

Green mode Quasi-resonant IC FA5640N / 41N / 42N / 43N / 44N / 48N Power supply design example : 24V/96W

Reference Design

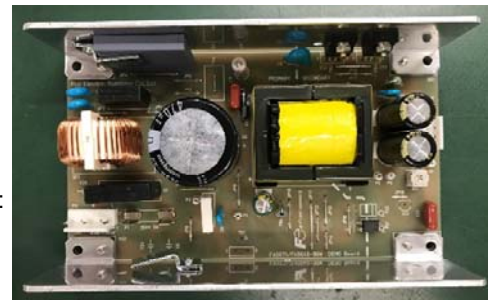
1. Overview

This document describes the design example of flyback converter using the green mode Quasi-resonant IC FA5640 series. The input is universal (85Vac to 264Vac) and the output is 24V/96W.

FA5640 series are a quasi-resonant type switching power supply control IC with excellent stand-by characteristics. Though it is a small package with 8 pins, it has a lot of functions and enables to decrease external parts. Therefore it is possible to realize a small size and a high cost-performance power supply.

2. Features

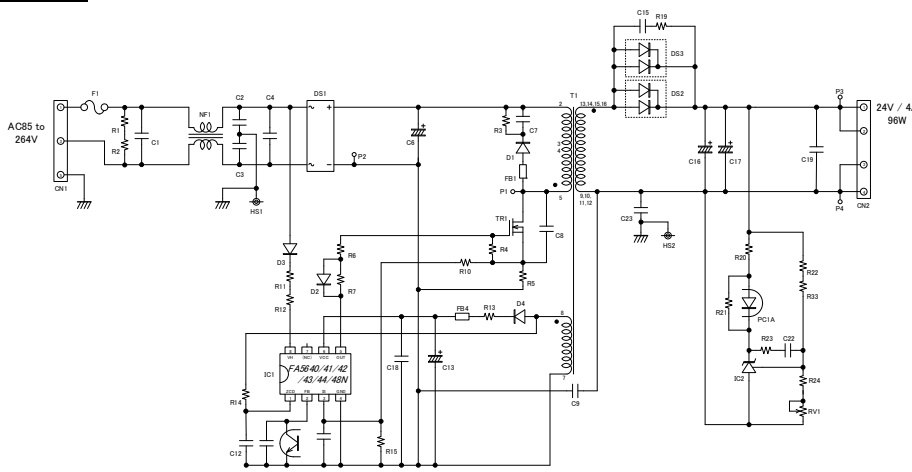
- A quasi-resonant type switching power supply
- A power supply with excellent standby characteristics
- Low power consumption achieved by integrated startup circuit
- Low current consumption, During operation: 0.85 mA
- Control of number of bottom skips by on-off width detection
- Burst operation function under light load
- Built-in drive circuit directly connectable to a power MOSFET, Output current: 0.5 A (sink)/0.25 A (source)
- Built-in overload protection function
- Built-in latch protection function based on overvoltage detection on the secondary side
- Maximum input threshold voltage of IS pin and threshold voltage of stopping on-pulse are compensated by detecting high-line voltage.
- Built-in under voltage lock out function, ON threshold voltage: 14 V and 10 V
- Package: SOP-8



Function list by type

Type	Overload protection	ON threshold voltage	Operation compensation	Minimum switching frequency	Delay time of restart	IS pin one shot latch function	Changing of overload protection levels due to external signal detection	Change point from 1st bottom to 2nd bottom
FA5640	Auto recovery	14V	Yes	No	25us	No	Yes	110kHz
FA5641	Auto recovery	14V	Yes	25kHz	7.6us	No	Yes	110kHz
FA5542	Auto recovery	10V	No	No	25us	No	Yes	110kHz
FA5543	Auto recovery	14V	Yes	25kHz	25us	Yes	No	110kHz
FA5544	Timer latch	14V	Yes	No	25us	No	Yes	110kHz
FA5548	Auto recovery	14V	Yes	No	12.5us	No	No	260kHz (High-frequency)

3. Application circuit





4. Specifications of the Power supply

Item	Value	Unit
Input voltage	85 to 264	Vac
Output voltage	24	Vdc
Output current	4	A

