO 7637-2 standard, the cold crank transient test waveform falls from 12V to 3V in approximately 1ms. Regulation is achieved during and has only 200mV or deviation from the target output voltage of 5V. Refer to the cold crank section of the report for test results.

Specifications

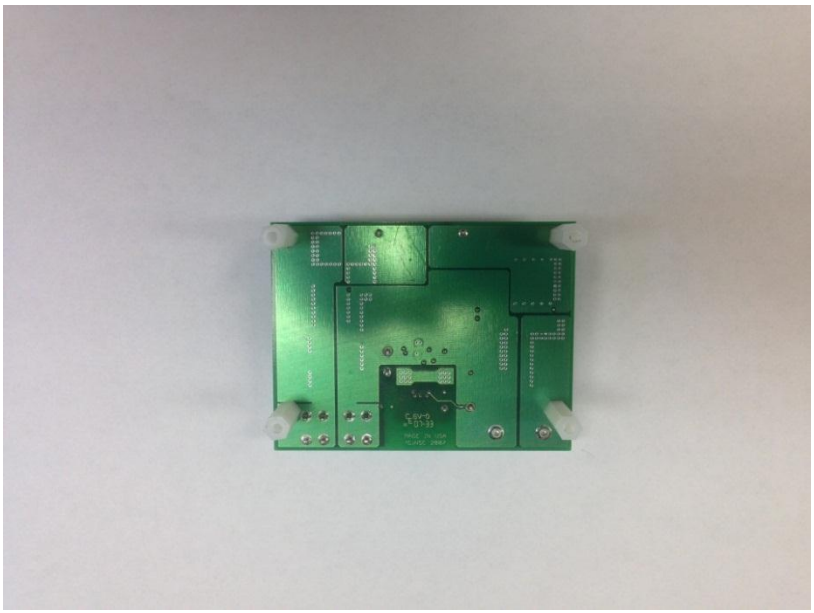
Parameter	Values
Vin Min (Operating) (Start-Up)	3V, 5V
Vin Typ	12V
Vin Max	42V
Vout	5V
Iout	3A
Switching Frequency	250kHz

