SPC5 Applications in Various Automotive Systems

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Greater China & South Asia Region
STMicroelectronics
EMS: Monaco + L9779 Solution

Proven Solution in MP

SPC563M64
Monaco
SPC54A80
Andorra
EMS: SPC574K72 + L9788 Solution

Proven Solution in MP

SPC574K72
K2
(SPC58NN84) (Bernina)

L9788

ASILD
SEooc

MSC

Boost Regulator
Buck Regulator
VDDS Regulator
3 x 150mA Tracking Regulator
Key in
Wake
Crank shaft Sensor
Test Machine
Start-Stop Module
Can Network

Pedal supply
Throttle supply
Ign Key
Wake

Knock Sensor
Accelerator-pedal travel
Throttle-valve aperture
Air mass
Battery voltage
Engine temperature

61k SRAM

GTM (Mid-End Version)

CAN FD
Watch Dog
Reset

6x Σ-Δ ADC
2x 10b ADC
5x 12b ADC

6x Σ-Δ ADC
2x 10b ADC
5x 12b ADC

MSC

L9616

L9959/L9960

L9788

Main Relay
Ignition 1-6
Injection 1-4
O2 Heater1-2
Solenoid (Canister Valve/VVT)
EGR
VVT
Turbo Dump Valve
Reserved LSD channels
Fuel Pump Relay
Fan Relay 1
AC switch relay
Fan Relay 2
Starter Relay
Engine Speed Output
Fuel Consumption Output
Reserved Relay Channel
Starter Relay Channel

1 x 1A LSD (MR)
6 x Ignition pre-Driver
4 x 3A LSD (INJ)
2 x 8A LSD (O2H)
2 x 3A LSD (SOL)
5 x MOSFET Pre-driver
5 x 1A LSD (RLY)
2 x 70mA LSD (LED)
3 x 1A HSD/LSD (STR)

19559/19660
DC motor Driver

L9959/19960
DC motor Driver

ETC Motor
Turbo waste gate

VB
5V

DC motor Driver

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Buck Regulator
VDDS Regulator
3 x 150mA Tracking Regulator
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19559/19660
DC motor Driver

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ETC Motor
Turbo waste gate
Key MCU Features

- **Multi-Core Capability**
  - Computational shell + peripheral shell
  - Performance Core + Safety Lock-step core targeted State of art ASIL-D concepts
- **Powerful GTM programmable flexible timer system**
  - Through full submodules modularity, GTM can offer complete scalability for EMS and TCU.
- **Analog Acquisitions**
  - Sigma delta ADCs of high dynamic signals acquisitions
  - SAR ADCs for other acquisitions
  - ADC quence + interleave interface with GTM MCS Core (Bernina)
- **ASIL-D Safety targets**
  - Lockstep, E2E ECC, BIST, monitor supervisor, FCCU, MEMU
- **Different sensors/actuator interface** : SENT, PSI5
- **Advantage engine calibration concepts**
Scooter EMS: SPC560Px + L9177 Solution

Key MCU Features

- **High-end PWM unit**
  - Fast frequency: up to 120MHz on Pictus (higher than f_{CPU})
  - dead time compensation circuit (independent top & bottom)
  - fault inputs

- **Advanced 10Bit ADC peripherals**
  - Fast sampling / overall conversion: 150ns / 800ns
  - Oversampling support for noise cancellation
  - Analog Watchdogs allows fast reaction time upon critical current values
  - Support of all shunt configurations

- **Cross Triggering Unit**
  - Synchronization ADC acquisition/PWM signals requires without CPU load!

- **eTIMER**
  - Support for encoders and hall sensors, crank shaft sensor
Safety Airbag Applications
Airbag: SPC560Px + L9680 (12-ch+4PSI5)

Key Safety Features

- **Core**
  - Supervisor mode support / NMI
- **Error Correction Code (ECC)**
  - Flash, SRAM (single bit correction double bit detection)
- **Monitoring and Provision**
  - Clock monitoring and Provision
  - Power Supervision
  - Software watchdog
- **Safety Key modules**
  - CRC Unit
  - Junction Temperature Sensor
  - Fault Collection Unit

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**SPC560Px Pictus**

- Boost (23V/33V)/Buck/Linear (3.3V/5V)
- ISO 9141
- VSF 7.2v PSI Supply
- 3 GPO Driver
- Watchdog
- 9 channel Hall-effect, resistive or switch sensor interface
- Clock 8MHz
- System voltage diagnostics with integrated ADC
- Temperature sensor

**Arming Logic**

- Roll over
- X/Y ACC

**12 Squib Drivers**

**12V Warning Lamp**

**12V Seat Position**

**Roll over Squib**

**M Code sensors x12**

**High End Application**
**Airbag: Velvety Extension**
(20-Ch + 8 PSI5)

**Safety : Lock – step Core**

Next generation safety concept

Enhanced Safety (DMA, Core-peripheral path, peripheral specific e.g. ADC)  
Reduced cost of safety (smarter than just replication (e.g. E2E ECC))

