2010 China ATV Symposium
Power Devices
Automotive Power's broad & cost optimized product portfolio

**Power System IC's**

**Smart Power**

System Integration: Embedded Power Products
- Single package smart power and controller integration possible

**TEMPFET**
- protected low-side-Switch
- Overload protection
- Thermal shutdown

**HITFET**
- Current limitation
- Short-circuit protection
- Overvoltage protection
- Open load detection

**MOSFET**

**PROFET**
- protected high-side-Switch
- Integrated charge pump
- Overload protection
- Current limitation
- Short-circuit protection
- Overvoltage protection
- Open load detection
- Diagnostic feedback
- Multi-Channel

**ASIC’s System IC types**

**Embedded Power Products**
- Single package smart power and controller integration possible

**Smart Power IC’s**
- ABS / AIRBAG
- Powertrain

**Multi-Channel Switches**
- Bridges
- Driver-IC’s
- Voltage Regulators
- CAN/LIN Transceiver
- DC/DC Converter

**Power System IC's**
- Smart Power
- System Integration: ABS / AIRBAG
- Powertrain
Overview of Automotive Applications

- HVAC Flap Control
- Idle Speed Control*
- Body Control Module
- Powertrain
- Safety

* Idle Speed Control for small car & motorcycle (Power Train)

Door Lock + Mirror Control + Door Lighting
= Door Control Module IC

13.09.2010
Power Devices in BCM Applications

- PROFET – Smart High Side Switches
- SPOC – SPI Power Controller for Advanced Light Control
- HITFET – Low Side Protected Switches
- SPIDER – SPI Driver for Enhanced Relay Control
- LED Drivers
- Power supply and communication
PROFET in Lighting Control

Central Body Control Module

- 16/32-bit Microcontroller XC22xx
- Voltage Regulator TLE 4699
- LIN Transceiver TLE 7205-2GE

Highside Driver

- PROFET™ BTS 5012
- PROFET™ BTS 5014/16
- PROFET™ BTS 50080-1
- PROFET™ BTS 5242-2
- PROFET™ BTS 5235-2
- PROFET™ BTS 5236-2

Lowside Driver

- PROFET™ BTS 5242/46-2
- PROFET™ BTS 5235/36-2
- PROFET™ BTS 5231-2
- PROFET™ BTS 5232x-2

LED Driver

- LED Driver with Status BCR 40x
- LED Driver without Status BCR 40x
- LED Driver With Status TLE 424x

Communication

- CAN Transceiver TLE 6254-3
- CAN Transceiver TLE 6254-4

Supply

- CAN Bus
- LIN Bus
- +12V from Battery

Right Rear Light Control

- Brake 27W
- Indicator 27W
- Backlight 10W
- Fog 10W

Left Rear Light Control

- Brake 27W
- Indicator 27W
- Reverse 27W
- Backlight 10W

Right Front Light Control

- Brake 27W
- Indicator 27W
- Park or Daylight 10W
- Fog 10W
- Reverse 27W

Left Front Light Control

- Brake 27W
- Indicator 27W
- Reverse 27W
- Backlight 10W
- Fog 10W

LEDs

- Logic Signals on VBAT level e.g. Switched VBAT Rails

Relay

- Interior Light 5W, 10W
- Interior LEDs

BCR 40x

- Interior LEDs

Highbeam 65W

- Lowbeam 55W
- Indicator 27W
- Park 10W

Add 5W Out

- Optional Fog 55W
- Park or Daylight 10W

Reverse 27W

- Brake 27W
- Fog 27W
- Indicator 27W
- Backlight 10W

Q2 2010
**PROFET™ Features and Benefits**

### Basics
- N channel DMOS with integrated charge pump
- CMOS and TTL compatible input
- PWM capable

### Protection
- Current Limitation
- Short-circuit protection
- Thermal shutdown
- Over voltage protection (incl. load dump)
- Reverse battery protection (with external resistor)
- Under- and over voltage shutdown
- Loss of ground and loss of Vbb protection
- Fast inductive energy demagnetization

### Diagnostics
- Over temperature / short circuit to GND
- Open load detection
- Proportional load current sense (optional)
PROFET™+ is our next generation PROFET™ family

The new Benchmark in terms of

- Modularity and Flexibility
- Protection and Diagnosis
- Cost Effectiveness
PROFET™+ offers Maximum Design Flexibility by Cross-Device Feature & Package Compatibility …

**Pin Compatibility**

if you know 1 PROFET device, you know the whole family

**Identical Feature Set**

- Loss of ground/battery protection
- More than 100k short circuit cycles at worst case
- Th. shutdown with auto restart
- Sense Multiplexing
- OL@OFF, OL@ON diagnosis
- PWM capability up to 200Hz
- Improved kilis accuracy
- Green Robust
- Exposed Pad Packages

… at improved Short Circuit Robustness!

2010/9/13
BTS 5020-2EKA – 1st Member in PROFET+ Family
2 Channel PROFET™ + 2x20mOhm

Feature Set

- Improved SC robustness
- Th. shutdown with auto restart
- Sense Multiplexing
- OL@OFF, OL@ON diagnosis
- PWM capability up to 200Hz
- Improved kilis accuracy
- Green Robust
- PG-DSO14 Exposed Pad Package
- ES: Q1/2009
SPOC - SPI Power Controller for Advanced Lighting Control

HiC PROFET™ BTS 5012

BTS 5242-2

BTS 5235-2

BTS 5236-2

BTS 5014/16

BTS 6133/43

BTS 50080-1

Highbeam 65W

Lowbeam 55W

Indicator 27W

Park 10W

Highside Driver

Lowside Driver

Communication

Supply

LED Driver

Relay

Interior Light

5W, 10W

Logic Signals on VBAT level e.g. Switched VBAT Rails

+12V from Battery

LIN Bus

CAN Bus

+12V from Battery

Highside Driver

Lowside Driver

SPOC BTS5566, BTS5576, BTS5590

BTS 5x62, BTS5x72, BTS5662

SPOC BTS5566, BTS5576, BTS5590

BTS 5012 BTS 6133/43 BTS 50080-1

Highbeam 65W

Lowbeam 55W

Indicator 27W

Park 10W

Optional Fog 55W

Park or Daylight 10W

HITFET™ BTS 3110/18

BTS 3134 BTS 3160 CAN Transceiver

TLE 724x TLE 723x

TLE 424x

TLE 4699

TLE 6251G/DS

Voltage Regulator

TLE 6254-3

TLE 7259-2GE

TLE 6258-2

TLE 7270-2

TLE 7469

BTS 3110/18

BTS 3134 BTS 3160 CAN Transceiver

TLE 724x TLE 723x

TLE 424x

TLE 4699

TLE 6251G/DS

Voltage Regulator

TLE 6254-3

TLE 7259-2GE

TLE 6258-2

TLE 7270-2

TLE 7469
Benefits & Savings vs. Discrete Solution

PCB
- Less traces on PCB
- Less parts on PCB
- Less PCB area
- Less ext. HW (BCR, diode,...)

