Module Description

Application

The coupling module for master station is used within a PROCONTROL master station.

It provides the connection between the bus of the master station and the local bus and, hence, also the remote bus.

Features

The module can be plugged into every master station of the PROCONTROL bus system. It is provided with a standard interface to the bus of the master station and a standard interface to the local bus. The remote bus is connected via the remote bus/local bus coupling module (88 FN01/FN02) and the frequency module for master station (88 FV01).

A maximum of 8 remote bus lines can be connected to every master station. Therefore, also up to 8 coupling modules are available per master station.

Eight light-emitting diodes are provided at the front of the module. Four are designed to indicate the number of connected remote bus line. Four are designed to indicate the various operating statuses (see "Annunciation functions").

Furthermore, a test plug is provided at the front. At this plug, the most important transfer signals can be measured by means of an oscilloscope (see "Test functions").

Tasks

Also in the master station, it is essential to control the station-bus in order to ensure correct data communication between the modules connected to it. In contrast to the multi-purpose processing station (where only one bus control module 88 TV01 is used), the control functions in the master station are handled by several modules together (88 VA01, 88 VP01/VP02, 88 VT01/VT02). These modules are described below under heading "Bus control".

Serving as connecting link between the master station bus and the PROCONTROL local bus, the coupling module for master station has to perform the following tasks:

- To transfer data telegrams from the "bus control" or other coupling modules for master station to the local bus or remote bus

- To transfer data telegrams from the local bus and remote bus to the "bus control" or other coupling modules for master station

- To monitor and store any event annunciation which arrives via the noise channel during data telegram transfer on the remote bus line

- To transmit event annunciations to the "bus control", but only when requested to do so

- To perform abbreviated scans on its remote bus line to identify the location of an event and to store the addresses of all stations signalling an event

- To transfer a station address to the "bus control" when requested to do so

- To supervise acknowledgement whenever a telegram has been transferred (with the exception of short telegrams)

- To count the acknowledgement errors and to monitor them for a maximum number

- To transfer the status messages (event, acknowledgement error, etc.) to the "bus control" when requested to do so.
Functional sequences

TRANSFER SEQUENCES ON THE MASTER STATION BUS

In addition to the three main lines for serial data transfer (data, frame, clock), the master station bus contains a number of other signal lines. These include four address lines, three command lines and eight internal data lines. The latter serve to handle communication between the coupling module and the "bus control".

Every coupling module within the station is allocated an address (that of its remote bus line). This address is set on the module by means of jumpers (see "Operating modes"). In this way, the coupling modules can be addressed either individually or collectively by the "bus control" via the address lines.

On the command lines, the three main types of command, i.e. "Set", "Status scanning" and "Reset", are transferred to the coupling module(s).

These main commands are further subdivided by the parallel data lines.

Transfer of the command "Set" or "Reset" requires one station-bus cycle. Two cycles are required for status scanning and scanning of the event generating station address:
(first cycle: command to the coupling module, second cycle: response from the coupling module).

By the above-mentioned combinations of commands, the coupling module is prepared for the functional sequences described below.

TELEGRAM TRANSFER

The master station is designed to handle, by the "bus control", all data communication in the PRO-CONTROL remote bus system. The master station successively permits every multi-purpose processing station connected to the bus system to transfer data telegrams. To this end, a "call telegram" whose address part contains the address of the desired station is transferred via the coupling module associated with the respective remote bus.

In the next step, this particular coupling module is prepared for the reception of the response telegrams, while all other coupling modules of the master station are conditioned for further transfer of these telegrams.

Immediately after arrival of the response telegrams, these are sent to the master station bus and thus distributed to all other coupling modules connected to the bus. These coupling modules then transfer the telegrams on their respective remote bus lines. This procedure ensures that every data telegram is available in the entire bus system for further processing.

EVENT ANNUNCIATION

Whenever a telegram is transferred to the remote bus (transmission) or from the remote bus (reception), the coupling module monitors the noise channel for event annunciation(s) (this does not apply for abbreviated scans).

The noise transmitter of every multi-purpose processing station is switched off after detection of the start synchronizing signal in the received telegram if no event is present in this station. Now, the noise receiver in the coupling module cannot detect a noise signal. This fact is stored as "no event" and scanned by the "bus control" as a status annunciation after a telegram transfer.

If an event is present at one or more stations, the station(s) concerned does (do) not switch off its (their) noise transmitter(s). This fact is recognized by the noise receiver of the coupling module, stored as "one (or several) event(s)" and scanned by the "bus control".

