GSI ONLINE for Leica TPS and DNA

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- when it has to be right

Leica Geosystems

Table of contents

1 Introduction

A large set of interfacing commands support the Leica TPS Total Stations and Digital Levels to allow direct access to computers and data loggers via RS232 serial interface.

The Leica Geo Serial Interface (GSI) is a general purpose, serial data interface for bi-directional communication between the instrument and the computer. GSI uses a simple command structure to read/write values from/to the sensor. Global and instrument specific Word Indexes (WI) are used to specify various data types. GSI provides specific sets of commands adapted to the functionality of the various instrument series.

In addition to the former Online Guide "WILD INSTRUMENTS ONLINE", this User Guide focuses the Leica Series of Total Stations TPS100/110C/300/400/700/1000/1100/2000/5000 and of the Digital Levels DNA03/DNA10. The guide is designed as a simple command listing and therefore basic aspects of serial data communications will not be covered. For detailed information and advice on GSI communication, we strongly recommend to consult the "WILD INSTRUMENTS ONLINE" guide.

The document is divided into a section for TPS and a section for DNA instruments.

2 TPS Section

2.1 GSI data format

GSI data is transmitted in blocks with each block ending with a terminator (CR or CR/LF). Every block consists of several data words (see the examples below). The data word begins with a two character Word Index, the WI code, specifying the data type within this block. The GSI-8 block has in total 16 characters, consisting of 7 information characters (e.g. WI, sign), followed by 8 data characters and by the blank character (ASCII code 32) at the end of the data word. The GSI-16 block is similar to the GSI-8 block but the block begins with "*" and the data word contains 16 characters for large values such as UTM coordinates, large alphanumeric codes, attributes or point IDs.

Example 1 shows a GSI-8 block sequence with the words for point ID (11), easting coordinate (81) and northing coordinate (82). Example 2 shows a GSI-16 block sequence with the words for point ID (11), horizontal (21) and vertical angle (22).

Example 1: GSI-8

| <---- Word 1 ----> | <---- Word 2 ----> | <---- Word 3 ----> |

```
1234567890123456  (16 characters per word)

110001+0000A110 81..00+00005387 82..00-00000992
110002+0000A111 81..00+00007586 82..00-00003031
110003+0000A112 81..00+00007536 82..00-00003080
110004+0000A113 81..00+00003839 82..00-00003080
110005+0000A114 81..00+00001241 82..00-00001344
        |←8 ch. →|
```

GSI-8 data word structure:

Pos. 1-2:	Word Index (WI)	e.g. "11" (WI for PtID)
Pos. 3-6:	Information related to data	e.g. "0003" (block number in word 1)
Pos. 7:	Sign	e.g. "+" or "–"
Pos. 8-15:	Data (8 digits)	e.g. "0000A113" (PtID)
Pos. 16:	Blank (= separating character)	

Example 2: GSI-16

| <---------- Word 1 ----------> | <---------- Word 2 ----------> | <---------- Word 3 ----------> |

```
 1234567890123456789012345678901234  (24 characters per word)

*110001+000000000PNC0055 21.002+0000000013384650 22.002+0000000005371500
*110002+000000000PNC0056 21.002+0000000012802530 22.002+0000000005255000
*110003+000000000PNC0057 21.002+0000000011222360 22.002+0000000005433800
*110004+000000000PNC0058 21.002+0000000010573550 22.002+0000000005817600
*110005+000000000PNC0059 21.002+0000000009983610 22.002+0000000005171400
        | <---- 16 char. ----> |
```

GSI-16 data word structure:

Pos. 1-2:	Word Index (WI)	e.g. “11”; WI code
Pos. 3-6:	Information related to data	e.g. “002”
Pos. 7:	Sign	e.g. "+" or "-"
Pos. 8-23:	GSI-16 data (16 digits)	e.g. “000000000PNC0058”; PtID
Pos. 16/24:	Blank (= separating character)	

2.2 GSI word information

Position	*Explanation*	*Applicable for*
3	No significance	All words
4	**AUTOMATIC INDEX INFORMATION** 0: Automatic index OFF 1: Automatic index OPERATING 3: Automatic index OPERATING	All words containing angle information
5	**INPUT MODE** 0: Original measured values transferred from the instrument 1: Manual input from keyboard 2: Measured value, Hz-Correction ON 3: Measured value, Hz-Correction OFF 4: Result of special function	Measured data
6	**UNITS** 0: Meter (last digit: 1mm) 1: Feet (last digit: 1/1000ft) 2: 400 gon 3: 360° decimal 4: 360° sexagesimal 5: 6400 mil 6: Meter (last digit: 1/10mm) 7: Feet (last digit: 1/10‘000ft) 8: Meter (last digit: 1/100mm)	Measured data
7	**SIGN** +: Positive value -: Negative value	Measured data
8-15 (8-23)	**DATA** Data includes a sequence of 8(16) numerical or alphanumerical characters. Note that certain data blocks are allowed to carry more than 1 value (e.g. PPM/MM). Those data are automatically transferred with a sign before each single value.	Measured data
16 (24)	**SEPARATING CHARACTER** _: Blank	All words

[Tab.1]

2.3 Online command structure

GSI online commands represent a simple syntax structure consisting of four basic commands. To access a wide range of settings or values, commands can be enhanced with a limited sequence of word indexes (WI) and parameters. Following, a short summary explaining the meaning of the basic commands continued with some examples.

- SET Set instrument parameters
- CONF Read internal parameter settings
- PUT Write/change values within the Total station
- GET/I/… Get instant values from the Total Station (last valid value)
- GET/M/… Release measurement and get measured values from the Total Station

Examples:

SET commands
SYNTAX: SET/<set spec>/<parameter><CR/LF>
EXAMPLE: SET/30/0
RESPONSE: ?

Instrument BEEP:	SET/30/0 SET/30/1	OFF (disable) ON (enable)

CONF commands
SYNTAX: CONF/<conf spec><CR/LF>
EXAMPLE: CONF/30
RESPONSE: 0030/000

Above CONF/30 reads the BEEP setting	0030/0000 0030/0001	Beep disabled Beep enabled

PUT commands
SYNTAX: PUT/<put spec> <Value>_<CR/LF>
EXAMPLE: PUT/11….+00000012
RESPONSE: ?
CONFIRMATION: <CR/LF>

Writes Pointnumber	PUT/11….+00000012	➔ PtNo “1234”

☞ Make sure you put a space (_), behind <Value>!

GET commands
SYNTAX: GET/n/WI<get spec><CR/LF>
EXAMPLE: GET/M/WI21
RESPONSE: 21.102+12149400

Read Hz-Angle value	GET/I/WI21	➔ 21.104+12149400
Read Hz-,and V-Angles	GET/I/WI21/WI22;	➔ 21.104+12149400 ➔ 22.104+08832420

2.4 TPS100 Series (TC400/600/800/900)

The TPS100 Series were introduced in 1996/97. These Total Stations were the first series supporting an enhanced set of GSI interfacing commands. The additional functionality conducted to increasing operational benefit, compared to its predecessor TC500 which is described in the WILD INSTRUMENTS ONLINE, Appendix E.

Supported Instruments:
- TC403L, TC600, TC800 (Firmware Version 2.13 and higher)
- TC605/L, TC805/L TC905/L (collectively the “TCx05” series)

The following command listing is split into separate sections for each basic command (SET, CONF, PUT, GET). Some of the listed features may require specially equipped instruments (e.g. instruments with Laser Plummet or EGL). For detailed description of single functions, we recommend to consult the corresponding User Manual.

Low Level commands
SYNTAX: <command>CR/LF
RESPONSE: ?

<Command>:	a	Powers on the instrument
	b	Powers off the instrument
	c	Clears a distance measurement

Restrictions:
[1)] Applies to TCx05 instruments only
[2)] Applies to TCx00/403 instruments only
[3)] Applies to instruments equipped with EGL (Electronic Guide Light) only
[4)] Applies to instruments equipped with Laser Plummet only

2.4.1 SET

Syntax: SET/<SET SPEC>/<Parameter><CR/LF>

<SET SPEC>	*FUNCTION*	*<PARAMETER>*	*SETTING*
30	BEEP	0 1	OFF ON
32	Display contrast	0 1 2 3	Low contrast Medium contrast Medium to high contrast High contrast
34	BEEP @ 90°	0 1	OFF ON
40	Angle UNIT	0 1 2	GON Degree decimal Degree sexagesimal
41	Distance UNIT	0 1	Meter Feet
44	V angle READING	0 1 2	Zenith Horizontal Slope in percent
49 [1)]	Time/Date format	0 1	Form 1 (am/pm) Form 2 (24 hours)
50	Angle rounding	0 1 2	Low Medium High (➔ refer to manual)
70	Baudrate	0 1 2 3 4 5	300 Baud 600 Baud 1200 Baud 2400 Baud 4800 Baud 9600 Baud
71	Parity	0 1 2	None Odd Even
73	Terminator	0 1	CR CR/LF
76	Data recording device	0 1	Internal Memory RS232
80 [3)]	EGL activity	0 1	OFF ON
81 [3)]	EGL intensity	0 1 2	Poor Medium Strong
95	AutoOFF	0 1	OFF ON
102 [4)]	Laser plummet	0 1	OFF ON
103 [4)]	Laser plummet availibility	0 1	No Yes
135	RS232 recording mask	0 1	Mask1 (11, 21, 22, ….) Mask2 (11,…., 81, 82, 83)

[…cont.]

<SET SPEC>	*FUNCTION*	*<PARAMETER>*	*SETTING*
136	Data transfer output format	0 1 2 3	Mask1 Mask2 Activates user format #1 Activates user format #2 (➔ refer to manual)
137	RS232 format length	0 1	GSI-8 GSI-16
138 [1)]	Quick code recording	0 1	Before measurement After measurement
149	Display MASK	0 1 2 3[1)]	WI 11, 21, 22, 31 WI 21, 22, 32, 33 WI 11, 81, 82, 83 WI 11, 41, 32, 87
160	Setting measured distance to invalid	0	Set distance (WI31,32,33) and coordinates (WI81,82,83) to invalid
171	Direction of horizontal circle reading (Hz-Angle)	0 1	Clockwise Counterclockwise
177	Compensator	0 1	OFF ON
178 [1)]	Hz compensator	0 1	OFF ON (➔ refer to manual)
179 [1)]	Hz collimation	0 1	OFF ON (➔ refer to manual)

[Tab.2]

Example:
Intended action: Change Display contrast to “HIGH” contrast
Command: SET/32/3<CR/LF>
Response: ?

2.4.2 CONF

Syntax: CONF/<CONF SPEC><CR/LF>

<CONF SPEC>	*FUNCTION*	*RESPONSE*	*CONFIGURATION*
30	BEEP	0030/0000 0030/0001	OFF ON
32	Display contrast	0032/0000 0032/0001 0032/0002 0032/0003	Low contrast Medium contrast Medium to high contrast High contrast
34	BEEP @ 90°	0034/0000 0034/0001	OFF ON
40	Angle UNIT	0040/0000 0040/0001 0040/0002	GON Degree decimal Degree sexagesimal
41	Distance UNIT	0041/0000 0041/0001	Meter Feet
44	V angle READING	0044/0000 0044/0001 0044/0002	Zenith Horizontal Slope in percent
49 [1)]	Time/Date format	0049/0000 0049/0001	Form1 Form2 (➔ refer to manual)
50	Angle rounding	0050/0000 0050/0001 0050/0002	low medium high
70	Baudrate	0070/0000 0070/0001 0070/0002 0070/0003 0070/0004 0070/0005	300 Baud 600 Baud 1200 Baud 2400 Baud 4800 Baud 9600 Baud
71	Parity	0071/0000 0071/0001 0071/0002	NONE ODD EVEN
73	Terminator	0073/0000 0073/0001	CR CR/LF
76	Data recording device	0076/0000 0076/0001	Internal Memory RS232
80 [3)]	EGL activity	0080/0000 0080/0001	OFF ON
81 [3)]	EGL intensity	0081/0000 0081/0001 0081/0002	poor medium strong
90	Battery level	0090/000n	N[1=empty..9=full]
91	Instr. Temperature	0091/00nn	nn<100: Temp in °C nn>200: nn-255= temperature in -°C
95	AutoOFF	0095/0000 0095/0001	OFF ON
102 [4)]	Laser plummet	0102/0000 0102/0001	OFF ON
103 [4)]	Laser plummet availability	0103/0000 0103/0001	Not available Available
135	RS232 recording mask	0135/0000 0135/0001	Mask1 (11, 21, 22, ….) Mask2 (11,…., 81, 82, 83)

[…cont.]

