OwnTech
Open Digital Power

OwnTech TWIST Board
Non-Isolated Dual Channel Reprogrammable Converter

The TWIST Board is a reprogrammable, bi-directional 300W power converter. It features a dual 12V to 72V low side and a single 10V to 110V high side. Its maximum current value is 8A per power channel.
The power channels can be used independently, yielding two output voltages or combined to double the current capacity.

The **TWIST Board** is fully open-source, compatible with either the SPIN board or any other programming system. It can communicate via CAN-bus or RS-485.

SPECIAL FEATURES

- **2 phase design**
- **DUAL or SINGLE power channel configuration**
- **Up to 97% Efficiency**
- **Standard size: 100mmx160mmx35mm**
- **Wide voltage operating range**
- **DC or AC operation**
- **Can be connected in parallel for higher power**
- **CAN bus communication compatible**
- **RS485 communication bus compatible**
- **Fully open-source**
- **Voltage and current mode libraries available**
- **Gitlab source here**

AT A GLANCE

Rated Power

300W per module

Number of channels

Dual low side
Single high side

Current ratings

8A per channel
16A in parallel

Voltage ratings

12V to 72V low side
12V to 100V high side

CONVERTER PINOUT

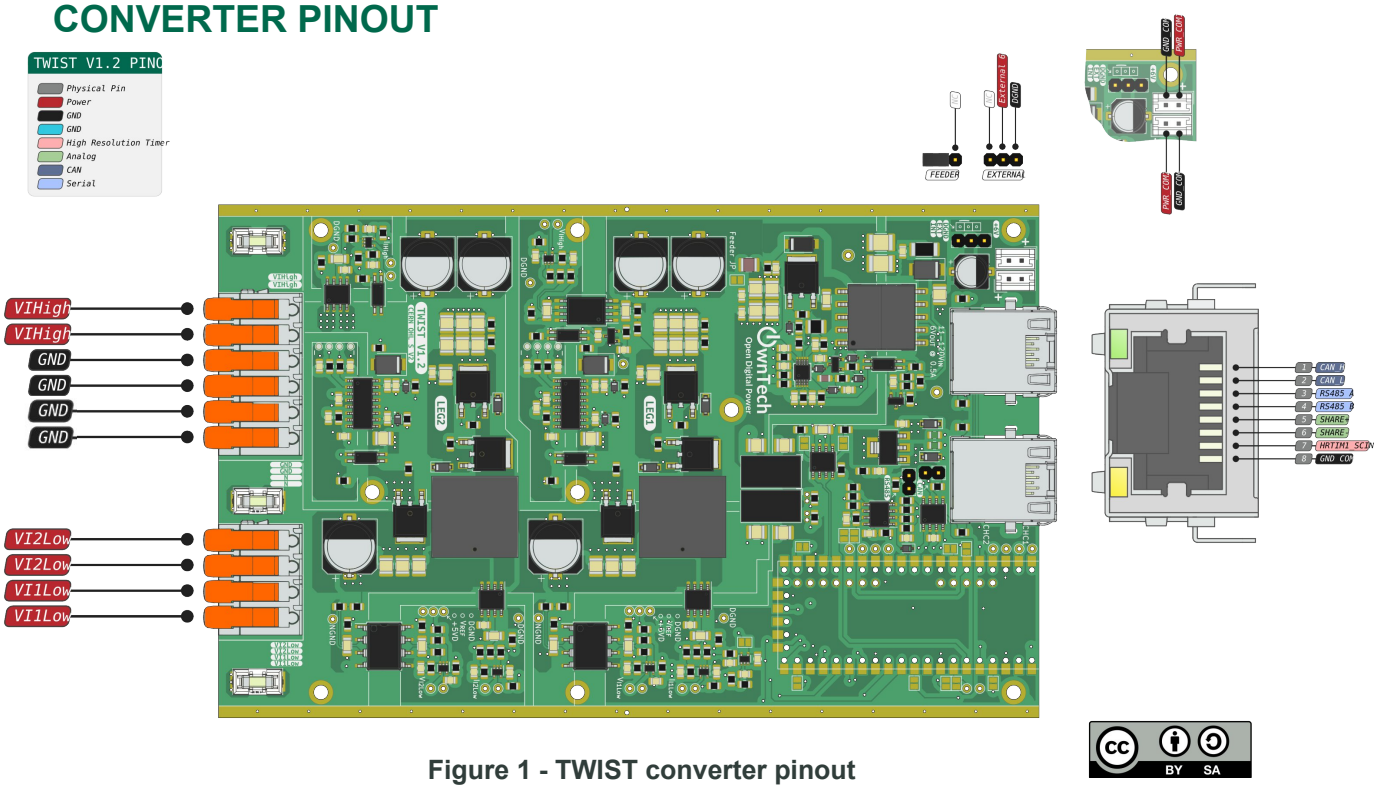


Figure 1 - TWIST converter pinout

TWIST NON-ISOLATED DUAL CHANNEL CONVERTER

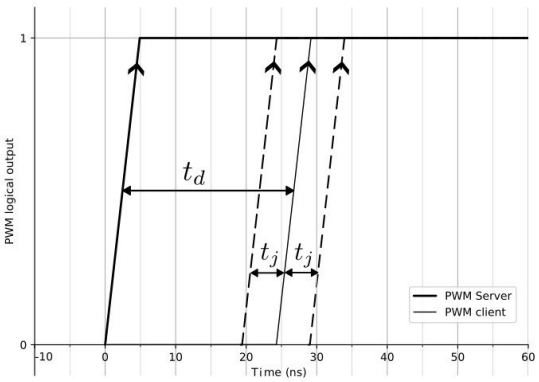
I. General Power Block specifications

