NCP10672F12GEVB

NCP10672 Flyback Converter

Universal AC Mains, Up to 4.8 Watt Isolated Power Supply

ON Semiconductor®

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EVAL BOARD USER'S MANUAL

Overview

This evaluation board manual describes a simple and low power (up to 4.8 W) flyback converter designed to be opeated in universial input lines. The converter provides constant voltage multiple outputs. The supply can be used for powering utility electric meters, white goods or similar industrial equipments where isolation from the AC mains is required. The main benefits of provided solution are high efficiency, cost effectiveness and low no−load power consumption. The converter is utilizing monolithic ON Semiconductor switcher NCP10672 integrated with R_{DSON}, 12 Ω MOSFET in a SOIC 7 package. The evaluation board manual provides complete circuit diagram and bill of materials.

Key Features

- Universal AC Input Range (90 ~ 264 Vac)
- Very Low No−load Power Consumption
- Skip−Cycle Operation at Low Peak Currents Only
- Frequency Jittering for Better EMI Signature
- Current−Mode Fixed Frequency Operation – 100 kHz
- Input Filter for Conducted EMI Attenuation

Circuit Description

The Flyback converter is composed of the high voltage switching regulator U1, transformer T1, freewheeling diode D8, D9. Electrolytic−Capacitor EC1, EC4, EC5 and EC6 are used as the output filtering and energy storage. Resistor R12, R13, capacitor C5 and diode D4 are forming voltage clamp for the switcher drain. Opto−coupler U2, and shunt regulator U3 is used in feedback network. Resistors R8 and R9 form resistive divider and sets output voltage. Diode D6 and elector−capacitor EC3 provide supply voltage for U1 Vcc from auxiliary winding.

Table 1. GENERAL INFORMATIONS

Parameter	Value
Input Voltage Range	90 Vac to 264 Vac
Output Voltage	12 V
	5 V
Maximum Output Current	300 mA [12 V]
	250 mA [5 V]
Output Power	4.8 W
Operating Frequency @ Full Load Condition	100 kHz
Input Protection	Fuse
Operating Temperature Range	0°C to + 50°C
No−load Power Consumption	< 50 mW over whole input lines

