PENTAX

DATA COMMUNICATION MANUAL

PTS-III

ASAHI PRECISION CO., LTD.

Ver. 1.0

FOREWARD

This manual mentions data communications between the PTS-III and personal computers and describes the communications functions of TS for those who understand how personal computers work and who wish to construct a system which makes use of TS.

---- CONTENTS ----

1. OVERVIEW

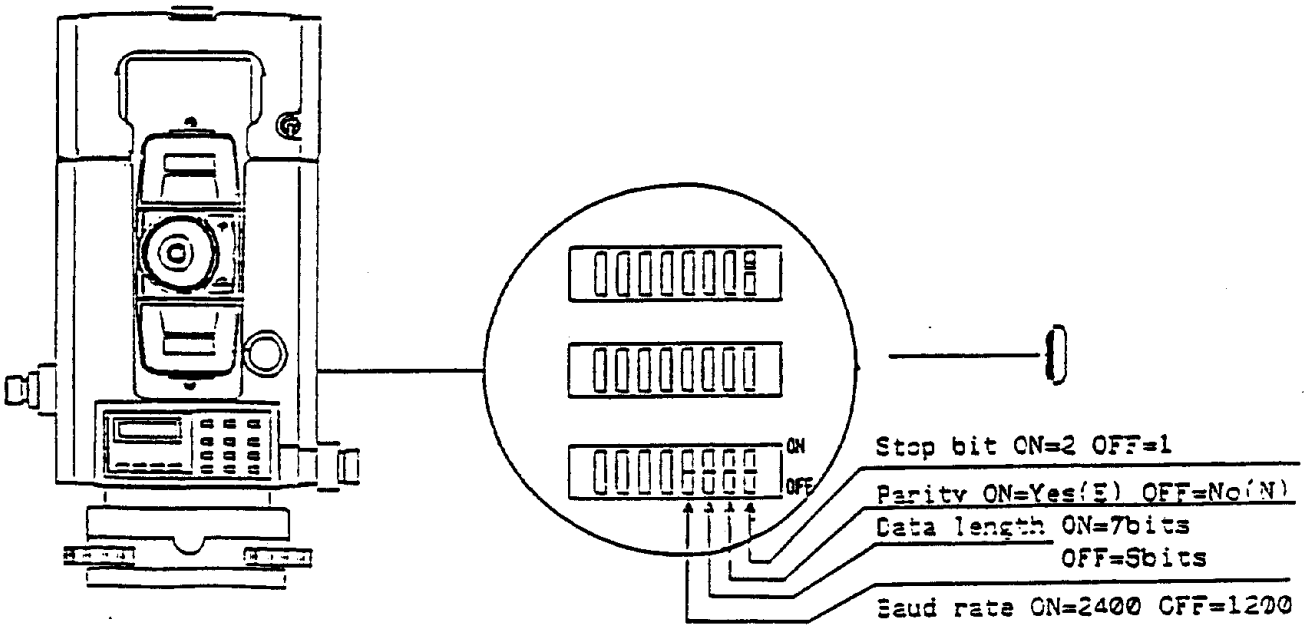
The PTS-III has a communication function which allows bidirectional communication with personal computers and handheld terminals which has RS-232C interfaces. This allows users to construct their own original measuring systems. Furthermore, it will also be possible to record data from the personal computer after the equipment is set up and the prism is collimated.

1-1. TS and Personal Computer Connections

A special cable is required to connect the PTS-III to external equipment. The PTS-III connector and personal computer connector are commercially available, so that making a special cable should not be difficult. Refer to " 2. Interface specifications" in regard to the actual connections.

1-2. Setting TS

After the hardware is connected (with a cable), the communication parameters must be set for communications. This means that the conditions on both sides must be set, so that electrical signals which are exchanged between the TS and external equipment will be handled as data. The settings are made on the TS with the DIP switches on the right side of the TS body.
Refer to " 3. Data communications " for details.



1-3. Communication with TS

When TS receives specific code from external equipment, it returns measurement data to the external data, or switches to a specified mode. Also, if the data from external equipment is defective, then the specified code will be sent to the external equipment. Refer to " 3. Data communications " for further details.

