CA-IS3211x-based 100W Half-Bridge DC/DC Buck Converter

1   CA-IS3211x Introduction

The CA-IS3211 devices are a family of single-channel, opto-compatible isolated gate driver capable of sinking 5A and sourcing 6A currents. These devices operate with dual supplies or a single supply of up to 30V wide voltage range of V_{CC} - V_{EE}, making them ideal to drive power MOSFET, IGBT or SiC transistors in various inverter, motor control or isolated power supply systems. The CA-IS3211 can be configured as low-side or high-side drivers. All devices have integrated digital galvanic isolation using Chipanalog's proprietary capacitive isolation technology and feature isolation for a withstand voltage rating of 5.7kV$_{RMS}$ for 60 seconds with minimum common-mode transient immunity (CMTI) of 150kV/μs. These devices can be used as replacement for the industry standard optocoupler-based gate drivers while providing high CMTI, low propagation delay(70ns, typ.), small pulse width distortion(35ns, max.) and small part-to-part skew.

This application note provides a reference design based on CA-IS3211x gate-driver: 100W half-bride DC/DC Buck converter. Two pcs of CA-3211x are used to drive the main switching IGBT and synchronous rectification IGBT respectively. The external micro-controller programs high-side and low-side dead-time to prevent shoot-through current caused by high-side and low-side power transistors overlap.

2   CA-IS3211x Reference Design Board

Figure 1. CA-IS3211x reference design board

3   Basic Configuration

Basic Configuration	
HVDC Input	400V/0.3A
VCC Input	15V/0.3A
Output	48V/2A
Switching frequency	20kHz
PWM Duty cycle	12%

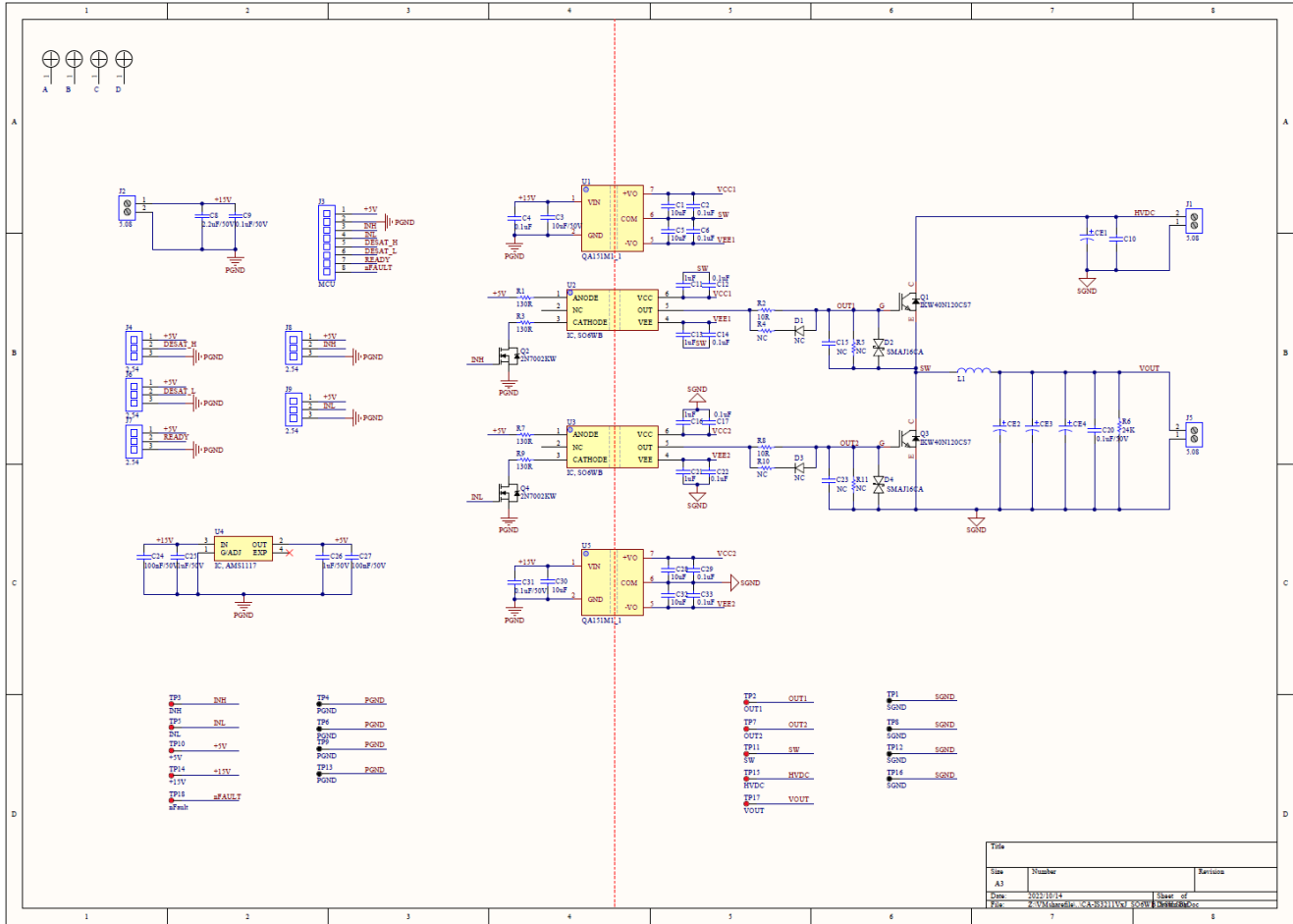## 4 CA-IS3211x Reference Design Schematic

