

WPMIx9200501S / 1779205x4**MagI³C Power Module**
FISM – Fixed Isolated SIP Module

**5V – 24V / 1W / 4kV functional isolated
unregulated 5V Output**

DESCRIPTION

The FISM series of the unregulated MagI³C Power Module family is a functional isolated, fully integrated DC/DC converter. The module integrates the switching power stage, control circuitry, transformer and capacitors all in one package.

The module requires no external components for operation thus reducing design effort and complexity to a minimum.

The FISM ensures fast time to market and low development costs.

The FISM series achieves typically an efficiency of 75% to 81%.

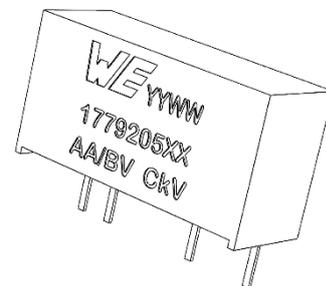
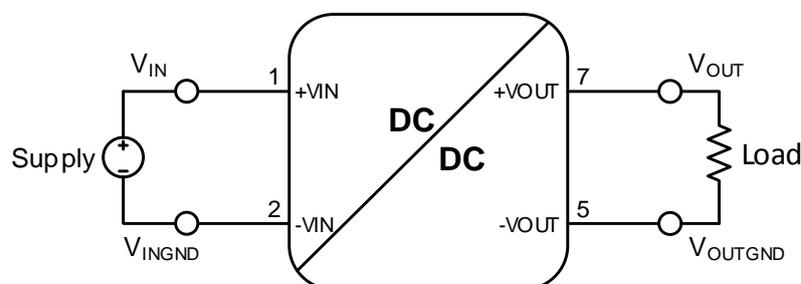
The THT package with industrial standard SIP7 pinout allows for easy assembly.

FEATURES

- 4kV DC functional isolation
- Current capability up to 0.2A
- Nominal input voltage rails: 5V / 12V / 24V
- Output voltage: 5V unregulated
- No minimum load required
- Continuous output power: 1W
- Integrated capacitors and transformer
- Low output voltage ripple: typ. 60mV at full load
- Output voltage accuracy: 5% max.
- Operating frequency range 50 kHz to 105 kHz
- -40°C to 85°C ambient operating temperature range
- RoHS & REACH compliant
- UL94V-0 package material
- EN55022 Class B compliant
- UL60950-1, 2nd Edition – pending
- C22.2 No. 60950-1-07 2nd Edition – pending
- IEC/EN60950-1, 2nd Edition – pending

TYPICAL APPLICATIONS

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

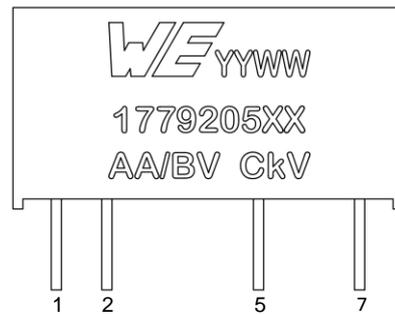
**TYPICAL CIRCUIT DIAGRAM**

WPMIx9200501S / 1779205x4

MagI³C Power Module
FISM – Fixed Isolated **SIP** Module

**MARKING DESCRIPTION**

MARKING	DESCRIPTION
WE	Würth Elektronik Tradename
YY	Year
WW	Calendar week
1779205XX	Ordering Code
AA	Input voltage
B	Output voltage
C	Isolation voltage

PACKAGE**PIN DESCRIPTION**

SYMBOL	NUMBER	TYPE	DESCRIPTION
+ VIN	1	Power	Input voltage
- VIN	2	Power	V _{IN} ground
-VOUT	5	Power	V _{OUT} ground
+VOUT	7	Power	Output voltage

ORDERING INFORMATION

ORDER CODE	PART DESCRIPTION	SPECIFICATIONS	PACKAGE	PACKAGING UNIT
177920514	WPMIB9200501S	5V _{IN} / 5V _{OUT} version	SIP-7	Tube with 25 pieces
177920524	WPMIA9200501S	12V _{IN} / 5V _{OUT} version	SIP-7	Tube with 25 pieces
177920534	WPMID9200501S	24V _{IN} / 5V _{OUT} version	SIP-7	Tube with 25 pieces

SALES INFORMATION

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

WPMIx9200501S / 1779205x4

MagI³C Power Module
FISM – Fixed Isolated SIP Module



ABSOLUTE MAXIMUM RATINGS

Caution:

Exceeding the listed absolute maximum ratings may affect the device negatively and may cause permanent damage. These are stress ratings only, which do not imply functional operation of the device at these or any other condition beyond those indicated under "Operation Conditions".

SYMBOL	PARAMETER	LIMITS		UNIT	
		MIN ⁽¹⁾	MAX ⁽¹⁾		
VIN	Input pin voltage for 10s@10% Load	177920514	4.00	5.75	V
		177920524	9.60	13.8	V
		177920534	19.2	27.6	V
VOUT	Output pin voltage	0	10	V	
V _{ISO}	Isolation voltage input to output, 100% tested for 1 second ⁽²⁾	-	4000	V	
C _{ISO}	Isolation capacitance		45	pF	
R _{ISO}	Isolation resistance	1		GΩ	
T _{storage}	Assembled, non-operating storage temperature	-55	125	°C	
V _{ESD}	ESD voltage (Human Body Model), according to EN61000-4-2		±2000	V	
Vibration		MIL-STD-202G		-	

OPERATING CONDITIONS

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

MIN and MAX limits are valid for the recommended ambient temperature range of **-40°C to 85°C**. Typical values represents statistically the utmost probability at following conditions: V_{IN} = 5V V_{OUT} = 5V (177920514), V_{IN} = 12V, V_{OUT} = 5V (177920524), V_{IN} = 24V, V_{OUT} = 5V (177920534), I_{OUT} = 0.2A unless otherwise noted.

