9V - 36V Input / 6W / 1.6kV Functional Isolated / Regulated 5V Output

DESCRIPTION

The FIRM 1770105311 MagI³C power module is a regulated, functionally isolated, fully integrated DC/DC converter.

The module integrates the switching power stage, control circuitry, transformer and capacitors.

The FIRM module ensures fast time to market and low development costs.

The 1770105311 module achieves an efficiency up to 82%.

The module is available in an SIP-8 package (22.0 x 12.0 x 9.5mm).

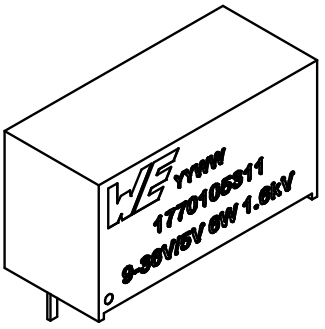
This module has integrated protection circuitry that protects against electrical damage using overcurrent, short-circuit and undervoltage protections.

FEATURES

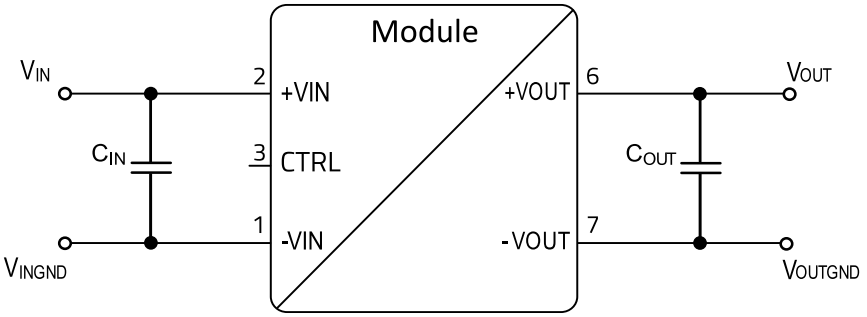
- 1.6kV DC functional isolation for 60s
- Input voltage range: 9V to 36V
- Output voltage: regulated 5V
- Low output voltage ripple: Typ. 30mV at full load
- Output voltage accuracy: Typ. 1% at full load
- Suitable for high power density designs
- Output power: 6W (1.2A)
- Undervoltage lockout
- Overcurrent protection
- Continuous short-circuit protection
- Isolation capacitance of typ. 1000pF
- Integrated C_{IN}, C_{OUT} and transformer
- Included internal Y-capacitor
- Spread-spectrum variation for improved EMI performance
- Operating ambient temperature range: -40°C to 105°C
- RoHS & REACH compliant
- Complies with EN55032 (CISPR-32) class B conducted and radiated emissions standard

TYPICAL APPLICATIONS

- Data acquisition
- Test and measurement systems
- Interface and microcontroller supplies
- Industrial control



TYPICAL CIRCUIT DIAGRAM



CONTENTS

1 PINOUT

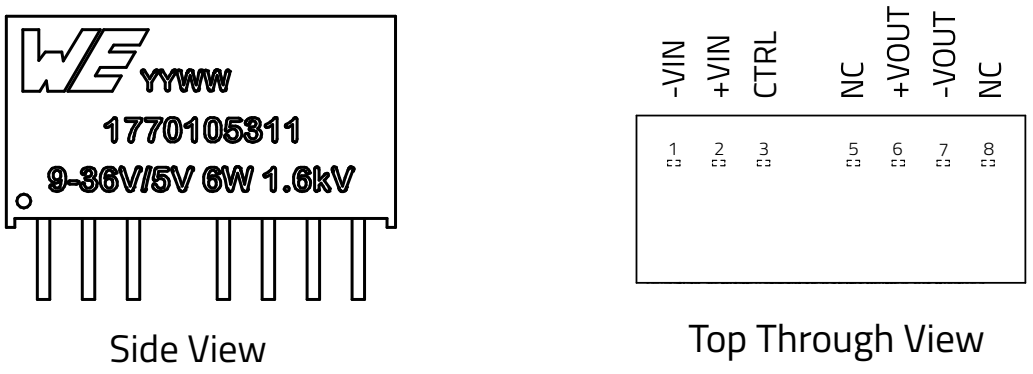


Figure 1: Pinout.

Table 1: Marking description.

MARKING	DESCRIPTION
WE	Würth Elektronik eiSos GmbH & Co. KG
YY	Year
WW	Calendar week
1770105311	Order code
9-36V/5V 6W 1.6kV	Input voltage/output voltage, output power, isolation voltage

Table 2: Pin description.

SYMBOL	NUMBER	TYPE	DESCRIPTION
-VIN	1	Power	Input ground pin.
+VIN	2	Power	Input voltage pin.
CTRL	3	Input	Control pin. Setting this pin high or left floating enables the device, while setting this pin low shuts down the device.
-VOUT	7	Power	Output ground pin.
+VOUT	6	Power	Output voltage pin.
NC	5,8	—	Not connected.

2 ORDERING INFORMATION

Table 3: Ordering information.

ORDER CODE	SPECIFICATIONS	PACKAGE	PACKAGING UNIT
1770105311	9-36V Vin / 5V Vout / 6W	SIP-8	Tube (22 pieces)

3 SALES INFORMATION

Table 4: Sales information.

SALES CONTACT
Würth Elektronik eiSos GmbH & Co. KG EMC and Inductive Solutions Max-Eyth-Str. 1 74638 Waldenburg Germany Tel. +49 (0) 7942 945 0 www.we-online.com/powermodules Technical support: wpme-support@we-online.com

4 ABSOLUTE MAXIMUM RATINGS

Caution:
Exceeding the listed absolute maximum ratings may affect the device negatively and may cause permanent damage.

Table 5: Absolute maxiumum ratings.

SYMBOL	PARAMETER	LIMIT		UNIT
		MIN[1]	MAX[1]	
VIN	Input pin voltage	-0.6	40	V
VCTRL	Control pin voltage	-0.6	40	V
VOUT	Output pin voltage	-0.4	6.3	V
V_{ISO}	Isolation voltage input to output for 60s[6]	—	1.6	kV
$T_{storage}$	Assembled, non-operating storage temperature	-40	125	°C
V_{ESD}	ESD Voltage (HBM)[4]	-4	4	kV

5 OPERATING CONDITIONS

Operating conditions are conditions under which the device is intended to be functional. All values are referenced to GND.

MIN and MAX limits are valid for the recommended ambient temperature range of -40°C to 105°C.

Table 6: Operating conditions.

SYMBOL	PARAMETER	MIN[1]	TYP[3]	MAX[1]	UNIT
V_{IN}	Input voltage	9	—	36	V
V_{OUT}	Output voltage	—	5	—	V
I_{OUT}	Nominal output current[5]	—	—	1.2	A
P_{OUT}	Nominal output power (without derating)	—	—	6	W
C_{OUT_MAX}	Maximal output capacitance	—	—	1000	µF
T_a	Ambient temperature range	-40	—	105[2]	°C
T_{JOP}	Junction temperature range	-40	—	125	°C

6 THERMAL SPECIFICATION

Caution:
Exceeding the listed thermal specification may affect the device negatively and may cause permanent damage.

Table 7: Thermal specification.

SYMBOL	PARAMETER	TYP[3]	UNIT
T_{Case_Max}	Maximum case temperature (top side)	105	°C

7 ELECTRICAL SPECIFICATIONS

Caution:
MIN and MAX limits are valid for the recommended ambient temperature range of -40°C to 105°C. Typical values represent statistically the utmost probable values at the following conditions: T_A = 25°C, unless otherwise noted.

Table 8: Electrical specifications.

SYMBOL	PARAMETER	TEST CONDITIONS	MIN[1]	TYP[3]	MAX[1]	UNIT
Input voltage						
V_{TC}	Input transient capability	1s max.	-0.7	—	50	V
V_{UVLO}	Input undervoltage lockout	—	5.5	6.5	—	V
Output Current						
I_{OC}	Overcurrent limit	—	1.3	1.9	2.75	A
Output Voltage						
V_{OUT}	Line regulation	Input voltage variation at full load[7]	—	±0.5	±1	%
	Load Regulation	V_{IN} nominal, V_{OUT} = 5V I_{OUT} = 0.06A to 1.2A	—	±0.5	±1.5	%
	Output voltage accuracy	V_{IN} nominal, I_{OUT} = 1.2A	—	±1	—	%
	Output voltage ripple & noise	V_{IN} nominal, V_{OUT} = 5V 20MHz BWL	—	30	—	mV_{PP}
Switching Frequency						
f_{SW}	Switching frequency, internal clock	V_{IN} nominal, I_{OUT} = 1.2A	—	500	—	kHz
Input Current						
I_{IN}	No load input current	V_{IN}= 24V, I_{OUT} = 0A	—	5	—	mA
Efficiency						
η	Efficiency	V_{IN}= 24V, I_{OUT} = 1.2A	—	82	—	%
Isolation Characteristics						
C_{ISO}	Isolation capacitance	100kHz/0.1V	—	1000	—	pF
R_{ISO}	Isolation resistance	500VDC	1	—	—	GΩ

Table 9: Electromagnetic Compatibility (EMC).

Emissions (EMI)	CE	CISPR32/EN55032 CLASS B (see Design EXAMPLE)		
	RE	CISPR32/EN55032 CLASS B (see Design EXAMPLE)		
Immunity (EMS)	ESD	IEC/EN61000-4-2	Contact ±4kV	perf. Criteria B
	RS	IEC/EN61000-4-3	10V/m	perf. Criteria A
	EFT	IEC/EN61000-4-4	±2kV(see Design Example)	perf. Criteria B
	Surge	IEC/EN61000-4-5	±500V(see Design Example)	perf. Criteria B
	CS	IEC/EN61000-4-6	3 Vr.m.s	perf. Criteria A
	Voltage dips, short interruption and voltage variation immunity	IEC/EN61000-4-29	0-70%	perf. Criteria A

8 RoHS, REACH

Table 10: RoHS, REACH.

RoHS directive	COMPLIANT RoHS&REACH WÜRTH ELEKTRONIK	Directive 2011/65/EU of the European Parliament and the Council of June 8th, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
REACH directive		Directive 1907/2006/EU of the European Parliament and the Council of June 1st, 2007 regarding the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH).

9 PACKAGE SPECIFICATIONS

Table 11: Package specifications.

ITEM	PARAMETER	TYP[3]	UNIT
Case	UL94 V-0 (Refer to UL approval E150608)	—	—
φ (RH)	Maximum storage humidity (see HANDLING RECOMMENDATIONS for soldering requirements)	95	%
Weight		4.7	g
Vibration	10-150Hz, 5G, 0.75mm. along X, Y and Z		
IP	According to IEC/EC 60529	IPX0	
Washing	Washing compatible with standard industrial water based washers.		

10 RELIABILITY

Table 12: Reliability.

SYMBOL	PARAMETER	TEST CONDITIONS	TYP[3]	UNIT
MTBF[8]	Mean Time Between Failures	+25 °C: Ground Benign	$9040 \cdot 10^3$	h
		+85 °C: Ground Benign	$2919 \cdot 10^3$	h

11 NOTES

(1) Min and Max limits are 100% production tested at 25°C. Limits over the operating temperature range are guaranteed through correlation using Statistical Quality Control (SQC) methods.

(2) Measured without heatsink. Natural convection (0 - 20LFM / 0 - 0.1m/s) Test PCB 80mm x 80mm horizontal orientation 35µm copper on top and bottom.

(3) Typical numbers are valid at 25°C ambient temperature and represent statistically the utmost probability assuming the Gaussian distribution.

(4) The human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin. Test method is per JESD-22-114.

(5) Depending on ambient temperature, see thermal derating diagram (Thermal Derating).

(6) Not production tested. It is a design parameter. Test voltage as defined by the UL62368-1. EOL test is done with elevated voltage level of 1.76kV for 3s.

(7) Within the complete V_{IN} operating range.