Figure 2. CA-IS3211x reference design schematic
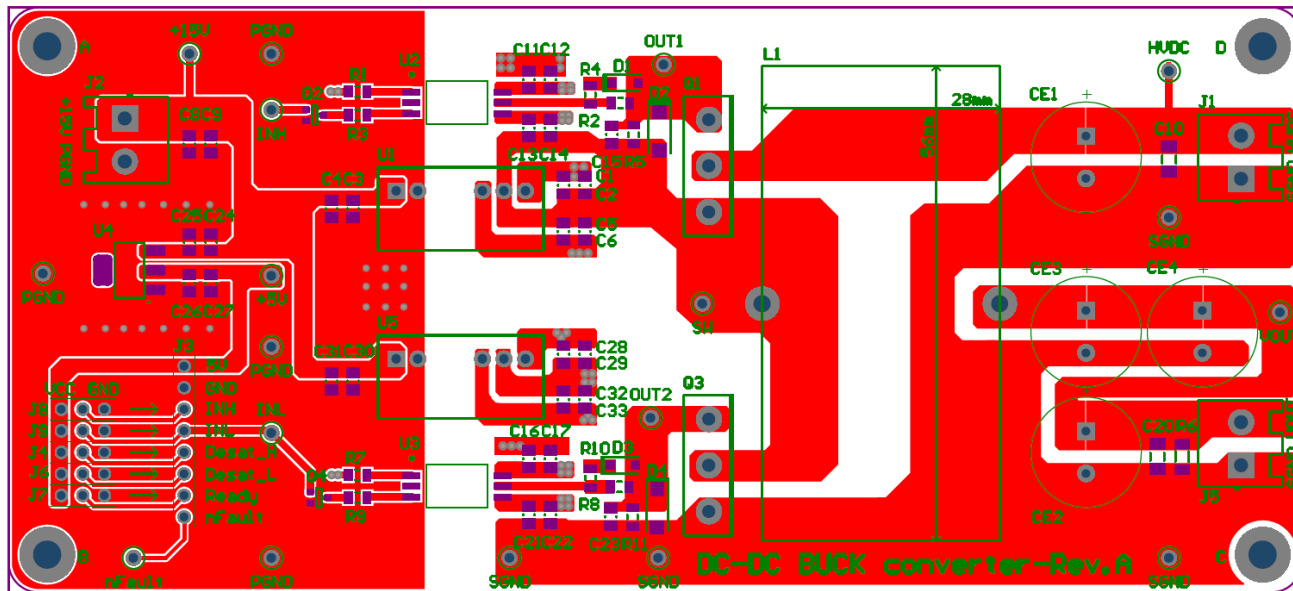
5   CA-IS3211x Reference Design PCB Layout

