2.5V - 5.5V Input / 2A Output / 0.6V - 4V Output

DESCRIPTION

The VDMM 171020560 MagI³C MicroModule provides a fully integrated DC-DC power supply including the switching regulator IC with integrated MOSFETs, controller, compensation and shielded inductor in one package.

The 171020560 offers high efficiency and delivers up to 2A of output current. It operates with an input voltage from 2.5V to 5.5V and is designed for a small solution size.

The automatic mode transitions ensure the best efficiency and output voltage ripple at all load currents. The 171020560 is available in an LGA-9 package (3.5 x 3.5 x 1.5mm).

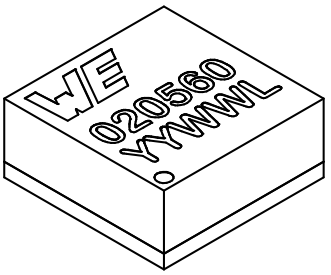
This module has integrated protection circuitry that guards against thermal overstress with thermal shutdown and protects against electrical damage using overcurrent, short-circuit and undervoltage protections.

FEATURES

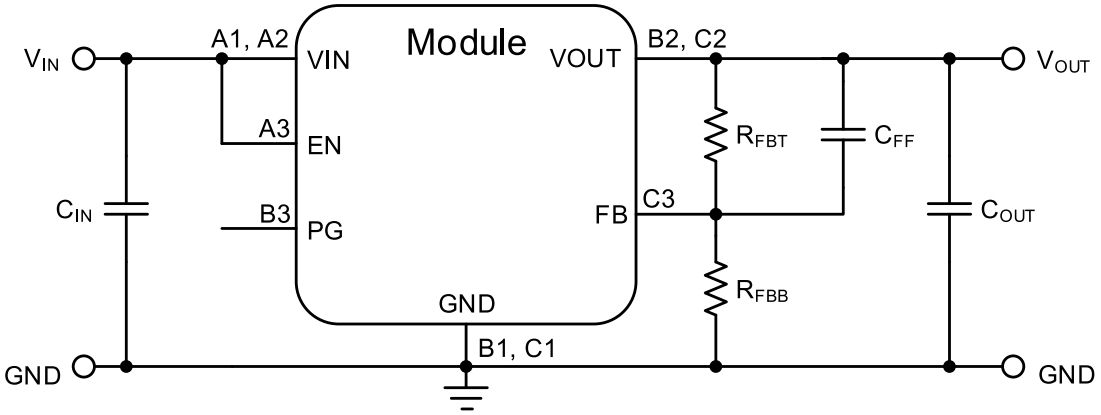
- Peak efficiency up to 96%
- Current capability up to 2A
- Input voltage range: 2.5V to 5.5V
- Output voltage range: 0.6V to 4V
- 4µA typical quiescent current
- Integrated shielded inductor
- Low output voltage ripple: ±7mV typ.
- Output voltage accuracy: 1%
- Fixed switching frequency: 4MHz
- Automatic PFM/PWM mode
- Synchronous operation
- Undervoltage lockout
- Power good indicator
- Internal soft-start
- Thermal shutdown
- Short-circuit protection
- RoHS und REACH compliant
- Operating ambient temperature up to 105°C
- Operating junction temp. range: -40°C to 125°C
- Complies with EN55032 (CISPR-32) class B radiated emissions standard

TYPICAL APPLICATIONS

- General point of load power supply for low power systems
- Replacement of linear regulators
- DSP and FPGA power supply, auxiliary voltages
- Portable instruments
- Battery powered equipment



TYPICAL CIRCUIT DIAGRAM



CONTENTS

1 PINOUT

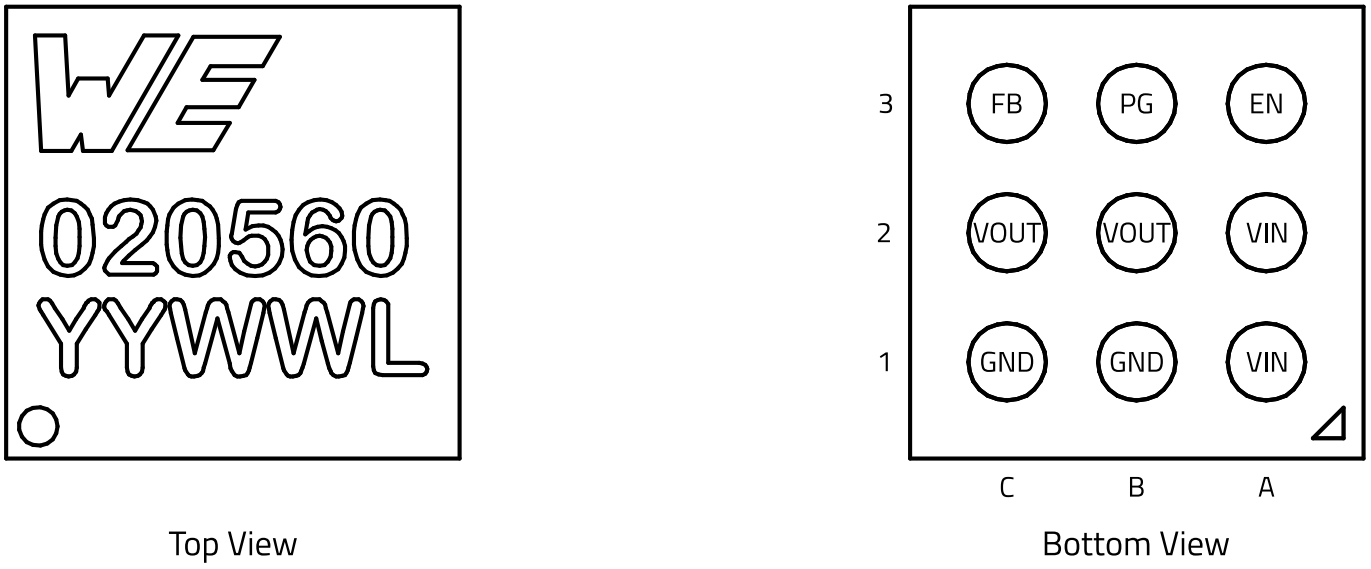


Figure 1: Pinout

Table 1: Marking Description

MARKING	DESCRIPTION
WE	Logo
020560	Part number
°YYWWL	Pin 1 indicator, year, week and lot number

Table 2: Pin Description

SYMBOL	NUMBER	TYPE	DESCRIPTION
VIN	A1, A2	Power	Input voltage. Place the input capacitor as close as possible to VIN and GND.
EN	A3	Input	Enable pin. Setting this pin high enables the device, while setting this pin low shuts down the device. This pin must not be left floating.
GND	B1, C1	Power	Power ground. It must be connected to the ground plane and to the exposed pad.
VOUT	B2, C2	Power	Output voltage. Place output capacitors as close as possible to VOUT and GND. For thermal performance, use copper plane(s) at this pin.
PG	B3	Output	Power good flag pin. This open drain output asserts low if the output voltage is out of regulation. A pull-up resistor of 100kΩ is required if this function is used.
FB	C3	Input	Feedback pin. This pin must be connected to the external resistor divider (between VOUT and GND) to adjust the output voltage.

2 ORDERING INFORMATION

Table 3: Ordering information.

ORDER CODE	SPECIFICATIONS	PACKAGE	PACKAGING UNIT
171020560	2A / 0.6V - 4V Vout	LGA-9	7" Reel (1000 pieces)
178020560	2A / 0.6V - 4V Vout	Eval Board	1 piece

3 PINOUT COMPATIBLE FAMILY MEMBERS

Table 4: Pinout compatible family members.

ORDER CODE	SPECIFICATIONS	PACKAGE	PACKAGING UNIT
171010560	1A / 0.6V - 4V Vout	LGA-9	7" Reel (1000 pieces)
171030560	3A / 0.6V - 4V Vout	LGA-9	7" Reel (1000 pieces)

4 SALES INFORMATION

Table 5: 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

5 ABSOLUTE MAXIMUM RATINGS

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

Table 6: Absolute Maximum Ratings.

SYMBOL	PARAMETER	LIMIT		UNIT
		MIN	MAX	
VIN	Input voltage pin	-0.3	6	V
VOUT	Output voltage pin	-0.3	V_{IN} + 0.3	V
FB	Feedback pin	-0.3	6	V
EN	Enable pin	-0.3	6	V
PG	Power good pin	-0.3	6	V
$T_{storage}$	Assembled, non-operating storage temperature	-40	125	°C
V_{esd}	ESD Voltage (HBM), all pins (C=100pF, R=1.5kΩ)[4]	-2	2	kV

6 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 7: Operating Conditions.

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT
V_{IN}	Input voltage	2.5	—	5.5	V
V_{OUT}	Output voltage	0.6	—	4	V
I_{PG}	PG sink current	—	—	1	mA
T_a	Ambient temperature range	-40	—	105	°C
T_{jop}	Junction temperature range	-40	—	125	°C
I_{out}	Output current[5]	0	—	2	A

7 THERMAL SPECIFICATIONS

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

Table 8: Thermal Specifications

SYMBOL	PARAMETER	TYP	UNIT
Θ_{JA}	Junction-to-ambient thermal resistance[2]	42.5	K/W
Θ_{JC}	Junction-to-case (top) thermal resistance[2]	28.4	K/W
T_{SD}	Thermal shutdown, rising	150	°C
	Thermal shutdown, hysteresis	20	°C

8 ELECTRICAL SPECIFICATIONS

Caution:
MIN and MAX limits are valid for the recommended ambient temperature range of -40°C to 105°C. Typical values represents statistically the utmost probable values at the following conditions: V_{IN} = 5V, V_{OUT} = 1.5V, C_{IN} = 10µF ceramic, C_{OUT} = 2x 10µF MLCC, T_A = 25°C unless otherwise noted.

Table 9: Electrical Specifications.

SYMBOL	PARAMETER	TEST CONDITIONS	LIMIT			UNIT
			MIN[1]	TYP[3]	MAX[1]	
Output Current						
I_{OC-HS}	Overcurrent limit, high-side switch		—	4.3	—	A
Output Voltage						
V_{OUT}	Load regulation		-2	—	2	%
	Output voltage ripple[6]	I_{OUT} = 2A	—	7	—	mV
V_{FB}	Reference voltage		594	600	606	mV
I_{FB}	Feedback pin bias current		—	10	50	nA
Switching Frequency						
f_{SW}	Switching frequency		—	4	—	MHz
Enable and Undervoltage Lockout						
V_{UVLO}	V_{IN} undervoltage threshold	V_{IN} increasing	2.1	2.2	2.3	V
	V_{UVLO} hysteresis		—	160	—	mV
V_{EN}	EN threshold	Enable logic high	1	—	—	V
		Enable logic low	—	—	0.4	V
I_{EN}	EN pin input current		—	10	100	nA
Soft-Start						
t_{SS}	Soft-start time	EN high to 95% of V_{OUT}	—	1.25	—	ms
Power Good						
V_{PG}	PG lower threshold	V_{PG} rising	—	96	—	%
		V_{PG} falling	—	92	—	%
	PG upper threshold	V_{PG} rising	—	105	—	%
		V_{PG} falling	—	110	—	%
Input Quiescent and Shutdown Current						
I_{SD}	Shutdown current	EN = low	—	50	500	nA
I_Q	Quiescent current	EN = high, no switching	—	4	—	µA
Efficiency						
η	Efficiency	I_{OUT} = 1.1A	—	89	—	%
		V_{OUT} = 4V, I_{OUT} = 1.1A	—	96	—	%

9 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).