(8) MIL-HDBK-217F; GB Ground, Benign: Non mobile, temperature and humidity controlled environments readily accessible to maintenance; includes laboratory instruments and test equipment, medical electronic equipment, business and scientific computer complexes, and missiles and support equipment in ground silos; MTBF value is referring to 1770105311.

12 ISOLATION VOLTAGE

To verify the integrity of the isolation a test voltage is applied for a specified time across a component that is designed to provide electrical isolation. This test is known as 'High Pot Test', 'Flash Tested', 'Withstand Voltage', 'Proof Voltage', 'Dielectric Withstand Voltage' or 'Isolation Test Voltage'.

All isolated Power Modules are 100% production tested at their stated isolation voltage. This is 1.760 kVDC for 3 seconds.

The isolation test voltage indicated in this datasheet is for voltage transient immunity only. It does not allow this part to be used within a safety isolation system.

The module will function properly with several hundreds of volts applied continuously across the isolation barrier, however surrounding components must be individually analyzed to ensure proper insulation. Isolation measures must be taken into account to prevent any user-accessible circuitry from causing harm.

12.1 Dielectric Test Setup (High Pot Test)

Connect all input and output terminals together (see figure below) before connecting the supply voltage. When testing, set the cut-off current to 1mA with a test voltage of 1.760kVDC and test time of 3s.

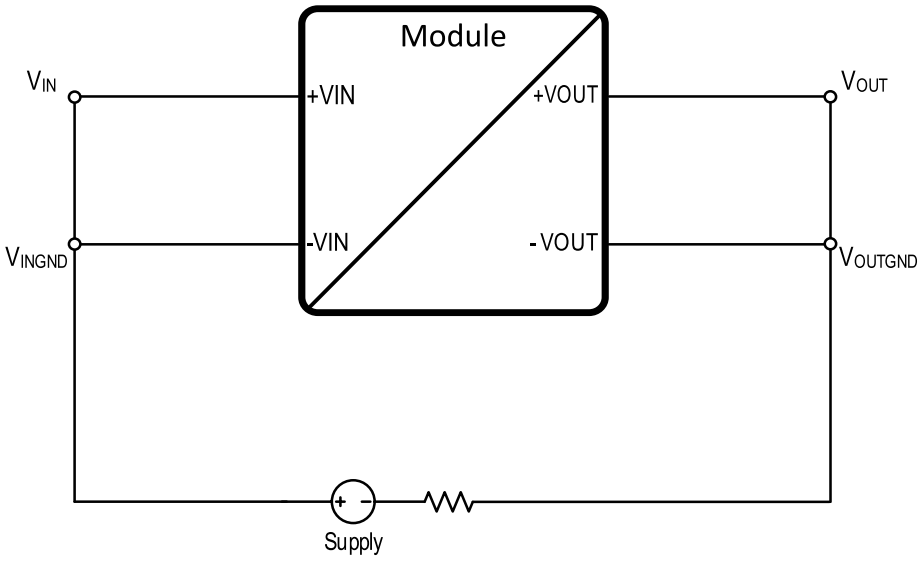


Figure 2: Dielectric test setup.

12.2 Repeated High-Voltage Isolation Testing

A repeated high voltage test of a barrier component degrades its isolation capabilities.
The primary and secondary windings within this transformer are enameled (coated) but do not possess additional isolation. Typically, parts can withstand multiples of their stated test voltage and still perform optimally. The magnet wire coating can degrade over time due to chemical reactions that occur at high voltages. We recommend keeping high voltage isolation testing to a minimum to better protect the isolation between the windings. If repeated high voltage isolation testing is required, consider reducing the voltage by a significant amount e.g. 20% from the test voltage stated within the datasheet.

These safety concerns are equally applicable to components that utilize functional isolation beyond wire coating (i.e. physical barriers or spacing).

13 TYPICAL PERFORMANCE CURVES

If not otherwise specified, the following conditions apply: T_A = 25°C, V_{IN} = 24V, I_{OUT} = 1.2A.

13.1 Radiated and Conducted Emissions EN55032 (CISPR-32) Class B Compliance

The 1770105311 power module is tested with a standard EMC configuration (1m wire between the module and the load) to give more realistic information about implementation in the applications. The test setup is based on CISPR-16 with the limit values taken from CISPR-32.
Measured with module on the design example shown in chapter DESIGN EXAMPLE in a Fully Anechoic Room (FAR) at 3m antenna distance.

13.1.1 Radiated Emissions EN55032 (CISPR-32) Class B Compliant Test Setup

- Measured in a Fully Anechoic Room (FAR) at 3m antenna distance
- Input wire length: 160cm (80cm horizontal + 80cm vertical)
- Output wire length: 1m

13.1.2 Conducted Emissions EN55032 (CISPR-32) Class B Compliant Test Setup

- Measurement input wire length: 80cm
- Output wire length: 1m

13.1.3 Radiated And Conducted Emissions

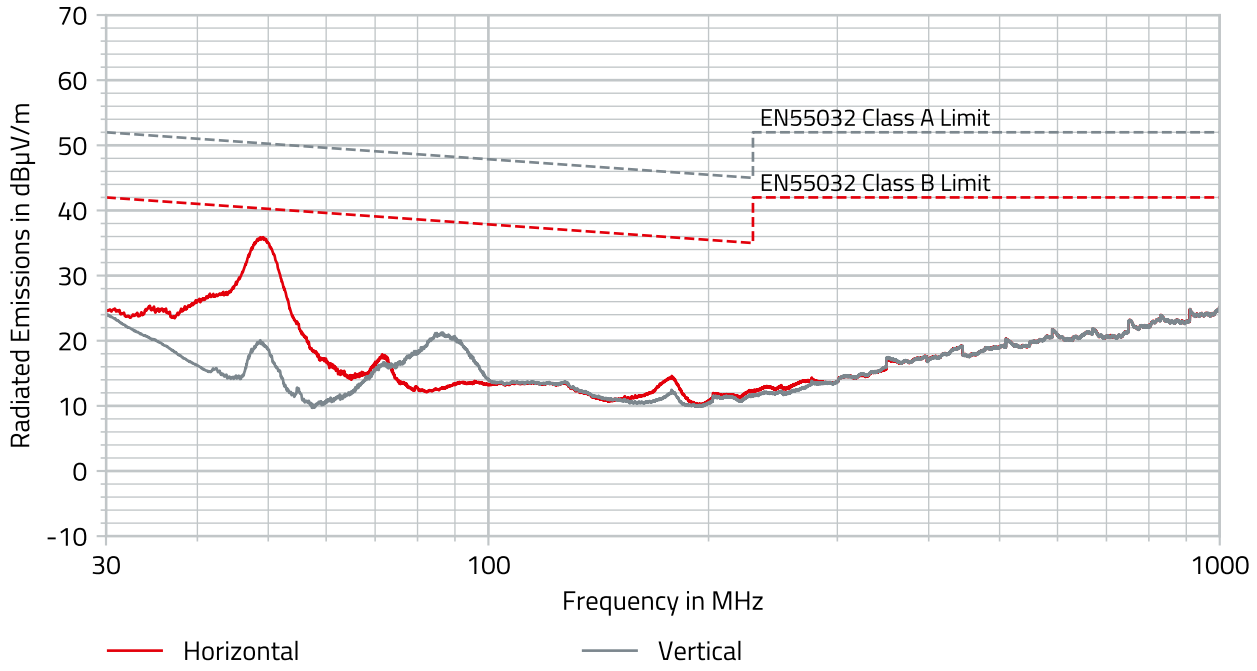


Figure 3: Radiated emissions V_{IN} = 24V, V_{OUT} = 5V, I_{LOAD} = 1.2A with input filter.

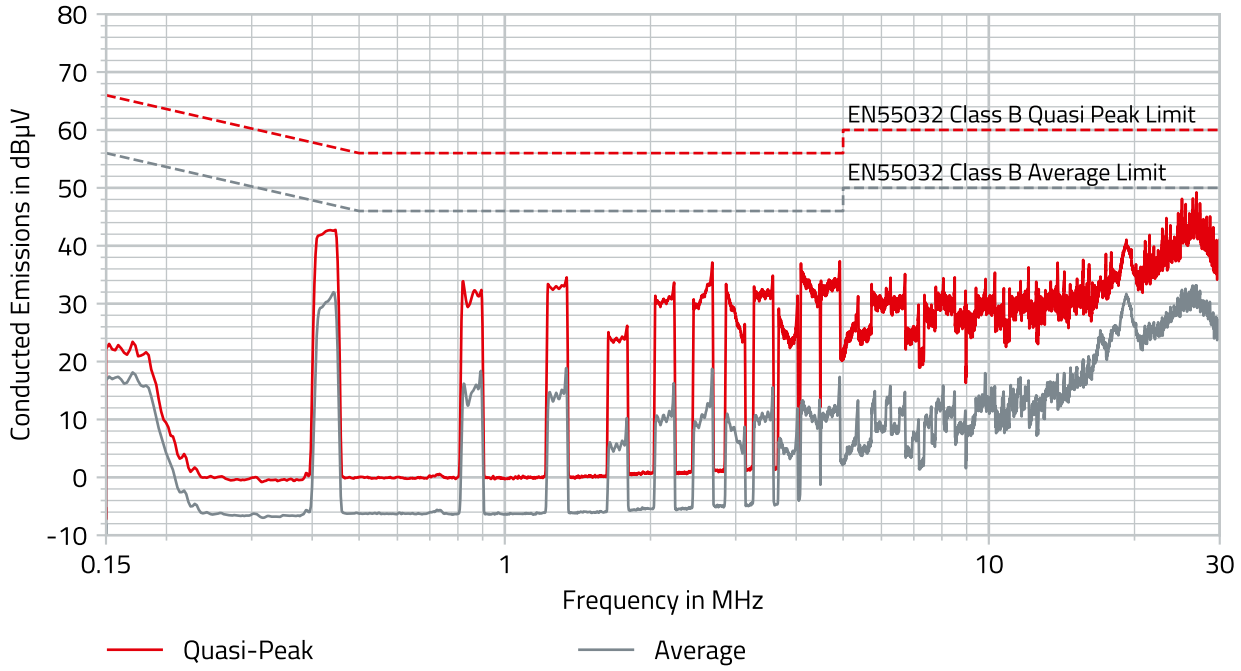


Figure 4: Conducted emissions V_{IN} = 24V, V_{OUT} = 5V, I_{LOAD} = 1.2A with input filter.

13.2 DC Performance Curves

13.2.1 Efficiency

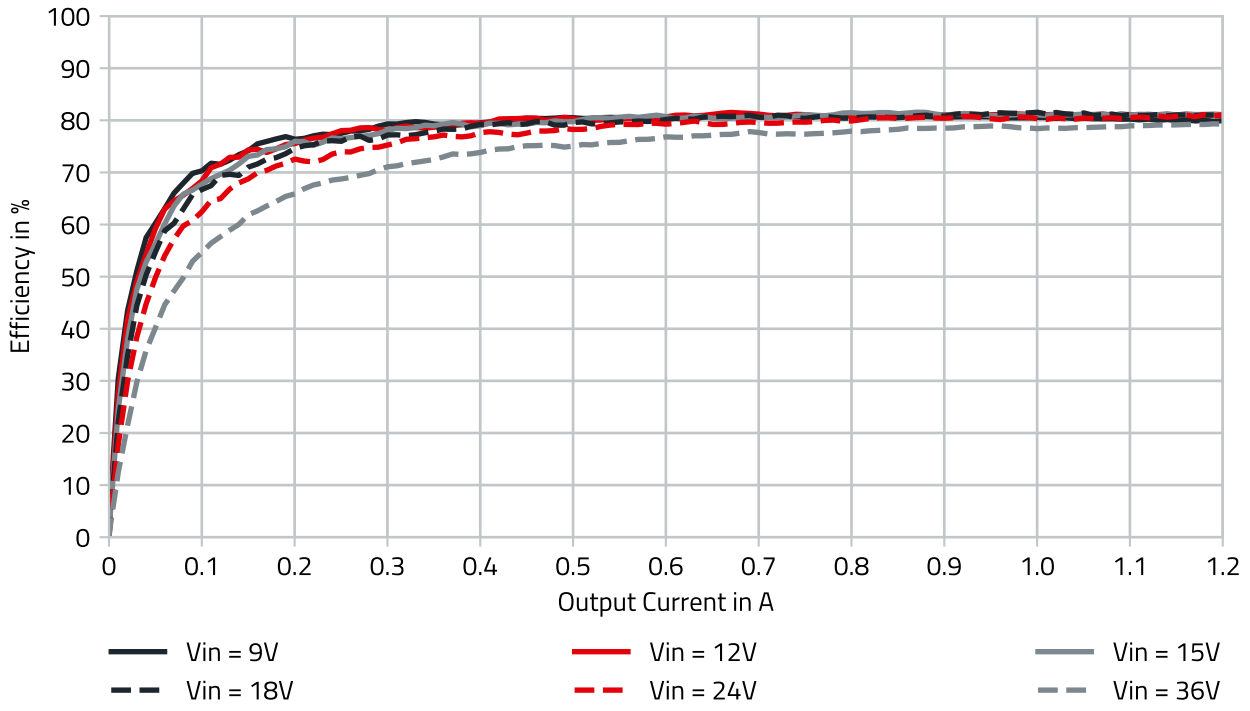


Figure 5: Efficiency.

