Automotive Electronics

Product Information
Multiple Power Supply – CY320

BOSCH
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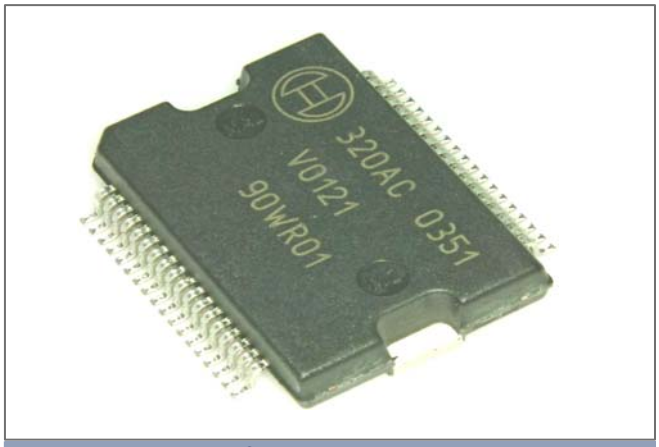


Power Supply ASIC for Automotive Engine Control Units

Customer benefits:

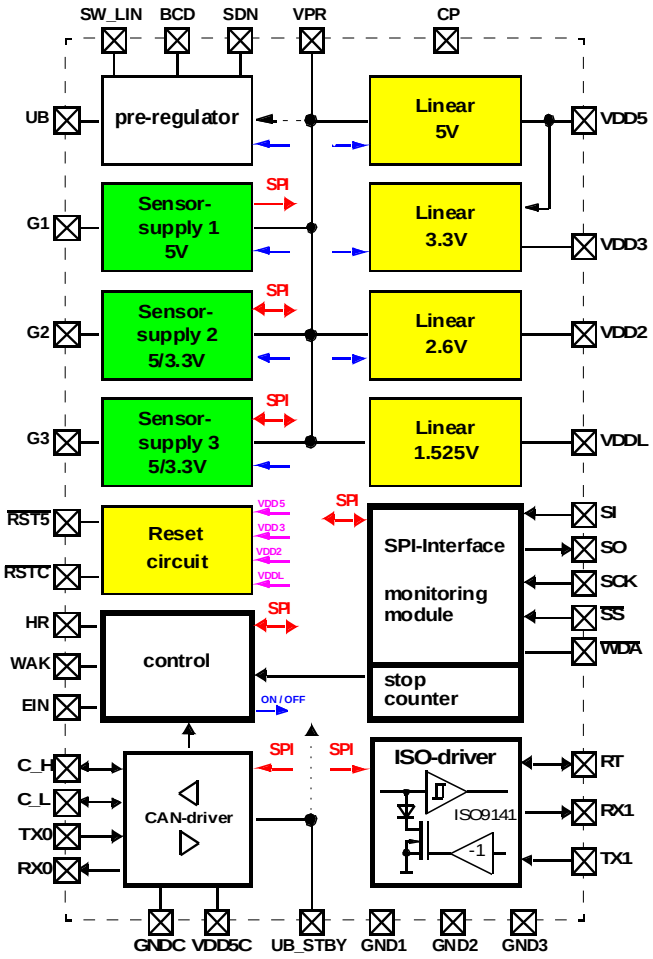
- VDA 2.0 compliance with 3 level Watchdog
- C&S certified CAN transceiver with WakeUp capability
- 5/3.3V independent sensor supply
- Designed for AUDO2 µC Family

With a buck pre-regulator, four power regulators, three sensor supplies and several peripheral inputs and outputs the CY320 is a highly integrated power circuit, designed for supply signal processors and motor management controllers.
Serial interfaces for internal (SPI) and external (CAN, ISO) communication management are integrated.

