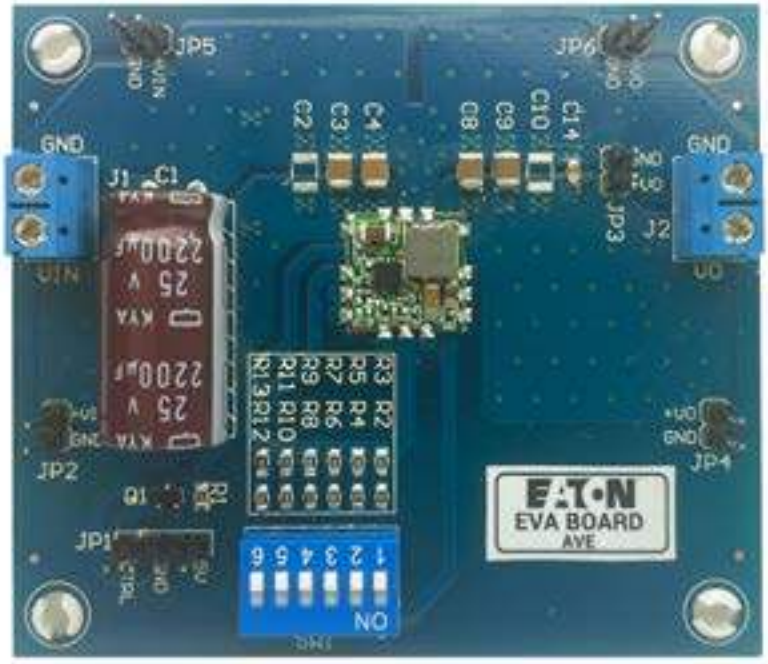
EPM12V2 Evaluation kit user guide



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Contents

Introduction

This document describes the operations of evaluation kits (EVK) concerning the Eaton's EPM DC-DC non-isolated converter product. The EVK includes test points for all main points where probing is necessary for evaluation. The EVK supports many options for Eaton's product configuration. Using these options, the user is allowed to test all desired electrical specifications. This guide describes the test configurations and typical equipment setup. The typical input and output waveforms are also presented.

Important notice

- Please read the product datasheet and EVK user guide before using the EVK.
- Please do not remove the product from the EVK.
- This product is an ESD sensitive component and should be tested in an ESD protected area.
- The EVK is designed to operate in clean and dust-free office or laboratory. The EVK should be protected from sunlight and sources of heat, and making sure air is flowing across the tool. Please keep it away from vibration or strong electromagnetic fields generated by electrical equipment.
- When connecting and disconnecting the power interface, please turn off the power supply to avoid accidental short circuits causing injury.
- The power connection must avoid reverse voltage application.
- During the test, the electrical rating should be kept within the range specified in the data sheet.

Description

This EVK supports user test electrical performance of Eaton's DC-DC non-isolated converter part number EPM12V2-05R5-12R0P and EPM12V2-05R5-12R0N.

Figure 1 shows the EPM12V2 EVK (PN: EPM12V2-P-EVK, positive logic), (PN:EPM12V2-N-EVK, negative logic) and function outline. This EVK is made up of the input and output connectors and the DC/DC converter. There are six additional functions, output voltage trim function, voltage sense, remote on/off function, power good, synchronization, and sequencing.

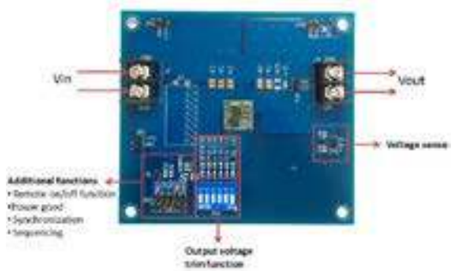


Figure 1. EPM12V2 EVK

Specifications

Table 1 shows the EPM12V2 EVK general performance specifications. The EPM12V2 EVK can deliver up to 12 A of output current and with a wide DC input. The modules can achieve high efficiency up to 91%, wide operation temperature from -40 °C to +90 °C, and has short circuit protection. Input range is from 3 V to 14.4 V, nominal input voltage is 12 V. Please refer to the product data sheet for the detailed specifications EPM12V2 data sheet.