13.2.2 Temperature Derating

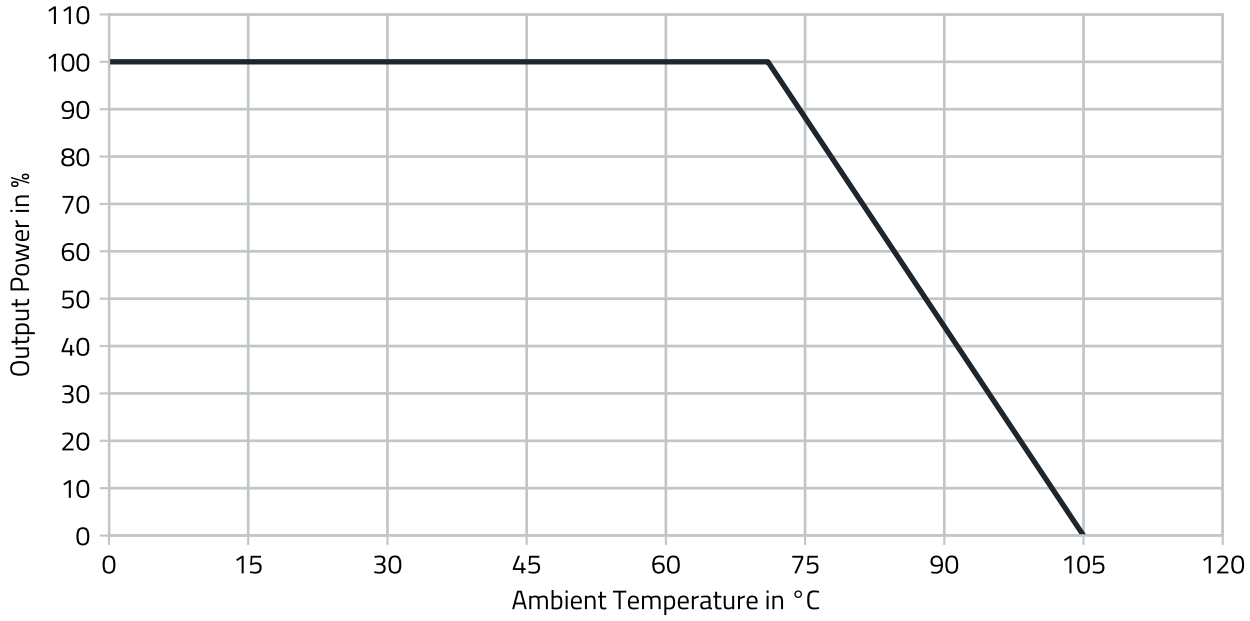


Figure 6: Output current thermal derating V_{IN}=24V.

13.2.3 Load Regulation $5V_{OUT}$

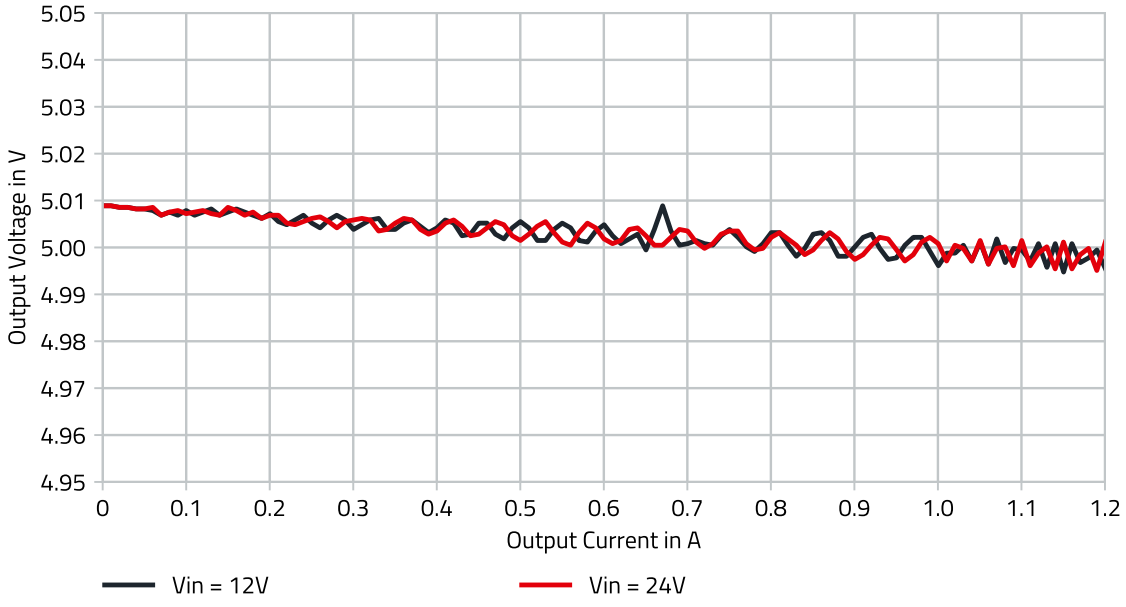


Figure 7: Load Regulation V_{OUT} = 5V.

13.2.4 Line Regulation $5V_{OUT}$

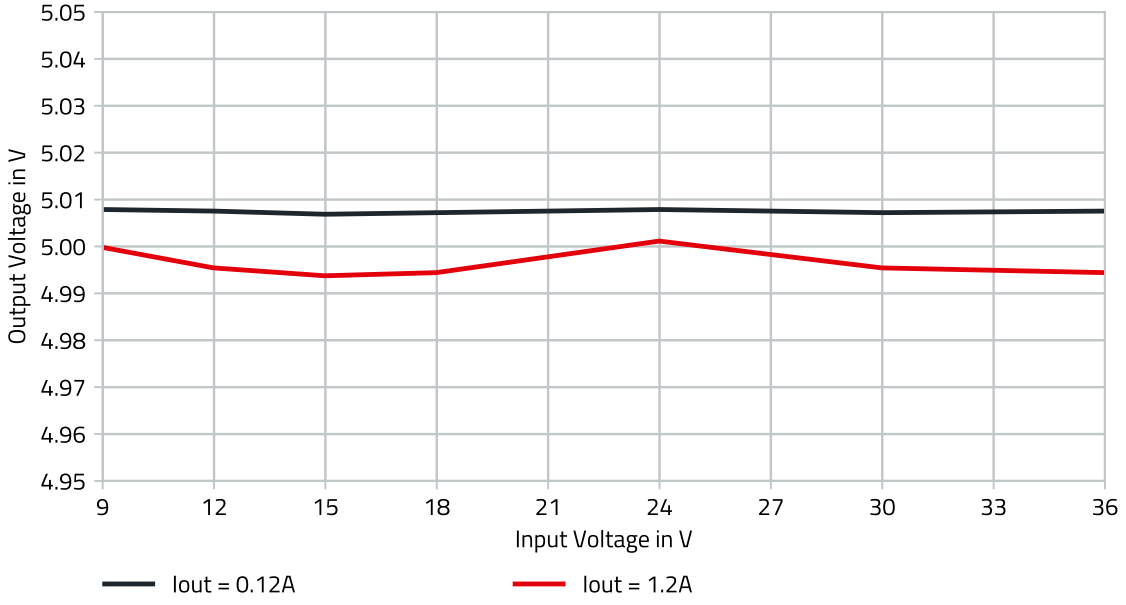


Figure 8: Line Regulation V_{IN} = 24V, V_{OUT} = 5V.

14 BLOCK DIAGRAM

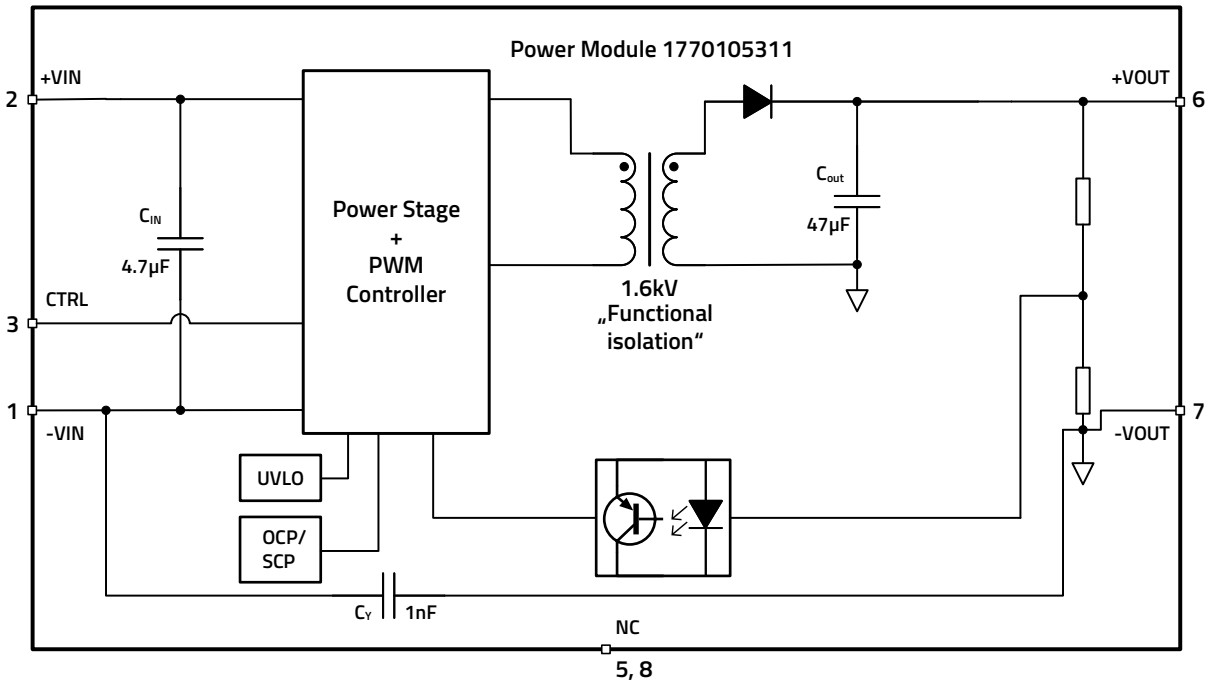


Figure 9: Block diagram.

15 CIRCUIT DESCRIPTION

The MagI³C power module 1770105311 is based on a flyback topology. The module integrates the PWM controller IC, primary-side switching stage, transformer, rectifying diode, input capacitor, and output capacitor into a single package. The functional isolation barrier is implemented by two independent paths: the power transfer path through the integrated transformer, and the output voltage feedback path through an optocoupler, ensuring galvanic separation between input and output at all operating conditions.
The integrated Y-capacitor provides a low-impedance path for common-mode currents across the isolation barrier. The topology allows a low output voltage ripple of typical 30mV peak-to-peak at full load.