Fabrication

Dimensions: 3.45 x 2.65 inches

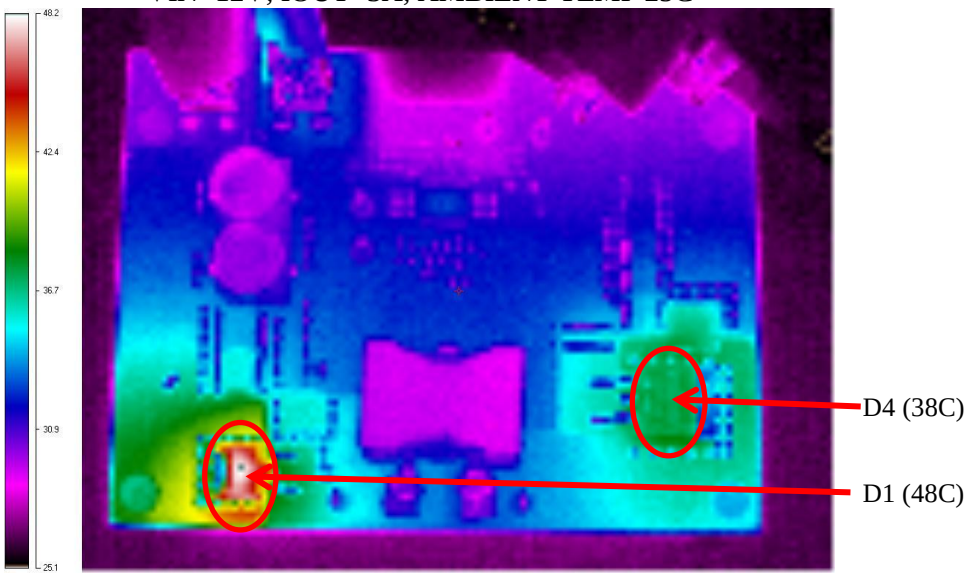
Front Side

Back Side

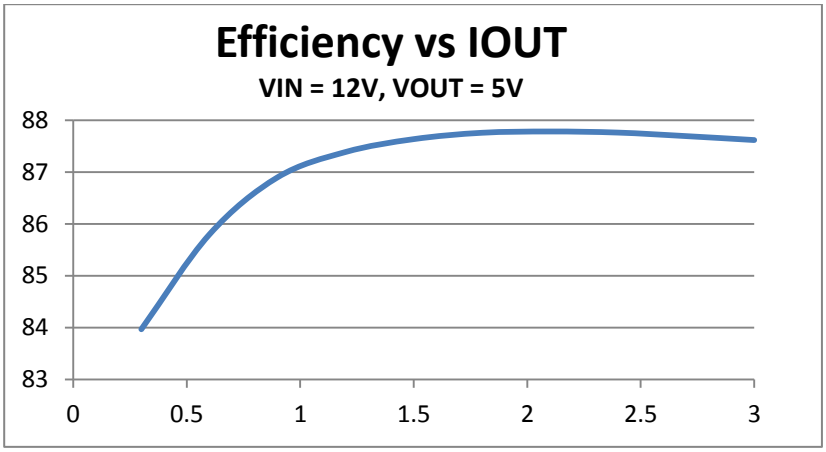


Thermal Image

VIN=12V, IOUT=3A, AMBIENT TEMP 25C



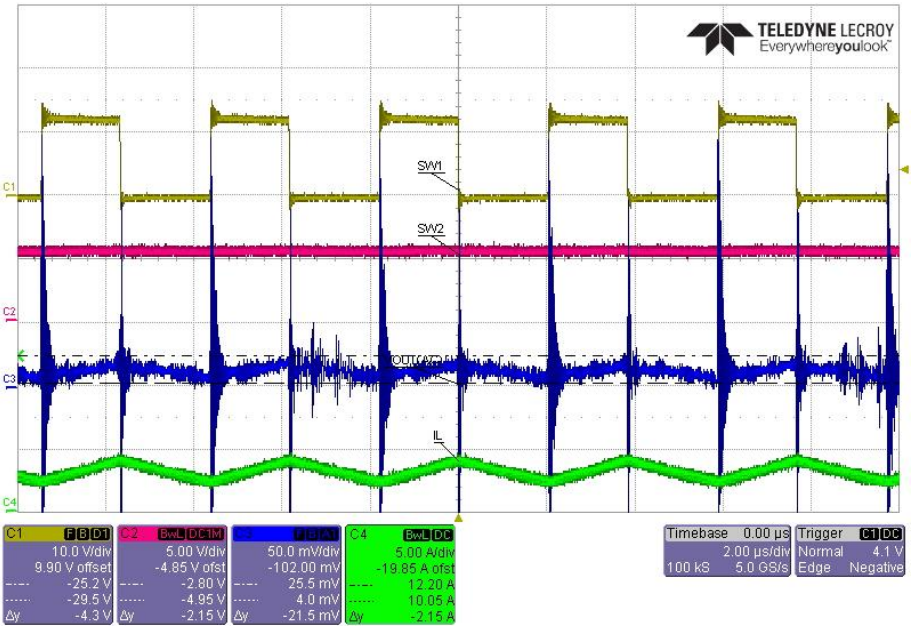
Efficiency



VIN	IIN	VOUT	IOUT	PIN	POUT	Efficiency
12.005	0.143	5.031	0.287	1.716715	1.443897	83.968
12.005	0.287	5.031	0.588	3.445435	2.958228	85.797
12.006	0.429	5.03	0.89	5.150574	4.4767	86.897
12.005	0.571	5.03	1.191	6.854855	5.99073	87.386
12.006	0.713	5.029	1.492	8.560278	7.503268	87.634
12.006	0.857	5.028	1.795	10.28914	9.02526	87.756
12.006	1	5.028	2.096	12.006	10.53869	87.781
12.006	1.144	5.027	2.397	13.73486	12.04972	87.76
12.006	1.288	5.026	2.699	15.46373	13.56517	87.692
12.006	1.433	5.026	3	17.2046	15.078	87.616

Steady State

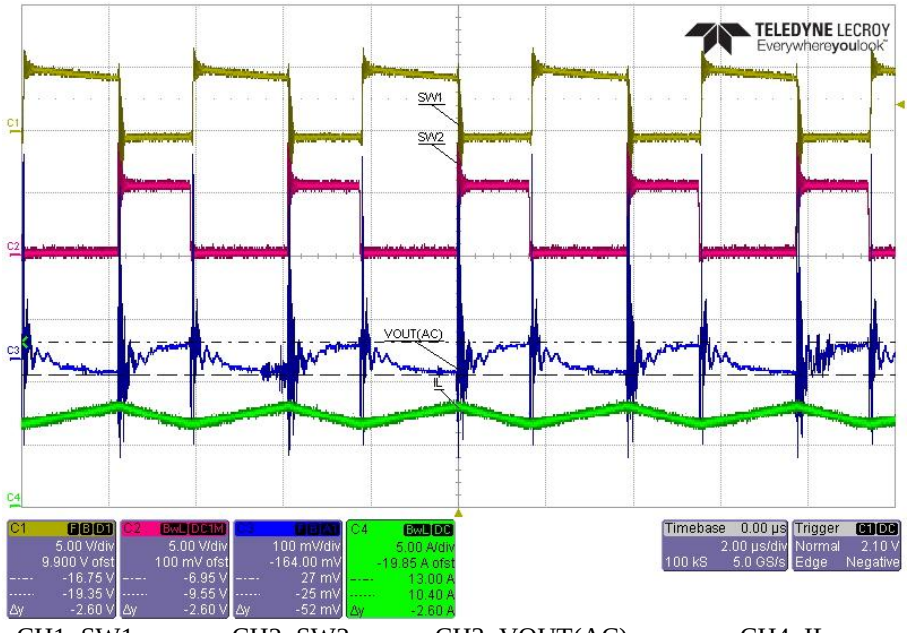
VIN = 12V, IOUT=3A



CH1: SW1 (10V/div) CH2: SW2 (5V/div) CH3: VOUT(AC)(50mV/div) CH4: IL(5A/div)