Table 1- General specifications

	Parameter	Conditions	Minimum	Nominal	Maximum	Unit
Input	Input voltage		3	12	14.4	Vdc
	Input current	Vin=nom, no load		30		mA
	Start-up voltage	Iout=0% ~ 100% load		3		Vdc
Output	Voltage trim*		0.6		5.5	Vdc
	Minimum load		0			%
	Output current	Full load			12	A
	Ripple and noise**	Vo < 1.2 V Vo ≥ 1.2 V		3% Vo	50	mVp-p mVp-p

* The output voltage range is limited by Vin. (Vout ≤ Vin -2 Vdc)
** Ripple & noise: Measured with 20 MHz bandwidth and 47 µF + 47 µF + 0.1 µF ceramic capacitor.

Test set-up

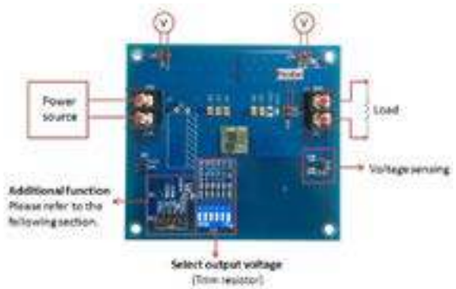


Figure 2: Test set-up example

Table 2- Pin configuration

Connector	Function	Pin symbol	Description
J1	Input terminal	VIN GND	Connect the VIN and GND terminals to the DC power source respectively.
J2	Output terminal	VO GND	Connect the VO and GND terminals to the (electronic) load.
JP1/JP6	Input voltage measuring point	+VIN GND	Connect the +VIN and GND terminals to the voltage meter.
JP2	Functional terminal	SYNC	Synchronization can be done by using the external signal applied to the SYNC of the module. If synchronization is not being used, connect the SYNC to GND.
		SEQ	The SEQ can be used when master-slave power-supply tracking is required.
		PG	The Power Good signal indicates that the output voltage regulation is in the specification limits.
		5 V	For use with remote function, connect to a 5 V power supply
		CTRL	Switch the module on or off through controlling CTRL (or Remote on/off) signal in positive logic or negative logic.
		GND	Ground.
JP3	Voltage sensing	VS+ VS-	VS+ and VS- are remote sense pins. VS+ and VS- are connected to the positive and negative terminal of the load or output terminal respectively for voltage sensing.
JP4	Output ripple measuring point	+VO GND	Connect the +VO and GND terminals to the probe with short ground lead.
JP5	Output voltage measuring point	+VO GND	Connect the +VO and GND terminals to the voltage meter.
SW1	Volatge trim selector	1, 2, 3, 4, 5, 6	Adjust the output voltage with trim resistors. There is a DIP switch with six choices for six voltages.

Operation notes

Output voltage trim function

Using a resistor in parallel between Trim and SIG_GND (Figure 3) can adjust the output voltage of the converter. The following formula can calculate the trim resistor of the corresponding voltage.

$$R_{trim}\,(k\Omega) = \frac{12}{V_o - 0.6}$$

Refer to Table 3 for the basic values of the resistors and switch positions. Only one switch should be on at a time. Figure 4 is an example for trimming 5 V output voltage.