16 MODES OF OPERATION

Depending on the load current and input voltage, the 1770105311 module is in one of two operational modes:

- PWM at heavy load when load current is above the light load threshold.
- PFM mode during light load operation: Auto transition to PFM operation when switching frequency is decreased at very light load.

16.1 PWM Operation

In PWM mode, the module operates at a fixed switching frequency. During each switching cycle, energy is stored in the integrated transformer while the primary switch is conducting, and transferred to the output during the off-time. The output voltage is regulated cycle-by-cycle by controlling the peak energy stored in the transformer per switching cycle, ensuring stable output voltage under varying input voltage and load conditions. PWM mode is active under nominal and medium-to-high load conditions and provides fast dynamic response to line and load transients.

16.2 PFM Operation

Under light load conditions, the module automatically transitions from PWM mode into a power-saving operating mode to maintain high efficiency across the full load range. In this mode, both the switching frequency and the energy transferred per switching cycle are progressively reduced as the load current decreases. This dual reduction minimizes switching losses and drive-related power dissipation, resulting in high efficiency even at low output loads. As the load demand increases, the module transitions back to fixed-frequency PWM operation to ensure stable regulation and fast dynamic response.

16.3 Spread Spectrum

Under any load condition the module is operating with spread spectrum functionality with a jitter frequency of 6.9ms. This distributes the engergy across the frequency spectrum to improve EMI performance. The effect can be seen in the Radiated And Conducted Emission section.

17 OUTPUT VOLTAGE RIPPLE

Due to the integrated input and output filters, the output voltage ripple is significantly reduced without the need for extensive external filtering. The measured peak-to-peak ripple is approximately 53 mVpp under full load conditions (see Figure 11).

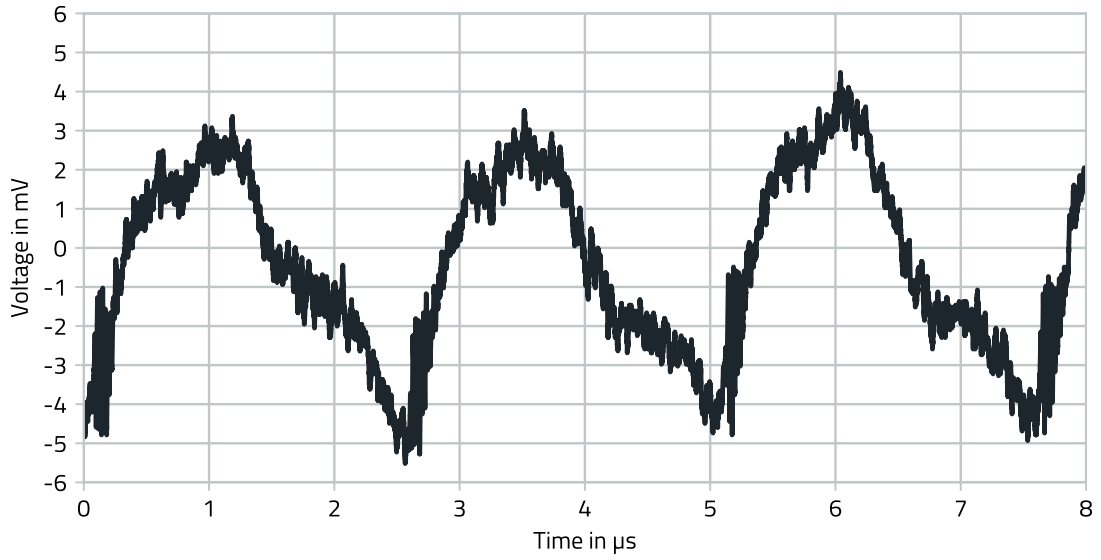


Figure 10: Output Voltage Ripple V_{IN} = 24V, V_{OUT} = 5V, I_{OUT} = 120mA, C_{OUT} = 10µF.

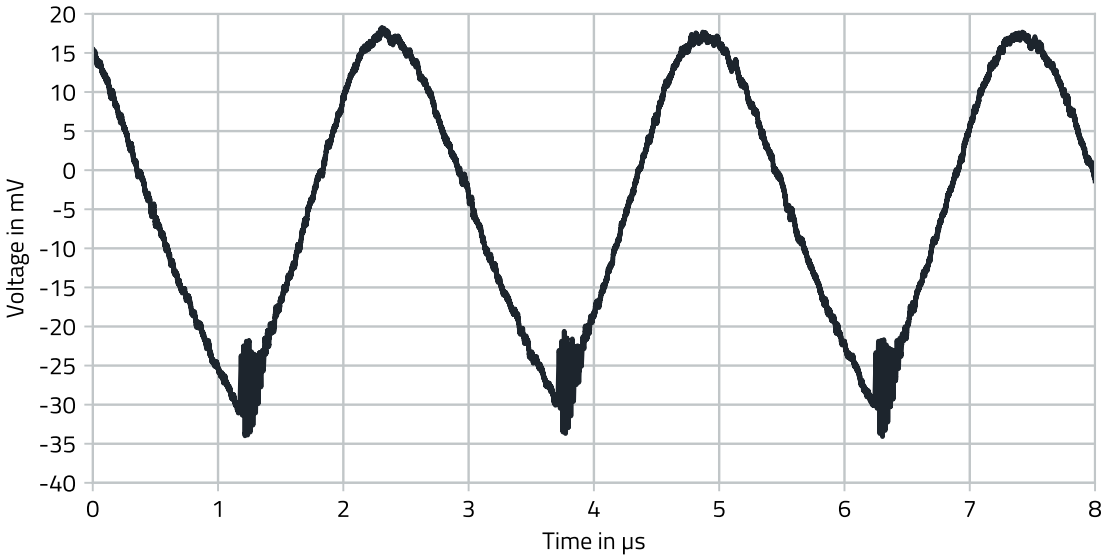


Figure 11: Output Voltage Ripple V_{IN} = 24V, V_{OUT} = 5V, I_{OUT} = 1.2A, C_{OUT} = 10µF.

18 PROTECTION FEATURES

18.1 Over Current Protection (OCP)

The 1770105311 power module provides continuous protection against overcurrent and short-circuit conditions at the output. When the output current exceeds the overcurrent protection (OCP) threshold indicated in the Electrical Specifications, the module limits the energy transferred per switching cycle to protect the internal components. Under this condition, the output voltage decreases with increasing load current, signaling an overload condition to the system.

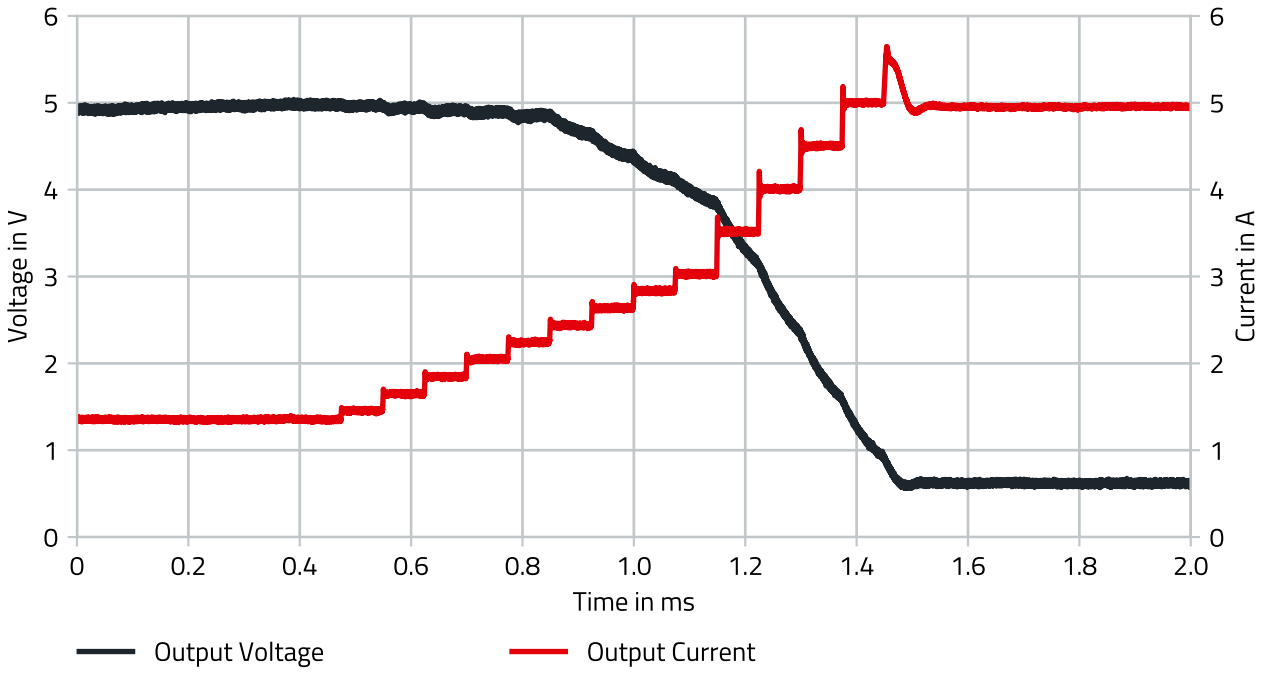


Figure 12: Over Current protection.

18.2 Integrated UVLO

The device incorporates an internal input undervoltage lockout (UVLO) to protect against unexpected behavior at input voltages below the recommended values. The thresholds of the internal UVLO are indicated in the Electrical Specifications.

This function is often used in battery-powered systems to prevent deep discharge of the system battery.

18.3 Short Circuit Protection (SCP)

The short-circuit protection (SCP) provides additional protection in the event of a complete output short circuit. When the output voltage collapses due to a short-circuit fault, the module detects the loss of regulation and enters a hiccup mode, disabling the switching operation after a defined blanking time. It then periodically attempts to restart via the internal soft-start sequence until the fault is removed.

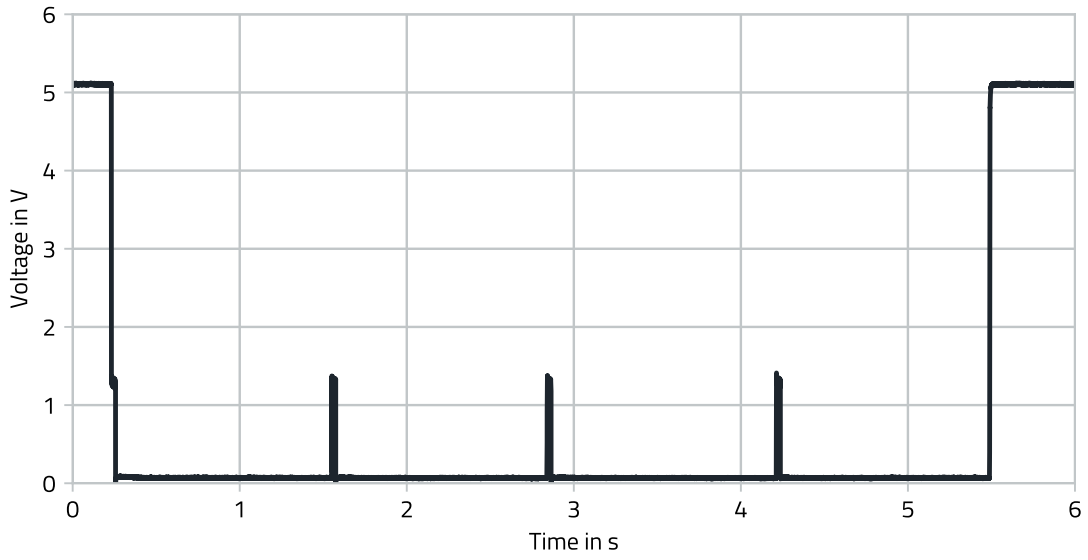


Figure 13: Short circuit protection.

