

Users Manual

BCT-100 Digital Fingerprint Sensor Controller

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1. Features

- Controller IC for BMF fingerprint sensor BLP-100
- Serial I/F (designed for TI DSP C54x or CPU with clocked serial function)
- 8bit Parallel I/F
- 8 bit ADC
- Control register
- Human body inspection (option)
- ID code Certification
- Output sampling data: 8 bit grayscale bitmap data
- VCC = 3.3V
- System clock: 12 MHz
- Package: 64pin SQFP (10mm × 10mm)
- Easy to use with BMF fingerprint sensor

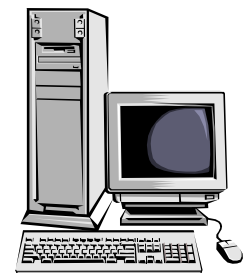
2. Product Description

Simply write the execution commands from application CPU or DSP to BCT-100, fingerprint scan starts automatically. Choose between serial and parallel transfer for the output of fingerprint data.

3. Applications

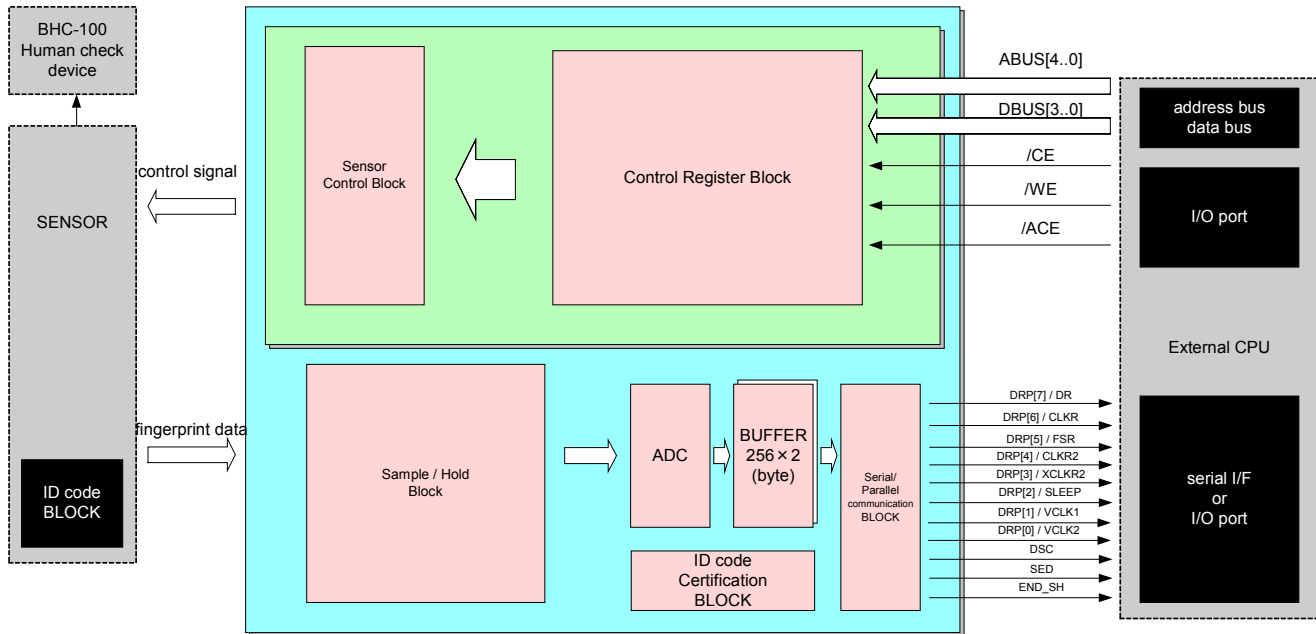
Applications using BMF fingerprint sensor.

- M-commerce
- Cellular phone
- PDA
- IT-security (keyboard, mouse...etc)
- Access control
- Automotive
- Stamp verification
- Signature verification ...etc



4. System Block Diagram

Figure 1 System block diagram



*BCT-100 operates normally without connecting BHC-100

5. Pin Connection Diagram

64 pin SQFP (10 × 10)

