Sup*IR*Buck™

USER GUIDE FOR IRDC3710-QFN EVALUATION BOARD

DESCRIPTION

The IR3710M is a single phase sync-buck PWM controller IC optimized for efficiency in high performance portable electronics. The switching modulator uses constant ON-time control. Constant ON-time with diode emulation provides the highest light load efficiency required for all applications.

Key features offered by the IR3710M include: programmable switching frequency, soft start, forced continuous conduction mode (FCCM) operation at light load and over current protection.

Additional features include pre-bias startup, very precise 0.5V reference, over/under voltage fault protection, power good output, and enable input with voltage monitoring capability. The gate drive is designed to operate up to 7.5V to enhance over all system efficiency.

This user guide contains the schematic and bill of materials for the IRDC3710-QFN evaluation board. The guide describes operation and use of the evaluation board itself. Detailed specifications and application information for IR3710M is available in the IR3710M data sheet.

BOARD FEATURES

- V_{in} = +12V Typical (8-19V input Voltage range. Pls. see note below)
- PV_{cc}= +5.0V
- Vcc=+3.3V
- V_{out} = +1.1V @ 0- 20A
- F_s = 300kHz @ 20A
- L = 0.5uH
- C_{in}= 2x10uF (ceramic 1210) + 1x330uF (electrolytic)
- C_{out}= 2x10uF (ceramic 1206) + 3x330uF(SP Cap)

Note: At low input line an additional 10uF ceramic capacitor is recommended at input to handle higher ripple current)

CONNECTIONS and OPERATING INSTRUCTIONS

A regulated +12V input supply should be connected to VIN+ and Vin-. A maximum 20A load should be connected to VOUT+ and VOUT-. The connection diagram is shown in Fig. 1 and inputs and outputs of the board are listed in Table I.

IRDC3710-QFN has three input connectors, one for gate drive supply (PVcc),one for biasing (Vcc) and the third one as input voltage (Vin). Separate supplies should be applied to these inputs. PVcc input should be a well regulated 4.5V-5.5V supply and it would be connected to +5V and GROUND and Vcc input should be a well regulated 3.0V-3.6V supply and it would be connected to +3.3V and GROUND. An external signal can be provided as Enable signal to turn on or turn off the converter if desired. This signal is not required to power up the Evaluation board as EN pin is connected to a voltage divider from Vin. The absolute maximum voltage of Enable signal is +3.9V.

The evaluation board is configured for use with 2x10uF (ceramic 1206) + 3x330uF (SP) capacitors. However, the design can be modified for an all ceramic output cap configuration by adding the inductor DCR sensing circuit as show in the schematic.

Table 1: Connections

Connection	Signal Name
VIN+	VIN (+12V)
VIN-	Ground of VIN
+5V	PVcc input (+5.0V)
+3.3V	Vcc input (+3.3V)
GROUND	Ground for PVcc and Vcc input
VOUT+	V_{out} (+1.1V)
VOUT+	Ground of V_{out}
Enable	Enable input

LAYOUT

The PCB is a 4-layer board. All layers are 2 Oz. copper. The IR3710M and other components are mounted on the top and bottom side of the board.

Power supply decoupling capacitors, the Bootstrap capacitor and feedback components are located close to IR3710M. The feedback resistors are connected to the output voltage at the point of regulation and are located close to IR3710M. To improve efficiency, the circuit board is designed to minimize the length of the on-board power ground current path.

