4.5V - 32V / 1A / 1.2V - 6V Output

DESCRIPTION

The VDMM series MagI^{3}C power module provides a fully integrated DC-DC power supply including the switching regulator with integrated MOSFETs, controller and compensation, as well as the shielded inductor in one package.

The 171013201 offers high efficiency and delivers up to 1A of output current. It operates with an input voltage from 4.5V to 32V and is designed for a small solution size.

The power module maintains high efficiency throughout the output current range by automatically transitioning between operating modes based on the load demands.

The 171013201 is available in an LGA-10 package (3.8 x 3 x 1.8mm).

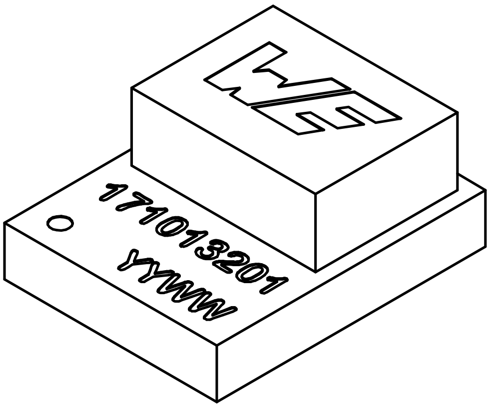
This power module has integrated protection circuitry that guards against thermal overstress with thermal shutdown and protects against electrical damage using overcurrent, short circuit and undervoltage detection.

FEATURES

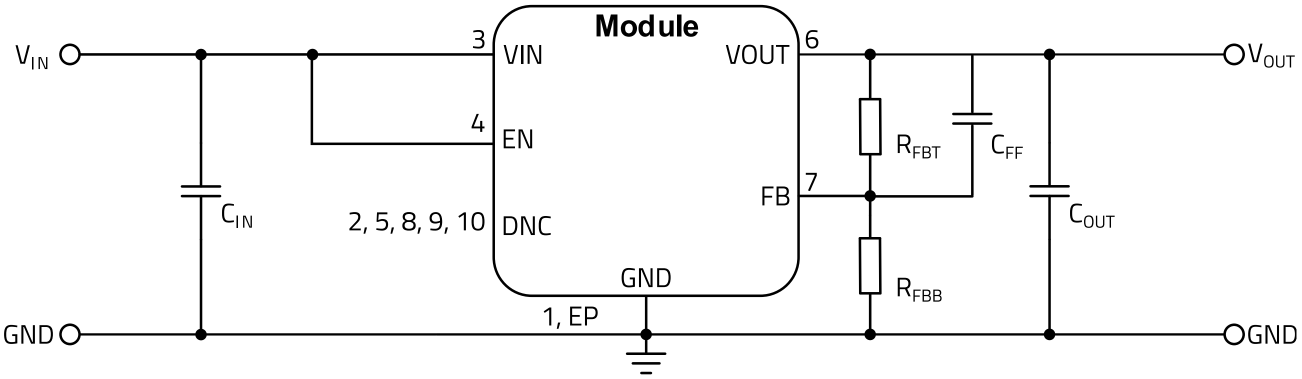
- Peak efficiency up to 93%
- Current capability up to 1A
- Input voltage range: 4.5V to 32V
- Output voltage range 1.2V to 6V
- 18µA typical quiescent current
- Integrated shielded inductor
- Low output voltage ripple: typ. 10mVpp
- Output voltage accuracy: 1%
- Fixed switching frequency: 2MHz
- Current mode control
- Automatic PFM/PWM mode
- Synchronous operation
- Undervoltage lockout
- Internal soft-start
- Thermal shutdown
- Short circuit protection
- Overcurrent protection
- Cycle-by-cycle current limit
- RoHS and REACH compliant
- Operating ambient temp. range: -40°C to 85°C
- Operating junction temp. range: -40°C to 125°C
- Complies with EN 55032 / CISPR 32 class B conducted and radiated emissions standard

TYPICAL APPLICATIONS

- Point-of-Load DC-DC applications
- Industrial and medical applications
- Test and measurement applications
- DSPs, MCUs and MPUs supply
- I/O interface power supply



TYPICAL CIRCUIT DIAGRAM



1 PINOUT

Top View

Top-Through View

Figure 1: Pinout

Table 1: Marking Description

MARKING	**DESCRIPTION**
WE	Logo
171013201	Part number
°YYWW	Pin 1 indicator, year and week

Table 2: Pin description.

SYMBOL	**NUMBER**	**TYPE**	**DESCRIPTION**
GND	1	Power	Power ground. This pin must be connected to the ground plane and to the exposed pad.
VIN	3	Power	Input voltage pin. Place the input capacitors as close as possible to VIN and GND.
EN	4	Input	Enable pin. Applying a voltage higher than 1.4V to this pin enables the device, while pulling this pin low shuts down the device. This pin **must not** be left floating.
VOUT	6	Power	Output voltage pin. Place output capacitor as close as possible to VOUT and GND.
FB	7	Input	Feedback pin to the internal error amplifier. This pin must be connected to the external resistor divider to adjust the output voltage.
DNC	2, 5, 8, 9, 10	DNC	These pins **must not** be connected externally for electrical functionality.
GND	EP	Power	Power ground exposed pad. This pin is internally connected to GND. It is recommended to connect this pin to the ground plane(s) for heat dissipation.

2 ORDERING INFORMATION

Table 3: Ordering information.

ORDER CODE	SPECIFICATIONS	PACKAGE	PACKAGING UNIT
171013201	1A / 1.2V - 6V Vout	LGA-10	7" Reel (900 pieces)
178013201	1A / 1.2V - 6V Vout	Eval Board	1 piece

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 maximum ratings.

SYMBOL	PARAMETER	LIMIT		UNIT
		MIN	MAX	
VIN	Input voltage pin	-0.3	40	V
VOUT	Output voltage pin	-0.3	20	V
FB	Feedback pin	-0.3	20	V
EN	Enable pin	-0.3	40	V
$T_{storage}$	Assembled, non-operating storage temperature	-40	125	°C
V_{ESD}	ESD voltage (HBM); VIN, VOUT, FB, EN pins (C=100pF R=1.5kΩ)	-1.5	1.5	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 85°C. Typical values represents statistically the utmost probable values at the following conditions: V_{IN} = 24V, V_{OUT} = 5V, C_{IN} = 2x 10µF, C_{OUT} = 2x 10µF ceramic, T_A = 25°C unless otherwise noted.

Table 6: Operating conditions.

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT
V_{IN}	Input Voltage	4.5	–	32	V
V_{OUT}	Output voltage	1.2	–	6	V
T_A	Ambient temperature range	-40	–	85	°C
T_{JOP}	Junction temperature range	-40	–	125	°C
I_{OUT}	Output current	-	–	1	A

6 THERMAL SPECIFICATIONS

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

Table 7: Thermal specifications.

SYMBOL	PARAMETER	TYP(3)	UNIT
Θ_{JA}	Junction-to-ambient thermal resistance(2)	100	K/W
T_{SD}	Thermal shutdown, rising	150	°C
	Thermal shutdown, hysteresis	15	°C

7 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 probable values at the following conditions: V_{IN} = 24V, V_{OUT} = 5V, V_{EN} = V_{IN}, I_{OUT} = 1A, C_{IN} = 2x 10µF ceramic, C_{OUT} = 2x 10µF ceramic, T_A = 25 °C unless otherwise noted.

Table 8: Electrical Specifications.

SYMBOL	PARAMETER	TEST CONDITIONS	LIMIT			UNIT
			MIN(1)	TYP(3)	MAX(1)	
Output Current						
I_{OC-HS}	Overcurrent limit, high-side switch		1.6		2.5	A
Output Voltage						
V_{OUT}	Load regulation	20 % to 100% load	-2	—	2	%
	Output voltage ripple	I_{OUT} = 1A	—	10	—	mVpp
	Line regulation	$V_{OUT} \leq 3.3V$	-1.5	—	1.5	%
		$V_{OUT} > 3.3V$	-1	—	1	%
V_{FB}	Reference voltage		0.792	0.8	0.808	mV
I_{FB}	Feedback pin bias current		—	—	50	nA
Switching Frequency						
f_{SW}	Switching frequency		—	2	—	MHz
T_{ON_MIN}	Minimum on-time		—	80	—	ns
T_{Off_Min}	Minimum off-time		—	100	—	ns
Enable and Undervoltage Lockout						
V_{UVLO}	V_{IN} undervoltage threshold	V_{IN} increasing	3.6	4	4.2	V
	V_{UVLO} hysteresis		—	0.6	—	mV
V_{EN}	EN threshold	Enable logic high	1.4	—	—	V
		Enable logic low	—	—	1	V
Soft-Start						
t_{SS}	Soft-start time	EN high to 95% of V_{OUT}	—	1	—	ms
Input Quiescent and Shutdown Current						
I_{SD}	Shutdown current	EN = low	—	1	2	µA
I_Q	Quiescent current	EN = high, no switching	—	18	—	µA
I_{NL}	No load input current	EN = high, switching	—	32	—	µA
Efficiency						
η	Efficiency	V_{IN}=9V, V_{OUT}=6V, I_{OUT} = 1A	—	93	—	%
		V_{IN}=12V, V_{OUT}=5V, I_{OUT} = 1A	—	87	—	%
			—	84	—	%

8 RoHS, REACH

Table 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).

9 PACKAGE SPECIFICATIONS

Table 10: Package Specifications

ITEM	PARAMETER	TYP(3)	UNIT
Lead Finish	ENEPIG	-	-
Weight	-	0.06	g

10 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 80 x 80mm four layer board, with 70µm (2 ounce) copper on outer layers and 35µm (1 ounce) copper on inner 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.

11 TYPICAL PERFORMANCE CURVES

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

11.1 Radiated and Conducted Emissions (With EMI Input Filter)

The 171013201 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.