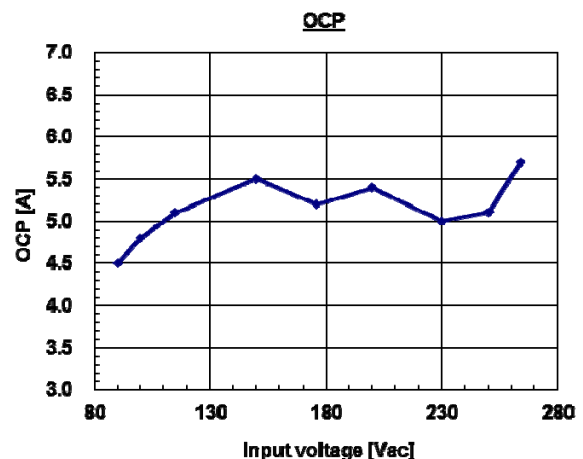
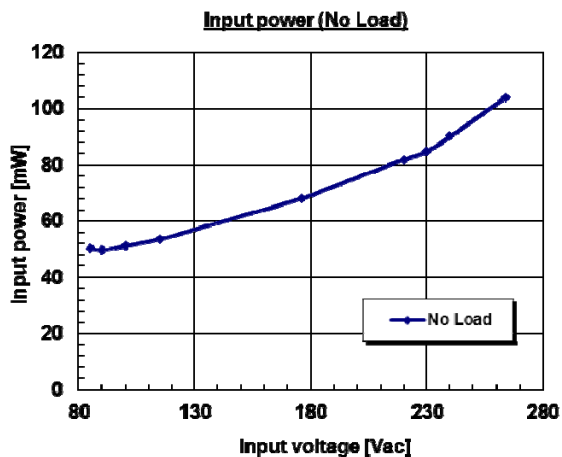
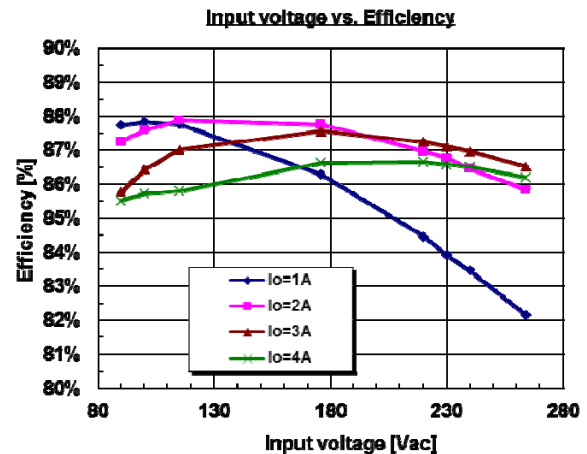
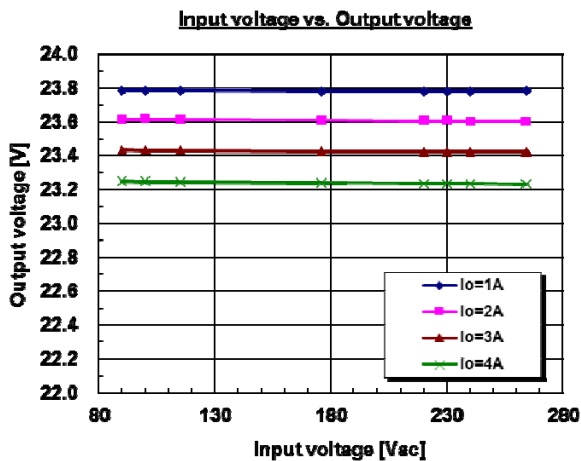
5. Efficiency

Load (%)	25	50	75	100	Ave.
Efficiency at 100Vac (%)	87.8	87.6	86.4	85.7	86.9
Efficiency at 230Vac (%)	83.9	86.8	87.1	86.6	86.1

Measured using cable with a length (L) =1.9m and a diameter (Φ) =1.1mm.

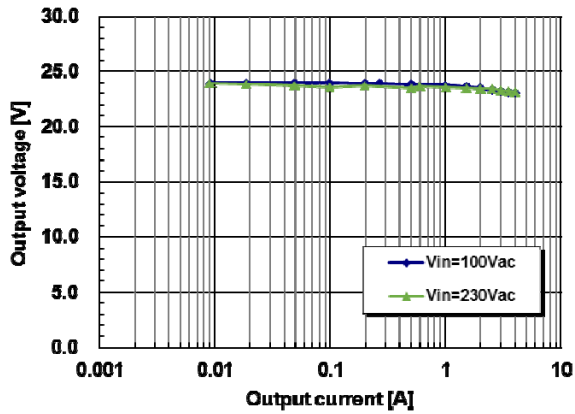
Input voltage	100Vac	230Vac
Input power at NO Load	51.1mW	84.5mW
Over Current Protect	4.8	5.0

