STR-ACF-12V100WPSU-GEVB Test Report

© Semiconductor Component Industries, LLC, 2020
January, 2020 – Rev. 0

Publication Order Number:
Contact your local Sales Representative

Contents

INTRODUCTION 3
Circuit Description 3
Specifications 4
Key features 4
Applications 4
BOARD IMAGES 5
TEST RESULT 6
Output ripple 6
Rise time (no-load by CR load mode) 6
Rise time (Full load by CR load mode) 7
Hold time (Full load by CR load mode) 7
Dynamic load response (load 25% - 75%), CR mode 7
Vsw Switching waveform @ input voltage=264Vac 8
Behavior of transition DCM to ACF, ACF to DCM 8
Regulation by input voltage variation 9
Regulation by load current 9
Efficiency Vin=100Vac 10
Efficiency Vin=230Vac 11
MAGNETICS DESIGN DATA SHEET (TRANSFORMER) 12
MAGNETICS DESIGN DATA SHEET (INDUCTOR) 13
PCB INFORMATION 14
PCB INFORMATION (CONTINUED) 15

Introduction

This Test Report describes an output power 100W, universal AC input (90 – 264Vac), constant output voltage power supply for industrial application and the power supply for which isolation from AC main is required.

Circuit Description

The feature of this power source is having combined the Boost follower PFC and Active Clamp Fly back utilizing ON Semiconductor's NCP1622 CrM VSFF PFC controller, NCP1568 ACF controller, NCP51530 high performance high / low side MOS FET driver, NCP4306 secondary side synchronous rectification driver, FCMT229N60 PFC switching FET, FCPF165N65S3L1 ACF switching FET and FDMT800150DC SR switching FET. Active Clamp Fly back topology effectively recycles the leakage energy. Another feature of this topology is the ZVS operation of the power MOSFETs.

The Strata software watches and detects the input of this power supply source and output side, and provides a display on a screen for the following value and graph by a telemetry system.

Input voltage (Vrms), Input current (Arms), Input (Active) power (W), Apparent power (VA), Reactive power (Var), Power factor, Line frequency (Hz), Loss (Pin-Pout)(W), Output voltage (V), Output current (A), Output power (W) and Efficiency (%). The display screen is below (this screen displays at case of no input and no output).

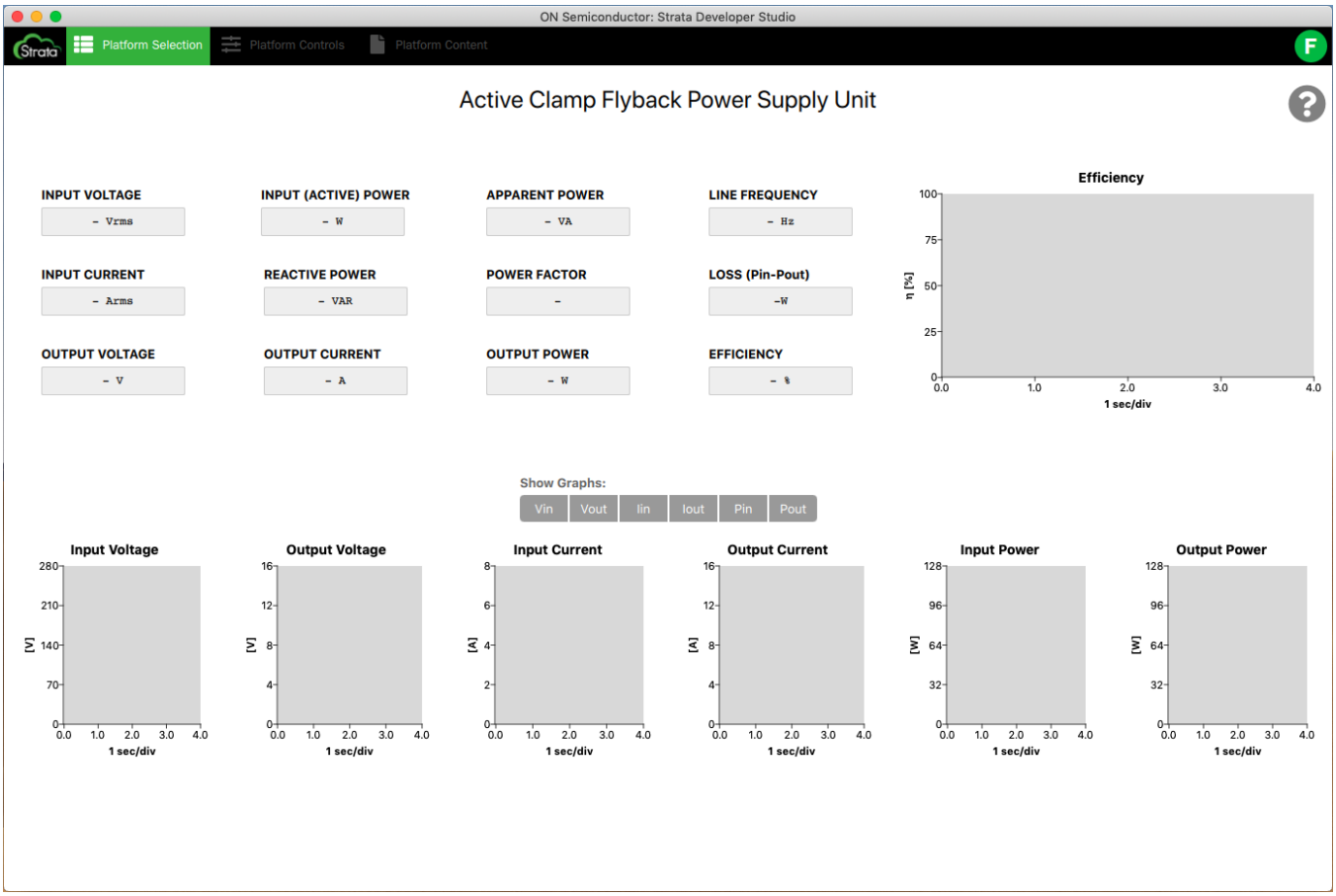


Figure 1 Screen image

This Test Report provides the performance test result for Output ripple voltage, Output voltage behavior of Rise time and Hold time, Dynamic load response, Line regulation, Load regulation, Efficiency, MOS switching waveform, etc. are shown in the pictures, charts and graphs below.

Specifications

- Input voltage: 90Vac – 264Vac
- Output voltage: 12V
- Output current: 0 - 8.5A
- Output Power: 102W
- Output Ripple: 100mVp-p max
- Input / Output isolation: 3kV
- PFC: Yes
- No load input consumption: <150mW
- Efficiency in full load: >86%
- Inrush limiting: 10 ohm NTC, 14A@100Vac, 32A@230Vac
- Fuse 3.15A / 250Vac
- Protection: OCP, OVP, SCP, TSD

Key features

- Low output ripple noise
- High efficiency at full load
- Universal input range, 90V – 264Vac line
- Auto re-start over current protection
- Latched output over voltage protection
- Over power protection
- Boost follower PFC control
- Active Clamp Fly back with peak current mode
- High frequency operation
- Board size 166mm x 103mm x 33mm
- Telemetry system by Strata solution
- PFC controller NCP1622
  - Critical Conduction Mode (CrM)
  - Valley Synchronized Frequency Fold−back (VSFF): Low frequency operation is forced at low current levels (9 pre−programmed settings)
  - Fast line / load transient compensation (Dynamic Response Enhancer)
- Active Clamp Fly back controller NCP1568
  - Active Clamp Fly back topology aids in ZVS
  - Proprietary Multi−Mode operation to enhance light load efficiency
  - Proprietary adaptive ZVS allows high frequency operation while reducing EMI
  - Inbuilt adaptive Dead−Time for both main and active clamp FETs
  - Peak current−mode control with Inbuilt slope compensation with options
  - Customer programmable optional transition to DCM - DCM and light load operation
  - Integrated frequency fold back with minimum frequency
  - Clamp for highest performance in standby mode
  - Minimum frequency clamp and Quiet Skip eliminates audible noise
- SR controller NCP4306
  - Self−contained control of Synchronous Rectifier in CCM, DCM and QR for Fly back or LLC applications
  - Precise true secondary zero current detection
  - Typically 15ns turn off delay from current sense input to driver
  - Rugged current sense pin (up to 200 V)
  - 7A / 2A Peak current sink / Source drive capability
  - Automatic light−load disable mode
  - Maximum operation frequency up to 1MHz