SYMBOL	PARAMETER	MIN ⁽¹⁾	TYP ⁽³⁾	MAX ⁽¹⁾	UNIT	
VIN	Input voltage	177920514	4.5	5	5.5	V
		177920524	10.8	12	13.2	V
		177920534	21.6	24	26.4	V
VOUT	Nominal output voltage (I _{OUT} range 10% to 100%)	4.75	5	5.25	V	
I _{OUT}	Nominal output current ⁽⁴⁾	0	-	200	mA	
P _{OUT}	Nominal output power	-	-	1	W	
C _{OUT MAX}	Maximum output capacitor for default startup time	1779205x4	-	-	1000	µF
T _A	Ambient temperature range	-40	-	85	°C	

WPMIx9200501S / 1779205x4

MagI³C Power Module
FISM – Fixed Isolated SIP Module

**THERMAL SPECIFICATIONS**

SYMBOL	PARAMETER	TYP ⁽³⁾	UNIT
Θ_{CA}	Case-to-ambient thermal resistance ⁽⁵⁾	40	°C/W
$T_{case\ max}$	Maximum Case Temperature	105	°C
φ (RH)	Operating humidity	5 - 95	%

PACKAGE SPECIFICATIONS

Case:

Part Number	Material	UL Class	Certificate Number
1779205x4	WH-9100	UL94V-0	E150608

Potting:

Part Number	Potting Material	UL Class	Certificate Number
1779205x4	IR-401	UL94V-0	E129811

Weight
2.7g

WPMIx9200501S / 1779205x4

MagI³C Power Module
FISM – Fixed Isolated SIP Module



ELECTRICAL SPECIFICATIONS

MIN and MAX limits are valid for the recommended ambient temperature range of **-40°C to 85°C**. Typical values represents statistically the utmost probability at following conditions: $T_A = 25^\circ\text{C}$, $V_{IN} = 5\text{V}$, $V_{OUT} = 5\text{V}$ (177920514), $V_{IN} = 12\text{V}$, $V_{OUT} = 5\text{V}$ (177920524), $V_{IN} = 24\text{V}$, $V_{OUT} = 5\text{V}$ (177920534), $I_{OUT} = 0.2\text{A}$ unless otherwise noted.

SYMBOL	PARAMETER	TEST CONDITIONS	MIN ⁽¹⁾	TYP ⁽³⁾	MAX ⁽¹⁾	UNIT
Output Current						
I_{MOC}	Maximum overload current	5s	-	-	300 ⁽⁶⁾	mA
I_{OCP}	Over current protection		-	-	No ⁽⁷⁾	mA
Accuracy						
V_{OUT}	Line regulation	per 1.0% change in input voltage ⁽⁸⁾	-	± 1.2	-	%
	Load regulation	10% to 100% load current, 5V _{out} – see tolerance envelope	-	-	-5 +15	%
	Output voltage accuracy	V_{in} nominal	-	-	± 5	%
	Output voltage ripple	20MHz BW, without external MLCC capacitor	-	60	-	mV _{pp}
Switching frequency						
f_{SW}	Switching frequency	$V_{IN} = 12\text{V}$	50	-	105	kHz
Input current						
I_{IN}	No load input current (Operating, switching)	177920514	-	30	-	mA
		177920524	-	15	-	mA
		177920534	-	10	-	mA
Efficiency						
η	Efficiency	$V_{IN} = 5\text{V}$, $V_{OUT} = 5\text{V}$	-	75	-	%
		$V_{IN} = 12\text{V}$, $V_{OUT} = 5\text{V}$	-	80	-	%
		$V_{IN} = 24\text{V}$, $V_{OUT} = 5\text{V}$	-	81	-	%

RELIABILITY

SYMBOL	PARAMETER	CONDITIONS	MIN ⁽¹⁾	TYP ⁽³⁾	MAX ⁽¹⁾	UNIT
MTBF ⁽⁹⁾	Mean Time Between Failures	+25°C: Ground Benign	13200 x10 ³ h			h
		+85°C: Ground Benign	5200 x10 ³ h			h

APPROVALS

UL 60950		Recognized for use as Information Technology Equipment, U.S.A. (UL 60950-1) - pending and Canada (C22.2 No. 60950-1) - pending; applicable for altitudes up to 2000m
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WPMIx9200501S / 1779205x4**MagI³C** Power Module
FISM – Fixed Isolated SIP Module**NOTES**

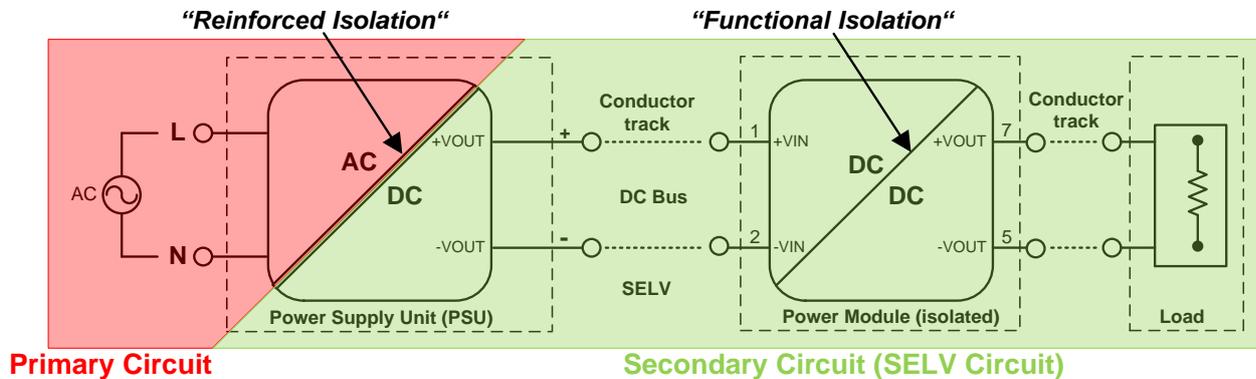
- (1) Min and Max limits are 100% production tested at 25°C. Limits over the operating temperature range are guaranteed through correlation using Statistical Quality Control (SQC) methods.
- (2) Test voltage as defined by the UL60950-1
- (3) Typical values are valid at 25°C ambient temperature and represent statistically the utmost probability assuming the Gaussian distribution.
- (4) Depending on temperature, see safe operating area diagram (SOA)
- (5) Measured without heatsink, no air flow
- (6) Overload current, see overload behavior diagram
- (7) The module output is not current limited or short circuit protected. Continuous operation above the specified values will damage the device.
- (8) Within the complete V_{IN} tolerance range
- (9) 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 177920514

WPMIx9200501S / 1779205x4

MagI³C Power Module FISM – Fixed Isolated SIP Module



INTENDED USE – Typical Application



The 1779205x4 MagI³C Power Modules are only intended to be used as a CLASS III equipment according to the UL60950-1 standard. That requires that the Power Module is supplied by a **SELV** (safe extra low voltage) circuit which provides protection against electric shock. There are no HAZARDOUS voltages present in CLASS III Equipment.

A **SELV** circuit is a **secondary circuit** that is designed to be protected from excessive voltages ($\geq 42 \text{ Vac}$ or $\geq 60 \text{ Vdc}$) during normal operating conditions and single fault conditions. A reinforced isolation is required at the boundary between the primary and the secondary circuit.

A circuit which has no direct connection to the primary circuit and derives its power from a transformer, converter or equivalently isolated device, or a battery, is defined as a **secondary circuit**.

In accordance to the Safety Standard UL60950-1, functional insulation (insulation) is defined as:

*“1.2.9.1 Functional Insulation: insulation that is necessary only for the correct functioning of the equipment
 NOTE: Functional Insulation by definition does not protect against electric shock. It may, however, reduce the likelihood of ignition and fire.”*

*“1.2.9.5 Reinforced Insulation: single insulation system that provides a degree of protection against electric shock equivalent to Double Insulation under the conditions specified in this standard.
 NOTE: The Term “insulation system” does not imply that the insulation has to be in one homogeneous piece. It may comprise several layers that cannot be tested that cannot be tested as Basic Insulation and Supplementary Insulation*

The above Figure shows a typical application of an isolated Power Module. V_{DC1} is a hazardous voltage and V_{DC2} is a SELV voltage.