6. Characteristics curves

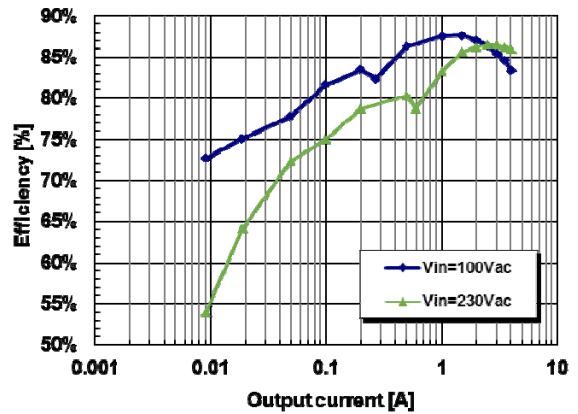


6. Characteristics curves

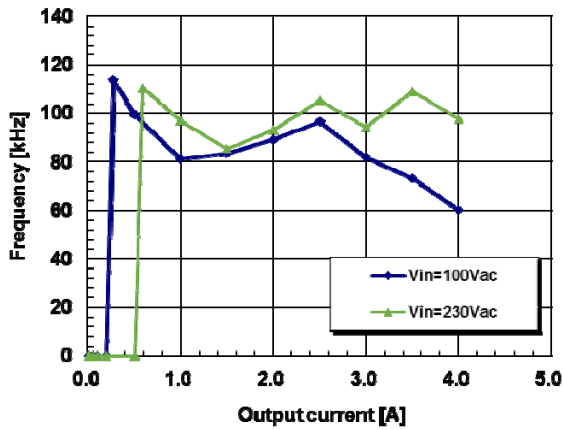
