

LLC Current Resonant Mode
Controller ICs

MCZ5205SE

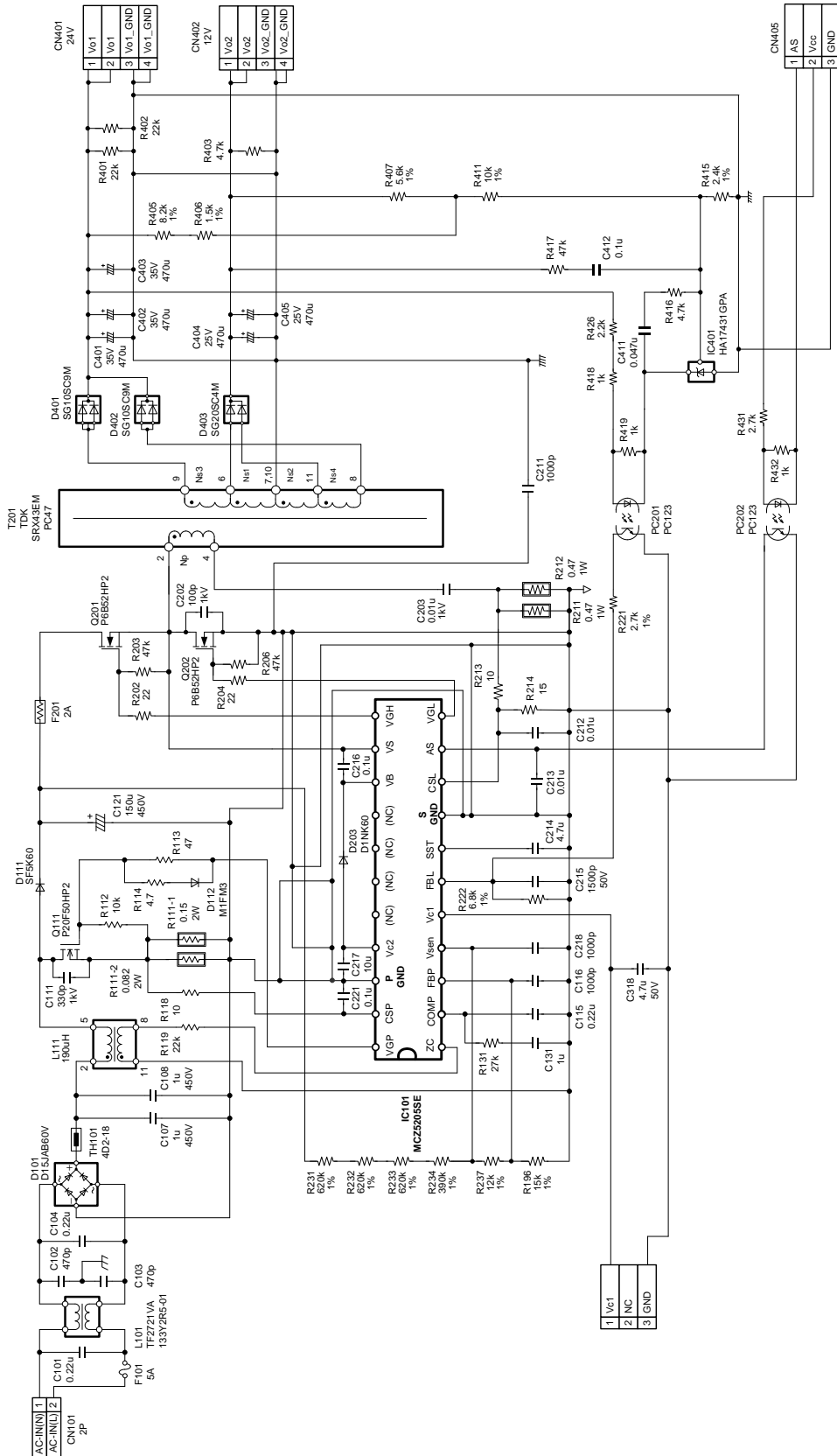
Input voltage : AC 90 ~ 264V

Output	Voltage [V]	Output Current [A]		
		min	typ	max
1	+12	0.5	2.0	4.0
2	+24	0.0	3.0	4.0
Total Power [W]		6.0	96.0	144.0

