

LLC电流共振电源IC **MCZ5211ST**

评估用电源

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	-

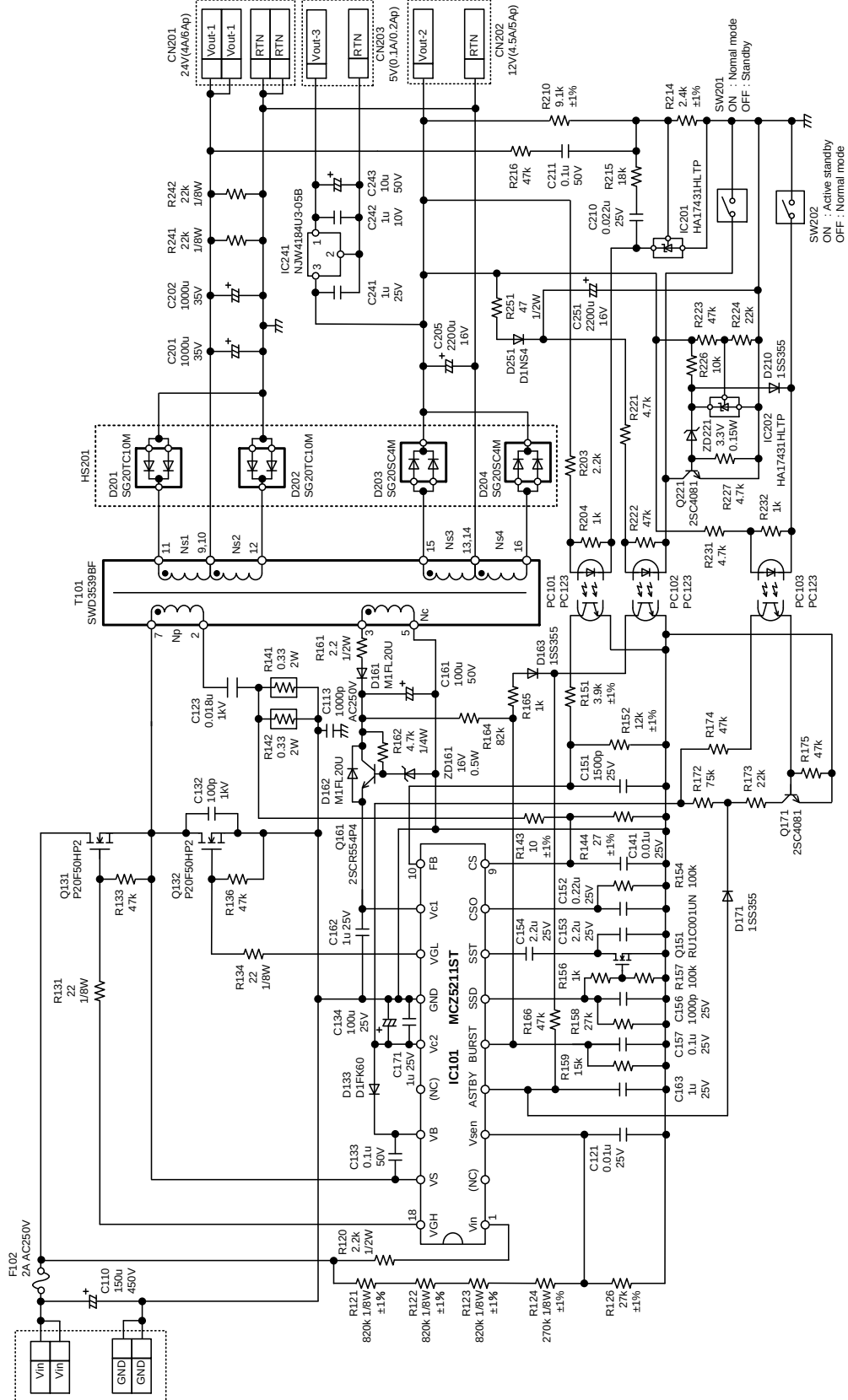
Standby mode

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	-

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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 2.2k Ω		KOA	-
R204	Chip Resistor	1	1/10W 1k Ω		KOA	-
R210	Chip Resistor	1	1/10W 9.1k Ω		KOA	1%
R214	Chip Resistor	1	1/10W 2.4k Ω		KOA	1%
R215	Chip Resistor	1	1/10W 18k Ω		KOA	-
R216	Chip Resistor	1	1/10W 47k Ω		KOA	-
R221	Resistor	1	1/4W 4.7k Ω		KOA	-
R222	Chip Resistor	1	1/10W 47k Ω		KOA	-
R223	Chip Resistor	1	1/10W 47k Ω		KOA	-
R224	Chip Resistor	1	1/10W 22k Ω		KOA	-
R226	Chip Resistor	1	1/10W 10k Ω		KOA	-
R227	Chip Resistor	1	1/10W 4.7k Ω		KOA	-
R231	Chip Resistor	1	1/10W 4.7k Ω		KOA	-
R232	Chip Resistor	1	1/10W 1k Ω		KOA	-
R241	Chip Resistor	1	1/8W 22k Ω		KOA	-
R242	Chip Resistor	1	1/8W 22k Ω		KOA	-