18.4 Soft-Start

The MagI³C power module implements an internal soft-start in order to limit the inrush current and avoid output voltage overshoot during start-up. The typical duration of the soft-start is around 0.5ms (see figure 14).

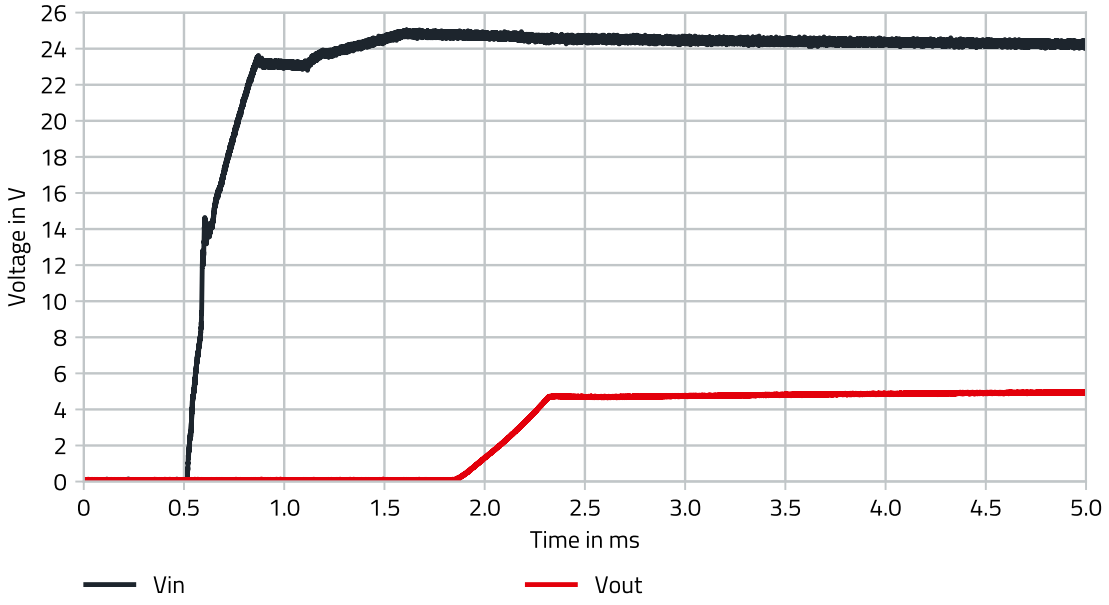


Figure 14: Soft-start.

19 DESIGN EXAMPLE - EN55032

The design example shows a possible solution for 24V to 5V with a max. Iout of 1.2A. All of the necessary components to fullfill the requirements of the CISPR-32 EMI conducted and radiated emissions tests are included in the design example. It passes the conducted emissions class B with 0.8m input and 1m output lines and passes the radiated emissions class B in a FAR at 3m measurement distance with 0.8m horizontal, 0.8m vertical input and 1m horizontal output lines. In the final application filter components may be omitted depending on the requirements.

19.1 Layout

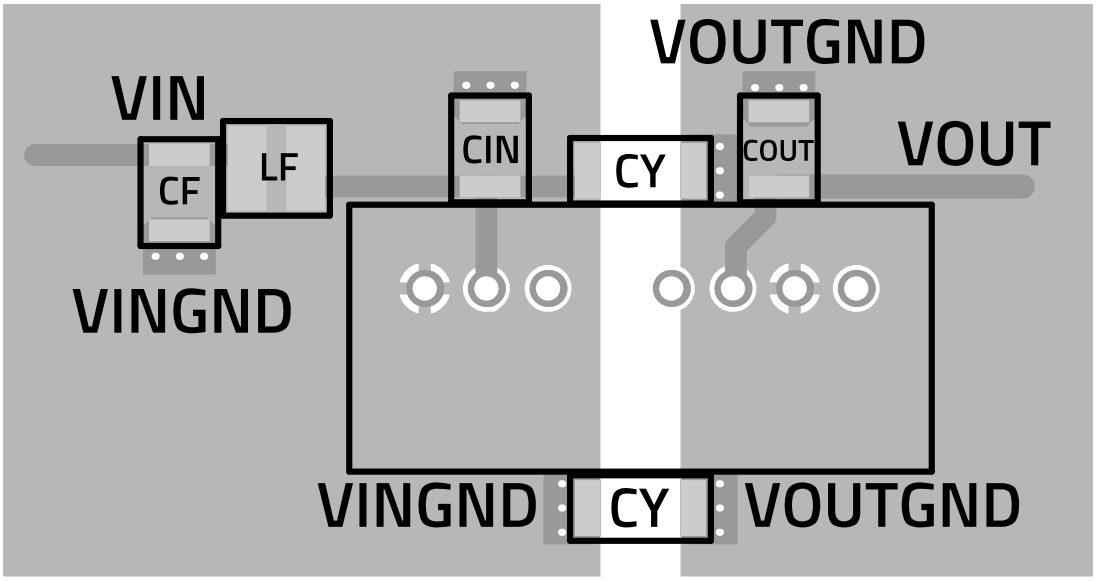


Figure 15: Layout recommendation to pass CISPR-32 class B radiated and conducted emissions.

The layout above has been evaluated to provide the optimal performance in terms of transient response, efficiency, ripple and EMI. The design footprint can be reduced at the expense of performance in these parameters. The following recommendation should be followed when designing the layout:

1. The input capacitor should be placed as close as possible to the +VIN and -VIN pins of the device.
2. The output capacitor should be placed as close as possible to the +VOUT and -VOUT pins of the device.
3. The Y-capacitors should be placed as close as possible to the +VIN and -VOUT pins as well as the -VIN and -VOUT pins of the device.

19.2 Schematic

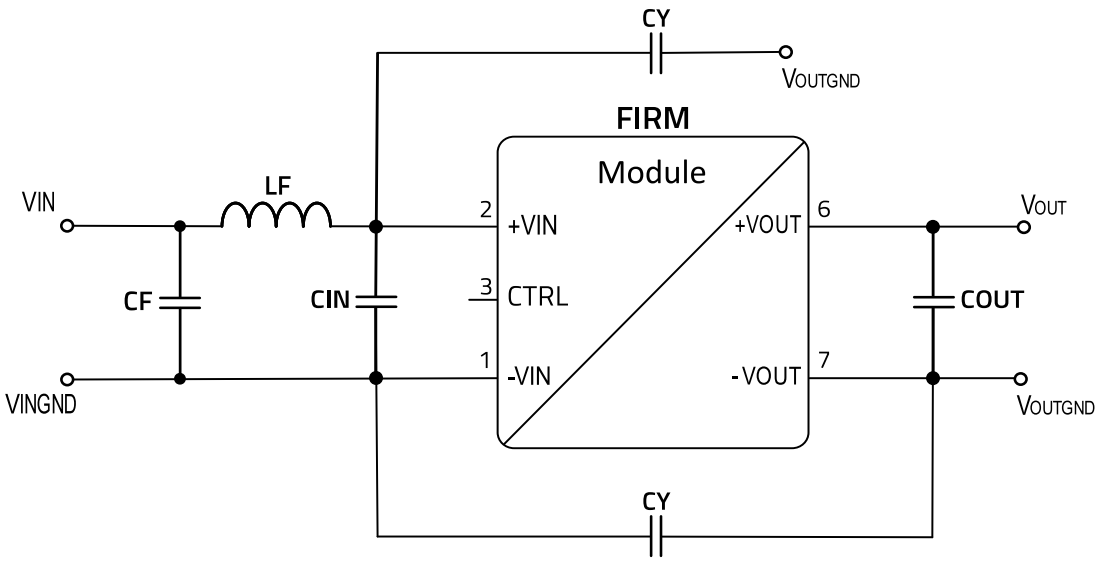


Figure 16: Recommended external component schematic to pass CISPR-32 class B radiated and conducted emissions.

19.3 Bill of Materials

Table 13: 1770105311 recommended external components bill of materials.

DESIGNATOR	DESCRIPTION	FUNCTION	QUANTITY	ORDER CODE	MANUFACTURER
FIRM	MagI³C Power Module	Power supply	1	1770105311	WE
LF	Filter inductor, 4.7µH/1.16A PD2, 3521	Input Filter	1	7447732047	WE
CF	Ceramic chip capacitor 10µF/50V X7R, 1210	Input Filter	1	885012209073	WE
CIN	Ceramic chip capacitor 10µF/50V X7R, 1210	Input Filter / Electrical Performance	1	885012209073	WE
COUT	Ceramic chip capacitor 10µF/10V X7R, 1210	Output Filter / Electrical Performance	1	885012209005	WE
CY	Ceramic chip capacitor 2.2nF/2kV Impulse X7R, 1808	Y-Cap	2	885342210002	WE

20 DESIGN EXAMPLE - FULL EMC COMPLIANCE

The design example shows a possible solution for 24V to 5V with a max. Iout of 1.2A. All of the necessary components to fullfill the requirements of the CISPR-32 EMI conducted and radiated emissions tests as well as the IEC/EN61000-4 immunity tests are included in the design example. It passes the conducted emissions class B with 0.8m input and 1m output lines and passes the radiated emissions class B in a FAR at 3m measurement distance with 0.8m horizontal, 0.8m vertical input and 1m horizontal output lines. The shown immunity filter is only required to pass conducted immunity (Surge). In the final application, filter components may be omitted depending on the requirements.

20.1 Layout Full EMC Compliance

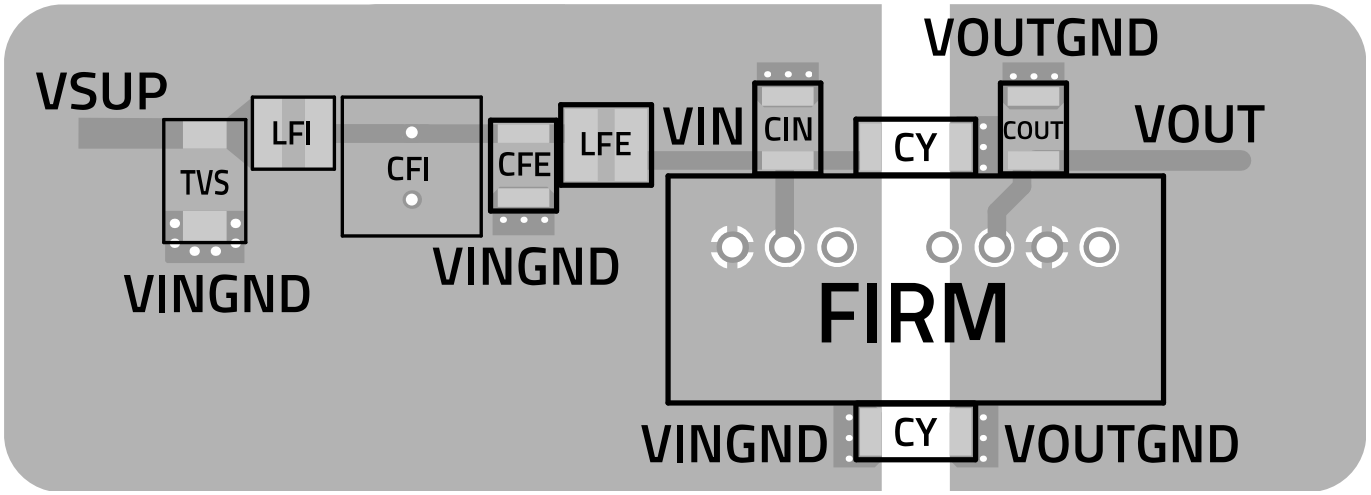


Figure 17: Layout recommendation for full EMC compliance.