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Reference circuit diagram



Bill Of Material

No.	Type	Qty	Spec	Model Name	Vendor	Remarks
F101	Fuse	1	5A			-
F201	Fuse	1	2A	ULHQ2A	SOC	-
L101	Line Filter	1		TF2721VA133Y2R5-01		-
L111	PFC Choke Coil	1	190uH	PQ26/25		-
TH101	Power Thermistor	1	4Ω	4D2-18	SEMITEC	-
T201	LLC Transformer	1	870uH			-
IC101	Control IC	1		MCZ5205SE	SHINDENGEN	-
IC401	Shunt Regulator	1		HA17431GPA	RENESAS	-
PC201	Opto Coupler	1		PC123	SHARP	-
PC202	Opto Coupler	1		PC123	SHARP	-
Q111	Power MOSFET	1	500V 20A	P20F50HP2	SHINDENGEN	-
Q201	Power MOSFET	1	525V 6A	P6B52HP2	SHINDENGEN	-
Q202	Power MOSFET	1	525V 6A	P6B52HP2	SHINDENGEN	-
D101	Bridge Diode	1	600V 15A	D15JAB60V	SHINDENGEN	-
D111	FRD	1	600V 5A	SF5K60	SHINDENGEN	-
D112	SBD	1	30V 3A	M1FM3	SHINDENGEN	-
D203	FRD	1	600V 0.8A	D1NK60	SHINDENGEN	-
D401	SBD	1	90V 10A	SG10SC9M	SHINDENGEN	-
D402	SBD	1	90V 10A	SG10SC9M	SHINDENGEN	-
D403	SBD	1	40V 20A	SG20SC4M	SHINDENGEN	-
C101	X-Capacitor	1	AC250V 0.22uF	ECQU2A224ML	Panasonic	-
C104	X-Capacitor	1	AC250V 0.22uF	ECQU2A224ML	Panasonic	-
C102	Y-Capacitor	1	AC250V 470pF	CD95-B2GA471KYNSA	TDK	-
C103	Y-Capacitor	1	AC250V 470pF	CD95-B2GA471KYNSA	TDK	-
C211	Y-Capacitor	1	AC250V 1000pF	CD85-E2GA102MYNSA	TDK	-
C107	Film Capacitor	1	450V 1uF	450MPK105K	Rubycon	-
C108	Film Capacitor	1	450V 1uF	450MPK105K	Rubycon	-
C111	Disk Ceramic Capacitor	1	1kV 330pF	DE1005SL331J1K	Murata	-
C202	Disk Ceramic Capacitor	1	1kV 100pF	CC45SL3AD101JYNNA	TDK	-
C203	Film Capacitor	1	1kV 0.01uF	FL1000HP103	SHINYEI	-
C121	Electrolytic Capacitor	1	450V 150uF		Rubycon	-
C401	Electrolytic Capacitor	1	35V 470uF		Rubycon	-
C402	Electrolytic Capacitor	1	35V 470uF		Rubycon	-
C403	Electrolytic Capacitor	1	35V 470uF		Rubycon	-
C404	Electrolytic Capacitor	1	25V 470uF		Rubycon	-
C405	Electrolytic Capacitor	1	25V 470uF		Rubycon	-
C115	MLCC	1	16V 0.22uF			-
C131	MLCC	1	16V 1uF			-
C116	MLCC	1	50V 1000pF			-
C212	MLCC	1	16V 0.01uF			-
C213	MLCC	1	16V 0.01uF			-
C214	MLCC	1	16V 4.7uF			-
C215	MLCC	1	50V 1500pF			-
C216	MLCC	1	16V 0.1uF			-
C217	MLCC	1	16V 10uF			-
C218	MLCC	1	50V 1000pF			-
C221	MLCC	1	16V 0.1uF			-
C318	MLCC	1	50V 4.7uF			-
C411	MLCC	1	16V 0.047uF			-
C412	MLCC	1	25V 0.1uF			-

