

UD: Serial Protocols

- UD Series displays of type “L” can be set to a “Serial” mode in order to receive and decode serial data strings transmitted from a controlling device.
- Basically, the controlling device should transmit the protocol once per second.
- This document describes serial data protocols with respect to those relevant parts an UD Series display needs for decoding. It does not give a complete description of a protocol including all items the controlling device may utilize.
- These data protocols can be divided into “real-time” and “display” protocols.

Real-time protocols

- These protocols convey time, date, and status data.
- Time should be continuously up-counting – except during legal time jumps according to a leap second or a DST switching.
- These protocols are suitable for a real-time operation of an UD Series display.
- Connecting a precise pulse per second (PPS) can enhance the accuracy of time display and of synchronizing the internal clock.
- Please refer to document “Installation and Operating Manual UD Series Displays” for details about connecting and status display.

Overview:

Protocol	Format	No of char.	*
Meinberg Standard	<STX>D:d ₁₀ d ₁ .mt ₁₀ mt ₁ .y ₁₀ y ₁ ;T:w;U:h ₁₀ h ₁ .m ₁₀ m ₁ .s ₁₀ s ₁ ;uvxy<ETX>	32	
NMEA 0183 \$GPGGA	\$GPGGA,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,<10>,<11>,<12>,<13>,<14>*check<CR><LF>	84 max	8
NMEA 0183 \$GPRMC	\$GPRMC,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,<10>,<11>,<12>*check<CR><LF>	76 max	8
NMEA 0183 \$GPZDA	\$GPZDA,<1>,<2>,<3>,<4>,<5>,<6>*check<CR><LF>	40 max	8
Wharton Format 1	<STX>s ₁ s ₁₀ m ₁ m ₁₀ h ₁ h ₁₀ d ₁ d ₁₀ mt ₁ mt ₁₀ y ₁ y ₁₀ <ETX>	14	
Wharton Format 1 + Status	<STX>s ₁ s ₁₀ m ₁ m ₁₀ h ₁ h ₁₀ d ₁ d ₁₀ mt ₁ mt ₁₀ y ₁ y ₁₀ <status><ETX>	15	
Wharton Format 2	Ty ₁₀ y ₁ :mt ₁₀ mt ₁ :d ₁₀ d ₁ :0w:h ₁₀ h ₁ :m ₁₀ m ₁ :s ₁₀ s ₁ <CR><LF>	23	

*8 This protocol requires 8 data bits.

Meinberg Standard

32 ASCII characters: <STX>D:d₁₀d₁.mt₁₀mt₁.y₁₀y₁;T:w;U:h₁₀h₁.m₁₀m₁.s₁₀s₁;uvxy<ETX>

1.	<STX>	Start of protocol	02h
2.	D		44h
3.	:	Colon	3Ah
4.	d ₁₀	Ten day	30h – 33h
5.	d ₁	Unit day	30h – 39h
6.	.	Decimal point	2Eh
7.	mt ₁₀	Ten month	30h – 31h
8.	mt ₁	Unit month	30h – 39h
9.	.	Decimal point	2Eh
10.	y ₁₀	Ten year	30h – 39h
11.	y ₁	Unit year	30h – 39h
12.	;	Semicolon	3Bh
13.	T		54h
14.	:	Colon	3Ah
15.	w	day-of-week	30h – 37h 30h = day-of-week not available 31h = Monday ... 37h = Sunday
16.	;	Semicolon	3Bh
17.	U		55h
18.	:	Colon	3Ah
19.	h ₁₀	Ten hours	30h – 32h
20.	h ₁	Unit hours	30h – 39h
21.	.	Decimal point	2Eh
22.	m ₁₀	Ten minutes	30h – 35h
23.	m ₁	Unit minutes	30h – 39h
24.	.	Decimal point	2Eh
25.	s ₁₀	Ten seconds	30h – 35h
26.	s ₁	Unit seconds	30h – 39h
27.	;	Semicolon	3Bh
28.	u	Status 1	' ' 20h Clock synchronized after power-on '#' 23h Clock not synchronized after power-on
29.	v	Status 2	' ' 20h Clock currently synchronized '*' 2Ah Clock currently not synchronized
30.	x	Time zone	' ' 20h Standard time, winter time; CET 'S' 53h Daylight Saving Time, summer time; CEST 'U' 55h UTC
31.	y	Early warnings	' ' 20h No warning '!' 21h Daylight Saving Time switching 'A' 41h Leap second warning
32.	<ETX>	End of protocol	03h