<CONF SPEC>	*FUNCTION*	*RESPONSE*	*CONFIGURATION*
136	Data transfer output format	0136/0000 0136/0001 0136/0002 0136/0003	Mask1 Mask2 Activates user format #1 Activates user format #2 (➔ refer to manual)
FORM/n	Check format name; n:[1..4]	"Format_1" "Format_n"	e.g. CONF/FORM/1 -> „GSI 2"
137	RS232 format length	0137/0000 0137/0001	GSI-8 GSI-16
138 [1)]	Quick code recording	0138/0000 0138/0001	Before measurement After measurement
149	Display MASK	0149/0000 0149/0001 0149/0002 0149/0003[1)]	WI 11, 21, 22, 31 WI 21, 22, 32, 33 WI 11, 81, 82, 83 WI 11, 41, 32, 87
160	Validity of measured distance	0160/0000 0160/0001	Invalid DIST Valid DIST
161	EDM measuring mode	0161/0000 0161/0001	IR Fine mode IR Rapid mode
171	Direction of horizontal circle reading (Hz-Angle)	0171/0000 0171/0001	Clockwise Counterclockwise
177	Compensator	0177/0000 0177/0001	OFF ON
178	Hz compensator	0178/0000 0178/0001	OFF ON
179	Hz collimation	0179/0000 0179/0001	OFF ON)
180	Instrument Series	0180/0004 0180/0006 0180/0008 0180/0009	TC403 TC600/605 TC800/805 TC905
181	Instrument Type	0181/0000 0181/0001	T (Theodolite) TC (Total Station)
182	Firmware version	0182/0217	e.g. Version 2.17

[Tab.3]

2.4.3 PUT

Syntax: SET/<PUT SPEC>/<Parameter>_<CR/LF>

<PUT SPEC>	*FUNCTION*	*Access/Example*
11	Set Pointnumber	PUT/11….+00001234_<CR/LF> ➔ puts PtID “1234”
21	Hz Angle	PUT/21…n+10000000_<CR/LF> n[2..4]; angle units must be specified ➔ for n=2; puts Hz=”100.0000 gon”
58	Prism const	PUT/58….+00000200_<CR/LF> ➔ puts reflector constant to “20mm”
59	PPM	PUT/59….+02200000_<CR/LF> ➔ puts PPM correction to “220”
84	Station Easting	PUT/84…n+00100000_<CRLF> n[0..1]; distance unit must be specified ➔ for n=0; puts Easting=”100.000 m”
85	Station Northing	PUT/85…n+00100000_<CRLF> n[0..1]; distance unit must be specified ➔ for n=0; puts Northing=”100.000 m”
86	Station Elevation	PUT/86…n+00045000_<CRLF> n[0..1]; distance unit must be specified ➔ for n=0; puts Elevation=”45.000 m”
87	Reflector height	PUT/87…n+00001700_<CRLF> n[0..1]; distance unit must be specified ➔ for n=0; puts hr=”1.700 m”
88	Instrument height	PUT/88…n+00001500_<CRLF> n[0..1]; distance unit must be specified ➔ for n=0; puts hi=”1.500 m”

[Tab.4]

2.4.4 GET

Syntax: GET/n/WI<GET SPEC>/<Parameter><CR/LF>

<GET SPEC>	*FUNCTION*	*Access/Example*
11	Pointnumber	GET/M/WI11<CR/LF>; e.g. 11….+00000H66 ➔ PtNo="H66"
21	Hz Angle	GET/M/WI21<CR/LF>; e.g. 21.102+17920860 ➔ Hz „179.086" gon
22	Vertical Angle	GET/M/WI22<CR/LF>; e.g. 22.102+07567500 ➔ V: „75.675" gon
31	Slope distance	GET/M/WI31<CR/LF>; e.g. 31..00+00003387 ➔ Sdist: „3.387" m
32	Horizontal distance	GET/M/WI32<CR/LF>; e.g. 32..00+00003198 ➔ Hdist: „3.198" m
33	Height difference	GET/M/WI33<CR/LF>; e.g. 33..00+00001119 ➔ Hdiff: „1.119" m
51	PPM and Prism constant	GET/I/WI51; e.g. 51….+0220+002 ➔ PPM „220" and Prism const „2" mm
58	Prism constant	GET/I/WI58; e.g. 58..16+00000020 ➔ Prism „2" mm
59	PPM	GET/I/WI59; e.g. 59..16+02200000 ➔ PPM „220"
81	Target Easting (E)	GET/M/WI81; e.g. 81..00+01999507 ➔ E: "1999.507"m
82	Target Northing (N)	GET/M/WI82; e.g. 82..00-00213159 ➔ N: "-2139.159"m
83	Target Elevation (H)	GET/M/WI83; e.g. 83..00+00032881 ➔ H: "32.881"m
84	Station Easting (E0)	GET/I/WI84; e.g. 84..11+00393700 ➔ E: "393.700"m
85	Station Northing (N0)	GET/I/WI85; e.g. 85..11+06561220 ➔ N: "6561.220"m
86	Station Height (H0)	GET/I/WI86; e.g. 86..11+00065618 ➔ H: "65.618"m
87	Reflector height (hr)	GET/I/WI87; e.g. 87..11+00001700 ➔ hr: "1.700" m
88	Instrument height (hi)	GET/I/WI88; e.g. 88..11+00001550 ➔ hi: "1.550" m
GETDATE [1)]	read date	GETDATE; (dd:mm:yy) ➔ 07/02/00
GETTIME [1)]	read time	GETTIME; (hh:mm:ss) ➔ 04:06:58p

[Tab.5]

2.4.5 Remote Stake Out

The TCx05 series support a remote set-out method for surveyors using handheld or external recording devices. Stake out data can be transferred from via RS232 interface to the instrument's onboard Remote Stake Out application. The following procedure describes a possible way for successful field stake out. [Note: "_" represents a space character]

- Remote Set Station

Start Remote S/O	SETOUT<CR/LF>	Calls onbard S/O
Set Station Pointnumber	PUT/16….+000S7000_<CRLF>	e.g. "S7000"
Set Station Easting	PUT/84…0+00100000_<CRLF>	e.g. "100.000"[m]
Set Station Northing	PUT/85…0+00100000_<CRLF>	e.g. "100.000"[m]
SetStation Height	PUT/86…0+00050000_<CRLF>	e.g. "50.000"[m]
Set Instrument Height	PUT/88…0+00001500_<CRLF>	e.g. "1.500" [m]

- Remote Set Orientation

Set Hz-Orientation	PUT/21…2+00000000_<CRLF>	e.g. "0.000" gon (respectively Hz=0)

- Remote Target Point setting out

Set Target Pointnumber	PUT/11….+000S7000_<CRLF>	e.g. "S7000"
Set stakeout bearing	PUT/24…2+00102000_<CRLF>	e.g. "102.000"[m]
Set stakeout distance	PUT/34…0+00103000_<CRLF>	e.g. "103.000"[m]
Set stakeout height	PUT/83…0+00053000_<CRLF>	e.g. "53.000"[m]
Set Reflector height	PUT/87….+00001500_<CRLF>	e.g. "1.500" [m]
Release DIST or ALL key to measure a distance		
Terminating remote S/O	X<CR/LF>	Quits remote S/O

For further information, please refer to the corresponding instrument manual.
Refer also to „Basic Knowledge" BK99/44.

2.4.6 Warnings and Errors

Message ID	*Meaning*	*Possible reasons*
@W100	Instrument busy	Any other device is still interfacing the instrument; check interfacing priorities
@W127	Invalid command	The string sent to the TC could not be decoded properly or does not exist; check the syntax, or … Input buffer overflow (max. 100 characters)
@W139	EDM error	The EDM could not proceed the requested measurement; no or weak signal; Check EDM mode and target
@W158	One of the instruments sensor corrections could not be assigned.	Instrument is not stable or levelled; Tilt is out of range (e.g. when tilt sensor is out of range)
@E101	Value out of range	Check parameter range
@E103	Invalid Value	No valid value; Check parameter range
@E112	Battery low	Low Battery; check voltage
@E114	Invalid command	No valid command; check the syntax
@E117	Initialisation error	Contact service
@E119	Temperature out of range	Refer to manual for temperature range
@E121	Parity error	Wrong parity set; check Com-Port settings
@E122	RS232 time-out	The instrument was waiting for a response for the last 2 seconds
@E124	RS232 overflow	RS232 overflow; check Com-Port settings
@E151	Compensator error	Inclination Error; check instrument setup or switch of the compensator
@E155	EDM intensity	Weak signal; target is most likely outside the field of view
@E156	EDM system error	Contact service
@E158	One of the instruments sensor corrections could not be assigned.	Instrument is not stable, not levelled or suffering of vibration; Tilt is out of range (e.g. when tilt sensor is out of range); Level instrument or switch off compensator
@E190	General hardware error	Contact service
@E197	Initialization error	Contact service

[Tab.6]

2.5 TPS110C/300/400/700 series

The TPS300 and TPS700 series were introduced in 1998/99/2001, TPS400 in 2002; TPS110C and 410C in 2003. Featuring the latest generation technology, these instruments have further increased their interfacing capabilities. Considering the new firmware and application platform, lots of new commands have been added or existing commands being changed compared to its predecessors, the TPS100 Total Stations. However, basic functions use the same commands and therefore most of the existing TPS100 interfacing applications will still support the TPS110C/300/400/700 series.

Supported Instruments:

- TCR110C
- TC302, TC303, TC305, TC307
- TCR302, TCR303, TCR305, TCR307
- TC403, TC405, TC407, TC410
- TCR403, TCR405, TCR407, TCR410
- TCR403*power*, TCR405*power*, TCR407*power*
- TC702, TC703, TC705
- TCR702, TCR703, TCR705
- TC(R)702 auto, TC(R)703 auto, TC(R)705 auto

The following command listing is split into separate sections for each basic command (SET, CONF, PUT, GET). Some of the listed features may require specially equipped instruments (e.g. Reflectorless EDM ➔ RL). For detailed description of single functions, we recommend to consult the corresponding User Manual.

Low Level commands

SYNTAX: <command>CR/LF
SYNTAX: BEEP/<value>

<Command>:	a b c	Powers on the instrument Powers off the instrument Clears a distance measurement
<Value>:	BEEP/0 BEEP/1 BEEP/2	Short beep Long beep Alarm beep (short beep, 3 times)

Restrictions:

[1)] TCR models ONLY
[2)] Instruments equipped with EGL3 only
[3)] TC(R) auto models ONLY

2.5.1 SET

Syntax: SET/<SET SPEC>/<Parameter><CR/LF>

<SET SPEC>	*FUNCTION*	*<PARAMETER>*	*SETTING*
30	BEEP	0 1 2	OFF Medium Loud
31	Display illumination	0 1 2 3	Off Low Medium High
32	Display contrast	[0..100] 0 50 100	➔ [range] Low contrast Medium contrast High contrast
34	BEEP @ 90°	0 1	OFF ON
35[2)]	EGL activity	0 1 2 3	OFF Low Medium High
36[1)]	Laser Pointer	0 1	OFF ON
40	Angle UNIT	0 1 2 3 *4*	GON Degree decimal Degree sexagesimal Mils Radiant *(not available)*
41	Distance UNIT	0 1 2 3 4	Meter US Feet, decimal Intl. Feet, decimal US Feet/Inch Intl. Feet/Inch *(not available)*
42	Temperature UNIT	0 1	Degree Celcius Degree Fahrenheit
43	Pressure UNIT	0 1 2 *3* 4 *5* *6*	hPa MmHg Mbar *PSI (not available)* InchHg *Atm (not available)* *Torr (not available)*
50	Angle; displayed decimals	0 1 2 3 4	,0000 ,n000 ,nn00 ,nnn0 ,nnnn
51	Distance; displayed decimals	0 1 2 3 4	,000 ,n00 ,nn0 ,nnn ,nnn(n) *(not available)*
55	Angle rounding	[0..10]	e.g. n=3: 0.3, 0.6, 0.9, …
56	Distance rounding	[0..10]	e.g. n=3: 0.3, 0.6, 0.9, …

[…cont.]

<SET SPEC>	*FUNCTION*	*<PARAMETER>*	*SETTING*
70	Baudrate	*0* *1* *2* 3 4 5 6	*300 Baud (not available)* *600 Baud (not available)* *1200 Baud (not available)* 2400 Baud 4800 Baud 9600 Baud 19200 Baud
71	Parity	0 1 2	None Odd Even
73	Terminator	0 1	CR CR/LF
75	Protocol	0 1	Off On
76	Data recording device	0 1	Internal Memory RS232
78	Timeout delay	[0..50]	Increase of 10ms/unit
95	AutoOFF	0 1 2	Off On Sleep mode
102	Laser plummet	0 1	Off On
105	Laser plummet intensity	[0..100] 0 100	[range] Low Bright
106	Display heat	0 1	Off On
120	Orientation face definition	0 1	Face I Face II
121	Orientation definition	0 1	Normal Turn
130	Aim-Type	0 1 2 3 4 5	User Definition Round Prism Mini Prism 360° Prism Tape Refless
135	Recording mask	0 1	WI 11..21..22..31..51..87..88.. WI 11..21..22..31..81..82. 83. 87
136	Output format number	0 1 2 3 4 5	GSI format IDEX format User format User format User format User format
137	RS232 format length	0 1	GSI-8 GSI-16
138	Quick code recording	0 1	Before measurement After measurement
139	Insert GSI-blocknumber in GSI-Format	0 1	OFF ON
158[3)]	ATR (OFF/ON)	0 1	OFF ON

[…cont.]