Bill Of Material

No.	Type	Qt'y	Spec	Model Name	Vendor	Remarks
R111-1	Metal Plate Resistor	1	2W 0.15Ω			-
R111-2	Metal Plate Resistor	1	2W 0.082Ω			-
R112	Chip Resistor	1	1/10W 10kΩ			-
R113	Chip Resistor	1	1/8W 47Ω			-
R114	Chip Resistor	1	1/8W 4.7Ω			-
R118	Chip Resistor	1	1/10W 10Ω			-
R119	Chip Resistor	1	1/10W 22kΩ			-
R131	Chip Resistor	1	1/10W 27kΩ			-
R196	Chip Resistor	1	1/10W 15kΩ			1%
R202	Chip Resistor	1	1/8W 22Ω			-
R204	Chip Resistor	1	1/8W 22Ω			-
R203	Chip Resistor	1	1/10W 47kΩ			-
R206	Chip Resistor	1	1/10W 47kΩ			-
R211	Metal Film Resistor	1	1W 0.47Ω			-
R212	Metal Film Resistor	1	1W 0.47Ω			-
R213	Flame Retardant Chip Resistor	1	1/10W 10Ω			1%
R214	Flame Retardant Chip Resistor	1	1/10W 15Ω			1%
R221	Chip Resistor	1	1/10W 2.7kΩ			1%
R222	Chip Resistor	1	1/10W 6.8kΩ			1%
R231	Chip Resistor	1	1/8W 620kΩ			1%
R232	Chip Resistor	1	1/8W 620kΩ			1%
R233	Chip Resistor	1	1/8W 620kΩ			1%
R234	Chip Resistor	1	1/8W 390kΩ			1%
R237	Chip Resistor	1	1/10W 12kΩ			1%
R401	Chip Resistor	1	1/10W 22kΩ			-
R402	Chip Resistor	1	1/10W 22kΩ			-
R403	Chip Resistor	1	1/10W 4.7kΩ			-
R405	Chip Resistor	1	1/10W 8.2kΩ			1%
R406	Chip Resistor	1	1/10W 1.5kΩ			1%
R407	Chip Resistor	1	1/10W 5.6kΩ			1%
R411	Chip Resistor	1	1/10W 10kΩ			1%
R415	Chip Resistor	1	1/10W 2.4kΩ			1%
R416	Chip Resistor	1	1/10W 4.7kΩ			-
R417	Chip Resistor	1	1/10W 47kΩ			-
R418	Chip Resistor	1	1/10W 1kΩ			-
R419	Chip Resistor	1	1/10W 1kΩ			-
R426	Chip Resistor	1	1/10W 2.2kΩ			-
R431	Chip Resistor	1	1/10W 2.7kΩ			-
R432	Chip Resistor	1	1/10W 1kΩ			-

※ Please select the L101 that meets your company's standards.

PFC Choke Coil

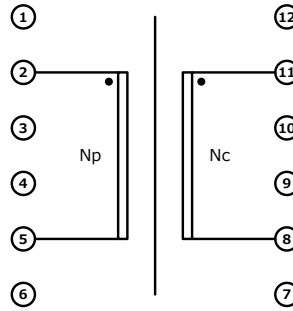
Vin= AC90~264V fmin= 40kHz
Po= 100W(typ)

Inductance (Np)	2-5pin	190μH	1kHz
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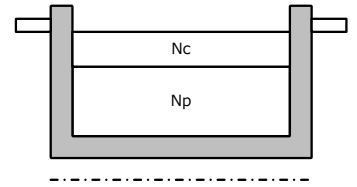
Core			
PQ2625	Material : PC44	Manufacturer :	-