10 PACKAGE SPECIFICATIONS

ITEM	PARAMETER	TYP(3)	UNIT
Mold Compound	UL94V-0	-	-
Weight	-	0.056	g

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) on a 40 x 60mm four layer board, with 35µm (1 ounce) copper on all layers.

(3) Typical numbers are valid at 25°C ambient temperature and represent statistically the utmost probable values assuming a 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) Dependent on ambient temperature; see THERMAL DERATING.

(6) The industry standard for comparison of the output voltage ripple between switching regulators or modules requires a 10µF ceramic (sometimes additional 1µF ceramic in parallel) at the point of load where the voltage measurement is done using an oscilloscope with its probe and probe jack designed for low voltage/high frequency (low impedance) measurement. The oscilloscopes bandwidth is limited at 20MHz.

12 TYPICAL PERFORMANCE CURVES

If not otherwise specified, the following conditions apply: T_A = 25°C.

12.1 Radiated Emissions (With EMI Input Filter)

The 171020560 power modules were tested in several EMC configurations to give more realistic information about implementation in the applications. The test setup is based on CISPR 16 with the limit values of CISPR 32. All measurements were performed with the layout and components shown in DESIGN EXAMPLE.

12.1.1 Radiated Emissions EN 55032 (CISPR 32) Class B Complaint Test Setup

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

12.1.2 Radiated Emissions

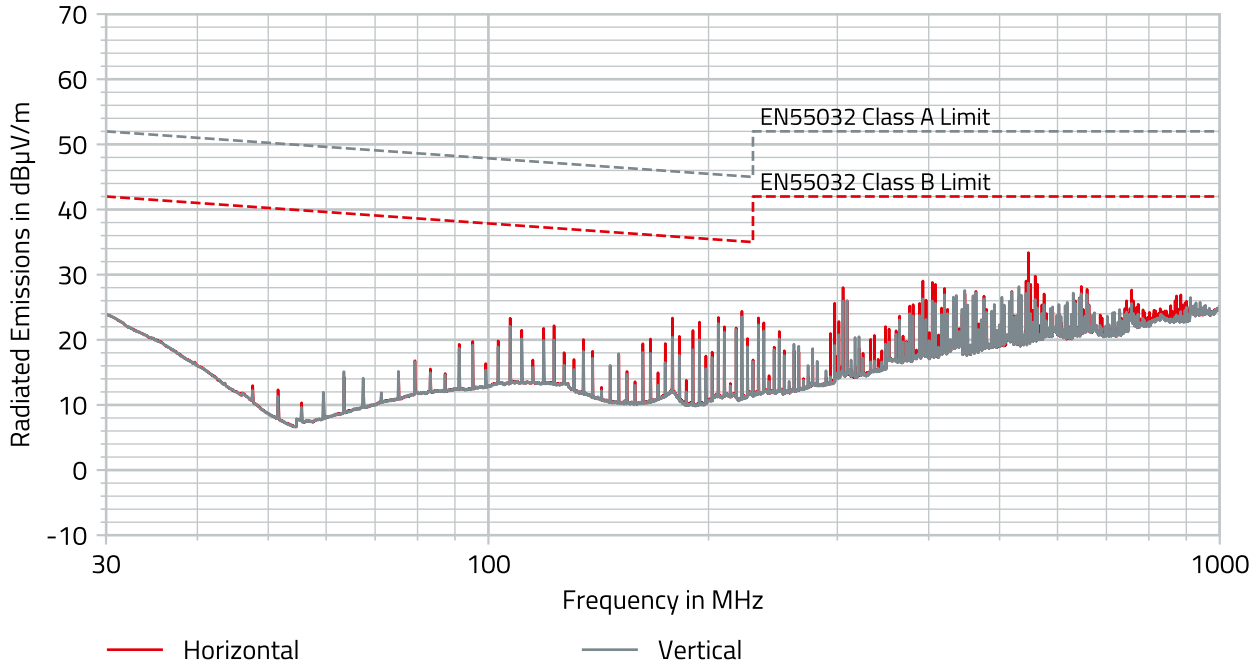


Figure 2: Radiated emissions 171020560 V_{IN} = 5V, V_{OUT} = 3.3, I_{LOAD} = 2A with input filter.

13 DC PERFORMANCE CURVES

13.1 Efficiency $5V_{IN}$

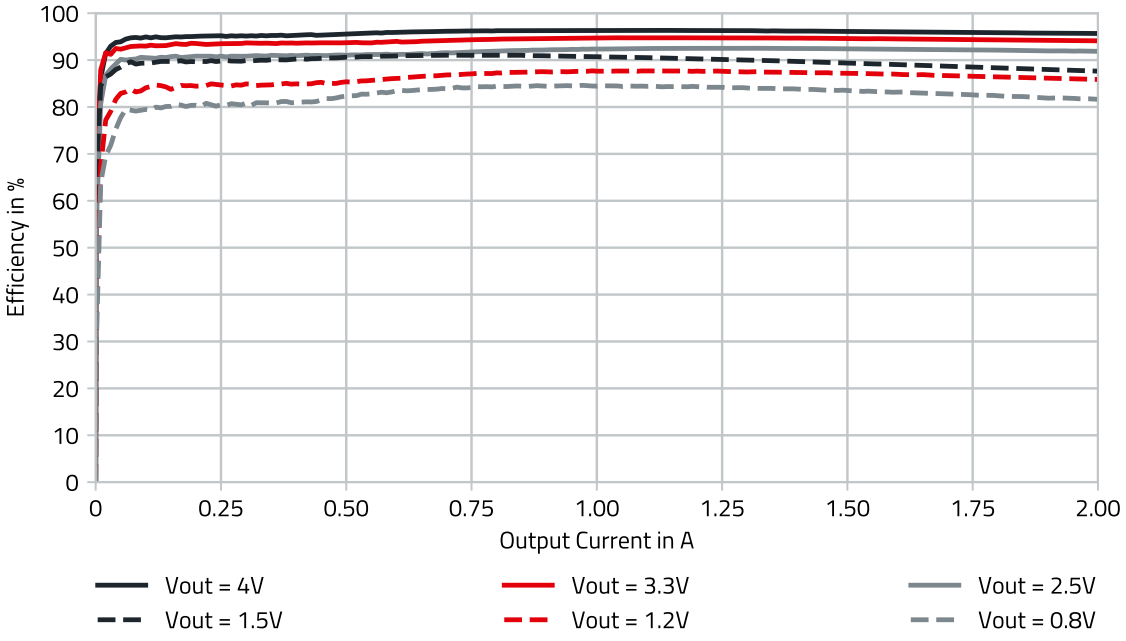


Figure 3: 171020560 efficiency V_{IN} = 5V.

13.2 Efficiency $3.3V_{IN}$

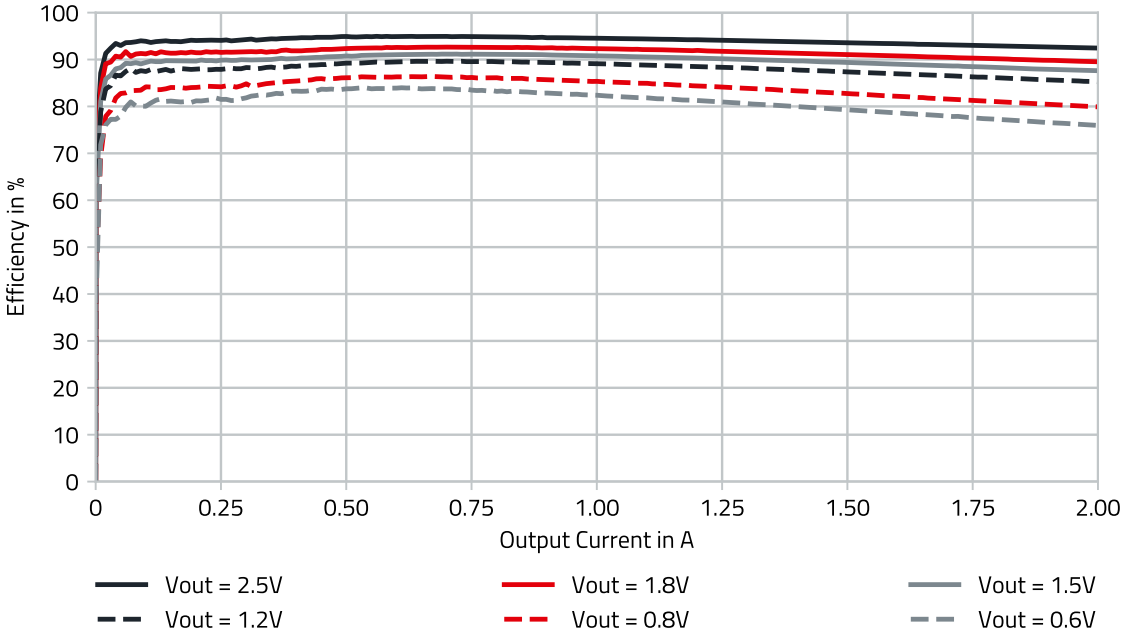


Figure 4: 171020560 efficiency V_{IN} = 3.3V.

13.3 Thermal Derating $5V_{IN}$

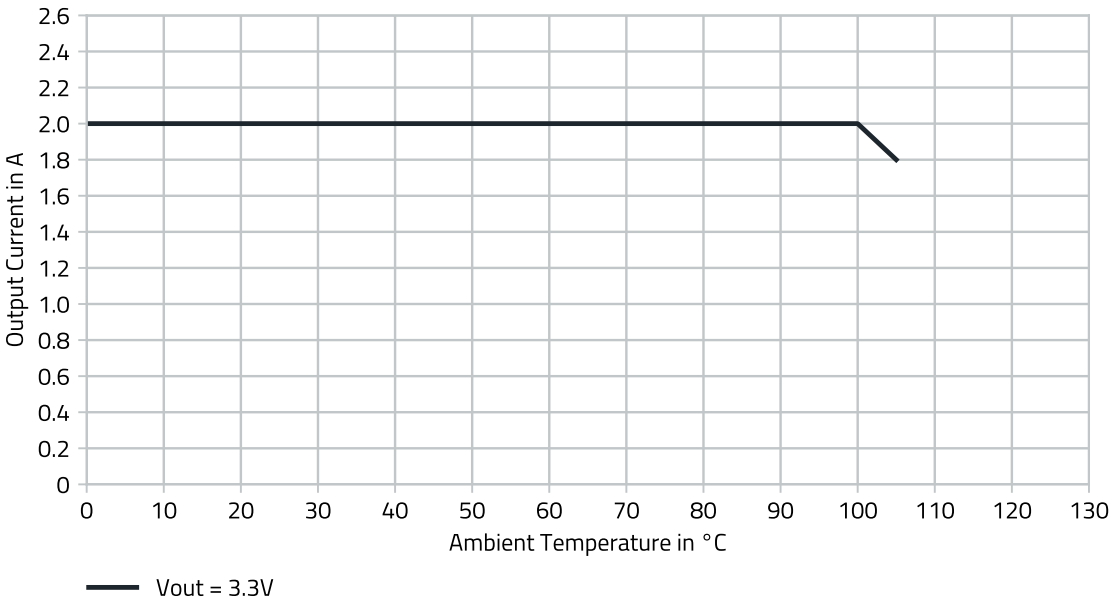


Figure 5: 171020560 output current thermal derating V_{IN} = 5V.

