

## 1. Introduction

TOPCON Total Station GTS-4 can be directly connected to a computer.

This manual gives the information about the interface between the GTS-4 and a computer.

Sample interface programs are listed in this manual for SHARP PC-1600 computer.

For other computers or application programs, users are kindly asked to modify the sample program in this manual.

Please refer to the GTS-4 Instruction Manual for its operation.

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The specification of the GTS-4 including the interface  
with a computer may be changed for improvement by the  
manufacturer without notice.  
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## 2. Equipment required to make the system.

The following equipments are required to make the system:

- 1) TOPCON Total Station GTS-4

To connect with the PC-1600,

- 2) TOPCON interface Cable F-1
- 3) SHARP PC-1600 computer

## 3. Setting the Interface Mode of the GTS-4

For connecting the GTS-4 to a computer, the interface mode of the GTS-4 must be changed according to the procedures described below.

These procedures make the GTS-4 to add the ASCII characters CRLF to the end of the output data strings in order to make easy interface with a computer.

- 1) Turn on the power switch with pressing the [F2] key continuously for about 1 sec.

display: " [PARAMETERS SET]"

- 2) After that, Parameters menu is displayed.

```

+-----+
| PARAMETERS  1/2 |
| 1: ANGLE     |
| 2: DIST      |
| 3: DATA-OUT |
+-----+

```

- 3) Press the [3] key.

```

+-----+
| DATA-OUT    1/2 |
| CRLF:OFF     |
| SET ITEM -- SLCT |
+-----+

```

- 4) Press the [F4] key.

```

+-----+
| DATA-OUT    1/2 |
| CRLF:ON      |
| SET ITEM -- SLCT |
+-----+

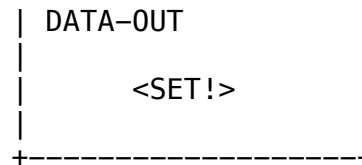
```

- 5) Press the [F1] key.

```

+-----+

```



- 6) Display is returned to Parameters menu.
- 7) Turn off the power.

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#### 4. Connecting the GTS-4 to the PC-1600

Cable connection is illustrated in Fig. 1.

FIG.1

#### 5. Pin connection between the GTS-4 and the computer.

|              | GTS-4 (6pin) | F-1 cable | PC-1600 (15pin) |
|--------------|--------------|-----------|-----------------|
|              | 1. GND       | -----     | 7. SG           |
|              | 2. N. C.     |           |                 |
| note1) ---   | 3. TD        | ----->    | 3. RD           |
|              | 4. RD        | <-----    | 2. TD           |
| note2) ---   | 5. RTS       | ----->    | 5. CTS          |
| (+8.4 v) --- | 6. Vcc       | ---->     | 6. DSR          |
|              |              | -----     | 1. FG           |

- note1) The output voltage is about +4V of high level and -4V of low level with a 3 kilo-ohm resistor.
- note2) The pin is always pulled up to the high signal level (+8.4V typ.) through a 1 kilo-ohm resistor.

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note3) In case of the coarse mode, the signal level and the

## 6. The Data Format of the GTS-4

### 6-1 Character Format

Each character is shown by the ASCII code.

|START| B0 | B1 | B2 | B3 | B4 | B5 | B6 | EP |STOP|

Baud Rate : 1200 baud

Start Bit : 1 bit ("0"=high)

Data Bit : 7 bits ("0"=high, "1"=low)

Parity Bit: Even Parity ("0"=high, "1"=low)

Stop Bit : 1 bit ("1"=low)

### 6-2. Data Format

#### 6-2-1. The measurement data from the GTS-4

##### 1) SD mode (ID: 3FH)

?=01178481m0852030+1203040d+01174572t15+00+25099ETX(CRLF)

|    |    |     |   |  |   |       |    |     |   |   |   |     |  |  |  |
|----|----|-----|---|--|---|-------|----|-----|---|---|---|-----|--|--|--|
|    |    |     |   |  |   |       |    |     |   |   |   |     |  |  |  |
| ID | SD | m/f | V |  | H | d/g/m | HD | t/* | L | P | 0 | BCC |  |  |  |

ID : An identification character which discriminates the kind of data (ASCII 3FH)

SD : Slope distance 1178.481m (+/-, 8 digits)

m/f : meter/feet

V : Vertical angle 85 20'30" (7 digits)

H : Horizontal angle 120 30'40" (+/-, 7 digits)

+/- : angle turned to right (+) or left (-)

d/g/m : degree/grad/mil

HD : Horizontal distance 1174.572m (+/-, 8 digits)

t/\* : Tilt correction -- t: yes, \*: no  
 L : EDM return signal level 15 (2 digits)  
 P : EDM atmospheric correction +00 ppm (+/-, 2 digits)  
 O : EDM instrument offset +25mm (+/-, 2 digits)  
 BCC : Block check characters 099 (3 digits)  
 ETX : The ASCII character (03H) to show the end of text  
 CR : The optional ASCII character (0DH)  
 LF : The optional ASCII character (0AH)

note1) The distance data is represented in the unit of 0.001m or 0.001ft. The data length is fixed 8 digits.  
 note2) The angle data is represented in the form of xxx xx'xx" or in the form of xxx.xxxx grad or xxxx.xxx mil. The data length is fixed 7 digits.