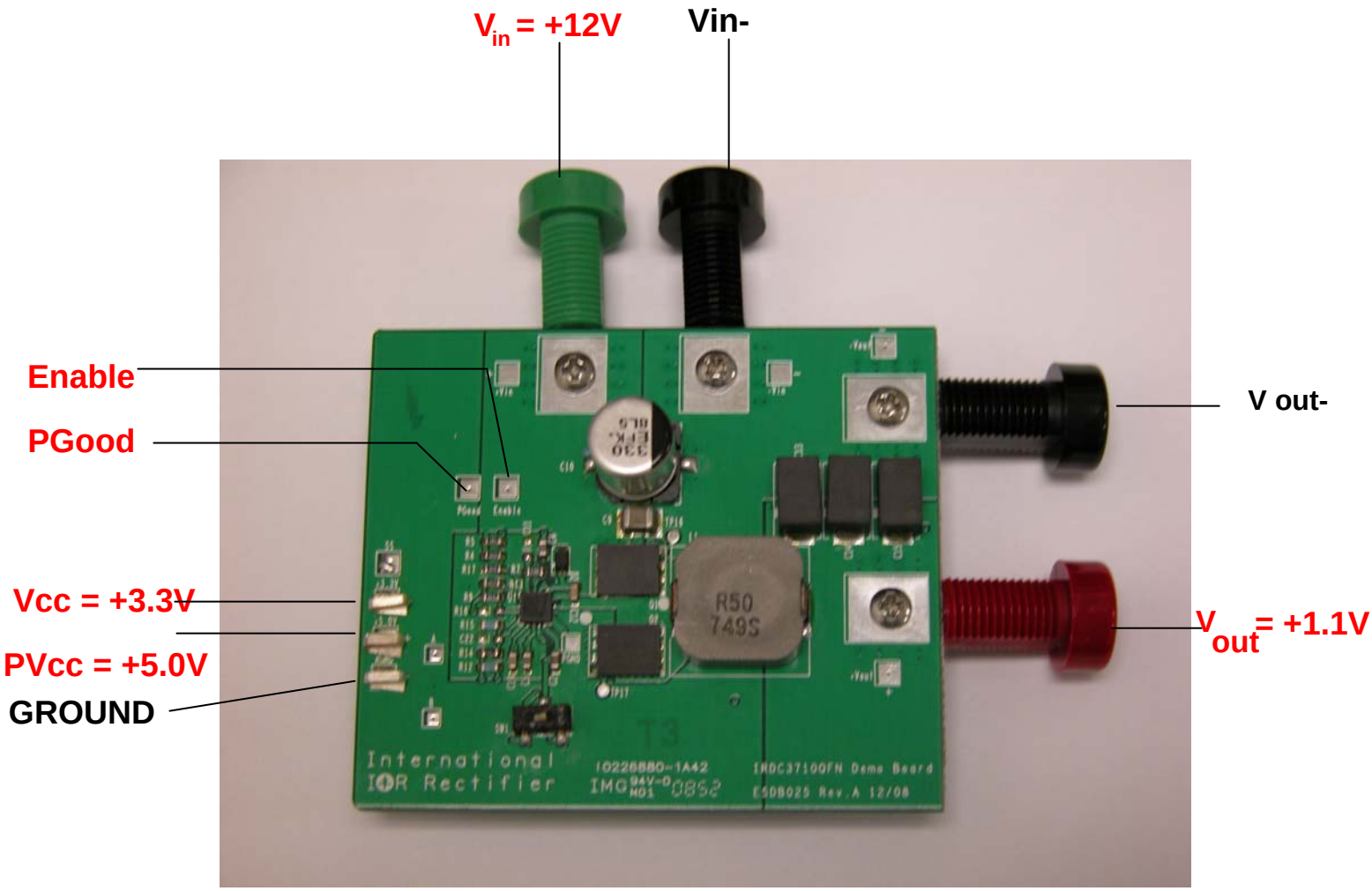


Figure 1: Connection diagram of IRDC3710-QFN evaluation board

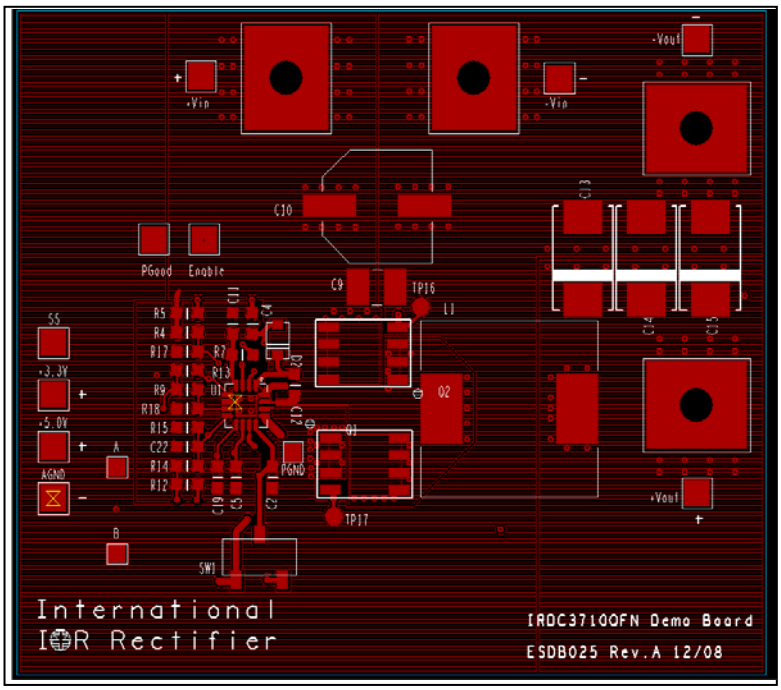


Figure 2: PCB layout, top layer

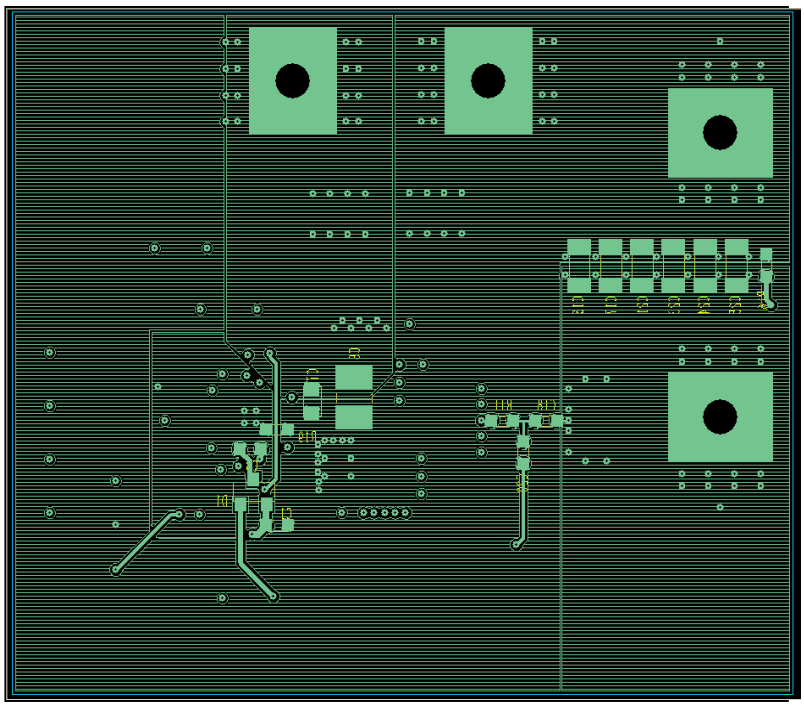


Figure 3: PCB layout, bottom layer

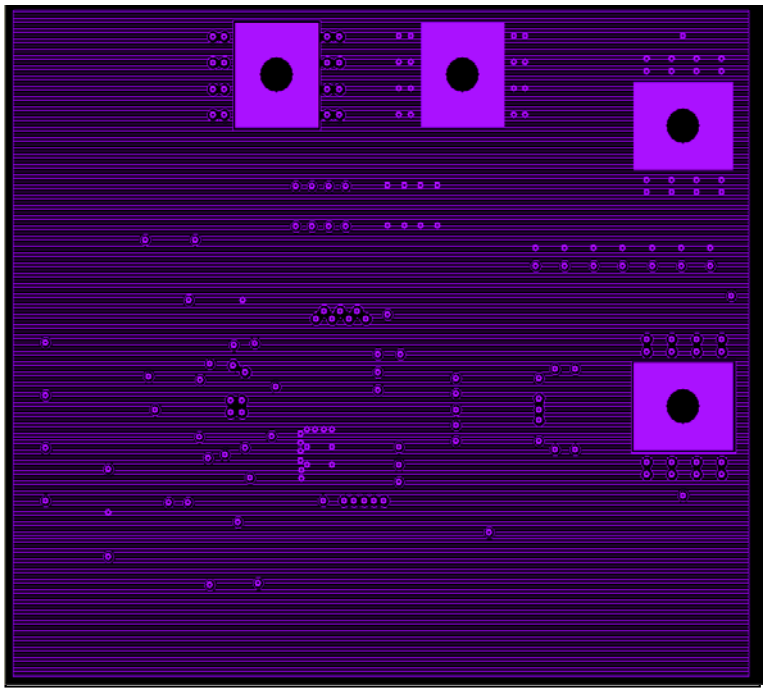


Figure 4: Board layout, mid-layer I

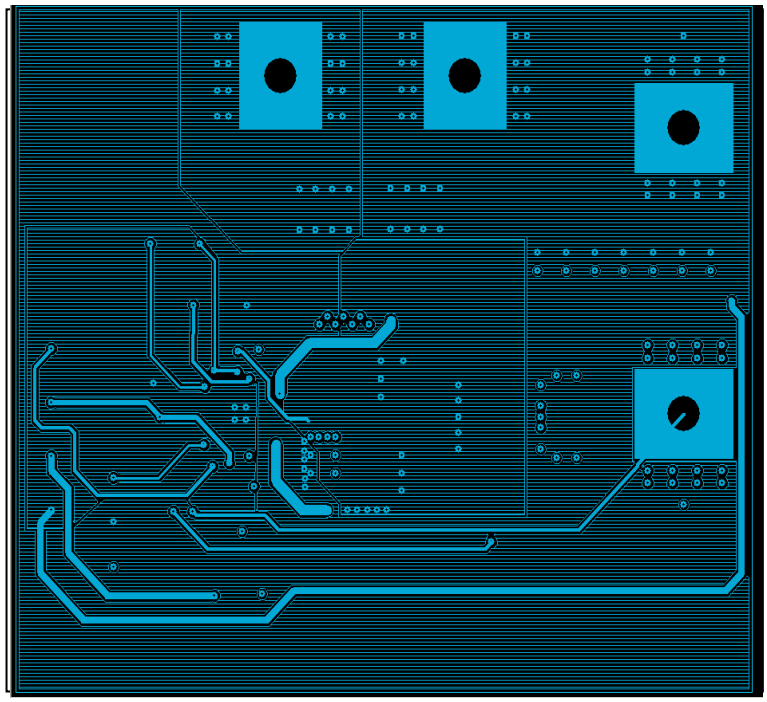


Figure 5: Board layout, mid-layer II

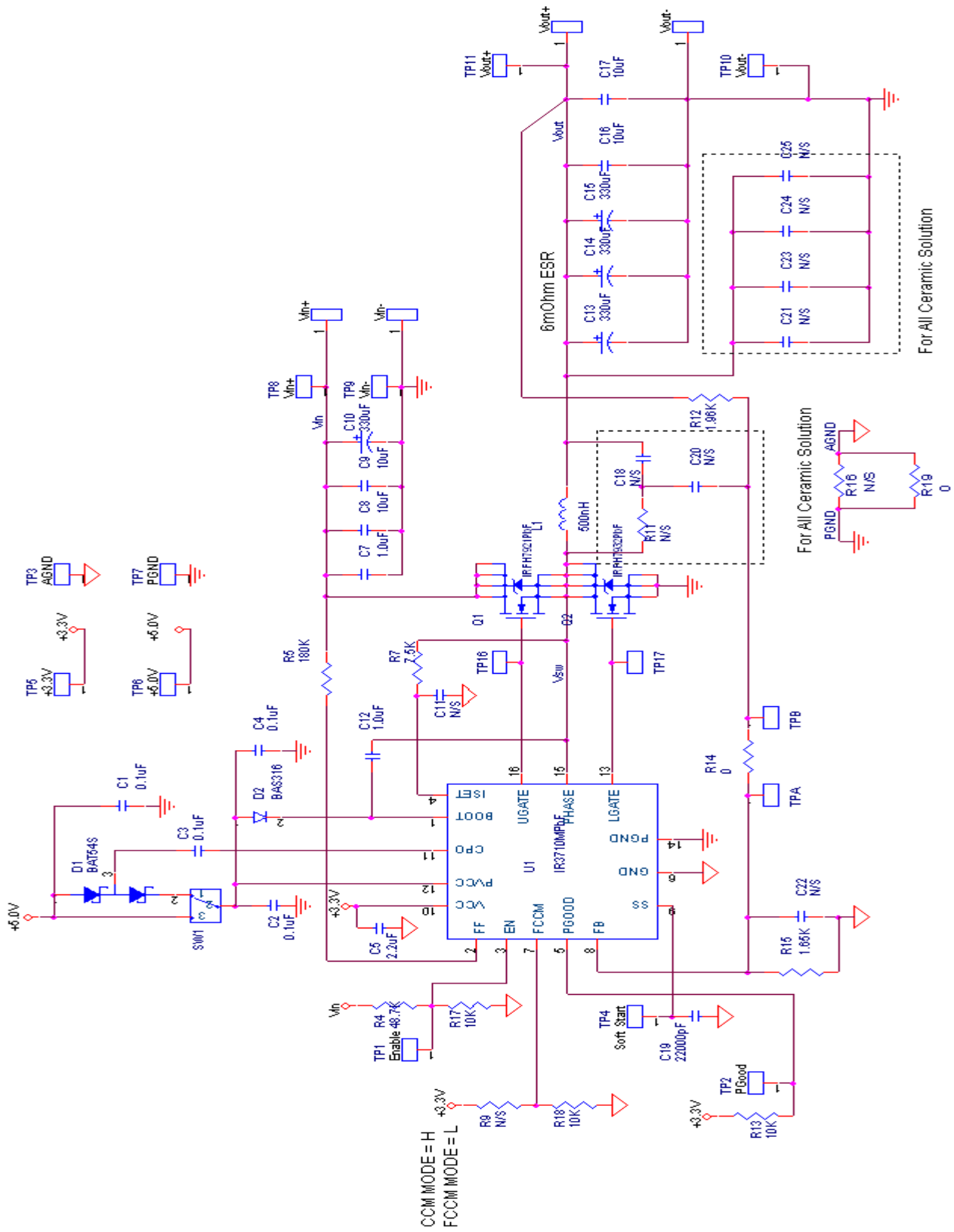


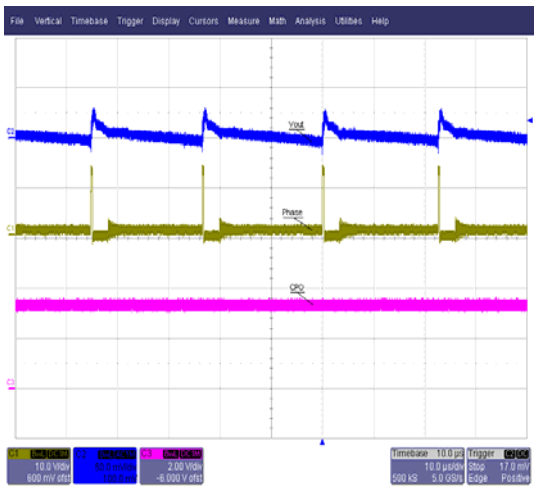
Figure 6: Schematic of the IRDC3710-QFN Evaluation board

Bill of Materials

Item Number	Quantity	Part Reference	Value	Description	Manufacturer1	Manufacturer Part Number
1	4	C1 C2 C3 C4	0.1uF	Ceramic,25V,0603,X7R,10%	Murata Electronics North America	GRM188R61E105KA12D