Schematics

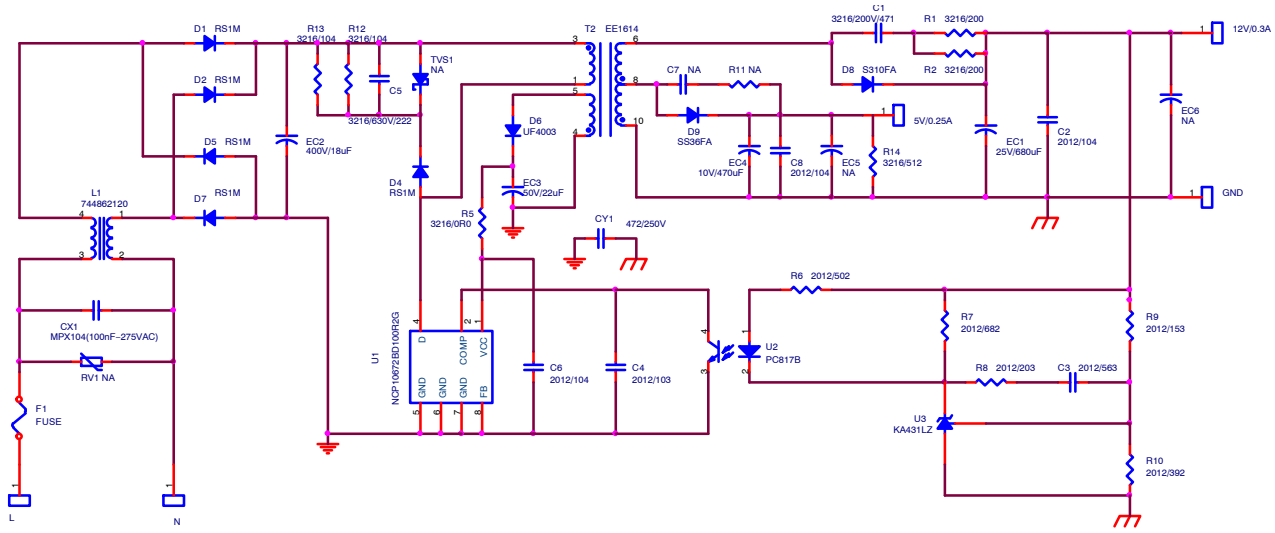


Figure 1. Evaluation Board Schematic

Evaluation Board

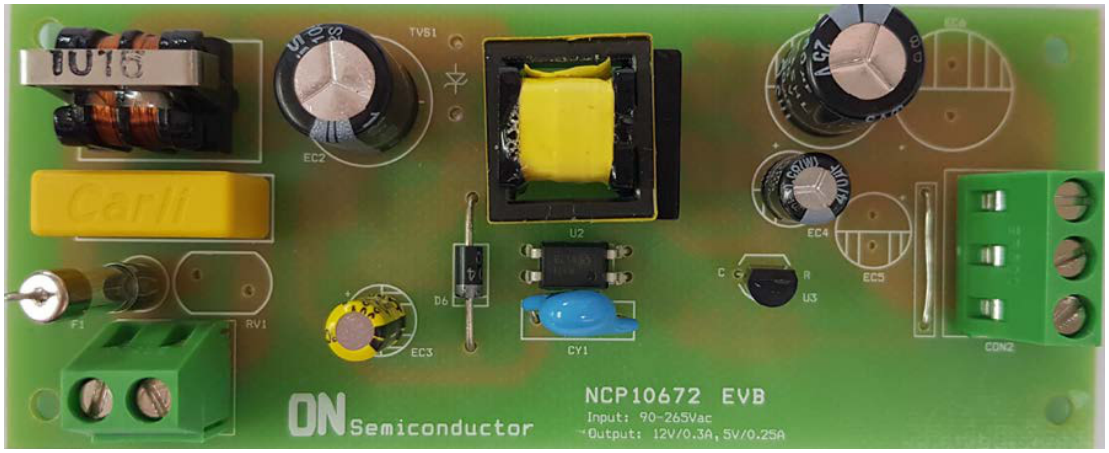


Figure 2. Top Side of Evaluation Board

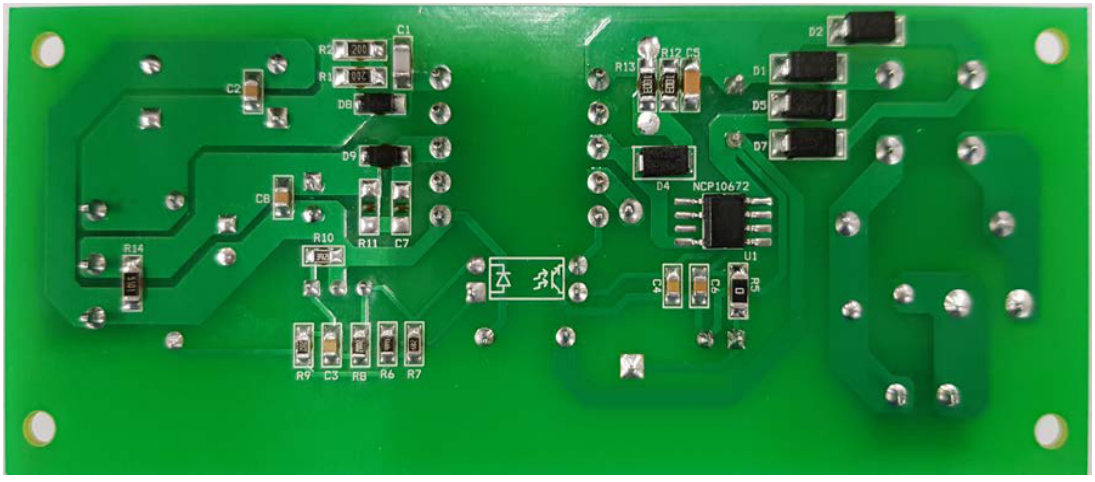


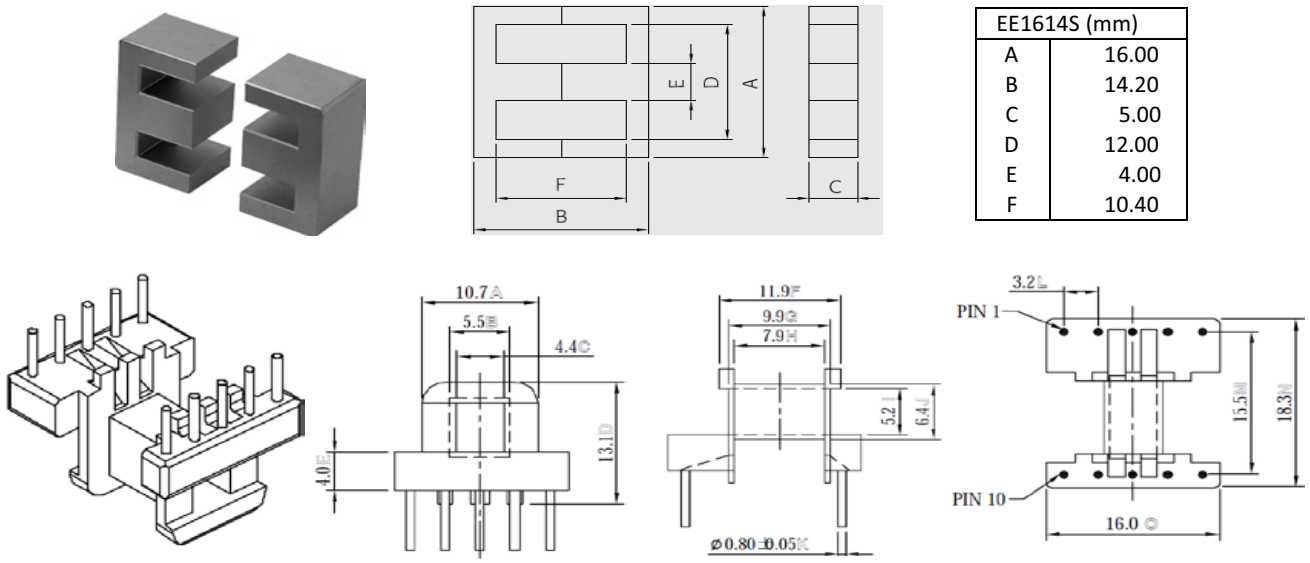
Figure 3. Bottom Side of Evaluation Board

Table 2. BILL OF MATERIALS

Description	Location No.	Value	Part Name	Qty.	Vendor
X−Capacitor	CX1	100 nF	MPX104	1	Carli
Y−Capacitor	CY1	1.0 nF	DE2E3KY102MN3AM02F	1	Murata
Ceramic Capacitor	C1	3216, 470 pF / 200 V	C1206C471J2GACTU	1	Kemet
Ceramic Capacitor	C2, C6, C8	2012, 100 nF / 50 V	C0805C104K5RACTU	3	Kemet
Ceramic Capacitor	C3	2012, 56 nF / 50 V	C0805C563K5RACTU	1	Kemet
Ceramic Capacitor	C4	2012, 10 nF / 50 V	C0805C103K5RACTU	1	Kemet
Ceramic Capacitor	C5	3216, 2.2 nF /1 kV	C1206C222kDRACTU	1	Kemet
Diode	D1, D2, D4, D5, D7	RS1M	RS1M	5	ON Semi
Diode	D3	S310FA	S310FA	1	ON Semi
Diode	D6	UF4003	UF4003	1	ON Semi
Diode	D8	SS36FA	SS36FA	1	ON Semi
Electrolytic Capacitor	EC1	680 uF, 25 V	SHL, 25 V / 680 uF	1	Samyoung
