

Green mode PWM IC FA8A00N Power supply design example: 19V/65W

Reference Design

1. Overview

This document describes the design example of flyback converter using the green mode PWM IC FA8A00N series.

The input is universal (90Vac to 264Vac) and the output is 19V/65W.

This IC can improve efficiency of middle load to reduce the switching frequency according to the load. Furthermore, it can realize low standby power to change the burst mode switching at the light load.

2. Features

■Low standby power

- Built-in discharge function for X-Capacitor
(Reduce loss of the discharge resistor)
- Low operating current
(During normal operation $I_{VCCOP1}=450\mu A$ typ.)
- Reduce of switching frequency at middle load
- Burst mode at light load
- Built-in 500V high voltage startup circuit.

■Various Protection

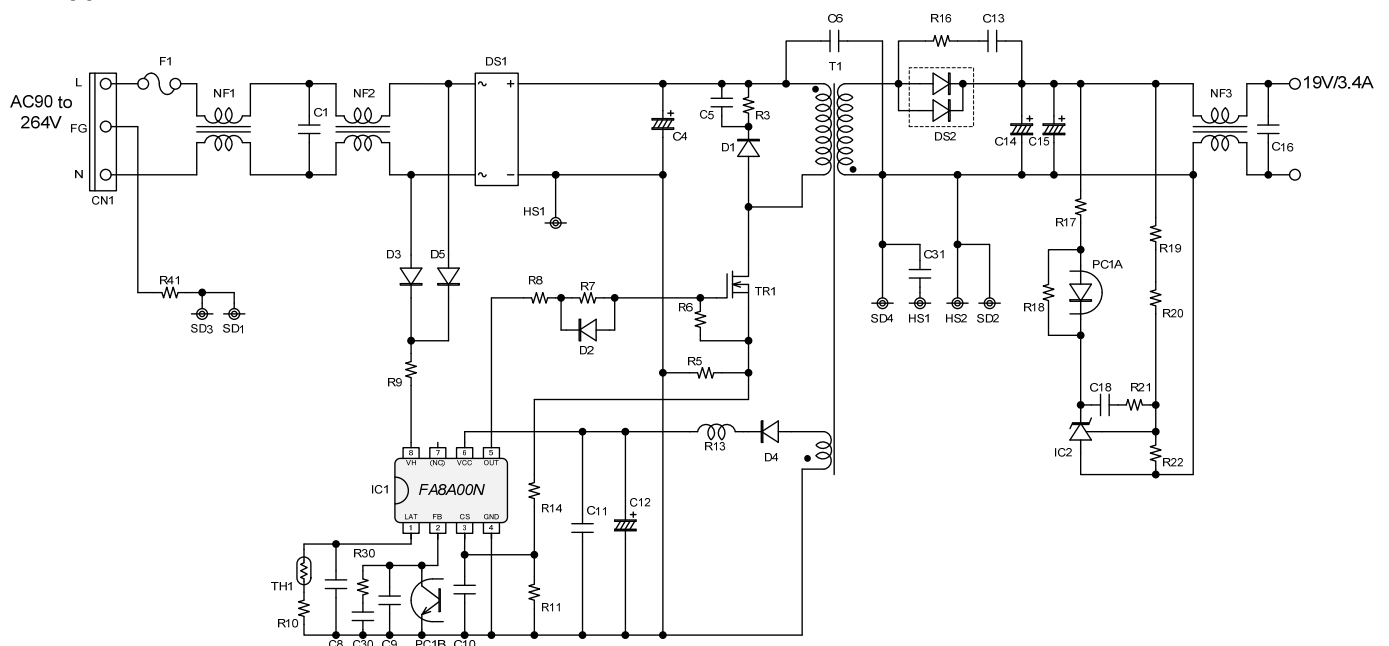
- Two-stages Over Load Protection.(Delay time $T_{dlyolp}=70msec$ typ.)
- Built-in OLP line compensation
- Short Circuit Protection for secondary side
- Latch stop function by pull-up/pull-down of LAT pin.
- Over-Voltage Protection ($V_{thovp}=25.5V$ typ.)
- Under-Voltage Protection ($V_{VCCOFF}=6.5V$ typ.)
- Brown-IN/OUT Function
- Soft-Start function ($T_{SS}=11msec$ typ.)
- Built-in Minimum ON width function

■Low EMI by Frequency diffusion function

■Drive circuit for MOSFET : $-0.5A$ (sink)/ $0.5A$ (source)