2	1	C5	2.2uF	Ceramic, 6.3V, 0603, X7R, 10%	Murata Electronics North America	GRM185R60J225KE26D
3	1	C7	1.0uF	Ceramic, 25V, 0805, X5R, 10%	Taiyo Yuden	TMK212BJ105KG-T
4	2	C8 C9	10uF	Ceramic,25V,1210,X5R,10%	Taiyo-Yuden	TMK325BJ106MN-T
5	1	C10	330uF	SMD Electrolytic, 25V, F-size,20%	Panasonic	EEE-FK1E331P
6	1	C12	1.0uF	Ceramic,25V,0603,X5R,10%	Murata Electronics North America	GRM188R61E105KA12D
7	3	C13 C14 C15	330uF	SP-Cap,Dcase,4V,20%	Panasonic	EEFUE0G331XE
8	2	C16 C17	10uF	Ceramic,6.3V,1206,X5R,20%	Murata Electronics North America	GRM21BCB0G106ME19F
		C11,C18,C20,C22		N/S		
		C21,23,C24, C25		N/S		
9	1	C19	22000pF	Ceramic,50V,0603,X7R,10%	TDK Corporation	C1608X7R1H223K
10	1	D1	BAT54S	Diode,40V,BAT54S,SOT-23	Diodes, Inc.	BAT54S
11	1	D2	BAS316	Diode 75V , 0.25A, SOD323	NXP	BAS316
12	1	L1	500nH	SMT-Inductor, 0.8mOhm,12.1x13.4mm,20%	Toko	FDUE1245-R50M