<SPEC>	*FUNCTION*	*<PARAMETER>*	*SETTING*
160	Setting measured distance to invalid	0	Setting WI31,32,33 and coordinates WI81,82,83 to invalid; (CONT variables only; contact a TPS product manager)
161	EDM modes (SET/161/n)	0 1 2 3 4 5 6[1)] 7[1)] 8 9[1)] 10	IR Standard IR Fast *(not available)* *(not available)* *(not available)* IR Tracking RL Long (with prisms) RL Short *(not available)*. RL Tracking IR Tape
171	Direction of horizontal circle reading (Hz-Angle)	0 1	Clockwise Counterclockwise
173	Compensator	0 1	OFF ON
178	Standing axis correction	0 1	OFF (1-Axis) ON (2-Axis) (➔ refer to manual)
179	Hz collimation	0 1	OFF ON (➔ refer to manual)

2.5.2 CONF

Syntax: CONF/<CONF SPEC><CR/LF>

<CONF SPEC>	*FUNCTION*	*RESPONSE*	*CONFIGURATION*
30	BEEP	0030/0000 0030/0001 0030/0002	Off Normal Loud
31	Display illumination	0031/0000 0031/0001 0031/0002 0031/0003	Off Low Medium High
32	Display contrast	0032/0nnn	n:[0..100] 0: lowest contrast 50: Medium contrast 100: Highest contrast
34	BEEP @ 90°	0034/0000 0034/0001	Off On
35[2)]	EGL activity	0035/0000 0035/0001 0035/0002 0035/0003	Off Low Medium High
36[1)]	Laser Pointer	0036/0000 0036/0001	Off On
40	Angle UNIT	0040/0000 0040/0001 0040/0002 0040/0003 *0040/0004*	Gon Degree decimal Degree sexagesimal Mil *Radiant (not available)*
41	Distance UNIT	0041/0000 0041/0001 0041/0002 0041/0003 0041/0004	Meter US Feet, decimal Intl. Feet, decimal US Feet/Inch Intl. Feet/Inch
42	Temperature UNIT	0042/0000 0042/0001	Degree Celcius Degree Fahrenheit
43	Pressure UNIT	0043/0000 0043/0001 0043/0002 *0043/0003* 0043/0004 *0043/0005* *0043/0006*	hPa mmHg mBar *PSI (not available)* InchHg *Atm (not available)* *Torr (not available)*
50	Angle; displayed decimals	0050/0000 0050/0001 0050/0002 0050/0003 0050/0004	,0000 ,n000 ,nn00 ,nnn0 ,nnnn
51	Distance; displayed decimals	0051/0000 0051/0001 0051/0002 0051/0003 *0051/0004*	,000 ,n00 ,nn0 ,nnn ,nnn(n) *(not available)*
55	Angle rounding	0055/00nn	n:[1..10]
56	Distance rounding	0056/00nn	n:[1..10]

[…cont.]

<CONF SPEC>	*FUNCTION*	*RESPONSE*	*CONFIGURATION*
70	Baudrate	*0070/0000* *0070/0001* *0070/0002* 0070/0003 0070/0004 0070/0005 0070/0006	*300 Baud (not available)* *600 Baud (not available)* *1200 Baud(not available)* 2400 Baud 4800 Baud 9600 Baud 19200 Baud
71	Parity	0071/0000 0071/0001 0071/0002	NONE ODD EVEN
73	Terminator	0073/0000 0073/0001	CR CR/LF
75	Protocol	0075/0000 0075/0001	Off On
76	Data recording device	0076/0000 0076/0001	Internal Memory RS232
78	Timeout delay	[0..50]	Increase of 10ms/unit
90	Battery level	0090/00nn	n:[0..10] 0: Empty 10: Full
91	Temperature	0091/0nnn	[0..±100] °C
95	Auto-OFF	0095/0000 0095/0001	Off On
102	Laser plummet	0102/0000 0102/0001	Off On
103	Laser plummet availability	0103/0000 0103/0001	Not available Available
105	Laser plummet intensity	0105/0nnn	N: [0..100] 0: Low 100: bright
106	Display heat	0106/0000 0106/0001	Off On
107	Status of display Heat Activity	0107/0000 0107/0001	
120	Orientation face definition	0120/0000 0120/0001	Face I Face II
121	Orientation definition	0 1	Normal Turn
122	Orientation face status (face of last measurement)	0122/0000 0122/0001	Face I Face II (➔ refer to manual)
130	Aim Type	0130/0000 0130/0001 0130/0002 0130/0003 0130/0004 0130/0005	User definition Round Prism Mini Prism 360° Prism Tape Refless
131	Aim Value	0131/0000 0131/0001	Relativ Absolut
135	RS232 recording mask	0135/0000 0135/0001	WI 11..21..22..31..51..87..88.. WI 11..21..22..31..81..82..83..87

[…cont.]

<CONF SPEC>	*FUNCTION*	*RESPONSE*	*CONFIGURATION*
136	Output format number	0136/0000 0136/0001 0136/0002 0136/0003 0136/0004 0136/0005	GSI format IDEX format User format User format User format User format
137	RS232 recording length	0137/0000 0137/0001	GSI-8 GSI-16
138	Quick code recording	0138/0000 0138/0001	Before measurement After measurement
139	Insert GSIBlocknumber in GSI format	0139/0000 0139/0001	Off On
149	Display MASK	0138/000n	N: [0..8]
151[3)]	Status of motorisation	0151/0000 0151/0001 0151/0002	Off O.K. Busy
158[3)]	ATR (OFF/ON)	0158/0000 0158/0001	OFF ON
160	Validity of measured distance	0160/0000 0160/0001	Distance invalid Distance valid
161	EDM modes (SET/161/n)	0161/0000 0161/0001 0161/0005 0161/0006[1)] 0161/0007[1)] 0161/0009[1)] 0161/0010	IR Standard IR Fast IR Tracking RL Long (with prisms) RL Short RL Tracking IR Tape
170	Detect current face	0170/0000 0170/0001	Face I Face II (➔ refer to manual)
171	Direction of horizontal circle reading (Hz-Angle)	0171/0000 0171/0001	Clockwise Counterclockwise
173	Compensator	0173/0000 0173/0001	OFF ON
174	Compensator Status	0174/0000 0174/0001 0174/0002 0174/0003 0174/0004	Off O.K. Tilt Old Fail
178	Standing axis correction	0178/0000 0178/0001	OFF (1-Axis) ON (2-Axis) (➔ refer to manual)
179	Hz collimation	0179/0000 0179/0001	OFF ON (➔ refer to manual)

2.5.3 PUT

Syntax: SET/<PUT SPEC>/<Parameter>_<CR/LF>

<PUT SPEC>	*FUNCTION*	*Access/Example*
11	Set Pointnumber	PUT/11….+00001234_<CR/LF> ➔ puts PtID “1234”
16	Station Pointnumber	PUT/16....+0000A100_<CR/LF> ➔ puts StNr “A100”
21	Hz Angle	PUT/21…n+10000000_<CR/LF> n[2..4]; angle units must be specified ➔ for n=2; puts Hz=”100.0000 gon”
41	Code-Block ID	PUT/41....+0000TREE_<CR/LF> ➔ puts code value “TREE”
42	Information 1	PUT/42....+000012.4_<CR/LF> ➔ puts info value “12.4”
43	Information 2	PUT/43....+0000CAT2_<CR/LF> ➔ puts info value “CAT2”
44	Information 3	PUT/44....+000000NN_<CR/LF> ➔ puts info value “NN”
45	Information 4	PUT/45....+000000NN_<CR/LF> ➔ puts info value “NN”
46	Information 5	PUT/46....+000000NN_<CR/LF> ➔ puts info value “NN”
47	Information 6	PUT/47....+000000NN_<CR/LF> ➔ puts info value “NN”
48	Information 7	PUT/48....+000000NN_<CR/LF> ➔ puts info value “NN”
49	Information 8	PUT/49....+000000NN_<CR/LF> ➔ puts info value “NN”
58	Prism const	PUT/58….+00000200_<CR/LF> ➔ puts reflector constant to “20mm”
59	PPM	PUT/59….+02200000_<CR/LF> ➔ puts PPM correction to “220”
84	Station Easting	PUT/84…n+00100000_<CRLF> n[0..1]; distance unit must be specified ➔ for n=0; puts Easting=”100.000 m”
85	Station Northing	PUT/85…n+00100000_<CRLF> n[0..1]; distance unit must be specified ➔ for n=0; puts Northing=”100.000 m”
86	Station Elevation	PUT/86…n+00045000_<CRLF> n[0..1]; distance unit must be specified ➔ for n=0; puts Elevation=”45.000 m”
87	Reflector height	PUT/87…n+00001700_<CRLF> n[0..1]; distance unit must be specified ➔ for n=0; puts hr=”1.700 m”
88	Instrument height	PUT/88…n+00001500_<CRLF> n[0..1]; distance unit must be specified ➔ for n=0; puts hi=”1.500 m”

[…cont.]

<PUT SPEC>	*FUNCTION*	*Access/Example*
531	Atmos. Correction Pressure	PUT/531.16+10132500_<CRLF> ➔ "1013 hPa"
532	Atmos. Correction Temperature	PUT/532.16+00120000_<CRLF> ➔ Temperature "12"^{o}C
560	Time: [hh.mm.ss]	PUT/560..6+00113059_<CRLF> ➔ "11:30:59"
561	Date: [mm.dd]	PUT /561..6+00020800_<CRLF> ➔ February 8th 2000
562	Year: [yyyy]	PUT/562...+00002000_<CRLF> ➔ year "2000"
912	Station Pointnumber	PUT/912...+0000ST15_<CRLF> ➔ puts Station PtID "ST15"

[Tab.9]

2.5.4 GET

Syntax: GET/n/WI<GET SPEC>/<Parameter><CR/LF>

<GET SPEC>	*FUNCTION*	*Access/Example*
11	Pointnumber	GET/M/WI11<CR/LF>; e.g. 11….+00000H66 ➔ PtNo="H66"
12	Serial number	GET/I/WI12<CR/LF>; e.g. 12....+00640054 ➔ S.No. "640054"
13	Instrument type	GET/I/WI13<CR/LF>; 13....+00TCR305 ➔ Instr. "TCR305"
16	Station Pointnumber	GET/I/WI16; e.g. 16....+00000100" ➔ St.No. "100"
17	Date [DD.MM.YYYY]	GET/I/WI17; e.g. 17....+08022000 ➔ "Feb. 8th 2000"
18	Year Second	GET/M/WI18; e.g. 18....+01130000
19	Time [MM.DD.hh.mm]	GET/I/WI19; e.g. 19....+02081029 ➔ "Feb. 8th ; 10:29"
21	Horizontal Angle	GET/M/WI21<CR/LF>; e.g. 21.102+17920860 ➔ Hz „179.086" gon
22	Vertical Angle	GET/M/WI22<CR/LF>; e.g. 22.102+07567500 ➔ V: „75.675" gon
31	Slope distance	GET/M/WI31<CR/LF>; e-g. 31..00+00003387 ➔ Sdist: „3.387" m
32	Horizontal distance	GET/M/WI32<CR/LF>; e.g. 32..00+00003198 ➔ Hdist: „3.198" m
33	Height difference	GET/M/WI33<CR/LF>; e.g. 33..00+00001119 ➔ Hdiff: „1.119" m
41	Code-Block ID	GET/I/WI41<CR/LF>; e.g. 41....+00000013 ➔ Code: „13" m
42	Information 1	GET/I/WI42<CR/LF>; e.g. 42....+000TREES ➔ Info1: „TREES"
43	Information 2	GET/I/WI43<CR/LF>; e.g. 43....+000004.5 ➔ Info2: „4.5"
44	Information 3	GET/I/WI44<CR/LF>; e.g. 44....+00CAT.02 ➔ Info3: „CAT.02"
45	Information 4	GET/I/WI45<CR/LF>; e.g. 45....+000000NN ➔ Info4: „NN"
46	Information 5	GET/I/WI46<CR/LF>; e.g. 46....+000000NN ➔ Info5: „NN"
47	Information 6	GET/I/WI47<CR/LF>; e.g. 47....+000000NN ➔ Info6: „NN"
48	Information 7	GET/I/WI48<CR/LF>; e.g. 48....+000000NN ➔ Info7: „NN"
49	Information 8	GET/I/WI49<CR/LF>; e.g. 49....+000000NN ➔ Info8: „NN"
58	Prism constant	GET/I/WI58; e.g. 58..16+00000020 ➔ Prism „2" mm
59	PPM	GET/I/WI59; e.g. 59..16+02200000 ➔ PPM „220"

[…cont.]