Note: Thermal derating graphs were measured on the 178020560 Evaluation Board[2] (80 x 80 mm, four layers, 70 µm outer layers, 35 µm inner layers copper thickness). Please see T_A limits in OPERATING CONDITIONS.

13.4 Load Regulation $3.3V_{OUT}$

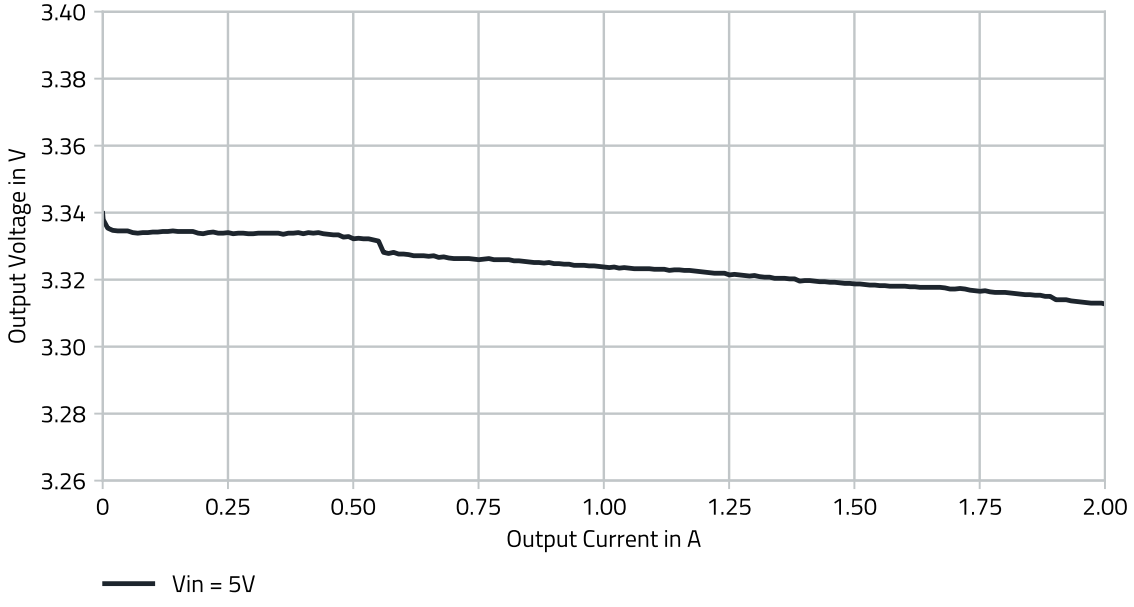


Figure 6: 171020560 Load Regulation V_{OUT} = 3.3V.

13.5 Load Regulation 1.5V_{OUT}

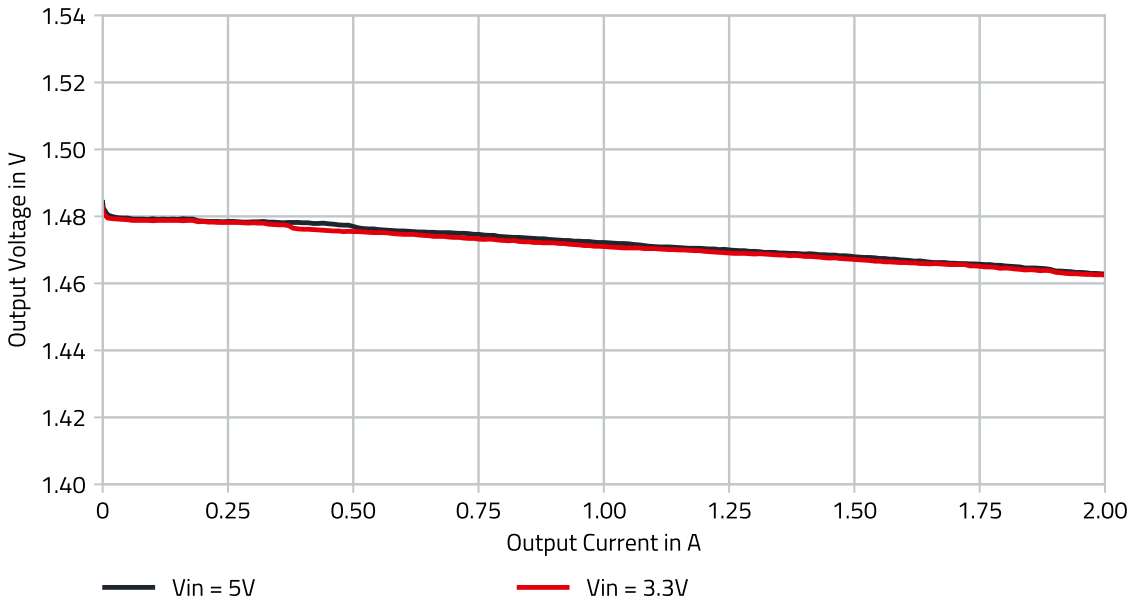


Figure 7: 171020560 Load Regulation V_{OUT} = 1.5V.

13.6 Line Regulation 1.5V_{OUT}

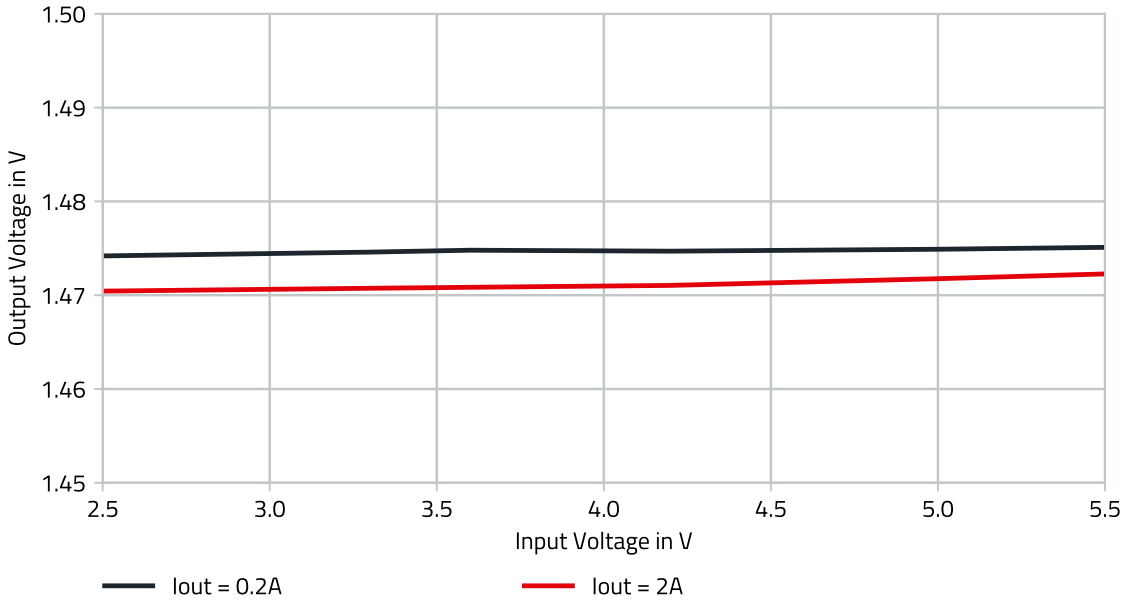


Figure 8: 171020560 Line Regulation V_{OUT} = 1.5V.

14 BLOCK DIAGRAM

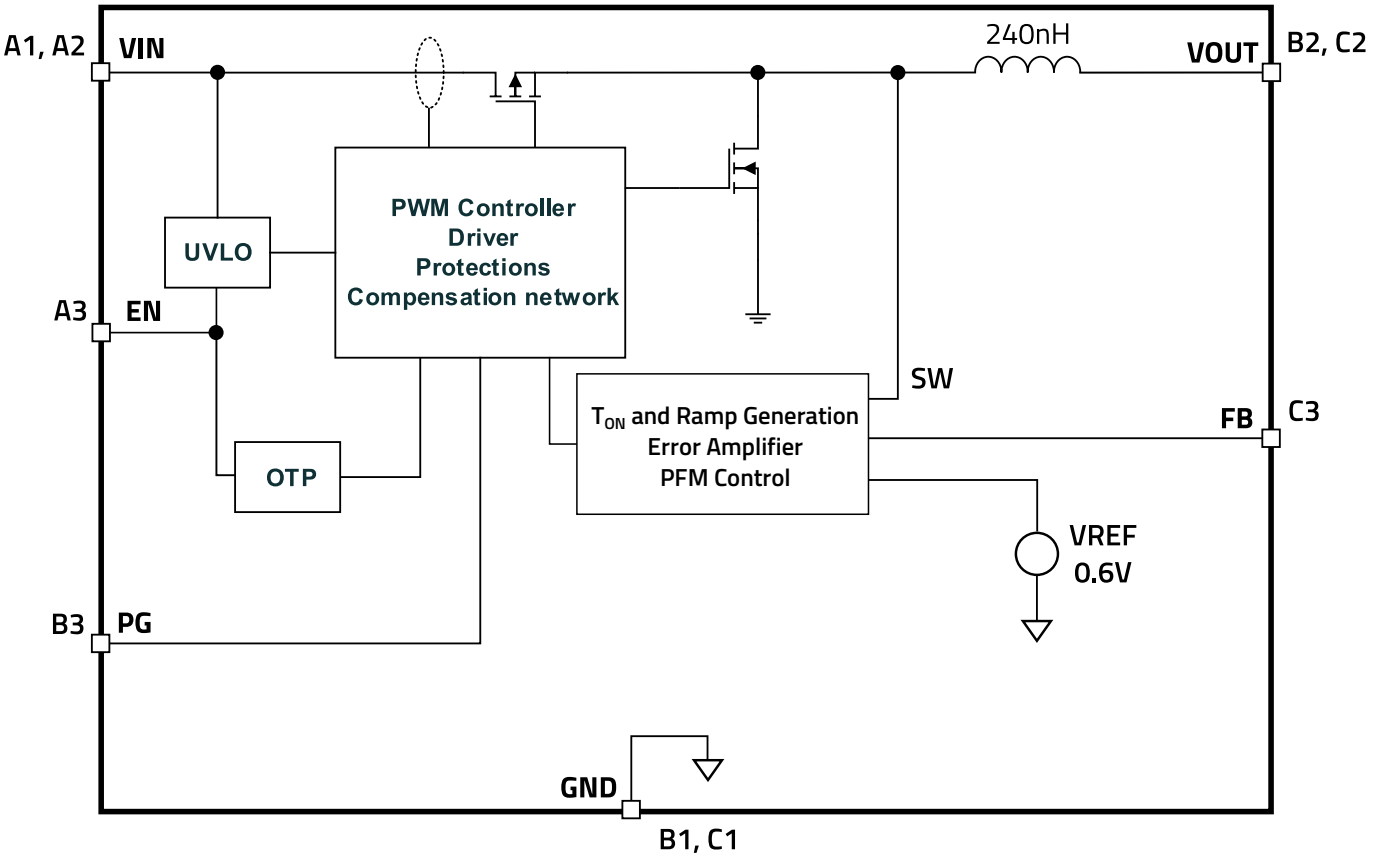


Figure 9: 171020560 block diagram.

