MEINBERG
FUNKUHREN

Technical Information

Operating Instructions

TGV510

Timecode Generator/Diplexer

Impressum

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Abstract

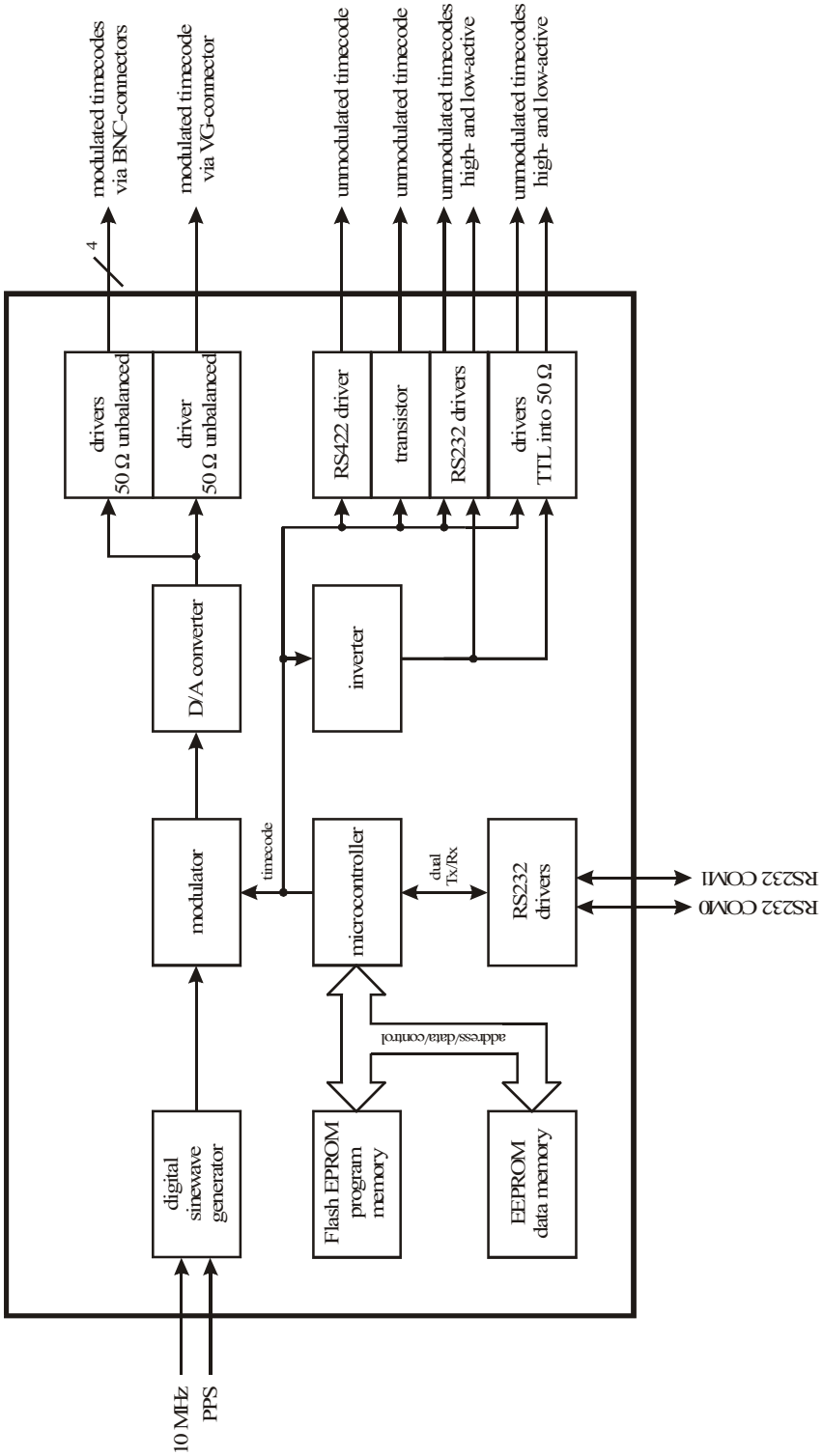
The transmission of coded timing signals began to take on widespread importance in the early 1950´s. Especially the US missile and space programs were the forces behind the development of these time codes, which were used for the correlation of data. The definition of time code formats was completely arbitrary and left to the individual ideas of each design engineer. Hundreds of different time codes were formed, some of which were standardized by the "Inter Range Instrumantation Group" (IRIG) in the early 60´s.

