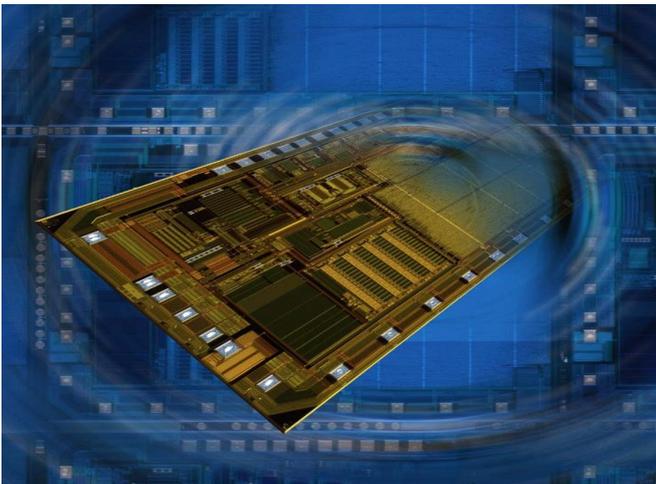


## Product Information Dual Digital Current Regulator – CG208



**BOSCH**

Invented for life



**Current Regulator ASIC for  
Automotive Transmission Control Units**

### Customer benefits:

- ▶ No end of assembly line adjustment necessary
- ▶ Easy application and straight adaptable to new solution
- ▶ Regulator with minimum of external components
- ▶ Hardware synergies by multi-channel application (synchronization)
- ▶ No need for  $\mu\text{C}$  real time computing power for current regulators
- ▶ Frequency controlled valves for best EMC performance
- ▶ High safety level due to sophisticated diagnosis features and  $\mu\text{C}$  autonomous fail safe action
- ▶ Power stage temperature under control
- ▶ High quality, high robustness design & package

The CG208 is a fully integrated digital two-channel current regulator. Each channel comprises a digital regulator, low-side power switch, a freewheeling diode and a shunt resistor. A complete current regulator can be established with a minimum number of external components.

The load current is sensed by the internal shunt and the voltage drop is digitized by an integrated A / D converter.

The power stage is switched with constant frequency and variable duty cycle. The load current is sensed entirely in both switch phases.

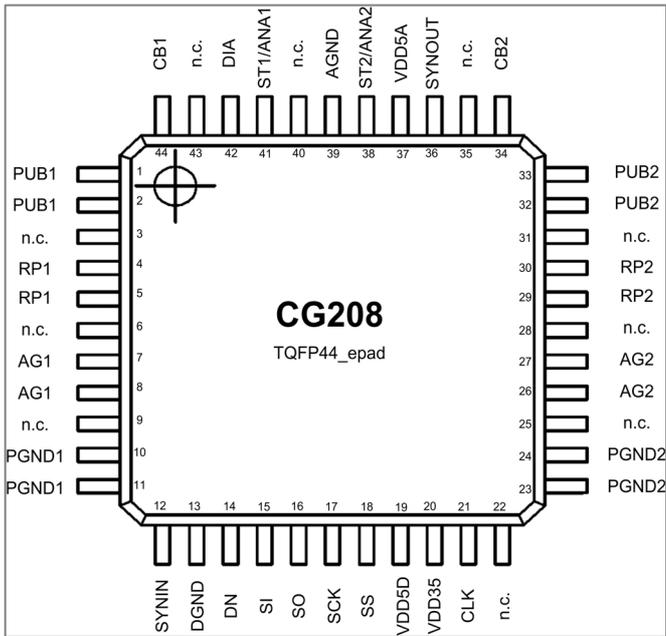
A digital current regulation circuitry compares the actual shunt current with the target current value and controls the duty cycle of the low-side power switch with a programmable cycle frequency. Also the settling- and regulation time constants are set via a SPI interface. This allows the software to adopt the regulator characteristics to changing ambient conditions.

A diagnosis circuitry in each channel reports error conditions via SPI register. Additionally a digital error output as direct output pin reports the occurrence of an error. Alternatively each channel can operate as a processor controlled power switch bypassing the internal current regulator.

