

Automotive Electronics

Product Information

CG902-904 – Airbag System ICs



BOSCH
Invented for life



Product highlights

- ▶ All basic system functions integrated in one chip
- ▶ Adjustable to various system configurations thanks to 3 chip variants
- ▶ SW and HW compatible across all system configurations
- ▶ Supports a wide range of microcontroller families
- ▶ Fully automated diagnostic routines

Description

The CG902, -3 and -4 are integrated system ICs for Airbag applications with the possibility to realize a highly compact, two chip Airbag ECU consisting of a microcontroller and the system IC.

The CG90x combine power module, firing loop module, sensor interface module and a sophisticated safety module on a single chip

General functionality

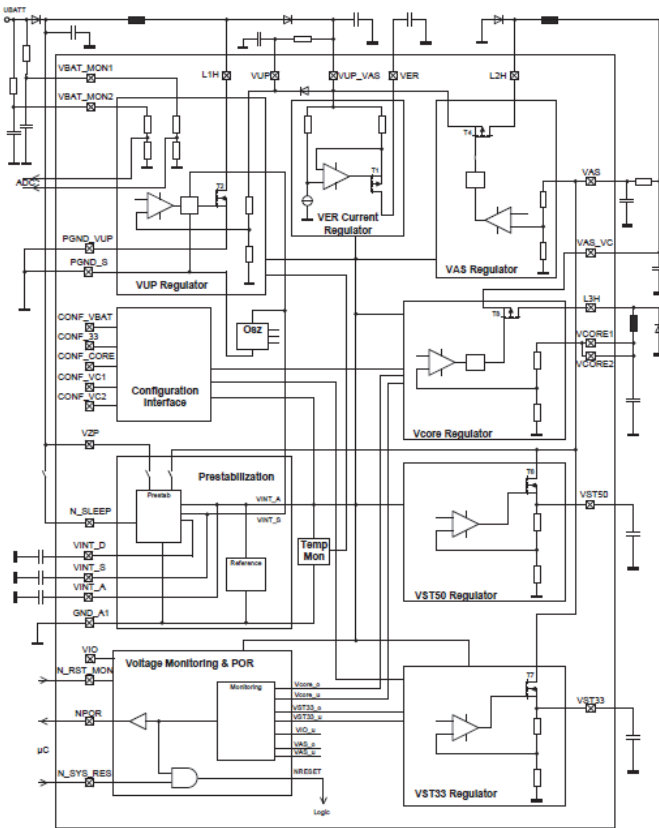
- ▶ System Power Supply
- ▶ 8, 12 or 16 Firing Loops
- ▶ 2, 4 or 6 PSI5 Interfaces
- ▶ 10 AIN, 2 AIO Interfaces
- ▶ Safety Controller
- ▶ LIN/K-Line Interface

Customer benefits

- ▶ Maximum system safety thanks to a sophisticated safety concept with fully automated diagnostics
- ▶ Simple design-in due to hardware and software compatibility
- ▶ ISO –compliant design

Power module (features)