R251	Carbon Resistor	1	1/2W 47 Ω			-
HS201	Heat Sink	1		15PTE23.5-L90	MARUSAN	-
SW201	Switch	1				-
SW202	Switch	1				-

LLC Transformer

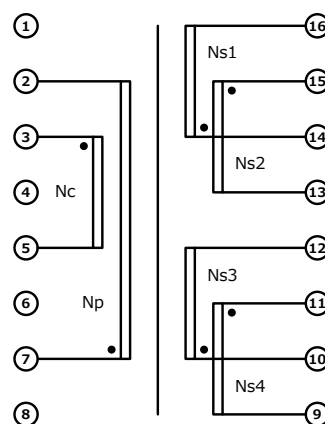
Vin= DC390V $\pm$ 30V fmin= 81kHz
Po= 150W(typ) 204W(max)

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

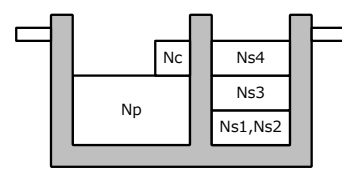
Core
SWD3539BF Material : - Manufacturer : TAMURA

Bobbin
SWD3539BF Pin Number : 16 Manufacturer : TAMURA

< Pin assignment >



< Structure drawing >



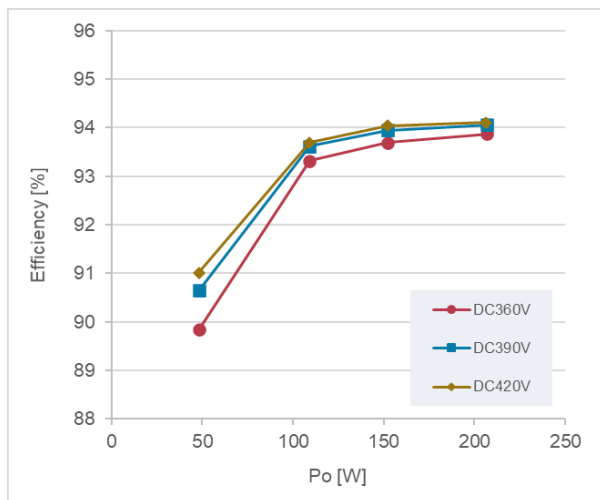
< Winding Specifications >

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 $\times$ 130p	Litz/1UEW	-	-	Aligned Winding
2	Ns1	14	16	2	0.08 $\times$ 120p	Litz/1UEW	12V	4.50 A	Bifilar Aligned Winding
3	Ns2	15	13	2	0.08 $\times$ 120p	Litz/1UEW			
4	Ns3	10	12	4	0.08 $\times$ 120p	Litz/1UEW	24V	4.00 A	Aligned Winding
5	Ns4	11	9	4	0.08 $\times$ 120p	Litz/1UEW			Aligned Winding
6	Nc	3	5	4	0.23	1UEW	24V	-	Aligned Winding

