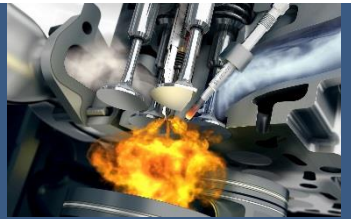
Alternator Regulator ICs

Automotive Electronics

BOSCH

Four business sectors

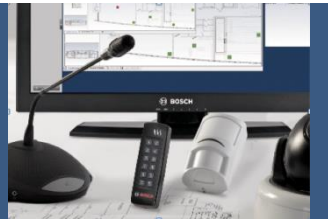
Mobility Solutions


Industrial Technology



Energy and Building Technology

Consumer Goods



We have the products behind the products

Automotive Market

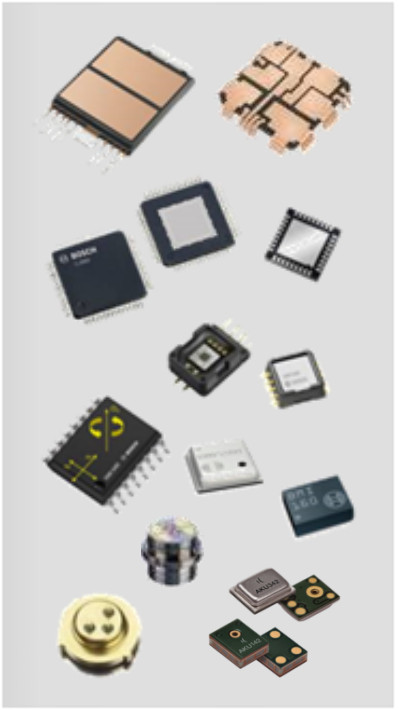
- Powertrain Systems
- Safety Systems
- Comfort Systems

Multimarket

- Consumer Electronics
- Connected Things
- Light eMobility
- Energy & Building Electronics

ECUs, mechatronics, systems & solutions

MEMS & semiconductors



Components portfolio

Semiconductors and Sensors

Powertrain Systems

Engine Management Systems
- System basis ICs
- Power supply ICs
- Injection valve drivers
- Low-side power switches
- A/D converters
- Sensor interfaces
- Ignition stage drivers
- Lambda probe interfaces
- H-bridges
- Barometric pressure sensors

Transmission Control Systems
- System basis ICs
- Current regulators
- Pressure sensors

Alternator electronics
- Voltage regulators

Vehicle Motion and Safety Systems

Airbag systems
- Airbag system ICs
- Safety controllers
- Firing loop drivers
- Sensor interfaces
- PSI5 receivers
- Acceleration sensors
- Angular rate sensors
- Combined inertial sensors
- Pressure sensors

Vehicle Dynamics Control VDC
- Sensors for VDC

In-vehicle communication
- CAN transceivers
- CAN controllers

Ultrasonic Parking System
- Evaluation IC
- Interface IC

Cockpit and Infotainment Systems

Driver information systems
- Combined inertial sensors
- Acceleration sensors
- Angular rate sensors

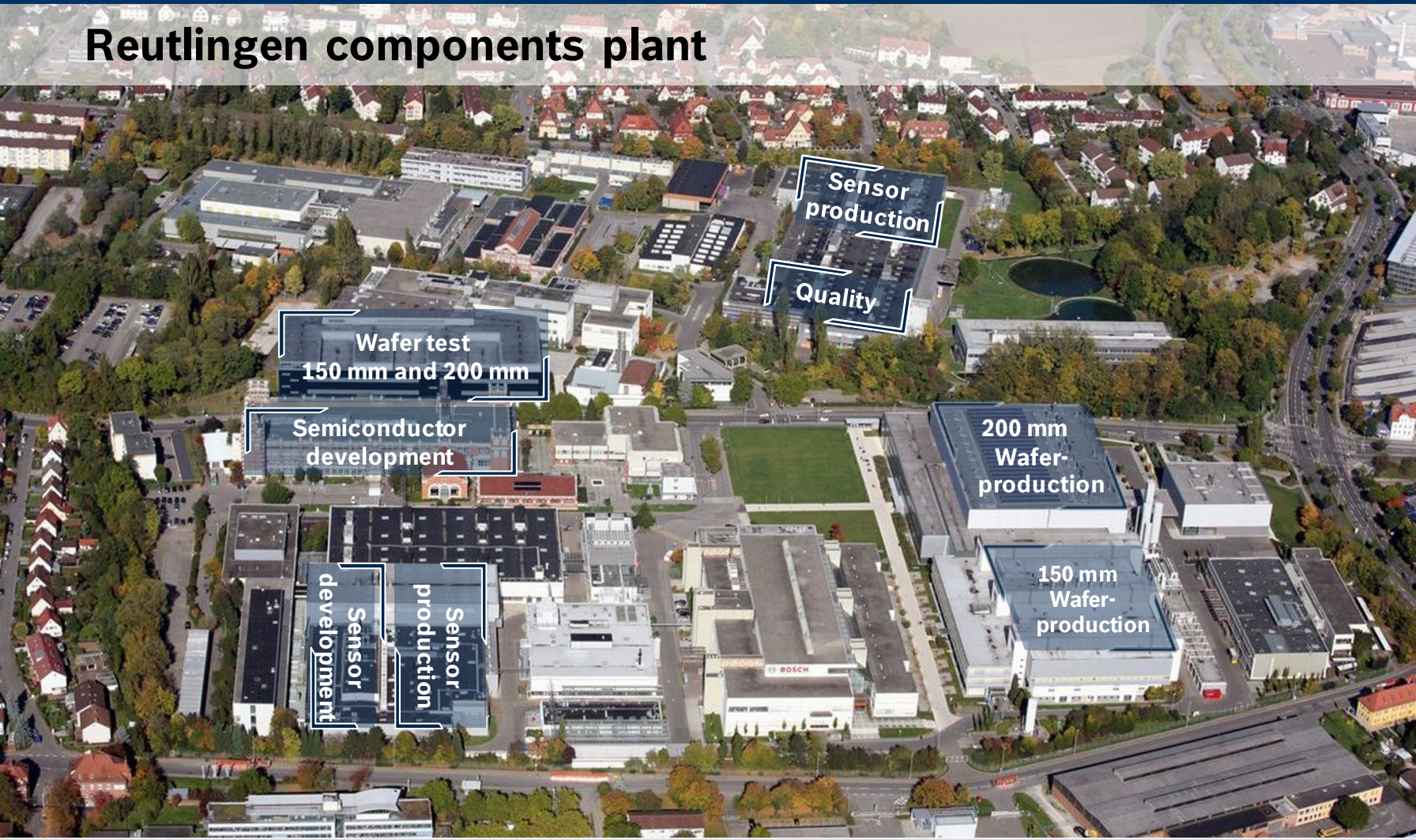
Active suspension
- Acceleration sensors

