EVHFC0300-S+MP6902-S-00A

Variable Off Time Controller EV Board

The Future of Analog IC Technology

DESCRIPTION

HFC0300 is a variable off time controller. Based on a fixed peak current technique, the controller decreases its frequency as the load becomes lighter. As a result, it offers excellent efficiency performance at light load while optimizing the efficiency in other load conditions.

When the frequency decreases to some level, peak current decreases with the decrease of the load to prevent transformer mechanical resonance. The controller enters burst mode when the output power falls below a given level.

The HFC0300 features various variable protections like Thermal Shutdown (TSD), V_{CC} Under Voltage Lockout (UVLO), Over Load Protection (OLP), Short Circuit Protection (SCP), Over Voltage Protection (OVP).

The MP6902 is a Low-Drop Diode Emulator IC that, combined with an external switch replaces Schottky diodes in high-efficiency, Flyback converters.

The HFC0300 and MP6902 are both available in the 8-pin SOIC8 package.

ELECTRICAL SPECIFICATION

Parameter	Symbol	Value	Units
Supply Voltage	V_{IN}	85 - 265	VAC
Output Voltage	V_{OUT}	5	V
Output Current	I_{OUT}	4	A

FEATURES

- Variable Off Time, Current Mode Control
- Universal Main Supply Operation (85V - 265VAC)
- Naturally Frequency Foldback with the Load Becoming Lighter
- Peak Current Compression Reduces the Transformer Noise
- Active Burst Mode for Low Standby Power Consumption
- Internal High Voltage Current Source
- Internal 200ns Leading Edge Blanking
- Thermal Shutdown (auto restart with hysteresis)
- VCC Under Voltage Lockout with Hysteresis (UVLO)
- Over Voltage Protection on VCC Pin
- Timer Based Over Load Protection
- Short Circuit Protection
- Natural Spectrum Shaping for Improved EMI Performance

APPLICATIONS

- Battery charger: cellular phone, digital camera, video camera, electrical shaver, emergency lighting system, etc
- Standby power supply: CRT-TV, Projection-TV, LCD-TV, PDP-TV, Desk top PC, Audio system, etc
- SMPS: Inc jet printer, DVD player/recorder, VCR, CD player, Set top box, Air conditioner, refrigerator, washing machine, dish washer, Adapter for NB, etc

All MPS parts are lead-free and adhere to the RoHS directive. For MPS green status, please visit MPS website under Quality Assurance.

"MPS" and "The Future of Analog IC Technology", are Registered Trademarks of Monolithic Power Systems, Inc..

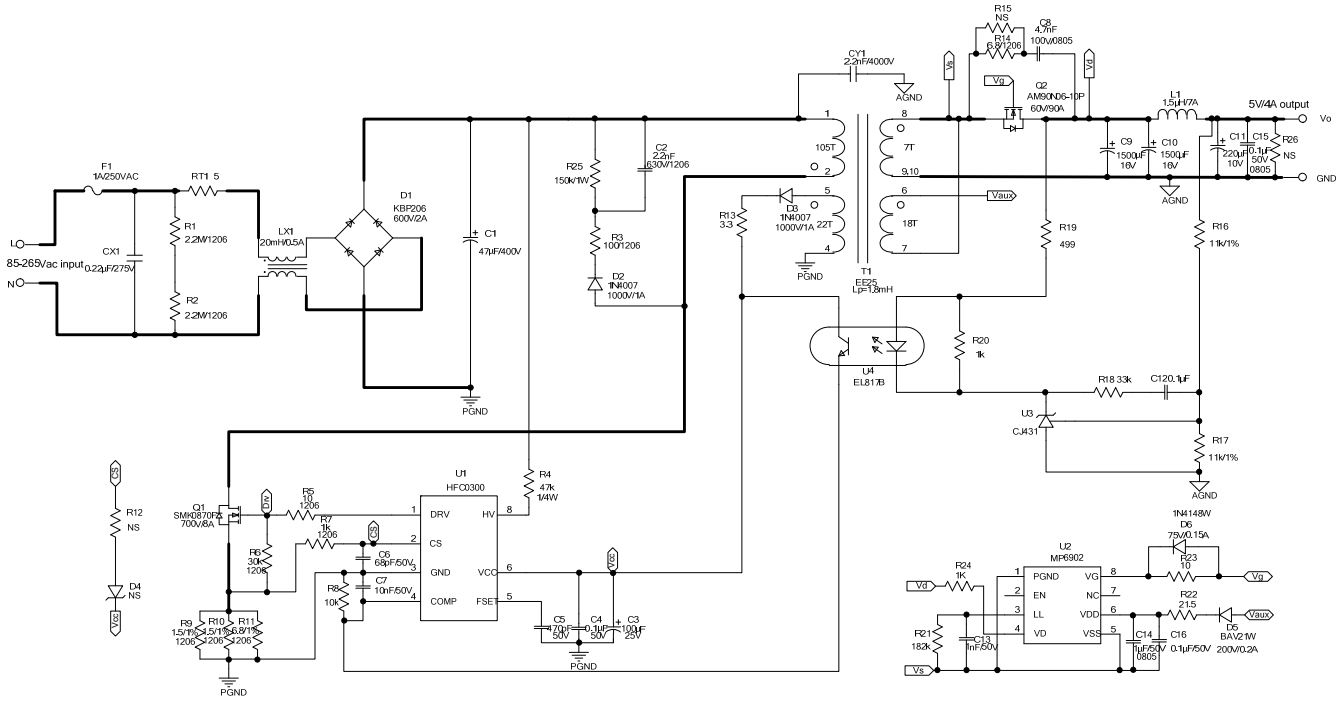
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2012 MPS. All Rights Reserved.