μProcessor
- Less I/O
- Less AD channels
- PWM optimized solution
- PWM operation over SPI

- Assembly cost
  - Less part numbers and logistical costs
  - Less pick and place
  - Less testing

- Quality improvement
  - Less parts to solder decreases the risk of reliability issues linked to soldering
  - Pre-tested “system on a chip”

- Diagnosis via SPI
  - SC to Vbb
  - small duty cycles for LED mode
SPOC Standard Protection and Diagnostic Features

**Basics**
- N channel DMOS with integrated charge pump
- CMOS and TTL compatible inputs
- PWM capable
- Limp home mode

**Diagnostics**
- Over temperature / short circuit to GND
- Open load detection
- Latching diagnostics in SPI registers
- Multiplexed proportional load current sense

**Protection**
- Current Limitation
- Short-circuit protection
- Thermal shutdown
- Over voltage protection (incl. load dump)
- Reverse battery protection (with external diode and resistor)
- Under- and over voltage shutdown
- Loss of ground and loss of Vbb protection
- Fast inductive energy demagnetization

**Additional Features (not on all devices)**
- LED Mode (low ohmic channels only)
- ReverseSave
- Self-generated PWM (SPOC FL)
- Control of external Smart Power switches through SPI (SPOC FL)
- Adjustable slew rate and current trip points (SPOC Duo)
Body Computer - Example "Light Module"
Where to find Smart Multichannel Switches

- HiC PROFET™
  - BTS 5012
  - BTS 6133/43
  - BTS 50080-1

- HiC PROFET™
  - BTS 5014/16
  - BTS 6133/43

- HiC PROFET™
  - BTS 5242-2
  - BTS 5235-2
  - BTS 5236-2

- SPOC BTS5566, BTS5576, BTS5590

- Highbeam 65W
- Lowbeam 55W
- Indicator 27W
- Park 10W

- Highside Driver
- Lowside Driver

- Communication
  - SPIDER TLE 724x TLE 723x
  - TLE 7259-2GE TLE 7259-2GU TLE 6258-2
  - CAN Transceiver TLE 6254-3 TLE 66516/D6
  - LIN Transceiver TLE 7259-2GE TLE 7259-2GU TLE 6258-2
  - Voltage Regulator TLE 4699 TLE 7270-2 TLE 7469

- Supply
  - 16/32-bit Microcontroller XC22xx

- Interior Light
  - 5W, 10W

- Exterior Light with LEDs
  - Brake 27W
  - Indicator 27W
  - Backlight 10W
  - Fog 27W

- Add. 5W Out

- Logic Signals on VBAT level e.g. Switched VBAT Rails
  - +12V from Battery

- Voltage Regulator
  - TLE 4699 TLE 7270-2 TLE 7469

- LED Driver
  - With Status TLE 424x
  - Without Status BCR 40x

- LED Driver
  - With Status BTS 3110/18 BTS 3134 BTS 3160

- CAN Bus

- LIN Bus

- Left Front Light Control
- Right Front Light Control
- Left Rear Light Control
- Right Rear Light Control
Customer Questions

- What are SPIDERS?
- What are the target applications?
- Why should I use SPIDERs?
- What are the advantages against a discrete solution?
What are SPIDERs?

Reduced system costs
- Reduced μC pin count (SPI, daisy-chaining)
- Smaller μC
- Reduced board space
What are the Target Applications?

Inductive Loads
- Relays
- Motors

Resistive Loads
- LEDs
- Heating elements

Other Loads
- Small Bulbs

Automotive

Industrial
SPIDER Family Overview

Channels

- **TLE 7239SL** PG-SSOP-24
- **TLE 7238SL** PG-SSOP-24
- **TLE 7237SL** PG-SSOP-24
- **TLE 7240SL** PG-SSOP-24
- **TLE 7236SE** PG-DSO-20
- **TLE 7235SE** PG-DSO-20
- **TLE 7234SE** PG-DSO-20
- **TLE 7243SL** PG-SSOP-24
- **TLE 7244SL** PG-SSOP-24
- **TLE 7236EM** PG-SSOP-24EP
- **TLE 7235EM** PG-SSOP-24EP
- **TLE 7234EM** PG-SSOP-24EP
- **TLE 7247EM** PG-SSOP-24EP
- **TLE 7246EM** PG-SSOP-24EP
- **TLE 7233G** PG-SSOP-24
- **TLE 7231G** PG-DSO-14

- **SPIDER HS/LS** High / Low-Side
- **SPIDER LS** Low-Side
- **SPIDER HS** High-Side
- **SPIDER LS** Low-Side

- 8 Channels
- 6 Channels
- 4 Channels

- 200mA**
- 250mA**
- 300mA**
- 350mA**
- 400mA**

** Max nom. load current

- = in production
- = ES avail
SPIDER LS - TLE 7240SL
Relays, LEDs, Ohmic Loads

- Smart octal lowside switch for relays in body control modules
- **Low-ohmic** $R_{\text{DS(ON)}} \text{ typ.} \; 1.5 \; \Omega$
- Embedded Protection and Diagnosis (Multichannel Family Standard)

**Status**

- Parallel control of 4 channels, fully configurable to all outputs for PWM application
- Limp Home (fail-safe mode)
- Current limitation
- Extremely small PG-SSOP-24 Finepitch (0.65) package
- 3.3V and 5V µC compatible
- Stand-by Mode with <10 µA