Features

- Buck converter to 6 V (optional use as linear regulator to 6 V)
- 5 V linear voltage regulator 500 mA
- 3.3 V linear voltage regulator 200 mA
- 2.6 V linear voltage regulator 300 mA
- 1.525 V linear voltage regulator 600 mA
- Three independent sensor supply outputs with integrated diagnosis
- Correlated softstart of all regulators
- Main relay output stage with integrated clamping and diagnosis
- Control of voltage regulators, sensor supplies and main relay drive
- Reset circuit
- Approved ISO interface, slew rate limitation, bidirectional serial interface driver according ISO 9141, LIN and BSS compatible
- Advanced CAN transceiver (with WakeUp-capability) ISO 11898
- Approved SPI interface
- Digital microcontroller Watchdog via SPI
- Digital monitoring functions for system diagnosis
- Stop counter (with WakeUp-capability)
- Ignition input (KL15 input), WakeUp Input
- Compatible with Infineon microcontroller family AUDO2
- Package : PSO36

Block diagram



Maximum ratings

Parameter	Min	Max	Unit
Voltage resistance, UB	-0.3	40	V
Voltage resistance, UB_STBY	-15	40	V
Voltage resistance, sensor supply pins	-1	28	V
Voltage resistance CAN bus, C_H, C_L	-15	52	V
Voltage resistance, RT	-15	52	V
Voltage resistance, MR	-15	36	V
Voltage resistance, all signal pins	-0.3	U_{VDDx} +0.3	V
Input current, static, EIN, WAK	-15	15	mA
Operating junction temperature	-40	150	°C
Thermal resistance, $T_{junction}$ to case	3.5		K/W
ESD HBM 100pF / 1.5k, all pins	- 2	+ 2	kV
ESD HBM 100pF / 1.5k, CAN, ISO	- 4	+ 4	kV

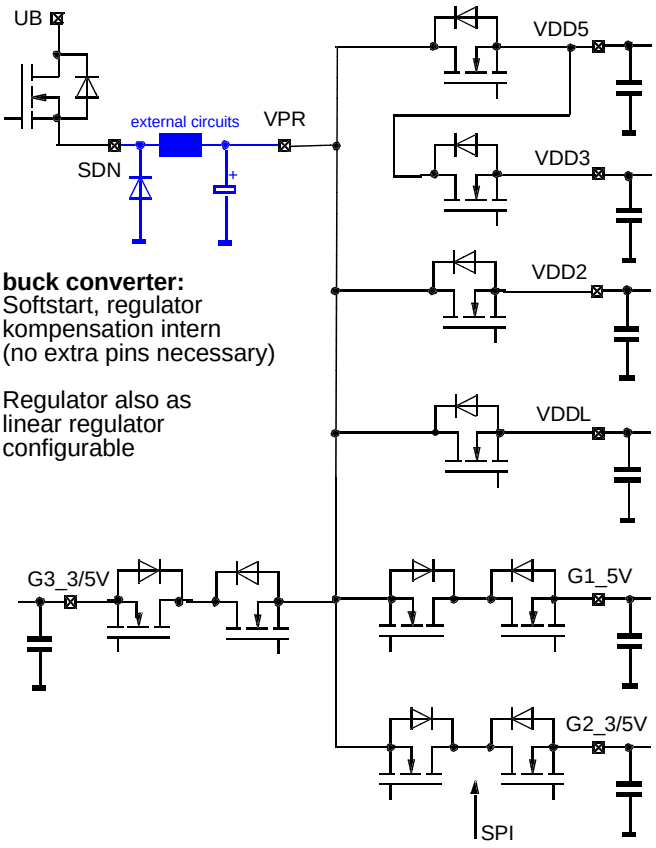
Pin description

Pin	Name	Function
20	UB	High current battery supply input, KL30 for a permanent-powered systems, main-relay contact for a non-permanent powered systems
23	UB_STBY	Battery supply for internal modules, WakeUp-Receiver CAN and stop counter
22	SDN	Output buck regulator
21	BCD	Booster-C buck regulator
25	VPR	Preregulated voltage output for VDD5, VDD2, VDDL and sensor supplies and feedback for the buck regulator optional as input
12	SW_LIN	Configuration switch-mode / linear mode; Pre-regulator
26	VDD5	Main regulator 5 V output
27	VDD3	Main regulator 3.3 V output
28	VDD2	Main regulator 2.6 V output
31	VDDL	Main regulator 1.525 V output
11	G1_5V	Sensor supply 1 output
10	G2_3/5V	Sensor supply 2 output
9	G3_3/5V	Sensor supply 3 output
24	CP	Charge-pump output for external smoothing capacitor
5	EIN	KL15 input (ignition input)
6	WAK	WakeUp Input
2	MR	Main relay stage output
30	RST5	Bidirectional undervoltage reset signal, active low, open collector
29	RSTC	Bidirectional core supply undervoltage reset signal, active low
33	SS	SPI slave-select signal
32	S	Slave-Out signal (SPI data output)
34	SI	Slave-In signal (SPI data input)
35	SCK	SPI serial clock input
8	WDA	Monitoring module open drain output
14	TX0	CAN driver: Transmitter input
13	RX0	CAN driver: Receiver output
17	C_H	CAN bus High
16	C_L	CAN bus Low
15	VDD5C	CAN driver 5V supply
4	RX1	Receiver output driver ISO9141
7	TX1	Transmitter input driver ISO9141
3	RT	Input/output driver ISO9141
36	GND1	Ground
1	GND2	Ground
19	GND3	Ground
18	GNDC	Ground CAN