11.1.1 Radiated Emissions EN 55032 (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)
- Measurement output wire length: 100cm

11.1.2 Conducted Emissions EN 55032 (CISPR 32) Class B Compliant Test Setup

- Measurement input wire length: 80cm
- Measurement output wire length: 100cm

11.1.3 Radiated Emissions

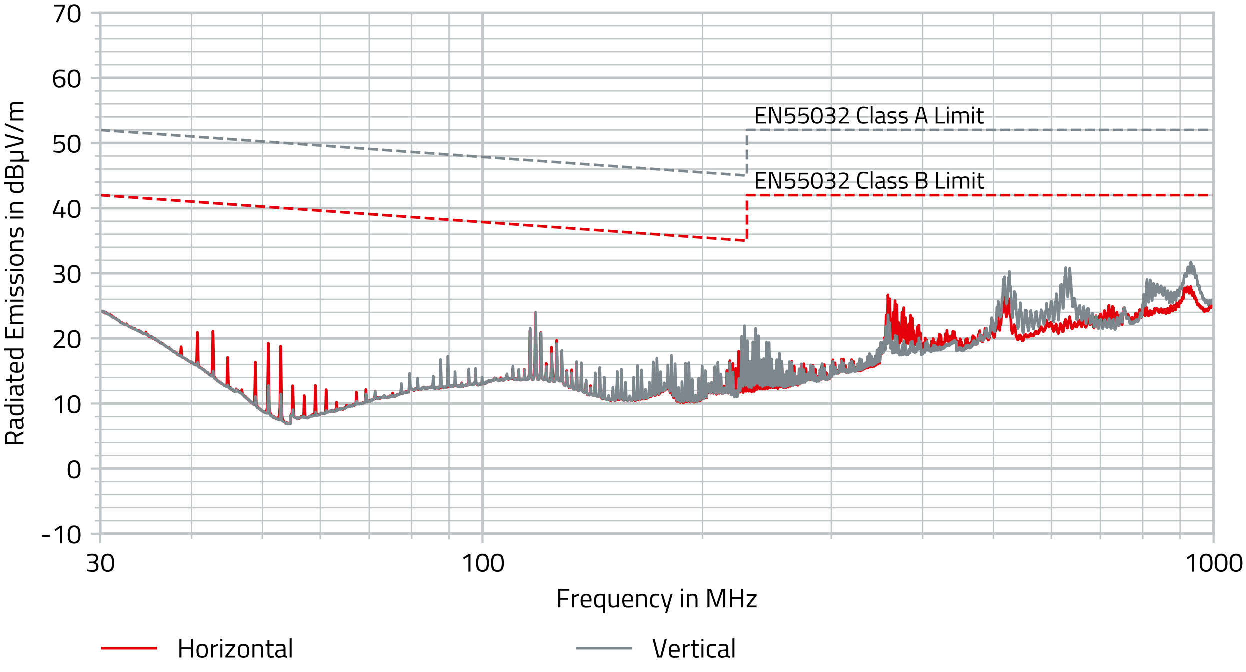


Figure 2: Radiated emissions 171013201 V_{IN} = 24V, V_{OUT} = 5V, I_{LOAD} = 1A with input filter.

11.1.4 Conducted Emissions

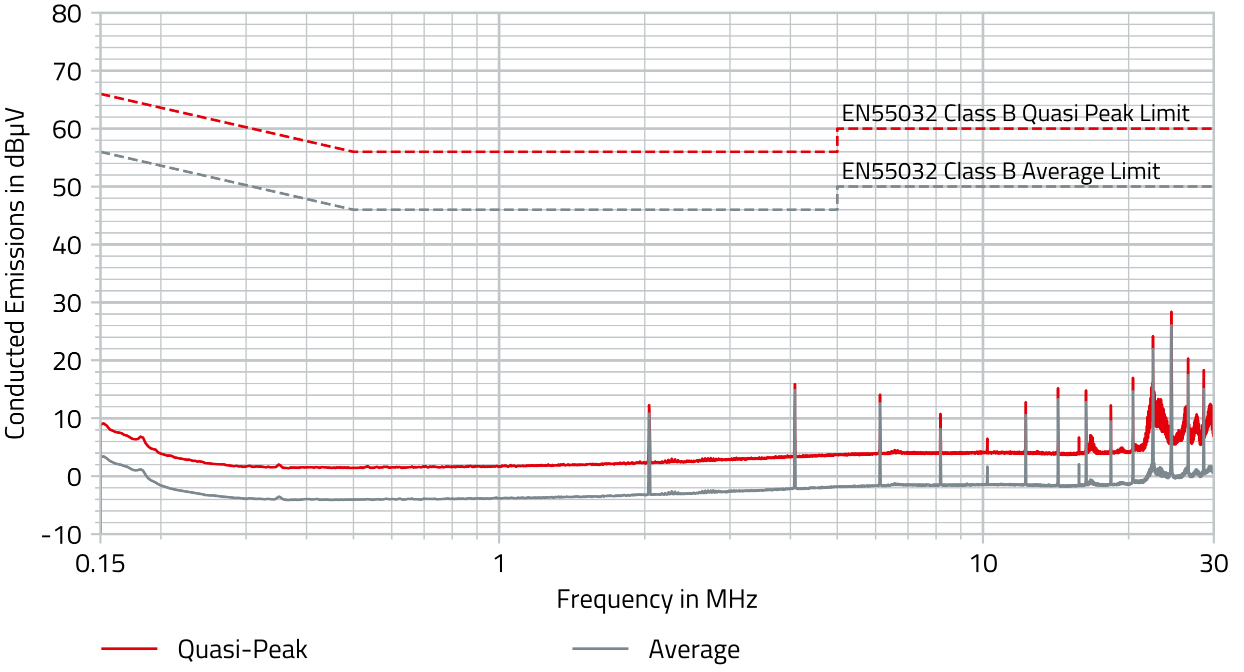


Figure 3: Conducted emissions 171013201 V_{IN} = 24V, V_{OUT} = 5V, I_{LOAD} = 1A with input filter.

11.2 DC Performance Curves

11.2.1 Efficiency $12V_{IN}$

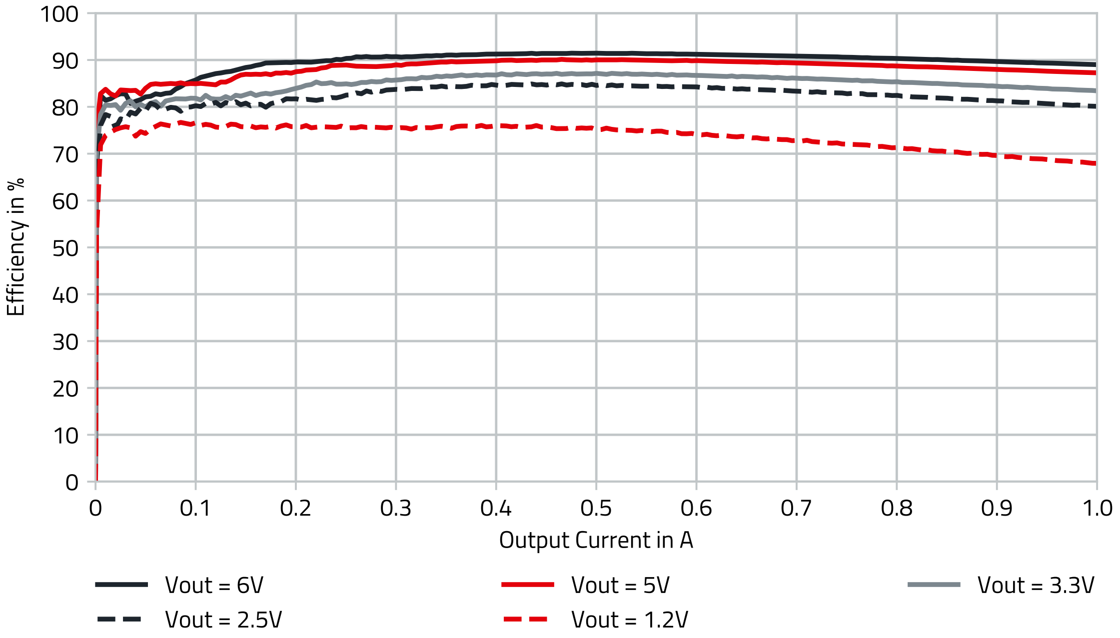


Figure 4: 171013201 efficiency V_{IN} = 12V.

11.2.2 Efficiency $24V_{IN}$

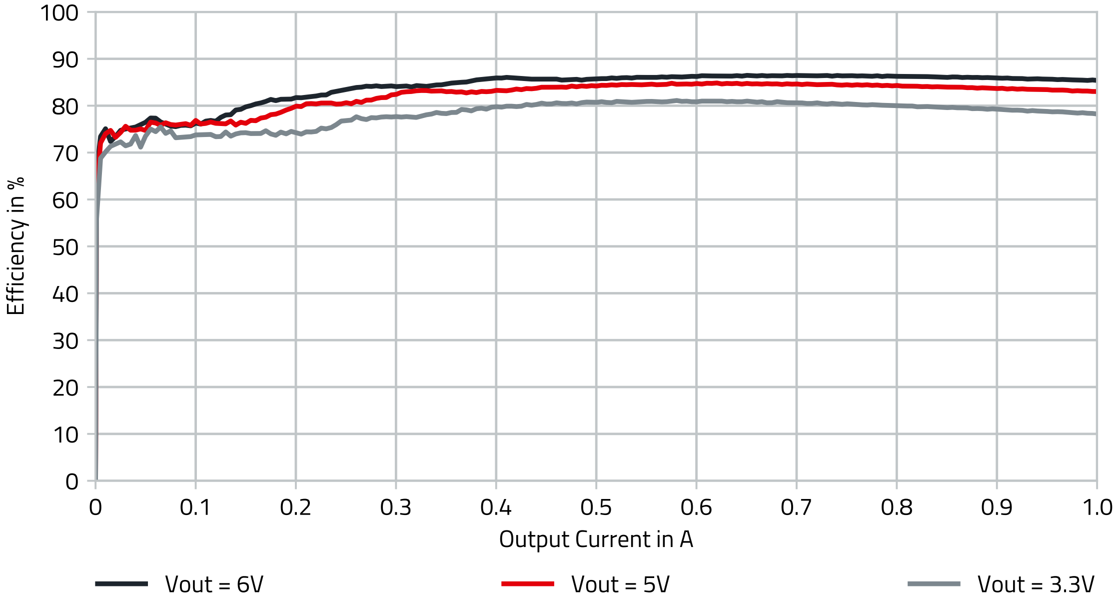


Figure 5: 171013201 efficiency V_{IN} = 24V.

11.2.3 Thermal Derating $12V_{IN}$

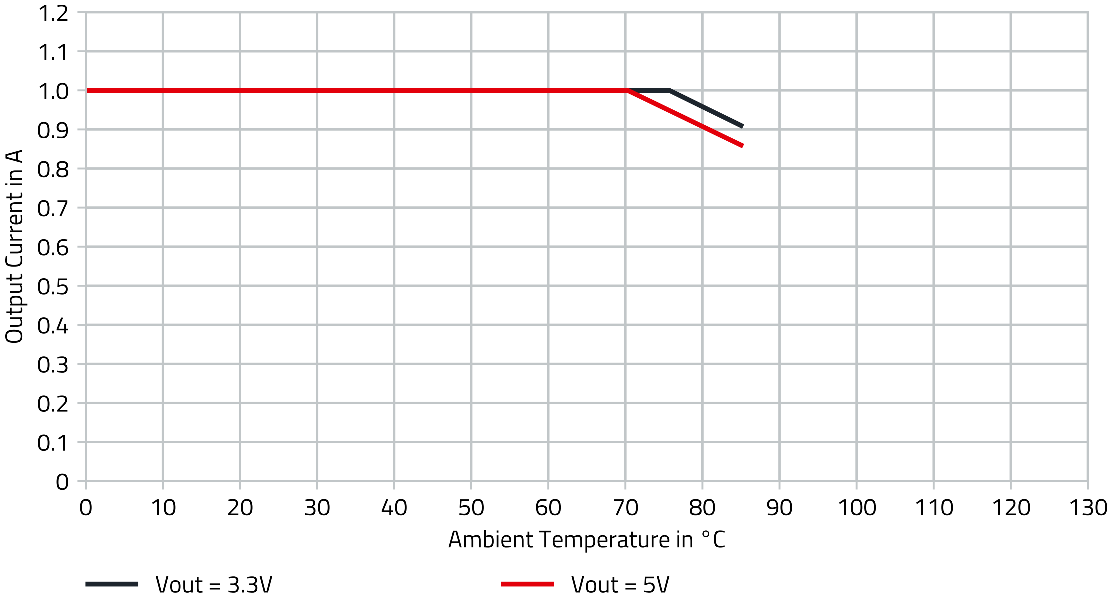


Figure 6: 171013201 output current thermal derating V_{IN} = 12V.