ISOLATION VOLTAGE

To verify the integrity of an 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 a ‘Hi Pot Test’, ‘Flash Tested’, ‘Withstand Voltage’, ‘Proof Voltage’, ‘Dielectric Withstand Voltage’ & ‘Isolation Test Voltage’.

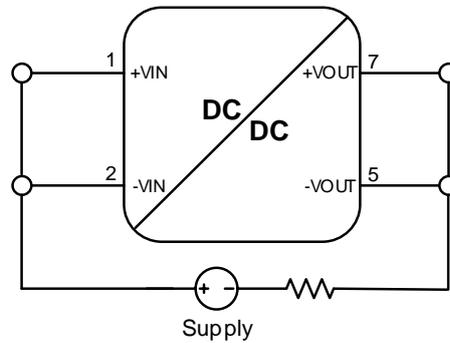
All isolated Power Modules are all 100% production tested at their stated isolation voltage. This is 4kVDC for 1 second.

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 part 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 are taken to prevent any user-accessible circuitry from causing harm.

WPMIx9200501S / 1779205x4

MagI³C Power Module
FISM – Fixed Isolated SIP Module

**DIELECTRIC STRENGTH TEST SETUP (HIGH POT TEST)**

Connect all input – and output terminals together (see Figure) before connecting the supply voltage. When testing, set the cut-off current to 1mA.

Parameters Supply Device: Current limit set to 1mA, Test voltage 4000Vdc, Test time 1sec.

REPEATED HIGH-VOLTAGE ISOLATION TESTING

A repeated high voltage test of a barrier component will degrade its isolation capabilities.

The primary and secondary windings within this transformer are enameled (coated) but do not possess additional isolation. Typically, parts can withstand many times their stated test voltage and still perform optimally. The enamel 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 enamel (i.e. physical barriers or spacing).

WPMIx9200501S / 1779205x4

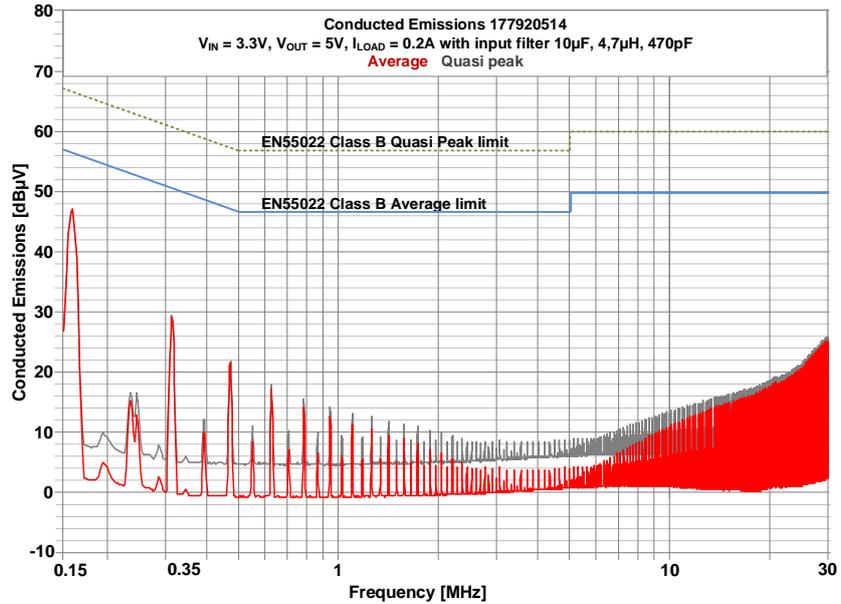
MagI³C Power Module
FISM – Fixed Isolated SIP Module



TYPICAL PERFORMANCE CURVES

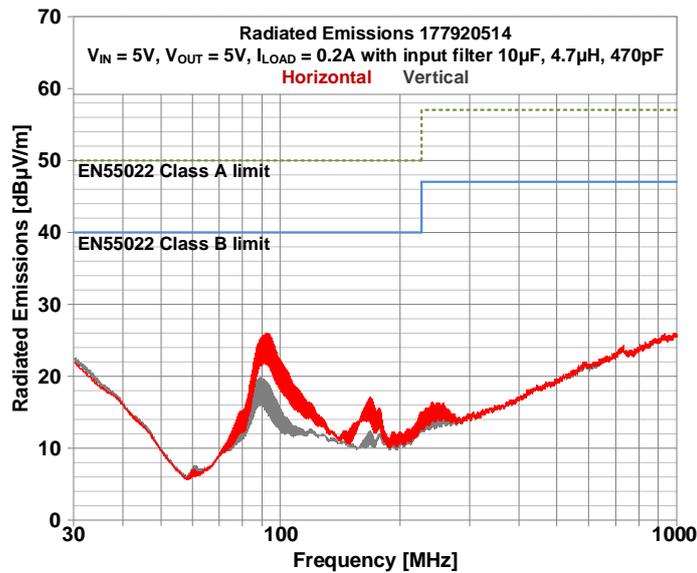
If not otherwise specified, the following conditions apply: $T_{AMB} = 25^{\circ}\text{C}$.

5V → 5V (177920514) - CONDUCTED EMISSION INPUT (EN55022)



5V → 5V (177920514) - RADIATED EMISSION INPUT (EN55022)