13	1	Q1	IRFH7921PbF	Mosfet 30V 8.5mOhm PQFN	International Rectifier	IRFH7921PbF
14	1	Q2	IRFH7932PbF	Mosfet 30V 3.3mOhm PQFN	International Rectifier	IRFH7932PbF
15	4	R13 R17 R18	10K	Thick-film,0603,1/10W,1%	Vishay/Dale	CRCW060310K0FKEA
		R4	48.7K	Thick-film,0603,1/10W,1%	Rohm	MCR03EZPFX4872
16	1	R5	180K	Thick-film,0603,1/10W,1%	Rohm	MCR03EZPFX1803
17	1	R7	7..5K	Thick-film,0603,1/10 W,1%	Rohm	MCR03EZPFX7501
18	1	R12	1.96K	Thick-film,0603,1/10W,1%	Rohm	MCR03EZPFX1961
19	3	R14 R19	0	Thick-film,0603,1/10 W,5%	Vishay/Dale	CRCW06030000Z0EA
		R9,R11,R16	N/S			
20	1	R15	1.65K	Thick-film,0603,1/10W,1%	Panasonic - ECG	ERJ-3EKF1651V
21	1	SW1	Switch, 2-Pos.	Switch, DIP, 2-Pos., SPDT	Copal Electronics Inc	CJS-1200TB
22	1	U1	IR3710MPbF	IR3710, Controller,PQFN,3x3mm	International Rectifier	IR3710MPbF

