MEINBERG
FUNKUHREN

Technical Information

Operating Instructions

DCF77C51

Werner Meinberg
Auf der Landwehr 22
D-31812 Bad Pyrmont

Telefon: ++49 52 81 - 9309-0
Telefax: ++49 52 81 - 9309-30

Internet : http://www.meinberg.de
E-Mail : info@meinberg.de

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General Information about DCF77

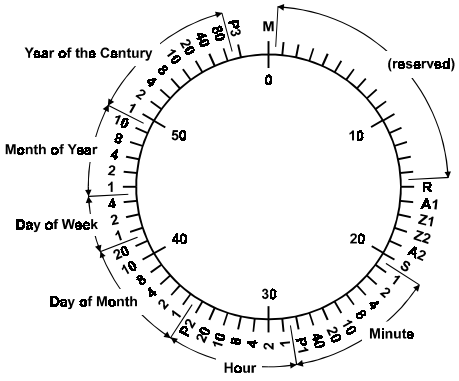
The radio remote clocks made by Meinberg receive the signal from the long wave transmitter DCF77. This long wave transmitter installed in Mainflingen near Frankfurt/Germany transmits the reference time of the Federal Republic of Germany. This time reference is either the Central European Time (Mitteleuropäische Zeit, MEZ) or the Central European Summer Time (Mitteleuropäische Sommerzeit, MESZ). The transmitter is controlled by the atomic clock plant at the Federal Physical Technical Institute (PTB) in Braunschweig/Germany and transmits the current time of day, date of month and day of week in coded second pulses. Once every minute the complete time information is available.

At the beginning of every second the amplitude of the high precision 77.5 kHz carrier frequency is lowered by 75% for a period of 0.1 or 0.2 sec. The length of these time marks represent a binary coding scheme using the short time mark for logical zeroes and the long time mark for logical ones. The information on the current date and time as well as some parity and status bits can be decoded from the time marks of the 15th up to the 58th second every minute. The absence of any time mark at the 59th second of a minute signals that a new minute will begin with the next time mark.

Our radio remote clocks decode the highly accurate information on date and time within a wide range around Germany. So some of our clocks are installed in Bilbao/ Spain as well as in the city of Umeå in northern Sweden - fully satisfying the requirements of the users. The radio remote clocks automatically switch to summertime and back. The reception of the time information is free of charge and does not need to be registered.

Generally it is important to position the antenna in an optimal way. It should be mounted at least 30 centimeters away from the clock unit and from solid steel. The antenna should be aligned at a right angle to the direction of the transmitter (Frankfurt).

Figure: Decoding Scheme



M	Start of Minute (0.1 sec)
R	RF Transmission via secondary antenna
A1	Announcement of a change in daylight saving
Z1, Z2	Time zone identification
	Z1,Z2 = 0,1: Daylight saving disabled (MEZ)
	Z1,Z2 = 1,0: Daylight saving enabled (MESZ)
A2	Announcement of a leap second
S	Start of time code information (0.2 sec)
P1, P2, P3	Even parity bits

DCF77C51

The radio remote clock DCF77C51 has been designed for applications where only the serial interface is used to transmit information on date and time to other devices. The clock has an enhanced LF receiver and is manufactured using surface mounting technology (SMT). The electronic assembly is mounted in a plastic case with four LEDs in the front panel which let the user monitor the clock's status.

Overview

Antenna and LF Receiver

An external ferrit antenna is used to receive the signal from DCF77. Optionally, a weather-proof antenna is available which can be mounted outdoor. A coaxial cable which can be up to more than 100 meters in length is used to pass the antenna's output signal to the on-board LF receiver where it is demodulated by a synchronous detector with automatic gain control. The demodulated time marks are fed to the clock's microprocessor.

Microprocessor Circuit

Time marks from the receiver circuit are filtered and decoded by the microprocessor. If no errors are detected in the current time message an additional plausibility check against the previous time message is performed. If that plausibility check passes, too, the real time clock on the board is adjusted corresponding to the decoded time and date. The real time clock is read periodically and it's date and time are passed to the serial port drivers. Additionally, the microprocessor generates output pulses when the second or minute changes. An on-board microprocessor supervisory circuit provides a watchdog timer which lets the microprocessor recover from malfunction, along with a power-fail comparator which resets the microprocessor if the supply voltage drops below a specified threshold.

Buffered Real Time Clock

If the board's power supply is turned off, a gold cap capacitor on the board lets the real time clock keep time and status for a minimum of 48 hours (typically 180 hours). This capacitor does not need any maintenance. Alternatively, the clock can be ordered with a lithium battery which has 10 years of life time guaranteed.

