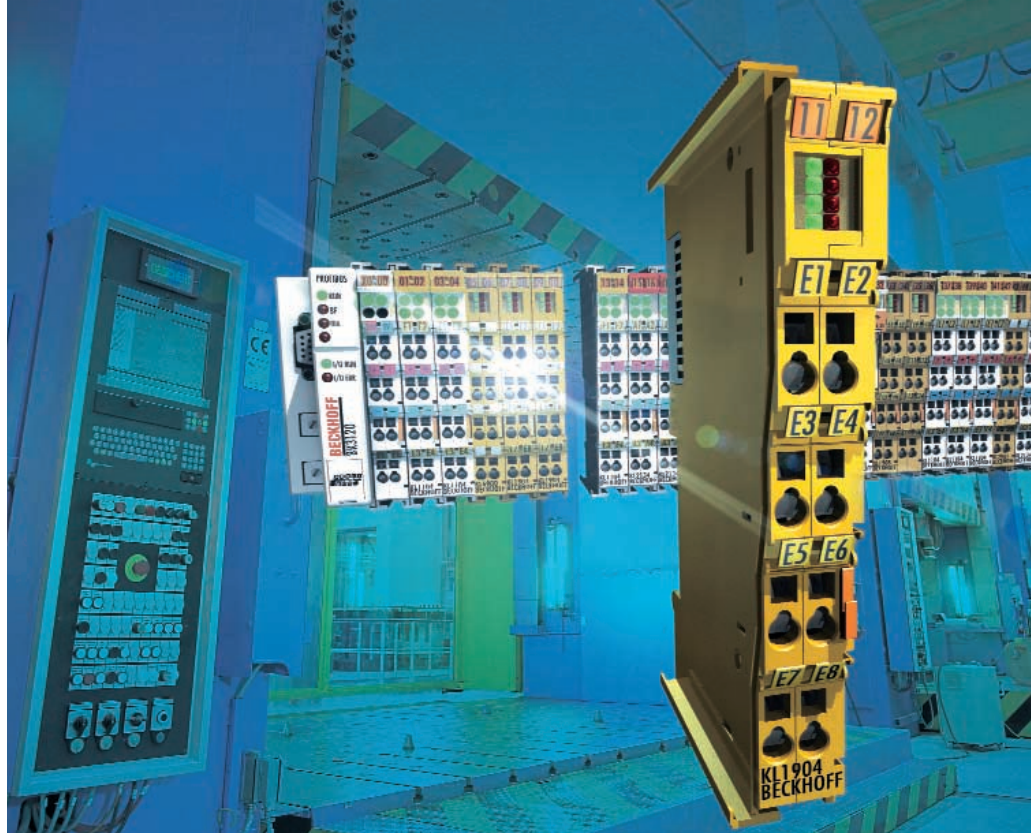


## Safety technology with TwinSAFE Bus Terminals and PROFIsafe technology



→ Fieldbus technology has benefited users in nearly all automation applications. The wiring effort has been reduced, and the machines and systems have become more modular and smaller. New techniques and components tap further potential for rationalization. A previously unexploited aspect of fieldbus technology, safety technology, is now attracting more and more attention.

## Fieldbus technology? – A safe bet!

The wiring of Emergency Off switches, light barriers and other components ensuring machine safety now takes up a significant proportion of the space available in cable ducts and control cabinets. High time for fieldbus technology to deal with the transfer of safety-relevant signals. Technically this has already been possible for some time, but the problem so far has been the absence of a manufacturer-independent open interface with a certificate guaranteeing adequate safety.

With the integration of safety technology into the Beckhoff Bus Terminal system, the advantages of the fieldbus system now also apply to applications in the machine and plant safety sector. The new TwinSAFE Bus Terminals are PROFIsafe-compatible and can be operated in stand-alone mode or with an associated fail-safe control.

### The I/O construction kit is extended “safely”

The merging of safety and I/O equipment in the Bus Terminal system provides added benefits to the customer. The total solution costs in terms of components, assembly and planning work are minimized. A reduced number of interfaces makes the system easier to comprehend, and simplifies access to all safety-relevant information.

The “safety technology” in the I/O system opens new applications to the user, allowing machines and plants to become more compact and efficient. Applica-

tions automated with TwinSAFE offer significantly higher diagnostic levels and reduced downtimes. The user only needs to know one system, TwinSAFE, and not multiple safety systems.

With the new TwinSAFE Bus Terminals, Beckhoff offers the option of expanding the proven Bus Terminal system very easily with safety Bus Terminals, thereby replacing the complete cabling for safety circuits. “Safe” signals can be mixed with standard signals without restriction. This saves design effort, installation and material. Maintenance is simplified significantly through faster diagnosis and simple replacement of only a few components. The new TwinSAFE Bus Terminals only include three basic functionalities: digital KL19xx input terminals, digital KL29xx output terminals and a KL6900 link unit. This enables all common safety sensors and actuators to be connected, e.g. emergency off switch, safety lock, position switch, two-hand switch, cable-operated switch, light curtain, light barrier, laser scanner etc., as well as actuators such as contactor, protective door switch with tumbler, signal lamp or servoamplifier.

