

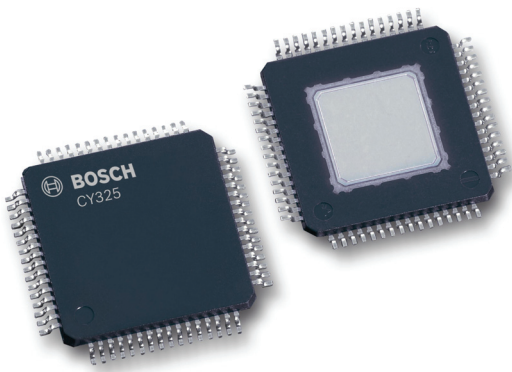
Automotive Electronics

Product Information

CY325 – System Basis Chip



BOSCH
Invented for life



Customer benefits:

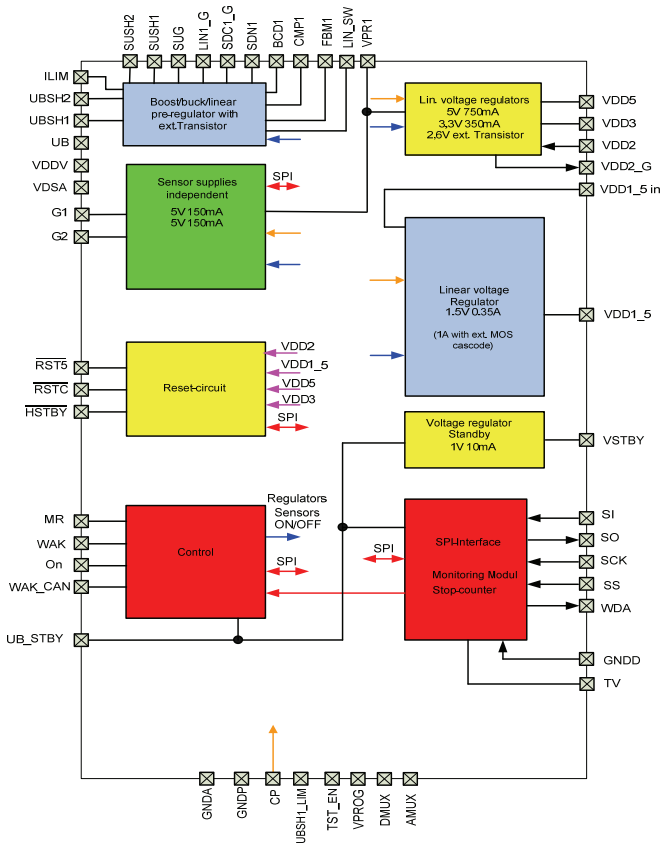
- ▶ VDA 3.0 compliance with Watchdog
- ▶ 5V independent sensor supply
- ▶ Designed for Freescale or Infineon μ C Families

CY325 is designed for use either in a permanently supplied system or in a non-permanently supplied system. With a configurable step up/step down/linear pre-regulator, two linear power regulators, one linear regulator for the μ C core voltage extendible for high current application via external power MOS cascade including 2,6V linear regulator and several peripheral inputs and outputs, the CY325 is a highly integrated power circuit designed for supply engine management controllers and signal processors. The 1V standby regulator also enables the use of Freescale μ C. An SPI interface enables simple communication with the μ C.