EVHFC0300-S+MP6902-S-00A EVALUATION BOARD

(L x W x H) 75mm x 45mm x 28mm

Board Number	MPS IC Number
EVHFC0300-S+MP6902-S-00A	HFC0300HS MP6902DS

EVALUATION BOARD SCHEMATIC



MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2012 MPS. All Rights Reserved.

EVHFC0300-S+MP6902-S-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Part Number
1	C1	47μF	Electrolytic Cap;400V	DIP	Jianghai	CD261-400V47
1	C2	2.2nF	Ceramic Cap;630V	1206	Murata	GRM31BR72J222KW01L
1	C3	100μF	Electrolytic Cap;25V	DIP	Rubycon	100uF/25V
3	C4, C12, C16	0.1μF	Ceramic Cap;50V;X7R	0603	Murata	GRM188R71H104KA93D
1	C5	470pF	Ceramic Cap;50V;C0G	0603	Murata	GRM1885C1H471JA01
1	C6	68pF	Ceramic Cap;50V;NPO	0603	Lion	0603N680J500T
1	C7	10nF	Ceramic Cap;50V;X7R	0603	Murata	GRM188R71H103KA01D
1	C8	4.7nF	Ceramic Cap; 100V;X7R	0805	TDK	C2012X7R2A472K
2	C9, C10	1500μF	Electrolytic Cap;16V	DIP	Mouser	UHM1C152MPD
1	C11	220μF	Electrolytic Cap;10V	DIP	Jianghai	CD110-10V220
1	C13	1nF	Ceramic Cap;50V;X7R	0603	TDK	C1608X7R1H102K
1	C14	1μF	Ceramic Cap;50V;X7R	0805	Murata	GRM21BR71H105KA12L
1	C15	0.1μF	Ceramic Cap;50V;X7R	0805	Murata	GRM21BR71H104KA01L
1	CX1	0.22μF	X-CAP;275V	DIP	Kaili	PX224K3ID49L270D9R
1	CY1	2.2nF	Y-CAP;4000V	DIP	Hongke	JNK12E222MY02N
1	D1	KBP206	Diode;600V;2A	DIP	Diodes	KBP206
2	D2, D3	1N4007	Diode;1000V;1A	DO-41	Diodes	1N4007
1	D4	NS				
1	D5	BAV21W	Schottky Diode; 200V;0.2A	SOD-123	Diodes	BAV21W-7-F
1	D6	1N4148W	Diode;75V;0.15A	SOD-123	Diodes	1N4148W
1	F1	1A	Fuse;250V;1A	DIP	Cooper Bussmann	SS-5-1A
1	L1	1.5μH	1.5μH;7A	DIP	Wurth	744732015
1	LX1	20mH	Common filter; 1Ω, 0.5A	DIP	Wurth	744821120
1	Q1	SMK0870F	N-Channel Mosfet; 700V,8A	TO-220F-3L	AUK	SMK0870F
1	Q2	AM90N06-10P	Mosfet; 60V; 90A; 10mohm	TO-220	Analog Power	AM90N06-10P
2	R1, R2	2.2MΩ	Film Res;5%;1/4W	1206	Royalohm	1206J0225T5E

MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2012 MPS. All Rights Reserved.