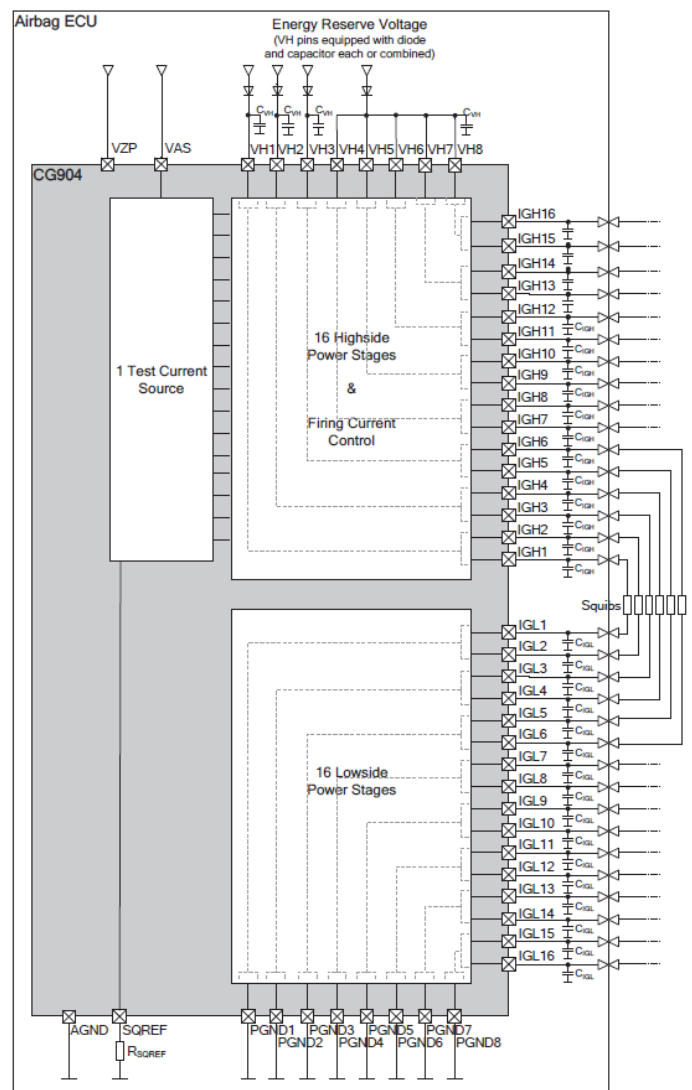
- ▶ Bandgap references for voltage regulation and voltage monitoring
- ▶ Internal reference current
- ▶ Internal oscillator with 1.875MHz
- ▶ VUP boost converter from VZP=5.2V...18V to VUP=33V/24V with 1.875MHz
- ▶ VER charger with programmable current levels
- ▶ VER test current functionality for capacitor and ESR test
- ▶ SPI control of supply test functions, supply status, VUP programming (output voltage and current limitation)
- ▶ Monitoring of battery voltage by dedicated VBAT_MON pins
- ▶ VAS buck converter VUP=10V...36V to VAS=6.7V with 1.875MHz
- ▶ VCore buck converter VAS=6.7V to VCore=3.3V/1.29V with 1.875MHz
- ▶ Programmable converter slope shaping and frequency jitter for improved EMC performance
- ▶ VST50 linear regulator VAS to VST50=5V (CAN supply, ECU internal sensors)
- ▶ VST33 linear regulator VAS to VST33=3.3V (analog & digital supply)
- ▶ VCore/VST33 configuration by dedicated CONF pins
- ▶ Bandgap references for voltage regulation and voltage
- ▶ Voltage monitoring of low voltage pins and power-on reset logic
- ▶ Sleep mode control with $I_{\text{sleep}} \leq 60\mu\text{A}$
- ▶ Over-temperature shut down of VUP converter

Power module (block diagram)**Firing loop module (features)**

- ▶ 16 firing loops (CG904), 12 firing loops (CG903) or 8 firing loops (CG902)
- ▶ highside and lowside power stages short-circuit protected
- ▶ hardware switch-off of power stages
- ▶ general disable for power stages
- ▶ special disable of dedicated power stages
- ▶ independent control and power supply of highside and lowside power stages
- ▶ different firing modes programmable by SPI:
 - ▶ static mode I: 1.85 A for 0.7 ms
 - ▶ static mode II: 1.75 A for 0.5 ms
 - ▶ static mode III: 1.2 A for 2 ms
 - ▶ dynamic mode V: 1.75 A for 0.7 ms, automatic extension to 1.2 A for 2.0 ms possible
 - ▶ dynamic mode VI: 1.5 A for 1.5 ms, automatic extension up to 3.0 ms possible
- ▶ high resolution firing current counters (40 kHz, 7 bit), independent of firing current
- ▶ automatic high precision loop diagnosis:
 - ▶ short detection on all IGH and IGL pins to detect short circuits or leakage resistors to battery or ground
 - ▶ cross coupling test to detect short circuits between the firing loops
 - ▶ VH voltage measurement and SVR diagnosis by the internal ADC