15 CIRCUIT DESCRIPTION

The WPME-VDMM 171020560 power module is a DC-DC power supply including the switching regulator with integrated MOSFETs, controller and compensation, as well as the shielded inductor integrated in one package. The control scheme is based on a combined architecture integrating voltage, current and hysteretic control loops.

The V_{OUT} of the regulator is divided by the feedback resistor network R_{FBT} and R_{FBB} and fed into the FB pin. The error amplifier compares this signal with the internal 600mV reference. The error signal is amplified to adjust the on-time, keeping the frequency almost constant. This signal drives the power MOSFETs.

The operational frequency adjusts based on the input voltage and load conditions, ensuring the best regulation and noise performance for the given conditions.

This architecture supports fast transient response and very small output voltage ripples (<7mV_{p-p}).

16 DESIGN FLOW

The following simple steps will show how to select the external components to design the 171020560 into an application.

Essential Steps

1. Set output voltage
2. Select input capacitor
3. Select output capacitor
4. Select feed-forward capacitor

Optional Steps

5. Set the power good resistor

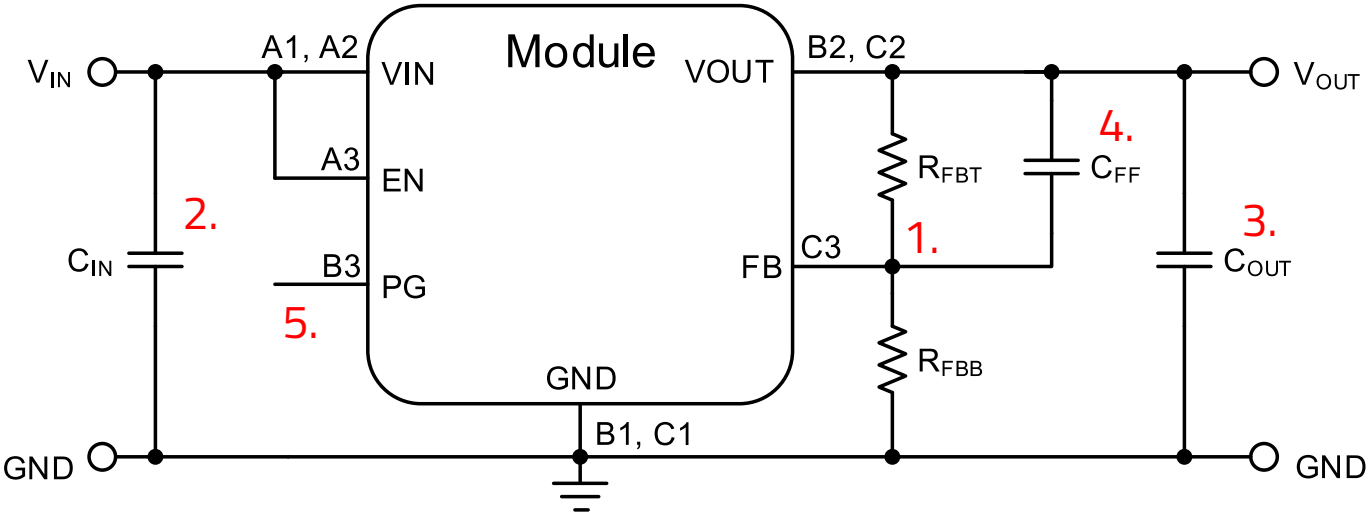


Figure 10: Design flow schematic.

16.1 STEP 1 Set the Output Voltage (V_{OUT})

The output voltage is selected with an external resistor divider between V_{OUT} and GND (see figure 11). The voltage across the lower resistor of the divider is provided to the FB pin and compared with a reference voltage of 600mV (V_{REF}). The module can provide the entire output current of 2A with an output voltage range of 0.6V to 4V. The output voltage can be calculated according to the following formula:

$$V_{OUT} = V_{REF} \cdot \left(\frac{R_{FBT}}{R_{FBB}} + 1 \right) \quad (1)$$

One resistor must be chosen and then the other resistor can be calculated. The recommended value for R_{FBT} is between 100kΩ to 1MΩ. For example, if R_{FBT} = 100kΩ then the resistance value of the lower resistor in the feedback network is indicated in the table below for common output voltages.

Table 10: 171020560 output voltage selection.

V_{OUT} (V)	0.8	1.2	1.5	1.8	2.5	3.3
R_{FBB} (E96) (kΩ)	301	100	68	49.9	31.6	22.1

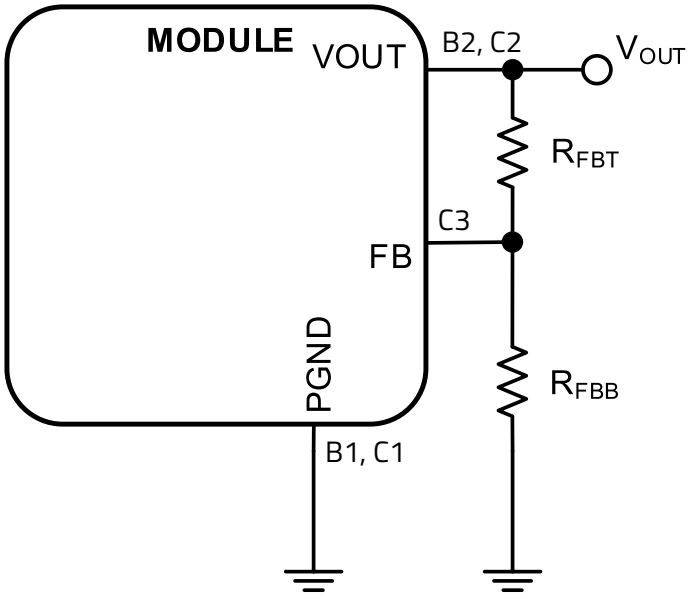


Figure 11: Output voltage selection schematic.

16.2 STEP 2 Select the Input Capacitor (C_{IN})

The energy at the input of the power module is stored in the input capacitor. MLCC (multi-layer ceramic capacitor) input capacitors are required externally to provide cycle-by-cycle switching current and to support load transients. The external input capacitor must be placed directly at the VIN pin. Attention must be paid to the voltage, frequency, temperature derating and thermal class of the selected capacitor. One Würth Elektronik 885012207026 MLCC has been experimentally verified to work with this power module.

16.3 STEP 3 Select the Output Capacitor (C_{OUT})

The output capacitor should be selected in order to minimize the output voltage ripple and to provide a stable voltage at the output. It also affects the loop stability. Attention must be paid to the voltage, frequency and temperature derating and thermal class of the selected capacitor.
In general, the output voltage ripple can be calculated using the following equation:

$$V_{OUT,ripple} = \Delta I_L \cdot ESR + \Delta I_L \cdot \left(\frac{1}{8 \cdot f_{SW} \cdot C_{OUT}} \right) \quad (2)$$

where ΔI_L is the inductor current ripple and can be calculated with the following equation:

$$\Delta I_L = \frac{V_{OUT} \cdot (V_{IN} - V_{OUT})}{f_{SW} \cdot L \cdot V_{IN}} \quad (3)$$

The external output capacitors must be placed as close to the VOUT pin as possible. An output capacitance value of 20µF is recommended for best performance. Two Würth Elektronik 885012207026 MLCCs have been experimentally verified to work with this power module.

Using the recommended output capacitors, the transient response of the power module can appear as follows:

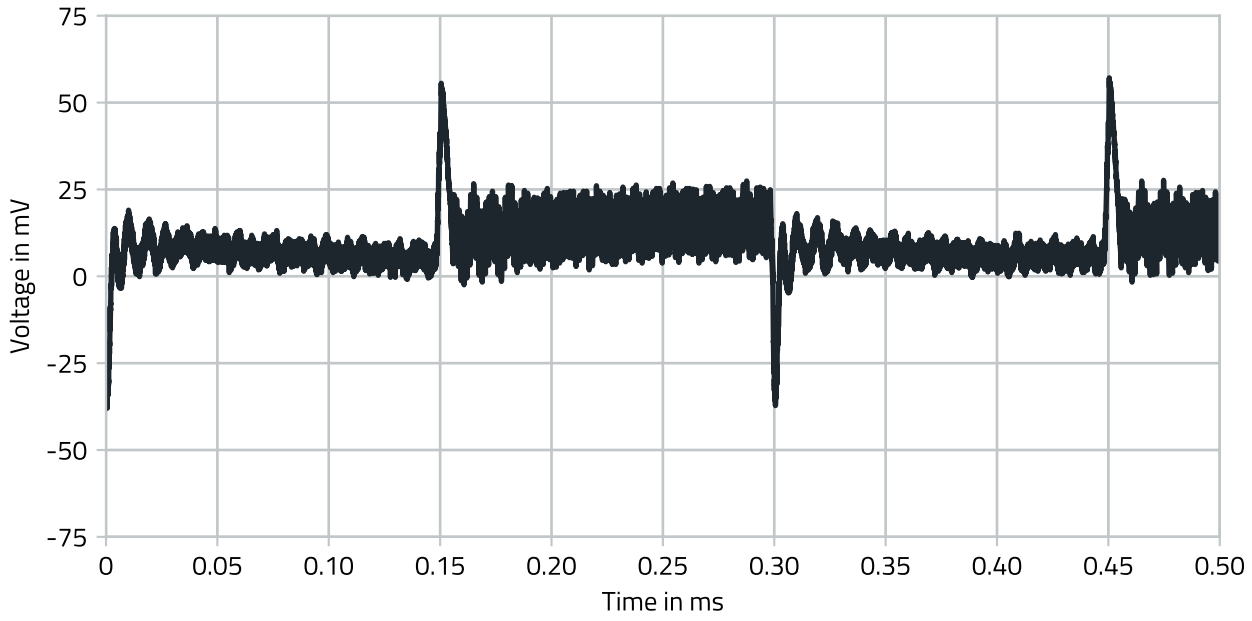


Figure 12: 171020560 V_{IN} = 5V, V_{OUT} = 3.3V, load jumps 0% - 100%.

16.4 STEP 4 Select the Feed-Forward Capacitor (C_{FF})

The 171020560 MagI³C power module allows for the selection of a feed forward capacitor, C_{FF}. The Würth Elektronik 885012005032 MLCC has been experimentally verified to work with this power module.

16.5 STEP 5 Optional: Set the Power Good Resistor

The PG pin is an open-drain output. Once the output voltage is above 96% (typ.) of the internal reference voltage the PG pin transitions to a high impedance state. The recommended pull-up resistor value is 100kΩ, which should be connected to a voltage source such as VOUT. The PG pin is pulled low when the output voltage is lower than 92% (typ.) or higher than 105% (typ.) of the internal reference voltage. The PG pin will be pulled low when the UVLO or thermal shutdown activates or when the EN pin is pulled low.

17 MODES OF OPERATION

Depending on the load current, input voltage and output voltage, the 171020560 power module automatically switches between one of three operational modes:

- PFM: power saving operational mode for light loads where the inductor current would become discontinuous.
- PWM: standard operational mode once the load current exceeds half of the inductor ripple current. The device will no longer operate in PFM mode, transitioning to PWM mode automatically.
- Dropout: 100% duty cycle operational mode when the input voltage approaches the set output voltage.