IDENTIFICATION OF EVENT LOCATION

Event location identification is only performed if an event annunciation has been detected.

Event location is carried out by the coupling module at the request of the "bus control" after termination of the current telegram transfer.

The addresses of all stations connected to the remote bus line are stored in the coupling module (address PROM 3, see "Mechanical design", "Programming note"). The module now starts an abbreviated scan through the noise channel.
The stations are scanned successively by way of the station address. Whenever a station recognizes its address while an event is present, it turns on its noise transmitter for a certain period of time. This signal is evaluated by the coupling module.

At the end of the abbreviated scan, the coupling module has stored the addresses of all those stations at which an event was present. The end of the abbreviated scan is then communicated to the "bus control" by the status scan. Following this, the addresses of the event generating stations are read by the "bus control" for further processing. The program for the abbreviated scan, which is carried out automatically, is filed in the PROMs 1 and 2 (see "Mechanical design").

ACKNOWLEDGEMENT

Reception of a telegram is acknowledged by each station connected to the remote bus. Acknowledgement is effected in the form of a positive common signal, i.e. all stations acknowledge reception simultaneously.

After the trailing edge of the end synchronizing signal in the telegram, all receiving stations switch off their noise transmitters if they have correctly received the information (this is determined on the basis of the security characters in the telegram). If there are transmission errors or if an information signal is completely "missing", the noise transmitter of the corresponding station remains switched on.

The coupling module evaluates the noise channel via its noise receiver, and thus detects any acknowledgement errors. This is communicated to the "bus control" by the status scan. The telegram (or telegrams, max. 8) is (are) then transferred once again by the master station. Telegram transfer is repeated until the maximum number of permitted acknowledgement errors, which is set on the coupling module, has been reached (see "Operating modes").

Operating modes

Five switches and 12 plug-in jumper places are provided on the module. With these, the following operating modes can be set.

SETTING OF ADDRESS

One coupling module is required for every remote bus line (a maximum of 8) connected to the master station. To enable the "bus control" of the master station to address each of the coupling modules, the number of the remote bus line must be set as an address on the coupling module.

Setting is done by means of 4 plug-in jumpers (designation "ADR" on the printed circuit board) on the module (see "Mechanical design").

The following table shows the plug-in jumper combinations necessary for every remote bus number. The numbers of the plug-in jumpers are printed on the printed circuit board.

<table>
<thead>
<tr>
<th>Plug-in Jumper No.</th>
<th>8</th>
<th>4</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote bus 1</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>-</td>
</tr>
<tr>
<td>Remote bus 2</td>
<td>x</td>
<td>x</td>
<td>-</td>
<td>x</td>
</tr>
<tr>
<td>Remote bus 3</td>
<td>x</td>
<td>x</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Remote bus 4</td>
<td>x</td>
<td>-</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Remote bus 5</td>
<td>x</td>
<td>-</td>
<td>x</td>
<td>-</td>
</tr>
<tr>
<td>Remote bus 6</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>x</td>
</tr>
<tr>
<td>Remote bus 7</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Remote bus 8</td>
<td>-</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

Explanation: x = Jumper in place
- = Jumper removed

NUMBER OF ACKNOWLEDGEMENT ERRORS

If an acknowledgement error is recognized, communicated to the master station, the telegram or the telegram block is repeated.

The number of acknowledgement errors permitted can be set using plug-in jumpers on the module (designation "QF" on the printed circuit board).

Every acknowledgement error is communicated to the "bus control". When the number of acknowledgement errors permitted is reached, the repetition process is stopped and the program of the master station resumes data transfer (in cyclic or event mode). This is to prevent a multi-purpose processing station that performs inadequately from blocking data communication on the entire bus system.
A maximum of 15 acknowledgement errors can be set on the module. Here, the following applies:

Number of repetitions = set number of errors - 1.
The following table shows the plug-in jumper combination required in each case.
The numbers of the plug-in jumpers are printed on the printed circuit board.

<table>
<thead>
<tr>
<th>Acknowledgement Error No.</th>
<th>Jumper Number</th>
<th>8</th>
<th>4</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>X</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Explanation:  
x = Jumper in place  
- = Jumper removed  
* = Standard setting when delivered

**SETTING OF TIME**

Both during transmission and reception on the remote bus, the coupling module evaluates the noise channel in order to detect any event announcements and acknowledgement errors. In all four cases, the coupling module waits a certain time before evaluating the noise channel, to give the stations enough time to turn off their noise transmitters. These waiting times differ in length for technical reasons of transfer.