Features

- ▶ 550KHz Step-up/step-down converter as pre-regulator with external transistors
Step-down converter also as linear regulator configurable.
- ▶ 5.0V \pm 2% linear regulator 750mA (includes the 350mA of 3.3V)
- ▶ 3.3V \pm 2% linear regulator 350mA
- ▶ 2,6V \pm 3% linear regulator with external MOS Transistor
- ▶ 1.5V \pm 2% linear regulator 350mA (extendible to 1A with external MOS-Cascode)
- ▶ two independent sensor power supplies 150mA (tracking to VDD5 \pm 5mV)
- ▶ Co-ordinated soft start-up of all regulators
- ▶ Main relay output stage with integrated clamping and diagnosis
- ▶ Controlling of voltage regulators, sensor power supplies and main relay drive
- ▶ Reset circuit with additional external reset
- ▶ 1.0V \pm 10% standby linear regulator 10mA
- ▶ Quiescent current typ. 50uA (in stop counter mode typ.100uA)
- ▶ Watchdog full fills VDA 3.0 requirements
- ▶ Approved SPI interface
- ▶ 22 bit stop counter with 1s resolution (incl. wake-up capability)
- ▶ Wake-up input
- ▶ Ignition input (T.15 input)
- ▶ Wake-up input for CAN signal (compatible to TJA 1041)

Block diagram



Maximum ratings

Parameter	Min	Max	Unit
Voltage Pin UB, UB_STBY, UBSH1..2,	-0.3	40	V
Voltage Pin G1,G2	-1	32	V
Voltage Pin MR	-0.3	36	V
Operating junction temperature	-40	150*	°C
Thermal resistance package	3		K/W
ESD HBM	-2	2	KV
ESD MM	-200	200	V
Storage temperature	-55	125*	°C

* Bare die 170°C

Pin description

Pin	Name	Function
1	LIN1_G	Gate driver external transistor for linear regulator operation
2	SDC1_G	Gate driver external transistor for switched regulator operation
3	SDN1	Input step down converter (buck converter) connected to Source of the external Transistor
4	BCD1	Boost capacitance buck regulator
5+6	UBSH2	UBatt shunt output for current sensing for buck converter
7+8	UBSH1	UBatt shunt input for current sensing for buck converter
9	CP	Charge-pump output for external smoothing capacitance
10	UBSH1_LIM	UBSH1 limited voltage ~10V (Reference voltage for the CP-Cap) The CP-Cap must be connected between CP and UBSH1_LIM
11	HSTBY	Reset output
12	RSTC	Core supply undervoltage reset signal, active-low
13	RST5	IO-undervoltage reset signal, active-low, open-collector
14	WDA	Monitoring module open-drain output
15	AMUX	Testpin (only factory mode)
16	nc	Not connected
17	TST_EN	Testmode enable
18	DMUX	Testpin (only factory mode)
19	TV	Testpin (only factory mode)
20 + 21	VDDV+VDDV_V	Internal supply voltage (Output for external block capacitor)
22	GND_A	Ground Analog
23	GND_D	Ground Digital
24+25	VDSA+VDDVD	Internal supply voltage (Output for external block capacitor)
26	VSTBY	Standby regulator 1V
27	VPROG	Programming voltage (only factory mode)
28	UB	Battery supply input, T30 for a permanent-powered systems, main-relay contact for a non-permanent powered systems (only for detection of UB)
29	UB_STBY	T30 Battery supply input for control unit, stop counter and Standby Voltage Regulator

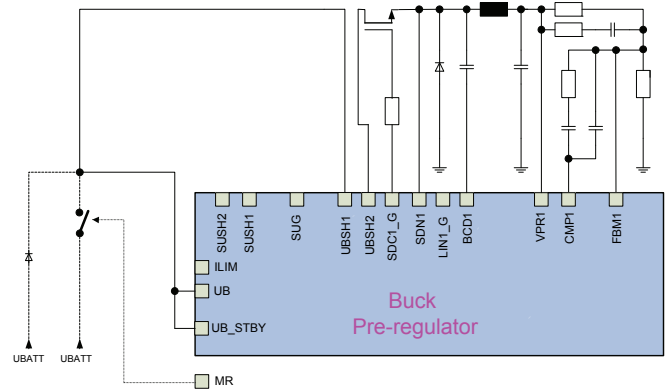
Pin description (continued)