Except these "IRIG Time Codes" other formats, like NASA36, XR3 or 2137, are still in use. The board TGV510 however generates the IRIG-A or IRIG-B, AFNOR NFS 87-500 code as well as IEEE1344 code which is an IRIG-B123 coded extended by information for time zone, leap second and date. If desired other formats are available.

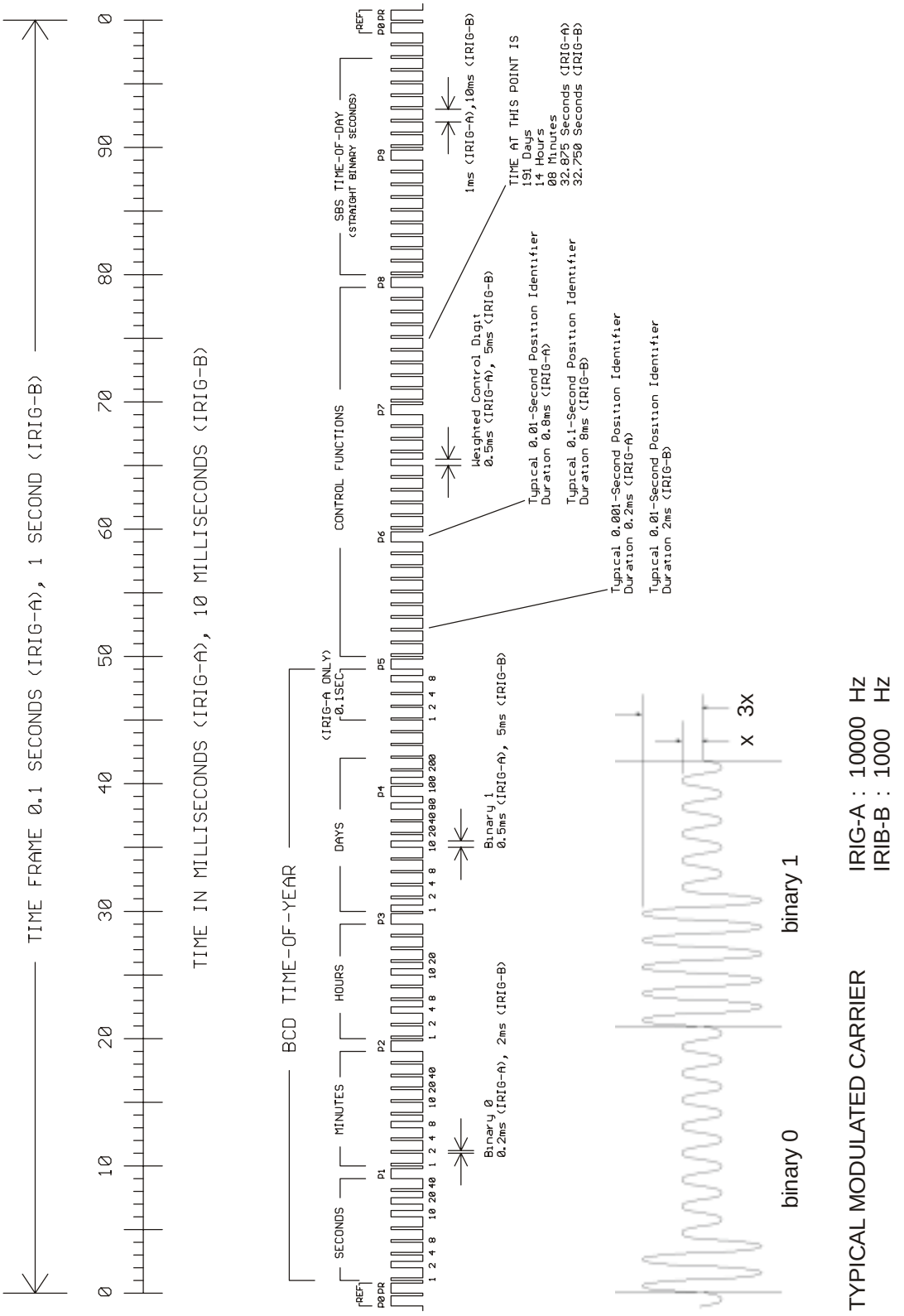
Principle of Operation

The Board TGV510 was designed for the generation and distribution of IRIG, AFNOR and IEEE1344 standard time codes. Particularly it is intended for operation with the Meinberg GPS radio clocks GPS161, GPS163 and GPS167 as well as the DCF77 correlation receiver PZF509. Apart from the digitally generated amplitude-modulated code, TGV510 also provides the unmodulated DC-Level shift code. The modulated timecode is available at five outputs (4 x BNC- or SMB-connector, 1 x VG-connector). The modulated sine wave carrier and the boards internal time pattern are derived from the radio clocks disciplined oscillator. For special applications, the board can be equipped with a freewheeling oscillator (OCXO or TCXO). Signals needed for operation are a synchronuos pulse per second signal (PPS), a serial time string at RS232 level, and a 10MHz reference clock as mentioned above. After reading the serial timestring the IRIG code is phase-locked to the precise pulse per second signal coming from the radio clock. TCR510 uses a special software regulation to stabilize the internal time pattern. Bounces of the external PPS signal less than +/- 300µs are corrected in steps of 1µs per second. In AFNOR-Mode the output signal level is automatically set according to French-Std. NFS-87500.

