GEC ALSTHOM

T&D

K-Bus Interface Guide

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Preface

This document details the K-Bus communication standard used on GEC ALSTHOM T&D Protection & Control relays in sufficient detail to enable third parties to interface these relays to other systems and to develop other slave devices (relays) which utilise this communication system. It describes how messages are formed and transmitted from one device to another. It does not describe what the messages mean as this is dependent on the application to which K-Bus is put and the particular format of the data that is transmitted.

This guide should be used with the appropriate user guide for the particular application that the K-Bus system will be used with.

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Chapter 1: K-Bus Communication Standard

K-Bus is a communication system which was developed to connect remote devices (slave devices) to a central point of access (a master control unit), thus allowing remote control and monitoring functions to be performed using an appropriate communication language. It is not designed to allow direct communication between slave devices, but merely between a master control unit and several slave devices. It was initially developed for use in the electrical supply industry at distribution voltage levels, but can equally be applied to other voltage levels or indeed in other systems which would benefit from such a communication system.

The main concerns of a communication system at this level are as follows:

1. Cost effectiveness.
2. Security.
3. Ease of installation.
4. Ease of use.

The K-Bus standard described in this document is oriented on the ISO-OSI model 2 of open systems interconnection, the enhanced performance architecture (EPA).

Layer	Name
7	Application
6	
5	
4	
3	
2	Link
1	Physical

Model 2: Enhanced Performance Architecture (EPA)

K-Bus equates to layers 1 and 2 of the model, the physical network. The Courier Protocol equates to layer 7 of the model, the application layer, which is described in a separate document.

1.1. PHYSICAL LAYER

This part of the model defines the physical medium of the communication standard and how it is connected.

1.1.1. TRANSMISSION MEDIUM

Recommended cable:
Twisted pair of wires with outer screen, to DEF STANDARD 16-2-2c 16/0.2mm dia., 40 mohm/M per core, 171 pf/M core/core, 288 pf/M core/screen.

Connection Method
K-Bus is a multi-drop standard. The K-Bus cable extends from a Master Control Unit and is daisy-chained from one Slave Device to the next in a radial fashion. The total K-Bus cable from the master control unit to the farthest slave device is known as a spur. Each spur must contain one Master Control Unit which may be connected at any point on the spur. No branches may be made from the spur.

Cable Termination:
4mm looped screw termination or fast-on connection (as per MiDOS standard screw terminations). The outer screen should be earthed at one point of the cable only, preferably at the connection to a Master Control Unit. The transmission wires should be terminated using a 150 Ohm resistor at both extreme ends of the cable.

Cable Polarity:
No polarisation is required for the 2 twisted wires.

Maximum Spur length:
1000m.

Maximum Slave Devices per Spur:
32.

1.1.2. K-BUS ELECTRICAL STANDARD:

Electrical Interface:
Transformer coupled:
Primary: 100T, 0.15mm
Secondary: 100T, 0.15mm
Primary Inductance = 60mH
RM6 core to DIN41980 & IEC431
Signal transformer grade ferrite:
Initial permeability, $\mu_i = 10{,}000$
Effective area $A_e = 36.6mm^2$

Isolation:
2kV rms for one minute.

Voltage Signals:
Based on RS485 differential voltage levels:
Unloaded driver differential output = ±5V.
Receiver input sensitivity = ±200mV.