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
ABSOLUTE MAXIMUM RATINGS					
Low-Side voltage				90	V_{DC}
High-Side voltage		8		120	V_{DC}
Low-Side peak current per channel				8	A
Power Output				300	W
LOW-SIDE RATINGS					
Number of power channels			2		
Voltage range		12		72	V_{DC}
Max low-side peak current per channel				8	A
Voltage ripple			0.3		V_{DC}
HIGH-SIDE RATINGS					
Number of power channels			1		
Voltage range		12		100	V_{DC}
Voltage ripple			0.3		V_{DC}
SWITCHING CHARACTERISTICS					
Switching frequency			200		kHz
Selectable Deadtime	set resistors : 20kΩ		200		ns
Maximum gate current			4		A
TEMPERATURE AND DIMMENSIONS					
Operating temperature		-20		+60	°C
Cooling principle			Natural convection		
Dimensions			L100 W100 H35		mm
PROTECTION FEATURES					
High side fuse	Tamb = 25°C		8		A
Low side fuse	Tamb = 25°C		8		A

II. Communication specifications

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
CAN-FD					
Baudrate			500	500	kBauds
Half Duplex RS485					
Baudrate			10	20	MBauds
SPI					
Baudrate			0.5	20	MBauds
USART					
Baudrate			115200		Bauds

III. Synchronization



Test with 2 boards connected with a 15cm RJ45 cable, measure taken with a 500Mhz bandwidth oscilloscope.

Figure 2. PWM synchronization between two boards, a server and a client.

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
PWM slewrate			660		mV/ns
Delay between server PWM, and synchronized client PWM	td		24.2		ns
Jitter of PWM client	tj		4.8		ns

