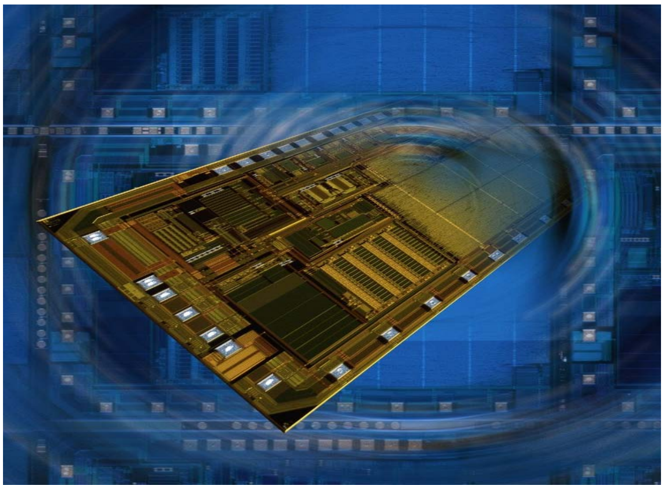
Automotive Electronics

Product Information
Lambda Probe Interface IC - CJ125

BOSCH
Invented for life



Integrated circuit for continuous lambda regulation with Ri measurement

The integrated circuit CJ125 is a control and amplifier circuit for a wide range λ-Sensor LSU4.x for the continuous regulation of λ in combination with the sensor in the range of λ = 0.65... • (air).

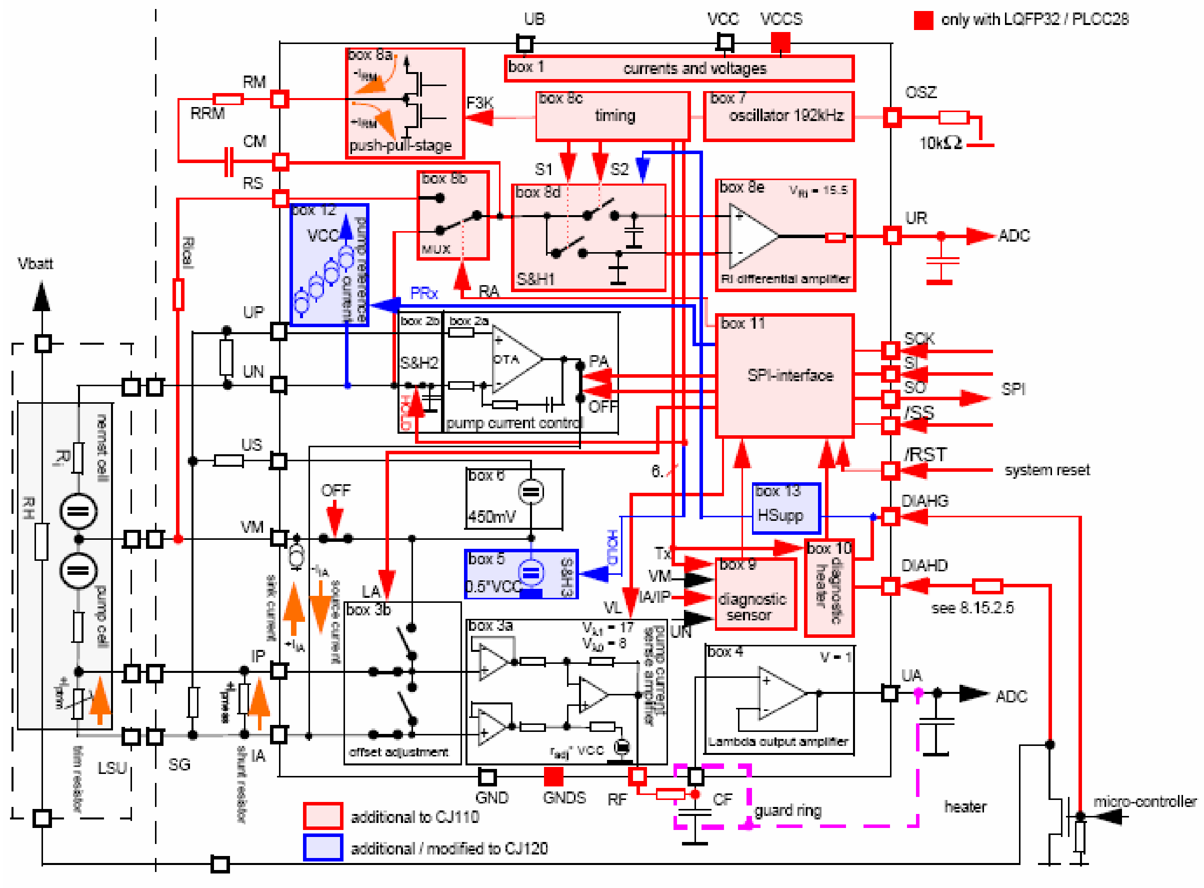
Customer benefits:

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

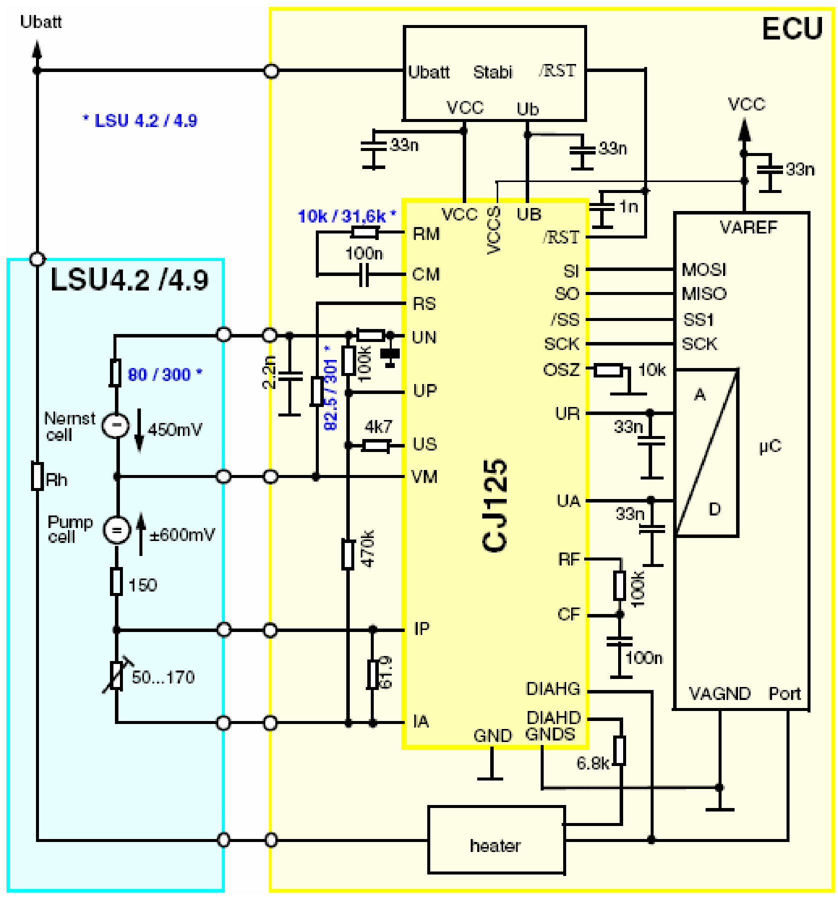
Features

- Currents and Voltages (box 1)
- Pump current control (boxes 2a to 2b)
- Pump current sense amplifier (boxes 3a to 3b)
- Lambda output amplifier (box 4)
- Virtual ground voltage source for sensor and pump current control (box 5)
- Nernst cell reference voltage source (box 6)
- Oscillator (box 7)
- Circuit for Ri or Rical measurement (boxes 8a to 8d)
- Diagnostic of sensor lines (box 9)
- Diagnostic of external heater (box 10)
- Serial-Peripheral-Interface (SPI; box 11)
- Programmable reference pumping currents (box 12)
- Suppression of Ri-measurement (box 13)

Block-/ functional diagram



Application circuit (only proposal!)