**SPIDER** = **Serial Peripheral Interface Driver for Enhanced Relay control**
LED Driver
in Lighting control
Infineon Offers a Comprehensive Set of LED Driver Families for Automotive Lighting Solutions

- **Infineon® Basic LED Driver**: Low/medium current LED driver
- **Infineon® Power LED Driver**: High current LED driver
- **Infineon® SPI LED Driver**: SPI controlled LED driver
- **Infineon® LIN LED Driver**: LIN controlled LED driver
## Individual Automotive LED Driver Product Portfolio of Linear Current Sources

<table>
<thead>
<tr>
<th>Current</th>
<th>Open Load Detection</th>
<th>PWM/Enable</th>
<th>Hi/Low Current Switch</th>
<th>Package</th>
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<td>TO-263</td>
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</table>
Infineon® Power LED Driver
Cover the Full-Range of Integration Steps

Smart DC/DC Controller IC
- Driver stages for external switching transistors implemented

Smart DC/DC Driver IC
- Switching transistors integrated

Integrated Smart DC/DC Driver IC
- Switching transistors + freewheeling diode integrated
Infineon® SPI LED Driver
Features description

- 6 ch High Side (6x400mA nom.)
- 2 Separate Battery Feeds (for left/right)
- Analogue Current Sense
- Works down to 3V (cranking)
- Option for PWM Generator
- Fail-Safe Mode (Limp Home)
- Very Small Exposed Pad Package
- Targeting Exterior Rear Light and Interior Light

RoHS  AEC Qualified

STATUS
- ES avail
- DR Q2/10
Smart LED module with Infineon® LIN LED Driver
→ system diagram

Control module / Gateway

- PROFET BTS5045-2 (Parallel)
- Hermes TLE8264
- 3 LIN transceiver
- μC XC2000
- LDO VCC1
- LDO VCC2
- CAN transceiver

VS

LED module

LIN bus

Simple Extension of decentral nodes:
→ just 2 wires required for LED module
Smart LED module with Infineon® LIN LED Driver → Application diagram

LED Module with 3 connections only!
Power Supply and Communication in Lighting Control

- **Highbeam**: 65W
- **Lowbeam**: 55W
- **Indicator**: 27W
- **Park**: 10W

**Option: Fog 55W**

- **Left Front Light Control**
- **Right Front Light Control**

**LIN Bus**

**CAN Bus**

**+12V from Battery**

**Central Body Control Module**

- **16/32-bit Microcontroller**: XC22xx

**Interior LEDs**

**Logic Signals on VBAT level e.g. Switched VBAT Rails**

**Highside Driver**

**Lowside Driver**

**LED Driver without Status**: BCR-40x

**LED Driver with Status**: TLE 424x

**VOLTAGE REGULATOR**: TLE 4699 TLE 7270-2 TLE 7469

**LIN Transceiver**: TLE 7259-2GU TLE 7258-2

**CAN Transceiver**: TLE 6254-3 TLE 6251G/DS

**SPIDER**: TLE 724x TLE 723x

**HITFET™**: BTS 5110/18 BTS 3134 BTS 3160

**PROFET™**: BTS 5242-2/46-2 BTS 5235-2/36-2

**LED Driver**: without Status TLE 424x

**Supply**

**LIN Transceiver**: TLE 7259-2GU TLE 7258-2

**Voltage Regulator**: TLE 4699 TLE 7270-2 TLE 7469

- **Highbeam 65W**
- **Lowbeam 55W**
- **Indicator 27W**
- **Park 10W**

**Interior Light**: 5W, 10W

**Backlight 10W**

**Left Rear Light Control**

- **Brake 27W**
- **Indicator 27W**
- **Backlight 10W**

**Right Rear Light Control**

- **Brake 27W**
- **Indicator 27W**
- **Backlight 10W**

**Add. 5W Out**
Linear Voltage Regulators at Infineon

Infineon:
- is the **market-leader in automotive Power Supply**
- offers the **most extensive product portfolio** in the market
- sells on average **7 Voltage Regulators per car**
- is the only supplier for **bipolar technology in 8”**
- offers products with the **best quality** level available on the market
- has **over 15 years’ experience** in the automotive arena
Infineon’s Power Supplies address a Broad Range of Applications – for Automotive and Beyond

Supply

Linear voltage regulators
- Industrial Applications
- ECU supplies (Ipeak<500mA)
  - IFXxxxx
  - TLE42xx
  - TLE44xx
  - TLE42xx4

Linear voltage trackers
- Infotainment Applications
- Memory supply
- Additional voltage levels
- Heat distribution
- Off-board sensor supplies
- TLE46xx
- TLE425x
- TLFxxxx
- TLE42xx
- TLE72xx
- TLE74xx
- TLE425x
Infineon Automotive Power offers a Comprehensive Portfolio of Voltage Regulator Products...

*incl. monitor functions, adj. current limitation
Infineon’s Automotive Transceivers - The perfect match for in-vehicle-networking

- Infineon is the No. II in the transceiver market
- Infineon offers a complete product portfolio
- Infineon delivers excellent quality, <0.05 defects per million pcs
- Infineon has outstanding robustness
- Infineon is set up for high volume manufacturing
Infineon’s Automotive Transceivers - Complete product portfolio

- **In-vehicle-network transceivers**
  - **CAN High Speed (ISO 11898-2/-5)**
    - Up to 20 kbit/s
    - TLE6251DS
    - TLE6251-2G
  - **CAN Low Speed**
    - Up to 1 Mbit/s
    - TLE6250G
    - TLE6250GV33
    - TLE8250G
    - **With wake-up**
      - TLE6251DS
      - TLE6251-2G
    - **Without wake-up**
      - TLE6250G
      - TLE6250GV33
      - TLE8250G
  - **FlexRay (FlexRay 3.0)**
    - Up to 10 Mbit/s
    - TLE9221
  - **Fault Tolerant (ISO 11898-3)**
    - TLE6254-3G
  - **Single Wire (GMLAN20)**
    - TLE6255G
  - **TWIN LIN**
    - TLE7269G
  - **With Vreg**
    - TLE6285G
    - TLE6286G
    - TLE8458G
  - **Up to 125 kbit/s**
    - **Single LIN (LIN 1.3/2.1; SAE-J2602)**
      - TLE6258-2G
      - TLE7259-2GE
      - TLE7259-2GU
      - TLE7258D
  - **Up to 20 kbit/s**
    - **LIN (LIN 1.3/2.1; SAE-J2602)**
      - TLE6258-2G
      - TLE7259-2GE
      - TLE7259-2GU
      - TLE7258D
SUMMARY OF GUN TEST RESULTS* (IEC-1000-4-2)
High Speed CAN Transceivers

* Test done on 12 devices/type, without supply and a minimum external wiring.
Direct contact discharges (negative and positive) coupled to bus pins CAN H, CAN L, in 500V steps
Failure criteria: diode characteristics of the bus pins
What is an SBC and why an SBC?