### PROFIsafe-based safety concept

The TwinSAFE Bus Terminals are based on the new PROFIsafe standard. Together with a PROFIsafe-compatible fail-safe control, applications ranging from simple to complex can be realized. The Profibus User Organization (PNO) has created a “profile” for secure data transmission in PROFIsafe that permits safety devices to

be operated within the Profibus network. No changes to the RS485 bus cable or the wiring are required. Only one fieldbus system for safety-related and non-safety-related automation tasks is implemented. PROFIsafe can be used for tasks up to SIL3 IEC 61508, Cat. 4 EN 954 or DIN V 19251 AK 6. Mechanisms were created for safeguarding the data against the following types of fault: repetition, loss, insertion, wrong sequence, corruption of the user data, delay, coupling of safety-relevant and non-safety-relevant data and incorrect addressing.

PROFIsafe offers consecutive numbering of the safety telegrams. The communication is time-monitored at the master and at the slave and is password-protected. For safeguarding data integrity, PROFIsafe uses a 16/32 bit CRC (cyclic redundancy check). A maximum of 12 (16 bit CRC) or 122 bytes (32 bit CRC) of fail-safe data can be transmitted per telegram. As part of the secure telegram, the PROFIsafe user not only transfers user data but also a status byte or a control byte. The state of the communication partner and of the data transmission link is checked for each telegram via the life counter, (sequenz number).

### Fieldbus-independent solution

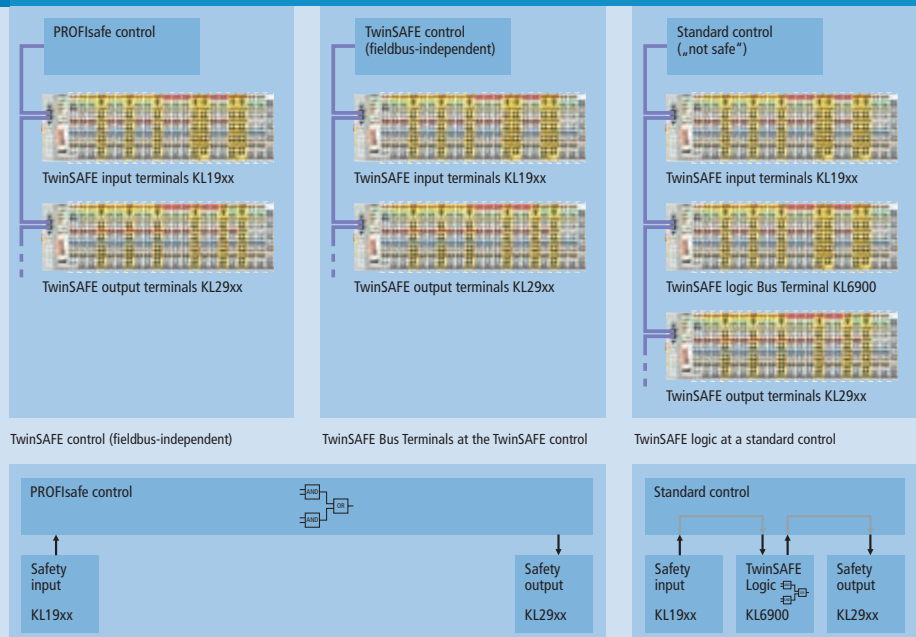
The mechanisms used by PROFIsafe keep the data inside a data frame safe from the possible effects of the transmission route. As well as Profibus, this route could include any other transmission system. From the point of view of a bus system, PROFIsafe represents a small data block that has to be transported coherently and without error – which is not a particularly difficult task for a fieldbus. The implementation of secure data packing in a Bus Terminal means that the secure data is available for any fieldbus. The only condition is that an appropriate Bus Coupler exists for the bus system. The facility for also transmitting the

PROFIsafe data over a number of different bus systems at the same time is particularly helpful for users. "Secure data" can therefore be exchanged across the boundaries of different controllers and systems.