Intellectual property

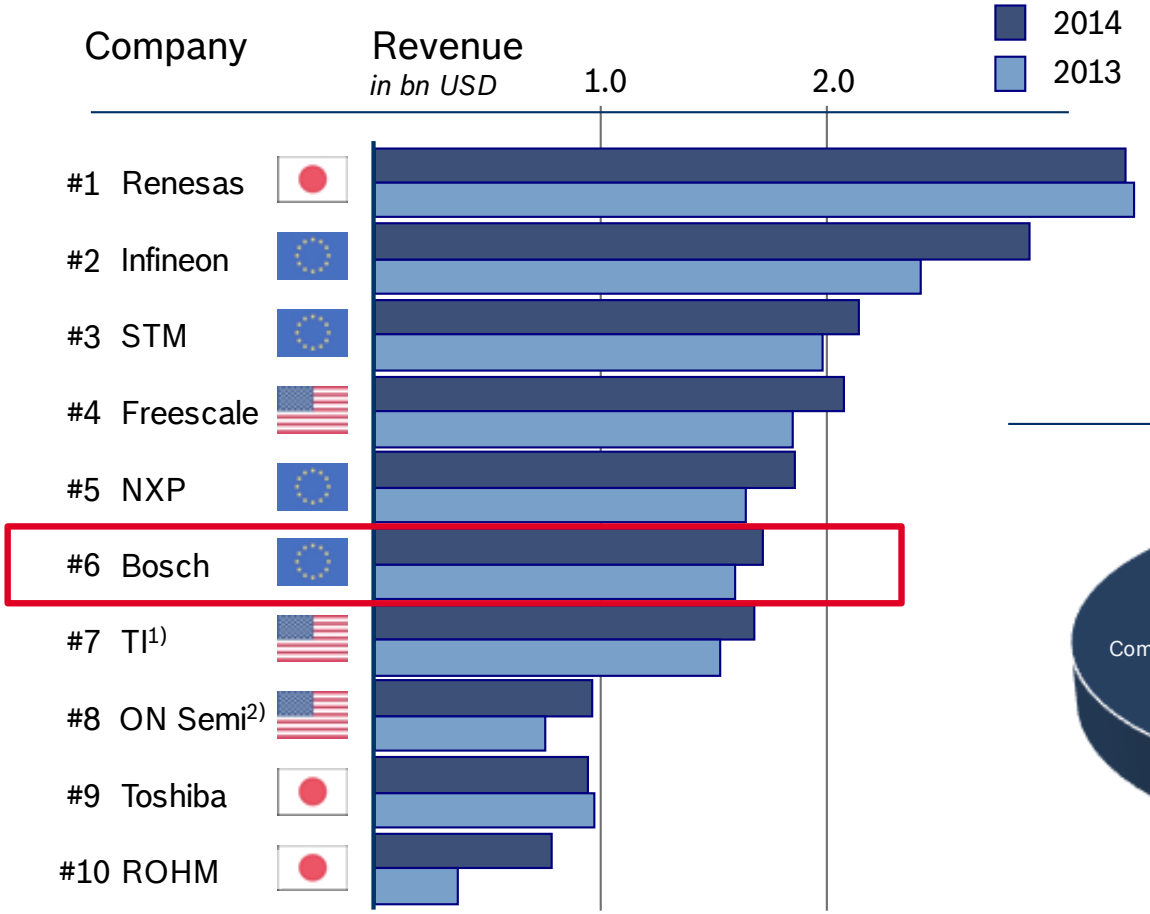
IP modules for in-vehicle communication
- CAN, FlexRay, LIN

IP modules for powertrain
- GTM IP module

Reutlingen components plant



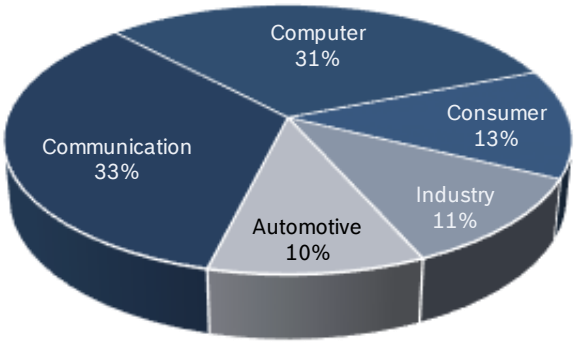
Semiconductors Market Position



[1)] incl. NSC, [2)] incl. Sanyo

Market segmentation

TNS $336bn

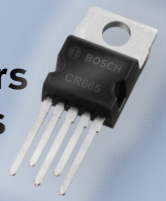


Source: Strategy Analytics, WSTS, Bosch

Business Overview

Bosch Automotive Electronics

Semiconductors MEMS-Sensors



Component Sales

Factories

ECUs and Modules Services

Bosch Supply

Worldwide Tier 2+1

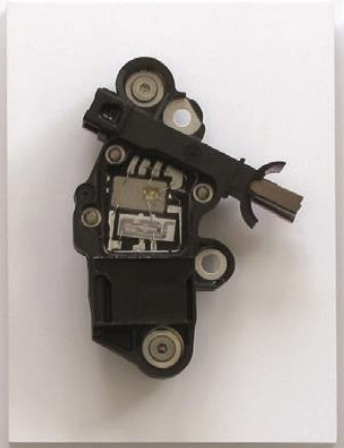
Bosch Tier1

Regulator bare die & packaged

Bosch Alternator Regulator ICs

Regulator IC
Bare-die

Key features
- Metallized backside for soldering and optimal heat transfer
- Large pads for bonds up to 250 µm
- Available as tape on reel for cost-efficient and high throughput manufacturing



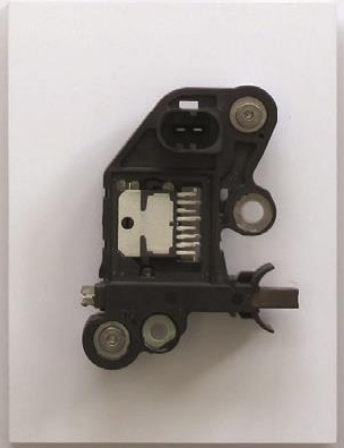
Alternator regulator
Bare-die type

Processing
- In clean room environment
- Bare-die pick and place equipment
- Wirebond equipment
- One-sided component mounting

Components
- Simple lead frame due to flexible wirebond connections
- Bare-die attached to heat spreader
- Capacitors on PCB or ceramic board

Regulator IC
Packaged

Key features
- Standard package (Multiwatt 8, TO220-5)
- Straight leads
- Ready for cost-efficient welding