<GET SPEC>	*FUNCTION*	*Access/Example*
81	Target Easting (E)	GET/M/WI81; e.g. 81..00+01999507 ➔ E: “1999.507”m
82	Target Northing (N)	GET/M/WI82; e.g. 82..00+00213159 ➔ N: “2139.159”m
83	Target Elevation (H)	GET/M/WI83; e.g. 83..00-00032881 ➔ H: “32.881”m
84	Station Easting (E0)	GET/I/WI84; e.g. 84..11+00393700 ➔ E: “393.700”m
85	Station Northing (N0)	GET/I/WI85; e.g. 85..11+06561220 ➔ N: “6561.220”m
86	Station Height (H0)	GET/I/WI86; e.g. 86..11+00065618 ➔ H: “65.618”m
87	Reflector height (hr)	GET/I/WI87; e.g. 87..11+00001700 ➔ hr: “1.700” m
88	Instrument height (hi)	GET/I/WI88; e.g. 88..11+00001550 ➔ hi: “1.550” m
531	Atmos. correction: pressure	GET/I/WI531; e.g. 531.16+10130000 ➔ “1013”
538	Coefficient of refraction	GET/I/WI538; e.g. 538.16+00001300 ➔ “1.300”
560	Time: [hh.mm.ss]	GET/I/WI560; e.g. 560..6+00105018 ➔ “10:50:18”
561	Date: [mm.dd]	GET/I/WI561; e.g. 561..6+00020800 ➔ “2.8.2000”
562	Year: [yyyy]	GET/I/WI562; e.g. 562...+00002000 ➔ year “2000”
590	SW-Version: Application	GET/I/WI590; e.g. 590..6+00021000 ➔ “V2.10”
591	SW-Version: Operating system	GET/I/WI591; e.g. 591..6+00020000 ➔ “V2.00”
592	SW-Version: OS interface	GET/I/WI592; e.g. 592..6+00010000 ➔ “V1.00”
593	SW-Version: GEOCOM	GET/I/WI593; e.g. 593..6+00022000 ➔ “V2.20”
594	SW-Version: Gsi communi-cation	GET/I/WI594; e.g. 594..6+00010000 ➔ “V1.00”
595	SW-Version: Edm Device	GET/I/WI595; e.g. 595..6+00011100 ➔ “V1.11”
913	Job	GET/I/WI913; e.g. 913...+BLDG.A12 ➔ “BLDG.A12”
914	Operator	GET/I/WI914; e.g. 914...+0MM-3519 ➔ “MM-3519”

[Tab.10]

2.5.5 Telescope positioning (TC(R) auto models only)

Command	***Function***
GSI/EXTEND	Allows the use of the following commands. It must be sent at least once after the instrument is switched on
CFACE	Turns the telescope to the opposite face
POSIT/<spec>Hz/V	Turns the telescope to the given direction horizontally and vertically. Hz and V are given in the unit set in the instruments
List of <spec>	
A	Absout positioning to the given values
R	Relative positioning from the current position
P	Turn the telescope to the direction of the last distance measurement
S	Search for a reflector in the given range from the Current position (only valid for TCA)

Example:

POSIT/A/123.4567/99.8754	Turns the telescope to the circle reading 123.4567 gon Hz and 99.8754 gon Vertical.
POSIT/R/20/0	Turns the telescope 20 units clockwise.
POSIT/P/1/-1	Tuns to the last position where a distance has been measured with 1 gon offset horizontal and vertical.
POSIT/S/2/2	Searches for a reflector in the range of 2 gons Horizontal and vertical.

2.5.6 Warnings and Errors

Message ID	***Meaning***	***Possible reasons***
@W100	Instrument busy	Any other device is still interfacing the instrument; check interfacing priorities
@W127	Invalid command	The string sent to the TC could not be decoded properly or does not exist; check the syntax, or … Input buffer overflow (max. 100 characters)
@E139	EDM error	The EDM could not proceed the requested measurement; no or weak signal; Check EDM mode and target
@E158	One of the instruments sensor corrections could not be assigned.	Instrument is not stable, not levelled or suffering of vibration; Tilt is out of range (e.g. when tilt sensor is out of range); Level instrument or switch off compensator

[Tab.11]

2.6 TPS1000/1100/2000/5000 Series

The TPS1000 and its successor TPS1100, TPS2000 and the industrial TPS5000 series represent the very high end level of Leica's Total Station products. Functionality has increased and instruments do more and more support customized remote control options. Thus controlling instruments with GSI commands has come to a technical limit. However, to provide access to all implemented functions, a new interfacing tool has been developed, called GEOBASIC. As GEOBASIC will not be covered within this reference guide, we kindly ask you to consult the corresponding GEOBASIC USER MANUAL, for further information on GEOBASIC. You will find the manual on every CD-ROM's delivered with TPS Total Stations. Following, the complete set of GSI ONLINE commands providing access to TPS1000/1100/2000/5000 GSI functions.

Supported Instruments (TPS1000 Series)
- TC1100/L, TC1500/L, TC1700/L, TC1800/L
- TCM1100/L, TCM1800/L
- TCA1100/L, TCA1800/L

Supported Instruments (TPS1100 Series)
- TC1101, TC1102, TC1103, TC1105
- TCR1101, TCR1102, TCR1103, TCR1105
- TCM1101, TCM1102, TCM1103, TCM1105
- TCRM1101, TCRM1102, TCRM1103, TCRM1105
- TCA1101, TCA1102, TCA1103, TCA1105
- TCRA1101, TCRA1102, TCRA1103, TCRA1105

Supported Instruments (TPS2000 Series)
- TC2003
- TCA2003

Supported Instruments (TPS5000 Series)
- TM5000, TDM5000, TDA5000
- TM5000, TDM5000, TDA5000
- TM5100, TM5100A

For standard recording, the instrument needs to be activated in any "Measure&Record" mode. To avoid unnecessary miscommunication, we therefore recommend to enable the autostart function for remote control applications.

Low Level commands
SYNTAX: <command>CR/LF
SYNTAX: BEEP/<value>

<Commands>:	a b c	Powers on the instrument Powers off the instrument Clears a distance measurement
Example:	BEEP/0 BEEP/1 BEEP/2	Short beep Long beep Alarm beep (TPS1000/2000/5000 series only!)

2.6.1 SET

Syntax: SET/<SET SPEC>/<Parameter><CR/LF>

<SET SPEC>	*FUNCTION*	*<PARAMETER>*	*SETTING*
30	BEEP	0 1 2	OFF Medium Loud
31	Display (DSP) and Cross-hairs (X-hairs)-illumination	0 1 2 3	Off DSP on, X-hairs low DSP on, X-hairs medium DSP on, X-hairs bright
32	Display contrast	0 1 2 3	Low Low-Medium Medium-High High
35	EGL	0 1	Off On
40	Angle UNIT	0 1 2 3	Gon Degree decimal Degree, sexagesimal Mils
41	Distance UNIT	0 1 2 3 4	Meter US Feet, decimal Intl. Feet, decimal US Feet/Inch Intl. Feet/Inch
42	Temperature UNIT	0 1	°C °F
43	Pressure UNIT	0 1 2 3 4	hPa mmHg mbar PSI inchHg
50	Angle; displayed decimals	2 3 4	123.12 123.123 123.1234 or … max. accuracy
51	Distance; displayed decimals	0 1 2 3 4 5	123. 123.1 123.12 123.123 123.1234 123.12345
71	Parity	0 1 2	None Odd Even
73	Terminator	0 1	CR CR/LF

[…cont.]

<SET SPEC>	*FUNCTION*	*<PARAMETER>*	*SETTING*
75	Protocol	0 1	Without GSI
76	Data recording device	0 1	Memory card RS232 interface
95	AutoOFF	0 1	Off On
137	RS232 format length	0 1	GSI-8 GSI-16
160	Setting measured distance to invalid	0	Setting WI31,32,33 and coordinates WI81,82,83 to invalid
161	EDM modes (SET/161/n)	0 1 2 3 4 5 6 7 9 10 11 12	IR Standard IR Fast IR Average IR Precise[1)]/Standard[2)] IR Tracking IR Rapid tracking RL Stand. long range[2)] RL Standard[2)] RL Tracking[2)] IR Tape[1)] RL Average long range[2)] RL Average[2)]
173	Compensator	0 1	Off On

[Tab.12]

[1)] TPS1000/2000/5000 only
[2)] TPS1100 only

2.6.2 CONF

Syntax: CONF/<CONF SPEC><CR/LF>

<CONF SPEC>	*FUNCTION*	*RESPONSE*	*CONFIGURATION*
30	BEEP	0030/0000 0030/0001 0030/0001	OFF Medium Loud
31	Display (DSP) and Cross-hairs (X-hairs)-illumination	0031/0000 0031/0001 0031/0002 0031/0003	Off DSP on, X-hairs low DSP on, X-hairs medium DSP on, X-hairs bright
32	Display contrast	0032/0000 0032/0001 0032/0002 0032/0003	Low Low-Medium Medium-High High
35	EGL	0035/0000 0035/0001	Off On
40	Angle UNIT	0040/0000 0040/0001 0040/0002 0040/0003	Gon Degree decimal Degree, minute, second Mil
41	Distance UNIT	0041/0000 0041/0001 0041/0002 0041/0003 0041/0004	Meter US Feet, decimal Intl. Feet, decimal US Feet/Inch Intl. Feet/Inch
42	Temperature UNIT	0042/0000 0042/0001	°C °F
43	Pressure UNIT	0043/0000 0043/0001 0043/0002 0043/0003 0043/0004	hPa mmHg mBar PSI InchHg
50	Angle; displayed decimals	0050/0002 0050/0003 0050/0004	123.12 123.123 123.1234 or … max. accuracy
51	Distance; displayed decimals	0051/0000 0051/0001 0051/0002 0051/0003 0051/0004	123. 123.1 123.12 123.123 123.1234 or … max. accuracy
70	Baudrate	0070/0003 0070/0004 0070/0005 0070/0006	2400 Baud 4800 Baud 9600 Baud 19200 Baud

[…cont.]

<CONF SPEC>	*FUNCTION*	*RESPONSE*	*CONFIGURATION*
71	Parity	0071/0000 0071/0001 0071/0002	None Odd Even
73	Terminator	0073/0000 0073/0001	CR CR/LF
75	Protocol	0075/0000 0075/0001	Without GSI
76	Data recording device	0076/0000 0076/0001	Memory card Serial interface
90	Battery level	0090/000n	N:[1..9]; n=1: low
95	AutoOFF	0095/0000 0095/0001 0095/0002	Off On Sleep
135	Recording mask	0135/0000	Mask 1
137	RS232 format length	0137/0000 0137/0001	GSI-8 GSI-16
149	Display MASK	0149/0001	Mask 1
160	Validity of measured distance	0160/0000 0160/0001	Distance/Coords invalid Distance/Coords valid
161	EDM modes (SET/161/n)	0161/0000 0161/0001 0161/0002 0161/0003 0161/0004 0161/0005 0161/0006 0161/0007 0161/0009 0161/0010 0161/0011 0161/0012	IR Standard IR Fast IR Average IR Precise[1)]/Standard[2)] IR Tracking IR Rapid tracking RL Stand. long range[2)] RL Standard[2)] RL Tracking[2)] IR Tape[1)] RL Average long range[2)] RL Average[2)]
170	Detect current face	0170/0000 0170/0001	Face I Face II (➔ refer to manual)
171	Direction of horizontal circle reading (Hz-Angle)	0171/0000 0171/0001	Clockwise Counterclockwise
173	Compensator	0173/0000 0173/0001	OFF ON
182	Software version	0182/00nn	Version n.n
184	Active application running	0184/0000 0184/0001	No Yes

[Tab.13]

2.6.3 PUT

Syntax: SET/<PUT SPEC>/<Parameter>_<CR/LF>

<PUT SPEC>	*FUNCTION*	*Access/Example*
11	Set Pointnumber	PUT/11….+00001234_<CR/LF> ➔ puts PtID “1234”
21	Hz Angle	PUT/21…n+10000000_<CR/LF> n[2..4]; angle units must be specified ➔ for n=2; puts Hz=”100.0000 gon”
58	Prism const	PUT/58….+00000200_<CR/LF> ➔ puts reflector constant to “20mm”
59	PPM	PUT/59….+02200000_<CR/LF> ➔ puts PPM correction to “220”
71	Remark 1 (or Attribute 1)	PUT/71....+000012.4_<CR/LF> ➔ puts info value “12.4”
72	Remark 2 (or Attribute 2)	PUT/72....+0000CAT2_<CR/LF> ➔ puts info value “CAT2”
73	Remark 3 (or Attribute 3)	PUT/73....+000000NN_<CR/LF> ➔ puts info value “NN”
74	Remark 4 (or Attribute 4)	PUT/74....+000000NN_<CR/LF> ➔ puts info value “NN”
75	Remark 5 (or Attribute 5)	PUT/78....+000000NN_<CR/LF> ➔ puts info value “NN”
76	Remark 6 (or Attribute 6)	PUT/76....+000000NN_<CR/LF> ➔ puts info value “NN”
77	Remark 7 (or Attribute 7)	PUT/77....+000000NN_<CR/LF> ➔ puts info value “NN”
78	Remark 8 (or Attribute 8)	PUT/78....+000000NN_<CR/LF> ➔ puts info value “NN”
79	Remark 9 (or Attribute 9)	PUT/79....+000000NN_<CR/LF> ➔ puts info value “NN”
84 [a)]	Station Easting	PUT/84…n+00100000_<CRLF> ➔ for n=0; puts Easting=”100.000 m”
85 [a)]	Station Northing	PUT/85…n+00100000_<CRLF> ➔ for n=0; puts Northing=”100.000 m”
86 [a)]	Station Elevation	PUT/86…n+00045000_<CRLF> ➔ for n=0; puts Elevation=”45.000 m”
87 [a)]	Reflector height	PUT/87…n+00001700_<CRLF> ➔ for n=0; puts hr=”1.700 m”
88 [a)]	Instrument height	PUT/88…n+00001500_<CRLF> ➔ for n=0; puts hi=”1.500 m”

[Tab.14]

[a)] For WI84-88; distance unit must be specified with n[0..1]; refer to page 5.