Efficiency

Medium - Heavy load Efficiency

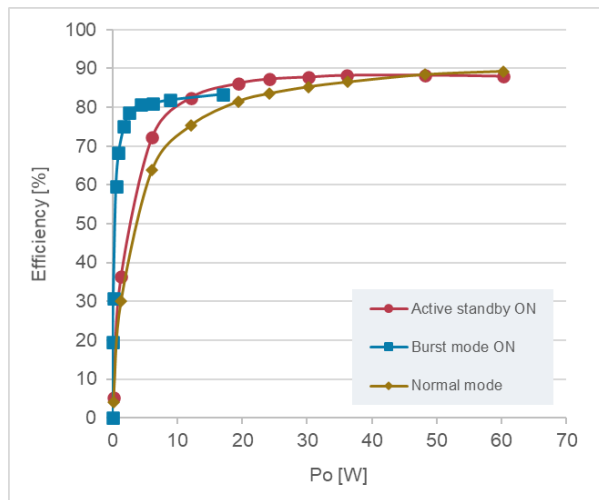
Vc1=16V



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

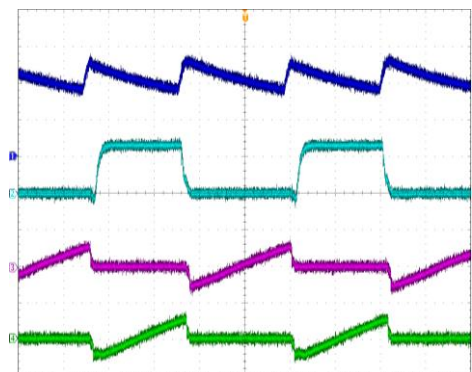
	MCZ5211ST	High side MOSFET	Low side MOSFET	transformer Np	transformer Ns	transformer Core	24V Output Diode	12V Output Diode
Temperature T [°C]	51.1	48.0	48.0	64.4	60.0	63.2	60.9	59.7
Temperature rise ΔT [deg.]	20.0	16.9	16.9	33.3	28.9	32.1	29.8	28.6

Operation waveform

Photo.1 Normal condition waveform

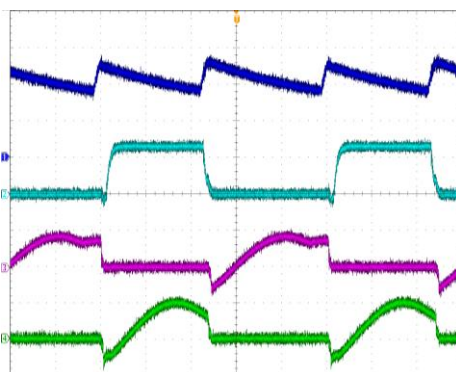
CH1 : F/B terminal voltage 2V/div
CH2 : Low side MOSFET V_{GL} 10V/div
CH3 : High side MOSFET I_{DH} 2A/div
CH4 : Low side MOSFET I_{DL} 2A/div
Time : 2 μ s/div