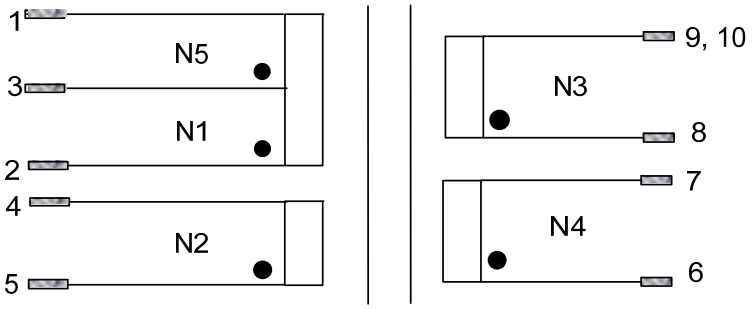
EVHFC0300-S+MP6902-S-00A BILL OF MATERIALS *(continued)*

Qty	Ref	Value	Description	Package	Manufacturer	Part Number
1	R3	100Ω	Film Res;1%	1206	Yageo	RC1206FR-07100RL
1	R4	47kΩ	DIP Res;1%,1/4W	DIP	Any	Any
1	R5	10Ω	Film Res;1%	1206	Yageo	RC1206FR-0710RL
1	R6	30kΩ	Film Res;1%	1206	Royalohm	1206F3002T5E
1	R7	1kΩ	Film Res;1%	1206	Royalohm	1206F1001T5E
1	R8	10kΩ	Film Res;1%	0603	Yageo	RC0603FR-0710KL
2	R9, R10	1.5Ω	Film Res;1%	1206	Royalohm	1206F150KT5E
2	R11, R14	6.8Ω	Film Res;1%	1206	Royalohm	1206F680KT5E
3	R12, R15, R26	NS				
1	R13	3.3Ω	Film Res;5%	0603	Yageo	RC0603JR-073R3L
2	R16, R17	11kΩ	Film Res;1%	0603	Yageo	RC0603FR-0711KL
1	R18	33kΩ	Film Res;1%	0603	Yageo	RC0603FR-0733KL
1	R19	499Ω	Film Res;1%	0603	Yageo	RC0603FR-07499RL
2	R20, R24	1kΩ	Film Res;1%	0603	Royalohm	0603F1001T5E
1	R21	182kΩ	Film Res;1%	0603	Yageo	RC0603FR-07182KL
1	R22	21.5Ω	Film Res;1%	0603	Yageo	RC0603FR-0721R5L
1	R23	10Ω	Film Res;1%	0603	Yageo	RC0603FR-0710RL
1	R25	150kΩ	1W	DIP	Any	Any
1	RT1	5Ω	NTC Res	DIP	Xingshun	5D2-10
1	T1	1.8mH	EE25,1.8mH, 105:7:22:18	Through Hole	Emei	FX0247
1	U1	HFC0300HS	Off Time Controller	SOIC8-7	MPS	HFC0300HS
1	U2	MP6902DS	SR Cpntroller	SOIC8	MPS	MP6902DS
1	U3	CJ431	Shunt Regulator,2.5V	SOT-23	Changdian	CJ431
1	U4	EL817B	Photocoupler; 1-Channel	DIP	Sharp	EL817B

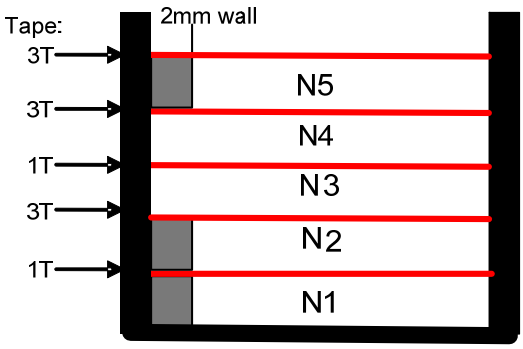
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2012 MPS. All Rights Reserved.