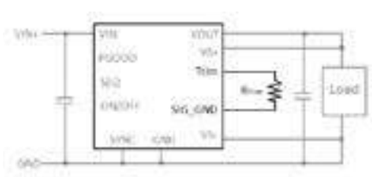


Figure 3: Voltage trim resistor diagram

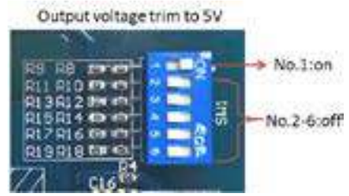


Figure 4: 5 V trimming output example

Table 3- Resistor value and switch position

Output voltage	Calculated Rtrim	Option
5 V	2.7 kΩ	SW 1 : on
3.3 V	4.7 kΩ	SW 2 : on
2.5 V	6.2 kΩ	SW 3 : on
1.8 V	10 kΩ	SW 4: on
1.5 V	13 kΩ	SW 5 : on
1.2 V	20 kΩ	SW 6 : on

Voltage sensing

VS+ and VS- is the voltage sensing pin at the JP3 connector. VS+ and VS- are connected to the positive and negative terminal of the load respectively. This function makes the converter detect the voltage across the load without being disturbed by the impedance of the wires. The sense wire is not the main path of the system and carries a low current. It is recommended to use twisted wires for the VS+ and VS- wires or shielded cables to avoid noise and unwanted inductance. If voltage sensing is not needed, VS+ and VS- should connect to the positive and negative output terminals of the converter by using the zero-ohm resistor each.

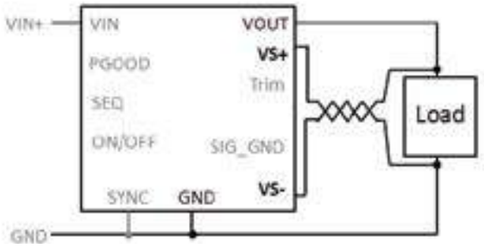


Figure 5: Voltage sense configuration

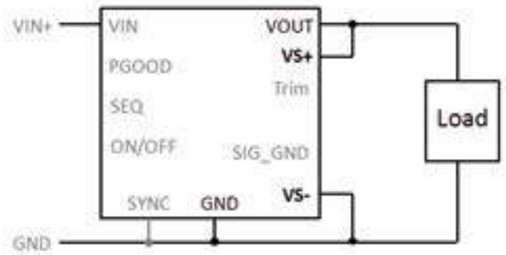


Figure 6: No voltage sense configuration

Remote on/off function

The EVK can switch the converter on or off by controlling the Remote ON/OFF signal in positive logic. If the status of ON/OFF is open or from 1.6 V to 5 V, the converter will turn on. Otherwise, if the status of ON/OFF is short to ground or from 0 V to 0.6 V, the converter will shut down.

The remote control circuit on EVK shows below. There are CTRL and 5 V pins at connector JP3. For example, when CTRL is high level, the converter will shut down. When CTRL is low level, the converter will turn on.

