Application Description

**PROCONTROL P**

**Communication**

**Coupling Module**

for the **PROCONTROL—PS Protection System**

**87TS01 – E/R1239**

**Publication No.**
D KWL 6315 96 E, Edition 04/96

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**Application**

This coupling module is used for serial process data transfer between a PROCONTROL P station and the PROCONTROL—PS protection system.

The coupling function requires the following modules:

- 87TS01 – E/R1239: PROCONTROL P coupling module
- 70BK03 – E/R1: PROCONTROL—PS coupling module

These modules are used always in pairs (see Figure 1). The 87TS01/R1239 module is used on the PROCONTROL P station bus, the 70BK03/R1 module on the PROCONTROL—PS bus. Both modules are interconnected by a cable.

Data transfer is in both directions. Both modules equally participate in serial data exchange.

The module may be plugged into any station of the PROCONTROL bus system with redundant 24 V module supply (from 89MS01/R0200 or 89MS02/R0100). It is provided with a standard interface to the PROCONTROL station bus.

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**Description**

The 87TS01 – E/R1239 module is equipped with a standard interface for the PROCONTROL P station bus.

Data exchange with the 70BK03 module takes place through a serial module interface according to RS232 at 19200 baud, and according to the PROCONTROL—PS protocol. For cable connection to the 87TS01/R1239, front connector X1 or X2 is used; for the 70BK03/R1, front connector X7 is used.

Up to 192 PROCONTROL P telegrams can be transferred in both directions. For this purpose, the 87TS01/R1239 is provided with 192 receive registers for receiving send—location addressed telegrams, and with 192 send registers for transmitting.

1 analog value or 1 to 14 binary signals can be transferred per telegram. The data contents of the telegrams is transmitted unchanged.

The telegrams are exchanged cyclically between both systems, the cycle time depending only on the number of telegrams to be transmitted and on the transfer rate. The direction of transfer is irrelevant. The standard transfer rate is 19200 baud. The transfer times can be calculated on the basis of the following formula:

\[ TÜZ \ [\text{msec}] = T1 \ [\text{msec}] + T2 \ [\text{msec}] + n \ast T3 \ [\text{msec}] \]

- TÜZ: overall transfer time for cyclic transfer of all telegrams in both directions
- T1: coupling module time for 87TS01 approx. 10.00 msec, (processing + protocol—related waiting time)
- T2: coupling module time for 70BK03 24.36 msec, (processing + protocol—related waiting time at 19200 baud)
- n: number of all telegrams in both directions
- T3: telegram time 2.86 msec, (transfer time between 87TS01 and 70BK03 for a telegram at 19200 baud)

Figure 2 shows the achievable typical transfer times.
Figure 2:
Transfer time at the interface depending on the number of telegrams.

If more than 192 telegrams are required for data exchange, or if shorter transfer times are needed, additional coupling modules have to be used.

Internal module functions, reception of telegrams from the station bus (receive monitoring), as well as the protocol execution at the serial interface are being monitored on the module. Any errors detected are indicated to the PROCON-TROL P bus in the 246 diagnosis register of the 87TS01/R1239 module.
Connection

A line amplifier with a potential—isolation facility needs to be used to electrically isolate both systems. This solution is preferred for shorter distances (see Figure 3).

For larger distances, line amplifiers can be used in pairs employing a transforming function for another electrical interface, for instance an RS422 interface. The maximum distance will then be 500 m (see Figure 4).

Figure 3: Connection diagram including an RS232/RS232 line amplifier

Figure 4: Connection diagram including two RS232/RS422 line amplifiers
Transfer

Data transfer between both coupling modules is performed according to the protocol defined by the 70BK03.

Initialization

After the connection to the power supply is made, the initialization phase is run through, all internal memory areas of the 87TS01 module being cleared and the module parameters are set. Listening—in on telegrams coming from the PROCONTROL P bus will then be released and the connection is set up via the serial interface. All programmed addresses are called. From this point on, data transfer from the PROCONTROL P system to the PROCONTROL—PS system is enabled. Initialization is completed as soon as three complete transfer cycles have been run through at the interface. Then, the release statement for transmission to the PROCONTROL P system is given.

Based on the defined procedures during initialization and depending on the number of telegrams to be transmitted, this may take up to 10 seconds. During this time red disturbance lamp "ST" will be on.

During the phase of connection set—up, no transmission to the PROCONTROL P system will take place. After the initialization phase is completed, the module will enter its operation phase.

Operation phase

At the interface with the 70BK03, all telegrams are transferred cyclically. At the interface with the PROCONTROL P system transfer is carried out cyclically as well as in the event mode.