K-Bus interface

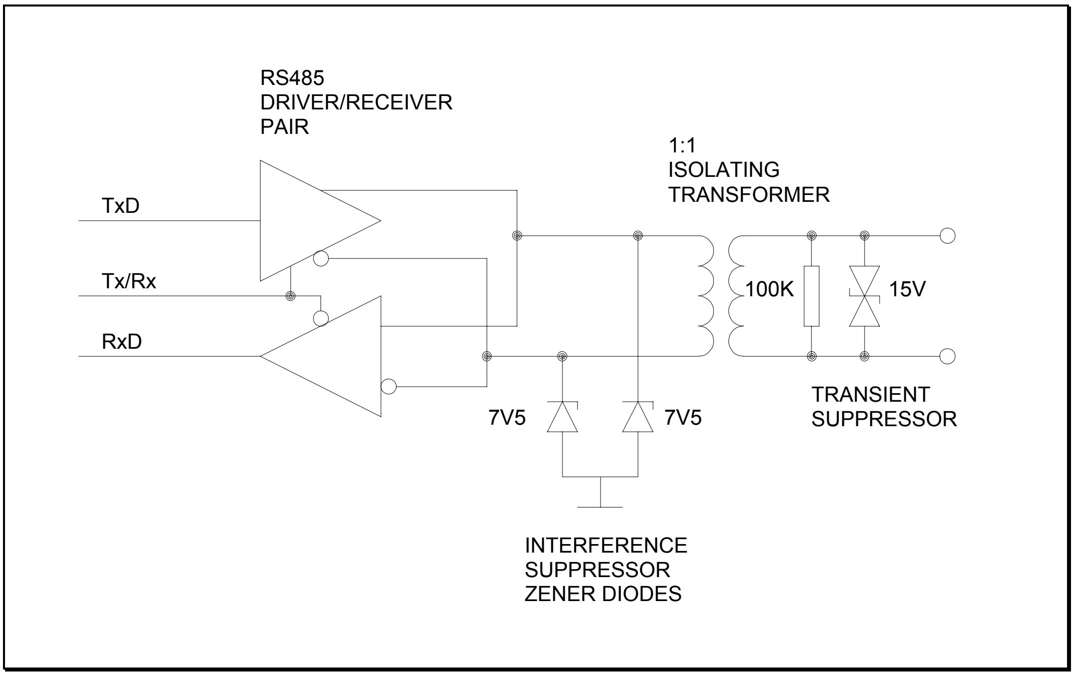

Figure 1. Circuit diagram of K-Bus electrical interface.

1.1.3. TRANSMISSION METHOD

Transmission :
Half Duplex synchronous transmission.

Transmission Rate:
64Kbits/sec.

Data Encoding:
Frequency modulated signal using FM0 encoding.
A digital 0 is represented by 1 cycle of 64KHz.
A digital 1 is represented by 1/2 cycle of 32KHz.
Line idle is indicated by no differential voltage level between the two transmission wires.

1.2. DATA LINK LAYER

1.2.1. MEDIA ACCESS

The media access layer defines how access is obtained on the media to transport data.

K-Bus messages are transmitted as frames. A K-Bus frame is based upon the ISO High level Data Link Control (HDLC) protocol. This is a bit oriented protocol and eliminates much of the control overhead associated with byte oriented protocols. The information field of the HDLC frame is totally transparent and the information can take on any form and contain any binary bit combination. The HDLC standards define the proper operation of the data link for both point to point and multi-point configurations.

Preamble FFh FFh	*Start flag*	*Address AA*	*HDLC Information field xx xx ...... xx xx*	*CRC xx xx*	*Stop flag*

Figure 2. K-Bus message frame.

A frame begins with a preamble of at least 16 bits of the lower of the two frequencies (1 in FM0) to allow the receiver to synchronise with the incoming data stream. This is followed by one or more start flags consisting of a binary sequence of 01111110 (7Eh). The frame is terminated by a stop flag, also consisting of a binary sequence of 01111110 (7Eh). In order to make the start and stop flags unique, the HDLC protocol uses zero bit insertion to prevent any more than 5 consecutive bits of 1 from being sent in any of the fields between the start and stop flag of the frame.

The address field is a single byte which designates the destination device in request messages from a master control unit to a slave device and the source device in response messages from a slave device to a master control unit. A slave device should only receive messages with an address field matching its own device address or the global address of 255. Master control units should accept all messages from slave devices regardless of the address field.

The two bytes immediately preceding the stop flag consist of a Cyclic Redundancy Checksum (CRC) using the CCITT polynomial ($X^{16}+X^{12}+X^5+1$), calculated over the whole of the HDLC information field and the address field. The CRC is normally appended and checked by the serial communication controller.

The HDLC information field is located between the start flag and the CRC field.

1.2.2. LOGICAL LINK

The logical link layer defines a valid K-Bus frame for a network address and its format. Invalid frames should be discarded.

HDLC Information Field:

Network Address	*Length*	*Data field*
{AA..AA} 00	Lk	dd..dd

Figure 3. HDLC Information field.

The network address field allows the address field to be extended by an additional 0 to 5 address bytes. The network address field is terminated by a zero byte, thus precluding any of the 5 possible additional address bytes from taking the value 0.

The length byte (Lk) is used to indicate how many bytes of data there are in the remainder of the information field. This length bytes gives additional security over the standard HDLC frame validation and should be compared with the total frame length to guard against zero bit insertion errors. There should be a whole number of bytes in the HDLC information field.

The Data Field of the information field is totally transparent and the information can take on any form and contain any binary bit combination.

Chapter 2: K-Bus Addressing

A single K-Bus spur consists of a Master Control Unit and up to 32 Slave Devices. A Master Control Unit may be interfaced to a maximum of 8 spurs. Each slave device has a single byte device address in the range 0-255, although addresses 0 and 255 have special functions described below. No two slave devices connected to a Master Control Unit may have the same device address. To ease the allocation of addresses to spurs, all slave devices on the same spur will have addresses in the same 32 address range as follows:

Spur	Address Range
1	1-31
2	32-63
3	64-95
4	96-127
5	128-159
6	160-191
7	192-223
8	224-254

Table 1. K-Bus spur address ranges.

Reserved addresses:

Address 255 is a global address. Request frames transmitted to address 255 from a Master Control Unit are received by all slave devices.

Address 0 is reserved for auto addressing modes. A slave device on any spur may temporarily have an address of 0. When a master control unit receives a response frame from a slave device with address 0, it should reassign the slave device's address to an unused address on the spur.

AMENDMENTS

Issue	Date	Changes
A	06/05/93	First Issue
B	20/05/93	Changed headers & KBUS preamble.
C	12/04/95	corrected CCITT polynomial