

LLC Current Resonant Mode Controller ICs **MCZ5209SN**

Input voltage : AC 90 ~ 264V

Normal mode

Output	Voltage [V]	Output Current [A]		
		min	typ	max
1	+24	0.0	5.0	6.0
2	+12	0.0	2.0	3.0
3	+5	0.0	0.0	0.0
Total Power [W]		0.0	144.0	180.0

Active standby mode

Output	Voltage [V]	Output Current [A]		
		min	typ	max
1	+24	-	0.5	-
2	+12	-	0.0	-
3	+5	-	0.0	-
Total Power [W]		-	12.0	-

Burst mode

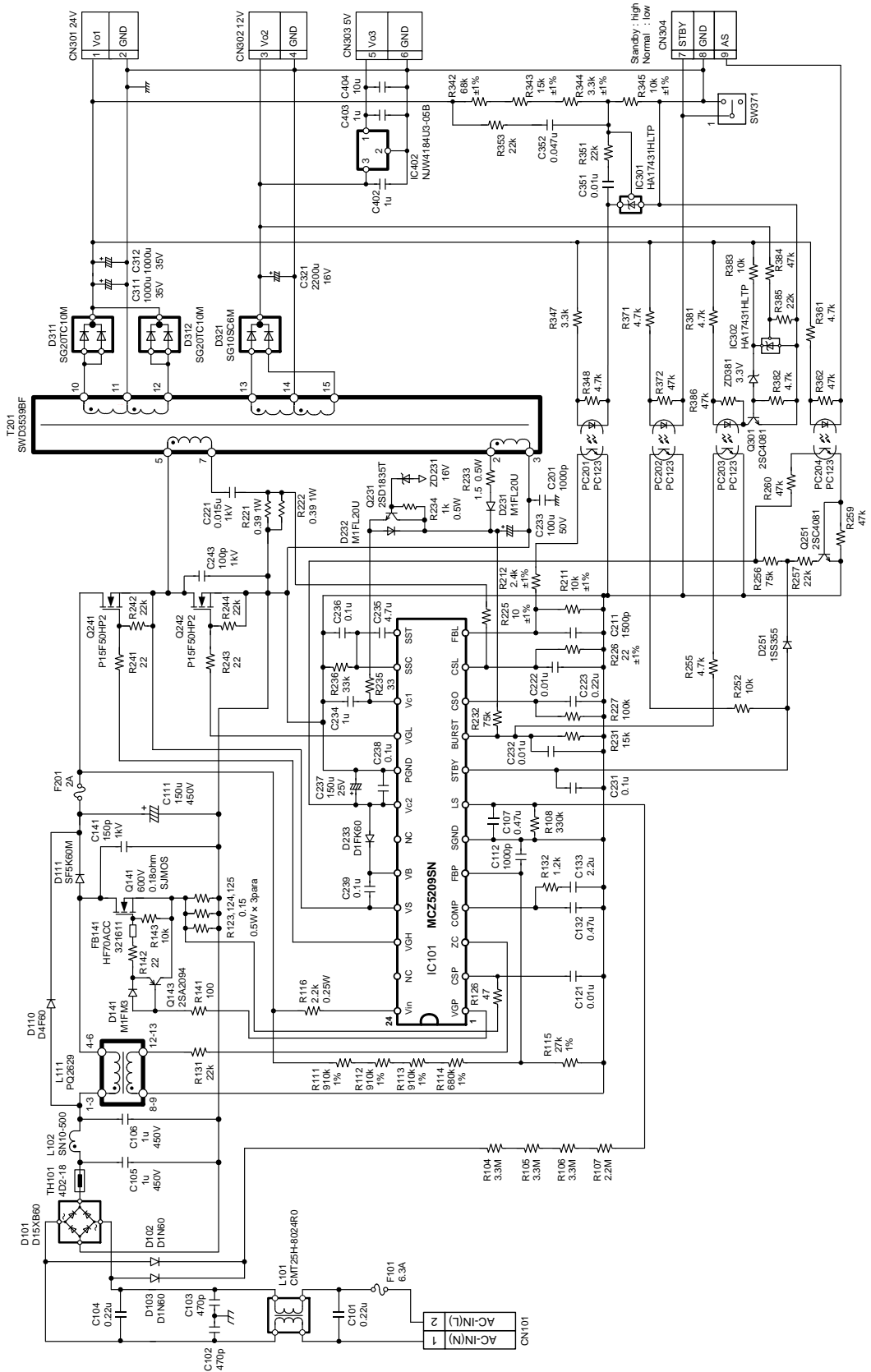
Output	Voltage [V]	Output Current [A]		
		min	typ	max
1	+24	-	0.0	0.0
2	+12	-	0.0	0.0
3	+5	-	0.1	0.1
Total Power [W]		-	0.5	0.5

