Application Description

PROCONTROL P
Communication

Coupling Module
Time Master

87TS01−E/R1313

Application

Within the PROCONTROL system, module 87TS01−E/R1313 functions as a master clock which is set by a radio clock (over a serial interface; reception is from the DCF77 time transmitter), and which needs to be synchronized. The time received from the radio clock is made available to the entire PROCONTROL system and is used as system time. It is transmitted cyclically in the form of time telegrams.

The time telegrams containing the system time may be received and processed by modules specifically designed for this purpose.

Features

The time telegrams are transmitted cyclically. The current time is transferred through the RS232c interface coming from the DCF77 time receiver. Modules which conform to the prescribed time data format and transfer protocol are suitable for use as DCF77 time receivers.

The master clock is synchronized by the time receiver every 60 sec.

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.

Description

Modes of operation

For the R1313 version, the 87TS01 module can be used as a master clock only. Use of the module's other modes of operation is not possible.

Every 59th second, a DCF77 time receiver coupled to the 87TS01−E/ R1313 module through an RS232c interface, conforming to the prescribed time data format and transfer protocol, sends the complete time telegram of the following full minute and, in the 60th second, sends a synchronization character. This synchronization character is evaluated, and the internal clock in module 87TS01−E/R1313 is synchronized.

The master clock follows a 5−msec−rhythm and is synchronized to the DCF77 time receiver every 60 sec. Disturbance signals are generated if the time receiver or the internal clock should fail. If synchronization takes place every 60 sec, the master clock tends to go slow by < 5 msec. In the event of a failure of the time receiver, the typical inaccuracy of the internal master clock is 3.4 sec/24 hrs. If an inaccuracy of a maximum of ± 1 sec is detected, the master clock is immediately switched over to the time received from the DCF77 time receiver. If an inaccuracy of more than ± 1 sec is detected, the master clock will be synchronized only after three successive plausible telegrams have been received, a message will then be entered in diagnosis register 211, and bit 3 is set in diagnosis register 246.

Processing

With its internal timer, the processor of the 87TS01−E/R1313 constitutes the master clock. Via the internal timer, the processing section receives an interrupt every 5 msec which causes it to increment the time variables in the memory. This internal timer contains the complete data record for year, month, day, hour, minute, second, and millisecond in 5−msec−increments.

The master clock is synchronized internally by a crystal oscillator and externally every minute by a synchronization data record and a control character from the time receiver.

For each data record received from the time receiver, a parity check and plausibility check is carried out. The synchronization procedure is performed only with a valid and plausible data record. In case a fault is being detected, the clock is synchronized to the external time provided by the time receiver only after three successive valid and plausible data records have been detected.

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Should there be no synchronization within 5 min, a "Time synchronization failure" is indicated in register 211, and the time passing from the point of failure on will be entered. Additionally, bit 3 is set in diagnosis register 246.

The inaccuracy to be expected without external master clock synchronization corresponds to a typical deviation of 3.4 sec/24 hrs. A consistency code is added to each time data record. The consistency code identifies the system time to be received in the PROCONTROL system as a single entity.

Changeover from winter time to summer time (daylight−saving time) and vice versa is done by means of the time data records sent by the time receiver to the master clock and by means of the time telegrams sent to the entire PROCONTROL system. This changeover is announced in a status information which is part of the data record received via the serial interface from the DCF77 time receiver. This status information is made available to the PROCONTROL system in send register 7.

Initialization

The module is initialized upon reception of three successive plausible data records from the time receiver which also sets and synchronizes the master clock. The module does not send any time telegrams as long as the time receiver and three plausible data records have not arrived.

The module's state of waiting for the first three plausible data records from the time receiver is indicated by alternate flashing of the two light−emitting diodes M1 and M2.

Addressing and allocation

Allocation of the time and module data to the registers is fixed. Time data are represented in binary code.