3. Application circuit

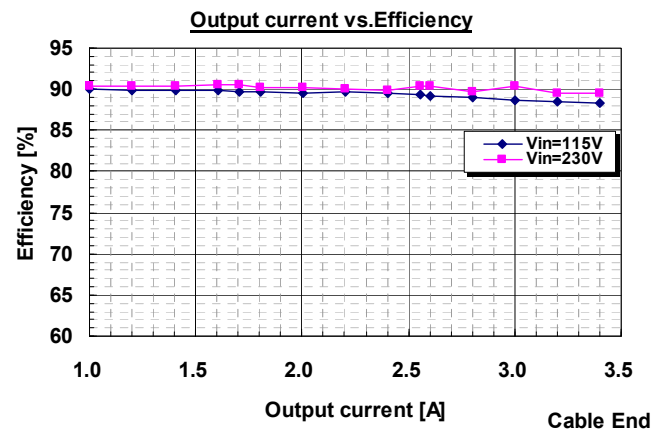
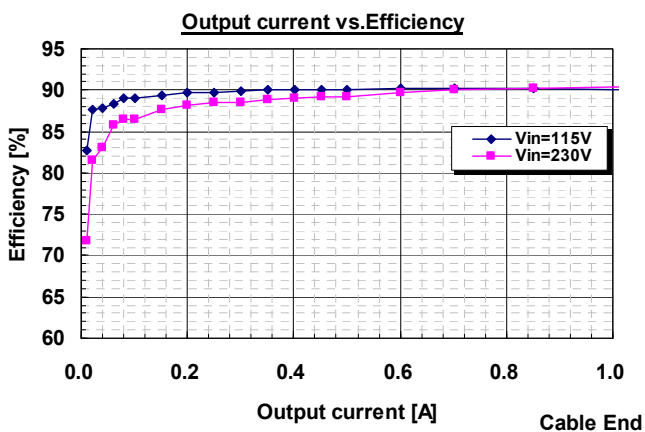
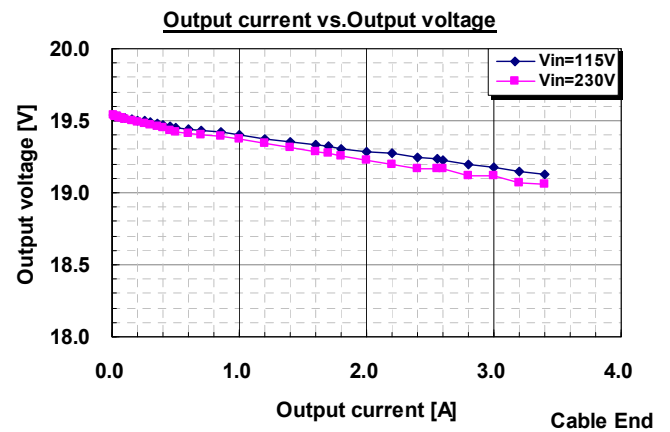
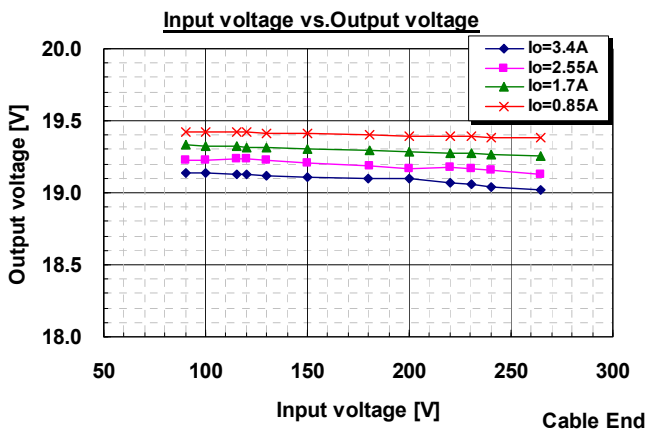


4. Specifications of the power supply

| Item | Value | Unit |
|----------------|-----------|------|
| Input voltage | 90 to 264 | Vac |
| Output voltage | 19 | Vdc |
| Output current | 3.4 | A |