17.1 PFM Operation

PFM mode is used during light load conditions and relies on pulse skipping. In this mode, the feedback voltage is compared to an internal reference. If the feedback voltage falls below the reference, a minimum on-time pulse is triggered to activate the high-side MOSFET and deliver energy to the output capacitor. If the feedback voltage exceeds the reference, the pulse is skipped. As the load increases, more pulses are generated until the switching frequency reaches its nominal value, at which point the system transitions smoothly into PWM mode.

17.2 PWM Operation

PWM mode is active under medium to heavy load conditions. It operates using an adaptive constant on-time control strategy, which ensures excellent transient response and maintains an almost constant switching frequency. The system monitors the switch node to estimate the actual output voltage and generates a ramp signal proportional to this value. An error amplifier produces a control signal that is compared with the adaptive ramp. This comparison adjusts the on-time duration—either extending or shortening it—to maintain stable operation.

17.3 Dropout Operation

This power module can operate at 100% duty cycle. During dropout operation the high-side switch remains on while the low-side switch remains off. In order to maintain regulation, a buffer of typically 5% more than the desired output voltage must be maintained at the input.

18 OUTPUT VOLTAGE RIPPLE

The output voltage ripple is determined by the operational mode of the power module. During PWM operation, a typical output voltage ripple of 7mV can be expected. The switching frequency of 4MHz can be seen in the output ripple. During PFM, a slightly increased ripple can be expected, to maximize the power saving of the power module while a lower frequency envelope can be observed on the output voltage ripple due to the switching and non-switching portions of operational mode.

18.1 PFM Operation

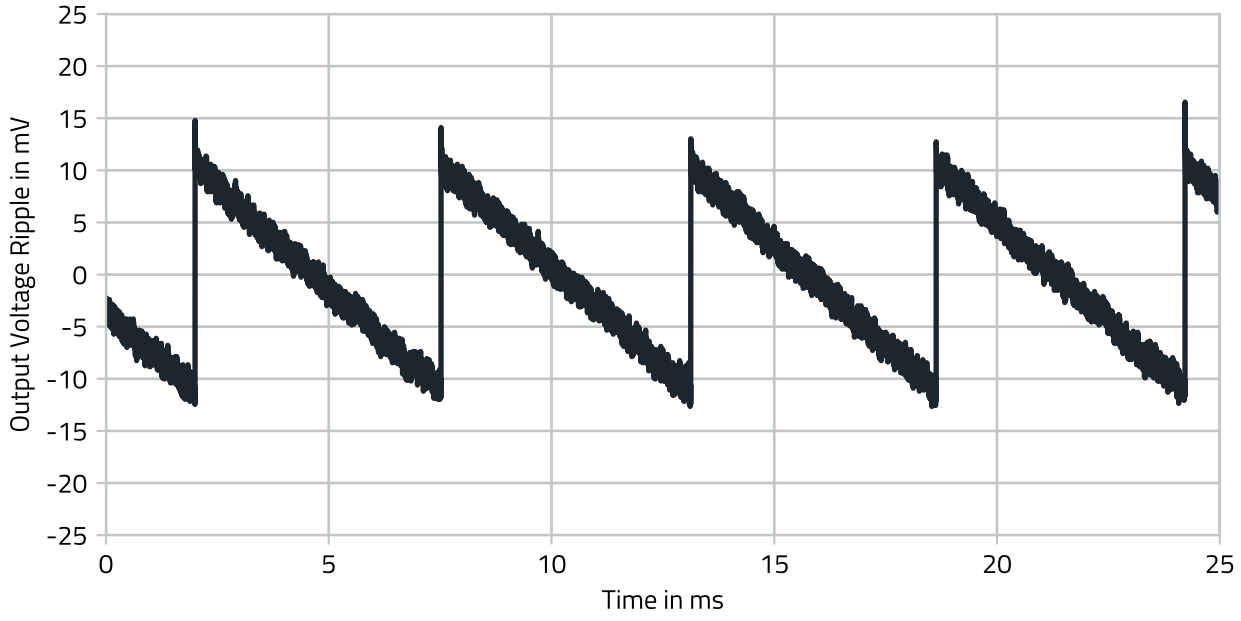


Figure 13: 171020560 output voltage ripple V_{IN} = 5V, V_{OUT} = 3.3V, I_{OUT} = 0A.

18.2 PWM Operation

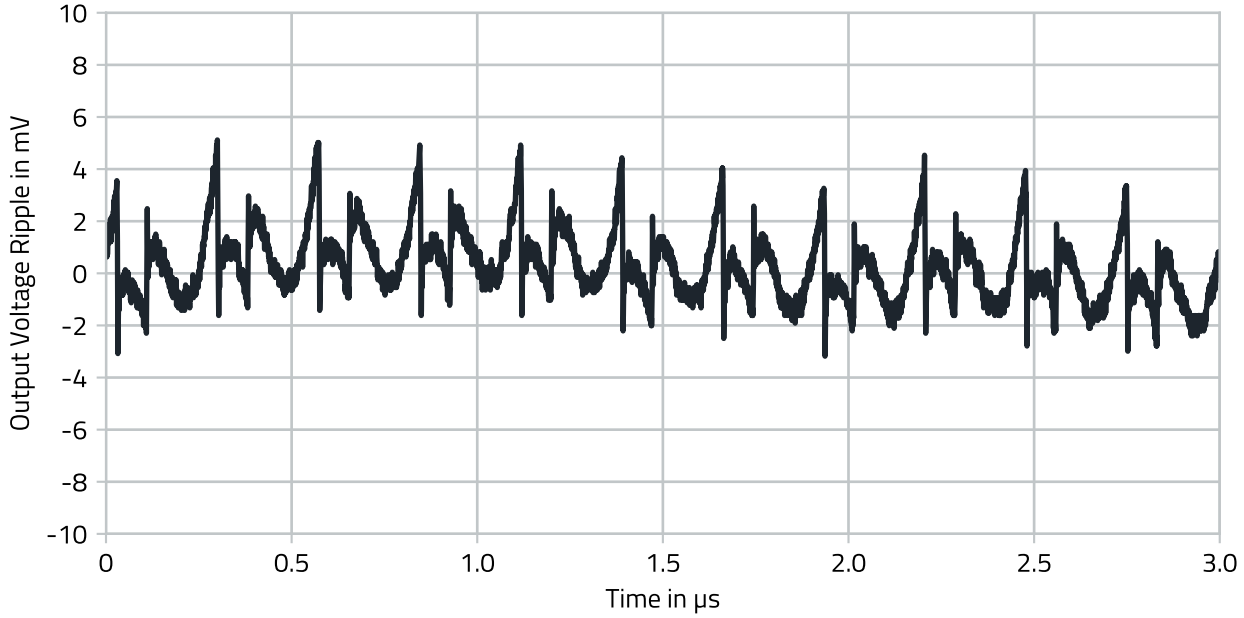


Figure 14: 171020560 output voltage ripple V_{IN} = 5V, V_{OUT} = 3.3V, I_{OUT} = 2A.

19 PROTECTION FEATURES

19.1 Overcurrent Protection (OCP) and Short Circuit Protection (SCP)

The MagI³C 171020560 power module implements a cycle-by-cycle high-side switch current limit (see ELECTRICAL SPECIFICATION). When the limit is hit 32 times, the device will stop switching, leaving both switches open, then resume operation after a fixed time delay. If the output fault condition remains, this behavior will repeat, functioning as hiccup protection for the device. Once the output fault has been removed and the device finishes a period of no switching, the device will resume normal operation.

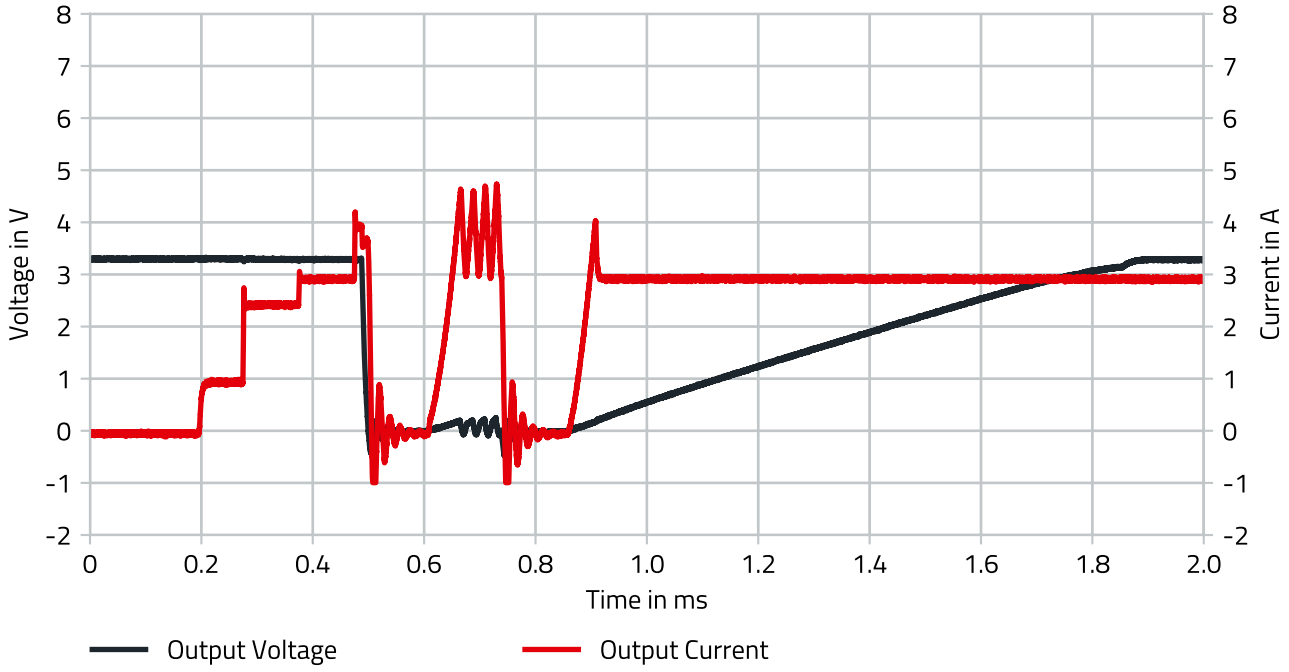


Figure 15: 171020560 overcurrent protection V_{IN} = 5V, V_{OUT} = 3.3V, I_{OUT} = 0A to 4A.

