

Quasi-Resonant Power Supply ICs **MS1003SH**

Input voltage : AC 90 ~ 276V

Output	Voltage [V]	Output Current [A]		
		min	typ	max
1	+24	0.0	3.0	3.0
Total Power [W]		0.0	72.0	72.0

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Bill Of Material

No.	Type	Qt'y	Spec		Model Name	Vendor	Remarks
F101	Fuse	1	AC250V	5A	-	-	-
L101	Line Filter	1	33mH	1.5A	-	-	-
L201	Choke Coil	1	4.7uH	5.8A	-	-	-
T101	Transformer	1	-	-	EER3547	SUMIDA	-
IC111	Control IC	1	-	-	MS1003SH	SHINDENGEN	-
PH111	Opto Coupler	1	-	-	PC123FY2J00F	SHARP	-
PH141	Opto Coupler	1	-	-	PC123FY2J00F	SHARP	-
IC261	Shunt Regulator	1	-	-	HA17431GPA	RENESAS	-
Q111	IGBT	1	900V	2.7A	T2R7F90B	SHINDENGEN	-
Q241	Transistor	1	50V	0.15A	KTC3198Y	KEC	-
Q301	Transistor	1	50V	0.15A	KTC3198Y	KEC	-
D101	Bridge Diode	1	600V	4A	D3SB60	SHINDENGEN	-
D111	FRD	1	1000V	1A	D1NK100	SHINDENGEN	-
D112	FRD	1	200V	1A	D1NL20U	SHINDENGEN	-
D141	FRD	1	200V	1A	D1NL20U	SHINDENGEN	-
D171	FRD	1	1000V	1A	D1NK100	SHINDENGEN	-
D201	SBD	1	100V	20A	SG20TC10M	SHINDENGEN	-
DZ181	Zenor diode	1	20V	0.5W	TFZ20B	ROHM	-
C101	Film Capacitor	1	AC250V	0.22uF	LE224	OKAYA	-
C102	Film Capacitor	1	AC250V	0.22uF	LE224	OKAYA	-
C103	Ceramic Capacitor	1	AC250V	220pF	-	TDK	-
C104	Ceramic Capacitor	1	AC250V	220pF	-	TDK	-
C105	Ceramic Capacitor	1	AC250V	220pF	-	TDK	-
C106	Electrolytic Capacitor	1	400V	220uF	-	Rubycon	-
C111	Film Capacitor	1	50V	220pF	-	-	-
C112	Ceramic Capacitor	1	2kV	470pf	CC45SL3AD101JYNNA	TDK	-
C113	Electrolytic Capacitor	1	35V	82uF	-	Rubycon	-
C114	Film Capacitor	1	50V	100pF	-	-	-
C115	Film Capacitor	1	50V	1000pF	-	-	-
C171	Ceramic Capacitor	1	1kV	2200pF	-	TDK	-
C201	Electrolytic Capacitor	1	35V	2200uF	-	Rubycon	-
C204	Electrolytic Capacitor	1	35V	680uF	-	Rubycon	-
C261	Film Capacitor	1	50V	0.047uF	-	-	-
C262	Film Capacitor	1	50V	0.047uF	-	-	-
C301	Film Capacitor	1	50V	0.1uF	-	-	-
R111	Carbon Resistor	1	1/4W	33kΩ	-	-	-
R112	Carbon Resistor	1	1/2W	10Ω	-	-	-
R113	Carbon Resistor	1	1/4W	100Ω	-	-	-
R114	Metal Plate Resistor	1	2W	0.18Ω	-	-	-
R115	Carbon Resistor	1	1/4W	10kΩ	-	-	-
R116	Carbon Resistor	1	1/4W	10kΩ	-	-	-
R117	Carbon Resistor	1	1/4W	47kΩ	-	-	-
R118	Carbon Resistor	1	1/2W	10Ω	-	-	-
R171	Metal Oxide Film Resistor	1	1W	100kΩ	-	-	-
R173	Metal Oxide Film Resistor	1	1W	100kΩ	-	-	-
R181	Carbon Resistor	1	1/2W	390Ω	-	-	-