Output current vs. Output voltage



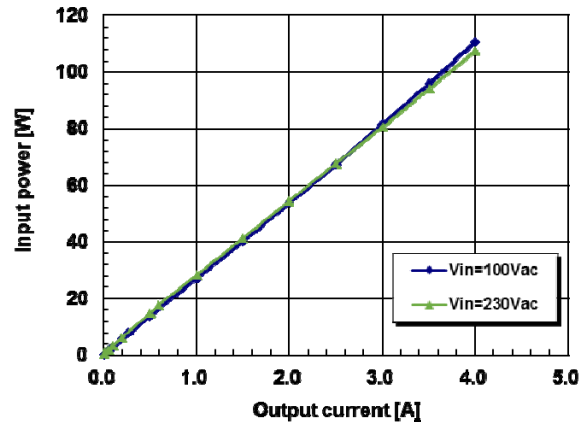
Output current vs. Efficiency



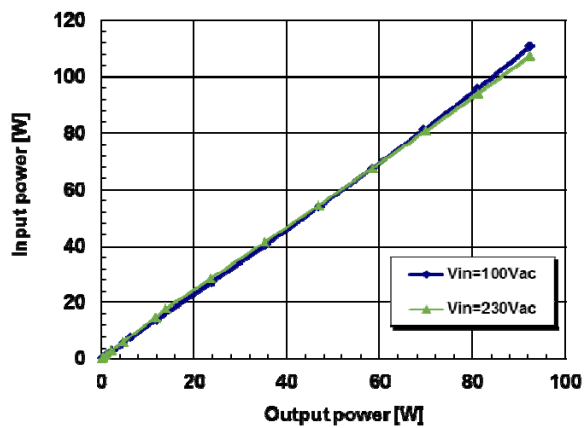