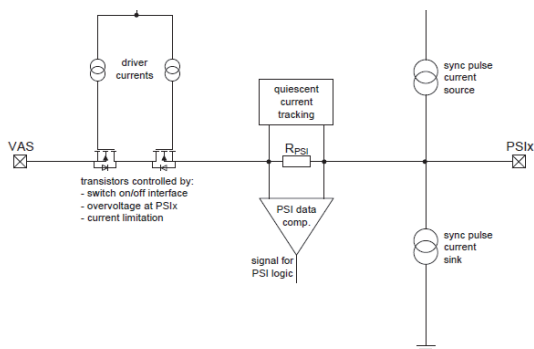
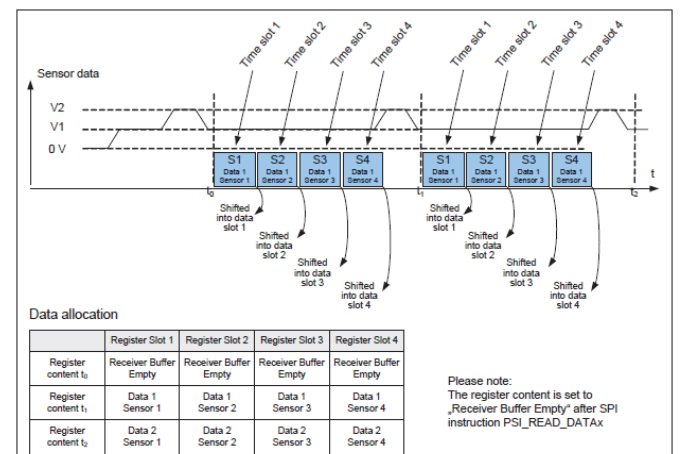
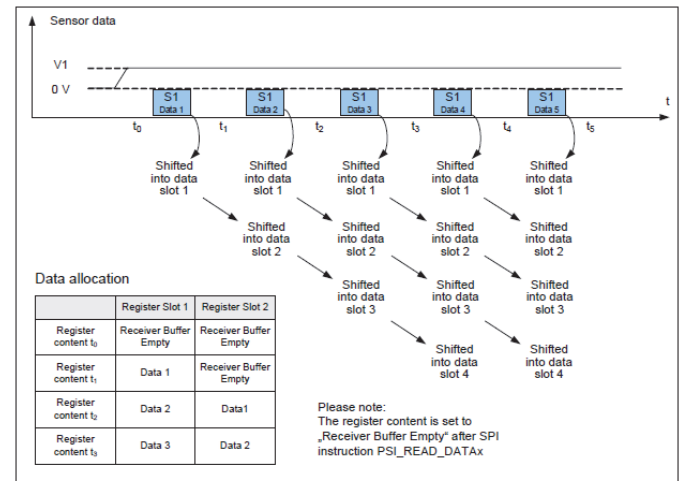
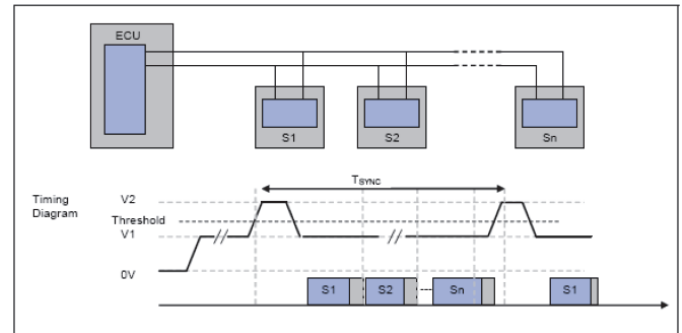
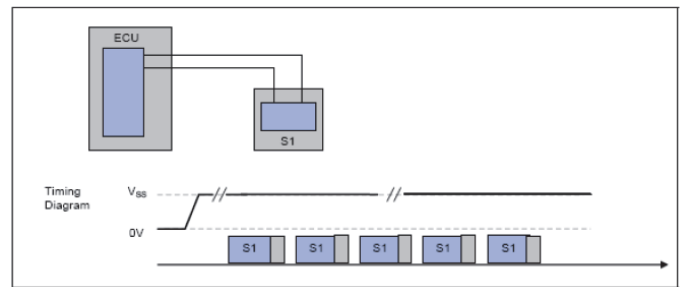
▶ automatic high precision loop diagnosis:

- ▶ squib resistance measurement for determining the ohmic part
 - ▶ test current level and duration for squib resistance measurement programmable via SPI
 - ▶ squib detection test for detecting an open load
 - ▶ safe power stage diagnosis test
 - ▶ connector capacitor diagnosis
- ▶ maximum distance between highside and lowside power stages due to cross placement on chip

Firing loop module (block diagram)

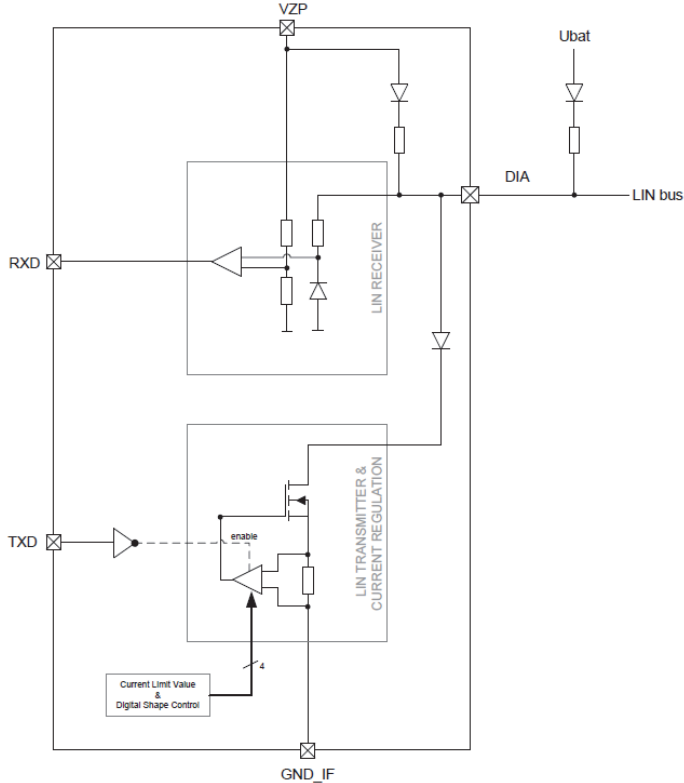
Interface module (features)