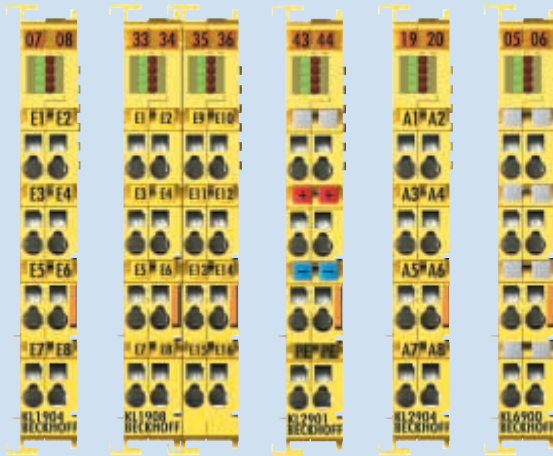
### Fail-safe PLC functionalities in Bus Terminals

The current safety solution using one or more safety relays gets expensive because of the very limited possibilities for combining the signals logically. The classic safety PLC saves space and makes assembly easier, but can cost more than the drives, PLC, and HMI combined. The controller looks on either of these approaches as an isolated solution. The interface that is able to provide information about the status of the safety controller consists of a few digital signal contacts that are given additional wiring, or of a fieldbus interface that requires considerable effort to parameterize.

The TwinSAFE Bus Terminals operate together with PROFIsafe-compatible secure controllers. In small to medium-size applications, the secure inputs and outputs are operated on a "non-secure" controller with the KL6900 TwinSAFE Logic Bus Terminal. A higher-level PLC or a CX1000 Embedded PC or a series BC or BX Bus Terminal Controller with directly connected safety terminals can serve as controller. The TwinSAFE Logic Bus Terminal is the link unit between the safety input and output terminals. It enables the configuration of a simple, flexible and cost-effective decentralized fail-safe control with up to 64 channels. To this end, the required logical safety functions for linking the inputs with the outputs are implemented as a function block and are parameterized depending on the application. For small configurations, the tasks of a small fail-safe PLC can thus be handled within the Bus Terminal system. The additional expense required for the in-



## Standard and safety I/Os in a single system



The KL1904 and KL1908 TwinSAFE Bus Terminals are digital input terminals with four and eight fail-safe channels respectively. With two-channel connection, the terminals meet the requirements of IEC 61508 SIL3 and EN 954 Cat. 4 or DIN V 19251 AK6.

The KL2904 TwinSAFE Bus Terminal is a digital output terminal with four channels. It switches 24 V DC actuators with up to 2 A. The safety standards SIL3 according to IEC 61508 or EN 954 Cat. 4 and DIN V 19251 AK6 are satisfied by the KL2904 Safety Bus Terminal. If the Bus Terminal detects a fault, it switches off automatically (fail stop).

The KL2901 TwinSAFE Bus Terminal is a potential feed terminal with integrated switch-off of the power supply. These feed terminals can be placed at any location between the input and output terminals of a Bus Terminals station. The potential is transferred to the subsequent Bus Terminal via the power contacts. This enables separate potential groups to be realized at a bus station. The KL2901 communicates with the fail-safe control via the PROFIsafe protocol and can be switched off by a higher-level fail-safe control. Switch-off also occurs if the terminal detects an internal fault (fail stop).



interface in the controller PLC is no longer needed. All the states of the "safe controller" are generally available. The KL6900 is suitable for applications up to SIL3 (Safety Integrity Level) according to IEC 61508 or EN 954 Cat. 4 and DIN V 19251 AK6.

The TwinSAFE Logic is easily parameterized via the Bus Coupler or the fieldbus. For the PC, the TwinCAT System Manager is available as a tool. Independently of TwinCAT, the KL6900 can be configured through the Bus Coupler using the KS2000 configuration software. Parameters that have once been chosen are stored in the terminal and secured against power failure or corruption. Access is password protected. Operation is only possible in a secured condition that has not been interfered with.

With the Beckhoff Bus Terminals and based on PROFIsafe, users can now install and operate comprehensive automation networks, including safety-relevant applications, very cost-efficiently. The TwinSAFE system offers open standard hardware and software interfaces for safety technology. Through co-operation in the working groups of different user organizations, Beckhoff have actively contributed to the implementation of new technologies in user-friendly standards.

### Further developments

The Safety Logic KL6900 brings a new performance class to the world of secure signal processing: it is more than a relay, and less than a secure PLC. The KL6900 is limited to a maximum of 64 channels, in order to hold the cost down for small and simple applications. The number of channels can be increased by combining more than one KL6900. Using the Safety Logic at the various hierarchical levels of the secure signals makes an ideal adaptation to the requirements of the plant possible. Complex signal processing and reaction times below 50 ms remain tasks that must be undertaken by a secure PLC.

As a next step, Beckhoff will offer a fast, secure PLC. A total reaction time for the system of 2 ms and a link time of 100  $\mu$ s for 1 kB commands are the targeted performance. The secure PLC is under development as a piggy back for plugging on to a PC fieldbus card or a fieldbus master in the CX1000 Embedded PC family. Programming is carried out, as usual, in IEC 61131-3. The link to the "non-secure" part of the PLC is automatically implemented by the system. From the user's point of view, the secure signals are simply "secure variables" that can be linked into the program at any location.

### Product announcement

Estimated market release for the TwinSAFE terminals KL190x, KL2904, KL2901 4th quarter 2003. The TwinSAFE logic terminal in 1st quarter 2004. We reserve the right to make technical changes.