11.2.4 Thermal Derating $24V_{IN}$

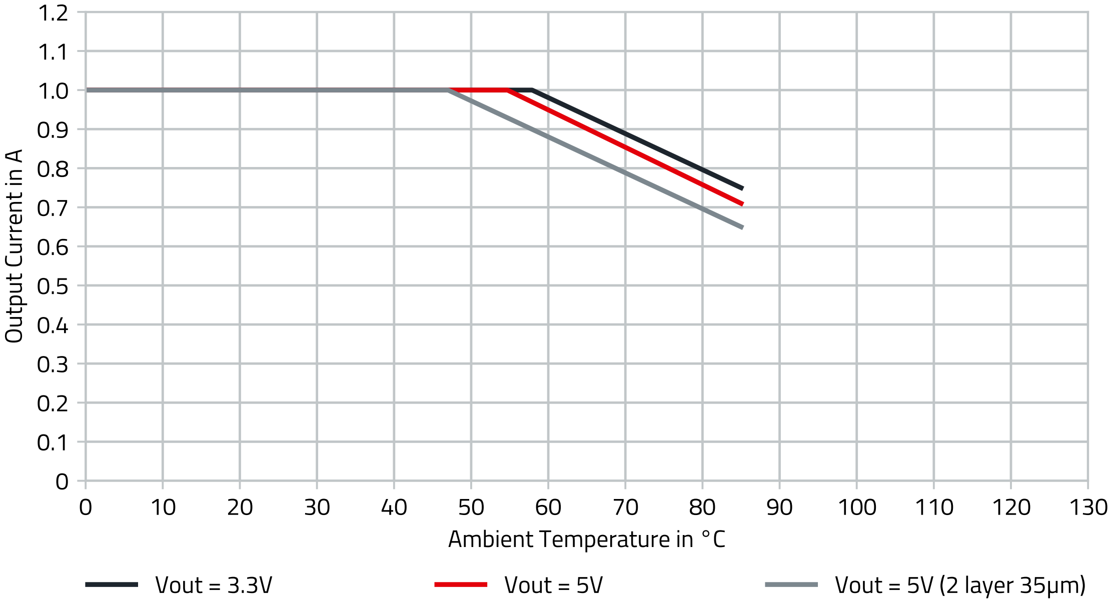


Figure 7: 171013201 output current thermal derating V_{IN} = 24V.

Note: Both thermal derating graphs were measured on the 178013201 Evaluation Board[(2)] (80 x 80 mm, four layers, 70 µm outer layers, 35 µm inner layers copper thickness). A reduced layer stack-up in either number or thickness compared to EVB 178013201 (80 x 80 mm, four layers, 70 µm outer layers, 35 µm inner layers copper thickness) results in a reduced thermal derating shown in Figure 7 trace Vout = 5V (2 layer 35µm). Please see T_A limits in OPERATING CONDITIONS.

11.2.5 Load Regulation 3.3V_{OUT}

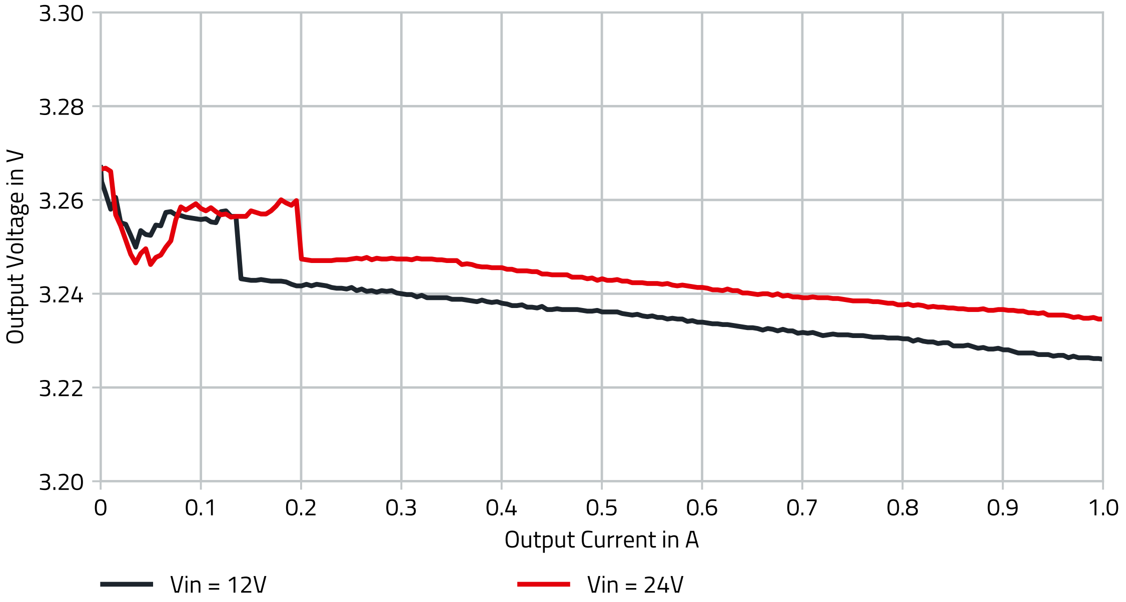


Figure 8: 171013201 Load Regulation V_{OUT} = 3.3V.

11.2.6 Load Regulation 5V_{OUT}

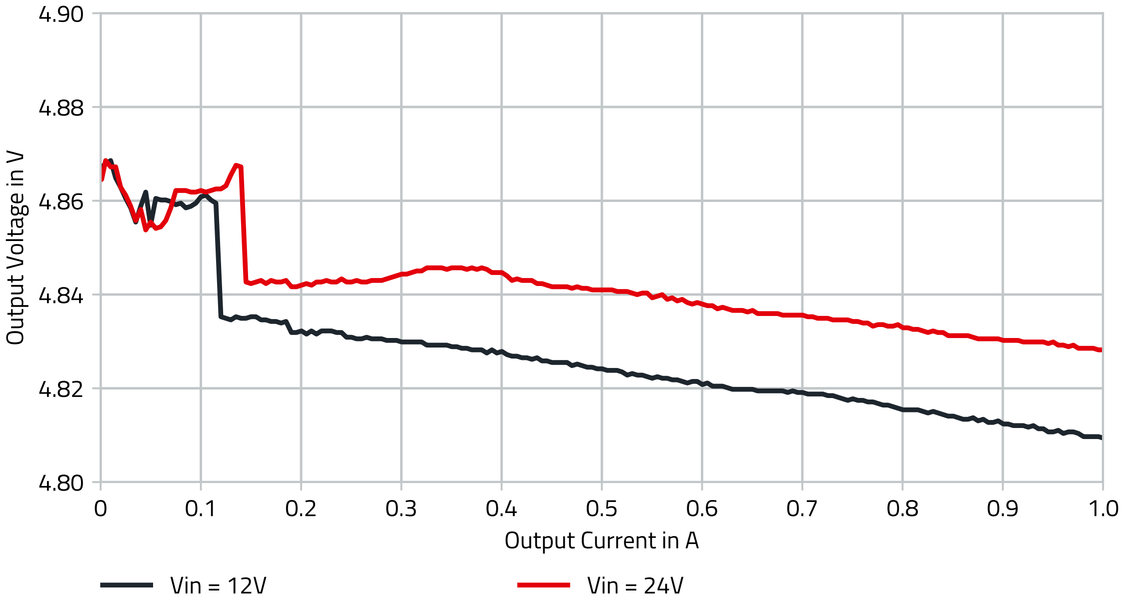


Figure 9: 171013201 Load Regulation V_{OUT} = 5V.

11.2.7 Line Regulation 3.3V_{OUT}

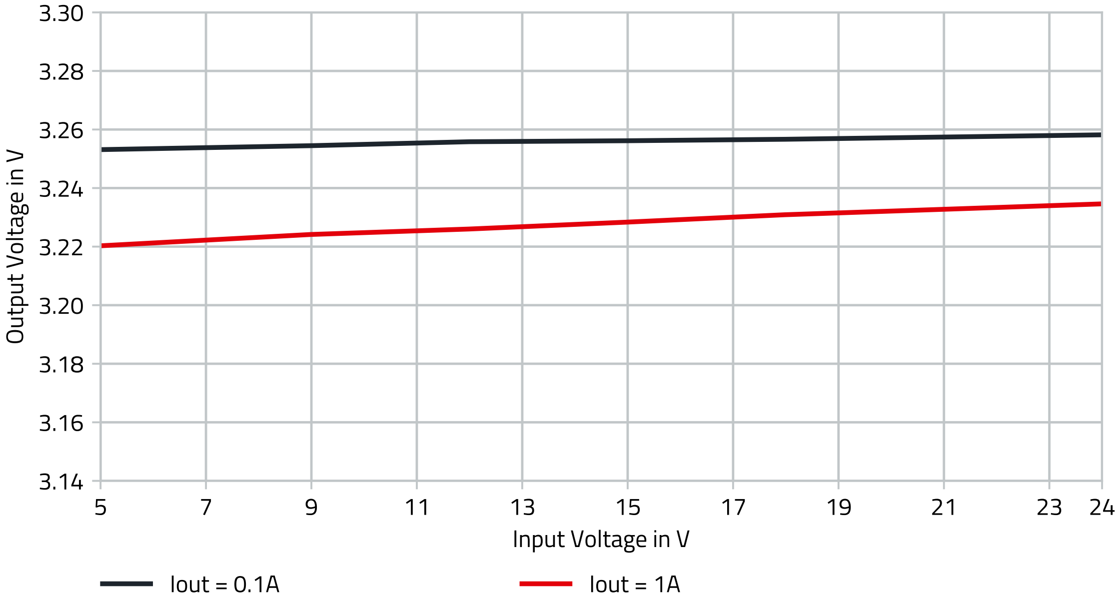


Figure 10: 171013201 Line Regulation V_{OUT} = 3.3V.