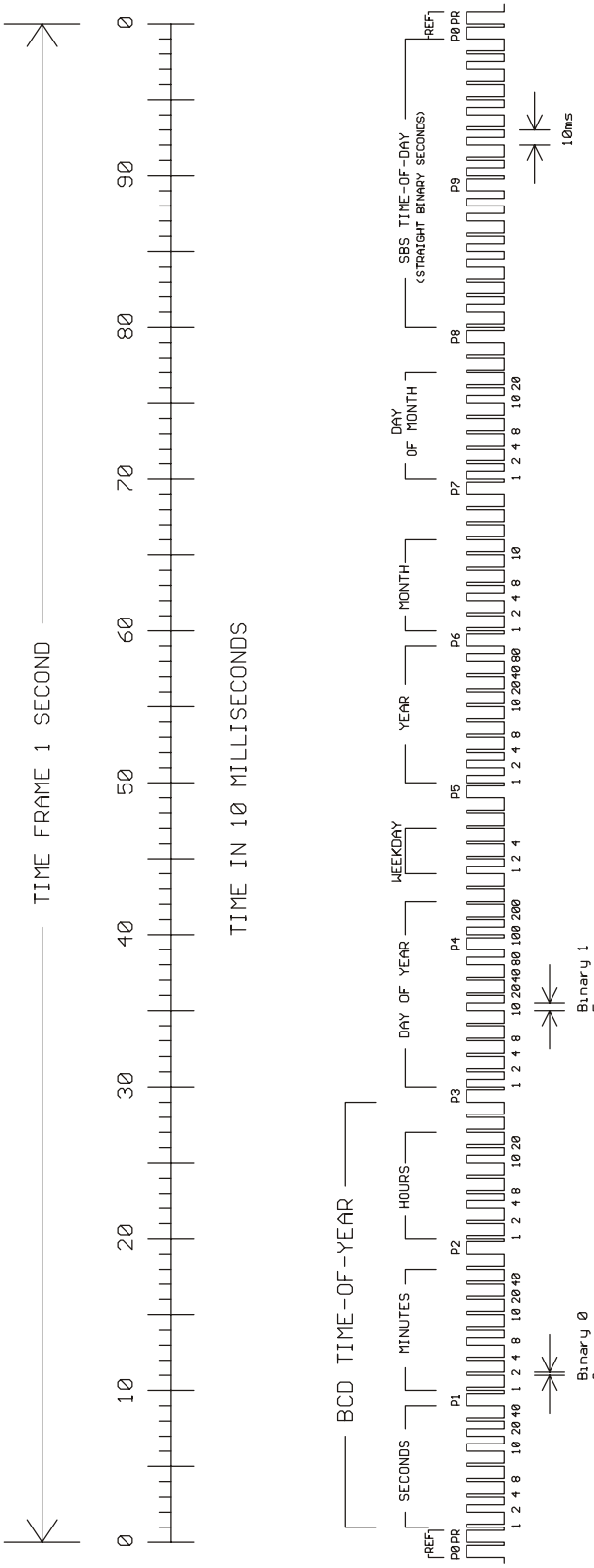
Block diagram TGV510



IRIG standard format



AFNOR-standard format



Assignment of CF Segment in IEEE1344 mode

Bit No.	Designation	Description
49	Position Identifier P5	
50	Year BCD encoded 1	low nibble of BCD encoded year
51	Year BCD encoded 2	
52	Year BCD encoded 4	
53	Year BCD encoded 8	
54	empty, always zero	
55	Year BCD encoded 10	high nibble of BCD encoded year
56	Year BCD encoded 20	
57	Year BCD encoded 40	
58	Year BCD encoded 80	
59	Position Identifier P6	
60	LSP - Leap Second Pending	set up to 59s before LS insertion
61	LS - Leap Second	0 = add leap second, 1 = delete leap second [1.)]
62	DSP - Daylight Saving Pending	set up to 59s before daylight saving changeover
63	DST - Daylight Saving Time	set during daylight saving time
64	Timezone Offset Sign	sign of TZ offset 0 = '+', 1 = '-'
65	TZ Offset binary encoded 1	Offset from IRIG time to UTC time. Encoded IRIG time plus TZ Offset equals UTC at all times !
66	TZ Offset binary encoded 2	
67	TZ Offset binary encoded 4	
68	TZ Offset binary encoded 8	
69	Position Identifier P7	
70	TZ Offset 0.5 hour	set if additional half hour offset
71	TFOM Time figure of merit	time figure of merit represents approximated clock error. [2.)] 0x00 = clock locked 0x0F = clock failed
72	TFOM Time figure of merit	
73	TFOM Time figure of merit	
74	TFOM Time figure of merit	
75	PARITY	parity on all preceding bits incl. IRIG-B time

[1.)] current firmware does not support leap deletion of leap seconds

[2.)] TFOM is cleared, when clock is synchronized first after power up. *see chapter Selection of generated timecode*

Generated timecodes