Example: To receive constant data (Temperature, Atmospheric pressure, Prism constant)from TS.

1) External equipment sends "f" to TS.
2) Constant data is sent from TS.
3) If the code sent to TS is defective, then TS will send "j".

2. Interface Specifications

2-1. Mechanical and Electrical Characteristics

1. Connector Types

Manufacturer: HIROSE ELECTRIC CO.,LTD. Model:HR10A-7R-6S

Round-receptacle 6-pins (receptacle)

2. Signal identification

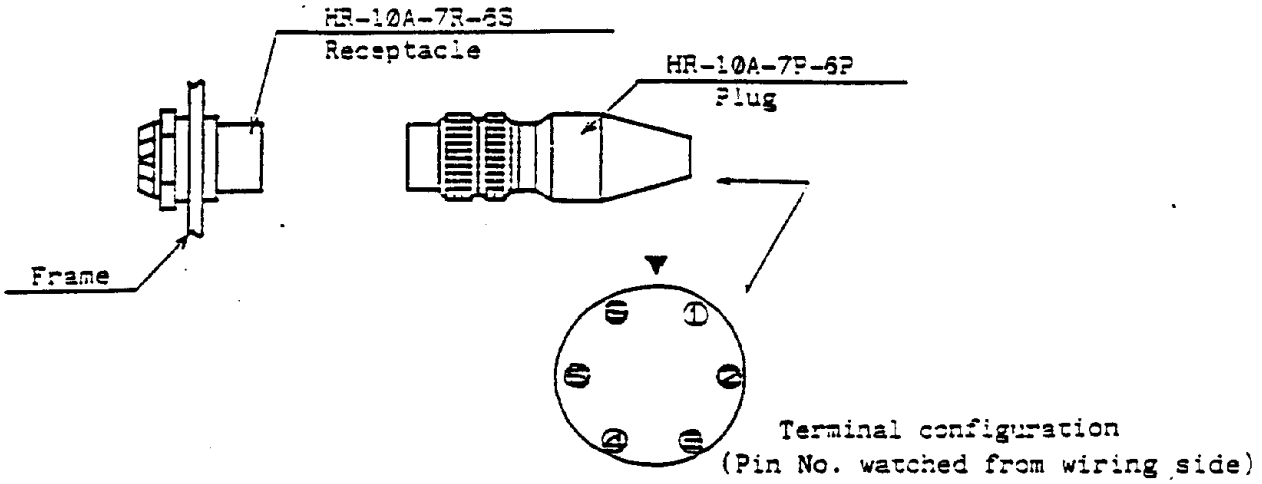
Control signal	Frequency	Logic	Code	Voltage-polarity
ON	FA(High)	0	Space	+9
OFF	FZ(Low)	1	Mark	-9

3. Pin assignment

Detachable type(PTS-III 05/10)				Shift type(05C/10C)
No	Signal name	Circuit name	Direction	Signal name
1	SD(TXD)	Sending data	out	SD
2	RD(RXD)	Receiving data	in	RD
3	CS(CTS)	Clear to send	in	---
4	RS(RTS)	Request to send	out	---
5	SG	Signal grand	---	SG
6	FG	Frame grand	---	FG

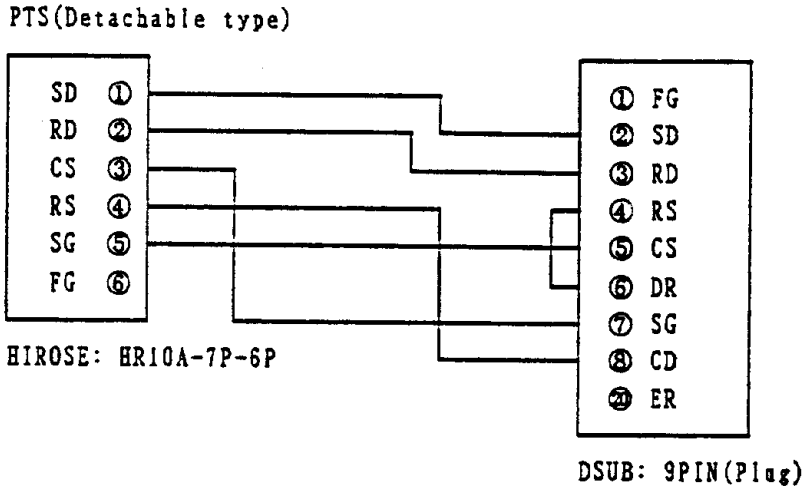
* CS and RS are connected in the instrument.(Shift type only.)