DC360V Minimum load



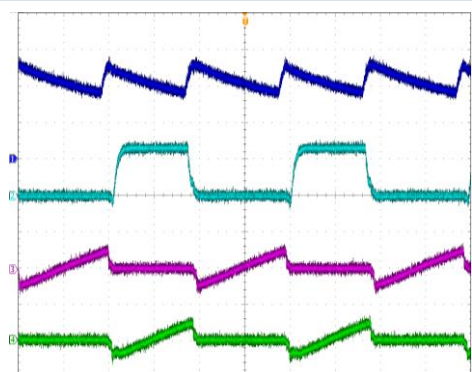
Operating frequency $f=112\text{kHz}$

DC360V Typical load



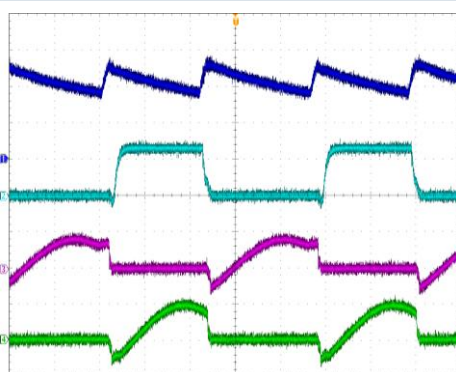
Operating frequency $f=99.4\text{kHz}$

DC390V Minimum load



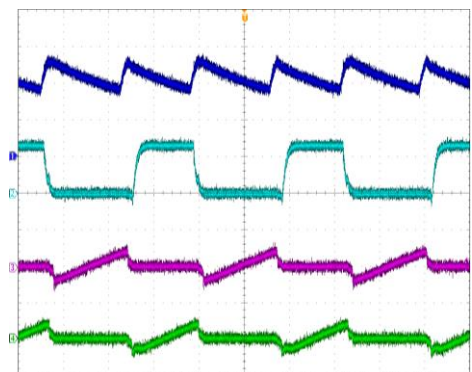
Operating frequency $f=128\text{kHz}$

DC390V Typical load



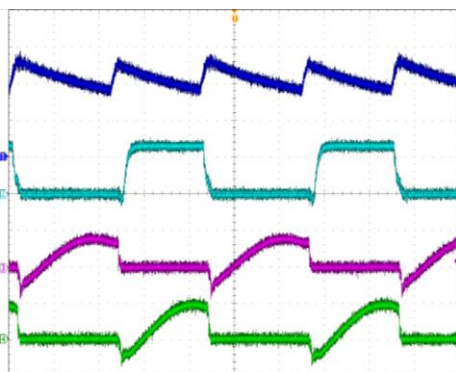
Operating frequency $f=108\text{kHz}$

DC420V Minimum load



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

DC420V Typical load



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

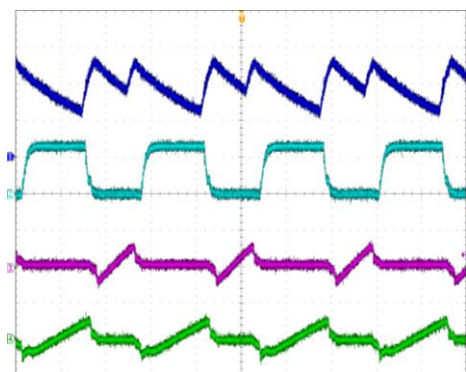
Operation waveform

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 μ s/div

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



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

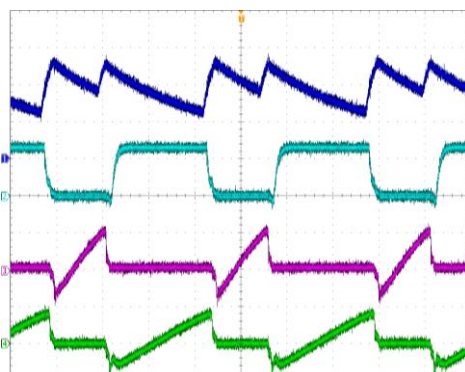
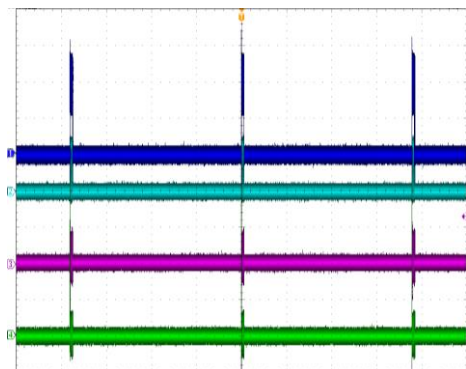


Photo.3 Burst mode waveform

Vin=DC390V

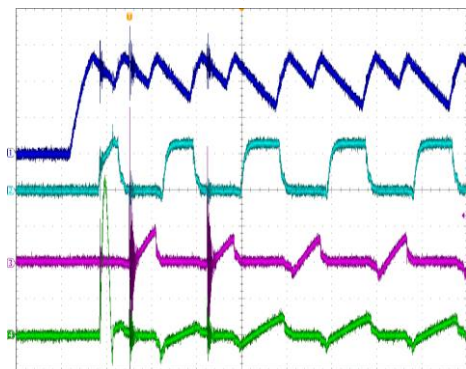
CH1 : F/B terminal voltage 2V/div
CH2 : Low side MOSFET V_{GL} 10V/div
CH3 : High side MOSFET I_{DH} 1A/div
CH4 : Low side MOSFET I_{DL} 1A/div

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



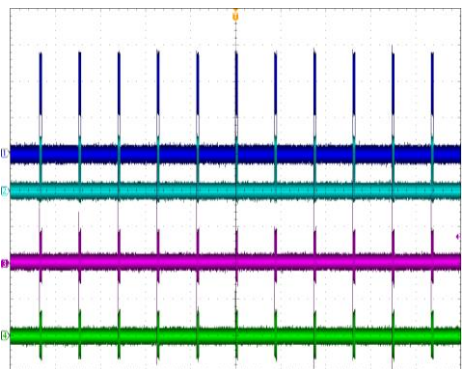
Zoom ↓

20ms/div



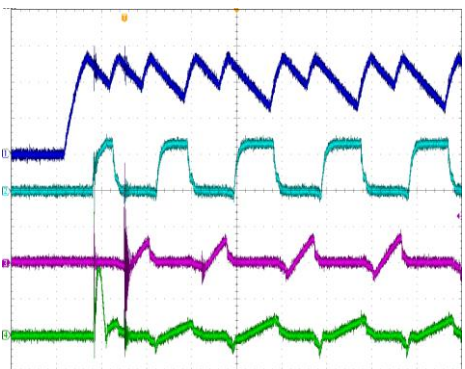
2 μ s/div

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



Zoom ↓

20ms/div



2 μ s/div