Functional description

Power supply

- 8 voltage regulators
- Fully integrated system and microcontroller supply
- Supply for external sensors
- Minimal power dissipation, maximal robustness
- Permanent or non permanent power supply with or without CAN wake up capability



The voltage regulators VDD5, VDD3, VDD2, VDDL, G1_5V, G2_3/5V and G3_3/5V regulate down from the voltage at VPR and the pre-regulator VPR regulate down from UB.

The integrated pre-regulator is realized as switched PWM regulator with softstart and can be configured as linear regulator as well. It has a current limitation, but is not protected against permanent short circuit.

Operation with no load on a sensor supply regulator does not affect the adjacent stages. The sensor outputs are robust against reverse-feed, in order to avoid a reverse-feed to VPR when a sensor output is short-circuit to UBatt. Thus the sensor supplies are realized as back-to-back structures.

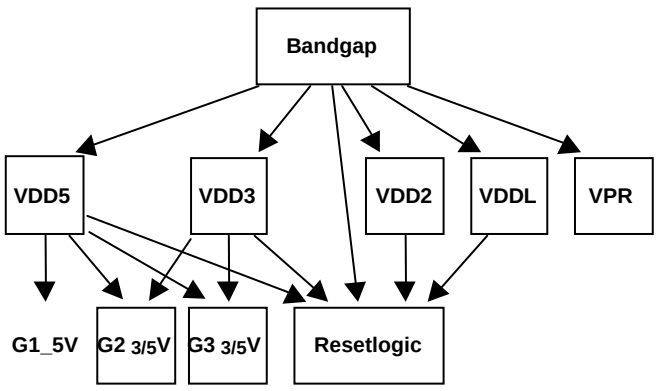
The sensor supply outputs are each monitored and filtered with two comparators for over- and undervoltage the corresponding set voltage of the regulator, in order to detect short-circuit to UBatt or ground.

Parameter	Min	Max	Unit
Output voltage, VPR, 6V < U_{UB} < 18V	5.7	6.3	V
Output voltage, VPR, 18V < U_{UB} < 40V	5.5	6.5	V
Output voltage, VPR, linear mode	5.75	6.25	V
Output voltage, VDD5	4.9	5.1	V
Output voltage, VDD3	3.23	3.37	V
Output voltage, VDD2	2.55	2.65	V
Output voltage, VDDL	1.495	1.555	V
Output voltage, G1_5V, G2_3/5V, G3_3/5V as 5 V output	4.9	5.1	V
Output voltage, G2_3/5V, G3_3/5V as 3.3 V output	3.23	3.37	V
Tracking G1_5V to VDD5	-5	5	mV
Tracking G2_3/5V, G3_3/5V to VDD3/5	-5	5	mV
Output average current, switch mode SDN		1400	mA
Output current, SDN, linear mode		500	mA
Supply current, UB_STBY		15	mA
Standby current			
UB_STBY without CAN- WakeUp		80	µA
UB_STBY with CAN-WakeUp		110	µA
UB		5	µA
Output current, VDD5		500	mA
Output current, VDD3		200	mA
Output current, VDD2		300	mA
Output current, VDDL		600	mA
Output current, G1_5V, G2_3/5V		150	mA
Output current, G3_3/5V		70	mA
Threshold for switch mode SW_LIN	0.5	2.5	V
PWM frequency, switch mode	305	395	kHz

Voltage regulator dependencies

The output voltages VDD5, VDD3, VDD2, VDDL and VPR are derived independently from a bandgap reference.