11.2.8 Line Regulation 5V_{OUT}

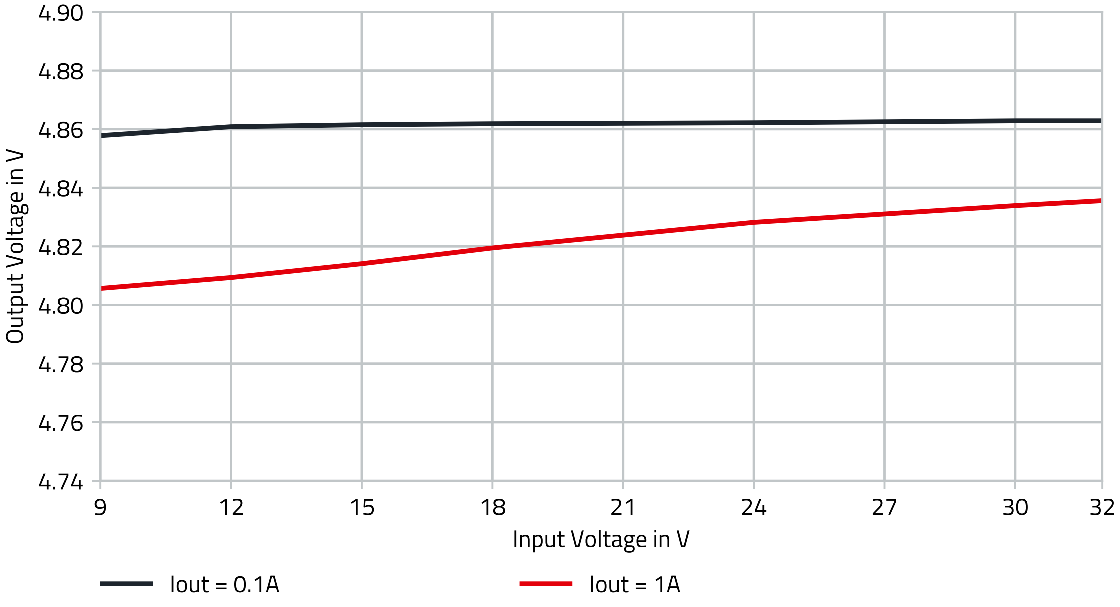


Figure 11: 171013201 Line Regulation V_{OUT} = 5V.

12 BLOCK DIAGRAM

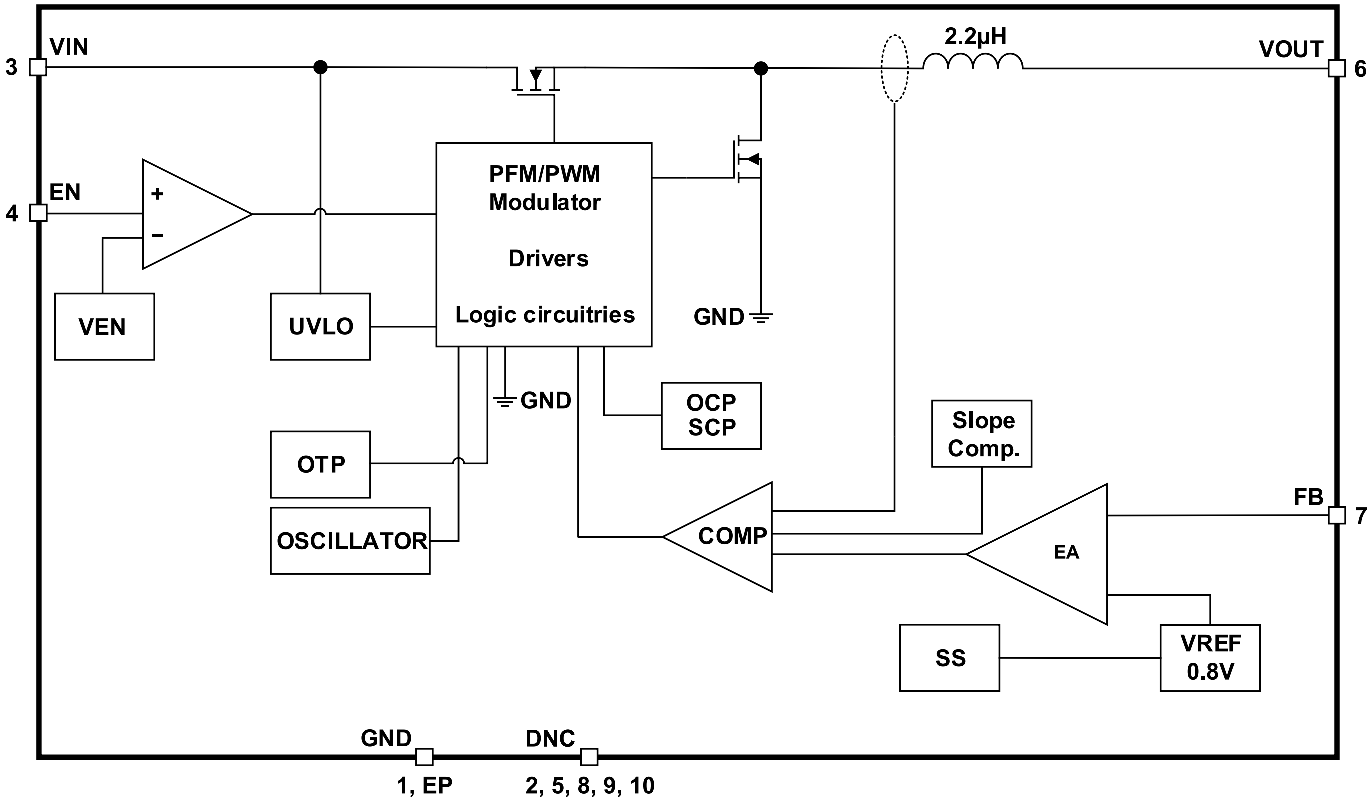


Figure 12: 171013201 block diagram.

13 CIRCUIT DESCRIPTION

The WPME-VDMM 171013201 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 current mode (CM) regulation loop.

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 0.8V reference. The error signal is amplified and controls the on-time of a fixed frequency pulse width generator. This signal drives the power MOSFETs.

The current mode architecture features a constant frequency during load steps. Only the on-time is modulated. It is internally compensated and stable with low ESR output capacitors and requires no external compensation network.

This architecture supports fast transient response and very small output voltage ripples ($<10mV_{p-p}$) are achieved.

14 DESIGN FLOW

The following simple steps will show how to select the external components to design the 171013201 into an application.

Essential Steps

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

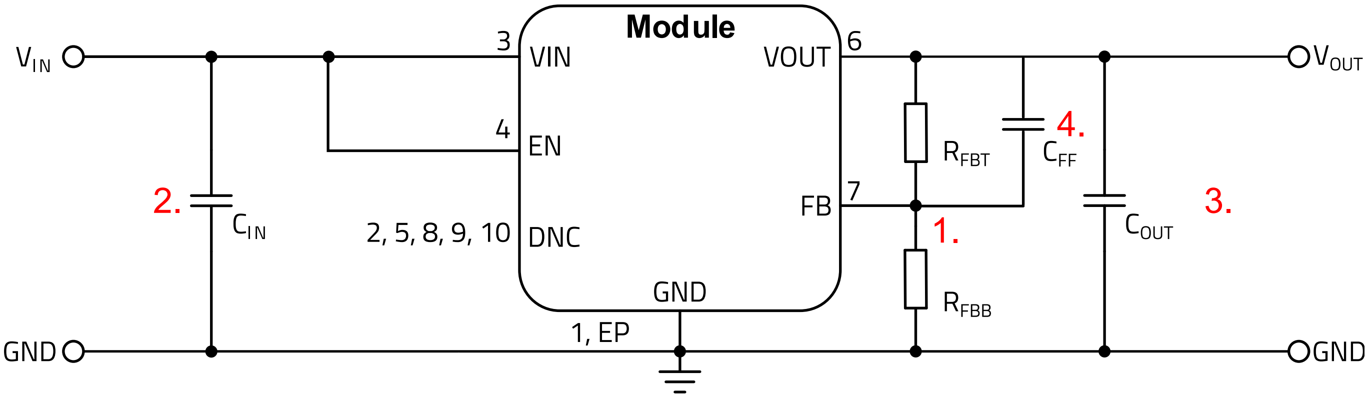


Figure 13: Design flow schematic.

14.1 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 14). The voltage across the lower resistor of the divider is provided to the FB pin and compared with a reference voltage of 0.8V (V_{REF}). The module can provide the entire output current of 1A with an output voltage range of 1.2V to 6V. The output voltage can be calculated according to the following formula:

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

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 11: 171013201 output voltage selection.

V_{OUT} (V)	1.2	1.5	1.8	2.5	3.3	5.0	6.0
R_{FBB} (E96) (kΩ)	200	115	80.6	47.5	32.4	19.1	15.4

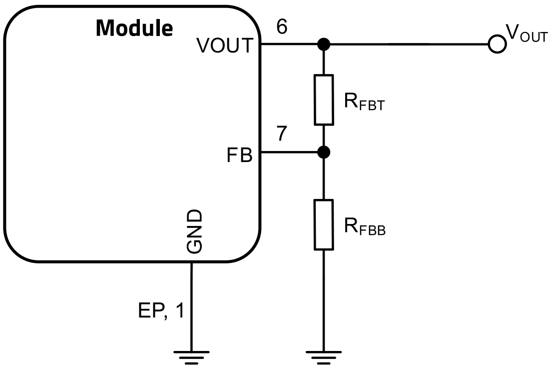


Figure 14: Output voltage selection schematic.

14.2 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 (2x 10µF) 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. Two of the Würth Elektronik 885012209073 MLCCs have been experimentally verified to work with this power module. Please check the DESIGN EXAMPLE section to see the recommended layout.

14.3 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. Two external MLCCs of 10µF are recommended for all application conditions. Attention must be paid to the voltage, frequency, and temperature deratings as well as the thermal class of the selected capacitor. The Würth Elektronik part number 885012209073 has been experimentally verified to work with this power module. For output voltages $\leq$ 2.5V it is recommended to add a 180µF polymer chip capacitor. The Würth Elektronik 875015119005 capacitor has been experimentally verified to work with this power module.
In general, the output voltage ripple can be calculated using the following equation:

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

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

$$\Delta I_{\text{L}} = \frac{V_{\text{OUT}} \cdot (V_{\text{IN}} - V_{\text{OUT}})}{f_{\text{SW}} \cdot L \cdot V_{\text{IN}}} \tag{3}$$

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

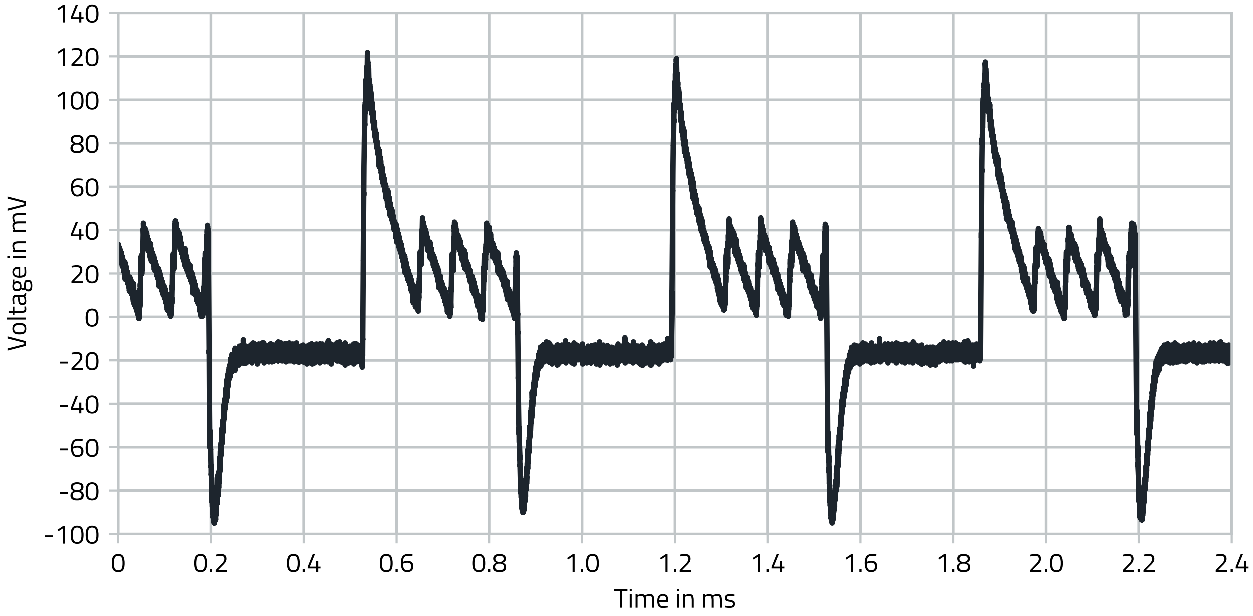


Figure 15: 171013201 V_{IN} = 24V, V_{OUT} = 5V, C_{OUT} = 2x 10µF MLCC, load jumps 0% - 100%.