Figure 2 Pin connection diagram

6. Pin Function

Table 1 Pin function list

Name	I/O	Pin number	Function
FPSC3	I	16	Fingerprint Sensor sampling synchronization signal. Connected to the same name Pin of the BCT-100. Necessary to exchange 12V to 3.3V, because Sensor out is 12V.
FPSC4	O	15	Fingerprint sensor control signal. Connected to the same name Pin of the BCT-100.
FPSC5	O	14	Fingerprint sensor control signal. Connected to the same name Pin of the BCT-100.
FPSC6	O	13	Fingerprint sensor control signal. Connected to the same name Pin of the BCT-100.
FPSC7	O	12	Fingerprint sensor control signal. Connected to the same name Pin of the BCT-100.
FPSC8	O	10	Fingerprint sensor control signal. Connected to the same name Pin of the BCT-100.
FPSC9	O	9	Fingerprint sensor control signal. Connected to the same name Pin of the BCT-100.
FPSC10	O	7	Fingerprint sensor control signal. Connected to the same name Pin of the BCT-100.
FPSC11	O	6	Fingerprint sensor control signal. Connected to the same name Pin of the BCT-100.
FPSC12	O	5	Fingerprint sensor control signal. Connected to the same name Pin of the BCT-100.
FPSC13	O	4	Fingerprint sensor control signal. Connected to the same name Pin of the BCT-100.
FPSC14	I	3	Fingerprint Sensor sampling synchronization signal. Connected to the same name Pin of the BCT-100. Necessary to exchange 12V to 3.3V, because Sensor out is 12V.
FPSD1	I	21	Fingerprint analog data. Connected to the same name Pin of the BCT-100.
FPSD2	I	20	Fingerprint analog data. Connected to the same name Pin of the BCT-100.
FPSD3	I	19	Fingerprint analog data. Connected to the same name Pin of the BCT-100.
FPSD4	I	18	Fingerprint analog data. Connected to the same name Pin of the BCT-100.
DSC	O	42	Synchronization signal of sampling data output. Only for parallel output.
DRP0/VCLK2	O	34	Sampling data output Pin. SDOUT=0: Parallel data bus (bit0). SDOUT=1: Clock output Pin for 12V Charge pump circuit.
DRP1/VCLK1	O	35	Sampling data output Pin. SDOUT=0: Parallel data bus (bit1). SDOUT=1: Clock output Pin for 12V Charge pump circuit.
DRP2/SLEEP	O	36	Sampling data output Pin. SDOUT=0: Parallel data bus (bit2). SDOUT=1: Sleep Mode check Pin.
DRP3/XCLKR2	O	37	Sampling data output Pin. SDOUT=0: Parallel data bus (bit3). SDOUT=1: XCLKR2 Pin for 2 wire serial I/F.
DRP4/CLKR2	O	38	Sampling data output Pin. SDOUT=0: Parallel data bus (bit4). SDOUT=1: CLKR2 Pin for 2 wire serial I/F.
DRP5/FSR	O	39	Sampling data output Pin. SDOUT=0: Parallel data bus (bit5). SDOUT=1: FSR Pin for 3 wire serial I/F.

DRP6/CLKR	O	40	Sampling data output Pin. SDOUT=0: Parallel data bus (bit6). SDOUT=1: CLKR Pin for 3 wire serial I/F.
DRP7/DR	O	41	Sampling data output Pin. SDOUT=0: Parallel data bus (bit7). SDOUT=1: DR Pin for 3 wire serial I/F.
SED	O	46	Sampling data output state Pin. SED=0: Transferring the data. SED=1: Not Transferring the data..
END_SH	O	48	Sampling state Pin. END_SH=0: Sampling start. END_SH=1: Sampling end.
DBUS [3:0]		53-50	Data bus.
ABUS [4:0]	I	59-57,55,54	Address bus.
/CE	I	60	Chip enable Pin.
/WE	I	61	Write enable Pin.
/ACE	I	62	Address chip enable Pin.
/RESET	I	64	Reset Pin.
MCLK	I	44	Master Clock input Pin. Input 12MHz.
SDOUT	I	45	Sampling data output protocol select Pin. SDOUT=0: Parallel output. SDOUT=1: Serial output.
C1	O	26	Condenser connect Pin for S/A circuit. Connect the 20pH Condenser.
C2	O	25	Condenser connect Pin for S/A circuit. Connect the 20pH Condenser.
C3	O	23	Condenser connect Pin for S/A circuit. Connect the 20pH Condenser.
C4	O	22	Condenser connect Pin for S/A circuit. Connect the 20pH Condenser.
REFIN	I	28	Reference voltage change Pin for ADC. Connected to REFOUT.
REFOUT	O	29	Reference voltage change Pin for ADC. Connected to REFIN.
VRH	I	33	Reference voltage input Pin for ADC. Connected to AVCC. Connect the 0.1-1uF Condenser.
VRC	I	31	Reference voltage creation Pin. Connect the 0.1-1uF Condenser.
AVCC		24,32	Power supply for analog circuit. Input 3.3V.
AGND		17,30	Ground Pin for analog circuit.
DVCC		8,56	Power supply for digital circuit. Input 3.3V.
DGND		11,49	Ground Pin for digital circuit.
TEST1	I	1	Test Pin. Connected to GND.
TEST2	I	2	Test Pin. Connected to GND.
TEST3	I	43	Test Pin. Connected to GND.
TESTS	I	63	Test Pin. Open
AD TEST	I	27	Test Pin. Open.
SERR_CHK	O	47	Test Pin. Open.