Bill Of Material

No.	Type	Qt'y	Spec	Model Name	Vendor	Remarks
R201	Carbon Resistor	1	1/2W 5.6kΩ	-	-	-
R202	Carbon Resistor	1	1/4W 2.2kΩ	-	-	-
R241	Carbon Resistor	1	1/4W 3.6kΩ	-	-	-
R242	Carbon Resistor	1	1/4W 10kΩ	-	-	-
R246	Carbon Resistor	1	1/4W 22kΩ	-	-	-
R247	Carbon Resistor	1	1/4W 22kΩ	-	-	-
R248	Carbon Resistor	1	1/4W 22kΩ	-	-	-
R261	Metal Film Resistor	1	1/4W 82kΩ	-	-	1%
R262	Metal Film Resistor	1	1/4W 5.6kΩ	-	-	1%
R263	Metal Film Resistor	1	1/4W 10kΩ	-	-	1%
R265	Carbon Resistor	1	1/4W 4.7kΩ	-	-	-
R266	Carbon Resistor	1	1/4W 3.3kΩ	-	-	-
R302	Carbon Resistor	1	1/4W 100kΩ	-	-	-
R303	Carbon Resistor	1	1/4W 100kΩ	-	-	-
HS101	Heat Sink	1	- 8.9K/W	BPUE46-30	MIZUDEN	-
HS201	Heat Sink	1	- 11.4K/W	BPUE36-25	MIZUDEN	-

QRC Transformer

Vin= AC90~276V
Po= 74.4W

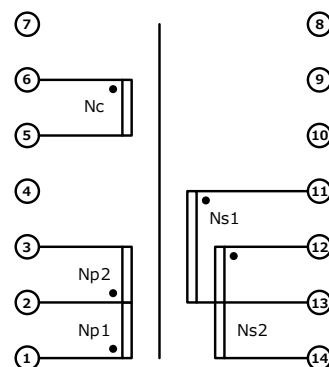
fmin= 36kHz

Inductandce (Np) 1-3pin 0.59mH

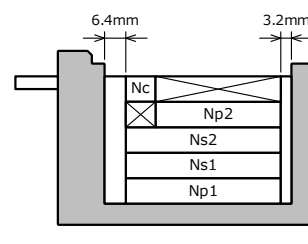
Core
EER3547 Material : PC40 Manufacturer : SUMIDA

Bobbin
EER3547 Pin Number : 14 Manufacturer : SUMIDA

< Pin assignment >



< Structure drawing >



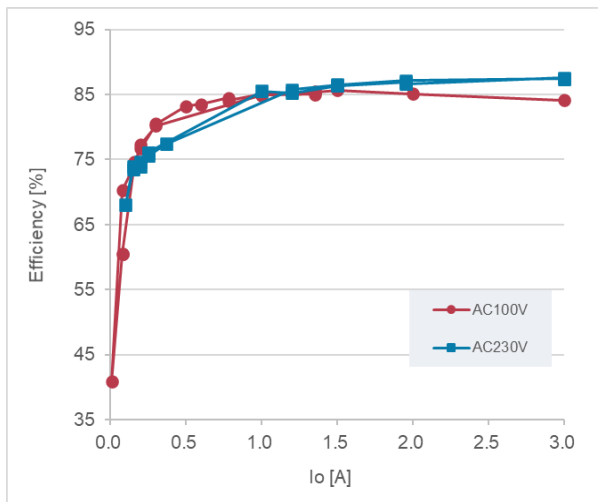
< Winding Specifications >

Winding Order	Current Name	Pin Number		Turn [T]	diameter [mm dia]	Material	Output		Notes
		Start	End				Voltage	Current	
1	Np1	2	3	31	0.45×2	1UEW	-	-	Aligned Winding
2	Ns1	11	13	7	0.45×4	1UEW	24V	3.00 A	Aligned Winding
3	Ns2	12	14	7	0.45×4	1UEW			Aligned Winding
4	Np2	1	2	26	0.45×2	1UEW			Aligned Winding
5	Nc	6	5	6	0.23	1UEW	16V	-	Aligned Winding

