

LLC Current Resonant Mode Controller ICs **MCZ5216ST**

Input voltage : AC 180 ~ 264V

Normal mode

Output	Voltage [V]	Output Current [A]		
		min	typ	max
1	+24	0.0	4.0	6.0
2	+12	0.0	4.5	5.0
3	+5	0.025	0.025	0.025
Total Power [W]		0.125	150.1	204.1

Active standby mode

Output	Voltage [V]	Output Current [A]		
		min	typ	max
1	+24	0.0	0.1	-
2	+12	0.0	1.6	-
3	+5	0.025	0.025	-
Total Power [W]		0.125	21.7	-

Standby mode

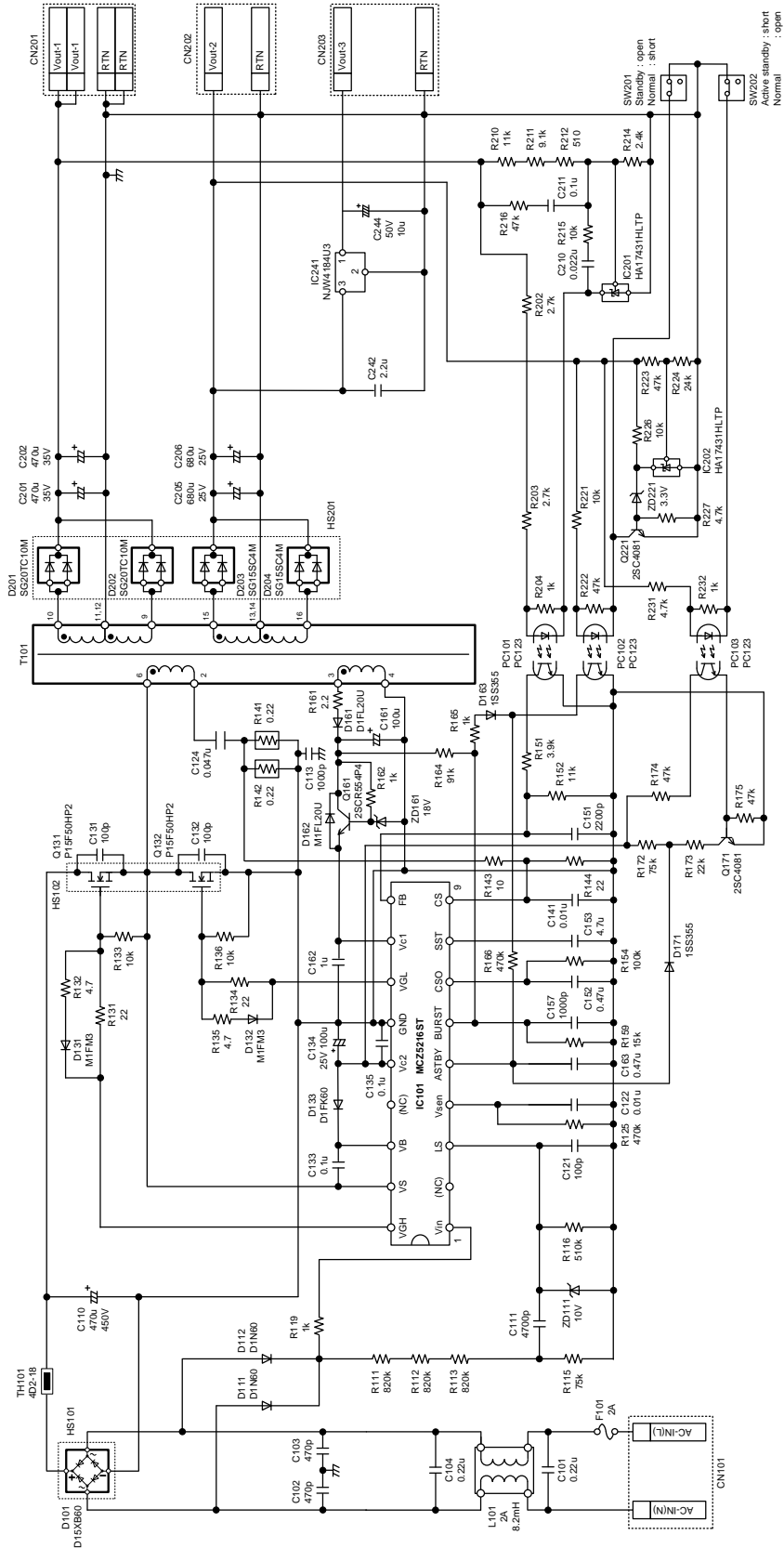
Output	Voltage [V]	Output Current [A]		
		min	typ	max
1	+24	0.0	0.0	-
2	+12	0.0	0.0	-
3	+5	0.0	0.025	-
Total Power [W]		0.0	0.125	-