Applications

- Industrial use
- General-purpose power supply

BOARD IMAGES

Figure 2 Top view

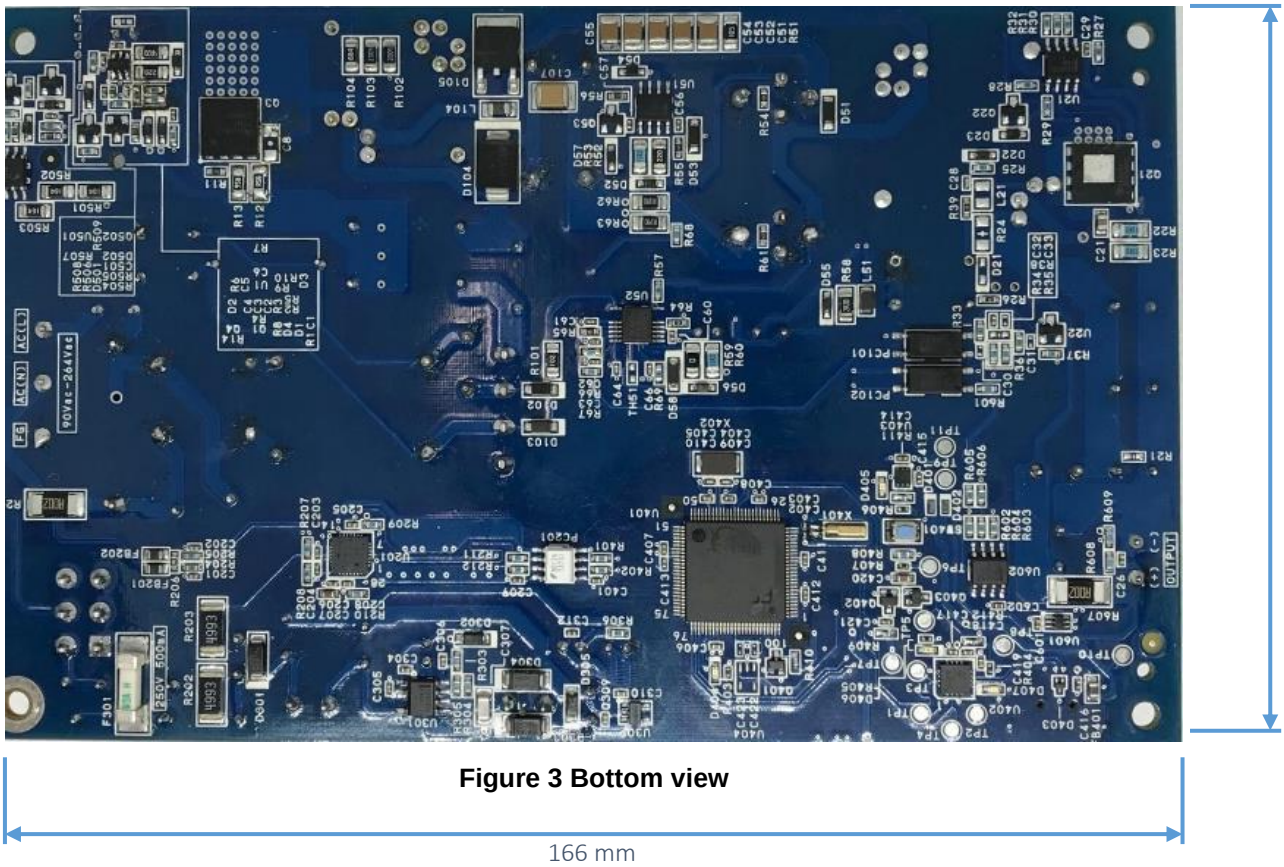


Figure 3 Bottom view

TEST RESULT

Output ripple

Figure 4-1 Vin=100Vac, V=50mV/div, H=20ms/div
Vout ripple=50mVp-p, Pout=0W

Figure 4-2 Vin=230Vac, V=50mV/div, H=20ms/div
Vout ripple=74mVp-p, Pout=0W

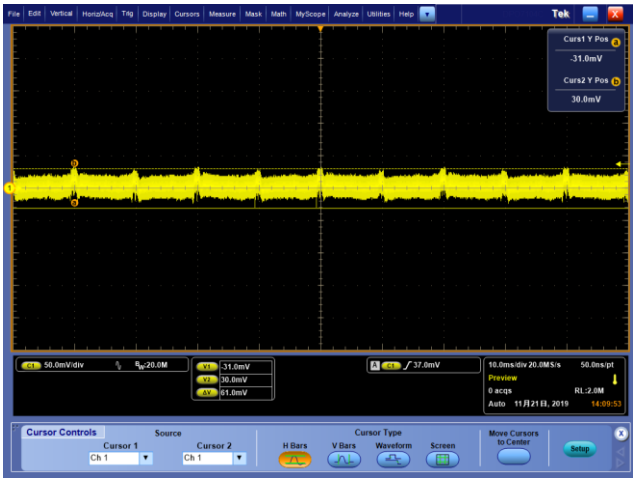


Figure 4-3 Vin=100Vac, V=50mV/div, H=10ms/div
Vout ripple=61mVp-p, Pout=102W

Figure 4-4 Vin=230Vac, V=50mV, H=10ms/div
Vout ripple=68mVp-p, Pout=102W

Rise time (no-load by CR load mode)

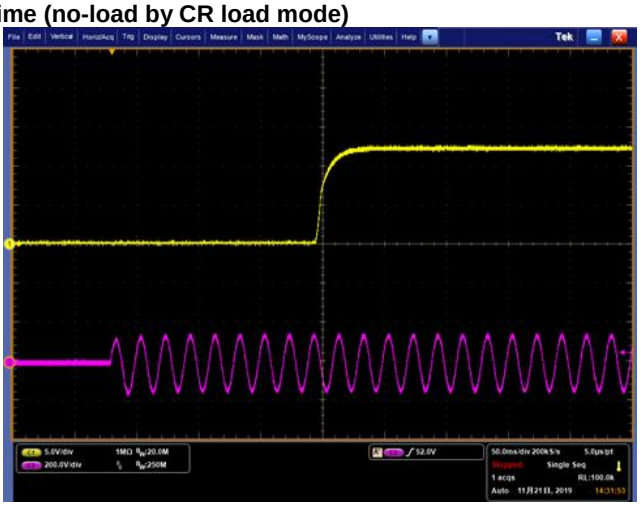


Figure 5-1 Vin=100Vac, V=5V/div, H=50ms/div

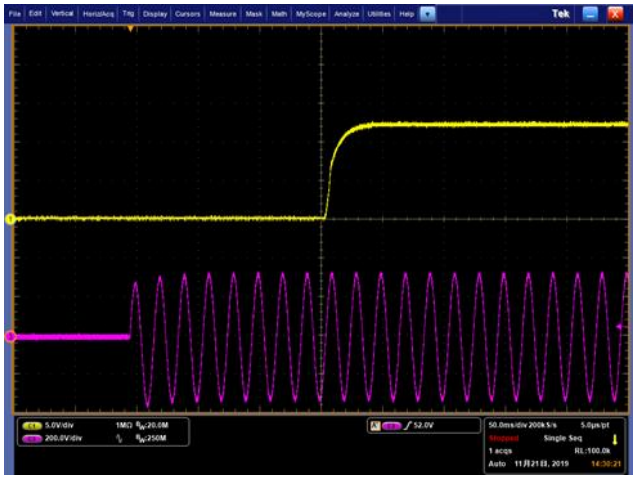


Figure 5-2 Vin=230Vac, V-5V/div, H=50ms/div

Rise time (Full load by CR load mode)