J562-1-en(2023.09)

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Reference circuit diagram



Bill Of Material

No.	Type	Qt'y	Spec	Model Name	Vendor	Remarks
F101	Fuse	1	AC250V 6.3A			-
F201	Fuse	1	2A			-
L101	Line Filter	1	8mH 4A	CMT25H-8024R0	TAMURA	-
L102	Short	1				-
L111	PFC Choke Coil	1		PQ3220		-
TH101	Power Thermistor	1	4Ω	4D2-18	SEMITEC	-
T201	LLC Transformer	1		SWD3539BF	TAMURA	-
IC101	Control IC	1		MCZ5209SN	SHINDENGEN	-
IC301	Shunt Regulator	1		HA17431HLTP	RENESAS	-
IC302	Shunt Regulator	1		HA17431HLTP	RENESAS	-
IC402	Low Drop Out Regulator	1		NJW4184U3-05B	JRC	-
PC201	Opto Coupler	1		PC123FY2J00F	SHARP	-
PC202	Opto Coupler	1		PC123FY2J00F	SHARP	-
PC203	Opto Coupler	1		PC123FY2J00F	SHARP	-
PC204	Opto Coupler	1		PC123FY2J00F	SHARP	-
Q141	Power MOSFET	1	600V 16A			-
Q143	Small Signal BJT(PNP)	1		2SA2094	ROHM	-
Q231	BJT(NPN)	1		2SD1835T	SANYO	-
Q241	Power MOSFET	1	500V 15A	P15F50HP2	SHINDENGEN	-
Q242	Power MOSFET	1	500V 15A	P15F50HP2	SHINDENGEN	-
Q251	Small Signal BJT(PNP)	1		2SC4081	ROHM	-
Q301	Small Signal BJT(PNP)	1		2SC4081	ROHM	-
FB141	Ferrite Beads	1		HF70ACC321611	TDK	-
D101	Bridge Diode	1	600V 15A	D15XB60	SHINDENGEN	-
D102	General Purpose Diode	1	600V 1A	D1N60	SHINDENGEN	-
D103	General Purpose Diode	1	600V 1A	D1N60	SHINDENGEN	-
D110	General Purpose Diode	1	600V 4A	D4F60	SHINDENGEN	-
D111	FRD	1	600V 5A	SF5K60M	SHINDENGEN	-
D141	SBD	1	30V 3A	M1FM3	SHINDENGEN	-
D231	FRD	1	200V 1.1A	M1FL20U	SHINDENGEN	-
D232	FRD	1	200V 1.1A	M1FL20U	SHINDENGEN	-
D233	FRD	1	600V 0.8A	D1FK60	SHINDENGEN	-
D251	Small Signal Diode	1	80V 0.1A	1SS355	ROHM	-
D311	SBD	1	100V 20A	SG20TC10M	SHINDENGEN	-
D312	SBD	1	100V 20A	SG20TC10M	SHINDENGEN	-
D321	SBD	1	60V 10A	SG10SC6M	SHINDENGEN	-
ZD231	Zenor Diode	1	0.5W 16V			-
ZD381	Zenor Diode	1	0.2W 3.3V			-
C101	X-Capacitor	1	AC250V 0.22uF		OKAYA	-
C102	Y-Capacitor	1	AC250V 470pF			-
C103	Y-Capacitor	1	AC250V 470pF			-
C104	X-Capacitor	1	AC250V 0.22uF		OKAYA	-
C105	Film Capacitor	1	450V 1uF		Rubycon	-
C106	Film Capacitor	1	450V 1uF		Rubycon	-
C107	MLCC	1	25V 0.47uF		TDK	-
C111	Electrolytic Capacitor	1	450V 150uF		Rubycon	-
C112	MLCC	1	50V 1000pF		TDK	-
C121	MLCC	1	50V 0.01uF		TDK	-
C132	MLCC	1	16V 0.47uF		TDK	-
C133	MLCC	1	16V 2.2uF		TDK	-
C141	Disk Ceramic Capacitor	1	1kV 150pF		TDK	-