Measured with external filter at 3m antenna distance

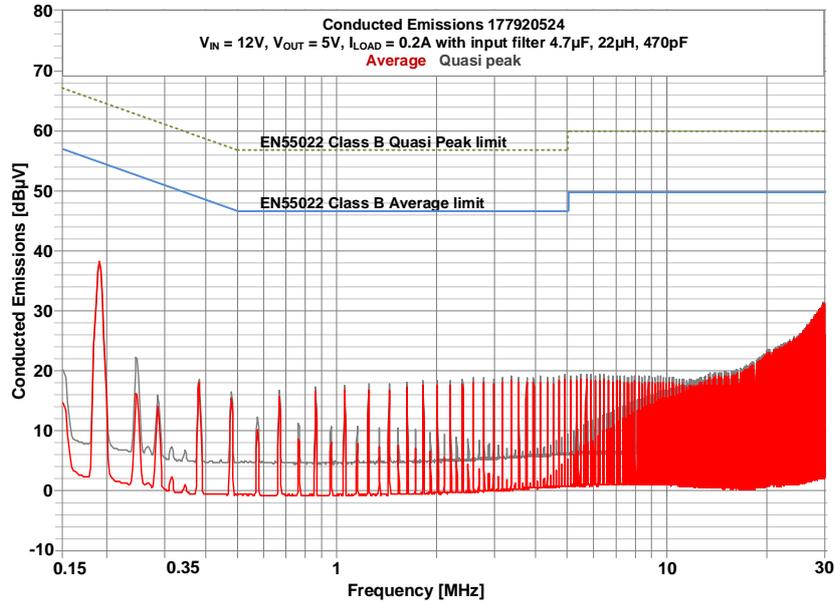


WPMIx9200501S / 1779205x4

MagI³C Power Module
 FISM – Fixed Isolated SIP Module

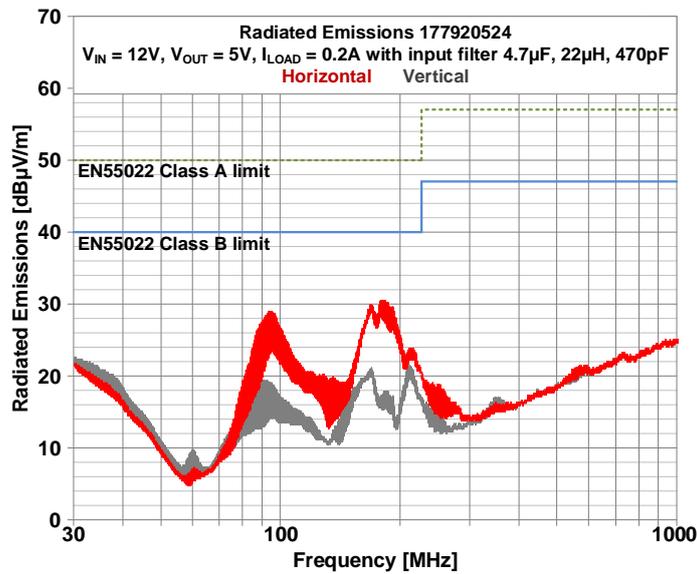


12V → 5V (177920524) - CONDUCTED EMISSION INPUT (EN55022)



12V → 5V (177920524) - RADIATED EMISSION INPUT (EN55022)

Measured with external filter at 3m antenna distance

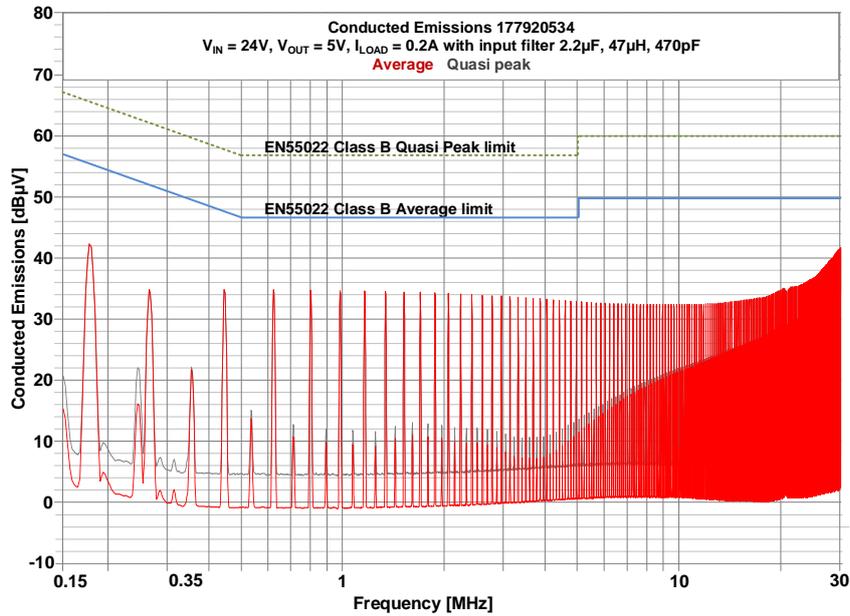


WPMIx9200501S / 1779205x4

MagI³C Power Module
FISM – Fixed Isolated **SIP** Module

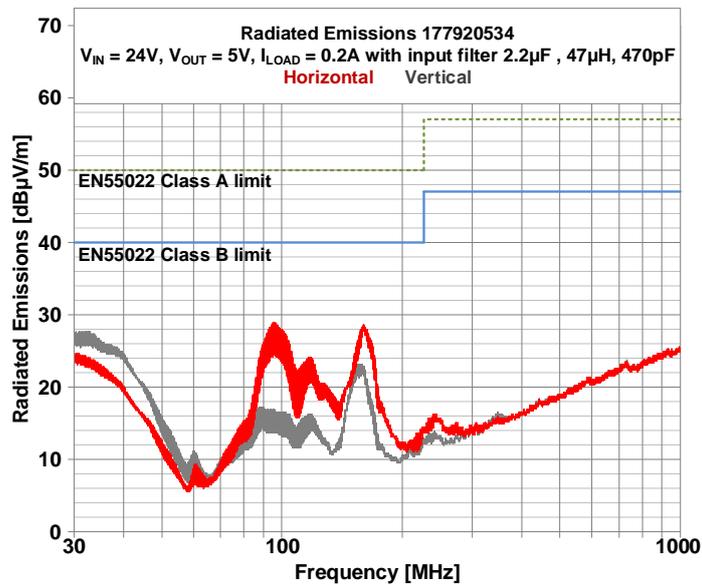


24V → 5V (177920534) - CONDUCTED EMISSION INPUT (EN55022)



24V → 5V (177920534) - RADIATED EMISSION INPUT (EN55022)

