

WPMDL9500xx / 17395xx78**MagI³C** Power Module**FDSM** - Fixed Step Down Regulator Module**28V / 0.5A / 3.3V and 5V Output****DESCRIPTION**

The FDSM series of the MagI³C power module family is a fixed output voltage, fully integrated dc/dc power supply. The module integrates the switching power stage, control circuitry and inductor all in one package.

The module requires no external components for operation. Input and output capacitors are integrated. Design effort and complexity is reduced to a minimum.

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

It is pin compatible with the common 78xx linear regulator series. The high efficiency reduces the power dissipation and in many cases heatsinks and assembly parts are no longer necessary.

Typical 12V to 3.3V conversion achieves 85% efficiency. 12V to 5V conversion achieves 92 %.

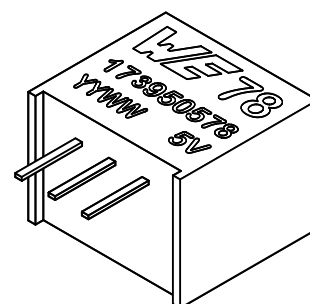
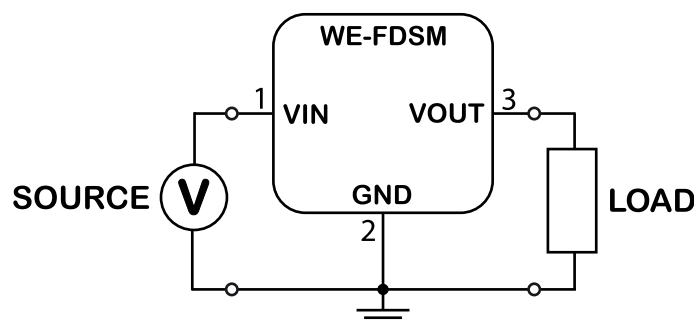
The standard THT package allows for easy assembly.

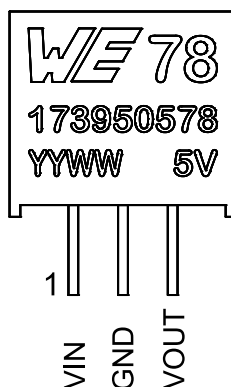
FEATURES

- Peak efficiency up to 95%
- 6V to 28V input voltage range
- 3.3V or 5V fixed output voltage
- 500mA output current
- Low output voltage ripple (typ. 10mV)
- Short circuit protection
- -40°C to 85°C ambient operating temperature range
- Thermal shutdown
- Integrated capacitors and inductor
- Pulse skipping for high efficiency at light loads
- Fixed 570 kHz switching frequency
- Output overvoltage protection
- RoHS & REACH compliant
- UL94V-0 package material

TYPICAL APPLICATIONS

- Point-of-Load from 18V, 15V, 12V, 9V rail
- Replacement for linear regulators
- Interface and microcontroller supply
- General purpose

**TYPICAL CURCUIT DIAGRAM**

WPMDL9500xx / 17395xx78**MagI³C** Power Module**FDSM** - Fixed Step Down Regulator Module**PACKAGE****PIN DESCRIPTION**

PIN	SYMBOL	TYPE	PIN DESCRIPTION
1	V_{IN}	Power	Input supply voltage
2	GND	Power	Ground, reference for V_{in} and V_{out}
3	V_{OUT}	Power	Output voltage

ORDERING INFORMATION

ORDER CODE	PART DESCRIPTION	PACKAGE	VOUT VERSION	PACKAGING UNIT
173950578	WPMDL950005	SIP-3	5V	TUBE 42 pcs.
173950378	WPMDL950003	SIP-3	3.3V	TUBE 42 pcs.

