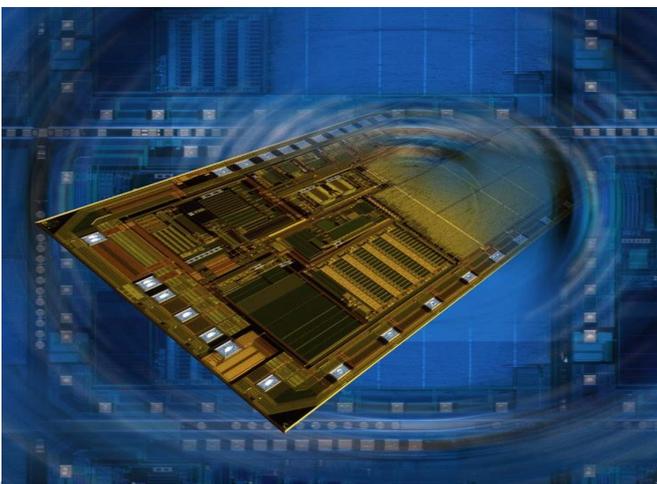# Automotive Electronics

Product Information
Ignition Driver with Diagnosis – CK200

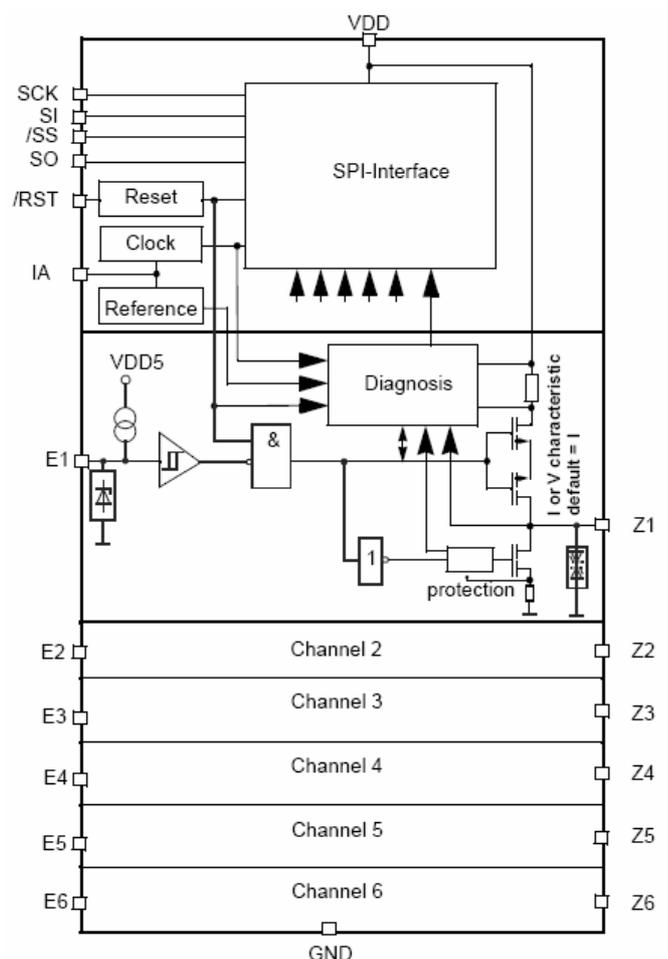**BOSCH**
Invented for life

Ignition Driver with Diagnosis

Customer benefits:
- Excellent system know-how
- Smart concepts for system safety
- Secured supply
- Long- term availability of manufacturing processes and products
- QS9000 and ISO/TS16949 certified