7. BCT-100 Operational Flow

The process of sampling the fingerprint data is shown.

1. Initialization of BCT-100 and the Fingerprint sensor.
2. Issuance of fingerprint sampling start.
3. Reception and processing of sampling data.
4. End 1 picture sampling (sampling start command waiting).

When a sampling is not performed for certain period of time.

5. Sleep mode/Wake up (from sleep mode)

7.1. Initialization of BCT-100 and Fingerprint Sensor

【Summary and feature】

- To use the fingerprint sensor and BCT-100, it is necessary to initialize both.
- Initialization of fingerprint sensor takes maximum of 250 ms after writing 0 to the CRST flag.

【Initialization method】

Set 1 to the CRST. Wait for over 100 us, and start initialization by clearing the CRST to 0.

【Note】

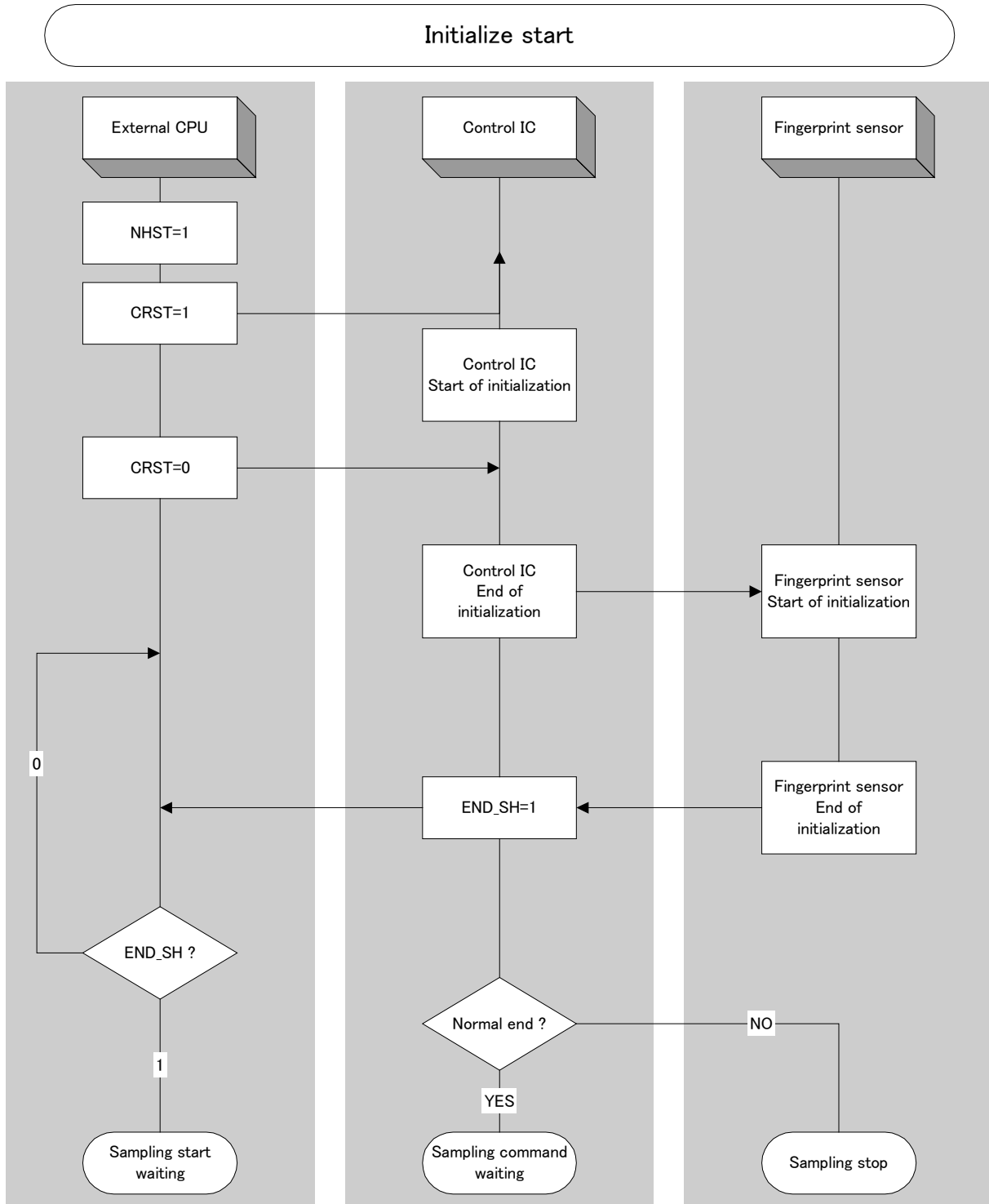
When initialization attempt fails, sampling will not start even if start command.