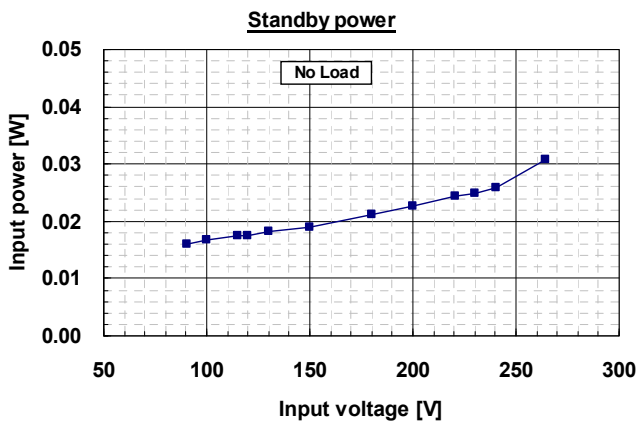
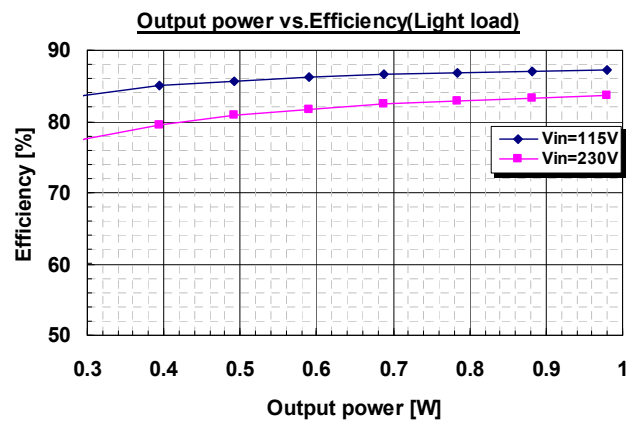
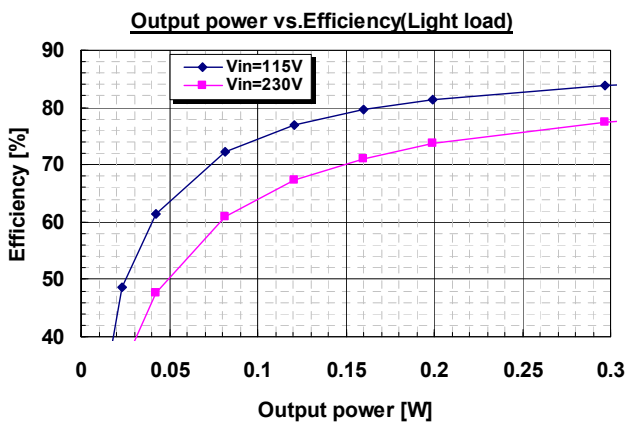
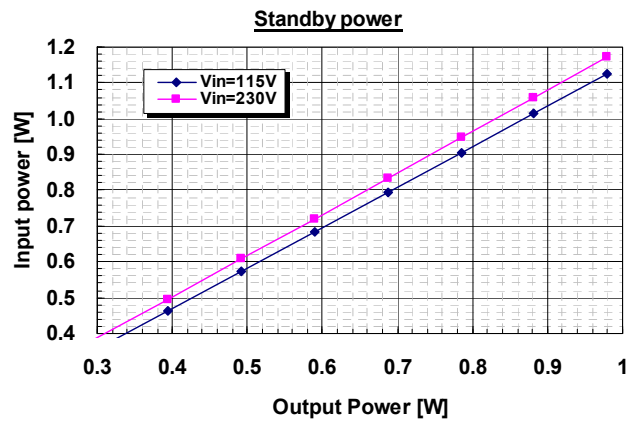
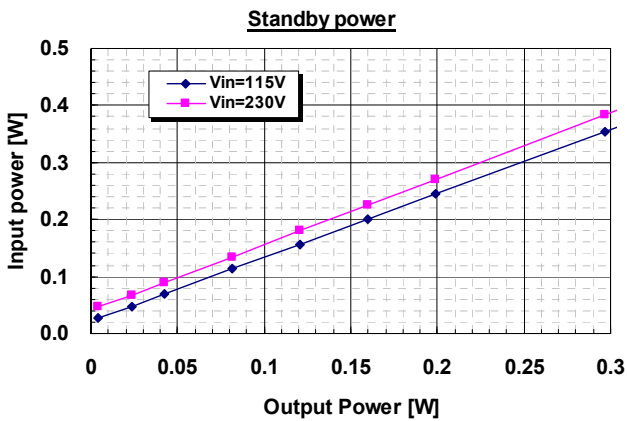
5. Characteristics

| Item | | 115Vac | 230Vac |
|------------------------|----------------|--------|--------|
| Efficiency | Ave. | 89.40% | 90.19% |
| | Typ Load(3.4A) | 88.33% | 89.59% |
| Input power at NO Load | | 17.5mW | 24.9mW |
| OLP | | 4.16A | 4.04A |

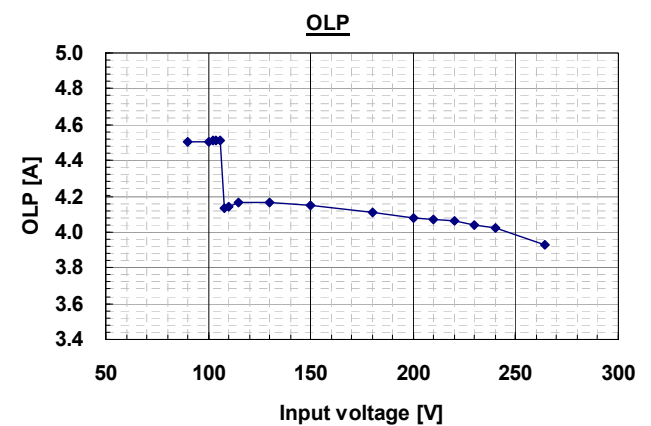
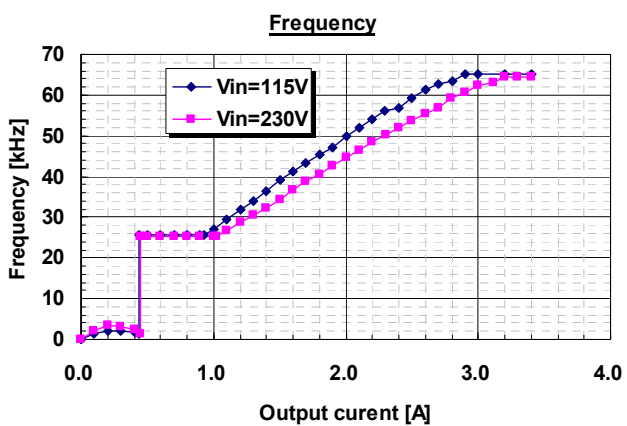
6. Characteristics curves