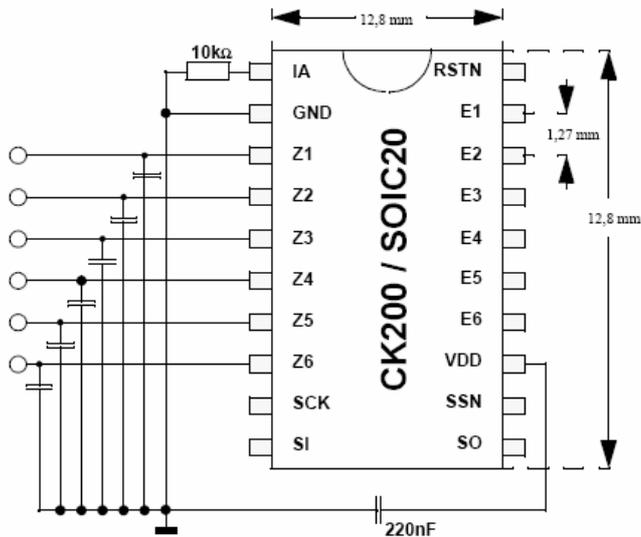### Features
- 6 channel with programmable
  - operating mode and
  - low side switch (on/off)
- Bi-Directional-Interface (BDI):
  - OUT: voltage source
  - IN: programmable current monitor I_{TH}
- Outputs short circuit protected to GND and V_{Batt}
- Diagnosis:
  - Wiring: short circuit to GND ,short circuit to V_{BATT} or Open load
  - Ignition coil: assessment of current relating to time (t_{COMP}) and level (I_{TH})
- Serial-Peripheral-Interface (SPI)
- Single supply VDD (5V)
- ESD-protection

Block- / functional diagram

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Application circuit

Pin	Description
VDD	Power supply input (5V)
GND	Ground
IA	R_{extern} = 10kΩ; reference for current threshold I_{TH} in V-mode, output current in I-mode and oscillator frequency.
E1... 6	Input
Z1... 6	Output
SCK	Input SPI-clock (from µC)
SI	Input serial data (SPI, from µC)
SO	Output serial data (SPI, to µC)
/SS	Slave select (SPI, from µC)
/RST	Input Reset

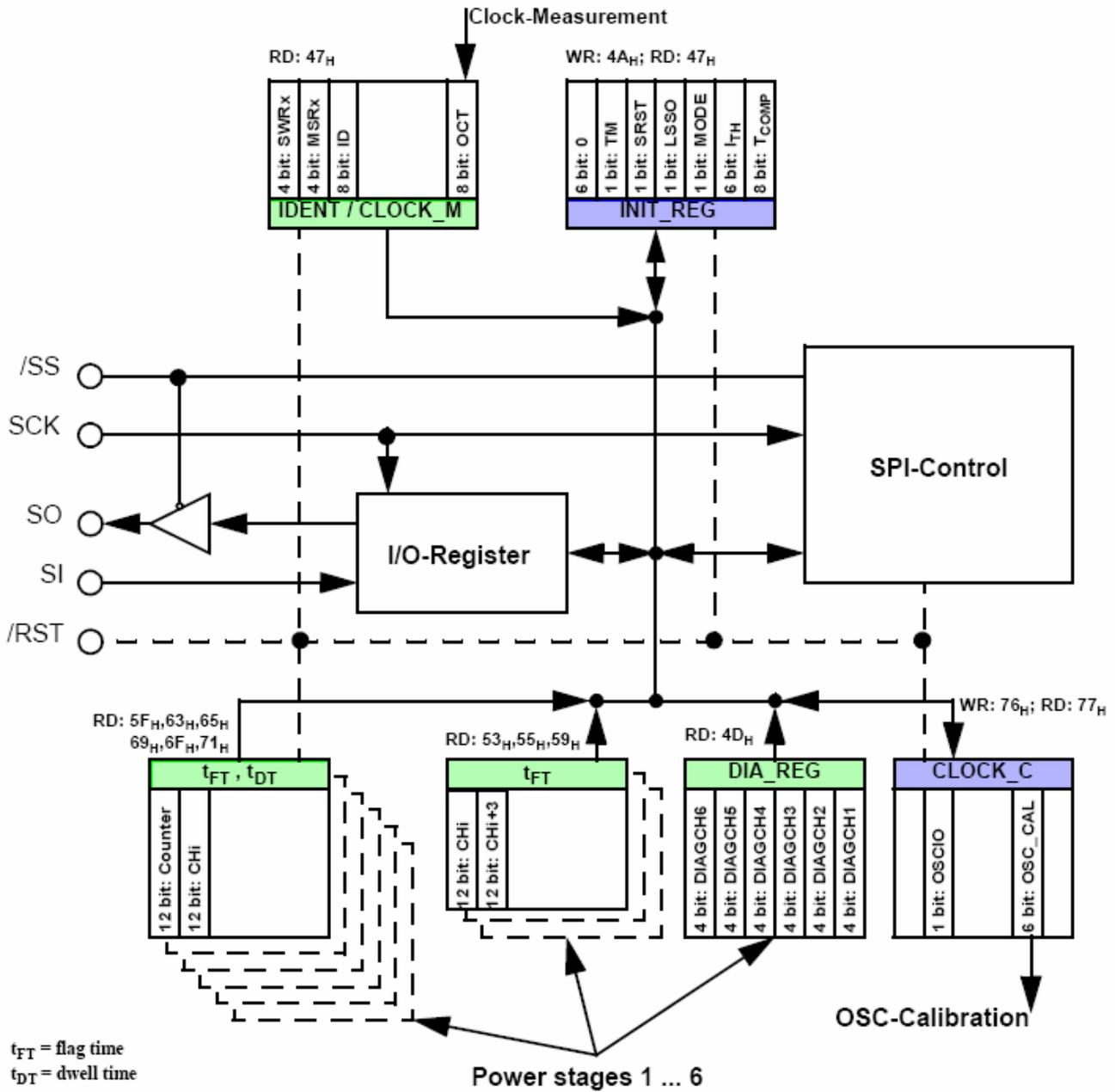The application circuit of the CK200 consists of the following parts :