SALES INFORMATION

SALES CONTACT
<p> Würth Elektronik eiSos GmbH & Co. KG EMC & Inductive Solutions Max-Eyth-Str. 1 74638 Waldenburg Germany Tel. +49 (0) 79 42 945 - 0 www.we-online.com powermodules@we-online.com </p>

WPMDL9500xx / 17395xx78

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FDSM - Fixed Step Down Regulator Module

**ABSOLUTE MAXIMUM RATINGS**

Caution:

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

SYMBOL	PARAMETER	LIMITS	UNIT
V_{IN}	Input voltage	-0.3 to 30	V
V_{ESD}	ESD voltage (Human Body Model) ⁽¹⁾	-2000 to +2000	V
T_{ST}	Storage temperature	-55 to 125	°C

OPERATING CONDITIONS

Operating conditions are conditions under which operation of the device is intended to be functional. All values are referenced to GND and to a free ambient operating temperature of $T_A = 25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ unless otherwise specified.

SYMBOL	PARAMETER	MIN ⁽³⁾	TYP ⁽⁴⁾	MAX ⁽³⁾	UNIT
V_{IN}	Input voltage (173950378) 3.3V _{OUT} version	6	-	28	V
V_{IN}	Input Voltage (173950578) 5V _{OUT} version	7	-	28	V
T_A	Ambient temperature range ⁽²⁾	-40	-	+85	°C
I_{OUT}	Output current	5	-	500	mA
$C_{LOADMAX}$	Maximum capacitive load	-	-	220	μF

THERMAL SPECIFICATIONS

SYMBOL	PARAMETER	MIN ⁽³⁾	TYP ⁽⁴⁾	MAX ⁽³⁾	UNIT
Θ_{JA}	Thermal resistance junction to ambient		166		K/W

WPMDL9500xx / 17395xx78**MagI³C** Power Module
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MIN and MAX values are valid for recommended ambient temperature range of **-40°C to 85°C**. Typical values represent statistically the utmost probability at following conditions: $V_{in} = 6V$ (3.3V version), $V_{in} = 7V$ (5V version) to 28V at ambient temperature of 25°C (unless otherwise noted)

SYMBOL	PARAMETER	CONDITIONS	MIN ⁽³⁾	TYP ⁽⁴⁾	MAX ⁽³⁾	UNIT
V_{OUT}	Regulated output voltage	order no. 173950578	4.850	5	5.150	V
	Regulated output voltage	order no. 173950378	3.201	3.3	3.399	V
	Output voltage tolerance	$V_{out} = 3.3V$ and 5V	-	-	3	%
	Switch current limit	$V_{in} = 12V$	2.3	3.5	5.3	A
$\Delta V_{OUT} / \Delta V_{IN}$	Line regulation	$V_{in MIN}$ to $V_{in MAX}$ $I_{OUT} = 5mA$ to 500mA	-	-	0.5	%
$\Delta V_{OUT} / \Delta I_{OUT}$	Load regulation	10% to 100% load	-	-	1	%
f_{SW}	Switching frequency	$V_{in} = 12V$	400	570	740	kHz
I_Q	Quiescent current	$V_{in} = 24V$, no load	-	1.5	-	mA

RELIABILITY

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
MTBF ⁽⁵⁾	MTBF at 25°C	MIL-HDBK-217F	4185 • 10 ³			h
MTBF ⁽⁵⁾	MTBF at 75°C	MIL-HDBT-217F	2182 • 10 ³			h

NOTES

- ⁽¹⁾ The human body model is defined as a 100pF capacitor which is discharged through a 1.5 kΩ resistor into each pin according to JESD-22-114.
- ⁽²⁾ Device mounted without heatsink. No air flow.
- ⁽³⁾ 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.
- ⁽⁴⁾ Typical numbers are valid at 25°C ambient temperature and represent statistically the utmost probability assuming the Gaussian distribution.
- ⁽⁵⁾ MTBF: Mean time before failure

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PROTECTIVE FEATURES

Overvoltage transient protection

This protection mode minimizes the occurrence of output voltage overshooting. Once the output voltage reaches an overvoltage threshold the switching from V_{in} will be stopped immediately via the high side FET. When the output voltage falls below the overvoltage trip the high side FET will be enabled again.