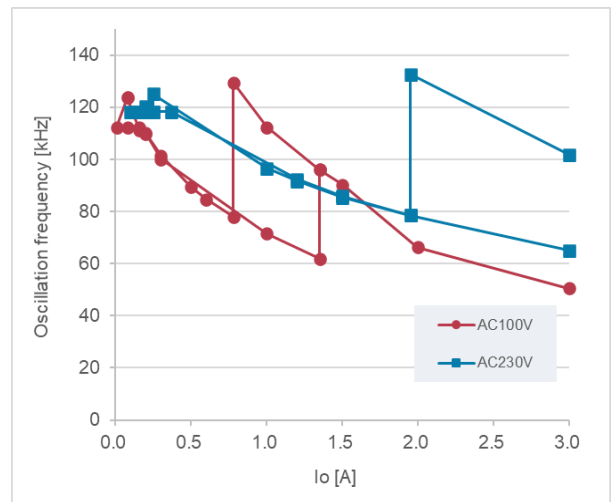
Efficiency

Vin [V]	Pin [W]	Po [W]	η [%]	24V Vo [V]	24V Io [A]	f [kHz]	mode
AC100	86.7	72.90	84.11	24.3	3.0	50.5	Quasi resonant
	57.2	48.7	85.10	24.3	2.0	66.3	Quasi resonant
	42.6	36.5	85.70	24.4	1.5	90.2	Quasi resonant
	38.5	32.9	85.36	24.4	1.4	96.0	Quasi resonant
	28.7	24.4	85.01	24.4	1.0	112.2	Quasi resonant
	22.7	19.0	84.04	24.4	0.8	129.4	Quasi resonant
	22.6	19.1	84.50	24.4	0.8	78.0	Bottom skip
	17.6	14.7	83.48	24.4	0.6	84.6	Bottom skip
	14.7	12.2	83.20	24.5	0.5	89.4	Bottom skip
	9.1	7.3	80.47	24.5	0.3	101.5	Bottom skip
	6.4	4.9	76.73	24.5	0.2	109.9	Bottom skip
	5.3	3.9	74.69	24.5	0.2	111.1	Bottom skip
	3.2	2.0	60.54	24.5	0.1	123.6	Bottom skip
	3.2	2.0	60.54	24.5	0.1	123.6	Burst mode
	0.6	0.2	40.88	24.5	0.0	112.2	Burst mode
	2.8	2.0	70.30	24.5	0.1	112.2	Burst mode
	5.3	3.9	74.24	24.5	0.2	112.2	Burst mode
	6.3	4.9	77.35	24.5	0.2	110.0	Bottom skip
	9.2	7.3	80.24	24.5	0.3	100.0	Bottom skip
	28.8	24.4	84.90	24.4	1.0	71.5	Bottom skip
38.7	32.9	85.07	24.4	1.4	61.8	Bottom skip	
38.5	32.9	85.38	24.4	1.4	96.0	Quasi resonant	
AC230	83.0	72.67	87.57	24.2	3.0	101.9	Quasi resonant
	54.6	47.3	86.65	24.3	2.0	132.5	Quasi resonant
	54.6	47.4	86.84	24.3	2.0	78.6	Bottom skip
	42.3	36.5	86.39	24.4	1.5	85.3	Bottom skip
	34.3	29.3	85.26	24.4	1.2	91.7	Bottom skip
	28.5	24.4	85.51	24.4	1.0	96.5	Bottom skip
	8.1	6.1	76.07	24.5	0.3	125.0	Bottom skip
	8.1	6.1	76.07	24.5	0.3	118.3	Burst mode
	6.6	4.9	73.91	24.5	0.2	118.3	Burst mode
	5.0	3.7	73.96	24.5	0.2	118.3	Burst mode
	3.6	2.5	68.09	24.5	0.1	118.3	Burst mode
	5.0	3.7	73.46	24.5	0.2	118.3	Burst mode
	6.6	4.9	74.70	24.5	0.2	120.2	Burst mode
	8.1	6.1	75.60	24.5	0.3	118.3	Burst mode
	11.7	9.1	77.38	24.5	0.4	118.3	Burst mode
	34.1	29.3	85.73	24.4	1.2	92.4	Bottom skip
	42.2	36.5	86.48	24.4	1.5	85.9	Bottom skip
	54.5	47.4	87.12	24.3	2.0	78.6	Bottom skip
	83.3	72.8	87.39	24.3	3.0	65.1	Bottom skip