Bobbin			
PQ2625	Pin Number : 12	Manufacturer :	-

< 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	53	0.06×80p	USTC/2UEW	-	-	
2	Nc	11	8	5	0.23	1UEW	-	-	

LLC Transformer

Vin= DC380V±10% fmin= 68kHz
Po= 96W(typ) 144W(max)

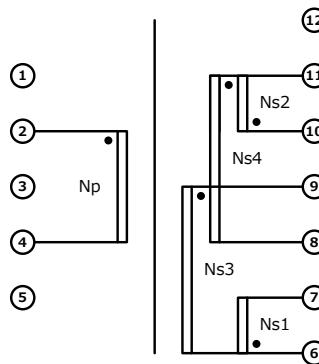
Inductance (Np)	2-4pin	870μH	10kHz
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Leakage Inductance (Np)	2-4pin	310μH	10kHz
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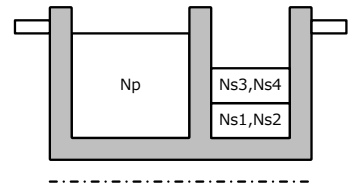
Core			
SRX43EM	Material : -	Manufacturer :	TDK

Bobbin			
SRX43EM	Pin Number : 12	Manufacturer :	TDK

< 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	4	60	0.06×80p	USTC/2UEW	-	-	
2	Ns1	6	7	3	0.06×180p	USTC/2UEW	12.0V	2.00 A	Bifilar Winding
3	Ns2	10	11	3	0.06×180p	USTC/2UEW			
4	Ns3	9	6	3	0.06×180p	USTC/2UEW	24.0V	3.00 A	Bifilar Winding
5	Ns4	11	8	3	0.06×180p	USTC/2UEW			

Efficiency

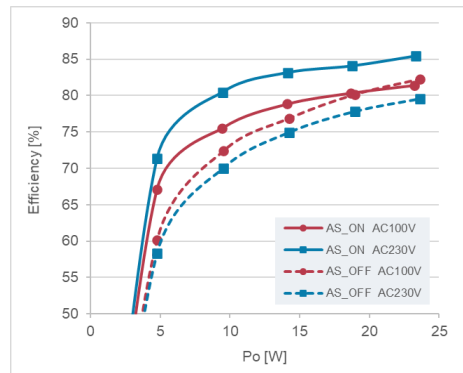
Active standby mode OFF Efficiency

Min/Typ/Max load condition
Vc1=16V

Vin [V]	Pin [W]	Po [W]	η [%]	Power Factor	12V Vo [V]	12V Io [A]	24V Vo [V]	24V Io [A]
90	9.12	5.97	65.43	0.839	11.94	0.50	24.66	0.00
	110.80	97.71	88.18	0.982	12.01	2.00	24.57	3.00
	169.90	146.43	86.19	0.988	11.93	4.00	24.68	4.00
100	9.10	5.97	65.57	0.821	11.93	0.50	24.66	0.00
	109.90	97.70	88.90	0.979	12.01	2.00	24.56	3.00
	168.00	146.43	87.16	0.987	11.93	4.00	24.68	4.00
230	9.40	5.97	63.48	0.415	11.94	0.50	24.66	0.00
	107.80	97.70	90.63	0.930	12.01	2.00	24.56	3.00
	162.00	146.44	90.39	0.946	11.93	4.00	24.68	4.00
264	9.30	5.97	64.17	0.364	11.94	0.50	24.66	0.00
	107.90	97.70	90.55	0.912	12.01	2.00	24.56	3.00
	162.10	146.44	90.34	0.936	11.93	4.00	24.68	4.00