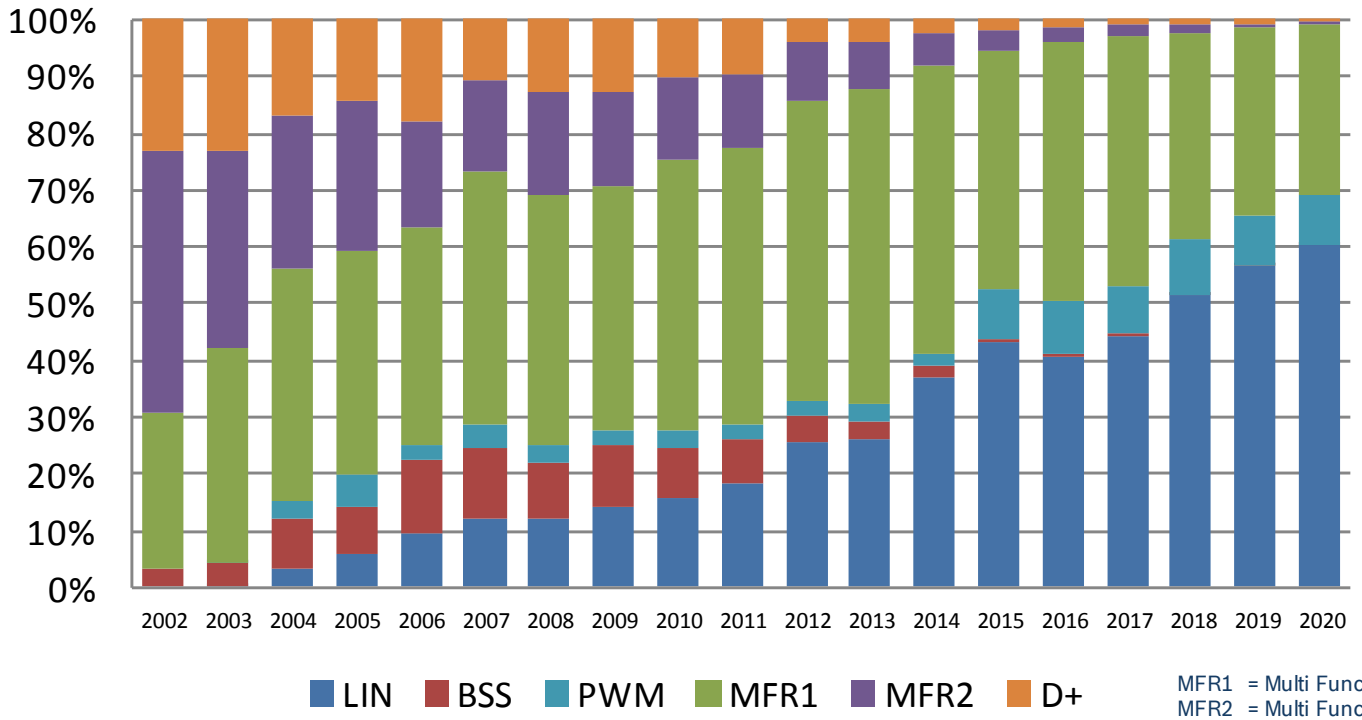
Alternator regulator
Packaged type

Processing
- No clean room environment
- Component pick and place equipment
- Welding equipment
- Two-sided component mounting

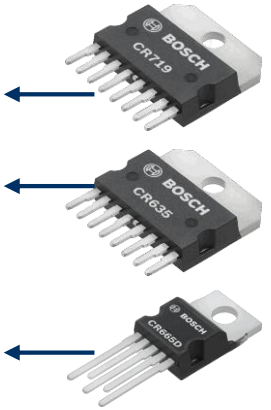
Components
- Complex lead frame due to fixed IC package
- Regulator IC welded on lead frame, heat slug on heat spreader side
- Capacitors welded on lead frame on inner side
- No need for PCB or ceramic board

Supply & forecast, all AE customers

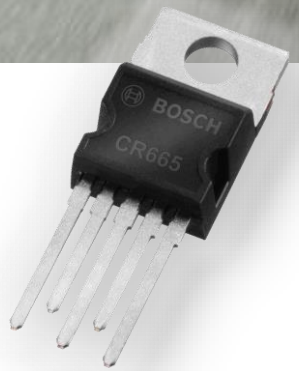
Regulator Types (%pcs)



typical devices for the class



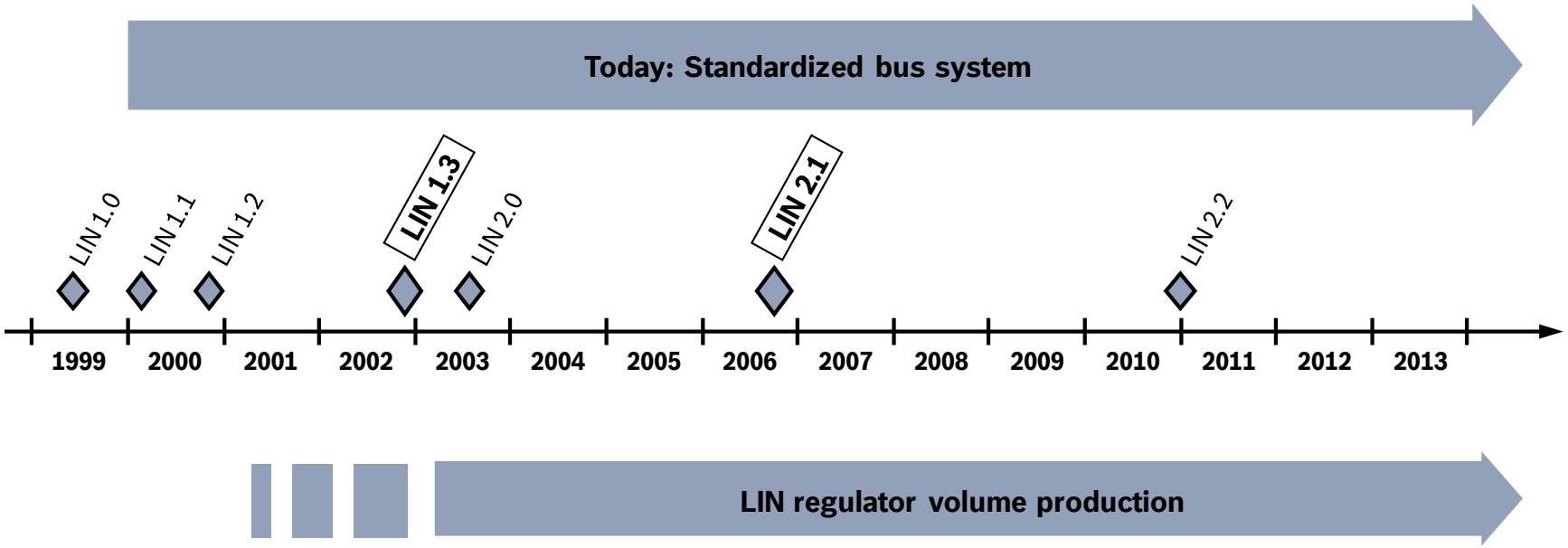
MFR1 = Multi Function Regulator, one IC solution
MFR2 = Multi Function Regulator, two IC solution
D+ = Monofunction regulator
BSS = Bosch specific communication regulators