Bill Of Material

No.	Type	Qt'y	Spec	Model Name	Vendor	Remarks
C201	Y-Capacitor	1	AC250V 1000pF		TDK	-
C211	MLCC	1	50V 1500pF		TDK	-
C221	Film Capacitor	1	1kV 0.015uF	FLS(441)1000HP153	SHINYEI	-
C222	MLCC	1	50V 0.01uF		TDK	-
C223	MLCC	1	16V 0.22uF		TDK	-
C231	MLCC	1	25V 0.1uF		TDK	-
C232	MLCC	1	25V 0.01uF		TDK	-
C233	Electrolytic Capacitor	1	50V 100uF		Rubycon	-
C234	MLCC	1	50V 1uF		TDK	-
C235	MLCC	1	25V 4.7uF		TDK	-
C236	MLCC	1	25V 0.1uF		TDK	-
C237	Electrolytic Capacitor	1	25V 150uF		Rubycon	-
C238	MLCC	1	25V 0.1uF		TDK	-
C239	MLCC	1	50V 0.1uF		TDK	-
C243	Disk Ceramic Capacitor	1	1kV 100pF		TDK	-
C311	Electrolytic Capacitor	1	35V 1000uF		Rubycon	-
C312	Electrolytic Capacitor	1	35V 1000uF		Rubycon	-
C321	Electrolytic Capacitor	1	16V 2200uF		Rubycon	-
C351	MLCC	1	50V 0.01uF		TDK	-
C352	MLCC	1	50V 0.047uF		TDK	-
C402	MLCC	1	50V 1uF		TDK	-
C403	MLCC	1	10V 1uF		TDK	-
C404	MLCC	1	10V 10uF		TDK	-
R104	Chip Resistor	1	1/8W 3.3MΩ		KOA	-
R105	Chip Resistor	1	1/8W 3.3MΩ		KOA	-
R106	Chip Resistor	1	1/8W 3.3MΩ		KOA	-
R107	Chip Resistor	1	1/8W 2.2MΩ		KOA	-
R108	Chip Resistor	1	1/10W 330kΩ		KOA	-
R111	Chip Resistor	1	1/8W 910kΩ		KOA	1%
R112	Chip Resistor	1	1/8W 910kΩ		KOA	1%
R113	Chip Resistor	1	1/8W 910kΩ		KOA	1%
R114	Chip Resistor	1	1/8W 680kΩ		KOA	1%
R115	Chip Resistor	1	1/10W 27kΩ		KOA	1%
R116	Fuse Resistor	1	1/4W 2.2kΩ		KOA	-
R123	Chip Resistor	1	1/2W 0.15Ω		KOA	-
R124	Chip Resistor	1	1/2W 0.15Ω		KOA	-
R125	Chip Resistor	1	1/2W 0.15Ω		KOA	-
R126	Chip Resistor	1	1/10W 47Ω		KOA	-
R131	Chip Resistor	1	1/10W 22kΩ		KOA	-
R132	Chip Resistor	1	1/10W 1.2kΩ		KOA	-
R141	Chip Resistor	1	1/8W 100Ω		KOA	-
R142	Chip Resistor	1	1/8W 22Ω		KOA	-
R143	Chip Resistor	1	1/10W 10kΩ		KOA	-

