

# Automotive Electronics Product Information

## Oxygen sensor control and evaluation 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  $\lambda$  sensor LSU4.x for the continuous regulation of  $\lambda$  in combination with the sensor in the range of  $\lambda = 0.65 \dots \infty$  (air).

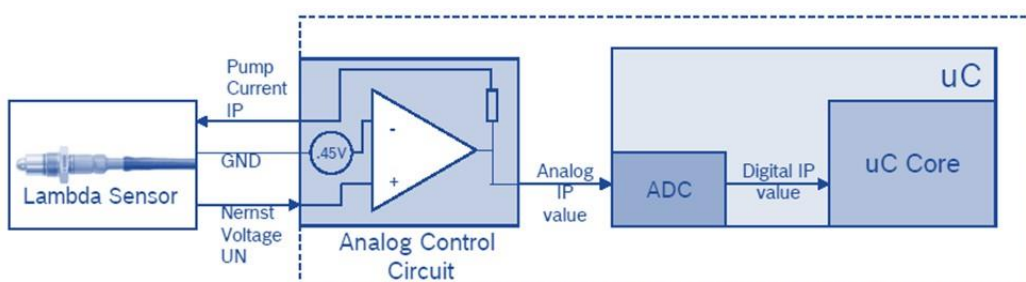
### Features

- ▶ Pump current control
- ▶ Pump current sense amplifier
- ▶ Lambda output amplifier
- ▶ Virtual ground voltage source for sensor and pump current control
- ▶ Nernst cell reference voltage source
- ▶ Circuit for Ri or Rical measurement
- ▶ Diagnostic of sensor lines
- ▶ Diagnostic of external heater
- ▶ Serial-Peripheral-Interface
- ▶ Programmable reference pumping currents
- ▶ Suppression of Ri-measurement

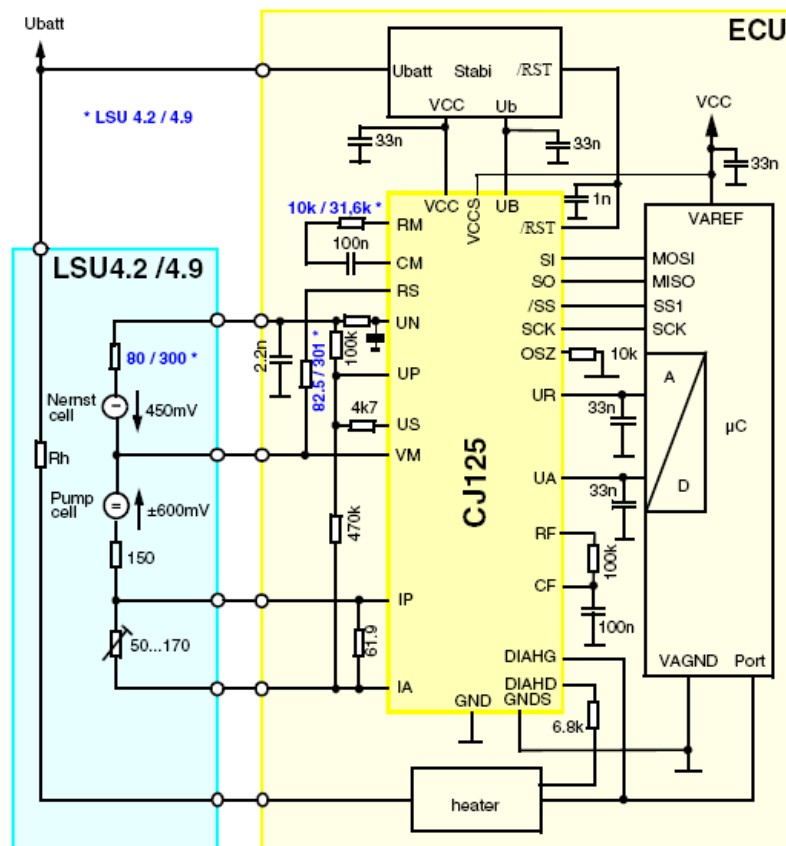
### Customer benefits:

- ▶ Simple application
- ▶ Long- term availability of manufacturing processes and products
- ▶ QS9000 and ISO/TS16949 certified

### Block Diagram



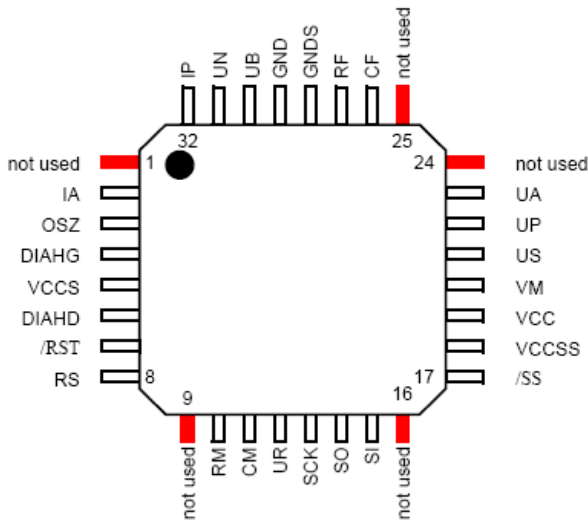
## Application circuit (proposal only!)