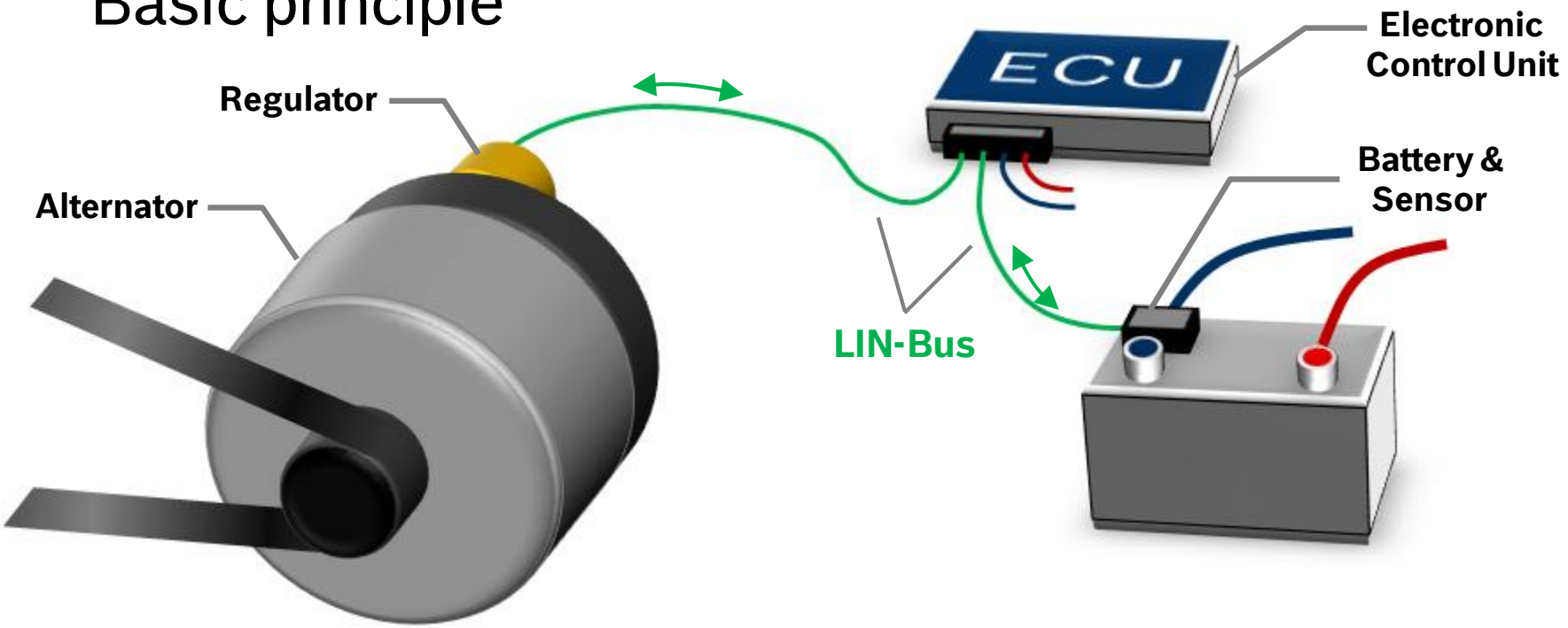
LIN Regulator – General Introduction

LIN development

- LIN = Local Interconnect Network
- Low cost single-wire communication system for smart sensors and actuators where the bandwidth and versatility of CAN is not required



Basic principle

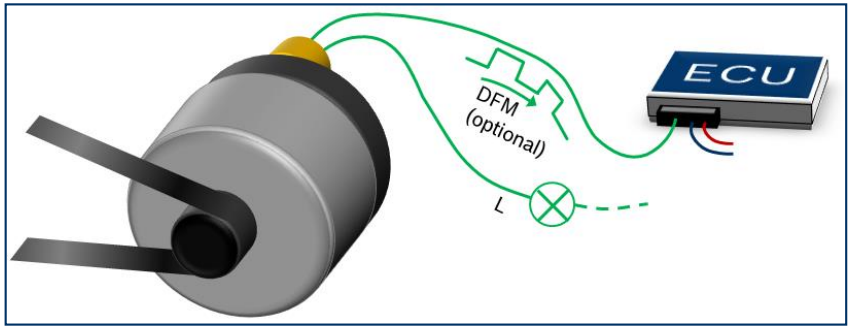


LIN = Local Interconnect Network

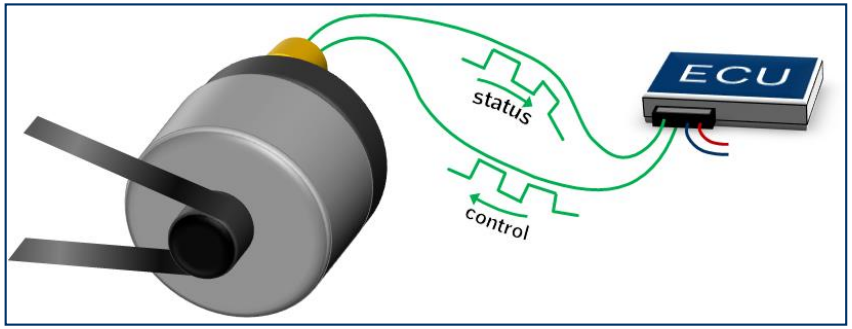
- Digital Interface to share information & communicate with regulator