Pin	Name	Function
30	WAK_CAN	Input for wakeup via CAN
31	WAK	Input for wakeup via peripherals
32	ON	Ignition key input (T.15 input)
33	SUSH2	Shunt input for boost converter
34	SUSH1	Shunt input for boost converter
35	ILIM	Limit Current Boost regulator
36	MR	Main relay stage output
37+45	GNDP	Ground Power
38+39	G1S+G1	Sensor supply 1
40+41	VPR1	output of buck/linear regulator → Input for VDD5, -3, -2, -1_5, Gx
42+43	GS2+G2	Sensor supply 2
44	LIN_SW	Linear or switch mode VPR regulator
46	SUG	Gate driver for an external transistor for boost converter
47	SCK	SPI serial clock input
48	nc	Not connected
49	SO	Slave-Out signal (SPI data output)
50	SI	Slave-In signal (SPI data input)
51	SS	SPI slave-select signal
52+53	VDD5S+VDD5	Main regulator 5V output
54+55	VDD3+VDD3S	Main regulator 3.3V output
57+56	VDD1_5+VDD1_5S	Main regulator 1.5V output
58	VDD1_5 in	VDD1_5 input voltage
59+60	VDD2S+VDD2	Feedback input of VDD2 regulator
61	VDD2_G	Output for external MOS transistor VDD2
62	FBM1	Feed back, voltage divider VPR1
63	CMP1	External compensation network
64	nc	Not connected

* if boost converter is not used **no** external components must be connected to the pins

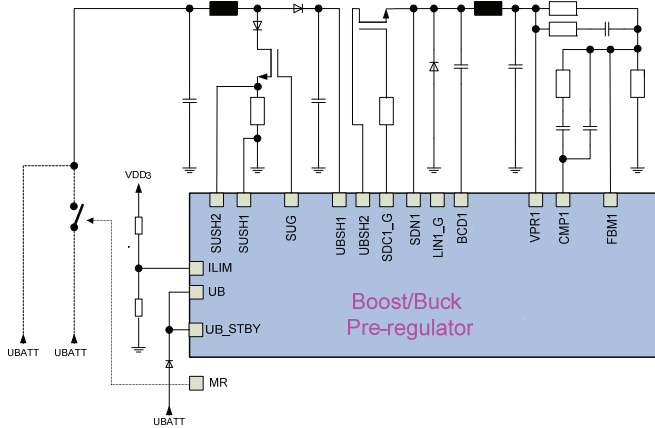
Functional description
Power supply

- ▶ Fully integrated system and microcontroller supply
- ▶ Supply for external sensors
- ▶ Minimal power dissipation, maximal robustness

Buck pre-regulator:


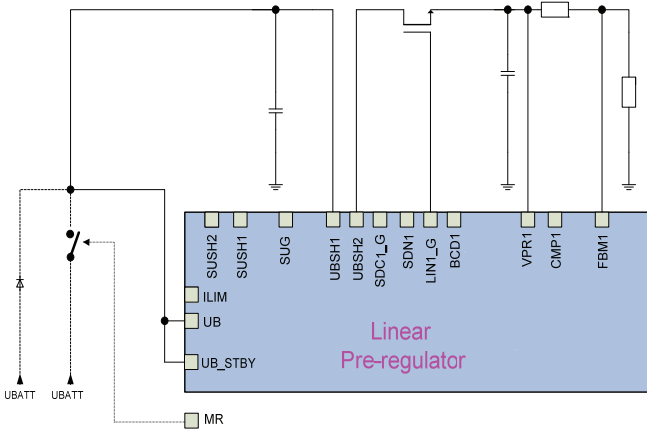
Parameter	Comment	Symbol	Min	typ	Max	Unit
Output voltage		U_{buck_out}	5.7		6.5	V
Switching frequency		f_{buck}	490	550	610	kHz
Soft start time	external inductance	T_{soft}	3		4,5	ms
Inductivity	external capacitance	L1	10		100	μ H
Capacitive load		CL	10		47	μ F

Boost/Buck pre-regulator:



Parameter	Comment	Symb.	Min	typ	Max	Unit
Switching frequency	Phase relation between Boost and buck converter Phi 180° (typ)	f _{boost}	490	550	610	KHz
Input voltage start boost regulator	UB must be >6.4V before UB drops down	U _B	5.8		6.4	V

Linear Regulator:



Parameter	Comment	Symb.	Min	Max	Unit
Output voltage		U _{linear_out}	5.7	6.3	V
Capacitive load		C _L	2,2	47	μF
ESR Capacitive load		ESRCL	0	t.b.d.	Ω

Voltage regulator dependencies

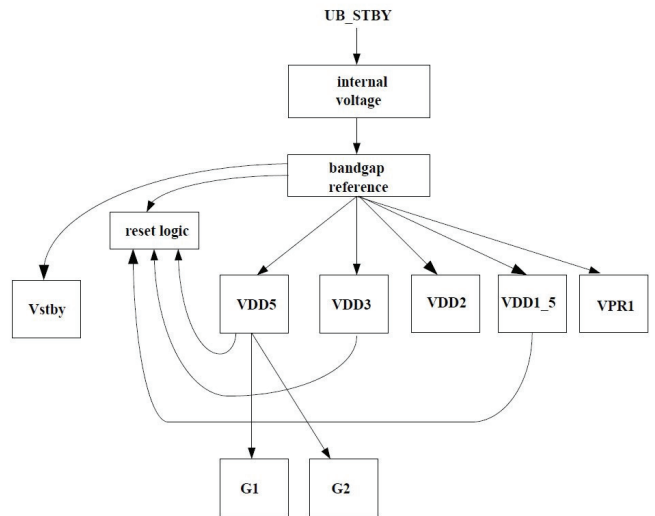
The output voltages VPR, VDD5, VDD3, VDD2 and VDD1_5 are derived independently from a bandgap reference. The sensor supplies G1 and G2 track to VDD5. A short-circuit of one of the sensor supplies G1 and G2 does not affect the other outputs.

Reset circuit

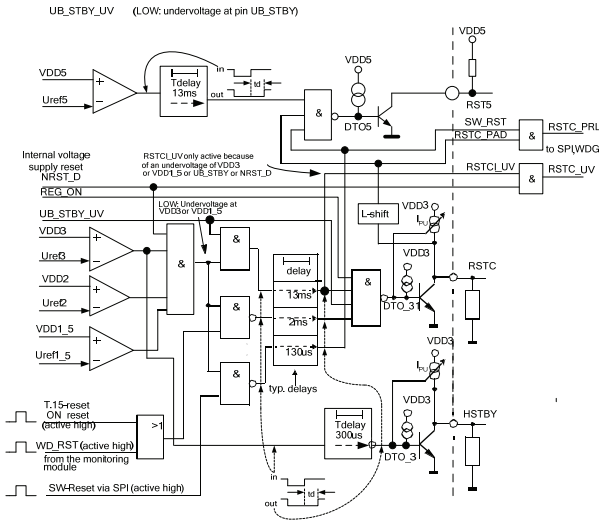
The reset-circuit monitors the 5V-supply voltage [VDD5], the 3.3V-supply voltage [VDD3], the 1.5V-supply voltage [VDD1_5], and the signal at the inputs [ON, UB_STBY] for undervoltage.

The circuit has three reset pins:

- [RST5] Reset for IO (peripheral reset)
- [RSTC] Reset for digital core
- [HSTBY] Reset for μCs



Parameter	Comment	Symb.	Min	Max	Unit
Output voltage		U _{linear_out}	5.7	6.3	V
Capacitive load		C _L	2,2	47	μF
ESR Capacitive load		ESRCL	0	t.b.d.	Ω



Digital functions

Parameter	Comment	Sym	Min	Max	Unit
SPI Inputs	Shortcut for Pins SI, SCK, SS → xx				
Input LOW level		U _{xx}	-0.3	0.3x UVDD3	V
Input HIGH level		U _{xx}	0.65x UVDD3	UVDD3 +0.3	V