| Efficiency | 25%Load (0.85A) | 50%Load (1.7A) | 75%Load (2.55A) | 100%Load (3.4A) | Ave. |
|------------|--------------------|-------------------|--------------------|--------------------|--------|
| 115Vac | 90.14% | 89.73% | 89.39% | 88.33% | 89.40% |
| 230Vac | 90.30% | 90.54% | 90.32% | 89.59% | 90.19% |

measurement by cable end

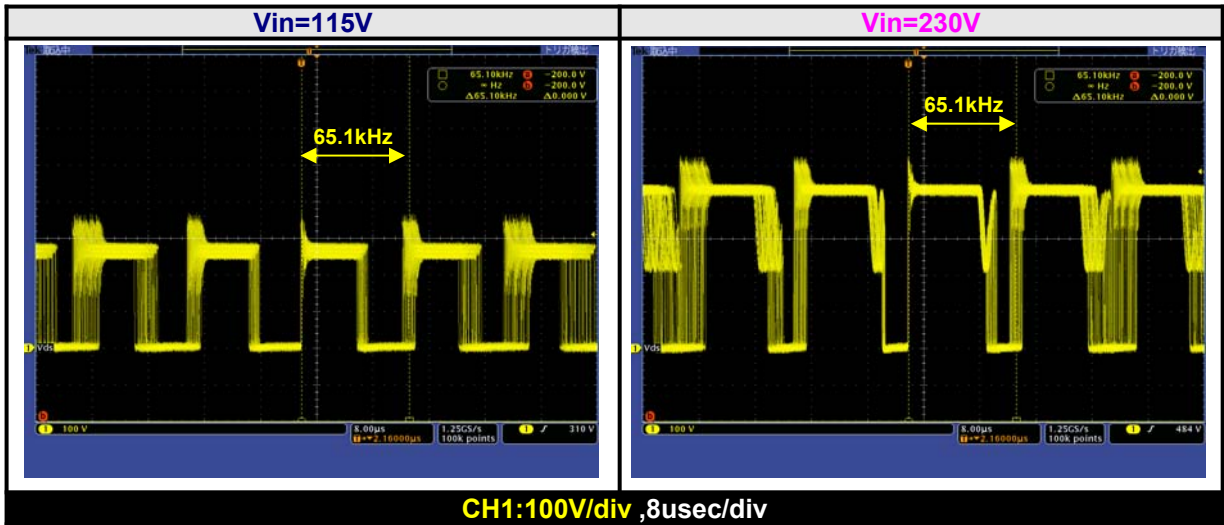


| Input voltage | 115Vac | 230Vac | 264Vac |
|-----------------------|--------|--------|--------|
| Input power (No-Load) | 17.5mW | 24.9mW | 30.9mW |

