

## LLC Current Resonant Mode Controller ICs **MCZ5211ST**

**Input voltage : DC 360 ~ 420V**

Normal mode

Output	Voltage [V]	Output Current [A]		
		min	typ	max
1	+12	0.0	4.5	5.0
2	+24	0.0	4.0	6.0
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	+12	0.0	1.6	-
2	+24	0.0	0.0	-
3	+5	0.025	0.025	-
Total Power [W]		0.125	19.3	-

Standby mode

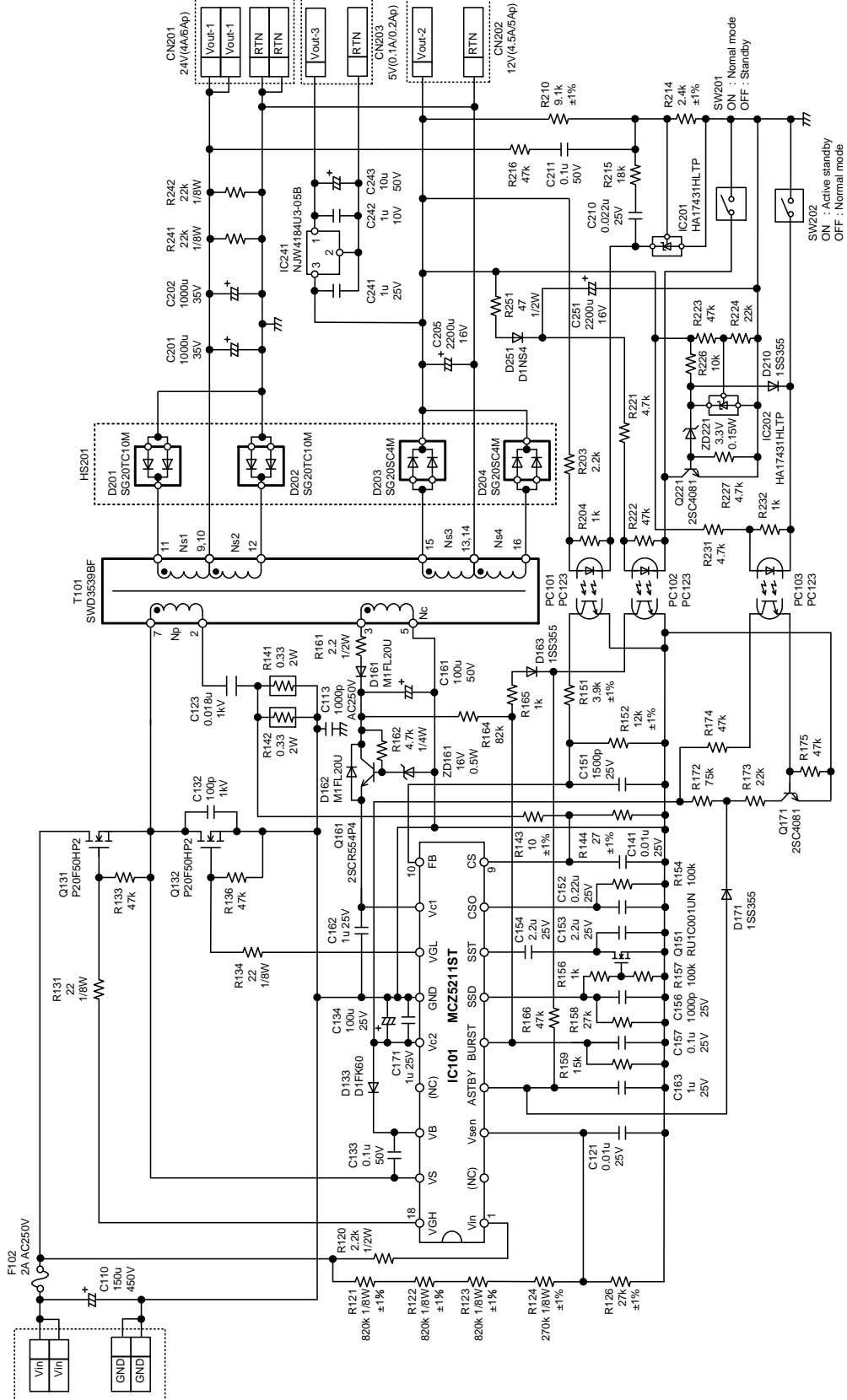
Output	Voltage [V]	Output Current [A]		
		min	typ	max
1	+12	0.0	0.0	-
2	+24	0.0	0.0	-
3	+5	0.0	0.025	-
Total Power [W]		0.0	0.125	-