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note3) In case of the coarse mode, the signal level and the instrument offset are replaced by "\*\*".  
 (example)  
 ?+01178481m0852030+1203040d+01174572t\*\*+00+\*\*096ETX(CRLF)

2) HD or VD mode (ID: 52H)

R+01174572m0852030+1203040d+00095802t15+00+25010ETX(CRLF)

|    |    |     |   |   |       |    |     |   |   |   |     |
|----|----|-----|---|---|-------|----|-----|---|---|---|-----|
|    |    |     |   |   |       |    |     |   |   |   |     |
| ID | HD | m/f | V | H | d/g/m | VD | t/* | L | P | O | BCC |

VD : Vertical distance 95.802m (+/-, 8 digits)

note) In case of the coarse mode, the signal level and the instrument offset are replaced by "\*\*".  
 (example)  
 R+01174572m0852030+1203040d+00095802t\*\*+00+\*\*009ETX(CRLF)

3) V or H angle mode (ID: 3CH)

< 0862405 +1745545 +0127 d 082 ETX (CRLF)

|    |   |   |      |       |     |
|----|---|---|------|-------|-----|
|    |   |   |      |       |     |
| ID | V | H | tilt | d/g/m | BCC |

TILT: Tilt correction +1' 27" (+/-, 4 digits)

note1) The tilt angle is represented asxx'xx" or 0.xxxx grad or

x.xxx mil.  
 note2) The TILT data would be replaced by "\*\*\*\*" if the correction is stopped by the option switch.

4) N or E or Z coordinates mode (ID: 55H)

U-00596337+01011930+00095802m+1203040d 110 ETX (CRLF)  
 | | | | | | |  
 ID N E Z m/f H d/g/m BCC

N: N (X) coordinate -596.337m (+/-, 8 digits)  
 E: E (Y) coordinate +1011.930m (+/-, 8 digits)  
 Z: Z coordinate +95.802m (+/-, 8 digits)

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5) H Repeat Angle mode (ID: 50H)

P +1745545 +03495130 d 014 ETX (CRLF)  
 | | | | |  
 ID Hm Ht d/g/m BCC

6) SD TRK (Tracking) mode (ID: 44H)

D +01178480 m 001 ETX (CRLF)  
 | | | |  
 ID SD m/f BCC

7) HD TRK mode (ID: 41H)

A +01174570 m 006 ETX (CRLF)  
 | | | |  
 ID HD m/f BCC

8) VD TRK mode (ID: 45)

E +00095800 m 007 ETX (CRLF)

|    |    |     |     |
|----|----|-----|-----|
|    |    |     |     |
| ID | VD | m/f | BCC |

## 6-2-2. Preset Data

The GTS-4 can be preset the following data by the computer:

note) The leading zeros of the preset data can be omitted.

### 1) Horizontal angle reading of a known direction

J +650 d 054 ETX (CRLF) (ID: 4AH)

|    |   |       |     |        |
|----|---|-------|-----|--------|
|    |   |       |     |        |
| ID | H | d/g/m | BCC | *note1 |

H: Horizontal angle +6'50" (+/-, 1-7 digits)

note1) The GTS-4 ignores the CRLF characters.

note2) The unit of "d" or "g" must be the same one which is already set in the GTS-4.

## 2) Stake out distance

K +200000 m h 103 ETX (CRLF) (ID: 4BH)  
| | | | |  
ID D m/f h/v/s BCC

D: Stake out distance +200.000m (+/-, 1-8 digits)  
h/v/s -- h: Horizontal distance v: Vertical distance  
s: Slope distance

note) Only one of the stake out distance can be preset at a time.

## 3) The coordinates of an occupied station

I +10000000 +20000000 m 039 ETX (CRLF) (ID: 49H)  
| | | | |  
ID N E m/f BCC

Z coordinate must be preset separately from the N/E coordinates.

K -300000 m z 114 ETX (CRLF) (ID: 4BH)  
| | | | |  
ID Z m/f z BCC

Z: Z coordinate 300.000m (-/+, 1-8 digits)  
z: indicates the preset data is Z coordinate.

note) The sign of the Z coordinate preset data must be reversed because the GTS-4 subtracts the preset data from the measurement data as in the case of the stake out distance



data.

$$Z_m - (-Z) = Z_m + Z$$

$Z_m$ : Measured Z coordinate with the occupied station coordinates being (0,0,0).