Besides the amplitude modulated sine wave signal, the board also provides unmodulated DC-Level Shift outputs (TTL, RS232, RS422, open drain) in parallel. Thus ten time codes are available.

a) A002: 1000pps, PWM-DC-Signal, no carrier
BCD time of year

b) A132: 1000pps, AM-Sine wave signal, 10 kHz carrier frequency
BCD time of year

c) A003: 1000pps, PWM-DC-Signal, no carrier
BCD time of year, SBS time of day

d) A133: 1000pps, AM-Sine wave signal, 10 kHz carrier frequency
BCD time of year, SBS time of day

e) B002: 100pps, PWM-DC-Signal, no carrier
BCD time of year

f) B122: 100pps, AM-Sine wave signal, 1 kHz carrier frequency
BCD time of year

e) B003: 100pps, PWM-DC-Signal, no carrier
BCD time of year, SBS time of day

f) B123: 100pps, AM-Sine wave signal, 1 kHz carrier frequency
BCD time of year, SBS time of day

g) AFNOR: Code according to NFS-87500, 100pps,
AM-Sine wave signal, 1kHz carrier frequency,
BCD time of year, complete date, SBS-Time of Day,
Signal level according to NFS-87500

h) IEEE1344: Code according to IEEE1344-1995, 100pps,
AM-Sine wave signal, 1kHz carrier frequency,
BCD-time of year, SBS time of day, IEEE1344
extensions for date, timezone, daylight-saving
and leap second in control functions (CF) segment.
also see table 'Assignment of CF segment in IEEE1344 mode'

Setting TGV510 into operation

Please pay attention to the following points, to ensure a correct operation of the TGV510

Supply Voltage

The board needs a single power supply of +5V/@ 170mA only. If the time code generator is synchronized by the correlation receiver PZF509 this voltage should be sourced by a linear regulated power supply, because harmonics of a switched mode power supply could make the reception of the DCF-signal worse.