Event generation

Event generation is possible in the 87TS01 only from the PROCONTROL—PS to the PROCONTROL P system.

All cyclically transferred data from the PROCONTROL—PS are entered identically into the transmitting shared memory of the 87TS01/R1239 and are transferred to the PROCONTROL P bus in cyclic mode. Simultaneously, all data are subjected to a previous—value/new—value comparison. If binary data have changed by one bit or if analog values have changed by a certain threshold value, an event—oriented transmission takes place.

Programming of the threshold value can be done commonly for all analog values. The threshold value can be selected by the user, the standard setting being 1.56 %. There is no time delay.

All data received by the PROCONTROL P bus, either in cyclic or in event mode, are entered into the memory for transmission to the PROCONTROL—PS system and are transmitted identically to the 70BK03/R1 in cyclic mode.

In the case of multiple changes of a value during cyclic transmission to the PROCONTROL—PS system, always the value valid last will be transmitted.

Simulation memory

When being used as a coupling module with the protection system, the simulation function may be activated only for servicing purposes, e.g. during commissioning.

The PDD system allows to simulate all output data to the PROCONTROL—PS bus (analog or binary). The user—defined simulation values are entered into the simulation memory. The real data — belonging to any of the PROCONTROL—PS output addresses — will still be received continuously and written into the shared memory of the PROCONTROL P bus. For this reason, always both values are available in the module.

Character format

The character format is defined as: 1 start bit, 8 data bits, 1 parity—even bit, 1 stop bit.

Telegram format

The entire data transfer at the interface is performed with the aid of two telegrams, "instruction telegram for send—location addressed transmission" and "send—location addressed data telegram". An instruction telegram or data telegram comprises 5 bytes (2 bytes for addresses, 2 bytes for data and 1 byte for check sum).

A telegram at the serial interface comprises

— one instruction telegram
— one instruction telegram and n data telegrams
\( (n = \text{max. 192}) \)
— n data telegrams.

Data formats

Data exchange between the two coupling modules is done identically in the form of complete registers. Bit marshalling is not possible. Only binary values and analog values are transmitted (data type DA = 1 for binary data, data type DA = 5 for analog data in the PROCONTROL P system).

In the PROCONTROL—PS system, the data are identified by the PROCONTROL—PS bus address.

— Binary value register

For transfer of the binary value register between PROCONTROL—PS and PROCONTROL P, attention is to be paid to the fact that, in the PROCONTROL P system, the binary value (DA = 1) carries disturbance bit information "SB" at bit position D0. No other information may be placed at this position by the PROCONTROL—PS system.

— Analog value register

For transfer of the analog value register between PROCONTROL—PS and PROCONTROL P, attention is to be paid to the fact that, in the P system, the analog value (DA = 5) carries the measuring range information at bit positions D1 and D2. Disturbance bit information "SB" at D0 is identical for both systems. For analog value transfer from PROCONTROL—PS to PROCONTROL P, bit positions D1 and D2 are set to 00 using a mask available in the 87TS01. Bit significance for D2 = 0.024 % and D1 = 0.012 % are cancelled.
Protocol control

Protocol execution is time-controlled by each one of the partners. There are no administrative telegrams or acknowledgments. Data transfer via the serial interface is asynchronous and non-interfering with transfer operations in the PROCONTROL–PS and PROCONTROL P systems.

Coupling module addresses

As coupling module addresses, settings 1 ... F can be chosen. The 87TS01/R1239 module is assigned bus coupling module address 2 (see settings).

Module 70BK03/R1 is assigned bus coupling module address 9.

The following address pairs are to be preferred:

<table>
<thead>
<tr>
<th></th>
<th>87TS01</th>
<th>70BK03</th>
</tr>
</thead>
<tbody>
<tr>
<td>for one coupling module</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>for the next coupling module</td>
<td>3</td>
<td>10</td>
</tr>
</tbody>
</table>

Address PROM

In the address PROM A104 of the 87TS01/R1239 coupling module, all addresses from both systems are programmed for data marshalling.

For generating the address PROM, generating program PEB is used on a personal computer.

Personal computer: AT from 80286 on upwards, IBM-compatible

Operating system: from MS-DOS 3.3 on upwards

The following information is to be programmed per telegram:

Data exchange from PROCONTROL P to PROCONTROL–PS

- P system address 0 ... 3
- P station address 1 ... 249
- P module address 1 ... 58
- P register address 0 ... 191
- PS coupling module address 1 ... F (preferably 9)
- PS bus telegram address 1 ... FF
- Data type A = analog, B = binary

Data exchange from PROCONTROL–PS to PROCONTROL P

- P system address predefined by the module slot
- P station address predefined by the module slot
- P module address predefined by the module slot
- P register address 0 ... 191
- PS coupling module address 1 ... F (preferably 9)
- PS bus telegram address 1 ... FF
- Data type A = analog, B = binary

Notes on 70BK03/R1 programming:

In the 70BK03/R1 coupling module, the interface parameters such as baud rate, coupling module address and the telegrams to be transferred from PROCONTROL P to PROCONTROL–PS need to be programmed. Generation of the address PROM requires the use of a 70SK06 service unit.