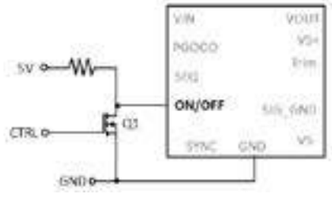


Figure 7: Remote on/off circuit diagram

Positive logic

Table 4- Remote on/off conditions

Condition	CTRL	Q1
DC-DC ON	Low level	Off
DC-DC OFF	High level	On

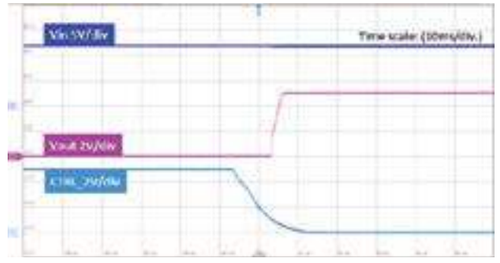


Figure 8: CNTL low level, DC-DC on

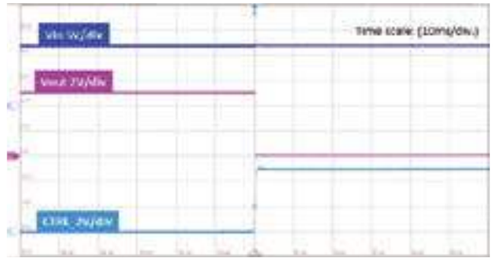


Figure 9: CNTRL high level, DC-DC off

Negative logic

Table 5- Remote on/off conditions

Condition	CTRL	Q1
DC-DC ON	High level	On
DC-DC OFF	Low level	Off

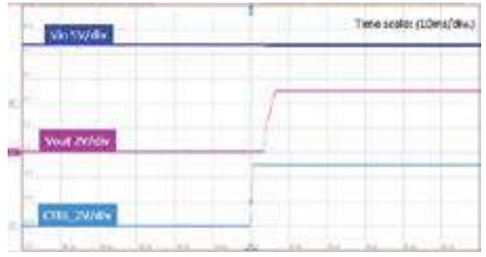


Figure 10: CNTL high level, DC-DC on

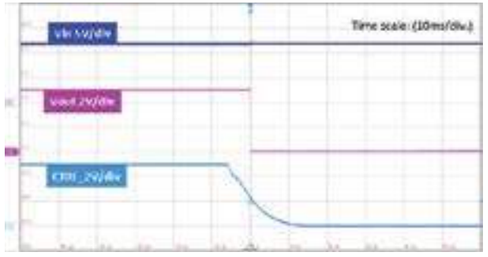


Figure 11: CNTRL low level, DC-DC off

Synchronization

The frequency of EVK can be synchronized with an external signal. The external signal should be in the specified range and applied to the SYNC pin as shown in Figure 12. The converter will synchronize by the rising edge of the external signal. If the synchronization function is not needed, connect the SYNC pin to the ground.

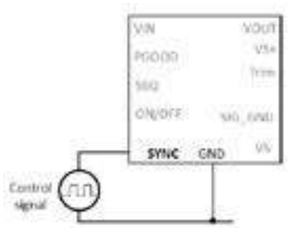


Figure 12: External signal to SYNC circuit diagram

Table 6- Synchronization general specifications

Parameter	Minimum	Typical	Maximum	Unit
Synchronization frequency range		800	840	kHz
High level input voltage	2			V
Low level input voltage		0.8		V
Input current SYNC		1		µA

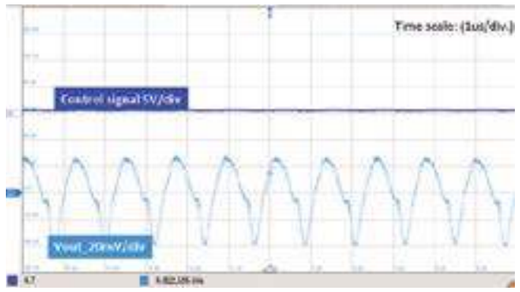


Figure 13:

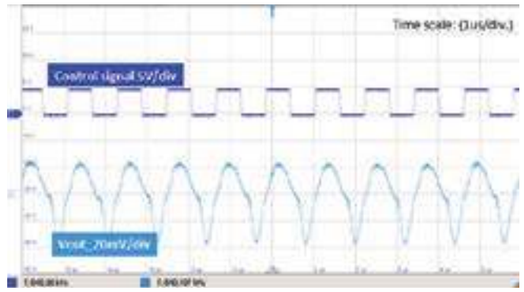


Figure 14:

Power good

The PGOOD signal can indicate the output voltage regulation is within the specification limits. This open-drain output goes low during over current, short-circuit, UVLO, overvoltage and under voltage, over temperature, or when the output is not regulated (such as a pre-bias output). The PGOOD should connect through a pull-up resistor to a source of 5 Vdc. The Power good design on EVK is shown in Figure 15.