Output current vs. Frequency



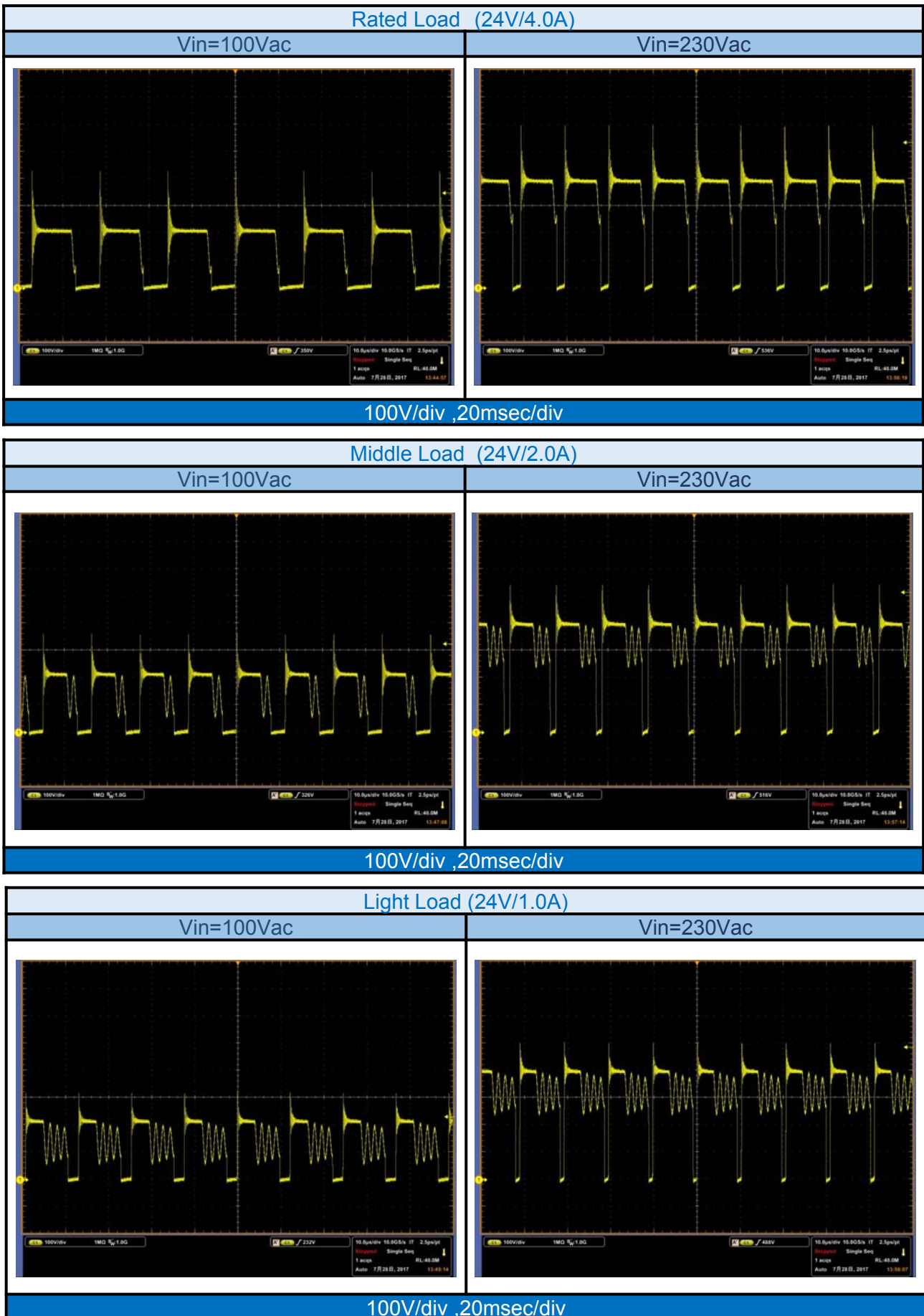
Output current vs. Input power