IV. Analog communication

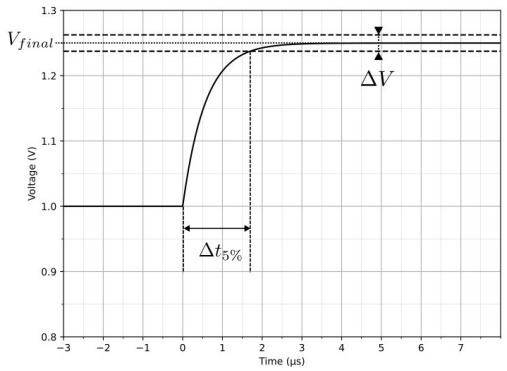


Figure 3. Step response of the analog communication

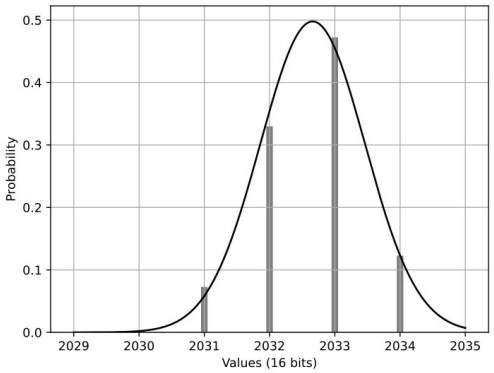
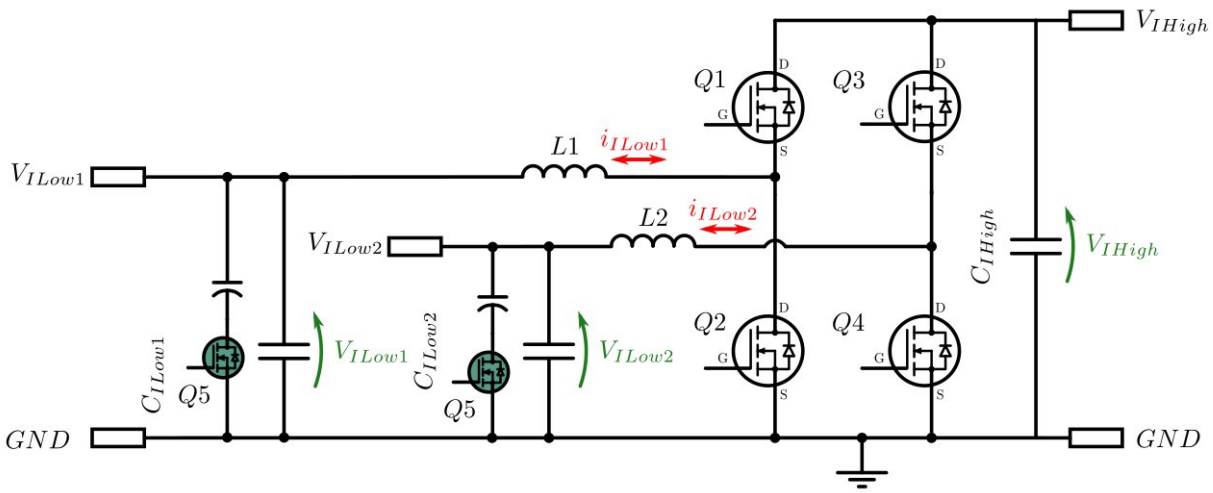


Figure 4. Statistical distribution of the values received by the server board

Test made with 2 boards (a server and a client), connected with a 15cm RJ45 cable. The server board is sending a 16 bit value equal to 2000 via the analog communication.
The step response is measured with a 500Mhz bandwidth oscilloscope.

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Step response from 1V to 1.25V analysis					
Time to reach and stay at ±5% of the steady-state value	Δt5%		1.7		µs
Steady-state value	Vfinal		1.25		V
±5% Steady-state value interval	ΔV = 0.1*Vfinal		0.125		V
Bandwidth	$f_c = \frac{3}{2 * \pi * \Delta t_{5\%}}$		281		kHz
Statistical distribution of 10235 data samples received by the client board when server sends a 16bit value of 2000					
Approximate normal distribution mean	µ		2032.65		
Approximate normal distribution variance	σ²		0.795		

V.1 Indication of where analog measures are made on the board



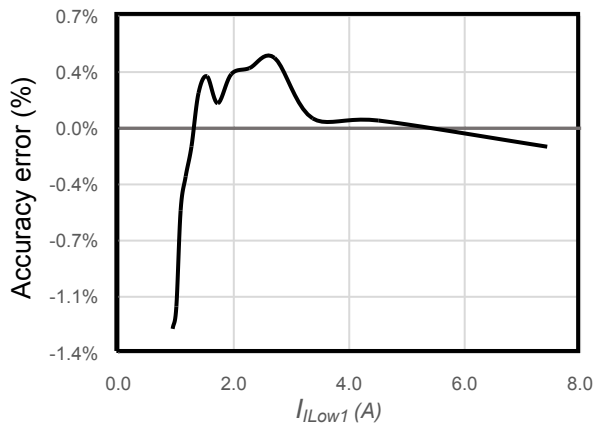
V.2 Measurement chain

OwnTech's TWIST Board implements full observability on all low-side and high-side power channels through isolated measurements.