14.4 STEP 4 Select The Feed-Forward Capacitor (C_{FF})

The MagI^{3}C power module requires the use of a feed forward capacitor. A 100pF C_{FF} capacitor has been evaluated experimentally as a value with suitable efficiency and transient characteristics for most applications. The Würth Elektronik part number 885012006038 has been experimentally verified to work with this module.

Deviation from the recommendation is taken at the user's own risk and should be evaluated in the designated application to ensure proper functionality. A lower value of C_{FF} will increase the light load efficiency while slowing down the response time as well as increasing the overshoot and undershoot. Increasing the C_{FF} value results in a vice versa effect.

The picture below shows the transient behavior of the power module in response to a load transition from 0A to 1A using the recommended C_{FF} = 100pF.

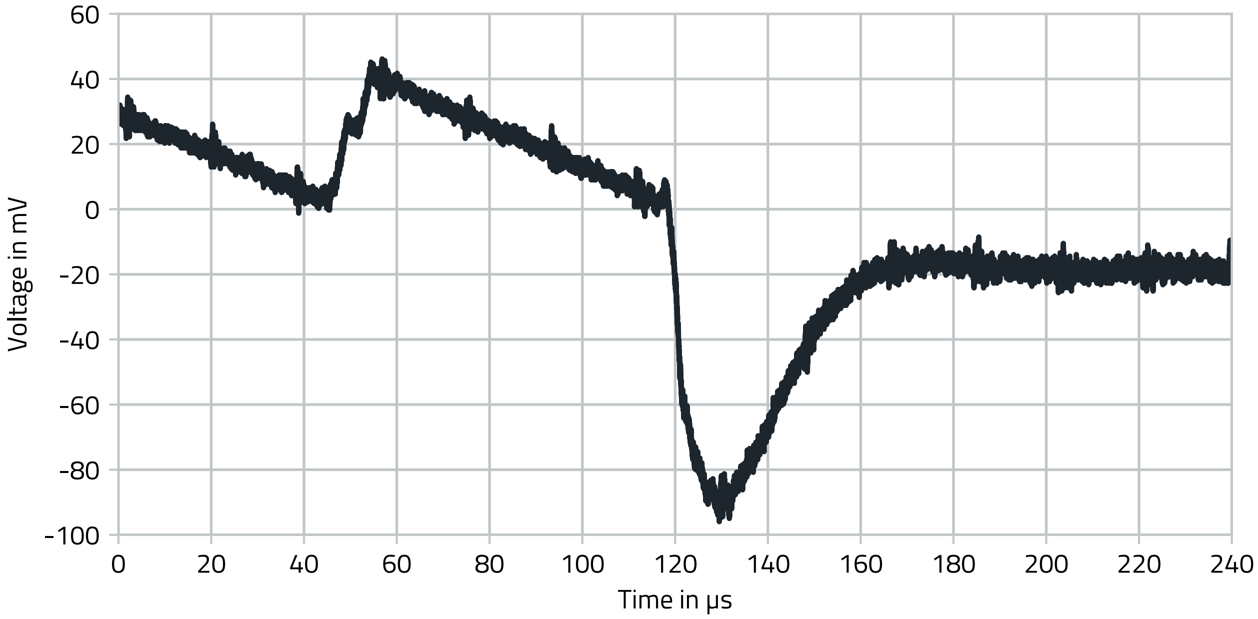


Figure 16: 171013201 V_{IN} = 24V, V_{OUT} = 5V, C_{OUT} = 2x 10µF MLCC, C_{FF}=100pF MLCC, load jumps 0% - 100%.

15 MODES OF OPERATION

Depending on the load current, input voltage and output voltage, the 171013201 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.

15.1 PWM Operation

In PWM mode, the module maintains stable regulation under nominal and medium-to-high load conditions, while providing fast response to line and load transients. The effective output voltage or current is determined by the ratio of on-time to off-time of the switching cycle.

15.2 PFM Operation

Under light load conditions, the power module uses Pulse Frequency Modulation to maintain high efficiency. In PFM mode, the switching frequency decreases as the load current is reduced, thereby lowering gate-drive and switching-related losses. This helps maintain high efficiency during standby or low-power operation. As load demand increases, the module automatically transitions from PFM mode to PWM mode to ensure stable regulation and improved dynamic performance.

At higher values of input voltage it is possible that the set input to output voltage ratio violates the minimum on-time. In such cases the module enters pulse skipping independent of the mode of operation. It is expected that the output voltage ripple is increased compared to normal operation. Please see the minimum on-time in ELECTRICAL SPECIFICATIONS.

16 OUTPUT VOLTAGE RIPPLE

If the power module is working in PWM mode the output voltage ripple is very low and is determined by the switching frequency. If the load current is low enough to be in the PFM mode of operation then the output voltage ripple will be higher with a frequency lower than the nominal switching frequency (see figures 17, 18).

16.1 PFM Operation

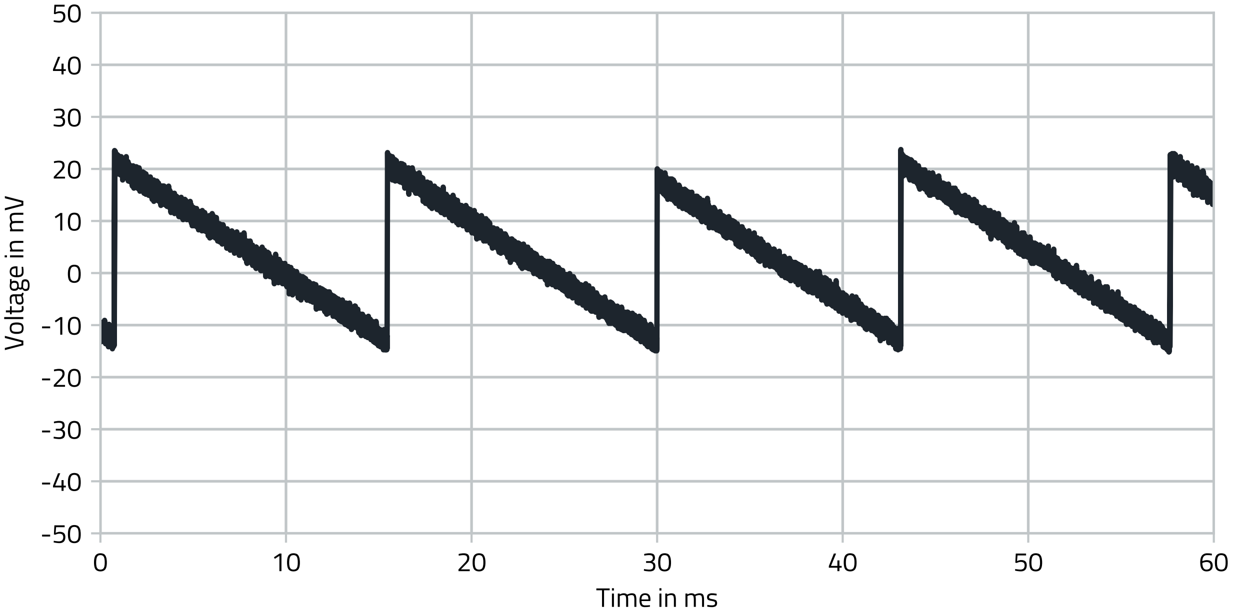


Figure 17: 171013201 output voltage ripple V_{IN} = 24V, V_{OUT} = 5V, I_{OUT} = 0A, C_{OUT} = 2x 10μF.

16.2 PWM Operation

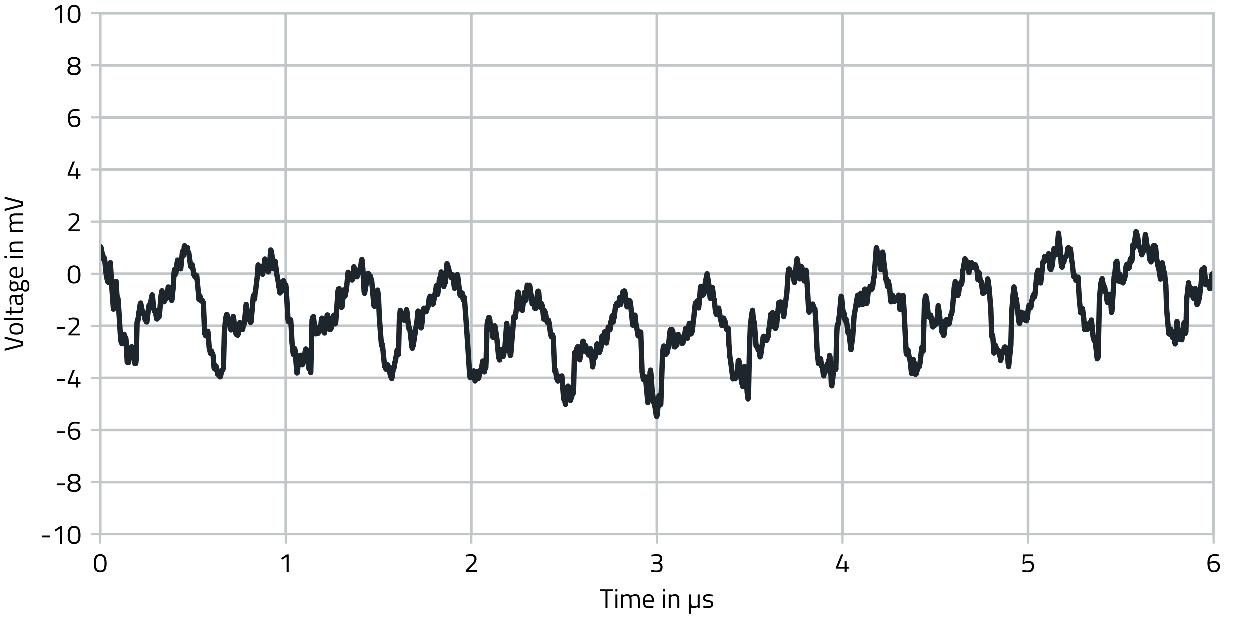


Figure 18: 171013201 output voltage ripple V_{IN} = 24V, V_{OUT} = 5V, I_{OUT} = 1A, C_{OUT} = 2x 10μF.