4. Connector shapes

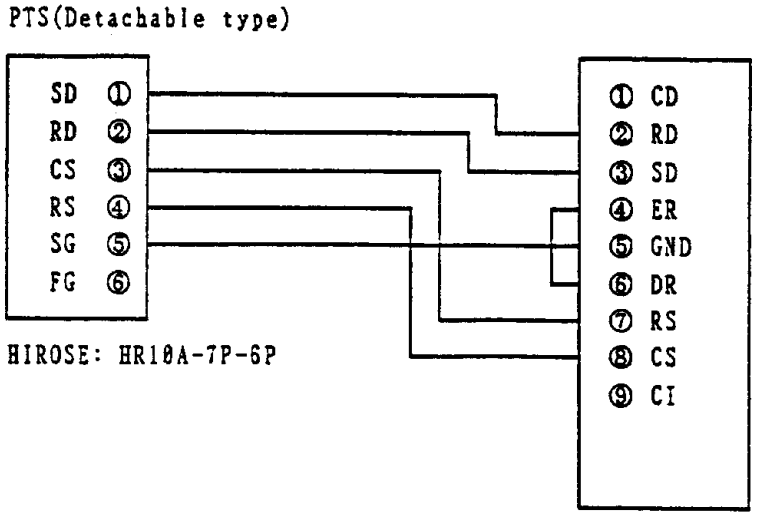


2-2. Connecting to computers

1. IBM-PC

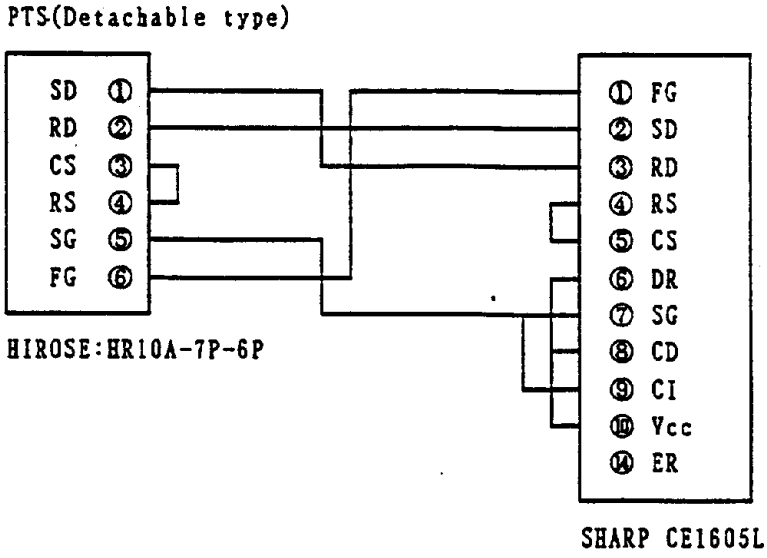


2. J-3100



DSUB 9PIN(Receptacle)

3. J-3100

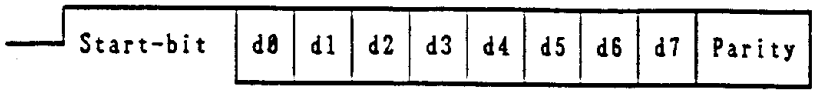


Note: If shift type (05C/10C), then ③ CS and ④ RS are connected internally.

