EVHF900-P-00A

85VAC/60Hz~420VAC/60Hz,
13.5V/300mA;8V/50mA;8V/50mA
Off-line SWITCHING Regulator
Evaluation Board

DESCRIPTION

The HF900 is a flyback regulator with a 900V MOSFET integrated, targeting high AC input voltage application. The switching frequency can be programmed with one external resistor

The EVHF900-P-00A Evaluation Board is designed to demonstrate the capabilities of HF900 and is also designed for off-line high input voltage (85VAC~420VAC) application with triple outputs (13.5V/300mA, 8V/50mA, 8V/50mA). The 8V output rail can power the LDO for MCU power supply.

The EVHF900-P-00A has an excellent performance and meets EN55022 conducted EMI requirements easily with frequency jittering function. It has various protections like Over Temperature Protection (OTP), VCC Under Voltage Lockout (UVLO), Over Load Protection (OLP), Over Voltage Protection (OVP), Short Circuit Protection (SCP) and built-in PRO pin for extra protection setting.

ELECTRICAL SPECIFICATION

Parameter	Symbol	Value	Units
Input Voltage	V_{IN}	85 to 420	VAC
Output1 Voltage	V_{OUT1}	13.5	V
Output1 Current	I_{OUT1}	300	mA
Output2 Voltage	V_{OUT2}	8	V
Output2 Current	I_{OUT2}	50	mA
Output3 Voltage	V_{OUT3}	8	V
Output3 Current	I_{OUT3}	50	mA

FEATURES

- Internal Integrated 900V MOSFET
- Programmable switching frequency up to 300kHz
- Frequency jittering
- Current-mode operation
- Internal high voltage current source
- Low standby power consumption via active burst mode
- Internal leading-edge blanking
- Built-in soft-start function
- Internal slope compensation
- Built-in PRO pin pull-up auto restart function
- Over-temperature protection
- V_{CC} under-voltage lockout with hysteresis
- Over-voltage protection on V_{CC}
- Time-based over-load protection
- Short-circuit protection

APPLICATIONS

- Power supply for meter
- Any high AC input voltage power supply

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Warning: Although this board is designed to satisfy safety requirements, the engineering prototype has not been agency approved. Therefore, all testing should be performed using an isolation transformer to provide the AC input to the prototype board.

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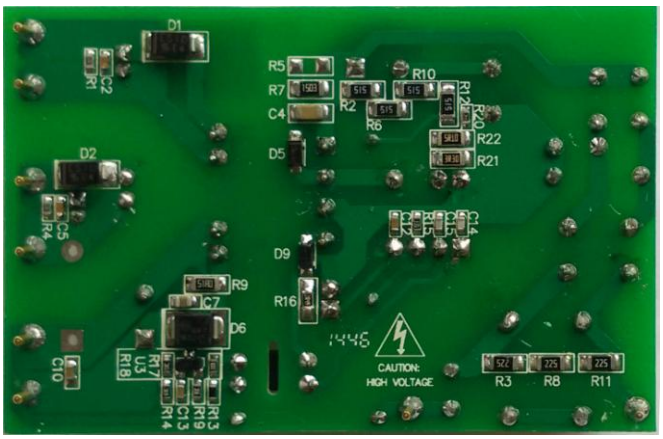
EVHF900- P-00A EVALUATION BOARD