Sensor Supplies G1, G2:

Parameter	Comment	Sym	Min	Max	Unit
Output current		ΔUG1,G1		150	mA
Output voltage	0mA < - IG1,G2 < 150mA	UG1 ;G2	4.9	5.1	V
Tracking to VDD5	U _{off} = UVDD5 - UG1 ;G2 0mA < - IG1,G2 < 150mA 0mA < - IVDD5 < 750 mA	U _{off}	-5	5	mV
Drop voltage	-IG1,G1 = 150mA ΔU _{dp} G1,G1 = UVPR1 - UG1 ;G2	ΔU _{dp} G1,G1		600	mV
Capacitive load		CLG1,G1	0.1	1	μF
ESR Capacitive load		ESRCLG1,G1	0	0,3	Ω

Main Relay:

Parameter	Comment	Sym	Min	Max	Unit
Output current		IMR		350	mA
LOW voltage	IMR = 100mA IMR = 350mA	VMR VMR		250 875	mV mV
Clamping voltage	IMR = 150mA	VCLA	36	50	V
Clamping energy	UB = 14V, tab > 1ms UB = 26V, tab > 3ms Only for jump start	Eab Eab		6 15	mJ mJ

Parameter	Comment	Sym.	Min	Max	Unit
RST5 output	output for internal reset signals, active LOW. Monitoring the VDD5 voltage regulator for undervoltage				
Undervoltage threshold	UVDD5 < Uref5 => RST5 = Low	Uref5	4.48	4.7	V
Reset time	Reset active after undervoltage appears and disappears	TRST5	11	15	ms
RSTC input/output	Bi-directional pin, output for internal reset signals, active LOW. Monitoring the VDD3 and VDD1_5 voltage regulators for undervoltage				
and					
HSTBY output	Output for internal reset signals, active LOW. Monitoring the VDD3 voltage regulators for undervoltage				
Undervoltage threshold for VDD3	UVDD3 < Uref3 => RSTC and HSTBY = Low	Uref3	3.0	3.20	V
Undervoltage threshold for VDD1_5	UVDD1_5 < Uref1_5 => RSTC = Low	Uref1_5	1.36	1.42	
Reset time	Power-on reset; active reset after undervoltage	tRSTC tHSTBY	11 300	15 600	ms μs

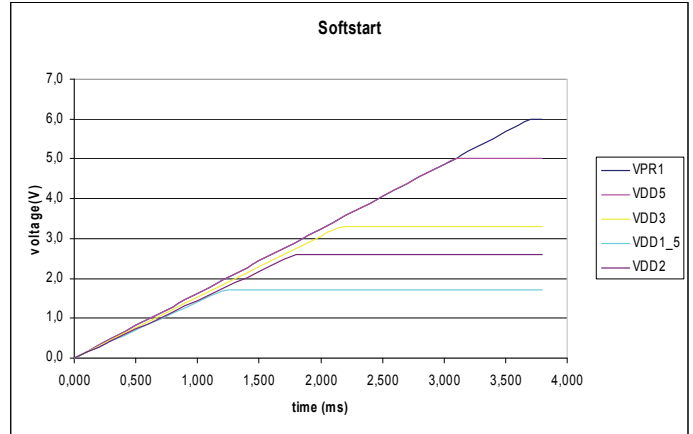
Pin UB:

Parameter	Comment	Sym	Min	Max	Unit
Current consumption Standby Active	-40°C < Tj < 150°C	I _{UB} I _{UB}		4 100	μA μA

Pin UB_STBY:

Parameter	Comment	Sym	Min	Max	Unit
Current consumption Standby	-40°C < Tj < 150°C				
	Stop counter and VSTBY “off”	I _{UB_STBY}		50	μA
	Stop counter active and VSTBY “off”	I _{UB_STBY}		90	μA
	Stop counter “off” and VSTBY active	I _{UB_STBY}	70+	I _{VSTBYext}	μA
	External current	I _{VSTBYext}		10	mA