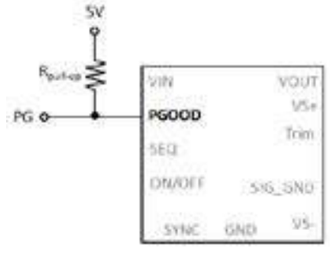


Figure 15: PGOOD circuit diagram

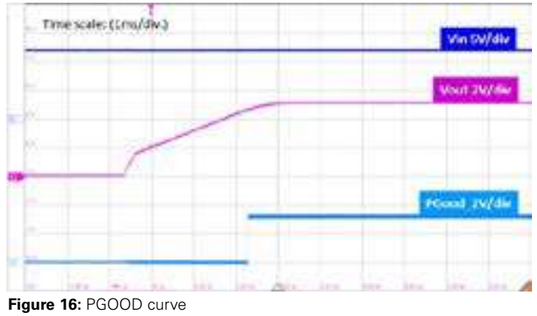


Figure 16: PGOOD curve

Output voltage sequencing

The sequencing feature can fulfill the end user to sequencing the output voltage and is achieved by dividing down the master's output voltage with a resistor network as shown in Figure 17. Rseq equals R5 on the evaluation board, and Rtrim equals R6.

When an analog voltage is applied to the SEQ pin, the output voltage tracks this voltage until the output reaches the set-point voltage. By connecting multiple modules, multiple modules can track their output voltages to the voltage applied on the SEQ pin. Besides, a small capacitor (suggested value is 100 pF) can be connected across the Rtrim. If there is no need for the sequencing feature, leave the SEQ pin open.

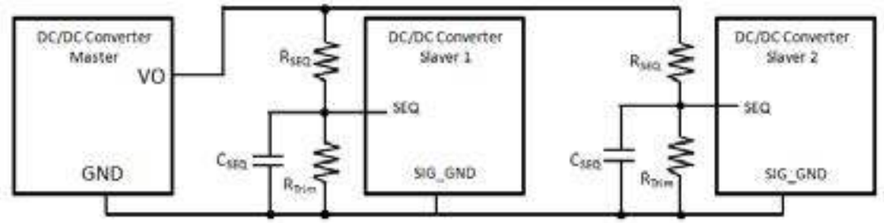


Figure 17: Sequencing circuit diagram

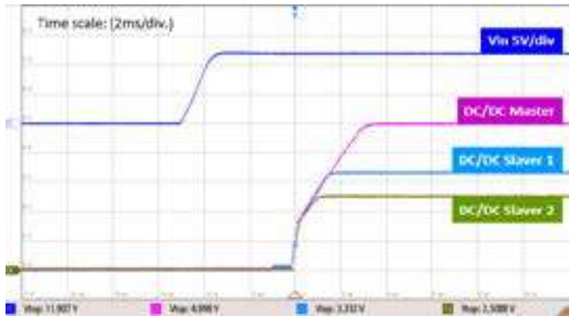


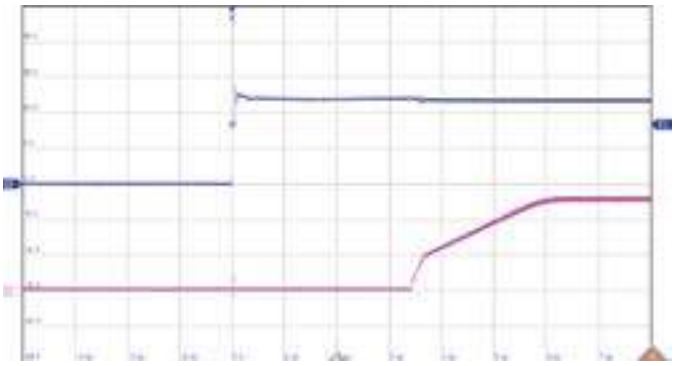
Figure 18: Sequencing curve

Test results

EVK set-up and operation wave form

Model number: EPM12V2 EVK
Conditions: Ta=+25 °C, VIN=12 V, VO=5 V, IO=12 A (full load). This ΔT plus ambient should remain below the specified maximum operating temperature for the module (please refer to the EPM12V2 data sheet).