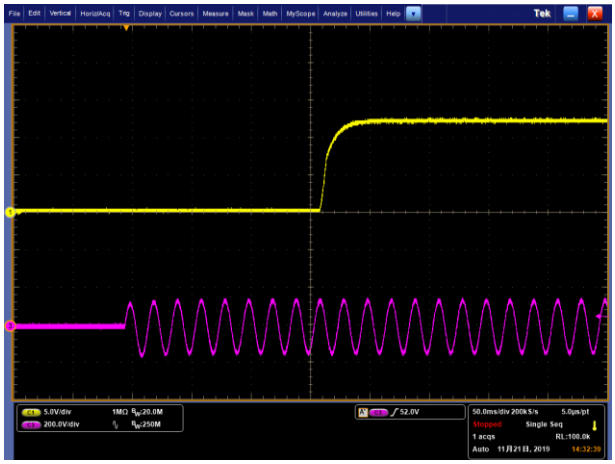


Figure 5-3 Vin=100Vac, V=5V/div, H=50ms/div

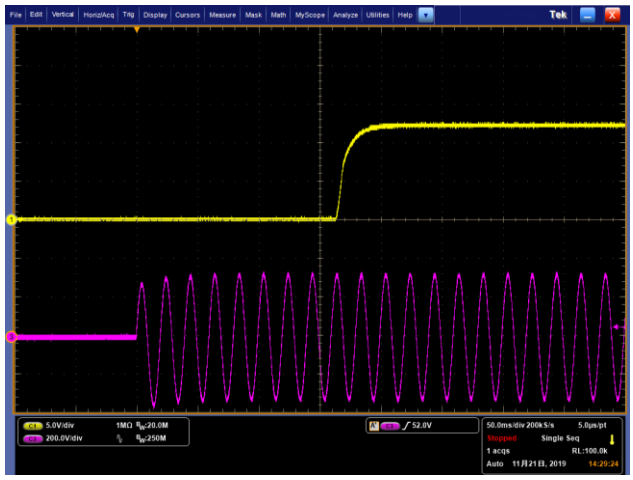


Figure 5-4 Vin=230Vac, V-5V/div, H=50ms/div

Hold time (Full load by CR load mode)

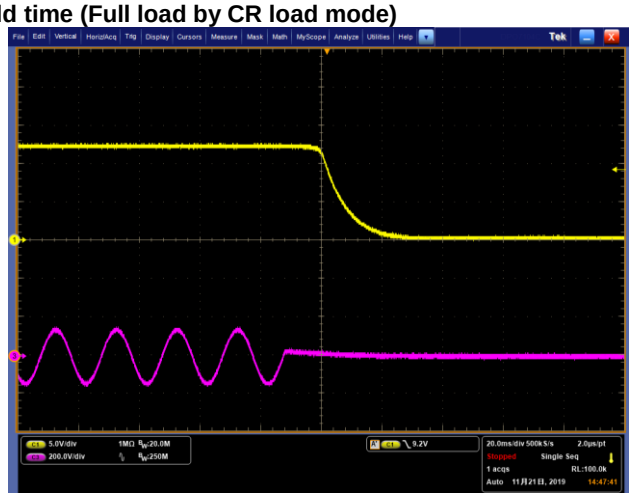


Figure 6-1 Vin=100Vac, V=5V/div, H-20ms/div

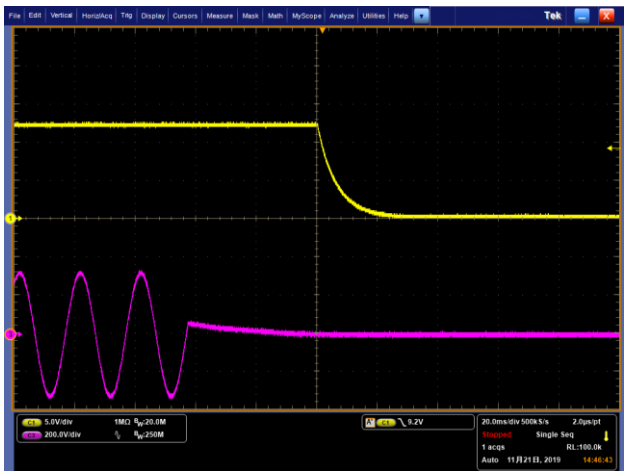


Figure 6-2 Vin=230V, V=5V/div, H=20ms/div

Dynamic load response (load 25% - 75%), CR mode

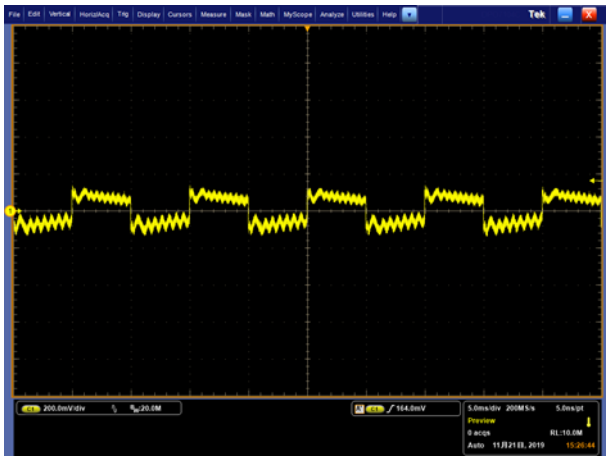


Figure 7-1 Vin=100Vac, V=200mV/div, H=5ms/div

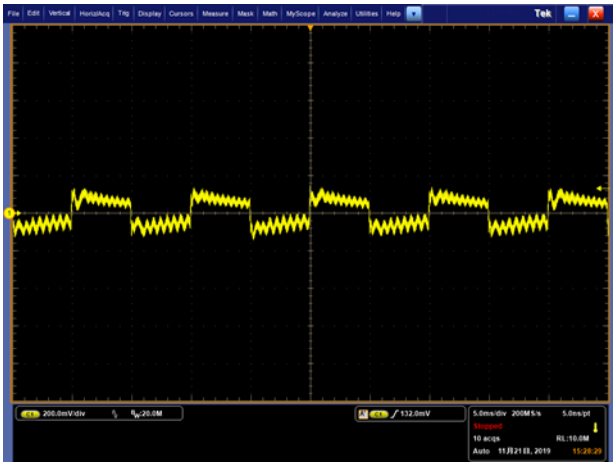


Figure 7-2 Vin=230Vac, V=200mV/div, H=5ms/div

Vsw Switching waveform @ input voltage=264Vac

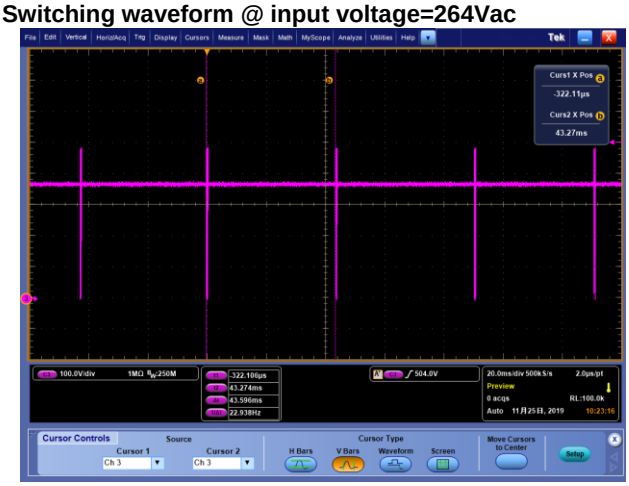


Figure 8-1 No-load, V=100V/div, H=20ms/div, Skip mode, f=22.9 kHz

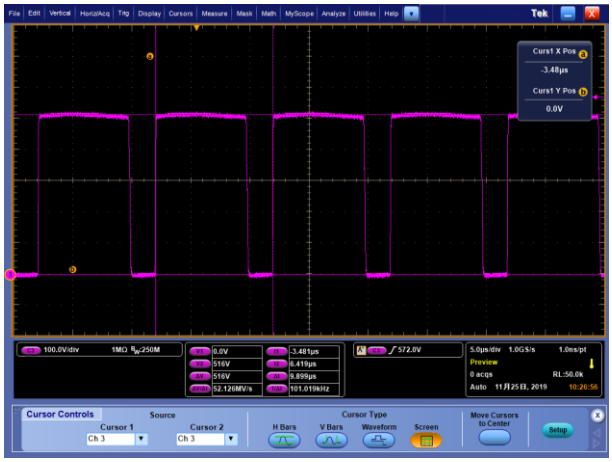


Figure 8-2 100% load, V=100V/div, H=5us/div ACF mode. F=101 kHz, Vsw=516V

Figure 8-3 Max voltage of Vsw in DCM operation, V=100V/div, H=10us/div, Vsw=518V/div, f=47.8 kHz