Measured with external filter at 3m antenna distance

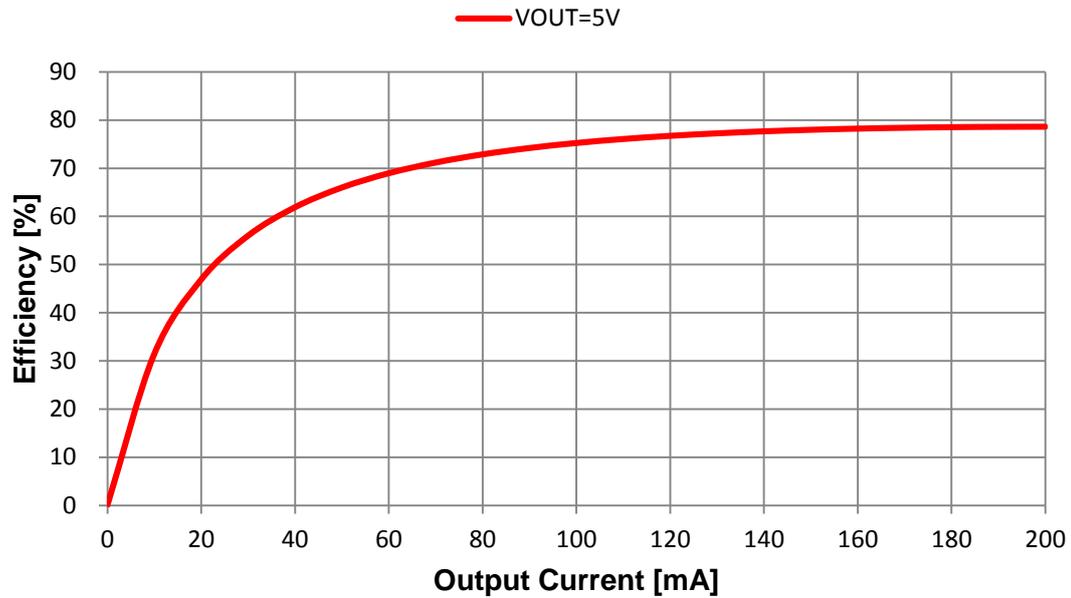
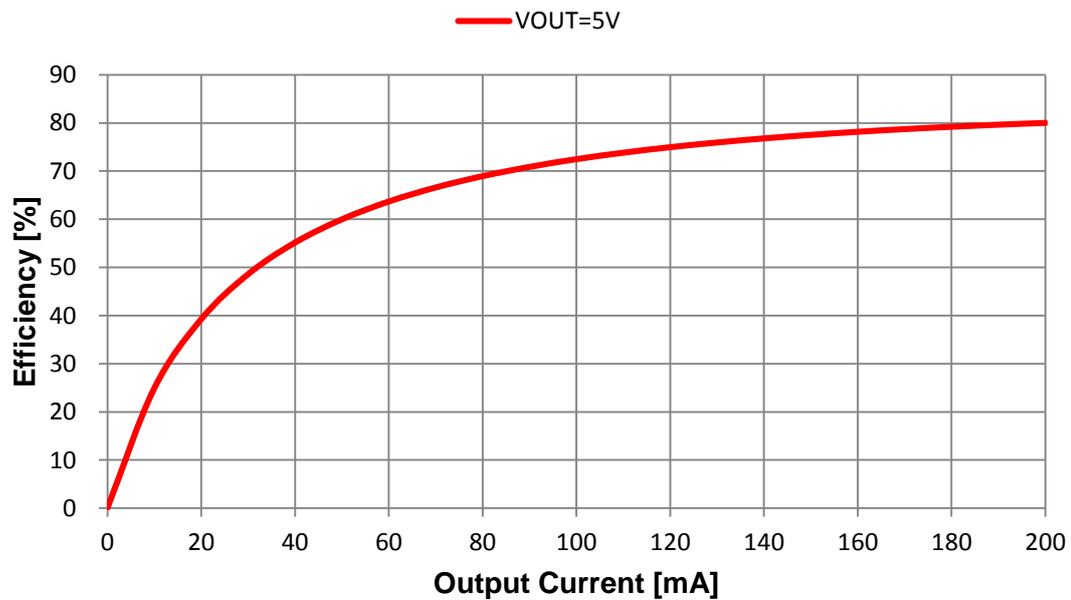


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MagI³C Power Module
FISM – Fixed Isolated SIP Module



EFFICIENCY

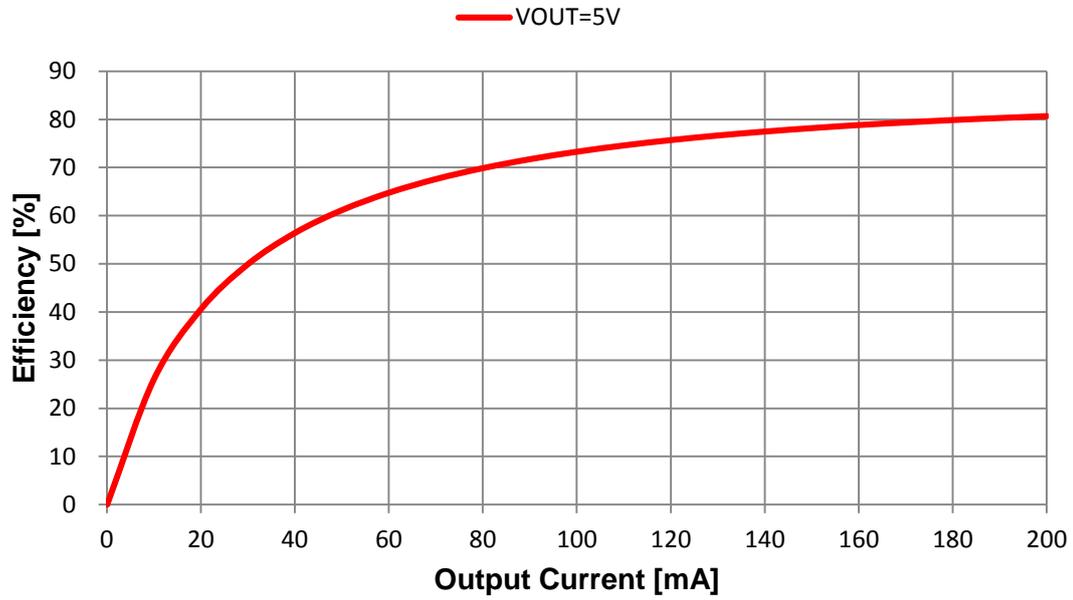
177920514 Efficiency - $V_{in} = 5V$ 177920524 Efficiency - $V_{in} = 12V$ 