Thermal shutdown

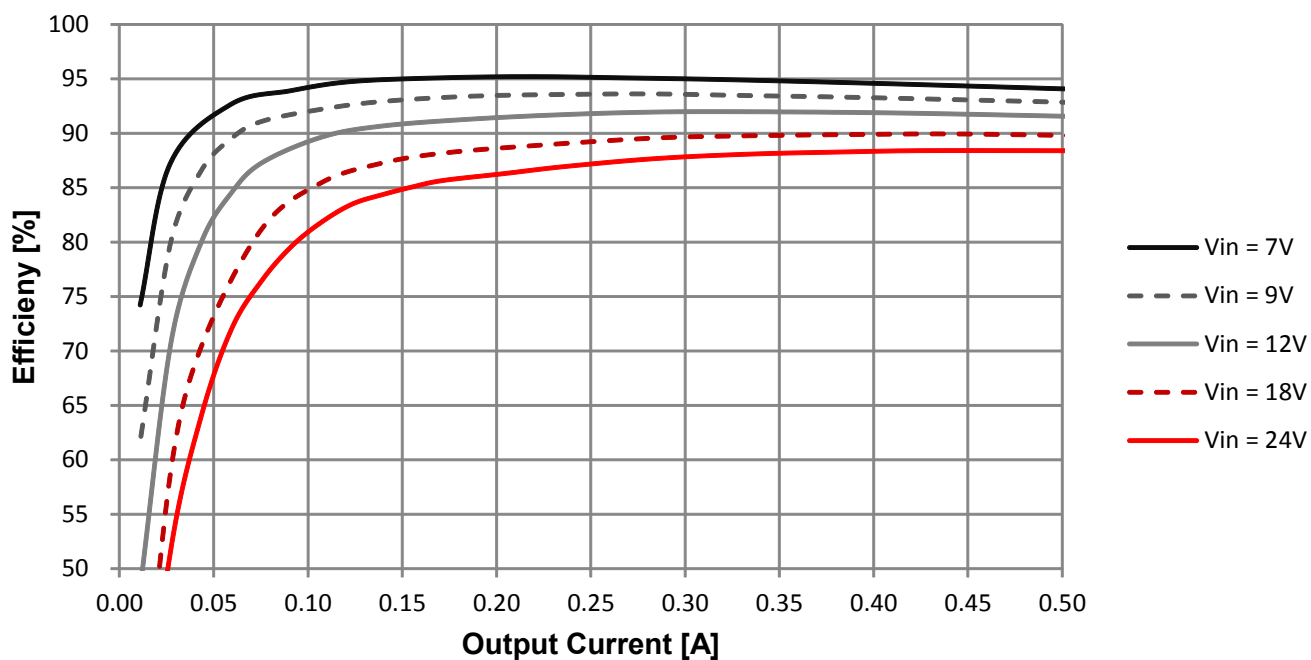
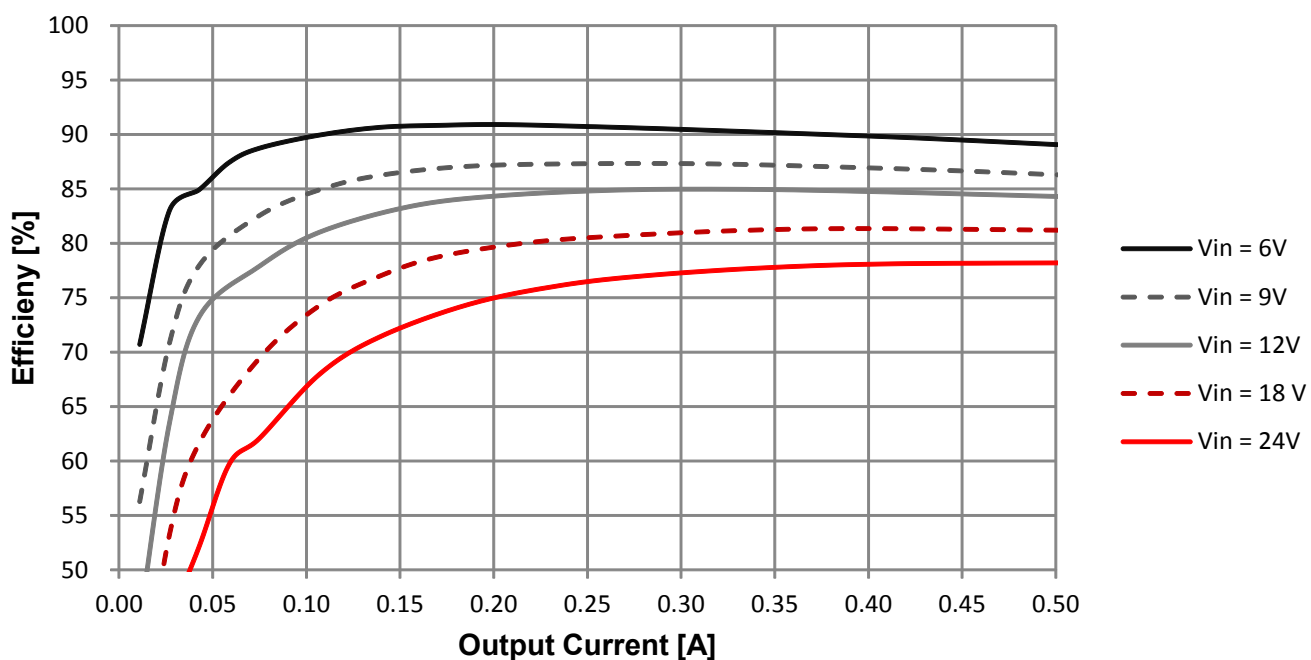
When the junction temperature exceeds a specific value the device stops switching until the junction temperature falls below this value.