$VOUT_{P-P}$ = 21.5mV

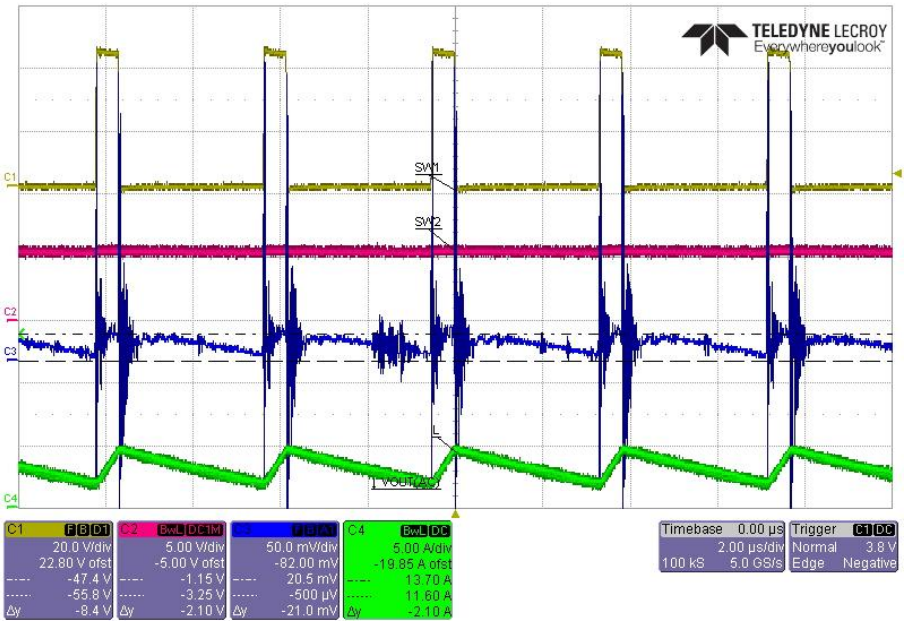
VIN = 5V, IOUT=3A



CH1: SW1 (5V/div) CH2: SW2 (5V/div) CH3: VOUT(AC)(100mV/div) CH4: IL(5A/div)

$VOUT_{P-P}$ = 52mV

VIN = 42V, IOUT=3A

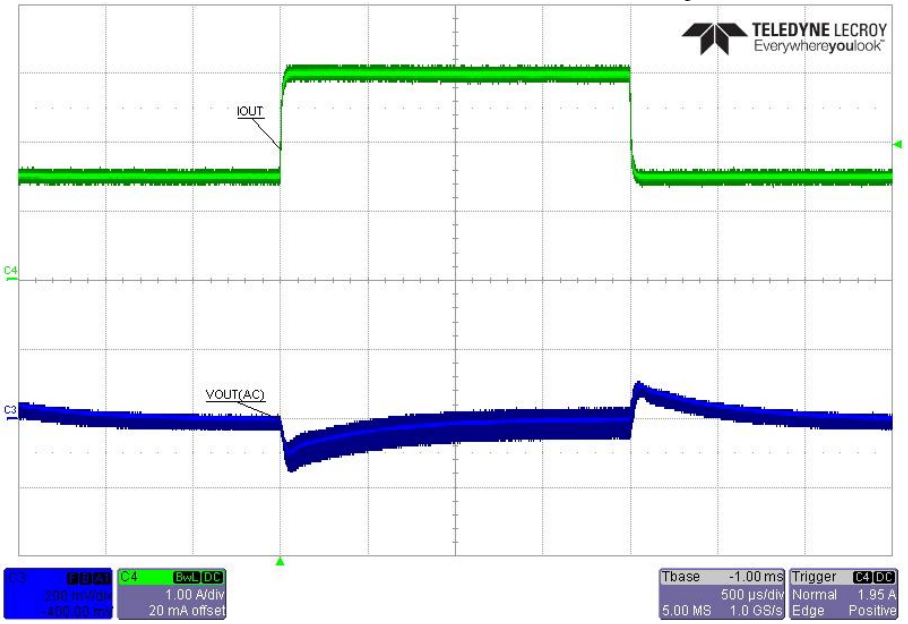


CH1: SW1 (20V/div) CH2: SW2 (5V/div) CH3: VOUT(AC)(50mV/div) CH4: IL(5A/div)