The same applies when multi-purpose processing stations are connected directly to the 88 VK01 via the local bus (see "Mode of connection"). In this case, the corresponding local bus signal (of the 88 TK02) is evaluated.

The time is set with 8 contacts of each of the switches S1 to S4. The location and designation of the switches on the module are specified under "Mechanical design".

The following tables show the required times and positions of the contacts.

<table>
<thead>
<tr>
<th>Waiting time</th>
<th>Contacts : 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8</th>
</tr>
</thead>
</table>

|-------------------|------------------------------------------|

| Trans- 76 μs | S1 ON |
| Recp- 66 μs  | S2 ON |
| Trans- 56 μs | S3 ON |
| Trans- 49 μs | S4 ON |

* These switch positions apply to stations connected directly via the local bus (without remote bus).

Also during the abbreviated scan to locate the event generating station(s), the coupling module waits a certain time before evaluating the noise channel (local bus signal).

The time is set by means of the 8 contacts of switch S5.

The following table shows the time and the position of the switch S5.
<table>
<thead>
<tr>
<th>Waiting time</th>
<th>S5:1:2:3:4:5:6:7:8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event location</td>
<td>44 μs ON</td>
</tr>
<tr>
<td></td>
<td>34 μs * ON</td>
</tr>
</tbody>
</table>

* These switch positions apply to stations connected directly via the local bus (without remote bus).

**Noise channel times**  

If using the OWG couplers * 88 FT03 or 88 FV03, the noise channel scanning times on module 88 VK01 must be set as instructed below for the relevant remote bus line (also see module description 88 FT03 and 88 FV03).

**Cable delay**  
\[ t(K) = 4.833 \text{ μs/km} \]  
(for 50/125 μm graded-index fiber)

**Telegram delay**  
\[ t(VTLG) = \text{cable delay x cable length} \]
\[ t(VTLG) = 4.833 \text{ μs/km x length} \]

**Formulae for switches S1 ... S5:**

**Event TRANSMISSION**  
\[ t(AES) = 2 \times t(VTLG) + 40 \text{ μs}, \]  
setting S1 = \( t(AES) / 0.4 \text{ μs} \)

**Event RECEPTION**  
\[ t(AEE) = \text{fixed value 56 μs}, \]  
setting S2 = \( 56 / 0.4 = 140 \text{ μs} \)

**Acknowledgement TRANSMISSION**  
\[ t(AQS) = 2 \times t(VTLG) + 24 \text{ μs}, \]  
setting S3 = \( t(AQS) / 0.4 \text{ μs} \)

**Acknowledgement RECEPTION**  
\[ t(AQE) = \text{fixed value 24 μs}, \]  
setting S4 = \( 24 / 0.4 = 60 \text{ μs} \)

**Event address determination**  
\[ t(AEA) = 2 \times t(VTLG) + 35 \text{ μs}, \]  
setting S5 = \( t(AEA) / 0.4 \text{ μs} \)

* OWG = Optical waveguide
MODE OF CONNECTION

The PROCONTROL bus system is connected to the coupling module for each remote bus line (see "Connection diagram").

The local bus provides the connection between 88 VK01 and remote bus/local bus coupling module 88 FNO1. The remote bus is connected via the last-mentioned module and the frequency module for master station 88 FVO1.

Certain local bus signals must be bridged for making the connection. This is done by means of plug-in jumpers on the module.

Figure 1 shows the required plug-in jumpers and their arrangement on the module.

Connection of the remote bus via 88 FNO1:

Setting of SE signals permanently:

Setting of SE signals under program control:

The signal SE1 or SE2 is used to switch on the transfer output stages in the frequency modules. Using the jumpers SE, this signal can be set either permanently (normal case) or under program control. The diagrams 2 and 3 show the positions of the jumpers.

(Jumpers RS and RE are not considered)
Test functions

The front of the module is provided with a test plug X1 at which the following signals can be measured:

(Figure 5 shows the positions of the contacts)

K1: \( \text{SR} = \text{Transmission frame} \) to local bus or remote bus
K2: \( \text{ST} = \text{Transmission clock} \)
K3: \( \text{SD} = \text{Transmission data} \)
K4: \( \text{ER} = \text{Reception frame} \) from local bus or remote bus
K5: \( \text{ET} = \text{Reception clock} \)
K6: \( \text{ED} = \text{Reception data} \)
K7: \( \text{RS} = \text{Noise signal} \)
K9: \( \text{ZD} = \text{Reference potential} \)

The signals K1 - K7 may only be measured via a high resistance.