TYPICAL OPERATING WAVEFORMS

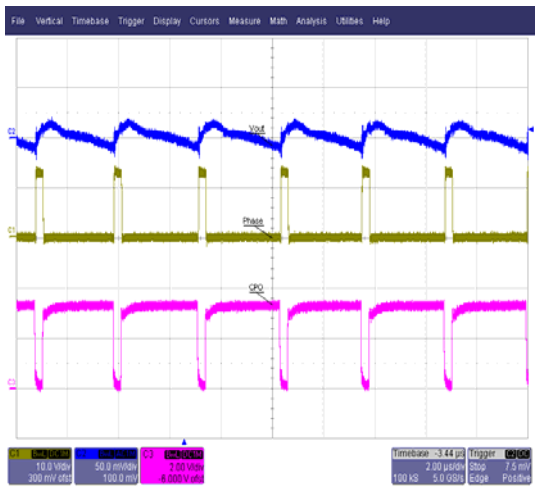
Vin=12V, PVcc=5.0V, Vcc=3.3V,Vo=1.1V, Io=0- 20A, , Room Temperature, No Air Flow



Ch1-Phase Voltage(10V/Div)
Ch3-CPO(2V/Div)

Ch2-Vout(50mV/div)
Time: 10uS/Div)

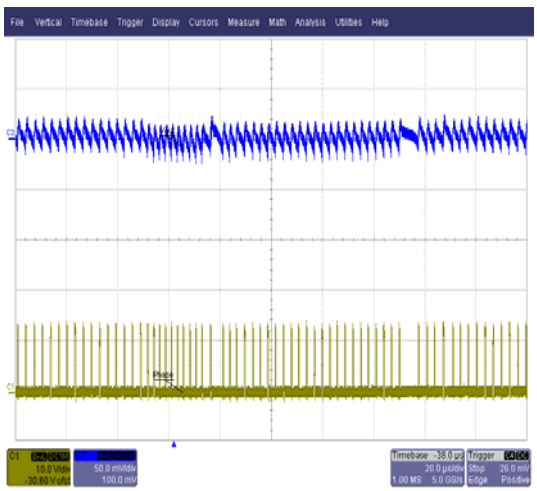
Figure 7: Charge Pump Off at Iout = 0.5A



Ch1-Phase Voltage(10V/Div)
Ch3-CPO(2V/Div)

Ch2-Vout(50mV/div)
Time: 2uS/Div)

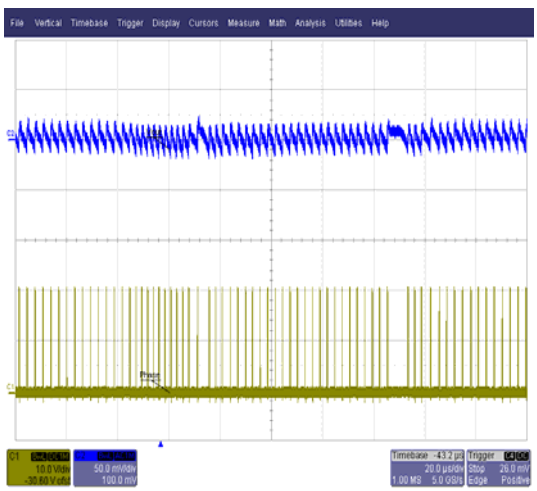
Figure 8: Charge Pump On at Iout =5A



Ch1-Phase Voltage (10V/Div)

Ch2-Vout(50mV/Div)

Figure 9: Load Step (5A to 15A) Transient at 12Vin



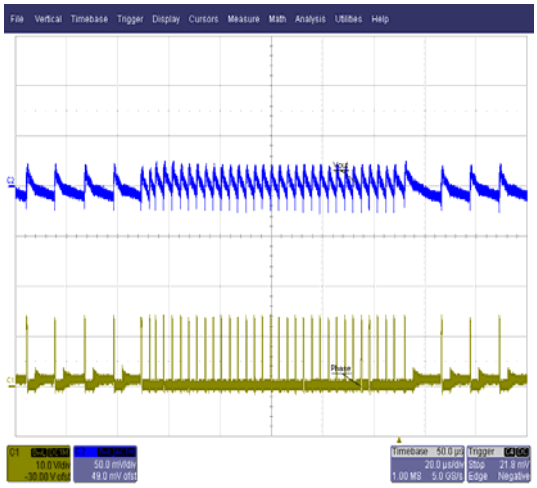
Ch1-Phase Voltage (10V/Div)

Ch2-Vout(50mV/Div)