$Z$  : Preset coordinate

#### 6-2-3. Recalled data

The GTS-4 sends the preset data back to the computer when recalled by the computer.

|  |   |       |   |           |     |   |     |   |       |     |
|--|---|-------|---|-----------|-----|---|-----|---|-------|-----|
|  |   |       |   | (ID: 4CH) |     |   |     |   | m/f   | BCC |
|  |   |       |   |           |     |   |     |   |       |     |
| L+0000650d+10000000+20000000m+00300000m+00200000mh055ETX(CRLF) |   |       |   |           |     |   |     |   |       |     |
|  |   |       |   |           |     |   |     |   |       |     |
| ID   | H | d/g/m | N | E         | m/f | Z | m/f | D | h/v/s |     |

#### 6-2-4. Commands

The commands are classified as follows:

Type 1: makes the GTS-4 to start measurement and to send the measurement data to the computer

|       | command        |                      |
|-------|----------------|----------------------|
| ID    | BCC ETX (CRLF) | MODE   (ASCII of ID) |
| ----- |                |                      |
| 1) C  | 067 ETX (CRLF) | unchanged   (43H)    |

Type 2: answers for the validity of received data

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| command               | (ASCII of ID) |
|-----------------------|---------------|
| -----                 |               |
| 1) ACK 006 ETX (CRLF) | (06H)         |
| 2) NAK 021 ETX (CRLF) | (15H)         |

note) The GTS-4 ignores the CRLF characters.

Type 3: stops the GTS-4 from sending tracking data

| command             | (ASCII of ID) |
|---------------------|---------------|
| -----               |               |
| 1) N 078 ETX (CRLF) | (4EH)         |

Type 4: presets data in the GTS-4

These commands must be sent before the preset data (6-2-2) are sent to the GTS-4

|    | command          | TYPE OF DATA                        | (ASCII of ID) |
|----|------------------|-------------------------------------|---------------|
| 1) | J 074 ETX (CRLF) | H-Angle                             | (4AH)         |
| 2) | K 075 ETX (CRLF) | Stake out Dist.<br>and Z coordinate | (4BH)         |
| 3) | I 073 ETX (CRLF) | N/E Coordinates                     | (49H)         |

Type 5: recalls the preset data in the GTS-4

|    | command          | (ASCII of ID) |
|----|------------------|---------------|
| 1) | L 076 ETX (CRLF) | (4XH)         |

Type 6: changes the measurement mode of the GTS-4

|     | command            | MODE        | (ASCII of ID)    |
|-----|--------------------|-------------|------------------|
| 1)  | Z10 091 ETX (CRLF) | H           | (5A H,31 H,30 H) |
| 2)  | Z12 089 ETX (CRLF) | HR          | (5A H,31 H,32 H) |
| 3)  | Z13 088 ETX (CRLF) | HL          | (5A H,31 H,33 H) |
| 4)  | Z20 088 ETX (CRLF) | V           | (5A H,32 H,30 H) |
| 5)  | Z31 088 ETX (CRLF) | SD TRK      | (5A H,33 H,32 H) |
| 6)  | Z32 091 ETX (CRLF) | SD CRS      | (5A H,33 H,32 H) |
| 7)  | Z33 090 ETX (CRLF) | SD CRS RPT  | (5A H,33 H,33 H) |
| 8)  | Z34 093 ETX (CRLF) | SD FINE     | (5A H,33 H,34 H) |
| 9)  | Z35 092 ETX (CRLF) | SD FINE PRT | (5A H,33 H,35 H) |
| 10) | Z41 095 ETX (CRLF) | HD TRK      | (5A H,34 H,31 H) |

|     |                    |             |                  |
|-----|--------------------|-------------|------------------|
| 11) | Z42 092 ETX (CRLF) | HD CRS      | (5A H,34 H,32 H) |
| 12) | Z43 093 ETX (CRLF) | HD CRS RPT  | (5A H,34 H,33 H) |
| 13) | Z44 090 ETX (CRLF) | HD FINE     | (5A H,34 H,34 H) |
| 14) | Z45 091 ETX (CRLF) | HD FINE RPT | (5A H,34 H,35 H) |
| 15) | Z51 094 ETX (CRLF) | VD TRK      | (5A H,35 H,31 H) |
| 16) | Z52 093 ETX (CRLF) | VD CRS      | (5A H,35 H,32 H) |
| 17) | Z53 092 ETX (CRLF) | VD CRS RPT  | (5A H,35 H,33 H) |
| 18) | Z54 091 ETX (CRLF) | VD FINE     | (5A H,35 H,34 H) |
| 19) | Z55 090 ETX (CRLF) | VD FINE RPT | (5A H,35 H,35 H) |
| 20) | Z61 093 ETX (CRLF) | N TRK       | (5A H,36 H,31 H) |
| 21) | Z62 094 ETX (CRLF) | N CRS       | (5A H,36 H,32 H) |