### Features

- ▶ High precision regulation  $\pm 1\%$  at 1.2 A, 25°C
- ▶ High precision over of hole temperature range:  
TQFP\_epad:  $-40^\circ\text{C} \leq T_J \leq 150^\circ\text{C}$   
Bare die:  $-40^\circ\text{C} \leq T_J \leq 175^\circ\text{C}$
- ▶ High current resolution ( $\Delta = 0.6\text{mA}$ ) over the current regulation range from 0.6mA to 1228mA
- ▶ Wide battery voltage range from 6.3 V to 43 V
- ▶ Daisy chain frequency synchronization
- ▶ Software adjustable a) power stage cycle frequency  
b) integrator control time c) regulator step response and fast settling features
- ▶ Fully programmable sinusoidal dither function
- ▶ Current measurement can be accessed via SPI and via analog values
- ▶ Self protected power stage via over current limiter and additional over current/temperature shut down
- ▶ Extra PIN for report error status for interrupt action and various diagnostics via fast 4 MHz SPI
- ▶ 3 V / 5 V compatible digital I / O pins
- ▶ Optional use as processor controlled power switch
- ▶ Package: TQFP44\_epad & bare die

## PIN configuration



Picture: Pin Configuration package TQFP44\_epad V2.00

## Maximum ratings

Parameter	Min	Max	Unit
Supply voltage PUB1, PUB2	-0.3	42	V
Supply voltage VDD5A, VDD5D	-0.3	5.5	V
Supply voltage, VDD35	-0.3	5.5	V
Supply current, VDD5A, VDD35		9.0	mA
Operating junction temperature bare die	- 40	175	°C
TQFP	- 40	150	°C
ESD HBM 100pF / 1.5k power stage	- 4	+ 4	kV
all other pins	- 2	+ 2	kV

## Functional description

Pin	Name	Function
<b>Control / Power stage Channel 2</b>		
1,2	PUB1	Battery supply connector, cathode of the freewheel diode.
7,8	AG1	Output low side power stage 1, negative CBS1-connection
4,5	RP1	Load connector in Regulation Mode.
44	CB1	Positive connector for the bootstrap-capacitor channel 1.
10,11	PGND1	Ground connector of power stage1.
<b>Control / Power stage Channel 2</b>		
32,33	PUB2	Battery supply connector, cathode of the freewheel diode.
26,27	AG2	Output low side power stage 1, negative CBS2-connection
29,30	RP2	Load connector in Regulation Mode.
34	CBS2	Positive connector for the bootstrap-capacitor channel 2.
23,24	PGN2	Ground connector of power stage2.

Pin	Name	Function
<b>Control / Power stage Channel 2</b>		
1,2	PUB1	Battery supply connector, cathode of the freewheel diode.
7,8	AG1	Output low side power stage 1, negative CBS1-connection
4,5	RP1	Load connector in Regulation Mode.
44	CB1	Positive connector for the bootstrap-capacitor channel 1.
10,11	PGND1	Ground connector of power stage1.
<b>Control / Power stage Channel 2</b>		
32,33	PUB2	Battery supply connector, cathode of the freewheel diode.
26,27	AG2	Output low side power stage 1, negative CBS2-connection
29,30	RP2	Load connector in Regulation Mode.
34	CBS2	Positive connector for the bootstrap-capacitor channel 2.
23,24	PGN2	Ground connector of power stage2.
<b>Voltage supply</b>		
37	VDD5A	Analog supply 5V, external connection to VDD5D
39	AGND	Analog ground for analog supply (reference signal inputs)
19	VDD5D	Digital supply 5V, external connection to VDD5A
20	VDD35	I/O Supply 5V or 3,3V
13	DGND	Digital ground for the digital supply (reference SYNIN, SPI, DN)
37	VDD5A	Analog supply 5V, external connection to VDD5D
<b>Diagnosis / SPI Interface</b>		
12	SYNIN	Synchronization input of oscillator, positive edge-triggered, pullup current source
14	DN	Reset input, active low, pulldown current source
18	SS	Slave-select-signal for SPI-interface, pullup current source
17	SCK	Serial-clock-input (SPI-cycle input), pullup current source
15	SI	Slave-in-signal (data input of SPI-interface), pullup current source
16	SO	Slave-out-signal (data output of SPI-interface), tri-State
21	CLK	External 2MHz clk-intake, pullup current source
42	DIA	Status of both channel
36	SYNOUT	SYNOUT output
41	ST1/ANA1	Status output 1/ Analog output of actual load current 1
38	ST2/ANA2	Status output 2 / Analog output of actual load current 2