Behavior of transition DCM to ACF, ACF to DCM

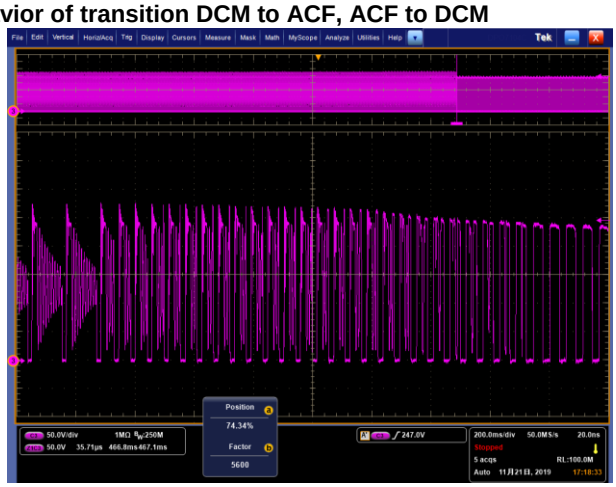


Figure 9-1 DCM to ACF in 100Vac, V=50V/div, H=35us/div

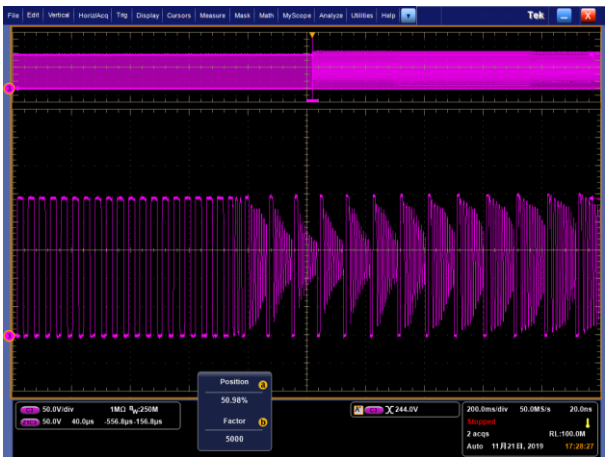


Figure 9-2 ACF to DCM in 100Vac, V=50V/div, H=40us/div

Regulation by input voltage variation
Tested at the board end.

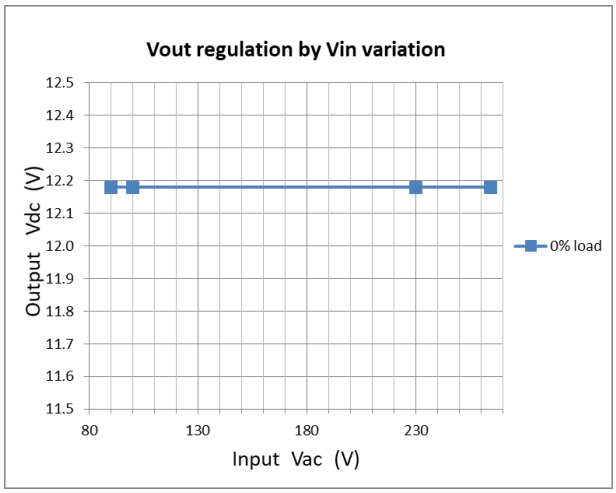


Figure 10-1 No-load (12V, 0A)

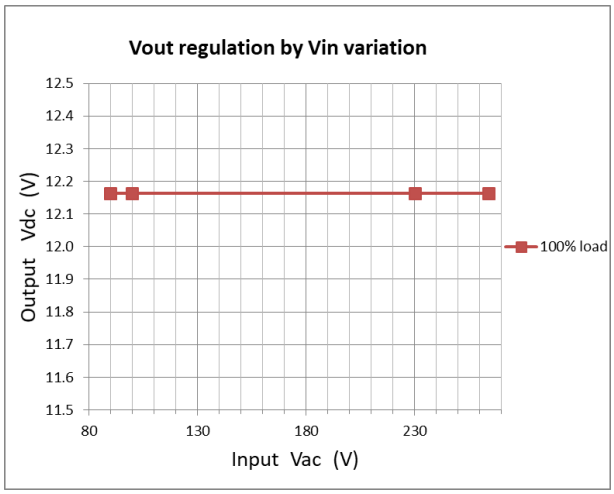


Figure 10-2 Full load (12V, 8.5A)

Regulation by load current
Tested at the board end.

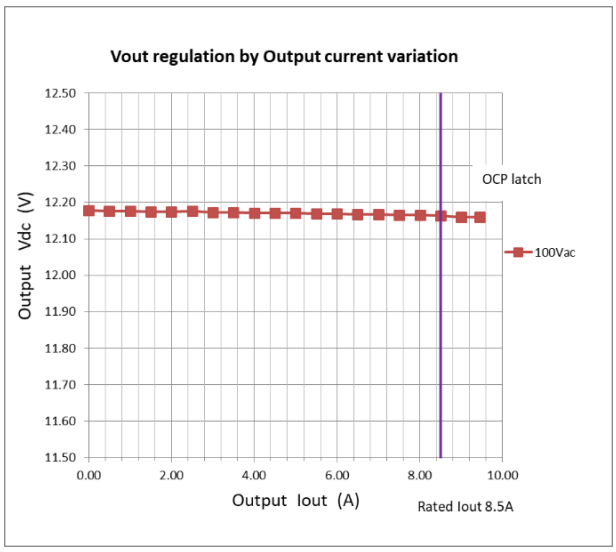


Figure 11-1 Input voltage=100Vac

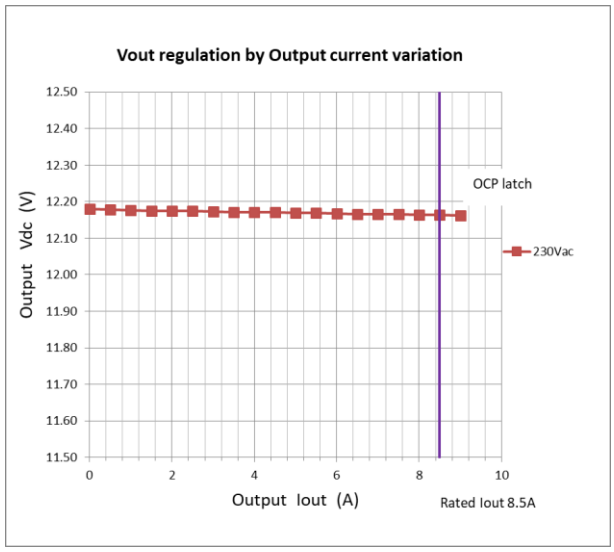


Figure 11-2 Input voltage=230Vac

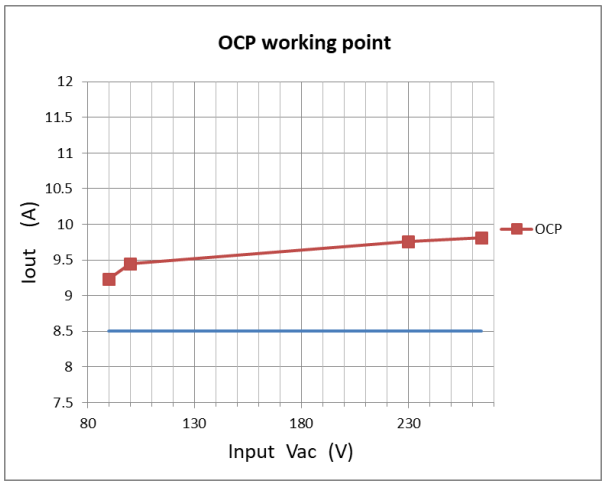


Figure 11-3 OCP working point

Efficiency Vin=100Vac
Tested at the board end.