Setting

Before commissioning the interface, the following settings need to be selected, or respectively checked on the 87TS01/R1239 (see also "Module description" for the 87TS01/R12...).

Switch S1: e.g. set coupling module address “2”

S1.1 off, S1.2 on, S1.3 off, S1.4 off

Jumper setting for 19200 baud transfer rate

Jumper X7/2 – X7/9: wire wrap connection

Jumper X16/1 – X16/2: jumper closed

Before commissioning the interface, on the 70BK03/R1 the followingEPROM positions need to be checked.

<table>
<thead>
<tr>
<th>Slot</th>
<th>Order number</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>A702/FW1</td>
<td>HESG492052B</td>
<td>Firmware for PS/PS coupling</td>
</tr>
<tr>
<td></td>
<td>HESG446953R1</td>
<td></td>
</tr>
<tr>
<td>A703/AL1</td>
<td>GJTN160145P2</td>
<td>Instruction list</td>
</tr>
<tr>
<td></td>
<td></td>
<td>User entries:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– baud rate 19200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– sequence no. 3,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>transmitting all telegrams</td>
</tr>
<tr>
<td></td>
<td></td>
<td>per cycle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– PROCONTROL–PS bus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>coupling module address,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>preferably 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– PROCONTROL–PS bus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>telegram addresses</td>
</tr>
</tbody>
</table>

Interface monitoring

The 87TS01/R1239 module performs the following monitoring functions on data reception at the serial interface:

- Character monitoring
  - Character length
    - (1 start bit, 8 data bits, 1 parity bit, 1 stop bit)
    - Parity error per character (parity even)
  - Block monitoring
    - Job telegram, format and contents, PROCONTROL–PS
      bus coupling module address, PROCONTROL–PS bus
telegram address, check sum
    - Data telegram, format, PROCONTROL–PS bus coupling
      module address, PROCONTROL–PS bus telegram
      address, check sum
  - Protocol monitoring
    - Time check for receiving the next valid data record.
    - Data records where any parity error, data record error, or
      protocol error has been detected, will be discarded. There will be
      no repeating. Calls or telegrams with faulty address data will
      not be processed.

After the same disturbance has occurred three times, the error will be indicated in the diagnosis register, 246/bit 3.
Receive monitoring

All telegrams received cyclically from the PROCONTROL P bus are subjected to the receive monitoring function. Receive monitoring is activated whenever telegrams are missing and is indicated in diagnosis register 246/bit 4 of the module.

After receive monitoring has been activated, the telegram in question will no longer be transmitted to the PROCONTROL–PS coupling module.

The receive monitoring response time may take from 30 to a maximum of 65 seconds.

All telegrams from the PROCONTROL–PS bus received at the serial interface are also subjected to receive monitoring on the 87TS01/R1239 module. Receive monitoring is activated whenever telegrams are missing and is indicated in diagnosis register 246/bit 3 together with additional information in diagnosis register 211 of the module.

After the receive monitoring function has been activated, the telegram in question will no longer be transmitted to the PROCONTROL P bus.

Receive monitoring response time at the serial interface for data coming from the PROCONTROL–PS bus amounts to approx. 4 seconds.

Diagnosis and annunciation functions

Errors at the module or at the serial interface are detected by the module’s diagnosis function and are annunciated (see also "Module description" for 87TS01/R1239).

Disturbance annunciation on the module

On the module front, red light–emitting diodes indicate:

<table>
<thead>
<tr>
<th>Designation of LED</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST</td>
<td>Disturbance</td>
</tr>
<tr>
<td>STV</td>
<td>Processing disturbance</td>
</tr>
</tbody>
</table>

ST

Light–emitting diode ST emits a steady light either if a disturbance is detected in the area of the bus interface or if the receive monitoring function has responded.

STV

Light–emitting diode STV emits a steady light if a disturbance has been detected in the area of the processing section. Processing not ready for operation.