|     |     |     |            |  |   |      |     |  |                  |
|-----|-----|-----|------------|--|---|------|-----|--|------------------|
| 22) | Z63 | 095 | ETX (CRLF) |  | N | CRS  | RPT |  | (5A H,36 H,33 H) |
| 23) | Z64 | 088 | ETX (CRLF) |  | N | FINE |     |  | (5A H,36 H,34 H) |
| 24) | Z65 | 089 | ETX (CRLF) |  | N | FINE | RPT |  | (5A H,36 H,35 H) |
|     |     |     |            |  |   |      |     |  |                  |
| 25) | Z71 | 092 | ETX (CRLF) |  | E | TRK  |     |  | (5A H,37 H,31 H) |
| 26) | Z72 | 095 | ETX (CRLF) |  | E | CRS  |     |  | (5A H,37 H,32 H) |
| 27) | Z73 | 094 | ETX (CRLF) |  | E | CRS  | RPT |  | (5A H,37 H,33 H) |
| 28) | Z74 | 089 | ETX (CRLF) |  | E | FINE |     |  | (5A H,37 H,34 H) |
| 29) | Z75 | 088 | ETX (CRLF) |  | E | FINE | RPT |  | (5A H,37 H,35 H) |
|     |     |     |            |  |   |      |     |  |                  |
| 30) | Z81 | 083 | ETX (CRLF) |  | Z | TRK  |     |  | (5A H,38 H,31 H) |
| 31) | Z82 | 080 | ETX (CRLF) |  | Z | CRS  |     |  | (5A H,38 H,32 H) |
| 32) | Z83 | 081 | ETX (CRLF) |  | Z | CRS  | RPT |  | (5A H,38 H,33 H) |
| 33) | Z84 | 086 | ETX (CRLF) |  | Z | FINE |     |  | (5A H,38 H,34 H) |
| 34) | Z85 | 087 | ETX (CRLF) |  | Z | FINE | RPT |  | (5a H,38 H,35 H) |

### 6-3. How to make a BCC.

- Step 1: Treat each character as a 7/8-bit ASCII code.
- Step 2: Make bitwise EXCLUSIVE-OR of the BCC (initially which is a NULL code of the ASCII 00H) and the first character.
- Step 3: Regard the result as the next BCC used.
- Step 4: Make bitwise Exclusive-OR of the BCC and the next character.
- Step 5: Repeat the step 3 to 4 until the final character is operated.
- Step 6: Convert the result of the 7/8- bit code to a 3-digit decimal number.

#### <Example>

Assume the data is "013468AE". Each character of the data is represented as an 8-bit code. Making bitwise EXCLUSIVE-OR of a NULL code and the first character "0" results as follows:

|       |          |
|-------|----------|
| NULL  | 00000000 |
| "0"   | 00110000 |
| ----- |          |
|       | 00110000 |

The result is used to make EXCLUSIVE-OR with the next character "1":

|     |          |
|-----|----------|
|     | 00110000 |
| "1" | 00110001 |

|       |          |
|-------|----------|
| ----- |          |
|       | 00000001 |

Repeat the same procedure until the last character.

|     |          |
|-----|----------|
|     | 00000001 |
| "3" | 00110011 |

|       |          |
|-------|----------|
| ----- |          |
|       | 00110010 |

|     |          |
|-----|----------|
| "4" | 00110100 |
|-----|----------|

|       |          |
|-------|----------|
| ----- |          |
|       | 00000110 |

|     |          |
|-----|----------|
| "6" | 00110110 |
|-----|----------|

|       |          |
|-------|----------|
| ----- |          |
|       | 00110000 |

|     |          |
|-----|----------|
| "8" | 00111000 |
|-----|----------|

|       |          |
|-------|----------|
| ----- |          |
|       | 00110000 |

|     |          |
|-----|----------|
| "A" | 01000001 |
|-----|----------|

|       |          |
|-------|----------|
| ----- |          |
|       | 01001001 |

|     |          |
|-----|----------|
| "E" | 01000101 |
|-----|----------|

|       |          |
|-------|----------|
| ----- |          |
|       | 00001100 |

The final result "00001100" is converted to decimal "012" which is the BCC for the data "013468AE".

## 7. Communication protocol

- 7-1. Start measurement and receive data in the Single or the Repeat mode.

The GTS-4 will start measurement and send data when the (REC) key of the GTS-4 is operated twice.

The following is another method to start the measurement and

receive data by sending a command from the computer.

- 1) The computer sends the Type 1 command ("C" command) to the GTS-4
- 2) The GTS-4 checks the BCC of the "C" command and sends the "ACK" back to the computer within 0.05 sec if the command is received correctly.

If the "C" command is not received correctly, the GTS-4 will send the "NAK" or no answer within 0.05 sec to the computer.

- 3) When the computer received the "NAK" or no response from the GTS-4 within 0.05 sec, it must send the "C" command again.
- 4) The step 3) may be repeated up to 10 times, after that, the computer can terminate the communication and show an error message.
- 5) The GTS-4 starts measurement and sends data after the measurement is finished. In the angle measurement mode, the measurement is done in a moment and that data will be sent to the computer within 0.6 sec after sending the "ACK". In the distance measurement mode, the time interval is nearly equal to the measuring time (ie. about 5 sec in the single/continuous mode or 0.5 sec in the tracking mode).
- 6) The computer must send the "ACK" back to the GTS-4 within 0.3 sec when the data is correctly received by checking the BCC characters. The communication is terminated when the GTS-4 receives the "ACK"
- 7) If the received data has any transmission error, the computer may send the "NAK" within 0.3 sec to the GTS-4 and the GTS-4 will send the same data again to the computer after 0.02 to 0.06 sec.