Typical softstart of 1.5V regulator



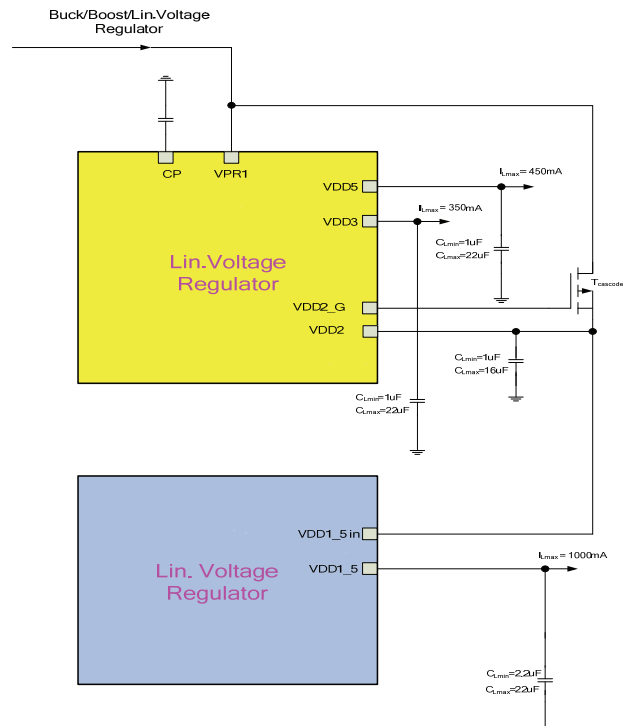
VSTBY Regulator:

Parameter	Comment	Sym	Min	Max	Unit
Output current		-I _{VSTBY}		10	mA
Output voltage	0mA < I _{VSTBY} < 10mA	V _{VSTBY}	0.9	1.1	
Capacitive load		CL _{VSTBY}	0.35	t.b.d.	μF
ESR Capacitive load		ESRCL _{VSTBY}	0	t.b.d.	Ω

Pin ON, Pin WAK, PIN WAK_CAN:

Parameter	Comment	Sym	Min	Max	Unit
Threshold	0 < V _{UB_STBY} < V _{UB_STBY max}	V _{ONthr}	3.6	4.5	V
	V _{UB_STBY} < V _{UB_STBY threshold}	V _{Offthr}	2.8	4	V
	V _{UB_STBY} > V _{UB_STBY threshold}	V _{Offthr}	2.9	3.6	V

Typical linear 1.5V regulator application



VDD3 Regulator:

Parameter	Comment	Sym	Min	Max	Unit
Output current	0mA < -IVDD3 < 350mA	-IVDD3		350	mA
Output voltage	0mA < -IVDD3 < 350mA	UVDD3	3.23	3.37	V
Drop voltage	-IVDD3 = 350mA	ΔU_{dpVDD3}		300	mV
Capacitive load		CLVDD3	0.8	28	μ F
ESR Capacitive load		ESRCLVDD3	0	t.b.d.	Ω