Status annunciation on the module

On the module front, green light–emitting diodes indicate:

<table>
<thead>
<tr>
<th>Designation of LED</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>Data transfer through serial interface</td>
</tr>
<tr>
<td>M2</td>
<td>Internal processing ON</td>
</tr>
</tbody>
</table>

M1

Light–emitting diode M1 is flashing when the serial interface is used for data transfer with the external system. In the case of interruption–free, cyclic transfer at the interface, this LED emits a steady light.

M2

Light–emitting diode M2 is flashing (approx. 1 Hz) when instruction processing is active in the processing section of the module. If the LED is continuously off or emitting a steady light, there is an operational disturbance within the processing section.

Disturbance annunciation signal to the annunciation system

The CDS control diagnostic system receives the coupling module’s disturbance signal from the bus.

Diagnosis

Within the processing section of the module, the telegrams received, the generation of telegrams to be sent, as well as internal signal processing are monitored for errors (self–diagnosis).

In the event of a disturbance, the type of error is filed in the diagnosis register and, simultaneously, a general disturbance annunciation signal is sent to the PROCONTROL P system.

Upon request, the module will send a telegram containing the data stored in diagnosis register 246 (see Figure 5).
Annunciation signals from the diagnosis register

The diagnosis programs executed in the bus and processing program are designed to check all essential module functions. The results are filed in diagnosis register 246. Figure 5 shows the interrelations of signals and annunciations on the module.

- Bus reset activated
- Module transmitter of 88TV01 disconnected
- Module error during initialization

<table>
<thead>
<tr>
<th>Bit Type</th>
<th>Description</th>
<th>CDS messages</th>
<th>$\geq 1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Processing fault</td>
<td></td>
<td>$\geq 1$</td>
</tr>
<tr>
<td>14</td>
<td>Checksum error detected</td>
<td>6601, 6602</td>
<td>$\geq 1$</td>
</tr>
<tr>
<td>13 S</td>
<td>Timer defective</td>
<td>6604</td>
<td>$\geq 1$</td>
</tr>
<tr>
<td>12 S</td>
<td>Module restart executed</td>
<td>6605</td>
<td>$\geq 1$</td>
</tr>
<tr>
<td>11 S</td>
<td>Bus deactivation defective</td>
<td>6606</td>
<td>$\geq 1$</td>
</tr>
<tr>
<td>11 D</td>
<td>Receive section fault</td>
<td>6607</td>
<td>$\geq 1$</td>
</tr>
<tr>
<td>10 S</td>
<td>Receive enable in AS missing</td>
<td>6609</td>
<td></td>
</tr>
<tr>
<td>10 D</td>
<td>Receive monitoring responded</td>
<td>6610</td>
<td></td>
</tr>
<tr>
<td>9 D</td>
<td>Bus coupling fault</td>
<td>6611</td>
<td></td>
</tr>
<tr>
<td>8 S</td>
<td>Event mode fault</td>
<td>6612</td>
<td></td>
</tr>
<tr>
<td>8 D</td>
<td>Transmit section defective</td>
<td>6613</td>
<td></td>
</tr>
<tr>
<td>7 D</td>
<td>Section fault</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 S</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 S</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 S</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5: Annunciations on the module

D: Dynamic signals are reset by reading out the diagnosis register.
S: Static signals are reset automatically when activation is cancelled.

When bit 3 in diagnosis register 246 ("Bus coupling fault") is set, additional information on the disturbance will be given in register 211.

Register 211, general structure

<table>
<thead>
<tr>
<th>15</th>
<th>15</th>
<th>15</th>
<th>15</th>
<th>0</th>
</tr>
</thead>
</table>

Type of error

0000  Module all right
0001  Spare
0011  Sequential control in initialization phase
0100  Receive register FIFO overflow
0101  Send register FIFO overflow
0110  Spare
0111  Spare
1000  Spare
1001  Spare
1010  Send register monitoring (of PROCONTROL–PS bus) responded
1011  Spare
1100  Job memory error (see additional information on type of error)
1101  UART error (see additional information on type of error)
1110  Simulation error, discrepancy of duplicate lists, address field contains input no.
1111  Reset of processing (see additional information on type of error)

*) The control diagnosis system (CDS) provides a description for every annunciation number. This description provides, among other data:
- Information on cause and effect of the disturbance
- Recommendations for its elimination.