The computer can omit to send the "NAK" which also causes the GTS-4 to send the same data after 0.3 to 0.5 sec.

- 8) The step 7) may be repeated up to 10 times, after that, the computer can terminate the communication and show an error message.

| GTS-4 |                  | Computer                   |
|-------|------------------|----------------------------|
| <--   | C 067 ETX        |                            |
|       | ACK 006 ETX      | -->                        |
|       |                  | 12                         |
|       | MEASUREMENT DATA | -->                        |
| <--   | ACK 006 ETX      | : successful communication |

```

-----
<-- C 067 ETX
    NAK 021 ETX      -->
<-- C 067 ETX
    NAK 021 ETX      -->
      |
    MAX. 10 times    : unsuccessful communication
-----
    MEASUREMENT DATA -->
<-- NAK 021 ETX
    MEASUREMENT DATA -->
    NAK 021 ETX
      |
    MAX. 10 times    : unsuccessful communication

```

## 7-2. Start measurement and receive data in the Tracking mode

- 1) Operation of the (REC) key one time or sending the "C" command causes GTS-4 to put out the measurement data to the computer.
- 2) The GTS-4 will send the next measurement data if it receives the "ACK" from the computer, while it will terminate the communication in the Single or the Repeat mode.
- 3) The GTS-4 will send the same data if it receives the "NAK" or no response within 0.3 sec from the computer.
- 4) To stop the data output from the GTS-4, the computer must send the Type 3 command ("N" command) instead of the "ACK" command.

| GTS-4             | Computer               |
|-------------------|------------------------|
| <-- C 067 ETX     |                        |
| ACK 006 ETX       | -->                    |
| MEASUREMENT DATA1 | -->                    |
| <-- ACK 006 ETX   |                        |
| MEASUREMENT DATA2 | -->                    |
| <-- ACK 006 ETX   |                        |
|                   |                        |
| MEASUREMENT DATAn | -->                    |
| <-- N 078 ETX     | : stop the data output |

## 7-3. To preset data

- 1) The computer sends the Type 4 command ("J", "K" or "I") to the GTS-4.
- 2) The GTS-4 will send the "ACK" or "NAK" back to the computer within 0.05 sec depending on whether the command was received correctly or not.
- 3) When the computer received the "NAK" or no response within 0.05

sec from the GTS-4 it must send the command again.

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- 4) The step 3) may be repeated up to 10 times, after that, the computer can terminate the communication and show an error message.
- 5) When the computer received the "ACK", it must send the preset data within 1 sec.
- 6) The GTS-4 will check the BCC of the preset data from the computer and send the "ACK" within 0.05 sec if the data was received correctly.

The computer may send the same preset data if it does not receive the "ACK" within 0.05 sec after sending the data.

This procedure can be done up to 10 times.

The GTS-4 will show the error message "E82" after that, regarding a correct data cannot be received. In this case, the error message can be reset by operating the key of the GTS-4 which makes the same measurement mode as before.

| GTS-4              | Computer                     |
|--------------------|------------------------------|
| <-- Type 4 command |                              |
| ACK 006 ETX -->    |                              |
| <-- PRESET DATA    |                              |
| ACK 006 ETX -->    | : successful communication   |
| -----              |                              |
| <-- Type 4 command |                              |
| NAK 021 ETX -->    |                              |
| <-- Type 6 command |                              |
| NAK 021 ETX -->    |                              |
|                    |                              |
| MAX. 10 times      | : unsuccessful communication |
| -----              |                              |
| <-- Type 4 command |                              |
| ACK 006 ETX -->    |                              |
| <-- PRESET DATA    |                              |
| NAK 021 ETX -->    |                              |
| (or no answer)     |                              |
|                    |                              |
| MAX. 10 times      | : unsuccessful communication |

#### 7-4. To recall the preset data

- 1) The computer sends the Type 5 command ("L" command) to the GTS-4
- 2) The GTS-4 will send the "ACK" or "NAK" back to the computer within 0.05 sec depending on whether the command was received correctly or not.
- 3) When the computer received the "NAK" or no response within 0.05 sec from the GTS-4 the computer must send the same command

again.

- 4) The step 3) may be repeated up to 10 times, after that, the computer can terminate the communication and show an error message.