J564-1-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	2A			-
L101	Line Filter	1	2A	8.2mH	LF2628NP-R822	SUMIDA	-
TH101	Power Thermistor	1			4D2-18	SEMITEC	-
T101	LLC Transformer	1		260uH	SWD3539BF	TAMURA	-
IC101	Control IC	1			MCZ5216ST	SHINDENGEN	-
IC201	Shunt regulator	1			HA17431HLTP	RENESAS	-
IC202	Shunt regulator	1			HA17431HLTP	RENESAS	-
IC241	IC	1			NJW4184U3-05B	JRC	-
PC101	Opto Coupler	1			PC123	SHARP	-
PC102	Opto Coupler	1			PC123	SHARP	-
PC103	Opto Coupler	1			PC123	SHARP	-
Q131	Power MOSFET	1	500V	15A	P15F50HP2	SHINDENGEN	-
Q132	Power MOSFET	1	500V	15A	P15F50HP2	SHINDENGEN	-
Q161	BJT(NPN)	1			2SCR554P4	ROHM	-
Q171	Small Signal BJT(NPN)	1			2SC4081	ROHM	-
Q221	Small Signal BJT(NPN)	1			2SC4081	ROHM	-
D101	Bridge Diode	1	600V	15A	D15XB60	SHINDENGEN	-
D111	FRD	1	600V	0.8A	D1NK60	SHINDENGEN	-
D112	FRD	1	600V	0.8A	D1NK60	SHINDENGEN	-
D131	SBD	1	30V	3A	M1FM3	SHINDENGEN	-
D132	SBD	1	30V	3A	M1FM3	SHINDENGEN	-
D133	FRD	1	600V	0.8A	D1FK60	SHINDENGEN	-
D161	FRD	1	200V	1.1A	D1FL20U	SHINDENGEN	-
D162	FRD	1	200V	1.1A	M1FL20U	SHINDENGEN	-
D163	Small Signal Diode		90V	0.1A	1SS355VM	ROHM	-
D171	Small Signal Diode	1	90V	0.1A	1SS355VM	ROHM	-
D201	SBD	1	100V	20A	SG20TC10M	SHINDENGEN	-
D202	SBD	1	100V	20A	SG20TC10M	SHINDENGEN	-
D203	SBD	1	40V	15A	SG15SC4M	SHINDENGEN	-
D204	SBD	1	40V	15A	SG15SC4M	SHINDENGEN	-
ZD111	Zenor diode	1	1W	10V	KDZ10B	ROHM	-
ZD161	Zenor diode	1	0.5W	18V	KDZV18B	ROHM	-
ZD221	Zenor diode	1	0.2W	3.3V	UDZV3.3B	ROHM	-
C101	X-cap	1	AC250V	0.22uF			-
C102	Y-cap	1	AC250V	470pF			-
C103	Y-cap	1	AC250V	470pF			-
C104	X-cap	1	AC250V	0.22uF			-
C110	E.L Capacitor	1	450V	470uF		Rubycon	-
C111	MLCC	1	50V	4700pF			-
C113	Y-Capacitor	1	AC250V	1000pF		TDK	-
C121	MLCC	1	50V	100pF			-
C122	MLCC	1	50V	0.01uF			-
C124	Film Capacitor	1	1kV	0.047uF	FLS(441)1000HP473	SHINYEI	3%
C131	Disk Ceramic Capacitor	1	1kV	100pF		TDK	-
C132	Disk Ceramic Capacitor	1	1kV	100pF		TDK	-
C133	MLCC	1	50V	0.1uF			-
C134	E.L Capacitor	1	25V	100uF		Rubycon	-
C135	MLCC	1	50V	0.1uF			-
C141	MLCC	1	50V	0.01uF			-