The application circuit 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



## Pin description

Pin	Description
UB	Power supply input (14V)
VCC, VCCS <sup>a)</sup>	Power supply input (5V)
GND, GNDS <sup>b)</sup>	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 $\mu$ C)
SI	Input serial data (SPI, from $\mu$ C)
SO	Output serial data (SPI, to $\mu$ C)
/SS	Slave select (SPI, from $\mu$ C)
/RST	Input Reset
OSZ	$R_{\text{extern}} = 10\text{k}\Omega$

- a.) For hybrid version it is recommended to connect VCCS 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 <sub>UB</sub>	-0.3	35	V
Supply voltage VCC		V <sub>VCC</sub>	-0.3	5.5	V
Temperature	junction storage for max 50h ambient for max 50h	T <sub>J</sub>	-40	150	°C
		T <sub>ST</sub>	-40	150	°C
			-40	125	°C
				125	°C
			140	°C	
Maximum allowed voltages valid for pins: RM, UP, US,RF, CF, UA, UR, DIAHG, DIAHD; SCK, SI, SO, /SS, /RST, OSZ		V <sub>X</sub>	-0.3	V <sub>VCC</sub> + 0.3	V
Allowed current	ext. resistor 6.8 kΩ	I <sub>DIAHD</sub>	-1	10	mA
Maximum allowed voltages, no destruction when ISO-pulses 3a,b are applied. Valid for board pins: RS, UN, VM, IA, IP, CM		V <sub>X</sub>	-0.3	28	V
Offset between GND and GNDS		ΔV <sub>GND</sub>	-0.25	0.25	V
Offset between VCC and VCCS		ΔV <sub>VCC</sub>	-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
<b>Power Supply</b>					
Power supply	V <sub>GND</sub> = V <sub>GNDS</sub>	V <sub>UB</sub>	9	18	V
Operating range	V <sub>VCC</sub> = V <sub>VCCS</sub>	V <sub>VCC</sub>	4.75	5.25	V
Current consumption		I <sub>VCC</sub>		76	mA
Current consumption		I <sub>VCCS</sub>		4	mA
<b>Pump current control</b>					
Offset voltage		V <sub>off</sub>	-10	10	mV
Input current	-40°C ≤ T <sub>j</sub> < 150°C	I <sub>UP, UN</sub>	-1	1	μA
Input offset current	-40°C ≤ T <sub>j</sub> < 150°C	I <sub>off</sub>	-1	1	μA
Output current source condition	V <sub>UN</sub> < V <sub>UP</sub> ; PA = 1; 0.5V < V <sub>IA</sub> < V <sub>CC</sub> -0.5V	-I <sub>A</sub>	10	30	mA
Output current sink condition	V <sub>UN</sub> > V <sub>UP</sub> ; PA = 1; 0.6V < V <sub>IA</sub> < V <sub>CC</sub> -0.5V	I <sub>A</sub>	10	30	mA
No output current	PA = 0	I <sub>A</sub>	-10	10	μA
<b>Pump current sense amplifier (LA = 0: measurement mode; LA = 1: adjustment mode)</b>					
Input current	-40°C ≤ T <sub>j</sub> < 150°C	I <sub>IP</sub>	-1	1	μA
Amplification	SPI-bit VL = 1	A <sub>0</sub>	16.62	17.24	
Amplification	SPI-bit VL = 0	A <sub>0</sub>	7,82	8.15	
Common mode rejection ratio	CMRR <sup>-1</sup> = ΔV <sub>UA</sub> / ΔV <sub>IP</sub> V <sub>IP</sub> = V <sub>IA</sub> = 1...4V 0.5V < V <sub>UA</sub> < V <sub>CC</sub> -0.5V   I <sub>UA</sub>   < 10μA	CMRR <sup>-1</sup>		12	mV/V
Output voltage swing	I <sub>UA</sub>   < 10μA; LA = 0	V <sub>UA</sub>	0.20	V <sub>VCC</sub> - 0.18	V
Output voltage adjustment	I <sub>RF</sub> = 0μA; LA = 1	V <sub>FR</sub> / V <sub>VCC</sub>	0.285	0.315	
Output error offset adjust	ΔV <sub>UA</sub> = V <sub>UA</sub> (LA = 1) - V <sub>UA</sub> (LA = 0) V <sub>IP</sub> = V <sub>IA</sub> = V <sub>VM</sub>   I <sub>UA</sub>   < 10μA	ΔV <sub>UA</sub>	-3	3	mV

## Electrical characteristics

Parameter	Condition	Symbol	Min.	Max.	Unit
<b>Diagnosis of sensor lines</b>					
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
<b>Diagnosis of external heater</b>					
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	$\mu A$
Short circuit to ground	DIAHG = low	$I_{DIAHD}$	-1000	-350	$\mu A$
Short circuit to Vbat	DIAHG = high	$I_{DIAHD}$	-100	10 000	$\mu A$
Open load	DIAHG = low	$I_{DIAHD}$	-100	100	$\mu A$
No failure	DIAHG = high	$I_{DIAHD}$	-1000	-350	$\mu A$
No failure	DIAHG = low	$I_{DIAHD}$	350	10 000	$\mu A$
Filter time	$T = 1 / f$	$t_{DIAG} / T$	30 / 32	32 / 32	
<b>SPI</b>					
Data rate				2	Mbaud
Bit-frame				16	bit
Number of read / write commands				6	
Number of register				4	

## Regional sales contacts

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