TRANSFORMER STRUCTURE

Electrical Diagram

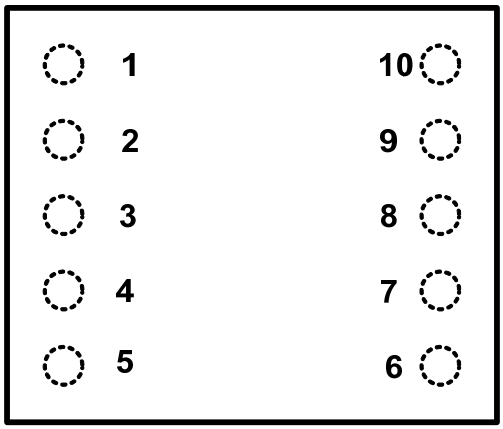


Winding Diagram



Pin Definition of Bobbin

Pin Out



View from the top

MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2012 MPS. All Rights Reserved.

Table 1—Electrical Characteristic

Parameter	Condition	Value
Primary Inductance	Lp(2-1)	1.8mH±5%
Core		EE25
Bobbin		EI25
Core Material		PC40 or equivalent
Turn Ratio	N1:N2:N3:N4:N5	52:22:7:18:53

Table 2—Winding Specification

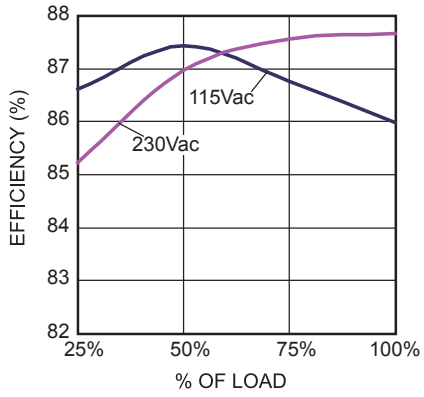
Tape Turns	Winding No.	Margin Tapes	Start&End	Wire Diameter (mm)	Turns
1	N1	2mm	2→3	0.3×1	52
1	N2	2mm	5→4	0.20×1	22
3	N3		8→9,10	0.4×5(T.I.W)	7
1	N4		6→7	0.20×1(T.I.W)	18
3	N5	2mm	3→1	0.3×1	53

MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2012 MPS. All Rights Reserved.

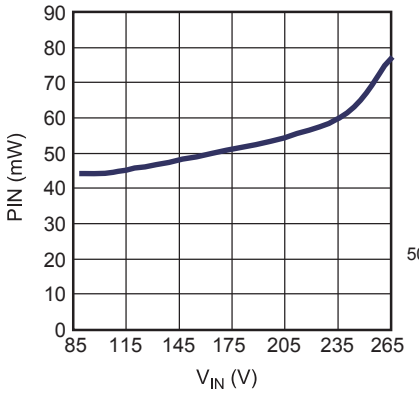
EVB TEST RESULTS

Performance waveforms are tested on the evaluation board.
V_{IN} = 230VAC, V_{OUT} = 5V, L = 1.8mH, T_A = 23ºC, unless otherwise noted.