NMEA 0183 \$GPGGA

84 (maximum) ASCII characters:

\$GPGGA,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,<10>,<11>,<12>,<13>,<14>*check<CR><LF>

Field	Description	Relevance to display
\$GPGGA	Identification of the NMEA 0183 sentence	Checked
<1>	UTC time, hhhmmss or hhhmmss.ss format	Plausibility check → time display
<2>	Latitude	Ignored
<3>	Latitude hemisphere	Ignored
<4>	Longitude	Ignored
<5>	Longitude hemisphere	Ignored
<6>	Quality indicator	Status display
<7>	Number of satellites in use	Ignored
<8>	Horizontal dilution	Ignored
<9>	Antenna height	Ignored
<10>	Units of antenna height	Ignored
<11>	Geoidal height	Ignored
<12>	Units of geoidal height	Ignored
<13>	Age of DGPS data	Ignored
<14>	DGPS reference station	Ignored
check	Checksum = 2Ah () + two parity bytes	Checked if present
<CR><LF>	Termination	Checked

NMEA 0183 \$GPRMC

76 (maximum) ASCII characters:

\$GPRMC,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,<10>,<11>,<12>*check<CR><LF>

Field	Description	Relevance to display
\$GPRMC	Identification of the NMEA 0183 sentence	Checked
<1>	UTC time, hhmmss or hhmmss.ss format	Plausibility check → time display
<2>	Status: 'A' = valid, 'V' = warning	Status display
<3>	Latitude	Ignored
<4>	Latitude hemisphere	Ignored
<5>	Longitude	Ignored
<6>	Longitude hemisphere	Ignored
<7>	Speed over ground	Ignored
<8>	Course over ground	Ignored
<9>	UTC date of position fix, ddmmyy format	Plausibility check → date display
<10>	Magnetic variation	Ignored
<11>	Magnetic variation direction	Ignored
<12>	Mode indicator	Ignored
check	Checksum = 2Ah () + two parity bytes	Checked if present
<CR><LF>	Termination	Checked

NMEA 0183 \$GPZDA

40 (maximum) ASCII characters:

\$GPZDA,<1>,<2>,<3>,<4>,<5>,<6>,*check<CR><LF>

Field	Description	Relevance to display
\$GPZDA	Identification of the NMEA 0183 sentence	Checked
<1>	UTC time, hhmmss or hhmmss.ss format	Plausibility check → time display
<2>	UTC day, format dd	Plausibility check → date display
<3>	UTC month, format mm	Plausibility check → date display
<4>	UTC year, yyyy	Plausibility check → date display
<5>	Local time zone, offset hours	Ignored
<6>	Local time zone, offset minutes	Ignored
check	Checksum = 2Ah () + two parity bytes	Checked if present
<CR><LF>	Termination	Checked

Wharton Format 1

14 ASCII characters: <STX>s₁s₁₀m₁m₁₀h₁h₁₀d₁d₁₀mt₁mt₁₀y₁y₁₀<ETX>

1.	<STX>	Start of protocol	02h
2.	s ₁	Unit seconds	30h – 39h
3.	s ₁₀	Ten seconds	30h – 35h
4.	m ₁	Unit minutes	30h – 39h
5.	m ₁₀	Ten minutes	30h – 35h
6.	h ₁	Unit hours	30h – 39h
7.	h ₁₀	Ten hours	30h – 32h
8.	d ₁	Unit day	30h – 39h
9.	d ₁₀	Ten day	30h – 33h
10.	mt ₁	Unit month	30h – 39h
11.	mt ₁₀	Ten month	30h – 31h
12.	y ₁	Unit year	30h – 39h
13.	y ₁₀	Ten year	30h – 39h
14.	<ETX>	End of protocol	03h

