ePH1660

Handwriting Recognition Microcontroller

Product Specification

DOC. VERSION 0.2

ELAN MICROELECTRONICS CORP.

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Specification Revision History

Doc. Version	Revision Description	Date
0.1	Initial Preliminary Specification	2007/10/22
0.2	1. Modify fig6-1c 2. YN wakeup clock modify	2008/04/07

1 Introduction

The ePH1660 IC is an 8-bit RISC microcontroller embedded with finger touch recognition core. When connected to an external resistance type touch panel, the IC becomes suitable for handwriting recognition application products, such as SMS, Stylus Remote Controllers, mobile phones, handwriting input devices, etc. The ePH1660 has low power consumption, low cost, and yet is capable of providing high rate of recognition performance. These quality features are helpful and vital in meeting schedule when new handwriting recognition related product or pressure-sensitive screen input device development is under short lead-time pressure.

2 Features

Product	Package	Supported Input	Output	Interface	Remarks
ePH1660	CSP/ QFN32	1. Simplified Chinese 2. ASCII 3. Gesture 4. European characters*	Unicode /GB2312	UART	Can recognize up to 6,763 Simplified Chinese (GB2312) characters, 83 European and 66 Russian characters.

* *European characters includes Danish & Norwegian, Dutch, Finnish, French, German, Italian, Portuguese, Spanish, and Swedish (operating under Windows 1252, Western Europe Latin 1)*

3 Block Diagram

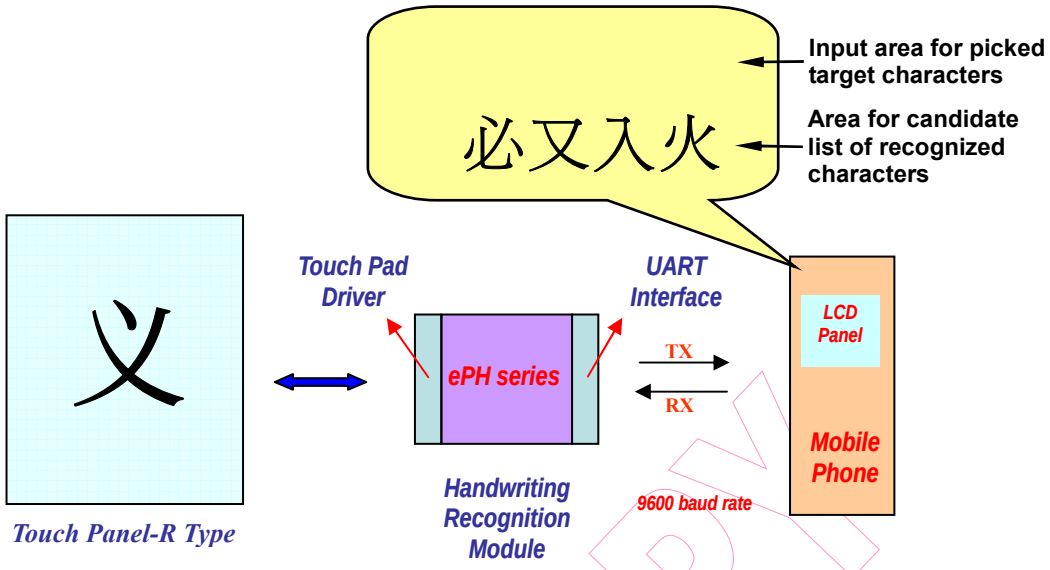


Figure 3-1 ***ePH1660*** *Functional Block Diagram*

4 Pin Assignment

4.1 QFN 32 Pins

No.	Pin Name	No.	Pin Name	No.	Pin Name	No.	Pin Name
1	HTEST	9	YN(WKO)	17	SCK	25	NC
2	PLLC	10	XP	18	SDO	26	NC
3	OSCI	11	YP	19	SDI	27	NC
4	OSCO	12	TX	20	WKI/COM	28	NC
5	RESETB	13	RX	21	STEST	29	NC
6	VREX	14	VDD	22	CE	30	NC
7	VDD	15	VSS	23	SMODE	31	NC
8	XN	16	SSCMD	24	NC	32	NC

4.2 CSP (Chip Size Package) 23 Pins

Perspective view of the pin locations viewed from the top surface of the chip.
Precise package size: (3170±50) µm x (2550±50) µm

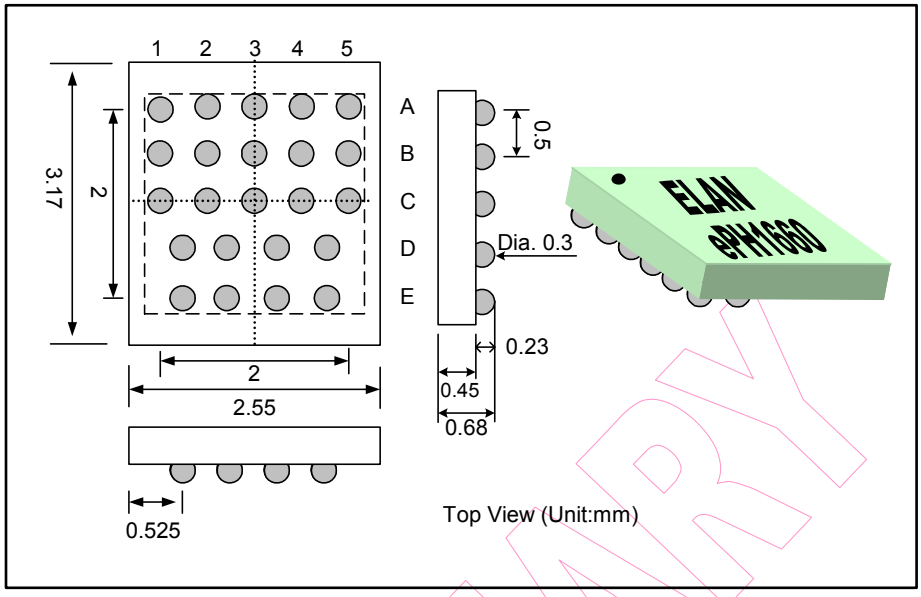


Figure 4-1a ePH1660 Pin Location

Perspective View from Top Side										(Unit:mm)
Y Coordinate \ X Coordinate		–1	-0.75	–0.5	-0.25	0	0.25	0.5	0.75	1
		1	1’	2	2’	3	3’	4	4’	5
1	A	HTEST	–	RESETB	–	RX	–	WKI/COM	–	STEST
0.5	B	PLLC	–	XN	–	TX	–	SSCMD	–	CE
0	C	OSCI	–	VREX	–	YP	–	SCK	–	SMODE
-0.5	D	–	OSCO	–	YN(WKO)	–	VSS	–	SDO	–
-1	E	–	VDD	–	XP	–	VDD	–	SDI	–

Actual pin location and assignment as viewed from the bottom side of the chip.

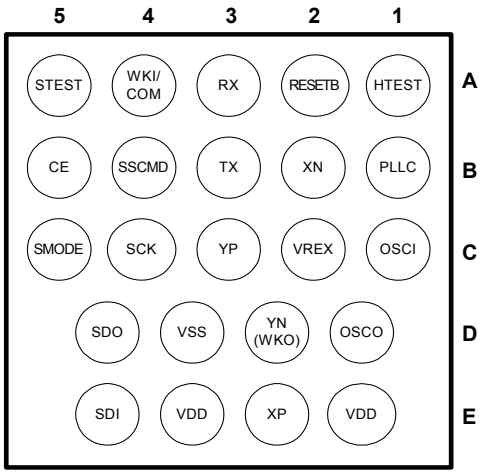


*Figure 4-1b **ePH1660** Actual Pin Location and Assignment (Viewed from the Bottom)*

4.3 Ordering Information

Orderable Part Number	Package Type	
ePH1660SHS	CSP	Tray of 72
ePH1660KSHS		Tape reel of 2000
ePH1660AWJ	QFN32 5×5 mm	

NOTE: *Red character stands for Green Package*

5 Pin Description

CSP	QFN32	Name	I/O/P Type	Description
E3’	14	VDD	P	Digital power supply ranging from 2.8V to 3.6V. It should be connected to VSS through a 0.1μF capacitor.
D3’	15	VSS	P	Negative power supply
E1’	7	VDD	P	Analog power supply ranging from 2.8V to 3.6V. It should be connected to VSS through a 0.1μF capacitor.
A2	5	RESETB	I	System reset input pin with built-in pull up resistor (typical value = 100KΩ). Should be connected to one GPIO pin.
A1	1	HTEST	I	Hardware testing. Normally connected to VSS.
C1	3	OSCI	I	Crystal or External Clock Source connector pin: • Crystal: Connect a 32.768 kHz crystal and connect to VSS through a 20pF capacitor • External Clock Source: Connect a 32.768 kHz (±20ppm) clock signal through a 0.1μF capacitor (Clock V_{PP}>0.3V_{DD})
D1’	4	OSCO	O	Crystal or External Clock Source connector pin: • Crystal: Connect a 32.768 kHz crystal and connect to VSS through a 20pF capacitor. • External Clock Source: Keep the pin floating
B1	2	PLLC	I	PLL capacitor connector pin. Should be connected to VSS through a 0.047μF capacitor.
C2	6	VREX	I/O	Internal reference voltage for A/D converter. Should be connected to VSS through a 0.1μF capacitor.
B5	22	CE	I	“Floating”: Chip Enable “L” : Chip power down. UART interface pin will change to High-Z status.
A5	21	STEST	I	Software testing. Normally floating or connected to VDD.
B3	12	TX	O	UART Interface Tx pin
A3	13	RX	I	UART Interface Rx pin
C3	11	YP	I	Touch screen Y direction positive pin
E2’	10	XP	I	Touch screen X direction positive pin

(Continuation)

CSP	QFN32	Name	I/O/P Type	Description
D2'	9	YN (WKO)	O	Touch screen Y direction negative pin. This pin should be connected to the host input pin. Such host input pin must be set as "non-pull-up" resistor type and provides a wake-up function.
B2	8	XN	O	Touch screen X direction negative pin
A4	20	WKI/ COM	I	***UART:*** Wake-up input pin. ***SPI master mode*:** Wake-up input and Host command pin. ***SPI slave mode*:** Should be connected to VSS.
C5	23	SMODE	I	SPI / UART interface select pin. ***UART mode*:** Normally floating. ***SPI master mode*:** Should be connected to VSS. ***SPI slave mode*:** Should be connected to VSS.
B4	16	SSCMD	O	***UART and SPI master mode*:** Normally floating. ***SPI slave mode*:** ePH1660 command pin.
C4	17	SCK	I/O	***UART mode*:** Normally floating ***SPI master mode*:** Serial clock out. ***SPI slave mode*:** Serial clock in.
D4'	18	SDO	O	Serial data output.
E4'	19	SDI	I	Serial data input.

6 Interface Control Timing Description

6.1 UART Interface Control (9600, N, 8, 1)

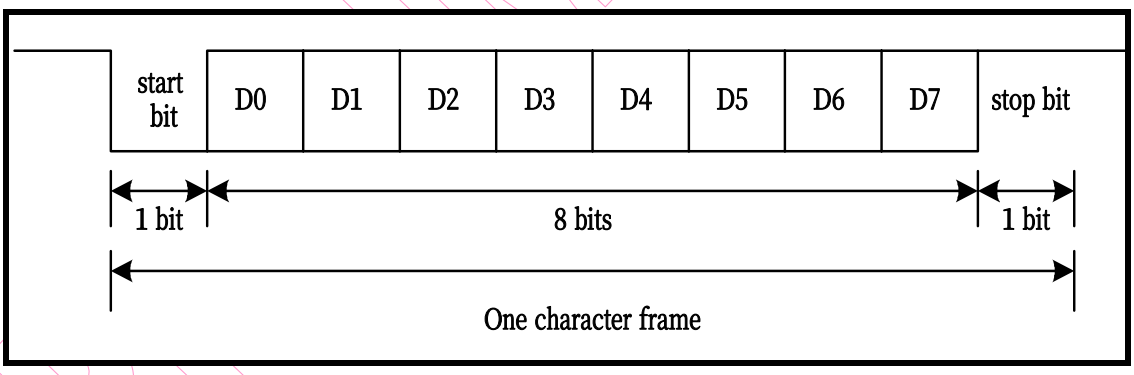


Figure 6-1a UART Interface Control Timing Diagram

6.2 SPI Master Interface Control (1.2MHz, MSB first, 8-bit)

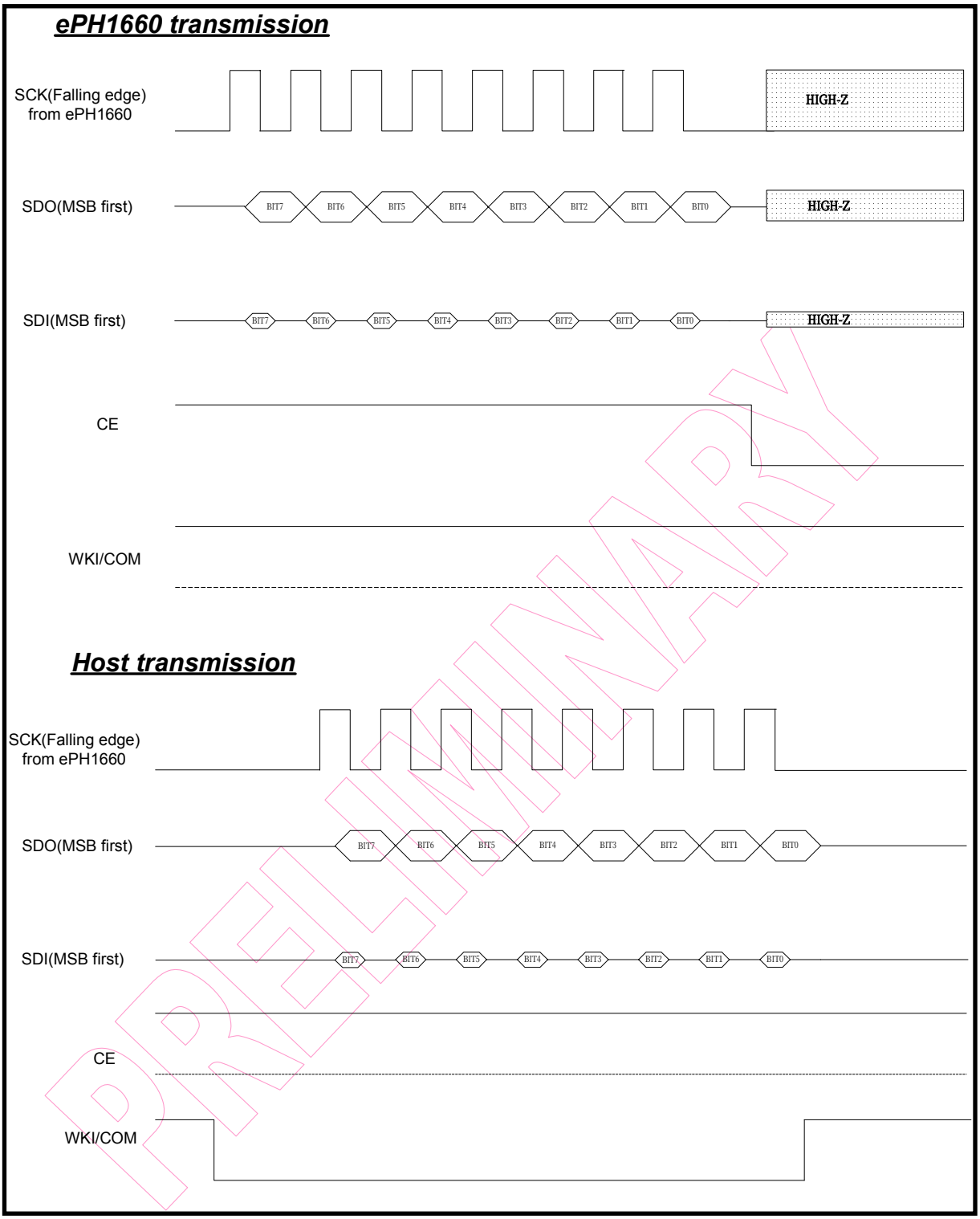


Figure 6-1b Master Interface Control Timing Diagram

6.3 SPI Slave Interface Control (1.2MHz, MSB first, 8-bit)

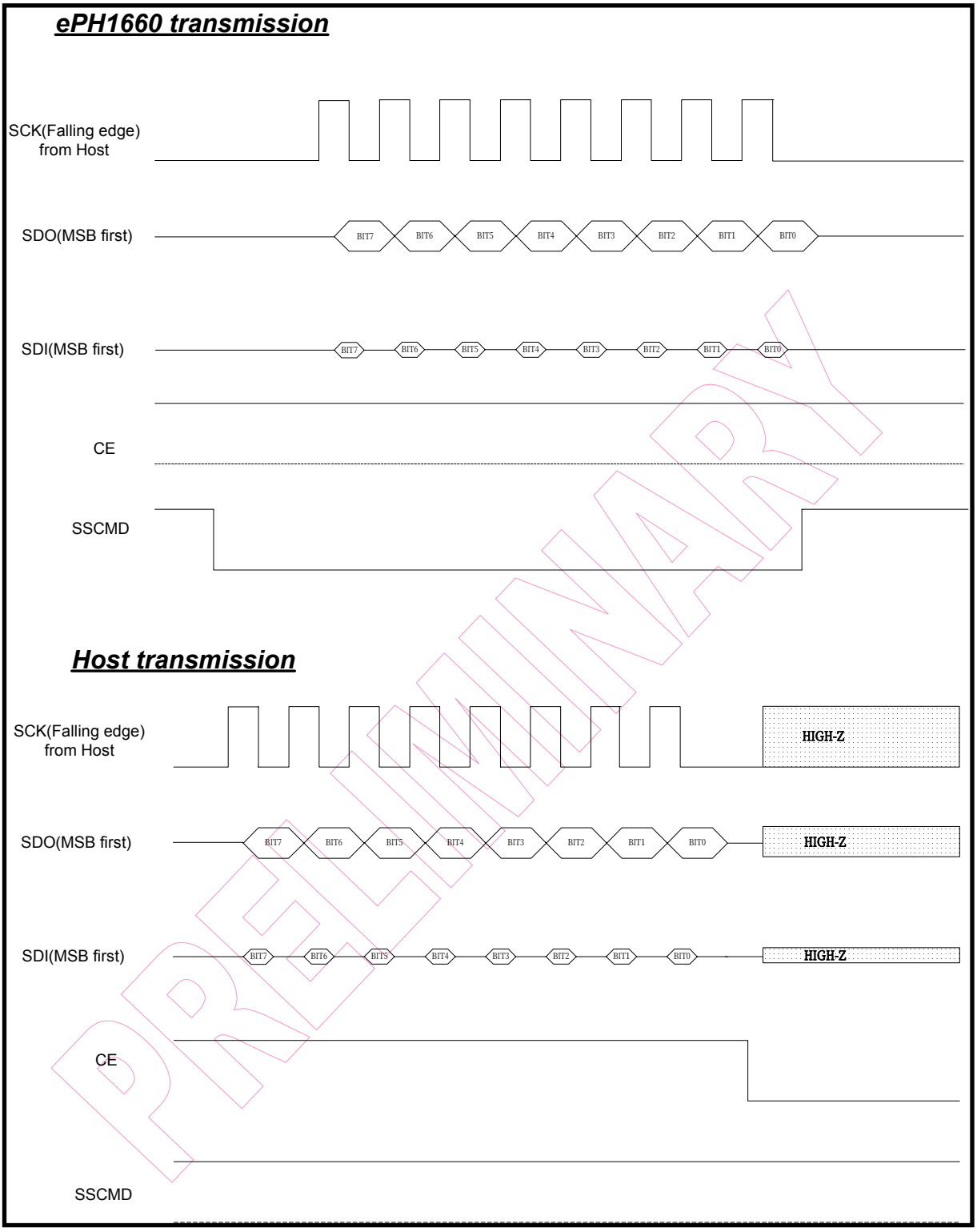


Figure 6-1c SPI Slave Interface Control Timing Diagram

7 Pin Option Description

7.1 CE Pin Option

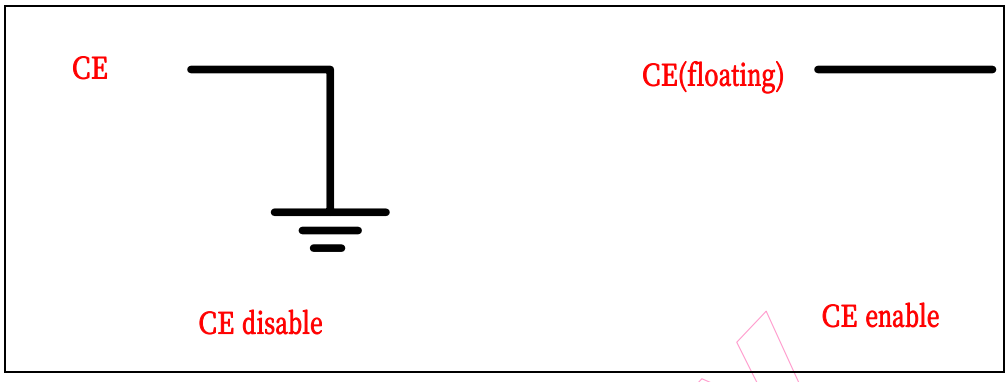


Figure 7-1 CE Pin Connection Option

7.2 Mode Selection

- **UART Mode**

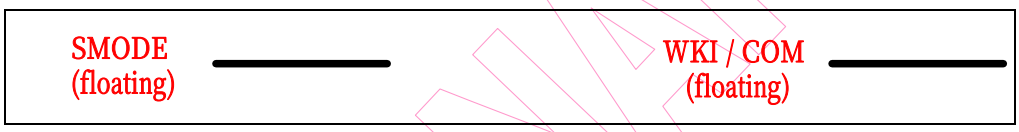


Figure 7-2a UART Mode Selection

- **SPI Master Mode**

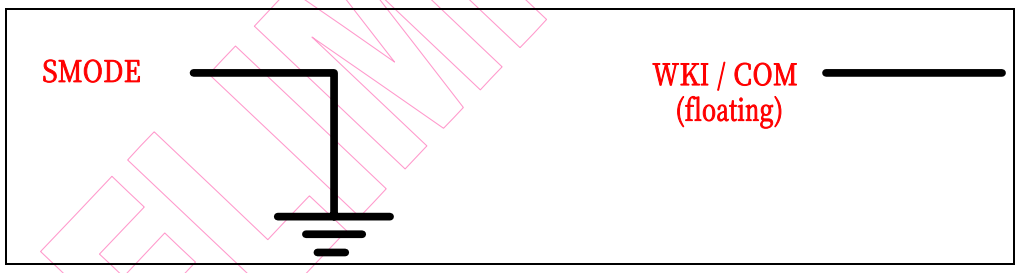


Figure 7-2b SPI Master Mode Selection

- **SPI Slave Mode**

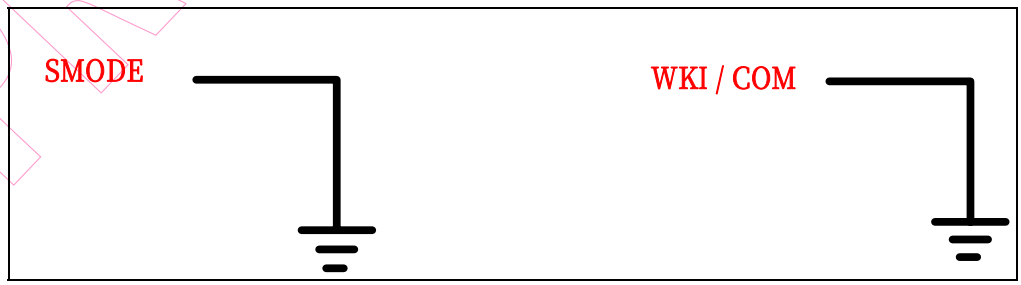


Figure 7-2c SPI Slave Mode Selection

8 Electrical Characteristic

8.1 Absolute Maximum Ratings

Items	Symbol	Condition	Limits	Unit
Supply Voltage	VDD	–	–0.3 to +3.6	V
Input Voltage (General Input Port)	VIN	–	–0.5 to VDD +0.5	V
Operating Temperature Range	TOPR	–	–20 to +80	°C
Storage Temperature Range	TSTR	–	–55 to +125	°C

8.2 Recommended Operating Conditions

Items	Symbol	Condition	Limits	Unit
Supply Voltage	VDD	–	2.8 to 3.6	V
	VDDA		2.8 to 3.6	
Input Voltage	VIH	–	VDD x 0.9 to VDD	V
	VIL	–	0 to VDD x 0.1	V
A/D Full-Scale Input Span	ADRG	Positive input–negative input	0 to VREX	V
Operating Temperature	TOPR	–	–20 to +80	°C

8.3 DC Electrical Characteristics

(Condition: Ta=25°C, VDD= 3.0 ± 0.3V)

Parameter	Symbol	Condition		Min	Type	Max	Unit
Clock	Fmain	Main-clock frequency		–	4.9	–	MHz
	Fsub	Sub-clock frequency	Crystal OSC	–	32.768	–	kHz
Supply Current	Idd2	Idle mode	VDD=3V, Crystal OSC.	–	5	8	µA
	Idd3	Fast mode	VDD=3V, Fmain=4.9MHz, without touch panel load	–	2000	3000	
Input Voltage	VIH1	Input pin		VDD×0.7	–	VDD	V
	VIL1			0	–	VDD×0.3	
Input Threshold Voltage (Schmitt)	VT+	RESETB pin		0.5×VDD	–	0.75×VDD	V
	VT–			0.2×VDD	–	0.4×VDD	
Output Current	IOH1	Output pin	VDD=3V, VOH=2.4V	–1.1	–2.2	–3.3	mA
	IOL1		VDD=3V, VOL=0.2V	+1.1	+2.2	+3.3	
Input Leakage Current	IIL	ALL Input port (without pull-up/down resistor) Vin=VDD or GND		–	–	±1	µA
Touch Panel Pull Down Resistance	RPD3	DET=1, Xn pin	Vin=VDD, VDD=3V	25	50	100	KΩ
Data Retention Voltage	Vret	–		1.6	–	–	V
Power-on Reset Voltage	Vpor	–		1.4	1.5	1.6	V

8.4 A/D Conversion

(VDD=3.0V, VDDA=3.0V, Ta=25°C, Fclk=12 × Fsample)

Parameter	Symbol	Condition	Min	Type	Max	Unit
Analog Input						
Mux Leakage Current	Imux	On/off leakage current, Vin=0 or VDD	–	0.1	1	μA
System Perfomance						
Resolution	-	–	–	10	–	Bits
Integral Non-Linearity	INL	–	-2	–	+2	LSB
Differential Non-linearity	DNL	–	-2	–	+2	LSB
Offset Error	OErr	–	-4	–	+4	LSB
Gain Error	GErr	–	-4	–	+4	LSB
Missing Code	MC	–	–	–	–	Bit
VDDA Supply Current	Ivdd3	VDD=3.0V, VDDA=3.0V, Fsample=20kHz, ADEN=1, VRS=1	–	0.5	0.7	mA
	Ivdd4	ADEN=0, VRS=1	–	–	1	uA
Driver Current	IOH	Xp, Yp (VDD= 2.9 ± 0.3V) (Voh=VDD-0.2V)	-20	-30	-45	mA
Sink Current	IOL	Xn, Yn (VDD= 2.9 ± 0.3V) (Vol=0.2V)	+20	+30	+45	mA

8.5 AC Electrical Characteristics

(Condition: Ta=25°C, VDD=3.0 ± 0.3V)

Parameter	Symbol	Condition	Min	Type	Max	Unit
A/D Conversion (VDD=3.0V, VDDA=3.0V, Ta=-10~+60°C)						
Throughput Rate	–	VDD=3.0V, VDDA=3.0V	–	–	80	ksps
		VDD=2.4V, VDDA=2.4V	–	–	60	
Power Supply Rejection Ratio	PSRR1+	Power noise: 1kHz, 100mV	37	40	–	dB
	PSRR1–	Power noise: 1kHz, 100mV	43	46	–	
Signal to Noise Ratio	SNR	–	51	54	–	dB

9 Power–up and Reset Timing

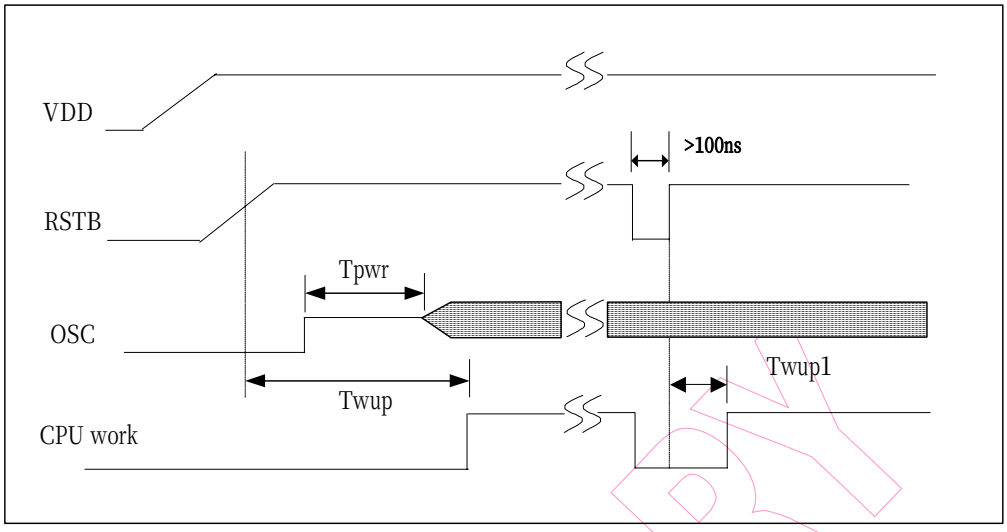


Figure 9 Power–up and Reset Timing Diagram

Where:

Symbol	Characteristics	Min.	Type	Max.	Unit
Tpwr	Oscillator start up time	100	226	300	ms
Twup	CPU warm up time	260	340	550	ms
Twup1	CPU reset time	18	22	44	ms

10 Application Circuit

10.1 UART Interface Application Circuit (with 32.768kHz Crystal)

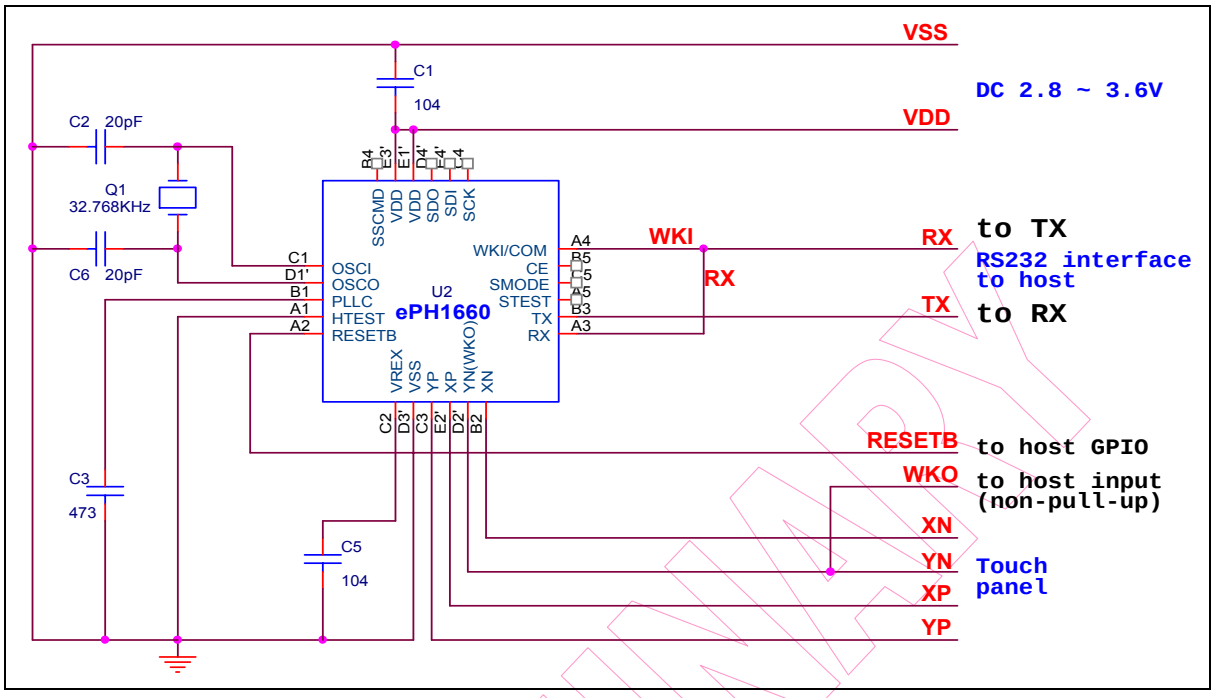


Figure 10-1 UART Interface Application Circuit (with Crystal)

■ BOM Table

Component	Component P/N	Pin Location	Packaging	Qty
MCU	ePH1660	U2	CSP	1
Oscillator	32768HZ Crystal	Q1	D	1
Capacitor	20pF	C2, C6	S	2
Capacitor	0.1μF (104)	C1, C5	S	2
Capacitor	0.047μF (473)	C3	S	1

10.2 UART Interface Application Circuit (with 32.768kHz External Clock)

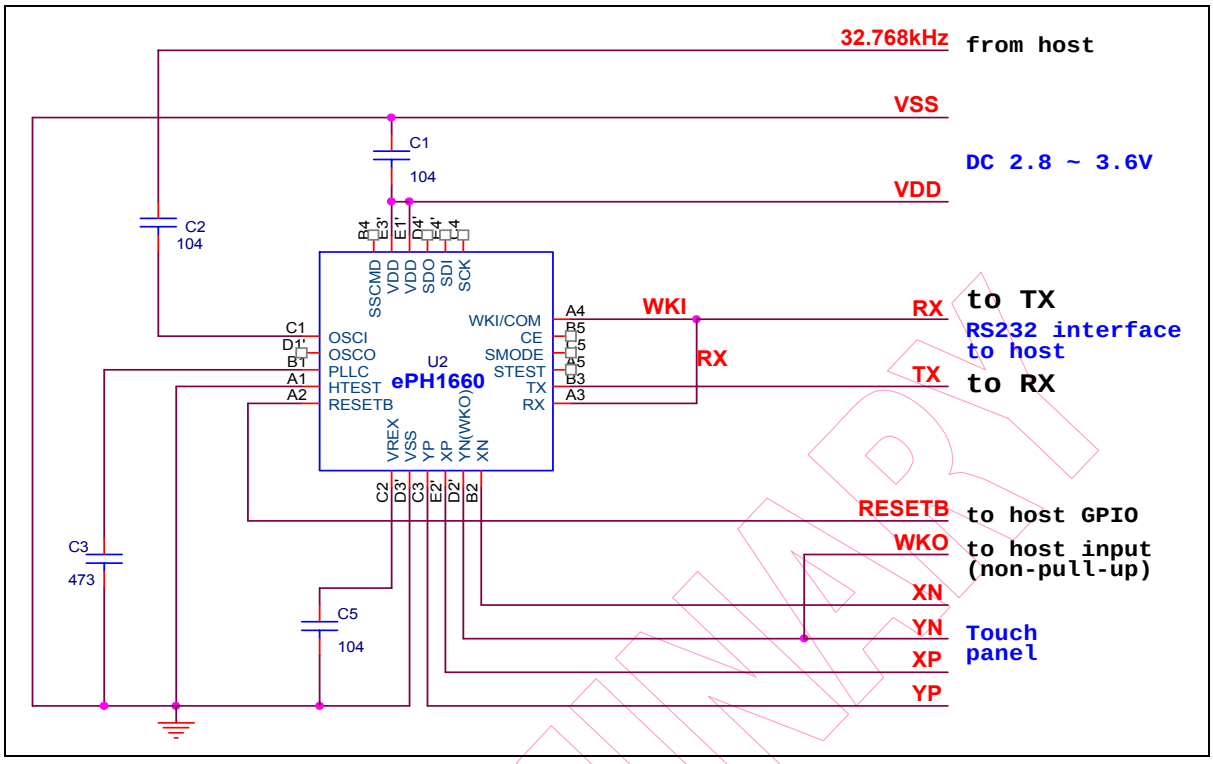


Figure 10-2 UART Interface Application Circuit (with External Clock)

■ BOM Table

Component	Component P/N	Pin Location	Packaging	Qty
MCU	ePH1660	U2	CSP	1
Capacitor	0.1μF (104)	C1, C2, C5	S	3
Capacitor	0.047μF (473)	C3	S	1

10.3 SPI Master Interface Application Circuit (with 32.768kHz Crystal)

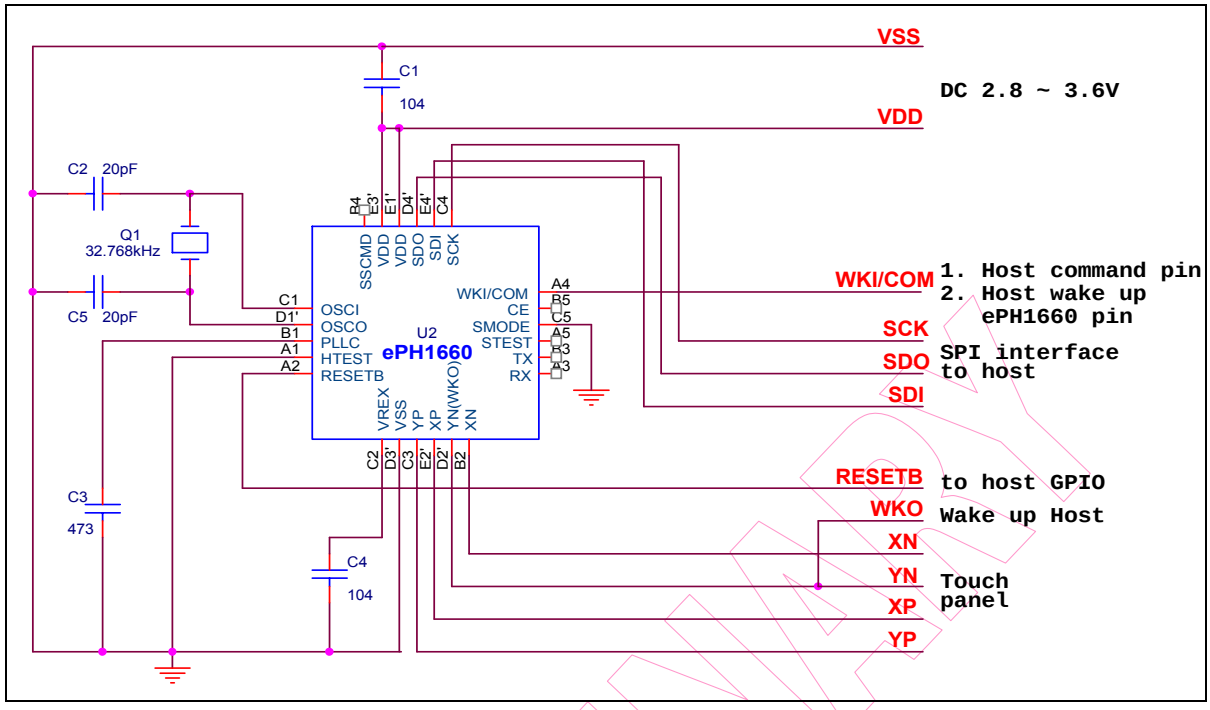


Figure 10-3 SPI Master Interface Application Circuit (with Crystal)

■ BOM Table

Component	Component P/N	Pin Location	Packaging	Qty
MCU	ePH1660	U2	CSP	1
Oscillator	32768HZ Crystal	Q1	D	1
Capacitor	20pF	C2, C5	S	2
Capacitor	0.1μF (104)	C1, C4	S	2
Capacitor	0.047μF (473)	C3	S	1

10.4 SPI Master Interface Application Circuit (with 32.768kHz External Clock)

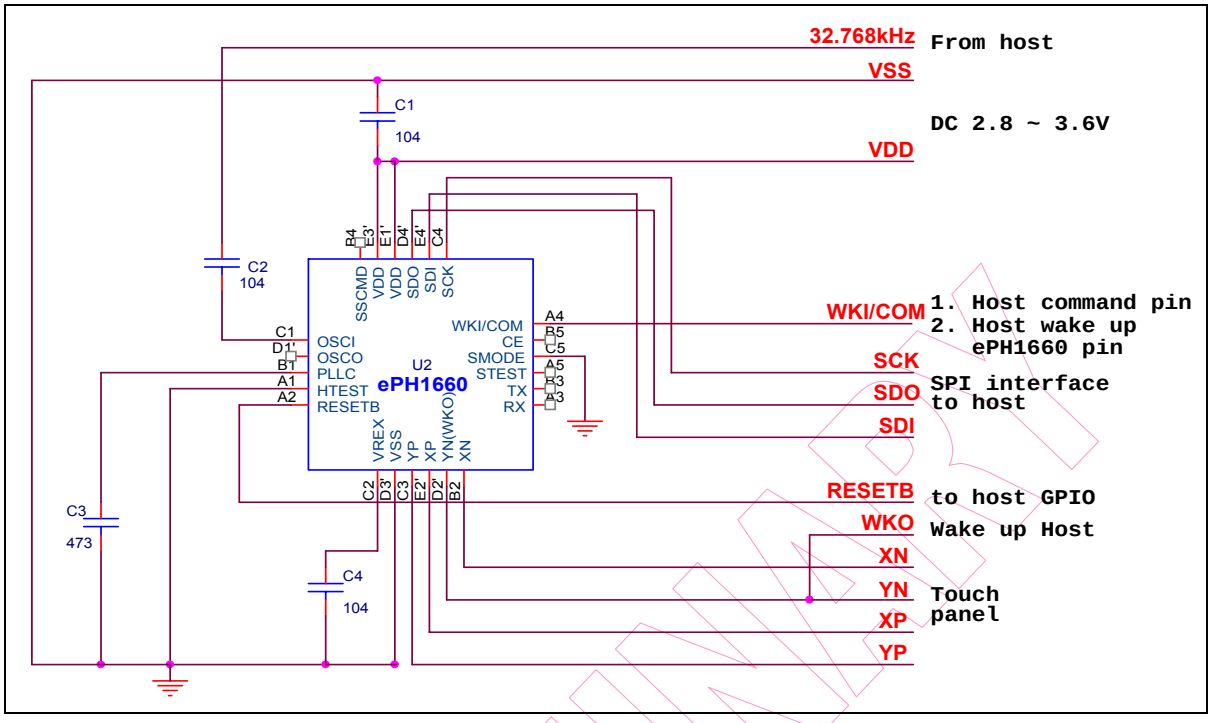


Figure 10-4 SPI Master Interface Application Circuit (with External Clock)

■ BOM Table

Component	Component P/N	Pin Location	Packaging	Qty
MCU	ePH1660	U2	CSP	1
Capacitor	0.1μF (104)	C1, C2, C4	S	3
Capacitor	0.047μF (473)	C3	S	1

10.5 SPI Slave Interface Application Circuit (with 32.768kHz Crystal)

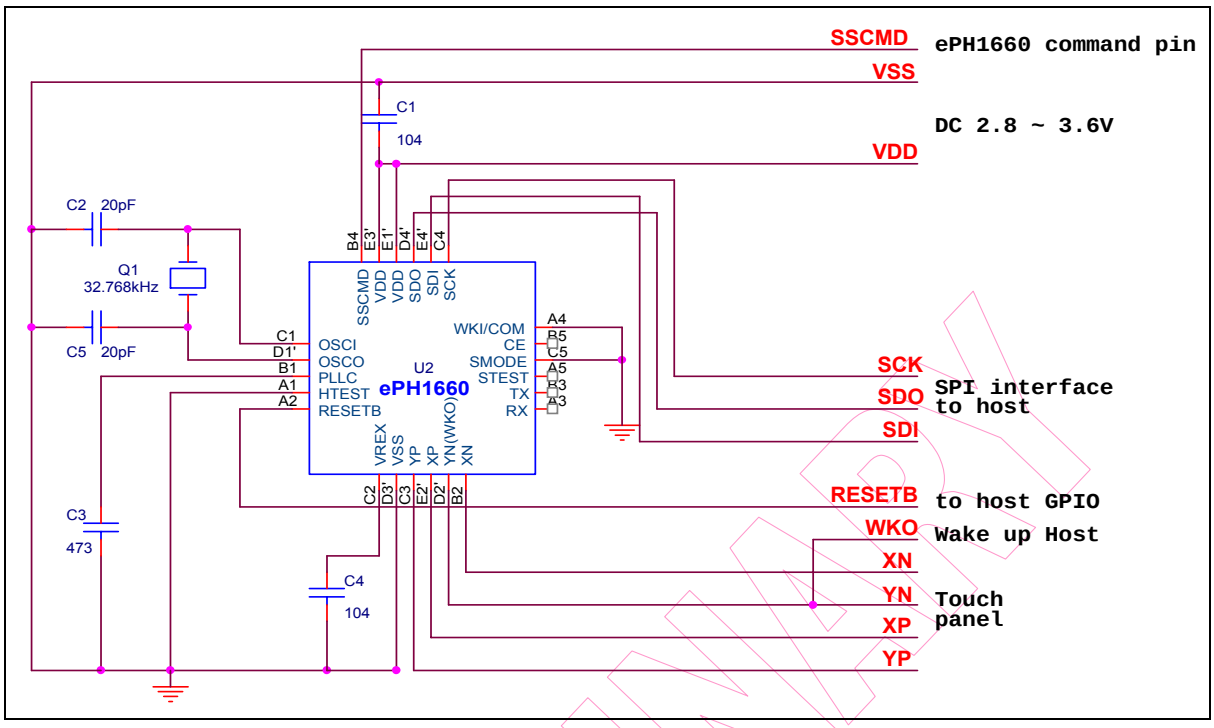


Figure 10-5 SPI Slave Interface Application Circuit (with Crystal)

■ BOM Table

Component	Component P/N	Pin Location	Packaging	Qty
MCU	ePH1660	U2	CSP	1
Oscillator	32768HZ Crystal	Q1	D	1
Capacitor	20pF	C2, C5	S	2
Capacitor	0.1μF (104)	C1, C4	S	2
Capacitor	0.047μF (473)	C3	S	1

10.6 SPI Slave Interface Application Circuit (with 32.768kHz External Clock)

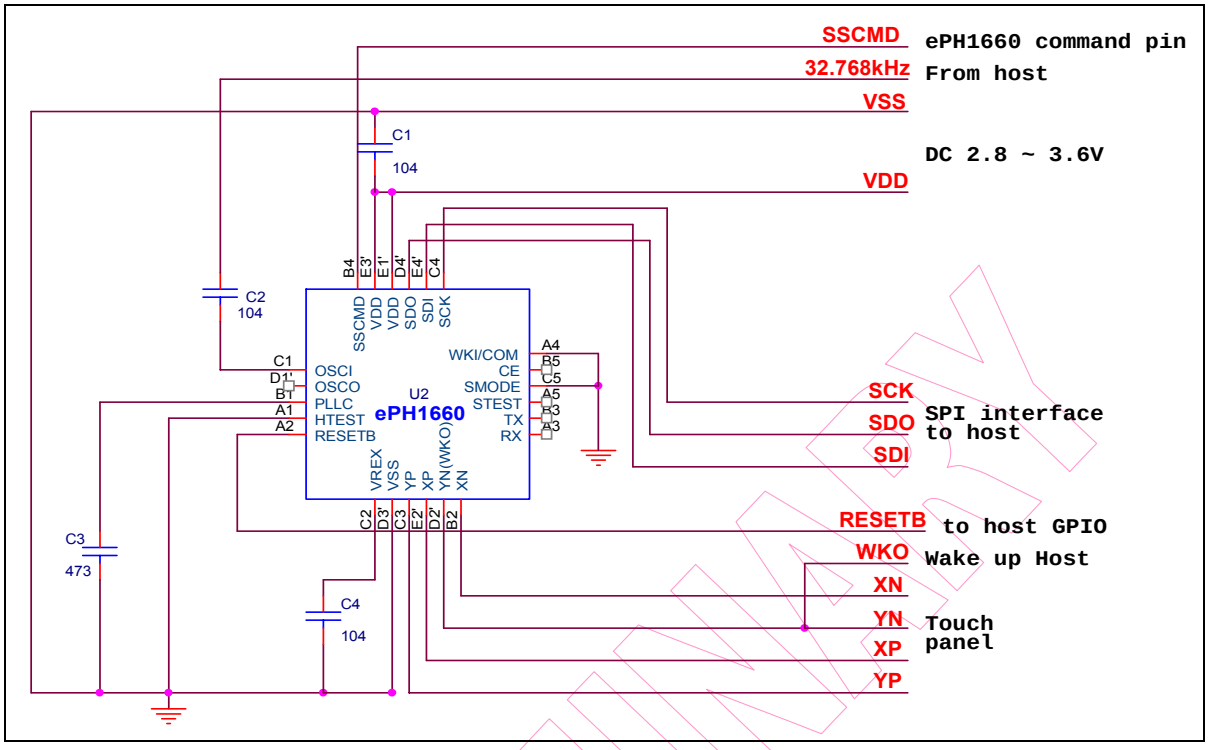


Figure 10-6 SPI Slave Interface Application Circuit (with External Clock)

■ BOM Table

Component	Component P/N	Pin Location	Packaging	Qty
MCU	ePH1660	U2	CSP	1
Capacitor	0.1μF (104)	C1, C2, C4	S	3
Capacitor	0.047μF (473)	C3	S	1

10.7 Touch Panel and YP, XP, YN, and XN Layout Format

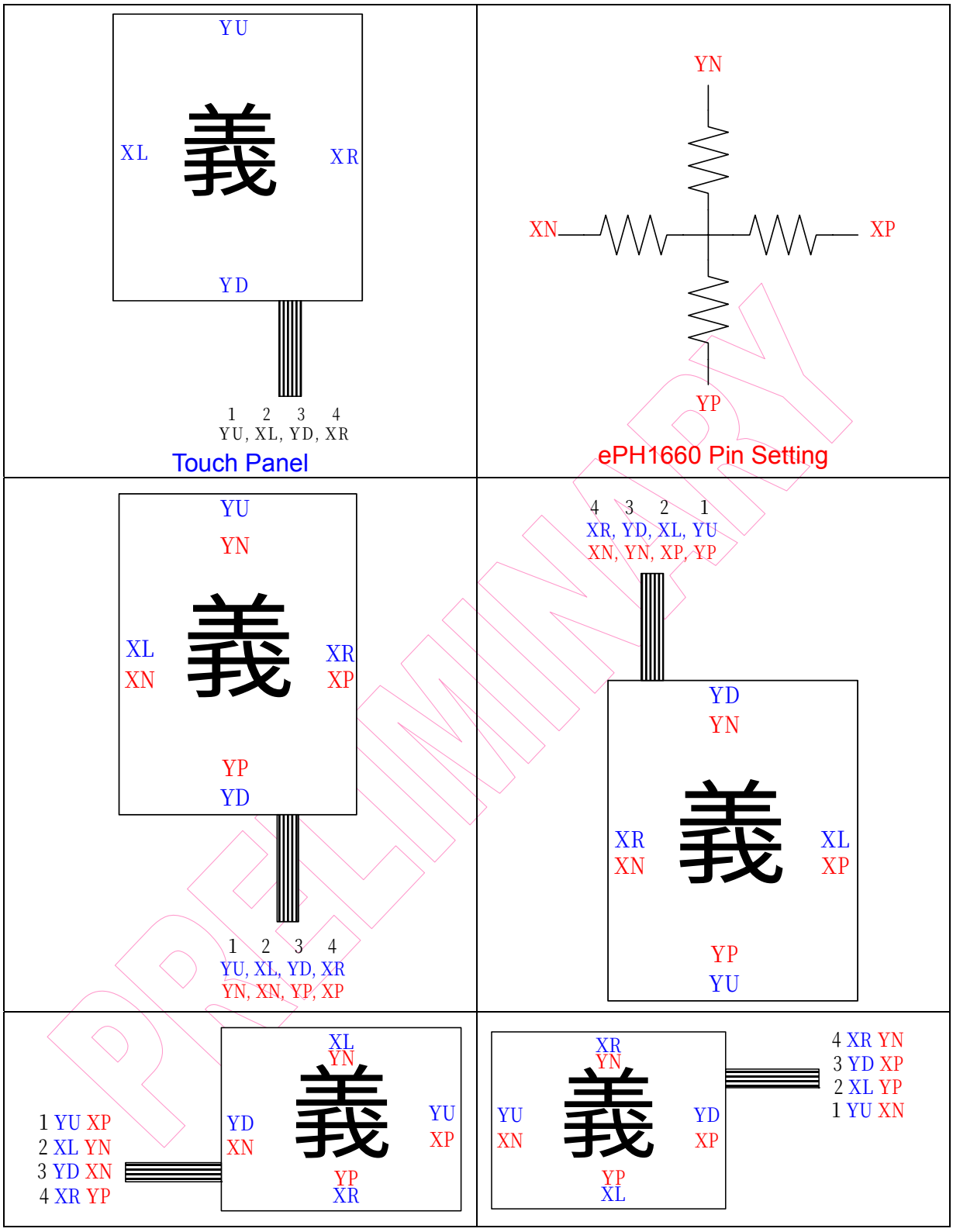


Figure 10-7 Touch Panel Layout Format

11 HWRE Software Specification

11.1 HWRE Software Description

- The ePH1660 provides seven free-hand input recognition proficiencies; including Chinese Character Set I, Chinese Character Set II, etc.
- You can choose to access the input as you write (inking) with recognized characters feedback, or to access the recognized characters only without accessing the inking (input).
- The ePH1660 transmits both hand-written characters and hand-drawn graphics. Graphics inking are transmitted without recognition.
- The ePH1660 can only transmit data to host through a defined touch panel button area coordinates (located at a designated area of the touch panel). When you tap and drag on the panel, only the tapping is transmitted. Dragging is ignored.

11.2 Communication Protocol and Command List

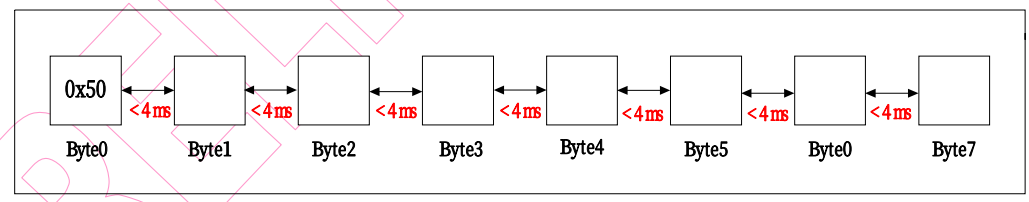
11.2.1 Communication Interface: UART

UART parameter: baud rate 9600; no parity check; 8 bits data length.
SPI parameter: bit rate 1.2MHz, MSB first, 8 bits data length.

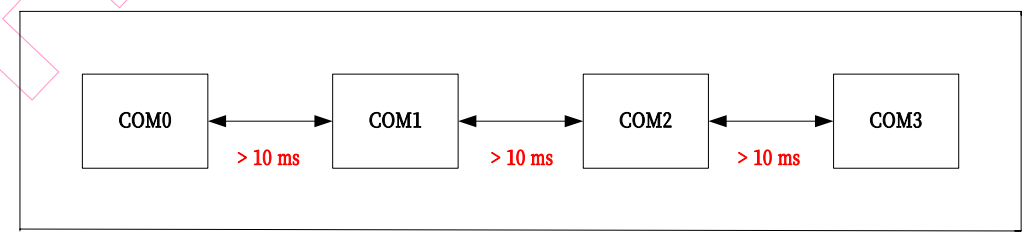
11.2.2 Command Timing Request

■ UART Interface

When host sends command to ePH1660, the time between two bytes must be less than 4ms. Otherwise, ePH1660 will not accept the command and access the “ACK error” message.



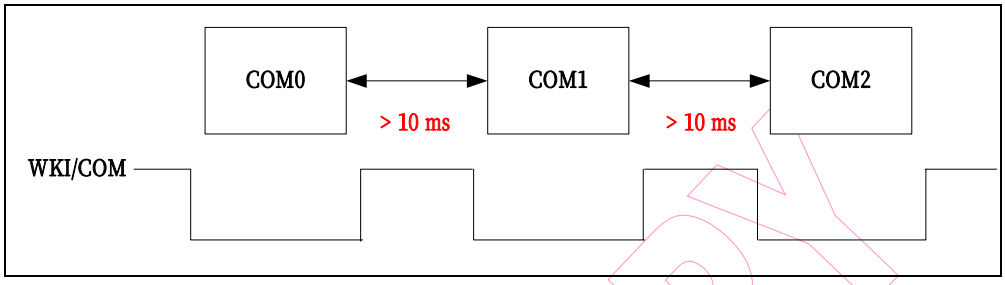
When host transmits command to ePH1660, the time between two consecutive commands must be longer than 10 ms.



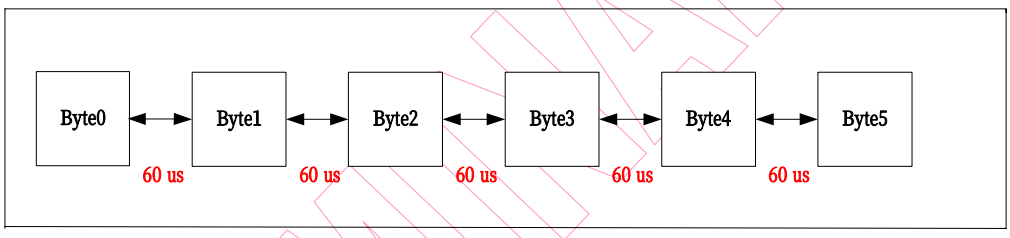
■ SPI Master Interface

Host commands restrictions:

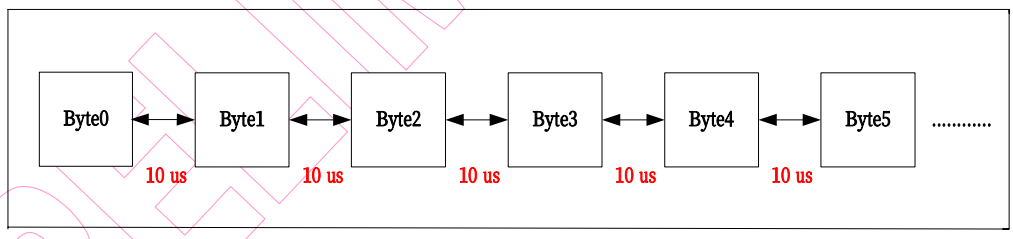
1. When the host is ready to transmit command, the WKI/COM pin must be pulled low by the host and kept at low level until the last byte is transmitted (see figure below). When the last byte is completely transmitted, then the host must pull high the WKI/COM pin to release ePH1660. If the WKI/COM pin remains at low level, ePH1660 will keep on waiting to release WKI/COM pin and transmit ACK.
2. When ePH1660 transmits ACK to host, the time between two consecutive bytes is 20μs.



ePH1660 inking timing: When host transmits inking data to ePH1660, the time between two consecutive bytes is 60μs.

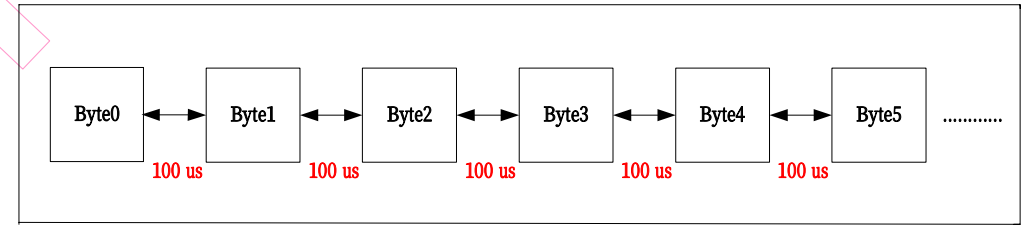


ePH1660 candidate timing: When host transmits inking data to ePH1660, the time between two consecutive bytes is 10μs.



■ SPI Slave Interface

Host clock restriction: When host transmits clock to ePH1660, the time between two consecutive bytes must be longer than 100μs.



11.2.3 Commands from Host *(see Section 11.3 for details)*

Command	Brief Description	Command Response	Response at Tapping*
0x33	Wake-up ePH1660 / Host Ready	Instantaneous	Instantaneous
0x10	Execute the set character recognition mode	Instantaneous	Instantaneous
0x14	Execute the set inking transmit switch	Instantaneous	Instantaneous
0x1A	Execute the set pen up (next tapping) waiting time	Instantaneous	Instantaneous
0x1B	Recognition before timeout	Instantaneous	As soon as pen is up
0x40	Get handwriting firmware version	Instantaneous	Instantaneous
0x41	Output with different code table	Instantaneous	Instantaneous
0x42	Software reset	Instantaneous	Instantaneous
0x43	Abort the current inking	Instantaneous	Instantaneous
0x46	Set writing area location	Instantaneous	Instantaneous
0x49	Set Recognition / Graphic mode	Instantaneous	Instantaneous
0x4A	Set power saving mode	Instantaneous	Instantaneous
0x4C	Rotate touch panel	Instantaneous	Instantaneous
0x4D	Set stroke over waiting time	Instantaneous	Instantaneous
0xF0	Output PROM/DROM checksum	Instantaneous	Instantaneous

* *1. Shows which command takes effect immediately when the host sends command to ePH1660 with the pen tapped and held on touch panel.*

2. If there is inadequate time to receive the host command, ePH1660 will initially access the "ACK error" message and wait for the host to send the correct command within 1.5 sec. After receiving a valid command or 1.5 sec timeout, ePH1660 continues to execute the original program.

11.2.4 Responses from ePH1660 *(see Section 11.4 for details)*

Command	Description
0x00	Ack error
0x16	Inking (written input) coordinates
0x17	Touch panel button area coordinates
0x18	Recognized characters array
0x33	Exit from power saving mode
0x42	Initial Power On
Host command dependent	Ack OK

11.3 Commands from Host Specifications

11.3.1 Wake up ePH1660/Host Ready (0x33; 8 Bytes)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0x33
2	Parameter length	1	HEX	0x04
3-6	Stuff	4	HEX	0x00; 0x00; 0x00; 0x00
7	Checksum	1	HEX	0xC7

Description: **1.** Host can use this command to wake up ePH1660.

2. This command can also be used by the host to notify the ePH1660, "I am ready." You can then start transmitting data after wake-up occurs (by tapping the touch pad).

Example: Same as Section 11.4.5, *Exit from Power Saving Mode*.

11.3.2 Set Character Recognition Mode (0x10; 8 Bytes)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0x10
2	Parameter length	1	HEX	0x04
3-4	Parameter	2	HEX	User defined
5-6	Stuff	2	HEX	0xFF; 0xFF
7	Checksum	1	HEX	–

Description: Set recognition type; 12 bits; default value: 0x3F01 (European/Russian characters & symbols disabled)

■ **Byte 3**

Bit No.	Recognition Type Description	Recognition Type Setting
0	Set Chinese Character Set I	0x0100
1	Set Chinese Character Set II	0x0200
2	Set capital letter	0x0400
3	Set numeral	0x0800
4	Set symbol	0x1000
5	Set default gesture	0x2000
6~7	Not defined	–

■ Byte 4

Bit No.	Recognition Type Description	Recognition Type Setting
0	Set small letter	0x0001
1~2	Not define	–
3	Set Russian (capital letter)	0x0008
4	Set Russian (small letter)	0x0010
5	Set European(capital letter)	0x0020
6	Set European(small letter)	0x0040
7	Set European(symbol)	0x0080

Stroke (Gesture) Definition:

Default Stroke Description	Default Stroke Setting
BackSpace	0x0008
Return/Enter	0x000D
Delete	0x0010
SPACE	0x0020

The following graphs show the default writing stroke. Dot on each stroke shows where to begin. Then lift the pen (stylus) at the end of the stroke. You only need to lightly tap and drag on the touch panel.

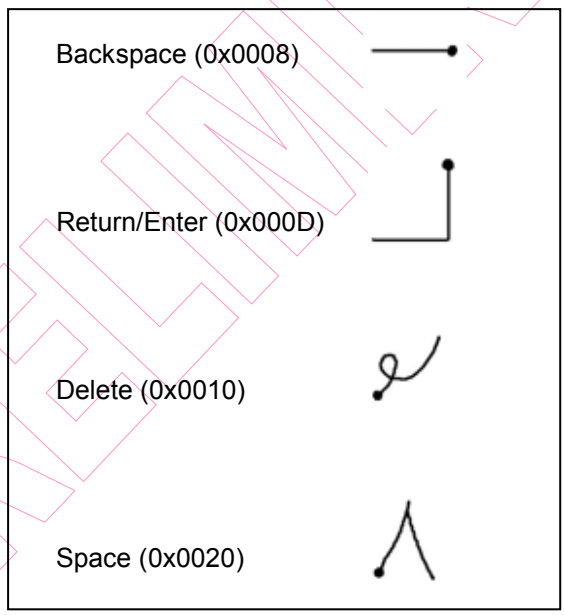


Figure 11-1 Default Writing Strokes

Example:

Command / Response	Host	ePH1660
COM (set recognition type)	50 10 04 FF 01 FF FF 19	–
ACK (set recognition type)	–	50 10 04 FF FF FF FF 59

11.3.3 Set Inking Transmit Switch (0x14; 8 Bytes)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0x14
2	Parameter length	1	HEX	0x04
3	User defined	1	HEX	On :0x01/Off: 0x00
4-6	Stuff	3	HEX	0xFF; 0xFF; 0xFF
7	Checksum	1	HEX	–

Description: Select whether to transmit or not the inking (written input). Default is to transmit (ON). During Graphic mode, inking transmit switch OFF command is ignored, but is carried out once you enter Recognition mode.

Examples:

1. Transmit inking coordinates (0x14)

Command / Response	Host	ePH1660
COM (Set inking transmit)	50 14 04 01 FF FF FF 3A	–
ACK (Set inking transmit)	–	50 14 04 FF FF FF FF FD

2. Do not transmit inking coordinates (0x14)

Command / Response	Host	ePH1660
COM (Do not transmit inking)	50 14 04 00 FF FF FF 2C	–
ACK (Do not transmit inking)	–	50 14 04 FF FF FF FF FD

11.3.4 Set Pen-up (Lifting of Stylus) Waiting Time (0x1A; 8 Bytes)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0x1A
2	Parameter length	1	HEX	0x04
3	User defined	1	HEX	–
4-6	Stuff	3	HEX	0xFF; 0xFF; 0xFF
7	Checksum	1	HEX	

Description: Set pen up (lifting of stylus) waiting time.

Pen-up Waiting Time Setting:

1. The ePH1660 divides the pen-up time into 20 steps. 1~20 are valid values, other values represent infinite waiting. Default is 600 ms.
2. Every step increases by an increment of about 100ms. "**1**" represents 1x100 ms, and "**10**" represents 10x100 ms. If infinite pen-up time is used, the ePH1660 must initially receive the "Recognizing immediately (0x1B)" command before executing character recognition.

Example:

Command / Response	Host	ePH1660
COM (set pen up waiting time)	50 1A 04 03 FF FF FF AF	–
ACK (set pen up waiting time)	–	50 1A 04 FF FF FF FF 44

11.3.5 Immediately Perform Recognition before Time out (0x1B; 8 Bytes)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0x1B
2	Parameter length	1	HEX	0x04
3-6	Stuff	4	HEX	0xFF; 0xFF; 0xFF; 0xFF
7	Checksum	1	HEX	0x6D

Description: Proceed to character recognition immediately.

Example:

Command / Response	Host	ePH1660
COM (recognize emmediately)	50 1B 04 FF FF FF FF 6D	–
ACK (can not recognize immediately)	–	50 1B 04 00 00 00 00 B3
ACK (can recognize immediately)	–	50 1B 04 FF FF FF FF 6D

11.3.6 Access the HWRE Firmware Version (0x40; 8 Bytes)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0x40
2	Parameter length	1	HEX	0x04
3-6	Stuff	4	HEX	0xFF; 0xFF; 0xFF; 0xFF
7	Checksum	1	HEX	0xB1

Description: Access the Handwriting Recognition Engine firmware version.

Example:

Command / Response	Host	ePH1660
COM (access firmware version)	50 40 04 FF FF FF FF B1	–
ACK (access firmware version)	–	50 40 04 01 01 7B 13 5E (V1.01 : 2007/11/13)

11.3.7 Output with Different Code Table (0x41; 8 Bytes)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0x41
2	Parameter length	1	HEX	0x04
3	User defined	1	HEX	default :GB2312 output 0x01:Unicode output others:GB2312 output
4-6	Stuff	3	HEX	0xFF; 0xFF; 0xFF
7	Checksum	1	HEX	–

Description: ePH1660 offers two code tables for your selection. Any value except "0x01" is regarded as default value. Default value is GB2312 output, and code table 0x01 is Unicode output. Note that European characters are only applicable under code table with Unicode output.

- write "华" → Unicode output (0x534E)
- write "华" → GB2312 output (0xBBAA)

Example:

Command / Response	Host	ePH1660
COM (output with different code table)	50 41 04 02 FF FF FF 65	–
ACK (output with different code table)	–	50 41 04 FF FF FF FF 98

11.3.8 Software Reset (0x42; 8 Bytes)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0x42
2	Parameter length	1	HEX	0x04
3-6	Stuff	4	HEX	0xFF; 0xFF; 0xFF; 0xFF
7	Checksum	1	HEX	0xE3

Description: Use this command to reset ePH1660. The ePH1660 will reset to initial power-on when this command is executed and all settings will return to its default values.

Example:

Command / Response	Host	ePH1660
COM (software reset)	50 42 04 FF FF FF FF E3	–
ACK (software reset)	–	50 42 04 FF FF FF FF E3
COM (initial power-on)	–	50 42 04 00 00 00 00 3D

11.3.9 Abort the Current Inking (0x43; 8 Bytes)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0x43
2	Parameter length	1	HEX	0x04
3-6	Stuff	4	HEX	0xFF; 0xFF; 0xFF; 0xFF
7	Checksum	1	HEX	0xCA

Description: Clear the current inking.

Example:

Command / Response	Host	ePH1660
COM (clear current inking)	50 43 04 FF FF FF FF CA	–
ACK (clear current inking)	–	50 43 04 FF FF FF FF CA

11.3.10 Set Writing Area Location (0x46; 8 Bytes)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0x46
2	Parameter length	1	HEX	0x04
3	Top-left X coordinate	1	HEX	0x00—0xFE
4	Top-left Y coordinate	1	HEX	0x00—0xFE
5	Bottom-right X coordinate	1	HEX	0x00—0xFE
6	Bottom-right Y coordinate	1	HEX	0x00—0xFE
7	Checksum	1	HEX	–

Description: Set the desired location of the writing area.

Example:

Command / Response	Host	ePH1660
COM (set writing area location)	50 46 04 10 10 F0 F0 96	–
ACK (set writing area location)	–	50 46 04 FF FF FF FF 47

11.3.11 Set Recognition Mode/Graphic Mode (0x49; 8 Bytes)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0x49
2	Parameter length	1	HEX	0x04
3	User defined	1	HEX	Recognition:0x00 / Graphic:0x01
4-6	Stuff	3	HEX	0xFF; 0xFF; 0xFF
7	Checksum	1	HEX	–

Description: Default is Recognition mode. Graphic mode transmission coordinates are similar to Recognition mode except recognition is not processed under Graphic mode.

Examples:

■ **Recognition Mode:**

Command / Response	Host	ePH1660
COM (set Recognition mode)	50 49 04 00 FF FF FF 06	–
ACK (set Recognition mode)	–	50 49 04 FF FF FF FF D7

■ **Graphic Mode (0x49):**

Command / Response	Host	ePH1660
COM (set Graphic Mode)	50 49 04 01 FF FF FF 10	–
ACK (set Graphic Mode)	–	50 49 04 FF FF FF FF D7

11.3.12 Set Power Saving Mode (0x4A; 8 Bytes)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0x4A
2	Parameter length	1	HEX	0x04
3	User defined	1	HEX	Enable “Tap to wake-up”: 0x01 Disable “Tap to wake-up”: 0x00
4	User defined	1	HEX	Idle time for idle mode to take effect: 1~20
5-6	Stuff	2	HEX	0xFF; 0xFF
7	Checksum	1	HEX	–

Description:

1. Byte 3 represents the tap on touch panel to wake-up switch
   0x01 → Enable “Tap to wake-up” function
   0x00 → Disable “Tap to wake-up” function

2. Byte 4 represents the idle (no input) time before power saving mode takes effect. The ePH1660 divides the time into 20 steps; i.e., 1~20 (valid values). Any other value above 20 is considered as "20." Every step increases by about 16 seconds. "**1**" represents 1x16 seconds and "**20**" represents 20x16 seconds. "**0**" value (default) is used to prevent the ePH1660 from going into power saving mode.
3. To instantly enter into power saving mode, add "0x80" to the defined idle time.

> **NOTE**
> *The instant power saving mode works only once and the defined idle time takes over.*

Example:

Command / Response	Host	ePH1660
COM (set power saving mode)	50 4A 04 01 02 FF FF 96	–
ACK (set power saving mode)	–	50 4A 04 FF FF FF FF AC

11.3.13 Rotate Touch Panel (0x4C; 8 Bytes)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0x4C
2	Parameter length	1	HEX	0x04
3	User defined	1	HEX	–
4~6	Stuff	3	HEX	0xFF; 0xFF; 0xFF
7	Checksum	1	HEX	–

Description: Swap touch panel X/Y axis.

■ **Byte 3**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	–	–	–	0	0	0	0

Bit 6=1 represents XN/YN positions change, XP/YP positions change

Bit 5=1 represents XN/XP position changes, Y position is fixed

Bit 4=1 represents YN/YP position changes, X position is fixed

Bit 7, Bits 0~3 must be fixed at 0.

Example:

Command / Response	Host	ePH1660
COM (rotate touch panel)	50 4C 04 70 FF FF FF B9	–
ACK (rotate touch panel)	–	50 4C 04 FF FF FF FF 5A

11.3.14 Set Stroke Over Waiting Time (0x4D; 8 Bytes)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0x4D
2	Parameter length	1	HEX	0x04
3	User defined	1	HEX	0x00 – 0xFF
4~6	Stuff	3	HEX	0xFF; 0xFF; 0xFF
7	Checksum	1	HEX	–

Description: Set stroke over waiting: 0x00~0xFF. Default value is 32 ms.

Example:

Command / Response	Host	ePH2610
COM (set stroke over waiting time: 32 ms)	50 4D 04 20 FF FF FF 6C	–
ACK (set stroke over waiting time)	–	50 4D 04 FF FF FF FF 73

11.3.15 Output PROM/DROM Checksum (0xF0; 8 Bytes)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0XF0
2	Parameter length	1	HEX	0x04
3~6	Stuff	4	HEX	0xFF; 0xFF; 0xFF ; 0xFF
7	Checksum	1	HEX	0xF8

Description: The ePH1660 can output PROM/DROM checksum through this command.

Example:

Command / Response	Host	ePH1660
COM (output PROM/DROM checksum)	50 F0 04 FF FF FF FF F8	–
ACK (output PROM/DROM checksum)	–	50 F0 04 FF FF FF FF F8
PROM checksum	–	50 F0 04 07 6C A6 F0 C3 ~~~~~~~~~~
DROM checksum	–	50 F0 04 EE 1C 56 BE 9F ~~~~~~~~~~

11.4 Responses from ePH1660 Specifications

11.4.1 ACK_ERROR (0x00; 8 Bytes)

Bytes	Function	Length	Data format	Remark
0	Header	1	HEX	0x50
1	Command	1	HEX	0x00
2	Parameter length	1	HEX	0x04
3-6	Stuff	4	HEX	0x00;0x00;0x00;0x00;
7	Checksum	1	HEX	0x19

Description: If the host sends an invalid command, the ePH1660 will respond with "ACK ERROR" to host.

Example:

Command / Response	Host	ePH1660
Response (ACK error)	–	50 00 04 00 00 00 00 19

11.4.2 Inking (Access to Written Input) Coordinates (0x16; 6 Bytes)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0x16
2	Parameter length	1	HEX	0x02
3	X coordinate	1	HEX	0x00—0xFE
4	Y coordinate	1	HEX	0x00—0xFE
5	Checksum	1	HEX	–

Description:

- **Normal inking:** when the stylus taps the touch panel, the coordinate is transmitted.
- **Stroke over:** when the stylus leaves the touch panel, "0xFF, 0xFF" is transmitted.
- **Word over:** when a word is completed, "0xFF, 0x00" is transmitted.

Example:

ePH1660 Inking Response	Desciption
50 16 02 60 60 ED	=>Normal inking
50 16 02 65 61 AB 50 16 02 6A 61 68 50 16 02 6F 60 2E 50 16 02 74 5F 53	
50 16 02 FF FF 1B	=>Stroke over
50 16 02 40 8D CE 50 16 02 45 8F 81 50 16 02 4A 8F 42 50 16 02 4F 8F 03 50 16 02 55 8E D1 50 16 02 5C 8E 6C 50 16 02 62 8D 4A 50 16 02 67 8D 0B 50 16 02 6F 8C A4 50 16 02 74 8B 71 50 16 02 79 8A 9F 50 16 02 7E 8A F4 50 16 02 83 89 00 50 16 02 89 89 82 50 16 02 8E 88 EE 50 16 02 93 87 7D 50 16 02 98 86 ED	
50 16 02 FF FF 1B	=>Stroke over
50 16 02 FF 00 E8	=>Word over
50 18 15 0A 8C 4E A0 4E AB 51 35 6C 09 4E 3D 00 3A 00 3B 00 69 00 21 00 F9	

11.4.3 Touch Panel Button Coordinates (0x17; 6 Bytes; 0XFF is Pen-up Signal)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0x17
2	Parameter length	1	HEX	0x02
3	X coordinate	1	HEX	0x00—0xFE; 0xFF
4	Y coordinate	1	HEX	0x00—0xFE; 0xFF
5	Checksum	1	HEX	–

Description: The default values of the touch panel writing area are (0x10, 0x10) and (0xF0, 0xF0). The ePH1660 will transmit coordinates through the touch panel button area (0x17) if the tapping occurs outside the writing area.

Example:

Command / Response	Host	ePH1660
Response (touch panel button)	–	50 17 02 01 01 3B

11.4.4 Recognized Characters Array (0x18; Maximum 25 Bytes; Minimum 6 Bytes)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0x18
2	Parameter length	1	HEX	–
3	Max. number of characters	1	HEX	–
4	Characters (low byte)	1	HEX	–
5	Characters (high byte)	1	HEX	–
….	–	–	–	–
N	Checksum	1	HEX	–

Description: Recognized characters array package. No character will utilize 6 bytes.

Example:

Command / Response	Host	ePH1660
Response (characters)	–	50 18 03 01 08 00 3A

11.4.5 Exit from Power Saving Mode (0x33; 8 Bytes)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0x33
2	Parameter length	1	HEX	0x04
3-6	Stuff	4	HEX	0xFF; 0xFF; 0xFF; 0xFF
7	Checksum	1	HEX	0x19

Description:

- **Wake-up Conditions**

  When the ePH1660 enters power saving mode, it will wake-up when one of the following conditions occurs:

  1. Touch panel wake-up ("tap to wake-up"):
     Tap the touch panel, the ePH1660 then wakes-up and sends 1 byte (0x00) to host. Host must respond "Host ready" within 8 sec, else ePH1660 will enter power saving mode again.

     NOTE
     The ePH1660 must have the tap-to-wake-up function enabled in order to perform this function.

Example:

Command / Response	Host	ePH1660
Touch panel wakeup response	–	00
Com (Host ready)	50 33 04 00 00 00 00 C7	–
ACK & Response	–	50 33 04 FF FF FF FF 19

  2. Command wake-up:
     Host executes command "50 33 04 00 00 00 00 C7" to wakeup ePH1660.

Example:

Command / Response	Host	ePH1660
Command wakeup	50 33 04 00 00 00 00 C7	–
Command wakeup response	–	50 33 04 FF FF FF FF 19

■ **ePH1660 Wake-up Response Signal Details**

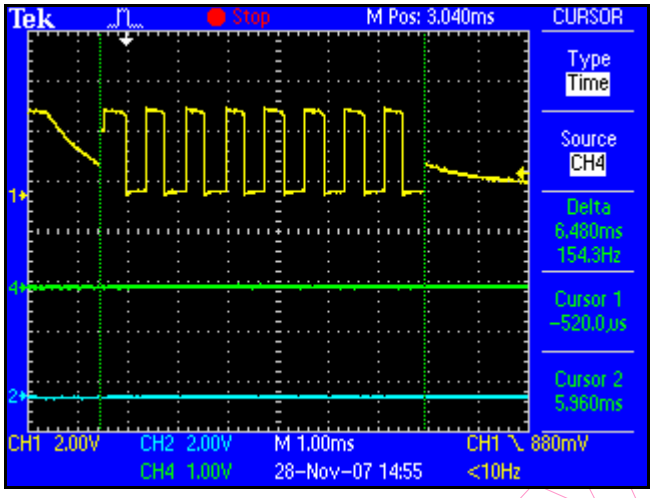


Figure 11-2 Response Signal Waveform after Wake-up

The above waveform illustrates the characteristics of the signal which ePH1660 sends to host after it wakes up from Idle mode.

11.4.6 Initial Power-on (0x42; 8 Bytes)

Bytes	Function	Length	Data Format	Remarks
0	Header	1	HEX	0x50
1	Command	1	HEX	0x42
2	Parameter length	1	HEX	0x04
3-6	Stuff	4	HEX	0x00; 0x00; 0x00; 0x00;
7	Checksum	1	HEX	0x3D

Description: When ePH1660 is powered on, it will send "Initial power-on" response to host.

Example:

Command / Response	Host	ePH1660
Response (initial power on)	–	50 42 04 00 00 00 00 3D

11.4.7 ACK_OK (Carry Out Host Command; 8 Bytes)

Bytes	Function	Length	Data format	Remark
0	Header	1	HEX	0x50
1	Follow host command	1	HEX	–
2	Parameter length	1	HEX	0x04
3-6	Stuff	4	HEX	0xFF,0xFF,0xFF,0xFF
7	Checksum	1	HEX	–

Description: After executing a host command, ePH1660 responds with an "ACK OK" format that corresponds to the given command.

Example: Refer to each command sample provided in this specification.

11.5 Checksum Program

Reference : www.6502.org:

Source: CRC Calculations

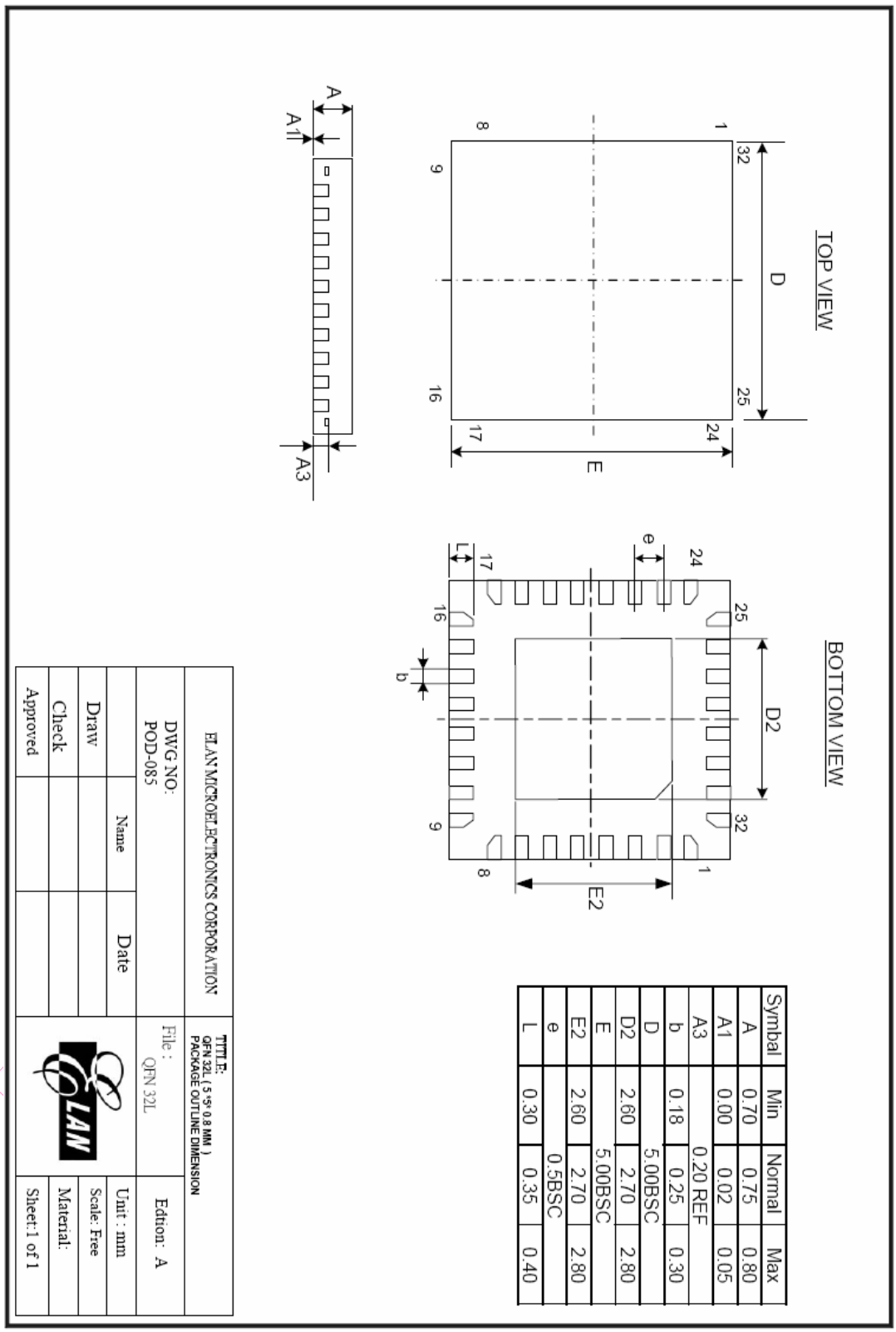
```
CRC-8 8bits checksum table
const BYTE CRCTable[256]={
0x00,0x07,0x0E,0x09,0x1C,0x1B,0x12,0x15,0x38,0x3F,0x36,0x31,
0x24,0x23,0x2A,0x2D,0x70,0x77,0x7E,0x79,0x6C,0x6B,0x62,0x65,
0x48,0x4F,0x46,0x41,0x54,0x53,0x5A,0x5D,0xE0,0xE7,0xEE,0xE9,
0xFC,0xFB,0xF2,0xF5,0xD8,0xDF,0xD6,0xD1,0xC4,0xC3,0xCA,0xCD,
0x90,0x97,0x9E,0x99,0x8C,0x8B,0x82,0x85,0xA8,0xAF,0xA6,0xA1,
0xB4,0xB3,0xBA,0xBD,0xC7,0xC0,0xC9,0xCE,0xDB,0xDC,0xD5,0xD2,
0xFF,0xF8,0xF1,0xF6,0xE3,0xE4,0xED,0xEA,0xB7,0xB0,0xB9,0xBE,
0xAB,0xAC,0xA5,0xA2,0x8F,0x88,0x81,0x86,0x93,0x94,0x9D,0x9A,
0x27,0x20,0x29,0x2E,0x3B,0x3C,0x35,0x32,0x1F,0x18,0x11,0x16,
0x03,0x04,0x0D,0x0A,0x57,0x50,0x59,0x5E,0x4B,0x4C,0x45,0x42,
0x6F,0x68,0x61,0x66,0x73,0x74,0x7D,0x7A,0x89,0x8E,0x87,0x80,
0x95,0x92,0x9B,0x9C,0xB1,0xB6,0xBF,0xB8,0xAD,0xAA,0xA3,0xA4,
0xF9,0xFE,0xF7,0xF0,0xE5,0xE2,0xEB,0xEC,0xC1,0xC6,0xCF,0xC8,
0xDD,0xDA,0xD3,0xD4,0x69,0x6E,0x67,0x60,0x75,0x72,0x7B,0x7C,
0x51,0x56,0x5F,0x58,0x4D,0x4A,0x43,0x44,0x19,0x1E,0x17,0x10,
0x05,0x02,0x0B,0x0C,0x21,0x26,0x2F,0x28,0x3D,0x3A,0x33,0x34,
0x4E,0x49,0x40,0x47,0x52,0x55,0x5C,0x5B,0x76,0x71,0x78,0x7F,
0x6A,0x6D,0x64,0x63,0x3E,0x39,0x30,0x37,0x22,0x25,0x2C,0x2B,
0x06,0x01,0x08,0x0F,0x1A,0x1D,0x14,0x13,0xAE,0xA9,0xA0,0xA7,
0xB2,0xB5,0xBC,0xBB,0x96,0x91,0x98,0x9F,0x8A,0x8D,0x84,0x83,
0xDE,0xD9,0xD0,0xD7,0xC2,0xC5,0xCC,0xCB,0xE6,0xE1,0xE8,0xEF,
0xFA,0xFD,0xF4,0xF3};

Code of producing and verifying checksum :
unsigned char GenerateCRC(unsigned char *Packet,
 int size)
{
int i;
unsigned char value;
value=0;
for(i=0;i<size-1;i++){
  value ^= Packet[i];
  value=CRCTable[value];
}
return value;
}

void main(void)
{
  unsigned char Packet[8]; //produce checksum of 8bytes package
  int I;
  for(I=0;I<8;I++)Packet[I]=0;
 Packet[7]=GenerateCRC(Packet,sizeof(Packet)) //checksum place the eighth
                                                byte }
```

12 Package Outline Drawing

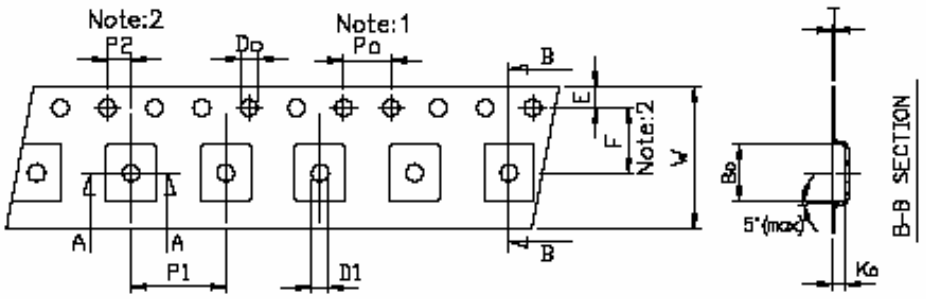
■ **QFN 32**

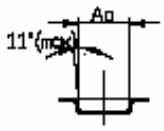


Symbal	Min	Normal	Max
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3		0.20 REF	
b	0.18	0.25	0.30
D		5.00BSC	
D2	2.60	2.70	2.80
E		5.00BSC	
E2	2.60	2.70	2.80
e		0.5BSC	
L	0.30	0.35	0.40

ELAN MICROELECTRONICS CORPORATION			TITLE: QFN 32L (5 *5* 0.8 MM) PACKAGE OUTLINE DIMENSION
DWG NO: POD-085			
	Name	Date	File : QFN 32L
Draw			Edition: A
Check			Unit : mm
Approved			Scale: Free
			Material:
			Sheet:1 of 1

13 Tape Reel Specification





A–A SECTION

Ao= 4.20±0.10 mm
Bo= 4.80±0.10 mm
Ko= 1.15±0.10 mm

Unit: mm

Symbol	Spec.
K1	–
Po	4.0±0.10
P1	8.0±0.10
P2	2.0±0.05
Do	1.55±0.05
D1	1.50(MIN)
E	1.75±0.10
F	5.50±0.05
10Po	40.0±0.10
W	12.0±0.20
T	0.30±0.05

Notice:

1. 10 Sprocket hole pitch cumulative tolerance is ±0.1mm
2. Pocket position relative to sprocket hole measured as true position of pocket not pocket hole.
3. Ao & Bo measured on a place 0.3mm above the bottom of the pocket to top surface of the carrier.
4. Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
5. Carrier camber shall be not than 1mm per 100mm through a length of 250mm.

SCALE: 2:1	MATERIAL:	TITLE: 4.5x3.9x0.87 Carrier Tape
UNIT: MM		
PROJ:	TREATMENT:	DWG NO: R1208-005401
DESIGNED: / DATE:	DRAWN: / DATE:	APPROVED: / DATE:

14 European Characters Table

0083	ƒ	00C2	Â	00D7	×	00EC	ì
0160	Š	00C3	Ã	00D8	Ø	00ED	í
0152	Œ	00C4	Ä	00D9	Ù	00EE	î
0161	š	00C5	Å	00DA	Ú	00EF	ï
0153	œ	00C6	Æ	00DB	Û	00F0	ð
009F	Ÿ	00C7	Ç	00DC	Ü	00F1	ñ
00A1	¡	00C8	È	00DD	Ý	00F2	ò
00A2	¢	00C9	É	00DE	Þ	00F3	ó
00A3	£	00CA	Ê	00DF	ß	00F4	ô
00A5	¥	00CB	Ë	00E0	à	00F5	õ
00A7	§	00CC	Ì	00E1	á	00F6	ö
00AB	«	00CD	Í	00E2	â	00F7	÷
00B1	±	00CE	Î	00E3	ã	00F8	ø
00B5	µ	00CF	Ï	00E4	ä	00F9	ù
00BB	»	00D0	Ð	00E5	å	00FA	ú
00BC	¼	00D1	Ñ	00E6	æ	00FB	û
00BD	½	00D2	Ò	00E7	ç	00FC	ü
00BE	¾	00D3	Ó	00E8	è	00FD	ý
00BF	¿	00D4	Ô	00E9	é	00FE	þ
00C0	À	00D5	Õ	00EA	ê	00FF	ÿ
00C1	Á	00D6	Ö	00EB	ë	-	-

15 Russian Characters Table

0x0410	А	0x0423	У	0x0436	ж	0x044A	ъ
0x0411	Б	0x0424	Ф	0x0437	з	0x044B	ы
0x0412	В	0x0425	Х	0x0438	и	0x044C	ь
0x0413	Г	0x0426	Ц	0x0439	й	0x044D	э
0x0414	Д	0x0427	Ч	0x043A	к	0x044E	ю
0x0415	Е	0x0428	Ш	0x043B	л	0x044F	я
0x0401	Ё	0x0429	Щ	0x043C	м		
0x0416	Ж	0x042A	Ъ	0x043D	н		
0x0417	З	0x042B	Ы	0x043E	о		
0x0418	И	0x042C	Ь	0x043F	п		
0x0419	Й	0x042D	Э	0x0440	р		
0x041A	К	0x042E	Ю	0x0441	с		
0x041B	Л	0x042F	Я	0x0442	т		
0x041C	М	0x0430	а	0x0443	у		
0x041D	Н	0x0431	б	0x0444	ф		
0x041E	О	0x0432	в	0x0445	х		
0x041F	П	0x0433	г	0x0446	ц		
0x0420	Р	0x0434	д	0x0447	ч		
0x0421	С	0x0435	е	0x0448	ш		
0x0422	Т	0x0451	ё	0x0449	щ		