Cycle by cycle current limiting

When the current through the high-side FET exceeds the current limit stated in the electrical specification the high side FET will stop the current flow until the following cycle.

Short circuit protection

The short circuit protection is realized via the cycle by cycle current limiting. The short circuit protection is indefinite with a recovery at the following switching cycle if the short circuit is removed.

WPMDL9500xx / 17395xx78**MagI³C** Power Module**FDSM** - Fixed Step Down Regulator Module**TYPICAL PERFORMANCE CURVES****173950578 5V Output****173950378 3.3V Output**

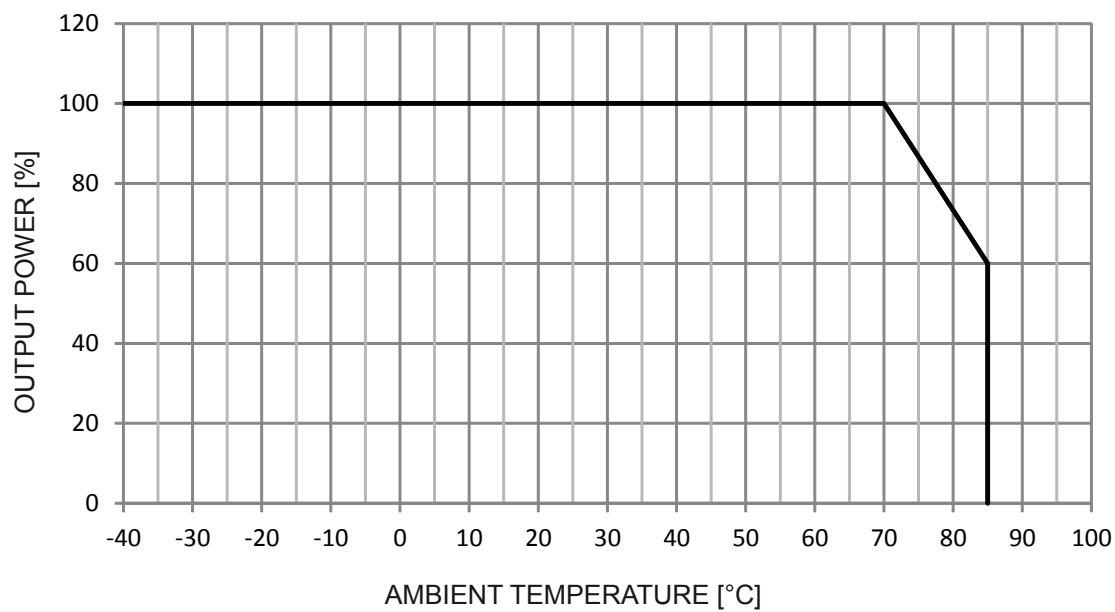
WPMDL9500xx / 17395xx78

MagI³C Power Module
FDSM - Fixed Step Down Regulator Module

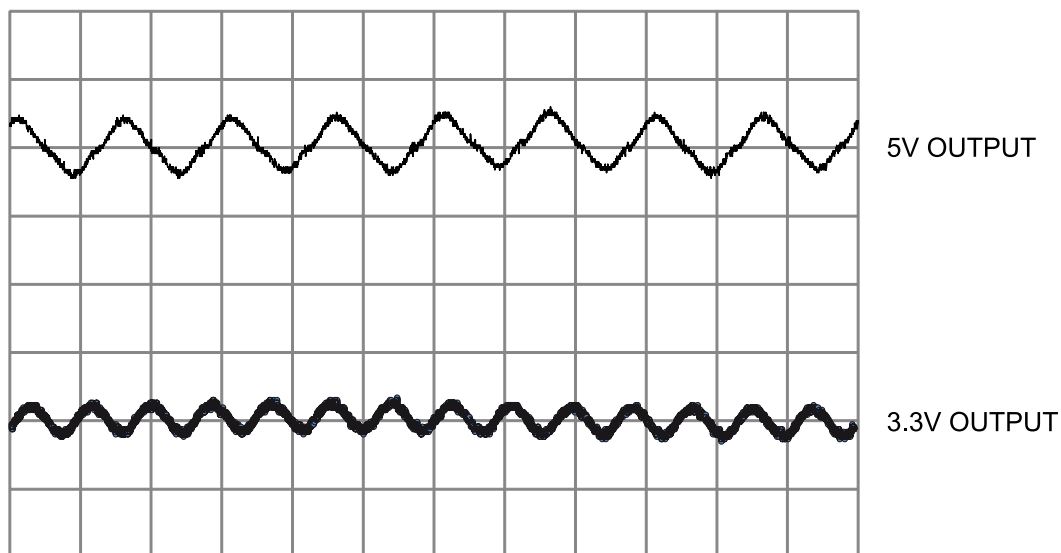


TYPICAL PERFORMANCE CURVES

OUTPUT POWER DERATING OVER TEMPERATURE



OUTPUT VOLTAGE RIPPLE $V_{IN} = 12V / I_{OUT} = 500mA$



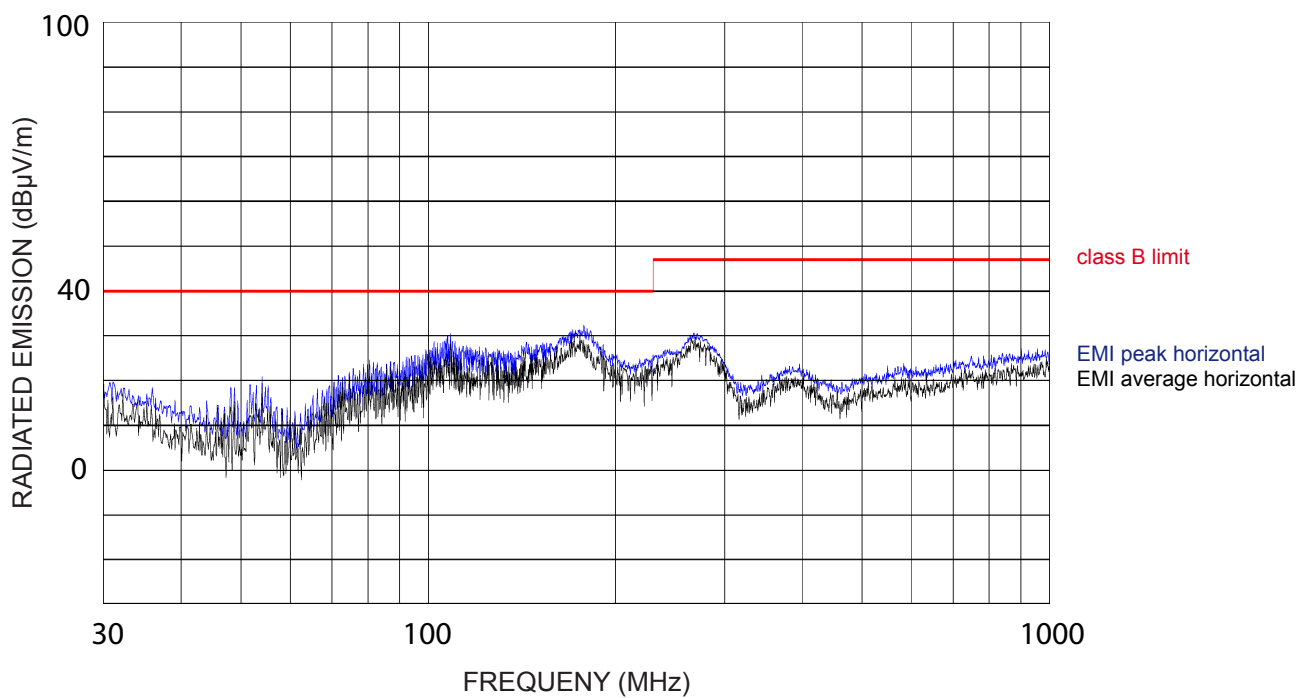
Y: 10mV/DIV AC BWL 20MHz

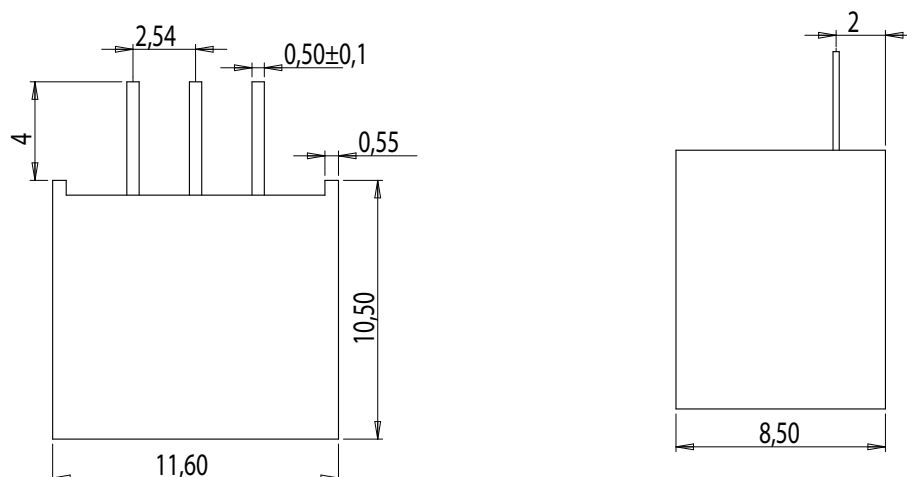
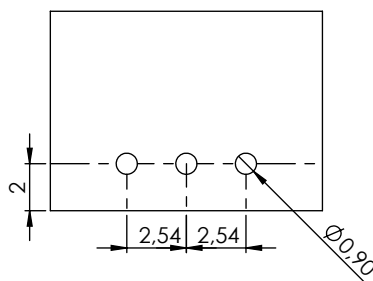