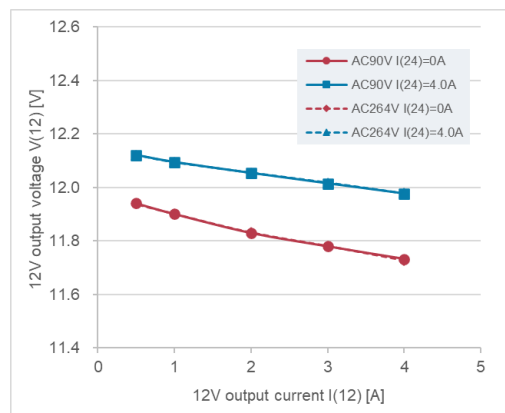
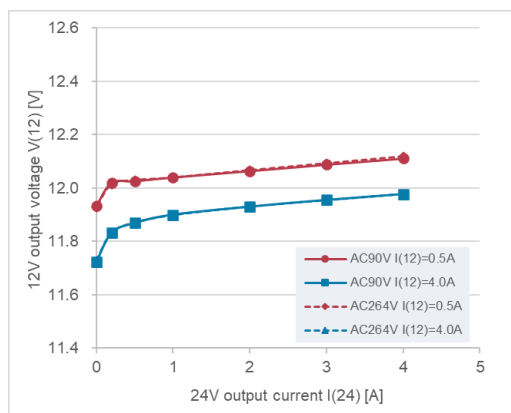
Active standby mode ON Efficiency

Active standby mode ON/OFF
Vc1=16V

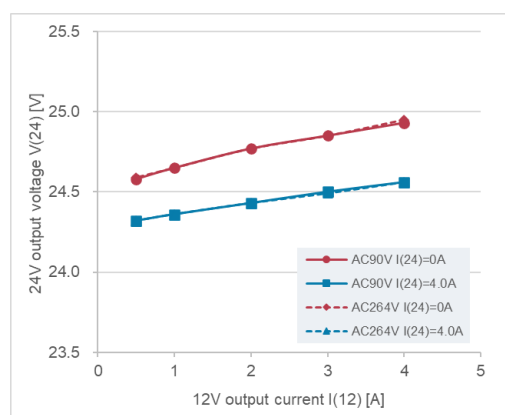
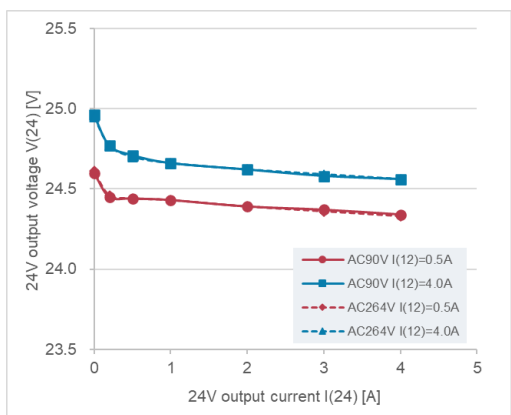


Cross regulation

12V output load regulation



24V output load regulation



Operation waveform

Photo.1 Normal condition PFC waveform

IC voltage $V_{c1}=16V$
Output current 12V/2A
24V/3A

CH1 : PFC MOSFET V_{DS} 200V/div
CH2 : PFC MOSFET V_{GP} 10V/div
CH3 : PFC MOSFET I_D 2A/div
CH4 : Z/C terminal voltage 10V/div