J563-1-en(2023.09)

## Notes on the use of this document

- 1. The technical information contained in this document describes the specifications, external dimensional drawings, typical operation, selection of components and handling precautions for the reference circuit of our products.**
- 2. The reference power supplies in this document are for understanding the performance of our products, and do not guarantee output, temperature, and any other characteristics, nor do they guarantee characteristics or safety specified by public authorities.**
- 3. Our products described in this document are semiconductor components for general electronic equipment and general industrial use. Please ensure the safety and reliability of your equipment are in accordance with the criticality of the applications. For further information, please contact our sales department.**
- 4. In applications where extremely high reliability and safety are required (e.g. for nuclear power control, aerospace equipment, traffic equipment, life support-related medical equipment, combustion control equipment and various safety devices), safety design with fail-safe in mind (such as using particularly reliable components) in order to ensure safety is required. For further information, please contact our sales department.**
- 5. Shindengen shall not bear any responsibility with regards to damages or infringement of any third-party patents and other intellectual property rights incurred due to the use of information in this document.**
- 6. Use of information in this document does not provide guarantee for, or grant license for, intellectual property rights and other rights of Shindengen or any third party.**
- 7. If a system employing any of our products described in this document falls under strategic goods under Japan's Foreign Exchange and Foreign Trade Control Law, an export licence from the Japanese Government under the above-mentioned law is required to export such products.**
- 8. The specifications and dimensions of our products listed in this document are subject to change without notice in order to improve their characteristics. When ordering, please contact our sales office as needed and refer to the latest specifications for individual products.**
- 9. No reprinting or reproduction of the materials on this website, either in whole or in part, is permitted without proper authorization from Shindengen.**

Reference circuit diagram



**Bill Of Material**

No.	Type	Qt'y	Spec		Model Name	Vendor	Remarks
F102	Fuse	1	AC250V	2A			-
T101	LLC Transformer	1		430uH	SWD3539BF	TAMURA	-
IC101	Control IC	1			MCZ5211ST	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	20A	P20F50HP2	SHINDENGEN	-
Q132	Power MOSFET	1	500V	20A	P20F50HP2	SHINDENGEN	-
Q151	MOSFET	1			RU1C001UN	ROHM	-
Q161	BJT(NPN)	1			2SCR554P4	ROHM	-
Q171	Small Signal BJT(NPN)	1			2SC4081	ROHM	-
Q221	Small Signal BJT(NPN)	1			2SC4081	ROHM	-
D133	FRD	1	600V	0.8A	D1FK60	SHINDENGEN	-
D161	FRD	1	200V	1.1A	M1FL20U	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	20A	SG20SC4M	SHINDENGEN	-
D204	SBD	1	40V	20A	SG20SC4M	SHINDENGEN	-
D210	Small Signal Diode		90V	0.1A	1SS355VM	ROHM	-
D251	SBD	1	40V	1A	D1NS4	SHINDENGEN	-
ZD161	Zenor diode	1	0.5W	16V	TFZ16B	ROHM	-
ZD221	Zenor diode	1	0.2W	3.3V	UDZV3.3B	ROHM	-
C110	Electrolytic Capacitor	1	450V	150uF		Rubycon	-
C113	Y-Capacitor	1	AC250V	1000pF		TDK	-
C121	MLCC	1	25V	0.01uF			-
C123	Film Capacitor	1	1kV	0.018uF	FLS(441)1000HP183	SHINYEI	3%
C132	Disk Ceramic Capacitor	1	1kV	100pF		TDK	-
C133	MLCC	1	50V	0.1uF			-
C134	Electrolytic Capacitor	1	25V	100uF		Rubycon	-
C141	MLCC	1	25V	0.01uF			-
C151	MLCC	1	25V	1500pF			-
C152	MLCC	1	25V	0.22uF			-
C153	MLCC	1	25V	2.2uF			-
C154	MLCC	1	25V	2.2uF			-
C156	MLCC	1	25V	1000pF			-
C157	MLCC	1	25V	0.1uF			-
C161	Electrolytic Capacitor	1	50V	100uF		Rubycon	-
C162	MLCC	1	25V	1uF			-
C163	MLCC	1	25V	1uF			-
C171	MLCC	1	25V	1uF			-