Send register allocation

Register no.	Information	Telegram																	Data type
		Bit position																	
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
0	time value	0 − 995 msec (1 bit = 5 msec)								0	0	0	0	x	x	x	SB		29
1	time value	0 − 59 sec								0	0	0	1	x	x	x	SB		29
2	time value	0 − 59 min								0	0	1	0	x	x	x	SB		29
3	time value	0 − 23 hrs								0	0	1	1	x	x	x	SB		29
4	time value	1 − 31 day								0	1	0	0	x	x	x	SB		29
5	time value	1 − 12 month								0	1	0	1	x	x	x	SB		29
6	time value	0 − 99 year								0	1	1	0	x	x	x	SB		29
7	Status	0	0	0						0	1	1	1	x	x	x	SB		29

SB = disturbance bit
X = consistency code
Bit 4 ... 7 = byte identification

0 no announcement hour ...
1 announcement hour ...
   ... for changeover
   daylight−saving time −> winter time −>
   daylight−saving time

0 winter time
1 daylight−saving time

00 time/date invalid
01 crystal−based
10 radio−based (regular accuracy)
    controlled by the DCF77
11 radio−based (high accuracy)
    controlled by the DCF77

0 no connection ...   } to the DCF77
1 connection ...   } time receiver

Annunciation and diagnostic functions

Faults in the module, in the DCF77 time receiver, and in the RS232c interface are detected and indicated by the module's diagnostic functions (cf. also the 87TS01−E/R13.. module description).

Annunciations on the module

Two red and two green light−emitting diodes are located on the front of the module:

− Light−emitting diode ST

 Red light−emitting diode ST emits a steady light whenever a disturbance has been detected in the area of the station bus interface and if − after synchronization of the master clock − no valid synchronization takes place within 5 min. After time synchronization is resumed again by the time receiver, light−emitting diode ST will go off.

− Light−emitting diode STV

 Red light−emitting diode STV emits a steady light if a disturbance has been detected in the processing section of the module, or if there is a disturbance present in the master clock.

− Light−emitting diodes M1 and M2

 Green light−emitting diodes M1 and M2 indicate operating states of the processing section.
 The following states are indicated:

 − M1 and M2 continuously off indicates an idle state

 − M1 and/or M2 continuously on indicates a fault status

 − M1 and M2 flashing alternately indicates that the module is in its initialization phase and awaits the first three successive plausible data records from the time receiver.

Messages in the time telegrams

In case data−related disturbances do occur, the disturbance bit is set in the time telegrams.

Possible diagnostic functions

The diagnosis cycle interrupts the current processing cycle when a period of 160 msec to 320 msec has elapsed since the last diagnosis cycle.

The following module−specific operations are performed, and the results are filed in the diagnosis registers:

− Function check of the master clock
− Check of the RS232c interface and of the DCF77 time receiver
− Evaluation of faults and messages, and the relevant entries in the diagnosis registers.

Immediately after every transfer from the DCF77 time receiver (radio clock) to the master clock via the serial interface, a parity and plausibility check is performed on the character received. Immediately after the entire data record has been transferred, there will be another plausibility check, and the time generated internally by the master clock is compared with the time received from the radio clock. If these checks result in any fault detection, there will be a message in diagnosis register 211 and in bit 3 of diagnosis register 246.

Module 87TS01−E/R1313 is able to generate two diagnosis telegrams which are filed in registers 246 and 211 in the shared memory. Additionally, the state of the radio clock connected to the serial interface is sent in send register 7 to the PROCONTROL bus.

The diagnosis registers can be read from the control system operator station. They contain information on the status of the module and of the connected DCF77 time receiver.

Data contents of send register 7:
− The data register provides information on the status of the DCF77 time receiver as transferred last (status)

Data contents of the diagnosis register under register address 211:
− In the event of a failure of the DCF77 time receiver, the data register provides information on the duration of the failure. The information is displayed in minutes in hexadecimal code.