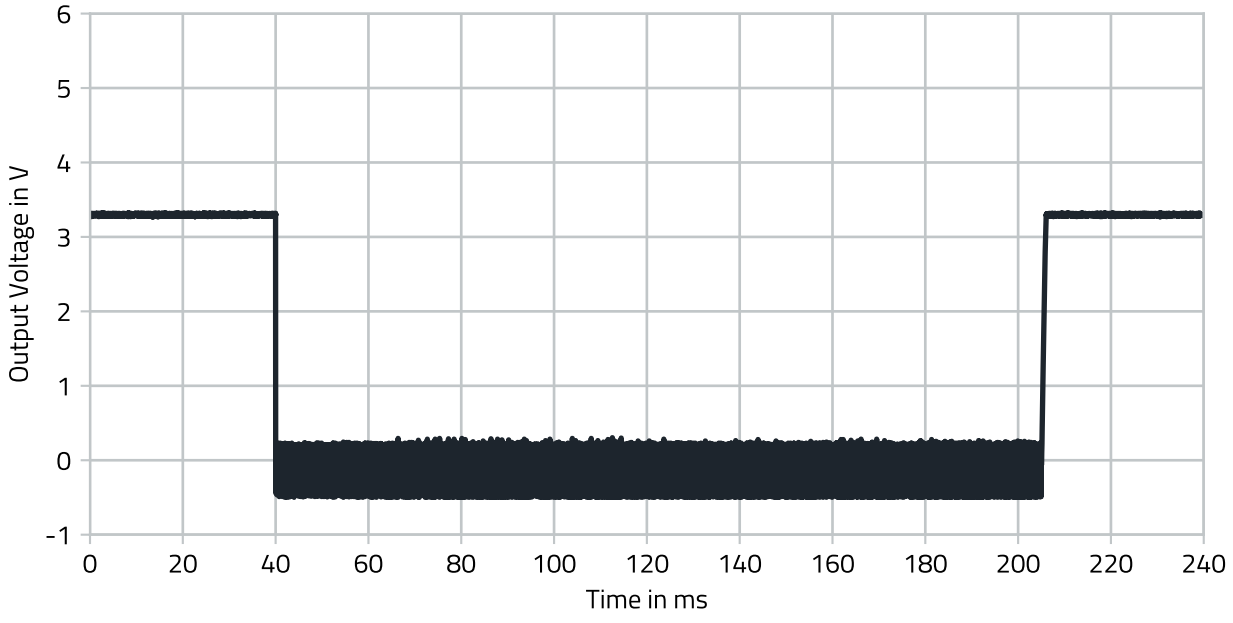


Figure 16: 171020560 short circuit protection V_{IN} = 5V, V_{OUT} = 3.3V.

19.2 Over Temperature Protection (OTP)

Thermal protection helps prevent catastrophic failures due to accidental device overheating. The junction temperature of the MagI³C power module should not be allowed to exceed its maximum ratings. Thermal protection is implemented by an internal thermal shutdown circuit, which activates when the junction temperature reaches 150°C (typ.). Under the thermal shutdown condition both MOSFETs remain off, causing the output voltage to drop. When the junction temperature falls below 130°C (typ.) the internal soft-start is released, the output voltage rises smoothly, and normal operation resumes.

19.3 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 1.25ms (see figure 17).

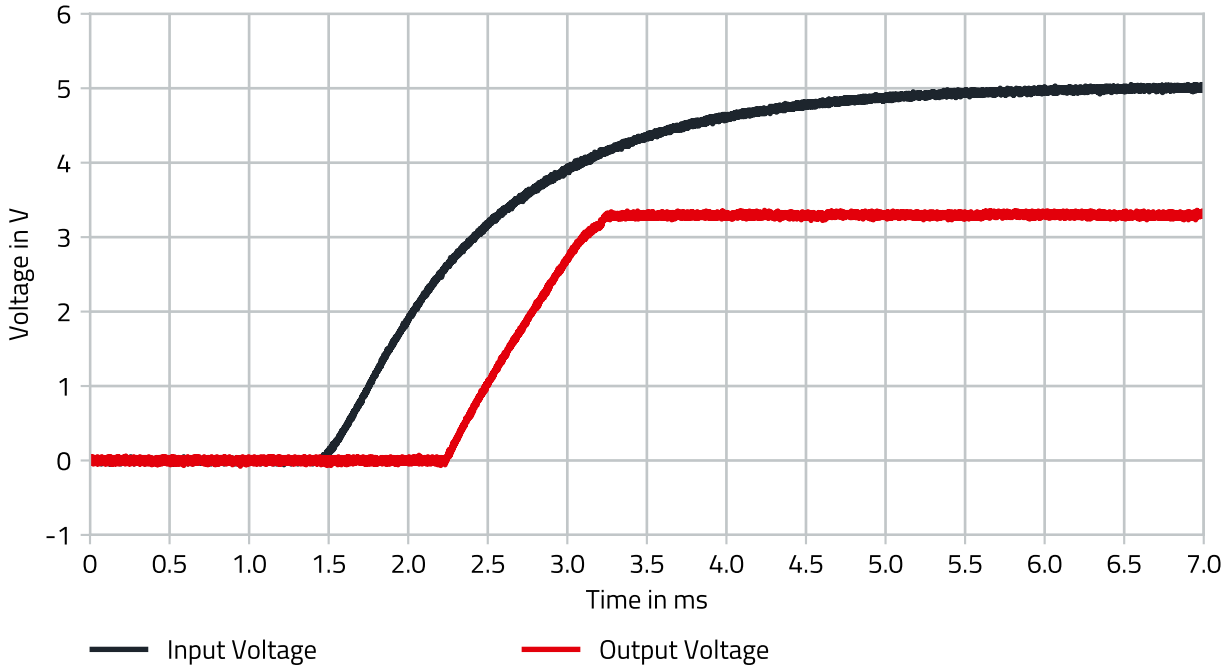


Figure 17: 171020560 soft-start V_{IN} = 5V, V_{OUT} = 3.3V.

19.4 Enable and Integrated/Adjustable UVLO

The MagI³C power module is enabled by setting the EN pin high. When the EN voltage reaches 1V the power module begins switching and the internal soft-start regulates the output voltage rise until the desired output voltage is met, allowing normal operation to take place.

The device incorporates an internal input undervoltage lockout (UVLO) to protect from unexpected behavior at input voltages below the recommended values. The thresholds of the internal UVLO are indicated in the ELECTRICAL SPECIFICATIONS.
An additional UVLO threshold of the power module can be externally set by adding a resistor between VIN and EN and a second resistor between EN and GND. This voltage divider should be chosen so that the desired minimum input voltage corresponds to 1V at EN.

The two resistors should be chosen based on the following ratio:

$$\frac{R_{ENT}}{R_{ENB}} = \frac{V_{UVLO(EXT.)}}{1} - 1 \quad (4)$$

$V_{UVLO\,(EXT.)}$ = Desired input voltage threshold to enable and disable the power module

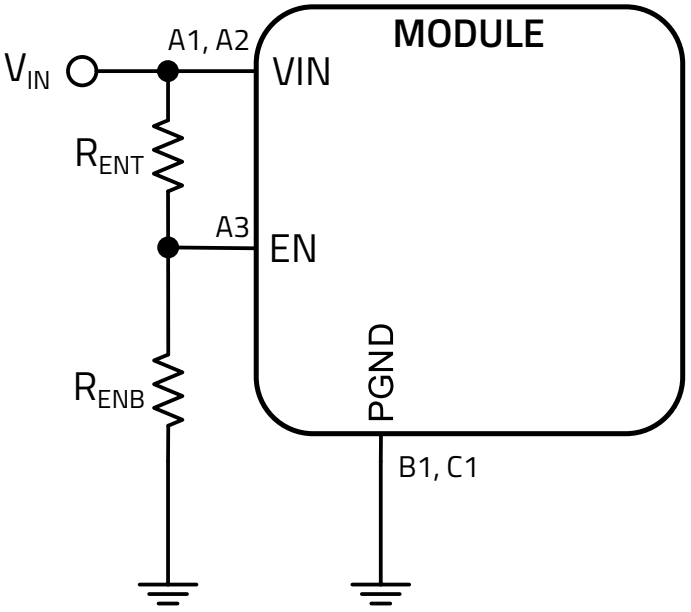


Figure 18: External UVLO voltage selection schematic.

This is often used in battery-powered systems to prevent deep discharge of the system battery. It is also useful in system designs with output rail sequencing or to prevent early turn-on of the supply as the main input voltage rail rises at power-up. Most systems will benefit by using the precision enable threshold to establish a system undervoltage lockout based on specific application parameters.

In the case of sequencing supplies, the divider is connected to a rail that becomes active earlier in the power-up cycle than the MagI³C power module output rail. The recommended approach is to choose an input UVLO level that is higher than the target regulated output voltage for the stage.

20 DESIGN EXAMPLE

The design example shows a recommended solution for 5V to 3.3V with a maximum output current of 2A. All necessary components to fulfill the CISPR 32 EMI conducted- and radiated emissions test requirements are included in the design example. The design example passes the conducted and radiated emissions requirements for class B with 0.8m input and the load directly soldered to the board. Filter components may be omitted depending on the requirements of the final application.

20.1 Layout

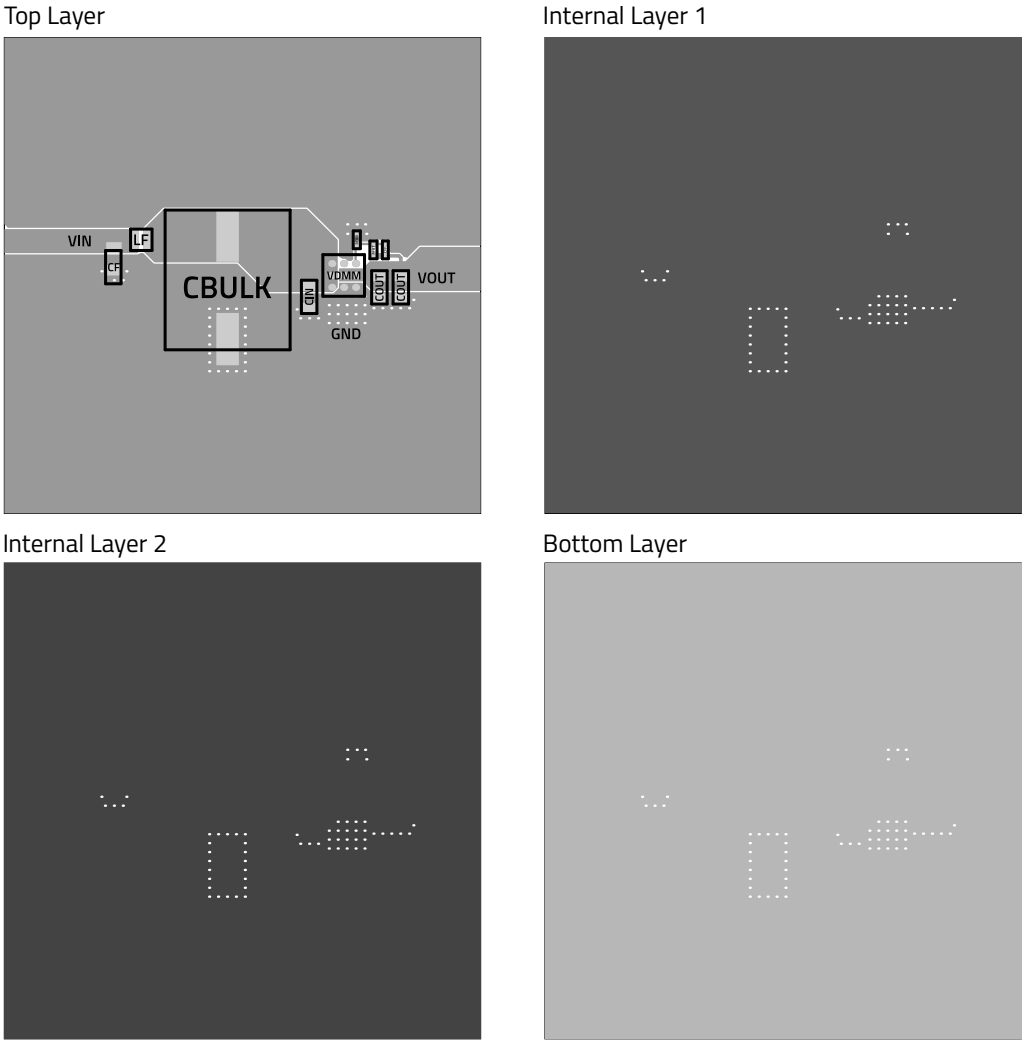


Figure 19: 171020560 layout recommendation.