The sensor supply G1_5V follows the VDD5, the sensor supplies G2_5/3V and G3_3/5V follows VDD5 or VDD3 (programmable via SPI). A short circuit of one of the sensor supplies does not affect the other outputs.



Reset circuit

All system reset concept
Two bidirectional reset pins RST5 and RSTC
Undervoltage reset
Software reset

Parameter	Min	Max	Unit
RST5, bidirectional reset pin, active low, monitoring VDD5 voltage			
Undervoltage threshold at VDD5 for Reset	4.5	4.7	V
Reset duration after undervoltage	14	17	ms
RSTC, bidirectional reset pin, active low, monitoring undervoltage			
Undervoltage threshold for VDD5	3.5	3.7	V
Undervoltage threshold for VDD3	2.9	3.1	V
Undervoltage threshold for VDD2	2.25	2.35	V
Undervoltage threshold for VDDL	1.32	1.40	V
Reset duration after undervoltage	14	17	ms
Internal soft reset duration via SPI	90	170	µs
Undervoltage threshold „on“, UB_STBY		5.2	V
Undervoltage threshold „off“, UB_STBY		4.3	V

Switch on cases

- Non-permanent supplied system (NPSS):
  UB and UB_STBY are supplied by the mainrelay contact
  Normal mode via EIN
  Wakeup with WAK
- Partial permanent supplied system (PPSS):
  UB supplied by the main relay contact; UB_STBY permanent supplied
  Normal mode via EIN
  Wakeup with WAK, CAN and StopCounter (STC)
- Permanent supplied system (PSS):
  UB and UB_STBY permanent supplied
  Normal mode via EIN
  Wakeup with WAK, CAN and StopCounter (STC)

Main relay stage

- Current limitated relay driver with diagnosis
- Detection of sticked main relay

The output stage for main-relay-control is realized with a low side switch with integrated clamping and a switched current-limitation for the error state short to battery. In a reverse polarity case the output is disabled.

With the diagnosis circuit of the main relay stage the following error states can be detected via SPI:

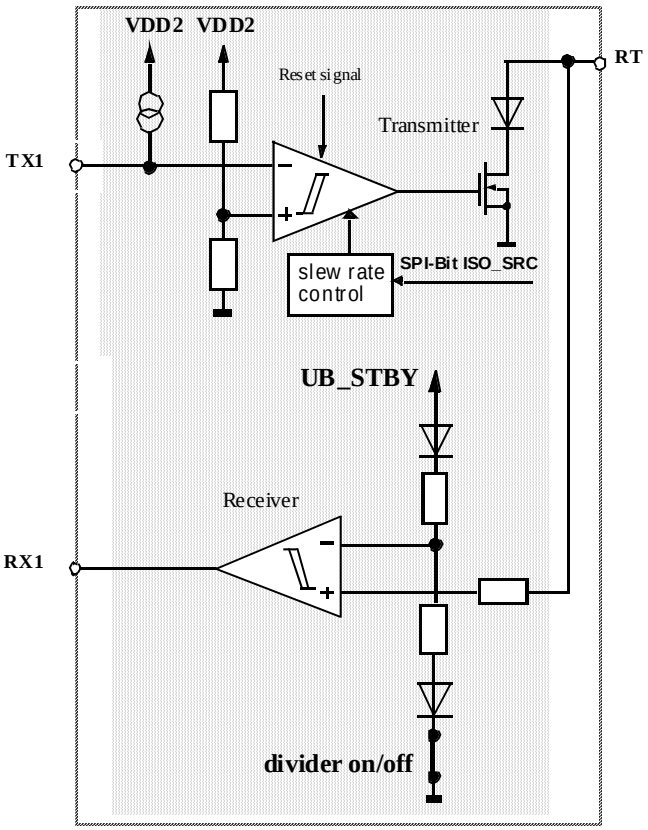
- SCB: short circuit to battery
- SCG: short circuit to ground
- OL: open load

The main relay output stage is switched-on by the ignition lock after the integrated filter time of typically 16 ms has expired. An additional supply for the IC except from pin EIN is not required for this, that means the control current into input EIN is sufficient to drive the main relay for a non permanent supply system NPSS.