17 PROTECTION FEATURES

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

The MagI^{3}C 171013201 power module integrates a hiccup based short-circuit and overcurrent protection. If the set VOUT drops below 50% of the set-point, the protection mode will be initiated. The device will shut down for approximately 5ms, and then restart with a complete soft-start cycle that is approximately 1ms. If the fault condition remains, another hiccup cycle of shutdown and restart will continue indefinitely.

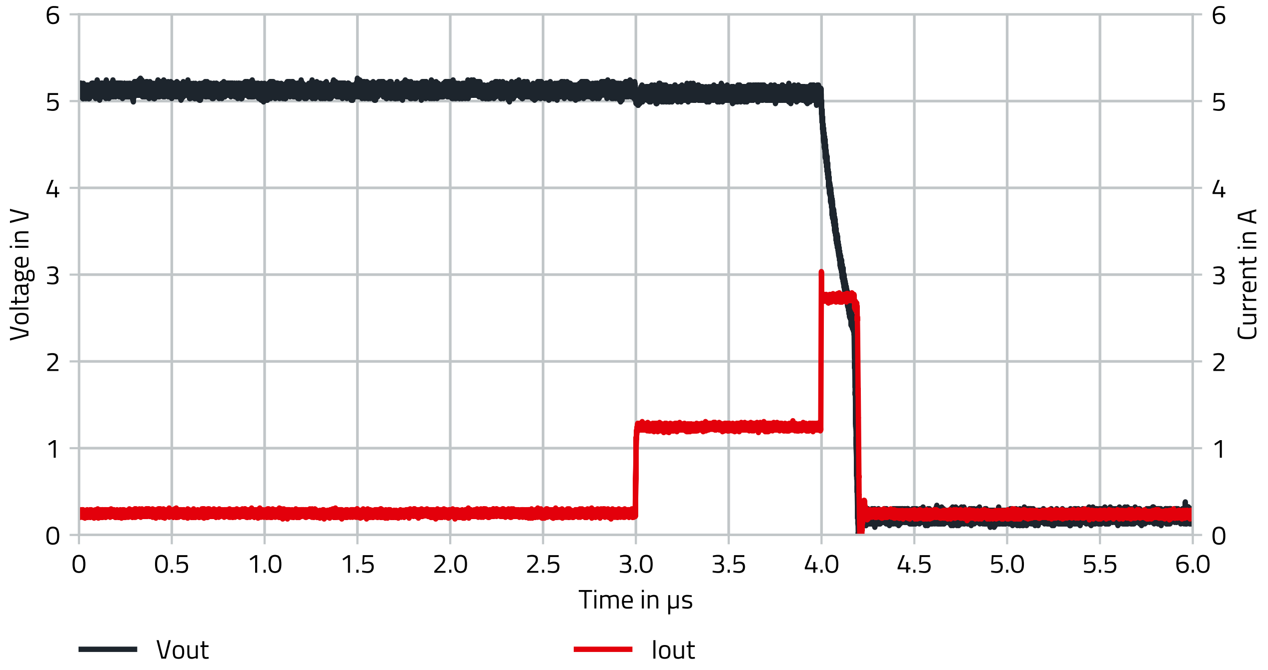


Figure 19: 171013201 overcurrent protection V_{IN} = 24V, V_{OUT} = 5V, I_{OUT} = 0A to 2.6A.

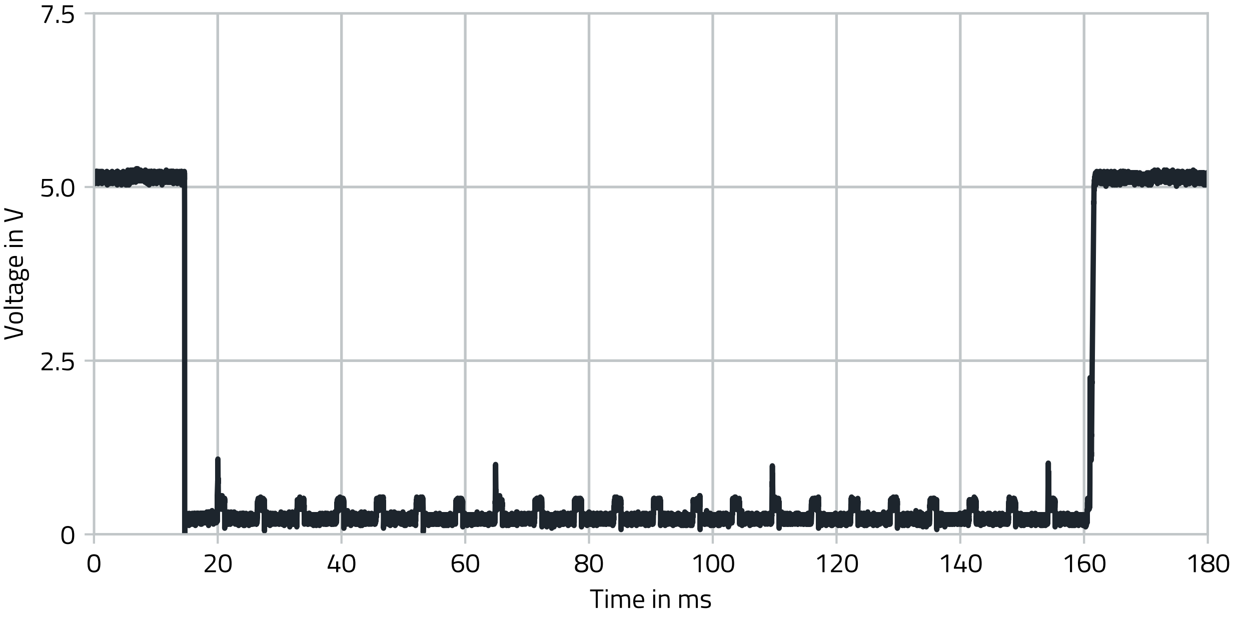


Figure 20: 171013201 short circuit protection V_{IN} = 24V, V_{OUT} = 5V.

17.2 Over Temperature Protection (OTP)

Thermal protection helps prevent catastrophic failures due to accidental device overheating. The junction temperature of the MagI^{3}C 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 135 °C (typ.) the internal soft start is released, V_{OUT} rises smoothly, and normal operation resumes.

17.3 Soft-Start

The MagI^{3}C 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 1ms (see figure 21).

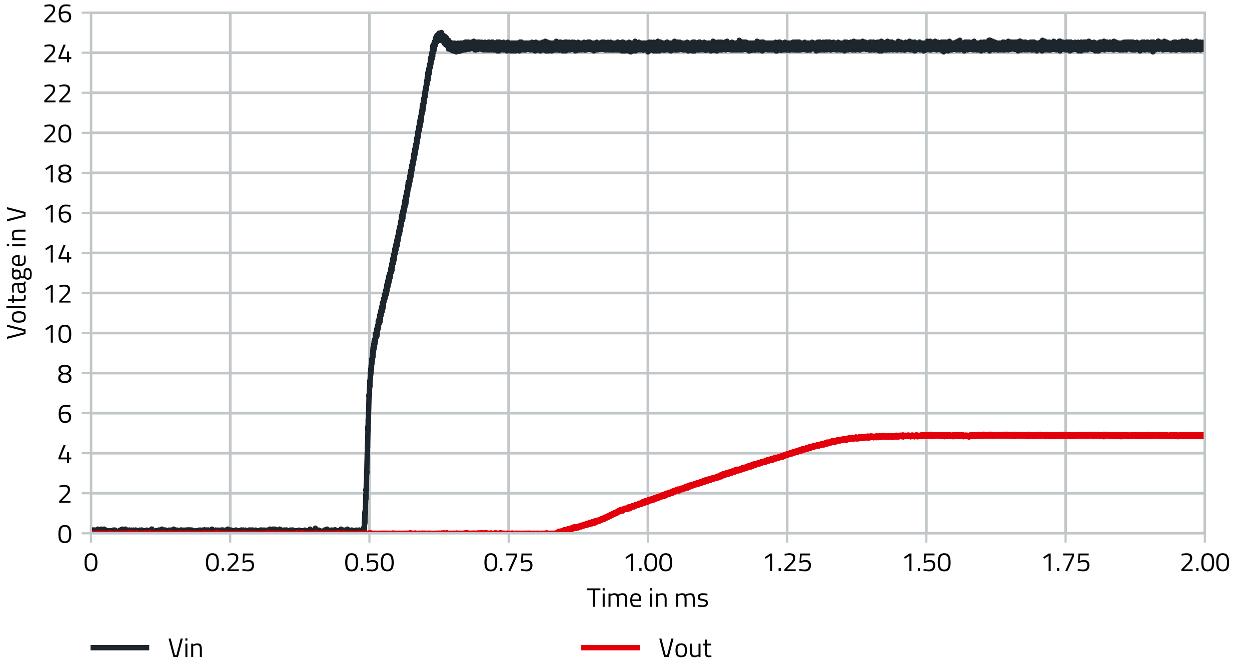


Figure 21: 171013201 soft-start V_{IN} = 24V, V_{OUT} = 5V, T_A = 25 °C.

17.4 Enable and Integrated/Adjustable UVLO

The MagI^{3}C power module is enabled by setting the EN pin high. When the EN voltage reaches 1.4V 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 1.4V at EN.

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

$$\frac{R_{\text{ENT}}}{R_{\text{ENB}}} = \frac{V_{\text{UVLO(EXT.)}}}{1.4} - 1 \tag{4}$$

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

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 MagI^{3}C 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.

18 Design Example

The example shows a recommended solution for 24V to 5V with a maximum output current of 1A. All necessary components to fulfill the CISPR 32 EMI conducted- and radiated emissions test requirements are included in the example. The example passes the conducted and radiated emissions requirements for class B with 0.8m input and the load directly connected to the output. The filter components may be omitted depending on the requirements of the final application.