WPMIx9200501S / 1779205x4

MagI³C Power Module
FISM – Fixed Isolated **SIP** Module



177920534 Efficiency - $V_{IN} = 24V$

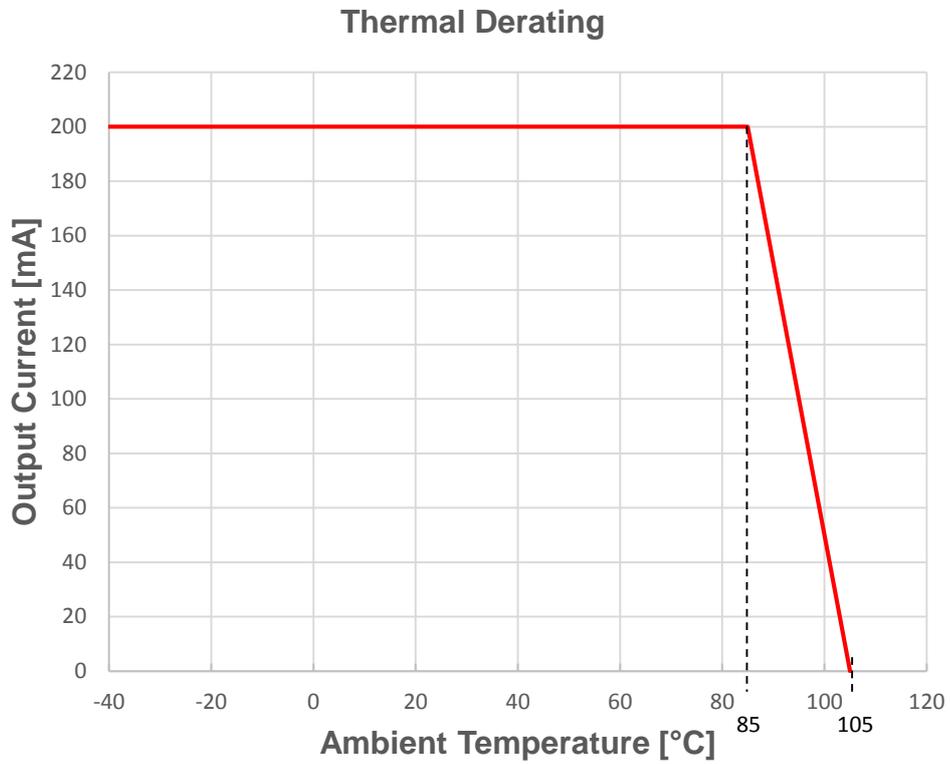


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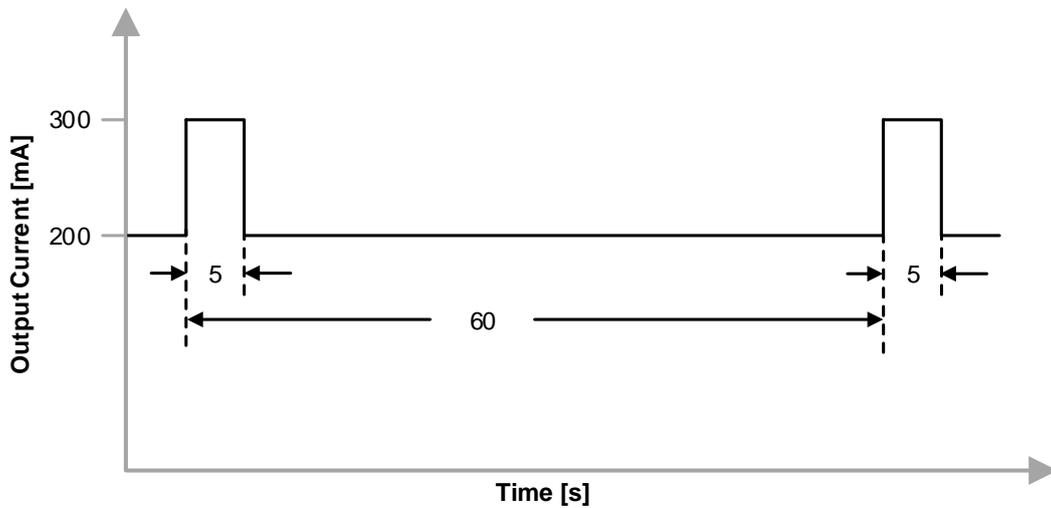
MagI³C Power Module
 FISM – Fixed Isolated SIP Module



OUTPUT POWER



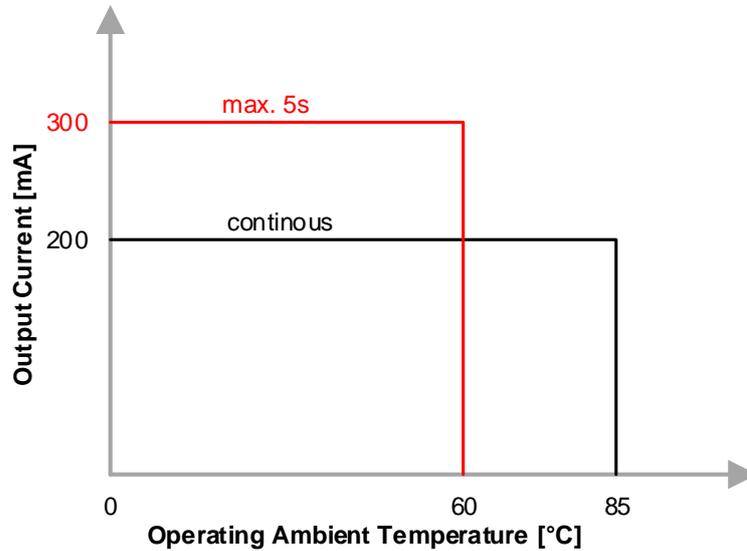
OVERLOAD BEHAVIOUR - I_{MOC} DUTY CYCLE



Note: The overload current of 300mA can be supplied for maximum 5s and requires a 55s recovery time till next overload event.

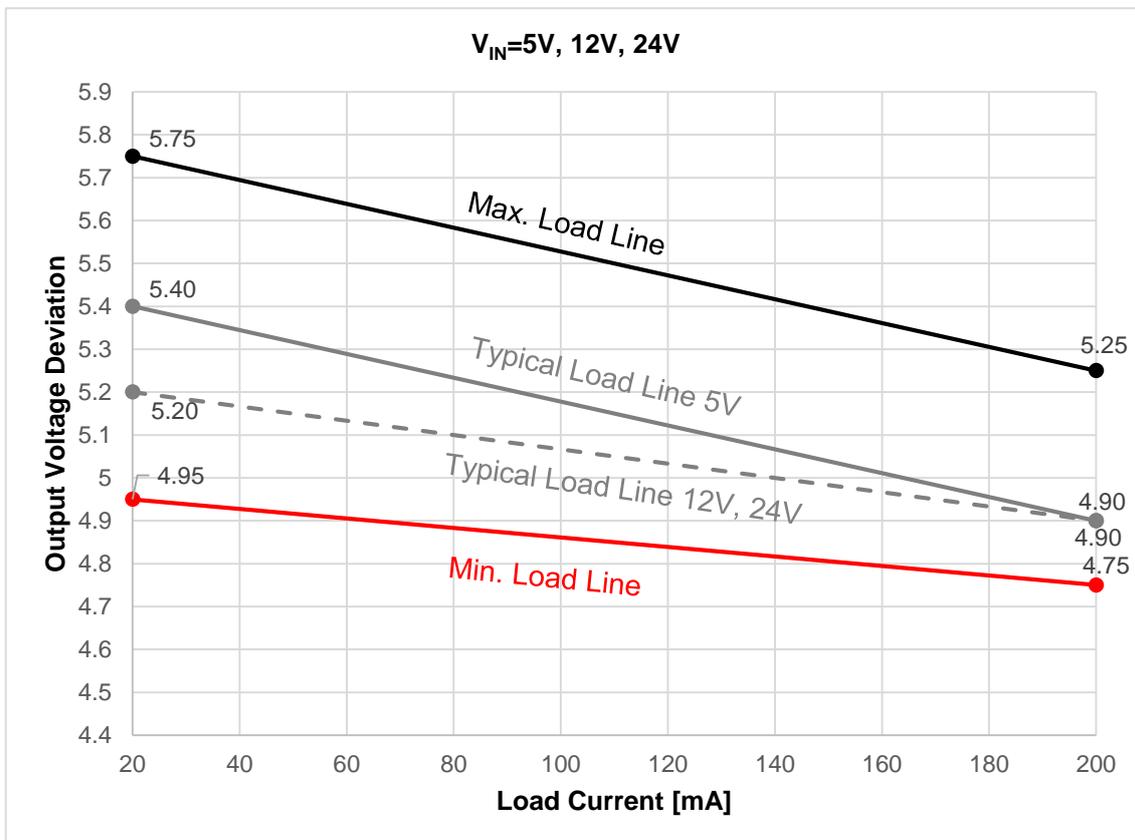
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Note: Valid for 5 LFM = 0.03m/s natural convection cooling / horizontal orientate