▸ Capacitor between [VDD5] and [GND] to stabilize the supply voltage VCC
▸ Resistor between [IA] and [GND] reference for current threshold, output current and internal clock
▸ Capacitor between [Ziext] and [GND]

Maximum ratings

Parameter	Condition / Pins	Symbol	Min.	Max.	Unit
Electrical					
Supply voltage VDD		V_{VDD}	-0.3	5.5	V
Maximum voltage	Pins Ei, i = 1 to 6, IA, /RST, /SS, SCK, SI, SO	V_X	-0.3	V_{VDD} +0.3	V
	Zi, i = 1 to 6	V_X	-2	16	V
ESD (Human Body)	R=1.5kΩ, C=100pF Pins Zi, i = 1 to 6	V	-4	4	kV
	R=1.5kΩ, C=100pF all other pins	V	-2	2	kV
Thermal					
Temperature	junction	T_J	-40	150	°C
	storage	T_{ST}	-55	150	°C
	ambient for SOIC	T_A	-40	125	°C
Thermal resistance		R_{thJC}	60	80	K/W
Operating range					
For operational function		V_{VDD}	4.5	5.5	V
For parameters		V_{VDD}	4.85	5.15	V
Supply current	all low side switch active	I_{VDD}		tbd	mA
Undervoltage switch off	/RST=high, low side switch= active	V_{VDD}	3.0	4.5	V
	/RST=high, low side switch= active or tristate	V_{VDD}		3.0	V
Logic inputs E1 ... E6; SI; /SS; SCK; /RST					
Input low voltage		V_{IL}	-0.3	0.8	V
Input high voltage		V_{IH}	2	V_{VDD} + 0.3	V
Input pull-up currents source	-0,3 ≤ V_{in} ≤ V_{VDD}- 0.9V	I_{in}	-10	-50	uA
SPI frequency (it is recommended to use 2 MHz)					
Frequency SCK		f_{SCK}	0.5	4	MHz