- ▶ 32bit SPI, 10MHz, 10 bit SPI instruction
- ▶ programming enable bit (pe)
- ▶ 16 bit input and output data
- ▶ 3 bit CRC for input and output signal
- ▶ 6 general status flags
- ▶ sensor data flag (S)
- ▶ 5 bit safety ID / 5 additional status flags
- ▶ global status flag (gs)
- ▶ 6 PSI5 interfaces integrated
 - ▶ Asynchronous (PSI5-A) and synchronous (PSI5) operation
 - ▶ Point-to-point and bus mode
 - ▶ 3 different data transmission modes selectable (83.3 kbps, 125 kbps, 189 kbps)
 - ▶ Operation with up to 4 sensors per interface (189 kbps data transmission)
 - ▶ Operation with up to 3 sensors per interface (125 kbps data transmission)
 - ▶ Operation with up to 2 sensors per interface (83.3 kbps data transmission)
 - ▶ Uni- and bidirectional communication
 - ▶ Two-wire interface (combined lines for supply and data transmission)
 - ▶ Manchester-coded digital data transmission
 - ▶ 10 bit data frame
 - ▶ 3 bit CRC mode or single bit parity mode selectable
 - ▶ Integrated comparator functionality for voltage monitoring of sensor channels
 - ▶ Safety identifier programmable for each channel and time slot
 - ▶ Integrated resistor for communication current detection
 - ▶ 3 different PSI sync pulse trigger modes (pin, SPI, automatic timing)
 - ▶ PSI sync pulse control
 - ▶ PSI quiescent current tracking
 - ▶ PSI comparator threshold control
 - ▶ VAS reverse current protection
 - ▶ PSI data path consistency check
 - ▶ Configurable handling of data words extending across time slot limits
 - ▶ Cross-coupling diagnosis
 - ▶ Automatic PSI deactivation in case of short-to-ground

PSI5 interface (block diagram)**Transmission of sensor data**

LIN/K-Line (features)

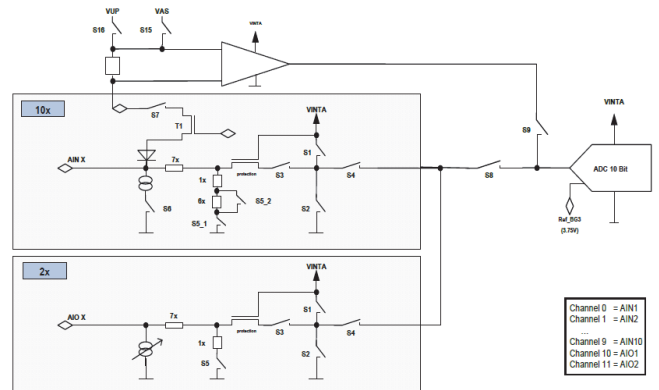
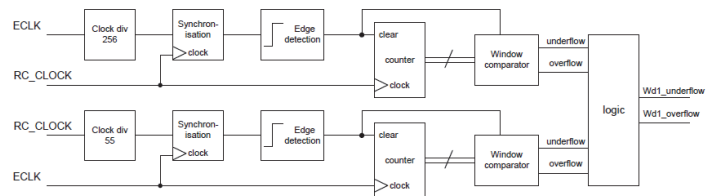
- ▶ LIN interface according to 2.1 standard
- ▶ General purpose mode as low side switch (current controlled)
- ▶ PWM control with 100, 200, 266, or 400Hz possible
- ▶ Short and timeout protected