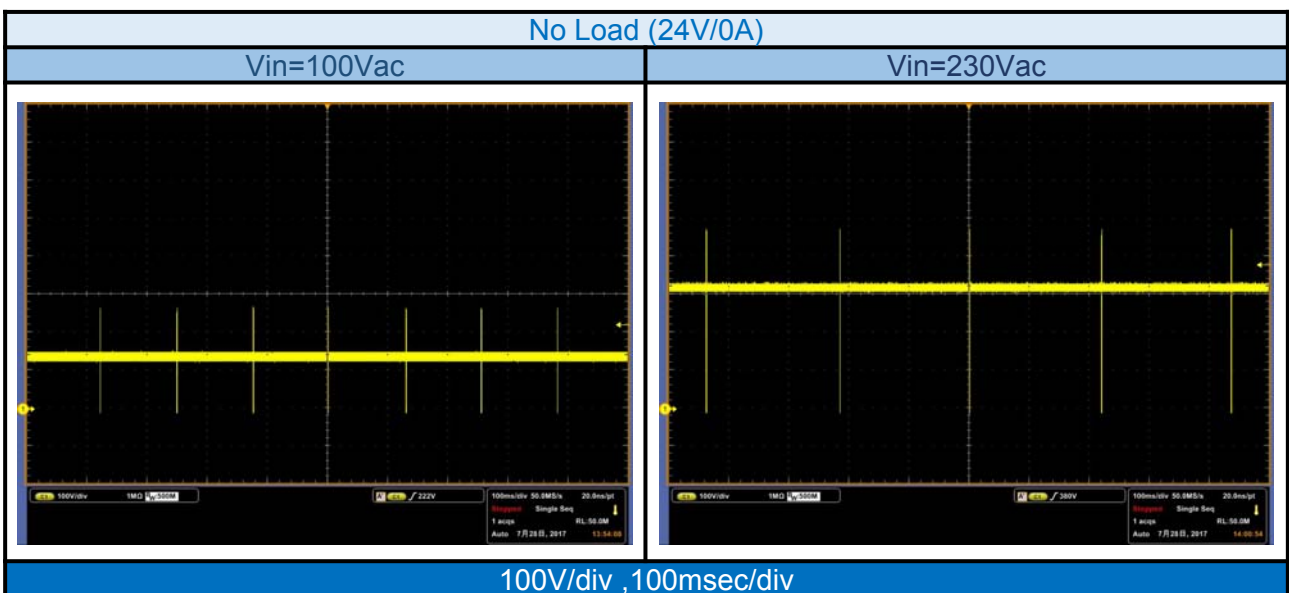
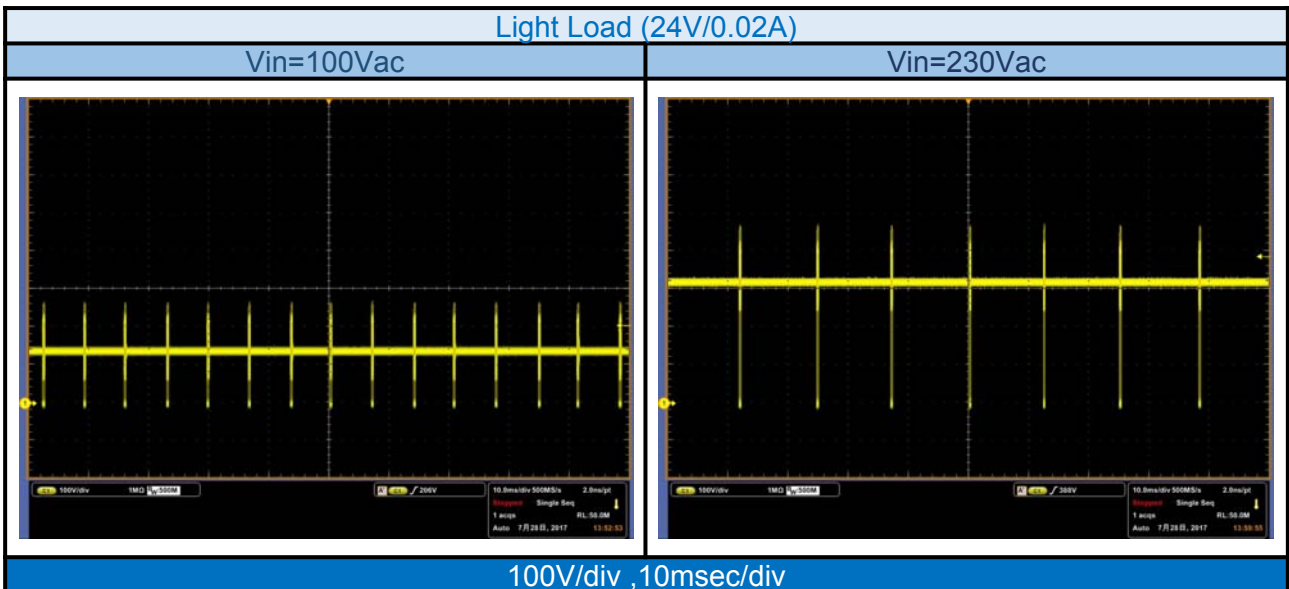
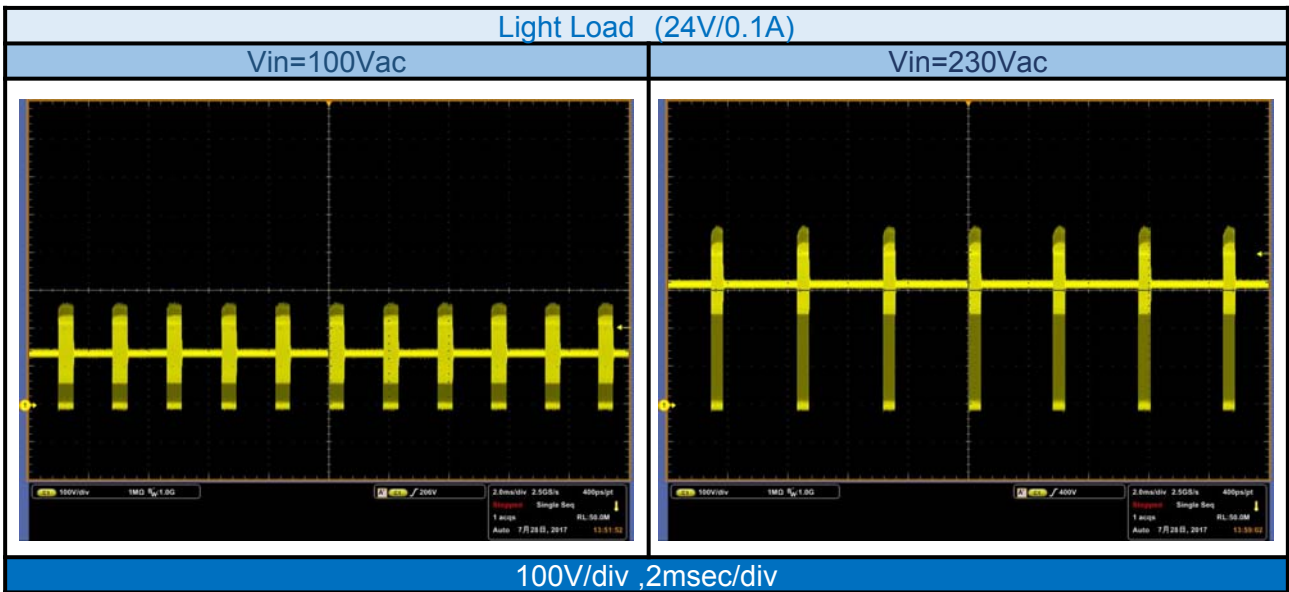
Output power vs. Input power