Asynchronous Serial Port

An asynchronous serial port can be used to transmit information on date and time to other devices. The port can be set up as either RS-232 port or 20 mA current loop.

Installation

The radio remote clock has a built in AC power supply. After the power cable has been connected, a green LED labeled **Netz** indicates that the clock is ready to operate. If the antenna cable has been connected to both the antenna and the clock's BNC connector, the brighness of the LED labeled **Feldstärke** reflects the signal strength of the 77.5 kHz carrier. In order to get the maximum signal, the antenna should be aligned in two steps. First it should be turned **slowly** until the **Feld** LED is mostly dimmed. Finally the antenna must be turned by 90° from this position to obtain maximum signal. The antenna should be installed at least 30 cm away from the clock and from steel girders or plates.

If the antenna is installed properly and the signal from DCF77 can be received without strong distortions, the green LED labeled **Modulation** starts blinking exactly once per second, corresponding to the time marks from DCF77. If this LED flashes intermediately, there is some electrical noise around which prevents the microprocessor from decoding the time message. In this case, a better location for the antenna must be found.

After reset, the red LED labeled **Freilauf** indicates that the clock is running on xtal and has not synchronized with DCF77 yet. Due to the plausibility checks, it can take up to three minutes after power-up until the clock is synchronized and this LED is turned off. The state of this LED only changes when a new minute begins.

Frontview

Serial Port

The asynchronous serial port can be configured by a DIL switch located inside the clock's case. When the clock is beeing shipped, the levers of the DIL switch have been set to some defaults which are marked by asterisks (*) in the tables below. If one of the switch settings has to be changed, the upper part of the clock's case must be removed by detaching the 4 screws located at the edges of the cover.

Serial Input and Output Drivers

The serial string generated by the microprocessor is fed into a RS-232 output driver plus a 20mA current loop driver in parallel. If the clock is configured to send time messages automatically once per second or once per minute, both of the outputs may be used concurrently.

The serial input drivers need to be connected only if a serial string shall be sent on request. Lever 10 of the DIL switch lets the user select either RS-232 input or current loop input. It is **not** possible to use both the current loop input and the RS-232 input together.

SW1-10	Input	
off	RS232	*
on	20mA	

Both the current loop input and output can be wired for either active or passive operation. If a current loop driver shall be operated in active mode, either -15V must be supplied at the connector or the corresponding pin of the port can be wired to ground An example application at the end of this manual shows how to connect the port.

Transmission Speed

The transmission speed can by selected by levers 1 to 3 of the DIL switch. Any commonly used speed from 600 baud through 19200 baud can be configured:

SW-1	SW-2	SW-3	Baud	
on	on	on	600	
off	on	on	1200	
on	off	on	2400	
off	off	on	4800	
on	on	off	9600	*
off	on	off	19200	
on	off	off	(reserved)	
off	off	off	(reserved)	

Framing

Levers 4 and 5 of the DIL switch are used to select the framing type of the serial port:

SW-4	SW-5	Framing	
on	on	7E1	
off	on	7E2	*
on	off	8N1	
off	off	8N2	

Framing types are usually labeled with three-character abbreviations. The first character represents the number of data bits (7 or 8), the second character indicates whether parity checking is used or not (N=no parity, E=even parity) and the last character gives the number of stop bits to use (1 or 2).

Output mode

The serial port sends a time string on request by incoming '?' character (ASCII code 3Fh). Additionally, a time string can be generated automatically either whenever a new second starts or when a new minute begins. Levers 6 and 7 are used to select the desired mode of operation:

SW-6	SW-7	String Mode	
on	on	once per second	*
off	on	once per minute	
on	off	on request only	
off	off	(reserved)	

Time Zone

Lever 8 of the DIL switch lets the user select the clock's time zone. The serial string may either contain the Central European Time rsp. Central European Summer Time (CET/CEST=MEZ/MESZ), or always UTC (formerly GMT).

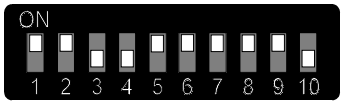
SW1-8	Time Zone	
off	UTC	
on	MEZ/MESZ	*

Pulse Outputs

Whenever a new second or minute starts, a corresponding pulse (P_SEC, P_MIN) with a width of 200msec is generated. These pulses are made available at the DB25 connector via optocoupler outputs. The P_SEC pulse is also available with RS-232 level (-3..12V/+3..12V). If required, Jumper JP2 must be set to activate this puls. See the technical description and application example at the end of this manual for details.