Wharton Format 1 + Status

15 ASCII characters: <STX>s₁s₁₀m₁m₁₀h₁h₁₀d₁d₁₀mt₁mt₁₀y₁y₁₀<status><ETX>

1.	<STX>	Start of protocol	02h
2.	s ₁	Unit seconds	30h – 39h
3.	s ₁₀	Ten seconds	30h – 35h
4.	m ₁	Unit minutes	30h – 39h
5.	m ₁₀	Ten minutes	30h – 35h
6.	h ₁	Unit hours	30h – 39h
7.	h ₁₀	Ten hours	30h – 32h
8.	d ₁	Unit day	30h – 39h
9.	d ₁₀	Ten day	30h – 33h
10.	mt ₁	Unit month	30h – 39h
11.	mt ₁₀	Ten month	30h – 31h
12.	y ₁	Unit year	30h – 39h
13.	y ₁₀	Ten year	30h – 39h
14.	<status>	Status	30h – 3Fh Bit 0: 0 = MSF 1 = DCF Bit 1: 0 = standard time (winter) 1 = Daylight Saving Time (DST, summer) Bit 2: 0 = not synchronized 1 = synchronized Bit 3: 0 = no early warning 1 = early warning
15.	<ETX>	End of protocol	03h

Wharton Format 2

23 ASCII characters: $Ty_{10}y_1:mt_{10}mt_1:d_{10}d_1:0w:h_{10}h_1:m_{10}m_1:s_{10}s_1<CR><LF>$

1.	T	Start of protocol	54h
2.	y ₁₀	Ten year	30h – 39h
3.	y ₁	Unit year	30h – 39h
4.	:	Colon	3Ah
5.	mt ₁₀	Ten month	30h – 31h
6.	mt ₁	Unit month	30h – 39h
7.	:	Colon	3Ah
8.	d ₁₀	Ten day	30h – 33h
9.	d ₁	Unit day	30h – 39h
10.	:	Colon	3Ah
11.	0		30h
12.	w	Day-of-week	30h – 37h 30h = not available 31h = Monday ... 37h = Sunday
13.	:	Colon	3Ah
14.	h ₁₀	Ten hours	30h – 32h
15.	h ₁	Unit hours	30h – 39h
16.	:	Colon	3Ah
17.	m ₁₀	Ten minutes	30h – 35h
18.	m ₁	Unit minutes	30h – 39h
19.	:	Colon	3Ah
20.	s ₁₀	Ten seconds	30h – 35h
21.	s ₁	Unit seconds	30h – 39h
22.	<CR>	Carriage return	0Dh
23.	<LF>	Line feed	0Ah

Display protocols

- These protocols can convey an up-counting, a down-counting, or a “frozen” time.
- Time data (= h_{10} , h_1 , m_{10} , m_1 , s_{10} , s_1) always should be ASCII characters. Time data will be checked for validity: range of hours = 00 – 23, range of minutes and seconds = 00 – 59. Additionally, it is permitted to transmit any character representing not a number: 20h – 2Fh and 3Ah – 7Fh. In this case, the display will blank the corresponding digit. The display will reject the whole data string if any time datum has a value of 00h – 1Fh or > 7Fh.
- These protocols support a minus sign. The minus sign replaces the tens of hours (h_{10}).
- Some protocols contain an address. The display accepts data only if the address matches the serial address selection of the set-up.
- Some protocols include separating signs between hours/minutes and minutes/seconds. Separating signs should be ASCII coded as 20h (= space), 2Eh (= decimal point), or 3Ah (= colon). The display will reject the whole data string if data should not match one of these values. The separating signs will be displayed according to received data if at “Display” set-up “delimiter = Auto” has been selected.
- Please have “real-time” mode disabled: uncheck the “Enable Real-Time” checkbox at “Real-Time” set-up.

Overview:

Protocol	Format	No of char.
ASCII	$h_{10}h_1<s>m_{10}m_1<s>s_{10}s_1<CR>$	9
BFE	$<STX><Addr>h_{10}h_1<s>m_{10}m_1<s>s_{10}s_1<ETX>$	11
LOUTH	$<STX><Addr><Cmd>h_{10}h_1m_{10}m_1s_{10}s_1<ETX>$	10
Omnibus/TSL	$<Header>< Ctrl>h_{10}h_1<s>m_{10}m_1<s>s_{10}s_1 \dots$ *8	10 min.
Omnibus/TSL + Color	$<Header>< Ctrl>h_{10}h_1<s>m_{10}m_1<s>s_{10}s_1 \dots$ *8	10 min.
DIS-6	$<STX><Addr><Ctrl>h_{10}h_1<s>m_{10}m_1<s>s_{10}s_1<ETX>$	12
DIS-11	$<STX><Addr>><Ctrl>< >> < >> < >> h_{10}h_1<s>m_{10}m_1<s>s_{10}s_1<ETX>$	16
Newport	$<STX><Addr><Ctrl>h_{10}h_1<s>m_{10}m_1<s>s_{10}s_1<CR><ETX>$	13
MaMu	$< Header>h_{10}h_1<s>m_{10}m_1<s>s_{10}s_1<CR>$	10