Bill Of Material

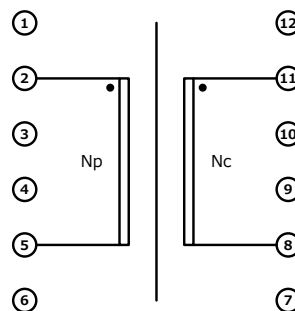
No.	Type	Qt'y	Spec	Model Name	Vendor	Remarks
R211	Chip Resistor	1	1/10W 10kΩ		KOA	1%
R212	Chip Resistor	1	1/10W 2.4kΩ		KOA	1%
R221	Metal-oxide Film Resistor	1	1W 0.39Ω			-
R222	Metal-oxide Film Resistor	1	1W 0.39Ω			-
R225	Chip Resistor	1	1/10W 10Ω		KOA	1%
R226	Chip Resistor	1	1/10W 22Ω		KOA	1%
R227	Chip Resistor	1	1/10W 100kΩ		KOA	-
R231	Chip Resistor	1	1/10W 15kΩ		KOA	-
R232	Chip Resistor	1	1/10W 75kΩ		KOA	-
R233	Chip Resistor	1	1/2W 1.5Ω		KOA	-
R234	Chip Resistor	1	1/2W 1kΩ		KOA	-
R235	Chip Resistor	1	1/8W 33Ω		KOA	-
R236	Chip Resistor	1	1/10W 33kΩ		KOA	-
R241	Chip Resistor	1	1/8W 22Ω		KOA	-
R242	Chip Resistor	1	1/10W 22kΩ		KOA	-
R243	Chip Resistor	1	1/8W 22Ω		KOA	-
R244	Chip Resistor	1	1/10W 22kΩ		KOA	-
R252	Chip Resistor	1	1/10W 10kΩ		KOA	-
R255	Chip Resistor	1	1/10W 4.7kΩ		KOA	-
R256	Chip Resistor	1	1/10W 75kΩ		KOA	-
R257	Chip Resistor	1	1/10W 22kΩ		KOA	-
R259	Chip Resistor	1	1/10W 47kΩ		KOA	-
R260	Chip Resistor	1	1/10W 47kΩ		KOA	-
R342	Chip Resistor	1	1/10W 68kΩ		KOA	1%
R343	Chip Resistor	1	1/10W 15kΩ		KOA	1%
R344	Chip Resistor	1	1/10W 3.3kΩ		KOA	1%
R345	Chip Resistor	1	1/10W 10kΩ		KOA	1%
R347	Chip Resistor	1	1/8W 3.3kΩ		KOA	-
R348	Chip Resistor	1	1/10W 4.7kΩ		KOA	-
R351	Chip Resistor	1	1/10W 22kΩ		KOA	-
R353	Chip Resistor	1	1/10W 22kΩ		KOA	-
R361	Chip Resistor	1	1/8W 4.7kΩ		KOA	-
R362	Chip Resistor	1	1/10W 47kΩ		KOA	-
R371	Chip Resistor	1	1/8W 4.7kΩ		KOA	-
R372	Chip Resistor	1	1/10W 47kΩ		KOA	-
R381	Chip Resistor	1	1/8W 4.7kΩ		KOA	-
R382	Chip Resistor	1	1/10W 4.7kΩ		KOA	-
R383	Chip Resistor	1	1/10W 10kΩ		KOA	-
R384	Chip Resistor	1	1/10W 47kΩ		KOA	-
R385	Chip Resistor	1	1/10W 22kΩ		KOA	-
R386	Chip Resistor	1	1/10W 47kΩ		KOA	-

PFC Choke Coil

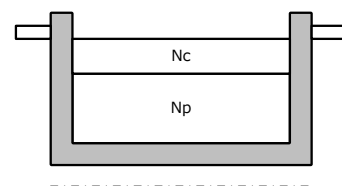
Vin= AC90~264V

Inductance (Np)	2-5pin	146μH	1kHz
Core	PQ2629		
Material :	-	Manufacturer :	SUMIDA
Bobbin	PQ2629		
Pin Number :	12	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	Np	2	5	42	0.08×80p	USTC/1UEW	-	-	
2	Nc	8	11	4	0.23	1UEW	-	-	

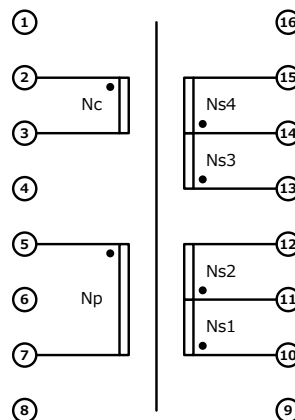
LLC Transformer

Vin= DC360~420V
Po= 180W

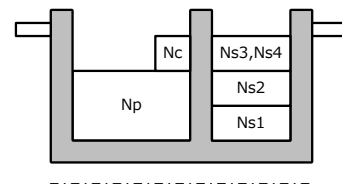
Inductance (Np)	5-7pin	500μH	100kHz
Leakage Inductance (Np)	5-7pin	120μH	100kHz

Core	SWD3539BF		
Material :	-	Manufacturer :	TAMURA
Bobbin	SWD3539BF		
Pin Number :	16	Manufacturer :	TAMURA

< 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	Np	5	7	40	0.08×80p	USTC/1UEW	-	-	
2	Nc	2	3	3	0.23	1UEW	-	-	
3	Ns1	10	11	4	0.08×150p	USTC/1UEW	24V	6.00 A	
4	Ns2	11	12	4	0.08×150p	USTC/1UEW			
5	Ns3	13	14	2	0.08×80p	USTC/1UEW	12V	3.00 A	
6	Ns4	14	15	2	0.08×80p	USTC/1UEW			