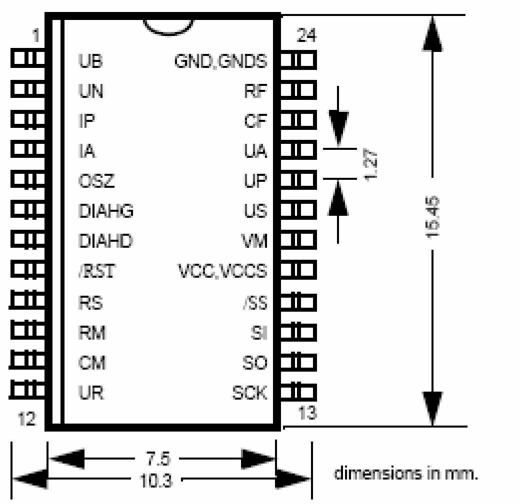


The application circuit of the CJ125 consists of the following parts:

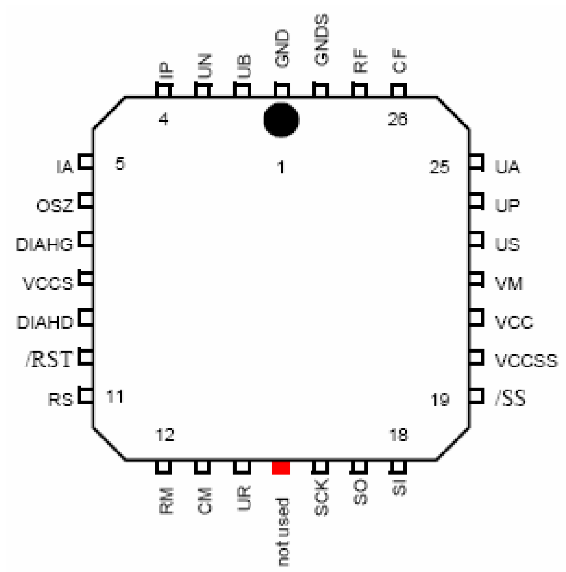
- Capacitor between [VCC] and [GND] to stabilize the supply voltage VCC
- Capacitor between [UB] and [GND] to stabilize the supply voltage VUB
- Capacitor between [CF] and [GND] to filter the lambda signal
- Capacitor between [UA] and [GND] to stabilize lambda signal output
- Capacitor between [UN] and [GND] to stabilize nernst signal
- Capacitor between [/RST] and [GND] to stabilize reset signal
- Shunt between [IA] and [IP] for pump current sensing
- Resistor between [IA] and [UP] to compensate parasitic effects of the lambda sensor
- Resistor between [US] and [UP] to feed the nernst cell reference voltage into the pump current control circuit
- Resistor between [UP] and [UN] for leakage detection
- Resistor between [RF] and [CF] to filter the lambda signal
- Capacitor between [UR] and [GND] to stabilize the output signal for ADC
- Capacitor between [UN] and [GND] for filtering
- Resistor between [RM] and capacitor at [CM] for adjustment of Ri measurement current
- Capacitor between [CM] and resistance at [RM] for DC filtering
- Resistor between [RS] and [VM] for adjustment
- Resistor between [DIAHD] and Drain of the external heater
- Resistor and capacitor before [UN] for filtering