LIN/K-Line (features)**AIN (features)**

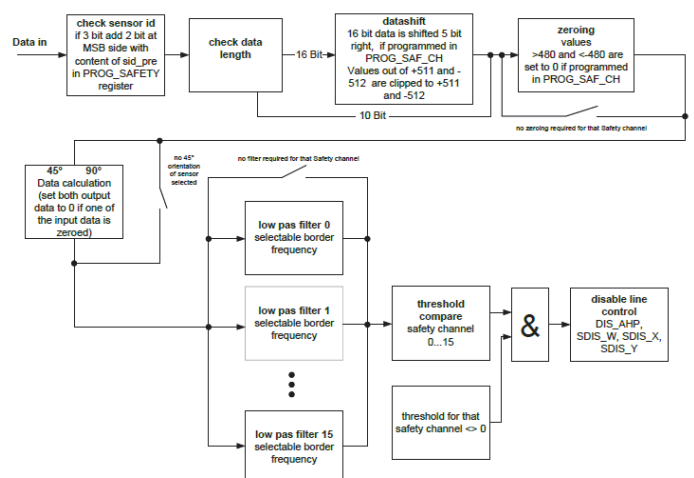
- ▶ Programmable VAS/VUP voltage at all AIN outputs (AIN1...10)
- ▶ Programmable current source from 3mA up to 18mA in fixed VAS current mode and 1.5mA up to 9mA in fixed VUP current mode
- ▶ Programmable voltage source with an ability to drive current of 30mA in fixed VAS voltage mode (hall mode) and 10mA in fixed VUP voltage mode
- ▶ Reference current generation
- ▶ Analog current measurement in fixed current and fixed voltage mode possible

AIO (features)

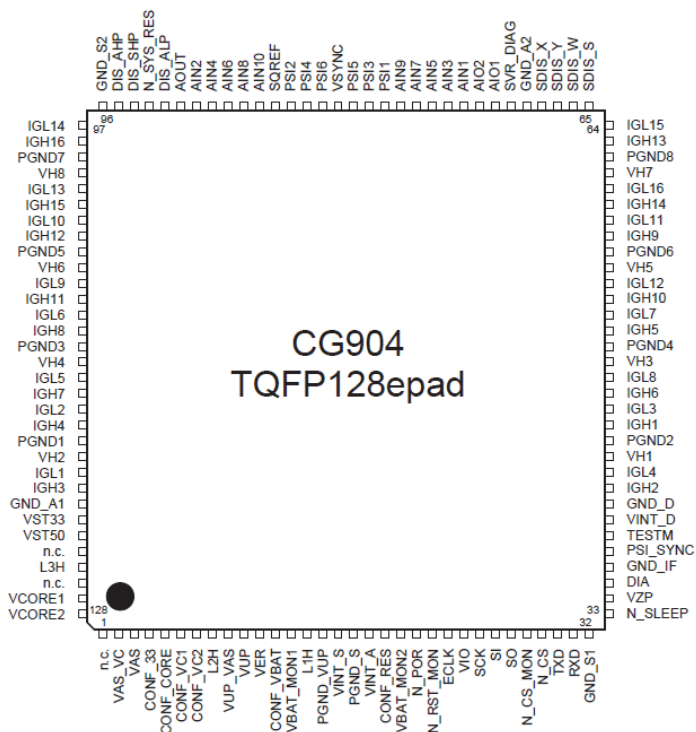
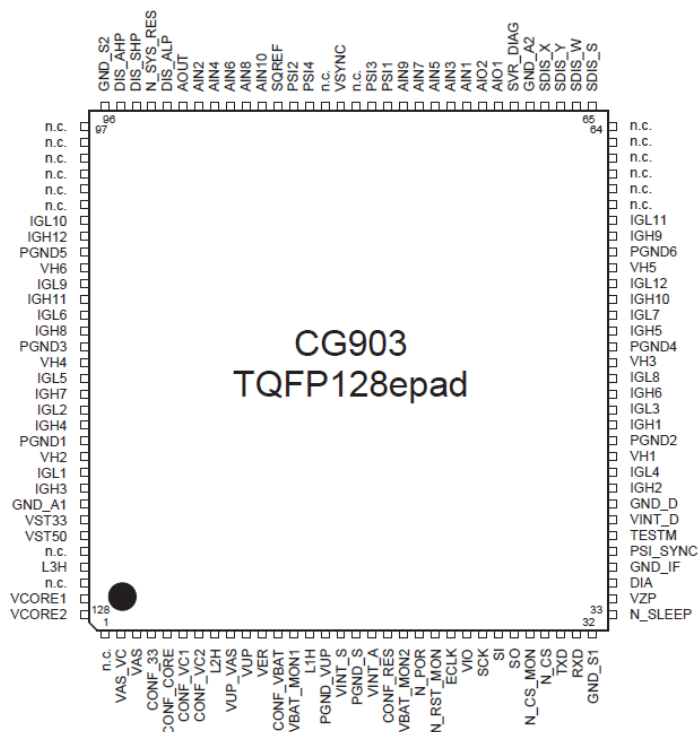
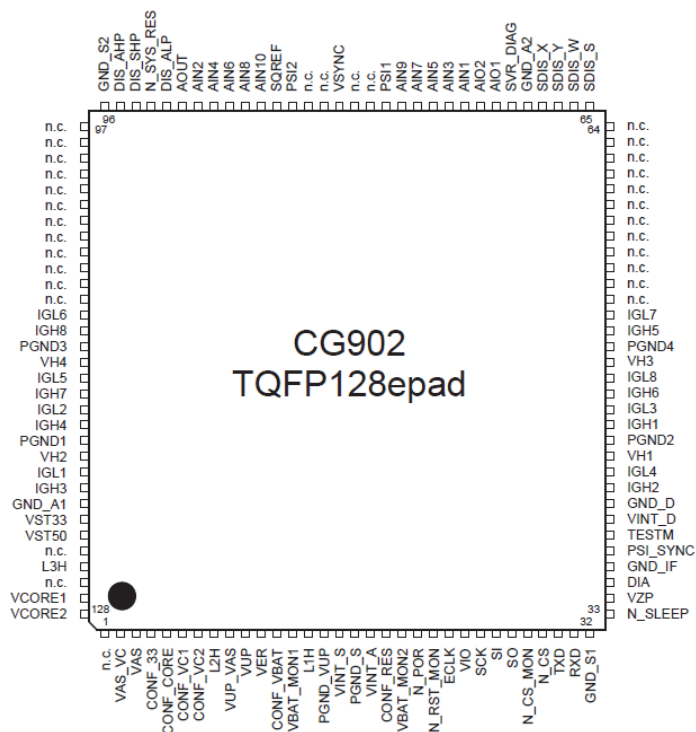
- ▶ AIO interfaces as programmable current sinks
- ▶ PWM control between 0 and 100% at 100, 200, 266, or 400Hz possible
- ▶ Programmable warning lamp mode
- ▶ Short detection