OUTPUT VOLTAGE TOLERANCE ENVELOPE

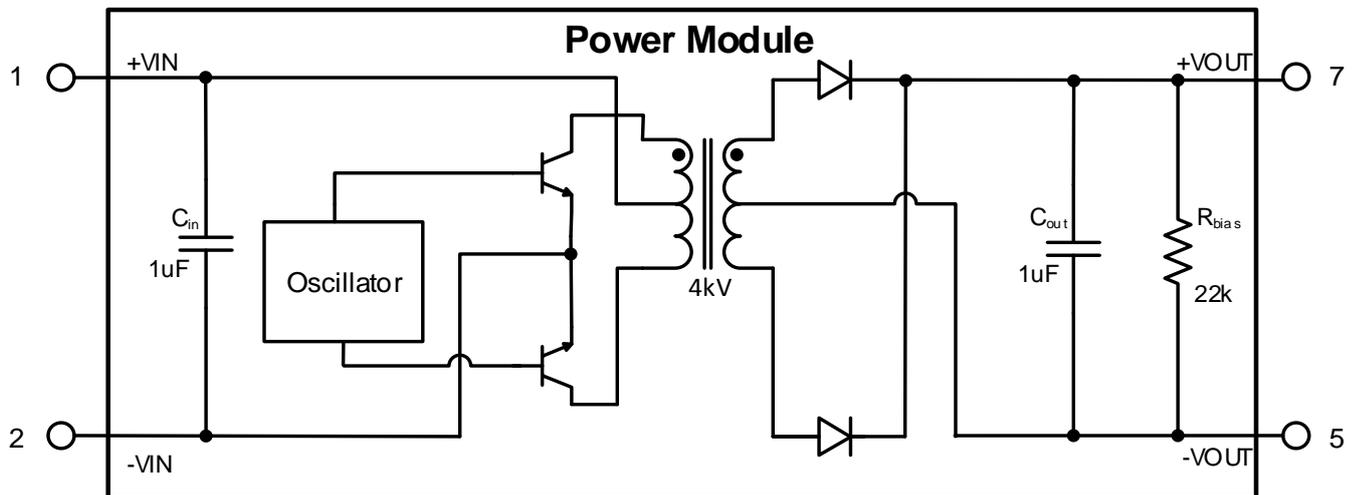


WPMIx9200501S / 1779205x4

Magl³C Power Module
FISM – Fixed Isolated SIP Module



BLOCK DIAGRAM



CIRCUIT DESCRIPTION

The Magl³C Power Modules 1779205x4 are based on a push – pull converter with integrated Transistors, rectifying diodes, isolated transformer, input and output capacitors. The modules are unregulated.

Since there is no feedback path from the output to the input, the duty cycle is fixed to 50%. The duty cycle is independent from the load (zero load to full load). The output voltage is basically defined by the turns ratio of the transformer.

PROTECTIVE FEATURES

Due to the structure of the Power Module following protective feature are **NOT** implemented:

- Over temperature protection (OTP)
- Over current protection (OCP)
- Output overvoltage protection (OVP)
- Input overvoltage protection
- Short circuit protection (SCP)
- Input reverse polarity protection

Note: To protect the source and the Magl³C Power Module in abnormal conditions (secondary side overload or short circuit) a primary side input fuse of max. 1A (slow blow) is recommended.

WPMIx9200501S / 1779205x4

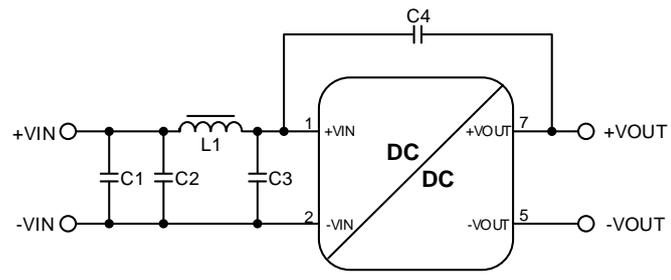
MagI³C Power Module
FISM – Fixed Isolated SIP Module



APPLICATION CONSIDERATIONS

Filter Suggestion for Conducted and Radiated EMI

The input filter shown in the schematic below is recommended to achieve conducted and radiated EMI compliance according to EN55022 Class B (see results on pages 9 to 11).



Component Values for Class B filters for the EN55022: C3 is an optional MLCC cap to build up a PI - Filter

Input Voltage 5V:

DESIGNATOR	DESCRIPTION	ORDER CODE	MANUFACTURER
C1	Filter ceramic chip capacitor 10µF/25V 1210 X7R	885012209028	Würth Elektronik
L1	Filter inductor, 4.7µH, PD2 family	744773047	Würth Elektronik
C4	Filter ceramic chip capacitor 470pF/250Vac/5000V Impulse Voltage 1812 X7R	885352211001	Würth Elektronik

Input Voltage 12V:

DESIGNATOR	DESCRIPTION	ORDER CODE	MANUFACTURER
C1	Filter ceramic chip capacitor 4.7µF/50V 1210 X7R	885012209048	Würth Elektronik
L1	Filter inductor, 22µH, PD2 family	744773122	Würth Elektronik
C4	Filter ceramic chip capacitor 470pF/250Vac/5000V Impulse Voltage 1812 X7R	885352211001	Würth Elektronik

Input Voltage 24V:

DESIGNATOR	DESCRIPTION	ORDER CODE	MANUFACTURER
C1	Filter ceramic chip capacitor 2.2µF/50V 1812 X7R	885012210032	Würth Elektronik
L1	Filter inductor, 47µH, PD2 family	744773147	Würth Elektronik
C4	Filter ceramic chip capacitor 470pF/250Vac/5000V Impulse Voltage 1812 X7R	885352211001	Würth Elektronik