2.6.4 GET

Syntax: GET/n/WI<GET SPEC>/<Parameter><CR/LF>

<GET SPEC>	*FUNCTION*	*Access/Example*
11	Pointnumber	GET/M/WI11<CR/LF>; e.g. 11….+00000H66 ➔ PtNo="H66"
12	Serial number	GET/I/WI12<CR/LF>; e.g. 12....+00640054 ➔ S.No. "640054"
13	Instrument type	GET/I/WI13<CR/LF>; 13....+00TCR305 ➔ Instr. "TCR305"
19	Time [MM.DD.hh.mm]	GET/I/WI19; e.g. 19....+02081029 ➔ "Feb. 8th ; 10:29"
21	Horizontal Angle	GET/M/WI21<CR/LF>; e.g. 21.102+17920860 ➔ Hz „179.086" gon
22	Vertical Angle	GET/M/WI22<CR/LF>; e.g. 22.102+07567500 ➔ V: „75.675" gon
31	Slope distance	GET/M/WI31<CR/LF>; e-g. 31..00+00003387 ➔ Sdist: „3.387" m
32	Horizontal distance	GET/M/WI32<CR/LF>; e.g. 32..00+00003198 ➔ Hdist: „3.198" m
33	Height difference	GET/M/WI33<CR/LF>; e.g. 33..00+00001119 ➔ Hdiff: „1.119" m
41	Code-Block ID	GET/I/WI41<CR/LF>; e.g. 41....+00000013 ➔ Code: „13" m
42	Information 1	GET/I/WI42<CR/LF>; e.g. 42....+000TREES ➔ Info1: „TREES"
43	Information 2	GET/I/WI43<CR/LF>; e.g. 43....+000004.5 ➔ Info2: „4.5"
44	Information 3	GET/I/WI44<CR/LF>; e.g. 44....+00CAT.02 ➔ Info3: „CAT.02"
45	Information 4	GET/I/WI45<CR/LF>; e.g. 45....+000000NN ➔ Info4: „NN"
46	Information 5	GET/I/WI46<CR/LF>; e.g. 46....+000000NN ➔ Info5: „NN"
47	Information 6	GET/I/WI47<CR/LF>; e.g. 47....+000000NN ➔ Info6: „NN"
48	Information 7	GET/I/WI48<CR/LF>; e.g. 48....+000000NN ➔ Info7: „NN"
49	Information 8	GET/I/WI49<CR/LF>; e.g. 49....+000000NN ➔ Info8: „NN"
51	PPM/mm	GET/I/WI51<CR/LF>; e.g. 51..1.+0000+034 ➔ "0"ppm; "34"mm
58	Prism constant	GET/I/WI58; e.g. 58..16+00000020 ➔ Prism „2" mm
59	PPM	GET/I/WI59; e.g. 59..16+02200000 ➔ PPM „220"

[…cont.]

<GET SPEC>	*FUNCTION*	*Access/Example*
71	Remark1 (or Attribute 1)	GET/I/WI71<CR/LF>; e.g. 71....+0000REM1 ➔ "REM1"
72	Remark2 (or Attribute 2)	GET/I/WI72<CR/LF>; e.g. 72....+0000REM2 ➔ "REM2"
73	Remark3 (or Attribute 3)	GET/I/WI73<CR/LF>; e.g. 73....+0000REM3 ➔ "REM3"
74	Remark4 (or Attribute 4)	GET/I/WI74<CR/LF>; e.g. 74....+0000REM4 ➔ "REM4"
75	Remark5 (or Attribute 5)	GET/I/WI75<CR/LF>; e.g. 75....+0000REM5 ➔ "REM5"
76	Remark6 (or Attribute 6)	GET/I/WI76<CR/LF>; e.g. 76....+0000REM6 ➔ "REM6"
77	Remark7 (or Attribute 7)	GET/I/WI77<CR/LF>; e.g. 77....+0000REM7 ➔ "REM7"
78	Remark8 (or Attribute 8)	GET/I/WI78<CR/LF>; e.g. 78....+0000REM8 ➔ "REM8"
79	Remark9 (or Attribute 9)	GET/I/WI79<CR/LF>; e.g. 79....+0000REM9 ➔ "REM9"
81	Target Easting (E)	GET/M/WI81; e.g. 81..00+01999507 ➔ E: "1999.507"m
82	Target Northing (N)	GET/M/WI82; e.g. 82..00+00213159 ➔ N: "2139.159"m
83	Target Elevation (H)	GET/M/WI83; e.g. 83..00-00032881 ➔ H: "32.881"m
84	Station Easting (E0)	GET/I/WI84; e.g. 84..11+00393700 ➔ E: "393.700"m
85	Station Northing (N0)	GET/I/WI85; e.g. 85..11+06561220 ➔ N: "6561.220"m
86	Station Height (H0)	GET/I/WI86; e.g. 86..11+00065618 ➔ H: "65.618"m
87	Reflector height (hr)	GET/I/WI87; e.g. 87..11+00001700 ➔ hr: "1.700" m
88	Instrument height (hi)	GET/I/WI88; e.g. 88..11+00001550 ➔ hi: "1.550" m

[Tab.15]

2.6.5 Telescope positioning (TM, TCM/TDM and TCA/TDA models only)

Command	***Function***
PASSWORD	Allows the use of the following commands. It must be sent at least once after the instrument is switched on
CFACE	Turns the telescope to the opposite face
POSIT/<spec>Hz/V	Turns the telescope to the given direction horizontally and vertically. Hz and V are given in the unit set in the instruments
List of <spec>	
A	Absolute positioning to the given values
R	Relative positioning from the current position
P	Turn the telescope to the direction of the last distance measurement
S	Search for a reflector in the given range from the Current position (only valid for TCA/TDA)

Example:

POSIT/A/123.4567/99.8754	Turns the telescope to the circle reading 123.4567 gon Hz and 99.8754 gon Vertical.
POSIT/R/20/0	Turns the telescope 20 units clockwise.
POSIT/P/1/-1	Turns to the last position where a distance has been measured with 1 gon offset horizontal and vertical.
POSIT/S/2/2	Searches for a reflector in the range of 2 gons Horizontal and vertical.

2.6.6 Warnings and Errors

Errors, initiated by an interface command are not always transferred to the interface. Instead of the error message the warning @W127 will be sent and the TPS will be ready to receive the next command.

Message ID	***Meaning***	***Possible reasons***
@W100	Instrument busy	Any other device is still interfacing the instrument; check interfacing priorities
@W127	Invalid command	The string sent to the TC could not be decoded properly or does not exist; check the syntax, or… Input buffer overflow (max. 100 characters)
@E112	Battery low	Low Battery; check voltage
@E117	Initialization error	Contact service
@E119	Temperature out of range	Refer to manual for temperature range
@E139	EDM error	The EDM could not proceed the requested measurement; no or weak signal; Check EDM mode and target
@E144	V or Hz collimation error	Check calibration data
@E150	Angle error	Call service
@E158	One of the instruments sensor corrections could not be assigned.	Instrument is not stable, not levelled or suffering of vibration; Tilt is out of range (e.g. when tilt sensor is out of range); Level instrument or switch off compensator
@E182	Telescope position out of range	Positioning timeout; Instrument could not position; Try again
@E190	General motorisation Error	If frequently occurs call service
@E191	Data error	Check record mask
@E194	General error	If frequently occurs call service
@E197	ATR error	ATR not enabled; check ATR function

[Tab.16]

2.7 TS02/06/09 series (FlexLine)

Supported Instruments:

- TS02/06/09

The following command listing is split into separate sections for each basic command (SET, CONF, PUT, GET). Some of the listed features may require specially equipped instruments (e.g. Reflectorless EDM ➔ RL). For detailed description of single functions, we recommend to consult the corresponding User Manual.

Low Level commands

SYNTAX: <command>CR/LF
SYNTAX: BEEP/<value>

<Command>:	a b c	Powers on the instrument Powers off the instrument Clears a distance measurement
<Value>:	BEEP/0 BEEP/1 BEEP/2	Short beep Long beep Alarm beep (short beep, 3 times)

Restrictions:

[1)] TCR models ONLY
[2)] Instruments equipped with EGL3 only

2.7.1 SET

Syntax: SET/<SET SPEC>/<Parameter><CR/LF>

<SET SPEC>	*FUNCTION*	*<PARAMETER>*	*SETTING*
30	BEEP	0 1 2	OFF Medium Loud
32	Display contrast	[0..100] 0 50 100	➔ [range] Low contrast Medium contrast High contrast
33	Display Illumination	[0100] 0 50 100	➔ [range] Off Medium Light Full Light
34	BEEP @ 90°	0 1	OFF ON
35[2)]	EGL activity	0 1 2 3	OFF Low Medium High
36[1)]	Laser Pointer	0 1	OFF ON
37	EDM Rect Illumination	[0..100] 0 50 100	➔ [range] Off Medium Light Full Light
40	Angle UNIT	0 1 2 3	GON Degree decimal Degree sexagesimal Mils
41	Distance UNIT	0 1 2 3 4 5 6 7	Meter US Feet, decimal Intl. Feet, decimal US Feet/Inch *(not available)* Intl. Feet/Inch *(not available)* US Feet/Inch Dec *(not available)* Intl. Feet/Inch 1/16 Inch *(not available)* US Feet/Inch 1/16 Inch
42	Temperature UNIT	0 1	Degree Celcius Degree Fahrenheit
43	Pressure UNIT	0 1 2 *3* 4 *5* *6*	hPa MmHg Mbar *PSI (not available)* InchHg *Atm (not available)* *Torr (not available)*

[…cont.]

<SET SPEC>	*FUNCTION*	*<PARAMETER>*	*SETTING*
50	Angle; displayed decimals	0 1 2 3 4	,0000 ,n000 ,nn00 ,nnn0 ,nnnn
51	Distance; displayed decimals	0 1 2 3 4	,0000 ,n000 ,nn00 ,nnn0 ,nnnn
55	Angle rounding	[0..10]	e.g. n=3: 0.3, 0.6, 0.9, …
56	Distance rounding	[0..10]	e.g. n=3: 0.3, 0.6, 0.9, …
70	Baudrate	*0* *1* *2* 3 4 5 6 7 9 10 11 12	1200 Baud TOPCON SOKKIA 2400 Baud 4800 Baud 9600 Baud 19200 Baud 38400 Baud 57600 Baud 115200 Baud EFIT 14400 Baud
71	Parity	0 1 2	None Odd Even
73	Terminator	0 1	CR CR/LF
75	Protocol	0 1	Off On
76	Data recording device	0 1	Internal Memory Interface
78	Timeout delay	[0..50]	Increase of 10ms/unit
95	AutoOFF	0 1	Off On
102	Laser plummet	0 1	Off On
105	Laser plummet intensity	[0..100] 0 100	[range] Low Bright
106	Display heat	0 1	Off On
120	Orientation face definition	0 1	Face I Face II
121	Orientation definition	0 1	Normal Turn

[…cont.]

<SET SPEC>	*FUNCTION*	*<PARAMETER>*	*SETTING*
130	Aim-Type	0 1 2 3 4 5 6 7 8	User Definition 1 Round Prism Mini Prism 360° Prism Tape Refless Japan Mini 360° Mini User Definition 2
135	Recording mask	0 1	WI 11..21..22..31..51..87..88.. WI 11..21..22..31..81..82. 83. 87
136	Output format number	0 1 2 3 4..n	GSI format IDEX format XML format DXF format User format
137	RS232 format length	0 1	GSI-8 GSI-16
138	Quick code recording	0 1	Before measurement After measurement
139	Insert GSI-blocknumber in GSI-Format	0 1	OFF ON
160	Setting measured distance to invalid	0	Setting WI31,32,33 and coordinates WI81,82,83 to invalid; (CONT variables only)
161	EDM modes (SET/161/n)	0 1 2 3 4 5 6[1)] 7[1)] 8 9[1)] 10	Prism Standard Prism Fast *(not available)* *(not available)* *(not available)* Prism Tracking Prism (>3.5km) Non-Prism STD *(not available)*. Non-Prism Tracking Tape
171	Direction of horizontal circle reading (Hz-Angle)	0 1	Clockwise Counterclockwise
173	Compensator	0 1	OFF ON
178	Standing axis correction	0 1	OFF (1-Axis) ON (2-Axis) (➔ refer to manual)
179	Hz correction	0 1	OFF ON (➔ refer to manual)

2.7.2 CONF

Syntax: CONF/<CONF SPEC><CR/LF>

<CONF SPEC>	*FUNCTION*	*RESPONSE*	*CONFIGURATION*
30	BEEP	0030/0000 0030/0001 0030/0002	Off Normal Loud
32	Display contrast	0032/0nnn	n:[0..100] 0: lowest contrast 50: Medium contrast 100: Highest contrast
33	Display Illumination	0033/0nnn	n:[0..100] Off Medium Light Full Light
34	BEEP @ 90°	0034/0000 0034/0001	Off On
35[2)]	EGL activity	0035/0000 0035/0001 0035/0002 0035/0003	Off Low Medium High
36[1)]	Laser Pointer	0036/0000 0036/0001	Off On
37	EDM Rect Illumination	0037/0nnn	n:[0..100] Off Medium Light Full Light
40	Angle UNIT	0040/0000 0040/0001 0040/0002 0040/0003 *0040/0004*	Gon Degree decimal Degree sexagesimal Mil *Radiant (not available)*
41	Distance UNIT	0041/0000 0041/0001 0041/0002 0041/0003 0041/0004 0041/0005 0041/0006 0041/0007	Meter US Feet, decimal Intl. Feet, decimal US Feet/Inch *(not available)* Intl. Feet/Inch *(not available)* US Feet/Inch Dec *(not available)* Intl. Feet/Inch 1/16 Inch *(not available)* US Feet/Inch 1/16 Inch
42	Temperature UNIT	0042/0000 0042/0001	Degree Celcius Degree Fahrenheit
43	Pressure UNIT	0043/0000 0043/0001 0043/0002 *0043/0003* 0043/0004 *0043/0005* *0043/0006*	hPa mmHg mBar *PSI (not available)* InchHg *Atm (not available)* *Torr (not available)*

[…cont.]