Comparison

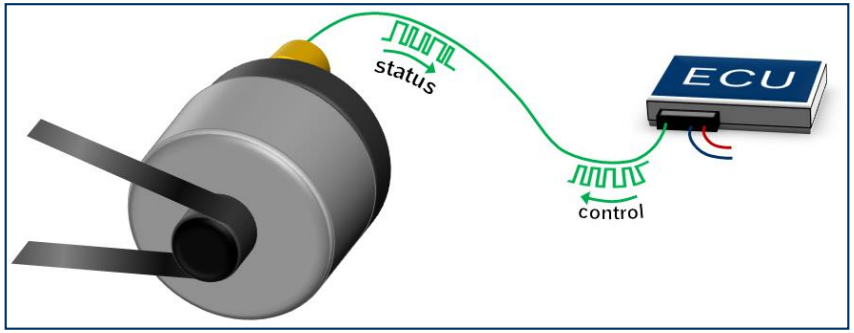
MFR



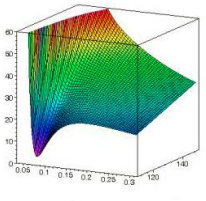
PWM



LIN



Comparison

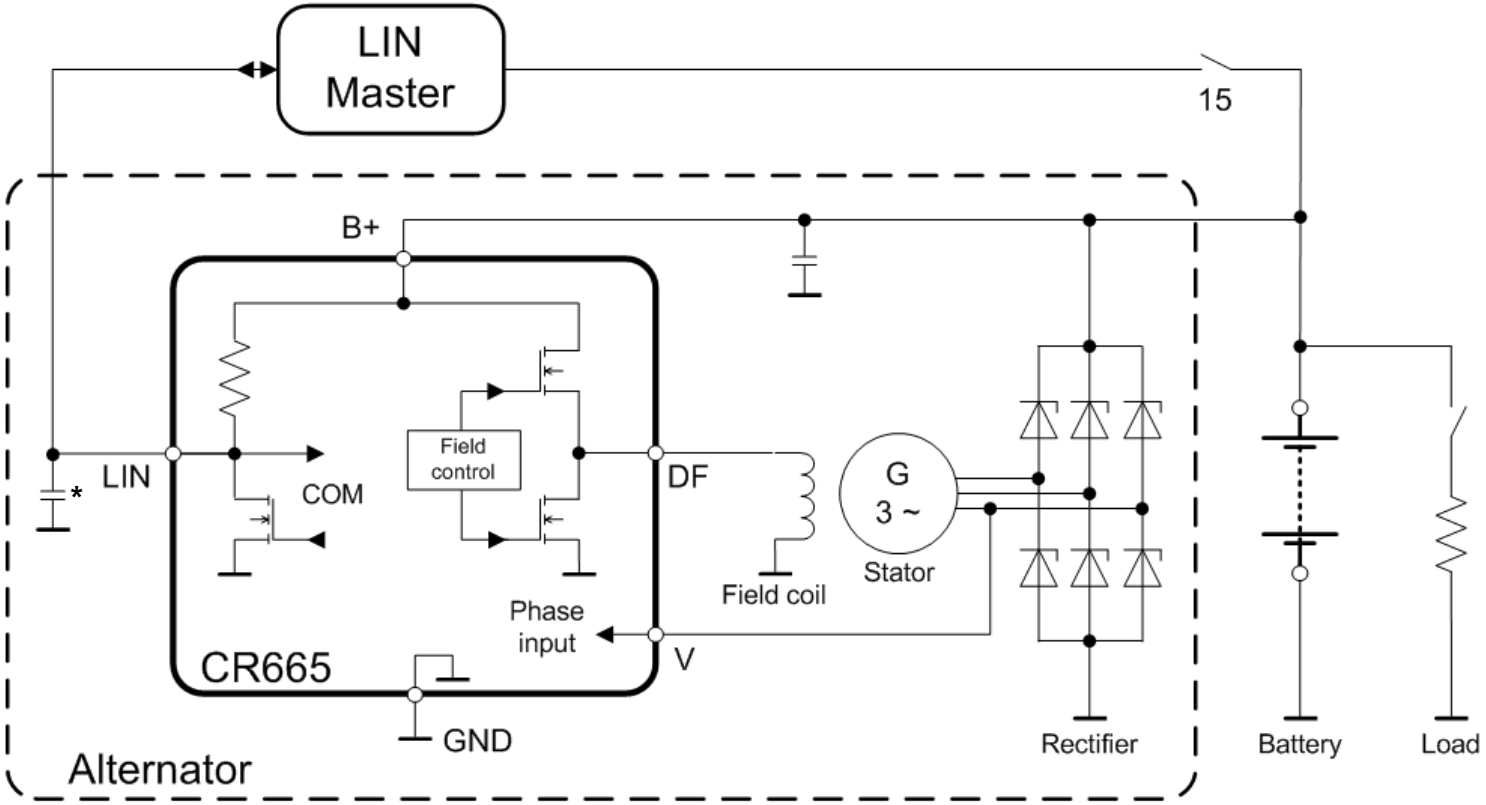


Status information	MFR	PWM	LIN
DF-monitor	☒	☒	☒
Status / Error	☒	☒	☒
Different error-flags			☒
Excitation current			☒
Chip temperature			☒
Alternator- /Manufact.-/ IC-ID			☒
Protocol-Error-Flags			☒
Alternator rotational speed			☒
Voltage setpoint			☒
Measured voltage			☒

Regulator Control	MFR	PWM	LIN
V_{set} adjust + Field shut off		☒	☒
Exc. current limitation			☒
LR-setup (time, on/off, rpm)			☒
High Temp-shutdown adjust			☒
Regulation dynamic adjust			☒
Control Parameter adjust			☒