Bill Of Material

No.	Type	Qt'y	Spec	Model Name	Vendor	Remarks
C151	MLCC	1	50V 2200pF			-
C152	MLCC	1	50V 0.47uF			-
C153	MLCC	1	50V 4.7uF			-
C157	MLCC	1	50V 1000pF			-
C161	E.L Capacitor	1	50V 100uF		Rubycon	-
C162	MLCC	1	50V 1uF			-
C163	MLCC	1	50V 0.47uF			-
C201	E.L Capacitor	1	35V 470uF		Rubycon	-
C202	E.L Capacitor	1	35V 470uF		Rubycon	-
C205	E.L Capacitor	1	25V 680uF		Rubycon	-
C206	E.L Capacitor	1	25V 680uF		Rubycon	-
C210	MLCC	1	25V 0.022uF			-
C211	MLCC	1	50V 0.1uF			-
C242	MLCC	1	50V 2.2uF			-
C244	E.L Capacitor	1	50V 10uF		Rubycon	-
R111	Chip Resistor	1	1/8W 820kΩ		KOA	-
R112	Chip Resistor	1	1/8W 820kΩ		KOA	-
R113	Chip Resistor	1	1/8W 820kΩ		KOA	-
R115	Chip Resistor	1	1/8W 75kΩ		KOA	-
R116	Chip Resistor	1	1/8W 510kΩ		KOA	-
R119	Fuse Resistor	1	1/8W 1kΩ		KOA	-
R125	Chip Resistor	1	1/8W 470kΩ		KOA	-
R131	Chip Resistor	1	1/8W 22Ω		KOA	-
R132	Chip Resistor	1	1/4W 4.7Ω		KOA	-
R133	Chip Resistor	1	1/8W 10kΩ		KOA	-
R134	Chip Resistor	1	1/8W 22Ω		KOA	-
R135	Chip Resistor	1	1/4W 4.7Ω		KOA	-
R136	Chip Resistor	1	1/8W 10kΩ		KOA	-
R141	Metal-oxide Film Resistor	1	3W 0.22Ω		KOA	-
R142	Metal-oxide Film Resistor	1	3W 0.22Ω		KOA	-
R143	Chip Resistor	1	1/8W 10Ω		KOA	1%
R144	Chip Resistor	1	1/8W 22Ω		KOA	1%
R151	Chip Resistor	1	1/8W 3.9kΩ		KOA	1%
R152	Chip Resistor	1	1/8W 11kΩ		KOA	1%
R154	Chip Resistor	1	1/8W 100kΩ		KOA	-
R159	Chip Resistor	1	1/8W 15kΩ		KOA	-
R161	Chip Resistor	1	1/2W 2.2Ω		KOA	-
R162	Chip Resistor	1	1/2W 1kΩ		KOA	-
R164	Chip Resistor	1	1/8W 91kΩ		KOA	-
R165	Chip Resistor	1	1/8W 1kΩ		KOA	-
R166	Chip Resistor	1	1/8W 470kΩ		KOA	-
R172	Chip Resistor	1	1/8W 75kΩ		KOA	-
R173	Chip Resistor	1	1/8W 22kΩ		KOA	-
R174	Chip Resistor	1	1/8W 47kΩ		KOA	-
R175	Chip Resistor	1	1/8W 47kΩ		KOA	-