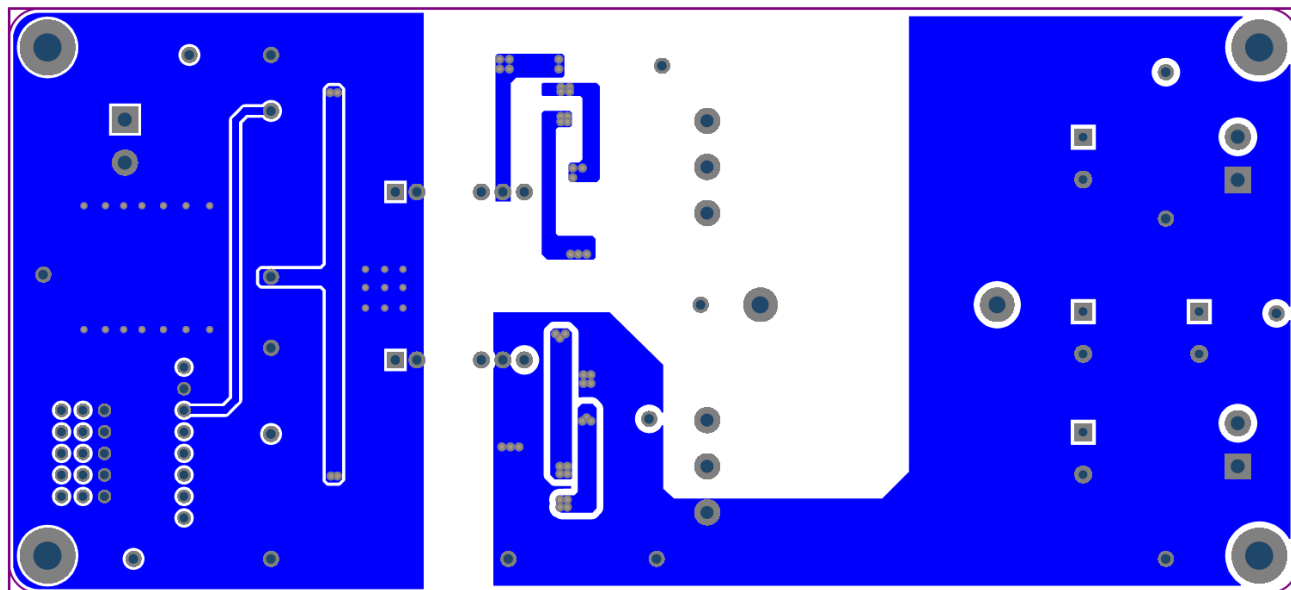Figure 3. CA-IS3211x reference design PCB layout _ top layer

Figure 4. CA-IS3211x reference design PCB layout _ bottom layer

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6 Reference Design Bill of Materials

Designator	Comment	Description	Footprint	Quantity
A, B, C, D	\	M3 MACHINE SCREW	M3	4
C1, C5, C28, C30, C32	10uF	10uF/50V, MLCC	C0805_L	5
C2, C4, C6, C12, C14, C17, C22, C29, C33	0.1uF	0.1uF/50V, MLCC	C0805_L	9
C3	10uF	10uF/50V, MLCC	C0805_L	1
C8	2.2uF	2.2uF/50V, MLCC	C0805_L	1
C9, C31	0.1uF	0.1uF/50V, MLCC	C0805_L	2
C10	10nF	10nF/500V, MLCC	C1206_L	1
C11, C13, C16, C21	1uF	1uF/50V, MLCC	C0805_L	4
C15, C23	NC	Capacitor	C0805_L	2
C20	0.1uF	0.1uF/50V, MLCC	C1206_L	1
C24, C27	100nF	100nF/50V, MLCC	C0805_L	2
C25, C26	1uF	1uF/50V, MLCC	C0805_L	2
CE1	10uF	Electronic capacitor, 10uF/500V	WCAP-ATG5_13x20x5	1
CE2, CE3, CE4	47uF	Electronic capacitor, 47uF/100V	WCAP-ATG5_13x20x5	3
D1, D3	NC	Diode, General	DIODE,SOD-123FL	2
D2, D4	NC	Diode, TVS, SMAJ16CA	DIODE,SMA,	2
J1, J2, J5	\	Connector, Screw Terminal, 5.08, 2P	con,tbk,508-2p,molex-0395443002	3
J3, J10	MCU	Header, Unshrouded , 2.54, Male, 8P	con,hdr,254-8p	2
J4, J6, J7, J8, J9	\	Header, Unshrouded , 2.54, Male, 3P	con,hdr,254-3p	5
L1	L1=2mH	Inductor, 2mH/10A	L, Vertical_27x56mm	1
Q1, Q3	IKW40N120CS7	IGBT, IKW40N120CS7, 80A/1200V	IGBT,THT,TO-247	2
Q2, Q4	2N7002KW	NMOSFET, 2N7002KW, 300mA/60V	MFET,SMD,SOT23-3	2
R1, R3, R7, R9	130R	130R/0805, Resistor	R0805_L	4
R2, R8	10R	10R/0805, Resistor	R0805_L	2
R4, R5, R10, R11	NC	Resistor	R0805_L	4
R6	24K	24k/1206, Resistor	R1206_L	1
R12, R13, R14	10k	10k/0805, Resistor	R0805_L	3
TP1, TP4, TP6, TP8, TP9, TP12, TP13, TP16	\	TEST POINT PC MINI .040"D BLK	tpt,keystone-5001	8
TP2, TP3, TP5, TP7, TP10, TP11, TP14, TP15, TP17, TP18	\	TEST POINT PC MINI .040"D RED	tpt,keystone-5000	10
U1, U5	QA151M1_1	Double rail power resource +15V/-5V	QA151M1	2
U2, U3	IC, CA-IS3211x	IC, CA-IS3211VxJ, SOIC6-WB	SOIC6-WB	2
U4	IC, AMS1117-5	IC, 5V LDO	SOT223	1