TOP VIEW



BOTTOM VIEW

(L x W x H) 74mm x 47mm x 22mm

Board Number	MPS IC Number
EVHF900-P-00A	HF900GPR

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EVALUATION BOARD SCHEMATIC

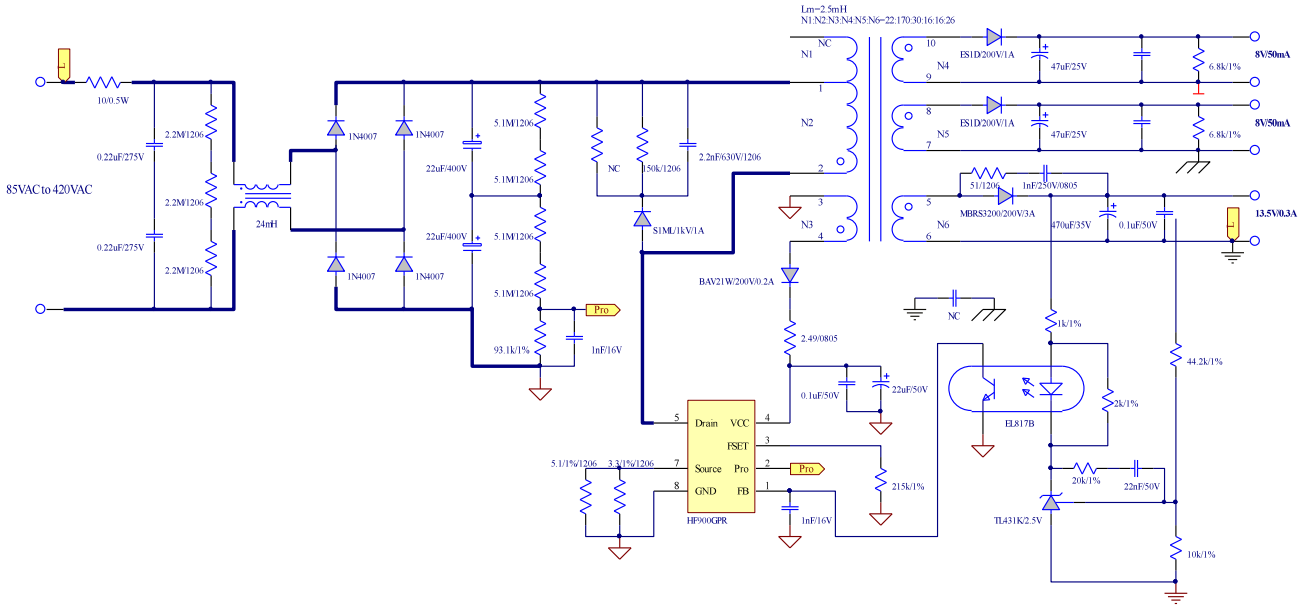

Figure 1—Schematic

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EVHF900-P-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufactuer_P/N
2	C1, C3	47μF	Ceramic Capacitor;25V	DIP	Jianghai	CD28L-25V47
2	C2,C5	1μF	Ceramic Capacitor; 25V;X7R	0603	Murata	GRM188R71E2105KA12D
1	C4,	2.2nF	Ceramic Capacitor; 630V;X7R	0603	Murata	GRM31BR72J222KW01L
2	C6,C8	22μF	Electroytic Cacitor;400V	DIP	Rubycon	400PX22MEFC12.5X20
1	C7	1nF	Ceramic Capacitor; 250V;X7R	0805	Murata	GRM21A7U2E102JW31D
1	C9	470μF	Ceramic Capacitor;35V	DIP	Jianghai	CD263-35V470
2	C10, C12	100nF	Ceramic Capacitor;50V	0603	Murata	GRM188R71H104KA93D
1	C11	22μF	Electrolytic Capacitor;50V	DIP	Jianghai	CD281L-50V22
1	C13	22nF	Ceramic Capacitor;50V	0603	Murata	GRM188R71H223KA01D
2	C14, C15	1nF	Ceramic Capacitor;16V	0603	Jianghai	GRM188R71C102KA01
2	CX1, CX2	0.22μF	X Capacitor;275V;10%	DIP	Carli	PX224K3IC59L270D9R
1	CY1	NC				
2	D1,D2	ES1D	Diode;200V;1A	SMA	Taiwan Semiconductor	ES1D
4	D3, D4, D7, D8	1N4007	Diode;1000V;1A	DO41	Diodes	1N4007
1	D5	S1ML	Diode;1000V;1A;	SMA	Diodes	S1ML
1	D6	MBRS3200T3G	Schottky Diode;200V;3A	SMB	Onsemi	MBRS3200T3G
1	D9	BAV21W	Diode;200V;0.2A;	SOD123	Diodes	BAV21W
1	LX1	24mH	EE8, Common Choke	DIP	Emei(1)	FX0344
1	FR1	10	Fuse Resistor;5%;1/2W	DIP	CTC	FKN50SJT-52-10R
2	R1, R4	6.8k	Film Resistor;1%	0603	Yageo	RC0603FR-076K8L
4	R2, R6, R10, R12	5.1M	Film Resistor;5%;1/4W	1206	Yageo	RI1206L515JT
3	R3, R8, R11	2.2M	Film Resistor;5%;1/4W	1206	Royalohm	1206J0225T5E
1	R5	NC				
1	R7	150k	Film Resistor;5%;1/4W	1206	Yageo	RC1206FR-07150KL
1	R9	51	Film Resistor;1%;1/4W	1206	Yageo	RC1206FR-0751RL