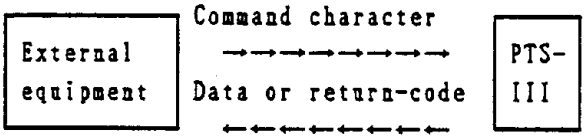
3. Data communications

3-1. Communication specifications

1) Communication method: Start-stop synchronized method(asynchronous), half-duplex
2) Transfer rate : 1200 baud,2400 baud(Switched with DIP switch)
3) Stop bit length : 1 bit,-2bit(Switched with DIP switch)
4) Parity method : Even(E), None(N) (Switched with DIP switch)
5) Data length : 7 bit, 8 bit (Switched with DIP switch)
6) Data structure :



7) Data flow control : By the X parameter
8) Code used : JIS 7 bits or 8 bits character code set
9) Time monitoring : None
10) Error control : Vertical parity (Dependent on external equipment processing.)
11) Control method : Control line(handshake) RTS/CTS monitoring (RTS on when the power supply is turned on)
12) Transmission control method: PENTAX protocol (PTS-III 05C,10C have no capability.) Control by TS command characters
13) Command format : One command character



Example: If TS receives "a", then it sends type 1 data.

3-2. TS command characters

Item	Char.	HEX	Direction	E.C	Contents
1. Type 1 data request	a	61h	→ TS	YES	H.A/V.A/S.D
2. Type 2 data request	b	62h	→ TS	YES	H.A/H.D/V.D
3. Type 3 data request	c	63h	→ TS	NO	Inst.Coordinates (X0,Y0,Z0)
4. Type 4 data request	d	64h	→ TS	YES	T.point Coordinates (X,Y,Z)
5. Type 5 data request	e	65h	→ TS	NO	H.A/V.A, Average of repeat angle /Sum/Numbers/V.A
6. Type 6 data request	f	66h	→ TS	NO	Tem./Pres./PPM/PRSM /AIM
7. Indicating AIM setting	g	67h	→ TS	NO	Unnecessary for PTS-II,III
8. Data output ending	h	68h	→ TS		Release of retention of measured distance value: Output end
9. Positive response	i	69h	← TS		With CR+LF
10. Negative response	j	6Ah	← TS		Incorrect request
11. Mode, data input request	l	6Ch	→ TS	NO	For mode control data input, send to TS
12. Mode data input wait	m	6Dh	← TS		Receiving "1", TS sends
13. Data re-request	n	6Eh	← TS		TS which have different least angle unit sends
14. TS mode control request	p	70h	→ TS		For TS mode control
15. Data input request	q	71h	→ TS		For data transmission to TS
16. Status information	r	72h	→ TS		Digit-switch status request
17. Type 7 data request	s	73h	→ TS	NO	Inst.Height request
18. Type 8 data request	t	74h	→ TS	NO	T.Point Height data request
19. Receiving O.K	X on	11h	→ TS		Flow control
20. Receiving stop	X off	13h	→ TS		Flow control
21. Data block ending	ETX	03h	→ TS		

H.A: Horizontal angle　　V.A: Vertical angle　　S.D : Slope distance
V.D: Vertical Distance　　Tem: Temperature　　Press. = Pressure
H.D: Horizontal distance　　AIM: AIM value　　Inst. = Instrument
E.C: Ending code　　T.point= Target point

3-3. Data block format

1). Output data (Data sent from TS to external equipment)
Each data line has the following structure

Data identifier or header	Space	Data	CR	LF

There are nine types of data blocks. The contents and the structure of each data block are shown below.

CR: Carriage Return code
LF: Line Feed code

Type 1	Horizontal angle Vertical angle Slope distance HHD ±####.##.##VVD ±####.##.##SLM +(#)####. ##.(#)[CR+LF]
Type 2	Horizontal angle Horizontal distance Vertical distance HHD ±####.##.##HOM +(#)####.##(#)VEM ±(#)####. ##.(#)[CR+LF]
Type 3	Inst.coordinates X Y Z X0M ±(#)####.##(#)Y0M ±(#)####.##(#)Z0M ±(#)####.##(#)[CR+LF]
Type 4	Measurement point coordinates X Y Z XXM ±(#)####.##(#)YYM ±(#)####.##(#)ZZM ±(#)####.##(#)[CR+LF
Type 5	Horizontal angle Vertical angle HHD ±####.##.##VVD ±####.##.##[CR+LF] or Horizontal angle, Average of horizontal angle, Numbers, V.A.(Average of repeat angle M.) HHD ±####.##.##HAD ±####.##.##RNO ##VVD ±####.##.##[CR+LF]
Type 6	Temperature, Pressure, PPM value, Prism Constant, AIM value TEC ±###PRM ###PPM ±###PSM ±##AIM ###[CR+LF]
Type 7	Instrument Height MZM ##.###[CR+LF]
Type 8	Prism Height PZM ##.###[CR+LF]
Type 9	Status Information STA ABC[CR+LF]

X0M, Y0M, Z0M: Middle letter is Zero.