For fingerprint data sampling, please initialize every time.

- * Handling of END_SH Pin is same as that of sampling end. [*See section 7.4](#)
- * About the flag and the register, [*See section 8.2](#)

The initialization flowchart of BCT-100 and the Fingerprint sensor is shown in figure 3.

Figure 3 Initialization flowchart of BCT-100 and fingerprint sensor



7.2. Sampling Start Command issuance

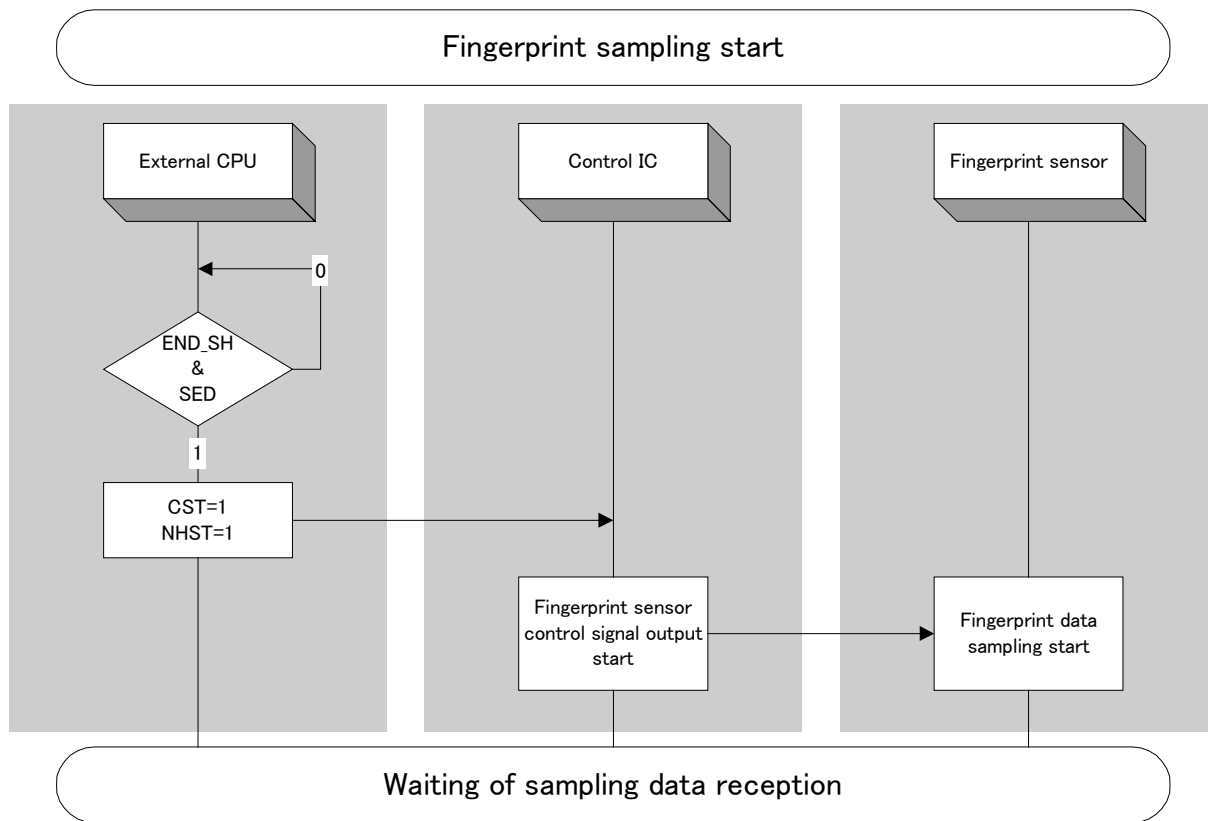
【Summary and feature】

- Set 1 to the CST and the NHST flags, to start sampling.
- If initialization ends normally, sampling of the fingerprint data starts automatically.
- The CST flag is cleared automatically to zero after the certain period.
- The NHST flag is used for receiving and processing the sampling data.