Electrolytic Capacitor	EC2	18 uF, 400 V	RK, 400 V / 18 uF	1	Aishi
Electrolytic Capacitor	EC3	22 uF, 50 V	NXH, 50 V / 22 uF	1	Samyoung
Electrolytic Capacitor	EC4	470 uF, 10 V	SHL, 10 V / 470 uF	1	Samyoung
Switcher	U1	NCP10672B, 100 kHz	NCP10672BD100R2G	1	ON Semi
Opto−Coupler	U2	PC817B	PC817B	1	ON Semi
Shunt Regulator	U3	KA431LZ	KA431LZ	1	ON Semi
Common Mode Choke	L1	744862120	744862120	1	Wurth
Fuse	F1	250 V, 1.25 A	BK/S500−V−1.25R	1	Bussmann
Resistor	R1, R2	3216, 200 Ω	RC1206JR−0720RL	2	Yageo
Resistor	R5	3216, 0 Ω	RC1206JR−070RL	1	Yageo
Resistor	R6	2012, 5 kΩ	RC0805JR−075KL	1	Yageo
Resistor	R7	2012, 6.8 kΩ	RC0805JR−076K8L	1	Yageo
Resistor	R8	2012, 20 kΩ	RC0805JR−0720KL	1	Yageo
Resistor	R9	2012, 15 kΩ	RC0805JR−0715kL	1	Yageo
Resistor	R10	2012, 3.9 kΩ	RC0805JR−073K9L	1	Yageo
Resistor	R12, R13	2012, 100 kΩ	RC1206JR−07100KL	2	Yageo
Resistor	R14	2012, 5.1 kΩ	RC1206JR−075K1L	1	Yageo
Transformer	T2	EE1614, 10pin	EE1614, V10p	1	
Connector	Con1	Terminal Block	395430002	1	Molex
Connector	Con2	Terminal Block	395430003	1	Molex
Not Assembly	TVS1, RV1,EC5, EC6, C7, R11		NC		