<Addr>	Address: ASCII 0 – 9 (30h – 39h)
<s>	Separating sign: ASCII ‘ ’ (20h) or ‘.’ (2Eh) or ‘:’ (3Ah). The separating signs will be displayed according to received data if at “Display” set-up “delimiter = Auto” has been selected.
*8	This protocol requires 8 data bits.

ASCII9 ASCII characters: $h_{10}h_1<s>m_{10}m_1<s>s_{10}s_1<CR>$

1.	h_{10}	Ten hours or minus sign	30h – 32h 2Dh
2.	h_1	Unit hours	30h – 39h
3.	<s>	Separating sign	20h or 2Eh or 3Ah
4.	m_{10}	Ten minutes	30h – 35h
5.	m_1	Unit minutes	30h – 39h
6.	<s>	Separating sign	20h or 2Eh or 3Ah
7.	s_{10}	Ten seconds	30h – 35h
8.	s_1	Unit seconds	30h – 39h
9.	<CR>	Carriage return	0Dh

BFE11 ASCII characters: $<STX><Addr>h_{10}h_1<s>m_{10}m_1<s>s_{10}s_1<ETX>$

1.	<STX>	Start of protocol	02h
2.	<Addr>	Address	30h – 39h
3.	h_{10}	Ten hours or minus sign	30h – 32h 2Dh
4.	h_1	Unit hours	30h – 39h
5.	<s>	Separating sign	20h or 2Eh or 3Ah
6.	m_{10}	Ten minutes	30h – 35h
7.	m_1	Unit minutes	30h – 39h
8.	<s>	Separating sign	20h or 2Eh or 3Ah
9.	s_{10}	Ten seconds	30h – 35h
10.	s_1	Unit seconds	30h – 39h
11.	<ETX>	End of protocol	03h

LOUTH10 ASCII characters: $<STX><Addr><Cmd>h_{10}h_1m_{10}m_1s_{10}s_1<ETX>$

1.	<STX>	Start of protocol	02h
2.	<Addr>	Address	30h – 39h
3.	<Cmd>	Command	'D' 44h or 'E' 45h or 'U' 55h
4.	h_{10}	Ten hours or minus sign	30h – 32h 2Dh
5.	h_1	Unit hours	30h – 39h
6.	m_{10}	Ten minutes	30h – 35h
7.	m_1	Unit minutes	30h – 39h
8.	s_{10}	Ten seconds	30h – 35h
9.	s_1	Unit seconds	30h – 39h
10.	<ETX>	End of protocol	03h

Omnibus/TSL

This protocol requires 8 data bits.

10 (minimum) characters: <Header><Ctrl>h₁₀h₁<s>m₁₀m₁<s>s₁₀s₁ ...

1.	<Header>	80h + address (0 – 9)	80h – 89h
2.	<Ctrl>	Control – without function	00h – 7Fh
3.	h ₁₀	Ten hours or minus sign	30h – 32h 2Dh
4.	h ₁	Unit hours	30h – 39h
5.	<s>	Separating sign	20h or 2Eh or 3Ah
6.	m ₁₀	Ten minutes	30h – 35h
7.	m ₁	Unit minutes	30h – 39h
8.	<s>	Separating sign	20h or 2Eh or 3Ah
9.	s ₁₀	Ten seconds	30h – 35h
10.	s ₁	Unit seconds	30h – 39h
...		Further data will be ignored until the display detects a valid header	

Omnibus/TSL + Colour

This protocol requires 8 data bits.

10 (minimum) characters: <Header><Ctrl>h₁₀h₁<s>m₁₀m₁<s>s₁₀s₁ ...