$VOUT_{P-P}$ = 21mV

Transient Response

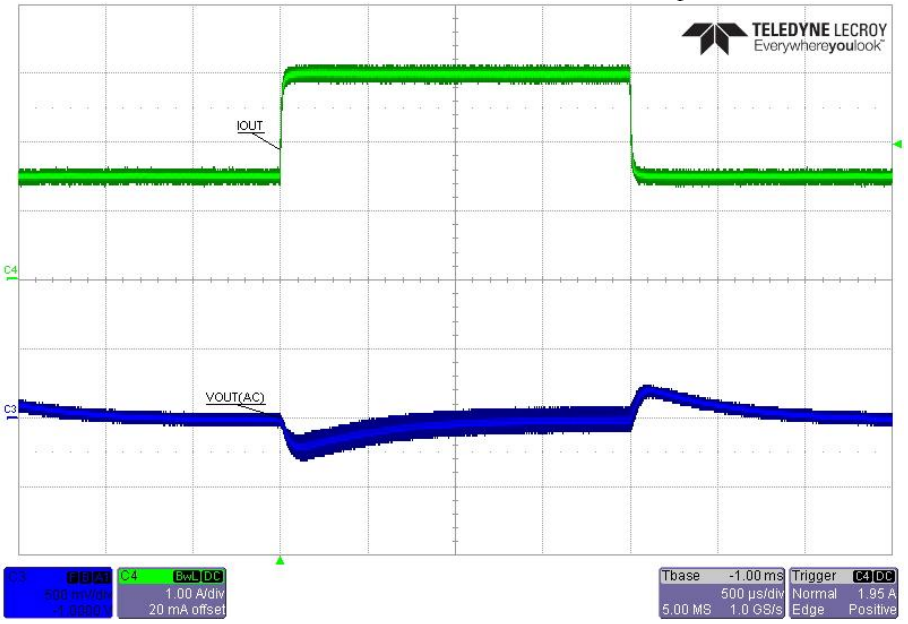
VIN = 12V, IOUT=1.5A to 3A Load Step



CH3: VOUT(AC) (200mV/div) CH4: IOUT (1A/div)

$VOUT_{DIP}$ = 150mV

VIN = 5V, IOUT=1.5A to 3A Load Step

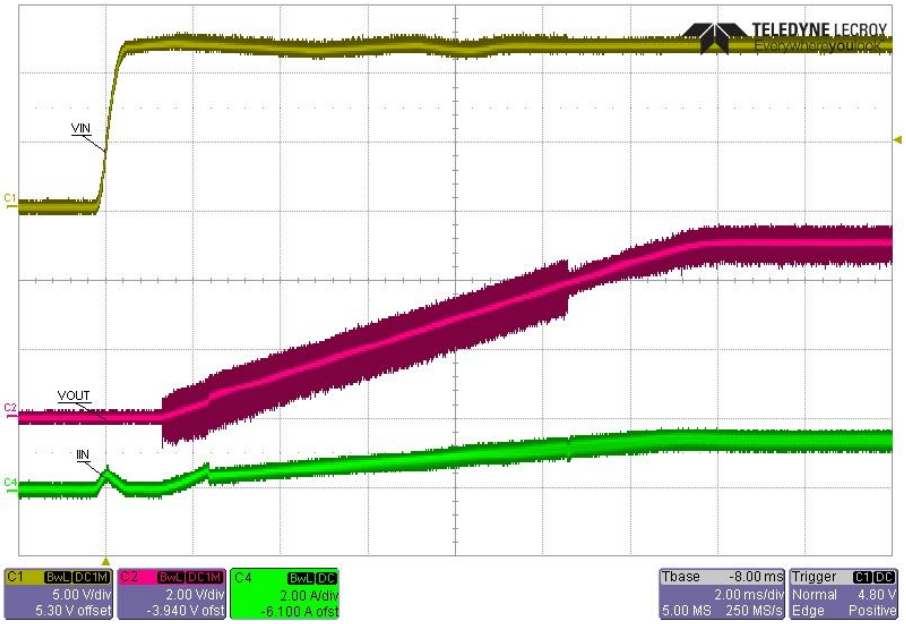


CH3: VOUT(AC) (200mV/div) CH4: IOUT (1A/div)