V_{Low1}			
Sensor technology		Voltage divider and isolation amplifier	
Bandwidth		60	kHz
Signal side amplitude		±250	mV
Full scale range		±80	V
V_{Low2}			
Sensor technology		Voltage divider and isolation amplifier	
Bandwidth		60	kHz
Signal side amplitude		±250	mV
Full scale range		±80	V
V_{High}			
Sensor technology		Voltage divider and isolation amplifier	
Bandwidth		100	kHz
Signal side amplitude		+2	V
Full scale range		120	V
I_{Low1}			
Sensor technology		Isolated Hall effect sensor	
Bandwidth		1000	kHz
Signal side amplitude		±20	A
Full scale range		±10	A
I_{Low2}			
Sensor technology		Isolated Hall effect sensor	
Bandwidth		1000	kHz
Signal side amplitude		±20	A
Full scale range		±10	A
I_{High}			
Sensor technology		Isolated Hall effect sensor	
Bandwidth		1000	kHz
Signal side amplitude		±20	A
Full scale range		±20	A
Heatsink temperature sensor			
Sensor technology		Thermistor	
Full scale range		-40 +110	°C
EMBEDDED ADC			
ADC Technology		Successive approximation (SAR)	
Independant ADC peripherals		2	-
Number of channels per ADC		1 3 6	
Sampling time		530	ns
ADC trigger		Programmable trigger instant on PWM period	
Trigger event typical frequency		200	kHz

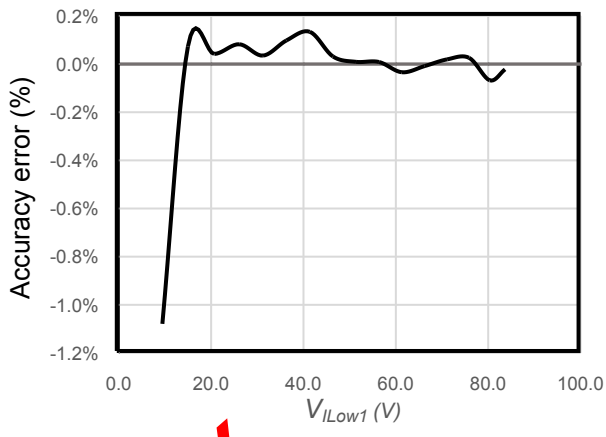
IV.2 Relative accuracy of voltage and current measure

Trigger value = 6%, carrier mode = center aligned unless specified



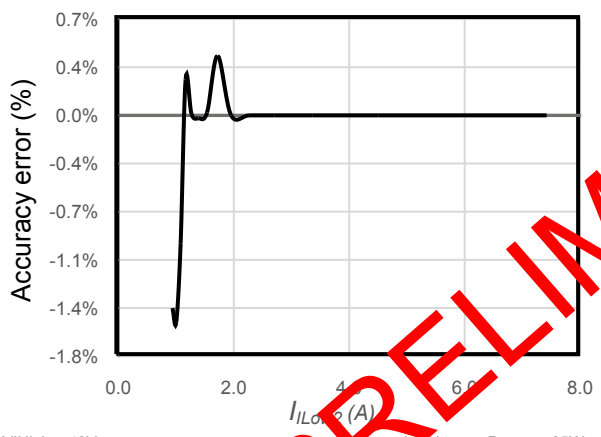
VIHigh = 48V — Load type : Power = 35W

Figure 1. **I_{ILow1} digital measure relative accuracy after calibration**



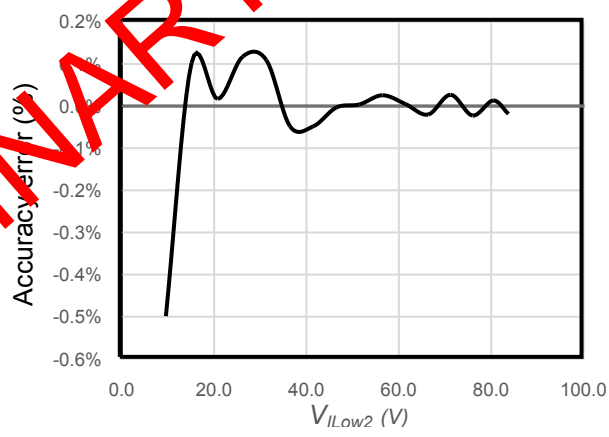
VIHigh = 100V — Load type : Current = 0.5 A