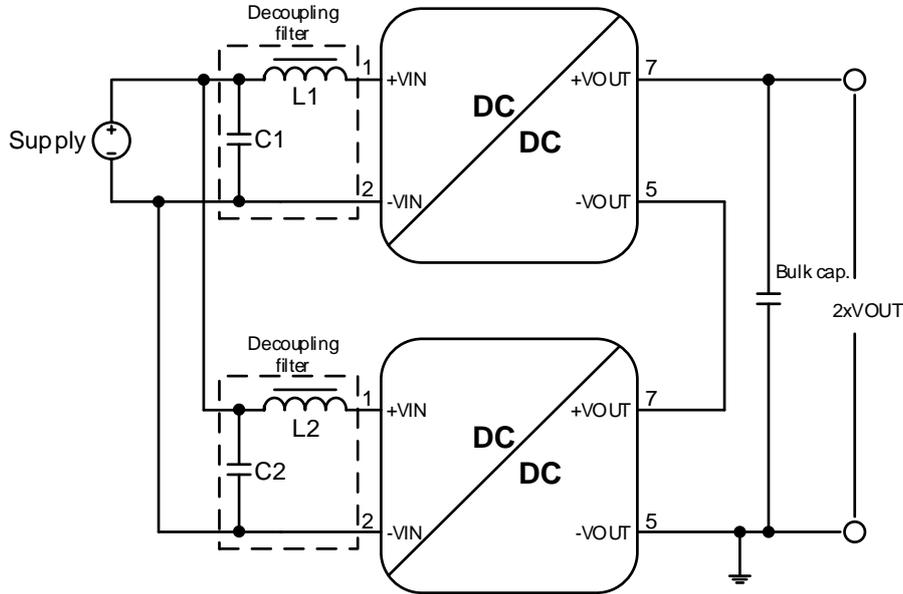
WPMIx9200501S / 1779205x4

MagI³C Power Module
FISM – Fixed Isolated SIP Module



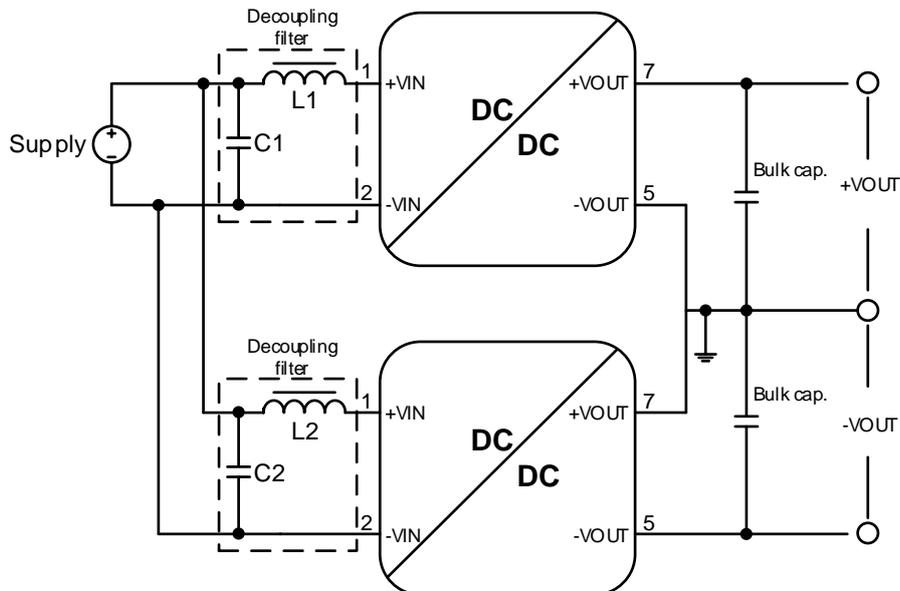
Series connection

To generate higher output voltage/special rail voltages.



Generating complementary output voltage

Another common requirement in industrial application is to provide a complementary voltage (e.g. $\pm 5V$). The circuit below shows how this target can be achieved by simply combining two 1779205x4 used in a standard configuration (delivering a positive output voltage) with a 1779205x4 in reverse configuration.



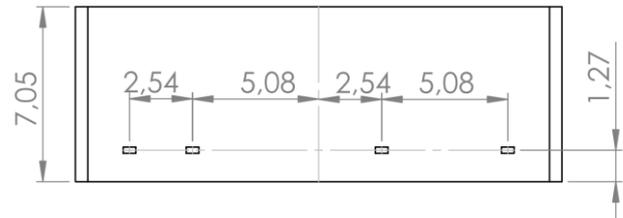
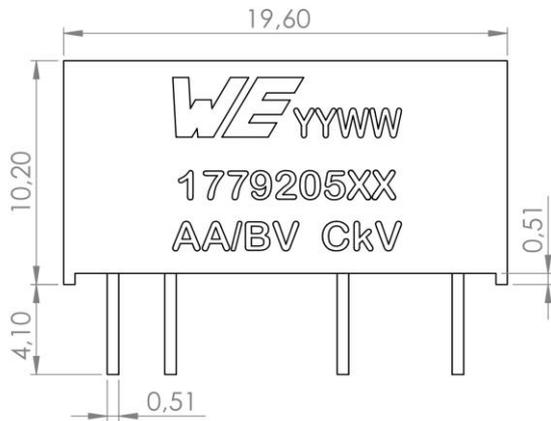
Note: A decoupling filter is present to avoid oscillations between the two Power Modules. The decoupling filter doesn't replace the EMI input filter.

WPMIx9200501S / 1779205x4

MagI³C Power Module
FISM – Fixed Isolated **SIP** Module

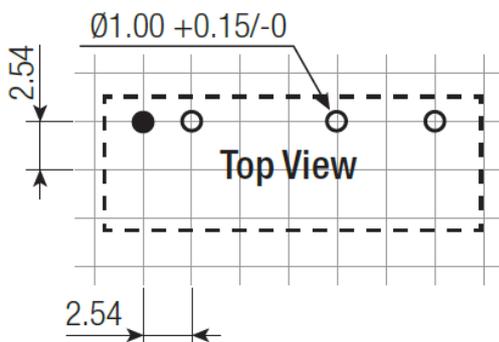


PHYSICAL DIMENSIONS

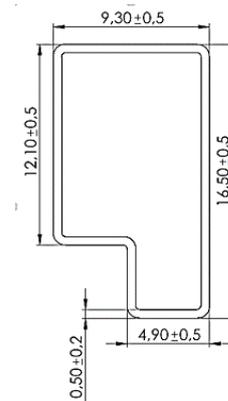


Tolerance: xx.x = ±0.5mm ; xx.xx = ±0.25mm

RECOMMENDED DRILL HOLES



TUBE



all dimensions in mm

DOCUMENT HISTORY

Revision	Date	Description	Comment
1.0	19.08.2016	Final version	

WPMIx9200501S / 1779205x4**MagI³C** Power Module
FISM – Fixed Isolated SIP Module**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.

WPMIx9200501S / 1779205x4

MagI³C Power Module
FISM – Fixed Isolated SIP Module



IMPORTANT NOTES

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

1. 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.

2. 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.

3. Best Care and Attention

Any product-specific notes, warnings and cautions must be strictly observed.

4. 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.

5. 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.

6. 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.

7. Property Rights

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.

8. General Terms and Conditions

Unless otherwise agreed in individual contracts, all orders are subject to the current version of the "General Terms and Conditions of Würth Elektronik eiSos Group", last version available at www.we-online.com.