$VOUT_{DIP}$ = 150mV

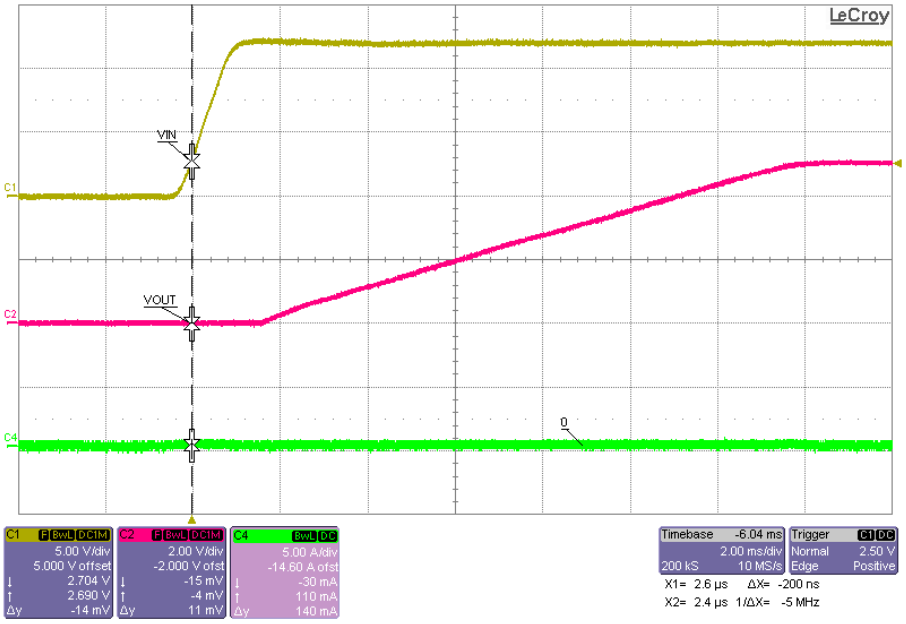
Start-Up

VIN = 12V, IOUT=3A



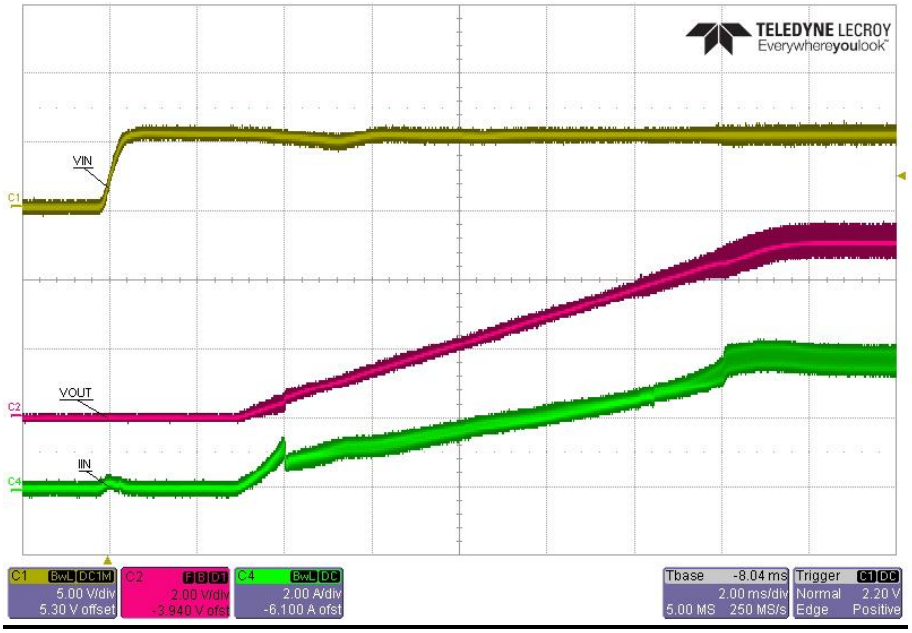
CH1: VIN (5V/div) CH2: VOUT (2V/div) CH4: IIN (2A/div)

VIN = 12V, IOUT=0A



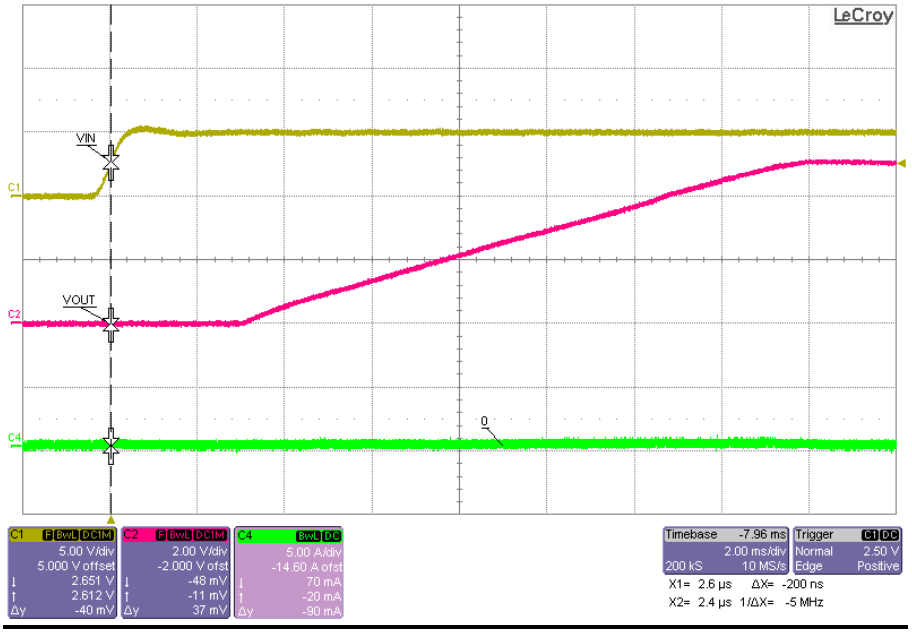
CH1: VIN (5V/div) CH2: VOUT (2V/div) CH4: IIN (5A/div)

VIN = 5V IOUT=3A



CH1: VIN (5V/div) CH2: VOUT (2V/div) CH4: IIN (2A/div)