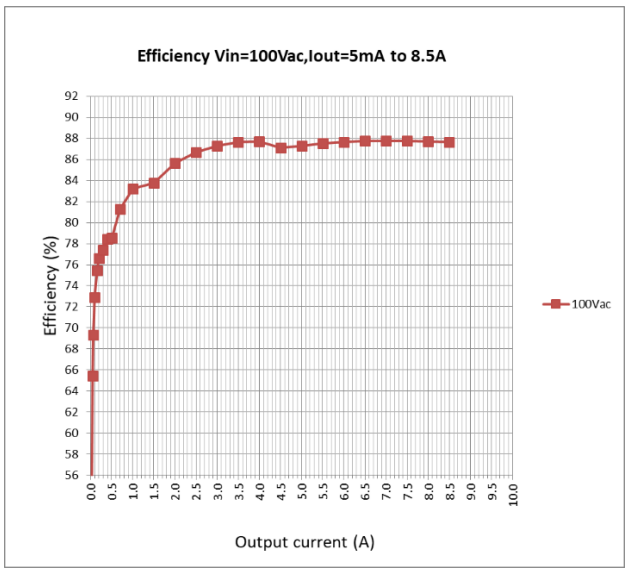


Figure 12-1 Output current = 5mA to 8.5A

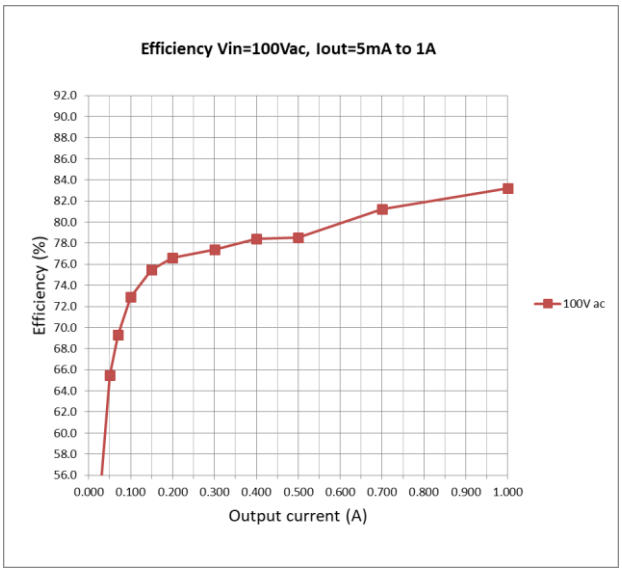


Figure 12-2 (Detailed) Output current = 5mA to 1A

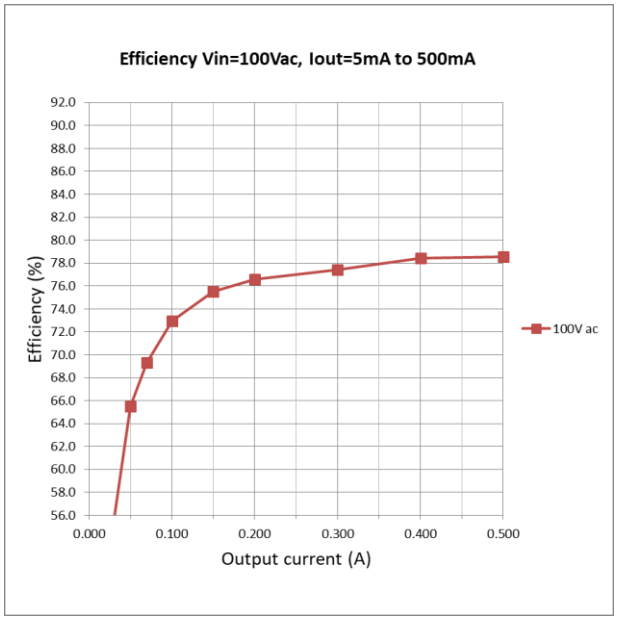


Figure 12-3 (Detailed) Output current = 5mA to 0.5A

Efficiency Vin=230Vac
Tested at the board end.

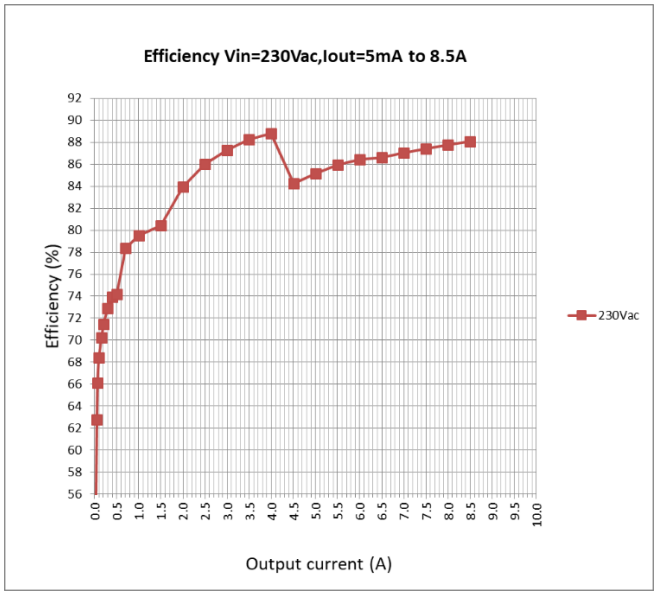


Figure 13-1 Output current = 5mA to 8.5A

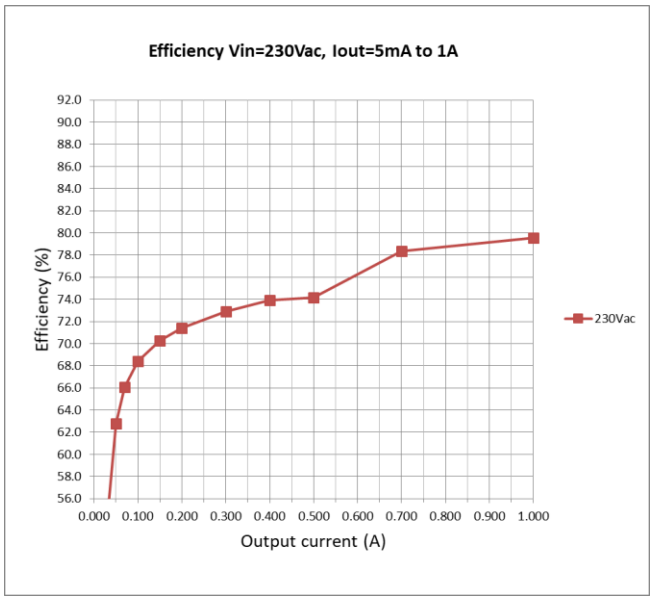


Figure 13-2 (Detailed) Output current = 5mA to 1A

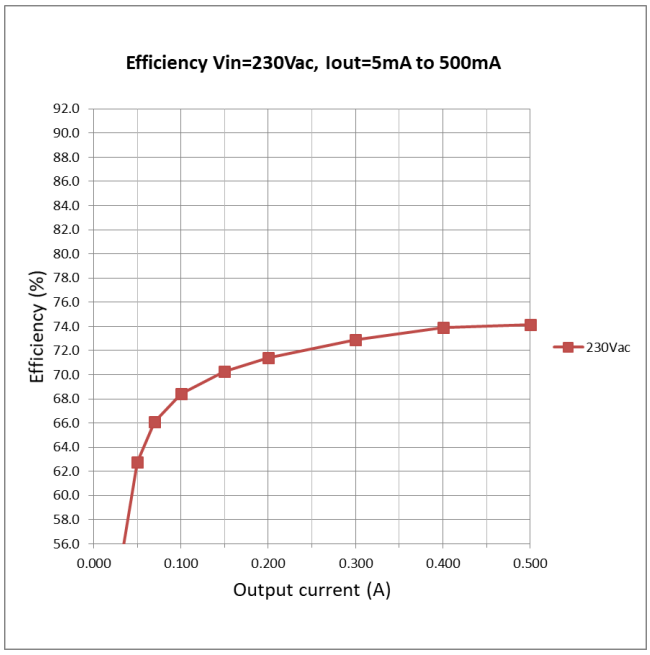


Figure 13-3 (Detailed) Output current = 5mA to 0.5A

MAGNETICS DESIGN DATA SHEET (Transformer)