PIN configuration

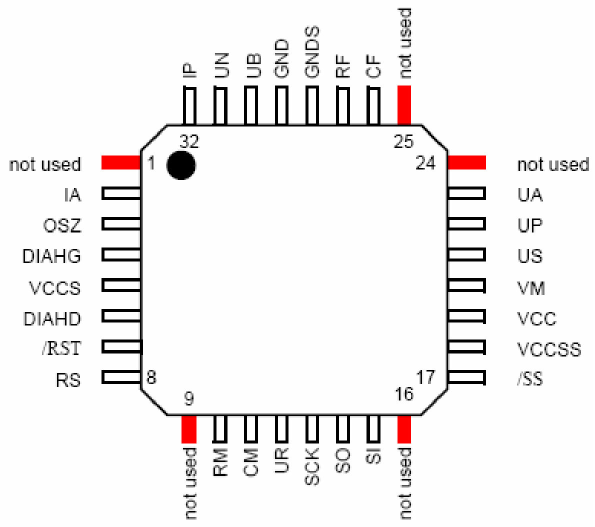
SOIC24



PLCC28



LQFP32



Pin description

Pin	Description
UB	Power supply input (14V)
VCC, VCCS[a)]	Power supply input (5V)
GND, GNDS[b)]	Ground
VM	Virtual ground of pump current control and of the LSU (0.5VCC)
US	Nernst cell reference voltage (450mV)
IP	Inverting input of pump current amplifier (shunt voltage)
IA	Non inverting input of pump current amplifier and output of the pump current control
RF	Output of pump current amplifier (-> external filter)
CF	Input of lambda output amplifier (after external filter)
UA	Output of lambda output amplifier
UP	Non inverting input of pump current control
UN	Inverting input of pump current control respective in-/output for Ri-measurement (LSU)

Pin	Description
RM	Output Ri-measurement current (DC)
CM	Input Ri-measurement current (AC, DC free)
RS	In-/output Ri-calibration measurement
UR	Output Ri-signal (analogous)
DIAHG	Diagnosis input (gate of external transistor)
DIAHD	Diagnosis input (drain of external transistor)
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
OSZ	R_{extern} = 10kΩ

a.) For hybrid version it is recommended to connect VVCS with the reference VCC for the ADC

b.) For hybrid version it is recommended to connect GNDS with the reference ground for the ADC