7. Switching waveforms



7. Switching waveforms



8. Bill of material

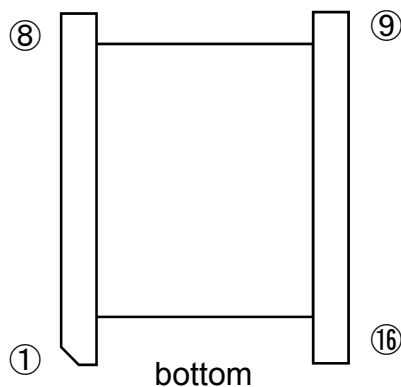
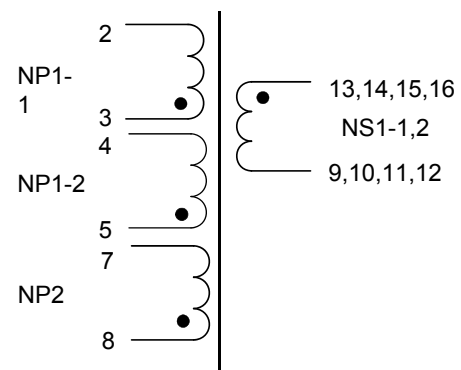
Component	Item	Value	Part. No	Maker	Note
T1	Transformer				
NF1	Ring core	4A, 8mH	SFC-2510-04802	SEIWA ELECTRIC	
FB1,4	Ferrite beads		B-20F-38	NEC TOKIN	
C1	Film capacitor	275V, 0.47uF	LE474	OKAYA ELECTRIC	
C2,3	Ceramic capacitor	250V, 2200pF	DE2E3KH222MA3B	MURATA	
C4	Film capacitor	275V, 0.22uF	LE224	OKAYA ELECTRIC	
C6	Electrolytic capacitor	400V, 470uF	LLG2G471MELB35	NICHICON	30*35
C7,23	Film capacitor	400V, 0.1uF	QXK2G104KTP	NICHICON	
C8	Ceramic capacitor	2kV, 220pF			
C9	Ceramic capacitor	250V, 2200pF	DE1E3KX222MA5BA01	MURATA	
C10,11	Chip ceramic capacitor	50V, 1000pF	GRM188SL1H102J	MURATA	
C12	Chip ceramic capacitor	50V, 10pF		MURATA	
C13	Electrolytic capacitor	50V, 100uF	UHD1H101MPD	NICHICON	8*11.5
C15	Ceramic capacitor	2kV, 470pF	DEHR33D471KA3B	MURATA	
C16, 17	Electrolytic capacitor	35V, 1500uF	UHE1V152MHD	NICHICON	12.5*35.5, 2880mA, 0.065Ω
C18, 19	Chip ceramic capacitor	50V, 0.1uF	GRM18BB11H104K	MURATA	
C22	Chip ceramic capacitor	50V, 0.047uF			
R1, 2	Chip resistor	1MΩ, 1/4W			3216
R3	Metal oxide film resistor	100kΩ, 3W			
R4	Chip resistor	10kΩ, 1/8W			2012
R5	Ceramic resistor	0.1Ω, 2W			
R6	Chip resistor	22Ω, 1/8W			2012
R7	Chip resistor	47Ω, 1/8W			2012
R10	Chip resistor	470Ω, 1/8W			2012
R11,12	Chip resistor	4.7kΩ, 1/4W			3216
R13	Chip resistor	4.7Ω, 1/8W			2012
R14	Chip resistor	100kΩ, 1/4W			3216
R15	Chip resistor	5.1kΩ, 1/8W			2012
R19	Metal oxide film resistor	22Ω, 2W			
R20	Chip resistor	1.5kΩ, 1/4W			3216
R21	Chip resistor	4.7kΩ, 1/8W			2012
R22	Chip resistor	130kΩ, 1/8W			2012
R23	Chip resistor	47kΩ, 1/8W			2012
R24	Chip resistor	15kΩ, 1/8W			2012
R33	Chip resistor	510Ω, 1/8W			2012
RV1	Cermet trimmer	300Ω	CT-6ETP301	COPAL	
DS1	Diode	600V, 10A	D10XB60H	SHINDENGEN	
DS2, 3	Diode	200V, 20A	YG906C2R	FUJI ELECTRIC	
D1	Diode	1kV, 0.5A	EG01C	SANKEN	
D2(5, 6)	Chip diode	200V, 1A	CRH01	TOSHIBA	
D3	Diode	600V, 1A	D1N60	SHINDENGEN	
D4	Chip diode	400V, 1A	CMH05	TOSHIBA	
IC1	Power supply control IC		FA5640N	FUJI ELECTRIC	SMD
IC2	IC		HA17432HUP	RENESAS	
TR1	MOSFET	700V, 11A	FMV11N70E	FUJI ELECTRIC	TO220
PC1	Photocoupler		TLP421F GR	TOSHIBA	
F1	Fuse	250V, 5A	FBT250V5A		

9. Transformer specifications

Bobbin	BEER-35-1116CPH
Core	PC40EER35-Z
Gap	0.65mm
Inductance	1pin~4pin 176uH±10%
Safety Rule	UL·IEC·PSE

Winding order	Layer	Wire material and size	Winding Turns	Winding starting position	winding ending position	Winding type	Insulation tape		Remark
							Barrier tape		
1	NP1-1	Litz wire $\Phi 0.3/7 \times 1$	20	3	2	Solenoid	up: 1.5mm/ down: 1.5mm	26mm 1T	1layer
2	NS1-1	TEX $\Phi 0.5 \times 5$	12	13,14, 15,16	9,10,11, 12	Solenoid	up: 0mm/down: 0mm		NS1-1 and NP2 winding are bifilar-wound.
3	NP2	UEW $\Phi 0.3 \times 1$	10	8	7		up: 0mm/down: 0mm	26mm 1T	
4	NS1-2	TEX $\Phi 0.5 \times 5$	12	13,14, 15,16	9,10,11, 12	Space	up: 0mm/down: 0mm	26mm 1T	
5	NP1-2	Litz wire $\Phi 0.3/7 \times 1$	20	5	4	Solenoid	up: 1.5mm/ down: 1.5mm	26mm 3T	1layer

	Insulation Resistance (M Ω)	Withstand Voltage (kV) 1min.
Np : Ns	100	3
Pri. Core	100	1
Sec. core	100	3

Pin Pattern (bottom view)

Connection




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