When the ignition key is opened (pin EIN not supplied), the relay is de-activated after the 16 ms filter time, if the “afterrun” function was not activated.

Parameter	Min	Max	Unit
Output current, MR		300	mA
Current limitation, MR	700	1400	mA
Low voltage, MR, I_{MR} = 300 mA		1.5	V
Low voltage, MR, I_{MR} = 100 mA		1.0	V
Leackage current, MR, U_{MR} < 14 V		25	µA
Leackage current, MR, U_{MR} < 12 V		10	µA
Input current, no UB_STBY undervoltage, EIN, WAK		0.4	mA
Input current at UB_STBY undervoltage at UB_STBY, EIN, WAK		0.9	mA
Threshold, EIN	3.6	4.5	V

Serial interface / ISO driver



Integrated in the CY320 is a bidirectional serial interface driver, enabling data transfer according to ISO9141. The driver can be used, for example, as the diagnosis interface, for an immobilizer, BSS interface and other serial interfaces.

- Bidirectional stage for high-speed serial communication up to 312.5 kBd
- Current limited open drain input/output RT, protected against destruction from ISO impulses 3a and 3b, disabled when reset signal RST5 is active in order to ensure short-circuit immunity during voltage startup

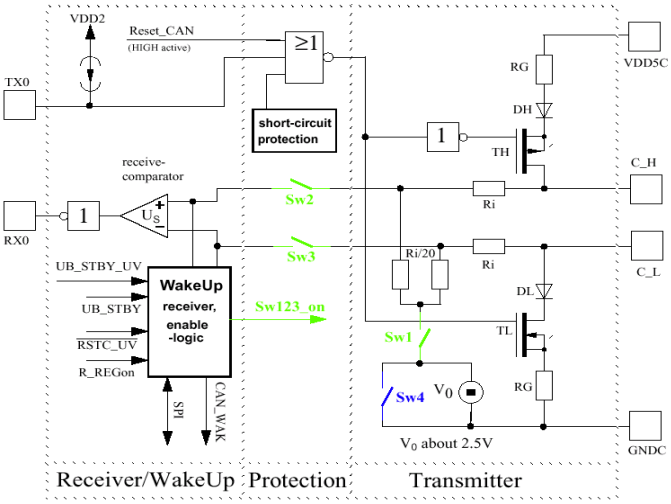
Parameter	Min	Max	Unit
RT low level at I_{RT} = 40 mA		1.4	V
RT short circuit current		150	mA
RT off state input current	-5	10	µA
RT slew rate limitation, negative edge, programmable via SPI[1)]	1	3	V/µs
RX1 low output voltage		0.4	V
RX1 high output voltage	U_{VDD3} – 0.4		V
TX1 low level	-0.3	0.3 * U_{VDD2}	V
TX1 high level	0.7 * U_{VDD2}	U_{VDD5} + 0.3	V

1) Pull up resistor 500 Ω against battery, 4..10 nF capacity to ground.

If the interface is not used, the transmitter side can be deployed as a small-signal stage.

CAN Transceiver

- Specification according ISO/DIS 11898
- Up to 1 MBaud
- Configurable WakeUp detection with several sleep and standby modes
- Compatible with 3.3 V (2.5 V) CAN controller
- RFI and EMI improved