Increased Availability  
e.g. E2E ECC, MEMU, FCCU

**Advanced Packaging**

High efficiency pinout

Advanced QFP technology

Exposed pad/power bars/ground rings

Small package solution

LFBGA package for high pin count / small package needs
Safety EPS Applications
EPS: SPC560Px + L9907

Key MCU Features

- **High-end PWM unit**
  - Fast frequency: up to 120MHz on Pictus (higher than CPU)
  - Dead time compensation circuit (independent top & bottom)
  - Fault inputs
- **Advanced 10Bit ADC peripherals**
  - Fast sampling / overall conversion: 150ns / 800ns
  - Oversampling support for noise cancellation
  - Analog Watchdogs allows fast reaction time upon critical current values
  - Support of all shunt configurations
- **Cross Triggering Unit**
  - Synchronization ADC acquisition/PWM signals requires without CPU load!
- **eTIMER**
  - Support for encoders and hall sensors
**EPS : SPC574S Safety Application**

**Enhanced MCU Features**

- **Full Dual 3ph BLDC Motor Control**
  - QFP144: Dual 3ph BLDC Motor control
  - QFP100: Single 3ph BLDC motor control
- **Highly enhanced ADC subsystem**
  - Enhanced Safety: Supervisor's ADCs
  - Up to 8ADC for dedicated ADC/phase, simultaneous sampling of all 2*3 phases
- **Next generation safety concept**
  - Safety Lock-step core targeted State of an ASIL-D concepts
  - Enhanced Safety ( DMA, Core-peripheral path, peripheral specific e.g. ADC)
  - Reduced cost of safety ( smarter than just replication e.g. E2E ECC)
  - Increased availability: E2E ECC, MEMU, FCCU
- **FlexPWM**
  - SWG emulation + FlexPWM synchronizer
Safety ABS/ESC Applications
ABS: SPC560Px + L9396 + L9301

Key Safety Features

- Core
  - Supervisor mode support / NMI
- Error Correction Code (ECC)
  - Flash, SRAM (single bit correction double bit detection)
- Monitoring and Provision
  - Clock monitoring and Provision
  - Power Supervision
  - Software watchdog
- Safety Key modules
  - CRC Unit
  - Junction Temperature Sensor
  - Fault Collection Unit
**Enhanced MCU Features**

- **Next generation safety concept**
  - Safety Lock-step core targeted State of art ASIL-D concepts
  - Enhanced Safety (DMA, Core-peripheral path, peripheral specific eg. ADC)
  - Reduced cost of safety (smarter than just replication e.g. E2E ECC)
  - Increased Availability: E2E ECC, MEMU, FCCU

- **Advanced & Flexible supply concept**
  - Fully External Supply or Fully integrated
  - Integrated regulator mode No external ballast, reduced decoupling capacitor

- **Miscellaneous**
  - CANFD protocol supported
  - Core Optimized for best performance/MHz

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**Solution under Development**

**ESC : SPC574S + L9300+L9301**

**Enhanced Safety** (DMA, Core-peripheral path, peripheral specific eg. ADC)

- **Reduced cost of safety** (smarter than just replication e.g. E2E ECC)
- **Increased Availability**: E2E ECC, MEMU, FCCU

- **Advanced & Flexible supply concept**
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- **Miscellaneous**
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**SPC574S Sphaero**

**L9300**

- Voltage Regulators
  - VDD1: buck, 6.5/5V (±3%, 1A)
  - VDD2: Linear, 5V (±2%, 200mA, ±20mV, 200mA)
  - VDD3: Linear, 0.8~5V, 1A
  - VDD4: Linear, 0.8~5V, 1A

**Wheel Speed Sensor Interfaces x 4**

**Warning Lamp**

**GPO Driver**

**Watchdog**

**High-Speed CAN BUS Transceiver**

**ESC : SPC574S + L9300+L9301**

**Pump Motor FET driver (PWM)**

**Failsafe FET driver**

**Configurable Current Control Driver x 6**

**ABS Valve Drivers Low side x 4**

**ABS Valve Drivers PWM x 4**
Body Applications
Key MCU Features

- Versatile Low Power Modes
  - Standby current < 50uA
  - Smart Wake-up unit for periodic monitoring
  - Fast start-up time < 500us

- Autonomous Synchronized Diagnostic
  - OPWMT trigger event define the diagnostic sampling point
  - The Cross Triggering Unit (CTU) Translates a trigger event into an ADC conversion
  - ADC conversion result is stored in a dedicated result register
  - Support of all shunt configurations

- Isolated Hardware Security Module
  - Secure Boot
  - Crypto accelerator (sym and asym algorithms)
  - Evita medium and full