Figure 19 above shows the top, inner and bottom routed layers for the design example. There are two internal GND layers that improve thermal performance. The pictures above show a possible layout for the 171020560 MagI³C power module. Nevertheless, some recommendations should be followed when designing the layout:

1. The input and output capacitors should be placed as close as possible to the VIN and VOUT pins of the device.
2. The feedback resistor divider should be placed as close as possible to the FB pin.
3. Avoid placing vias in any of the pads for the module.
4. Use as wide GND plane as possible to ensure stable operation of the power module.
5. Use an uninterrupted GND plane on the bottom layer, connected with adequate number of vias to the top layer to improve thermal performance and EMI behavior.
6. To avoid direct coupling of the DC/DC converter´s E- and H-fields into connectors, the susceptible components and traces must be placed as far away from the module as possible.

20.2 Schematic

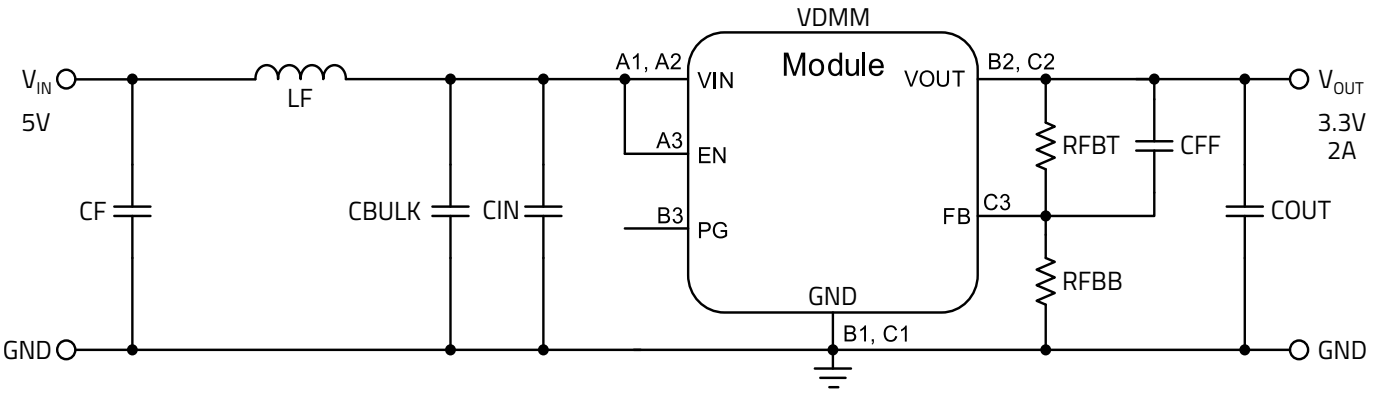


Figure 20: 171020560 design example schematic.

20.3 Bill of Materials

Table 11: Recommended External Components.

Designator	Description	Function	Quantity	Order Code
VDMM	Magl³C power module	Power supply	1	171020560
CF	0805, X7R, 10µF, 10VDC	Input filter	1	885012207026
LF	1610, 0.33µH, 1.9A	Input filter	1	744383130033
CBULK	Aluminum electrolytic, 1000µF, 6.3V	Input filter	1	865230157008
CIN	0805, X7R, 10µF, 10VDC	Electrical performance	1	885012207026
COUT	0805, X7R, 10µF, 10VDC	Electrical performance	2	885012207026
CFF	0603, NP0, 150pF, 16VDC	Electrical performance	1	885012006024
RFBT	100kΩ	Electrical performance	1	560112110019
RFBB	22kΩ for V_{OUT} = 3.3V	Electrical performance	1	560112110098

21 HANDLING RECOMMENDATIONS

1. The power module is classified as MSL3 (JEDEC Moisture Sensitivity Level 3) and requires special handling due to moisture sensitivity (JEDEC J-STD033D).
2. The parts are delivered in a sealed bag (Moisture Barrier Bag = MBB) and should be processed within one year.
3. When opening the moisture barrier bag, check the Humidity Indicator Card (HIC) for color status. Bake parts prior to soldering in case indicator color has changed according to the notes on the card.
4. Parts must be processed after 168 hour (7 days) of floor life. Once this time has been exceeded, bake parts prior to soldering per JEDEC J-STD033D recommendation.
5. Maximum number of solder cycles is two.
6. For minimum risk, solder the module in the last solder cycle of the PCB production.
7. For soldering process please consider lead material copper (Cu) and lead finish ENEPIG.
8. It is recommended to use a standard SAC Alloy such as SAC 305, type 3 or higher.
9. The profile below is valid for convection reflow only.
10. Other soldering methods (e.g. vapor phase) are not verified and have to be validated by the customer at their own risk.

22 SOLDER PROFILE

Table 12: Reflow solder profile.

Profile Feature	Symbol	Value
Preheat temperature minimum	T_{s_min}	150 °C
Preheat temperature maximum	T_{s_max}	200 °C
Preheat time from T_{s_min} to T_{s_max}	t_s	60-120 seconds
Liquidous temperature	T_L	217 °C
Time maintained above T_L	t_L	60-150 seconds
Classification temperature	T_C	260 °C
Peak package body temperature	T_P	$T_P \leq T_C$
Time within 5 °C of the specified T_C	t_P	$t_P \leq 30$ seconds
Ramp-up rate (T_L to T_p)		3 °C/second maximum
Ramp-down rate (T_p to T_L)		6 °C/second maximum
Time 25 °C to peak temperature		8 minutes maximum

Please refer to JEDEC J-STD020F for further information pertaining to reflow soldering of electronic components.

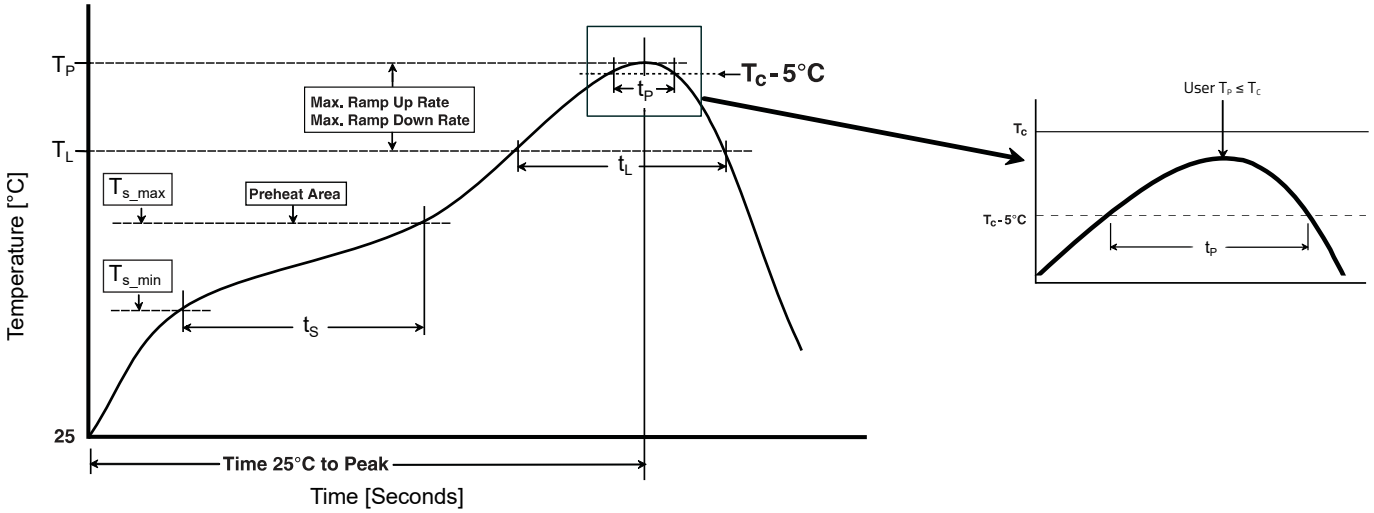


Figure 21: Solder profile.

23 PHYSICAL DIMENSIONS

23.1 Component

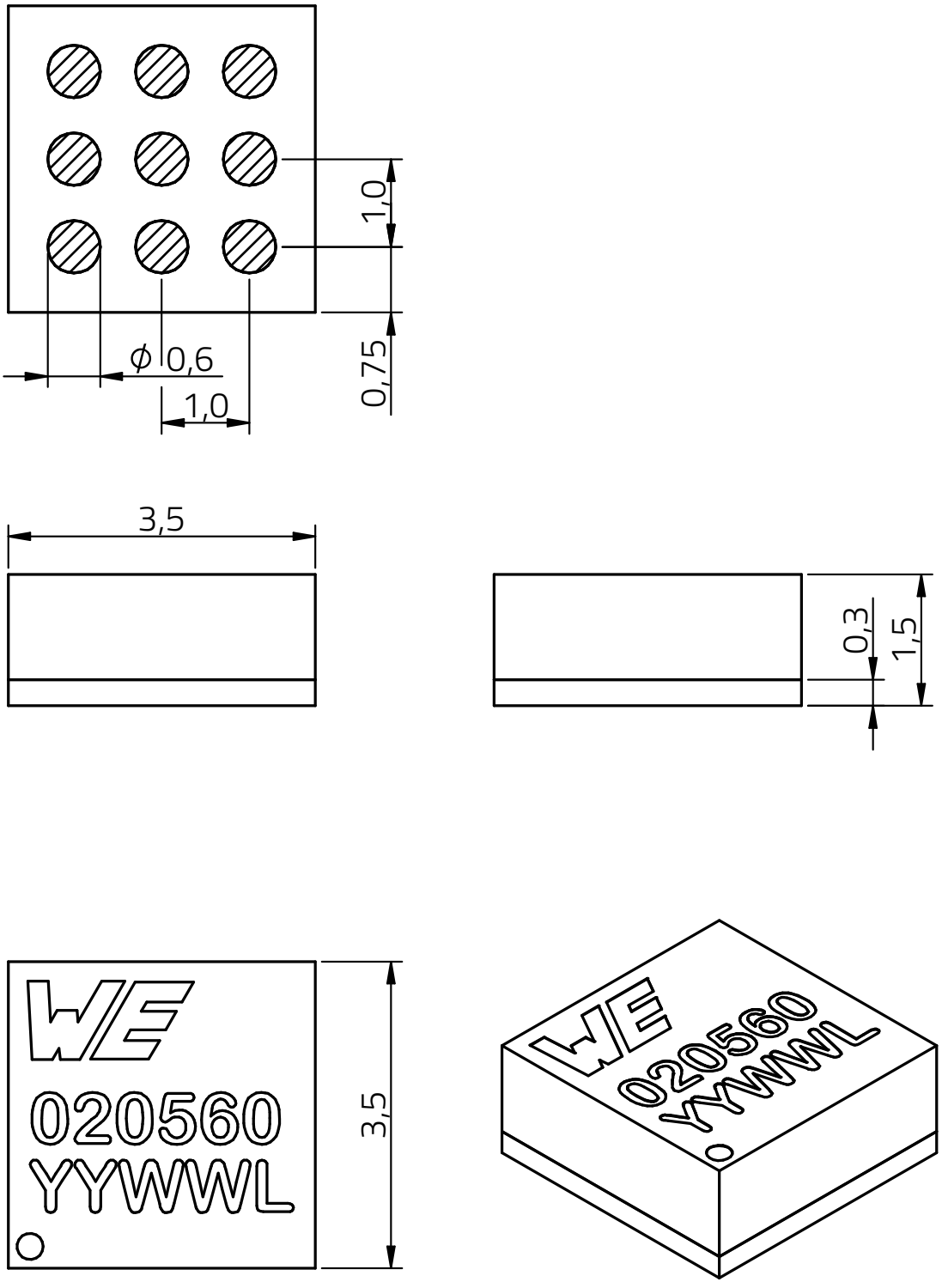


Figure 22: 171020560 Module Dimensions.