- **What is a System Basis Chip?**

- **Why to use an System Basis Chip?**
  - Reduction of overall cost
  - Smaller board space
  - Differentiation from competition
  - Additional features
  - Low quiescent current
    - Sleep Mode
    - Stop Mode
Infineon’s System base chips – Portfolio overview

System-Basis-Chips

- Low Speed CAN
  - Fault Tolerant
  - ISO 11898-3
  - Voltage Regulator
    - TLE6263G
    - TLE6263-3G
    - TLE6266G

- High Speed CAN
  - ISO 11898-2/5
  - 2/3 Voltage Regulator
    - TLE8261E
  - 2/3 Voltage Regulator
    - TLE7263E
    - TLE8262E
    - TLE8263E
    - TLE8264E

- LIN
  - LIN 1.3, 2.0, 2.1, SAE J2602
  - Voltage Regulator
    - TLE6285G
    - TLE6286G
    - TLE8458G/E
Hermes Family

**Hermes Family**

**TLE8261E**
**TLE8261-2E**
*No LIN*

---

**TLE8262E**
**TLE8262-2E**
*1 LIN*

---

**TLE8263E**
**TLE8263-2E**
*2 LIN*

---

**TLE8264E**
**TLE8264-2E**
*3 LIN*

- Same package, same pin-out
- Software compatible
Application 2 - Door Application

- **Mirror**
  - TLE8203E  
    (x-y-positioning + lamp driver)
  - TLE6208-3G (x-y-movement)

- **Central Door Module**
  - TLE8201R (E)  
    (incl. mirror positioning and lamp driver)

- **Window Lift**
  - TrilithIC/NovalitIC

- **Door Lock**
  - TrilithIC
Door Module Power IC (DoMoPo): TLE8201R

TLE8201R
Available

13.09.2010
TLE8203E – Mirror IC

- SPI Interface, current sense, PWM
- Inhibit function, <6µA
- 3 Half-Bridges for Mirror Positioning
- Mirror heat
- 2 Lamp Driver for 5 and 10W lamps or LEDs
Trilith IC: Integrated H-bridges

Steering column lock
Headrest
Steering wheel adj.

BTM 7700G
BTM 7740G
BTM 7741G

BTM 7752G
BTM 7755G

BTM 7710G
BTM 7750G
BTM 7751G

Mirror flap
Door-lock
Trilith IC
General Concept - Multi Chip Module (MCM)

- Integrated H-Bridge
- Short circuit protection
- Current limitation
- Under-voltage shutdown with auto-restart and hysteresis
- Diagnostic feedback
- 5V logic level input
- Green Product (RoHS compliant)
- AEC Qualified
Embedded Power Products
Central Architecture needs a lot of wiring, offers limited functionality
Decentralized architecture reduces wiring, enhanced functionality
Trend to Intelligent Window Lift Motors

Simple Motor
- No ECU
- Driven directly via window switches / door module or BCM

Source: Johnson (website)

Decentralization / One-touch up / Anti-Pinch Requirement

Intelligent Motor
- Plug-in ECU
- Anti-pinch functionality
- Communication e.g. via LIN or CAN bus
- Motor position feedback (Hall sensor)
- Decentralized drive concept
- Can include door electronics (mirror, door locks, lighting)

Source: Brose (website)
Embedded Power Functionality

Functionality needed for Intelligent Power Window Control

ePower
PCB Space Reductions by Integrating Electronics

- Fully discrete
- Partially integrated
- Embedded Power
Power Window Application Diagram

- LIN TRX
- VReg
- FUSE
- µC
- Relay Driver
- Motor Position Detection
- Hall Switch
- Motor
- V_BAT
Power Window Application Diagram – TLE7810

- LIN TRX
- VReg
- Relay Driver
- Hall Switch
- Motor Position Detection
- µC
- FUSE
- V\textsubscript{BAT}
- TLE7810 ePower

Infineon
TLE78xx – Building Blocks

- LDO Vreg
- VBAT/TEMP
- LIN PHY
- 5 Wake Up Inputs
- SPI
- Watchdog
- High Side
- 2 Low Sides
- 5V Supply
- 10bit ADC
- 8051 Core
- UART
- FLASH
- SSC
- RAM
- RESET
- On-Chip Oscillator
- Timer
- JTAG
- CCUS
- Microcontroller

V_{BAT}
LIN

Switches
LED Backlighting
Double Relay
Double Hall

Speed
Direction

LIN SBC

TLE7810
ePower Allows to Reduce PCB Space

- Double Hall Sensor TLE4966 for motor position sensing
- Relay
- Embedded Power IC TLE78xx

Source motor sketch: Bosch patent US6713913
## TLE78xx Released ePower Family

### In Mass Production

<table>
<thead>
<tr>
<th>TLE7809</th>
<th>TLE7810</th>
<th>TLE7824</th>
<th>TLE7826</th>
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<tbody>
<tr>
<td>Industrial</td>
<td>Automotive</td>
<td>Automotive</td>
<td>Automotive</td>
</tr>
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<td>with XC866</td>
<td>with XC885</td>
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<td>LIN 2.0</td>
<td>LIN 2.0</td>
<td>LIN 2.0</td>
<td>LIN 2.0</td>
</tr>
</tbody>
</table>

**flash size:** 16 ... 24 ... 32kB
Next Generation ePower
TLE9832QV

- **Industries Smallest Form Factor**
  - 7x7 VQFN48
- **Widest Supply Range**: VS 3V to 40V

- **Compatible to 8051 (XC800/TLE78xx)**
- 256 Byte RAM / 3 kByte XRAM
- 32 kByte NVM (Flash Memory)
- Hardware EEPROM emulation (4K)
- 8 Channel 10-bit A/D Converter
- CAPCOM Unit CCU6 + GPIO w/PWM
- LIN Transceiver
- On-chip oscillator
- Adv. Power Saving Modes & Cyclic Sen
- VReg w/Power-On & UV Reset
- 4 Power Outputs with OT/SC Prot.
Application 3 - HVAC Flap Control & Fan Control
Monolithic Bridges
TLE841xx family / flexible use

3 motors
0.5A cont.