Electrical characteristics

| Parameter	Conditions / Comments	Symbol	Min.	Max.	Unit
Logic outputs SO					
Output low voltage	I_{SO}= 2mA	U_{SOL}		0.4	V
Output high voltage	I_{SO}= -2mA	U_{SOH}	V_{VDD} - 0.75		V
leakage current	In tristate; $0V \leq V_{SO} \leq V_{VDD}$	I_{SO}	-10	10	uA
Oscillator					
Internal frequency	R_{IA}=10kΩ ± 1%	f_{clk}	3.2	4.8	MHz
Internal operating clock period	R_{IA}=10kΩ ± 1% ; T_{clk} = 32 / f_{clk}	T_{clk}	6.66	10.0	µs
High side; E_i = low (default = I - Mode; PR14 = 1)					
Output current	R_{IA}=10kΩ ± 1% I_{zi} = I_{th} defined by PR13 -PR8 BIT in INIT_Reg min: 010000; max: 101111 not allowed: 11xxxx	$-I_{zi}$	8	25	mA
Output voltage	V_{VDD}= 4,85V; I_{zi}= -25mA	V_{zi}	4.2		V
Short circuit threshold	SCG	V_{zi}	0.3	1.0	V
Short circuit switch off delay time	entry in error register	t_{off}/T_{CLK}	11	13	
Short circuit to supply detection voltage	SCB	V_{zi}	V_{VDD} + 0.1	V_{VDD} + 2.0	V
Open load	$-25mA < I_{zi}< -8mA$; k_{OL}= I_{zi} / I_{ziOL}	k_{OL}	5	27	
High side; E_i = low (V - Mode; PR14 = 0);					
Output voltage	V_{DD}= 4.85V; I_{out}= -25mA	V_{zi}	4.2		V
Output current	R_{IA}= 10kΩ	$-I_{zi}$	17.6	100	mA
Short circuit to GND threshold current	$-25mA < I_{th}< -8mA$ and $I_{ziSCGmax}$= 100mA; k_{SCG}= I_{ziSCG}/ I_{th}	k_{SCG}	2.2	12.5	
Short circuit switch off delay time	entry in error register	t_{off}/T_{CLK}	11	13	
Short circuit to supply detection voltage	SCB	V_{zi}	V_{VDD} + 0.1	V_{VDD} + 2.0	V
Open load	$-25mA < I_{Zi}< -8mA$; k_{OL}= I_{zi} / I_{ziOL}	k_{OL}	5	27	
Low side; E_i = high					
Output voltage	I_{zi}= 10mA , $V_{VDD} \geq 4.85V$	V_Zi		0.65	V
Output pull down current	/RST = high	I_{zi}	30	70	mA
Inverse current	$-2.0V \leq V_{zi} \leq 0V$	$-I_{zi}$	0	40	uA
Short cicuit to supply threshold voltage		V_{zi}	1.25	2.8	V
Short circuit to supply switch off delay time	entry in error register	t_{off}/T_{CLK}	11	13	
Output delay time	C_{zi}=10nF			10	us
Output rise / fall time	C_{zi}=10nF			10	us
SPI					
Cycle time	referred to master	t_{cyc}	250		ns
Enable lead time	referred to master		50		ns
Enable lag time	referred to master		125		ns
Data valid	referred to CK200; C_{Load}= 100pF High --> Low: SCK = 0.7V_{VDD} --> SO = 0.1V_{VDD} Low --> High: SCK = 0.7V_{VDD} --> SO = 0.9V_{VDD}			100	ns
Data setup time	referred to master		50		ns
Data hold time	referred to master		20		ns
Disable time	referred to CK200			50	ns
Transfer delay referred to master	command after write		800		ns
	Clock cycles between 2 RD_DIAG		4		
Select time	referred to master		50		ns
Access time	referred to master 2 + 32*1 +3+8		8,225		µs

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| Register (R) / Counter (C)	Description
IDENT / CLOCK_M	SWR: Software release; MSR: Mask Set Release; ID: Identifier; OCT: Number of rising and falling edges of internal clock (4 MHZ) during the first 15 clock periods of SCK (usefull for calibration; with SCK = 2MHz the result is 60)
INIT_REG	TM: Testmode (must be 0); SRST: Software Reset of Register; LSSO: Low side switch on; MODE: I or V; ITH: Current threshold or output current; TCOMP: Time value for comparison (bit value x 8µs)
tFT, (R) TDT (C)	tFT = flag time and tDT = dwell time or flag time of channel i and i+3 (bit value x 8µs)
DIAG_REG	DIAGCHx: 2 bits wiring and 2 bits BDI diagnosis for each Channel
CLOCK_C	OSCIO: 10kΩ present or not; OSC_CAL: calibration of internal oscillator