All dimensions in mm
Tolerances ±0,1mm unless otherwise specified

23.2 Example Landpattern Design

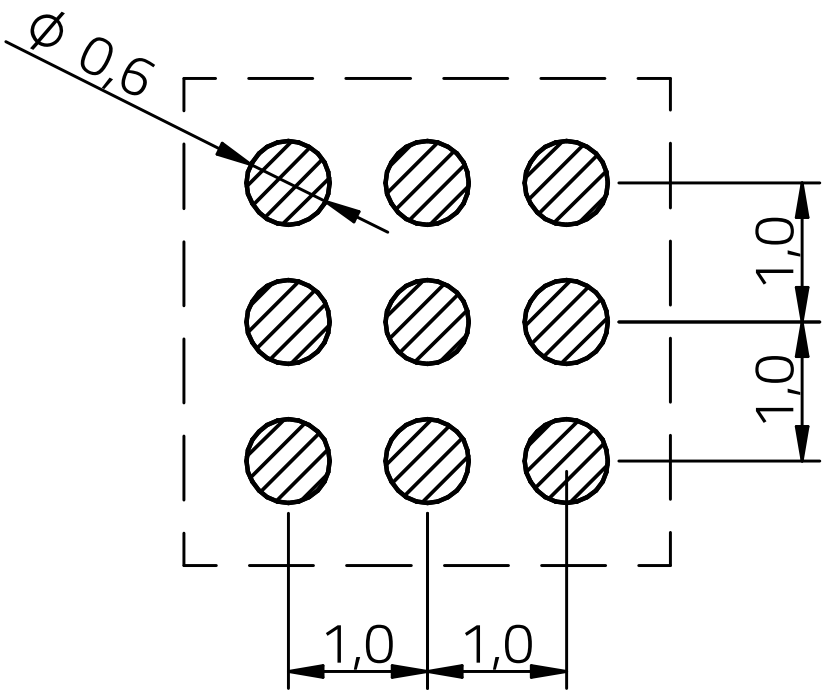


Figure 23: Example landpattern design.

All dimensions in mm
Stencil thickness of 100µm is recommended

23.3 Tape

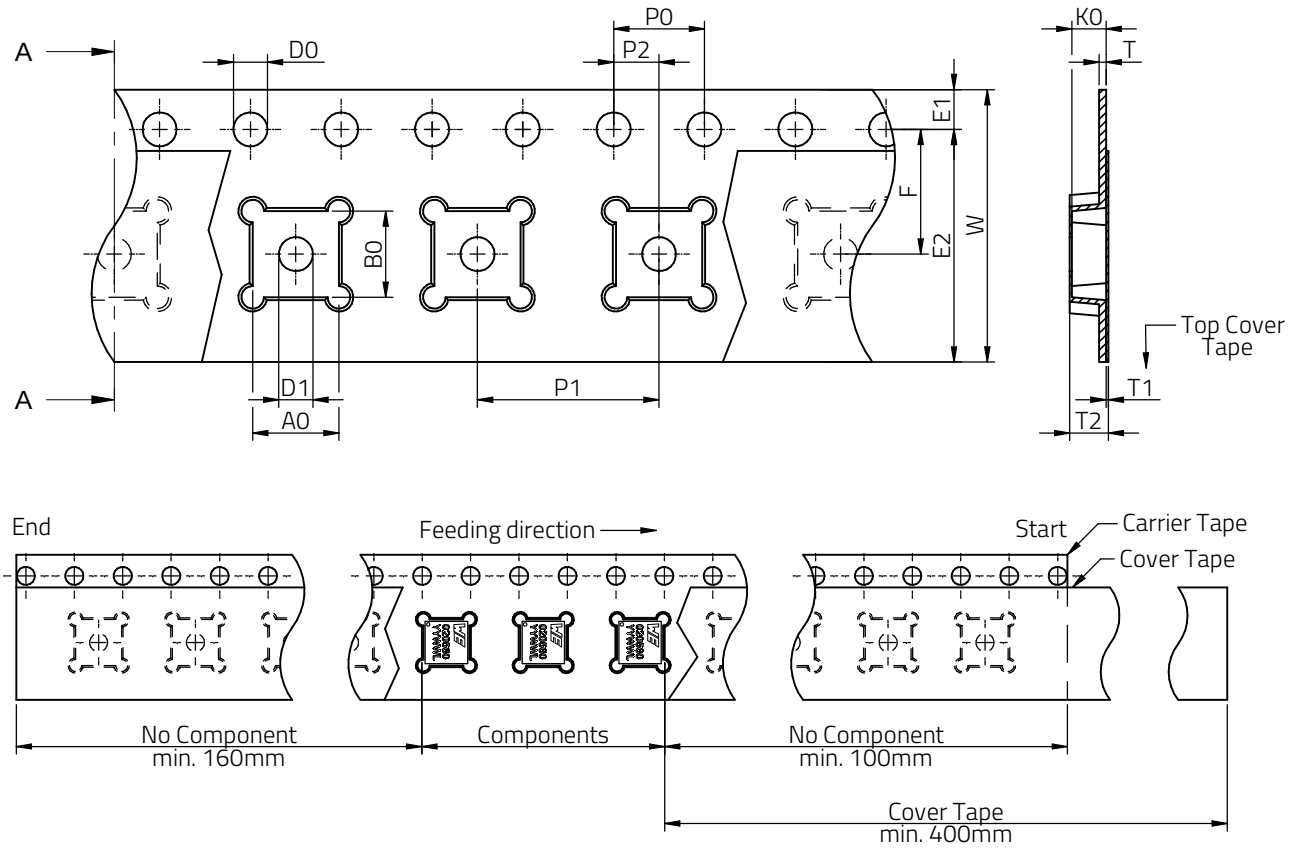


Figure 24: Tape.

Table 13: Tape dimensions.

Tape Type	A0	B0	W	T	K0	P0	P1	P2	D0	D1	E1	E2	F	Material
	typ.	typ.	+0.3/-0.1	ref.	typ.	±0.1	±0.1	±0.1	+0.1	Min.	±0.1	min.	±0.1	
2a	11.3	6.3	24	0.5	3.5	4	12	2	1.5	1.5	1.75	22.25	11.50	Polystyrene

All dimensions in mm

23.4 Reel

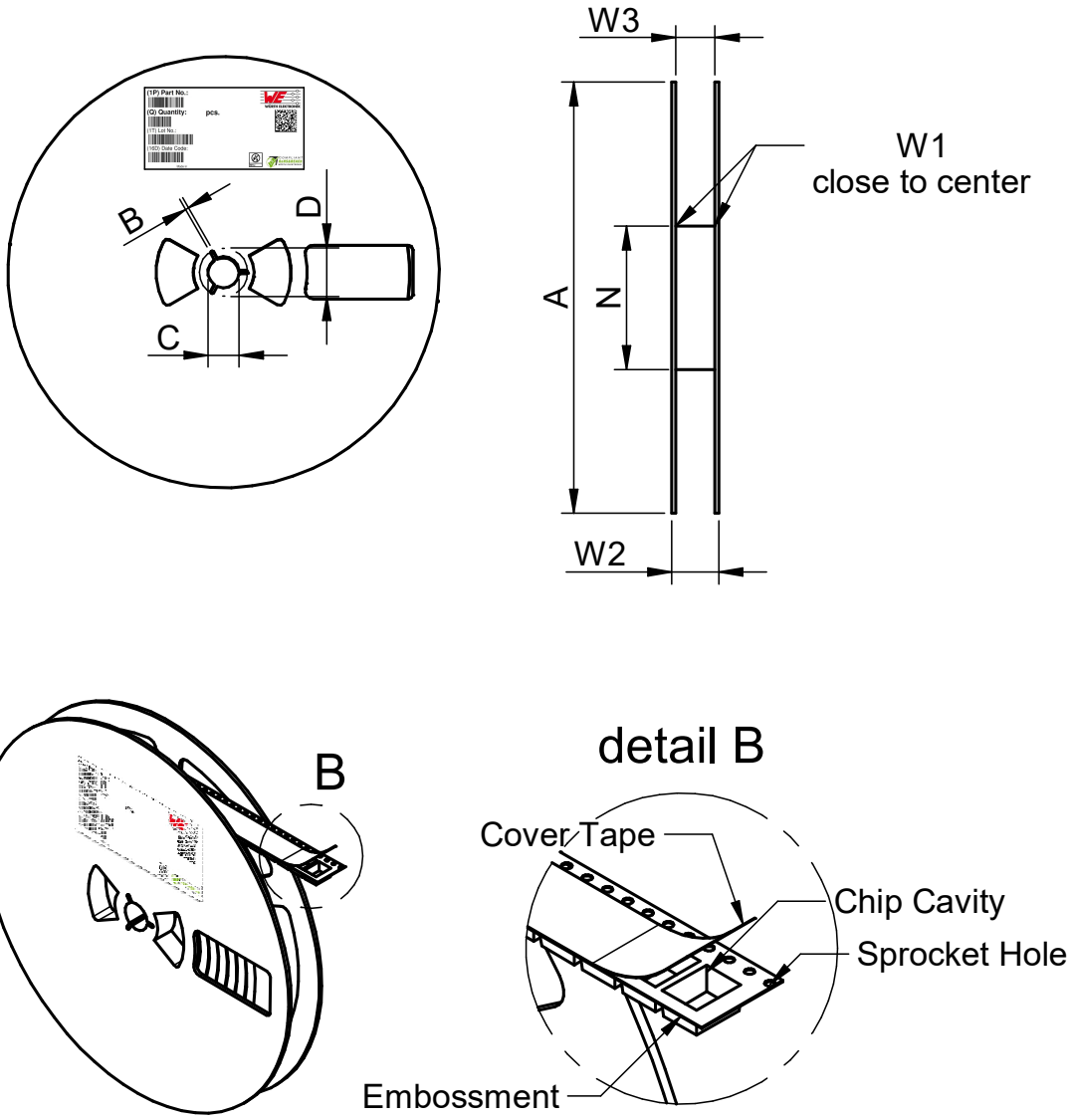


Figure 25: Reel.

Table 14: Reel dimensions.

A	B	C	D	N	W1	W2	W3	W3	Material
±2.0	±0.5	±0.5	typ.	±0.5	+1.5	±1.0	min.	±1.4	
178.00	2.50	13.00	17.0	60.0	13.2	16.0	23.90	13.60	Polystyrene

All dimensions in mm

24 DOCUMENT HISTORY

Table 15: Document history.

Revision	Date	Description	Comment
1.0	August 2025	Initial datasheet release	

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.

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.

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.