**Safety module - 3 level Watchdog****Monitor SPI for data plausibility check**

<i>n</i>	<i>checkword hex</i>	<i>response hex</i>
1	2020	E106
2	FDFD	9671
3	8A8A	4BAC
4	5757	3CDB
5	ECEC	D235
6	3131	A542
7	4646	789F
8	9B9B	0FE8

Programmable filter and threshold comparator

Pinout



Pin description list

pin	name	direction	description	module
1	n.c.	open	not connected	-
2	VAS_VC	power	power supply for VCORE	POM
3	VAS	power	stabilized analog supply 6,7 V	POM
4	CONF_33	input	configuration 3,3V regulator	POM
5	CONF_CORE	input	configuration core regulator	POM
6	CONF_VC1	input	configuration core regulator voltage	POM
7	CONF_VC2	input	configuration core regulator voltage	POM
8	L2H	power	coil 2 VAS high side connection	POM
9	VUP_VAS	power	power supply for VAS	POM
10	VUP	power	up converter output	POM
11	VER	power	energy reserve output	POM
12	CONF_VBAT	input	configuration boost converter on threshold	POM
13	VBAT_MON1	input	battery voltage monitoring	POM
14	L1H	power	coil 1 VUP high side connection	POM
15	PGND_VUP	ground	ground	POM
16	VINT_S	power	internal supply for switch regulator 4,75V	POM
17	PGND_S	ground	ground	POM
18	VINT_A	power	internal analog supply 4,75V	POM
19	CONF_RES	input	configuration reset behavior	SAM
20	VBAT_MON2	input	battery voltage monitoring	POM
21	N_POR	output	power on reset	POM
22	N_RST_MON	input	external reset monitoring	POM
23	ECLK	input	system clock 4MHz	System
24	VIO	power	internal I/O supply 3,3V	POM
25	SCK	input	SPI clock input	SPI
26	SI	input	SPI slave input	SPI
27	SO	bi-dir	SPI slave output (SO monitor internal)	SPI
28	N_CS_MON	input	chip select monitor	SPI
29	N_CS	input	chip select ASIC	SPI
30	TXD	input	transmit data	LIN
31	RXD	output	receive data	LIN
32	GND_S1	ground	ground	-