Required inputs

The following signals, provided by GPS16x or PZF509, are needed for operation of TGV510

a) 10 MHz Clock Signal, TTL-Level, VG-Connector Pin 12
   (if TGV510 is not equipped with an internal oscillator)
b) positive pulse per second, TTL-Level, VG-Connector Pin 6c
c) serial time telegram, once per seconde, VG-Connector Pin 24c

Configuration of the Board

All settings can be made using the on-board DIL-Switch. The manual DIL-Switch configuration for the generated code can be disabled, if TGV510 is connected to a radio clock supporting the serial configuarion feature of TGV510. In this case the non-volatile EEPROM settings are used. Please make sure that baud rate and framing of serial port COM0 correspond to the settings of the synchronizing radioclock. Timecode is only output if the pulse per second signal is available.

Configuration of serial port COM0 and COM1

Baudrate and Framing of the serial ports are configured using the DIL-Switches SW1-1 to SW1-3. COM0 is essential for operation, since the serial time string is read here.

SW1-1	SW1-2	baud rate
off	off	19200
on	off	9600
off	on	4800
on	on	2400

Baudrate of serial ports

SW1-3	framing
off	8N1
on	7E2

Framing of serial ports

Selection of serial timestring

DIP-Switch SW1-4 selects the type of serial time string to be used for synchronization of the TGV510. The Uni Erlangen/NTP telegram must be selected in case of generating a IEEE1344 timecode. *(see chapter 'Selection of generated timecode')*

SW1-4	String
off	Standard Meinberg
on	Uni Erlangen/NTP

Selection of serial timestring

Selection of generated time code

The time code to be generated can be selected via DIL-Switches SW1-8 to SW1-8. DC-Level Shift Codes (PWM-Signal), A00x/B00x) and modulated sine wave carrier (A13x/B12x) are always generated simulatneously. Both signals are provided at the VG64-Connecter, i.e if code A132 is selected also code A002 is available. This applies for the codes AFNOR NFS 87-500 and IEEE1344 as well. Combinations of DIP Switches SW1-5...SW1-8 not mentioned in the table below select code IRIG-B122/ B002. *For correct output of the IEEE1344 format the TGV510 must be synchronized by a Uni Erlangen/NTP telegram, for this time string contains information about the local timezone offset. Otherwise the timezone offset is set to zero in IEEE1344 mode.* All other codes can be generated with synchronization by either a Standard Meinberg or Uni Erlangen/NTP telegram.

SW1-5	SW1-6	SW1-7	SW1-8	Code
Off	Off	Off	Off	IRIG-B002/B122
On	Off	Off	Off	IRIG-B003/B123
Off	On	Off	Off	IRIG-A002/A132
On	On	Off	Off	IRIG-A003/A133
Off	Off	On	Off	AFNOR-NFS 87-500
On	Off	On	Off	IEEE1344

Selection of generated Code

The TFOM field in IEEE1344 code is set dependent on the 'already sync'ed' character ('#') which is sent in the serial time telegram. This character is set, whenever the preconnected clock was not able to synchronize after power up reset. The 'time figure of merit' (TFOM) field is set as follows.

Clock was synchronized once after power up : TFOM = 0000
Clock was <u>not</u> synchronized after power up : TFOM = 1111

For testing purposes the output of TFOM in IEEE1344 mode can be disabled. The segment is set to all zeros then. This option can be useful, if the IRIG generators preconnected clock cannot be synchronized during system testing.

SW1-9	Ignore TFOM
off	IEEE1344+TFOM
on	TFOM off

Disabling the output of TFOM

Serial configuration of the board

If the serial configuration feature of TGV510 shall be used, the DIL-Switch settings for the time code can be disabled using SW1-10. The output of serial timestring via TxD line of COM0 is disabled if serial configuration is selected.