<CONF SPEC>	*FUNCTION*	*RESPONSE*	*CONFIGURATION*
50	Angle; displayed decimals	0050/0000 0050/0001 0050/0002 0050/0003 0050/0004	,0000 ,n000 ,nn00 ,nnn0 ,nnnn
51	Distance; displayed decimals	0051/0000 0051/0001 0051/0002 0051/0003 *0051/0004*	,0000 ,n000 ,nn00 ,nnn0 ,nnnn
55	Angle rounding	0055/00nn	n:[1..10]
56	Distance rounding	0056/00nn	n:[1..10]
70	Baudrate	*0070/0000* *0070/0001* *0070/0002* *0070/0003* *0070/0004* *0070/0005* *0070/0006* *0070/0007* *0070/0008* *0070/0009* *0070/0010* *0070/0011* *0070/0012*	1200 Baud TOPCON SOKKIA 2400 Baud 4800 Baud 9600 Baud 19200 Baud 38400 Baud 56000 Baud 57600 Baud 115200 Baud EFIT 14400 Baud
71	Parity	0071/0000 0071/0001 0071/0002	NONE ODD EVEN
73	Terminator	0073/0000 0073/0001	CR CR/LF
75	Protocol	0075/0000 0075/0001	Off On
76	Data recording device	0076/0000 0076/0001	Internal Memory Interface
78	Timeout delay	[0..50]	Increase of 10ms/unit
90	Battery level	0090/00nn	n:[0..10] 0: Empty 10: Full
91	Temperature	0091/0nnn	[0..±100] °C
95	Auto-OFF	0095/0000 0095/0001	Off On
102	Laser plummet	0102/0000 0102/0001	Off On
103	Laser plummet availability	0103/0000 0103/0001	Not available Available
105	Laser plummet intensity	0105/0nnn	N: [0..100] 0: Low 100: bright
106	Display heat	0106/0000 0106/0001	Off On
107	Status of display Heat Activity	0107/0000 0107/0001	

[…cont.]

<CONF SPEC>	*FUNCTION*	*RESPONSE*	*CONFIGURATION*
120	Orientation face definition	0120/0000 0120/0001	Face I Face II
121	Orientation definition	0 1	Normal Turn
122	Orientation face status (face of last measurement)	0122/0000 0122/0001	Face I Face II (➔ refer to manual)
130	Aim Type	0130/0000 0130/0001 0130/0002 0130/0003 0130/0004 0130/0005 0130/0006 0130/0007 0130/0008	User definition 1 Round Prism Mini Prism 360° Prism Tape Refless Japan Mini 360° Mini User definition 2
131	Aim Value	0131/0000 0131/0001	Relativ Absolut
135	RS232 recording mask	0135/0000 0135/0001	WI 11..21..22..31..51..87..88.. WI 11..21..22..31..81..82..83..87
136	Output format number	0136/0000 0136/0001 0136/0002 0136/0003 0136/0004..n	GSI format IDEX format XML format DXF format User format
137	RS232 recording length	0137/0000 0137/0001	GSI-8 GSI-16
138	Quick code recording	0138/0000 0138/0001	Before measurement After measurement
139	Insert GSI Blocknumber in GSI format	0139/0000 0139/0001	Off On
160	Validity of measured distance	0160/0000 0160/0001	Distance invalid Distance valid
161	EDM modes (SET/161/n)	0161/0000 0161/0001 0161/0005 0161/0006[1)] 0161/0007[1)] 0161/0009[1)] 0161/0010	Prism Standard Prism Fast Prism Tracking Prism (>3.5 km) Non-Prism STD Non-Prism-Tracking Tape
170	Detect current face	0170/0000 0170/0001	Face I Face II (➔ refer to manual)
171	Direction of horizontal circle reading (Hz-Angle)	0171/0000 0171/0001	Clockwise Counterclockwise
173	Compensator	0173/0000 0173/0001	OFF ON
174	Compensator Status	0174/0000 0174/0001 0174/0002 0174/0003 0174/0004	Off O.K. Tilt Old Fail
178	Standing axis correction	0178/0000 0178/0001	OFF (1-Axis) ON (2-Axis) (➔ refer to manual)
179	Hz collimation	0179/0000 0179/0001	OFF ON (➔ refer to manual)

2.7.3 PUT

Syntax: SET/<PUT SPEC>/<Parameter>_<CR/LF>

<PUT SPEC>	*FUNCTION*	*Access/Example*
11	Set Pointnumber	PUT/11….+00001234_<CR/LF> ➔ puts PtID “1234”
16	Station Pointnumber	PUT/16....+0000A100_<CR/LF> ➔ puts StNr “A100”
21	Hz Angle	PUT/21…n+10000000_<CR/LF> n[2..4]; angle units must be specified ➔ for n=2; puts Hz=”100.0000 gon”
41	Code-Block ID	PUT/41....+0000TREE_<CR/LF> ➔ puts code value “TREE”
42	Information 1	PUT/42....+000012.4_<CR/LF> ➔ puts info value “12.4”
43	Information 2	PUT/43....+0000CAT2_<CR/LF> ➔ puts info value “CAT2”
44	Information 3	PUT/44....+000000NN_<CR/LF> ➔ puts info value “NN”
45	Information 4	PUT/45....+000000NN_<CR/LF> ➔ puts info value “NN”
46	Information 5	PUT/46....+000000NN_<CR/LF> ➔ puts info value “NN”
47	Information 6	PUT/47....+000000NN_<CR/LF> ➔ puts info value “NN”
48	Information 7	PUT/48....+000000NN_<CR/LF> ➔ puts info value “NN”
49	Information 8	PUT/49....+000000NN_<CR/LF> ➔ puts info value “NN”
58	Prism const	PUT/58….+00000200_<CR/LF> ➔ puts reflector constant to “20mm”
59	PPM	PUT/59….+02200000_<CR/LF> ➔ puts PPM correction to “220”
84	Station Easting	PUT/84…n+00100000_<CRLF> n[0..1]; distance unit must be specified ➔ for n=0; puts Easting=”100.000 m”
85	Station Northing	PUT/85…n+00100000_<CRLF> n[0..1]; distance unit must be specified ➔ for n=0; puts Northing=”100.000 m”
86	Station Elevation	PUT/86…n+00045000_<CRLF> n[0..1]; distance unit must be specified ➔ for n=0; puts Elevation=”45.000 m”
87	Reflector height	PUT/87…n+00001700_<CRLF> n[0..1]; distance unit must be specified ➔ for n=0; puts hr=”1.700 m”

[…cont.]

<PUT SPEC>	*FUNCTION*	*Access/Example*
88	Instrument height	PUT/88…n+00001500_<CRLF> n[0..1]; distance unit must be specified ➔ for n=0; puts hi="1.500 m"
531	Atmos. Correction Pressure	PUT/531.16+10132500_<CRLF> ➔ "1013 hPa"
532	Atmos. Correction Temperature	PUT/532.16+00120000_<CRLF> ➔ Temperature "12"^{o}C
560	Time: [hh.mm.ss]	PUT/560..6+00113059_<CRLF> ➔ "11:30:59"
561	Date: [mm.dd]	PUT /561..6+00020800_<CRLF> ➔ February 8th 2000
562	Year: [yyyy]	PUT/562...+00002000_<CRLF> ➔ year "2000"
912	Station Pointnumber	PUT/912...+0000ST15_<CRLF> ➔ puts Station PtID "ST15"

[Tab.9]

2.7.4 GET

Syntax: GET/n/WI<GET SPEC>/<Parameter><CR/LF>

<GET SPEC>	*FUNCTION*	*Access/Example*
11	Pointnumber	GET/M/WI11<CR/LF>; e.g. 11….+00000H66 ➔ PtNo="H66"
12	Serial number	GET/I/WI12<CR/LF>; e.g. 12....+00640054 ➔ S.No. "640054"
13	Instrument type	GET/I/WI13<CR/LF>; 13....+00TCR305 ➔ Instr. "TCR305"
16	Station Pointnumber	GET/I/WI16; e.g. 16....+00000100" ➔ St.No. "100"
17	Date [DD.MM.YYYY]	GET/I/WI17; e.g. 17....+08022000 ➔ "Feb. 8th 2000"
18	Year Second	GET/M/WI18; e.g. 18....+01130000
19	Time [MM.DD.hh.mm]	GET/I/WI19; e.g. 19....+02081029 ➔ "Feb. 8th ; 10:29"
21	Horizontal Angle	GET/M/WI21<CR/LF>; e.g. 21.102+17920860 ➔ Hz „179.086" gon
22	Vertical Angle	GET/M/WI22<CR/LF>; e.g. 22.102+07567500 ➔ V: „75.675" gon
31	Slope distance	GET/M/WI31<CR/LF>; e-g. 31..00+00003387 ➔ Sdist: „3.387" m
32	Horizontal distance	GET/M/WI32<CR/LF>; e.g. 32..00+00003198 ➔ Hdist: „3.198" m
33	Height difference	GET/M/WI33<CR/LF>; e.g. 33..00+00001119 ➔ Hdiff: „1.119" m
41	Code-Block ID	GET/I/WI41<CR/LF>; e.g. 41....+00000013 ➔ Code: „13" m
42	Information 1	GET/I/WI42<CR/LF>; e.g. 42....+000TREES ➔ Info1: „TREES"
43	Information 2	GET/I/WI43<CR/LF>; e.g. 43....+000004.5 ➔ Info2: „4.5"
44	Information 3	GET/I/WI44<CR/LF>; e.g. 44....+00CAT.02 ➔ Info3: „CAT.02"
45	Information 4	GET/I/WI45<CR/LF>; e.g. 45....+000000NN ➔ Info4: „NN"
46	Information 5	GET/I/WI46<CR/LF>; e.g. 46....+000000NN ➔ Info5: „NN"
47	Information 6	GET/I/WI47<CR/LF>; e.g. 47....+000000NN ➔ Info6: „NN"
48	Information 7	GET/I/WI48<CR/LF>; e.g. 48....+000000NN ➔ Info7: „NN"
49	Information 8	GET/I/WI49<CR/LF>; e.g. 49....+000000NN ➔ Info8: „NN"
58	Prism constant	GET/I/WI58; e.g. 58..16+00000020 ➔ Prism „2" mm
59	PPM	GET/I/WI59; e.g. 59..16+02200000 ➔ PPM „220"

[…cont.]