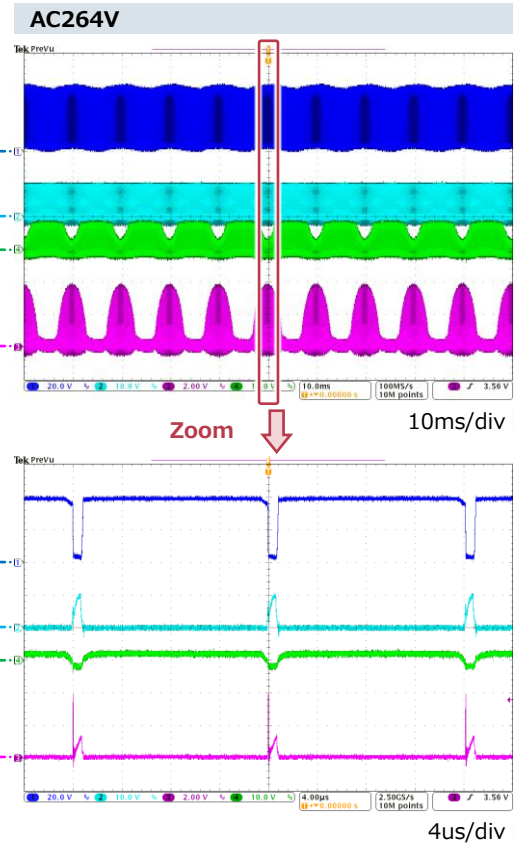
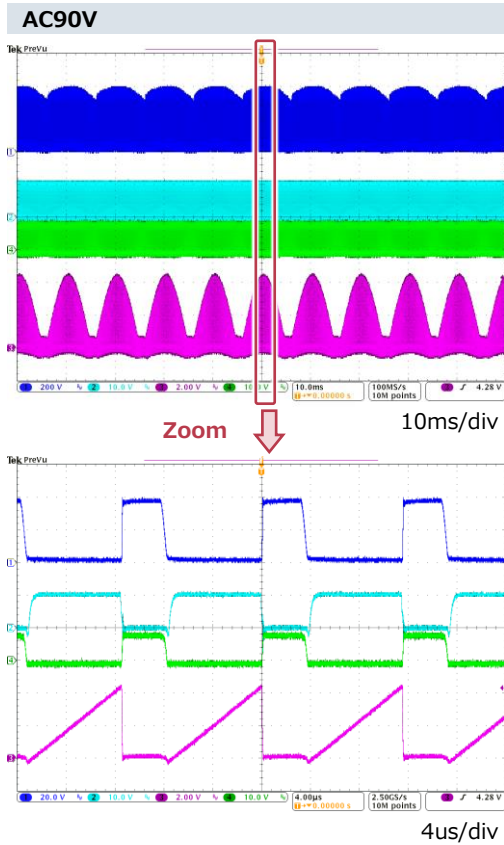
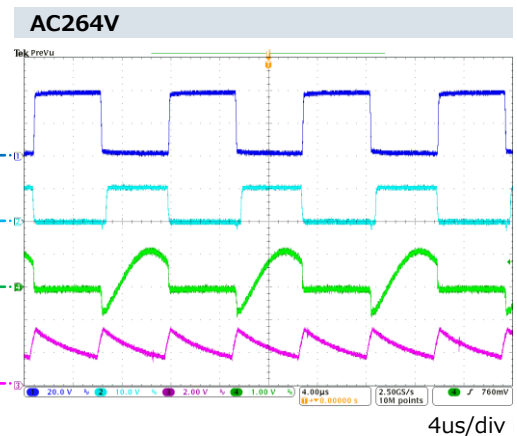
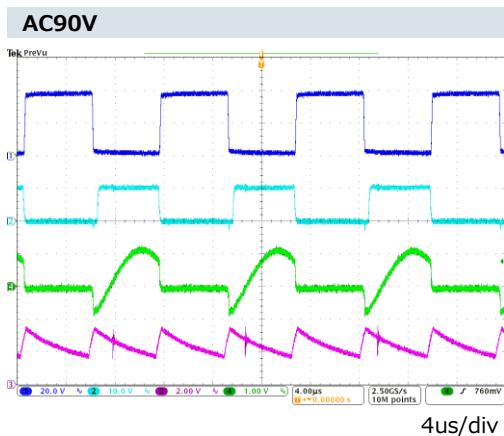


Photo.2 Normal condition LLC waveform

IC voltage $V_{c1}=16V$
Output current 12V/2A
24V/3A

CH1 : LLC Low MOSFET V_{DL} 200V/div
CH2 : LLC Low MOSFET V_{GL} 10V/div
CH3 : FBL terminal voltage 2V/div
CH4 : LLC Low MOSFET I_{DL} 1A/div