SW1-10	Configuration
On	Dip-Switch, manual configuration
Off	EEPROM, serial via RS232

Outputs

The module TGV510 provides modulated and unmodulated (DC-Level Shift) outputs. The format of the timecodes is illustrated on pages 6 and 7

AM-sine wave-outputs

The amplitude-modulated carrier is available at the VG-connector pin 28c and four RF-connectors (BNC in the frontpanel or SMB on the board). The carrier frequency depends on the code and has a value of 10 kHz (IRIG-A) or 1 kHz (IRIG-B). The signal amplitude is $3V_{pp}$ (MARK) and $1V_{pp}$ (SPACE) into 50 Ω. The encoding is made by the number of MARK-amplitudes during ten carrier waves. The following agreements are valid:

a) binary"0" : 2 MARK-amplitudes, 8 SPACE-amplitudes
b) binary"1" : 5 MARK-amplitudes, 5 SPACE-amplitudes
c) position-identifier : 8 MARK-amplitudes, 2 SPACE-amplitudes

PWM-DC-outputs

The pulse width modulated DC-signals shown on pages 6 and 7 are coexistent to the modulated output. The described time frames are valid for encoding a binary "0" or "1" and the "position-identifiers". The following signal levels are available at the VG-connector:

a) TTL int 50 Ω, high- und low-active
b) RS232, high- und low-active
c) RS422
d) open drain transistor-output

RS232-output

The received time-telegram is transmitted by the TGV510. In this way the loss of the RS232-interface of the clock for time-code-generation is avoided. Baud rate and framing of the telegram are the same as the received one (time string once a second).

Status-LED

The LED indicates the status of the time-code-generator. If it is switched on, the code is synchronous to the GPS167- or PZF509-time. A flashing LED signalizes that the internal time pattern correction has not settled.

Firmware Updates

Whenever the on-board software must be upgraded or modified, the new firmware can be downloaded to the internal flash memory via the serial port COM0. There is no need to open the metal case and insert a new EPROM.

If the pin '/BSL in' at the VG-connector is held in the TTL-low state while the system is powered up, a bootstrap-loader is actived and waits for instructions from the serial port COM0. The new firmware can be sent to TGV510 from any standard PC with serial interface. A loader program will be shipped together with the file containing the image of the new firmware.

The contents of the program memory will not be modified until the loader program has sent the command to erase the flash memory. So if the 'BSL in' input is in TTL-low state unintentionally while the system is powered up, the firmware will not be changed accidentially. After the next power-up, the system will be ready to operate again.

Technical data

Required inputs: 10 MHz oszillator-clock (TTL-level)
positive pulse per second (TTL-level)
serial time-telegram (RS232)

Outputs: 5 unbalanced AM-sine wave-signals (4 x RF-connector, 1 x VG):
$3V_{PP}$ (MARK) / $1V_{PP}$ (SPACE) into 50Ω (IRIG)
$2.17V_{PP}$ (MARK) / $0.688V_{PP}$ (SPACE) into 50Ω (AFNOR)

PWM-signal: TTL into 50Ω, high- and low-active
RS232, high- and low-active
RS422
open drain, data of transistor:
Uds_{max}: 100 VDC, Id_{max}: 150 mA, P_{tot}: 250mW

serial time-telegram (RS232)

Pilot-LED: Status of the time-code-generator

Power supply: +5V, @ 170mA

Temperature range: 0-60 degrees (Celsius)

Connectors: 64-pin rear VG edge connector DIN 41612
BNC-coaxial-plug connector for the sine wave-signal in the frontpanel if requested

Board dimension: 100mm x 160mm

Frontpanel: 4TE (20mm), 3HE(128,4mm)

Options: on-board 10 MHz reference oscillator
4 balanced outputs 600 Ω (4 x RF-connector)

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.

