

## 8 SAFE DIGITAL OUTPUTS, HIGH-SIDE SWITCHING FOR D-SC



- 8 digital outputs, 24 V, 48 V, 72 V, 96 V, 110 V
- 300 mA per channel, 1200 mA total
- High-side switch outputs (load to ground)
- Optical isolation from other cards
- Fail-safe board architecture
- Certified to EN 5012x (SIL 2/4), EN 50159, IEC 61508 (SIL 2/3)
- Developed acc. to EN 50129, EN 50128, IEC 61508
- Extensive supervision functions
- EN 50155 fully compliant
- -40°C to +85°C
- Conformal coating



### DIGITAL OUTPUTS FOR D-SC

The K1 is a safe digital output card for use in the duagon SAFE CONTROL (d-SC) System. The d-SC platform performs safe train control functions in rolling stock applications like Automated Train Protection (ATP) or CBTC (Communications Based Train Control). It usually consists of a controller system, e.g., MH50C, and safe remote I/O boxes, e.g., KT8. The K1 can be plugged into any of these systems, with one card providing 8 safe digital outputs with read-back and testing capabilities.

### SAFE COMMUNICATION (ETHERCAT AND FSOE)

d-SC I/O boards are EtherCAT slave devices, connected to the host via a backplane "EBUS" link. On top of EtherCAT, a safety layer called FSoE (Fail Safe Over EtherCAT) provides safe real-time Ethernet communication between the host system and the I/O board.

### MADE FOR RAIL I/O FUNCTIONS

The K1 can switch voltages from 24 V to 110 V nominal as specified by EN 50155. Typical loads are relay coils, digital inputs of other systems or LED indicators. The outputs are high-side switching, i.e. the load has to be connected to the low side. The I/O card provides functional safety: it enters the safe state if it detects an error. Front I/O is connected via a 24-pin PCB plug for fast installation thanks to reduced wiring.

### SAFETY-CERTIFIED

The K1 is certified to CENELEC standards EN 50128 and EN 50129. The board is developed in a SIL 4 process according to EN 50128 and EN 50129. The systematic capability of the K1 is SIL 3 according

to IEC 61508. However, to control a SIL 4 function according to EN 50128 and EN 50129 or SIL 3 function according to IEC 61508, the system design must provide a second cut-off path to put the load into a safe state. All d-SC I/O components come with dedicated certification packages from TÜV SÜD, reducing the integrator's certification effort and risk, and resulting in lower integration costs.

### EN 50155 ROLLING STOCK COMPLIANCE

Being usable in all types of different trains optimizes the card's interoperability. It supports operating temperatures of -40°C to +85°C according to EN 50155 class TX. Standard boards include conformal coating. With full EN 50155 compliance and a long-term availability on the market of 10 years minimum from the start of series production, the K1 is a rail-ready component. If required, the K1 can also comply to Railways (Wayside) standard EN 50121-4 and Industrial standard EN 61000-4-5 by connecting an external EMC suppressor circuitry.