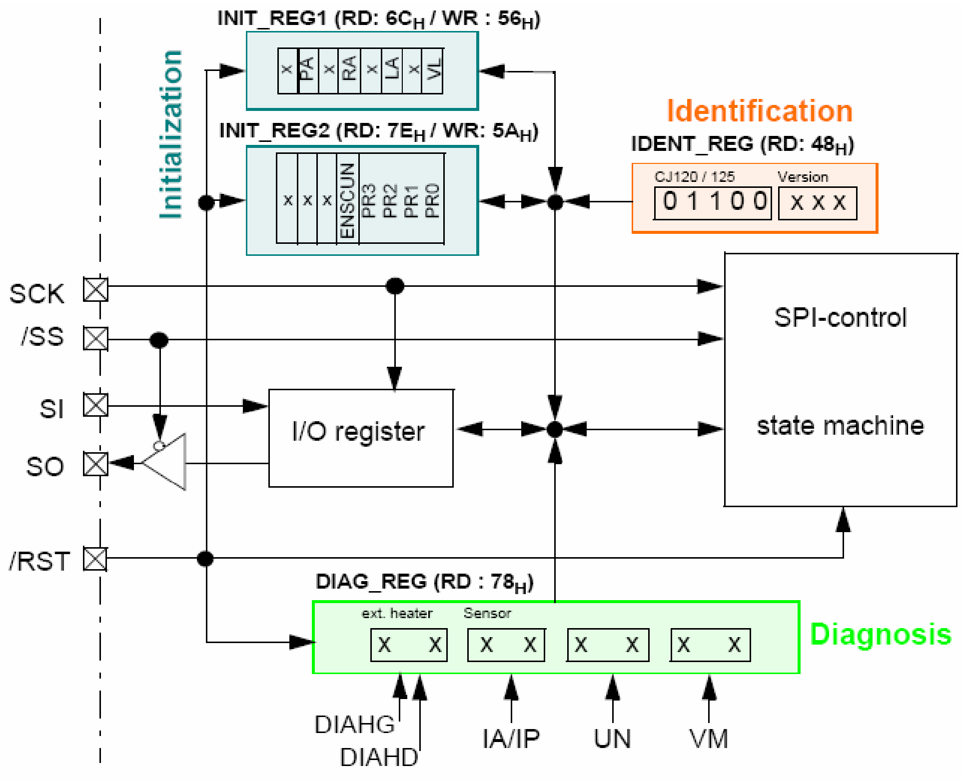
Maximum Ratings

Parameter	Condition	Symbol	Min.	Max.	Unit
Supply voltage UB		V_{UB}	-0.3	35	V
Supply voltage VCC		V_{VCC}	-0.3	5.5	V
Temperature	junction storage ambient for SOIC/PLCC *for max 50h* ambient for LQFP *for max 50h*	T_J T_{ST} T_A	-40 -40 -40 -40	150 150 110 125 125 140	°C °C °C °C °C °C
Maximum allowed voltages valid for pins: RM, UP, US,RF, CF, UA, UR, DIAHG, DIAHD; SCK, SI, SO, /SS, /RST, OSZ Allowed current	 ext. resistor 6.8 kΩ	V_X I_{DIAHD}	-0.3 -1	V_{VCC} + 0.3 10	V mA
Maximum allowed voltages, no destruction when ISO-pulses 3a,b are applied. Valid for board pins: RS, UN, VM, IA, IP, CM		V_X	-0.3	28	V
Offset between GND and GNDS		ΔV_{GND}	-0.25	0.25	V
Offset between VCC and VCCS		ΔV_{VCC}	-0.25	0.25	V
ESD	Human Body Model R=1.5kΩ, C=100pF		-2	2	kV

Electrical Characteristics

Parameter	Condition	Symbol	Min.	Max.	Unit
Power Supply					
Power supply Operating range	$V_{GND} = V_{GNDS}$ $V_{VCC} = VV_{CCS}$	V_{UB} V_{VCC}	9 4.75	18 5.25	V V
Current consumption		I_{VCC}		76	mA
Current consumption		I_{VCCS}		4	mA
Pump current control					
Offset voltage		V_{off}	-10	10	mV
Input current	-40°C • T_j < 150°C	$I_{UP,\ UN}$	-1	1	µA
Input offset current	-40°C • T_j < 150°C	I_{off}	-1	1	µA
Output current source condition	$V_{UN} < V_{UP}$; PA = 1; 0.5V < VIA < VCC-0.5V	$-I_A$	10	30	mA
Output current sink condition	$V_{UN} > V_{UP}$; PA = 1; 0.6V < V_{IA} < V_{CC}-0.5V	I_A	10	30	mA
No output current	PA = 0	I_A	-10	10	µA
Pump current sense amplifier (LA = 0: measurement mode; LA = 1: adjustment mode)					
Input current	-40°C • T_j < 150°C	I_{IP}	-1	1	µA
Amplification	SPI-bit VL = 1	A_0	16.62	17.24	
Amplification	SPI-bit VL = 0	A_0	7,82	8.15	
Common mode rejection ratio	$CMRR^{-1} = \Delta V_{UA} / \Delta V_{IP}$ $V_{IP}=V_{IA}$=1...4V 0.5V < V_{UA} < V_{CC}-0.5V | I_{UA} | < 10µA	$CMRR^{-1}$		12	mV/V
Output voltage swing	| I_{UA} | < 10µA; LA = 0	V_{UA}	0.20	V_{VCC} -0.18	V
Output voltage adjustment	I_{RF} =0µA; LA = 1	V_{FR}/ V_{VCC}	0.285	0.315	
