Technical Data

SCHAEFFLER ENGINEERING

***PRO*troniC** *TopLINE*

Article-No.: 1012246

Variant TCU (Transmission Control Unit)

***PRO*troniC** *TopLINE* – The All-rounder for production-oriented Rapid Control Prototyping.
The innovative dual processor architecture in combination with flexibly configurable FPGA technology and powerful communication interfaces gives users a completely new range of freedom – and that is all in a compact and robust unit.

Basic System	
Operating Voltage:	6.5 V ... 32 V DC
Temperature Range:	-40 °C ... +75 °C case temperature
Electrical Strength:	Short-circuit against Ground and V_{Bat} for all power supply terminals Power switches are also protected against overload
Mechanical Stress:	Vibration and temperature testing according to DIN ISO 16750-3 Part 4.1.3.1.5.2, DIN EN 60068-2-64
IP code (EN 60529):	IP64K
EMV Stability:	Interference emission/reception tests, CE conformal
External Connector:	2 x 70-pin (AMP) 1 x 5-pin (ODU) 3 x 10-pin (ODU)
Housing:	Aluminium, (W x H x L) 281 mm x 86 mm x 250 mm
Weight:	Approx. 6 kg

Dual-Processor Module	
Main Processor:	NXP MPC8544 (@1 GHz) ▪ 256 KByte level 2 cache ▪ double precision Floating-Point-Unit
Memory:	Flash: 64 MByte RAM: 256 MByte EEPROM: 32 KByte
Co-Processor:	IBM PPC440 (@400 MHz)
Memory:	Flash: 32 MByte DDR2-RAM: 32 MByte SRAM: 4 MByte EEPROM: 256 kbit
FPGA:	Virtex5 including 71,680 Logic Cells
Timer:	Wake-up via user configurable timer
Watchdog:	Watchdog for system monitoring

For further information and a current price list, please contact us at: info@schaeffler-engineering.com

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Communication Interfaces	
Measurement- & Calibration System:	1 x 10/100 Mbit/s Ethernet, galvanically isolated up to 1500 Vrms, fully compliant to standard-Ethernet-Network
Protocol:	XCP on TCP/IP, XCP on UDP/IP
IP-Address Distribution:	Manually or via DHCP
CAN:	3 x CAN 2.0B Full-CAN (High-Speed, 1 MBaud max./ISO DIS 11898) Alternative[3] 2 x ISO DIS 11898 and 1 x ISO DIS 11992 possible, 1 x CAN 2.0B Full-CAN (High-Speed, 1 MBaud max./ISO DIS 11898) wake-up capability
FlexRay (available as an option):	1 x FlexRay (2 channels) according to protocol specification 2.1, ■ Freescale MFR4310 Communication Controller ■ Software switchable termination ■ Feed-through support to avoid stubs (if termination is not activated)
LIN[2]:	2 x LIN, according to LIN specification 1.3, 2.0, 2.1, 2.2 Configurable as LIN-Master or LIN-Slave
Automotive Ethernet[5]:	2 x BroadR-Reach® Ethernet
SENT[6]:	6 x SENT, according to SENT specification SAE J2716 Configurable in groups of 3 as SENT-Master or SENT-Slave

The following interfaces are supported by hardware, but currently not supported by software	
LVDS[1]:	2 x 250 Mbit/s LVDS (low voltage differential signal), with dual ported memory

Analog Inputs	
Number:	24, 4 groups each with 6 channels Standard hardware set-up: 6 x: U = 0 ... 10.14 V, fc = 14 kHz, typical application: load amplifier, pressure sensor 2 x: U = 0 ... 10.14 V, fc = 1.4 kHz, typical application: pressure sensor, active sensors 6 x: U = 0 ... 5.07 V, fc = 0.7 kHz, typical application: pressure sensor, active sensors 6 x: U = 0 ... 5.07 V, fc = 0.7 kHz, typical application: temperature sensor 4 x: U = 0 ... 5.07 V, fc = 0.7 kHz, typical application: potentiometer, positional sensor
Resolution:	12 Bit
Input Voltage:	Uni-polar or bi-polar (depending on hardware set-up)
Input Filter (analog):	Low-pass 1st order, cut-off frequency can be set via hardware set-up
Input Filter (digital):	Low-pass 1st order, cut-off frequency configurable
Dynamic Behaviour:	Sampling rate per channel: › 100 kHz
Signal Types:	■ Analog input ■ Digital input (with programmable threshold and hysteresis)
Sensor Supply:	Per group: 0 V ... VBat / 100 mA

Analog Outputs, alternative[3] to Analog Input Group 4	
Number:	6, one group with 6 channels
Resolution:	12 Bit
Output Voltage:	0 ... 10 V/max. 10 mA
Dynamic Behaviour:	Update rate: 70 kHz