**Bill Of Material**

No.	Type	Qt'y	Spec	Model Name	Vendor	Remarks
C201	Electrolytic Capacitor	1	35V 1000uF		Rubycon	-
C202	Electrolytic Capacitor	1	35V 1000uF		Rubycon	-
C205	Electrolytic Capacitor	1	16V 2200uF		Rubycon	-
C210	MLCC	1	25V 0.022uF			-
C211	MLCC	1	50V 0.1uF			-
C241	MLCC	1	25V 1uF			-
C242	MLCC	1	10V 1uF			-
C243	Electrolytic Capacitor	1	50V 10uF		Rubycon	-
C251	Electrolytic Capacitor	1	16V 2200uF		Rubycon	-
R120	Fuse Resistor	1	1/2W 2.2kΩ		KOA	-
R121	Chip Resistor	1	1/8W 820kΩ		KOA	1%
R122	Chip Resistor	1	1/8W 820kΩ		KOA	1%
R123	Chip Resistor	1	1/8W 820kΩ		KOA	1%
R124	Chip Resistor	1	1/8W 270kΩ		KOA	1%
R126	Chip Resistor	1	1/10W 27kΩ		KOA	1%
R131	Chip Resistor	1	1/8W 22Ω		KOA	-
R133	Chip Resistor	1	1/10W 47kΩ		KOA	-
R134	Chip Resistor	1	1/8W 22Ω		KOA	-
R136	Chip Resistor	1	1/10W 47kΩ		KOA	-
R141	Metal-oxide Film Resistor	1	2W 0.33Ω		KOA	-
R142	Metal-oxide Film Resistor	1	2W 0.33Ω		KOA	-
R143	Chip Resistor	1	1/10W 10Ω		KOA	1%
R144	Chip Resistor	1	1/10W 27Ω		KOA	1%
R151	Chip Resistor	1	1/10W 3.9kΩ		KOA	1%
R152	Chip Resistor	1	1/10W 12kΩ		KOA	1%
R154	Chip Resistor	1	1/10W 100kΩ		KOA	-
R156	Chip Resistor	1	1/10W 1kΩ		KOA	-
R157	Chip Resistor	1	1/10W 100kΩ		KOA	-
R158	Chip Resistor	1	1/10W 27kΩ		KOA	-
R159	Chip Resistor	1	1/10W 15kΩ		KOA	-
R161	Chip Resistor	1	1/2W 2.2Ω		KOA	-
R162	Chip Resistor	1	1/4W 4.7kΩ		KOA	-
R164	Chip Resistor	1	1/10W 82kΩ		KOA	-
R165	Chip Resistor	1	1/10W 1kΩ		KOA	-
R166	Chip Resistor	1	1/10W 47kΩ		KOA	-
R172	Chip Resistor	1	1/10W 75kΩ		KOA	-
R173	Chip Resistor	1	1/10W 22kΩ		KOA	-
R174	Chip Resistor	1	1/10W 47kΩ		KOA	-
R175	Chip Resistor	1	1/10W 47kΩ		KOA	-