Figure 2. **V_{ILow1} digital measure relative accuracy after calibration**



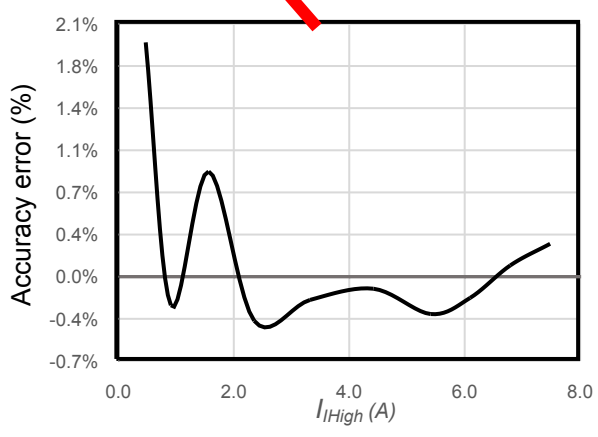
VIHigh = 48V — Load type : Power = 35W

Figure 3. **I_{ILow2} digital measure relative accuracy after calibration**



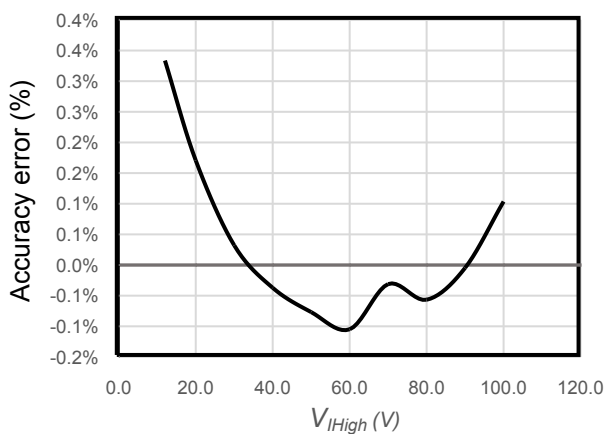
VIHigh = 100V — Load type : Current = 0.5 A

Figure 4. **V_{ILow2} digital measure relative accuracy after calibration**



VIHigh = 12V — Load type : Current = 12A

Figure 5. **I_{IHigh} digital measure relative accuracy after calibration**



Duty cycle = 20% — Load type : Current = 0.5 A

Figure 6. **V_{IHigh} digital measure relative accuracy after calibration**

V.1 Standard deviation on voltage and current specifications

Trigger value = 6%, carrier mode = center aligned unless otherwise noted

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{ILow1} STANDARD DEVIATION MEASURE					
	Not averaged		85		mV
	Average of 2 measures		61		mV
	Average of 3 measures		50		mV
	Average of 5 measures		39		mV
	Average of 10 measures		28		mV
V_{ILow2} STANDARD DEVIATION MEASURE					
	Not averaged		82		mV
	Average of 2 measures		58		mV
	Average of 3 measures		47		mV
	Average of 5 measures		37		mV
	Average of 10 measures		27		mV
V_{IHigh} STANDARD DEVIATION MEASURE					
	Not averaged		150		mV
	Average of 2 measures		108		mV
	Average of 3 measures		88		mV
	Average of 5 measures		68		mV
	Average of 10 measures		48		mV
I_{ILow1} STANDARD DEVIATION MEASURE					
	Not averaged		34		mA
	Average of 2 measures		24		mA
	Average of 3 measures		20		mA
	Average of 5 measures		16		mA
	Average of 10 measures		11		mA
I_{ILow2} STANDARD DEVIATION MEASURE					
	Not averaged		34		mA
	Average of 2 measures		24		mA
	Average of 3 measures		20		mA
	Average of 5 measures		15		mA
	Average of 10 measures		11		mA
I_{IHigh} STANDARD DEVIATION MEASURE					
	Not averaged		14		mA
	Average of 2 measures		10		mA
	Average of 3 measures		8		mA
	Average of 5 measures		6		mA
	Average of 10 measures		4		mA

V.3 Theoretical calibration coefficients – results in Volts and Ampere

Coefficient	Value
Gain VLow1	0,045
Offset VLow1	-94,364
Gain VLow2	0,045
Offset VLow2	-94,364
Gain VHigh	0,029964
Offset VHigh	0
Gain ILow1	0,005
Offset ILow1	-10
Gain ILow2	0,005
Offset ILow2	-10
Gain IHigh	0,005
Offset IHigh	-10

V.4 Theoretical calibration coefficients – results in milli Volts and milli Ampere

Coefficient	Value
Gain VLow1	45,021
Offset VLow1	-94364
Gain VLow2	45,021
Offset VLow2	-94364
Gain VHigh	29,964
Offset VHigh	0
Gain ILow1	5
Offset ILow1	-10000
Gain ILow2	5
Offset ILow2	-10000
Gain IHigh	5
Offset IHigh	-10000

VI. Typical applications

OwnTech's TWIST has a series of modes of operation shown in the table below.