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- 5) The GTS-4 will send the preset data back to the computer after 0.02 sec.
- 6) The computer must send the "ACK" or "NAK" within 0.3 sec depending on whether the data was received correctly or not.
- 7) The GTS-4 will send the preset data back to the computer again after 0.02 sec if the "NAK" was received. The GTS-4 will also send the preset data back to the computer if it had no response from the computer within 0.3 sec.
- 8) The step 7) may be repeated up to 10 times, after that GTS-4 will show the error message "E82" and terminate the communication.

| GTS-4              | Computer                     |
|--------------------|------------------------------|
| <-- Type 5 command |                              |
| ACK 006 ETX        | -->                          |
| RECALLED DATA      | -->                          |
| <-- ACK 006 ETX    | : successful communication   |
| -----              |                              |
| <-- Type 5 command |                              |
| NAK 021 ETX        | -->                          |
|                    |                              |
| MAX. 10 times      | : unsuccessful communication |
| -----              |                              |
| <-- Type 5 command |                              |
| ACK 006 ETX        |                              |
| RECALLED DATA      | -->                          |
| <-- NAK 021 ETX    |                              |
| RECALLED DATA      | -->                          |
| <-- NAK 021 ETX    |                              |
|                    |                              |
| MAX. 10 times      | : unsuccessful communication |

#### 7-5. Changing the mode of the GTS-4

Usually, the measurement mode is changed by operating the switch on the instrument. This section explains another method to change the mode by sending commands from the computer.

The procedure is as follows:

- 1) The computer sends the Type 6 command (6-2-4) to the GTS-4.
- 2) The GTS-4 checks the BCC of the command and sends the Type 2 command back to the computer within 0.05 sec.



When the received command from the computer is valid, the GTS-4 will send the "ACK" in the Type 2 command and terminate the communication, else it will send the "NAK".

3) When the computer receives the "NAK" or no response within 0.05 sec from the GTS-4, the computer must send the same command in the Type 6 again to the GTS-4.

4) The step 3) may be repeated up to 10 times, after that, the

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computer can terminate the communication and show an error message.

| GTS-4                                 | Computer                                       |
|---------------------------------------|--|
| <-- Type 6 command<br>ACK 006 ETX --> | : successful communication                     |
| -----                                 |  |
| <-- Type 6 command<br>NAK 021 ETX --> | : unsuccessful communication<br>or no response |
| <-- Type 6 command<br>NAK 021 ETX --> |  |
|                                       |  |
| MAX. 10 times                         |  |

## 8. Sample programs for the PC-1600

1) This program receives measurement data from the GTS-4 by operating the (REC) key and displays it.

```

10 AK$=CHR$ 6+"006"+CHR$ 3+CHR$ 13+CHR$ 10 'AK$=ACK+006+ETX+CR+LF
20 DIM A$ (0) *80 '80 characters memory
30 SETCOM"COM1:",1200,7,E,1 '1200bps,7-bit,Even,1-stop
40 OUTSTAT"COM1:",K1 'set DTR & RTS at a high level
50 SETDEV"COM1:",P0,KI 'assign I/O command to RS-232C
60 PCONSOLE"COM1:",0,2 'stop the auto-CRLF-sending
   set terminator to CRLF
70 INPUT A$(0) 'receive data
80 LPRINT AK$ 'send ACK
(90 INPUT C$ 'dummy input) *note2
100 PRINT A$ (1) 'display data
110 GOTO 70

```

note1) The tracking mode data cannot be received by this program.

note2) Usually, it is not necessary to have the line 90. However, if the user wants to keep the compatibility with TOPCON interface adapter RS-1/1A, the line must be inserted to receive the echo-back signal.

The GTS-4 can be switched internally for the compatibility.

Consult with TOPCON or your dealer.

< Sample display data >

```
?+01178481m0852030+1203040
d+01174572t15+00+25099
```

2) Next program is operated as follows:

-- To receive data with sending the "C" command, enter "C" (the BCC and the ETX will be automatically added), and the data will be  
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displayed on the PC-1600's display after the measurement is over. When the mode is TRK mode the each measurement data will be displayed continuously on the PC-1600's display. To stop the GTS-4 sending data, press any key for a moment.

-- To receive data without sending the "C" command, press [ENTER] key only and operate the (REC) switch of the GTS-4 twice.

-- To preset data of the GTS-4 enter "I", "J" or "K" followed by the preset data. (The BCC and the ETX will be added automatically.)

-- To recall the preset data, enter "L", and the preset data already set in the GTS-4 will be displayed on the PC-1600.