Transformer Specification

EE1614 which has 18.4 mm^2 of effective area is utilized for small form factor flyback converter design. In order to minimize leakage inductance, the primary winding was splitted on either side of the secondary to make primary winding as close as possible with secondary winding and the triple insulated wires for secondiary winding were used to be able to maximize all windings in bobbin window length.



EE1614S (mm)	
A	16.00
B	14.20
C	5.00
D	12.00
E	4.00
F	10.40

Figure 4. Core and Bobbin Dimension

Table 3. TRANSFORMER WINDING METHOD

Winding	Pin (S → F)	Wire	Turns	Winding Method
N_{P-1}	3 → 2	0.15 φ	88 Ts	Solenoid Winding
Insulation: Polyester Tape t = 0.025 mm, 3 Layers				
N_{S-1}	10 → 8	0.2 φ [TIW]	9 Ts	Solenoid Winding
N_{S-2}	8 → 6	0.2 φ [TIW]	8 Ts	Solenoid Winding
Insulation: Polyester Tape t = 0.025 mm, 3 Layers				
N_{P-2}	2 → 1	0.15 φ	43 Ts	Solenoid Winding
Insulation: Polyester Tape t = 0.025 mm, 3 Layers				
N_A	4 → 5	0.15 φ	14 Ts	Solenoid Winding
Insulation: Polyester Tape t = 0.025 mm, 3 Layers				

NOTE: Design parameters: L_p = 1.15 mH at pin 1 – 3, f = 100 kHz

System Efficiency

The efficiency was measured in 30 minutes since started at each line.