Figure 10: Load Step (5A to 15A) Transient at 19Vin

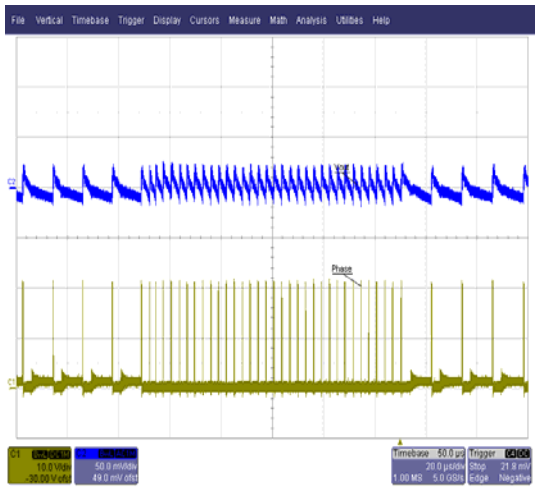
TYPICAL OPERATING WAVEFORMS

Vin=12V, PVcc=5.0V, Vcc=3.3V,Vo=1.1V, Io=0- 20A, Room Temperature, No Air Flow



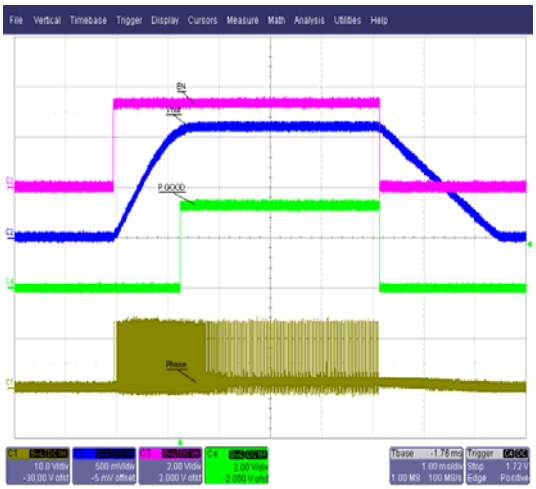
Ch1-Phase Voltage (10V/Div) Ch2-Vout(50mV/Div)

Figure 11: DCM/CCM transition from 1.0A to 5A at 12Vin



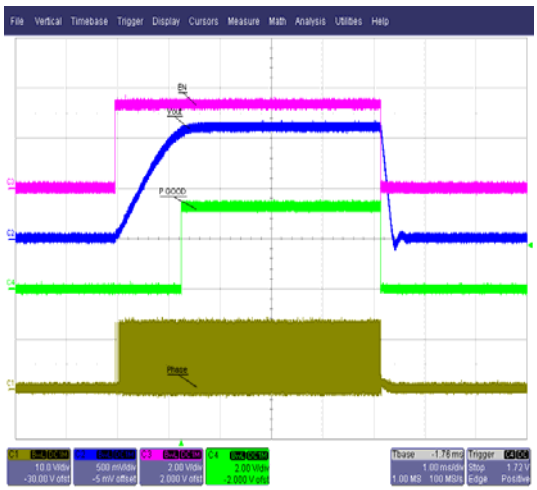
Ch1-Phase Voltage (10V/Div) Ch2-Vout(50mV/Div)

Figure 12: DCM/CCM transition from 1.0A to 5A at 19Vin



Ch1-Phase Voltage (10V/Div)
Ch3-EN(2V/Div)
Ch2-Vout(500mV/Div)
Ch4-PGood(2V/Div)

Figure 13: Startup/Shutdown 12Vin at 0.5A



Ch1-Phase Voltage (10V/Div)
Ch3-EN(2V/Div)
Ch2-Vout(500mV/Div)
Ch4-PGood(2V/Div)

Figure 14: Startup/Shutdown 12Vin at 5.0A

TYPICAL OPERATING WAVEFORMS

Vin=12V, PVcc=5.0V, Vcc=3.3V, Vo=1.1V, Io=0- 20A, , Room Temperature, No Air Flow

