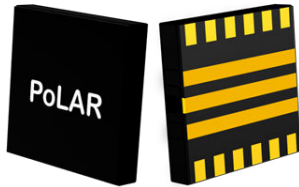



6 A synchronous step-down DC-DC converter



QFN 15 bondless 3x3

Features

- AEC-Q100 qualification target 
- Functional safety capable
- Input voltage range: 2.7 V to 5.5 V
- Output voltage from 0.5 V to 4.5 V
- Output voltage accuracy $\pm 1\%$ in PWM
- Load current output of 6 A
- Adjustable soft-start
- Forced PWM or PWM and PFM operation (power save mode)
- Adjustable switching frequency from 1.8 MHz to 4 MHz
- 100% duty cycle mode
- Output discharge
- Spread spectrum (dithering) available
- Power-good output with window comparator
- Thermal warning
- Configurable for paralleling power stages
- Internal compensation
- Extended temperature range
- Overcurrent, overvoltage, overtemperature and short circuit protection

Product status link

[POLAR06](#)

Product summary

Order code	POLAR06
Package	QFN 15 bondless 3x3
Packing	Tape and reel

Description

POLAR06 is part of a family of 2 A, 4 A and 6 A synchronous step-down DC-DC converters based on a peak current mode control topology. The PoLAR family is designed to support automotive applications.

Low resistive switches allow up to 6 A continuous output current at high ambient temperature. For systems with higher power requirements, a multiphasing parallel converter is readily implemented.

The switching frequency is externally adjustable in 4 steps, 1.8 MHz, 2.25 MHz, 3.26 MHz and 4 MHz, and can also be synchronized to an external clock in a continuous way in the same frequency range. In PWM/PFM mode, the POLAR06 automatically enters power Save mode at light loads to maintain high efficiency across the whole load range.

The POLAR06 provides 1% output voltage accuracy, which helps design a power supply with high output voltage accuracy.

The soft start limits the inrush current during startup.

The PoLAR family comes in a bondless 3x3 mm package, with wettable flanks.

1 Overview

The PoLAR is a family of synchronous switch mode DC-DC converters based on a peak current mode control topology. It can be used in safety relevant applications. It is available in a bondless QFN, a package that assures high efficiency at frequencies up to 4MHz. The output voltage is selectable by an external voltage divider.

The POLAR06 family is composed by 3 different devices, able to deliver, 2 A, 4 A and 6 A. POLAR06 can supply up to 6 A of continuous current.

The POLAR06 can work with an internal clock, whose frequency can be adjusted by pin at 1.8 MHz, 2.25 MHz, 3.26 MHz or 4 MHz with or without dithering, and can accept an external clock with a continuous frequency between 1.8 MHz and 4 MHz without spread spectrum. A single device is also able to output its clock to another device.

The device supports forced fixed frequency PWM operation or PFM/PWM. When acting on a pin, the device operates in power save mode (PFM) at low output current and automatically moves to fixed frequency PWM mode at higher output current. In PFM mode, the switching frequency decreases to sustain high efficiency down to very low output current.

The control loop is internally compensated and can be optimized with external components. It is possible to select among 4 different internal compensation networks, plus a configuration that uses external components, to allow more flexibility.

A capacitor connected to a pin allows setting the startup time and tracking of the output voltage to an external source. In this way, sequencing of different supply rails is performed.

A power-good output is present, that is pulled down in case of output OV and UV conditions or thermal shutdown.

A thermal warning pin is available. The microcontroller can monitor this pin and activate the necessary actions before the device moves to thermal shutdown.

The output discharge function brings the output voltage to ground level when the output is disabled.