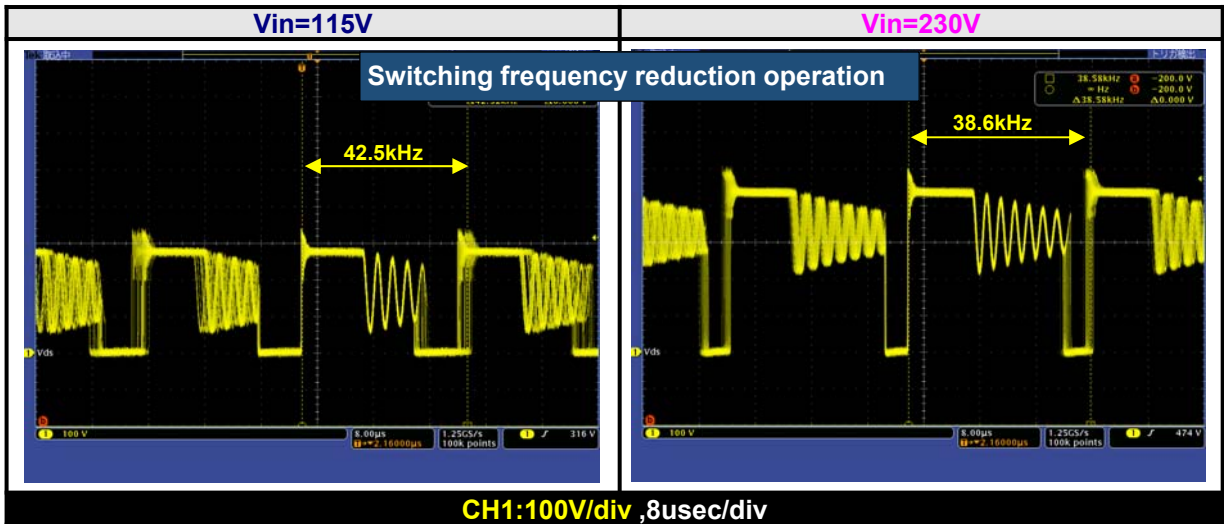


7. Switching waveform (Vds)

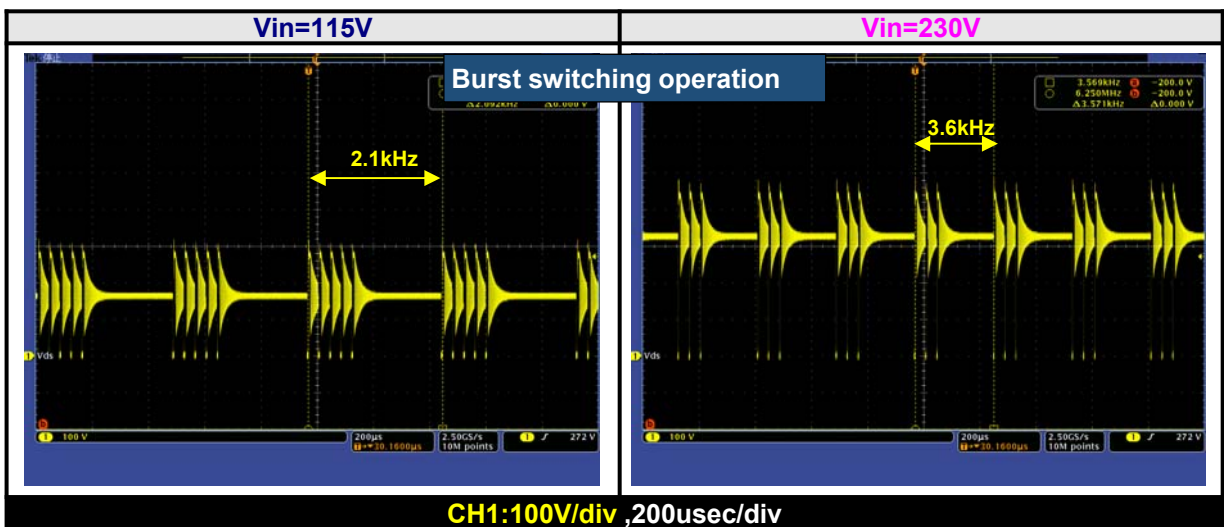
✓ **Rated Load (19V/3.4A)**



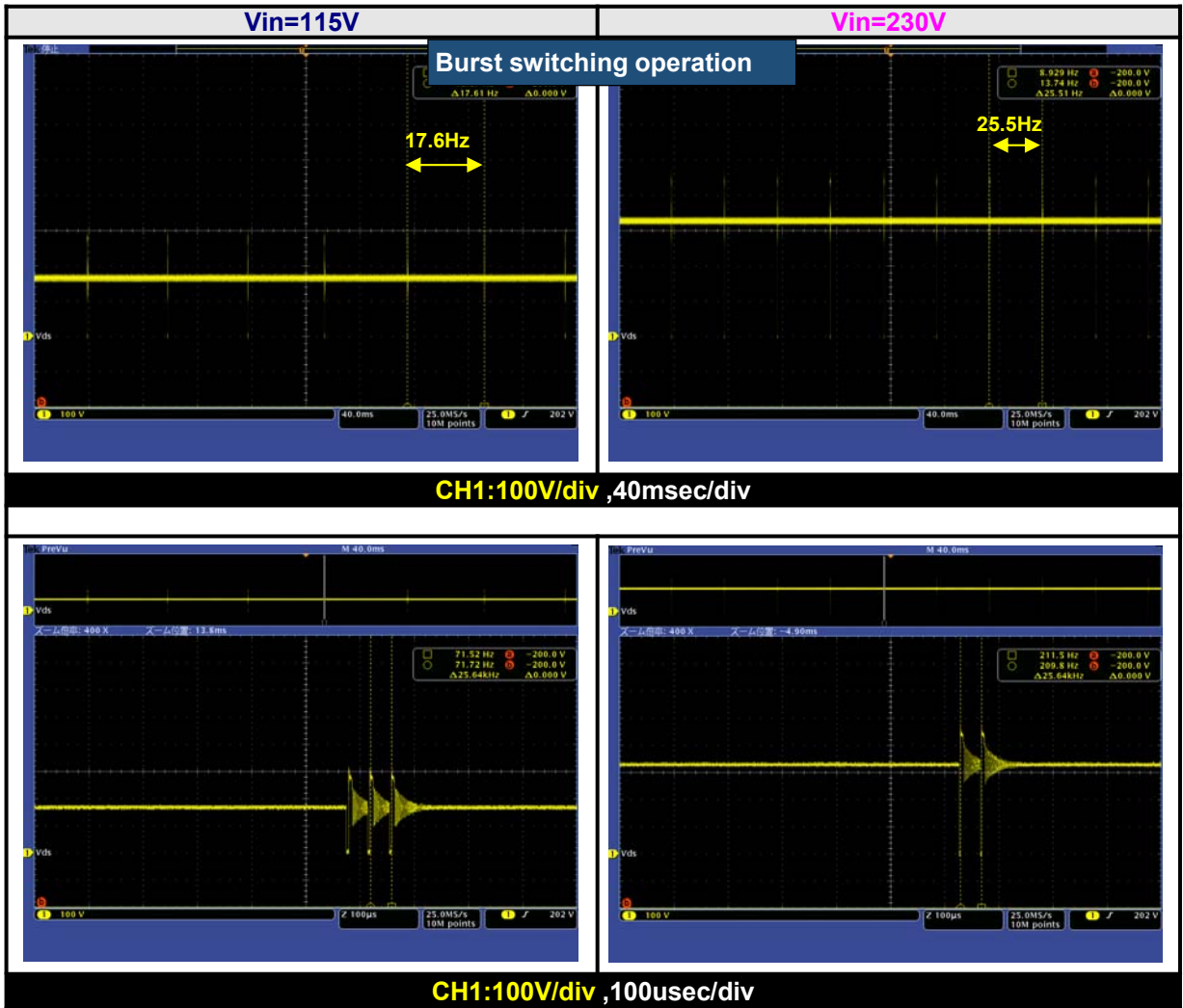
✓ **Middle Load (19V/1.7A)**