DIL-Switches

SW1-SW3	Baudrate	600/1200/2400/4800/9600/19200
SW4 - SW5	Framing	7E1 / 7E2 / 8N1 /8N2
SW6 - SW7	Output Mode	per second / per minute / on request
SW8	Timezone	UTC / (MESZ/MEZ)
SW9	reserved	
SW10	Serial Input	20mA / RS232



* default settings:
framing: 7E2 / baudrate: 9600 / output mode: per second / timezone: MESZ/MEZ

Technical Specifications

RECEIVER:	Synchronous demodulator with automatic gain control bandwidth: approx. 50Hz
ANTENNA:	Active external ferrite antenna in a plastic case Length of the cable: up to more than 100m
RF AMPLITUDE, MODULATION:	Indicated by LED
TIMECODE CHECK:	Parity and consistency checking over a period of two minutes RF distortions indicated by both LED and a status character in the serial output string Without RF signal the clock runs on XTAL with an accuracy of 10^{-6}
BATTERY BACKUP:	Gold Cap or Lithium battery when the power is turned off, the on-board RTC keeps the time based on XTAL for more than 48 hours (gold cap) rsp. more than 10 years (lithium battery)
RELIABILITY OF OPERATION:	Microprocessor supervisory circuit provides watchdog timer, power supply monitoring and backup-battery switchover
OUTPUT PULSES:	Optocoupler outputs (70V/20mA) provide pulses of 200msec width whenever a new second rsp. minute begins. P_SEC pulse with RS232-level (Jumper JP2 must be set)
ASYNCHRONOUS SERIAL PORT:	Transmission speed, framing, time zone and mode of operation configurable by DIL switch
TRANSMISSION SPEED:	600 through 19200 baud
FRAMING:	7E1, 7E2, 8N1 or 8N2
MODE OF OPERATION:	time string transmitted automatically once per second, once per minute, or when a request character '?' has been received

TIME ZONE:	MEZ/MESZ=CET/CEST, or UTC
OUTPUT STRING:	see "Format of the Meinberg Standard Time String"
SERIAL LINE DRIVERS:	Output: RS-232 and 20mA current loop (active or passive) Input: RS-232 or 20mA current loop (active or passive), selectable by jumper
CONNECTORS:	DB25 connector coaxial RF connector (BNC type)
POWER SUPPLY:	230V AC, 50Hz -15V only when using 20mA current loop
PHYSICAL DIMENSIONS:	Rolec Technobox TBA 084 L x B x H (160mm x 81mm x 62mm)
AMBIENT TEMPERATURE:	0 ... 50°C
HUMIDITY:	max. 85 %
OPTIONS:	Hardware and software modifications accordding to customer specification

CE Label

CE

This device conforms to the directive 89/336/EWG on the approximation of the laws of the Member States of the European Community relating to electromagnetc compatibility.

Format of the Meinberg Standard Time String

The Meinberg Standard Time String is a sequence of 32 ASCII characters starting with the STX (start-of-text) character and ending with the ETX (end-of-text) character. The format is:

<STX>D:*dd.mm.yy*;T:*w*;U:*hh.mm.ss*;*uvxy*<ETX>

The letters printed in *italics* are replaced by ASCII numbers whereas the other characters are part of the time string. The groups of characters as defined below:

<STX> Start-Of-Text (ASCII code 02h)

dd.mm.yy the current date:

dd	day of month	(01..31)
mm	month	(01..12)
yy	year of the century	(00..99)

w the day of the week (1..7, 1 = Monday)

hh.mm.ss the current time:

hh	hours	(00..23)
mm	minutes	(00..59)
ss	seconds	(00..59, or 60 while leap second)

uv clock status characters:

u: '#' clock has not synchronized after reset
' ' (space, 20h) clock has synchronized after reset
v: '*' DCF77 clock currently runs on XTAL
' ' (space, 20h) DCF77 clock is sync'd with transmitter

x time zone indicator:

'U'	UTC	Universal Time Coordinated, formerly GMT
' '	MEZ	European Standard Time, daylight saving disabled
'S'	MESZ	European Summertime, daylight saving enabled

y anouncement of discontinuity of time, enabled during last hour before discontinuity comes in effect:

'!' announcement of start or end of daylight saving time
'A' announcement of leap second insertion
' ' (space, 20h) nothing announced

<ETX> End-Of-Text (ASCII code 03h)

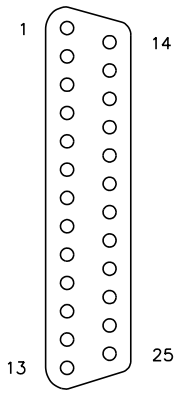
Connectors

Name	Type	Signal	Cable
Serial Interface	25 pin SUB-D	RS232 20mA	shielded data line
Pulse Outputs		pulse per second pulse per minute	
Antenna	BNC	77.5kHz	shielded coaxial line (RG174/RG58)
Power Supply		230V /AC	power supply cord