### Bill Of Material

No.	Type	Qt'y	Spec	Model Name	Vendor	Remarks
R203	Chip Resistor	1	1/10W 2.2kΩ		KOA	-
R204	Chip Resistor	1	1/10W 1kΩ		KOA	-
R210	Chip Resistor	1	1/10W 9.1kΩ		KOA	1%
R214	Chip Resistor	1	1/10W 2.4kΩ		KOA	1%
R215	Chip Resistor	1	1/10W 18kΩ		KOA	-
R216	Chip Resistor	1	1/10W 47kΩ		KOA	-
R221	Resistor	1	1/4W 4.7kΩ		KOA	-
R222	Chip Resistor	1	1/10W 47kΩ		KOA	-
R223	Chip Resistor	1	1/10W 47kΩ		KOA	-
R224	Chip Resistor	1	1/10W 22kΩ		KOA	-
R226	Chip Resistor	1	1/10W 10kΩ		KOA	-
R227	Chip Resistor	1	1/10W 4.7kΩ		KOA	-
R231	Chip Resistor	1	1/10W 4.7kΩ		KOA	-
R232	Chip Resistor	1	1/10W 1kΩ		KOA	-
R241	Chip Resistor	1	1/8W 22kΩ		KOA	-
R242	Chip Resistor	1	1/8W 22kΩ		KOA	-
R251	Carbon Resistor	1	1/2W 47Ω			-
HS201	Heat Sink	1		15PTE23.5-L90	MARUSAN	-
SW201	Switch	1				-
SW202	Switch	1				-

### LLC Transformer

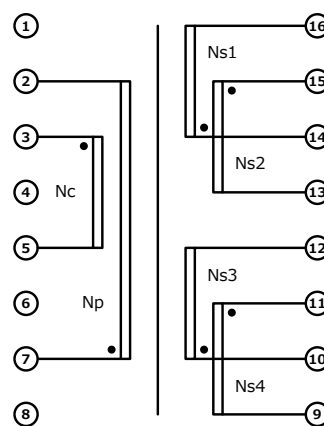
Vin= DC390V±30V      fmin= 81kHz  
Po= 150W(typ) 204W(max)

Inductance (Np)	2-7pin	430μH	10kHz
Leakage Inductance (Np)	2-7pin	108μH	10kHz

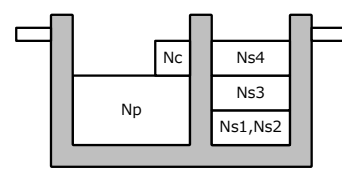
Core  
SWD3539BF      Material : -      Manufacturer : TAMURA