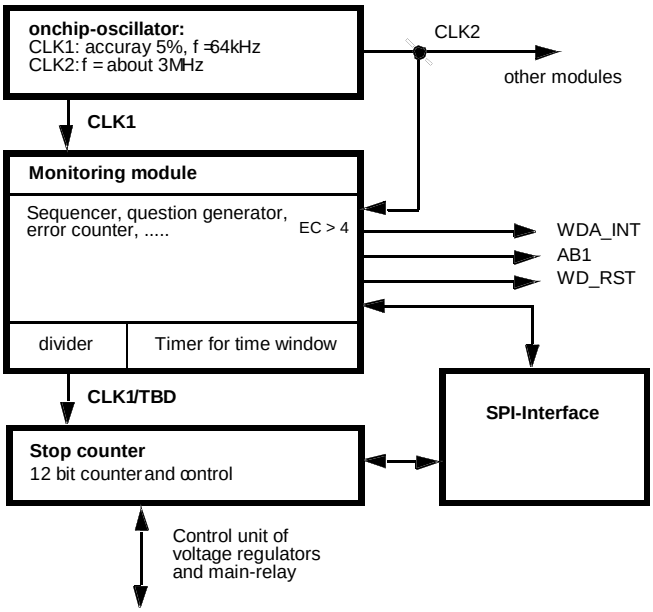
Parameter, voltages related to U_{GNDC}	Min	Max	Unit
Operating range, VDD5C	4.5	5.5	V
Supply current at VDD5C, RL dominant	50	150	mA
Supply current at VDD5C, RL recessive	3	10	mA
Output voltage, C_H, C_L, normal mode	0.4 *U_{VDD5}	0.6 *U_{VDD5}	V
Output differential voltage, I_{DIH}	1.5	3	V
Output differential voltage, I_{DIL}	-500	50	mV
Input common mode voltage	-12	+12	V
Input switching threshold, C_H, C_L	500	900	mV
Input resistance, C_H, C_L		50	kΩ
High output voltage RX0, I_{RX0}= -2 mA	U_{VDD3} –0.8	U_{VDD3}	V
Low output voltage RX0, I_{RX0}= 2 mA		0.4	V
High level, TX0	0.7 *U_{VDD}	U_{VDD5C} +0.3	V
Low level, TX0	0.3	0.3* U_{VDD2}	V
Wakeup detection time, three modes programmable via SPI	1	4	µs

Digital functions

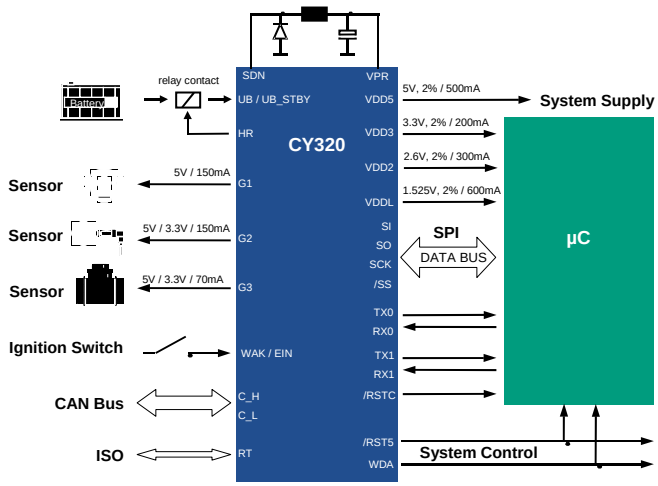
- Advanced digital watchdog of the µC-controller via SPI
- System diagnosis via SPI
- Open drain module monitoring at WDA and SPI interface
- WakeUp by CAN, input pin and watchdog
- Digital Stop Counter

The watchdog creates a 4 bit question and expects a 4 byte answer via the SPI in a defined time frame. Various actions are activated depending on the state of an error counter which is actualized after every correct, missing or wrong answer.

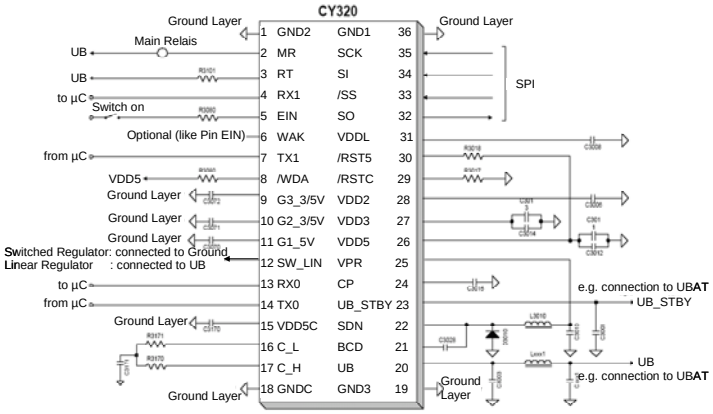
Parameter	Min	Max	Unit
Operating range, VDD5	3.4	5.5 0.4	V V
SPI transfer rate		2	MBd



Application example



Application circuit



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