Efficiency

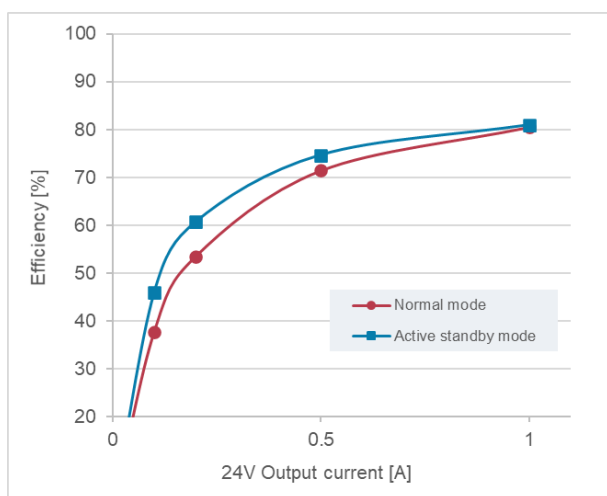
Normal mode Efficiency

Vin [V]	Pin [W]	Po [W]	η [%]	24V Vo [V]	24V Io [A]	12V Vo [V]	12V Io [A]	5V Vo [V]	5V Io [A]	Power Factor
100	28.4	22.6	79.6	23.95	0.00	11.30	2.00	5.00	0.00	0.955
	81.1	71.5	88.1	23.95	2.00	11.78	2.00	5.00	0.00	0.967
	161.3	143.8	89.1	23.96	5.00	11.98	2.00	5.00	0.00	0.986
	189.3	167.9	88.7	23.96	6.00	12.05	2.00	5.00	0.00	0.989
240	28.3	22.6	79.9	23.95	0.00	11.30	2.00	5.00	0.00	0.646
	80.1	71.5	89.2	23.95	2.00	11.78	2.00	5.00	0.00	0.929
	157.1	143.7	91.5	23.96	5.00	11.98	2.00	5.00	0.00	0.962
	183.5	167.9	91.5	23.96	6.00	12.05	2.00	5.00	0.00	0.967

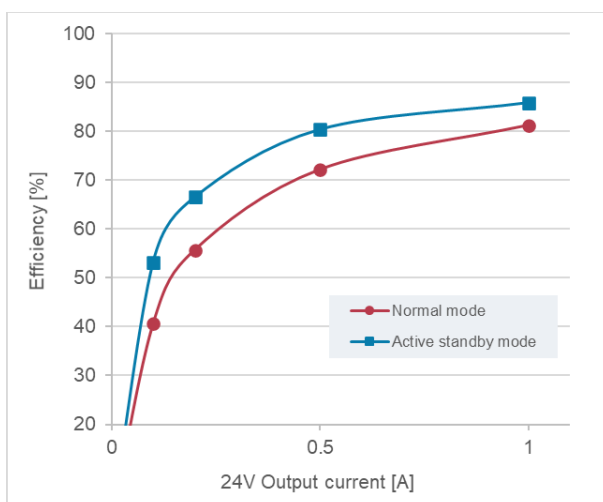
Active standby mode Efficiency

Vin [V]	Pin [W]	Po [W]	η [%]	24V Vo [V]	24V Io [A]	12V Vo [V]	12V Io [A]	5V Vo [V]	5V Io [A]
100	2.4	0.0	0.0	23.95	0.00	11.98	0.00	5.00	0.00
	5.2	2.4	45.9	23.95	0.10	12.11	0.00	5.00	0.00
	7.9	4.8	60.7	23.95	0.20	12.18	0.00	5.00	0.00
	16.0	12.0	74.7	23.95	0.50	12.32	0.00	5.00	0.00
	29.6	24.0	80.9	23.95	1.00	12.55	0.00	5.00	0.00
240	1.8	0.00	0.0	23.95	0.00	11.99	0.00	5.00	0.00
	4.5	2.4	53.2	23.95	0.10	12.08	0.00	5.00	0.00
	7.2	4.8	66.5	23.95	0.20	12.14	0.00	5.00	0.00
	14.9	12.0	80.4	23.95	0.50	12.29	0.00	5.00	0.00
	27.9	24.0	85.8	23.95	1.00	12.52	0.00	5.00	0.00

