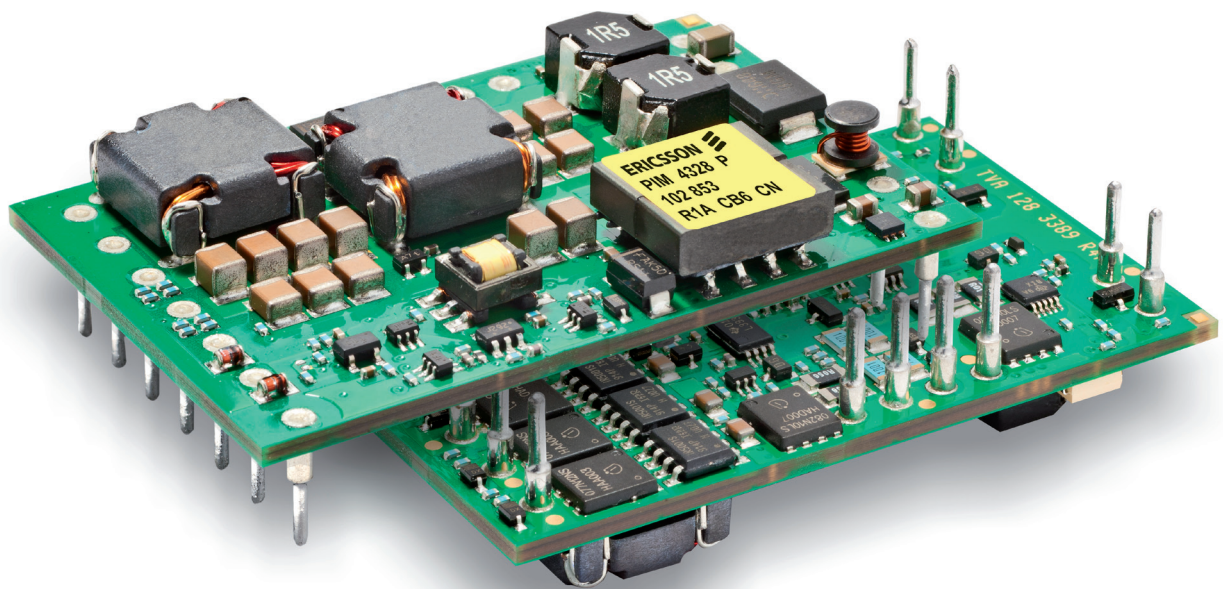


## APPLICATION NOTE 206

Ericsson Power Modules



# SET-UP AND DESIGN OF THE HOLD-UP FUNCTION WITH PIM4300

## Abstract

Telecom systems and many other applications require very low ohmic power distribution. To handle short circuits and other power supply interruptions, a hold-up function is included on the majority of the boards in a system. Systems that have higher ohmic distribution or that use a central pre-regulator do not require this holdup function.

The Ericsson PIM 4300 quarter-brick format power interface module integrates all the features required by the AdvancedTCA specification (PICMG 3.0).

## Application

The Ericsson PIM 4300 series are power interface modules that supply output currents of up to 10 A. These modules are designed to be placed at the 48 V input before the

DC/DC converter and include the supply, hold-up, and hot-swap functions together with EMC filtering, protection, supply management, and an input supply alarm.

Maximum output power is determined by the input voltage range, see table below.

Max specified output current	Input voltage range			
	36-75 V	40-72 V	48-56 V	54-64 V
10 A (dual ORing diodes)	360 W	400 W	480 W	540 W

The hold-up function provided by the PIM is designed to work with an external hold-up capacitor charged with an internally generated high voltage. This approach effectively reduces the size of the hold-up capacitor.

When the hold-up function is activated, the PIM connects the hold-up capacitor to the input of the DC/DC converter. This provides the energy that maintains DC/DC converter operation during the hold-up event, but also creates a voltage pulse at the DC/DC converter's input. The capacitors in the application circuit should be designed to ensure that the hold-up function operates efficiently while limiting the voltage transient that may result in undesirable behavior of the DC/DC converter.

This application note presents a method for optimizing the component values and limiting the input voltage transient. It also includes a table with suggested values for different Ericsson DC/DC converters.

## Implementation and Results

Figure 1 shows a diagram of a current sharing circuit that supplies one PIM and one DC/DC converter. All resistors of less than 1/3 W are 1% tolerance parts. All capacitors except for the hold-up capacitor are X7R types. C1 and C5 must have a 1500 V minimum rating. The hold-up capacitor C2 should be an electrolytic part with a 100 V minimum rating.

The AdvancedTCA hold-up time requirement is 8.70 ms minimum.

A. Start by calculating the size of the hold-up capacitor C2. The capacitance value is given by:

$$C2 = \frac{2 \times P_{out} \times \text{time}}{V_{hold}^2 - V_{inmin}^2}$$

$P_{out}$  is the power on the output, time is the required hold-up time,  $V_{hold}$  is the hold-up voltage and  $V_{inmin}$  is the minimum input voltage specified for the DC/DC converter.