Timing

Write access

v: command valid/not valid   dc: don't care ("-")   x: 0 or 1   Z: tristate
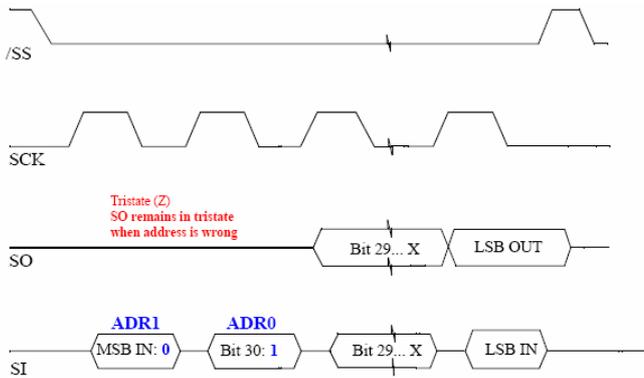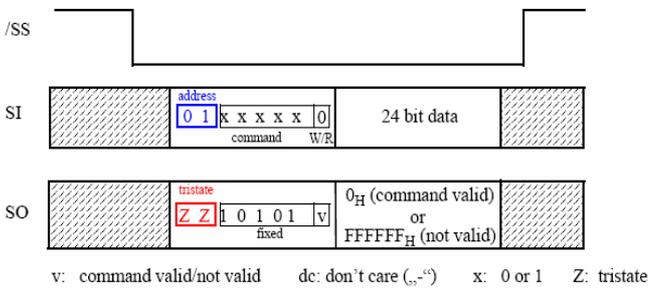
Read access
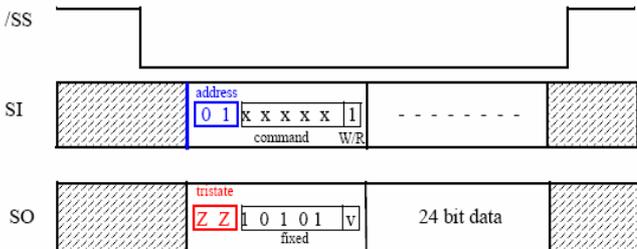
Diagnosis

Wiring diagnosis

DB1	DB0	Description [a.]
1	1	Channel ok; Reset value after RD_DIAG
1	0	Short circuit to battery (SCB)
0	0	Open load (OL)
0	0	Short circuit to ground (SCG)

a.) Last failure is stored until reset (/RST or SRST) or end of RD_DIAG

Ignition coil diagnosis (schematic)
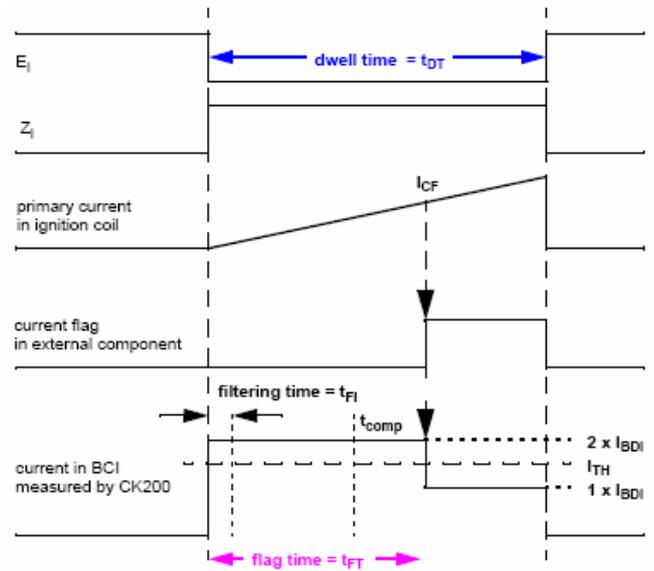
The threshold ITH for current assessment of BDI and time value for TCOMP can be modified via SPI.

DB1	DB0	Description
1	1	$t_{FT} \geq t_{COMP} > t_{FI}$
1	0	$0 \leq t_{FT} < t_{COMP}$
0	0	$t_{FT} \geq t_{DT}$
0	0	Any rising edge during $t_{FI} \leq t \leq t_{DT}$

Contact

Robert Bosch GmbH
Sales Semiconductors
Postbox 13 42
72703 Reutlingen
Germany
Tel.: +49 7121 35-2979
Fax: +49 7121 35-2170

Robert Bosch Corporation
Component Sales
38000 Hills Tech Drive
Farmington Hills, MI 48331
USA
Tel.: +1 248 876-7441
Fax: +1 248 848-2818

Robert Bosch K.K.
Component Sales
9-1, Ushikubo 3-chome
Tsuzuki-ku, Yokohama 224
Japan
Tel.: +81 45 9 12-83 01
Fax: +81 45 9 12-95 73

E-Mail: bosch.semiconductors@de.bosch.com   Internet: www.bosch-semiconductors.de