5 motors
0.5A cont.

8 motors
0.5A cont.
Integrated Half Bridge – NovalithIC: BTS 7960B

Current Limitation 43A typ. / 33A min.

25 kHz PWM w. Active Freewheeling

No Charge Pump less EMI
Optimized Solution for HVAC Fan Control

- Enables PWM control
- Fuel efficiency
- Reduced board space
- System in a Package
- System cost optimization
Business Line ATV PTS
Automotive Applications we serve with our Chips

POWERTRAIN:
- Engine
- Drives
- Transmission

Safety:
- EPS
- Airbag/Restraint

Engine Management
Engine Control
Starter
Alternator
Battery Management
Motor Drives
Control
Brush & Brushless
Transmission
E/EH Power Steering
Airbag & Pretension System
Transmission
Power Device in Transmission
## Product Comparison

<table>
<thead>
<tr>
<th>Feature</th>
<th>TLE7241E C³</th>
<th>TLE7242-2G Adler</th>
<th>TLE8242L Adler 2</th>
<th>TLE6288R</th>
<th>TLE82453SA Dragon (under development)</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Chan. &amp; Integration</td>
<td>2 – Low-side Fet(240mOhm)</td>
<td>4 – Low-side Pre-Driver</td>
<td>8 – Low-side Pre-Driver</td>
<td>3 – High-side 3 – HS/LS Configurable Fet(150mOhm)</td>
<td>3 – HS/LS Configurable Fet(150mOhm) Diode &amp; Res</td>
</tr>
<tr>
<td>Controller Type</td>
<td>Hysteretic</td>
<td>P-I Fixed-Freq.</td>
<td>P-I Fixed-Freq.</td>
<td>Peak &amp; Hold</td>
<td>ICC (IFX Proprietary)</td>
</tr>
<tr>
<td>Current Range</td>
<td>0 – 1.2A 10 bit resolution</td>
<td>0 – 1.2A 11 bit resolution</td>
<td>0 – 1.2A 11 bit resolution</td>
<td>0 – 3.6A 4 settings for Peak 4 settings for Hold</td>
<td>0 – 1.2A 11 bit resolution</td>
</tr>
<tr>
<td>Current Accuracy</td>
<td>Approximately +/-2% over full range</td>
<td>+/-2% over full range</td>
<td>+/-2% over full range</td>
<td>+/-20% over full range</td>
<td>+/-1.5% over full range +/-1% over -40°C – 125°C</td>
</tr>
<tr>
<td>Communication</td>
<td>Configurable SPI 16 bit</td>
<td>Configurable SPI 32 bit</td>
<td>Configurable SPI 32 bit</td>
<td>Configurable SPI 16 bit</td>
<td>Configurable SPI 32 bit</td>
</tr>
<tr>
<td>Operation Temp Range</td>
<td>-40°C – 150°C</td>
<td>-40°C – 150°C</td>
<td>-40°C – 150°C</td>
<td>-40°C – 150°C</td>
<td>-40°C – 150°C</td>
</tr>
<tr>
<td>Package Type</td>
<td>P-DSO-20-27</td>
<td>P-DSO-28</td>
<td>PG-LQFP-64</td>
<td>Power SO 36</td>
<td>Power SO 36</td>
</tr>
</tbody>
</table>
TLE8242L Product Features

- Eight channel current control pre-driver
- For low-side control of proportional control solenoids
- Serial Peripheral Interface (SPI)
- Supports PWM control using internal PWM generator
- Internal P-I controllers with programmable KI and KP gains
- Diagnostic bits for open load, short to battery, and short to ground faults. Accessed via SPI
- Synchronization feature allows control of phase offset between channels
- Current control gain error = +/- 2%
- Offset cancellation by auto-zero feature
- Package: PG-LQFP-64
Engine Management Systems
Power Device in EMS
Automotive Power MOSFET

- **Commitment**: Dedicated high quality products for automotive applications
- **Leadership**: OptiMOS-T2 best in class Trench Technology on the market
- **Portfolio**: 30V to 600V MOSFET technologies in variety of packages with more than 450 sales products
- **Volume**: IFX AutoMOS N° 2 WORLDWIDE and production volume DOUBLED in last 3 years
- **Quality**: <0,5dpm, several MOSFET with 0ppm
- **Robustness**: Automotive MOSFET feature Robust Package – most reliable package solution available today to meet automotive requirements
We need both planar and trench technologies to address the entire automotive MOSFET Market:

- OptiMOS => Planar => Rth driven applications
- OptiMOS T & T2 => Trench => Rdson driven applications
<table>
<thead>
<tr>
<th>Channel Type</th>
<th>OptiMOS</th>
<th>OptiMOS-T</th>
<th>OptiMOS-T2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N-channel 30V</strong></td>
<td>DPAK: 6.4 – 20.0 mΩ D2PAK: 2.7 – 12.6 mΩ</td>
<td></td>
<td>DPAK: 2.2 – 13.6 mΩ D2PAK: 0.9 – 14.9 mΩ</td>
</tr>
<tr>
<td><strong>N-channel 40V</strong></td>
<td>D2PAK: 2.7 – 4.0 mΩ</td>
<td>DPAK: 3.6 – 9.0 mΩ D2PAK: 1.5 – 6.5 mΩ</td>
<td>DPAK: 2.0 – 9.7 mΩ D2PAK: 0.99 – 7.4 mΩ</td>
</tr>
<tr>
<td><strong>N-channel 60V</strong></td>
<td>DPAK: 12.7 – 80.0 mΩ D2PAK: 4.4 – 12.0 mΩ</td>
<td></td>
<td>DPAK: 3.5 – 30.0 mΩ D2PAK: 1.7 – 9.4 mΩ</td>
</tr>
<tr>
<td><strong>N-channel 75V</strong></td>
<td>DPAK: 20.5 – 50.0 mΩ D2PAK: 6.5 – 7.4 mΩ</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>N-channel 100V</strong></td>
<td></td>
<td>DPAK: 11.1 – 31.0 mΩ D2PAK: 4.8 – 15.7 mΩ</td>
<td></td>
</tr>
<tr>
<td><strong>P-channel 30V</strong></td>
<td></td>
<td></td>
<td>DPAK: 4.0 – 10.5 mΩ D2PAK: 4.2 – 11.0 mΩ</td>
</tr>
</tbody>
</table>

- *Infineon will be first with 100A in DPAK (40V automotive)!*
- *Infineon will be first with sub 1mOhm in D2PAK (30V automotive)!*
- *Coming up next: PFET4 40V (e.g. for bridge configuration)!*
TEMPFET or HITFET
What’s the difference?