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EVHF900-P-00A BILL OF MATERIALS *(continued)*

Qty	Ref	Value	Description	Package	Manufacturer	Manufactuer_P/N
1	R13	1k	Film Resistor;1%	0603	Yageo	RC0603FR-071KL
1	R14	44.2k	Film Resistor;1%	0603	Yageo	RC0603FR-0744K2L
1	R15	215k	Film Resistor;1%	0603	Yageo	RC0603FR-07215KL
1	R16	2.49	Film Resistor;1%	0805	Yageo	RC0805FR-072R49L
1	R17	2k	Film Resistor;1%	0603	Yageo	RC0603FR-072KL
1	R18	10k	Film Resistor;1%	0603	Yageo	RC0603FR-0710KL
1	R19	20k	Film Resistor;1%	0603	Yageo	RC0603FR-0720KL
1	R20	93.1k	Film Resistor;1%	0603	Yageo	RC0603FR-0793K1L
1	R21	3.3	Film Resistor;1%;1/4W	1206	Yageo	RC1206FR-073R3L
1	R22	5.1	Film Resistor;1%;1/4W	1206	Yageo	RC1206FR-075R1L
1	T1	EE16	EE16, 2.5mH, N1:N2:N3:N4:N5:N6= 22:170:30:16:16:26	DIP	Emei(1)	FX0418
1	U2	HF900	Flyback regulator with 900V integrated MOS	PDIP8-7EP	MPS	HF900GPR
1	U1	EL817B	Photocoupler;1-Channel	DIP	Everlight	EL817B
1	U3	TL431	2.5V voltage reference	SOT23	Diodes	TL431

Note:

1) Emei transformer sample request please login on website: www.emeigroup.com

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PCB LAYOUT (SINGLE-SIDED)