Note:
Valid oscilloscope displays can only be obtained by means of a logic analyzer which generates a trigger signal for the oscilloscope. The logic analyzer has to be connected to the module test plug of the module 88 VP01/VP02. The same applies to the telegram handling module 88 VTO1/VTO2.

All local bus signals are provided at connector X3:

\[
\begin{align*}
d32 & \quad \text{SE1-} \\
d30 & \quad \text{SE1+} \\
b32 & \quad \text{SE2-} \\
b30 & \quad \text{SE2+} \\
d18 & \quad \text{RA+} \\
d20 & \quad \text{RA-} \\
d22 & \quad \text{DA+} \\
d24 & \quad \text{DA-} \\
d26 & \quad \text{TA+} \\
d28 & \quad \text{TA-} \\
z22 & \quad \text{UE+} \\
z24 & \quad \text{UE-} \\
z26 & \quad \text{FS+} \\
z28 & \quad \text{FS-} \\
z18 & \quad \text{RE+} \\
z20 & \quad \text{RE-} \\
z30 & \quad \text{RS+} \\
z32 & \quad \text{RS-} \\
z02 & \\
z04 & \\
z06 & \\
z08 & \\
z10 & \\
z12 & \\
z14 &
\end{align*}
\]

"Transmitter On"
Control signals
Telegram frame
Serial data
Clock frequency
Transmission disturbance detected
Error of transmitter
Noise transmitter ON
Noise signal
ZD reference potential

Annunciation functions

One red and 7 green light-emitting diodes are provided at the front of the module.

The red light-emitting diode QF is set when an acknowledgement error has been detected.

The green light-emitting diode ER is set when an event annunciation has been recognized.

The green light-emitting diode KA is set as long as the coupling module is carrying out an abbreviated scan for locating an event.

The green light-emitting diode RS is set as long as a noise signal is present on the remote or local bus.

The four light-emitting diodes 1, 2, 4 and 8 show the number of the connected remote bus in binary code. The numbers next to the light-emitting diodes denote the significance of the binary places. The number of remote bus line is obtained by adding the valency of all set light-emitting diodes.

Programming note:

All station addresses projected for each remote bus line are programmed in the station address PROM (for abbreviated scan). Here, the following applies:

- All station addresses must be entered in an uninterrupted sequence, beginning with memory location 00.
- The sequence of the station addresses is optional.
- Station address 0 (for PDOS) must be included in the list, otherwise no PDOS operation is possible on this remote bus line.
- All memory locations that are not required must have the content FF. The first content FF means for that module: no further stations are available, therefore end of abbreviated scan.

Due to this fact, stations can be added to the remote bus line at a later date.

The station address PROM is of the type 7641, has a memory capacity of 512 x 8 bits and is programmed in hexadecimal code.
The module is equipped with the two connectors X2 and X3. Connector X2 incorporates the master station-bus interface and the voltage supply.
Connection diagram

CONNECTION OF REMOTE BUS

![Connection Diagram]

Mechanical design

Board size: 6 units, 1 division, 220 mm deep

Connector: according to DIN 41 612
2 x 48-pole, edge connector type F
(for X2 and X3)

according to MIL C-24 308
1 x 9-pole, socket connector type HD
(Fabricated by AMP)
(for X1)

Weight: approx. 0.45 kg
POSITION OF THE PLUG-IN MEMORY MODULES, SWITCHES AND JUMPERS ON PRINTED CIRCUIT BOARD AND FRONT VIEW

Memory modules:
1 = Sequence control abbreviated scan
2 = Sequence control abbreviated scan
3 = Station address-PROM

Order number:  
(component)  
GJTN160051P1  
GJTN160052P1  
GJTN160053P1

Order number:  
(PROM programmed)  
GJR2351901Pxxxx  
GJR2351902Pxxxx

Note:  
xxxx = Position number corresponding to the appropriate revision.

Important:  
The modules 88 VK01 should only be plugged into the master station (in double subrack AA, AB) in the right section within the slot range 53 - 81.
Technical data

In addition to the system data, the following values apply:

POWER SUPPLY

Operating voltage bus section \( \text{UD}^+ = +5 \text{ V} \)

Current consumption \( l_D = 1.4 \text{ A} \)

Power dissipation typ. \( P_V = 7 \text{ W} \)

Reference potential bus section \( Z_D = 0 \text{ V} \)

STANDARD CONNECTIONS

VSS - Standard interface to the master station bus
NSS - Standard interface to the local bus

ORDERING DATA

Type designation: 88 VK01-E/R1010
Order number: GJR2312200R1010

Technical data are subject to change without notice.