Data contents of the diagnosis register under register address 246:
− The diagnosis register provides information on the status of data communication with the station bus and on the internal status.
− The diagnosis register contains the standard diagnosis data of the station bus modules with module addresses GA = 1...58.

Data contents of the status register under register address 248:
− The status register contains the standard status messages of the station−bus modules with module addresses GA = 1...58.

Operation of the module from the process operator station or the programming, diagnostic and display system is not provided.

Format of the diagnosis telegram under register address 246:

```
 15 14 13 12 11 10 9  8  7  6  5  4  3  2  1  0
 ┌──┬──┬──┬──┬──┬──┬──┬──┬──┬──┬──┬──┬──┬──┬──┬──┐
 │                                              │
 │ D          D    D  D  D        D  D          │
 │                                              │
 └──┴──┴──┴──┴──┴──┴──┴──┴──┴──┴──┴──┴──┴──┴──┴──┘
```

Invalid request telegram

Module fault in transmit section

Event-mode fault

Module fault in subsystem (DCF77 time receiver) *)

Receive monitoring responded

No receive release in PROCONTROL station

Invalid bring telegram

Module fault in receive section

Bus interface defective

Module restart

Module fault "Time monitoring defective"

Module fault in program memory

Module fault in processing section

The bit positions marked with "D" send out dynamic diagnosis messages.

Dynamic: The message is present until the next transmission takes place even if the cause of the message no longer exists.

Static: The message is present only as long as its cause exists.

*) For further information on faults cf. diagnosis register 211.

Format of the diagnosis telegram under register address 211:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Type of fault | Additional information
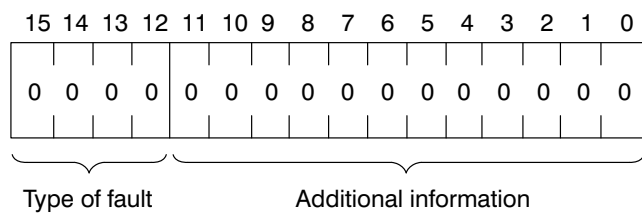
OK status: No module−related fault present
(in diagnosis register 246, bit 3 is also 0).

Allocation of register 211:

Type of fault	Additional information	Meaning
0001	xxxx xxxx xxxx	**Failure of time synchronization:** Time since failure in minutes (hexadecimal number, 3 digits)
0010	0000 0000 0001 0000 0000 0010 0000 0000 0100 0000 0000 1000	**Format error of data transferred:** Parity error in data record character Data record character not plausible *) Control character error Data record not complete
0011	0000 0000 0000	**Time/date transferred invalid**
0100	0000 00xx xxx1 0000 00xx xx1x 0000 00xx x1xx 0000 00xx 1xxx 0000 00x1 xxxx 0000 001x xxxx	**Time indicated not plausible:** Seconds indicated not plausible Minutes indicated not plausible Hour indicated not plausible Day indicated not plausible Month indicated not plausible Year indicated not plausible
0101	0000 0000 00nn	**No 3 successive plausible data records received yet during initialization** Number of successively received plausible data records nn = (00, 01, 10)
0110	0000 0000 0000	Time deviation of internal clock during normal operation greater than admissible value

*) Possible error:
ASCII number expected, but ASCII control character transferred.

Module settings, connection diagram

The PROMs A401, A106, A108 used for the R1313 version are plugged onto the positions provided.

The time receiver is connected to the module front using connector X1 or X2.

In the example depicted on the right, the time receiver is connected through connector X1 using interface SS1.