Efficiency



Oscillation frequency



Standby power

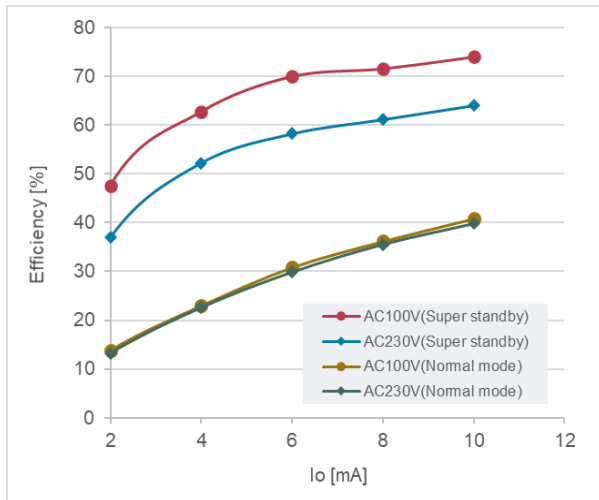
Super standby mode

Vin [V]	Pin [mW]	Po [mW]	η [%]	24V Vo [V]	24V Io [mA]
AC100	53.00	0.00	0.00	24.5	0.0
	76.00	36.20	47.63	18.1	2.0
	99.60	62.52	62.77	15.6	4.0
	122.60	85.80	69.98	14.3	6.0
	152.00	108.80	71.58	13.6	8.0
	179.20	132.60	74.00	13.3	10.0
AC230	83.50	0.00	0.00	24.5	0.0
	111.60	41.19	36.91	20.6	2.0
	131.80	68.84	52.23	17.2	4.0
	159.60	92.94	58.23	15.5	6.0
	191.00	116.80	61.15	14.6	8.0
	217.40	139.20	64.03	13.9	10.0

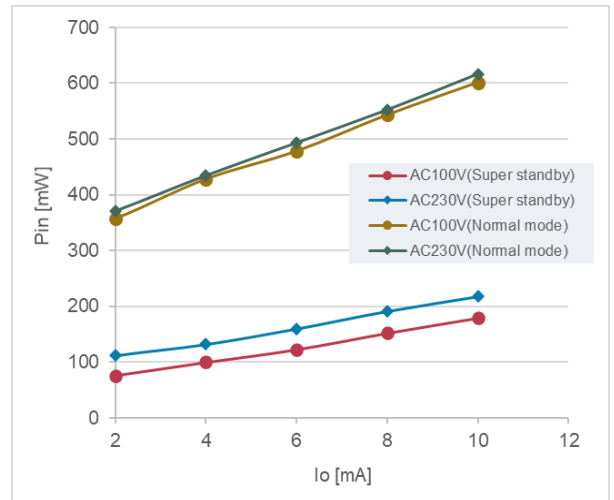
Normal mode

Vin [V]	Pin [mW]	Po [mW]	η [%]	24V Vo [V]	24V Io [mA]
AC100	299.50	0.00	0.00	24.5	0.0
	357.00	49.05	13.74	24.5	2.0
	428.00	98.10	22.92	24.5	4.0
	478.00	147.16	30.79	24.5	6.0
	543.00	196.20	36.13	24.5	8.0
	601.00	245.25	40.81	24.5	10.0
	AC230	314.90	0.00	0.00	24.5
371.00		49.05	13.22	24.5	2.0
434.40		98.10	22.58	24.5	4.0
493.00		147.15	29.85	24.5	6.0
552.00		196.20	35.54	24.5	8.0
616.00		245.25	39.81	24.5	10.0