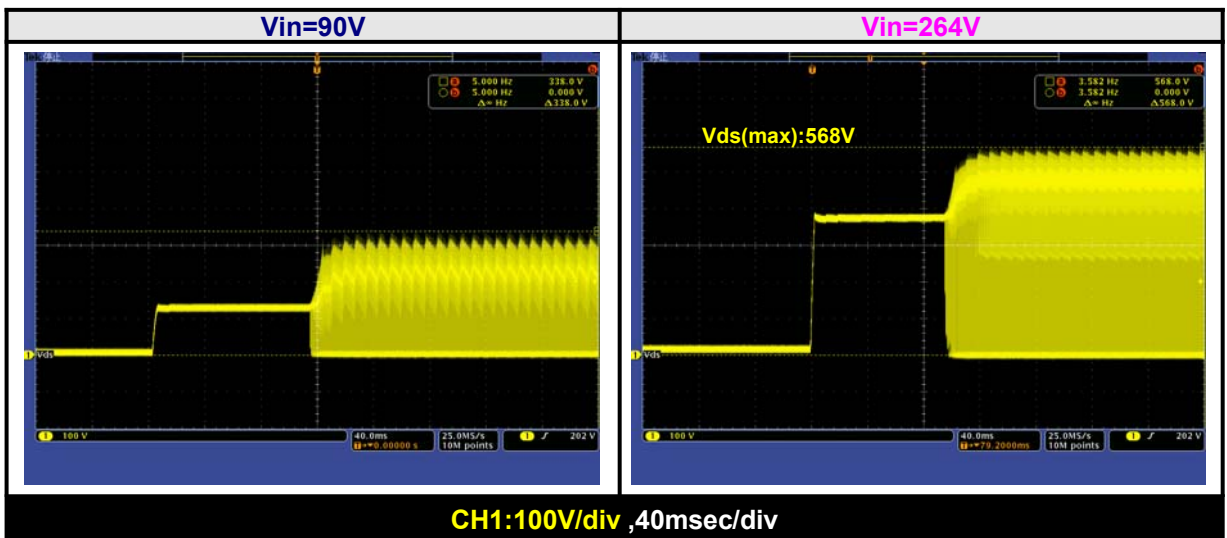
✓ **Light Load (19V/0.2A)**



✓ **No-Load (19V/0A)**

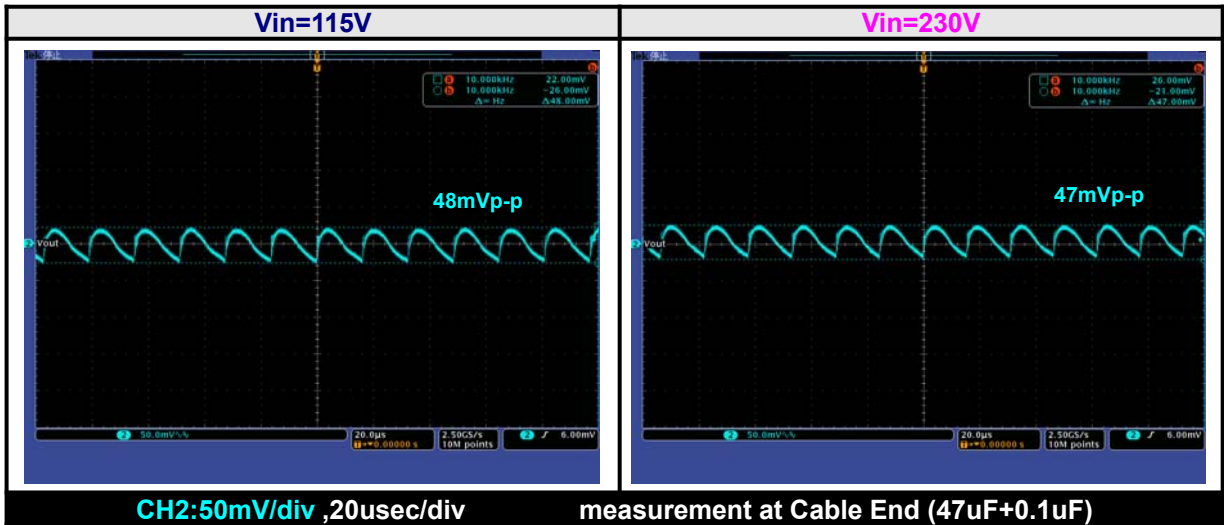


✓ **Start-up waveform Vds(19V/3.4A)**

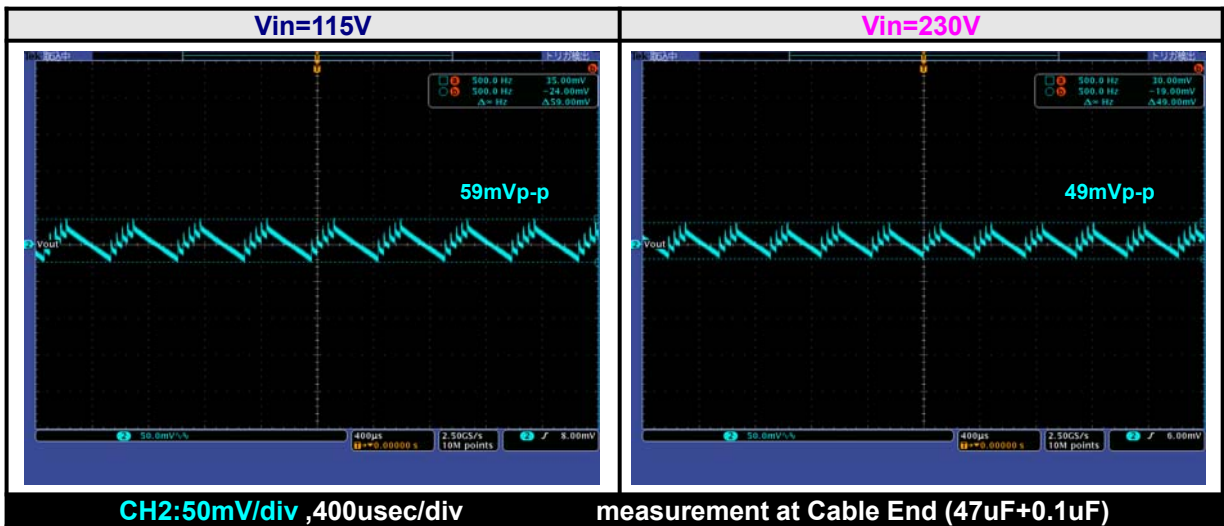


8. Output ripple voltage