-- To change the measurement mode, enter the ID character corresponding to the mode.

```
10 DIM A$(4)*80 'data or command buffer momory
20 RC=0: TK=0: SP=0: L=0
30 AK$=CHR$ 6+"006"+CHR$ 13+CHR$ 10 'ACK+BCC+ETX+CR+LF
40 ST$="N078"+CHR$ 3+CHR$ 13+CHR$ 10 'the type 3 command
50 SETCOM " COM:1",1200,7E,1,N,N '1200bps, 7bits, Even, 1 stop
60 PCONSOLE " COM1:",0,2
70 '***COMMAND INPUT***
80 SETDEV " COM1:",P0 'assign output command to RS-232C port
90 INPUT "COMMAND";A$(2) 'prompt the key input,
100 IF A$(2)="" THEN SETDEV "COM1:",P0,KI:GOTO 380
110 IF A$(2)="C" THEN LET RC=1: GOTO 230 'data request
120 IF A$(2)="L" THEN LET L =1: GOTO 230 'recall mode
130 IF A$(2)="Z31" THEN LET TK=1: GOTO 230 'HD TRK mode
140 IF A$(2)="Z41" THEN LET TK=1: GOTO 230 'SD TRK mode
150 IF A$(2)="Z51" THEN LET TK=1: GOTO 230 'VD TRK mode
160 IF A$(2)="Z61" THEN LET TK=1: GOTO 230 'N TRK mode
170 IF A$(2)="Z71" THEN LET TK=1: GOTO 230 'E TRK mode
```

```

180 IF A$(2)="Z81" THEN LET TK=1: GOTO 230          'Z TRK mode
190 AA$=LEFT$(A$(2),1)                             'pick up the ID character
200 IF AA$="1" THEN GOSUB 580:GOTO 230              'N/E/Z preset
210 IF AA$="J" THEN GOSUB 580:GOTO 230              'H preset
220 IF AA$="K" THEN GOSUB 580:GOTO 230              'S0 preset
230 A$(3)=A$(2)
240 GOSUB 500                                         'BCC calculation routine
250 BC$=STR$(B)                                       'convert the BCC value to
260 BC$+RIGHTS ("000"+BC$,3)                         the character strings
270 A$(2)=A$(2)+BC$+CHR$ 3+CHR$ 13+CHR$10           'COMMAND/DATA+BCC+ETX+CR+LF
280 SETDEV "COM1:",PO,KI                             'assign I/O command to
                                                    RS-232C port
290 LPRINT A$(2);                                     'send a command to GTS-4
(300 INPUT Z$                                         'dummy input)*note 2 on
                                                    page 18
310 INPUT C$                                           'receive ACK/NAK

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320 IF C$<>"006" THEN 290                            'if not ACK,GOTO 290
330 IF L=1 THEN 380                                    'recall mode ?
340 IF RC=1 THEN 380                                    'record mode ?
350 IF SP=1 THEN LET A$(2)=A$(4) :LET SP=0:GOTO 290
                                                    'clear the SP flag
360 A$(2)="" :GOTO 80                                'clear the buffer memory
370 '***DATA RECEIVE***
380 INPUT A$(1)                                       'receive data from GTS-31B
390 IF LEFT$(A$(1),3)="006" THEN LET A$(1)=MIS$(A$(1),4,19)
400 LPRINT AK$;                                       'send ACK to GTS-4
410 IF TK=0 THEN GOSUB 660 : IF ER=1 THEN 290 ELSE GOTO 80
420 CURSOR 0,3:PRINT A$(1)
430 I$=INKEY$                                         'check any key input to the
440 IF I$="" THEN GOTO 380                           GTS-4 sending the TRK mode
450 INPUT A$(1)
460 LPRINT ST$;
470 IF LEFT$(A$(1),3)="006" THEN LET A$(1)=MID$(A$(1),4,19)
480 CURSOR 0,3:PRINT A$(1)
490 RC=0:TK=0:A$(2)='':GOTO 80                      'TRK mode finished
500 B=0                                               'set the initial BCC value
510 FOR I=1 TO LEN (A$(3))
520 Q=ASC MID(A$(3),I,1)                             'convert the character to ASCII
530 B1=Q AND (NOT B)
540 B2=B AND (NOT Q)
550 B=B1 OR B2                                       'B=Q XOR B
560 NEXT I
570 RETURN
580 A$(3)=A$(2)
590 GOSUB 500
600 BC$=STR$(B)
610 BC$+RIGHT$("000"+BC$,3)                         'add the leading zeros

```

```

620 A$(4)=A$(2)+BC$+CHR$ 3+CHR$ 13+CHR$ 10
                                'PRESET DATA+BCC+ETX+CR+LF
630 A$(2)=AA$
640 SP=1
650 RETURN
660 LE=LEN(A$(1))                'BCC check routine
670 A$(3)=LEFT$(A$(1),LE-3)      'pick up the BCC from the data
680 BC$=RIGHT$(A$(1),3)
690 GOSUB 500
700 IF B<>VAL(BC$) THEN LET ER=1:RETURN
                                'transmission error
710 PRINT A$(1):RC=0:L=0:ER=0:A$(2)="":RETURN
                                'display the received data
720 END

```

## 9. The Data/Commands Summary of the GTS-4

note) The last characters of ETX and CRLF are omitted.