Efficiency



Standby power



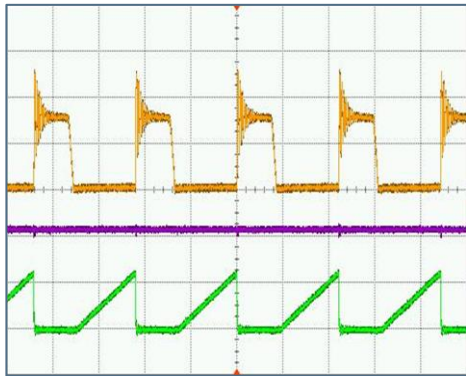
Operation waveform

Photo.1 Maximum load waveform

$I_o=3A$

CH1 : MOSFET V_{DS} 200V/div
 CH2 : MOSFET I_D 2A/div
 CH3 : V_{CC} terminal voltage 10V/div
 Time : 10us/div

AC100V Maximum load



AC230V Maximum load

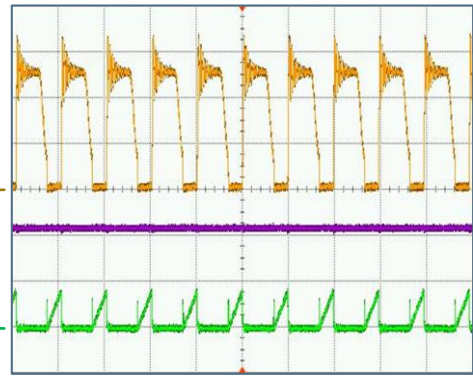
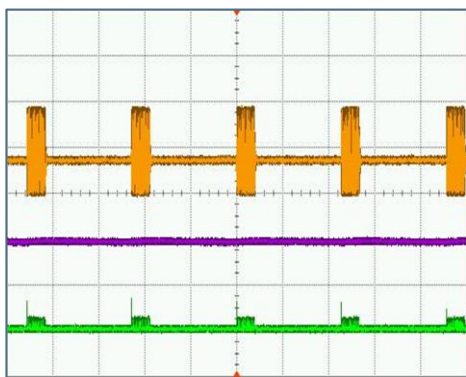


Photo.2 Minimum load waveform

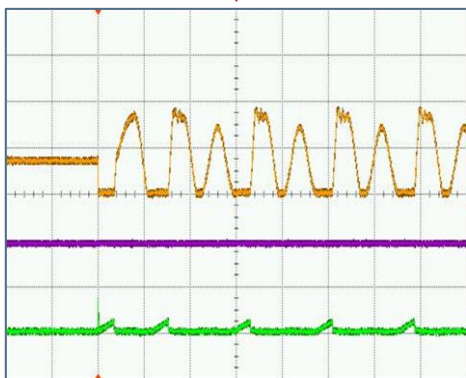
$I_o=0.02A$

CH1 : MOSFET V_{DS} 200V/div
 CH2 : MOSFET I_D 2A/div
 CH3 : V_{CC} terminal voltage 10V/div