TEMPFET is a „Temperature protected MOSFET“

Means a MOSFET with a integrated Temperature sensor
⇒ TEMPFET protection feature is Temperature protection
In a classic 3 pin TEMPFET the sensor is a Thyristor
which is hardwired between Gate and Source
At SPEED – TEMPFET the sensor is available externally.

HITFET „High Integrated TempFET“
is a further step in integration of MOSFET protection.

⇒ HITFET protection features
⇒ ESD protection
⇒ Short circuit and over load protection with current limiting or tripping
⇒ Over voltage protection (active clamping)
⇒ Over temperature protection with restart or latch behaviour
SPEED-TEMPFET™ Family

- BTS247Z: 6.7A, 18mOhm
- BTS244Z: 8A, 13mOhm
- BTS282Z: 11A, 6.5mOhm

- Family of 3 devices with different RDSon
- \( I_{D\text{nom}} \) from 6.7 A up to 11A
- Latching behaviour
- Temp. Sensor can be read out externally

Speed TEMPFET Family

Matured and well known robust products
HITFETs. Short description. Why IFX?

- Protected MOSFET switches (Current, Voltage, Temp, ESD)
- Used everywhere protection is needed
- Benefits:
  - cost - replaces discrete switching circuits & relays
  - space - saves PCB area
  - design cost + TTM – fast, simple design
- IFX Unique Selling Points:
  - broad product portfolio
    - $\text{R}_\text{dson}/\text{Inom}$, (10-700mohm; 0.35- 8A)
    - Vds (to 62V). Truck, high voltage applications
    - Clamping Energy capability
    - AEC qualified
    - Scalability inbetween and over package family(DPAK / SOT223 and DSO8)
    - Green & Robust
  - reputation for quality, reliability and robustness
  - wide knowledge of customer applications
  - well established relationships among all top players
HITFET™ Protected Low Side Switches: Overview

Product Portfolio
- Rdson: 10-700mΩ
- Id: 0.35A - 8A
- 1-2 Channels
- 12V, 24V to 42V
- Latch and Restart

Protections
- SC and over-load
- Over-voltage
- Open load
- Thermal Shut down
- ESD protection
- Digital Status feedback
- Diagnostic tool

Applications
- General-purpose protected switch
- Resistive, inductive and capacitive loads
- Lamp, LED drivers
- AC&DC motors
- Relay drivers
- Fan and Blowers
- Valve, Solenoid driver
- Many others

Packages
- SOT223
- DPAK
- DPAK5
- PDSO8
- TO220

30+ Product Portfolio: Automotive and Industrial Applications, Full Green
# HITFET™ Family Chart

### 12V applications (40V)

<table>
<thead>
<tr>
<th>Id-nom range</th>
<th>1-Ch Restart</th>
<th>1-Ch Latch</th>
<th>2-Ch Restart</th>
<th>1-Ch Restart</th>
<th>1-Ch Latch</th>
</tr>
</thead>
<tbody>
<tr>
<td>7A</td>
<td><strong>BTS3256D</strong> 7A, 10mΩ, DPAK</td>
<td><strong>BTS3160D</strong> 7.8A, 10mΩ, DPAK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6A</td>
<td><strong>BTS3151D</strong> 6A, 15mΩ, DPAK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5A</td>
<td><strong>BTS142D</strong> 4.6A, 30mΩ, DPAK</td>
<td><strong>BTS3142D</strong> 4.6A, 30mΩ, DPAK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3A- 4A</td>
<td><strong>BTS134D</strong> 3.5A, 50mΩ, DPAK</td>
<td><strong>BTS3134D</strong> 3.5A, 50mΩ, DPAK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3A- 4A</td>
<td><strong>BSP78</strong> 3A, 50mΩ, SOT223</td>
<td><strong>BTS3134N</strong> 3A, 50mΩ, SOT223</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2A</td>
<td><strong>BTS118</strong> 2.4A, 100mΩ, DPAK</td>
<td><strong>BTS3118D</strong> 2.4A, 100mΩ, DPAK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>BSP77</strong> 2.17A, 100mΩ, SOT223</td>
<td><strong>BTS3118N</strong> 2.17A, 100mΩ, SOT223</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1A</td>
<td><strong>BSP76</strong> 1.4A, 200mΩ, SOT223</td>
<td><strong>BTS3110N</strong> 1.4A, 200mΩ, SOT223</td>
<td></td>
<td><strong>BTS3410G</strong> 1.3A, 200mΩ, DSO8</td>
<td></td>
</tr>
<tr>
<td>&lt; 1A</td>
<td><strong>BSP75N</strong> 0.7A, 550mΩ, SOT223</td>
<td></td>
<td></td>
<td><strong>BTS3408G</strong> 0.55A, 550mΩ, DSO8</td>
<td><strong>BSP75N</strong> 0.7A, 550mΩ, SOT223</td>
</tr>
<tr>
<td></td>
<td><strong>BTS3207N</strong> 0.64A, 500mΩ, SOT223</td>
<td></td>
<td></td>
<td><strong>BTS3405G</strong> 0.35A, 700mΩ, DSO8</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>BTS3205G/N</strong> 0.35A, 700mΩ, DSO8 &amp; SOT223</td>
<td></td>
<td></td>
<td><strong>BTS3800SL</strong> 0.4A, 800mΩ, SCT595</td>
<td></td>
</tr>
</tbody>
</table>