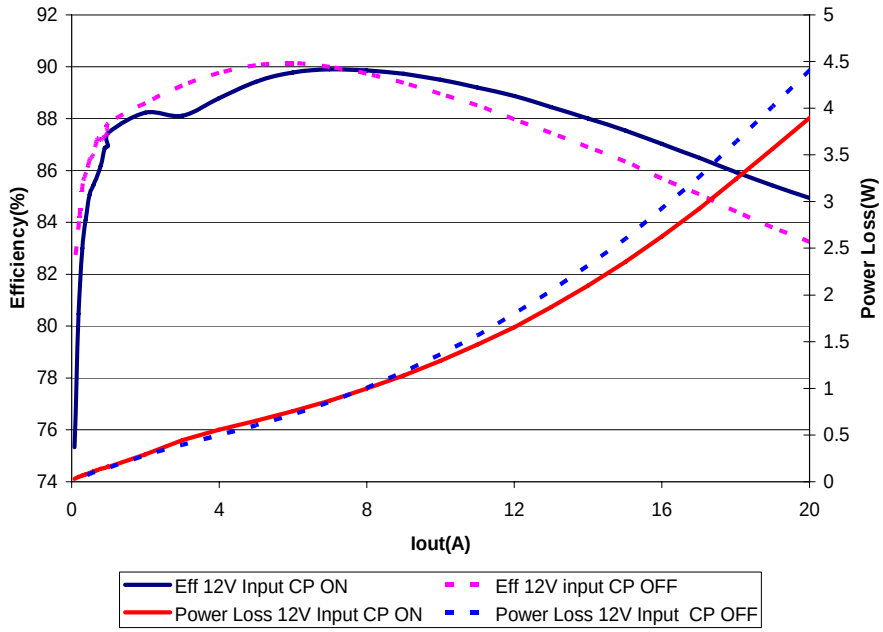


Figure 15: Typical Efficiency and Power Loss at Vin-12V

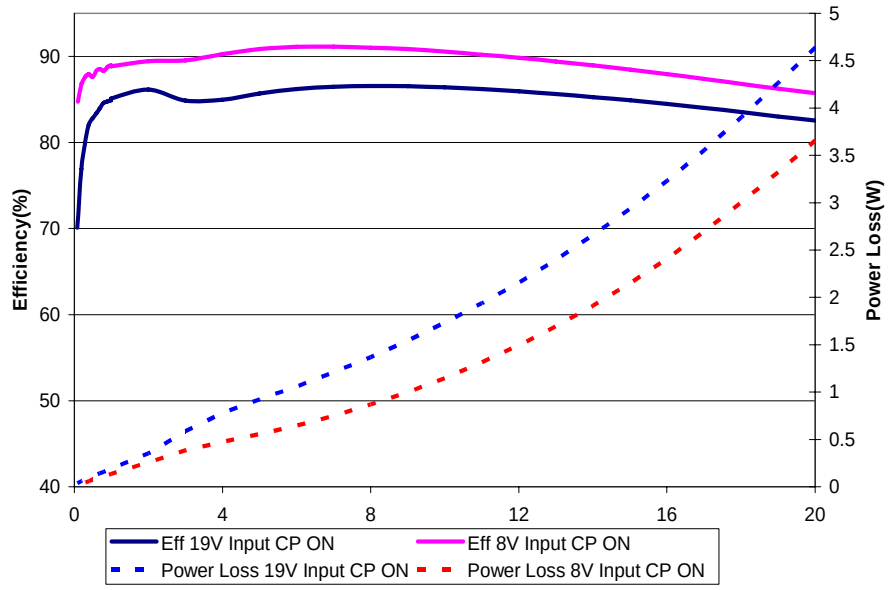


Figure 16: Typical Efficiency and Power Loss at Vin=8V and 19V

TYPICAL OPERATING WAVEFORMS

Vin=12V, PVcc=5.0V, Vcc=3.3V, Vo=1.1V, Io=0- 20A, , Room Temperature, No Air Flow

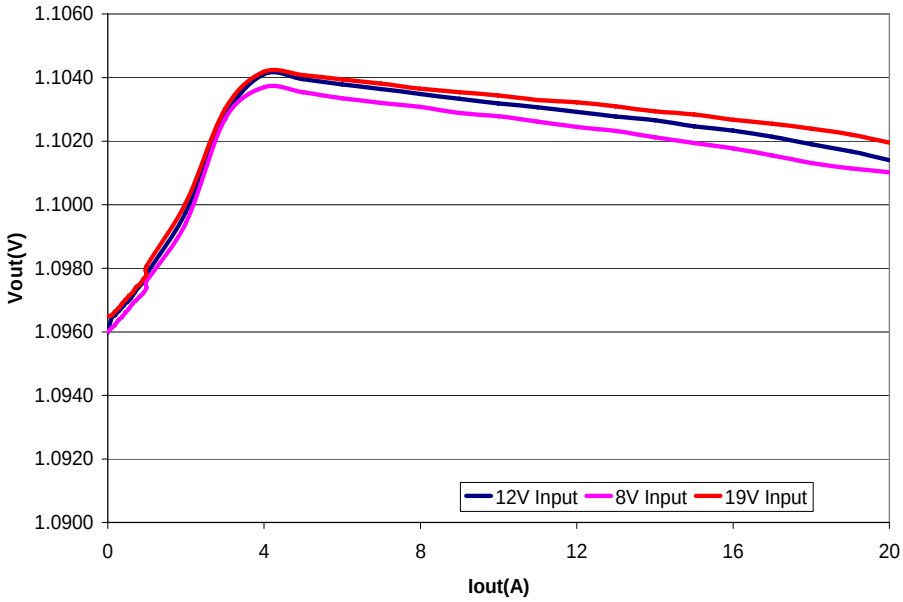
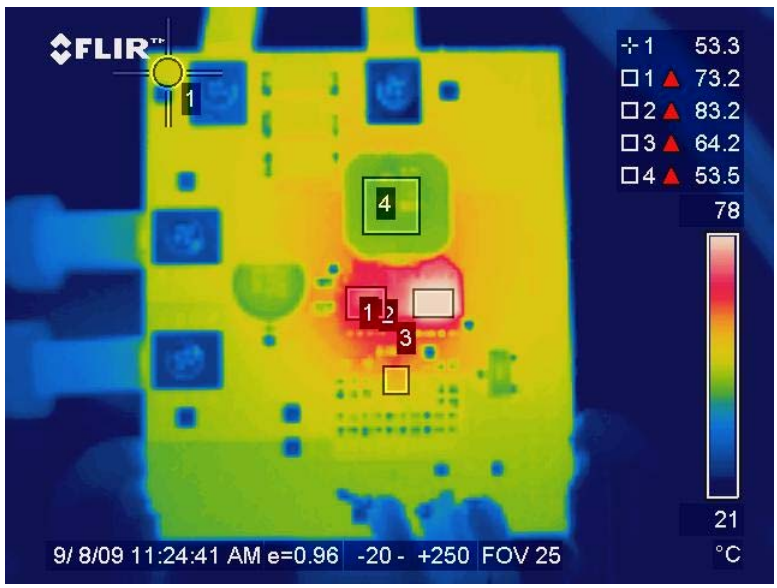