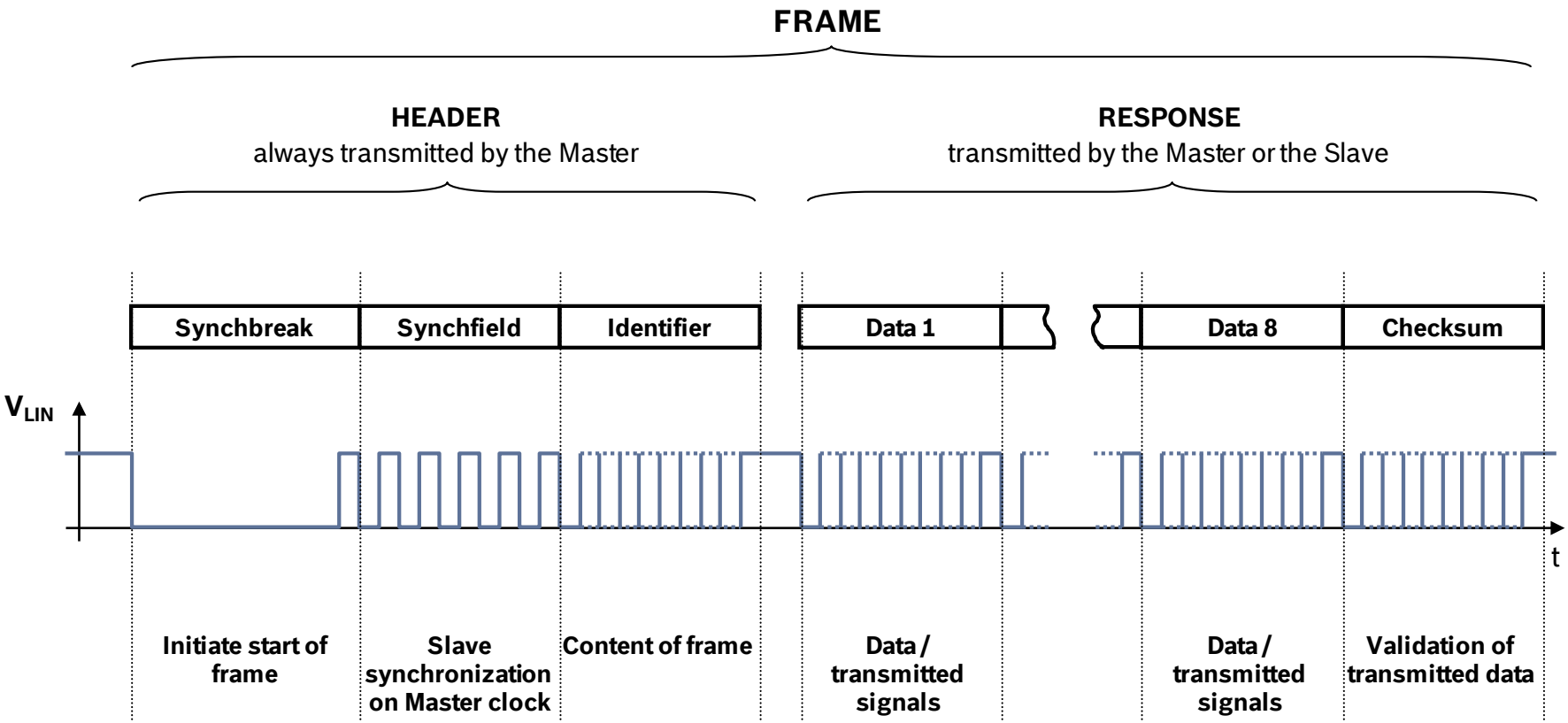
CR665 LIN Regulator IC

- Example wiring diagram



*optional

LIN protocol structure



CR665 LIN

- Single chip 14V automotive grade alternator regulator with LIN interface
- Useful customer OTP programming options
- Field driver stage
  - high-side output stage 0% to 100% 400Hz PWM
  - active freewheeling for low losses
- LIN-interface
  - Physical layer: LIN2.1
  - Data link layer: LIN1.3 and LIN2.1
- Compliant to VDA LIN alternator regulator specification
- Features
  - Set voltage between 10.6V and 16V
  - Switching-on and -off via LIN-interface
  - Readout of status information via LIN interface
  - Standby-mode
  - Advanced load response behavior
  - Self start, jump start and default modes
  - Excitation off function
  - Road–proven robustness

LIN	Local Interconnect Network
OTP	One-time Programmable
PWM	Pulse-Width Modulation
VDA	German car makers association

CR665 Key Parameters

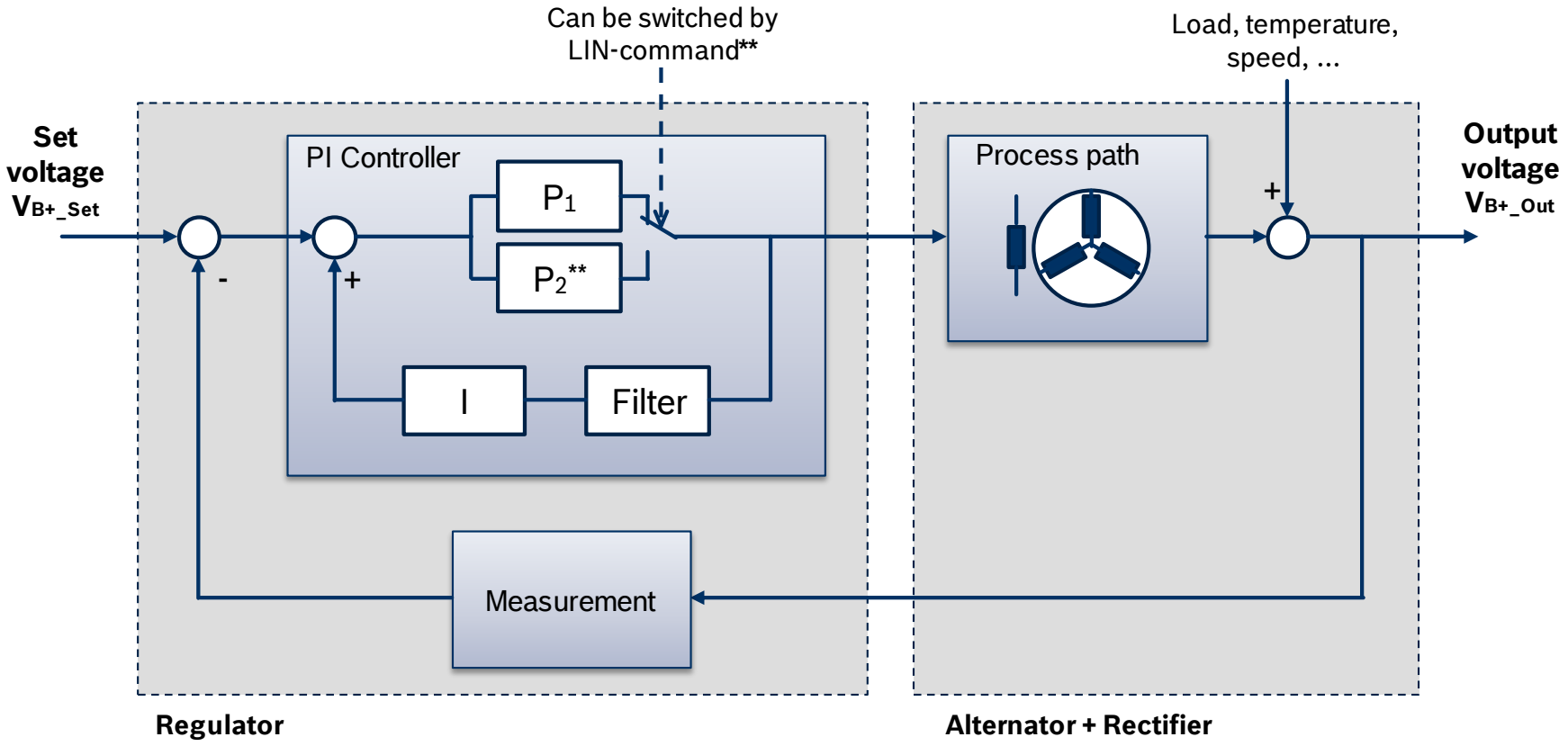
	Min	Typ	Max	Unit
Normal operating voltage range (V_{B+})	6.5		18	V
Restricted operating voltage range (V_{B+})	4		37	V
Supply voltage dynamic (t<500µs)			57	V
Junction temperature in operation (T_J)	-40		+175	°C
High temperature shutoff (T_{SHD})	+175	+190	+205	°C
Temperature sensing tolerance	-4		4	K
Average standby current including power stages (VB+=7.5 ... 13.5V, 25°C)		100	130	µA
High-side DMOS RON (25°C)		70		mΩ
ESD handling, HBM (all pins, to GND)	-8		+8	kV
LIN control examples				
Voltage set range by LIN	10.6		16	V
Load response cut-off by LIN	2400		8000	rpm
Load response gradient by LIN	off		7.7	A

