1. GENERAL

1.1 SCOPE

This specification covers the requirements for " Hybrid-GP with Keyboard"
(ALPS Glidesensor(GS) , Pentablet (PT) and Keymatrix controller)

The following sentences are called HGPK .

1.2 OUTLINE

ALPS Pen-GP consists of two sensor (capacitive (GS) and resistive (PT)) and Keymatrix.

GS (Capacitive sensor) of HGPK provides cursor control by detecting finger or thumb movement in using a technique known as field distortion sensing.

PT (Resistive sensor) of HGPK provides detecting Pen movement by handwriting input load in resistive analog tablet.

Keyboard of 8 x 16 key matrix ON/OFF sensing .

1.3 SYSTEM REQUIREMENTS CONDITION

HGPK requires to be connected to system with PS/2 mouse and PS/2 keyboard interface .

2. ENVIRONMENTAL CONDITION

2.1 TEST CONDITIONS

Test and measurements shall be made in the following standard conditions unless otherwise specified:

Temperature	20±15℃
Relative Humidity	65±20% R.H.
Pressure	860 to 1060 hPa [mbar]

In case any question arises from the judgment made, tests shall be conducted in the following conditions:

Temperature	20±2℃
Relative Humidity	65±5% R.H.
Pressure	860 to 1060 hPa [mbar]

2.2 OPERATING CONDITIONS

Operating Temperature	0 to 50℃
Operating Humidity	5 to 95% R.H. (non-condensing)
Storage Temperature	-20 to 60℃
Storage Humidity	5 to 95% R.H. (non-condensing)

3. THE OPERATING PRINCIPLE

3.1 STRUCTUREHGPK consists of the following parts.

Fig.1

3.2 DIAGRAM HGPK electrical constitution is as follows.

Fig.2

Fig.1 Structure

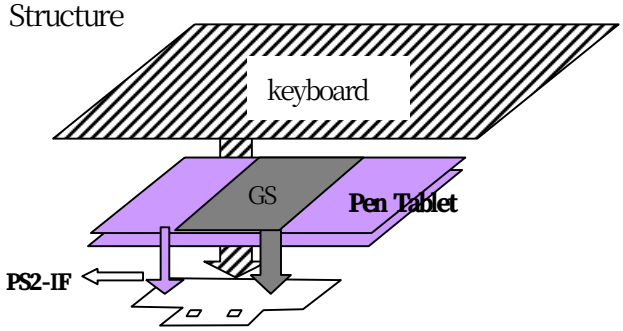
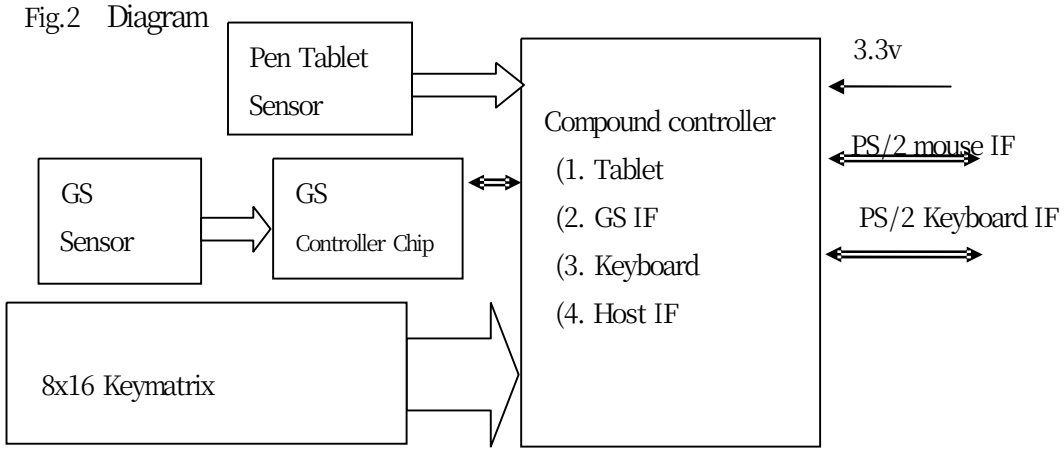


Fig.2 Diagram



4. SPECIFICATIONS

PHYSICAL SPECIFICATIONS

4.1.1.	DIMENSIONS	Shall conform to the product drawing.
4.1.2.	WEIGHT	50g max. (Circuit board & Sensor sheet)
4.1.3.	MOUNTING DIRECTION	Shall conform to the product drawing.

5. INFORMAL WORD

Pen Tablet	: PT
Glide Sensor	: GS
Glidesensor with Pentablet	: GS+PT

6. ELECTRICAL SPECIFICATIONS

6.1.1. SUPPLY VOLTAGE
3.3±0.3v DC

DC PROPERTY

Item	Symbol	Spec.			Unit	Condition
		Min.	Typ.	Max.		
Power voltage	VDD	3.0	—	3.6	V	
Power ripple	VRIP	—	—	100	mVp-p	—
"L" level output voltage	VOL	—	—	0.5	V	VDD=3.3V IOL=2mA
"H" level input voltage	VIH	2.7	—	3.3	V	VDD=3.3V
"L" level input voltage	VIL	0	—	0.5	V	VDD=3.3V
Power Consumption	ICC	—	6.0	11.0	mA	Run VDD=3.3V Ta=25℃

6.1.2. INTERFACE Connector pin assignment and signal definition are as follows.

Pin No.	Signal	Contents
1	VDD	+3. 3V
2	KB-DAT	PS/2 DATA Keyboard
3	KB-CLK	PS/2 CLOCK Keyboard
4	GND	Signal Ground
5	MS-DAT	PS/2 DATA Mouse
6	MS-CLK	PS/2 CLOCK Mouse

7. Firmware

7.1 Firmware Update History

Firmware Number	Date	Reference	Page
FM-A621A	2006/10/5	It changed to Hybrid-GP002B(20060710) as follows. It changes the controller for the keyboard support. Device ID change 67h 00h 0Ah => 67h 00h 14h It changes resolution by the size change of the pen tablet. 200cpi=>165cpi of pen tablet. The coordinates point is clarified. Support of keyboard matrix of 8x16.	--- --- Page 11 Page 6 Page 14 Page 19-27
	2006/10/13	The data loss might occur when host's reading is slow when continuously operating it. This trouble was corrected.	---
FM-A621B	2006/11/27	Device ID change 67h 00h 14h => 67h 00h 28h Both mode (GP and PT) cut Simultaneous mode cut GS sensor X axis Offset= +300 => Offset=0	Page 11 Page 10-13 Page 14
	2007/1/5	Keymatrix I/O Latch-up is protected. (The I/O port is refreshed.)	---
FM-A621B1	2007/2/9	ESD protected	---
FM-A621C	2007/2/24	Device ID change 67h 00h 28h => 67h 00h 3Ch Command addition Sensor calibration execution Automatic calibration setting Ena/Dis Pointing Device disable at Key operation Transmission of ALL-OFF code	Page 11 Page 13～14

7.2. Basic operation specification

7.2.1 ACCURACY OF PT

Linearity : ±10%

Resolution : 165cpi ±10 %

7.2.2 ACCURACY OF GS

Linearity : ±10%

Resolution : 200cpi ±10%

7.2.3 KEY SCAN SPEED

The scanning speed of the key matrix of 8X16 is usually done with 32mSec.

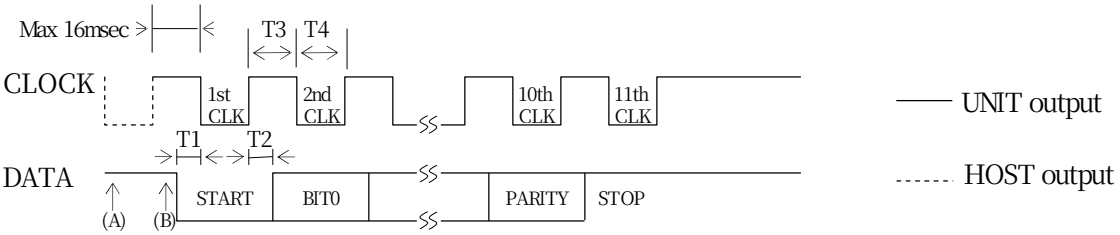
7.2.4 PROTOCOL(KB-DAT,KB-CLK , MS-DAT, MS-CLK)

DATA STREAM STRUCTURE

START bit : 1bit ("L" level) DATA bit : 8bit (bit7=MSB, bit0=LSB)

PARITY bit : 1bit (ODD parity) STOP bit : 1bit ("H" level)

A) DATA TRANSMITTING TIMING

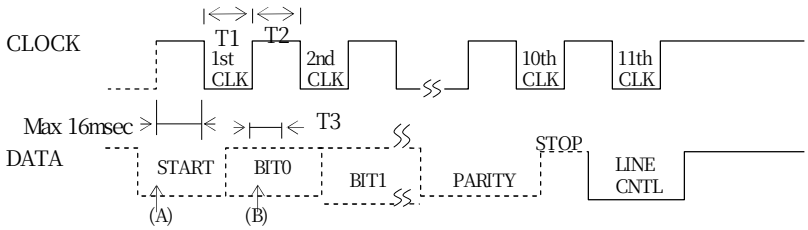


(UNIT: µSec)

	MIN.	MAX.
T1: Time from DATA transition to falling edge of CLOCK.	5	25
T2: Time from rising edge of CLOCK to DATA transition.	5	25
T3: Time of CLOCK Low.	30	50
T4: Time of CLOCK High.	30	50

NOTE (1) (A) HGPK checks the CLOCK line. When CLOCK line level is low, it does not transmit.
(2) (B) When CLOCK line is High, DATA line is High and HGPK has output-data, HGPK starts transmitting data to the system.

B) DATA RECEIVING TIMING



(UNIT: µSEC)

	MIN.	MAX.
T1:Time of CLOCK Low.	30	50
T2:Time of CLOCK High.	30	50
T3:Sampling position	10	30

NOTE (1) (A) When the system changes the CLOCK line from Low to High (triggered rising edge) and the DATA line is held as Low level, HGPK starts receiving CLOCK.
(2) (B) HGPK gets sampling data during CLOCK High.

There are a mouse specification and a keyboard specification.

The GS+PT(mouse) specification : on page 6
The keyboard specification : on page 19

- -

7.3. GS+PT (Mouse) Specification

7.3.1 POWER ON OPERATION

1) Operation at Power On

On resetting (after Power-ON reset), the HGPK performs a series of processes internal-initialization, self test (diagnostics), and sensor correction. If it has no problem, 1.0±0.2 seconds after the HGPK startup, it sends "AA," and "00" to the host.

If the sensor correction process has not been completed, the HGPK repeats corrective process until it is completed and at this point, it sends "AA" and "00" to the host.

It permits the host to enter a command 600ms. approx. after startup, whether sensor corrective process has been completed or not.

2) Starting to Produce an Operation Data Output

After startup, the HGPK remains inoperative for approximately 1.5 seconds to provide time for sensor adjustment, stabilization and other corrective processes.

If the operator operates the HGPK during this period, erratic data could be produced for tens of seconds. For this reason, the operator must not attempt to move it for 1.5 seconds or so immediately after turning the Power ON.

7.3.2 OPERATION MODE

The HGPK has the following four operating modes which are selected by the commands described later.

A) RESET MODE

A-1. CONDITIONS TO SWITCH TO RESET MODE

Power on or Receiving reset command

A-2. DESCRIPTION

When HGPK is changed to the reset mode, it executes self-test and is set in following default setting.

SAMPLING RATE	:12msec
SCALING	: 1:1
MODE	: stream mode
RESOLUTION	: (PT) 165 cpi
	: (GS) 200 cpi
DISABLE / ENABLE	: DISABLE

After initialization is completed, HGPK transmits completion code of AAh 00h.

B) STREAM MODE

In this mode, the HGPK sends out data by itself whenever a travel data is registered. When a data of more than a single count is produced within the HGPK, or a change in the switch on/off takes place, the HGPK sends data to the host. Following the data transmission, the cumulative counter is reset. However, while it is set to the disable status, the HGPK will not send any data.

C) REMOTE MODE

In this mode, the HGPK sends out data on demand of a data request command, it does not start up data transmissions by itself.

D) WRAP MODE

It is the communication channel acknowledge mode. The HGPK echoes back the code it has received as it is in this mode. In response to a reset or reset wrap command, however, it does not echo back but escapes from this mode.

7.3 COMMANDS

[FA] ACK

HGPK returns this command to the system when it receives any valid command except the resend command.

[FF] RESET

This command causes the HGPK to enter the reset mode.

[FE] RESEND

When HGPK receives this command, it transmits the last data packet.
And if HGPK receives an invalid command, it returns this command to the system.

[F6] SET DEFAULT

This command causes the HGPK to reinitialize, same as reset command.

[F5] DISABLE

When HGPK is in stream mode, this command stops the transmission of data.

[F4] ENABLE

When the HGPK is in stream mode, this command starts transmission.

[F3 xx] SET SAMPLING RATE

In the stream mode, this command sets the sampling rate of the HGPK .
Valid sampling rates are as follows.

SECOND BYTE [xx]	SAMPLING RATE (simultaneous mode) mSsec
[0A]	12 (16)
[14]	12 (16)
[28]	12 (16)
[3C]	12 (16)
[50]	12 (16)
[64]	12 (16)
[C8]	12 (16)

[F2] READ DEVICE TYPE

HGPK returns [00] when it receives this command.

[F0] SET REMOTE MODE

This command switches the HGPK to remote mode.

[EE] SET WRAP MODE

This command switches the HGPK to wrap mode.

[EC] RESET WRAP MODE

The command switches the HGPK back to it's pre-wrap mode.

[EB] READ DATA

This command causes the HGPK to transmit the following data packets.

In the stream mode, HGPK transmits same data packets.

Negative count data is expressed in binary 2's complement number.

BYTE	BIT	DESCRIPTION
3	7～0	Y direction count data BIT 0 is LSB
2	7～0	X direction count data BIT 0 is LSB
1	7	Y count data overflow 1=overflow
	6	X count data overflow 1=overflow
	5	Y count data sign 1=negative
	4	X count data sign 1=negative
	3	1
	2	0
	1	0=right switch (SWR) not pressed 1=right switch pressed
	0	0= left switch (SWL) not pressed 1=left switch pressed

[EA] SET STREAM MODE

This command sets HGPK to the stream mode.

[E9] STATUS REQUEST

HGPK transmits 3 bytes status report as follows.

BYTE	BIT	DESCRIPTION
3	7～0	Current sampling rate BIT 0 is LSB
2	7～0	Current resolution BIT 0 is LSB
1	7	0
	6	1=remote mode 0=stream mode
	5	1=enabled 0=disabled
	4	1=scaling 2:1 0=scaling 1:1
	3	0
	2	1=left switch (SWL) pressed 0=left switch not pressed
	1	0
	0	1=right switch (SWR) pressed 0=right switch not pressed

[E8 xx] SET RESOLUTION

Even if HGPK receives these command and parameter, internal resolution of HGPK is not changed.

[E7] SET SCALING TO 2:1

Even if HGPK receives this command, the count data is not converted.

[E6] RESET SCALING TO 2:1

Even if HGPK receives this command, the count data is not converted..

7. 4 SPECIFICATION OF OPERATING MODE

HGPK has two-operation mode, which are Mouse mode and Advanced mode.
In case of using the Device Driver, the HGPK takes behavior in Advanced mode by receiving particular commands from the system.

(1) Mouse mode

1) After Power on reset or received FFh (reset) command, GS outputs the data by the following format.

BYTE	BIT	DESCRIPTION
3	7～0	Y direction count data BIT 0 is LSB
2	7～0	X direction count data BIT 0 is LSB
1	7	Y count data overflow 1=overflow
	6	X count data overflow 1=overflow
	5	Y count data sign 1=negative
	4	X count data sign 1=negative
	3	1
	2	0
	1	0=right switch (SWR) not pressed 1=right switch pressed
	0	0=left switch (SWL) not pressed 1=left switch pressed

(2) Advanced mode

Since the HGPK received the transition command to the Advanced mode, HGPK outputs the count data by using the following format.

DATA STREAM STRUCTURE : Same as PS/2 format

DATA TRANSMITTING TIMING : HGPK outputs 6 bytes data every 12msec.

In this mode, HGPK does not follow the Set Sampling Rate command from the host system.

1) Data format of PT in Advanced mode

6 byte data : CF xx xx xx xx xx

	B7	B6	b5	B4	b3	B2	b1	b0
Byte1	1	1	0	0	1	1	1	1
Byte2	0	X6	X5	X4	X3	X2	X1	X0
Byte3	0	0	X9	X8	X7	*	PT-DSW	0
Byte4	0	Y9	Y8	Y7	1	0	SWR	SWL
Byte5	0	Y6	Y5	Y4	Y3	Y2	Y1	Y0
Byte6	0	Z6	Z5	Z4	Z3	Z2	Z1	Z0

Byte3 bit0 GS-DSW => 0 *B ver

2) Data format of GS in Advanced mode

6 byte data : FF xx xx xx xx xx

	B7	B6	b5	B4	b3	b2	b1	b0
Byte1	1	1	1	1	1	1	1	1
Byte2	0	X6	X5	X4	X3	X2	X1	X0
Byte3	0	X10	X9	X8	X7	*	GS-DSW	PT-DSW
Byte4	0	Y9	Y8	Y7	1	0	SWR	SWL
Byte5	0	Y6	Y5	Y4	Y3	Y2	Y1	Y0
Byte6	0	Z6	Z5	Z4	Z3	Z2	Z1	Z0

SWL (left button) :1=ON 0=OFF SWR (right button) : 1=ON 0=OFF

PT-DSW : Touch :1=ON Z=7F PT-DSW: Lift : 0=OFF Z=00

GS-DSW : Touch :1=ON GS-DSW: Lift : 0=OFF

X10 - X0 : X coordinates (X10=MSB)

Y9 - Y0 : Y coordinates (Y9=MSB)

Z6 - Z0 : Z value (Z6=MSB) (Z4,Z5,Z6=0)

* : Reserved (0)

3) ~~Data format of GS & PT (simultaneous mode) in Advanced mode~~ *B ver

9byte data : EB xx xx xx xx xx xx xx xx

	B7	b6	b5	B4	b3	b2	b1	b0
Byte1	1	1	1	0	1	0	1	1
Byte2	0	GX6	GX5	GX4	GX3	GX2	GX1	GX0
Byte3	0	GX10	GX9	GX8	GX7	PX9	PX8	PX7
Byte4	0	GY9	GY8	GY7	1	*	GS-DSW	PT-DSW
Byte5	0	GY6	GY5	GY4	GY3	GY2	GY1	GY0
Byte6	0	GZ6	GZ5	GZ4	GZ3	GZ2	GZ1	GZ0
Byte7	0	PY9	PY8	PY7	1	*	SWR	SWL
Byte8	0	PY6	PY5	PY4	PY3	PY2	PY1	PY0
Byte9	0	PX6	PX5	PX4	PX3	PX2	PX1	PX0

SWL(left button) :1=ON 0=OFF

SWR(right button) :1=ON 0=OFF

PT-DSW: Touch :1=ON

PT-DSW: Lift :0=OFF

GS-DSW : Touch :1=ON

GS-DSW : Lift :0=OFF

GX10 - GX0 : GS X coordinates (X10=MSB)

GY9 - GY0 : GS Y coordinates (Y9=MSB)

GZ6 - GZ0 : GS Z value (Z6=MSB)

PX9 - PX0 : PT X coordinates (PX9=MSB)

PY9 - PY0 : PTY coordinates (PY9=MSB)

* : Reserved

In case of receiving RESET command (FFh) in Advanced mode, the HGPK changes the operating mode of itself to Mouse mode.

7.5 SPECIFICATION OF EXTENDED FEATURE

When HGPK is used with Advanced Device Driver, the following functions can be achieved.

1) Device ID

ALPS Device ID

E7,E7,E7,E9 ← 67 00 3C (GS+PT+ Keyboard) <= Device ID *C ver

(E7,E7,E7,E9 ← 67 00 28 (GS+PT+ Keyboard) <= OLD Device ID) *B ver

(E7,E7,E7,E9 ← 67 00 14 (GS+PT+ Keyboard) <= OLD Device ID) *A ver

(E7,E7,E7,E9 ← 67 00 0A (GS+PT) <= OLD Device ID)

2) Operating mode

2-1) Advanced mode

When HGPK receives below commands HGPK changes operating mode to Advanced mode.

F5h,F5h,F5h,F5h Set HGPK Advanced mode

2-2) Mouse mode

After Power on reset or received FFh command HGPK sets operating mode to Mouse mode.

3) Data transmitting Enable/Disable

Data transmitting of PT and GS can be individually set in Enable or Disable.

In a word, this product has the following operation modes.

Only PT

Only GS (Default setting)

~~Both PT and GS (Default setting)~~ *B ver

3-1) Only PT

When the HGPK receives below commands PT is set to transmitting enable and PT is set to transmitting enable.

GS sensing Stop at this mode.

F5 : Disable

F2h,F2h,F2h,E7h : PT transmitting Enable

3-2) Only GS

When the HGPK receives below commands PT is set to transmitting disable and GP is set to transmitting enable.

PT sensing Stop at this mode. *B ver

However, only On/Off of the Pen is detected.

When the pen is operated excluding the detection area of GS, the coordinate data of GS transmits data as ORG point (X= 0, Y=0) .

F5 Disable

F2h,F2h,F2h,E6h : GS transmitting Enable

3-3) ~~Both GP and PT~~ *B ver

When the HGPK receives below commands both GS and PT are set to transmitting enable.

F2,F2,F2,E8,00 (default) GS First Priority mode

F2,F2,F2,E8,01 PT First Priority mode

F2,F2,F2,E8,02 GS-PT simultaneous mode (*note1)

F4h Both Enable

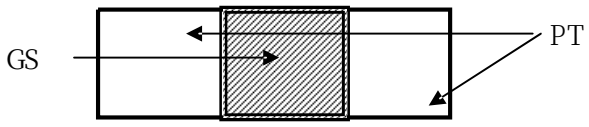
~~*note1) packet data are output every 16msec (sampling rate)~~

4) [F2,F2,F2,E9] Advanced Mode STATUS REQUES

HGPK transmits 3 bytes status report as follows.

BYTE	BIT	DESCRIPTION
3	7～0	Current GS or PT select Mode 14-Only PT 28-Only GS
2	7～0	** don't care
1	7	0
	6	*(reserved)
	5	1=enabled 0=disabled
	4	1=advanced mode 0=Normal
	3	0
	2	*(reserved)
	1	0
	0	*(reserved)

5) Button setting



Performance table

Device Driver setting	Pen Tablet Axis	PT-DSW	Glide Sensor Axis	GS-DSW	SWL SWR
Only PT	Enable	Enable	Disable	Disable	Enable
Only GS	Disable	**Enable**	Enable	Enable	Enable
Both PT+GS	Enable	Enable	Enable	Enable	Enable

* Both mode Cut * B ver

6) Sensor calibration execution command * C ver

When Power-up is done, do the self adjustment of the GS sensor of HGPK(OLPC).
When the operation side of GS is touched by the finger at this time
or the coin etc. are put, a wrong adjustment is done.
It is a command that correctly does this correction.
When this command is executed, it is necessary to display the message such as
"Please do not touch the GS sensor".
About 150mSec communication stops when this command is executed.
(The time to save the correction value is necessary though time not touching is about 50mSec.)

HGPK enters the state of Disable after it executes it.
It is necessary to send enable command (F4h).

F5 F5 E6 F5 : Calibration execution.

ex. F5 (FA) F5(FA) E6(FA) F5(FA) (150msecWait) F4(FA) 。

The same operation as the command execution is done by pushing the following
four keys (It is in the corner) besides the command at the same time.

Esc(key No. 110) + Frame(129) + -> (89) And, Fn(59).
The Fn key is pushed at the end though the order of three keys is not provided.

7) Automatic calibration setting command Enable/Disable * C ver

This command sets whether to do the calibration automatically when the following states are generated.
a. The high-speed operation not generated in the normal operation when continuing.
b. When you continuously generate the same position for ten seconds or more.

When the operation not generated is generated, calibrastion is compulsorily done usually.
HGPK enters the state of Disable after it executes it.
It is necessary to send enable command (F4h).

F5 F5 E7 F5 : Automatic calibration is enable.
F5 F5 EA F5 : Automatic calibration is disabled. (Defult setting)

ex. F5(FA) F5(FA) E7(FA) F5(FA) F4(FA)

8) **Automatic** Pointing disable at Key operation **(Enable/Disable) * C ver**

Setting that does pointing Device without can use when keyboard is operated
There is a problem that the cursor moves when the finger is brought close to GS sheet when the keyboard is operated.
It is a function to prevent this.
It operates as follows when setting it to enable.
When the key to the keyboard is operated, the operation detection of pointing (GS,Pen) is stopped for about one second.
It is time when operate of the key occurs the change in on-off as for the key.
The detection of the pointing device stops continuously when the key is operated continuously (interval within one second).
It doesn't function when it keeps continuously pushing the key.
This intends the case where GS is operated while pushing shift key and ctrl key, etc.
After the operation stabilizes (In one second), the operation becomes possible. (All keys are objects.)
HGPK enters the state of Disable after executing this command.
It is necessary to send enable command (F4h).

F5 F5 EC F5 : Automatic GS sensor stop is enable.
F5 F5 F0 F5 : Automatic GS sensor stop is disable. (Defult setting)

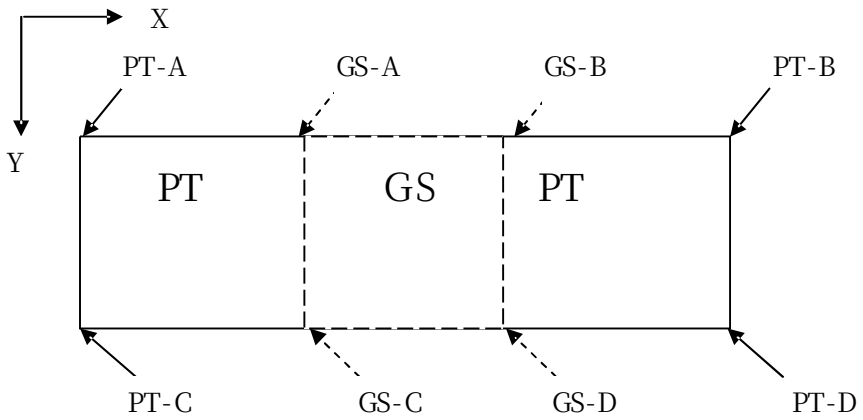
ex. F5(FA) F5(FA) EC(FA) F5(FA) F4(FA)

9) Transmission of ALL-OFF code * C ver

When GS or Pen of HGPK(OLPC) is operated, and the operation is ended
The data packet of GS-DSW or PT-DSW =0 is transmitted twice.
The purpose of this function is to prevent the loss as for the
packet of the turning off code.

7.6 Coordinates point

X axis and Y axis point



PenTablet point

PT-A : X=0 ,Y= 0 PT-B : X=999, Y=0

PT-C : X=0 ,Y= 239 PT-D : X=999, Y=239

GS sensor Point

~~GS-A: X=300 (0+300) ,Y=0 GS-B : X=699(399+300) , Y=0~~

~~GS-C: X=300 (0+300) ,Y=290 GS-D: X=699(399+300) ,Y=290~~

GS-A: X=0 , Y= 0 GS-B : X=399 , Y= 0

GS-C: X=0 , Y=290 GS-D : X=399 ,Y=290

Note.

~~a. X axis of the GS sensor reaches the value +300 offsets.~~ *B ver

b. The coordinate value is a theory value.
The error margin of 5% happens by the numerical value.

7.7 ERROR HANDLING

The HGPK transmits a Resend command [FE] when it receives an invalid command.
If HGPK receives 2nd invalid commands as soon as receives 1st invalid command, then it returns [FC] to the system.

7.8.1 GS ACTIVE AREA

When user finger touches the surface of the module GS active area, XY data will be transferred from the module. XY data is valid if user fingerprint is inside of active area.

7.8.2 PT ACTIVE AREA

When user writes (inputs) the surface of the module PT active area with pen (2.5N static load from vertical direction), XY data will be transferred from the module.

7.8.3 DEFINITION OF LINEARITY , RESOLUTION

7.8.3.1 LINEARITY OF GS

< Definition of the linearity >

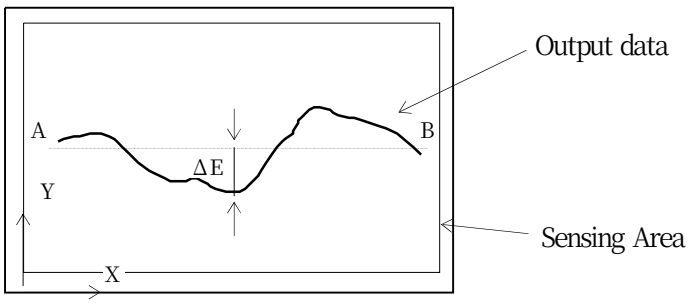


Fig.1 Definition of the Linearity

Measuring GS output data when a conductor connected with GND is traced a straight line AB which is parallel to X(Y) direction.

ΔE is the difference between output data and Line AB.

Linearity of X(Y) direction is expressed by the following equation.

Linearity = ΔE/AB

< Measuring method of the Linearity >

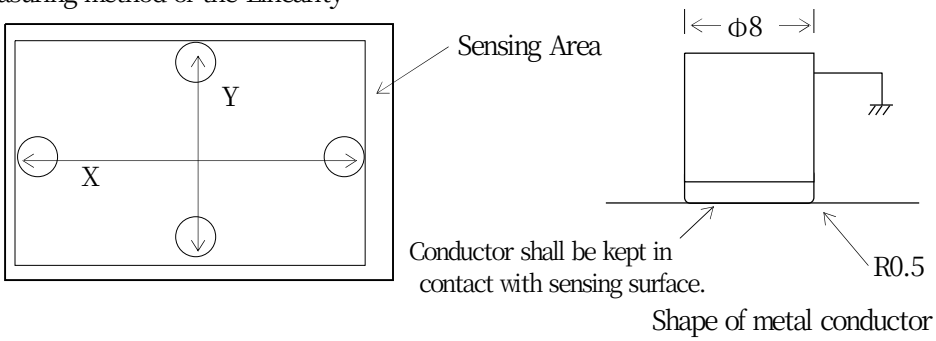


Fig.2 Measuring method of the Linearity

Measuring GS output data when a metal conductor traces straight lines to X and Y direction from center of sensing area at velocity of 25±5mm/sec, and calculating with the following expression.

Linearity of X(Y) direction (%)

= output counts of Y(X) direction / output counts of X(Y) direction × 100

7.8.3.2 RESOLUTION OF GS

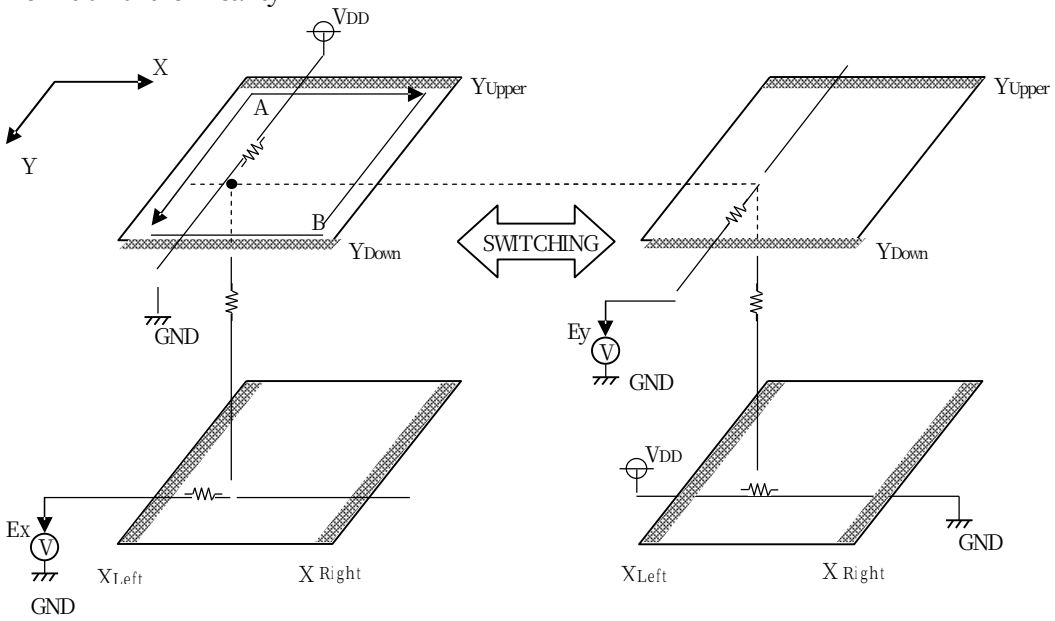
In case of the same measuring method as item 3.1.3, resolution of X(y) directions is expressed by the following equation.

Resolution of X(Y) direction(cpi)

= output counts of X(Y) direction / conductor movement of X(Y) direction (mm) ×25.4

7.8.3.3 LINEARITY OF PT

< Definition of the linearity >



* The voltage impresses VDD (D.C 3.3V) between electrode of the X-axis and Y-axis direction. The voltage aspect to impress changes it by a time sharing circuit.
* It inputs it continuously like the lattice on range of inspection enclosed between A-B. It measures voltage (Ex, Ey) of input point and non-voltage impression side.
* I input an inspection range surrounded between A-B in the shape of a lattice consecutively and measure the input point and the voltage (Ex, Ey) of a non-voltage aspect to impress.
* The output voltage to each measurement position is plotted.
△Ex and △Ey are assumed to be a difference between lattice voltage that encloses it between A-B and output voltage at the same position.
* The linearity of X(Y) direction of PT is ratio of the voltage difference between Ex, Ey, and A-B (ExA-B and EyA-B).

< Definition of the linearity >

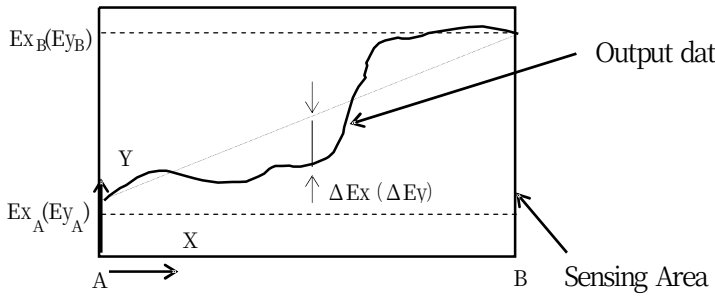


Fig.3 Definition of the Linearity

< Measuring method of the Linearity >

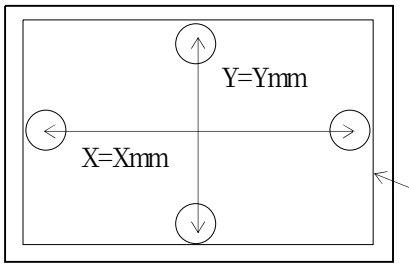


Fig.4 Measuring method of the Linearity

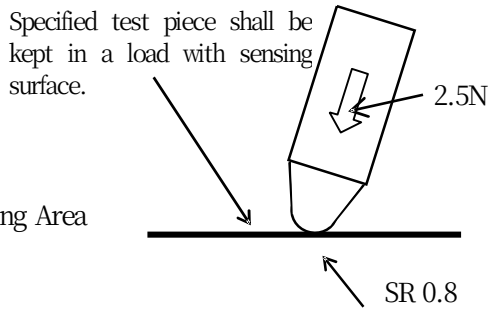


Fig.5 Shape of Specifed Test piece

Linearity of X-axis direction = $(\triangle Ex / \triangle Ex_{A-B}) \times 100$ [%]

Linearity of X-axis direction = $(\triangle Ey / \triangle Ey_{A-B}) \times 100$ [%]

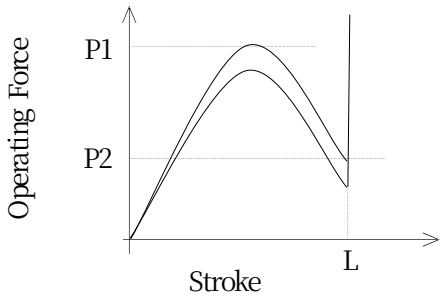
7.8.3.4 RESOLUTION OF PT

In case of the same measuring method as item 3.1.3, resolution of X(y) directions is expressed by the following equation.

Resolution of X(Y) direction(cpi)

= output counts of X(Y) direction / conductor movement of X(Y) direction (mm) ×25.4

7.9.1 SWL ,SWR SPECIFICATIONS

Item	Conditions	Specifications
7.9.1.1 SW Operating Force	SWL, SWR Push the center of TACT SWs.  Fig.5 Operating Force	SWL, SWR P1= 1.57±0.5N [160±50gf]
7.9.1.2 Stroke	Same as Item 7.9.1.1.	SWL, SWR L=0.25+0.2/-0.1mm

8. Keyboard Specification

8.1.1 Keyboard inputs the data (Host to Keyboard)

When the system sends data to the keyboard, it forces the `DATA` line to an inactive level and allows the `CLOCK` line to go to an active level. When the keyboard sends data to, or recieved data from the system, it generates the `CLOCK` signal to time the data.

8.1.2 Keyboard outputs the data (Keyboard to Host)

When the keyboard has any data and `CLOCK` and `DATA` are an active level, a keyboard sends data to the host.

8.1.3 Interruption of the data transfer

The system can prevent the keyboard from sending data by forcing the `CLOCK` line to an inactive level; the `DATA` line may be active or inactive during this time.

8.2. System Commands

The keyboard responds within 20 milliseconds, except when performing the BAT, or executing a Reset command.

8.2.1 Reset (FF Hex)

The keyboard shall send ACK command after receipt of the RESET command.
The system signals acceptance of ACK by raising the `CLOCK` and `DATA` lines high for a minimum of 500mSec.
The keyboard is disabled from the time it receives the Reset command until ACK is accepted,
or until another command is sent that overrides the previous command.
Following acceptance of ACK, the keyboard is reinitialized and performs the BAT. After returning the completion code, the keyboard defaults to scan code set 2.

8.2.2 Resend (FE Hex)

The keyboard shall re-transmit the code which has been sent to the system most recently.
(unless the previous output was Resend command, in which case the keyboard
sends the last byte before the Resend command.)

8.2.4 Set Default (F6 Hex)

The keyboard responds with ACK, clears its output buffer, sets the typamatic rate/delay,
clears the last typamatic key, and continues scanning.

8.2.5 Default Disable (F5 Hex)

The keyboard responds with ACK, clears its output buffer, sets the typamatic rate/delay,
clears the last typamatic key, and scanning is halted awaiting further commands from the system..

8.2.6 Enable (F4 Hex)

The keyboard responds with ACK, clears its output buffer, clears the last typamatic key, and starts scanning.

8.2.7 Read ID (F2 Hex)

The keyboard responds with ACK, and sends the two keyboard ID bytes.

8.2.8 Echo (EE Hex)

The keyboard responds with "Echo". This is a diagnostic aid.

8.2.9 Scan Code Select (F0 Hex + xx Hex)

This command instructs the keyboard to select one of two sets of scan codes.
The keyboard acknowledges receipt of this command with ACK and clears both the output buffer and the typamatic key (if one is active). The system then sends the option byte and the keyboard responds with another ACK.

The keyboard changes the scan-code set as follows:

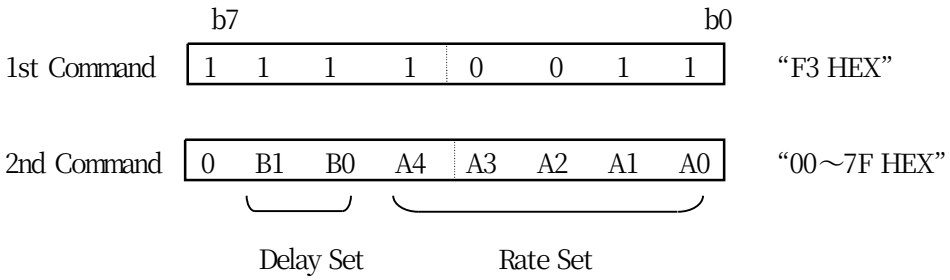
1st Command	2nd Command	Function
F0 Hex	00 Hex	Transmit the current scan code set state (01 to 02) to the system
F0 Hex	01 Hex	01 mode scan code set
F0 Hex	02 Hex	02 mode scan code set

8.2.10 Invalid (00～EC, EF, F1 Hex)

This Invalid commands are not supported. If one of these is sent, the keyboard does not acknowledge the command and returns a Resend command and continues in its prior scanning state. No other activities occur.

8.2.11 Set Rate/Delay (F3 Hex + xx Hex)

The keyboard responds with ACK, stop scanning, and waits for the system to issue the rate/delay value byte. The keyboard responds to the rate/delay value byte with another ACK, sets the rate and delay to the values indicated, and continues scanning (if it was previously enabled).



Typamatic Rate

(Rate±30%)

Bits A4	A3	A2	A1	A0	Rate (mS)	Bits A4	A3	A2	A1	A0	Rate (mS)
0	0	0	0	0	33	1	0	0	0	0	133
0	0	0	0	1	37	1	0	0	0	1	149
0	0	0	1	0	42	1	0	0	1	0	167
0	0	0	1	1	46	1	0	0	1	1	182
0	0	1	0	0	50.	1	0	1	0	0	200
0	0	1	0	1	54.	1	0	1	0	1	217
0	0	1	1	0	59	1	0	1	1	0	233
0	0	1	1	1	63	1	0	1	1	1	250
0	1	0	0	0	67	1	1	0	0	0	270
0	1	0	0	1	75	1	1	0	0	1	303
0	1	0	1	0	83	1	1	0	1	0	333
0	1	0	1	1	92	1	1	0	1	1	370
0	1	1	0	0	100	1	1	1	0	0	400
0	1	1	0	1	109	1	1	1	0	1	435
0	1	1	1	0	116	1	1	1	1	0	476
0	1	1	1	1	125	1	1	1	1	1	500

Typamatic Delay

(Delay±30%)

Bits B1	B0	Delay (mS)
0	0	250
0	1	500
1	0	750
1	1	1000

Note: When either POWER ON or Set Default command is performed,
Typamatic Rate and Delay shall be set as follows:
Typamatic Rate = 92mSec, Delay = 500mSec

8.3. Keyboard Commands (Keyboard → System)

This keyboard shall be able to transmit the following codes;

8.3. 1 Resend (FE Hex)

This command requires the system to retransmit the code when the code from the system has parity error or is invalid.

8.3. 2 ACK (FA Hex)

This code shall be sent after receipt of the command from the system except Echo and Resend command.

8.3. 3 Overrun (00 Hex or FF Hex)

This code shall be sent when the overflow on the keyboard buffer occurs or the phantom key is made.

Scan Code Set	Output Code
02	00 Hex
01	FF Hex

8.3. 4 BAT Complete (AA Hex)

Following satisfactory completion of the BAT, the keyboard sends AA hex. Any other code indicates a failure of the keyboard.

8.3. 5 BAT Failure (FC Hex)

If a BAT failure occurs, the keyboard sends FC hex, discontinues scanning, and waits for a system response or reset.

8.3. 6 Echo (EE Hex)

This code shall be sent to the system when the keyboard receives Echo command.

8.3. 7 Keyboard ID (AB Hex,83 Hex)

This code shall be sent to the system when the keyboard receives Read ID command.

1st Output Code ····· AB Hex

2nd Output Code ····· 83 Hex

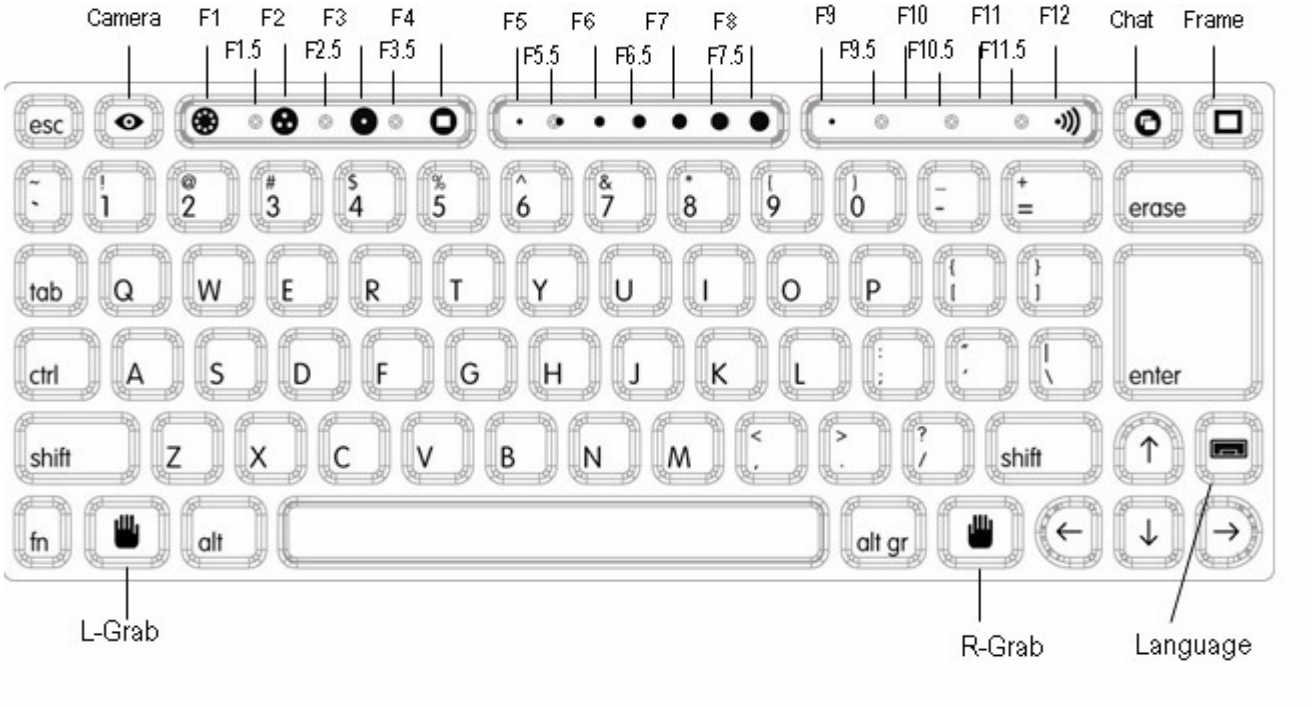
8.3. 8 Scan Code (01 Hex or 02 Hex)

The keyboard shall transmit either 01 or 02 Hex as the response to Scan Code Select command (F0 + 00 Hex).

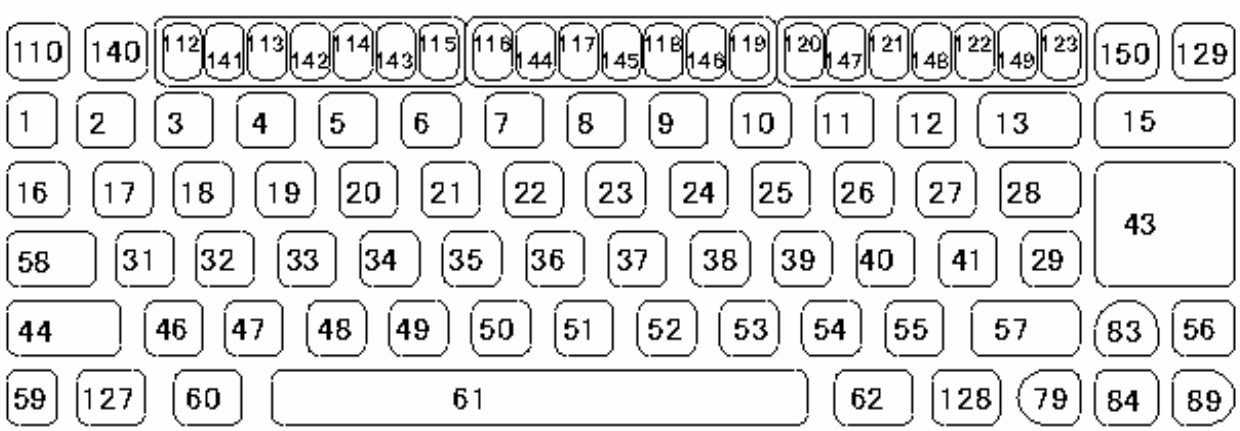
8.4. Fn Key emulation

When a specific key (Fn Emulation key) is pushed at the same time with pushing a Fn function key (Key 59), the output of the key code is changed as the bottom table.

8.5.1 **Key layouts**



8.5.2 **Key Number**



8.5.3 **Key Matrix**

Pin12			**112**		**50**	**119**	**56**	**150**	**51**		**13**	**123**		**62**		
Pin1		**110**	**115**	**127**	**35**	**118**		***149***	**36**		**41**	***122***			**15**	
Pin8	**58**	**16**	**114**		**21**	**117**	**28**	**148**	**22**		**27**	**121**				
Pin9		**1**	***113***		**6**	**116**		**59**	**7**		**12**	***120***	**129**		**29**	
Pin5		**31**	**33**		**34**	**32**	**38**	***147***	**37**		**40**	**39**			**43**	
Pin6		**46**	**48**	**128**	**49**	**47**	**53**	**146**	**52**	**44**	**55**	**54**			**61**	
Pin3		**2**	**4**		**5**	**3**	**9**	**145**	**8**		**11**	**10**		**60**	**84**	**89**
Pin2	**140**	**17**	**19**	**141**	**20**	**18**	**24**	***142***	**23**	**57**	**26**	**25**	**143**	**144**	**83**	**79**
	Pin7	Pin11	Pin13	Pin18	Pin14	Pin10	Pin17	Pin15	Pin16	Pin4	Pin23	Pin22	Pin19	Pin20	Pin21	Pin24

8.6 **Keycode table**

OLPC KEY CODE ASSIGNMENT

Normal	Reference	Scancode Set		Fn Key Emu	Reference	Scancode Set	
Key No.		Set 1	Set2	Key No.		Set 1	Set 2
1	~	29	0E				
2	!/1	02	16	112	(F1)	3B	05
3	@/2	03	1E	113	(F2)	3C	06
4	#/3	04	26	114	(F3)	3D	04
5	$/4	05	25	115	(F4)	3E	0C
6	%/5	06	2E	116	(F5)	3F	03
7	^/6	07	36	117	(F6)	40	0B
8	&/7	08	3D	118	(F7)	41	83
9	*/8	09	3E	119	(F8)	42	0A
10	(/9	0A	46	120	(F9)	43	01
11	)/0	0B	45	121	(F10)	44	09
12	_/-	0C	4E	122	(F11)	57	78
13	+/=	0D	55	123	(F12)	58	07
15	Erase(BS)	0E	66	76	Delete	E0 53(Note2)	E0 71(Note2)
16	tab	0F	0D				
17	Q	10	15				
18	W	11	1D				
19	E	12	24				
20	R	13	2D				
21	T	14	2C				
22	Y	15	35				
23	U	16	3C				
24	I	17	43				
25	O	18	44				
26	P	19	4D				
27	[	1A	54				
28	]	1B	5B				
31	A	1E	1C				
32	S	1F	1B				
33	D	20	23				
34	F	21	2B				
35	G	22	34				
36	H	23	33				
37	J	24	3B				
38	K	25	42				
39	L	26	4B				
40	:/;	27	4C				
41	"/'	28	52				
29	¦ \	2B	5D				
43	Enter	1C	5A				

Normal Key No.	Reference	Scancode Set		Fn Key Emu Key No.	Reference	Scancode Set	
		Set 1	Set 2			Set 1	Set 2
44	Left Shift	2A	12				
46	Z	2C	1A				
47	X	2D	22				
48	C	2E	21				
49	V	2F	2A				
50	B	30	32				
51	N	31	31				
52	M	32	3A				
53	<,	33	41				
54	>.	34	49				
55	?/	35	4A				
56	Language	73	51	107	(2nd Lang)	7E	6D
57	Right Shift	36	59	75	(Insert)	E0 52(Note2)	E0 70(Note2)
58	Left Ctrl	1D	14				
59	Fn	59	0F				
60	Left Alt	38	11				
61	Space	39	29	171	(kbd Light)	E0 56	E0 61
62	Right Alt gr	E0 38	E0 11				
79	Left Arrow	E0 4B(Note2)	E0 6B(Note2)	80	(Home)	E0 47(Note2)	E0 6C(Note2)
83	Up Arrow	E0 48(Note2)	E0 75(Note2)	85	(Pg Up)	E0 49(Note2)	E0 7D(Note2)
84	Down Arrow	E0 50(Note2)	E0 72(Note2)	86	(Pg Dn)	E0 51(Note2)	E0 7A(Note2)
89	Right Arrow	E0 4D(Note2)	E0 74(Note2)	81	(End)	E0 4F(Note2)	E0 69(Note2)
110	esc	01	76	151	(VeiwSrc)	E0 01	E0 76
112	(F1)	3B	05	172	(F1)	E0 3B	E0 05
141	(F1.5)	--	--	161	(F1.5)	E0 77	E0 62
113	(F2)	3C	06	173	(F2)	E0 3C	E0 06
142	(F2.5)	--	--	162	(F2.5)	E0 76	E0 5F
114	(F3)	3D	04	174	(F3)	E0 3D	E0 04
143	(F3.5)	--	--	163	(F3.5)	E0 75	E0 5C
115	(F4)	3E	0C	175	(F4)	E0 3E	E0 0C
116	(F5)	3F	03	176	(F5)	E0 3F	E0 03
144	(F5.5)	--	--	164	(F5.5)	E0 74	E0 53
117	(F6)	40	0B	177	(F6)	E0 40	E0 0B
145	(F6.5)	--	--	165	(F6.5)	E0 73	E0 51
118	(F7)	41	83	178	(F7)	E0 41	E0 83
146	(F7.5)	--	--	166	(F7.5)	E0 72	E0 39
119	(F8)	42	0A	179	(F8)	E0 42	E0 0A
120	(F9)	43	01	180	(F9)	E0 43	E0 01
147	(F9.5)	--	--	167	(F9.5)	E0 71	E0 19
121	(F10)	44	09	181	(F10)	E0 44	E0 09
148	(F10.5)	--	--	168	(F10.5)	E0 70	E0 13
122	(F11)	57	78	182	(F11)	E0 57	E0 78
149	(F11.5)	--	--	169	(F11.5)	E0 6F	E0 6F
123	(F12)	58	07	183	(F12)	E0 58	E0 07
127	L-Grab(L-Win)	E0 5B (Note2)	E0 1F (Note2)				
128	R-Grab(R-Win)	E0 5C (Note2)	E0 27 (Note2)				
129	Frame	E0 5D	E0 2F	152	(Win-Apr)	E0 5A	E0 17
140	Camera	E0 79	E0 64	153	(Mic)	E0 78	E0 63
150	Chat	E0 6E	E0 57	170	(Chat)	E0 64	E0 08

Note2 Scan Code Set 01

Make Code	Break Code	Typamatic Code	Shift Status R L	Num
E0 (Data)	E0 (Data+80h)	E0 (Data)	0 0	0
			0 1	1
			1 0	1
			1 1	1
E0 AA E0 (Data)	E0 (Data+80h) E0 2A	E0 (Data)	0 1	0
E0 B6 E0 (Data)	E0 (Data+80h) E0 36	E0 (Data)	1 0	0
E0 AA E0 B6 E0 (Data)	E0 (Data+80h) E0 36 E0 2A	E0 (Data)	1 1	0
E0 2A E0 (Data)	E0 (Data+80h) E0 AA	E0 (Data)	0 0	1

KEY No.	Key Top	Data
75	Insert	52
76	Delete	53
79	←	4B
80	Home	47
81	End	4F
83	↑	48
84	↓	50
85	Page Up	49
86	Page Down	51
89	→	4D
127	Left-Windows	5B
128	Right-Windows	5C

Note2 Scan Code Set 02

Make Code	Break Code	Typamatic Code	Shift Status R L	Num
E0 (Data)	E0 F0 (Data)	E0 (Data)	0 0	0
			0 1	1
			1 0	1
			1 1	1
E0 F0 12 E0 (Data)	E0 F0 (Data) E0 12	E0 (Data)	0 1	0
E0 F0 59 E0 (Data)	E0 F0 (Data) E0 59	E0 (Data)	1 0	0
E0 F0 12 E0 F0 59 E0 (Data)	E0 F0 (Data) E0 59 E0 12	E0 (Data)	1 1	0
E0 12 E0 (Data)	E0 F0 (Data) E0 F0 12	E0 (Data)	0 0	1

KEY No.	Key Top	Data
75	Insert	70
76	Delete	71
79	←	6B
80	Home	6C
81	End	69
83	↑	75
84	↓	72
85	Page Up	7D
86	Page Down	7A
89	→	74
127	Left-Windows	1F

9.

Item	Test conditions	Requirements
9.1 Electrostatic Discharge (ESD)	This test is based on the IEC-1000-4-2. (1) Environmental Condition Ambient Temperature 15 to 35℃ Relative Humidity 30 to 60%R.H. (2) Test time 9 points 1 times total 9 discharges	Air Discharge test No Function Error +/- 8 kV No breakdown +/- 13kV (PT+GS FG must connect GND of FG) It strengthens by connecting the steel of the sensor seat with FG of the main body of PC.

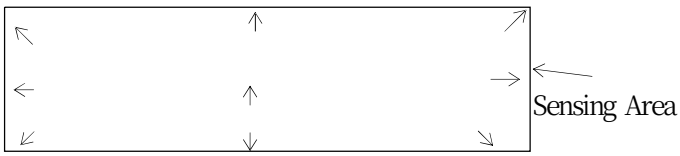


Fig.6 ESD TEST POINTS

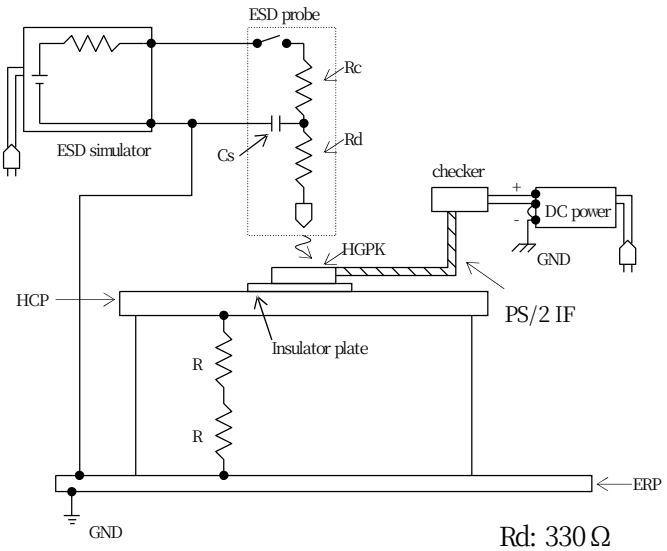


Fig.7 ESD TEST METHOD

10. CAUTIONS IN HANDLING

10.1 USAGE

ALPS PT+GS should be used as an ordinary pointing device, for computers and electronics devices, to move the cursor or to input data.

10.2 HOW TO OPERATE

Relax yourself and place your arm and hand naturally on the operation tablet. Either moves your finger smoothly on the surface or tap it lightly.

10.3 CAUTIONS IN HANDLING

The following paragraphs, 8.3.1 to 8.3.8, should be entered in the manual of the product.

10.3.1 GS can be operated by touching the surface lightly and tapping.

No pressure is required. Do not use poor posture, this could hurt your arms or fingers.

Do not use GS for a long time. Take a rest regularly and do some exercise, such as stretching, to relax your fingers, hands, wrists, upper arms and shoulders.

10.3.2 Because GS is designed to be operated by a finger, a finger wearing a glove, a pen, a ball-point pen or pencil will not make it work.

GS will not behave normally with two or more fingers on the surface or with something laying on the surface.

10.3.3 Do not use something pointed excluding the pen of the attachment.

10.3.4 GS may not behave normally when there is water on the surface, or under the following conditions; wet from condensation, a wet finger with water or perspiration.

10.3.5 In case there is lots of noise from electromagnetic waves in the environment, some abnormal phenomena as the cursor trembling or skipping may occur. In such a case, turn off the device creating the noise source or put it far away.

10.3.6 Do not spill liquid such as juice or coffee on PT+GS.

10.3.7 When the surface sheet becomes dirty, wipe it with a dry cloth. In case it becomes very dirty, wipe it with a wet cloth.

Do not turn on the PC while touching the surface, otherwise GLIDESONSOR may not be have normally.

In such a case, you should not touch the surface a few times by your finger so that GLIDESENSOR could be normal.

10.4 CUTIONS IN MOUNTING

10.4.1 In order to prevent IC from being hurt by static electricity, the operator must be grounded while installing it.

10.4.2 For electrostatic protection, the FG (Frame ground) of PT+GS must be connected to FG of the system.

10.4.3 PT+GS must be supported its hidden side except parts mounting area by an insulated flat.