Adjust the  $V_{hold}$  to as high value as possible depending on type and voltage rating of the capacitor with respect to your design guidelines. Ericsson recommends a  $V_{hold}$  of approx. 90 V for electrolytic capacitors with 100 V rating.

B. Calculate the resistor value to set the hold-up charge voltage:

$$R3 = \frac{500}{V_{hold} - 50} - 10 \text{ (k}\Omega\text{)}$$

C. Calculate the peak voltage across C3:

$$V_{in\_peak} = \frac{V_{HU} \times C2 + V_{inmin} \times C3}{C2 + C3}$$

C3 is the total capacitance at the input of the DC/DC converter,  $V_{inmin}$  is the minimum input voltage specified for the DC/DC converter.

Adjust the C3 value in this equation to limit the peak voltage generated by the PIM and its hold-up event to be within the permissible input voltage range of the DC/DC converter. Other input-related parameters - such as maximum step load at the input and maximum dV/dt - can also determine the peak voltage. These parameters can be found in the Technical Specification for the DC/DC converter of interest.

In practice, the peak voltage will be somewhat lower than its calculated value due to charge equalization losses.

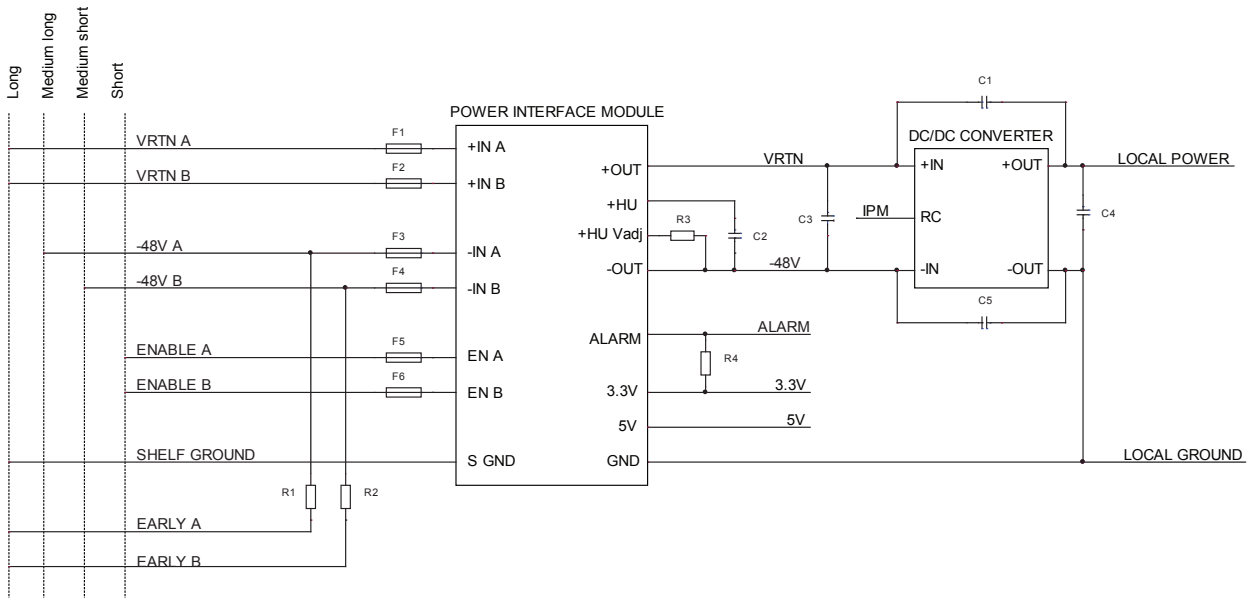


Figure 1

## Suggested designs

The following table suggests component values for different DC/DC converters and power ranges.

Workable PIM and DC/DC combinations and set-up								
Min input voltage: 36 V			Hold-up				intermediate capacitor (μF)	Notes
DC/DC part number	Size	Pout (W)	Time (ms)	Voltage (V)	resistor (kΩ)	capacitor (μF)		
PKM4113D	QB	132	8.7	87	3.6	330	100	
PKB4113C	EB	144	8.7	84	4.7	470	100	
PKM4213C	QB	204	8.7	92	1.9	470	220	
PKB4204	EB	240	8.7	91	2.2	550	220	
PKJ4316A	HB	350	8.7	91	2.2	800	330	
PKM4304	QB	380	8.7	94	1.36	800	470	Limit the transient to 80 V

This table is based on calculations made according to the methods described in this application note.

## References

PIM 4300 Technical specifications, 287 01/EN-LZT146 430.  
Ericsson Power Modules, February 2011

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Formed in the late seventies, Ericsson Power Modules is a division of Ericsson AB that primarily designs and manufactures isolated DC/DC converters and non-isolated voltage regulators such as point-of-load units ranging in output power from 1 W to 700 W. The products are aimed at (but not limited to) the new generation of ICT (information and communication technology) equipment where systems' architects are designing boards for optimized control and reduced power consumption.

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