【Note】

- * Before setting each flag, verify that the SED=1 and END_SH=1.
When SED=0 and END_SH=0, normal operation is not guaranteed.
- * Sampling does not start normally, if NHST=0 at sampling start.
[*See section 7.3.](#)

Figure 4 The flowchart of Fingerprint data sampling start



7.3. Sampling Data Reception and Processing

【Summary and feature】

- Fingerprint data sampling starts from Line 1 horizontally and move on to next line..
- When sampling at Line n, the data of Line n-1 is output.
- Output protocol of sampling data is selectable. (Serial or Parallel)
- [*See section 9.1.](#)
- Data sampling time of 1 line data, approximately 650 us.
- External CPU receives the data that output from BCT-100.
- While outputting the sampling data, the SED=0. SED=1 when the data output finished. Use SED Pin for watching data output state.
- It is possible to delay the data sampling by NOT setting NHST to 1.
- When the external CPU is not used for data processing, set NHST to 1 immediately after receipt of data.

【Note】

- * When setting 1 to NHST, verify that SED=1.
- * When SED=0, normal operation for setting NHST is not guaranteed.
- * NHST=0 when output from BCT-100 is finished. NHST is the flag for sampling start. Sampling will not start when NHST=0.

Figure 5 Image of Fingerprint data sampling and Output

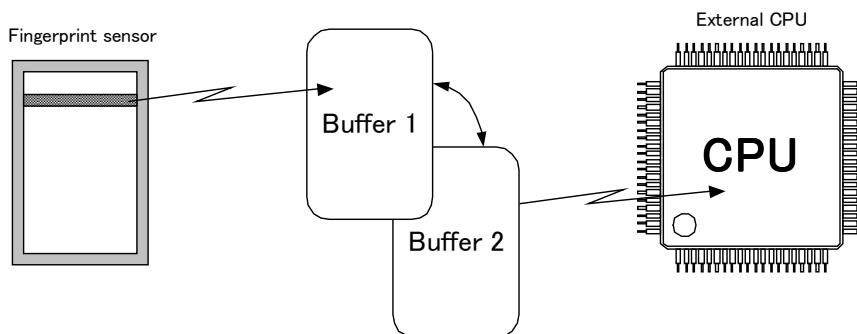


Figure 6 The flowchart of sampling data reception and processing

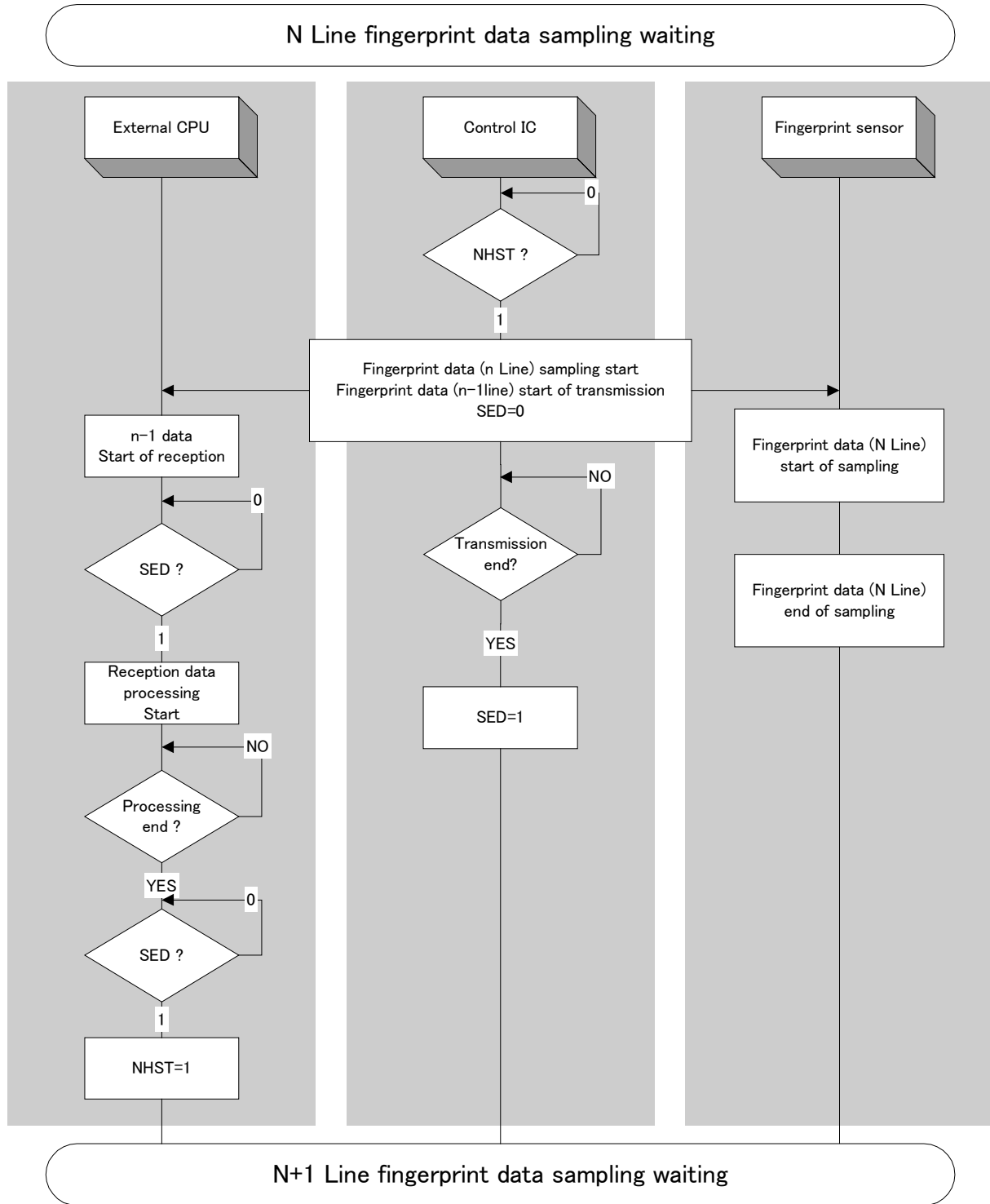
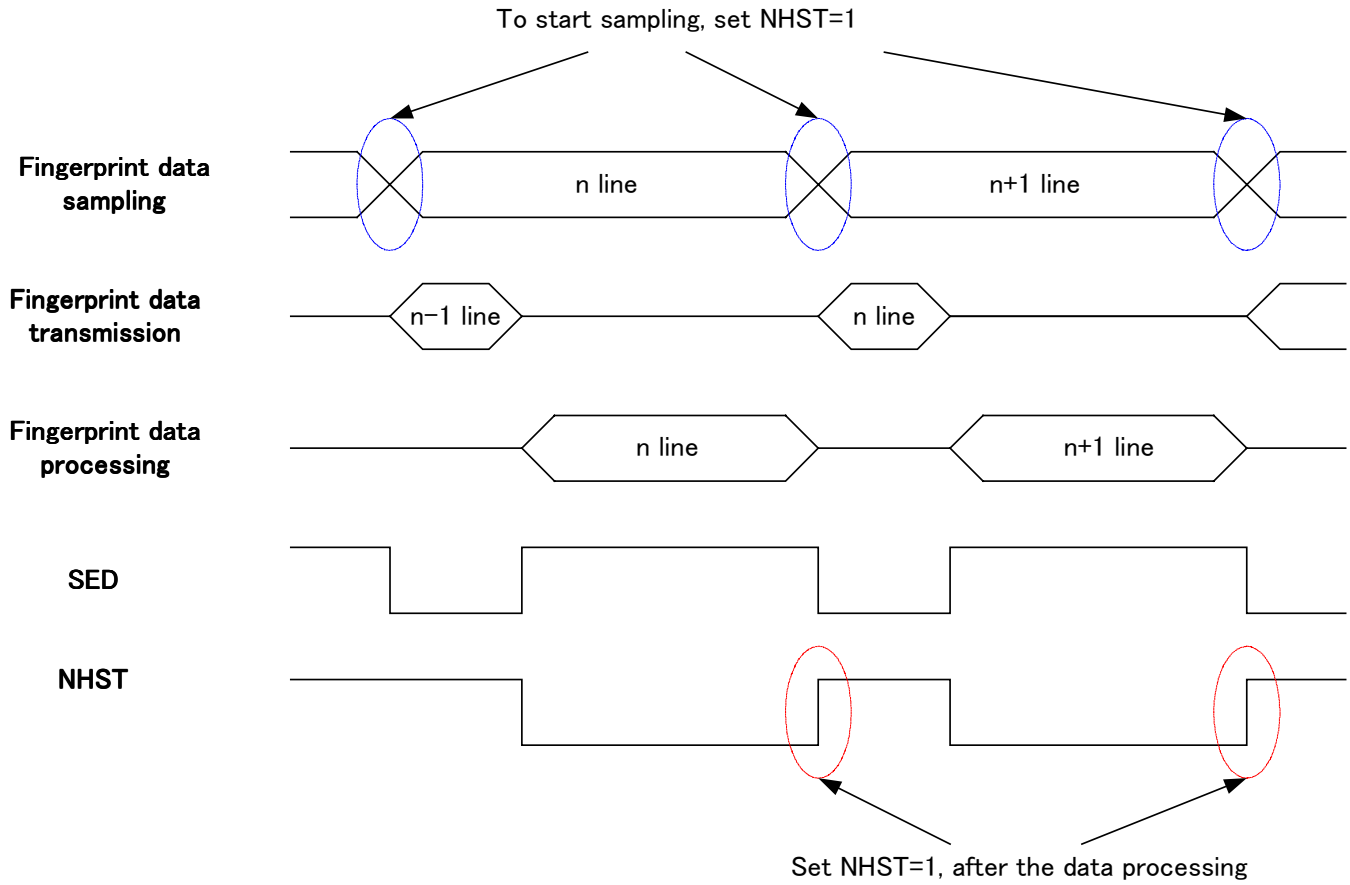