To be continued on the next page

* (#) is not valid for Tracking measurement mode.

(MSB)	b7	b6	b5	b4	b3	b2	b1	b0 (LSB)	
A:		-	-	-	-	Disp.	Comp.	Vang.	Unit
	On 1			1	1	1″	on	ZO°	Deg
	Off 0	0	0			5″	off	HO°	Gon
B:		-	-	-	-	Ave.	Unit	Coef.	Refr.
	On 1			1	1	3	M	0.14	on
	Off 0	0	0			5	F	0.20	off
C:		-	-	-	-	-	-	Poff	Atm.
	On 1			1	1			on	on
	Off 0	0	0			0	0	off	off

Notes: A,B and C are represented by 8 bits ASCII code.
The top 4 bits are fixed at 3, so that A,B and C are "30" through "3F".

Disp.=Display
Comp.=Compensator
Vang.=Vertical angle
Coef.=Refraction Coefficient
Refr.=Refraction
Poff =Power off
Atm. =Atmosphere

Example: In case STA ??3 is received
A=?(3F) B=?(3F) C=3(33) So that ?=0011 1111 ?=0011 1111 3=0011 0011
Interpreting these figures with the table above, we get the following.

(b3)	(b2)	(b1)	(b0) (LSB)
Angle display unit= 1″	Comp.= ON	Zenith=0°	Angle Unit= Degree
Average number=3	Distance unit= Meter	Comp.Co-efficient	Comp.= ON
		Auto power off= ON	Atmospheric comp.=ON

Comp.=Compensator

2) Input data

Input data means the data which can be sent from external equipment to TS.
The data format should be arranged , then sent to TS.
(If there is an error in the format or header,then TS will return "j".)

Data Item	Data format
1)Temp.Press.P.const.	TEC ±###PRM ###PSM ±##[ETX]
2)Prism constant	PSM ±##[ETX]
3)Inst.coordinates X,Y,Z	XON ±#####.###YOM ±#####.###ZOM ±## ###.###[ETX]
4)Inst.Height	MZM ##.###[ETX]
5)B.S.coordinates X,Y,Z	X1M ±#####.###Y1M ±#####.###Z1M ±## ###.###[ETX]
6)T.P.coordinates X,Y,Z	XXM ±#####.###YYM ±#####.###ZZM ±## ###.###[ETX]
7)Prism Height	PZM ##.###[ETX]
8)Horizontal angle	HHD ±0###.##.##[ETX]
9)S.O.distance	
Horizontal distance	HSM +#####.###[ETX]
Slope distance	SSM +#####.###[ETX]
10)V.D. Z coordinates	VSM ±#####.###ZSM ±#####.###[ETX]
11)X,Y coordinates	XSM ±#####.###YSM ±#####.###[ETX]

Temp.=Temperature Press.= Pressure P.const.= Prism constant
Inst.=Instrument V.D. = Vertical Distance S.O. = Stake Out
B.S. =Back sight T.P. = Target Point

3-4. Data header

The attributes of TS data are determined by an identifier.
This identifier is called the header.

Item ＼ Unit	(DEG)	(GRAD)
Horizontal angle	HHD	HHG

Unit / Item ＼	Zenith θ DEG	Horizontal θ DEG	Zenith θ GRAD	Horizontal θ GRED
Vertical angle	VDD	VHG	VDG	VHG

Item ＼ Unit	(m)	m/AV	(f)	f/AV
Slope distance	SLM	SAM	SLF	SAF
Horizontal distance	HOM	HAM	HOF	HAF
Vertical distance	VEM	VAM	VEF	VAF
X coordinate	XXM	XAM	XXF	XAF
Y coordinate	YYM	YAM	YYF	YAF
Z coordinate	ZZM	ZAM	ZZF	ZAF

Item＼Unit	° C	° F
Tempera-ture	TEC	TEF

Item＼Unit	mmHG	Inch
Pressure	PRM	PRI

Item ＼ Unit	m	f
XO coordinate	XØM	XØF
YO coordinate	YØM	YØF
ZO coordinate	ZØM	ZØF
F.S.X.coordinate	XSM	XSF
F.S.Y.coordinate	YSM	YSF
F.S.Z.coordinate	ZSM	ZSF
B.S.X.coordinate	Z1M	X1F
B.S.Y.coordinate	Y1M	Y1F
B.S.Z.coordinate	Z1M	Z1F

Item ＼ Unit	m	f
S.O.value(HOR)	HSM	HSF
S.O.value(SLP)	SSM	SSF
S.O.value(VER)	VSM	VSF
S.O.value(X)	XSM	XSF
S.O.value(Y)	YSM	YSF
S.O.value(Z)	ZSM	ZSF
IP Inst.height	MZM	MZF
FS Prism height	PZM	PZF

Item	
P Const. (mm only)	PSM
T/P correction	PPM
Light value	AIM

3-5. key Code Format(pXX)

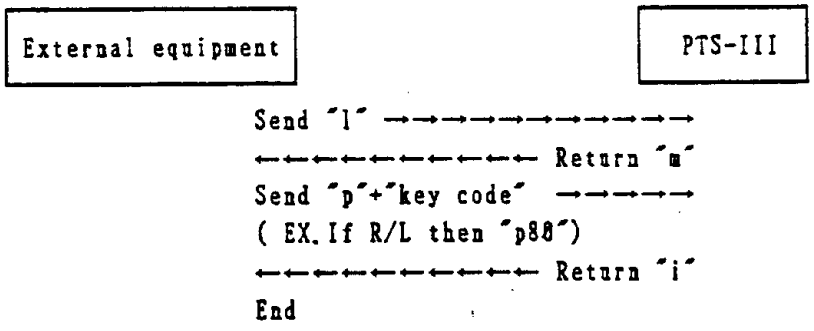
By sending specific series of character code to TS from external equipment, it is possible to control the operation mode of TS as if the TS keyboard were being operated. These control character codes are called "Key-code" and are composed of three characters of which first character starts from "p".
The two remaining characters are defined according to the table below.

XX	Corresponding PTS-III key	XX	Corresponding PTS-III key
00	TR(High speed)	70	Angle display
01	TR(Medium speed)	80	Left/right turn
10	[Exit special measurement]	90	Double angle
11	ROM — Special measure-	:0	Hold
12	TRV — Special measure-	;0	Measured distance average (Input)
13	INV — Special measure-	<0	LAMP
14	REM — Special measure-	=0	0 set
20	Temp./Press.	>1	HOR/H mode — Hor./Slope/ Ver.
30	Stake Out	>2	SLP/Z mode — Hor./Slope/ Ver.
40	Coordinate	>3	VER/Z mode — Hor./Slope/ Ver.
50	Inst. coordinate	?0	Measuring distance
60	Angle setting		(ex)High speed TR=send "p00"

Example: "p00" activates TS to start high speed Tracking measurement.

3-6. TS mode control protocol

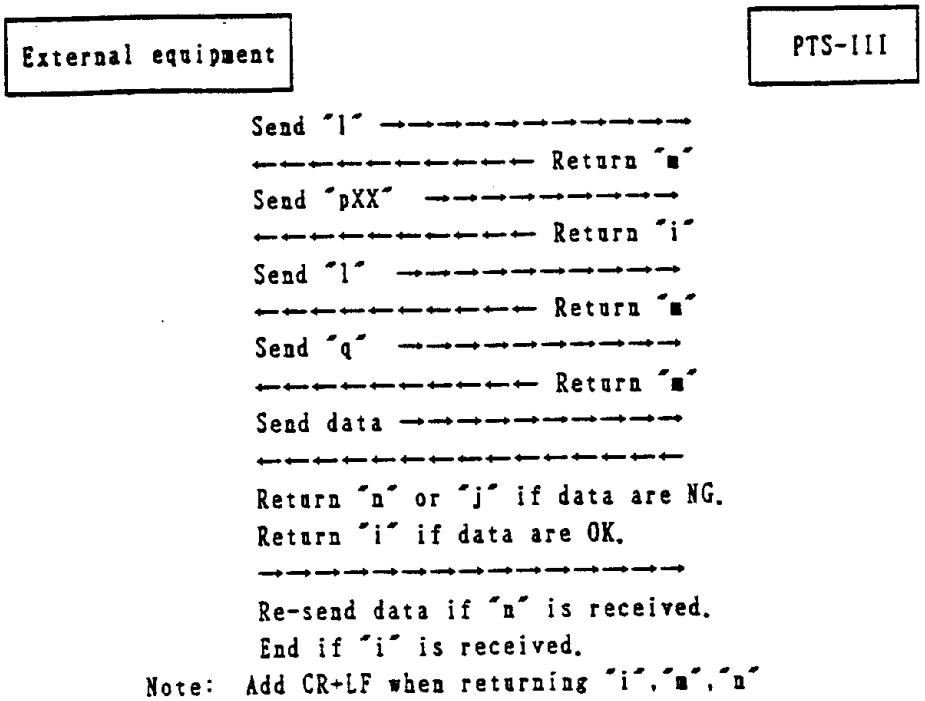
1. Mode Switching



1) After TS receives "1", it sends "m"

2) Next, TS receives "pXX", then it sends "i" and enters the mode.
(TS sends "j" when there is a character or code error.)

2. Data setting



Note: Add CR+LF when returning "i","m","n"

1) After TS receives "l", it sends "m".
2) TS receives "pXX", then sends "i" and enters the mode.
3) After TS receives "l", it sends "m"
4) TS receives "q", then sends "m" and it waits for data.
5) TS receives "data", then it sends "i"if data are OK
   and it sends "n" or "j" if data are NG.

(Data NG): If the minimum unit does not match during angle data input then "n" is sent. Other case; "j" is sent.

4 Data Block Format Which is Output from the TH-E

Type 1 data (during normal measuring)

HHD +####.##.##VVD +####.##.##CR/LF

Type 2 data (during repeat measuring)

HHD +###.##.##HAD +####.##.##RNO ##VVD +####.##.##CR/LF

Note: However, output data format completely depends on the operative condition of the TH-E. For example, in case the TH-E displays "ERROR" by some reason, data will not be output with the above format. These cases will be shown below. External device has to receive data, assuming these condition.

1) Type 1 (normal measuring mode)

TH-E

V 102.32.50 D (Normal condition)

H 357.48.40 D

Computer

(e) ↑ ↓

HHD +####.##,##VVD +####.##.##CR/LF

V 102.32.50 D (Horizontal angle error, compe slope)

TILT OVER LENGE

(e) ↑ ↓

VVD +####.##.##CR/LF

V 0 DETECT (Condition of vertical angle display being halted)

H 357.48.40 D

(e) ↑ ↓

HHD +####.##,##CR/LF

2) Type 2 (Repeat measuring mode)

```
3   28.10.20 D                    (Normal condition)

RH 142.40.50 D
↑  |
(e) ↓
   HHD +####.##.##HAD +####.##.##RNO ##VVD +####.##.##CR/LF
```

```
V   79.50.10 D                    (Horizontal angle error)

RH OVER SPEED
↑  |
(e) ↓
   VVD +####.##,##CR/LF
```

```
3   28.10.20 D                    (In case an error in vertical angle occurs.)

RH 142.40.50 D
↑  |
(e) ↓
   HHD +####.##,##HAD +####.##.##RNO ##CR/LF
```

Note; In this case, as the LCD of the TH-E displays horizontal angle average value in the upper and cummulative angle in the lower, the LCD does not display "ERROR" even though an error occurs in vertical angle. This is, if vertical angle data does not come out after the data request in this mode, some error in vertical angle is judged to occur.