Bobbin  
SWD3539BF      Pin Number : 16      Manufacturer : TAMURA

< Pin assignment >



< Structure drawing >



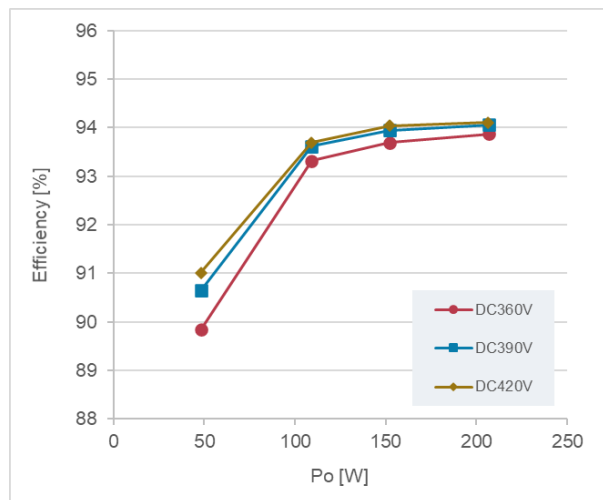
< Winding Specifications >

Winding Order	Current Name	Pin Number		Turn [T]	diameter [mm dia]	Material	Output		Notes
		Start	End				Voltage	Current	
1	Np	7	2	38	0.06×130p	Litz/1UEW	-	-	Aligned Winding
2	Ns1	14	16	2	0.08×120p	Litz/1UEW	12V	4.50 A	Bifilar Aligned Winding
3	Ns2	15	13	2	0.08×120p	Litz/1UEW			
4	Ns3	10	12	4	0.08×120p	Litz/1UEW	24V	4.00 A	Aligned Winding
5	Ns4	11	9	4	0.08×120p	Litz/1UEW			
6	Nc	3	5	4	0.23	1UEW	24V	-	Aligned Winding

## Efficiency

### Medium - Heavy load Efficiency

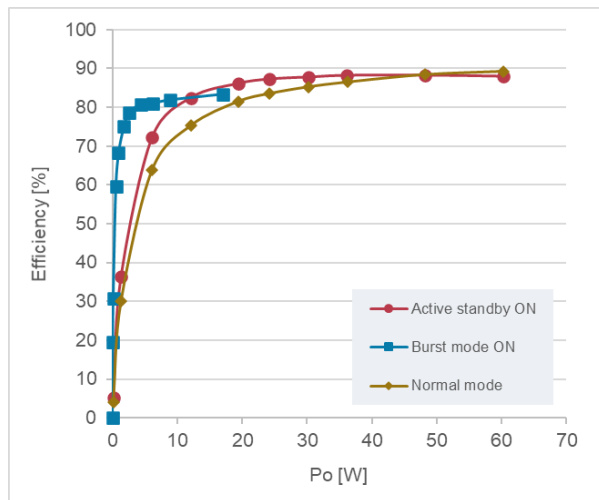
Vc1=16V



### Standby mode Efficiency

Vin=DC390V

Vc1=16V



## Component Temperature rise

IC voltage Vc1=16V  
Output current 12V/4.5A  
24V/4A  
5V/25mA

### DC360V

	MCZ5211ST	High side MOSFET	Low side MOSFET	transformer Np	transformer Ns	transformer Core	24V Output Diode	12V Output Diode
Temperature T [°C]	48.8	49.0	49.3	65.0	61.1	64.5	60.9	60.1
Temperature rise ΔT [deg.]	17.7	17.9	18.2	33.9	30.0	33.4	29.8	29.0

### DC390V

	MCZ5211ST	High side MOSFET	Low side MOSFET	transformer Np	transformer Ns	transformer Core	24V Output Diode	12V Output Diode
Temperature T [°C]	50.9	48.6	48.8	65.7	61.5	64.9	60.4	60.3
Temperature rise ΔT [deg.]	19.8	17.5	17.7	34.6	30.4	33.8	29.3	29.2

### DC420V

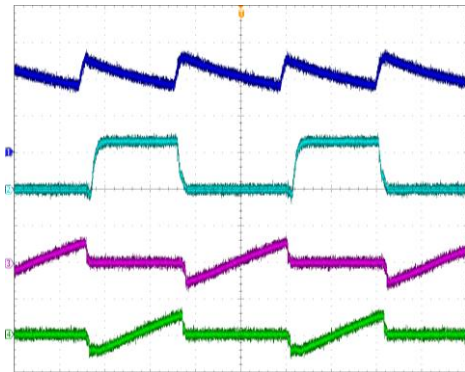
	MCZ5211ST	High side MOSFET	Low side MOSFET	transformer Np	transformer Ns	transformer Core	24V Output Diode	12V Output Diode
Temperature T [°C]	51.1	48.0	48.0	64.4	60.0	63.2	60.9	59.7
Temperature rise ΔT [deg.]	20.0	16.9	16.9	33.3	28.9	32.1	29.8	28.6