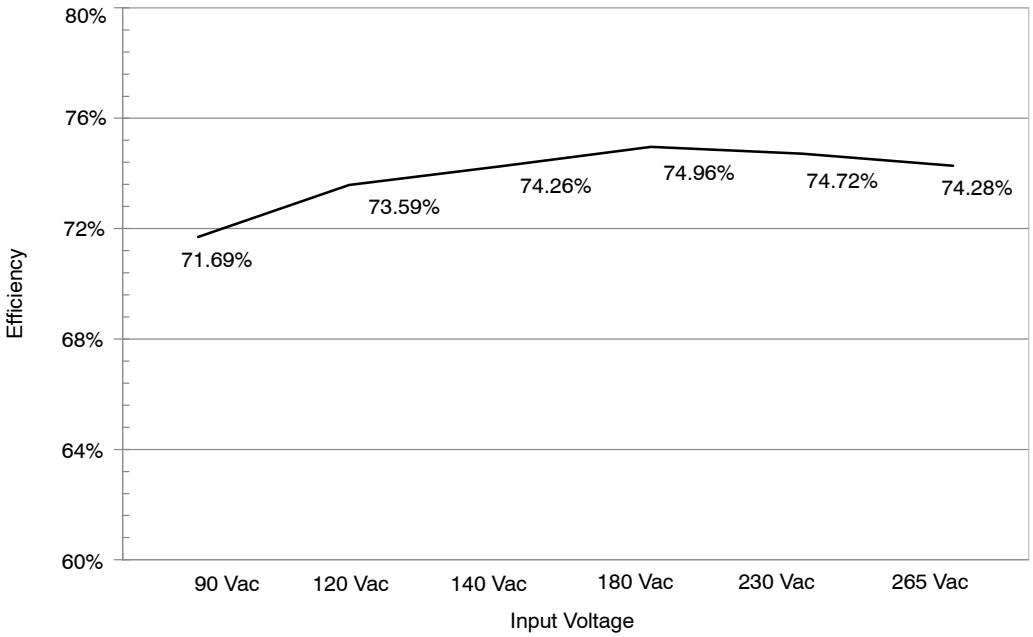


Figure 5. Efficiency for Input Lines

No−Load Power Consumption

The input power was measured in 10 minutes since started at each line.

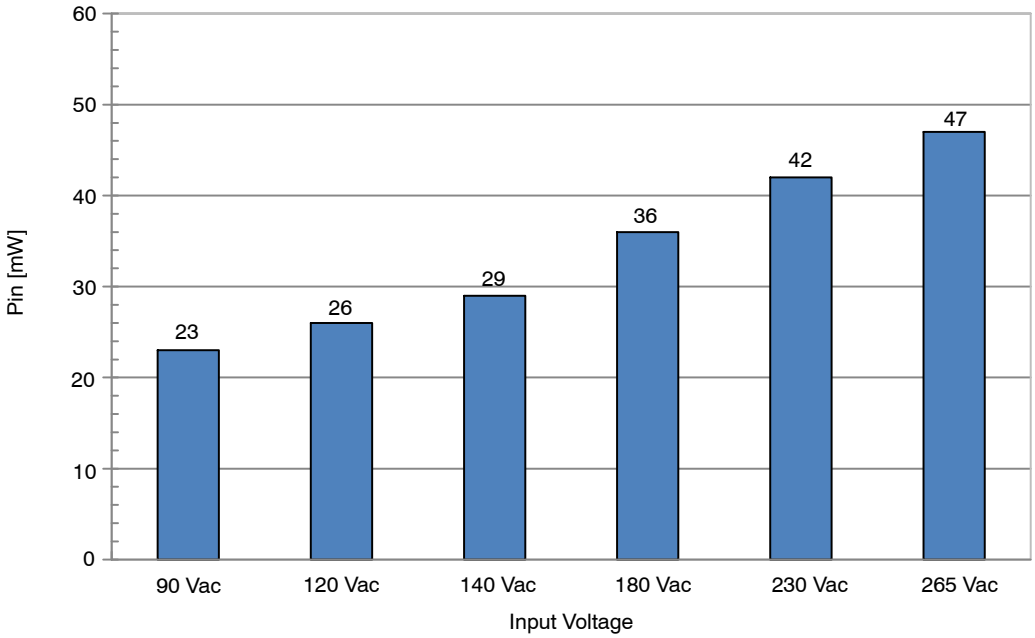
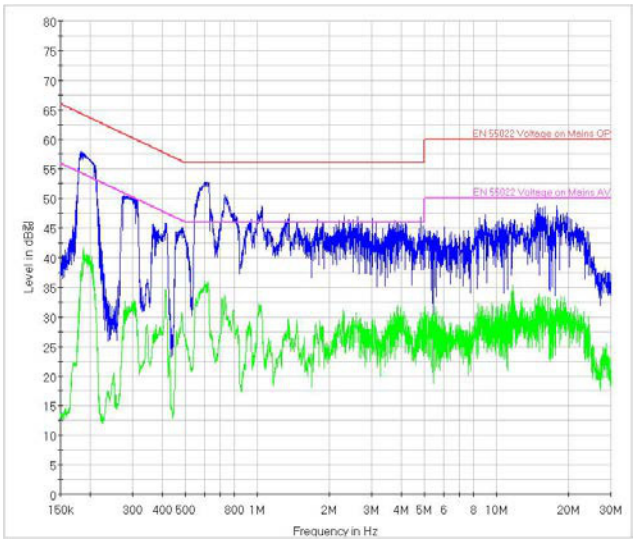