Project / Customer: ON Semiconductor – 100 watt, Single output NCP1568 ACF (optional NCP1622)

Part Description: 100 watt ACF transformer, single output (12V), 100 kHz

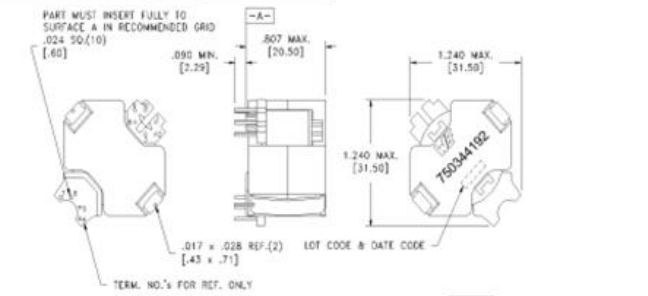
Schematics ID: T1, Bobbin Type: 10 pin for RM10

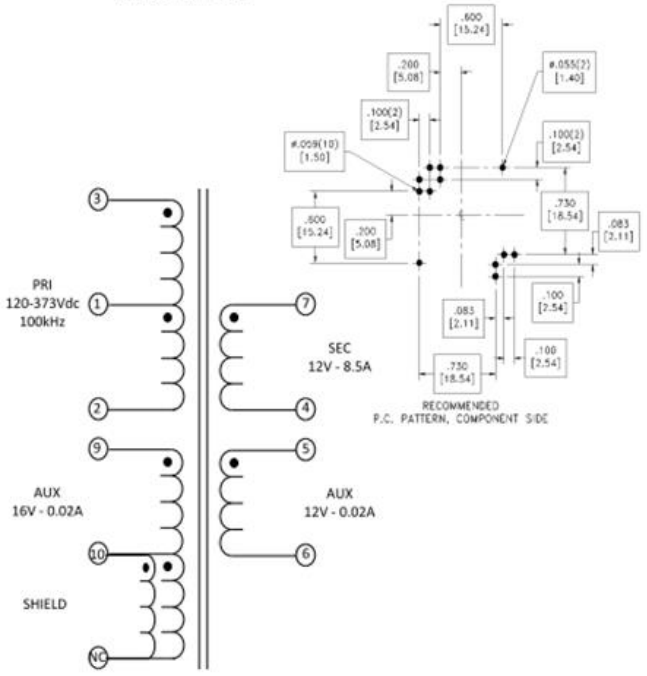
Core Type: RM10 ferrite core

Inductance: 150uH total (+/- 10%) measured between 2pin and 3pin

Manufacture: Wurth Elektronik Part No: 750344192

CUSTOMER TERMINAL	RoHS	LEAD(Pb)--FREE
Sn 96%, Ag 4%	Yes	Yes





ELECTRICAL SPECIFICATIONS @ 25° C unless otherwise noted:

PARAMETER		TEST CONDITIONS	VALUE
D.C. RESISTANCE	3-2	@20ºC	0.150 ohms max.
D.C. RESISTANCE	7-4	@20ºC	0.005 ohms max.
D.C. RESISTANCE	5-6	@20ºC	0.150 ohms max.
D.C. RESISTANCE	9-10	@20ºC	0.210 ohms max.
INDUCTANCE	3-2	100kHz, 100mV, Ls	150.00µH ±10%
SATURATION CURRENT	3-2	20% rolloff from initial	5A
LEAKAGE INDUCTANCE	3-2	tie(4+5+6+7+9+10),100kHz, 100mV, Ls	6µH max.
DIELECTRIC	3-4	tie(1+10,4+5), 3750VAC, 1 second	3000VAC, 1 minute
DIELECTRIC	7-CORE	tie(4+5), 3750VAC, 1 second	3000VAC, 1 minute
DIELECTRIC	1-10	625VAC, 1 second	
TURNS RATIO		(3-2):(7-4)	8.67:1, ±2%
TURNS RATIO		(3-2):(5-6)	8.67:1, ±2%
TURNS RATIO		(3-2):(9-10)	6.5:1, ±2%

GENERAL SPECIFICATIONS:

OPERATING TEMPERATURE RANGE: -40°C to +125°C including temp rise.

Designed to comply with the following requirements as defined by IEC60950-1, EN60950-1, UL60950-1/CSA60950-1 and AS/NZS60950.1:

- Reinforced insulation for a primary circuit at a working voltage of 265Vrms, 400Vpeak, Overvoltage Category II, Pollution Degree 2.

Wire insulation & RoHS status not affected by wire color. Wire insulation color may vary depending on availability.

DFM		Packaging Specifications	Tolerances unless otherwise specified:	DRAWING TITLE	PART NO.
DATE		Method: Tray	Angles: ±1° Decimals: ±.005 [.13]	TRANSFORMER	750344192
ENG	IYU	PKG-1175	Fractions: ±1/64 Footprint: ± .001 [.03]		
REV.	01	CONVENTION PLACEMENT	This drawing is dual dimensioned. Dimensions in brackets are in millimeters.		
DATE	3/20/2019				SPECIFICATION SHEET 1 OF 1

MAGNETICS DESIGN DATA SHEET (Inductor)

Project / Customer: ON Semiconductor – 100 watt, PFC stage with NCP1622

Part Description: 100 watt PFC inductor, 200 kHz

Schematics ID: L103, Bobbin Type: 12 pin for RM8

Core Type: RM8 ferrite core

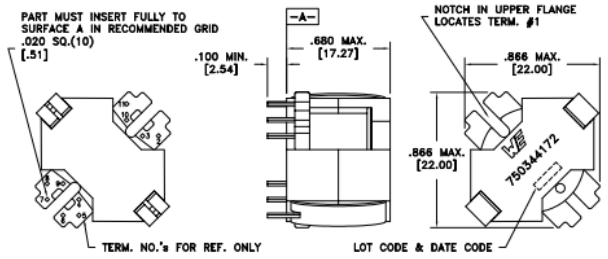
Inductance: 100uH total (+/- 10%) measured between 3pin and 10pin

Manufacture: Wurth Elektronik Part No: 750344172

CUSTOMER TERMINAL	RoHS	LEAD(Pb)–FREE
Sn96%, Ag4%	Yes	Yes

more than you expect

WÜRTH ELEKTRONIK

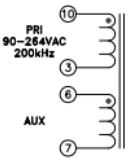


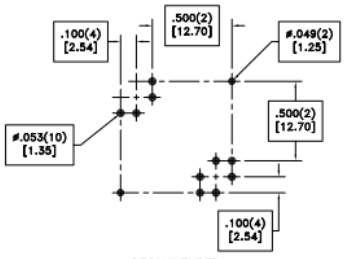
ELECTRICAL SPECIFICATIONS @ 25°C unless otherwise noted:

PARAMETER		TEST CONDITIONS	VALUE
D.C. RESISTANCE	10–3	@20°C	0.260 ohms max.
D.C. RESISTANCE	6–7	@20°C	0.210 ohms max.
INDUCTANCE	10–3	200kHz, 100mVAC, Ls	100.00uH ±10%
SATURATION CURRENT	10–3	20% rolloff from initial	5A
DIELECTRIC	10–Core	tie(3+6), 825VAC, 1 second	–
TURNS RATIO		(10–3):(6–7)	10:1, ±2%

GENERAL SPECIFICATIONS:
OPERATING TEMPERATURE RANGE: –40°C to +125°C including temp rise.

CURRENT RATING: 1.6A





RECOMMENDED
P.C. PATTERN, COMPONENT SIDE

Wire insulation & RoHS status not affected by wire color.
Wire insulation color may vary depending on availability.