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### 1) Measurement Data

```

SD      : ? +SD m V +H d +HD t L +P +0 BCC  (3FH)
HD, VD  : R +HD m V +H d +VD t L +P +0 BCC  (52H)
V , H   : < V +H +TILT d BCC  (3CH)

```

```

N,E,Z   : U +N +E +Z m +H d BCC  (55H)

```

```

H RPT   : P +HM =Ht d BCC  (50H)

```

```

SD TRK  : D +SD m BCC  (44H)
HD TRK  : A +HD m BCC  (41H)
VD TRK  : E +VD m BCC  (45H)

```

### 2) Preset Data

```

H angle : J +H      d BCC (4AH)

```

```

SO (HD) : K +D      m h BCC (4BH)
(VD)    : K +D      m v BCC (4BH)
(SD)    : K +D      m s BCC

```

```

N/E     : I +N +E m BCC (49H)
Z       : K +N      m z BCC (4BH)

```

### 3) Recalled Data

L +H d +N +E m +Z m +D m h BCC (4CH)

#### 4) Commands

Measure : C BCC (43H)

Answer : ACK BCC (06H)  
NAK BCC (15H)

Stop TRK data : N BCC (4EH)

#### 5) Change the measurement mode

H : Z10 BCC (5A H, 31 H, 30 H)  
HR : Z12 BCC (5A H, 31 H, 32 H)  
HL : Z13 BCC (5A H, 31 H, 33 H)

V : Z20 BCC (5A H, 32 H, 30 H)

SD TRK : Z31 BCC (5A H, 33 H, 31 H)  
SD CRS : Z32 BCC (5A H, 33 H, 32 H)  
SD CRS RPT : Z33 BCC (5A H, 33 H, 33 H)  
SD FINE : Z34 BCC (5A H, 33 H, 34 H)  
SD FINE RPT : Z35 BCC (5A H, 33 H, 35 H)

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HD TRK : Z41 BCC (5A H, 34 H, 31 H)  
HD CRS : Z42 BCC (5A H, 34 H, 32 H)  
HD CRS RPT : Z43 BCC (5A H, 34 H, 33 H)  
HD FINE : Z44 BCC (5A H, 34 H, 34 H)  
HD FINE RPT : Z45 BCC (5A H, 34 H, 35 H)

VD TRK : Z51 BCC (5A H, 35 H, 31 H)  
VD CRS : Z52 BCC (5A H, 35 H, 32 H)  
VD CRS RPT : Z53 BCC (5A H, 35 H, 33 H)  
VD FINE : Z54 BCC (5A H, 35 H, 34 H)  
VD FINE RPT : Z55 BCC (5A H, 35 H, 35 H)

N TRK : Z61 BCC (5A H, 36 H, 31 H)  
N CRS : Z62 BCC (5A H, 36 H, 32 H)  
N CRS RPT : Z63 BCC (5A H, 36 H, 33 H)  
N FINE : Z64 BCC (5A H, 36 H, 34 H)  
N FINE RPT : Z65 BCC (5A H, 36 H, 35 H)

E TRK : Z71 BCC (5A H, 37 H, 31 H)  
E CRS : Z72 BCC (5A H, 37 H, 32 H)  
E CRS RPT : Z73 BCC (5A H, 37 H, 33 H)  
E FINE : Z74 BCC (5A H, 37 H, 34 H)  
E FINE RPT : Z75 BCC (5A H, 37 H, 35 H)

|   |          |   |     |     |                    |
|---|----------|---|-----|-----|--------------------|
| Z | TRK      | : | Z81 | BCC | (5A H, 38 H, 31 H) |
| Z | CRS      | : | Z82 | BCC | (5A H, 38 H, 32 H) |
| Z | CRS RPT  | : | Z83 | BCC | (5A H, 38 H, 33 H) |
| Z | FINE     | : | Z84 | BCC | (5A H, 38 H, 34 H) |
| Z | FINE RPT | : | Z85 | BCC | (5A H, 38 H, 35 H) |

## 10. Interface cables

The followings are the cables available as a standard from TOPCON.

### 1) Cable F-1

This cable is used to connect with SHARP PC-1600.

|              | GTS-4 (6pin) |        | PC-1600 (15pin) |
|--------------|--------------|--------|-----------------|
|              | 1. GND       | -----  | 7. SG.          |
|              | 2. N.C.      |        |                 |
| note1) ---   | 3. TD        | -----> | 3. RD           |
|              | 4. RD        | <----- | 2. TD           |
| note2) ---   | 5. RTS       | -----> | 5. CTS          |
| (+8.4 v) --- | 6. Vcc       | ---->  | 6. DSR          |
|              |              | -----  | 1. FG           |

### 2) Cable F-2

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This cable is used to connect with SEIKO MAP-3010.

|              | GTS-4 (6pin) |        |        |
|--------------|--------------|--------|--------|
|              | 1. GND       | -----  | 6. GND |
|              | 2. N.C.      |        |        |
| note1) ---   | 3. TD        | -----> | 4. RD  |
|              | 4. RD        | <----- | 5. TD  |
| note2) ---   | 5. RTS       | -----> | 1. CTS |
| (+8.4 v) --- | 6. Vcc       |        |        |

note1) The output voltage is about +4V of high level and -4V of low level with a 3 kilo-ohm load.

note2) The pin is always pulled up to the high level (+8.4V typ.) through a 1 kilo-ohm resistor.