MODE NAME	HIGH SIDE	LOW SIDE	Electrolytic capacitor	TYPICAL APPLICATION	FIGURE
DC-DC Buck	Input	Output	ON	Battery charger	I
DC-DC Boost	Output	Input	ON	Fuel-cell converter	II
1phase DC-AC Buck inverter	Input	Output	OFF	AC micro-grids	III
3phase DC-AC Buck inverter	Input	Output	OFF	Permanent magnet low-voltage motor	IV

VI. 1 Interleaved DCDC modes

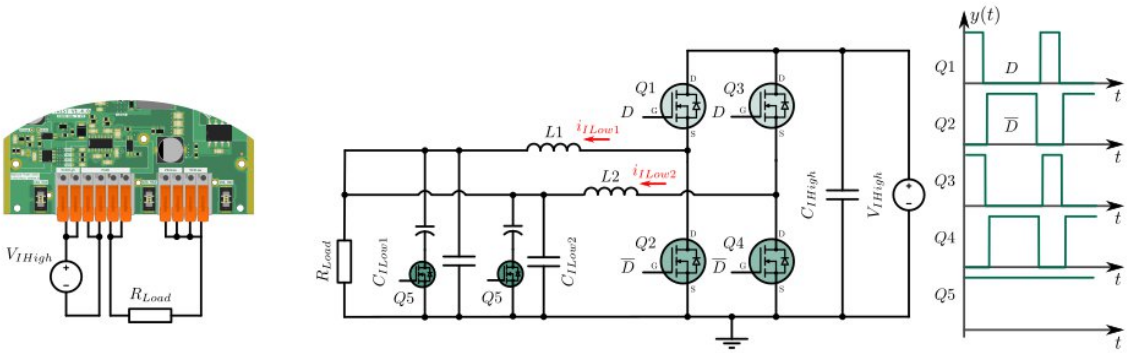


Figure I - TWIST converter in Buck Mode

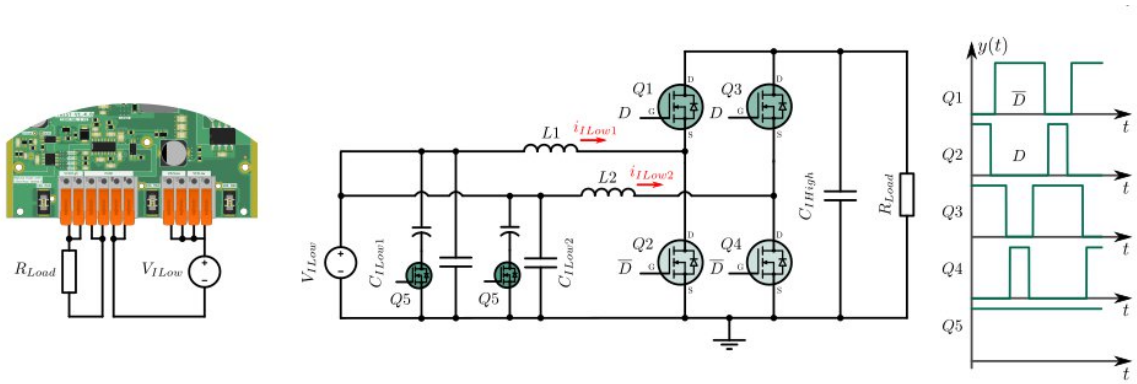


Figure II - TWIST converter in Boost Mode

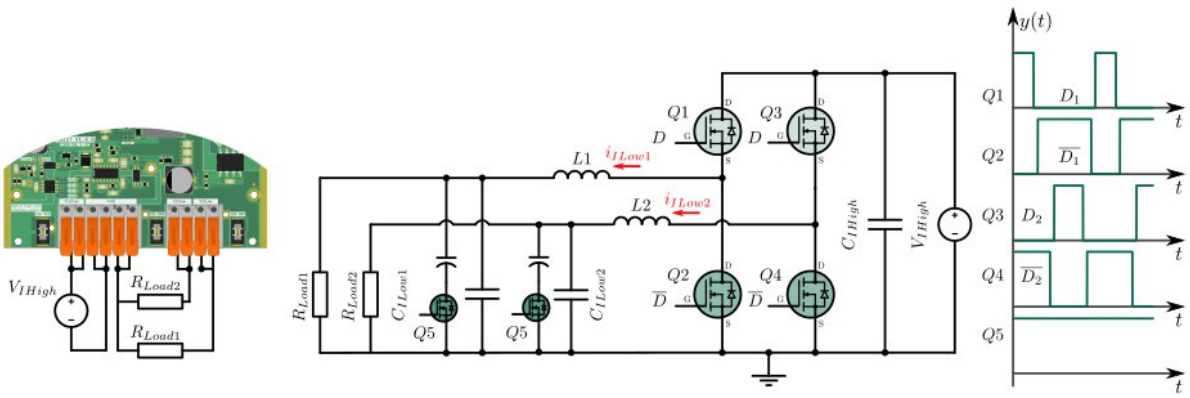


Figure II - TWIST converter in Independent Mode

DC-AC modes

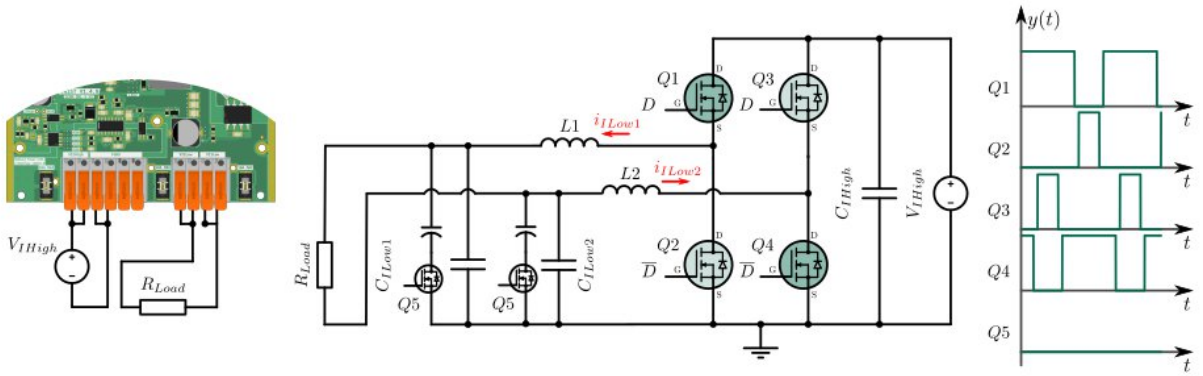