<GET SPEC>	*FUNCTION*	*Access/Example*
81	Target Easting (E)	GET/M/WI81; e.g. 81..00+01999507 ➔ E: “1999.507”m
82	Target Northing (N)	GET/M/WI82; e.g. 82..00+00213159 ➔ N: “2139.159”m
83	Target Elevation (H)	GET/M/WI83; e.g. 83..00-00032881 ➔ H: “32.881”m
84	Station Easting (E0)	GET/I/WI84; e.g. 84..11+00393700 ➔ E: “393.700”m
85	Station Northing (N0)	GET/I/WI85; e.g. 85..11+06561220 ➔ N: “6561.220”m
86	Station Height (H0)	GET/I/WI86; e.g. 86..11+00065618 ➔ H: “65.618”m
87	Reflector height (hr)	GET/I/WI87; e.g. 87..11+00001700 ➔ hr: “1.700” m
88	Instrument height (hi)	GET/I/WI88; e.g. 88..11+00001550 ➔ hi: “1.550” m
531	Atmos. correction: pressure	GET/I/WI531; e.g. 531.16+10130000 ➔ “1013”
538	Coefficient of refraction	GET/I/WI538; e.g. 538.16+00001300 ➔ “1.300”
560	Time: [hh.mm.ss]	GET/I/WI560; e.g. 560..6+00105018 ➔ “10:50:18”
561	Date: [mm.dd]	GET/I/WI561; e.g. 561..6+00020800 ➔ “2.8.2000”
562	Year: [yyyy]	GET/I/WI562; e.g. 562...+00002000 ➔ year “2000”
590	SW-Version: Application	GET/I/WI590; e.g. 590..6+00021000 ➔ “V2.10”
591	SW-Version: Operating system	GET/I/WI591; e.g. 591..6+00020000 ➔ “V2.00”
592	SW-Version: OS interface	GET/I/WI592; e.g. 592..6+00010000 ➔ “V1.00”
593	SW-Version: GEOCOM	GET/I/WI593; e.g. 593..6+00022000 ➔ “V2.20”
594	SW-Version: Gsi communication	GET/I/WI594; e.g. 594..6+00010000 ➔ “V1.00”
595	SW-Version: Edm Device	GET/I/WI595; e.g. 595..6+00011100 ➔ “V1.11”
913	Job	GET/I/WI913; e.g. 913...+BLDG.A12 ➔ “BLDG.A12”
914	Operator	GET/I/WI914; e.g. 914...+0MM-3519 ➔ “MM-3519”

[Tab.10]

2.7.5 Warnings and Errors

Message ID	*Meaning*	*Possible reasons*
@W100	Instrument busy	Any other device is still interfacing the instrument; check interfacing priorities
@W127	Invalid command	The string sent to the TC could not be decoded properly or does not exist; check the syntax, or … Input buffer overflow (max. 100 characters)
@E139	EDM error	The EDM could not proceed the requested measurement; no or weak signal; Check EDM mode and target
@E158	One of the instruments sensor corrections could not be assigned.	Instrument is not stable, not levelled or suffering of vibration; Tilt is out of range (e.g. when tilt sensor is out of range); Level instrument or switch off compensator

[Tab.11]

3 DNA Section

3.1 GSI data format

GSI data is transmitted in blocks with each block ending with a terminator (CR or CR/LF). Every block consists of several data words (see the examples below). The data word begins with a two or three character Word Index, the WI code, specifying the data type within this block. The GSI-8 block has in total 16 characters, consisting of 7 information characters (e.g. WI, sign), followed by 8 data characters and by the blank character (ASCII code 32) at the end of the data word. The GSI-16 block is similar to the GSI-8 block but the block begins with "*" and the data word contains 16 characters for large values such as UTM coordinates, large alphanumeric codes, attributes or point IDs.

Example 1 shows a GSI-8 block sequence with the words for point ID (11), horizontal distance (32) and the staff reading (330). Example 2 shows a GSI-16 block sequence with the words for point ID (11), horizontal distance (32), backsight (331), intermediate sight (333), foresight (332) and the point height (83).

Example 1: GSI-8 measurement blocks

```
|<---- Word 1 ---->|<---- Word 2 ---->|<---- Word 3 ---->|
1234567890123456  (16 characters per word)

110001+0000A110 32...8+02505387 330.08+00125972
110002+0000A111 32...8+02637586 330.08+00143031
110003+0000A112 32...8+02594636 330.08+00163780
110004+0000A113 32...8+02413839 330.08+00183292
110005+0000A114 32...8+02801241 330.08+00121344
       |←8 ch. →|
```

GSI-8 data word structure:

Pos. 1-2/3:	Word Index (WI)	e.g. "11" (WI for PtID)
Pos. 3/4-6:	Information related to data	e.g. "0003" (block number in word 1)
Pos. 7:	Sign	e.g. "+" or "–"
Pos. 8-15:	Data (8 digits)	e.g. "0000A113" (PtID)
Pos. 16:	Blank (= separating character)	

Example 2: GSI-16 measurement blocks

```
|<--------- Word 1 ------->|<-------- Word 2 -------->|<-------- Word 3 ------->|
 1234567890123456789012345678901234  (24 characters per word)

*110004+0000000000000001 32...8+0000000003417147 331.08+0000000000147534
*110005+000000000000P355 32...8+0000000003417147 333.08+0000000000269405
*110006+000000000000P355 83..08+0000000041269345
*110007+00000000000000A2 32...8+0000000003618502 332.08+0000000000182331
       |<-- 16 char. -->|
```

GSI-16 data word structure:

Pos. 1-2/3:	Word Index (WI)	e.g. “331” (WI for backsight)
Pos. 3/4-6:	Information related to data	e.g. “08” (flag for measurement and unit)
Pos. 7:	Sign	e.g. "+" or "-"
Pos. 8-23:	GSI-16 data (16 digits)	e.g. “0000000003618502”; Distance
Pos. 24:	Blank (= separating character)	

3.2 GSI word information

The flags at positions 5 to 6 in the data word are used for additional information.

Example with a GSI-8 data word:

```
Position:     1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6
              . . . . . . ± n n n n n n n n ×
```

Position 1-3: Word index.

Position 4: empty, marked as dot (.)

Position 5: Information about the measurement and earth-curvature correction.
0 = measured; without earth-curvature correction.
1 = entered manually; without earth-curvature correction.
2 = measured; with earth-curvature correction.
5 = entered manually; with earth-curvature correction.

Position 6: Units and decimal places. Note: The data is stored in the unit and resolution that is defined by the "Unit" and "Decimal" settings on the instrument during data export.
6 = metre, last place 0.1mm.
1 = foot, last place 0.001ft.
0 = metre, last place 1mm.
7 = foot, last place 0.0001ft (only DNA03).
8 = metre, last place 0.01mm (only DNA03).

Position 7-15: Measurement data (n)

Position 16: Space character, ASCII-Code 32 (×)

3.3 Word list

A block (record) is either of the type "Measurement" or of the type "Code". The measurement block begins with "11" which is the WI for the PtID. The code block begins with WI "41".

The measurement block consists of between 2 and 6 fixed data words. Individual words can not be selected. The code record consists of 9 words.

1) General data words
The following data words are used in the measurement and code blocks:

WI = 11	Point ID.
WI = 32	Horizontal distance to staff.
WI = 330	Staff reading in "Meas Only".
WI = 331	Staff reading, backsight or B1.
WI = 332	Staff reading, foresight or F1.
WI = 335	Staff reading, B2.
WI = 336	Staff reading, F2.
WI = 333	Staff reading, intermediate sight.
WI = 334	Staff reading, setting-out sight.
WI = 374	Setting-out difference of height measurements.
WI = 35	Setting-out difference of distance measurement.
WI = 390	Count of repeated measurements.
WI = 391	Mean mode: Standard deviation of the single measurement.
WI = 392	Median mode: Spread of measurements.
WI = 41	Code number.
WI = 42 – 49	Info1 to Info8
WI = 571	Station difference
WI = 572	Cumulative station difference
WI = 573	Distance balance
WI = 574	Total distance (= line length)
WI = 71	Remark
WI = 83	Ground height (starting point height or measured height)

2) Special data words
The following data words are generated by on-line command only:

WI = 12	Serial number
WI = 13	Instrument type
WI = 17	Date, year
WI = 19	Day, time
WI = 95	Instrument temperature [°C]
WI = 560	Time
WI = 561	Date
WI = 562	Year
WI = 599	Software version

For further information see "GET" command.

3) Special code blocks

The levelling technique is tagged by means of a special code block (WI = 41). It is recognizable by the "?" at the eighth position in the word.

Line levelling method **BF**	410000+?.....1
Line levelling method **BFFB**	410000+?.....2
Line levelling method **aBF**	410000+?.....3
Line levelling method **aBFFB**	410000+?.....4
Check & Adjust	410000+?.....10

3.4 Block list

The measured values (e.g. distance, staff reading etc.) and the results (e.g. ground height) are stored in separate blocks according to their type.

The data blocks in the various measurement programs:

1) Measure & Record
The structure is similar to the line levelling BF.

The start of a new line is indicated with the special code block for the line levelling method BF.

Different from line levelling:

- The first backsight display: Any number of single backsights can be recorded. The <CONT> function will close the display and record a start levelling code and a copy of the last backsight measurement.
- The foresight displays: Any number of single foresights can be recorded. The <CONT> function will close the display and record a result line for the last foresight measurement.
- The backsight displays: Any number of single backsights can be recorded until <CONT> is pressed.
- In all displays: The PtID remains unchanged for all measurements of a display unless it is changed by the user for individual measurements.

Measure & Record block sequence:

Block recorded	Data words (WI)	Remarks
Backsight	11, 32, 331	1. backsight
Backsight	11, 32, 331	additional backsight
Backsight	11, 32, 331	additional backsight
Backsight	11, 32, 331	last backsight
<CONT> pressed		
Method Start height	41 11, 83	Special code block
Backsight	11, 32, 331	Copy of last backsight
Foresight	11, 32, 332	1. foresight
Foresight	11, 32, 332	additional foresight
Foresight	11, 32, 332	additional foresight
Foresight	11, 32, 332	additional foresight
Last foresight	11, 32, 332	last foresight *)
<CONT> pressed		
Result	11, 573, 574, 83	*)
Backsight	11, 32, 331	1. backsight
Backsight	11, 32, 331	additional backsight
Backsight	11, 32, 331	additional backsight
...		...
<CONT> pressed		
Foresight	11, 32, 332	1. foresight
etc		

***)**

- Press <CONT> at the end of the line levelling in order to record the result block of the last foresight.
- If Intermediate or Setting-out sights are recorded after the foresight measurement and if <CONT> is pressed without remeasuring the foresight then the result line is not placed immediately after the last foresight. In such a case edit the data and move the last foresight measurement before the result line in order to have a consistent data set.

2) Measure Only

Block recorded	*Data words (WI)*	*Remarks*
Measurement	11, 32, 330	
Measurement	11, 32, 330	
Measurement	11, 32, 330	

3) Line levelling BF

Block recorded	*Data words (WI)*	*Remarks*
Method Start height	41 11, 83	
Backsight	11, 32, 331	
Foresight Result	11, 32, 332 11, 573, 574, 83	
Backsight	11, 32, 331	
Foresight Result	11, 32, 332 11, 573, 574, 83	

4) Line levelling aBF

Block recorded	*Data words (WI)*	*Remarks*
Method Start height	41 11, 83	
Backsight	11, 32, 331	even station: BF
Foresight Result	11, 32, 332 11, 573, 574, 83	
Foresight	11, 32, 332	odd station: FB
Backsight Result	11, 32, 331 11, 573, 574, 83	
Backsight	11, 32, 331	even station: BF
Foresight Result	11, 32, 332 11, 573, 574, 83	
Foresight	11, 32, 332	odd station: FB
Backsight Result	11, 32, 331 11, 573, 574, 83	

5) Line levelling BFFB

Block recorded	*Data words (WI)*	*Remarks*
Method Start height	41 11, 83	
B1	11, 32, 331	
F1	11, 32, 332	
F2	11, 32, 336	
B2	11, 32, 335	
Result	11, 571, 572, 573, 574, 83	
B1	11, 32, 331	
F1	11, 32, 332	
F2	11, 32, 336	
B2	11, 32, 335	
Result	11, 571, 572, 573, 574, 83	

6) Line levelling aBFFB

Block recorded	*Data words (WI)*	*Remarks*
Method Start height	41 11, 83	
B1	11, 32, 331	even station: BFFB
F1	11, 32, 332	
F2	11, 32, 336	
B2	11, 32, 335	
Result	11, 571, 572, 573, 574, 83	
F1	11, 32, 332	odd station: FBBF
B1	11, 32, 331	
B2	11, 32, 335	
F2	11, 32, 336	
Result	11, 571, 572, 573, 574, 83	
B1	11, 32, 331	even station: BFFB
F1	11, 32, 332	
F2	11, 32, 336	
B2	11, 32, 335	
Result	11, 571, 572, 573, 574, 83	
F1	11, 32, 332	odd station: FBBF
B1	11, 32, 331	
B2	11, 32, 335	
F2	11, 32, 336	
Result	11, 571, 572, 573, 574, 83	

7) Check & Adjust

Block recorded	*Data words (WI)*	*Remarks*
Method	41	
B1	11, 32, 331	Staff A1
F1	11, 32, 332	Staff B1
F2	11, 32, 336	Staff B2
B2	11, 32, 335	Staff A2

8) Other blocks

Block recorded	*Data words (WI)*	*Remarks*
Intermediate sight Result	11, 32, 333 11, 83	
SetOut Height or dh Result	11, 32, 334 11, 374, 83	dh = Height difference
SetOut Distance Result	11, 32, 334 11, 35	
Code with Info1 – Info8	41, 42, 43, 44, … 49	

9) Measure modes

Example with Backsight:

Block recorded	*Data words (WI)*	*Remarks*
Single mode	11, 32, 331	
Mean / Mean_s mode	11, 32, 331, **390, 391**	
Median mode	11, 32, 331, **390, 392**	
Rep. single mode	11, 32, 331, **390**	