Figure 6. Power Consumption

EMI

Vin [110 Vac]



Vin [220 Vac]

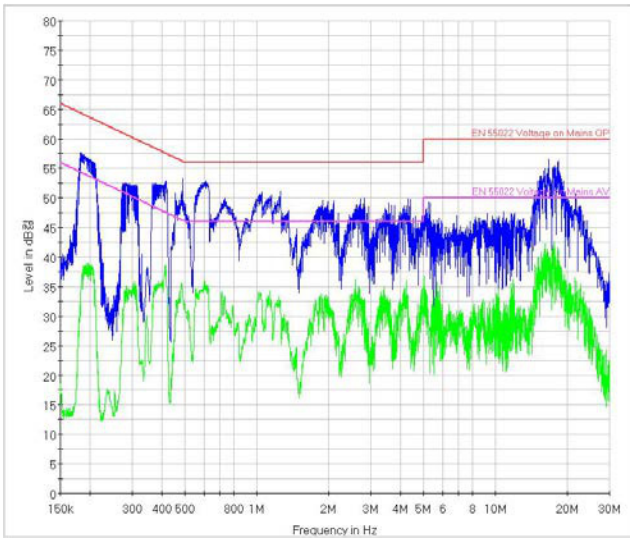
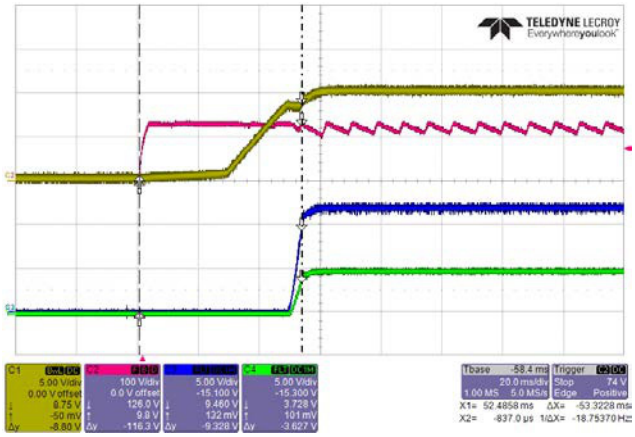


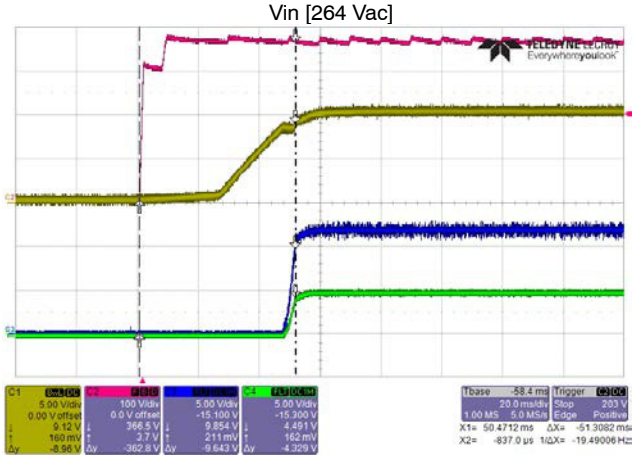
Figure 7. Conducted Emission at Full Load

Startup Time

Vin [90 Vac]



Vin [264 Vac]