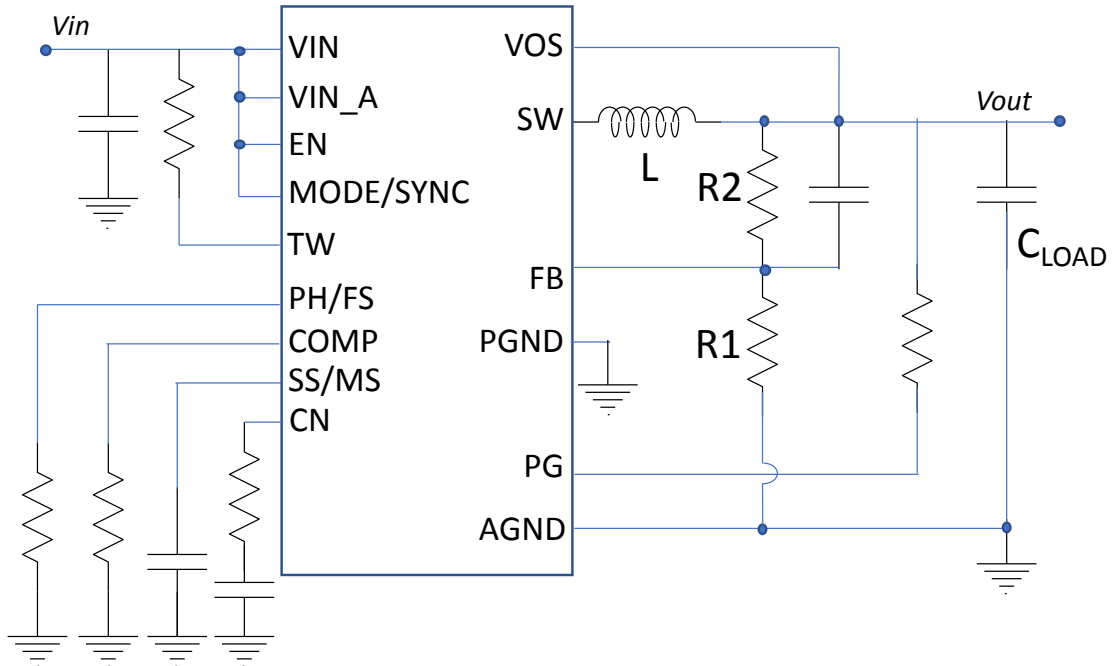
Placed in parallel, the POLAR06 composes a multiphase voltage regulator.

The PoLAR family helps to support the requirements of ISO26262.