Figure 7 Fingerprint data sampling and transmission timing chart

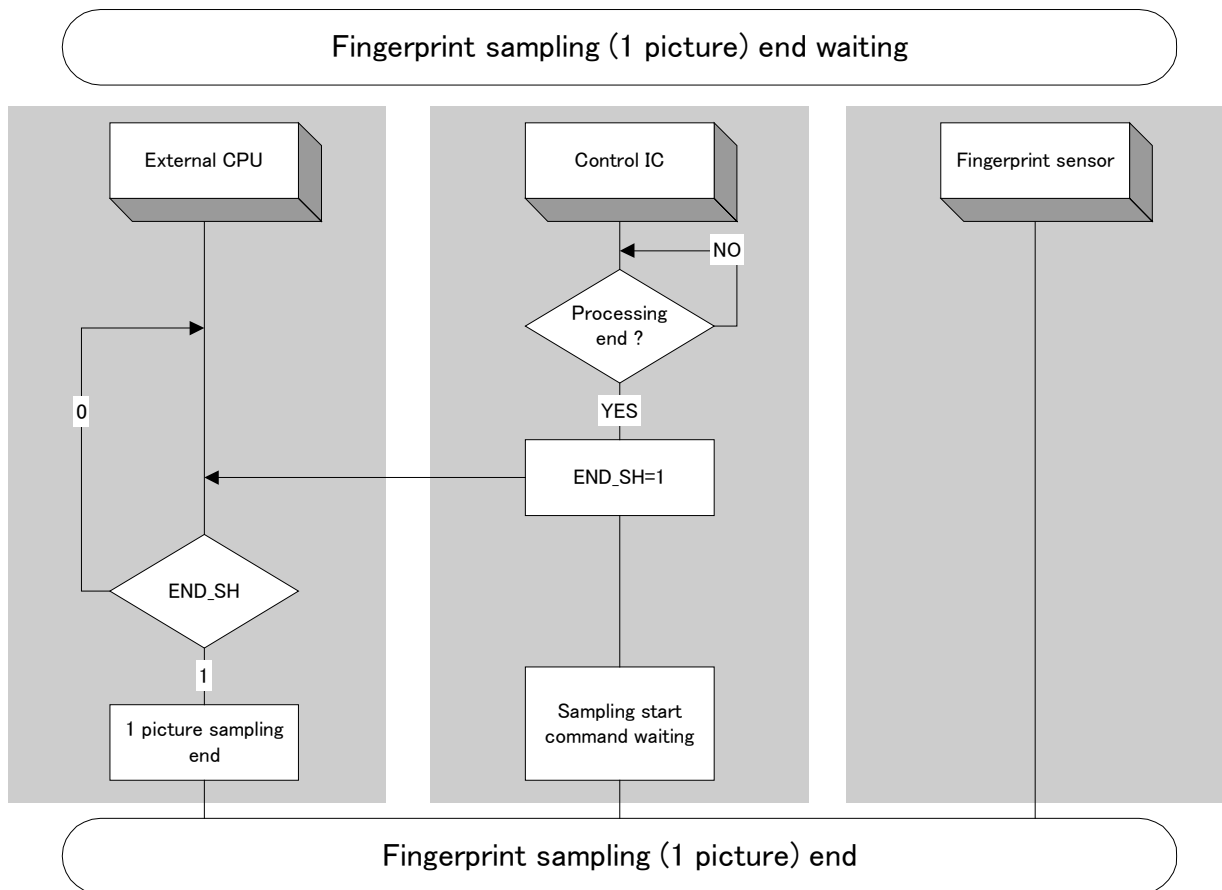


7.4. Sampling End Waiting

【Summary and feature】

When 1 picture sampling ends, the END_SH=1. END_SH=1 until the next 1 picture sampling (until CST=1).