Bill Of Material

No.	Type	Qt'y	Spec	Model Name	Vendor	Remarks
R202	Chip Resistor	1	1/8W 2.7kΩ		KOA	-
R203	Chip Resistor	1	1/8W 2.7kΩ		KOA	-
R204	Chip Resistor	1	1/8W 1kΩ		KOA	-
R210	Chip Resistor	1	1/8W 11kΩ		KOA	1%
R211	Chip Resistor	1	1/8W 9.1kΩ		KOA	1%
R212	Chip Resistor	1	1/8W 510Ω		KOA	1%
R214	Chip Resistor	1	1/8W 2.4kΩ		KOA	1%
R215	Chip Resistor	1	1/8W 10kΩ		KOA	-
R216	Chip Resistor	1	1/8W 47kΩ		KOA	-
R221	Chip Resistor	1	1/8W 10kΩ		KOA	-
R222	Chip Resistor	1	1/8W 47kΩ		KOA	-
R223	Chip Resistor	1	1/8W 47kΩ		KOA	-
R224	Chip Resistor	1	1/8W 24kΩ		KOA	-
R226	Chip Resistor	1	1/8W 10kΩ		KOA	-
R227	Chip Resistor	1	1/8W 4.7kΩ		KOA	-
R231	Chip Resistor	1	1/8W 4.7kΩ		KOA	-
R232	Chip Resistor	1	1/8W 1kΩ		KOA	-
HS101	Heat Sink	1	7.39°C/W	PUE-56-30	MIZUDEN	-
HS102	Heat Sink	1	11.2°C/W	15PTE23.5 L=50b	MARUSAN	-
HS103	Heat Sink	1	5.8°C/W	15PTE23.5 L=90b	MARUSAN	-
SW201	Switch	1				-
SW202	Switch	1				-

LLC Transformer

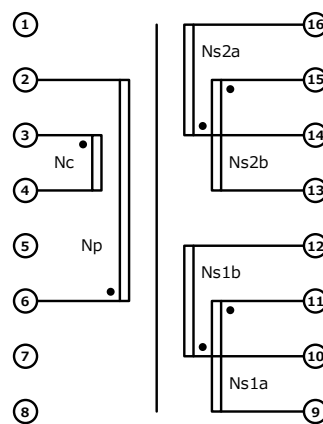
Vin= AC180~264V fmin= 55kHz
Po= 150W(typ) 204W(max)

Inductance (Np)	2-6pin	260μH	10kHz
Leakage Inductance (Np)	2-6pin	77μH	10kHz

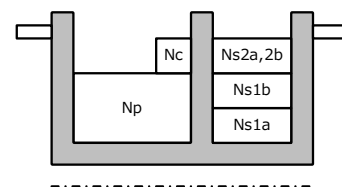
Core
SWD3539BF Material : - Manufacturer : TAMURA

Bobbin
SWD3539BF Pin Number : 16 Manufacturer : TAMURA

< Pin assignment >



< Structure drawing >

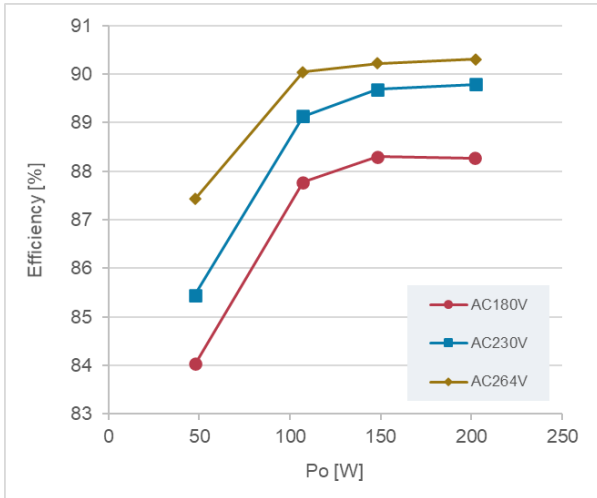


< Winding Specifications >

Winding Order	Current Name	Pin Number		Turn [T]	diameter [mm dia]	Material	Output		Notes
		Start	End				Voltage	Current	
1	Np	6	2	32	0.08×80p	Litz/1UEW	-	-	Aligned Winding
2	Ns1a	11	9	4	0.08×140p	Litz/1UEW	24V	4.00 A	Aligned Winding
3	Ns1b	10	12	4	0.08×140p	Litz/1UEW			Aligned Winding
4	Ns2a	14	16	2	0.08×140p	Litz/1UEW	12V	4.50 A	Bifilar
5	Ns2b	15	13	2	0.08×140p	Litz/1UEW			Aligned Winding
6	Nc	3	4	3	0.23	1UEW	18V	-	Aligned Winding