Efficiency

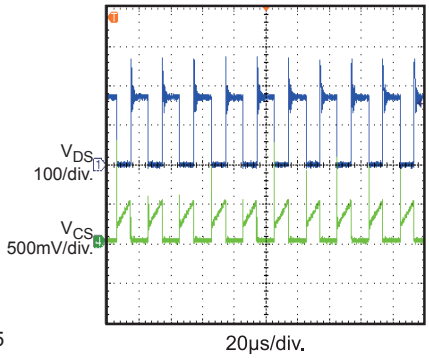


No Load Power Consumption



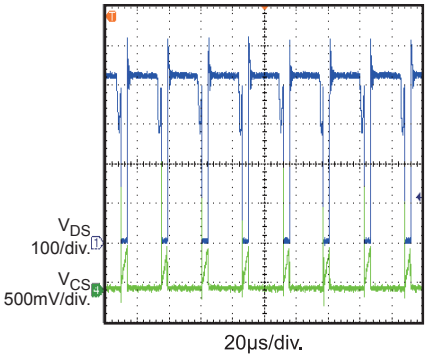
Voltage Stress

V_{IN} = 85Vac, Full load



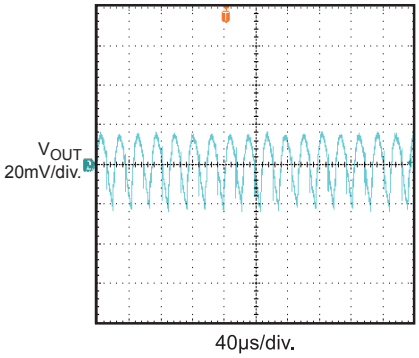
Voltage Stress

V_{IN} = 265Vac, Full load



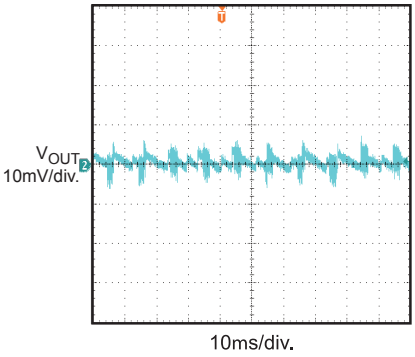
Output Ripple

V_{IN} = 115Vac, Full load



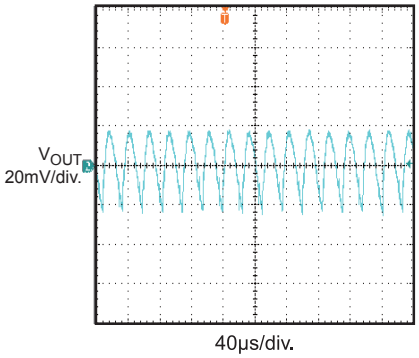
Output Ripple

V_{IN} = 115Vac, No load



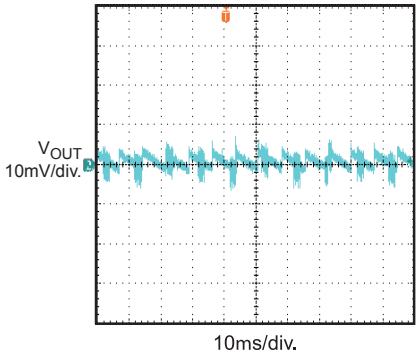
Output Ripple

V_{IN} = 230Vac, Full load



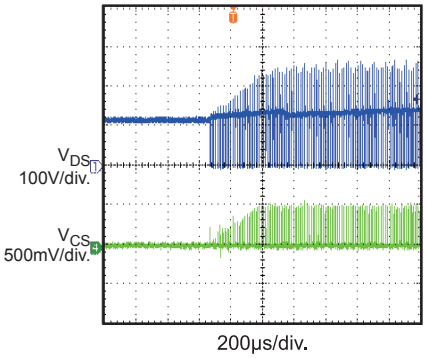
Output Ripple

V_{IN} = 115Vac, No load



Soft Start

V_{IN} = 85Vac, Full load

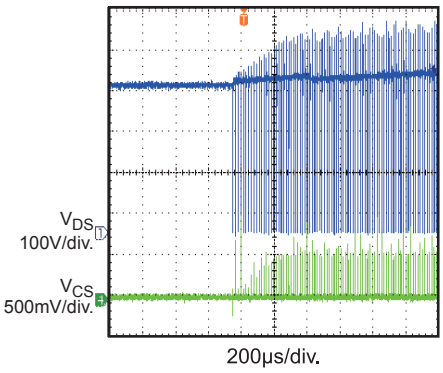


MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2012 MPS. All Rights Reserved.

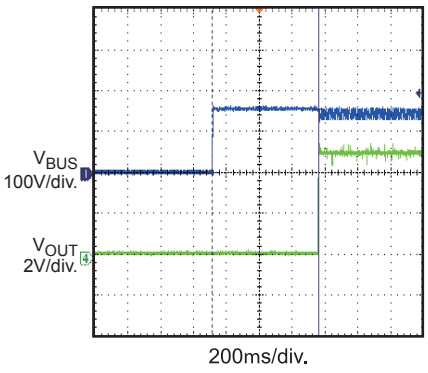
EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.
V_{IN} = 230VAC, V_{OUT} = 5V, L = 1.8mH, T_A = 23ºC, unless otherwise noted.