Operation waveform

Photo.3 Minimum condition PFC waveform

IC voltage Vc1=16V
Output current 12V/0.5A
24V/0A

CH1 : PFC MOSFET V_{DS} 200V/div
CH2 : PFC MOSFET V_{GP} 10V/div
CH3 : PFC MOSFET I_D 1A or 2A/div
CH4 : Z/C terminal voltage 10V/div

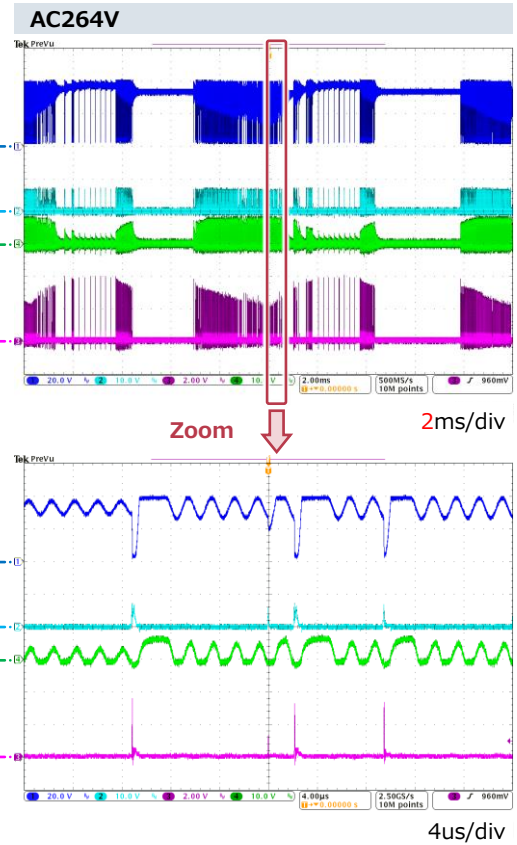
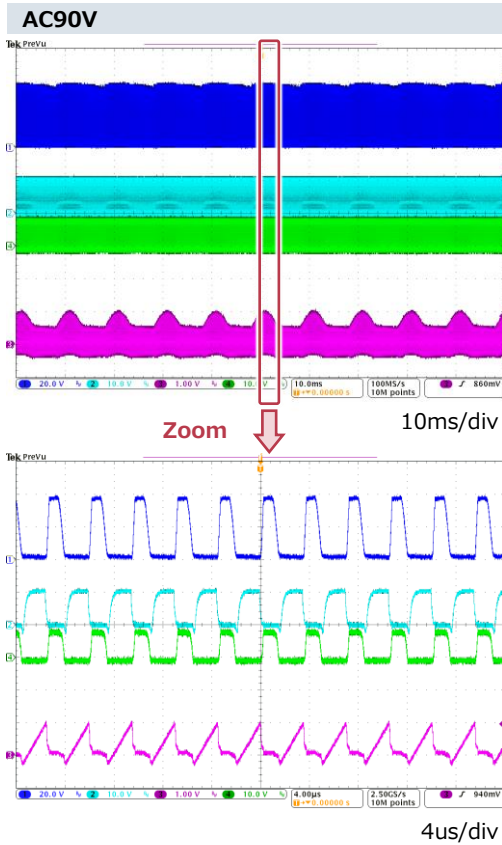
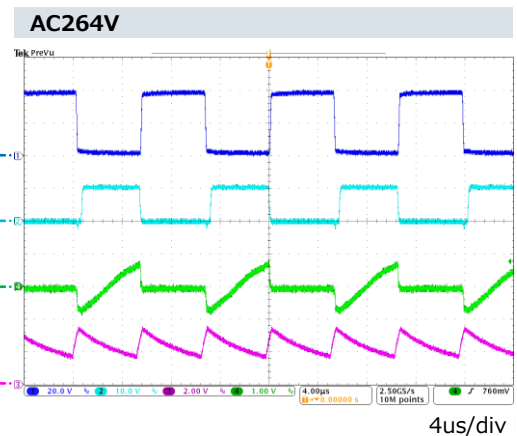
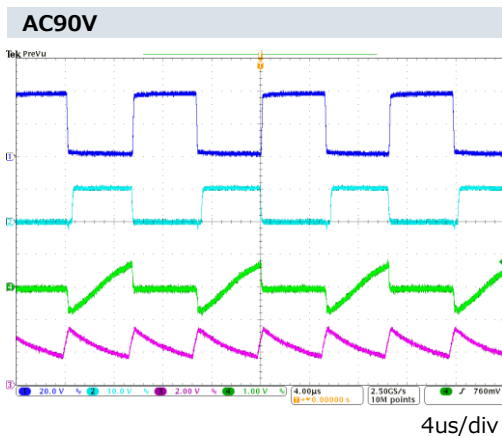