AC100V Minimum load

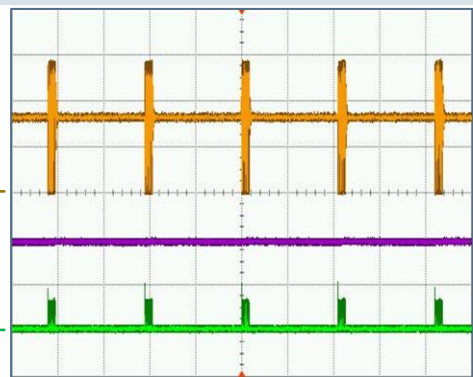


Zoom ↓ 5ms/div

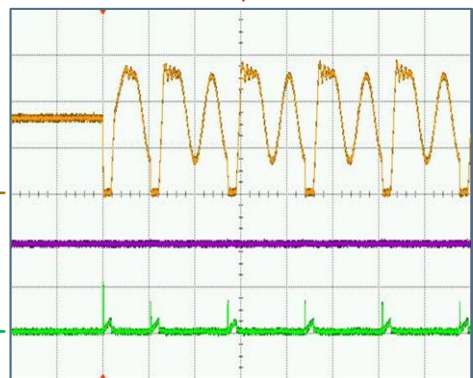


5us/div

AC230V Minimum load



Zoom ↓ 5ms/div



5us/div

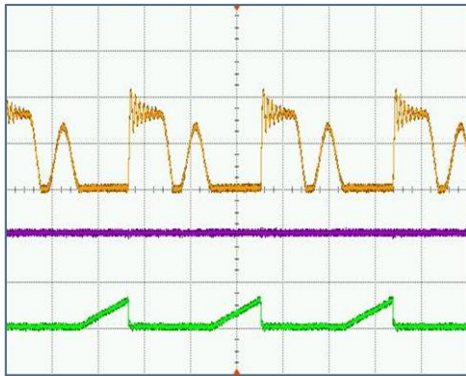
Operation waveform

Photo.3 Bottom skip waveform

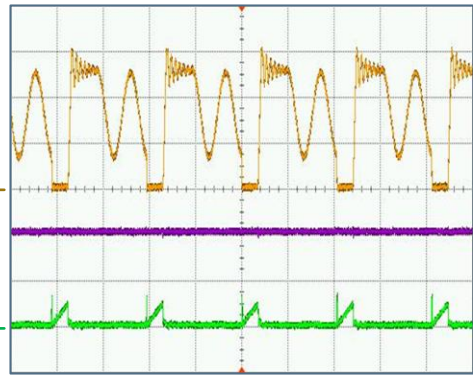
$I_o=1A$

CH1 : MOSFET V_{DS} 200V/div
 CH2 : MOSFET I_D 2A/div
 CH3 : V_{CC} terminal voltage 10V/div
 Time : 5 μ s/div

AC100V Bottom skip



AC230V Bottom skip



CH1 GND

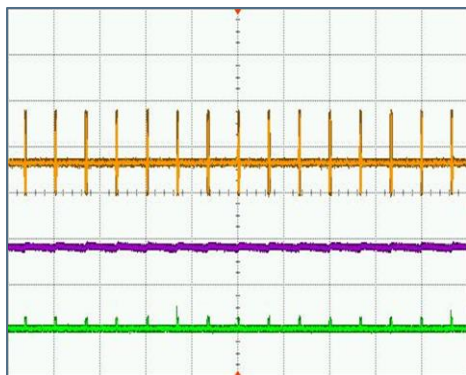
CH2 GND
CH3 GND

Photo.4 No load waveform

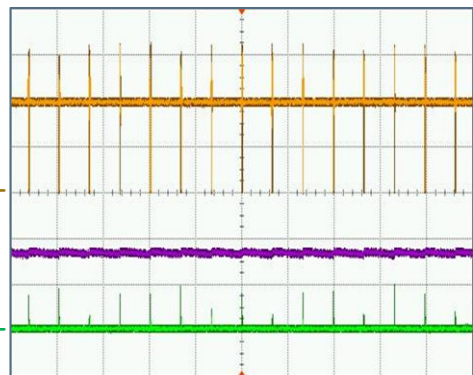
$I_o=0A$

CH1 : MOSFET V_{DS} 200V/div
 CH2 : MOSFET I_D 2A/div
 CH3 : V_{CC} terminal voltage 10V/div
 Time : 50ms/div

AC100V Minimum load



AC230V Minimum load



CH1 GND

CH2 GND
CH3 GND

Temperature

Maximum load temperature

24V/3A

Vin(AC) [V]	Bridge diode D101 ΔT [deg]	MOSFET Q111 ΔT [deg]	transformer Core ΔT [deg]	transformer Wire ΔT [deg]	Rectifier diode D201 ΔT [deg]	Control IC MS1003SH ΔT [deg]	Ambient temperature ΔT [deg]
90	37.0	41.2	28.8	28.8	25.9	15.8	32.6
100	31.5	36.2	27.2	26.9	26.3	11.3	32.9
230	13.5	27.9	29.5	28.6	25.8	11.6	32.1
276	11.9	34.9	30.2	29.5	25.7	13.3	31.9

Before bottom skip

24V/2.3A

Oscillation frequency : 131kHz

Vin(AC) [V]	MOSFET Q111 ΔT [deg]	Ambient temperature ΔT [deg]
276	33.0	31.8

Before bottom skip

24V/0.34A

Oscillation frequency : 122kHz

Vin(AC) [V]	MOSFET Q111 ΔT [deg]	Ambient temperature ΔT [deg]
276	19.5	31.8