AC100V Active standby mode Efficiency



AC240V Active standby mode Efficiency



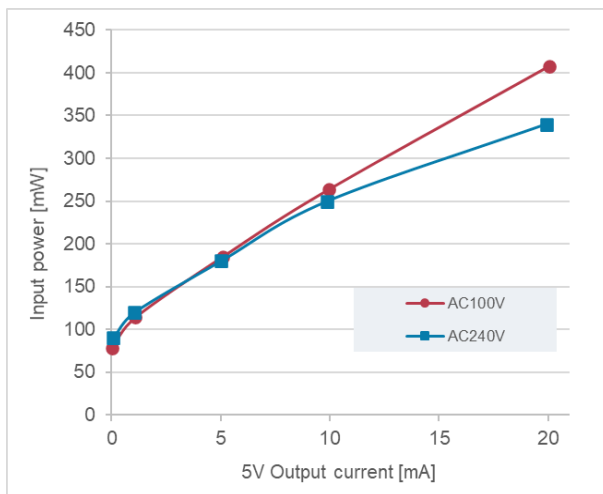
Input-output characteristics

Burst mode input-output characteristics

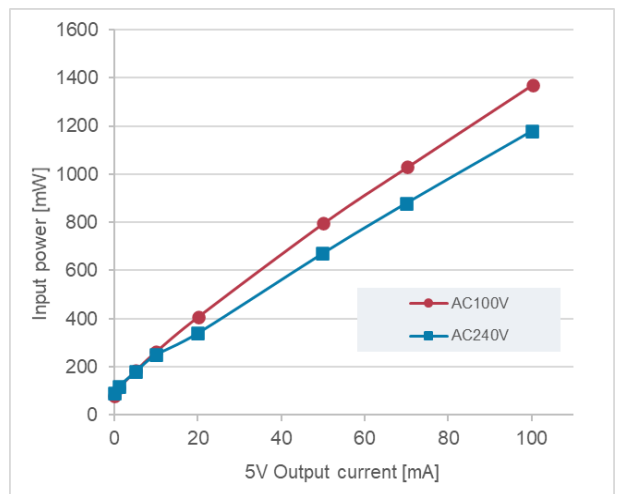
Vin [V]	Pin [mW]	Po [mW]	5V Vo [V]	5V Io [mA]
100	78.0	0.1	5.0	0.0
	114.0	5.5	5.0	1.1
	185.0	25.5	5.0	5.1
	264.0	49.9	5.0	10.0
	408.0	100.3	5.0	20.1
	796.0	250.4	5.0	50.1
	1029.0	350.7	5.0	70.3
	1371.0	500.4	5.0	100.3

Vin [V]	Pin [mW]	Po [mW]	5V Vo [V]	5V Io [mA]
240	90.0	0.4	5.0	0.1
	120.0	5.3	5.0	1.0
	180.0	25.1	5.0	5.0
	250.0	49.4	5.0	9.9
	340.0	99.6	5.0	19.9
	670.0	248.6	5.0	49.8
	880.0	349.3	5.0	70.0
	1180.0	499.3	5.0	100.1