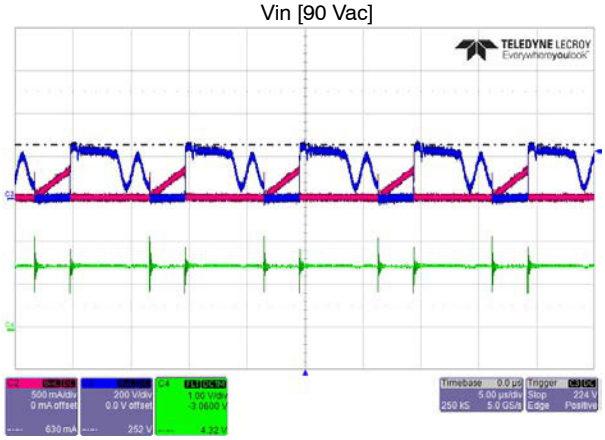


C1 [V_{DD}], C2 [V_{BULK}], C3 [$V_{OUT-12\ V}$], C4 [$V_{OUT-5\ V}$]

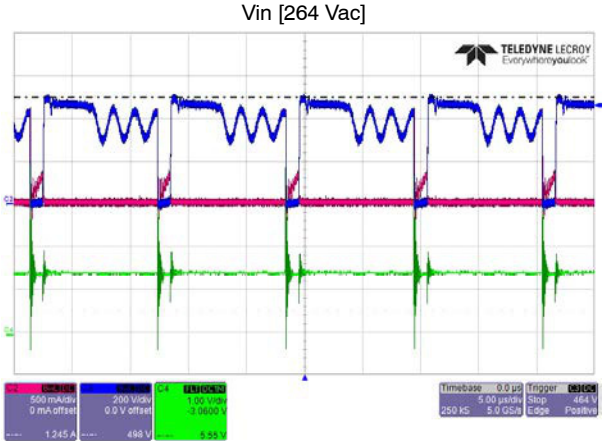
Figure 8. Startup Time at Full Load

Normal Operation at Full Load

Vin [90 Vac]



Vin [264 Vac]



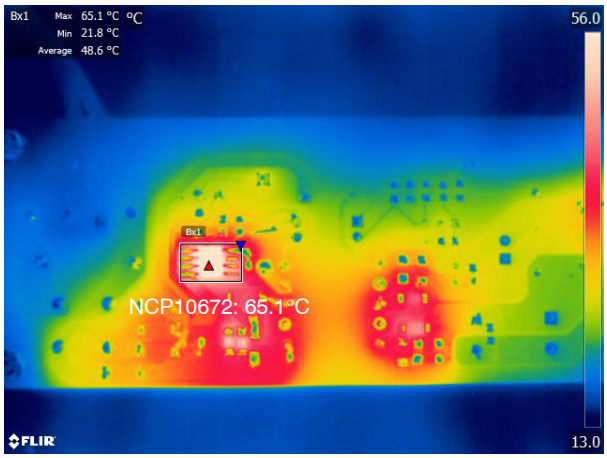
C2 [I_{DRAIN}], C3 [V_{DRAIN}], C4 [V_{COMP}]

Figure 9. Switching Voltage & Current Waveform at Full Load

IC Temperature

IC temperature was measured in 2 hours since started at full load.

Vin [90 Vac]



Vin [264 Vac]

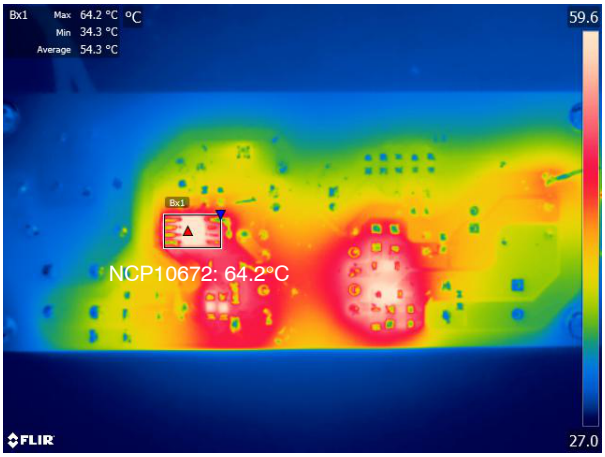


Figure 10. IC Temperature at Full Load

Reference

[1] ON Semiconductor datasheet for NCP10672B monolithic switcher
[2] ON Semiconductor NCP10672 Technical Documentation & Design Resources

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
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