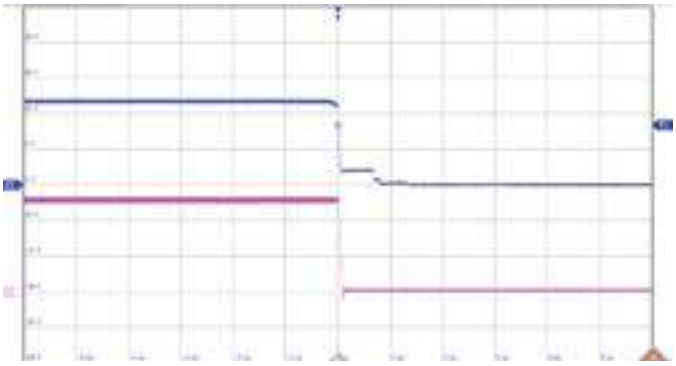
Start-up



Ch1: Input voltage (5 V/div.)
Ch2: Output voltage (2 V/div.)

Time scale: (1 ms/div.)

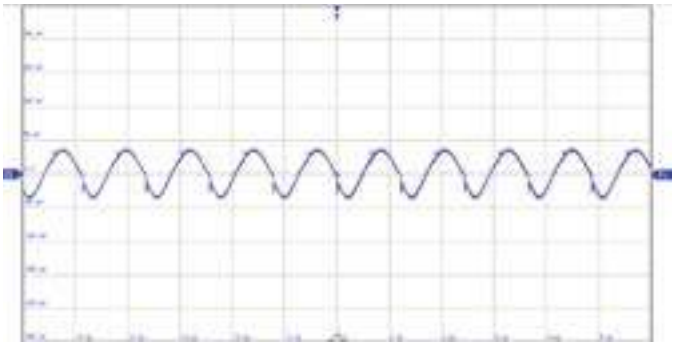
Shut-down



Ch1: Input voltage (5 V/div.)
Ch2: Output voltage (2 V/div.)

Time scale: (1 ms/div.)

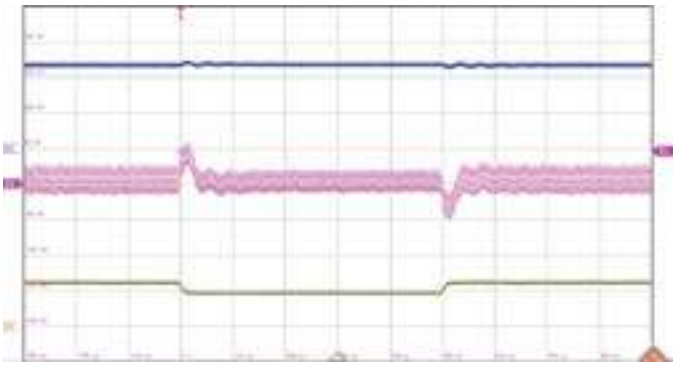
Output ripple and noise



Ch1: Output voltage (50 mV/div.)

Time scale: (1 us/div.)

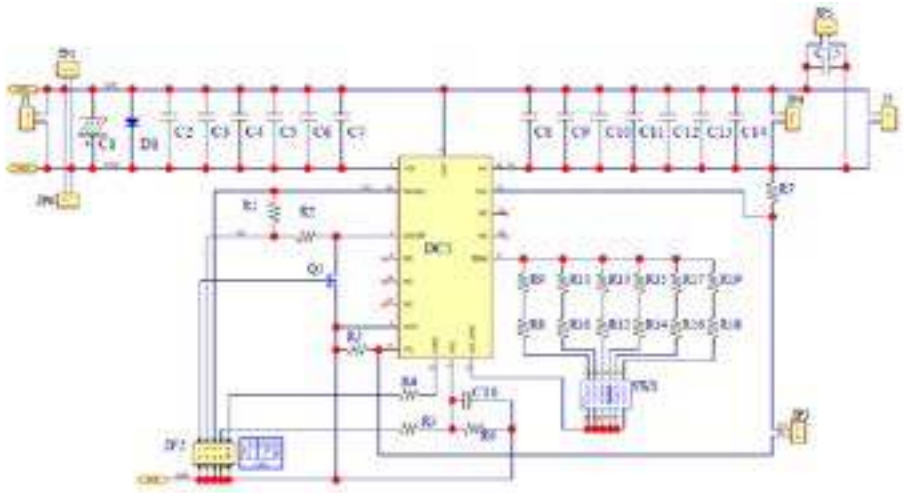
Transient response (75%-100% load)