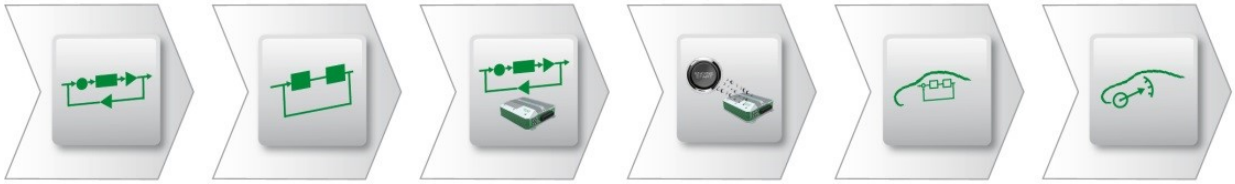
Fast Digital Inputs / Outputs	
Number:	12, 2 groups each with 6 channels, in groups as input / output configurable
Input:	5 ... 32 V, threshold configurable group-wise, standard equipment: 24.8 kΩ, pull-down
Output:	Push/pull output 75 Ω
Input signal types:	▪ Digital input ▪ Pulse and frequency measurement input ▪ Event generation at edge change input
Output signal types:	▪ Digital output ▪ PWM output

Power Switch Outputs	
Number:	16, 2 groups with 6 channels each and 1 group with 4 channels
Supply:	Per group, 6.5 ... 52 V external
Output:	Push/pull, low side or high side output 5 A, 11 A peak Parallel switching of up to 6 channels possible Load capacity of supply: max. 20 A per group
Signal Types:	▪ Digital output ▪ PWM output, 20 Hz ... 10 kHz ▪ Full bridge output, 20 Hz ... 10 kHz ▪ Peak & Hold output, 20 Hz ...10 kHz ▪ Peak & Hold current measurement ▪ Pulse output (angle-synchronous) ▪ Ignition output (control of external power stages), max. 20 ms ▪ Current controlled output

Variable Force / Proportional Solenoid Outputs	
Number:	16 independent current controlled outputs 2 groups with 8 low-side switches and one common high-side switch each
Supply:	Internal; KL30 protected
Outputs:	Current controlled with integrated PI controller and dither Load capacity of supply: max. 10 A per group
Features:	▪ Configurable output current with 11 bit resolution – Current control range = 0 to 2.4A (peak 3.2A) – Resolution = 1.56 mA (typ.) – Error: +/- 2% full scale over temperature (when autozero is used) ▪ Configurable PWM frequency 20 Hz to 4 kHz (typ.) ▪ Integrated P-I Controller for each channel with configurable gain – Configurable KP and KI coefficients for each PI controller channel ▪ Configurable dither – The dither can be configured for each channel independently by setting a dither step size and the number of PWM periods in each dither period. ▪ Protection – Over current shutdown – Over current threshold – Over current delay time – Over current retry time ▪ Diagnostics – Over current – Open load in on state – Open load in off state – Short to ground ▪ Control loop monitor capabilities – Average current measurement over the last completed dither or PWM cycle for a selected channel – Minimum and maximum current measurements over the last completed dither cycle for a selected channel

[1] Only supported by hardware, currently not supported by software.
[2] Additional software required (LIN ACI-Blockset).
[3] Not included in standard version.
[4] For incremental sensors, a lower maximum rev. speed applies depending on the number of teeth.
[5] Can be used only as Bypass-Master interface. Additional software required (Bypass ACI-Blockset).
[6] While using the SENT interface the fast digital I/O groups will be reduced by one.

Development Environment



Smooth transition from design to mass production

The development environment of the ***PRO*troniC** *TopLINE* is based on tools that are widespread in the automotive industry. It not only offers free scope when choosing the code generator but also for measurement and calibration tools.

1 Model-based software development

- Graphical modeling of control functions with MATLAB®, Simulink® and Stateflow®.

2 Offline simulation

- Testing and optimisation of the functional design against a plant design using offline simulation on the PC with MATLAB®, Simulink® and Stateflow®.

3 Hardware mapping

- Mapping and configuration of the control functions in the model to the inputs and outputs of the hardware using a graphic block library based on Simulink® – Application Controller Interface (ACI).

4 Automatic code generation

- Generation of highly efficient production code at the press of a button, alternatively with the code generators TargetLink® or Embedded Coder™.

5 Test and verification

- Downloading the generated software to the control unit with Schaeffler Engineering boot loader tool.
- Testing and verification of the new developed control functions on a test-stand, in the vehicle or via hardware-in-the-loop simulation.

6 Measurement and calibration

- Fine tuning and measurement of the control functions using a measurement and calibration tool, alternatively with **MARC I**, INCA or CANape.