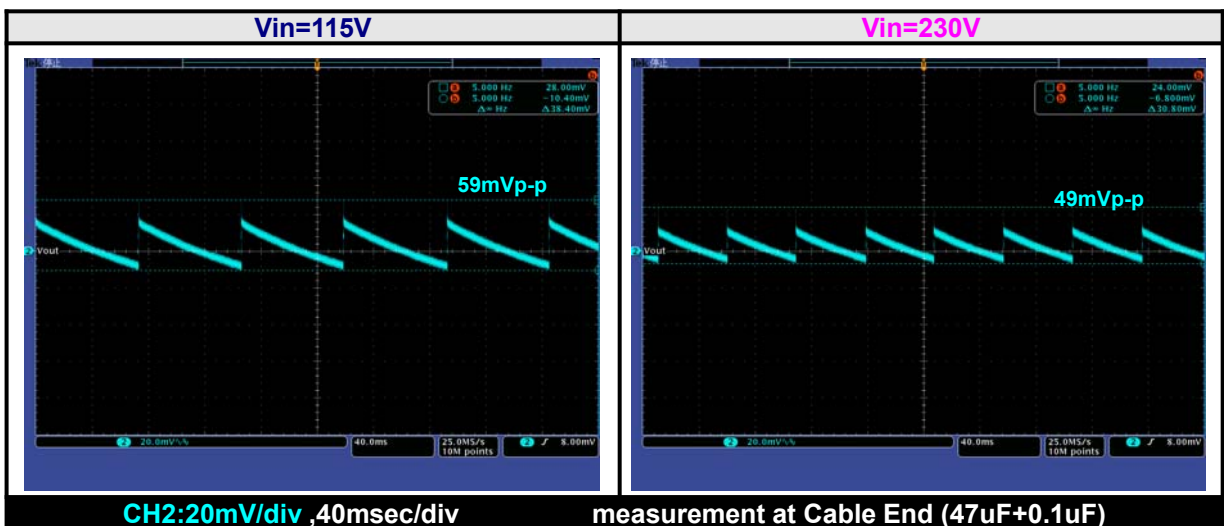
✓ **Rated load ($I_o=3.4A$)**



✓ **Light load ($I_o=0.2A$)**



✓ **No-Load ($I_o=0A$)**



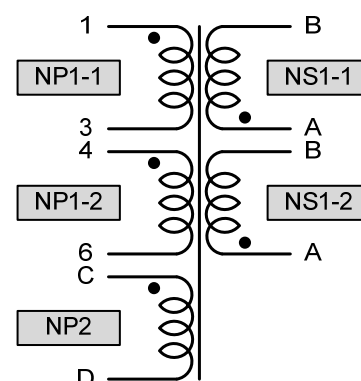
FA8A00N Reference Design
9. Bill of material