X: 2µs/DIV

Measured at a 10µF ceramic capacitor with 10mm distance to regulator.

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Measured on module without PCB or external filters at 3m antenna distance

 $V_{IN} = 12V$; $V_{OUT} = 5V$; $I_{OUT} = 0.5A$ 

WPMDL9500xx / 17395xx78**MagI³C** Power Module**FDSM** - Fixed Step Down Regulator Module**PHYSICAL DIMENSIONS****RECOMMENDED DRILL PATTERN**

All dimensions in mm. All tolerances ± 0.5 mm unless otherwise indicated.
 Recommended plated drill diameter 0.9 mm.

WPMDL9500xx / 17395xx78

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**DOCUMENT HISTORY**

REVISION	DATE	DESCRIPTION
0.1	2014.11.1	preliminary version
1.0	2014.12.18	final version

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MagI³C Power Module
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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 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 agents that are 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 longterm 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 break. As these devices are sensitive to electrostatic discharge customer shall follow proper IC Handling Procedures.

The customer acknowledges and agrees that they are 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 they have all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor these 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.

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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 and investigate, where appropriate, 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 advanced technological aid of suitable design for 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. Optimal 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 provide support in this matter.

5. Product Reasearch & Development

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 upon in individual contracts, all orders are subject to the current version of the "General Terms and Conditions of Würth Elektronik eiSos Group", of which the latest version is available at www.we-online.com.