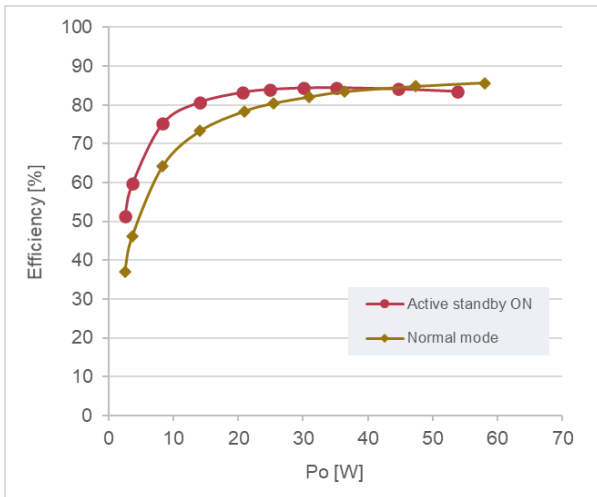
Efficiency

Medium ~ Heavy load Efficiency



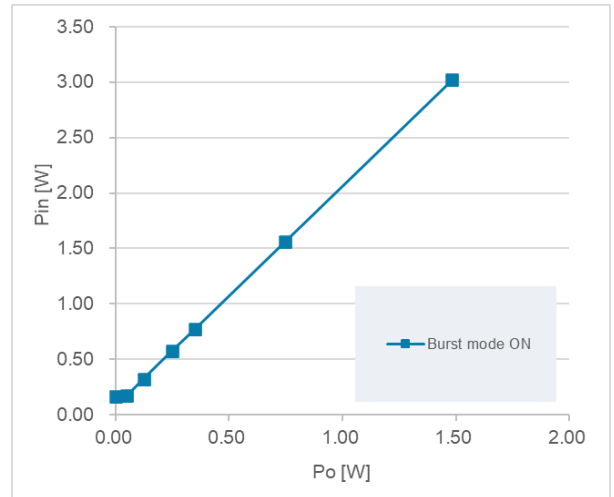
Standby mode Efficiency

Vin=AC230V



Burst mode input-output characteristics

Vin=AC230V

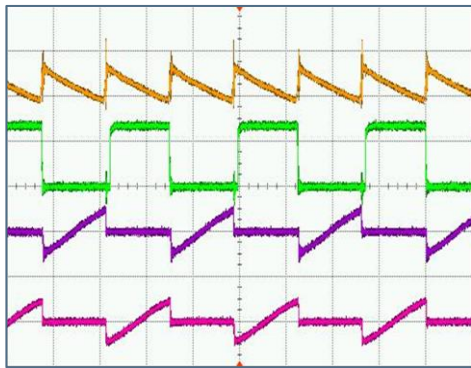


Operation waveform

Photo.1 Normal condition waveform

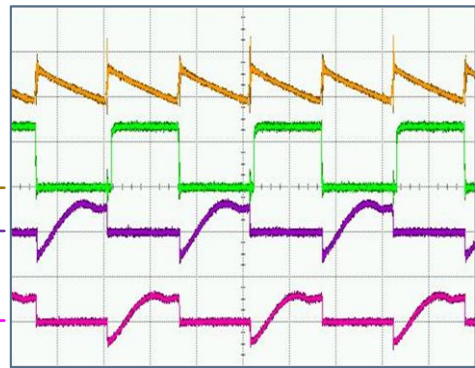
CH1	: F/B terminal voltage	2V/div
CH2	: Low side MOSFET V_{GL}	10V/div
CH3	: High side MOSFET I_{DH}	5A/div
CH4	: Low side MOSFET I_{DL}	5A/div
Time		: 5 μ s/div