## Diagnostics

The CG208 has self protecting functions for each channel. Detection of over temperature or over current condition shuts down the concerning low side switch.

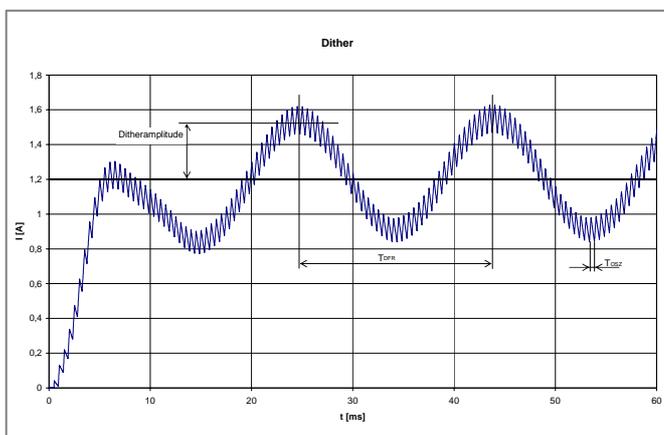
Every single error occurrence of each channel will be filtered and registered and can be examined by SPI communication, such as:

- ▶ Over temperature
- ▶ Over current
- ▶ Short to ground
- ▶ Open load
- ▶ Clock error

If at least one error bit is set, the open drain error flag ST is driven low.

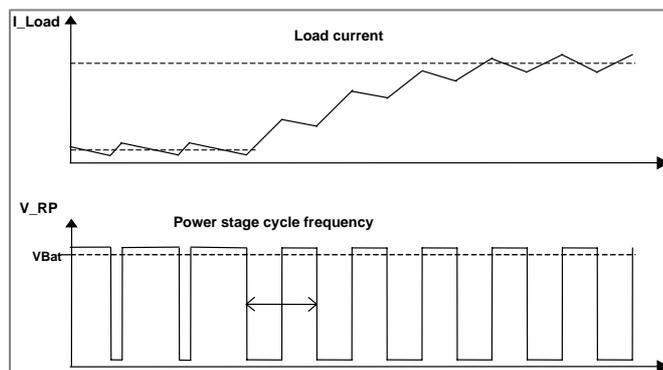
## Dither

Each current regulator channel has its own dither generator. The generator can superimpose a sine wave on the target current. The dither frequency and amplitude can be programmed through the dither frequency register DFRx register and dither amplitude register DAMx separately for each channel. The regulator takes care that the actual dither amplitude is always smaller than the target current without effecting the Dither amplitude register.