REV.	DATE	Packaging Specifications		Tolerances unless otherwise specified:	DRAWING TITLE	PART NO.
		Method: Tray		Angles: ±1° Decimals: ±.005 [.13]	INDUCTOR	750344172
		PKG–0002		Fractions: ±1/64 Footprint: ±.001 [.03]		
		www.we–online.com/midcom	CONVENTION PLACEMENT	This drawing is dual dimensioned. Dimensions in brackets are in millimeters.	eiSos p/n: 750344172	SPECIFICATION SHEET 1 OF 1
6A	11/19	SEE REVISION SHEET FOR REVISION LEVEL			compliant RoHS	

PCB information

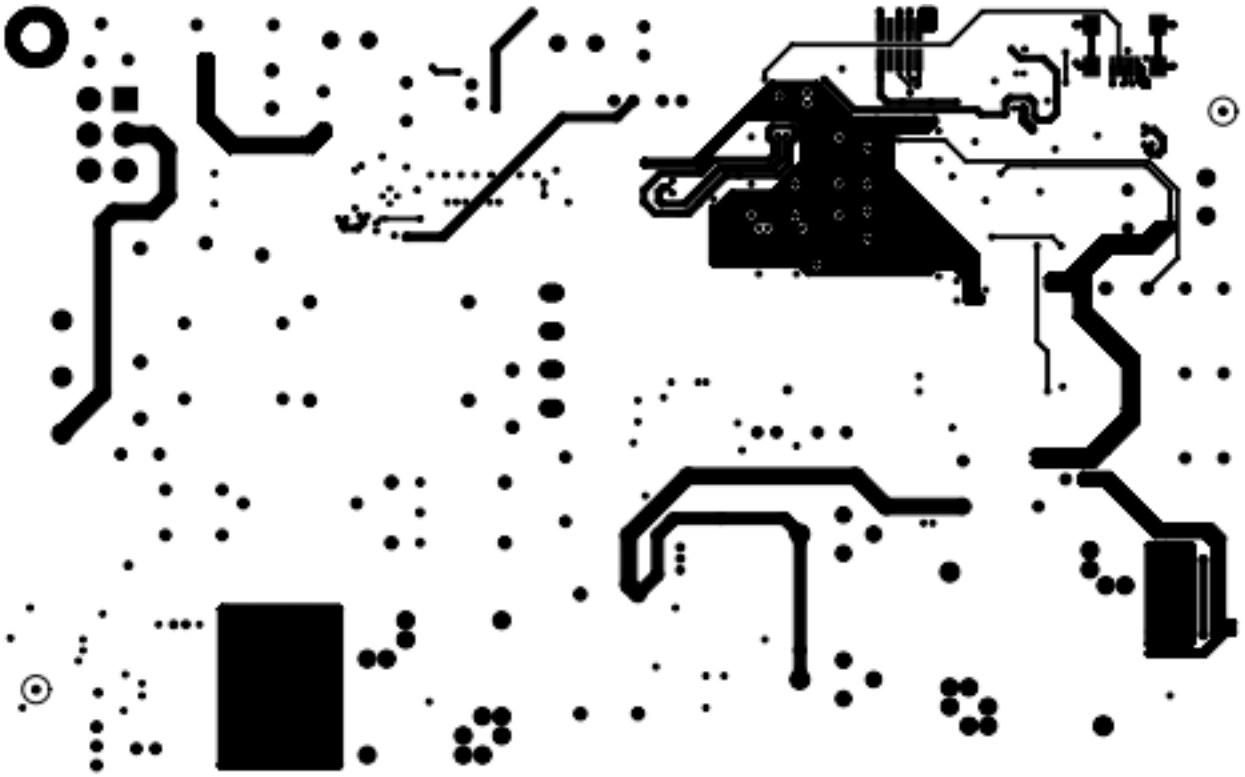


Figure 14-1 Top view of layer 1

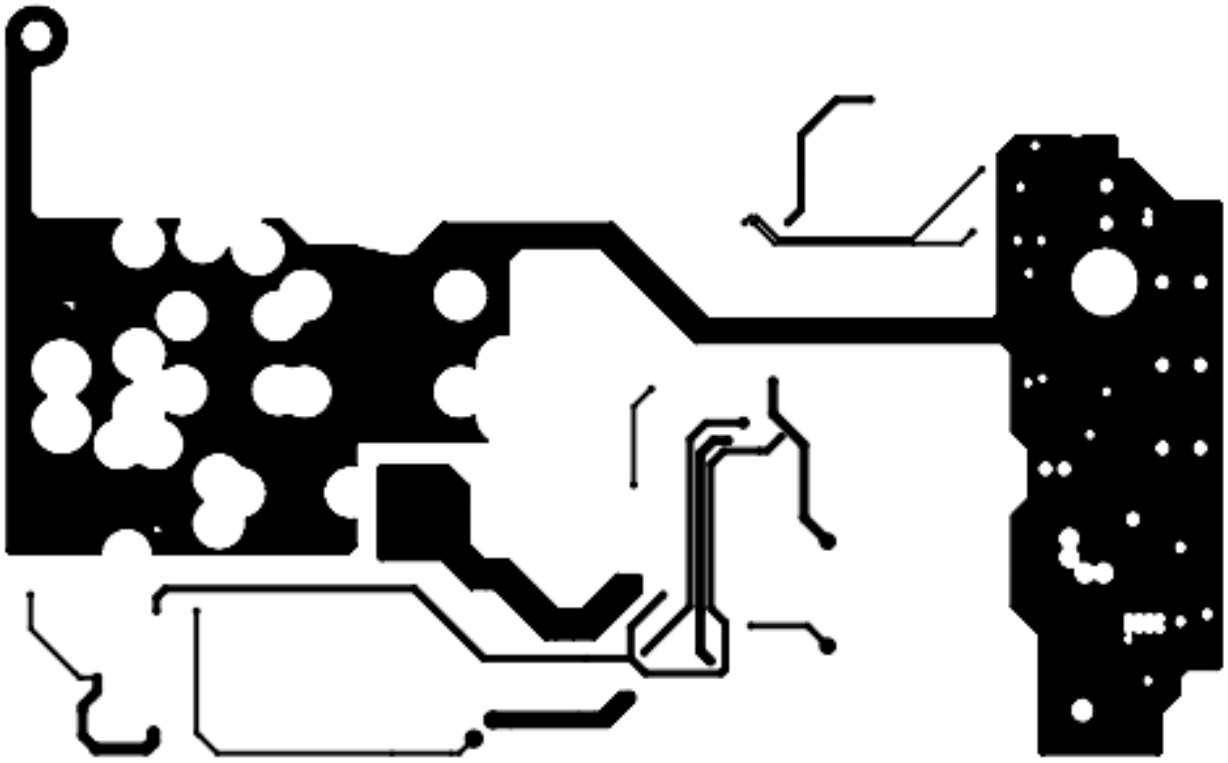


Figure 14-2 Top view of layer 2 (inner signal)

PCB information (continued)