3.5 Differences between DNA and NA series

Item	*DNA03 / DNA10*	*NA3003 / NA2002*
Repeating (undoing) a measurement or a station by stepping back	Key: <<Back - Original backsight and foresight data in line levellings and measurements in "Meas Only" are deleted. - Original data in "Meas & Rec" and all intermediate sights are not deleted.	Key: REP Code block to indicate start of repeated measurement: "410000+!....nnn" nnn = 331 / 332 / 333 / …
Code block	WI 41-49: total 9 words	WI 41-45: total 5 words
Remark word (REM1)	WI 71	--
Set out of - Height - Height difference	 Set-out difference is WI 374 Set-out difference is WI 374	 SO difference is WI 374 --
Set out of Distance	Set-out difference is WI 35 (Example: 35...8+00000012)	--
Resolution of all measurement values. Example: Distance = 32.12m	Highest possible resolution depending on the "Decimal" setting during data export and adaptable in case of data overflow. 32...**8**+03212345 (DNA03)	Different and fixed resolution for individual words. 32..0**0**+00032120
Mean mode with n and s (standard deviation). Example: n = 4 and s = 1.2mm	WI 390 (n) and WI 391 (s) 390...+00000004 391.06+00000012	WI 52 52..06+0004+012
Median mode with n and B (band width or spread). Example: n = 4 and B = 1.2mm	WI 390 (n) and WI 392 (B) 390...+00000004 392.06+00000012	WI 521 521.06+0004+012
Repeated single measure mode	Marked with WI 390 (n = number of last measurement when halted). Example: 390....+00000012 (measurement no. 12 was recorded)	--
Example of a backsight as a mean value and with a remark	WI: 11, 32, 331, 390, 391, 71	WI: 11, 32, 331, 52
Unit "Inch"	Display of US-ft and Inches with decimals. Data are recorded as US-ft.	Displayed and recorded as Inch (pos. 6 with "9").
Integration time	--	WI 57
Pos. 5 in word 32 (Distance). Example:	Empty ("**.**"). 32...8+03212345	With meas. flag "0": 32..**0**0+00032120
Pos. 4 in word 33x (Staff reading). Example:	Empty ("**.**"). 331.08+00125846	With compensator flag "1" 331**1**08+00125846
Pos. 5 in word 33x (Staff reading) for measurement flags:	Reduced set of flags: 0, 1, 2 and 5. Example: 331.**2**8+12345678	Flags: 0, 1, 2, 4, 5, 6 and 7
Pos. 5 in word 374 (Set-Out difference)	Value according to WI 334: 0, 1, 2 or 5. Example: 374.**2**8+00012345	"0": 374.**0**8+00012345
Pos. 5 in word 83 (Height): - Start height - Ground height	 Empty ("**.**"). Example: 83...8+12345768 Same flag as in word 33x: Example: 83..**2**8+12345768	 "1": 83..**1**8+12345768 "0": 83..**0**8+12345768
GSI-16	Yes	No

3.6 Sample GSI-8 data

Examples of data records in the various measurement programs:

MEAS ONLY

```
110014+00000124 32...6+00241234 330.06+00010509
 Block number            Distance       Staff reading
          Point ID
```

Start Levelling

```
410015+?......1                  (Method BF)
110016+0000P135 83...6+04026500
        Point ID     Ground height
```

Backsight

```
110017+00000035 32...6+00241234 331.06+00012554
        Point ID       Distance        Backsight
```

Foresight (first block for measurements, second block for results)

```
110018+00000036 32...6+00241234 332.06+00010473
        Point ID       Distance         Foresight

110019+00000036 573..6-00056105 574..6+01513910 83..06+04029024
              Distance balance   Total distance   Ground height
```

Intermediate sight (first block for measurements, second block for results)

```
110020+00000101 32...6+00241234 333.06+00013286
        Point ID       Distance      Intermediate sight

110021+00000101 83..06+04020337
                  Ground height
```

Setting-out height (first block for measurements, second block for results)

```
110022+00005501 32...6+00241234 334.06+00012054
       Point ID        Distance    Staff reading (setting-out)
110023+00005501 374.06-00000012 83..06+04027030
                Setting-out diff.    Ground height
```

Mean value and remark

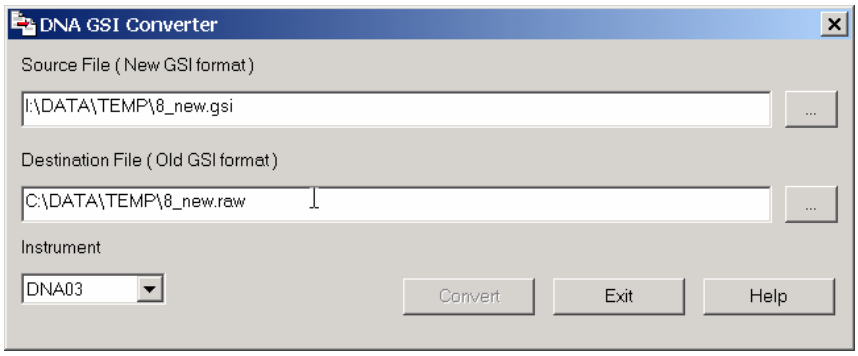
```
110024+00000016 32...6+00241234 330.06+00012054 390...+00000005 391.06+00000012 71....+0SURFACE
       Point number     Distance    Staff reading          1)             2)           Remark
    1) = Count of rep. measurements (5)
    2) = Standard deviation of a single measurement (1.2mm)
```

Code block

```
410025+00000099 42....+00020692 43....+00001122 44....+00000015 45....+00000788 …. 49....+000ABCDE
         Code           Info1          Info2           Info3         Info4              Info8
```

3.7 Conversion from new GSI format (DNA) to old GSI format (NA)

The DNA03/DNA10 produce a GSI format that is different from the GSI format of the NA3003/NA2002. Therefore a conversion tool is offered in Leica Survey Office to convert the GSI data of the DNA into the GSI format of the NA series. In Leica Survey Office go to "DNA Tools" and then open the "DNA GSI Converter" program.



Proceed as follows:

1. Select the source file (DNA03/DNA10 measurements) . The default extension is ".gsi".
2. Select the destination file. The default extension is ".raw".
3. Select the instrument type of the source data: DNA03 or DNA10.
4. Press "Convert"

Conversion rules

- The definitions with respect to the positions 4 to 6 in the data words are reinstalled to NA style.
- New words coming from new features, such as WI 71 (remark word), WI 35 (set-out difference of distance) or WI 390 (number of measurements in the "Rep. single" measure mode) are not removed from the measurement block.
- Measurements from new line levelling methods (aBF, aBFFB) and from Check&Adjust remain unchanged.
- New word combinations such as WI 390 + WI 391 or WI 390 + WI 392 are converted to WI 52 / WI 521.
- The additional new words of the code block (WI 46 to WI 49) are not removed.
- GSI-16 data are converted to GSI-8 data. Strings such as PtID, remarks and codes are reduced to 8 characters (the first 8 characters from the left are cut off).

3.8 Online command structure

Commands overview

- SET Set instrument parameters
- CONF Read internal parameter settings
- PUT Write/change values within the instrument
- GET/I… Get instant values from the instrument (last valid value)
- GET/M… Release a measurement and get value
- GET/C... Release continuous measurements and collect values until halted by key press [CE] on instrument or by external command "c".

Examples:

SET commands

SYNTAX: SET/<set spec>/<parameter><CR/LF>
EXAMPLE: SET/30/0
RESPONSE: ?

Instrument BEEP:	SET/30/0	OFF (disable)
	SET/30/1	ON (enable)

CONF commands

SYNTAX: CONF/<conf spec><CR/LF>
EXAMPLE: CONF/30
RESPONSE: 0030/000

CONF/30 reads the BEEP setting	0030/0000	Beep disabled
	0030/0001	Beep enabled

PUT commands

SYNTAX: PUT/<put spec> <Value>_<CR/LF>
EXAMPLE: PUT/11….+00000012
RESPONSE: ?
CONFIRMATION: <CR/LF>

Writes Pointnumber	PUT/11….+00000012

☞ Make sure you put a space (_), behind <Value>!

GET commands

SYNTAX: GET/n/WI<get spec><CR/LF> n = M / I / C
EXAMPLES: GET/M/WI32
RESPONSE: 32…0+00014940

Read Distance value	GET/I/WI32
Read distance and staff reading	GET/I/WI32/WI330

Combine several words in one command:
EXAMPLE: GET/M/WI11/WI32/WI330/WI95

Low Level commands

SYNTAX: <command>CR/LF

<Command>	Description
a	Powers on the instrument
b	Powers off the instrument
c	Clear
BEEP/0	Short beep
BEEP/1	Long beep
BEEP/2	Alarm beep (short beep, 3 times)

Output to serial interface
The table shows the output to RS232 for different measurement launching methods and for different measure mode settings:

Measure modes	**Press measure button at instrument**	**Command: GET/M/WI330 (single mode)**	**Command: GET/C/WI330 (continuous mode) **)**
Single	1 measurement	1 measurement	continuous measuring
Mean	1 meas. = last mean value	1 measurement *)	continuous measuring
Median	1 meas. = last median value	1 measurement *)	continuous measuring
Mean s	1 meas. = last mean value	1 measurement *)	continuous measuring
Repeated single **)	1 meas. = last measurement when measuring stopped.	1 measurement *)	continuous measuring

*) Only one single measurement is released and recorded.
**) Continuous measuring is halted by keyboard press [CE] or by external command "c".

3.9 SET and CONF

<SET SPEC>	<CONF SPEC>	FUNCTION	<PARA-METER>	RESPONSE	SETTING
30	30	BEEP	0 1 2	0030/0000 0030/0001 0030/0002	OFF Medium Loud
--	31	Display illumination	0 2 3	0031/0000 0031/0002 0031/0003	Off Circ. level Display + Circ. level
32	32	Display contrast	[0..100] 0 50 100	0032/0nnn	[range] Low contrast Medium contrast High contrast
41	41	Distance UNIT	0 1 2 5	0041/0000 0041/0001 0041/0002 0041/0005	Meter US Feet, decimal Intl. Feet, decimal US Feet/Inch decimal
42	42	Temperature UNIT	0 1	0042/0000 0042/0001	Degree Celcius Degree Fahrenheit
51	51	Decimals of staff readings in displays (depending on units and instr. type)	2 3 4 5	0051/0002 0051/0003 0051/0004 0051/0005	2 decimals 3 decimals 4 decimals 5 decimals
70	70	Baudrate	2 3 4 5 6	0070/0002 0070/0003 0070/0004 0070/0005 0070/0006	1200 Baud 2400 Baud 4800 Baud 9600 Baud 19200 Baud
71	71	Parity	0 1 2	0071/0000 0071/0001 0071/0002	None Odd Even
73	73	Terminator	0 1	0073/0000 0073/0001	CR CR/LF
75	75	Protocol	0 1	0075/0000 0075/0001	Off On
76	76	Data recording device	0 1	0076/0000 0076/0001	Internal Memory RS232
78	78	Delay between 2 strings sent	[0..50]	[0..50]	Increase of 10ms/unit
--	90	Battery level	--	0090/00nn	n:[0..10] 0: Empty 10: Full
--	91	Internal temp.	--	0091/0nnn	[0..±100] °C
95	95	AutoOFF	0 1 2	0095/0000 0095/0001 0095/0002	Off On Sleep mode
106	106	Display heater	0 1	0106/0000 0106/0001	Off On
125	125	Earth curvature correction	0 1	0125/0000 0125/0001	Off On

[…cont.]

<SET SPEC>	*<CONF SPEC>*	***FUNCTION***	*<PARA-METER>*	***RESPONSE***	***SETTING***
127	127	Staff mode	0 1	0127/0000 0127/0001	normal inverted
137	137	RS232 format length	0 1	0137/0000 0137/0001	GSI-8 GSI-16
138		Quick code recording	0 1	0138/0000 0138/0001	Before measurement After measurement

3.10 PUT and GET

<PUT SPEC>	*<GET SPEC>*	*FUNCTION*	*Access/Example*
11	11	Running PtID	PUT/11….+00001234_<CR/LF> GET/M/WI11<CR/LF>
71	71	Remark	PUT/71….+00001234_<CR/LF> GET/M/WI71<CR/LF>
560	560	Time: [hh.mm.ss]	PUT/560..6+00113059_<CRLF> GET/I/WI560<CRLF>
561	561	Date: [mm.dd]	PUT /561..6+00022500_<CRLF> GET/I/WI561<CRLF>
562	562	Year: [yyyy]	PUT/562...+00002002_<CRLF> GET/I/WI562<CRLF>
--	32	Horiz. distance	GET/M/WI32<CR/LF>
--	330	Staff reading	GET/M/WI330<CR/LF>
--	95	Internal temp. [°C]	GET/M/WI95<CR/LF>
--	12	Serial number	GET/I/WI12<CR/LF>
--	13	Instrument type	GET/I/WI13<CR/LF>
--	17	Date, Year: [DD.MM.YYYY]	GET/I/WI17<CR/LF>
--	19	Day, Time: [MM.DD.hh.mm]	GET/I/WI19<CR/LF>
--	599	SW Version of system	GET/I/WI599<CR/LF>

3.11 Warnings and Errors

Message ID	*Meaning*	*Possible reasons*
@W400	Instrument busy	Any other device is still interfacing the instrument; check interfacing priorities
@W427	Invalid command	The string sent to the Instrument could not be decoded properly or does not exist; check the syntax, or … Input buffer overflow (max. 100 characters)
@E458	Tilt sensor out of range	Instrument is not levelled-up.
@E439	Measurement not possible	For example no staff present or inverted staff or picture too dark.