pin	name	direction	description	module
65	SDIS_S	bi-dir	special disable switch evaluation	SAM
66	SDIS_W	bi-dir	special disable w-channel	SAM
67	SDIS_Y	bi-dir	special disable y-channel	SAM
68	SDIS_X	bi-dir	special disable x-channel	SAM
69	GND_A2	ground	ground	-
70	SVR_DIAG	dedicated	input test sink for SVR test	FLM
71	AIO1	dedicated	analog I/O	AIO
72	AIO2	dedicated	analog I/O	AIO
73	AIN1	dedicated	analog input	AIN
74	AIN3	dedicated	analog input	AIN
75	AIN5	dedicated	analog input	AIN
76	AIN7	dedicated	analog input	AIN
77	AIN9	dedicated	analog input	AIN
78	PSI1	dedicated	PSI channel	PSI
79	PSI3 *	dedicated	PSI channel	PSI
80	PSI5 **	dedicated	PSI channel	PSI
81	VSYNC	power	supply voltage for PSI sync pulse	PSI
82	PSI6 **	dedicated	PSI channel	PSI
83	PSI4 *	dedicated	PSI channel	PSI
84	PSI2	dedicated	PSI channel	PSI
85	SQREF	dedicated	squib reference resistor	FLM
86	AIN10	dedicated	analog input	AIN
87	AIN8	dedicated	analog input	AIN
88	AIN6	dedicated	analog input	AIN
89	AIN4	dedicated	analog input	AIN
90	AIN2	dedicated	analog input	AIN
91	AOUT	output	analog output multiplexer	System
92	DIS_ALP	bi-dir	disable all low side power stages	FLM
93	N_SYS_RES	input	system reset	System
94	DIS_SHP	input	disable special high side power stages	FLM
95	DIS_AHP	bi-dir	disable all high side power stages	FLM
96	GND_S2	ground	ground	-

*¹ pin is not connected in CG902**² pin is not connected in CG903/CG902

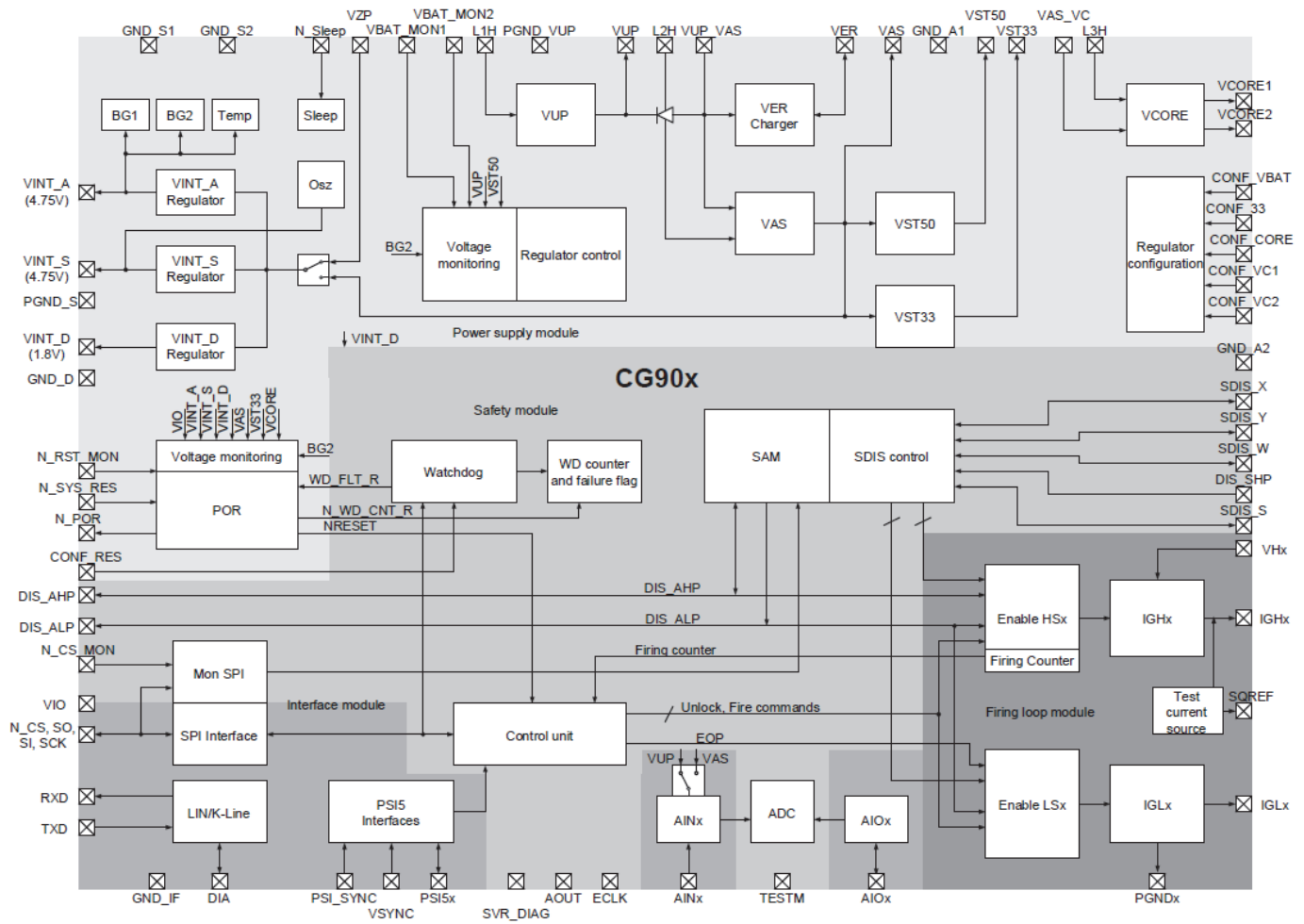
pin	name	direction	description	module
33	N_SLEEP	input	sleep control	POM
34	VZP	power	central protected supply	POM
35	DIA	dedicated	LIN bus	LIN
36	GND_IF	ground	ground	LIN
37	PSI_SYNC	input	PSI sync pulse synchronization	PSI
38	TESTM	input	ASIC test mode activation	System
39	VINT_D	power	internal digital supply 1,8V	POM
40	GND_D	ground	ground	POM
41	IGH2	dedicated	high side power stage 2	FLM
42	IGL4	dedicated	low side power stage 4	FLM
43	VH1	power	supply voltage high side power stage	FLM
44	PGND2	ground	power stage ground	FLM
45	IGH1	dedicated	high side power stage 1	FLM
46	IGL3	dedicated	low side power stage 3	FLM
47	IGH6	dedicated	high side power stage 6	FLM
48	IGL8	dedicated	low side power stage 8	FLM
49	VH3	power	supply voltage high side power stage	FLM
50	PGND4	ground	power stage ground	FLM
51	IGH5	dedicated	high side power stage 5	FLM
52	IGL7	dedicated	low side power stage 7	FLM
53	IGH10 *	dedicated	high side power stage 10	FLM
54	IGL12 *	dedicated	low side power stage 12	FLM
55	VH5 *	power	supply voltage high side power stage	FLM
56	PGND6 *	ground	power stage ground	FLM
57	IGH9 *	dedicated	high side power stage 9	FLM
58	IGL11 *	dedicated	low side power stage 11	FLM
59	IGH14 **	dedicated	high side power stage 14	FLM
60	IGL16 **	dedicated	low side power stage 16	FLM
61	VH7 **	power	supply voltage high side power stage	FLM
62	PGND8 **	ground	power stage ground	FLM
63	IGH13 **	dedicated	high side power stage 13	FLM
64	IGL15 **	dedicated	low side power stage 15	FLM