Photo.4 Minimum condition LLC waveform

IC voltage Vc1=16V
Output current 12V/0.5A
24V/0A

CH1 : LLC Low MOSFET V_{DL} 200V/div
CH2 : LLC Low MOSFET V_{GL} 10V/div
CH3 : FBL terminal voltage 2V/div
CH4 : LLC Low MOSFET I_{DL} 1A/div

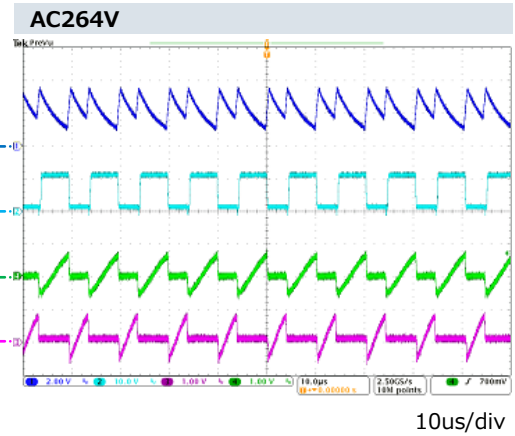
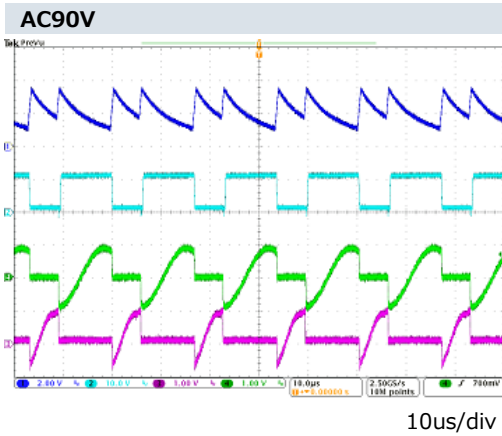


Operation waveform

Photo.5 Active standby mode waveform

Output current 12V/0.8A
24V/0A

CH1 : FBL terminal voltage 2V/div
CH2 : LLC Low MOSFET V_{GL} 10V/div
CH3 : LLC High MOSFET I_{DH} 1A/div
CH4 : LLC Low MOSFET I_{DL} 1A/div



Temperature

IC voltage $V_{c1}=16V$
Output current 12V/2A
24V/3A

AC90V

	Bridge Di	PFC			LLC					MCZ5205SE	ambient
		Choke coil	MOSFET	Diode	High side MOSFET	Low side MOSFET	transformer	12V Output Diode	24V Output Diode		
Temperature T [°C]	59.2	51.0	46.7	49.4	52.7	52.3	62.9	58.5	67.9	52.3	29.7
Temperature rise ΔT [deg.]	29.5	21.3	17.0	19.7	23.0	22.6	33.2	28.8	38.2	22.6	

AC264V

	Bridge Di	PFC			LLC					MCZ5205SE	ambient
		Choke coil	MOSFET	Diode	High side MOSFET	Low side MOSFET	transformer	12V Output Diode	24V Output Diode		
Temperature T [°C]	39.4	48.6	52.1	45.8	51.7	51.5	62.4	57.6	66.7	55.5	29.2
Temperature rise ΔT [deg.]	10.2	19.4	22.9	16.6	22.5	22.3	33.2	28.4	37.5	26.3	