1.	<Header>	80h + address (0 – 9)	80h – 89h
2.	<Ctrl>	Control: LED colour	00h auto 10h red 20h green 30h yellow
3.	h ₁₀	Ten hours or minus sign	30h – 32h 2Dh
4.	h ₁	Unit hours	30h – 39h
5.	<s>	Separating sign	20h or 2Eh or 3Ah
6.	m ₁₀	Ten minutes	30h – 35h
7.	m ₁	Unit minutes	30h – 39h
8.	<s>	Separating sign	20h or 2Eh or 3Ah
9.	s ₁₀	Ten seconds	30h – 35h
10.	s ₁	Unit seconds	30h – 39h
...		Further data will be ignored until the display detects a valid header	

DIS-6

12 characters: <STX><Addr><Ctrl>h₁₀h₁<s>m₁₀m₁<s>s₁₀s₁<ETX>

1.	<STX>	Start of protocol	02h
2.	<Addr>	Address	30h – 39h
3.	<Ctrl>	Control – without function	10h – 7Fh
4.	h ₁₀	Ten hours or minus sign	30h – 32h 2Dh
5.	h ₁	Unit hours	30h – 39h
6.	<s>	Separating sign	20h or 2Eh or 3Ah
7.	m ₁₀	Ten minutes	30h – 35h
8.	m ₁	Unit minutes	30h – 39h
9.	<s>	Separating sign	20h or 2Eh or 3Ah
10.	s ₁₀	Ten seconds	30h – 35h
11.	s ₁	Unit seconds	30h – 39h
12.	<ETX>	End of protocol	03h

DIS-11

16 characters: <STX><Addr>><Ctrl>< > >< > >< > >h₁₀h₁<s>m₁₀m₁<s>s₁₀s₁<ETX>

1.	<STX>	Start of protocol	02h
2.	<Addr>	Address	30h – 39h
3.	<Ctrl>	Control – without function	10h – 7Fh
4.	< >	Text – will be ignored	20h – 7Fh
5.	< >		
6.	< >		
7.	< >		
8.	h ₁₀	Ten hours or minus sign	30h – 32h 2Dh
9.	h ₁	Unit hours	30h – 39h
10.	<s>	Separating sign	20h or 2Eh or 3Ah
11.	m ₁₀	Ten minutes	30h – 35h
12.	m ₁	Unit minutes	30h – 39h
13.	<s>	Separating sign	20h or 2Eh or 3Ah
14.	s ₁₀	Ten seconds	30h – 35h
15.	s ₁	Unit seconds	30h – 39h
16.	<ETX>	End of protocol	03h

Newport

13 characters: <STX><Addr><Ctrl>h₁₀h₁<s>m₁₀m₁<s>s₁₀s₁<CR><ETX>

1.	<STX>	Start of protocol	02h
2.	<Addr>	Address	30h – 39h
3.	<Ctrl>	Control – without function	10h – 7Fh
4.	h ₁₀	Ten hours or minus sign	30h – 32h 2Dh
5.	h ₁	Unit hours	30h – 39h
6.	<s>	Separating sign	20h or 2Eh or 3Ah
7.	m ₁₀	Ten minutes	30h – 35h
8.	m ₁	Unit minutes	30h – 39h
9.	<s>	Separating sign	20h or 2Eh or 3Ah
10.	s ₁₀	Ten seconds	30h – 35h
11.	s ₁	Unit seconds	30h – 39h
12.	<CR>	Carriage return	0Dh
13.	<ETX>	End of protocol	03h

MaMu

10 characters: <Header>h₁₀h₁<s>m₁₀m₁<s>s₁₀s₁<CR>

1.	<Header>	ASCII 'T' or 't'	54h or 74h
2.	h ₁₀	Ten hours or minus sign	30h – 32h 2Dh
3.	h ₁	Unit hours	30h – 39h
4.	<s>	Separating sign	20h or 2Eh or 3Ah
5.	m ₁₀	Ten minutes	30h – 35h
6.	m ₁	Unit minutes	30h – 39h
7.	<s>	Separating sign	20h or 2Eh or 3Ah
8.	s ₁₀	Ten seconds	30h – 35h
9.	s ₁	Unit seconds	30h – 39h
10.	<CR>	Carriage return	0Dh

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