The layout above has been evaluated to provide the optimal performance in terms of transient response, efficiency, ripple and EMI. The design footprint can be reduced at the expense of performance in these parameters. The following recommendation should be followed when designing the layout:

1. The input capacitor should be placed as close as possible to the +VIN and -VIN pins of the device.
2. The output capacitor should be placed as close as possible to the +VOUT and -VOUT pins of the device.
3. The Y-capacitors should be placed as close as possible to the +VIN and -VOUT pins as well as the -VIN and -VOUT pins of the device.

Note: Immunity filter is only required to pass Surge.

20.2 Schematic Full EMC Compliance

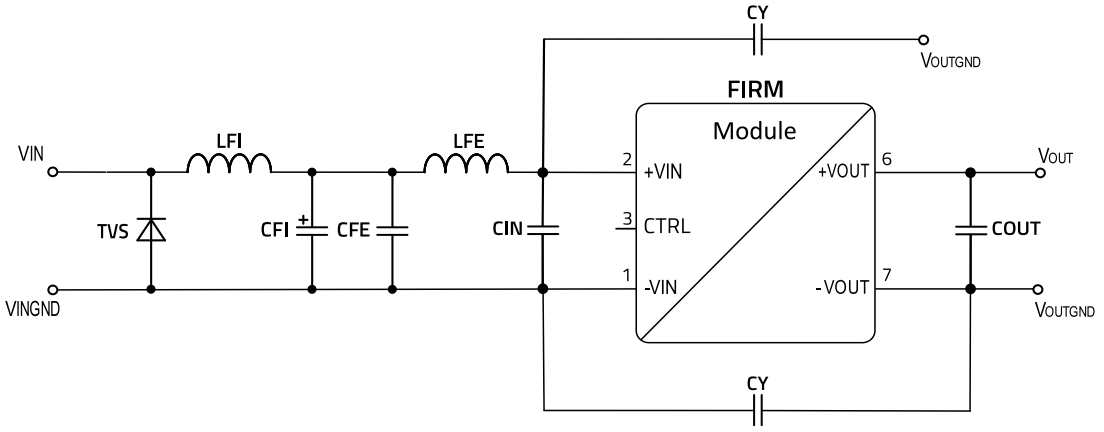


Figure 18: Recommended external component schematic for full EMC compliance.

20.3 Bill of Materials Full EMC Compliance

Table 14: Recommended external components for full EMC compliance bill of materials.

DESIGNATOR	DESCRIPTION	FUNCTION	QUANTITY	ORDER CODE	MANUFACTURER
FIRM	MagI³C Power Module	Power supply	1	1770105311	WE
TVS	Power TVS Diode, Unidirectional, 3000W, 33VDC, DO-214AB	Input Filter Immunity	1	824550331	WE
CFI	Aluminum electrolytic capacitor 270µF/50V	Input Filter Immunity	1	860160675027	WE
LFI	Filter inductor 33µH/1.09A PD2, 5848	Input Filter Immunity	1	744774133	WE
LFE	Filter inductor, 4.7µH/1.16A PD2, 3521	Input Filter	1	7447732047	WE
CFE	Ceramic chip capacitor 10µF/50V X7R, 1210	Input Filter Emission	1	885012209073	WE
CIN	Ceramic chip capacitor 10µF/50V X7R, 1210	Input Filter / Electrical Performance	1	885012209073	WE
COUT	Ceramic chip capacitor 10µF/10V X7R, 1210	Output Filter / Electrical Performance	1	885012209005	WE
CY	Ceramic chip capacitor 2.2nF/2kV Impulse X7R, 1808	Y-Cap	2	885342210002	WE

Note: Immunity filter is only required to pass Surge.

21 APPLICATION CONSIDERATIONS

21.1 Primary Side Parallel Connection

A standard industrial configuration is, that the power modules are supplied by a dc bus voltage. Multiple 1770105311 can be connected to one dc bus as shown in the figure below.
The outputs must not be connected in parallel to each other and could have individual voltages V_{OUT1} and V_{OUT2}. For serial connection of the output see also Secondary Side Serial Connection.
In case of using long supply lines or different wire length for each 1770105311 it is recommended to decouple each power

module with an additional LC filter (see schematic below). The decoupling LC filter is also recommended if the supplying dc bus has a high impedance so that high voltage swings at the input of each power module might be present.

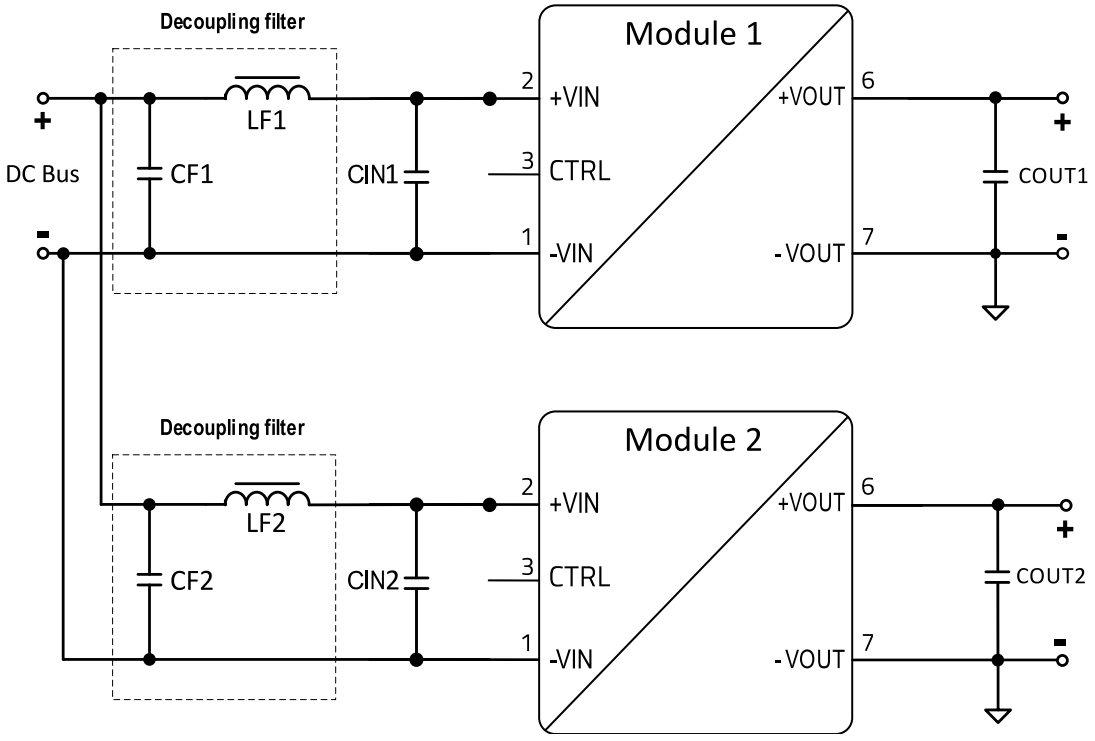


Figure 19: Decoupling for primary side parallel connection.

As a starting point for the decoupling filters, use the values of the reference filters - see also DESIGN EXAMPLE. The final appropriate filter for the application has then to be evaluated under operation in the target application by checking e.g. the change of the input ripple voltage.

21.2 Secondary Side Serial Connection

To generate a higher output voltage it is possible to put the outputs of the 1770105311 in series. It is common practice to connect an additional capacitor between the +VOUT and -VOUT.

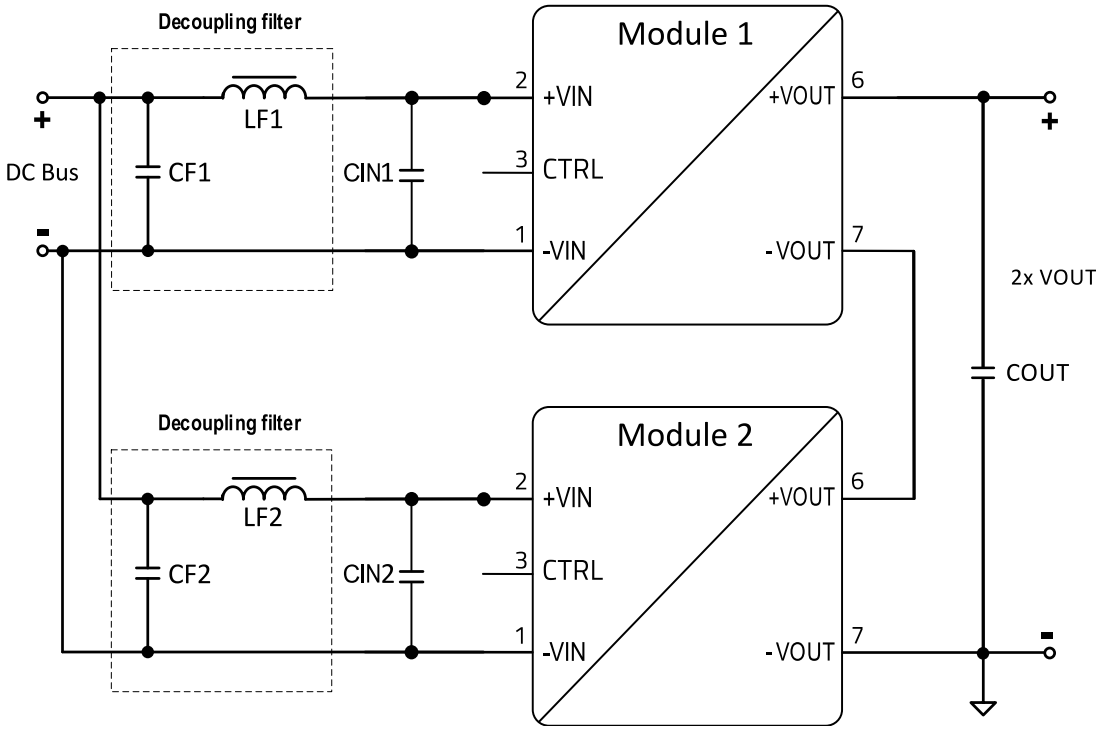


Figure 20: Secondary side serial connection.

In case of using long supply lines or different line length for each 1770105311 it is recommended to decouple each power module with an additional LC filter. The decoupling LC filter is also recommended for applications that have a high impedance dc bus as the supply to prevent high input voltage swings from being seen at the power module input. The EMI filter shown in DESIGN EXAMPLE can be used as an initial design. The final appropriate filter for the application should be evaluated under operation in the desired application.

21.3 Generating Complementary Output Voltages

Another common requirement in industrial applications is to provide a complementary voltage (±5V). This can be easily implemented by using two 1770105311 modules according to the schematic below. It is a common practice to connect an additional capacitor across each output voltage.

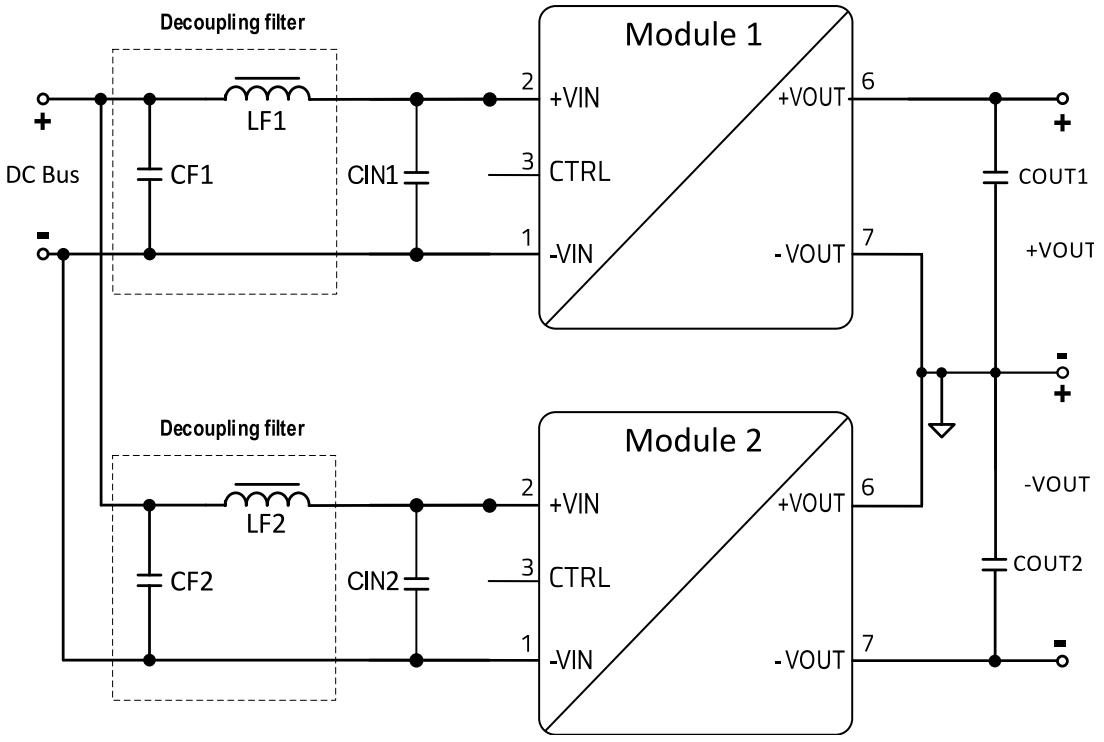


Figure 21: Generating complementary output voltages.