| Component | Item | Value | Part. No | Maker | Note |
|--------------|------------------------|-------------|--------------------|------------|-------------------|
| T1 | Transformer(RM10) | Lp=580uH | Y11FE580uH④ | | Np:Ns:Nsub=44:8:8 |
| NF1 | Noise filter | | E04RA140070100 | SEIWA | |
| NF2 | Noise filter | | ADR18SH02-120S | UENO | |
| NF3 | Noise filter | | E04RC100505 | SEIWA | |
| C1 | Film capacitor | 275V,0.33uF | LE334 | OKAYA | classX2 |
| C4 | Electrolytic capacitor | 400V,120uF | UCY2G121MHD | nichicon | |
| C5 | Ceramic capacitor | 3300pF | | | |
| C6 | Ceramic capacitor | 250V,4700pF | DE1E3KX472M A01 | MURATA | |
| C8 | Ceramic capacitor | 50V,3300pF | | | SMD |
| C9 | Ceramic capacitor | 50V,1000pF | | | SMD |
| C10 | Ceramic capacitor | 50V,100pF | | | SMD |
| C11,16 | Ceramic capacitor | 50V,0.1uF | | | SMD |
| C12 | Electrolytic capacitor | 50V,22uF | 50ME22AX | SUNCON | |
| C13 | Ceramic capacitor | 630V,1000pF | GRM31A7U2J102JW31D | MURATA | SMD |
| C14,15 | Electrolytic capacitor | 25V,680uF | | SUNCON | |
| C18 | Ceramic capacitor | 50V,47nF | | | |
| C30 | Ceramic capacitor | 50V,22nF | | | |
| C31 | Ceramic capacitor | 250V,470pF | DE1B3KX471K L01 | MURATA | |
| R3 | Metal oxide resistor | 100kΩ,2W | | | |
| R5 | Metal oxide resistor | 0.18Ω,2W | | | |
| R6 | Chip Resistor | 10kΩ,1/8W | | | 2125 |
| R7 | Chip Resistor | 300Ω,1/4W | | | 3216 |
| R8 | Chip Resistor | 10Ω,1/4W | | | 3216 |
| R9 | Chip Resistor | 5.6kΩ,1/4W | | | 3216 |
| R10,20 | Chip Resistor | 13kΩ,1/10W | | | 1608 |
| R11,18,21,30 | Chip Resistor | 10KΩ,1/10W | | | 1608 |
| R13 | Chip Inductance | 4.7uH | LB2518T4R7M | | |
| R14 | Chip Resistor | 1kΩ,1/10W | | | 1608 |
| R16 | Metal oxide resistor | 10Ω,2W | | | |
| R17 | Chip Resistor | 510Ω,1/8W | | | 2125 |
| R19 | Chip Resistor | 150kΩ,1/10W | | | 1608 |
| R22 | Chip Resistor | 24KΩ,1/10W | | | |
| DS1 | Diode Bridge | 600V,2A | D2SBA60A | SHINDENGEN | HETA SINK |
| DS2 | Diode | 120V,20A | YG865C12R | Fuji | HEAT SINK |
| D1 | Diode | 1KV, 0.5A | UF4007 | Vishay | |
| D2,4 | Chip Diode | 200V,1A | CRH01 | Toshiba | SMD |
| D3,D5 | Chip Diode | 600V,0.7A | CRF03 | Toshiba | |
| TR1 | MOSFET | 600V,11A | FMV11N60ES | Fuji | HEAT SINK |
| IC1 | IC | | FA8A01N | Fuji | |
| IC2 | IC | | HA17432HUP | RENESAS | |
| PC1 | Photo coupler | | TLP781F | Toshiba | |
| F1 | Fuse | 250V,3.15A | SST250V 3.15A | | |
| TH1 | thermistor | 100kΩ | TTC05104KSY | Thinking | |
| CN1 | AC Inlet | | RF-190-R | RONG FENG | |

10. Transformer specifications

| Winding order | layer | Wire type | turn | Pin | |
|---------------|-------|--------------|------|-------|--------|
| | | | | Start | Finish |
| 1 | NS1-1 | TEXφ0.35 × 4 | 8 | A | B |
| 2 | NP1-1 | UEWφ0.25 × 3 | 22 | 1 | 3 |
| 3 | NS1-2 | TEXφ0.35 × 4 | 8 | A | B |
| 4 | NP2 | UEWφ0.2 × 1 | 8 | C | D |
| 5 | NP1-2 | UEWφ0.25 × 3 | 22 | 4 | 6 |

| | |
|------------|------------------------|
| bobbin | BRM10-7112SDFR |
| core | PC40RM10Z-1 |
| Gap | 0.41mm(center gap) |
| inductance | 1pin to 6pin 580uH±10% |



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