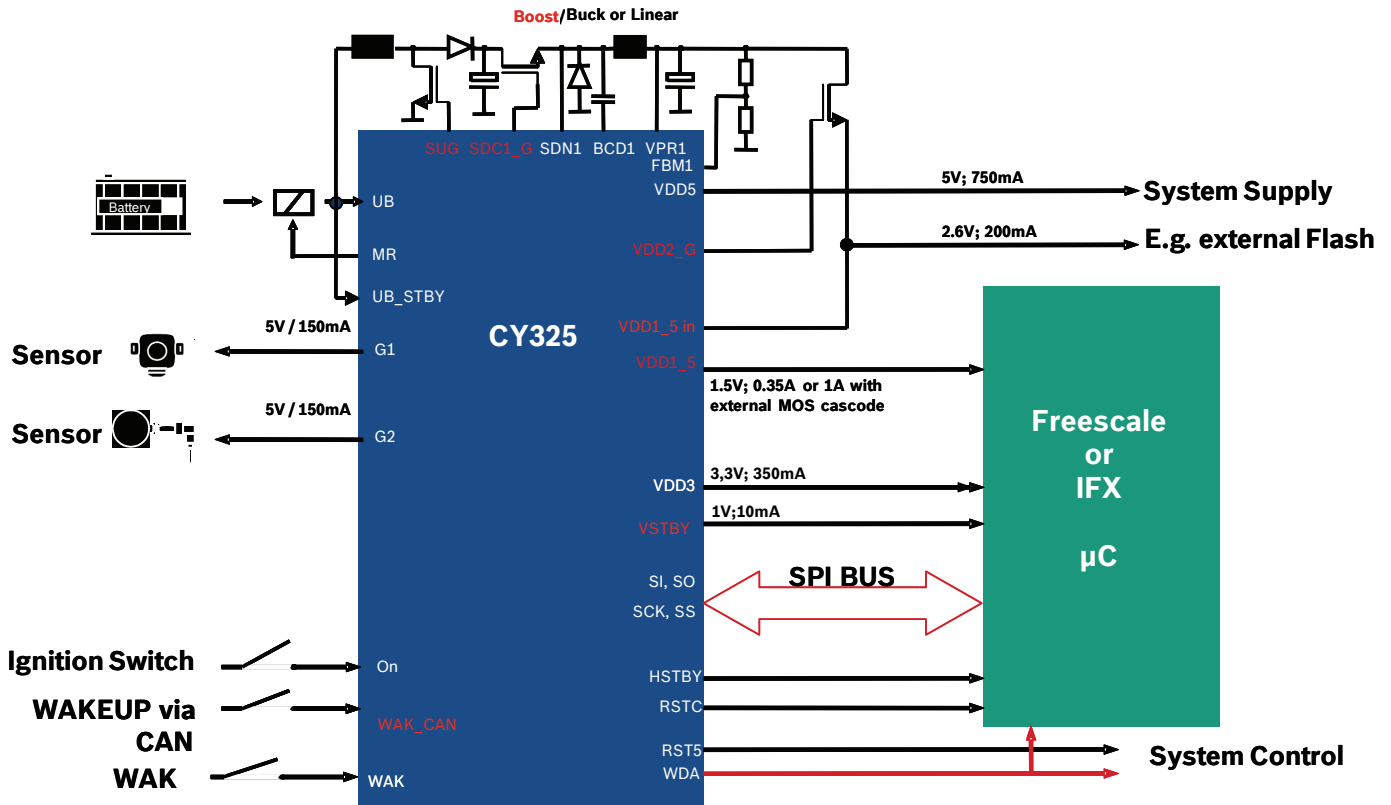
VDD1_5 Regulator without external VDD2:

Parameter	Comment	Sym	Min	Max	Unit
Output current		-IVDD1_5		350	mA
Output voltage	0mA < -IVDD1_5 < 350mA	UVDD1_5	1.470	1.530	V
Drop voltage	-IVDD1_5 = 350mA	ΔU_{dpVDD1_5}		50	mV
Capacitive load		CLVDD1_5	1.6	28	μ F
ESR Capacitive load		ESRCLVDD1_5	0	t.b.d.	Ω

VDD1_5 Regulator with external VDD2:

Parameter	Comment	Sym	Min	Max	Unit
Output current		-IVDD1_5		1	A
Output voltage	0mA < -IVDD1_5 < 1A	UVDD1_5	1.470	1.530	V
Drop voltage	-IVDD1_5 = 1A	ΔU_{dpVDD1_5}		210	mV
Capacitive load		CLVDD1_5	1.6	28	μ F
ESR Capacitive load		ESRCLVDD1_5	0	t.b.d.	Ω

Application example



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