For fault−free operation, the time receiver is to be set as follows:

Interface: RS 232c, no handshake

Transmission rate: 9600 baud

Character format: Parity even
                    1 start/stop bit
                    8−bit word length

Output format: − CET/daylight−saving time with
                      time presetting
                    − synchronization to time/date and
                      ETX control character with every
                      new minute
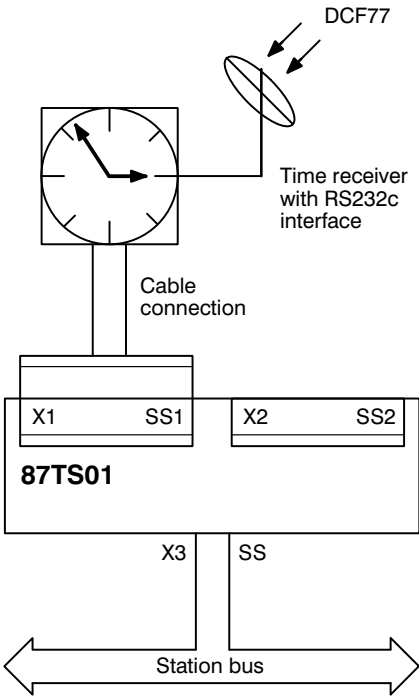
Connection examples:
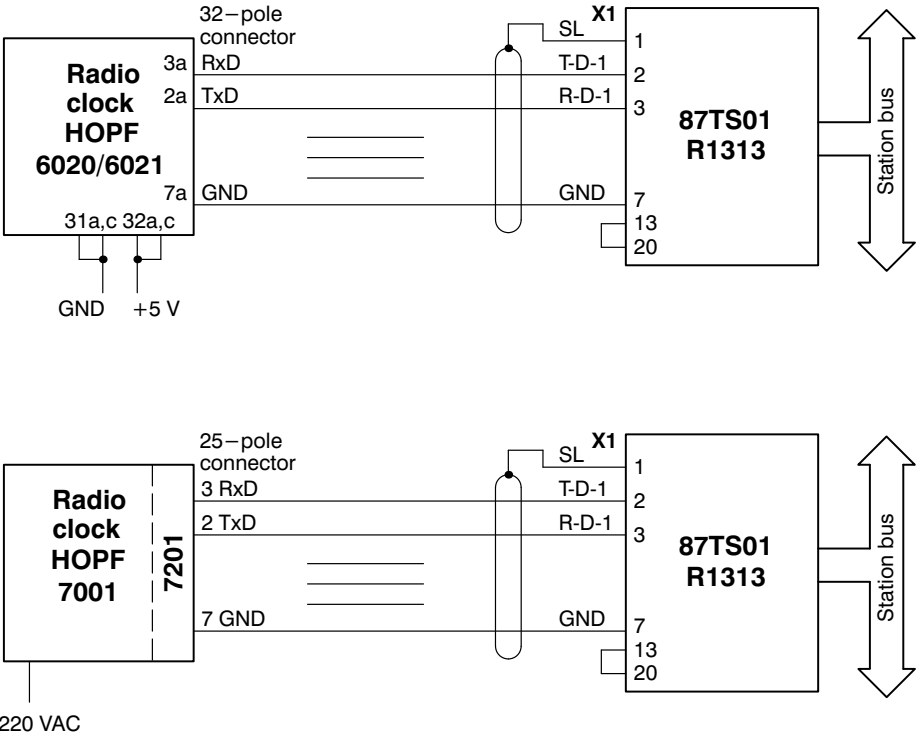
Cable connection

Pin assignments on module 87TS01 at connector X1
(D−type connector, 25−pole) as shown on the right.

Active contact assignments for interfaces type RS 232c achieved by mounting a jumper which connects contacts 13 and 20.

Pin assignments on the time receiver:

The cable specifications depend on the time receiver used.