Time Strings

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: different for DCF77 or GPS receivers:

'*' DCF77 clock currently runs on XTAL
GPS receiver has not checked its position

' ' (space, 20h) DCF77 clock is sync'd with transmitter
GPS receiver has determined its position

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)

Format of the Uni Erlangen String (NTP)

The time string Uni Erlangen (NTP) of a **GPS-clock** is a sequence of 68 ASCII characters starting with the STX (start-of-text) character and ending with the ETX (end-of-text) character. The format is:

<STX>tt.mm.jj; w; hh:mm:ss; voo:oo; acdfg i; bbb.bbbbn llll.llle hhhh*m*<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)

v sign of the offset of local timezone related to UTC

oo:oo offset of local timezone related to UTC in hours and minutes

ac clock status characters:

a: '#' clock has not synchronized after reset
' ' (space, 20h) clock has synchronized after reset

c: '*' GPS receiver has not checked its position
' ' (space, 20h) GPS receiver has determined its position

d time zone indicator:

'S'	MESZ	European Summertime, daylight saving enabled
' '	MEZ	European Standard Time, daylight saving disabled

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

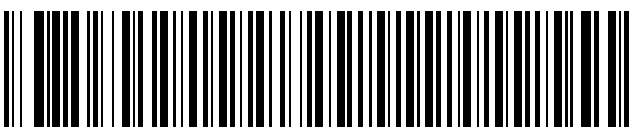
'!' announcement of start or end of daylight saving time
' ' (space, 20h) nothing announced

g	anouncement of discontinuity of time, enabled during last hour before discontinuity comes in effect: ‘A’ announcement of leap second insertion ‘ ‘ (space, 20h) nothing announced
i	leap second insertion ‘L’ leap second is actually inserted (active only in 60th sec.) ‘ ‘ (space, 20h) no leap second is inserted
bbb.bbbb	latitude of receiver position in degrees leading signs are replaced by a space character (20h)
n	latitude, the following characters are possible: ‘N’ north of equator ‘S’ south d. equator
llll.llll	longitude of receiver position in degrees leading signs are replaced by a space character (20h)
e	longitude, the following characters are possible: ‘E’ east of Greenwich ‘W’ west of Greenwich
hhhh	altitude above sea level in meters leading signs are replaced by a space character (20h)
<ETX>	End-Of-Text (ASCII-Code 03h)

Signals at VG-connector

Name	Pin	Description
GND	32a+c	Ground
VCC in (+5V)	1a+c	+5V Supply
VDD in	3a+c	Supply Voltage for Oscillator (optional) +5V/+12V depending on oscillator
/BSL in	4a	Boot Input, Bootstrap-Loader is started, if input is low during reset.
P_SEC in	6c	Pulse per second signal, TTL-Pegel, aktive high, duarion 200 msec
/RESET in/out	9c	Reset pulse, TTL-Level, aktive low
10 MHz in	12a	10 MHz Clock input, TTL-Level
RESERVED	13c,14c 15c	reserved I/O Lines
COM0 RxD in	24c	COM0 RS-232 Input
COM0 TxD out	30c	COM0 RS-232 Output
COM1 TxD out	27c	COM1 RS-232 Output
COM1 RxD in	29c	COM1 RS-232 Input
IRIG TTL out	25a	Unmodulated output, TTL int 50 Ω, high-active
/IRIG TTL out	26a	Unmodulated output, TTL int 50 Ω, low-active
IRIG OD out	26c	Unmodulated output, open drain
IRIG AM out	28c	Modulated sine wave output
IRIG RS422 B out	28a	Unmodulated output, RS422-level, negative pole
IRIG RS422 A out	29a	Unmodulated output, RS422-level, positive pole
/IRIG RS232 out	31a	Unmodulated output, RS232-level, low-active
IRIG RS232 out	31c	Unmodulated output, RS232-level, high-active

Rear connector pin assignments

	a	c
1	VCC in (+5V)	VCC in (+5V)
2		
3	VDD in (+5V)	VDD in (+5V)
4	/BSL in	
5		
6		PPS in
7		
8		
9		/RESET in/out
10		
11		
12	10 MHz in/out	
13		SCL
14		SCL_EN
15		SDA
16		
17		
18		
19		
20		
21		
22		
23		
24		COM0 RxD in
25	IRIG TTL out	
26	/IRIG TTL out	IRIG OD out
27		COM1 TxD out
28	IRIG RS422 B out	IRIG AM out
29	IRIG RS422 A out	COM1 RxD in
30		COM0 TxD out
31	/IRIG RS232 out	IRIG RS232 out
32	GND	GND

Connector according to DIN 41612, Type C 64, Rows a + c