Figure 17: Typical Output Voltage Regulation

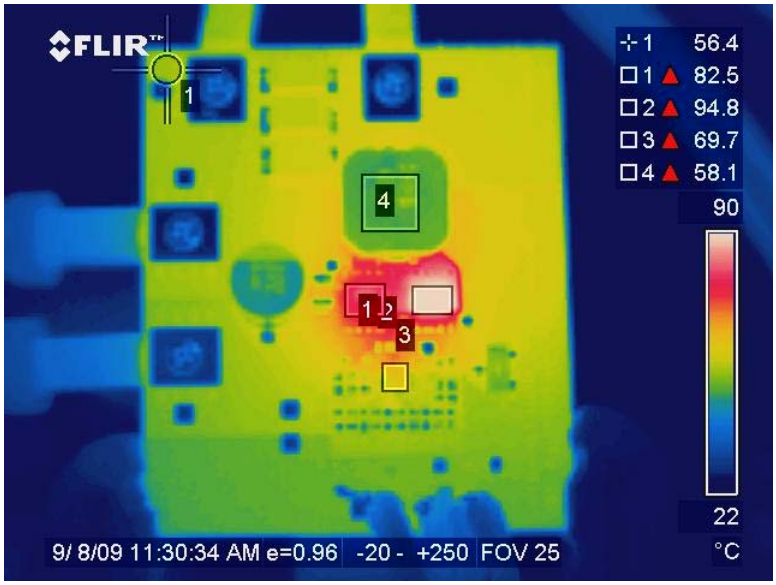


Q1: 73.2°C, Q2:83.2°C, IC-64.2°C,Inductor: 53.5°C, PCB: 53.3°C

Figure 18:Thermal Image @12Vin, 20A, With CP On

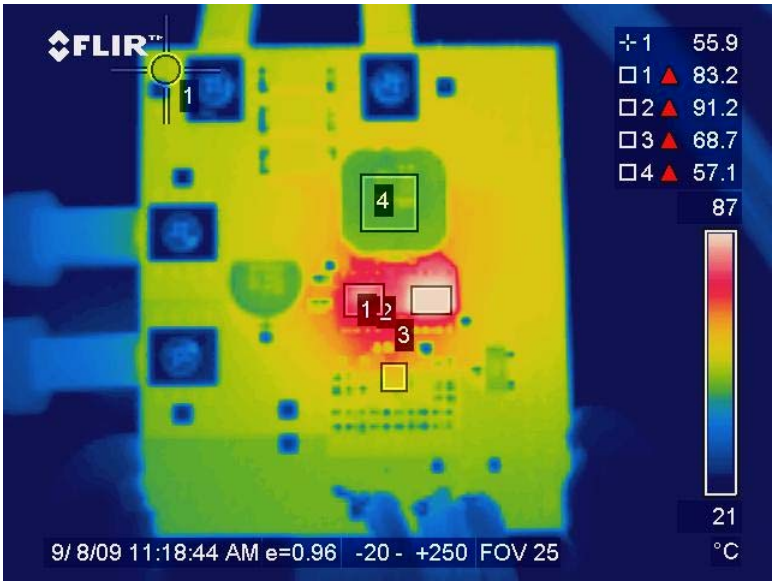
TYPICAL OPERATING WAVEFORMS

Vin=12V, PVcc=5.0V, Vcc=3.3V, Vo=1.1V, Io=0- 20A, , Room Temperature, No Air Flow



Q1: 82.5°C, Q2:94.8°C, IC-69.7°C,Inductor: 58.1°C, PCB: 56.4°C

Figure 19: Thermal Image @19Vin, 20A, With CP On

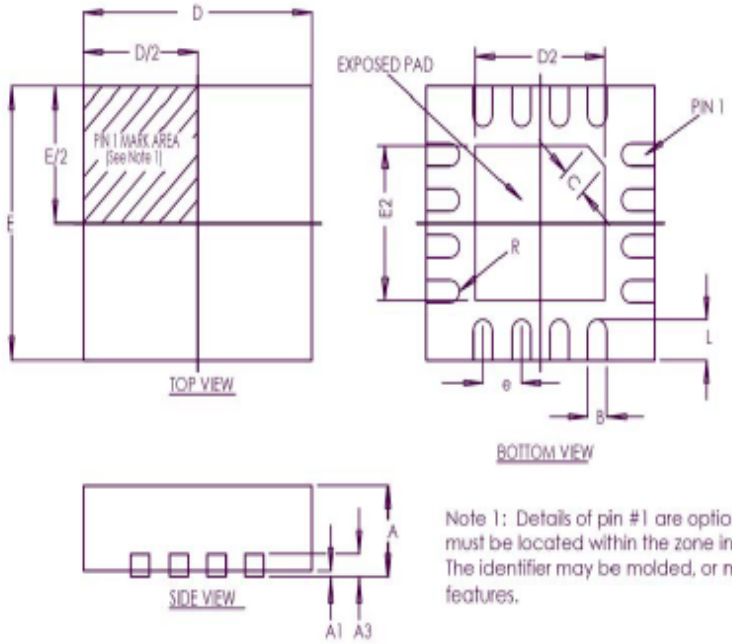


Q1:83.2°C,Q2:91.2°C, IC-68.7°C, Inductor: 57.1°C, PCB: 55.9°C

Figure 20: Thermal Image @12Vin, 20A, With CP Off

PACKAGE INFORMATION

3X3 MLP LEAD FREE PACKAGE AND LAYOUT INFORMATION



Note 1: Details of pin #1 are optional, but must be located within the zone indicated. The identifier may be molded, or marked features.

SYMBOL	16-PIN 3x3 (unit: MM)		
DESIGN	MIN	NOM	MAX
A	0.80	0.85	0.90
A1	0.00	0.02	0.05
A3		0.20 REF	
B	0.20	0.25	0.30
D		3.00 BSC	
D2	1.6	1.70	1.8
E		3.00 BSC	
E2	1.6	1.70	1.8
e		0.50 TYP	
L	0.30	0.40	0.50
R	0.125	---	---
C		0.35 TYP	

Data and specifications subject to change without notice.
This product has been designed and qualified for the Consumer market.
Qualification Standards can be found on IR's Web site.

International
IOR Rectifier

IR WORLD HEADQUATERS: 233 Kansas St, EL Segundo, California 90245, USA Tel: (310)-252-7105
TAC Fax: (310)-252-7903
Visit us at www.irf.com for sales contact information. www.irf.com