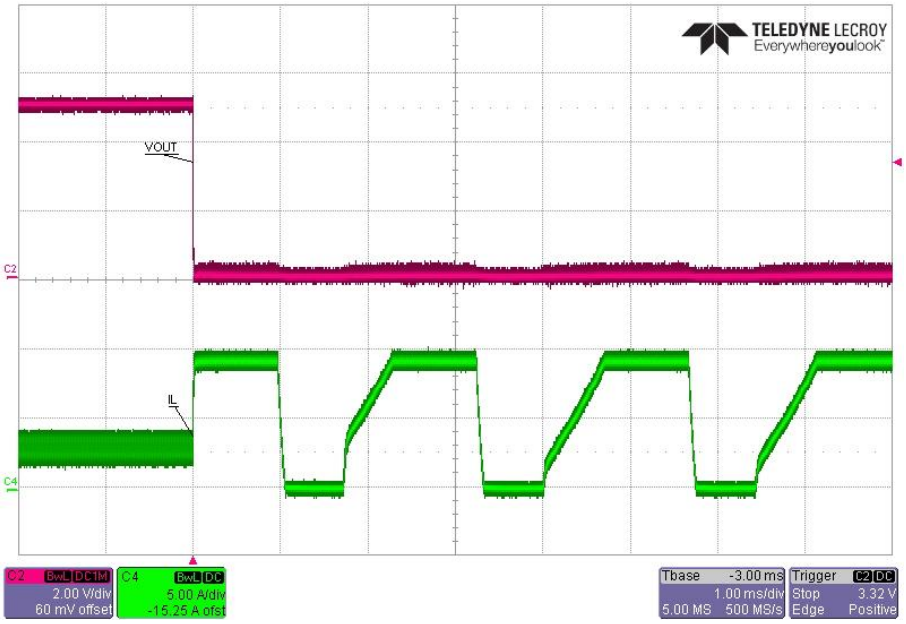
VIN = 5V IOUT=0A



CH1: VIN (5V/div) CH2: VOUT (2V/div) CH4: IIN (5A/div)

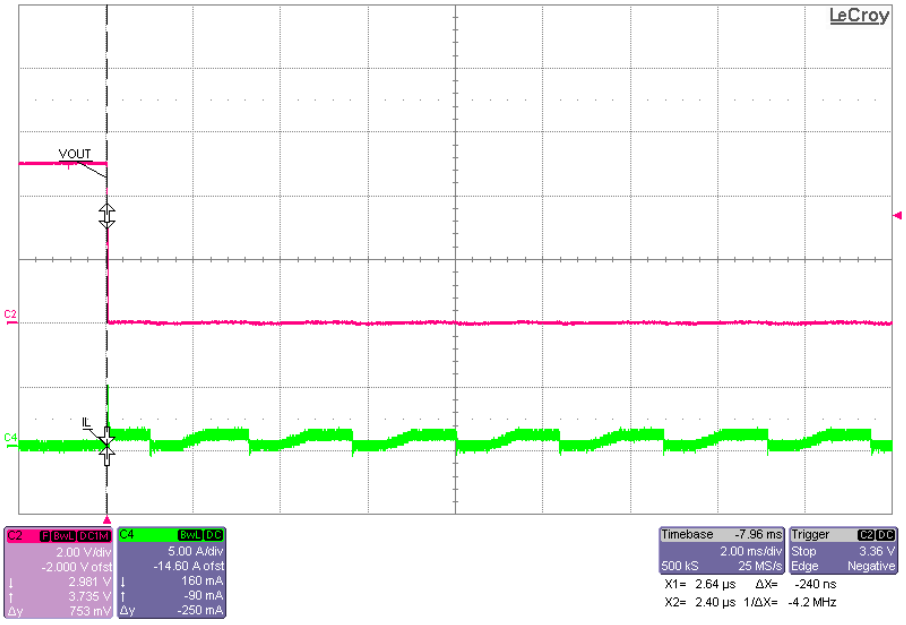
Short Circuit

VIN = 12V IOUT=3A Short Circuit



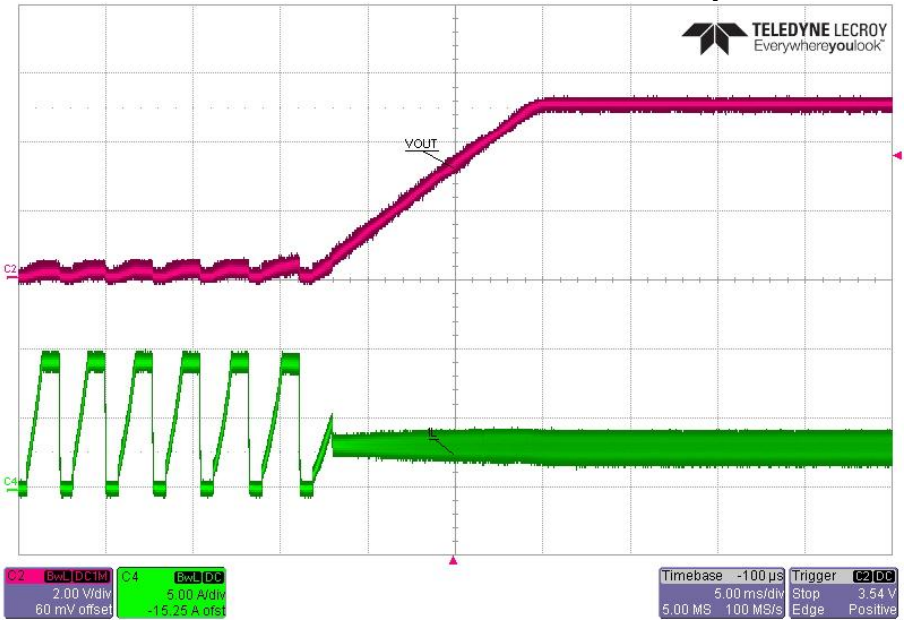
CH2: VOUT (2V/div) CH4: IL (5A/div)