DSUB-25 Connector Pin Assignments

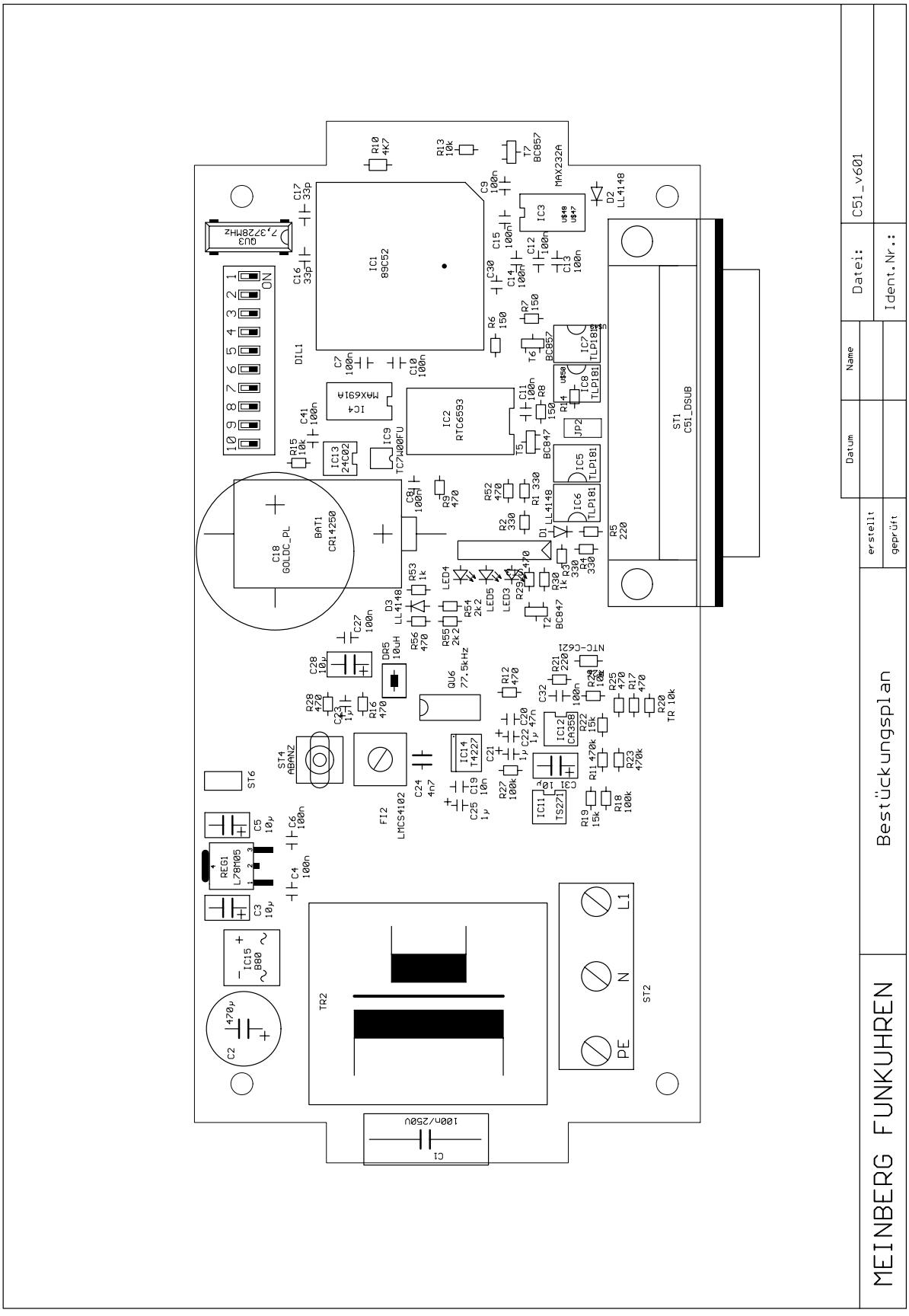
1	
2	RxD in
3	TxD out
4	RTS (connected with CTS)
5	CTS (connected with RTS)
6	DSR (connected with DTR)
7	GND
8	P_SEC (RS232)
9	-pass_in / +act_in
10	+pass_in
11	curr_loop +5V out
12	+pass_out
13	-pass_out / +act_out