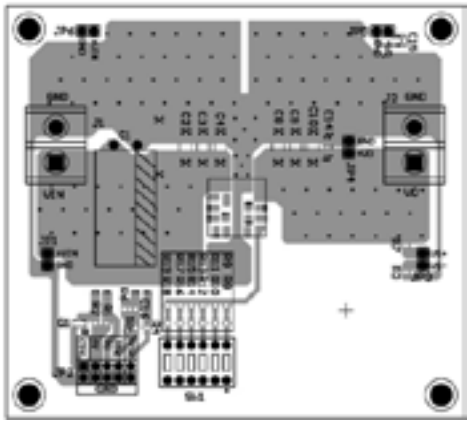
Ch1: Input voltage (5 V/div.)
Ch2: Output voltage (50 mV/div.)

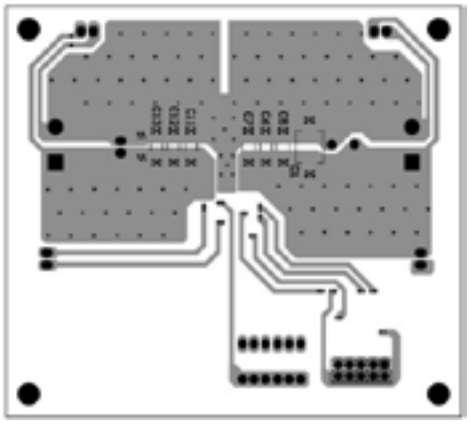
Ch4: Output current (10 A/div.)
Time scale: (100 us/div.)

Schematic



Layout





Component list

Description	Qty	Designator
EPM12V2 EVK	1	
Capacitor, X7R, 1210, 10UF±10%, 50V	5	C2, C3, C4, C5, C6
Capacitor, X7R, 1210, 47UF±10%, 10V	2	C8, C9
Capacitor, X7R, 0805, 0.1UF±10%, 50V	2	C14, C15
MOSFET, AO3442 (SOT-23), 100V, N-Channel	1	Q1
Resistor, 0805, 10KΩ, 1%	2	R1, R2
Resistor, 0805, 0Ω, 5%	3	R3, R4, R7
Resistor, 0805, 2.55KΩ, 1%	1	R8
Resistor, 0805, 200Ω, 1%	1	R9
Resistor, 0805, 2.2KΩ, 1%	2	R10, R11
Resistor, 0805, 3KΩ, 1%	1	R12
Resistor, 0805, 3.3KΩ, 1%	1	R13
Resistor, 0805, 10KΩ, 1%	1	R14
Resistor, 0805, 0Ω, 5%	1	R15
Resistor, 0805, 13KΩ, 1%	1	R16
Resistor, 0805, 330Ω, 1%	1	R17
Resistor, 0805, 470Ω, 1%	1	R13
Resistor, 0805, 20KΩ, 1%	1	R18
Resistor, 0805, 0Ω, 5%	1	R19
Capacitor, 220UF/200V, KXJ series, 12.5x25 mm	1	C1
Terminal Block, 2P, 250V, 15A	2	J1, J2
DIP Switch, six choices	1	SW1
Pin Header, single row, 14.2mm, 2P	5	JP1, JP3, JP4, JP5, JP6
Pin Header, dual row, 14.2mm, 10P	1	JP2

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