Output error offset adjust	$\Delta V_{UA}=V_{UA}$ (LA = 1) - V_{UA}(LA = 0) $V_{IP}=V_{IA}=V_{VM}$ | I_{UA} | < 10µA	•V_{UA}	-3	3	mV
Virtual ground voltage source					
Output current operating range		I_{VM}	$-I_{IA}$ -2	$-I_{IA}$ +2	mA
Output voltage ratio	$-I_{IA}$-1mA < I_{VM} < $-I_{IA}$ +1mA	V_{VM}/ V_{VCC}	0.48	0.52	
Nernst cell reference voltage source					
Output current operating range		IUS	-0.4	0.4	mA
Oscillator					
Frequency	external 10kΩ	f	2.49	3.51	kHz
Measurement current for Ri (RA = 0 measurement mode; RA =1 adjustment mode)					
Output resistor of push-pull-stage	-1mA • I_{RM} • 1mA	R	5	200	Ω
Ri amplifier					
Leakage current when switch is open		I_{LEAK}	-500	500	nA
Amplification		A_0	15	16.3	
Ron for a switch		Ron		200	Ω
Input voltage range at CM, UN and RS		V_{RI}	2	V_{VCC} -1.1	V
Output voltage range		V_{UR}	0.06 V_{VCC}	V_{VCC} – 0.2	V
Zero point for output trace		V_{UR}/ V_{VCC}	0.05	0.063	
Pump reference current					
Current range	programmable with SPI-bits PRx; x = 0 to 3	- I_{Un}	0	150	µA
Diagnosis of sensor lines					
Short circuit to ground		V_{VM} / V_{VCC}	0.35	0.45	
Short circuit to Vbat		V_{VM} / V_{VCC}	0.55	0.65	
Short circuit to ground		V_{UN} / V_{VCC}	0.30	0.40	
Short circuit to Vbat		V_{UN} / V_{VCC}	0.72	0.88	
Short circuit to ground		$V_{IA,IP}$	0.3	1.5	V
Short circuit to Vbat		V_{IA}	V_{VCC}	V_{VCC} + 2	V
Diagnosis of external heater					
Low level		V_{DIAHG}	-0.3	0.3 V_{VCC}	V
High level		V_{DIAHG}	0.7 V_{VCC}	V_{VCC} + 0.3	V
Input current (no pull up!)		- I_{DIAHG}	-1	1	µA
Short circuit to ground	DIAHG = low	I_{DIAHD}	-1000	-350	µA
Short circuit to Vbat	DIAHG = high	I_{DIAHD}	-100	10 000	µA
Open load	DIAHG = low	I_{DIAHD}	-100	100	µA
No failure	DIAHG = high	I_{DIAHD}	-1000	-350	µA
No failure	DIAHG = low	I_{DIAHD}	350	10 000	µA
Filter time	T = 1 / f	t_{DIAG} / T	30 / 32	32 / 32	
SPI					
Data rate				2	Mbaud
Bit-frame				16	bit
Number of read / write commands				6	
Number of register				4	