In case of using long supply lines or different line length for each 1770105311 it is recommended to decouple each power module with an additional LC filter. The decoupling LC filter is also recommended for applications that have a high impedance dc bus as the supply to prevent high input voltage swings from being seen at the power module input. The EMI filter shown in DESIGN EXAMPLE can be used as an initial design. The final appropriate filter for the application should be evaluated under operation in the desired application.

21.4 Reverse Polarity Protection

A simple way of creating an input reverse polarity protection is to place a diode in series with the positive input line. Due to the forward voltage drop of the diode the application efficiency drops.

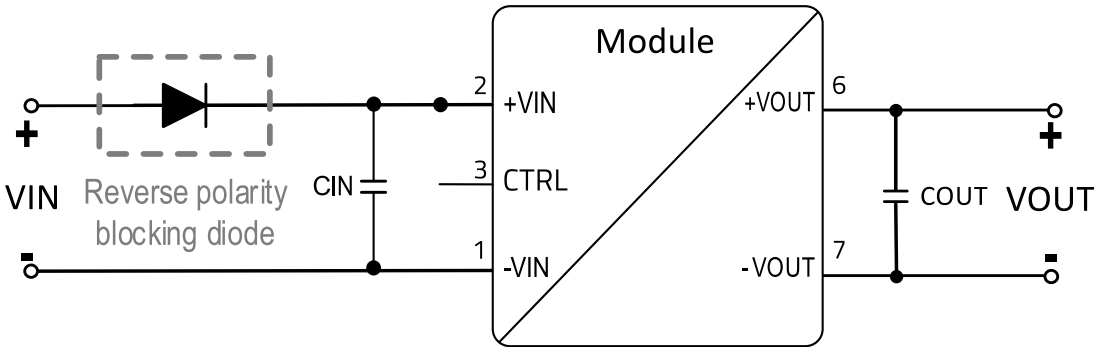


Figure 22: Reverse polarity protection.

22 HANDLING RECOMMENDATIONS

1. According to JEDEC J-STD033 an MSL classification is not applicable for THT components. Therefore the power module does not require special handling or storage to protect it from ambient moisture.
2. The profile below is valid for wave soldering only.

22.1 Solder Profile

Table 15: Wave solder profile according to EN61760-1:2006.

Profile Feature	Value
Final preheat temperature T_s	120°C
Preheat Time	70s
Ramp-up Rate ΔT from T_S to T_p	150°C max.
Peak temperature T_p	250°C-260°C
Time within peak temperature t_p	max. 10s max. 5s each wave
Ramp-down rate	-3.5°C/s
Time 25°C to 25 °C	4 minutes

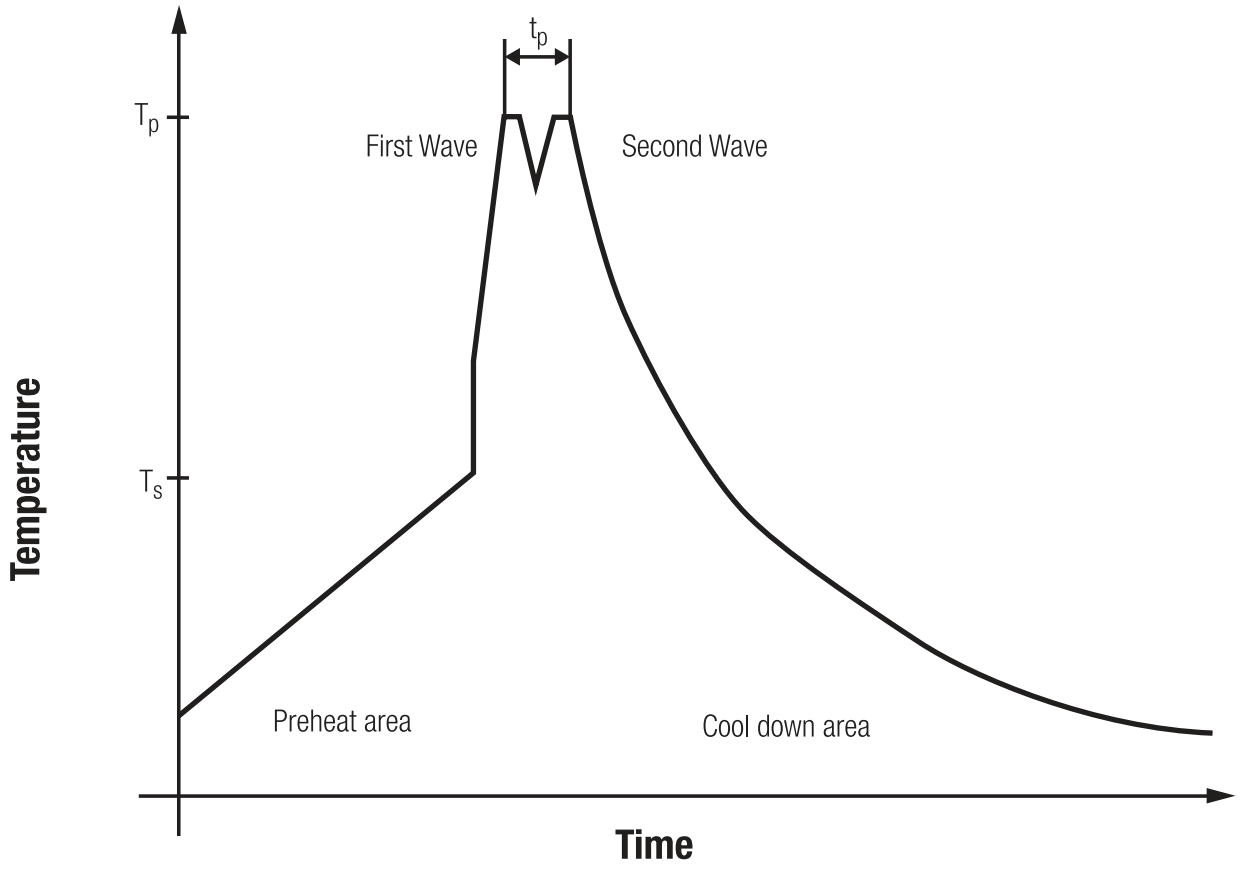


Figure 23: Wave solder profile according to EN61760-1:2006.

Manual Soldering

1. Maximum soldering temperature should not exceed 365°C±15°C.
2. Maximum soldering time: max. 3 seconds

23 PHYSICAL DIMENSIONS

23.1 Component

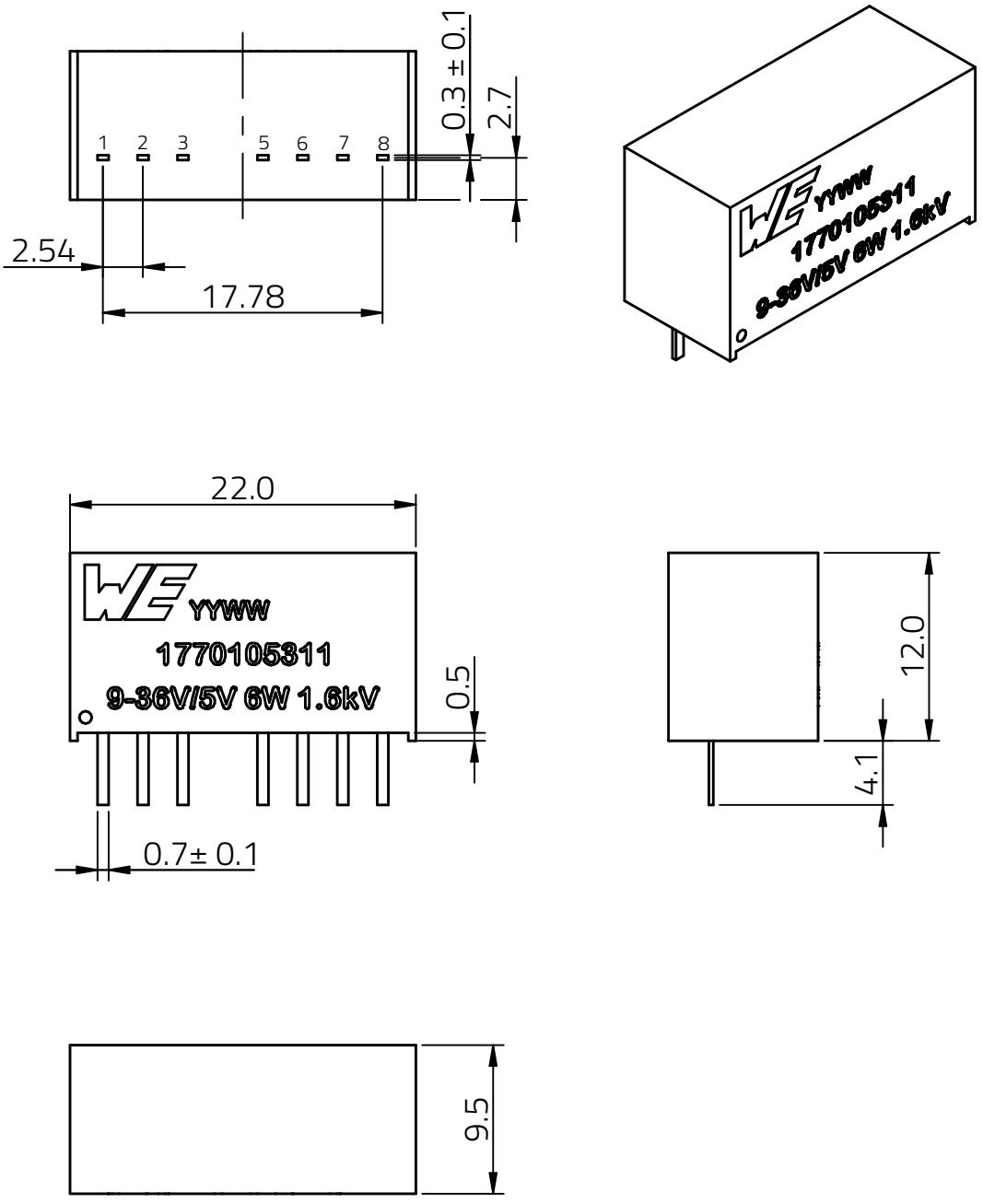


Figure 24: Physical dimensions.