VIN = 12V, IOUT=0A Short Circuit



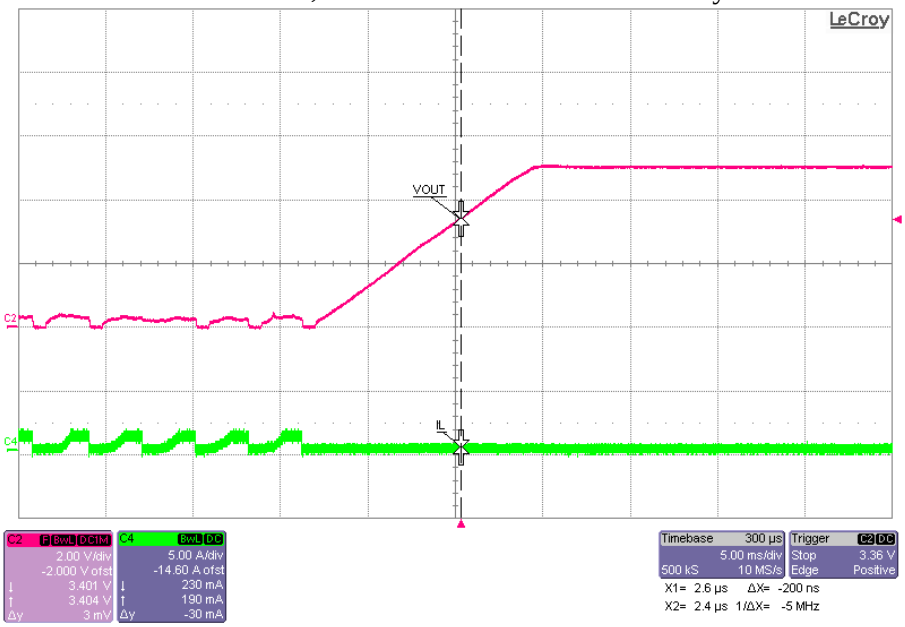
CH2: VOUT (2V/div) CH4: IL (5A/div)

VIN = 12V, IOUT=3A Short Circuit Recovery



CH2: VOUT (2V/div) CH4: IL (5A/div)

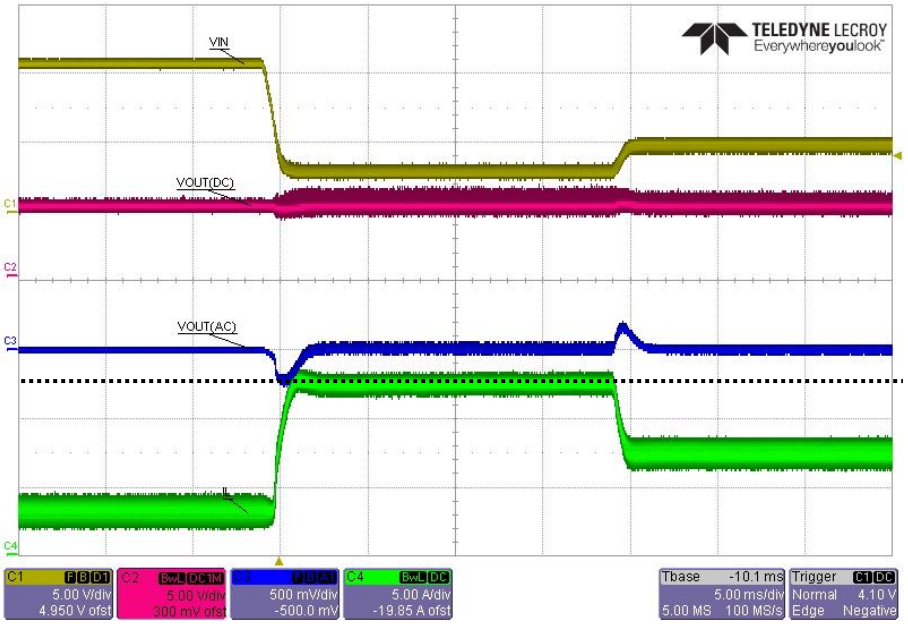
VIN = 12V, IOUT=0A Short Circuit Recovery



CH2: VOUT (2V/div) CH4: IL (5A/div)