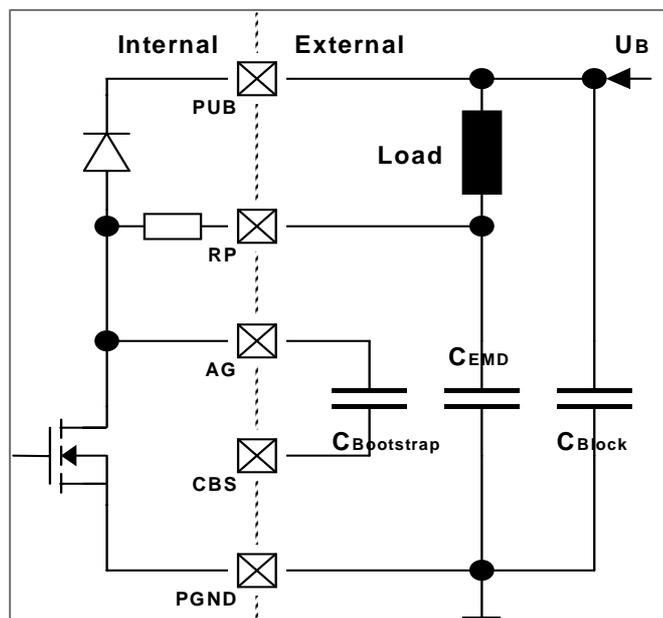
Picture: Dither amplitude and frequency

## Typical startup



Picture: Constant frequency and variable duty cycle

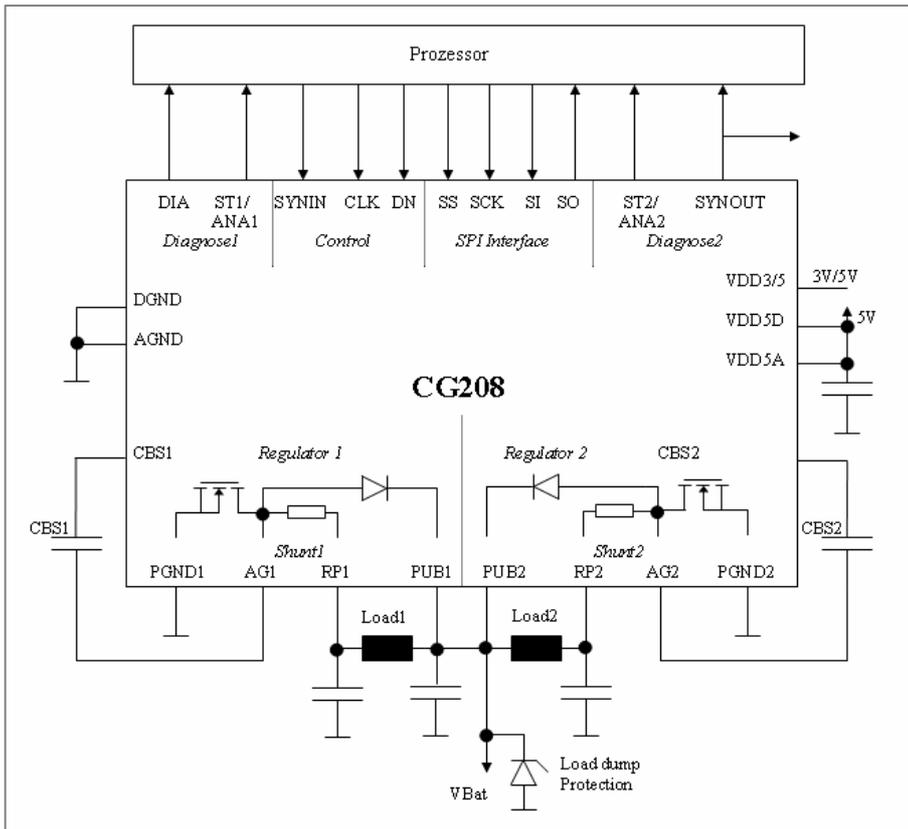
## Power stage



Picture: Power Stage V1.00

Parameter	Min	Max	Unit
Supply voltage, PUB1, PUB2	6.3	43	V
High accuracy	6.3	20	V
reduced accuracy	20	30	V
ISO Pulse	30	43	V
Regulation target range	0.6	1228	mA
Regulation target accuracy		1.2	mA
Regulation current accuracy			
20°C 1.2 A		± 1	%
-40°C ≤ T <sub>J</sub> ≤ +150°C			
Target regulation current		± 1.25	%
accuracy > 500 mA			
Target regulation current		± 8	mA
accuracy ≤ 500 mA			
Internal shunt resistance		0.5	Ohm
Internal FET resistance, R <sub>dson</sub>		0.3	Ohm
Cycle frequency, CLK = 2 MHz	30	3960	Hz
Dither frequency	0	780	Hz
Dither amplitude	0	290	mA
External CBS bootstrap capacitance	100	4700	nF

## Application diagram



Picture: Application Diagram V2.00

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