All dimensions in mm
Tolerance: xx.x = ±0.5mm ; xx.xx = ±0.25mm unless otherwise noted

23.2 Recommended Drill Holes

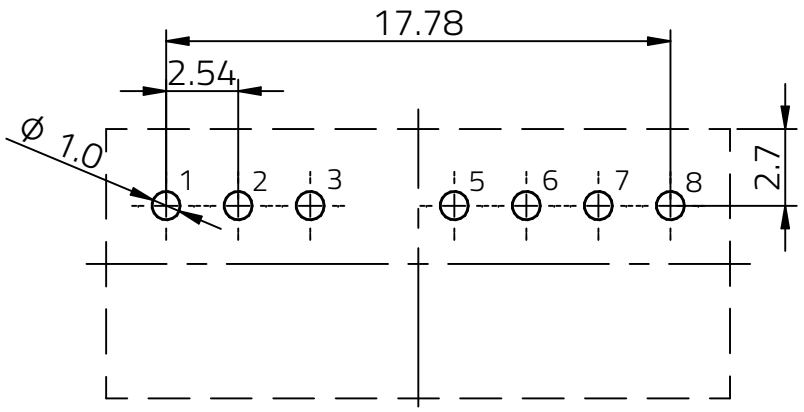


Figure 25: Recommended drill hole dimensions.

All dimensions in mm

23.3 Packaging

23.3.1 Tube

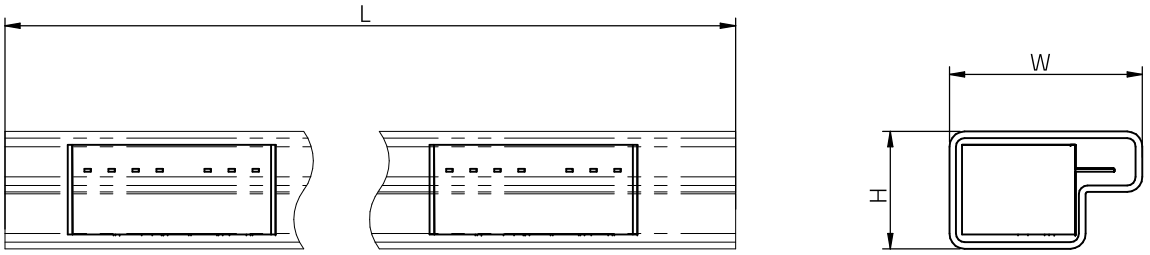


Figure 26: Tube dimensions.

Table 16: Tube dimensions.

Tube dimension	L	W	H
Tolerance	typ.	typ.	typ.
Value	522mm	20.4mm	12.4mm

23.3.2 Carton

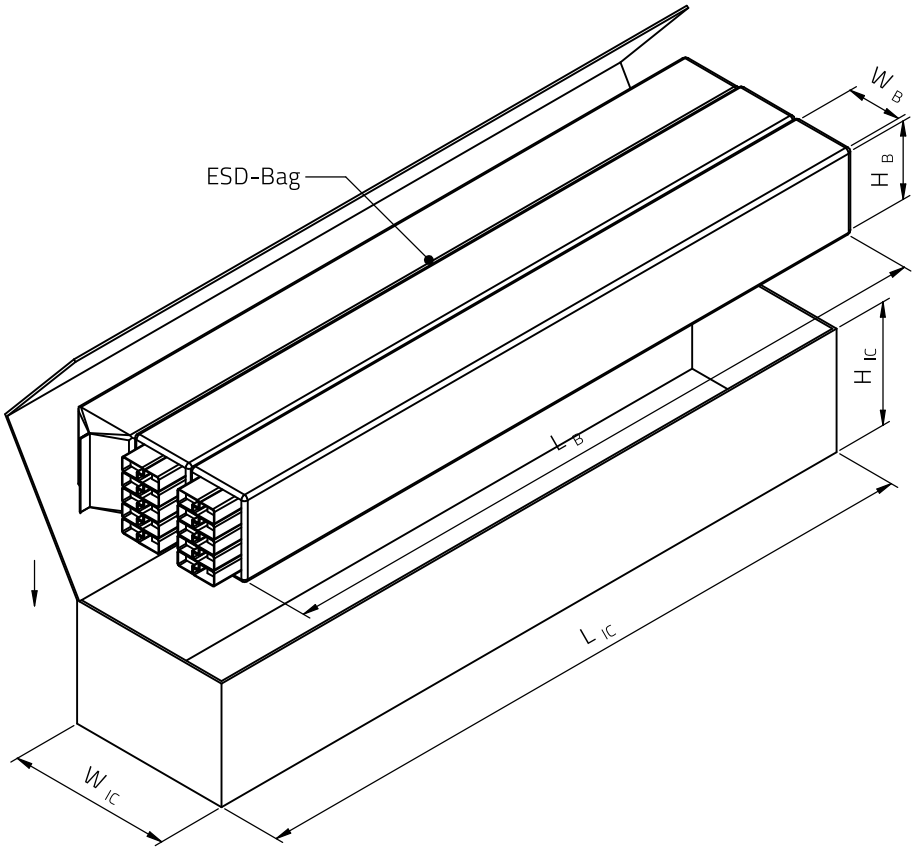


Figure 27: Inner carton and ESD bag dimensions.

Table 17: Inner carton and ESD bag dimensions.

Inner carton and ESD bag dimension	L_B	W_B	H_B	L_{IC}	W_{IC}	H_C
Tolerance	typ.	typ.	typ.	typ.	typ.	typ.
Value	570mm	38mm	55mm	575mm	135mm	100mm

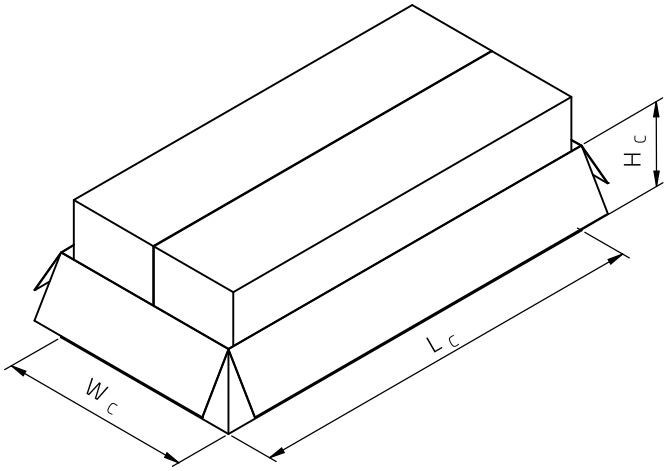


Figure 28: Carton dimensions.

Table 18: Outer carton dimensions.

Outer carton dimension	L_C	W_C	H_C
Tolerance	typ.	typ.	typ.
Value	600mm	285mm	125mm

24 DOCUMENT HISTORY

Table 19: Document history.

Revision	Date	Description	Comment
1.0	July 2026	Initial release of datasheet	

25 LIST OF FIGURES

26 LIST OF TABLES

27 CAUTIONS AND WARNINGS

The following conditions apply to all goods within the product series of MagI³C of Würth Elektronik eiSos GmbH & Co. KG:

General:

- All recommendations according to the general technical specifications of the data-sheet have to be complied with.
- The usage and operation of the product within ambient conditions which probably alloy or harm the component surface has to be avoided.
- The responsibility for the applicability of customer specific products and use in a particular customer design is always within the authority of the customer. All technical specifications for standard products do also apply for customer specific products
- Residual washing varnish agent that is used during the production to clean the application might change the characteristics of the body, pins or termination. The washing varnish agent could have a negative effect on the long term function of the product. Direct mechanical impact to the product shall be prevented as the material of the body, pins or termination could flake or in the worst case it could break. As these devices are sensitive to electrostatic discharge customer shall follow proper IC Handling Procedures.
- Customer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of Würth Elektronik eiSos GmbH & Co. KG components in its applications, notwithstanding any applications-related information or support that may be provided by Würth Elektronik eiSos GmbH & Co. KG.
- Customer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences lessen the likelihood of failures that might cause harm and take appropriate remedial actions
- Customer will fully indemnify Würth Elektronik eiSos and its representatives against any damages arising out of the use of any Würth Elektronik eiSos GmbH & Co. KG components in safety-critical applications

Product specific:

Follow all instructions mentioned in the datasheet, especially:

- The solder profile has to comply with the technical reflow or wave soldering specification, otherwise this will void the warranty.
- All products are supposed to be used before the end of the period of 12 months based on the product date-code.
- Violation of the technical product specifications such as exceeding the absolute maximum ratings will void the warranty.
- It is also recommended to return the body to the original moisture proof bag and reseal the moisture proof bag again.
- ESD prevention methods need to be followed for manual handling and processing by machinery.

Disclaimer:

This electronic component has been designed and developed for usage in general electronic equipment only. This product is not authorized for use in equipment where a higher safety standard and reliability standard is especially required or where a failure of the product is reasonably expected to cause severe personal injury or death, unless the parties have executed an agreement specifically governing such use. Moreover Würth Elektronik eiSos GmbH & Co. KG products are neither designed nor intended for use in areas such as military, aerospace, aviation, nuclear control, submarine, transportation (automotive control, train control, ship control), transportation signal, disaster prevention, medical, public information network etc. Würth Elektronik eiSos GmbH & Co. KG must be informed about the intent of such usage before the design-in stage. In addition, sufficient reliability evaluation checks for safety must be performed on every electronic component which is used in electrical circuits that require high safety and reliability functions or performance. These cautions and warnings comply with the state of the scientific and technical knowledge and are believed to be accurate and reliable. However, no responsibility is assumed for inaccuracies or incompleteness.

28 IMPORTANT NOTES

General Customer Responsibility

Some goods within the product range of Würth Elektronik eiSos GmbH & Co. KG contain statements regarding general suitability for certain application areas. These statements about suitability are based on our knowledge and experience of typical requirements concerning the areas, serve as general guidance and cannot be estimated as binding statements about the suitability for a customer application. The responsibility for the applicability and use in a particular customer design is always solely within the authority of the customer. Due to this fact it is up to the customer to evaluate, where appropriate to investigate and decide whether the device with the specific product characteristics described in the product specification is valid and suitable for the respective customer application or not. Accordingly, the customer is cautioned to verify that the datasheet is current before placing orders.

Customer Responsibility Related to Specific, in Particular Safety-Relevant, Applications

It has to be clearly pointed out that the possibility of a malfunction of electronic components or failure before the end of the usual lifetime cannot be completely eliminated in the current state of the art, even if the products are operated within the range of the specifications. In certain customer applications requiring a very high level of safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health it must be ensured by most advanced technological aid of suitable design of the customer application that no injury or damage is caused to third parties in the event of malfunction or failure of an electronic component.

Best Care and Attention

Any product-specific notes, warnings and cautions must be strictly observed. Any disregard will result in the loss of warranty.

Customer Support for Product Specifications

Some products within the product range may contain substances which are subject to restrictions in certain jurisdictions in order to serve specific technical requirements. Necessary information is available on request. In this case the field sales engineer or the internal sales person in charge should be contacted who will be happy to support in this matter.

Product R&D

Due to constant product improvement product specifications may change from time to time. As a standard reporting procedure of the Product Change Notification (PCN) according to the JEDEC-Standard we inform about minor and major changes. In case of further queries regarding the PCN, the field sales engineer or the internal sales person in charge should be contacted. The basic responsibility of the customer as per Section 1 and 2 remains unaffected.

Product Life Cycle

Due to technical progress and economical evaluation we also reserve the right to discontinue production and delivery of products. As a standard reporting procedure of the Product Termination Notification (PTN) according to the JEDEC Standard we will inform at an early stage about inevitable product discontinuance. According to this we cannot guarantee that all products within our product range will always be available. Therefore it needs to be verified with the field sales engineer or the internal sales person in charge about the current product availability expectancy before or when the product for application design-in disposal is considered. The approach named above does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.

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All the rights for contractual products produced by Würth Elektronik eiSos GmbH & Co. KG on the basis of ideas, development contracts as well as models or templates that are subject to copyright, patent or commercial protection supplied to the customer will remain with Würth Elektronik eiSos GmbH & Co. KG. Würth Elektronik eiSos GmbH & Co. KG does not warrant or represent that any license, either expressed or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, application, or process in which Würth Elektronik eiSos GmbH & Co. KG components or services are used.

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