This makes for fast elimination of disturbances.
### Additional information on error type 1100 (list transfer)
As far as reasonable, the low byte will contain an input no.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>General error in the job memory, no function code</td>
</tr>
<tr>
<td>0001</td>
<td>Error in number of bytes</td>
</tr>
<tr>
<td>0010</td>
<td>Error in destination address</td>
</tr>
<tr>
<td>0011</td>
<td>Error in end of instruction</td>
</tr>
<tr>
<td>0100</td>
<td>Instruction “Accept instruction” repeated</td>
</tr>
<tr>
<td>0101</td>
<td>Instruction “Execute instruction” repeated</td>
</tr>
<tr>
<td>0110</td>
<td>Instruction “Execute instruction” without instruction “Accept instruction”</td>
</tr>
<tr>
<td>0111</td>
<td>Single bit for SIM mask in case of analog value</td>
</tr>
<tr>
<td>1000</td>
<td>Spare</td>
</tr>
<tr>
<td>1001</td>
<td>Spare</td>
</tr>
<tr>
<td>1010</td>
<td>Spare</td>
</tr>
<tr>
<td>1011</td>
<td>Spare</td>
</tr>
<tr>
<td>1100</td>
<td>Spare</td>
</tr>
<tr>
<td>1110</td>
<td>Spare</td>
</tr>
<tr>
<td>1111</td>
<td>Spare</td>
</tr>
</tbody>
</table>

### Additional information on error type 1101 UART
As far as reasonable, the low byte will contain a PROCON-TROL—PS bus address

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>Spare</td>
</tr>
<tr>
<td>0001</td>
<td>Wrong checksum in the PROCONTROL—PS telegram</td>
</tr>
<tr>
<td>0010</td>
<td>Wrong telegram format, 3rd byte of instruction telegram</td>
</tr>
<tr>
<td>0011</td>
<td>Telegram block too long</td>
</tr>
<tr>
<td>0100</td>
<td>Wrong bus coupling module address sent by partner, bus coupling module address 9 expected</td>
</tr>
<tr>
<td>0101</td>
<td>Character time—out</td>
</tr>
<tr>
<td>0110</td>
<td>Wrong PROCONTROL—PS bus address received</td>
</tr>
<tr>
<td>0111</td>
<td>Reception overflow</td>
</tr>
<tr>
<td>1000</td>
<td>Character format error, parity error</td>
</tr>
<tr>
<td>1001</td>
<td>Wrong telegram format, 4th byte of instruction telegram</td>
</tr>
<tr>
<td>1010</td>
<td>Spare</td>
</tr>
<tr>
<td>1011</td>
<td>Wrong telegram format, 1st telegram byte</td>
</tr>
<tr>
<td>1100</td>
<td>PROCONTROL—PS instruction telegram sent to wrong bus coupling module address</td>
</tr>
<tr>
<td>1101</td>
<td>Multiple telegram time—out during transmission at PROCONTROL—PS coupling module interface</td>
</tr>
<tr>
<td>1110</td>
<td>Spare</td>
</tr>
<tr>
<td>1111</td>
<td>Spare</td>
</tr>
</tbody>
</table>

### Additional information on error type 1111, reset of processing
Also indicated in register 208

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>Cold start, new start</td>
</tr>
<tr>
<td>0001</td>
<td>Reset UART after error</td>
</tr>
<tr>
<td>0010</td>
<td>Instruction coming from PROCONTROL P bus</td>
</tr>
<tr>
<td>0011</td>
<td>Restart after internal error, watchdog, etc.</td>
</tr>
</tbody>
</table>
Technical data

Publications, additional documentation required:
Module Description
PROCONTROL P, Communication
Serial Interface on the Station Bus
87TS01−E/R12../R13../R15..
D KWL 6312 96 E
Gerätebeschreibung Hardware 70BK03/R1
Buskoppelgerät P13 Nahbus / Serielle Schnittstelle
HESL 400 420 9004
Gerätebeschreibung und Programmieranleitung 70BK03/R1
Buskoppelgerät P13/P13 Nahbus
HESL 400 421 9004

Setting for RS232
UART character format:
Start bit 1
Data bit 8
Parity Even
Stop bit 1
Baud rate 19200
Maximum line length:
RS232 up to line amplifier 15 m
RS422 between line amplifiers 500 m
Maximum transfer characteristics:
Receive register 192
Send register 192
Transfer times: See "Description"

ORDERING DATA

Order no. for entire module
Type designation: 87TS01−E/R1239
Order number: GJR2368900R1239

Order no. for plug−in memory modules
Memory module Position Order number
Bus interface section A401 PROM programed:
Processing section A106 GKWE 856 478 Pxxxx
Processing section A108 GKWE 856 472 Pxxx
Address EPROM A104 GKWE 856 473 Pxxx
Empty PROM:
HETN400829P0001 * (27C256)
HETN400839P0004 (27C512, basic equipment)
Pxxxx = Position number according to valid program version. * Observe jumper setting, see module description.

Signal cables
Cable assignments depending on the line amplifiers used.

Technical data are subject to change without notice!