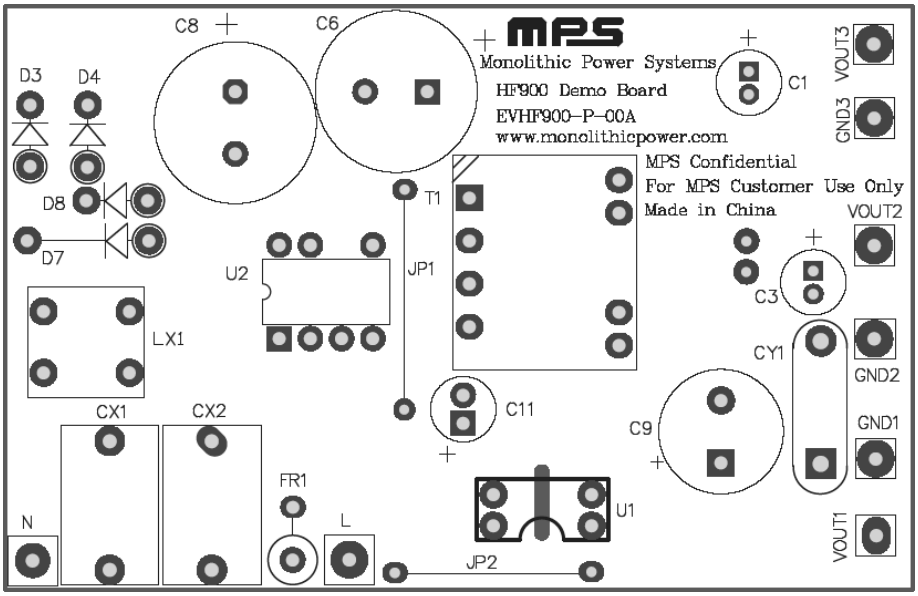

Figure 2—Top Layer

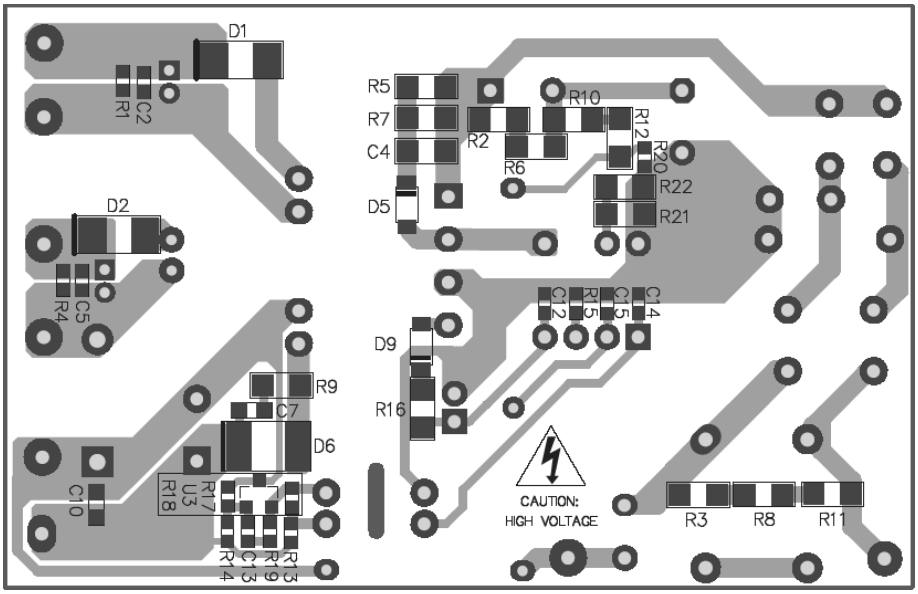

Figure 3—Bottom Layer

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CIRCUIT DESCRIPTION

The EVHF900-P-00A is configured for 5W triple outputs in power meter application. The 8V output rail can power the LCD for MCU power supply. The demo board is proper for three phase input power system.

FR1 is used to protect for the component failure or some excessive short events, also it can restrain the inrush current.

The CX1, CX2 and LX1 compose the EMI filter to guarantee the conducted EMI meet the EN55022 criteria. CX1 is in series with CX2 for 420VAC input. R3, R8 and R11 are used to discharge the energy stored in CX1 and CX2 in 1 second for safety requirement.

D3, D4, D7 and D8 compose the input stage to commute the AC voltage to DC voltage.

The C6 and C8 are used for energy storage reducing line noise and protecting against line surge. R2, R6, R10 R12 and R20 are for balancing the voltage of C6 and C8 and also configured for input over voltage protection.

R7, C4 and D5 are formed the RCD to restrain the high voltage spike to protect the MOSFET.

R15 is for switching frequency setup. Normally, the switching frequency is configured low to get good thermal performance under high voltage input applications. And switching frequency should be far away form data sampling frequency in power meter applications to avoid noise disturbing.

C11 is the power supply capacitor and C12 is the decoupling ceramic cap to decouple the voltage noise spike. C12 should be located near to IC.

R21, R22 are the sense resistors with 1% tolerance for peak current setup.

C1, C3, C9 are the output filter capacitor to restrain the output voltage ripple. One filter could be used for strict voltage ripple requirement.

R1, R4 are dummy load to regulate the output voltage within designed value.

R14, R17 are configured to set the output voltage. U1, U3, R19 and C13 compose the control loop to feedback the output signal to FB pin and guarantee the quick control loop response and system stability.

Input Line wire is connected to GND of main output for input AC frequency sample in power meter.