Figure III - TWIST converter in single phase unipolar inverter mode

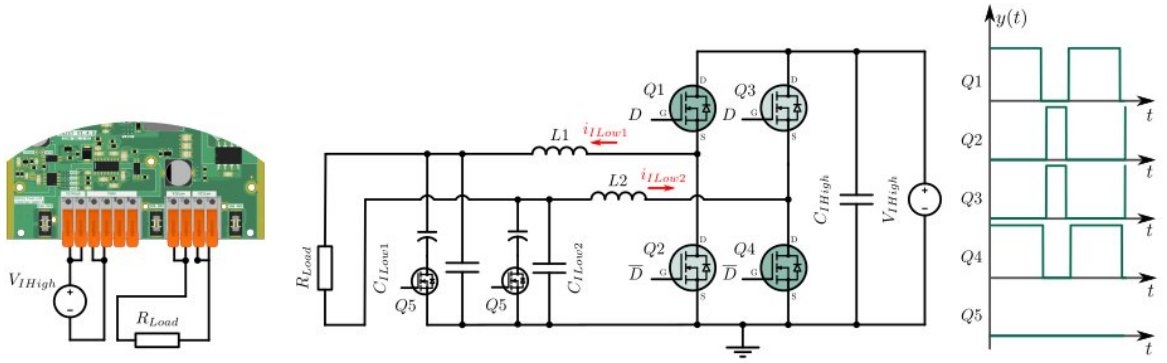


Figure III - TWIST converter in single phase bipolar inverter mode

VII. Mechanical specification

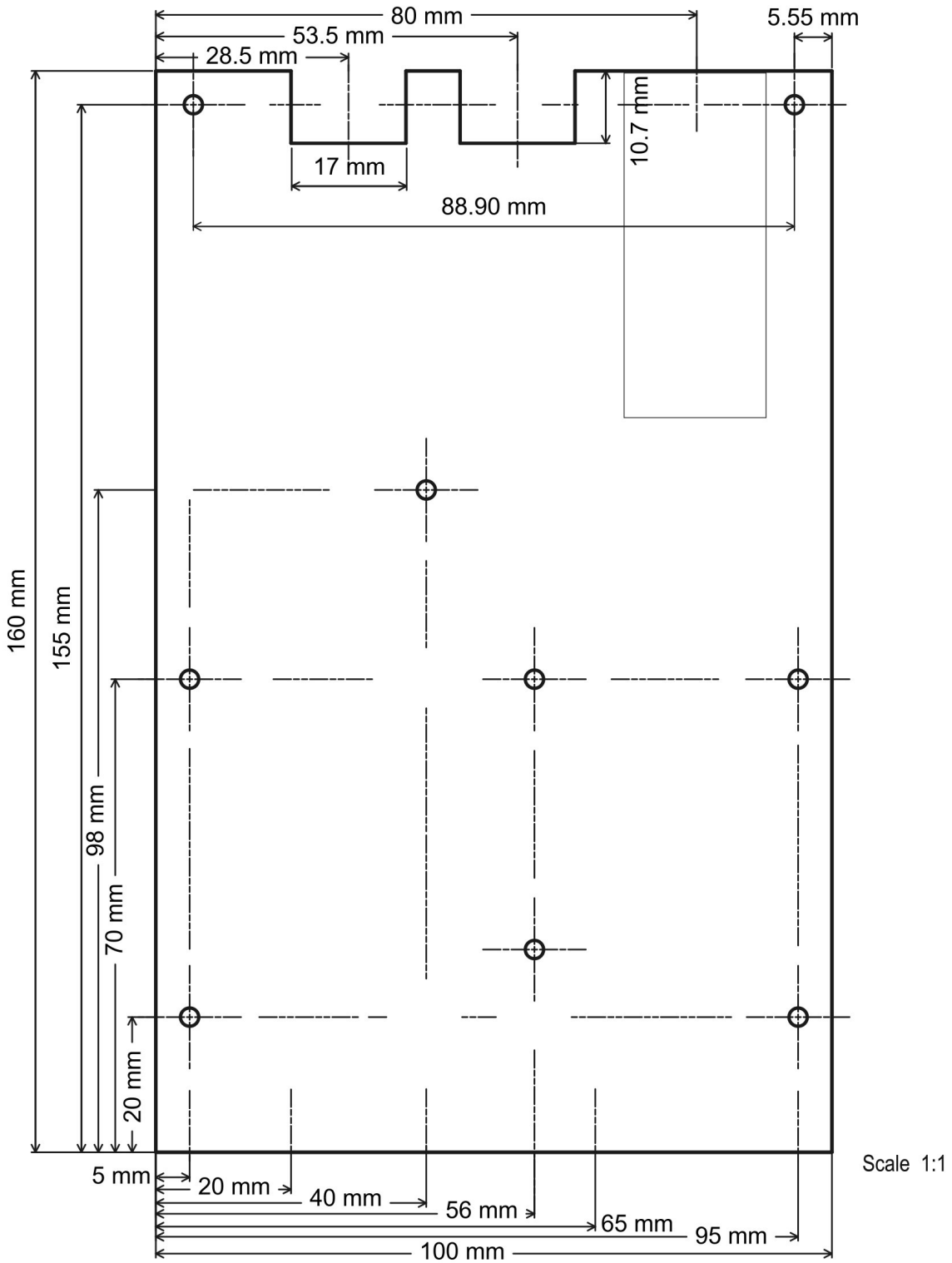


Figure 5 - TWIST converter assembly view

VII. Revision history

Date	Revision	Changes
01-Janv-2024	1	Initial release