Cold Crank

$VIN_{TRANSIENT}$ = 3V-12V, IOUT=3A

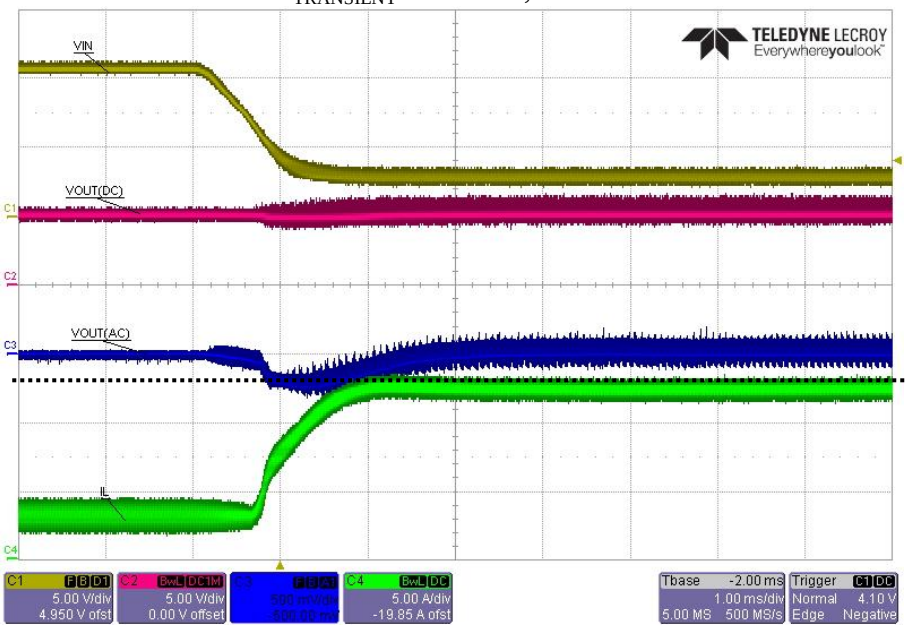


-200mv

CH1: VIN (5V/div) CH2: VOUT(DC) 5V/div CH3: VOUT(AC) (500mV/div) CH4: IL (5A/div)

$VOUT_{DIP}$ = 200mV

$VIN_{TRANSIENT}$ = 3V-12V, IOUT=3A

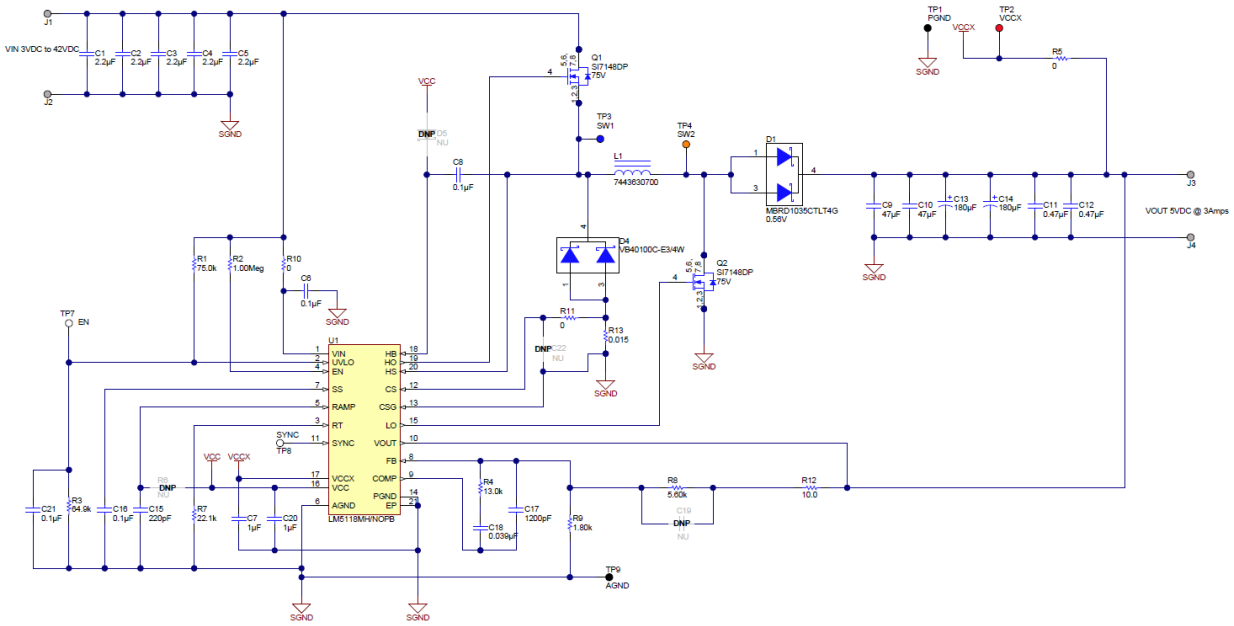


-200mv

CH1: VIN (5V/div) CH2: VOUT(DC) 5V/div CH3: VOUT(AC) (500mV/div) CH4: IL (5A/div)

$VOUT_{DIP}$ = 200mV, VIN_{TRANS}: 12V to 3V, t_{VIN_TRANS} >2ms

Schematic



Test Circuit Schematic

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