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TRANSFORMER SPECIFICATION

Electrical Diagram

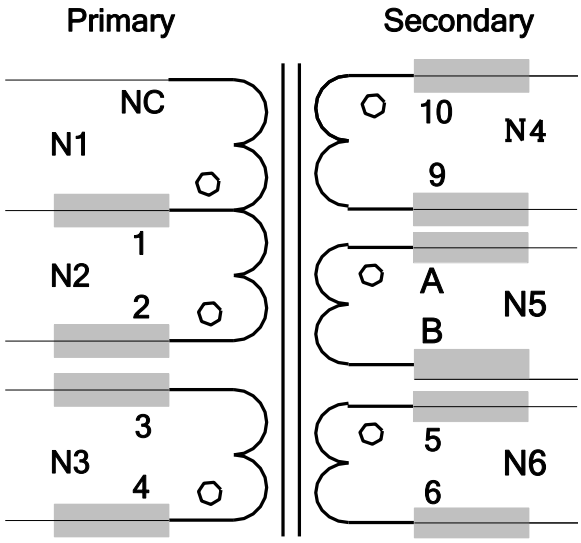

Figure 4—Transformer Electrical Diagram

Notes:

1、 All winding terminals are added tube;

2、 N5 is flying out from the bobbin. Terminal A is labed with black and terminal B is labed with white;

3、 Remove Pin7 and Pin8；

4、 Varnish the transformer.

Winding Diagram

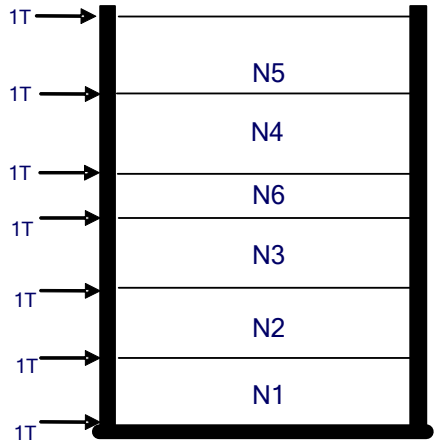

Figure 5—Winding Diagram

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Winding Order

Winding No.	Tape Layer Number	Start & End	Magnet WireΦ(mm)	Turns
N1	1	1→NC	0.15mm * 2	22
N2	1	2→1	0.15mm * 1	170
N3	1	4→3	0.1mm * 1	30
N6	1	5→6	0.30mm * 1 TIW	26
N4	1	10→9	0.16mm * 1 TIW	16
N5	1	A→B	0.16mm* 1 TIW	16

Electrical Specifications

Electrical Strength	60 second, 60Hz, from PRI. to SEC.	4500VAC
	60 second, 60Hz, from N4. to N6.	4500VAC
	60 second, 60Hz, from PRI. to CORE.	2500VAC
Primary Inductance	Pins 1 - 2, all other windings open, measured at 60kHz, 0.1 VRMS	2.5mH±10%

Materials

Item	Description
1	Core: EE16, UI=2300±25%, AL=1100nH/N^2±25% UNGAPPED
2	Bobbin: EE16 vertical, 4+6PIN 1SECT T-H
3	Wire:Φ0.15mm,, 2UEW, Class B
4	Wire:Φ0.1mm,, 2UEW, Class B
5	Triple Insulation Wire: Φ0.30mm TIW
6	Triple Insulation Wire: Φ0.16mm TIW
7	Tape: 8.5mm(W)×0.06mm(TH)
8	Tube:#26 BLACK; #26 CLEAR; #30 CLEAR; #23 CLEAR
9	Varnish: JOHN C. DOLPH CO, BC-346A or equivalent
10	Solder Bar: CHEN NAN: SN99.5/Cu0.5 or equivalent

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QUICK START GUIDE

1. Preset Power Supply to 85VAC ≤ V_{IN} ≤ 420VAC.
2. Turn Power Supply off.
3. Connect the Line and Neutral terminals of the power supply output to L and N port.
4. Connect Load to:
    a. Positive (+): VOUT
    b. Negative (–): GND
5. Turn Power Supply on after making connections.

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