CR665 Programmable Parameters (End Of Line Programming)

Description	Prog. Values
LIN-Settings	• Protocol • Baudrate, • LIN-ID • others
LR blind zone	3 or 12%
Blind zone switching	• Enable / disable • mapping
Exc. current limit	6,7,10, 12.6A
Duty cycle start behavior	3/12 or 25%
Excitation off	During start, always
Pre-excitation current limit	0.8, 1, 1.2A or “Off” (=25%)
Exc. current offset	-200 … +150mA (50mA step)
Reg. voltage offset	-150 … +200mV (50mV step)
Default reg. voltage	13.7, 14, 14.3, 14.6V
Field monitor freq.	50, 100, 150, 200Hz

Description	Prog. Values
ID-settings	• Manufacturer-ID • Alternator-ID
LR start time	0, 0.5, 1, 2s
LR Drive ramp	3 or 5s
LR Drive speed	3000, 4000rpm
Start speed	570, 800, 1450, 1720rpm
Self start speed	3000, 4000rpm
Pole pair number	6, 7, 8
High Temp. ramp down	132 … 160°C (4K step)
High Temp. cut off	160 … 172 (4K step)
High Temp. slope	-250 … 700mV/K (8 values)
Internal filter- and regulation loop parameters	Adjustable according alternator application
others	Enable / Disable Regulator Functions

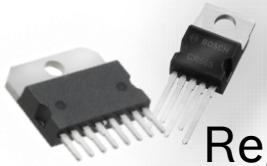
Platform* for Regulation Loop Circuit



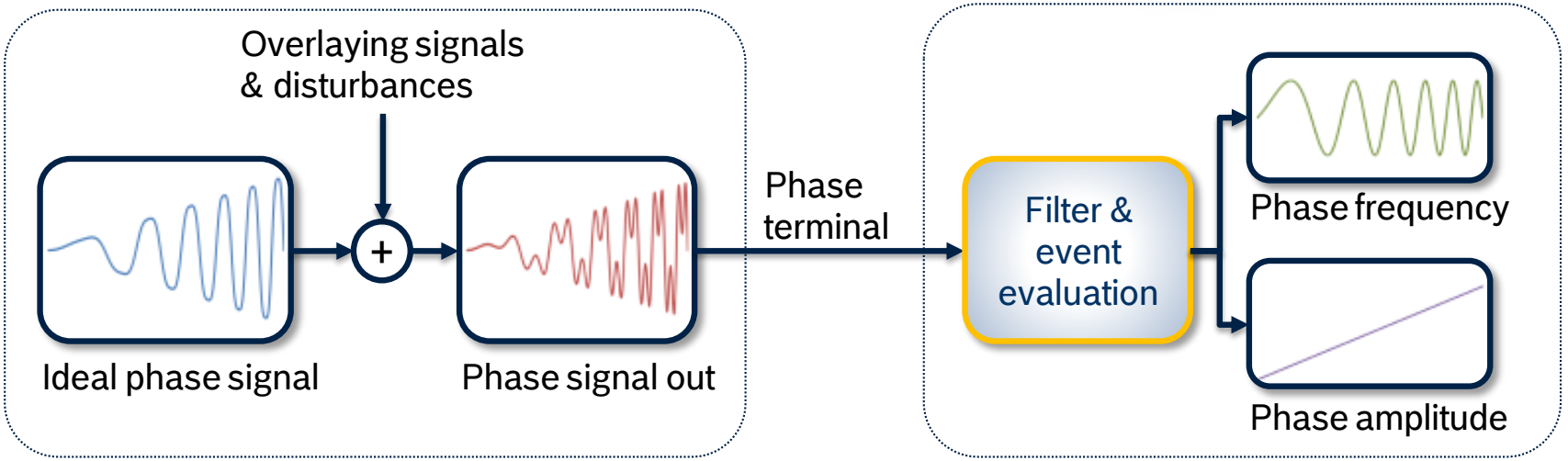
*CR724, CR635, CR636, CR665 **only for LIN-Regulator available

Phase Voltage Evaluation

Alternator



Regulator ICs



Goal: Filter out overlay signals & disturbances and detect correct phase frequency and amplitude

Challenge: New alternator concepts have complex phase signals

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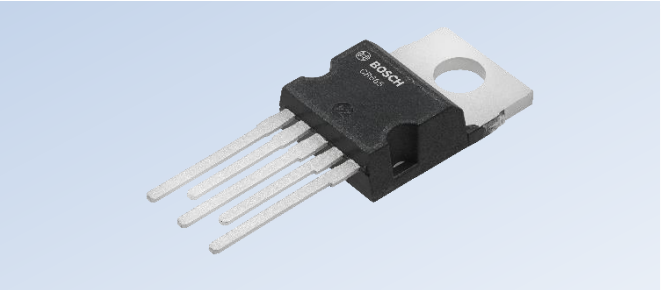
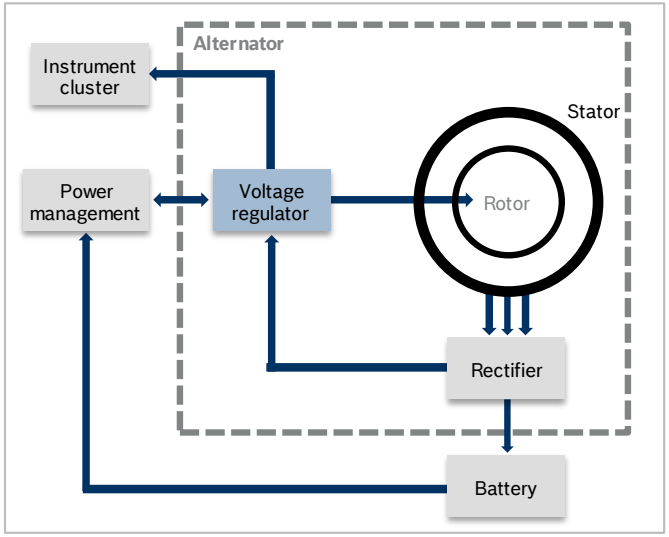
CR665: Alternator regulator with LIN-interface



CR665



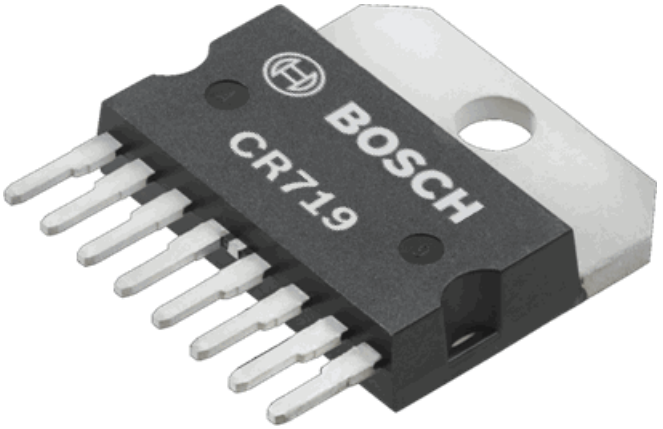
Highlights

- Alternator regulator IC with integrated field output stage and freewheeling circuit
- LIN interface to control and observe while running
- Final configuration at customer end of regulator production line
- Complies to VDA alternator regulator standard