0mA-20mA input-output characteristics



0mA-100mA input-output characteristics



Operation waveform

Photo.1 Normal mode / Typical load waveform

Output current 24V/5.0A
12V/2.0A
5V /0.0A

CH3 : PFC MOSFET I_D 2A/div
CH4 : LLC high-side MOSFET I_{DH} 2A/div

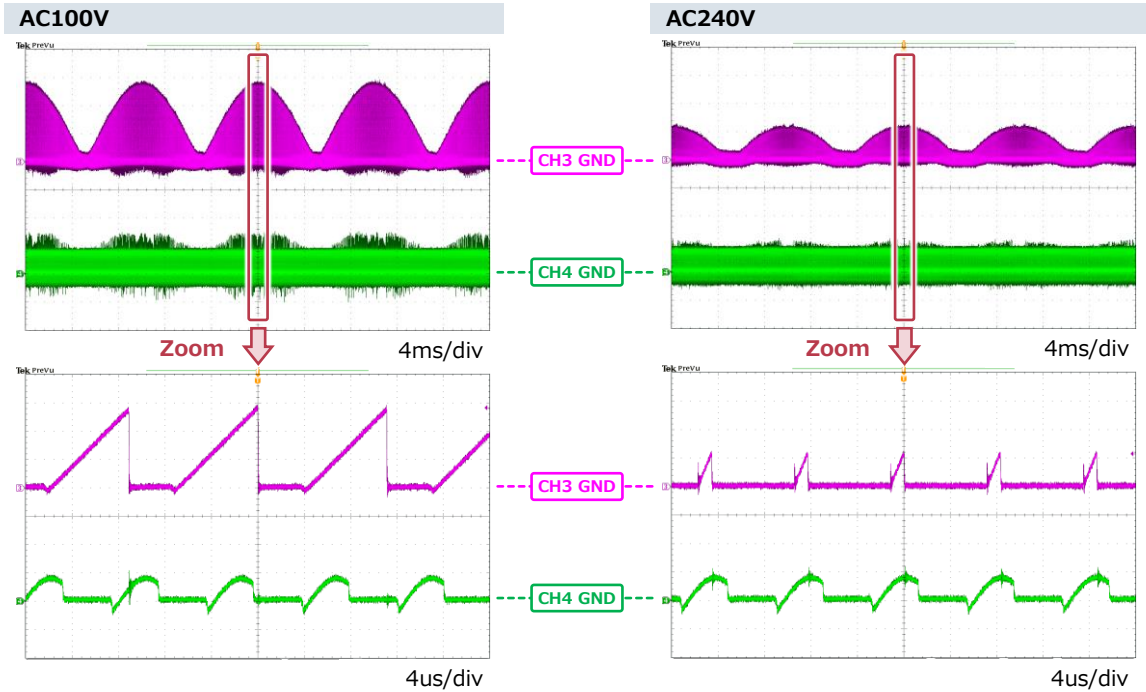
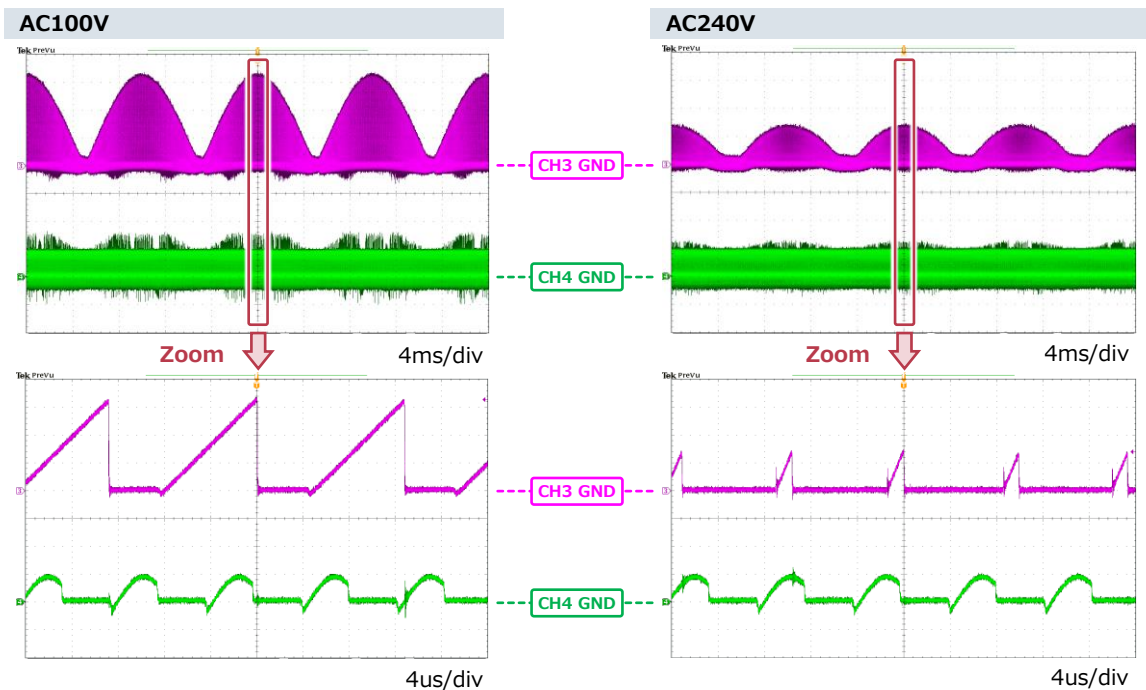


Photo.2 Normal mode / Maximum load waveform

Output current 24V/6.0A
12V/3.0A
5V /0.0A

CH3 : PFC MOSFET I_D 2A/div
CH4 : LLC high-side MOSFET I_{DH} 2A/div



Operation waveform

Photo.3 Burst mode waveform / Po=0W

Output current 24V/0.0A
12V/0.0A
5V /0.0A

CH2 : 5V output voltage 2V/div
CH3 : 12V output voltage 1V/div
CH4 : LLC high-side MOSFET I_{DH} 1A/div