Active contact assignments for interfaces type RS 232c:

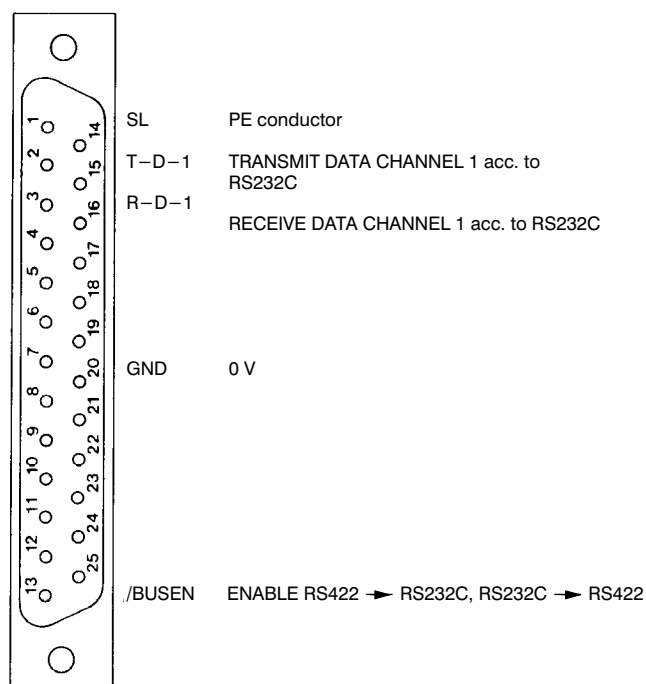|	
SL	PE conductor
T−D−1	TRANSMIT DATA CHANNEL 1 acc. to RS232C
R−D−1	RECEIVE DATA CHANNEL 1 acc. to RS232C
GND	0 V
/BUSEN	ENABLE RS422 ➞ RS232C, RS232C ➞ RS422

Data format

Consecutive character no.	Bit position 7 6 5 4	3 2 1 0	Meaning
1	0 0 0 0	0 0 1 0	STX (start of text)
2	X X X X		Status (cf. diagnosis register 210, bit 0 − 3)
3	X X X X	X X X X	Day of the week (not used here)
4	0 0 1 1		Tens unit position − hours (ASCII)
5	0 0 1 1		Units position − hours (ASCII)
6	0 0 1 1		Tens unit position − minutes (ASCII)
7	0 0 1 1		Units position − minutes (ASCII)
8	0 0 1 1		Tens unit position − seconds (ASCII)
9	0 0 1 1		Units position − seconds (ASCII)
10	0 0 1 1		Tens unit position − day (ASCII)
11	0 0 1 1		Units position − day (ASCII)
12	0 0 1 1		Tens unit position − month (ASCII)
13	0 0 1 1		Units position − month (ASCII)
14	0 0 1 1		Tens unit position − year (ASCII)
15	0 0 1 1		Units position − year (ASCII)
16	0 0 0 0	1 0 1 0	LF (line feed)
17	0 0 0 0	1 1 0 1	CR (carriage return)
18	0 0 0 0	0 0 1 1	ETX (end of text)

The data are sent in 8−bit ASCII format, and are secured with parity even.

X = any (not used)

Technical data

The data for the 87TS01−E/R13.. module (cf. module description) are applicable with the following additional specifications:

Timer connection	radio clock (e.g. HOPF 6020 acc. to GKWN000256) with reception from the DCF77 time transmitter via the RS 232c serial interface
Transmission rate	9600 baud
Cable type for connecting line	RD−Y(St)Y, 4 x 0.22 mm^2

Master clock

Time deviation during synchronization between DCF77 and internal clock	1 msec
Inaccuracy	
During synchronization, every minute	typ. 2.2 msec/ max. 4.8 msec
Upon loss of synchronization, T = 25 ˚C	typ. 3.4 sec/ max. 6.9 sec in 24 hrs
T = 70 ˚C	typ. 5.9 sec/ max. 13 sec in 24 hrs
Time resolution	5 msec

ORDERING DATA

Order no. for complete module:

Type designation: 87TS01−E/R1313	Order number:	GJR2368900R1313

Order no. of plug−in memory modules:

Memory module, position	A106	Order number:	GJR2352834Pxxxx
	A108		GJR2352835Pxxxx
	A401		GJR2352833Pxxxx

Pxxxx = Position number indicating the applicable program version.

Technical data are subject to change without notice!

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