AC180V Minimum load



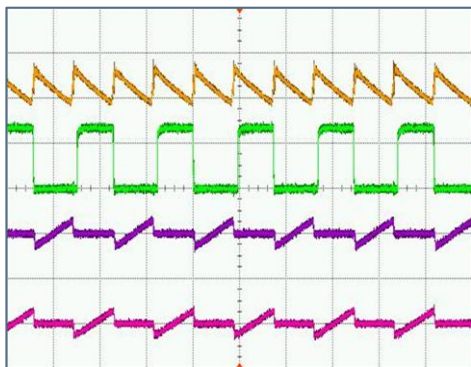
Operating frequency $f=72\text{kHz}$

AC180V Typical load



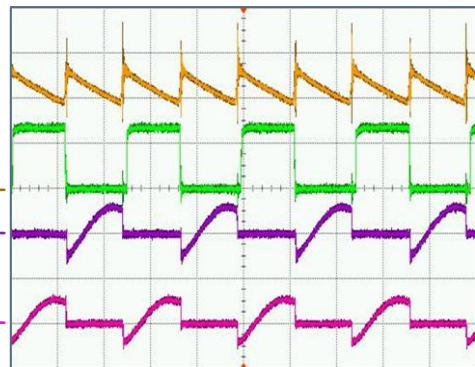
Operating frequency $f=63\text{kHz}$

AC230V Minimum load



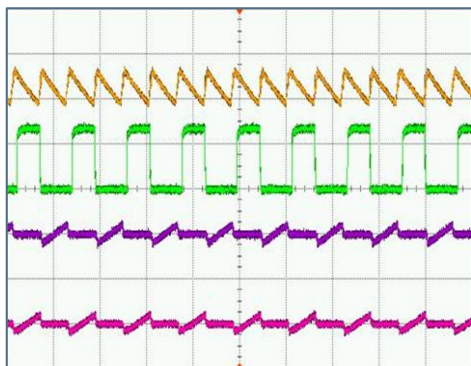
Operating frequency $f=115\text{kHz}$

AC230V Typical load



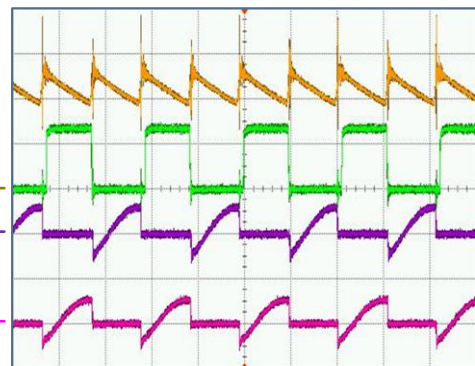
Operating frequency $f=80\text{kHz}$

AC264V Minimum load



Operating frequency $f=169\text{kHz}$

AC264V Typical load



Operating frequency $f=95\text{kHz}$

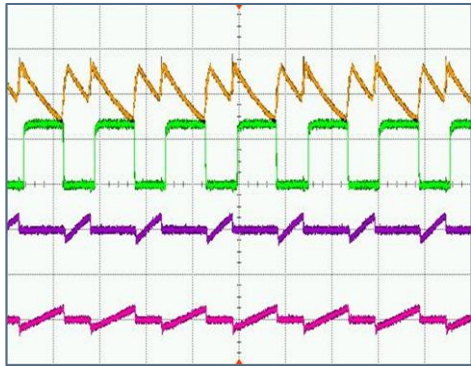
Operation waveform

Photo.2 Active standby mode waveform

Vin=AC230V

CH1	: F/B terminal voltage	2V/div
CH2	: Low side MOSFET V_{GL}	10V/div
CH3	: High side MOSFET I_{DH}	5A/div
CH4	: Low side MOSFET I_{DL}	5A/div
Time	: 5 μ s/div	

24V/0A 12V/0.1A 5V/25mA



24V/0A 12V/2A 5V/25mA

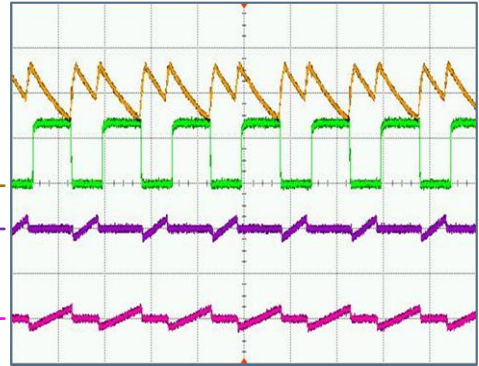
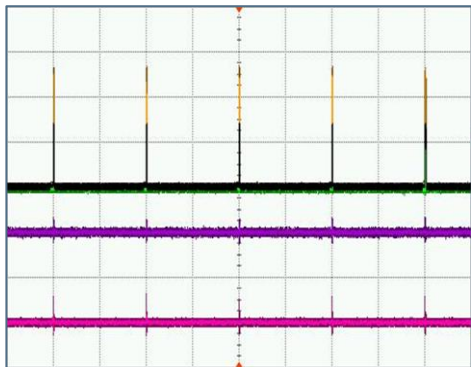