14	P_SEC out, collector
15	P_SEC out, emitter
16	P_MIN out, collector
17	P_MIN out, emitter
18	
19	
20	DTR (connected with DSR)
21	-act_in
22	
23	
24	curr_loop -15V in
25	-act_out



DB25 connector, female, front view

Component Layout

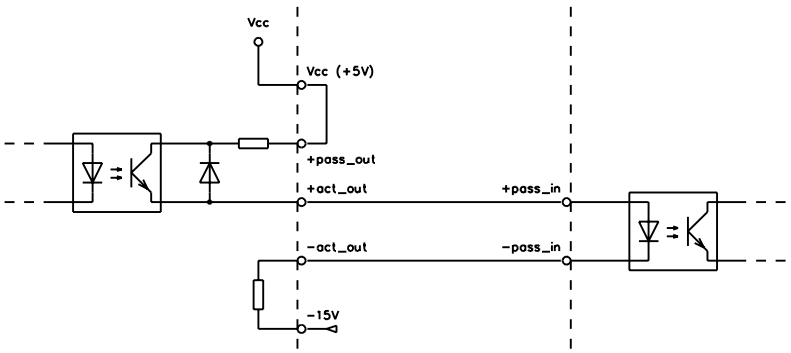


Usage of the Current Loop Interface

The current loop interface can be wired to work in one of two modes: active output drives passive input, or passive output to active input.

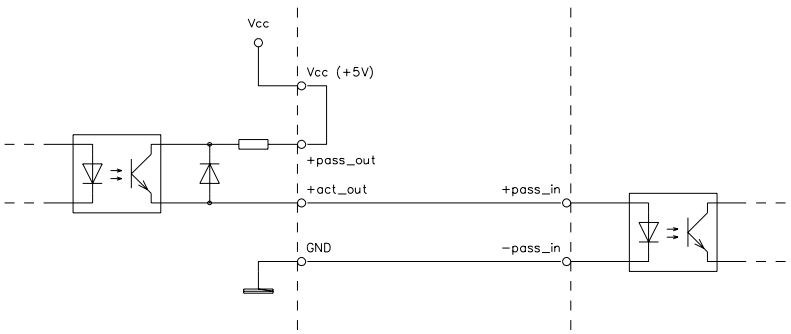
Active Output to Passive Input

If the clock's current loop output shall be wired to operate as active output, a connection from the pin labeled **+pass_out** to **Vcc (+5V)** must be provided. The pin labeled **-act_out** is pulled down to the auxiliary **-15V** supply, which must be made available by the user.



active current loop output with auxiliary -15V supply

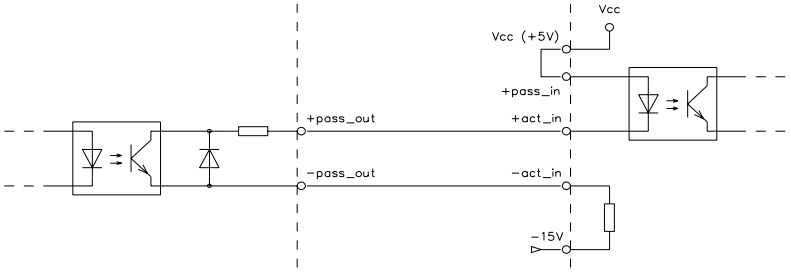
If an external -15V supply is not available, the **-act_out** signal can be connected directly to **GND**, as shown below:



active current loop output without auxiliary -15V supply

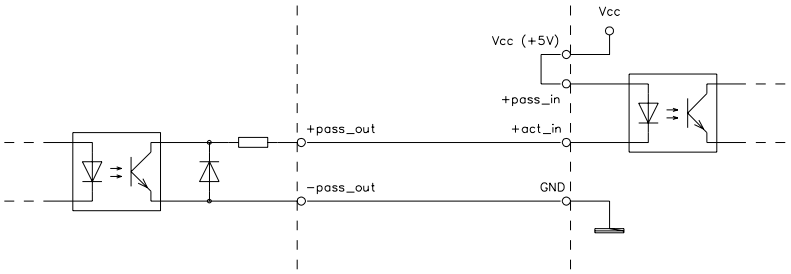
Passive Output to Active Input

If a current loop output shall be wired to operate as passive output, the input wust be wired to operate as active input. A connection from the pin labeled **+pass_in** to **Vcc (+5V)** must be provided. The pin labeled **-act_in** is pulled down to the auxiliary **-15V** supply, which must be made available by the user.



active current loop input with auxiliary -15V supply

If an external -15V supply is not available, the **-act_in** signal can be connected directly to **GND**, as shown below:



active current loop input without auxiliary -15V supply