SPI - Block schematic, register, RD / WR-commands with hec- code



Failure bits[a]	Ext. heater	Sensor[b]
0 0	Short circuit to ground	Short circuit to ground
0 1	Open load	Low battery [c]
1 0	Short circuit to Vbat	Short circuit to Vbat
1 1[d]	No failure	No failure

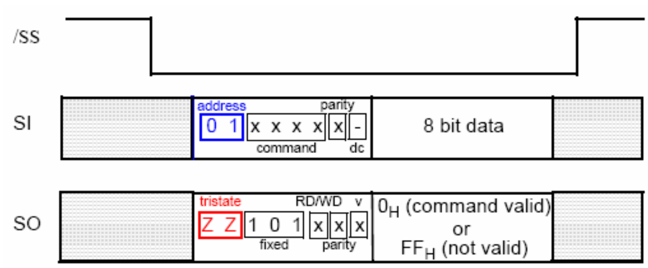
a) Only each failure of the sensor leads to a switch off of pump current and virtual ground

b) Failure identification at UN must be enabled with ENSCUN

c) Open load is not recognizable; bits used for low battery

d) After RD_DIAG or if no failure is present; Failure bits will be restored if failure is still present

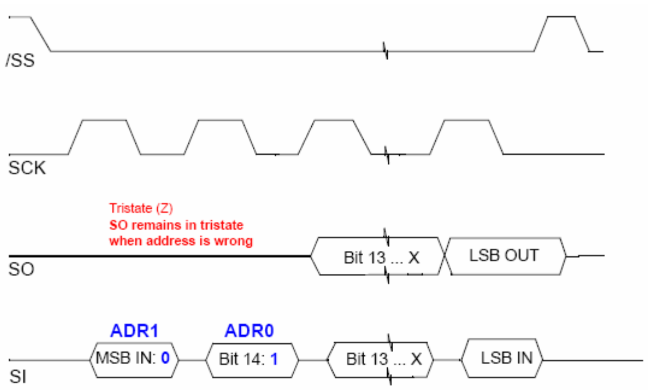
SPI – Write Access



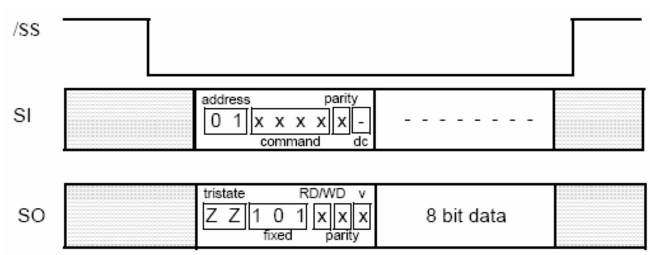
v: command valid/not valid; dc: don't care („-")

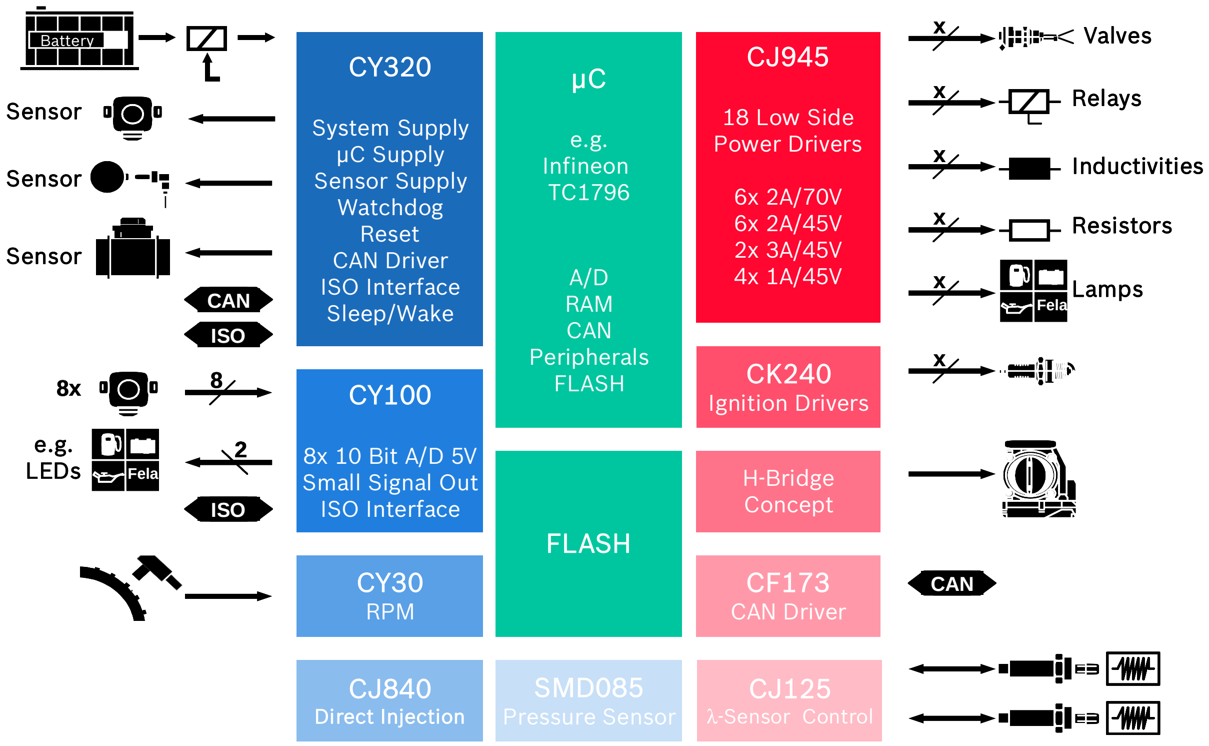
x: 0 or 1; Z: tristate

SPI - Timing



SPI – Read Access





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