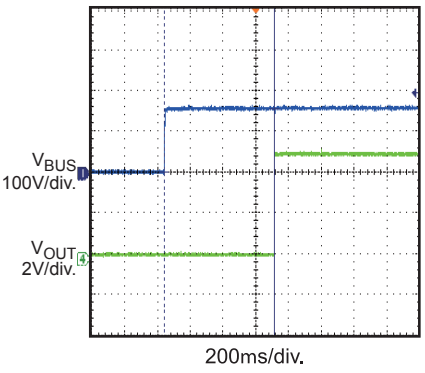
Soft Start
V_{IN} = 265Vac, Full load



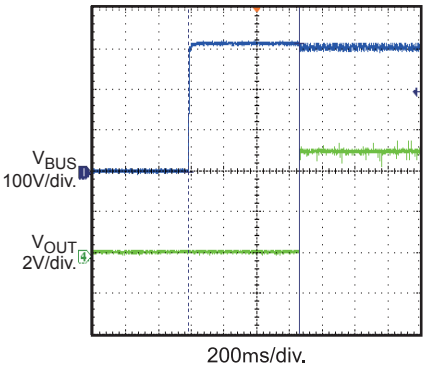
Turn On Delay
V_{IN} = 115Vac, Full load



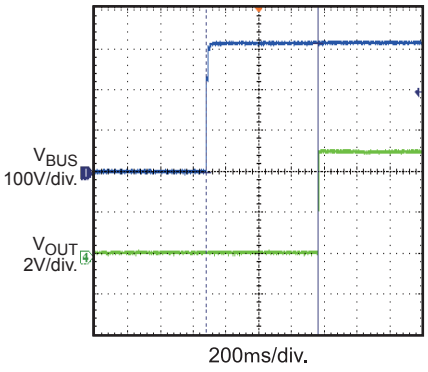
Turn On Delay
V_{IN} = 115Vac, No load



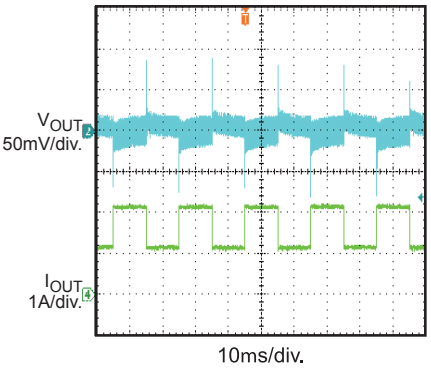
Turn On Delay
V_{IN} = 230Vac, Full load



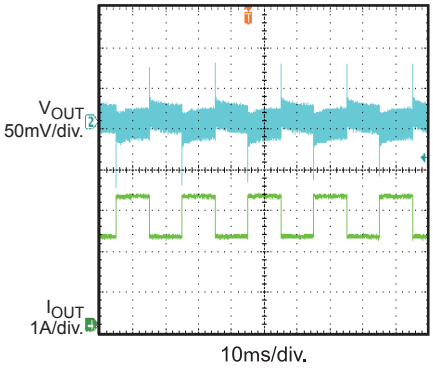
Turn On Delay
V_{IN} = 230Vac, No load



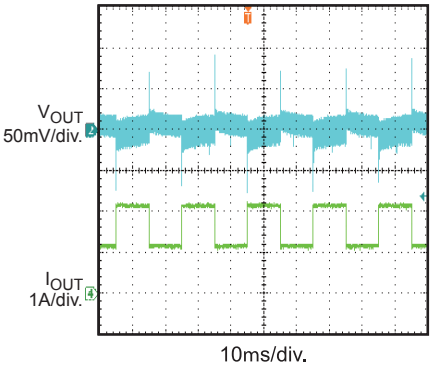
Load Transient
V_{IN} = 115Vac, 25% load to 50% load



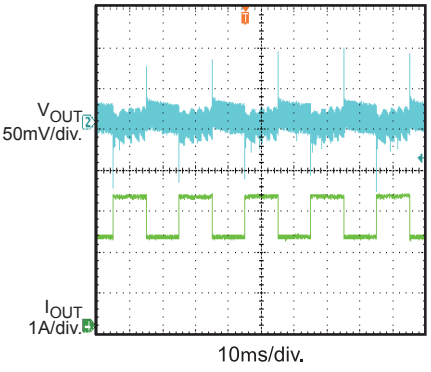
Load Transient
V_{IN} = 115Vac, 50% load to 75% load



Load Transient
V_{IN} = 230Vac, 25% load to 50% load



Load Transient
V_{IN} = 230Vac, 50% load to 75% load

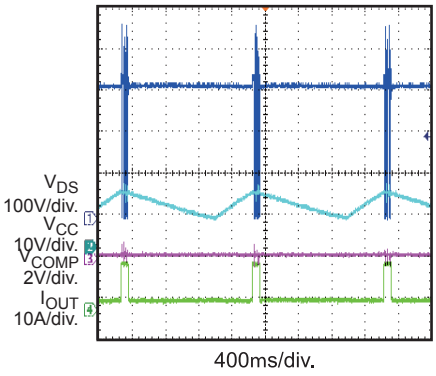


MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2012 MPS. All Rights Reserved.