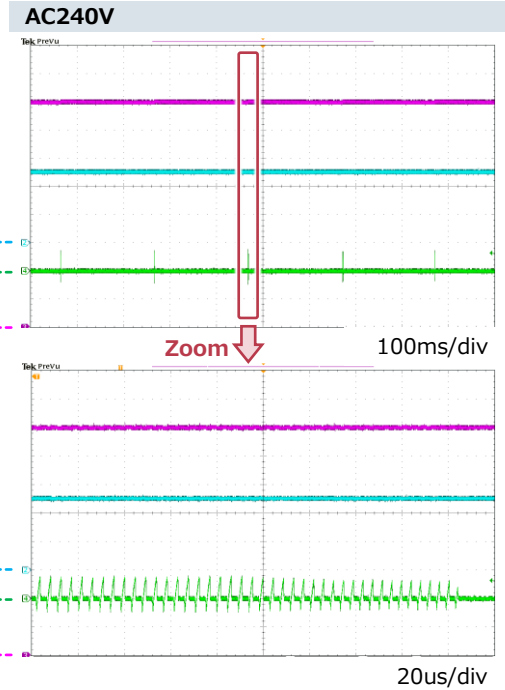
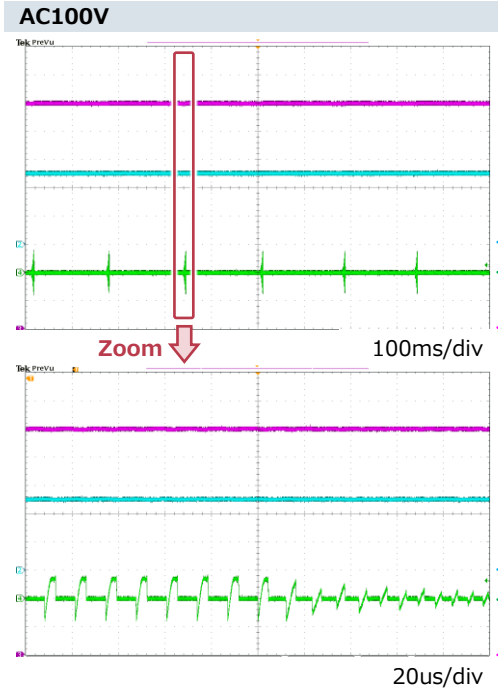
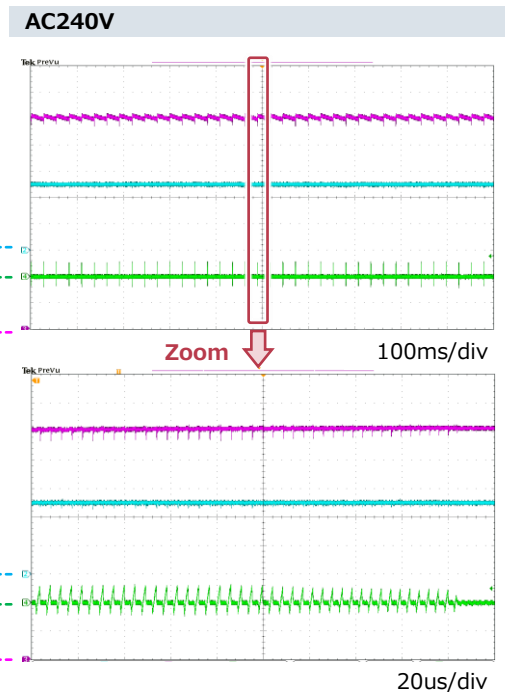
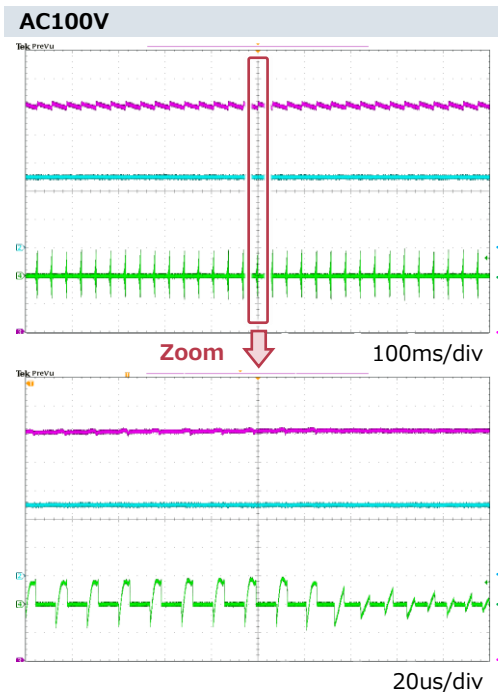


Photo.4 Burst mode waveform / Po=50mW

Output current 24V/0.0A
12V/0.0A
5V /0.01A

CH2 : 5V output voltage 2V/div
CH3 : 12V output voltage 1V/div
CH4 : LLC high-side MOSFET I_{DH} 1A/div



Operation waveform

Photo.5 Burst mode waveform / Po=500W

Output current 24V/0.0A
 12V/0.0A
 5V /0.1A

CH2 : 5V output voltage 2V/div
CH3 : 12V output voltage 1V/div
CH4 : LLC high-side MOSFET I_{DH} 1A/div