18.1 Layout

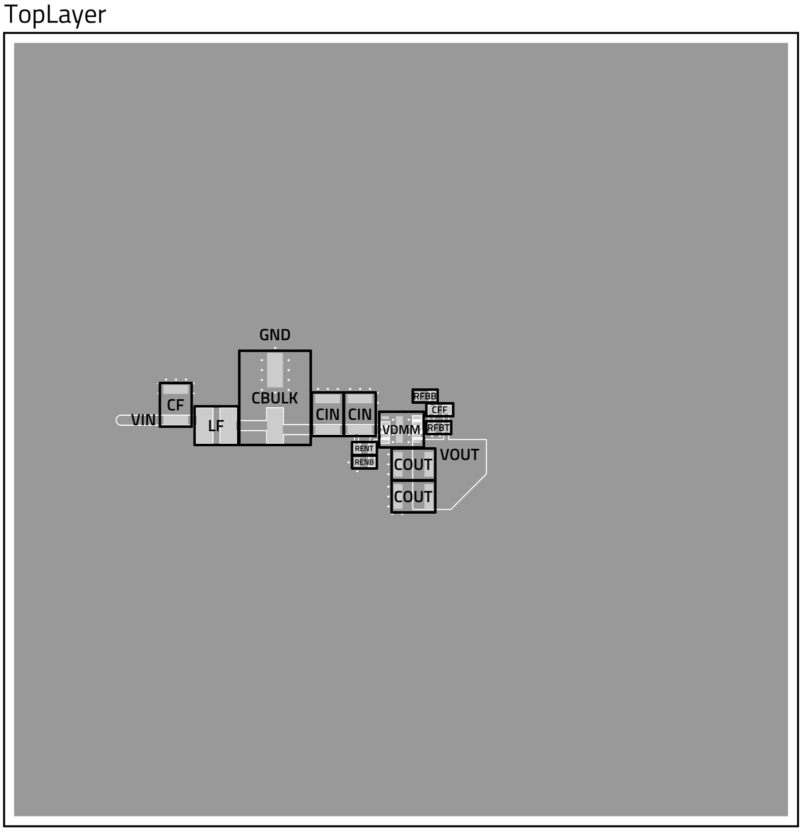


Figure 22: 171013201 layout recommendation.

Figure 22 above shows the top layer for the recommended four layer layout (70µm - 35µm - 35µm - 70µm). Two internal GND layers, additional to the top and bottom GND layer, are necessary for optimal thermal performance. The picture above shows a possible layout for the 171013201 MagI^{3}C 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 power module.
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 used by the power module.
4. Use as wide of a GND plane as possible to ensure stable operation of the power module.
5. Use an uninterrupted GND plane on the bottom layer, connected with an 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 power module as possible.

18.2 Schematic

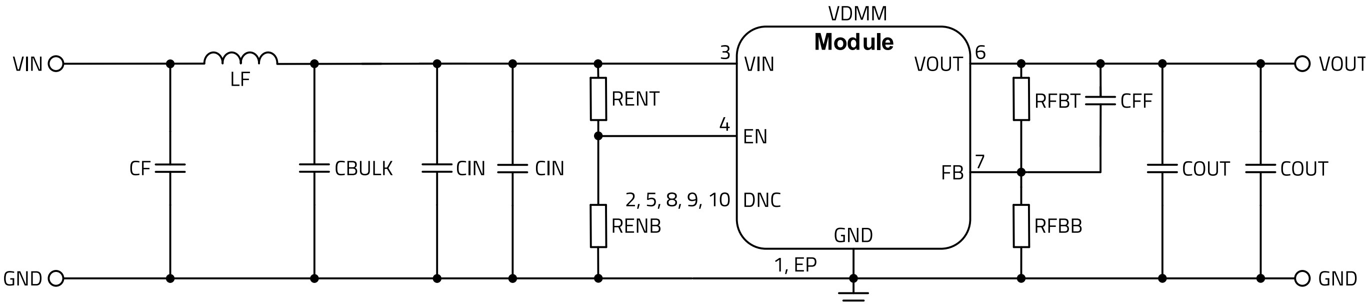


Figure 23: 171013201 recommended external component schematic.

18.3 Bill of Materials

Table 12: 171013201 recommended external components bill of materials.

Designator	Description	Function	Quantity	Order Code	Manufacturer
VDMM	MagI^{3}C power module	Power supply	1	171013201	WE
LF	Filter inductor, 1µH, PD2 family, I_{SAT} = 4.3A, I_R = 3A	Input Filter	1	7447732010	WE
CF	Ceramic chip capacitor 10µF, 50V, X7R, 1210		1	885012209073	WE
CBULK	Aluminum electrolytic capacitor 47µF, 50V		1	865080645012	WE
CIN	Ceramic chip capacitor 10µF, 50V, X7R, 1210	Electrical performance	2	885012209073	WE
COUT	Ceramic chip capacitor 10µF, 50V, X7R, 1210		2	885012209073	WE
CFF	Ceramic chip capacitor 100pF, 25V, NP0, 0603		1	885012006038	WE
RFBT	100kΩ, 0603	Adjustable Vout	1	560112116004	WE
RFBB	20kΩ, 0603		1	560112116015	WE
RENT	100kΩ, 0603	Adjustable UVLO	1	560112116004	WE
RENB	7.5kΩ, 0603		1	560112116080	WE

19 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.

20 SOLDER PROFILE

Table 13: 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-STD020E for further information pertaining to reflow soldering of electronic components.

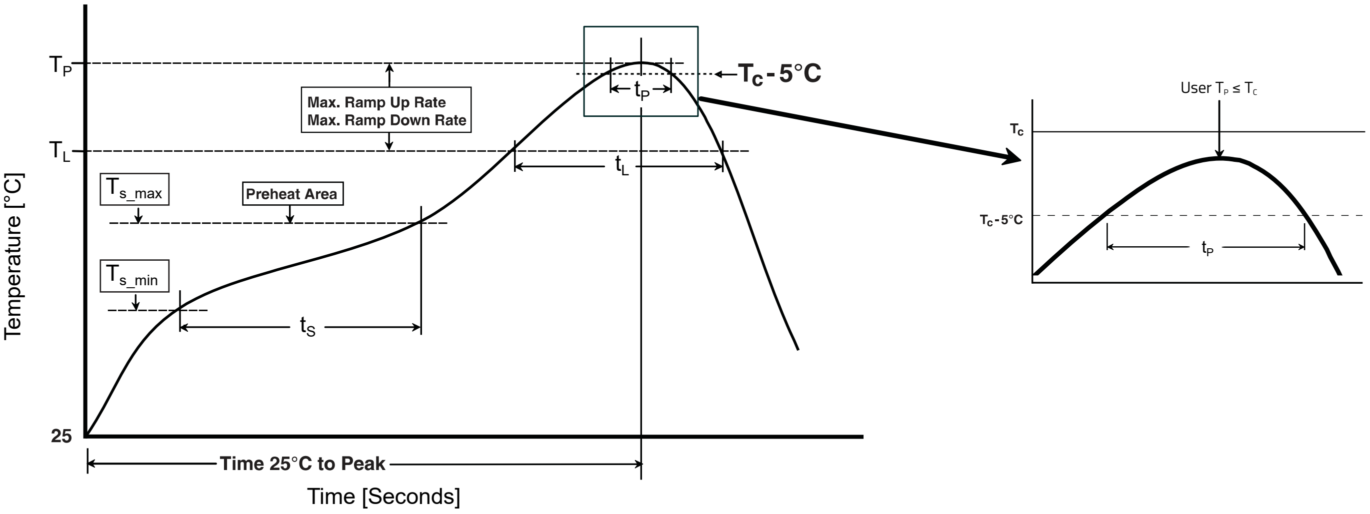


Figure 24: Solder profile.

21 PHYSICAL DIMENSIONS

21.1 Component

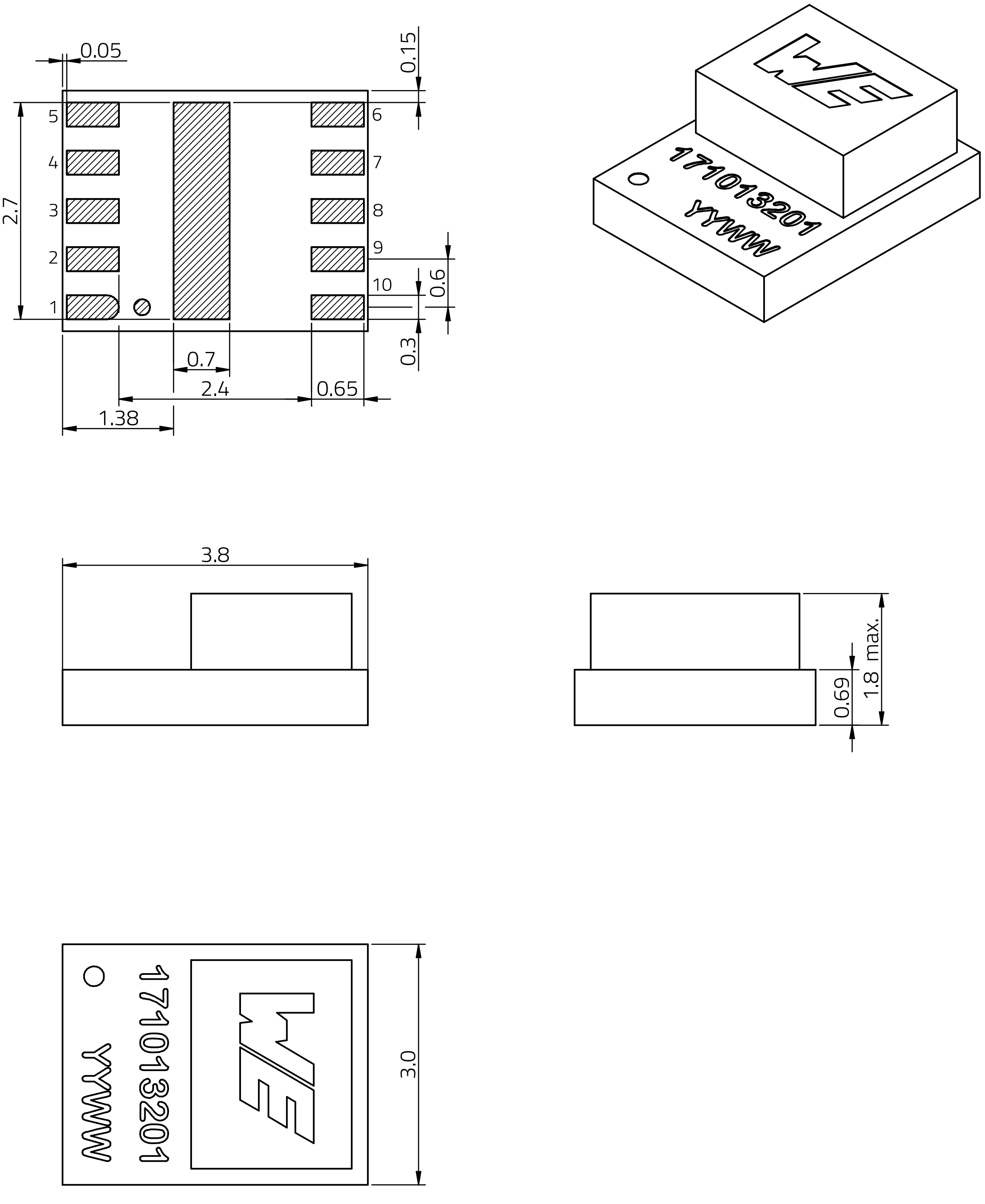


Figure 25: Physical dimensions.