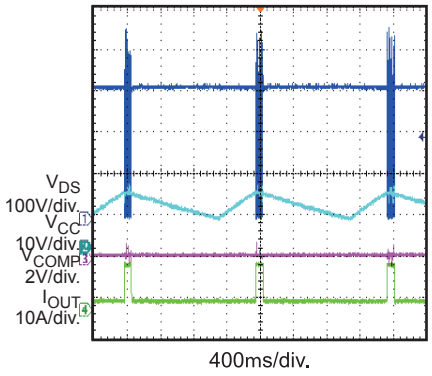
EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.
V_{IN} = 230VAC, V_{OUT} = 5V, L = 1.8mH, T_A = 23ºC, unless otherwise noted.

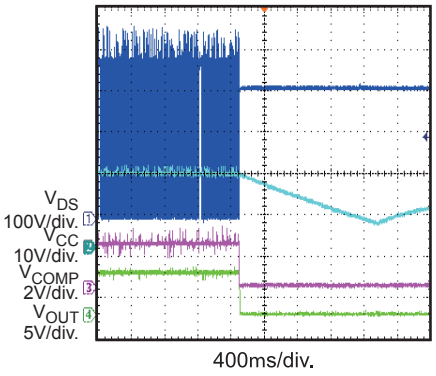
Short Circuit Protection
V_{IN} = 230Vac



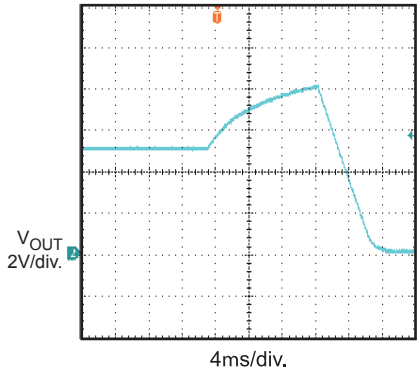
Over Load Protection
V_{IN} = 230Vac



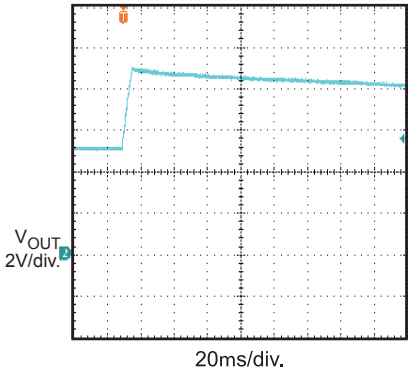
Thermal Shutdown



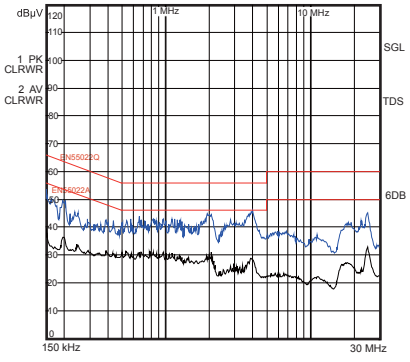
Over Voltage Protection
V_{IN} = 230Vac, Full load



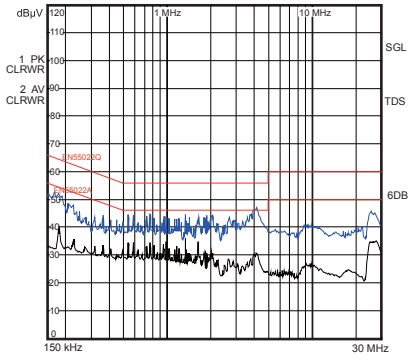
Over Voltage Protection
V_{IN} = 230Vac, No load



Conducted EMI
115Vac



Conducted EMI
230Vac



MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2012 MPS. All Rights Reserved.