Photo.3 Burst mode waveform

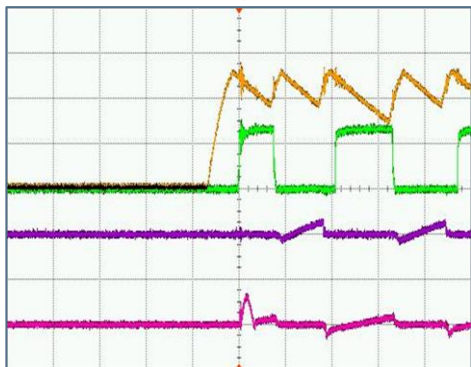
Vin=AC230V

CH1	: F/B terminal voltage	2V/div
CH2	: Low side MOSFET V_{GL}	10V/div
CH3	: High side MOSFET I_{DH}	5A/div
CH4	: Low side MOSFET I_{DL}	5A/div

24V/0A 12V/0A 5V/25mA

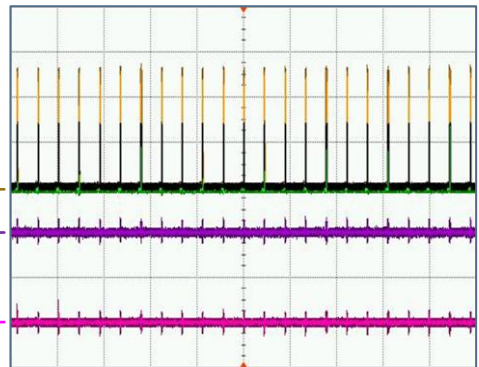


Zoom ↓ 20ms/div

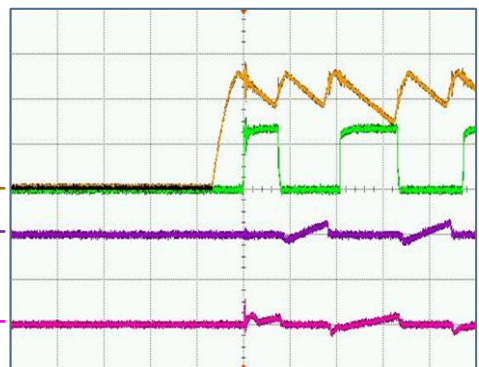


2 μ s/div

24V/0A 12V/0.1A 5V/25mA



Zoom ↓ 20ms/div



2 μ s/div

Component Temperature rise

IC voltage Vc1=18V
 Output current 24V/4A
 12V/4.5A
 5V/25mA

AC180V

	MCZ5216ST	High side MOSFET	Low side MOSFET	transformer Np	transformer Ns	transformer Core	24V Output Diode	12V Output Diode
Temperature T [°C]	43.6	59.4	60.7	76.2	70.4	76.5	60.2	60.3
Temperature rise ΔT [deg.]	11.4	27.2	28.5	44.0	38.2	44.3	28.0	28.1

AC230V

	MCZ5216ST	High side MOSFET	Low side MOSFET	transformer Np	transformer Ns	transformer Core	24V Output Diode	12V Output Diode
Temperature T [°C]	46.4	52.6	52.3	71.9	67.2	74.8	61.6	61.4
Temperature rise ΔT [deg.]	14.2	20.4	20.1	39.7	35.0	42.6	29.4	29.2

AC264V

	MCZ5216ST	High side MOSFET	Low side MOSFET	transformer Np	transformer Ns	transformer Core	24V Output Diode	12V Output Diode
Temperature T [°C]	48.3	49.8	50.7	72.9	70.7	74.4	62.8	62.3
Temperature rise ΔT [deg.]	16.1	17.6	18.5	40.7	38.5	42.2	30.6	30.1