*¹ pin is not connected in CG902**² pin is not connected in CG903/CG902

pin	name	direction	description	module
97	IGL14 **	dedicated	low side power stage 14	FLM
98	IGH16 **	dedicated	high side power stage 16	FLM
99	PGND7 **	ground	power stage ground	FLM
100	VH8 **	power	supply voltage high side power stage	FLM
101	IGL13 **	dedicated	low side power stage 13	FLM
102	IGH15 **	dedicated	high side power stage 15	FLM
103	IGL10 *	dedicated	low side power stage 10	FLM
104	IGH12 *	dedicated	high side power stage 12	FLM
105	PGND5 *	ground	power stage ground	FLM
106	VH6 *	power	supply voltage high side power stage	FLM
107	IGL9 *	dedicated	low side power stage 9	FLM
108	IGH11 *	dedicated	high side power stage 11	FLM
109	IGL6	dedicated	low side power stage 6	FLM
110	IGH8	dedicated	high side power stage 8	FLM
111	PGND3	ground	power stage ground	FLM
112	VH4	power	supply voltage high side power stage	FLM
113	IGL5	dedicated	low side power stage 5	FLM
114	IGH7	dedicated	high side power stage 7	FLM
115	IGL2	dedicated	low side power stage 2	FLM
116	IGH4	dedicated	high side power stage 4	FLM
117	PGND1	ground	power stage ground	FLM
118	VH2	power	supply voltage high side power stage	FLM
119	IGL1	dedicated	low side power stage 1	FLM
120	IGH3	dedicated	high side power stage 3	FLM
121	GND_A1	ground	ground	-
122	VST33	power	stabilized supply 3,3 V	POM
123	VST50	power	stabilized supply 5,0 V	POM
124	n.c.	open	not connected	-
125	L3H	power	coil 3 VCORE high side connection	POM
126	n.c.	open	not connected	-
127	VCORE1	power	core converter output	POM
128	VCORE2	power	core converter output	POM

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CG90x block diagram



Regional sales contacts

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