2 Block diagrams

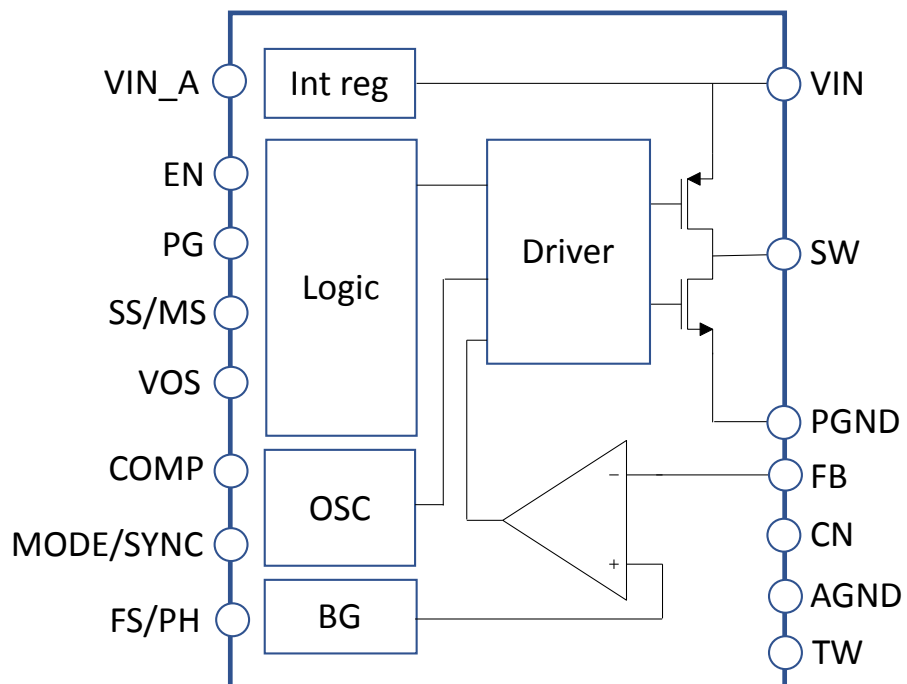
2.1 Power rails

Figure 1. Application block diagram

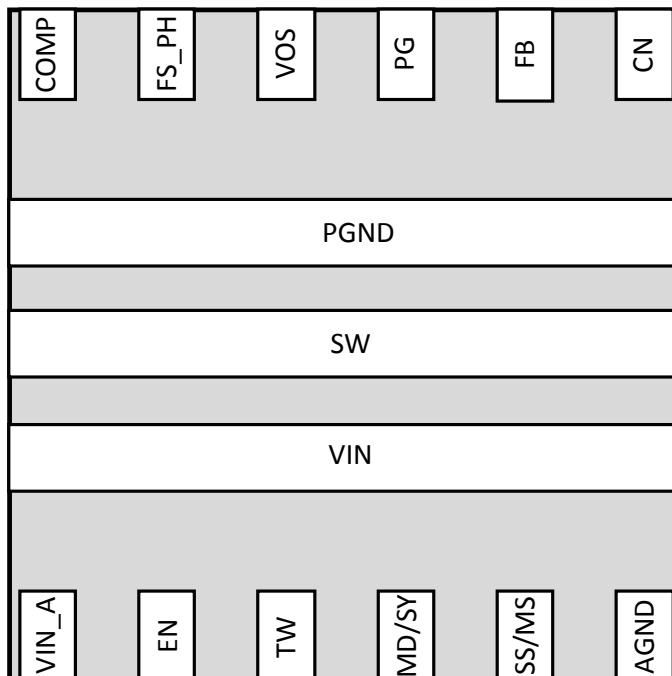


2.2 Functional block diagram

Figure 2. Functional block diagram



3 Pin description

Figure 3. Pin out (bottom view)

Table 1. Pin list

Pin #	Pin name	Description
A1	COMP	Used to set the compensation network and to define the frequency source.
A2	FS/PH	Used to set the working frequency and the phase shift.
A3	VOS	Vout sense pin, used for regulation purposes, to be connected to the output.
A4	PG	Open drain, power-good output.
A5	FB	Voltage feedback input.
A6	CN	Pin connected to internal compensation network for voltage control loop.
B1	PGND	Power ground.
B2	SW	Switching node, output of the converter.
B3	VIN	Power supply input dedicated to the switching converter.
A7	AGND	Analog ground pin.
A8	SS/MS	Pin used to configure the device in single or parallel mode.
A9	MODE/SYNC	Used to define the switching mode (PWM, PFM), and for synchronization.
A10	TW	Thermal warning, open drain.
A11	EN	Enable the pin of the device.
A12	VIN_A	Power supply input dedicated to the analog part.

4 Electrical specifications

4.1 Operating voltage and absolute maximum ratings

4.1.1 Operating voltage

Within the operating range, the part operates as specified and without parameter deviations. The device may not operate properly if maximum operating conditions are exceeded.

Once taken beyond the operative ratings and returned within, the part recovers with no damage or degradation.

All voltages are related to the potential at substrate ground pin.

Table 2. Operating ranges

Pin name	Parameter	Condition	Min.	Typ.	Max.	Unit
VIN	-	-	2.7	-	5.5	V
VIN_A	-	-	2.7	-	5.5	V
EN	-	-	2.7	-	VIN	V
AGND, PGND	-	-	-0.1	-	0.1	
VOS	-	-	0.5	-	4.5	V

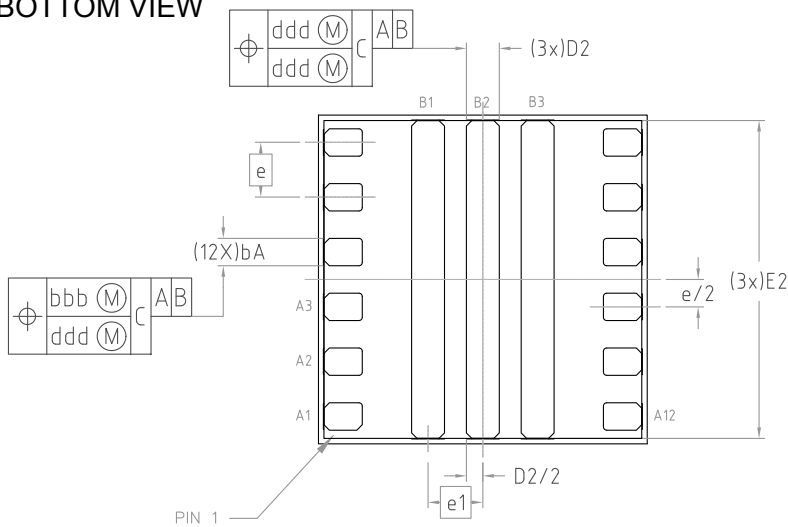
5 Package information

To meet environmental requirements, ST offers these devices in different grades of **ECOPACK** packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions, and product status are available at: www.st.com. ECOPACK is an ST trademark.