### 24V - 42V applications (60V)

<table>
<thead>
<tr>
<th>Id-nom range</th>
<th>1-Ch Restart</th>
<th>1-Ch Latch</th>
<th>2-Ch Restart</th>
<th>1-Ch Restart</th>
<th>1-Ch Latch</th>
</tr>
</thead>
<tbody>
<tr>
<td>12V</td>
<td><strong>BTS949</strong> 6.4A, 18mΩ, TO220</td>
<td></td>
<td></td>
<td><strong>BTS3028SDR</strong> 4.0A, 28mΩ, DPAK3</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>BTS149</strong> 6.4A, 18mΩ, TO220</td>
<td></td>
<td></td>
<td><strong>BTS141TC</strong> 5.1A, 28mΩ, TO220</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>BTS3028SDL</strong> 4.0A, 28mΩ, DPAK3</td>
<td></td>
<td></td>
<td><strong>BTS133TC</strong> 3.8A, 50mΩ, TO220</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>BTS3046SDL</strong> 2.8A, 46mΩ, DPAK3</td>
<td></td>
<td></td>
<td><strong>BTS3104SDL</strong> 2.0A, 104mΩ, DPAK3</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>BTS3104SDR</strong> 2.0A, 104mΩ, DPAK3</td>
<td></td>
<td></td>
<td><strong>BTS3104SDL</strong> 2.0A, 104mΩ, DPAK3</td>
<td></td>
</tr>
</tbody>
</table>

04/07/2010
Smart Multichannel Switches for Engine Management

Application Example

- **Voltage Regulator**
- **Powertrain Controller**
- **CAN / Transceiver**

**10 PWM Channels**
- **TLE 8110EE**
  - SPI Control
- **2 PWM Channels**
  - **TLE 8102SG**
    - SPI Control
- **4 PWM Channels**
  - **TLE 8104E**
    - SPI Control
- **1 PWM Channels**
  - **TLE 7231G**
    - SPI Control

**Injector Coils 1A**
**Inductive Loads 1,5A PWM**
**Cooling fan relay**
**Lambda heating 8A Inrush current**
**Cooling fan relay Idle speed control**
**Camshaft control Exhaust gas recirculation**
**Communication**
**Autom. Relays 100mA - 300mA**
**Signalling 50mA - 500mA**
Typical EMS Loads

- Typical „Load Classes“
  - relay & lamp class
    <300mA; <10Hz, inrush 500mA
  - injector class
    <1.5A; <100Hz; rep clamp
  - solenoid class
    <1.5A; <500Hz
  - solenoid class
    <4A; 500Hz
  - power signal line
    <50mA
  - O2 heater class
    <4-9A; inrush
Powertrain

Portfolio Overview

Product Details
## Smart Multichannel Switches

Basic Advantages of Powertrain Multichannel Family

<table>
<thead>
<tr>
<th>Family Overview (# of channels)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Protection</strong></td>
</tr>
<tr>
<td>- Short circuit and Overload</td>
</tr>
<tr>
<td>- Overtemperature</td>
</tr>
<tr>
<td>- Overvoltage (inductive clamping)</td>
</tr>
<tr>
<td>- Electrostatic discharge (ESD)</td>
</tr>
<tr>
<td>TLE 6214L (2x)</td>
</tr>
<tr>
<td>TLE 6220GP (4x)</td>
</tr>
<tr>
<td>TLE 6228GP (4x)</td>
</tr>
<tr>
<td>TLE 6232GP (6x)</td>
</tr>
<tr>
<td>TLE 6230GP (8x)</td>
</tr>
<tr>
<td>TLE 6240GP (16x)</td>
</tr>
<tr>
<td>TLE 6244X (18x)</td>
</tr>
<tr>
<td>TLE 8102SG (2x)</td>
</tr>
<tr>
<td>TLE 8104E (4x)</td>
</tr>
<tr>
<td>TLE 8110EE (10x)</td>
</tr>
<tr>
<td>TLE 8112SA* (12x)</td>
</tr>
<tr>
<td>TLE 8116SA (16x)</td>
</tr>
<tr>
<td>TLE 8718SA* (18x)</td>
</tr>
</tbody>
</table>

* development ongoing

## Basic Features

- Parallel Inputs for PWM (except TLE87xx families)
- Current limitation
- Open load detection
- Control of outputs via SPI, MSC or PWM (depending on family)
- 5V supply voltage
## Smart Multichannel Switches Portfolio

### Flex – New Device Replacement Correspondence

<table>
<thead>
<tr>
<th>Channels</th>
<th>Current device</th>
<th>Successor device</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>TLE 6244X MQFP64</td>
<td>TLE 8718SA P-DSO-36</td>
</tr>
<tr>
<td>16</td>
<td>TLE 6240GP PG-DSO-36</td>
<td>TLE 8116SA P-DSO-36</td>
</tr>
<tr>
<td>12</td>
<td>TLE 8112SA P-DSO-36</td>
<td>TLE 8110E PG-DSO-36</td>
</tr>
<tr>
<td>10</td>
<td>TLE 8110E PG-DSO-36</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>TLE 6230GP P-DSO-36</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>TLE 6232GP P-DSO-36</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>TLE 6228GP P-DSO-36</td>
<td>TLE 8104E PG-DSO-20</td>
</tr>
<tr>
<td>4</td>
<td>TLE 6220GP P-DSO-20</td>
<td>TLE 8102SG PG-DSO-12</td>
</tr>
<tr>
<td>2</td>
<td>TLE 6214L P-DSO-12</td>
<td></td>
</tr>
</tbody>
</table>

2006-02-11 For internal use only ATV PTS PM
New Flex family
Key Advantages of Flex ASSPs

- **Highest Flexibility required for adaptation to different:**
  - OEM loads
  - Engine configuration levels
  - PCB assemblies

- **Device Package**
  - Improved Thermal performance
  - Miniaturisation

- **Highest Reliability**
  - Protection and diagnostics

2006-02-11
**COREFlex - TLE 8102SG**

**ASSP for O² Heater**

- Smart dual current sense switch designed for fully integrated O²-Heater
- Configurable current limit (up to 8A)
- Low RDS(ON) 2 x 180 mΩ
- Configurable overload and overtemperature behaviour
- Small Outline Power-DSO-12 package