PRINTED CIRCUIT BOARD LAYOUT

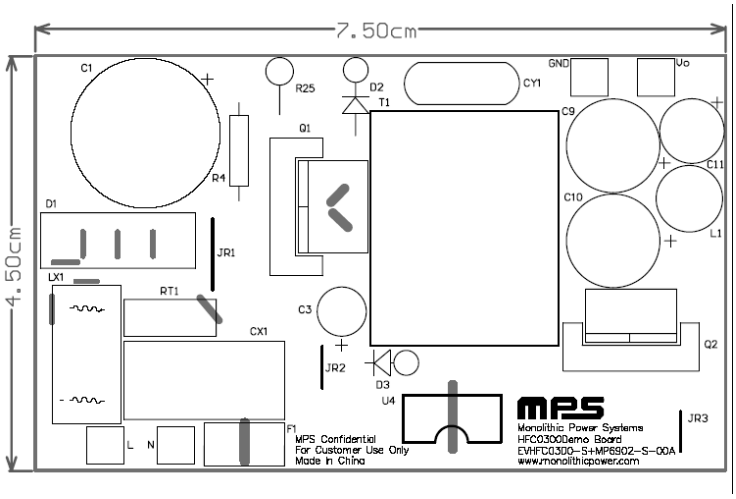


Figure 1 — Top Silk Layer

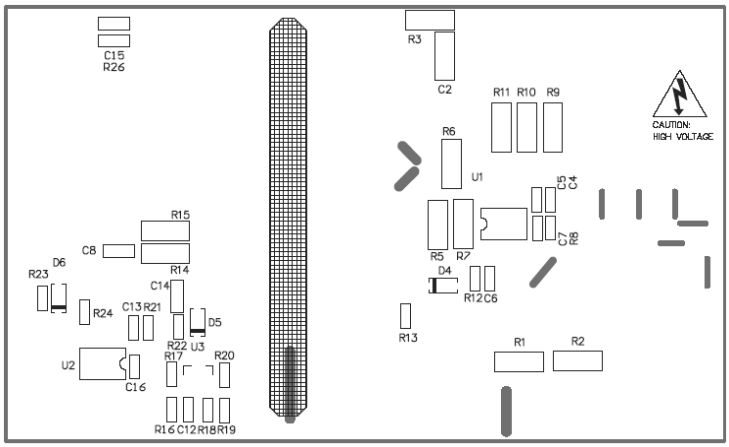


Figure 2 — Bottom Silk Layer

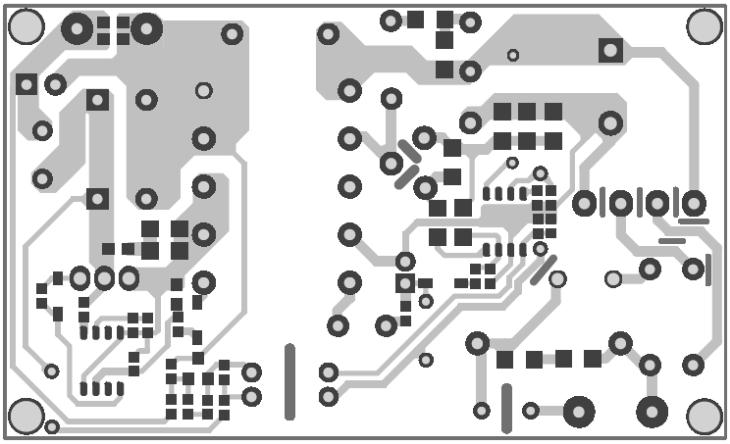


Figure 3 — Bottom Layer

MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2012 MPS. All Rights Reserved.

QUICK START GUIDE

1. Preset Power Supply to 85V ≤ V_{IN} ≤ 265V.
2. Turn Power Supply off.
3. Connect the power supply output to L and N pins respectively.
4. Connect the positive and negative terminals of the Load to Vo and GND pins respectively.
5. Turn Power Supply on after making connections.

NOTICE: The information in this document is subject to change without notice. Please contact MPS for current specifications. Users should warrant and guarantee that third party Intellectual Property rights are not infringed upon when integrating MPS products into any application. MPS will not assume any legal responsibility for any said applications.

MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2012 MPS. All Rights Reserved.