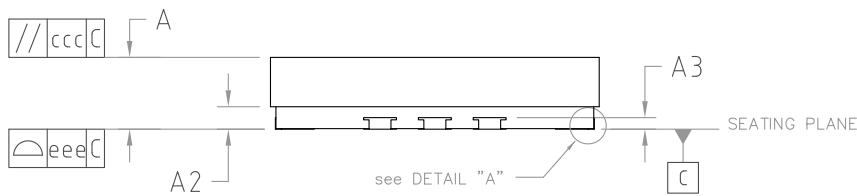
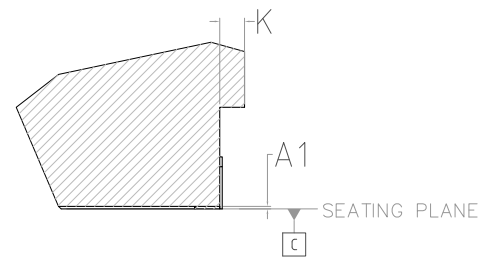
5.1 QFN 15 bondless 3x3 package information

Figure 4. QFN 15 bondless 3x3 package outline

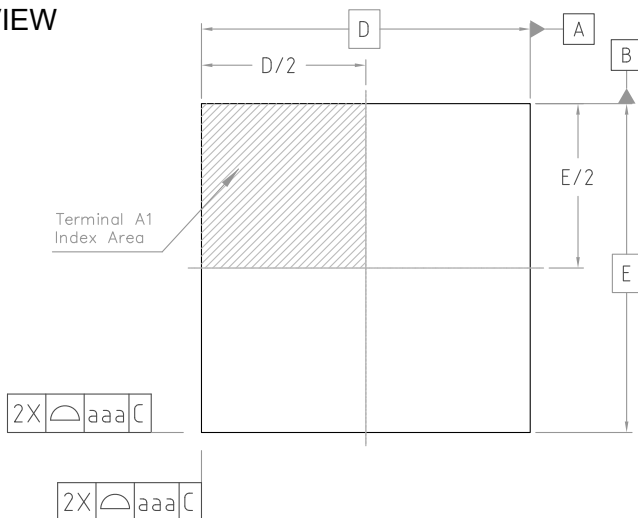
BOTTOM VIEW



Detail A (not to scale)



TOP VIEW



Detail lead (not to scale)

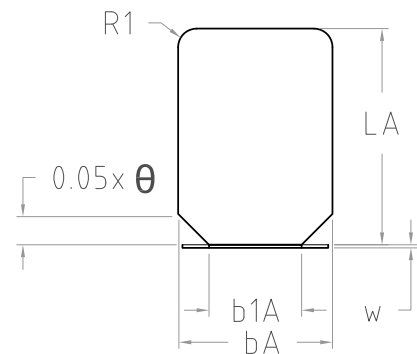


Table 3. QFN 15 bondless 3x3 package mechanical data

Symbol	Dimensions are in mm		
	Min.	Typ.	Max.
Θ		45°	
A	0.85	0.90	0.95
A1	0.005 REF		
A2			0.255
A3	0.085		
bA	0.20	0.25	0.30
b1A	0.10	0.15	0.20
D	3.00 BSC		
D1	-	-	-
D2	0.20	0.30	0.45
E	3.00 BSC		
E1	-	-	-
E2	2.80	2.90	3.00
e	0.50 BSC		
e1	0.50 BSC		
K	0.05 REF		
LA	0.30	0.40	0.50
N		15	
R1	0.03 REF		
w		0.005	
aaa		0.10	
bbb		0.05	
ccc	0.10		
ddd		0.025	
eee		0.08	
fff		0.10	

Revision history

Table 4. Document revision history

Date	Revision	Changes
10-Sep-2024	1	Initial release.

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