- Integrated proportional load current sense
- 8-bit SPI Interface for control and diagnosis
- Parallel control for PWM
- Standby Mode

**Status**

- ES: 01 / 08
- DR: 04 / 08

---

2006-02-11
**COREFlex - TLE 8104E**
General Purpose Engine Management, Solenoids

![Diagram of TLE 8104E](image)

**Status**
Samples available
In production

- RDS(ON) 4 x 350 mΩ
- High Performance P-DSO-20 exposed pad package
- General Fault Pin for Interrupt on Error
- Stand-by mode with Power Save

- Smart 4 channel low-side switch for engine management loads with lower switching frequency (solenoids, relays, …)
- 8-bit SPI Interface for control and diagnosis
- Parallel control of all channels for PWM
**SPEEDFlex – TLE 8718SA**
Injectors, Solenoids, Relays, General Purpose

- **Status**
  - **ES:** Q1 / 09
  - **DR:** Q2 / 10

- **RDS(ON)**
  - 4 x typ 470mΩ, 10 x typ 720mΩ,
  - 2 x typ 2400mΩ, 2x typ 12Ω

- **High Performance Power PG-DSO 36 package, small due to MSC**

- **Stand-by mode with Power Save**

- **CLAMPsafe™ for efficient parallel connection of equal channels**

- **Smart 18 channel low-side switch for engine management loads (injectors, solenoids, relays, …)**

- **SPI Interface for control and diagnosis**

- **Direct Interface**
### MultiChannel –Switches

#### Flex Family Selection Guide

<table>
<thead>
<tr>
<th>Channel's</th>
<th>Type</th>
<th>RoHS</th>
<th>(V_{CI}) (max) [V]</th>
<th>(R_{DS(	ext{on})}) (typ) [mΩ] (@T_J = 25^\circ\text{C})</th>
<th>(I_{DMAX}) (min) [A]</th>
<th>Package*</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>TLE 8102SG</td>
<td>✓</td>
<td>60</td>
<td>2 x 180</td>
<td>2 x 9.0</td>
<td>PG-DSO-12 (heatslug)</td>
</tr>
<tr>
<td>4</td>
<td>TLE 8104E</td>
<td>✓</td>
<td>60</td>
<td>4 x 320</td>
<td>4 x 3.0</td>
<td>PG-DSO-20 (Exposed Diepad)</td>
</tr>
<tr>
<td>4</td>
<td>TLE 6220GP</td>
<td>✓</td>
<td>60</td>
<td>4 x 320</td>
<td>4 x 3.0</td>
<td>PG-DSO-20 (heatslug)</td>
</tr>
<tr>
<td>6</td>
<td>TLE 6232GP</td>
<td>✓</td>
<td>60</td>
<td>4 x 250 2 x 500</td>
<td>4 x 3.0 2 x 1.5</td>
<td>PG-DSO-36 (heatslug)</td>
</tr>
<tr>
<td>8</td>
<td>TLE 6230GP</td>
<td>–</td>
<td>60</td>
<td>8 x 800</td>
<td>8 x 1.0</td>
<td>PG-DSO-36 (heatslug)</td>
</tr>
<tr>
<td>:0</td>
<td>TLE 8110EE</td>
<td>✓</td>
<td>60</td>
<td>2 x 250 4 x 300 4 x 600</td>
<td>4 x 2.6 4 x 1.7 2 x 3.7</td>
<td>PG-DSO-36 (Exposed Diepad)</td>
</tr>
<tr>
<td>:6</td>
<td>TLE 6240GP</td>
<td>✓</td>
<td>60</td>
<td>4 x 300 4 x 350 8 x 1000</td>
<td>8 x 3.0 8 x 1.0</td>
<td>PG-DSO-36 (heatslug)</td>
</tr>
<tr>
<td>:8</td>
<td>TLE 6244X</td>
<td>✓</td>
<td>60</td>
<td>2 x 220 8 x 300 4 x 320 4 x 620</td>
<td>4 x 1.1 2 x 1.0 12 x 2.2</td>
<td>PG-MHFP-64 (heatslug)</td>
</tr>
<tr>
<td>8</td>
<td>TLE 8718SA*</td>
<td>✓</td>
<td>60</td>
<td>4 x 190 4 x 270 6 x 310 4 x 1000</td>
<td>2 x 3.0/6.0 2 x 3.0 10 x 2.2 4 x 0.6</td>
<td>PG-DSO-36 (heatslug)</td>
</tr>
</tbody>
</table>

*Package: PG-DSO-12 (heatslug), PG-DSO-20 (heatslug), PG-DSO-36 (heatslug), PG-MHFP-64 (heatslug)
Infineon U-Chip for EMS applications

**Sensors**
- Pedal position
- MAP, BAP pressure
- Throttle position
- Camshaft, Crankshaft position

**Supply**
- Voltage Regulator
- Voltage Tracker
- DC/DC Converter Boost / Buck

**Bridges**
- H-Bridges for ETC, EGR, etc.

**Switches**
- LowSide Switches
- HighSide Switches
- Motor Drivers

**Transceiver**
- (HS) CAN
- LIN
- K-LINE

**Features**
- Voltage pre-regulator
- Integrated 5V regulator
- 2 integrated 5V trackers
- Separate internal supply
- Voltage monitoring
- K-LINE interface (KDS9141)
- HS CAN interface
- LIN interface
- Variable resistor sensor interface
- MSG with LVCC pads for low GME
- SPI and parallel inputs for high flexibility
- Main relay control
- 12 low side power stages for various inductive and resistive loads
- 4 low side small signal stages
- 4 half bridge stages for high flexibility
- 7 push pull stages for driving on-board MOSFET with drain feedback
- 4 push pull stages for driving on- and off-board GBT with back supply suppression
- 2 transconductance amplifiers for current measurement
- Over-boost, short-circuit and shorted-BAT diagnostic
- Overtemperature and short-to-BAT protection
- Challenge resistant window watchdog
- Green Pintrist (RoHS compliant)
- AEC Qualified

**Description**
The device is a U-Chip suitable for automotive engine management systems. It contains the basic functionality to supply the µController and the ECU, establish the communication on- and off-board and drive EMS typical actuators. Furthermore it controls the main relay.
Innovative semiconductor solutions for energy efficiency, communications and security.