**Operation waveform**

**Photo.1 Normal condition waveform**

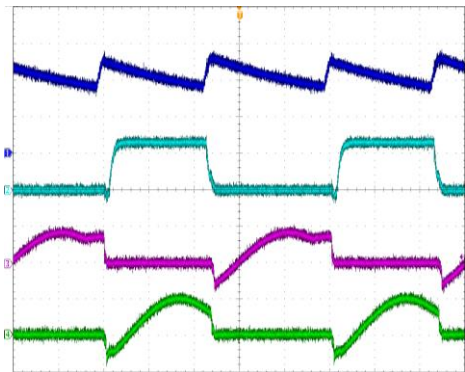
CH1	: F/B terminal voltage	2V/div
CH2	: Low side MOSFET $V_{GL}$	10V/div
CH3	: High side MOSFET $I_{DH}$	2A/div
CH4	: Low side MOSFET $I_{DL}$	2A/div
Time		: 2 $\mu$ s/div

**DC360V Minimum load**



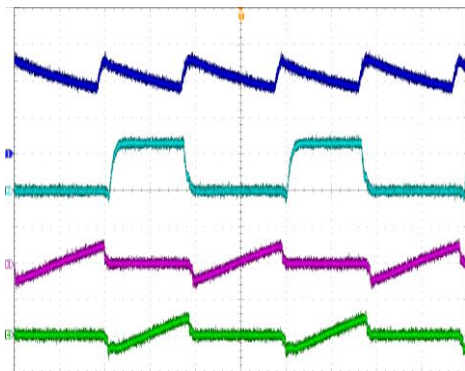
Operating frequency  $f=112\text{kHz}$

**DC360V Typical load**



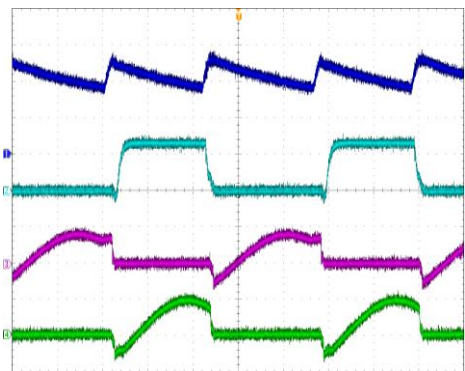
Operating frequency  $f=99.4\text{kHz}$

**DC390V Minimum load**



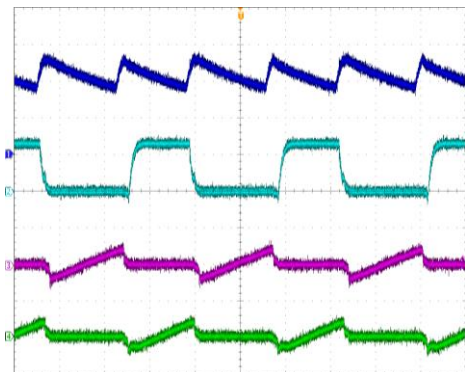
Operating frequency  $f=128\text{kHz}$

**DC390V Typical load**



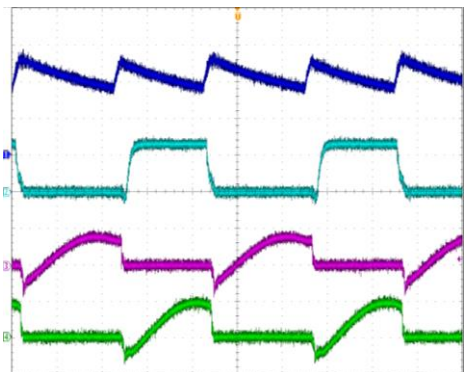
Operating frequency  $f=108\text{kHz}$

**DC420V Minimum load**



Operating frequency  $f=152\text{kHz}$

**DC420V Typical load**



Operating frequency  $f=119\text{kHz}$