Key benefits

- Meets the wide variety of OEM energy saving and performance demands
- Perfectly matches alternator efficiency concepts
- Provides optimal charging from 14V synchronous alternators regardless of load and driving situation

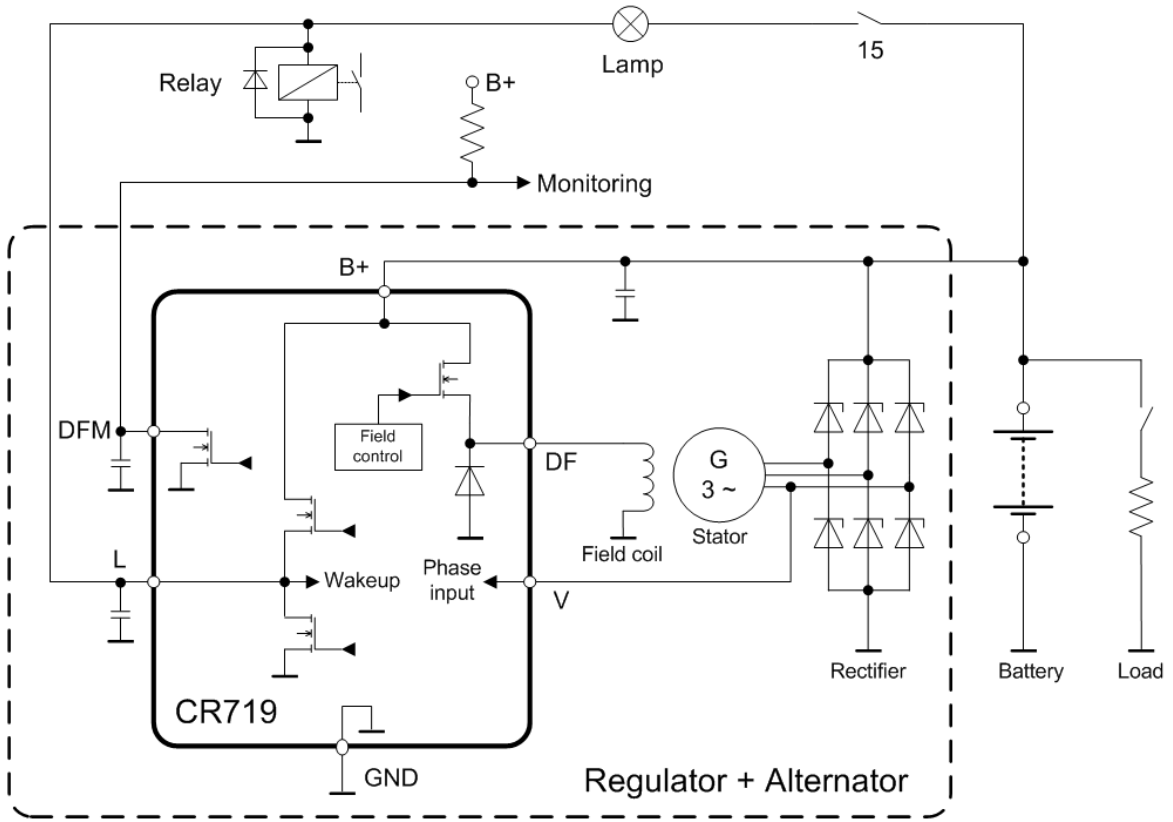
CR719 Multi Function Regulator



- Monolithic 14V multifunction regulator
- Integrated lamp and relay driver
- High side field driver stage on B+
  - 0% to 100% 150Hz PWM
  - freewheeling diode
- Defined start behavior
  - At fixed rotational speed
  - Independent of lamp circuit
  - Self start with broken L-wire
- Load response function reduces torque load in start and drive
- Regulation voltage ramp down start at max. 157°C
- DFM-terminal shows output stage duty cycle
- L-terminal indicates errors

CR719 Multi Function Regulator

- Example wiring diagram



CR719 variants and OEM usage examples

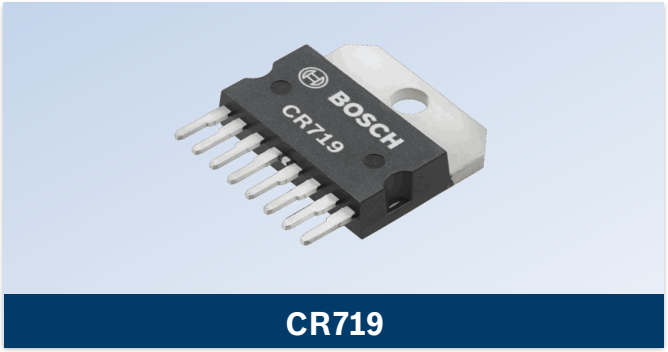
CR719

K	M	N	P
GM	RENAULT	TOYOTA	VW

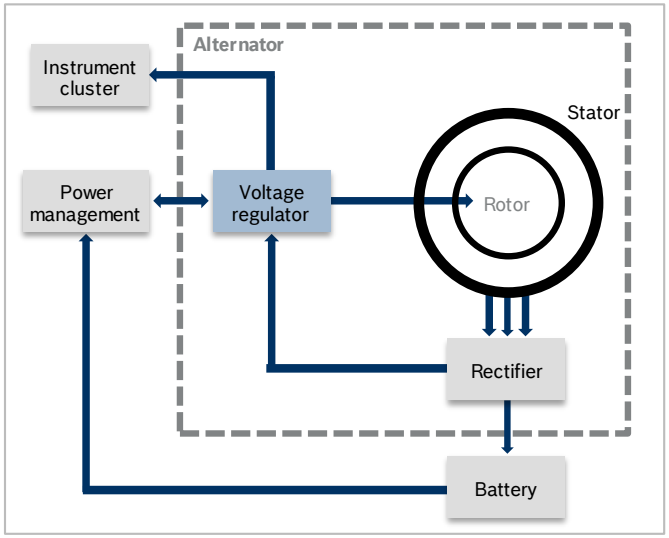
CR719 has been applied successfully for OEM projects since 2008

BOSCH

CR719: Multi-function type



CR719



Highlights

- Fully integrated autonomous regulator IC with field output stage and freewheeling diode
- Relay driver
- High temperature protection
- Lamp circuit independent of excitation

Key benefits

- load response function to optimize torque load in start and drive
- Feedback of excitation field strength to the motor control unit

Contact details – component sales

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