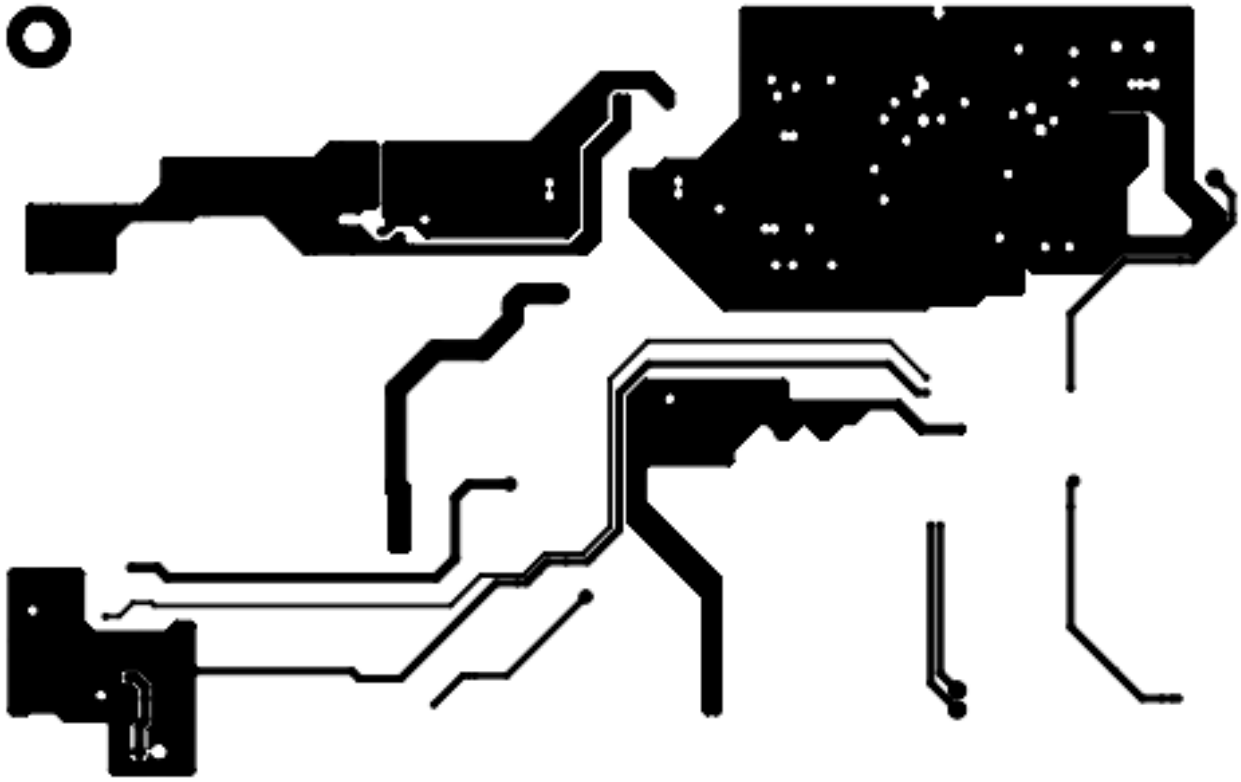


Figure 14-3 Top view of layer 3 (inner signal)

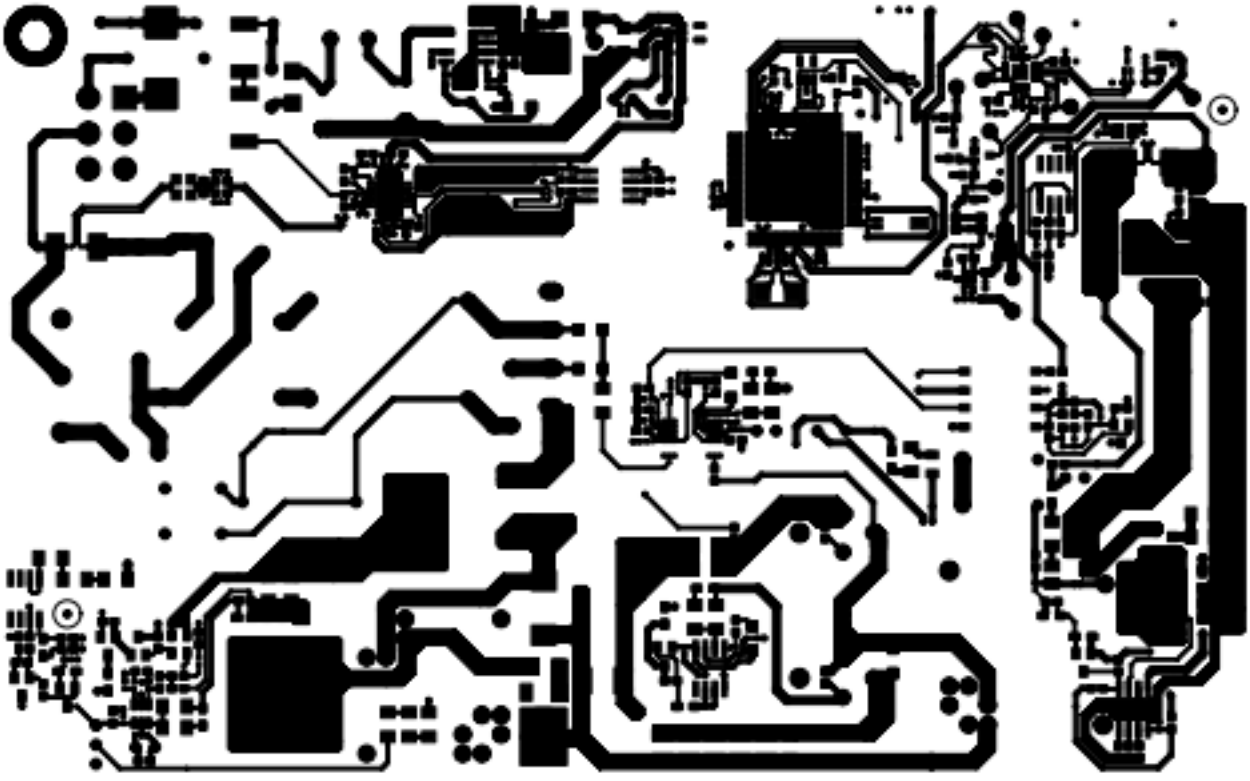


Figure 14-4 Top view of layer 4 (Bottom layer)

ON Semiconductor and the ON Semiconductor logo are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent−Marking.pdf. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

The evaluation board/kit (research and development board/kit) (hereinafter the "board") is not a finished product and is as such not available for sale to consumers. The board is only intended for research, development, demonstration and evaluation purposes and should as such only be used in laboratory/development areas by persons with an engineering/technical training and familiar with the risks associated with handling electrical/mechanical components, systems and subsystems. This person assumes full responsibility/liability for proper and safe handling. Any other use, resale or redistribution for any other purpose is strictly prohibited.

The board is delivered "AS IS" and without warranty of any kind including, but not limited to, that the board is production−worthy, that the functions contained in the board will meet your requirements, or that the operation of the board will be uninterrupted or error free. ON Semiconductor expressly disclaims all warranties, express, implied or otherwise, including without limitation, warranties of fitness for a particular purpose and non−infringement of intellectual property rights.

ON Semiconductor reserves the right to make changes without further notice to any board.

You are responsible for determining whether the board will be suitable for your intended use or application or will achieve your intended results. Prior to using or distributing any systems that have been evaluated, designed or tested using the board, you agree to test and validate your design to confirm the functionality for your application. Any technical, applications or design information or advice, quality characterization, reliability data or other services provided by ON Semiconductor shall not constitute any representation or warranty by ON Semiconductor, and no additional obligations or liabilities shall arise from ON Semiconductor having provided such information or services.

The boards are not designed, intended, or authorized for use in life support systems, or any FDA Class 3 medical devices or medical devices with a similar or equivalent classification in a foreign jurisdiction, or any devices intended for implantation in the human body. Should you purchase or use the board for any such unintended or unauthorized application, you shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the board.

This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and may not meet the technical requirements of these or other related directives.

FCC WARNING – This evaluation board/kit is intended for use for engineering development, demonstration, or evaluation purposes only and is not considered by ON Semiconductor to be a finished end product fit for general consumer use. It may generate, use, or radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment may cause interference with radio communications, in which case the user shall be responsible, at its expense, to take whatever measures may be required to correct this interference.

ON Semiconductor does not convey any license under its patent rights nor the rights of others.

LIMITATIONS OF LIABILITY: ON Semiconductor shall not be liable for any special, consequential, incidental, indirect or punitive damages, including, but not limited to the costs of requalification, delay, loss of profits or goodwill, arising out of or in connection with the board, even if ON Semiconductor is advised of the possibility of such damages. In no event shall ON Semiconductor's aggregate liability from any obligation arising out of or in connection with the board, under any theory of liability, exceed the purchase price paid for the board, if any.

PUBLICATION ORDERING INFORMATION

LITERATURE FULLFILLMENT:
Literature Distribution Center for ON Semiconductor 19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA

Phone: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support:
800−282−9855 Toll Free USA/Canada

Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910

ON Semiconductor Website:
https://www.onsemi.com/

Order Literature:
https://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative