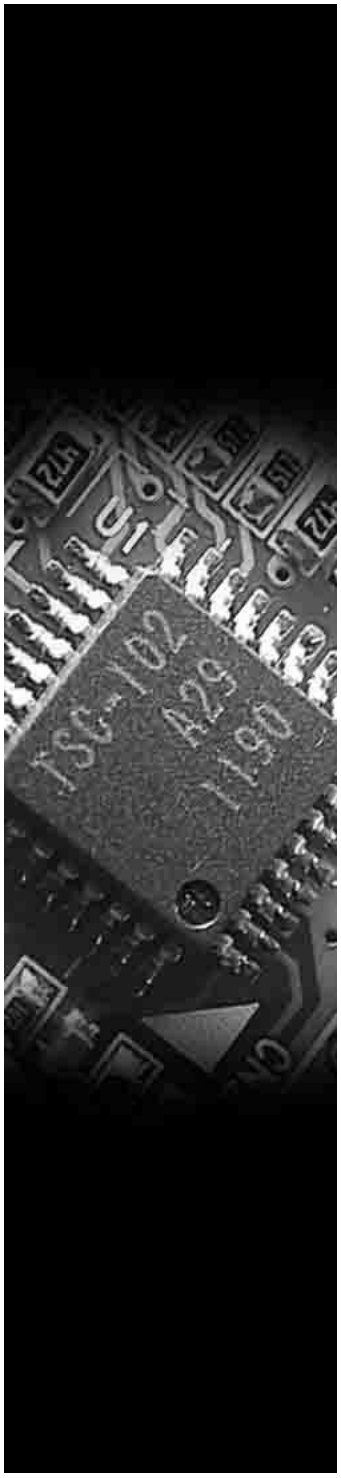


DMC Co., Ltd.

Analog Resistive Touch Screen Controller
TSC-50/IC Software Specification

Table of Contents

1. Scope of Application 2
2. Outline 2
3. Operation modes and functions 3
3-1. Outline 3
3-2. Initialization mode and idle mode 5
3-3. Coordinate data mode 9
3-4. Calibration data setup mode 15
3-5. Calibration data read mode 24
3-6. Calibration data mode 26
3-7. STOP mode 33
3-8. Panel ID/mode information acquisition 34
3-9. Mode list 36
4. Extended command 37
4-1. Panel ID setting (USB mode only) 37
4-2. Calibration data protection 38
5. Command list 40
6. Changes & Improvements 42
6-1. Version History 42
7. Notes on use 43
7-1. Overall handling 43
7-2. Others 43

1. Scope of Application

This specification applies to the TSC-50/IC.

2. Outline

This document explains

Mode information

Command communication with the host computer

Coordinate data format Etc…

3. Operation modes and functions

3-1. Outline

TSC-50/IC enters the Initialization mode immediately after it is turned on or reset. In this mode, no setting is made and each mode shall be set. To transition to the available state, select the coordinate output rate and coordinate output mode and set the operation mode.

§ Initialization mode

By either power supply ON or hardware reset/software reset, the internal initial setting is performed. In the serial scheme, communication with host is available. In USB scheme, device recognition process ends. In this mode, both serial and USB schemes receive a coordinate output rate command and transition to the idle mode.
After hardware reset, it takes 500ms to transition to the initialization mode.
In using the EEPROM, EEPROM data is read in this mode.

§ Idle mode

TSC-50/IC enters this operation waiting mode after the coordinate output rate setting command is received. Transition to each mode takes place in this mode.

§ Coordinate data mode

In this mode, analog data obtained from touch screen is output as coordinate data with 10 bit resolution without any calibration.
This mode starts in the " idle mode" by receiving the coordinate data send start command, and returns to " idle mode" again after receiving the coordinate data send end command. By receiving reset command, it transitions to the " initialization mode" .
This mode is used when host driver implements the calibration function, and also when necessary data is obtained in the calibration data setup mode.

§ Calibration data setup mode

In this mode, calibration data used in " calibration data mode" is set. Transition to this mode takes place when the setup mode start command is received in the idle mode. Select an appropriate calibration point among:
- X=2, Y=2 (four point calibration)
- X=3, Y=3 (nine point calibration) and
- X=2, Y=2 (four point calibration) plus one center position (five point calibration)

When this mode ends, calibration data is entered to EEPROM.

§ Calibration data read mode

In this mode, setup data is read out from EEPROM if in using EEPROM, data set in the " calibration data setup mode" is stored to EEPROM. It is used if setting data is to be confirmed. Transition to this mode takes place and calibration data is output to the host if in the idle mode, calibration data read command is received.

§ Calibration data mode

In this mode, individual difference and loss in the touch screen are corrected and coordinate value output is performed. Using calibration data set in the " calibration data setup mode" , touch screen input point and indicator' s cursor display position can be matched.
In using this mode, the host driver needs no calibration function.
Using " calibration data setup mode" setting value to set the coordinate data maximum value, maximum value can be limited to 10bits or less.
This mode starts when in the idle mode, any " calibration data send start command" is received, and returns to the idle mode when receiving the calibration data send end command. When receiving the reset command, this mode transitions to the initialization mode.

§ STOP mode

This mode is enabled only in the serial communication. This mode starts when in the idle mode, STOP mode start command is received. This mode stops ceramic vibrator’ s vibration and enters the power saving mode where the operation stops. By hardware reset, this mode transitions to the initialization mode. By receiving [00h] (null command) from host, the power saving mode ends and transitions to the idle mode.

§ Power-save mode

This mode is only enabled in the serial communication. If in the coordinate data mode transitioned from [01h] or the calibration data mode transitioned from [0Ah], there are no inputs on the touch screen for 20 samplings, the ceramic vibrator stops its vibration and enters the power saving mode where no operations are taken. By inputting the touch screen or receiving a command from host, power saving mode is released and the transition to “ coordinate data mode “ or ” calibration data mode“ takes place.

3-2. Initialization mode and idle mode

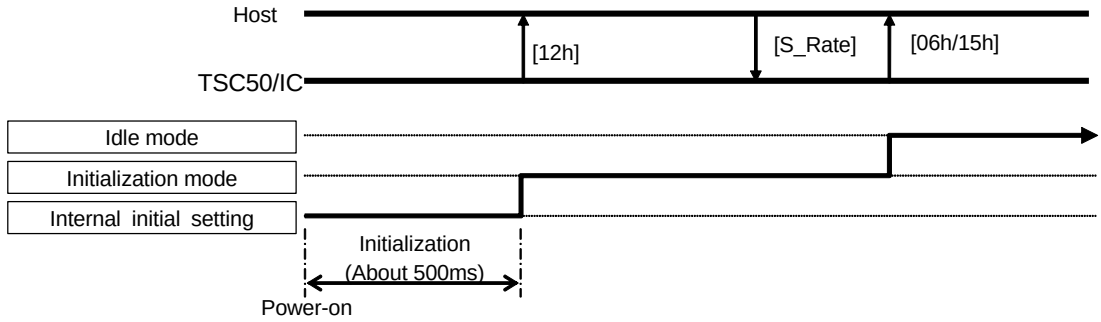
After the power up or hardware reset, internal initialization setting is performed (about 500ms) and the transition to the initialization mode occurs, where waiting for the communication with host. In this mode, if external EEPROM is used, EEPROM data is read.

In the initialization mode, use the coordinate output rate setting command to set the interval for sending a coordinate. Where, touch screen connection state and EEPROM data are checked and in either normal or abnormal case, data representing each state is output to the host. Thus, the initialization mode transitions to the idle mode. Transition to each mode occurs from the idle mode. Once coordinate output rate is set with transition to the idle mode, coordinate output rate setting may be available again.

If in either idle mode, coordinate data mode or calibration data mode, reset command is received, transition to the initialization mode occurs. Where, after receiving the reset command, internal processing takes a time, be sure to issue subsequent commands after 15ms or more is elapsed.

<Serial>

§ Mode transition



*After application of power (hardware-reset), to tell a host computer having changed into the state where TSC-50/IC can communicate, it outputs “ 12h” . But, “ 12h” is not outputted when software-reset is carried out.

§ Coordinate output rate setting command (S_Rate)

Mode	Sampling	Command	Description
Stream	30p/s	05h+40h	
	50p/s	05h+41h	
	80p/s	05h+42h	
	100p/s	05h+43h	
	130p/s	05h+44h	
	150p/s	05h+45h	
Point	Once when touched	05h+50h	In the coordinate (calibration) data mode, no pen-up data is output.

§ Response command (no EEPROM is used)

State	Response command	Byte width	Description of mode
Normal	06h (ACK)	1 byte	Touch screen connection normal
Abnormal	15h (NAK)	1 byte	Touch screen not connected

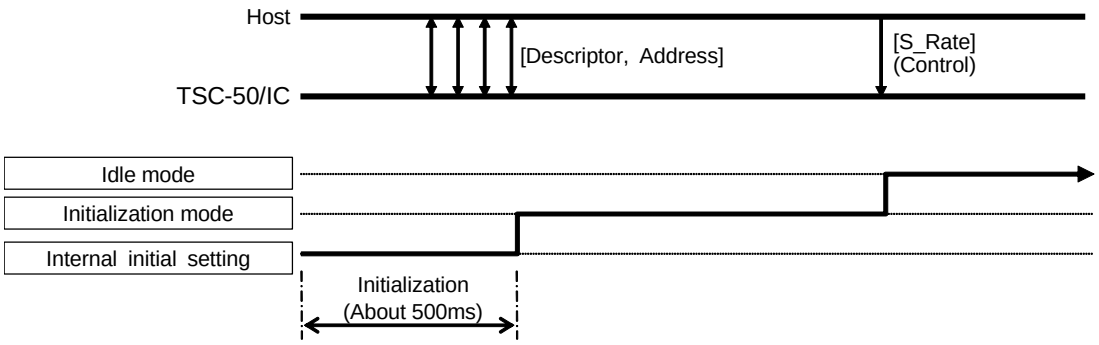
§ Response command (EEPROM is used)

State	Response command	Byte width	Description of mode
Normal	06h (ACK)	1 byte	Touch screen connection, EEPROM data normal
Abnormal	15h (NAK) + detail code		
	bit0=1 (01h)	2 bytes	EEPROM data empty
	bit1=1 (02h)		EEPROM data abnormal
	bit2=1 (04h)		EEPROM write error
	bit3=1 (08h)		Touch screen not connected

* If, in the initialization mode, coordinate output rate setting is performed, EEPROM is checked if data is present or not. Thus, error code only refers to EEPROM data empty (detail code: 01h).
In the idle mode, run the calibration data setup mode. After EEPROM data abnormal or EEPROM write error occurs, set the coordinate output rate, error code is output, indicating EEPROM data abnormal or EEPROM write error. Error flag can be deleted by either hardware reset or software reset.

<USB>

§ Mode transition



§ USB Device Descriptor

Offset address	Field name	Bit Width	Contents	Remarks
8	idVendor	2 bytes	0AFAh	
10	idProduct	2 bytes	03E8h	
15	iProduct	1 byte	00h:Panel ID=0 01h:Panel ID=1 02h:Panel ID=2 03h:Panel ID=3	These are set by Pin number 24/35 of TSC-50/IC. Please refer to 3-8.

§ Coordinate output rate setting command (Rate)

Rate	bmRequest Type	bRequest	wValue	wIndex	wLength	Data
30	C0h (IN)	05h	0040h	0000h	0002h	0600h/15##h*
50	C0h (IN)	05h	0041h	0000h	0002h	0600h/15##h*
80	C0h (IN)	05h	0042h	0000h	0002h	0600h/15##h*
100	C0h (IN)	05h	0043h	0000h	0002h	0600h/15##h*
130	C0h (IN)	05h	0044h	0000h	0002h	0600h/15##h*
150	C0h (IN)	05h	0045h	0000h	0002h	0600h/15##h*
Point	C0h (IN)	05h	0050h	0000h	0002h	0600h/15##h*

#: Differs per error type.

*: Refer to the response command (no EEPROM is used) and response command (EEPROM is used).

§ Response command (no EEPROM is used)

State	Response command	Byte width	State description
Normal	0600h	2 bytes	Touch screen connection normal
Abnormal	1500h	2 bytes	Touch screen not connected

§ Response command (EEPROM is used)

State	Response data	Byte width	State description
Normal	0600h	2 bytes	Touch screen connection, EEPROM data normal
Abnormal	1501h	2 bytes	EEPROM data empty
	1502h		EEPROM data abnormal
	1504h		EEPROM write error
	1508h		Touch screen not connected

* If, in the initialization mode, coordinate output rate setting is performed, EEPROM is checked if data is present or not. Thus, error code only refers to EEPROM data empty (detail code: 01h).
In the idle mode, run the calibration data setup mode. After EEPROM data abnormal or EEPROM write error occurs, set the coordinate output rate, error code is output, indicating EEPROM data abnormal or EEPROM write error. Error flag can be deleted by either hardware reset or software reset.

3-3. Coordinate data mode

Analog data input from analog touch screen is A/D converted for calculating the coordinate data, which is output in this mode.

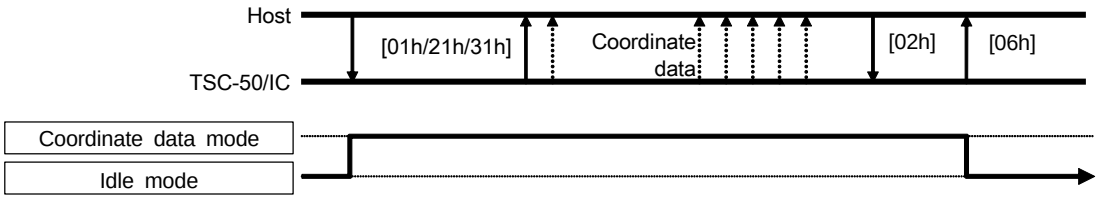
This mode is used if calibration is made in the host driver. In using the external EEPROM in the calibration data mode, previously performed ” calibration data setup mode“ needs raw data, which is obtained in this mode.

From the idle mode, this mode starts by receiving either command of coordinate data send start 1 – 3, and returns to the idle mode by receiving the coordinate data send end command. By receiving “ reset” command, the mode transition to the initialization mode.

At the touch screen input (when a finger or pen touches on the touch screen), coordinate data, including pen-down ID indicating that touch screen is input, is output to the host with coordinate output rate interval. If the touch screen input ends (when a finger or pen leaves the touch screen), pen-up ID of 1byte is output (excluding the point mode).

<Serial>

§ Mode transition



§ Command and each mode function

Mode name	Command	Function
Coordinate data send start 1	01h	Pen-down: Coordinate data including pen-down ID is output with the coordinate output rate interval. Pen-up: Pen-up ID is output one time. No input: If there are no inputs for 20 sampling times, transition to the power-save mode occurs.
Coordinate data send start 2	21h	Pen-down: Coordinate data including pen-down ID is output with the coordinate output rate interval. Pen-up: Coordinate data including pen-up ID is output with the coordinate output rate interval. No input: No transition to the power-save mode.
Coordinate data send start 3	31h	Pen-down: Coordinate data including pen-down ID is output with the coordinate output rate interval. Pen-up: Pen-up ID is output one time. No input: No transition to the power-save mode.
Coordinate data send end	02h	Coordinate data mode ends and transition to the idle mode occurs.

§ Response command (For coordinate data send end)

State	Response command	Byte width	Description of mode
Normal	06h (ACK)	1 byte	Ended normally.

§ Coordinate format

Pen-down data

	Meaning	b7	b6	b5	b4	b3	b2	b1	b0
Byte 0	Pen Down ID	SW0	SW1	0	1	0	0	0	1
Byte 1	X Upper	0	0	0	0	0	0	X9	X8
Byte 2	X Lower	X7	X6	X5	X4	X3	X2	X1	X0
Byte 3	Y Upper	0	0	0	0	0	0	Y9	Y8
Byte 4	Y Lower	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0

Pen-up data

	Meaning	b7	b6	b5	b4	b3	b2	b1	b0
Byte 0	Pen Up ID	SW0	SW1	0	1	0	0	0	0

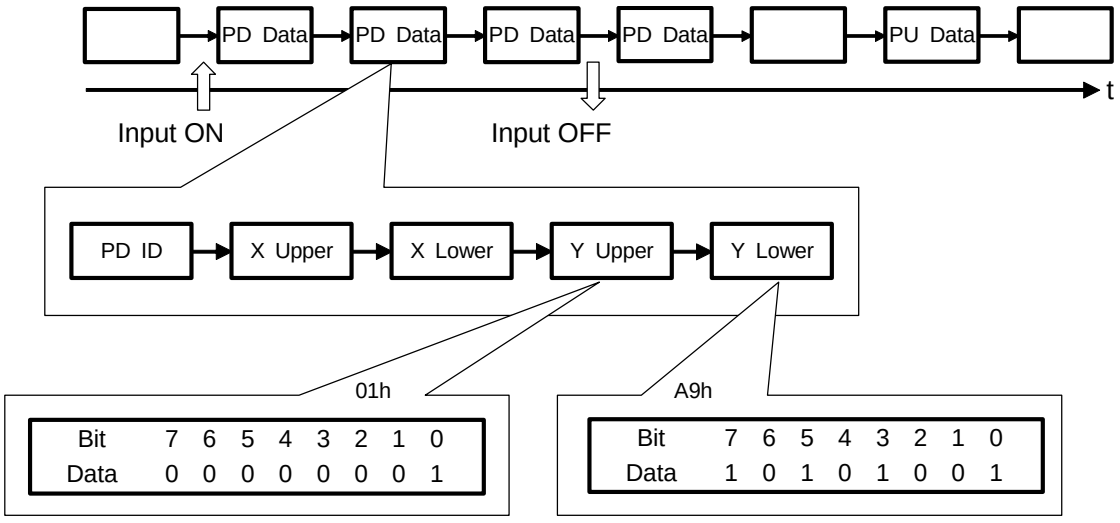
List of Pen-down ID (pen-down data Byte 0)

ID	SW0	SW1
11h	0	0
51h	0	1
91h	1	0
D1h	1	1

List of pen-up ID (pen-up data Byte 0)

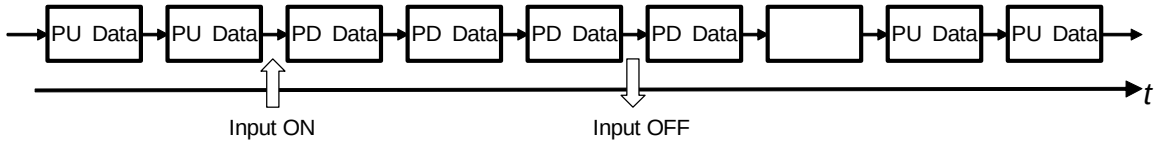
ID	SW0	SW1
10h	0	0
50h	0	1
90h	1	0
D0h	1	1

§ Example of Data (transmission starts at receiving [01h] or [31h]) (Where X = 0374h and Y = 01A9h)



Immediately after Pen-up, if the first sampling is pen-up, immediately preceding pen-down data is output. If second time sampling is pen-up, none is output. If third time sampling is pen-up, pen-up data is output once.

§ Example of data (transmission starts at receiving [21h])

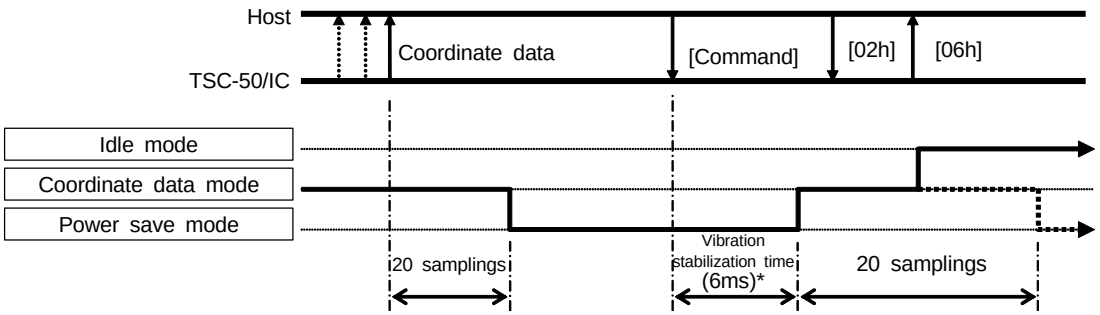


*: Immediately after Pen-up, if the first sampling is pen-up, immediately preceding pen-down data is output. If second time sampling is pen-up, none is output. If third time sampling is pen-up, pen-up data is output. Thereafter, pen-up data is output at the coordinate output rate interval.

§ Power-save mode

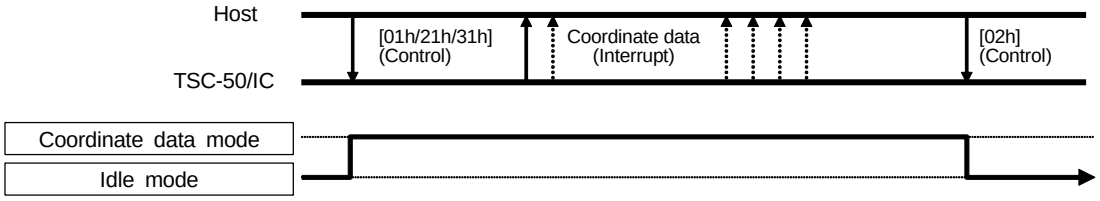
" Coordinate data send start 1" command (01h) activates the transition to the coordinate data mode. If for 20 sampling times (Example: 100p/s = 200ms), no touch screen is input, ceramic vibrator' s vibration stops and the operation ends by entering the power saving mode. Input to the touch screen (analog data input) or command reception from host will release this mode, and after the vibration stabilization time elapses (6ms*), the operation returns to the coordinate data mode.
If TSC-50/IC receives " coordinate data mode end" command (02h), this mode shall be released. Thus, within 20 sampling times in the condition where either command (or touch screen input) releases this mode, [02h] shall be received.

*Time to release this mode may change by the using vibrator or a circuitry. Please confirm it in environment to use before designing the software.



<USB>

§ Mode transition



§ Command

Mode	bmRequest Type	bRequest	wValue	wIndex	wLength	Data
Coordinate data send start 1	40h (OUT)	01h	0000h	0000h	0000h	-
Coordinate data send start 2	40h (OUT)	21h	0000h	0000h	0000h	-
Coordinate data send start 3	40h (OUT)	31h	0000h	0000h	0000h	-
Coordinate data send end	C0h (IN)	02h	0000h	0000h	0002h	0600h

§ Each mode function

Mode	Function
Coordinate data send start 1	Pen-down: Coordinate data including pen-down ID is output with the coordinate output rate interval. Pen-up: Pen-up ID is output one time. No input: No transition to the power-save mode.
Coordinate data send start 2	Pen-down: Coordinate data including pen-down ID is output with the coordinate output rate interval. Pen-up: Coordinate data including pen-up ID is output with the coordinate output rate interval. No input: No transition to the power-save mode.
Coordinate data send start 3	Pen-down: Coordinate data including pen-down ID is output with the coordinate output rate interval. Pen-up: Pen-up ID is output one time. No input: No transition to the power-save mode.
Coordinate data send end	Coordinate data mode ends and transition to the idle mode occurs.

§ Coordinate format

Pen-down data

	Meaning	b7	b6	b5	b4	b3	b2	b1	b0
Byte 0	Pen Down ID	SW0	SW1	0	1	0	0	0	1
Byte 1	X Lower	X7	X6	X5	X4	X3	X2	X1	X0
Byte 2	X Upper	0	0	0	0	0	0	X9	X8
Byte 3	Y Lower	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0
Byte 4	Y Upper	0	0	0	0	0	0	Y9	Y8

Pen-up data

	Meaning	b7	b6	b5	b4	b3	b2	b1	b0
Byte 0	Pen Up ID	SW0	SW1	0	1	0	0	0	0
Byte 1	X Lower	X7	X6	X5	X4	X3	X2	X1	X0
Byte 2	X Upper	0	0	0	0	0	0	X9	X8
Byte 3	Y Lower	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0
Byte 4	Y Upper	0	0	0	0	0	0	Y9	Y8

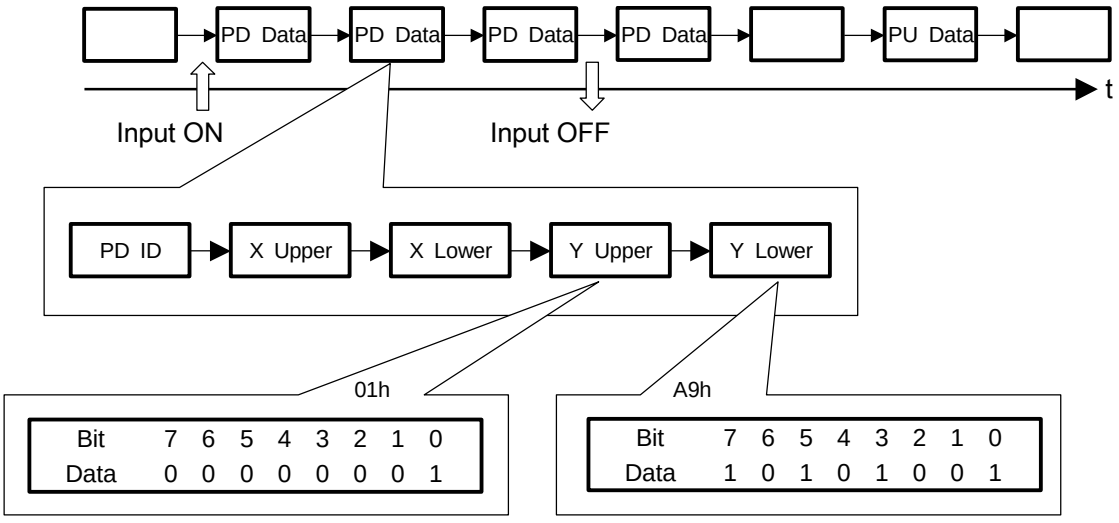
List of Pen-down ID (pen-down data Byte 0)

ID	SW0	SW1
11h	0	0
51h	0	1
91h	1	0
D1h	1	1

List of pen-up ID (pen-up data Byte 0)

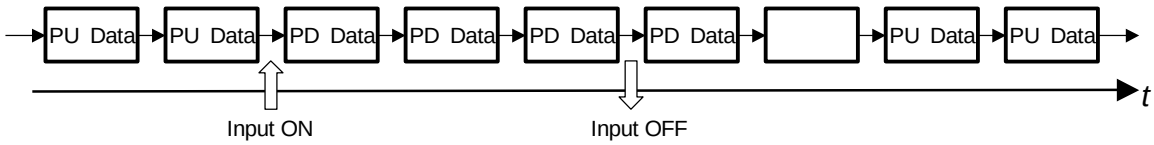
ID	SW0	SW1
10h	0	0
50h	0	1
90h	1	0
D0h	1	1

§ Example of data (transmission starts at receiving [01h] or [31h]) (Where, X = 0374h and Y = 01A9h)



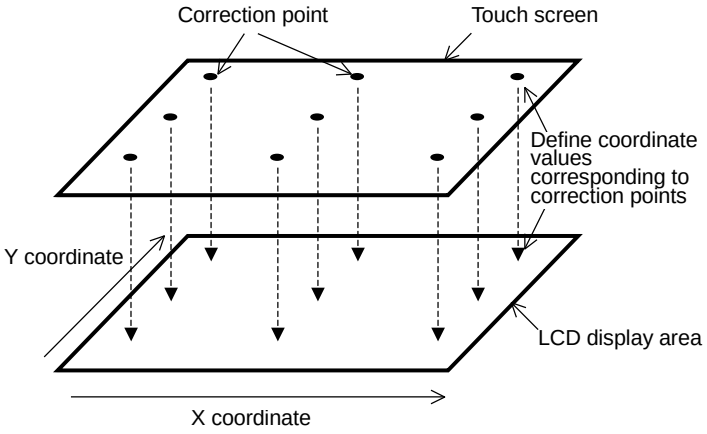
Immediately after Pen-up, if the first sampling is pen-up, immediately preceding pen-down data is output. If second time sampling is pen-up, none is output. If third time sampling is pen-up, pen-up data is output once.

§ Example of data (transmission starts at receiving [21h])



*: Immediately after Pen-up, if the first sampling is pen-up, immediately preceding pen-down data is output. If second time sampling is pen-up, none is output. If third time sampling is pen-up, pen-up data is output. Thereafter, pen-up data is output at the coordinate output rate interval. Coordinate value at pen-up always takes same coordinate value as the last pen-down data. After the coordinate data mode transition until the first pen-down, 0000h is output.

3-4. Calibration data setup mode

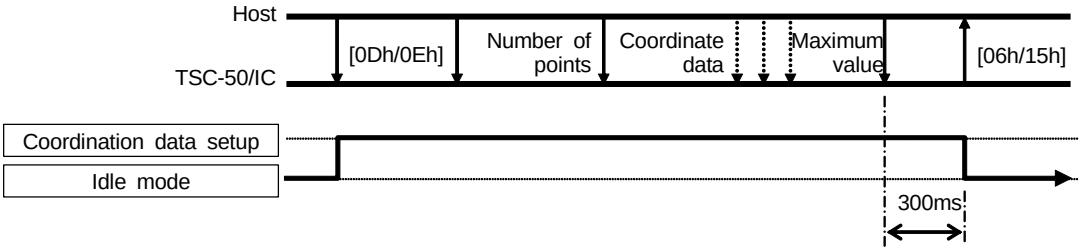


On the touch screen, due to offset and rotation caused by shifted pasting on touch screen and elements such as losses from surrounding circuit, touch screen input point and indicator coordinate indication may be unmatched with each other if A/D conversion value is output as coordinate value.
To resolve this, TSC-50/IC defines in advance any point on touch screen as a calibration point, where the calibration point' s raw coordinate (A/D conversion value) and calibration coordinate value to be output to the host after calibration, and in the actual operation, from defined coordinate value, corresponding calibration coordinate value of touch screen input point' s raw coordinate is calculated and output to the host (calibration data mode).
In this mode, data required for calibration is set up. Number of maximum calibration points is nine in total with X = 3 and Y = 3. Please choose 4, 5, 6 or 9 points.

For setup in this mode, coordinates of calibration points in the coordinate data mode shall be obtained in advance.
By receiving setup mode start command in the idle mode, the operation transitions to this mode and after setup processing ends, data corresponding to the normal end or abnormal end is output to the host, then the operation returns to the idle mode.
If the external EEPROM is used, this processing writes data to EEPROM.

<Serial>

§ Mode transition



* Within 300 msec after the last data (calibration data maximum value) is received and until the operation transitions to the idle mode, no command reception is available.

§ Command

Mode	Command	Function
Setup mode start 1	0Dh	Normal calibration (Specify the number of calibration points in X and Y each)
Setup mode start 2	0Eh	Five point calibration (four points at touch screen' s 4 corners and one point at the center)

§ Response command (no EEPROM is used)

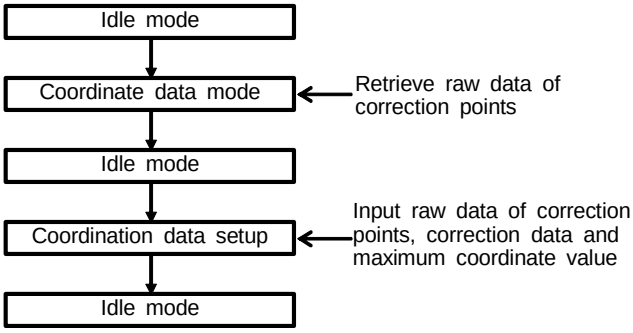
State	Response command	Bit width	Mode description
Normal	06h (ACK)	1 byte	Setting completed
Abnormal	15h (NAK)	1 byte	Parameter abnormal

§ Response command (EEPROM is used)

State	Response command	Bit width	Mode description
Normal	06h (ACK)	1 byte	EEPROM write normal
Abnormal	15h (NAK) + detail code		
	bit1=1 (02h)	2 bytes	EEPROM data abnormal
	bit2=1 (04h)		EEPROM write error

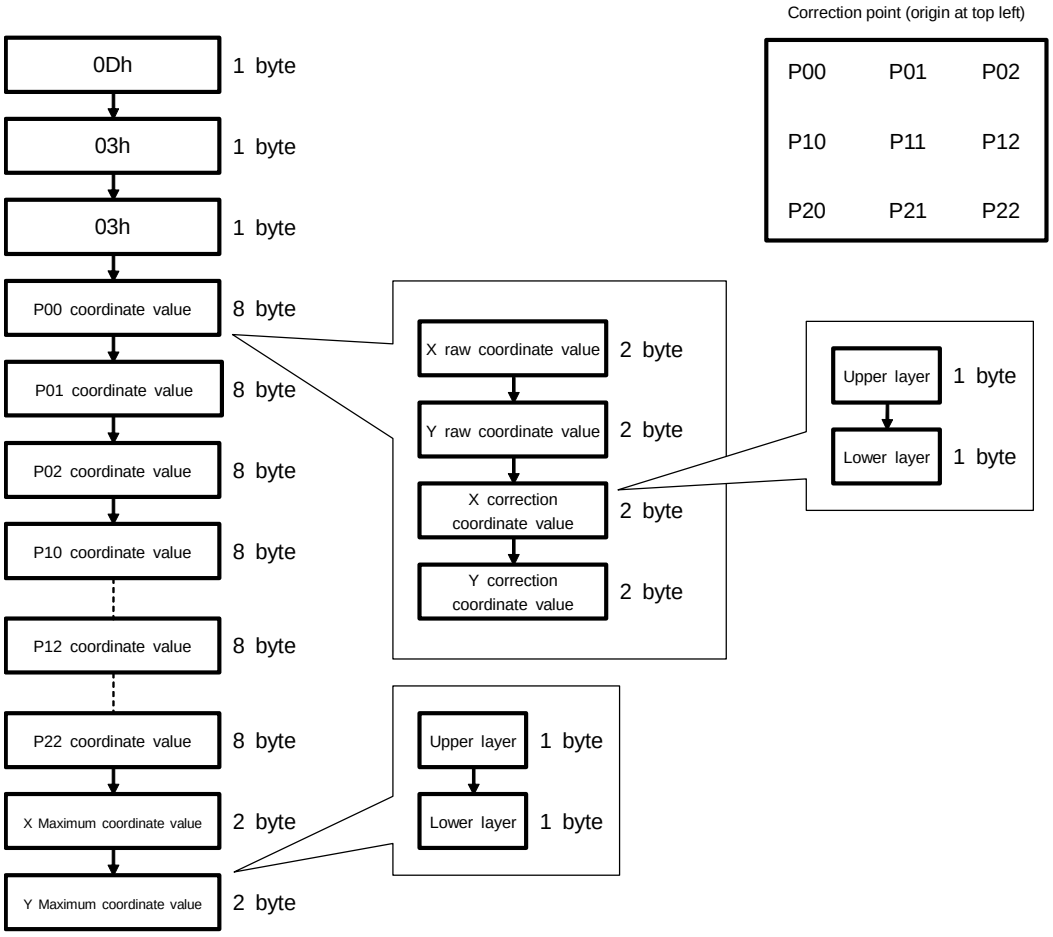
§ Setup procedure

1. Define calibration point and number of calibration points and display a cross mark and arrow on indicator to obtain coordinate values at the calibration point in the coordinate data mode.
2. Transmit command [0Dh/0Eh] to TSC-50/IC (transition to " calibration data setup mode"), and input data according to the calibration data setting format. After all data are input, ACK/NAK is output to the host and the operation automatically transitions to the idle mode.



§ Calibration data setting format

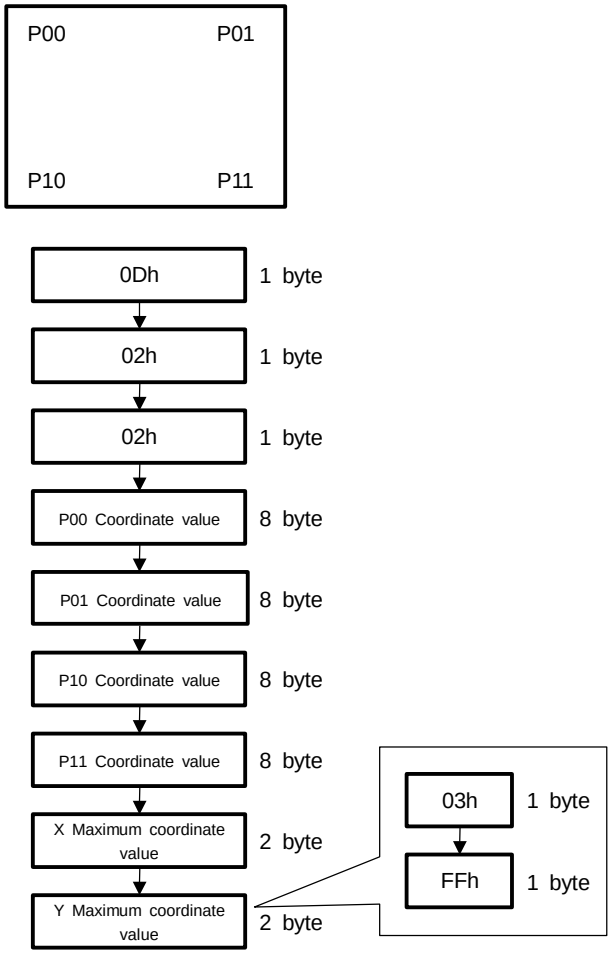
1. Number of points: X direction = 3, Y direction = 3 (Maximum coordinate value: 0000h - 03FFh)



2. Number of points: X = 2, Y = 2 and 5 point

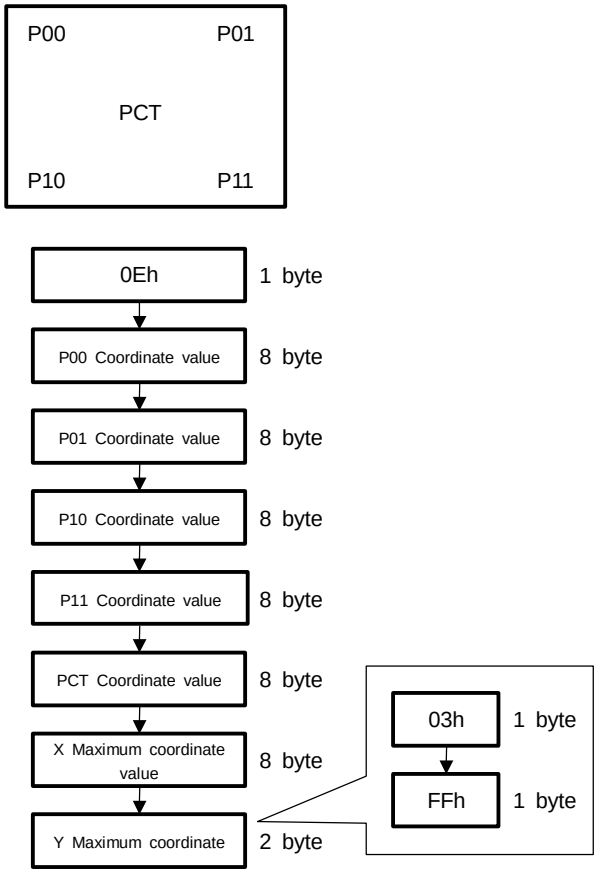
X=2, Y=2 (Maximum coordinate value: X=03FFh, Y=03FFh)

Correction point (origin: top left)



5 Point (Maximum coordinate value: X=03FFh, Y=03FFh)

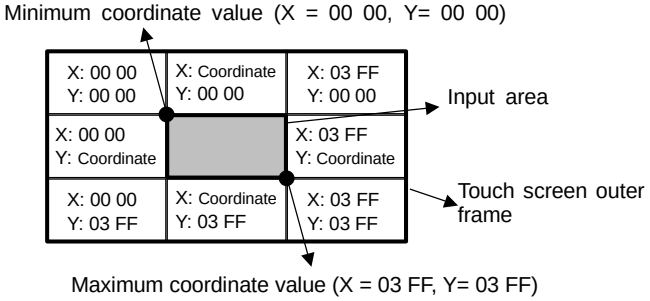
Correction point (origin: top left)



* PCT is at the center of indicator.

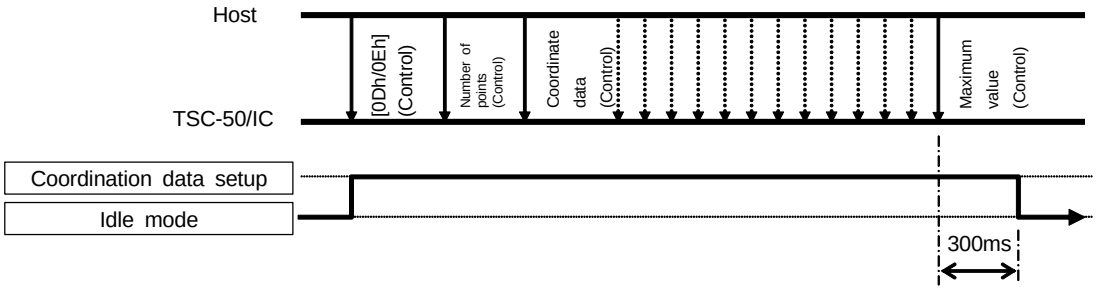
§ Handling outside the coordinate range

If a portion only of the touch screen is to be operated, some calibration may cause the touch screen input points even inside the input area to be located outside the maximum coordinate point (or minimum coordinate point). Where, touch screen input is not disabled and the following data is transmitted.



<USB>

§ Mode transition



* Within 300ms after the last data (calibration data maximum value) is received and until the transition to the idle mode occurs, no command reception is available.

§ Command

Mode	bmRequest Type	bRequest	wValue	wIndex	wLength	Data
Setup mode start 1	C0h (IN)	0Dh	0000h	0000h	0002h	0600h/150#h
Setup mode start 2	C0h (IN)	0Eh	0000h	0000h	0002h	0600h/150#h

#: Refer to the response command.

§ Function

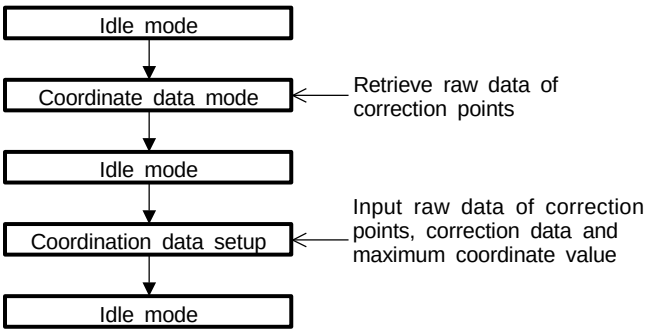
Mode	Function
Setup mode start 1	Normal calibration (Specify the number of calibration points in X and Y each)
Setup mode start 2	Five point calibration (four points at touch screen' s 4 corners and one point at the center)

§ Response command

State	Response command	Bit width	State description
Normal	06h + 00h	2 bytes	EEPROM write normal
Abnormal	15h (NAK) + detail code		
	bit1=1 (02h)	2 bytes	EEPROM data abnormal
	bit2=1 (04h)		EEPROM write error

§ Setup procedure

1. Define calibration point and number of calibration points and display a cross mark and arrow on indicator to obtain coordinate values at the calibration point in the coordinate data mode.
2. Transmit command[0Dh/0Eh] to TSC-50/IC (transition to " calibration data setup mode"), and input data according to the calibration data setting format. After all data are input, ACK/NAK is output to the host and the operation automatically transitions to the idle mode.



§ Calibration data setting format

Setup mode start 1 (calibration point: nine points (X=3, Y=3), where coordinate maximum value: X=1023 and Y=1023)

Correction point (origin: top left)

P00	P01	P02
P10	P11	P12
P20	P21	P22

Off Set	bmRequest Type	bRequest	wValue	wIndex	wLength	Data
0	C0h	0Dh	0303h	0000h	0002h	0600h/150#h
1	C0h	0Dh	P00 X Raw	0000h	0002h	0600h/150#h
2	C0h	0Dh	P00 Y Raw	0000h	0002h	0600h/150#h
3	C0h	0Dh	P00 X Cal	0000h	0002h	0600h/150#h
4	C0h	0Dh	P00 Y Cal	0000h	0002h	0600h/150#h
5	C0h	0Dh	P01 X Raw	0000h	0002h	0600h/150#h
6	C0h	0Dh	P01 Y Raw	0000h	0002h	0600h/150#h
7	C0h	0Dh	P01 X Cal	0000h	0002h	0600h/150#h
8	C0h	0Dh	P01 Y Cal	0000h	0002h	0600h/150#h
9	C0h	0Dh	P02 X Raw	0000h	0002h	0600h/150#h
10	C0h	0Dh	P02 Y Raw	0000h	0002h	0600h/150#h
11	C0h	0Dh	P02 X Cal	0000h	0002h	0600h/150#h
12	C0h	0Dh	P02 Y Cal	0000h	0002h	0600h/150#h
13	C0h	0Dh	P10 X Raw	0000h	0002h	0600h/150#h
14	C0h	0Dh	P10 Y Raw	0000h	0002h	0600h/150#h
15	C0h	0Dh	P10 X Cal	0000h	0002h	0600h/150#h
16	C0h	0Dh	P10 Y Cal	0000h	0002h	0600h/150#h
			⋮			
33	C0h	0Dh	P22 X Raw	0000h	0002h	0600h/150#h
34	C0h	0Dh	P22 Y Raw	0000h	0002h	0600h/150#h
35	C0h	0Dh	P22 X Cal	0000h	0002h	0600h/150#h
36	C0h	0Dh	P22 Y Cal	0000h	0002h	0600h/150#h
37	C0h	0Dh	03FFh	0000h	0002h	0600h/150#h
38	C0h	0Dh	03FFh	0000h	0002h	0600h/150#h

Error output conditions:

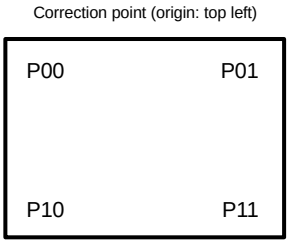
State	Errors	Output conditions
Abnormal	Data abnormal (number of calibration points: 1 or less)	With Off Set 0, 1502h is output and subsequently same data is output
	Data abnormal (number of calibration points: 4 or more)	When calibration of 5×5 points ends, 1502 is output.
	Data abnormal (coordinate data error)	With Off Set 38 (when all calibration ends), 1502h is output
	Write error	With Off Set 38 (when all calibration ends), 1504h is output.
Normal	Normal	For all responses, 0600h is output.

P00 X Raw: P00 X coordinate values in the coordinate data mode.

P22 Y Cal: P22 Calibration coordinate value in Y coordinate.

Off Set 37: Maximum X coordinate value.

Off Set 38: Maximum Y coordinate value. Setup mode start 1 (calibration point: four points (X=2, Y=2), where coordinate maximum value X=511, Y=511)

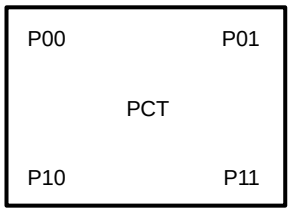


Off Set	bmRequest Type	bRequest	wValue	wIndex	wLength	Data
0	C0h	0Dh	0202h	0000h	0002h	0600h/1500h
1	C0h	0Dh	P00 X Raw	0000h	0002h	0600h/1500h
2	C0h	0Dh	P00 Y Raw	0000h	0002h	0600h/1500h
3	C0h	0Dh	P00 X Cal	0000h	0002h	0600h/1500h
4	C0h	0Dh	P00 Y Cal	0000h	0002h	0600h/1500h
5	C0h	0Dh	P01 X Raw	0000h	0002h	0600h/1500h
6	C0h	0Dh	P01 Y Raw	0000h	0002h	0600h/1500h
7	C0h	0Dh	P01 X Cal	0000h	0002h	0600h/1500h
8	C0h	0Dh	P01 Y Cal	0000h	0002h	0600h/1500h
9	C0h	0Dh	P10 X Raw	0000h	0002h	0600h/1500h
10	C0h	0Dh	P10 Y Raw	0000h	0002h	0600h/1500h
11	C0h	0Dh	P10 X Cal	0000h	0002h	0600h/1500h
12	C0h	0Dh	P10 Y Cal	0000h	0002h	0600h/1500h
13	C0h	0Dh	P11 X Raw	0000h	0002h	0600h/1500h
14	C0h	0Dh	P11 Y Raw	0000h	0002h	0600h/1500h
15	C0h	0Dh	P11 X Cal	0000h	0002h	0600h/1500h
16	C0h	0Dh	P11 Y Cal	0000h	0002h	0600h/1500h
17	C0h	0Dh	01FFh	0000h	0002h	0600h/1500h
18	C0h	0Dh	01FFh	0000h	0002h	0600h/1500h

Setup mode start 2 (where coordinate maximum value X=1023 and Y=1023)

* Stored in EEPROM by conversion into 3×3 format.

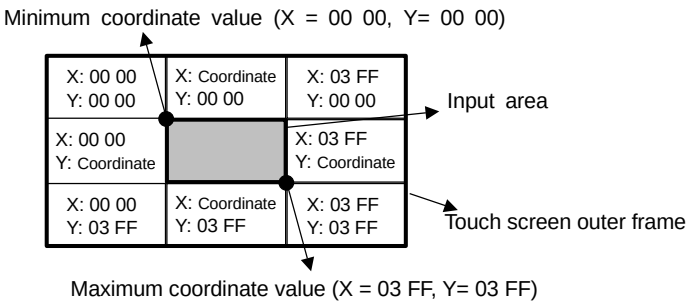
Correction point (origin: top left)



Off Set	bmRequest Type	bRequest	wValue	wIndex	wLength	Data
1	C0h	0Eh	P00 X Raw	0000h	0002h	0600h/1500h
2	C0h	0Eh	P00 Y Raw	0000h	0002h	0600h/1500h
3	C0h	0Eh	P00 X Cal	0000h	0002h	0600h/1500h
4	C0h	0Eh	P00 Y Cal	0000h	0002h	0600h/1500h
5	C0h	0Eh	P01 X Raw	0000h	0002h	0600h/1500h
6	C0h	0Eh	P01 Y Raw	0000h	0002h	0600h/1500h
7	C0h	0Eh	P01 X Cal	0000h	0002h	0600h/1500h
8	C0h	0Eh	P01 Y Cal	0000h	0002h	0600h/1500h
9	C0h	0Eh	P10 X Raw	0000h	0002h	0600h/1500h
10	C0h	0Eh	P10 Y Raw	0000h	0002h	0600h/1500h
11	C0h	0Eh	P10 X Cal	0000h	0002h	0600h/1500h
12	C0h	0Eh	P10 Y Cal	0000h	0002h	0600h/1500h
13	C0h	0Eh	P11 X Raw	0000h	0002h	0600h/1500h
14	C0h	0Eh	P11 Y Raw	0000h	0002h	0600h/1500h
15	C0h	0Eh	P11 X Cal	0000h	0002h	0600h/1500h
16	C0h	0Eh	P11 Y Cal	0000h	0002h	0600h/1500h
17	C0h	0Eh	PCT X Raw	0000h	0002h	0600h/1500h
18	C0h	0Eh	PCT Y Raw	0000h	0002h	0600h/1500h
19	C0h	0Eh	PCT X Cal	0000h	0002h	0600h/1500h
20	C0h	0Eh	PCT Y Cal	0000h	0002h	0600h/1500h
21	C0h	0Eh	03FFh	0000h	0002h	0600h/1500h
22	C0h	0Eh	03FFh	0000h	0002h	0600h/1500h

§ Handling of outside the coordinate range

If a portion only of the touch screen is to be operated, some calibration may cause the touch screen input points even inside the input area to be located outside the maximum coordinate point (or minimum coordinate point). Where, touch screen input is not disabled and the following data is transmitted.



3-5. Calibration data read mode

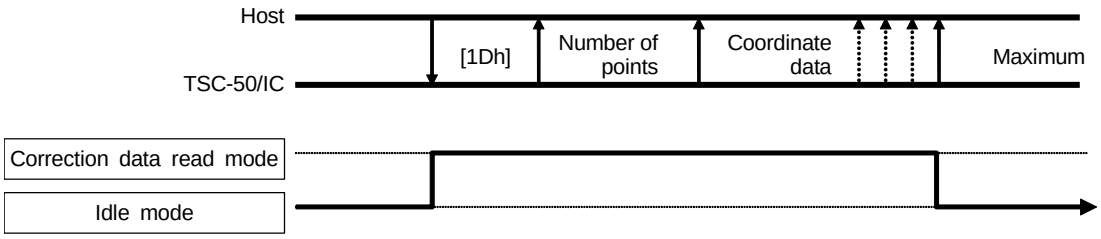
In this mode, data set in the calibration data setup mode is read from EEPROM, used to check the parameter setting.

This mode is executed from idle mode to transmit the stored calibration data, then the operation automatically transitions to idle mode. If no calibration data is stored in EEPROM, none is output.

Note) In this mode, number of calibration points is treated with 25 point (X=5, Y=5) format, since FIT-10/IC (discontinued product), a touch screen controller IC, supports the maximum 25 point calibration function and protocol compatibility in the serial mode shall be kept with FIT-10/IC. Coordinate data of calibration points not supported by TSC-50/IC are all output with 0000h.

<Serial>

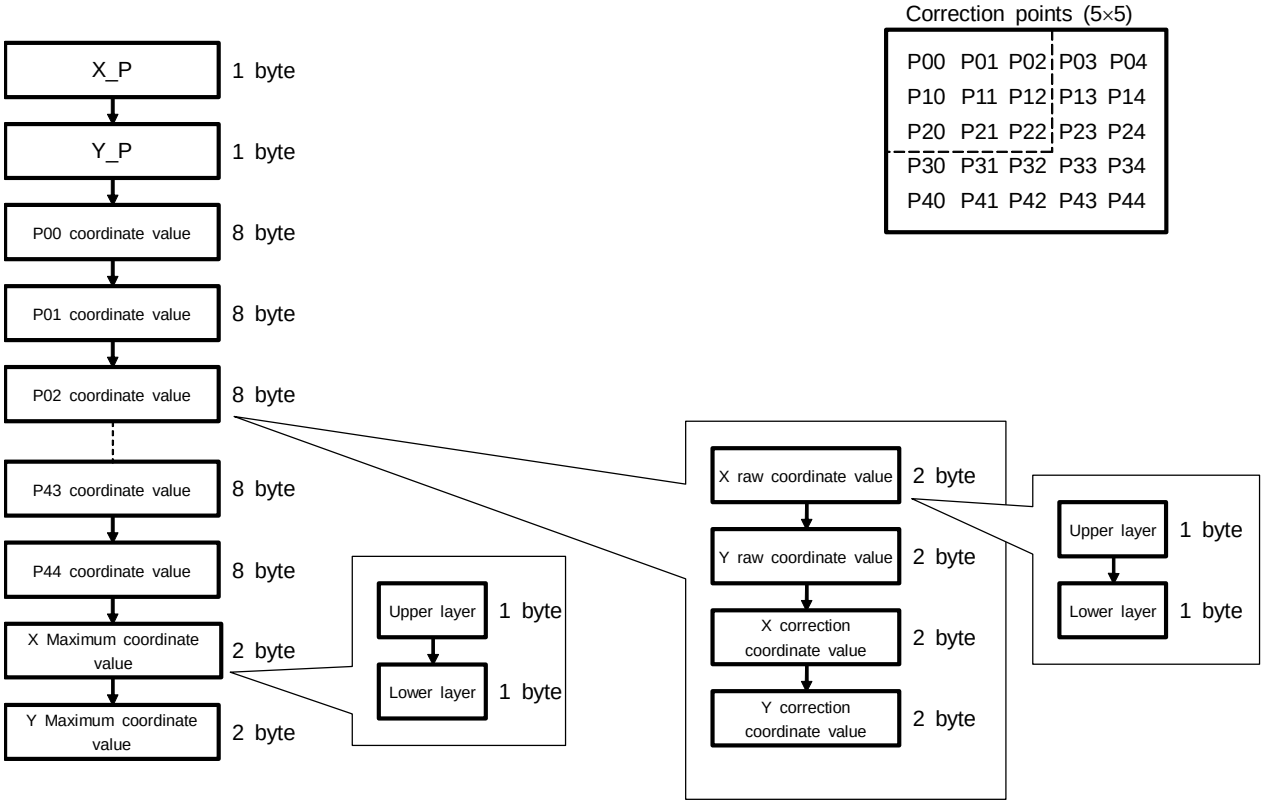
§ Mode transition



§ Calibration data send format

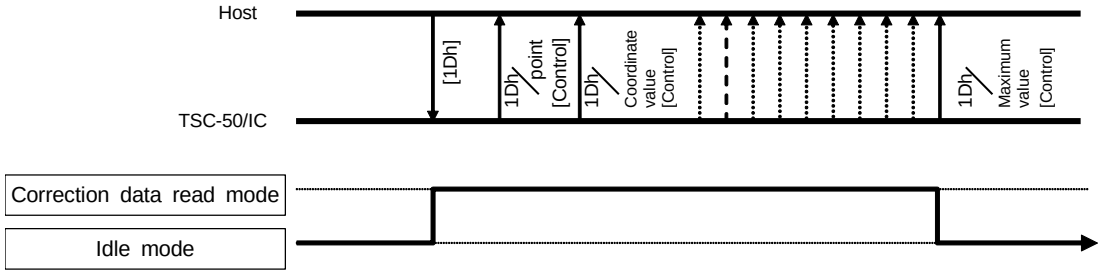
In the idle mode, if 1Dh is received, calibration data is sent to the host with the following format.

In the calibration data setup mode, if setup mode start 2 (0Eh) is used, data is converted to nine point calibration (X=3, Y=3) for setup mode start 1 (0Dh) then stored, thus if output to the host, it uses nine point calibration format.



<USB>

§ Mode transition



§ Calibration data send format

In the idle mode, if 1Dh is received, calibration data is output to the host as response data to IN token with the following format.

In the calibration data setup mode, if setup mode start 2 (bRequest= 0Eh) is used, data is converted to nine point calibration (X=3, Y=3) for setup mode start 1 (0Dh) then stored, thus if output to the host, it uses nine point calibration format.

Correction points (5×5)

P00	P01	P02	P03	P04
P10	P11	P12	P13	P14
P20	P21	P22	P23	P24
P30	P31	P32	P33	P34
P40	P41	P42	P43	P44

Off Set	bmRequest Type	bRequest	wValue	wIndex	wLength	Data
0	C0h (IN)	1Dh	0000h	0000h	0002h	X/Y Point
1	C0h (IN)	1Dh	0000h	0000h	0008h	P00 X/Y
2	C0h (IN)	1Dh	0000h	0000h	0008h	P01 X/Y
3	C0h (IN)	1Dh	0000h	0000h	0008h	P02 X/Y
4	C0h (IN)	1Dh	0000h	0000h	0008h	P03 X/Y
5	C0h (IN)	1Dh	0000h	0000h	0008h	P04 X/Y
6	C0h (IN)	1Dh	0000h	0000h	0008h	P10 X/Y
			⋮			
21	C0h (IN)	1Dh	0000h	0000h	0008h	P40 X/Y
22	C0h (IN)	1Dh	0000h	0000h	0008h	P41 X/Y
23	C0h (IN)	1Dh	0000h	0000h	0008h	P42 X/Y
24	C0h (IN)	1Dh	0000h	0000h	0008h	P43 X/Y
25	C0h (IN)	1Dh	0000h	0000h	0008h	P44 X/Y
26	C0h (IN)	1Dh	0000h	0000h	0004h	X/Y Max

3-6. Calibration data mode

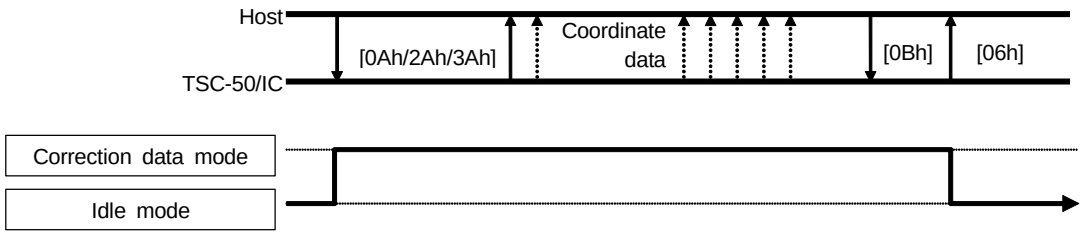
In this mode, based on calibration value obtained from the calibration data setup mode, coordinate value is corrected and output. In this mode, maximum output coordinate value can be limited.

From the idle mode, this mode starts by receiving either command of coordinate data send start 1 – 3, and returns to the idle mode by receiving the calibration data send end command. By receiving " reset" command, the mode transition to the initialization mode.

At the touch screen input (when a finger or pen touches on the touch screen), coordinate data, including pen-down ID indicating that touch screen is input, is output to the host with coordinate output rate interval. If the touch screen input ends (when a finger or pen leaves the touch screen), pen-up ID of 1byte is output (excluding the point mode).

<Serial>

§ Mode transition



§ Command and mode function

Mode name	Command	Function
Calibration data send start 1	0Ah	Pen-down: Coordinate data including pen-down ID is output with the coordinate output rate interval. Pen-up: Pen-up ID is output one time. No input: If there are no inputs for 20 sampling times, transition to the power-save mode occurs.
Calibration data send start 2	2Ah	Pen-down: Coordinate data including pen-down ID is output with the coordinate output rate interval. Pen-up: Coordinate data including pen-up ID is output with the coordinate output rate interval. No input: No transition to the power-save mode.
Calibration data send start 3	3Ah	Pen-down: Coordinate data including pen-down ID is output with the coordinate output rate interval. Pen-up: Pen-up ID is output one time. No input: No transition to the power-save mode.
Calibration data send end	0Bh	Coordinate data mode ends and transition to the idle mode occurs.

§ Response command (For coordinate data send end)

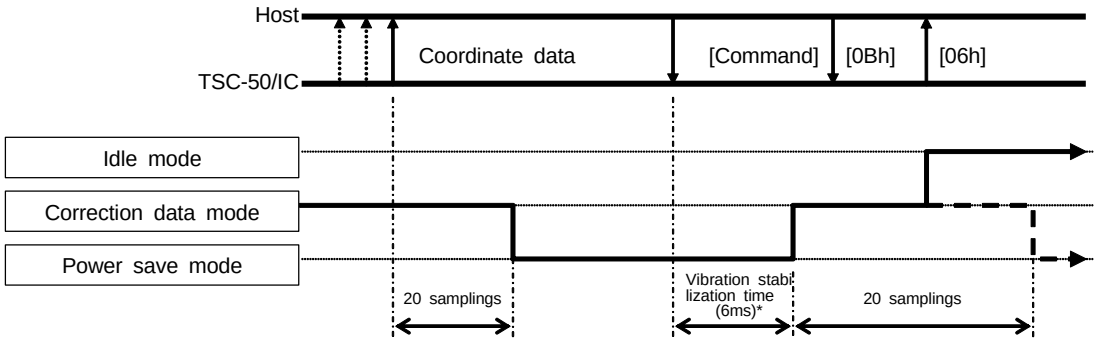
State	Response command	Byte width	Description of mode
Normal	06h (ACK)	1 byte	Ended normally.

§ Power-save mode

“ Coordinate data send start 1” command (0Ah) activates the transition to the coordinate data mode. If for 20 sampling times, no touch screen is input, ceramic vibrator’ s vibration stops and the operation ends by entering the power saving mode. Input to the touch screen (analog data input) or command reception from host will release this mode, and after the vibration stabilization time elapses (6ms*), the operation returns to the calibration data mode.

If TSC-50/IC receives “ calibration data mode end” command (0Bh), this mode shall be released. Thus, within 20 sampling times in the condition where either command (or touch screen input) releases this mode, [0Bh] shall be received.

*Time to release this mode may change by the using vibrator or a circuitry. Please confirm it in environment to use before designing the software.



§ Data description

Pen-down data

	Meaning	b7	b6	b5	b4	b3	b2	b1	b0
Byte 0	Pen Down ID	SW0	SW1	0	1	0	0	0	1
Byte 1	X Upper	0	0	0	0	0	0	X9	X8
Byte 2	X Lower	X7	X6	X5	X4	X3	X2	X1	X0
Byte 3	Y Upper	0	0	0	0	0	0	Y9	Y8
Byte 4	Y Lower	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0

Pen-up data

	Meaning	b7	b6	b5	b4	b3	b2	b1	b0
Byte 0	Pen Up ID	SW0	SW1	0	1	0	0	0	0

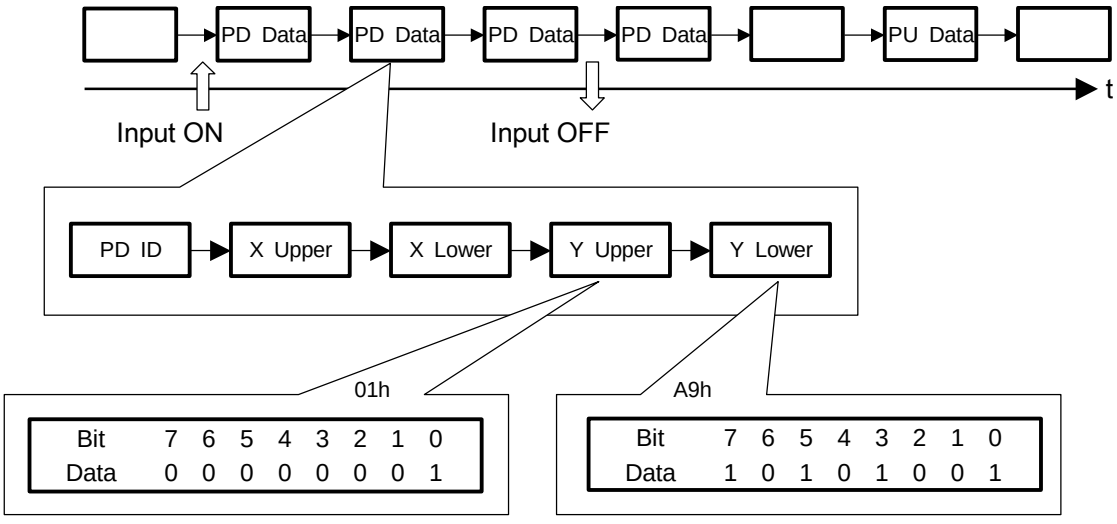
List of pen-down ID (pen-down data Byte 0)

ID	SW0	SW1
11h	0	0
51h	0	1
91h	1	0
D1h	1	1

List of pen-up ID (pen-up data Byte 0)

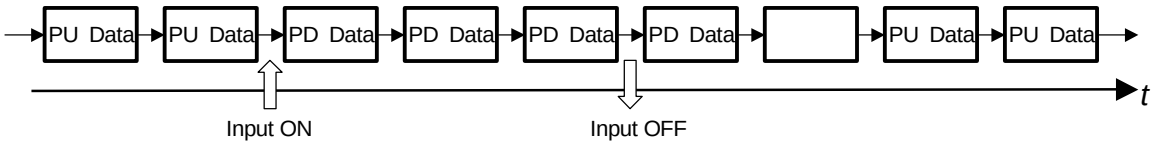
ID	SW0	SW1
10h	0	0
50h	0	1
90h	1	0
D0h	1	1

§ Example of data (transmission starts by receiving [0Ah] or [3Ah]) (Where, X = 0374h and Y = 01A9h)



Immediately after Pen-up, if the first sampling is pen-up, immediately preceding pen-down data is output. If second time sampling is pen-up, none is output. If third time sampling is pen-up, pen-up data is output once.

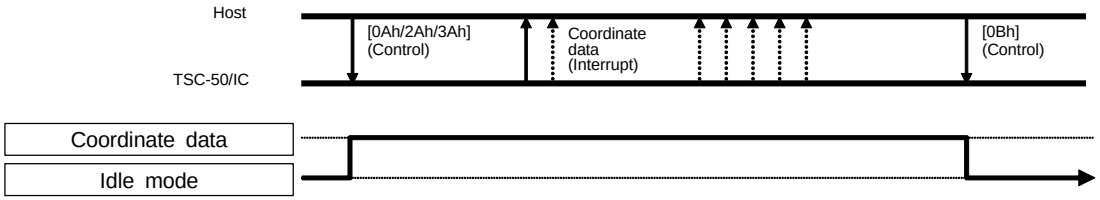
§ Example of data ([transmission starts by receiving 2Ah])



*: Immediately after Pen-up, if the first sampling is pen-up, immediately preceding pen-down data is output. If second time sampling is pen-up, none is output. If third time sampling is pen-up, pen-up data is output. Thereafter, pen-up data is output at the coordinate output rate interval.

<USB>

§ Mode transition



§ Command

Mode	bmRequest Type	bRequest	wValue	wIndex	wLength	Data
Calibration data send start 1	40h (OUT)	0Ah	0000h	0000h	0000h	-
Calibration data send start 2	40h (OUT)	2Ah	0000h	0000h	0000h	-
Calibration data send start 3	40h (OUT)	3Ah	0000h	0000h	0000h	-
Calibration data send end	C0h (IN)	0Bh	0000h	0000h	0002h	0600h

§ Mode function

Mode	Function
Calibration data send start 1	Pen-down: Coordinate data including pen-down ID is output with the coordinate output rate interval. Pen-up: Pen-up ID is output one time. No input: No transition to the power-save mode.
Calibration data send start 2	Pen-down: Coordinate data including pen-down ID is output with the coordinate output rate interval. Pen-up: Coordinate data including pen-up ID is output with the coordinate output rate interval. No input: No transition to the power-save mode.
Calibration data send start 3	Pen-down: Coordinate data including pen-down ID is output with the coordinate output rate interval. Pen-up: Pen-up ID is output one time. No input: No transition to the power-save mode.
Calibration data send end	Coordinate data mode ends and transition to the idle mode occurs.

§ Data description

Pen-down data

	Meaning	b7	b6	b5	b4	b3	b2	b1	b0
Byte 0	Pen Down ID	SW0	SW1	0	1	0	0	0	1
Byte 1	X Lower	X7	X6	X5	X4	X3	X2	X1	X0
Byte 2	X Upper	0	0	0	0	0	0	X9	X8
Byte 3	Y Lower	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0
Byte 4	Y Upper	0	0	0	0	0	0	Y9	Y8

Pen-up data

	Meaning	b7	b6	b5	b4	b3	b2	b1	b0
Byte 0	Pen Up ID	SW0	SW1	0	1	0	0	0	0
Byte 1	X Lower	X7	X6	X5	X4	X3	X2	X1	X0
Byte 2	X Upper	0	0	0	0	0	0	X9	X8
Byte 3	Y Lower	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0
Byte 4	Y Upper	0	0	0	0	0	0	Y9	Y8

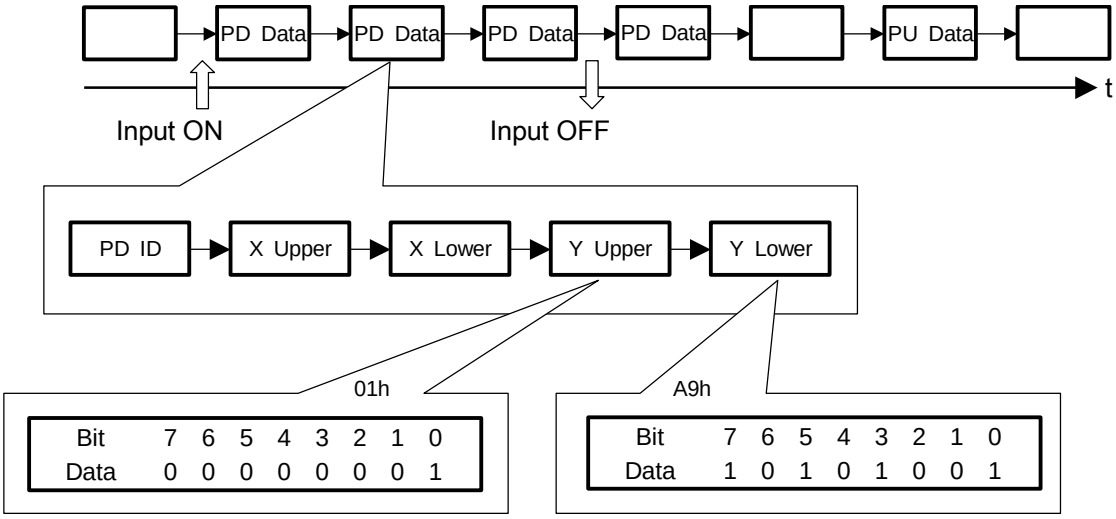
List of pen-down ID (pen-down data Byte 0)

ID	SW0	SW1
11h	0	0
51h	0	1
91h	1	0
D1h	1	1

List of pen-up ID (pen-up data Byte 0)

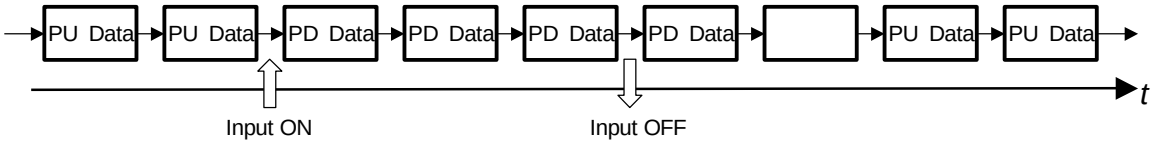
ID	SW0	SW1
10h	0	0
50h	0	1
90h	1	0
D0h	1	1

§ Example of data ([transmission starts by receiving 0Ah] or [3Ah]) (Where, X = 0374h and Y = 01A9h)



Immediately after Pen-up, if the first sampling is pen-up, immediately preceding pen-down data is output. If second time sampling is pen-up, none is output. If third time sampling is pen-up, pen-up data is output once.

§ Example of Data (transmission starts by receiving [2Ah])



*: Immediately after Pen-up, if the first sampling is pen-up, immediately preceding pen-down data is output. If second time sampling is pen-up, none is output. If third time sampling is pen-up, pen-up data is output. Thereafter, pen-up data is output at the coordinate output rate interval. Coordinate value at pen-up always takes same coordinate value as the last pen-down data. After the coordinate data mode transition until the first pen-down, 0000h is output.

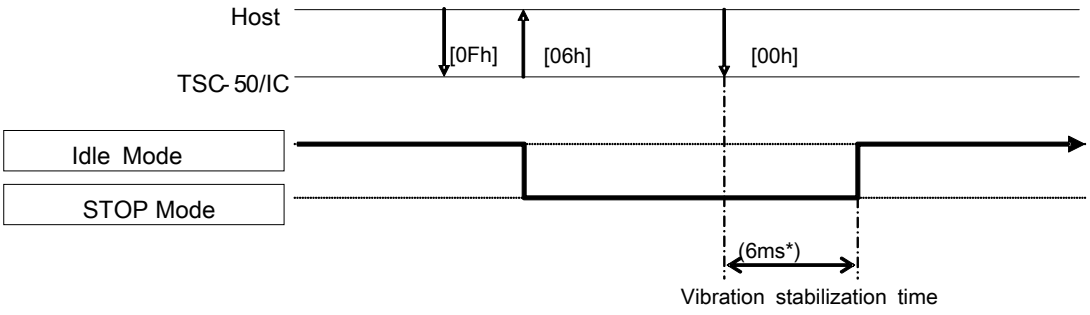
3-7. STOP mode

<Serial mode only>

This mode starts by receiving [0Fh] (STOP mode start command) and outputting ACK (06h) in the idle mode. In this mode, ceramic vibrator' s vibration stops and operation also stops in the power consumption mode. If hardware is reset, the operation transitions from this mode to initialization mode. By receiving [00h] (null command) from host, CPU STOP mode is released and after vibration stabilize waiting time (6ms*) is elapsed, the operation enters idle mode.

This mode operates in the serial mode only.

*Time to release this mode may change by the using vibrator or a circuitry. Please confirm it in environment to use before designing the software.



3-8. Panel ID/mode information acquisition

This function is used to obtain current transition mode, and used/unused status information of SW0, SW1 and EEPROM. It is used to know the current operation status.
This function is available in initialization mode, idle mode, coordinate data mode and calibration data mode.

Panel ID is enabled by releasing hardware reset. Thus, if, after hardware reset, pin information was changed, restart the power or reset hardware to enable the setting.

Mode information always outputs the last command. Therefore, be sure that even in the idle mode, output data differs per last command.

This function is used to check current mode, and used/unused status of SW0, SW1 and EEPROM.

<Serial>

Pin number 24(JP4), 35(JP5) setting allows you to obtain the panel ID information, though this function is unavailable in serial mode in terms of objectives of panel ID.

§ Command

Command	Output data	Command enabled mode
15h	2 bytes	Initialization mode Idle mode Coordinate (calibration) data mode

§ Description of output data

Data content: Byte 1 (Upper bits: b15 - b8) includes the transition mode information, and byte 2 (lower bits: b7 - b0) outputs the setting information. In the serial mode, b4 is fixed to " 0" .

Bit	Bit information		
b0	JP4 (pin number 24)	" 0" = PID 0 or 2	" 1" = PID 1 or 3
b1	JP5 (pin number 35)	" 0" = PID 0 or 1	" 1" = PID 2 or 3
b2	SW1 (pin number 22)	" 0" = SW OFF	" 1" = SW ON
b3	SW0 (pin number 21)	" 0" = SW OFF	" 1" = SW ON
b4	-	Fixed to " 0"	
b5	JP7 (pin number 37)	" 0" = 4/5-wire touch screen	" 1" = 8-wire touch screen
b6	JP6 (pin number 38)	" 0" = 4/8-wire touch screen	" 1" = 5-wire touch screen
b7	JP9 (pin number 45)	" 0" = EEPROM Used	" 1" = EEPROM Unused
b8-15	Transition mode information		
	00h: initialization mode		
	05h: idle mode (immediately preceding command sets the coordinate output rate)		
	01h: coordinate data mode start 1		
	21h: coordinate data mode start 2		
	31h: coordinate data mode start 3		
	02h: idle mode (immediately preceding command is 02h)		
	0Ah: calibration data mode start 1		
	2Ah: calibration data mode start 2		
	3Ah: calibration data mode start 3		
	0Bh: idle mode (immediately preceding command is 0Bh)		

<USB>

§ Command

bmRequest Type	bRequest	wValue	wIndex	wLength	Data	Command enabled mode
C0h (IN)	15h	0000h	0000h	0002h	Value*	Initialization mode Idle mode Coordinate (calibration) data mode

*: Refer to detailed output data description.

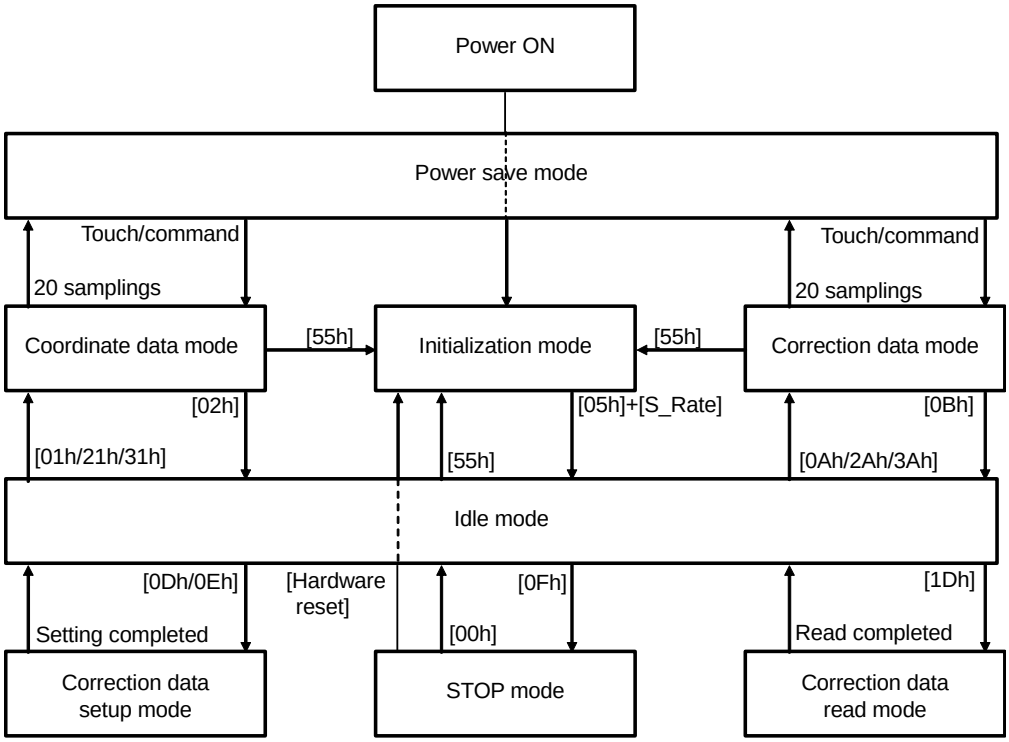
§ Output data description

Data content: Byte 1 (Upper bits: b15 - b8) includes the transition mode information, and byte 2 (lower bits: b7 - b0) outputs the setting information.

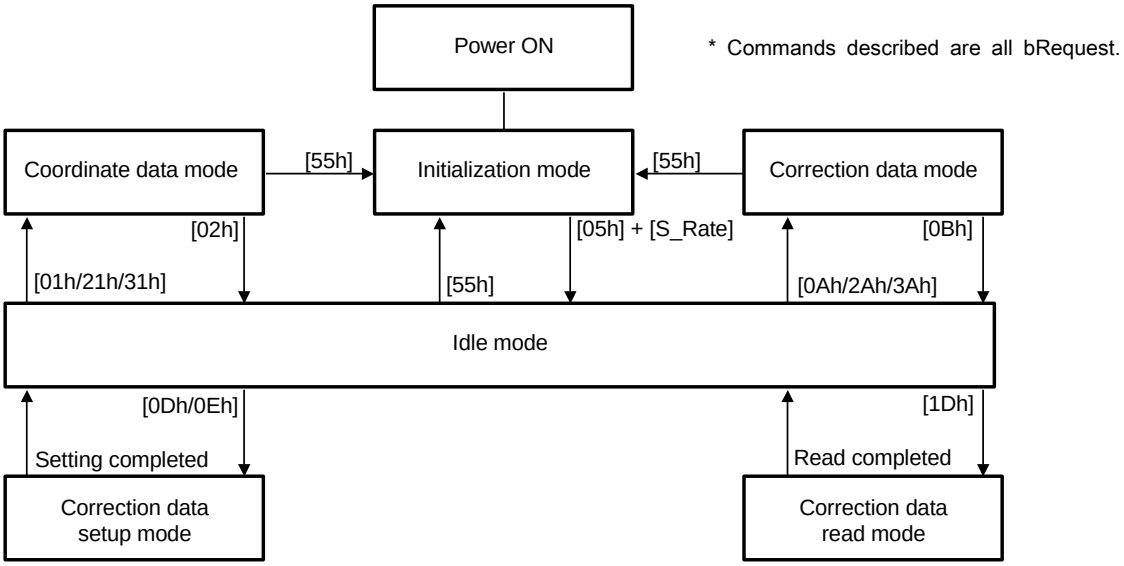
Bit	Bit information		
b0	JP4 (pin number 24)	" 0" = PID 0 or 2	" 1" = PID 1 or 3
b1	JP5 (pin number 35)	" 0" = PID 0 or 1	" 1" = PID 2 or 3
b2	SW1 (pin number 22)	" 0" = SW OFF	" 1" = SW ON
b3	SW0 (pin number 21)	" 0" = SW OFF	" 1" = SW ON
b4	-	Fixed to " 0"	
b5	JP7 (pin number 37)	" 0" = 4/5-wire touch screen	" 1" = 8-wire touch screen
b6	JP6 (pin number 38)	" 0" = 4/8-wire touch screen	" 1" = 5-wire touch screen
b7	JP9 (pin number 45)	" 0" = EEPROM Used	" 1" = EEPROM Unused
b8-15	Transition mode information		
	00h: initialization mode		
	05h: idle mode (immediately preceding command sets the coordinate output rate)		
	01h: coordinate data mode start 1		
	21h: coordinate data mode start 2		
	31h: coordinate data mode start 3		
	02h: idle mode (immediately preceding command is 02h)		
	0Ah: calibration data mode start 1		
	2Ah: calibration data mode start 2		
	3Ah: calibration data mode start 3		
	0Bh: idle mode (immediately preceding command is 0Bh)		

3-9. Mode list

<Serial>



<USB>



4. Extended command

4-1. Panel ID setting (USB mode only)

When you use it with plural USB controllers in multi-touch screen environment, you must set different ID to each controller. In TSC-50/IC, you can set 4 Panel ID at the maximum.

In serial mode, the panel ID setting is not necessary so that it is connected to the different COM port.

Multi-touch screen: It is to connect plural touch screen to one host computer and can operate it in each touch screen.

§ Panel ID setting with the hardware

You can set panel ID when you connect terminal number 24 (JP4) and 35 (JP5) of TSC-50/IC to H or L. The setting becomes effective after hardware reset.

JP4	JP5	Panel ID
L	L	0
H	L	1
L	H	2
H	H	3

§ Panel ID setting with the software

When terminal number 24 (JP4) and 35 (JP5) of TSC-50/IC are connected to " L" with both, you can set panel ID by software. However it is necessary for an EEPROM to be connected to TSC-50/IC to store setting information.

You can store panel ID setting to an EEPROM with 19h command. 19h is the command that is effective in all modes.

Mode	bmRequest Type	bRequest	wValue	wIndex	wLenght	Data
Panel ID = 0	C0h(IN)	19h	0001h	0002h	0002h	0600h
Panel ID = 1	C0h(IN)	19h	0011h	0002h	0002h	0600h
Panel ID = 2	C0h(IN)	19h	0021h	0002h	0002h	0600h
Panel ID = 3	C0h(IN)	19h	0031h	0002h	0002h	0600h

§ Response command

State	Response command	Byte width	Description of mode
Normal	0600h (ACK)	1 byte	Ended normally.

4-2. Calibration data protection

It can enable protection by the following command. It can protect the data in the EEPROM even if user calibrates it by mistake. It is reflected immediately when you set it. Therefore, software reset is not need.

<Serial>

§ Protect-ON

Command	Function	Command enabled mode
19 000F 0001h	It cannot write in coordinate data to the EEPROM.	Initialization mode Idle mode Coordinate (calibration) data mode

§ Response command

State	Response command	Byte width	Description of mode
Normal	06h (ACK)	1 byte	Ended normally.

If protection is enabled, TSC-50/IC outputs an error message (1504h) when calibration data is written to EEPROM.

§ Protect-OFF

It can release protection by carrying out follows in turn.

Command	Description of mode
19 0000 4550h	Processing to release protection 1
19 000F 0000h	Processing to release protection 2
19 0000 444Dh	Processing to release protection 3

Please send the next command after having received a response command.

§ Response command

State	Response command	Byte width	Description of mode
Normal	06h (ACK)	1 byte	Ended normally.

<USB>

§ Protect-ON

Mode	bmRequest Type	bRequest	wValue	wIndex	wLength	Data
EEPROM data protect	C0h(IN)	19h	0001h	000Fh	0002h	0600h

§ Response command

State	Response command	Byte width	Description of mode
Normal	06h (ACK)	2 byte	Ended normally.

If protection is enabled, TSC-50/IC outputs an error message (1504h) when calibration data is written to EEPROM.

§ Protect-OFF

It can release protection by carrying out follows in turn.

Mode	bmRequest Type	bRequest	wValue	wIndex	wLength	Data
Protect off 1	C0h(IN)	19h	4550h	0000h	0002h	0600h
Protect off 2	C0h(IN)	19h	0000h	000Fh	0002h	0600h
Protect off 3	C0h(IN)	19h	444Dh	0000h	0002h	0600h

Please send the next command after having received a response command.

§ Response command

State	Response command	Byte width	Description of mode
Normal	06h (ACK)	2 byte	Ended normally.

5. Command list

<Serial>

Command	Accompanying command (byte)	ACK/NAK	Name
00h	-	-	Null
05h	1	ACK/NAK	Coordinate output rate setting
01h	-	-	Coordinate data send start 1
21h	-	-	Coordinate data send start 2
31h	-	-	Coordinate data send start 3
02h	-	ACK	Coordinate data send end
0Ah	-	-	Calibration data send start 1
2Ah	-	-	Calibration data send start 2
3Ah	-	-	Calibration data send start 3
0Bh	-	ACK	Calibration data send end
0Dh	-	ACK/NAK	Calibration data setup mode start 1
0Eh	-	ACK/NAK	Calibration data setup mode start 2
1Dh	-	-	Calibration data read
0Fh	-	ACK	STOP mode start
19h	4	ACK	Write to EEPROM
55h	-	ACK	Reset
15h	-	-	Panel ID/ mode information retrieval

<USB>

bmRequest Type	bRequest	wValue	wIndex	wLength	DATA	Command name
40h (OUT)	00h	0000h	0000h	0000h	Unused	Null
C0h (IN)	05h	Value	0000h	0002h	Used	Coordinate output rate setting
40h (OUT)	01h	0000h	0000h	0000h	Unused	Coordinate data send start 1
40h (OUT)	21h	0000h	0000h	0000h	Unused	Coordinate data send start 2
40h (OUT)	31h	0000h	0000h	0000h	Unused	Coordinate data send start 3
C0h (IN)	02h	0000h	0000h	0002h	Used	Coordinate data send end
40h (OUT)	0Ah	0000h	0000h	0000h	Unused	Calibration data send start 1
40h (OUT)	2Ah	0000h	0000h	0000h	Unused	Calibration data send start 2
40h (OUT)	3Ah	0000h	0000h	0000h	Unused	Calibration data send start 3
C0h (IN)	0Bh	0000h	0000h	0002h	Used	Calibration data send end
C0h (IN)	0Dh	Value	0000h	0002h	Used	Calibration data setup (1)
C0h (IN)	0Eh	Value	0000h	0002h	Used	Calibration data setup (2)
C0h (IN)	1Dh	0000h	0000h	0002h/ 0004h/ 0008h	Used	Calibration data read wLength: 206bytes in total
C0h (IN)	19h	Value	00**h	0002h	Used	Write to EEPROM
C0h (IN)	55h	0000h	0000h	0002h	Used	Reset
C0h (IN)	15h	0000h	0000h	0002h	Used	Panel ID/ mode information retrieval

§ Wait after issuing command

After issuing the following commands, wait as specified before issuing the next command.

Command name	Command	Wait time
Reset	55h	15ms
Calibration data setup (1)	0Dh	300ms after issuing last data
Calibration data setup (2)	0Eh	300ms after issuing last data
Calibration data read	1Dh	0ms after reading last data (no wait required)
Write to EEPROM	19h	200ms after issuing last data

6. Changes & Improvements

6-1. Version History

Ver0.1 (February 1, 2016)
Tentative Edition

Ver1.0 (April 1, 2016)
First Edition
No change from ver0.1

7. Notes on use

7-1. Overall handling

§ When using the product, do not place it close to, or make it contact with, the conductive materials such as metal.

§ Do not touch the metal part in the product directly with your hands. Or, it may be destructed by the static electricity. If you contact, or may contact, it directly with your hand, prepare in advance the measure against static electricity.

§ To store the product, use an appropriate packing box and keep the storage temperature range with no overload on it.

§ In using the product or storing it, avoid the following conditions:

- Conditions where water is, or may be, attached to the product.
- Conditions where condensation takes place, or may take place.
- In the ambience of organic solvent or acidity or contact, or where the product contacts them.

§ Do not alter or disassemble the product.

7-2. Others

§ This specification may be changed for improvement without prior notices.

§ No liabilities are taken by us for any damage caused by use of this product.

§ This product intends to be used for the standard applications (e.g. office equipment and OA devices, industrial use, communication devices, household equipment). Avoid its use where failure or malfunction directly may affect the human body or special applications where extremely high reliability is required (e.g. airline and space industries, nuclear controls, medical use for life-sustaining).

§ Semi-conductor devices may fail in a certain possibility. Keep the safety design in your mind so that possible failure in this product shall not cause physical accidents such as injury and death, fire and other social damages.

TSC-50/IC Software Specification
Version 1.0: Issued on April 1, 2016
©2016 DMC Co., Ltd.

This document is allowed to redistribute but no alteration, part or all, is prohibited.

DMC Co., Ltd.

http://www.dmccoltd.com/english/
11F Takanawa Sengakuji Ekimae Building 2-18-10 Takanawa, Tokyo, 108-0074 Japan
Phone: +81-3-6721-6736 Fax: +81-3-6721-6736