BCM SPC58EC80 System Solution
Body Gateway Applications
Key MCU Features

- **Unprecedented Scalability**
  - HW & SW compatibility / Single Core 64MHz to triple core 200MHz / Flash size

- **Communications**
  - Streaming Ethernet shell ETH AVB2 and TSN support
  - 16 CAN-FD I/F, 24 * LIN, 1 * Flexray

- **Versatile low power modes**
  - Autosar start-up time <100ms
  - Standby current < 50uA

- **Isolated Hardware Security Module**
  - Secure Boot
  - Crypto accelerator (sym and asym algorithm)
  - Evita medium and full
EV/HEV
VCU in HV Platform: SPC574K72 + L9788
K2 Highlights in VCU Application

**ASIL-D**
- True ASIL-D concept relying on HW measures
- Sub digit residual FIT rate
- Provide necessary HW support to implement the application dependent ASIL-D Concept
- Key pillars of SPC57/58 safety architecture:
  - ASIL-D Development Process in place during product development processes
  - Lockstep on each ASILD processing channel (Cores, DMA, Interrupt Controller)
  - Access protection at all Levels of the Architecture (MPUs, e2e ECC)
  - HW Built-In-Self Test for Memory, Logic and specific IPs
  - Clock, Power, Temp., Debug/Test signal supervisions
  - Fault Collection, Control and Identification

**Multi-Core**
- Multicore architecture providing hardware structure that manages performance, power dissipation and safety requirements.
- Multicore architecture to gain system flexibility in dedicating cores for specific tasks
- Core architecture with local instruction & data RAM allowing up to 160KB 0WS memory per core to guarantee high performance on critical code and data sections

**L9788: MSC + GTM**
- I/O serialization is helping to reduce MCU package pin count
  - Microsecond bus for output serialization into L9788
    - More outputs capability from small QFP packages
    - Single ended: 4pins, Differential: 6 pins
- Generic Timer Module (GTM) is a fully programmable and flexible timer system designed to minimize CPU interaction / load.
New SPC5x High Performance Architecture
Answering System Safety Requirements

Increasing safety system requirements are managed through state-of-the-art ASIL-D concepts

- True ASIL-D concept relying on HW measures
- Sub digit residual FIT rate
- Provide necessary HW support to implement the application dependent ASIL-D Concept

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12V BMC/VCU Solution Low Platform

L9001
- Wake
- Buck1 3.3/5V 1A
- VDDA 3.3V/5V 100mA
- Buck2 0.8~5V 1A
- RSTN
- Watchdog

L9966
- ADC 12bit
- ISO-12V
- LDO
- SPI
- Digital Isolate

SPC560B50L5
SPC560B60L7

L9301
- OUT5 LSD
- OUT6 LSD
- OUT7 LSD
- OUT8 LSD
- OUT1 LSD
- OUT2 LSD
- OUT3 LSD
- OUT4 LSD
- OUT9 HSD/LSD
- OUT10 HSD/LSD
- OUT11 HSD/LSD
- OUT12 HSD/LSD

3.3 or 5V
V_ADC

Reset

IN1..8
SPI

IN x
SPI

VIPOWER Driver
HSD

OUT1 LSD
OUT2 LSD
OUT3 LSD
OUT4 LSD
OUT5 LSD
OUT6 LSD
OUT7 LSD
OUT8 LSD
OUT9 LSD
OUT10 LSD
OUT11 LSD
OUT12 LSD

<6A HV+ Contactor
<6A HV- Contactor
<6A Fast CNG+
<6A Fast CNG-
<3A OBC+
<3A Pre CNG
<3A Reserved
<3A Enable
<3A Contactor
<3A H-bridge/L9960
<3A Charger lock
<3A Contactor

Key-in/K15

CAN/L9616 x4

CAN

Insulation HV+
Insulation HV-
Vpack HV+
HV+
Fast charge HV+
OBC HV+
PTC HV+
Reserved
Insulation HV+ En
Insulation HV- En
Vpack HV+ En

Proven Solution in MP
T-Box Solution

Key MCU Features

- 6 CAN interfaces, platform scale
- 12bit ADC: diagnostic function
- eDMA to support SPI, high speed communication
- With external memory interface

![Diagram showing the connections of various components such as Battery, SBC, CAN BUS, CAN Transceiver, Switch Signal Collection, ACC Signal Collection, Voice broadcast module, Microphone, and more.]

Proven Solution in MP
HSM SW Platform Architecture

CUSTOMER

3rd PARTIES

HOST

SWC

SWC

SWC

SWC

RTE

OS

CSM

CryIF

CryDrv

Z4/Intc/…

HSM Registers

HSM

HSM SW Platform Architecture

HSM Services

Request Dispatcher

Key Management

Crypto Algorithm

HSM Interface

HSM Scheduler

Storage

Crypto Drivers

HSM Registers

Z0/Intc/…

MEM

TRNG/AES/HASH

HOST

HSM

3rd PARTIES
Thank You!