7 Test Result

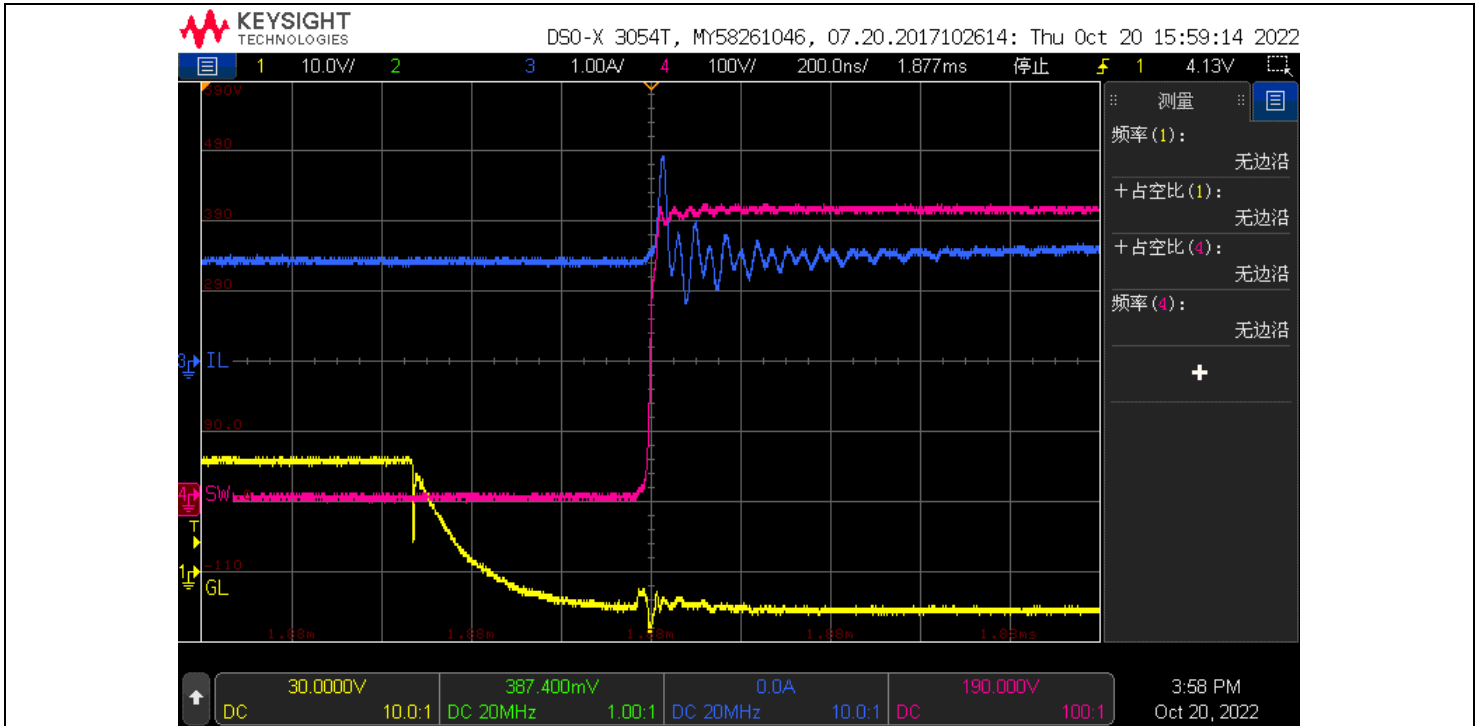1) Gate-driving waveforms

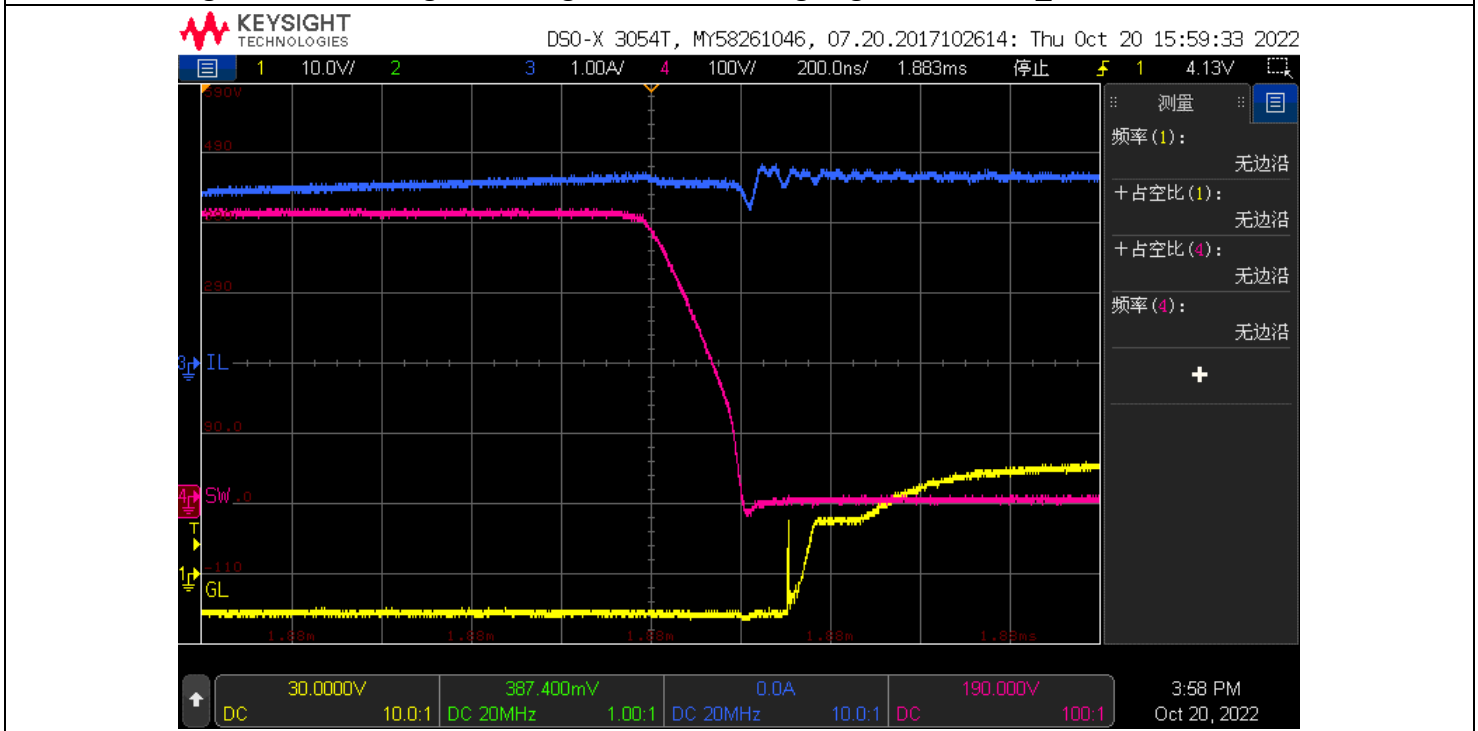Figure 5. Low-side gate driving waveform, falling edge; CH1: GATE_L, CH3: IL, CH4: SW
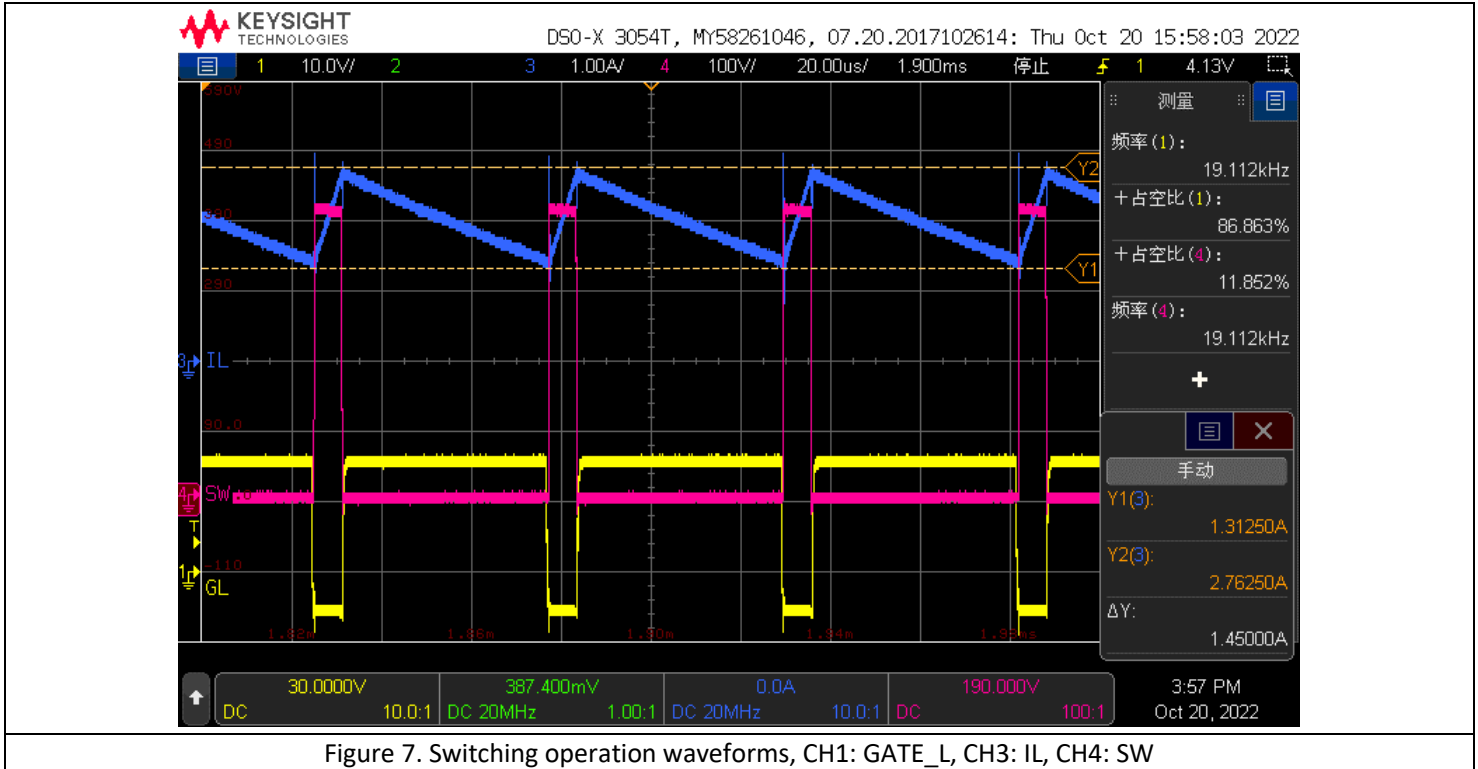

Figure 6. Low-side gate driving waveform, rising edge; CH1: GATE_L, CH3: IL, CH4: SW

Figure 7. Switching operation waveforms, CH1: GATE_L, CH3: IL, CH4: SW

2) Operating efficiency

Input voltage (V)	Input current (A)	Output voltage (V)	Output current (A)	Efficiency (%)
400	0.25	46	2.04	93.84

8   Revision History

Revision	Notes	Page	Editor	Date
Rev 1.0	Initial publish	All	Robin	2023.1.11
Rev 1.1	Update the file format	All	Robin	2024.7.18

9   Important statement

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