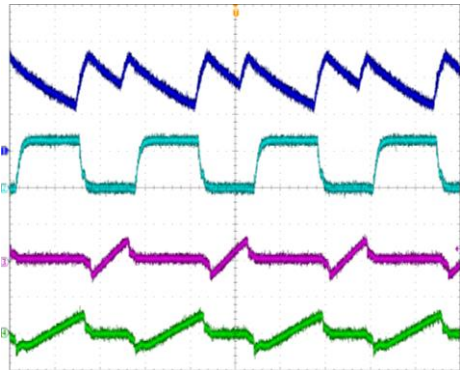
**Operation waveform**

**Photo.2 Active standby mode waveform**

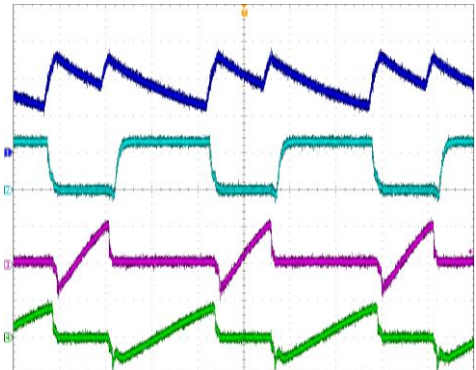
Vin=DC390V

CH1	: F/B terminal voltage	2V/div
CH2	: Low side MOSFET $V_{GL}$	10V/div
CH3	: High side MOSFET $I_{DH}$	1A/div
CH4	: Low side MOSFET $I_{DL}$	1A/div
Time		: 2 $\mu$ s/div

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



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

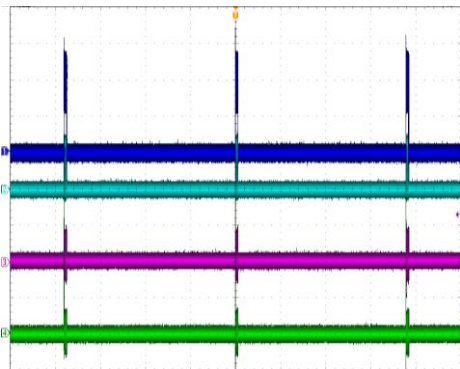


**Photo.3 Burst mode waveform**

Vin=DC390V

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

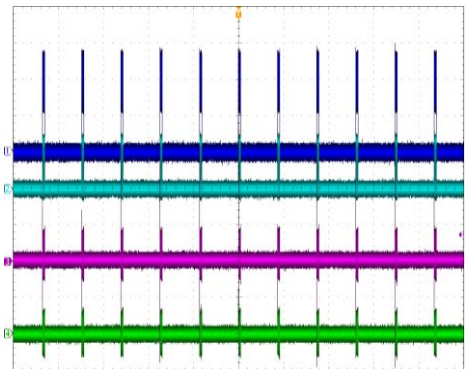
24V/0A 12V/0A 5V/25mA



Zoom ↓

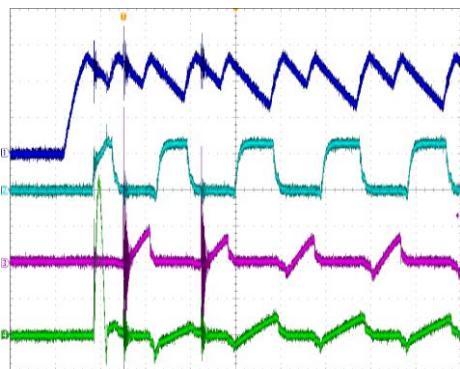
20ms/div

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

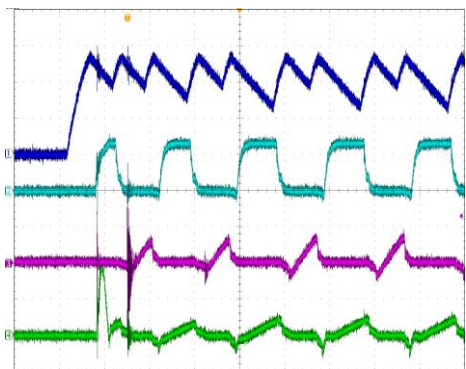


Zoom ↓

20ms/div



2 $\mu$ s/div



2 $\mu$ s/div