All dimensions in mm
Tolerances ±0.1mm unless otherwise specified

21.2 Example Landpattern Design

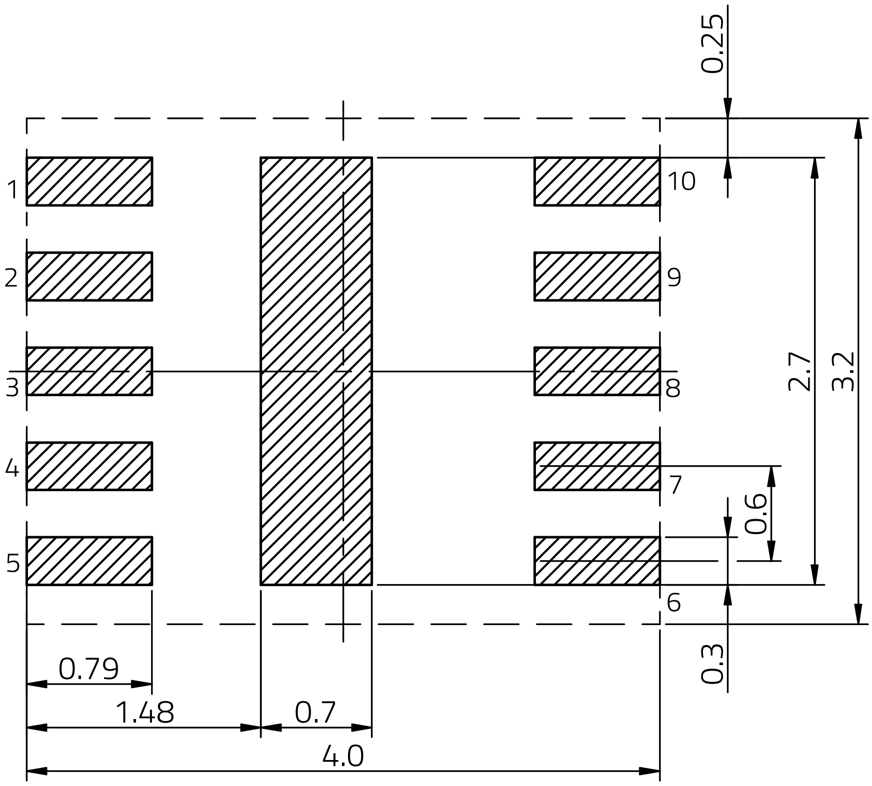


Figure 26: Example landpattern design.

All dimensions in mm
Stencil thickness of 100µm is recommended

21.3 Tape

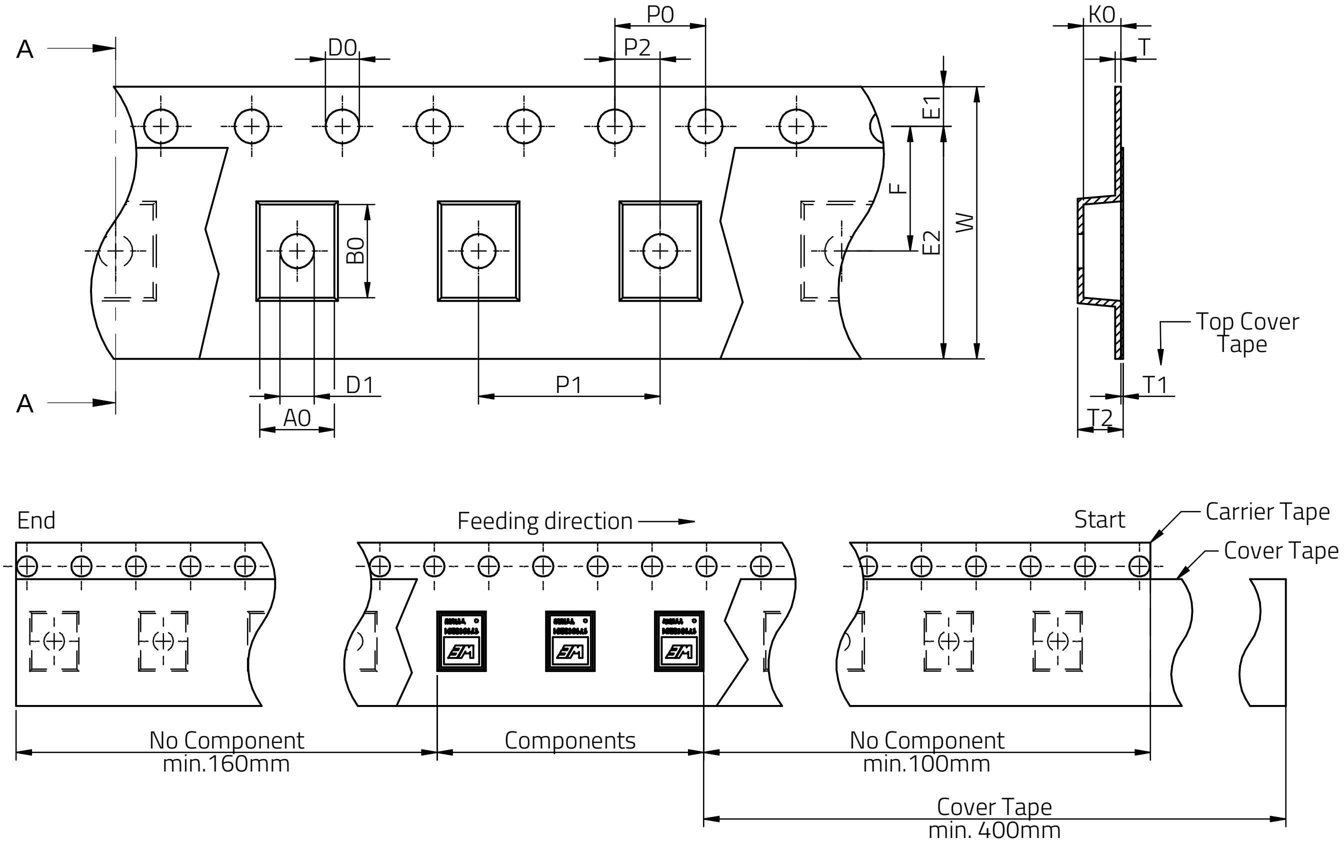


Figure 27: Tape.

Table 14: Tape dimensions.

Tape Type	A0	B0	W	T	T1	T2	K0	P0	P1	P2	D0	D1	E1	E2	F	Material
	typ.	typ.	+0.3/-0.1	ref.	ref.	typ.	typ.	±0.1	±0.1	±0.1	+0.1	Min.	±0.1	min.	±0.1	
2a	3.3	4.1	12.0	0.5	0.10	2.40	1.9	4.0	8.0	2.0	1.5	1.5	1.75	10.25	5.50	Polystyrene

All dimensions in mm

21.4 Reel

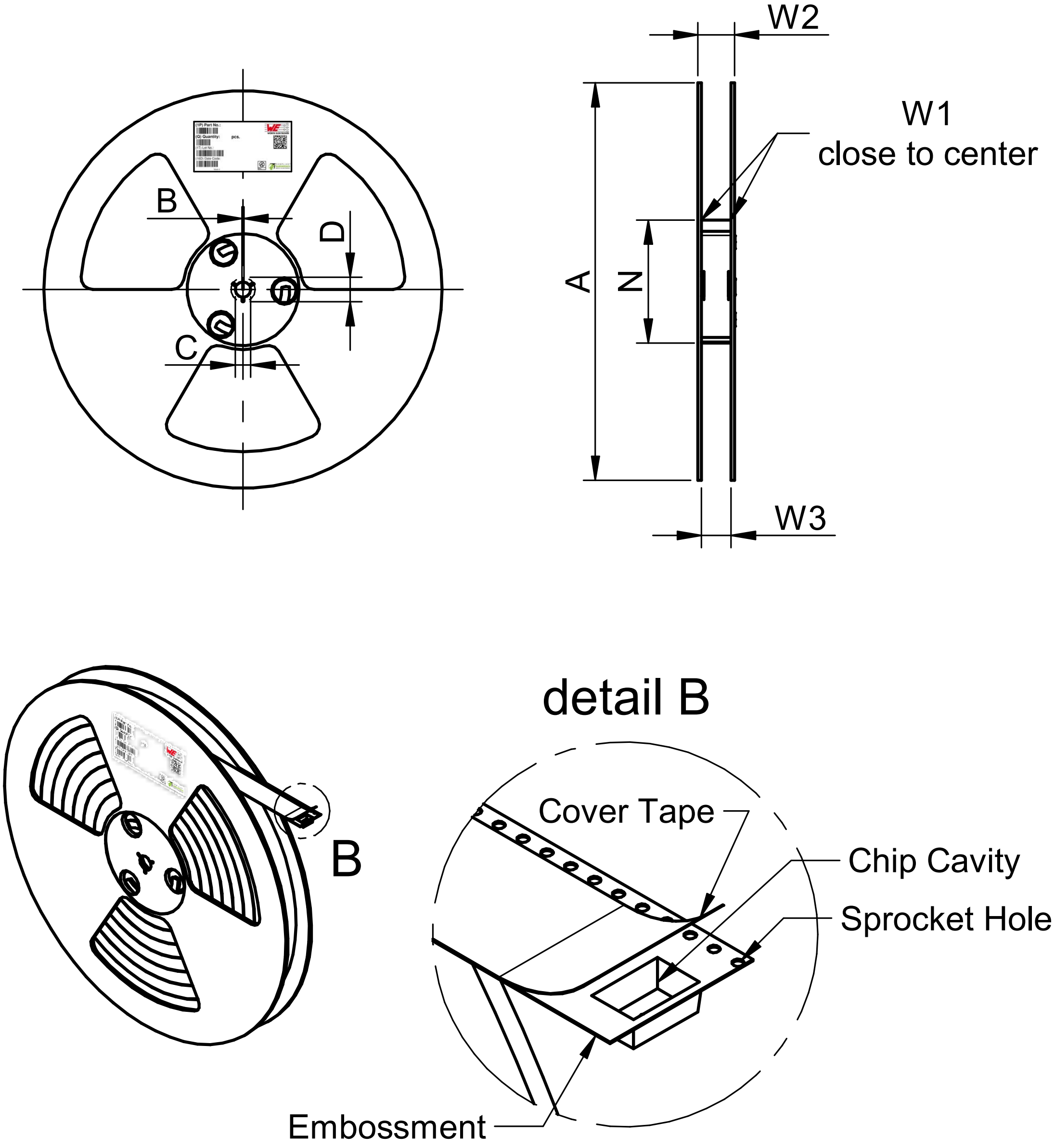


Figure 28: Reel.

Table 15: Reel dimensions.

A	B	C	D	N	W1	W2	W3	W3	Material
±2.0	min.	min.	min.	min.	+2.0	max.	min.	max.	
178.00	1.50	12.80	20.20	60.00	12.40	18.40	11.90	15.40	Polystyrene

All dimensions in mm

22 DOCUMENT HISTORY

Table 16: Document history.

Revision	Date	Description	Comment
1.0	April 2026	Initial data sheet release	

23 LIST OF FIGURES

24 LIST OF TABLES

25 CAUTIONS AND WARNINGS

The following conditions apply to all goods within the product series of MagI^{3}C 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.

26 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.