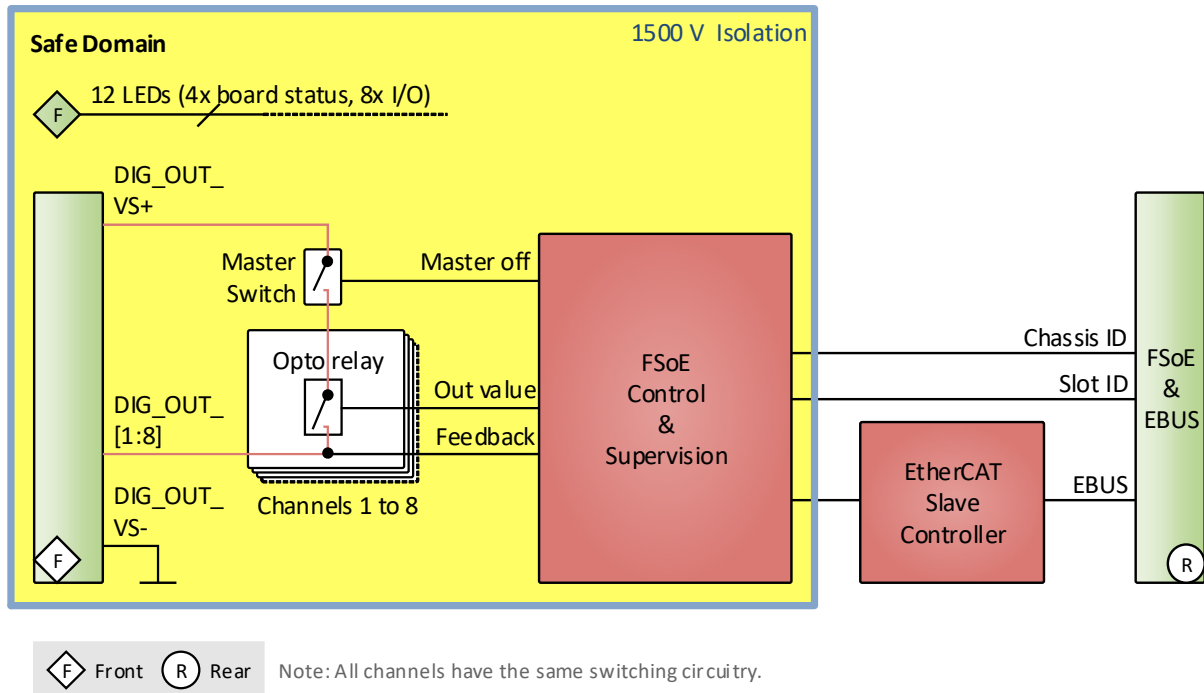
### SAFE SOFTWARE CONCEPT

All d-SC components are supported by certified QNX BSP and driver software. Application software accesses the K1 via the PACY software framework (Process Data Framework for Cyclic Applications). Its API allows the application to control and monitor all features of the K1.



**DATA SHEET**

## K1 | DIAGRAM



## K1 | TECHNICAL DATA

## DIGITAL OUTPUTS

- Eight channels
- Output voltage
  - 24 V, 48 V, 72 V, 96 V, 110 V nom. (EN 50155)
  - Voltage supplied from external source
- Output current
  - 300 mA max. per channel
  - 1200 mA max. total
- Output type
  - High-side switch outputs (load to ground)

## FRONT INTERFACES

- Digital I/O
  - One 24-pin PCB plug
  - Eight output channels

- Status LEDs
  - Binary channel status, one LED per channel
  - I/O error
  - FSoE activity
  - Real-time Ethernet error
  - Real-time Ethernet state indication

## REAR INTERFACES

- EBUS
  - Two real-time Ethernet channels, ETG.1000
- d-SC FSoE
  - Slot ID and chassis ID for unique FSoE address



## SUPERVISION AND CONTROL

- Safe supervisor
  - Check for overvoltage, undervoltage, excess temperature
  - Watchdog
  - Monitor self-test
  - Clock monitoring

## BACKPLANE STANDARD

- ETG.1000 EBUS

## ELECTRICAL SPECIFICATIONS

- Supply voltage
  - +12 V (10.8 to 13.2 V)
- Power consumption
  - 1.6 W typ.
  - 2.5 W max.

## MECHANICAL SPECIFICATIONS

- Dimensions
  - 100 mm x 100 mm, 4 HP
- Weight
  - 192 g (model 06K001-10)

## ENVIRONMENTAL SPECIFICATIONS

- Classification for railway applications
  - EN 50155: Rolling stock, vehicle body
  - EN 50125-3: Wayside, at least 1 m off the track inside a switch box, low temperature class T2 and high temperature class TX
- Temperature range (operation)
  - -40°C to +85°C (EN 50155, class TX)
- Temperature range (storage): -40°C to +85°C
- Cooling concept
  - Air-cooled, airflow 0.5 m/s
- Humidity
  - EN 50155: Rolling stock, vehicle body
- Vibration/Shock
  - EN 50155: Rolling stock, vehicle body class B
- Altitude: -300 m to +3000 m
- Pollution degree: PD 2
- Useful life: 20 years

## RELIABILITY

- MTBF
  - 757 137 h @ 40°C according to IEC/TR 62380 (RDF 2000) (model 06K001-10)

## SAFETY

- Functional Safety
  - Certifiable to SIL 2 with single channel according to EN 50129
  - Certifiable to SIL 4 with dual channel according to EN 50129
  - Hazard rate (HR=PFH) for safety functions  $\leq 3E-9$  / h (single card configuration)
  - SIL 2 according to IEC 61508 with single channel (HFT=0)
  - SIL 3 according to IEC 61508 with dual channel (HFT=1)
  - SFF > 99% according to IEC 61508
  - Board maintains safe state after a failure
- Electrical Safety
  - EN 50155: Rolling stock, vehicle body
- Flammability (PCBs)
  - UL 94 V-0
- Fire Protection
  - EN 45545-2, hazard levels HL1 to HL3

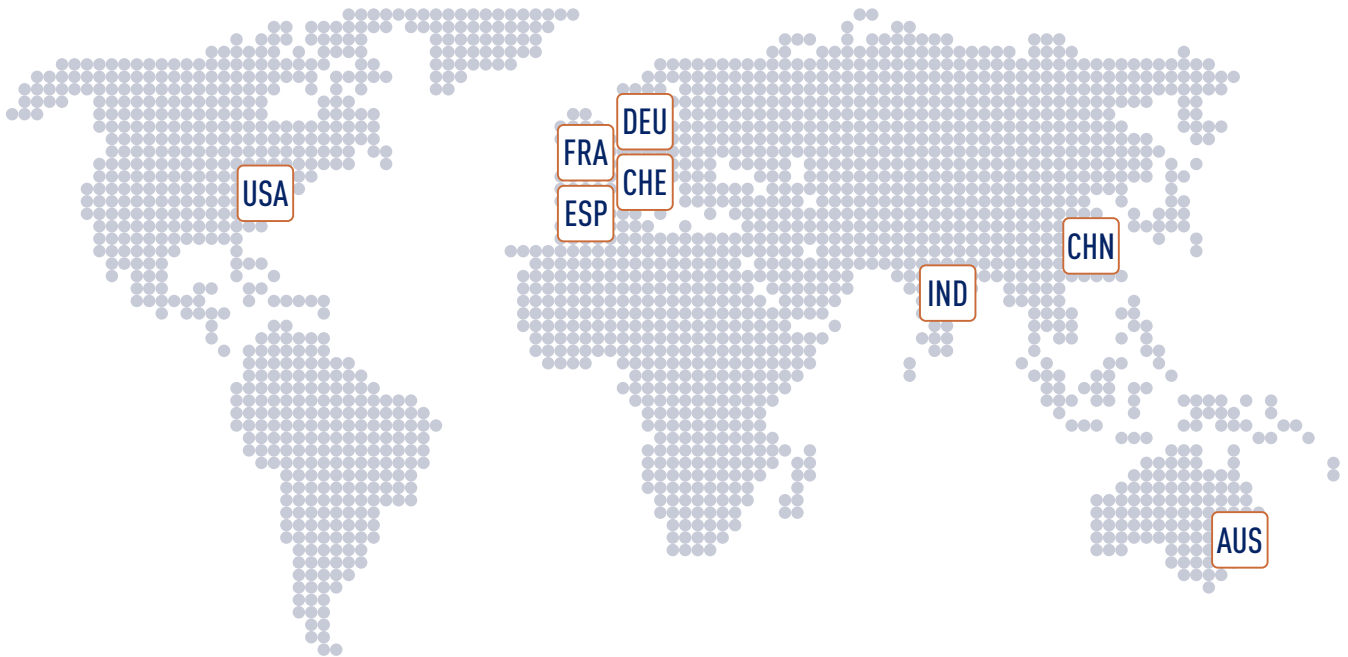
## EMC

- EN 50155: Rolling stock, vehicle body

## SOFTWARE SUPPORT

- PACY (Process Data Framework for Cyclic Applications)
- QNX

► See the product User Manual for details on software support: [www.duagon.com/products/k1/#doc](http://www.duagon.com/products/k1/#doc)



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