Figure 8 The flowchart of sampling end waiting



7.5. Sleep mode

【Summary and feature】

- It is possible to control BCT-100 operation mode from external CPU.
- Writing to BCT-100 register is the only possible operation at the sleep mode.
- Output Pin connected to Fingerprint sensor is all 0 at the sleep mode.
- When serial output is selected (SDOUT=1), it is possible to watch the operation mode.
 DRP2=1: Normal operation
 DRP2=0: Sleep mode

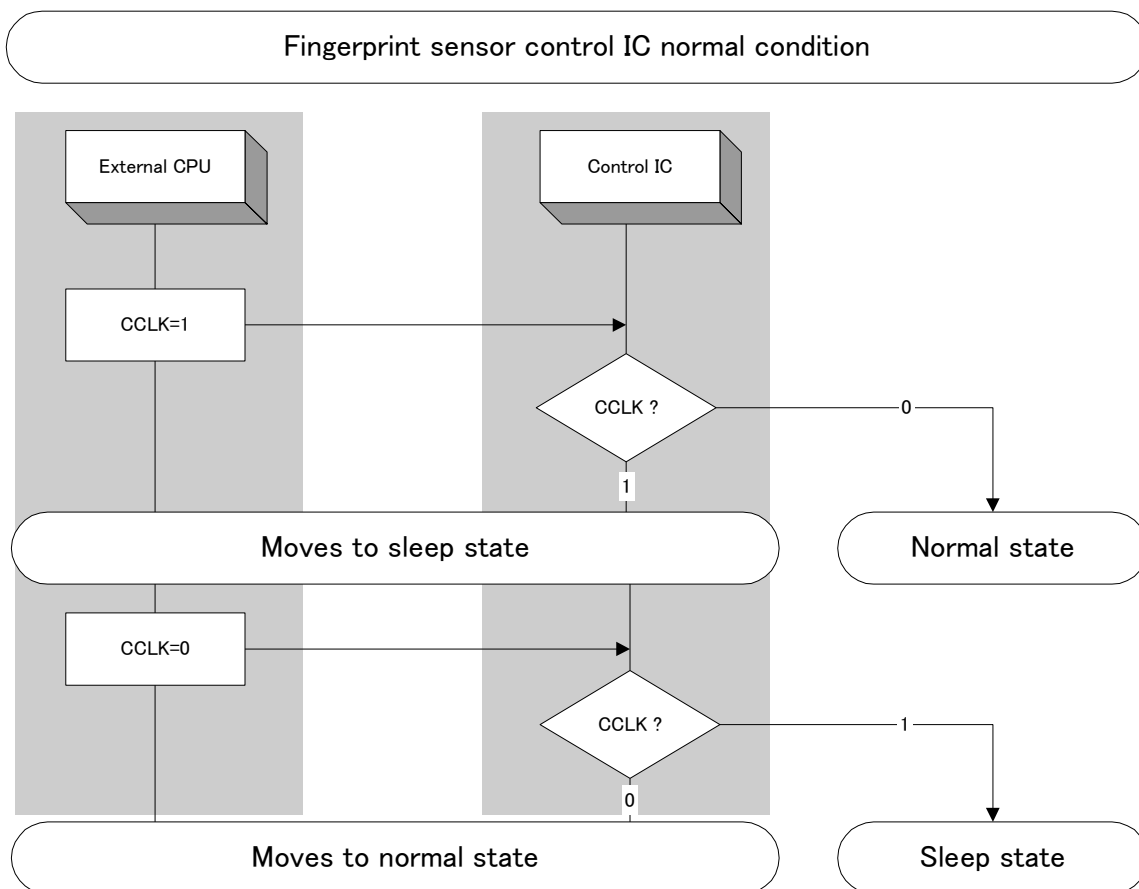
【Enabling sleep mode and wake up】

- CCLK=1: Sleep mode
- CCLK=0: Wake up from sleep mode

【Note】

Do not enabling sleep mode when sampling the data (END_SH=0). Normal operation is not guaranteed.

Figure 9 The flowchart of movement to sleep mode and wake up operation



8.2. Register Function

8.2.1. FRH

Table 3 FRH function list

Bit	Name	Function
3	CCLK	Operational mode setting flag. CCLK=0: Normal operation/wake up from sleep mode CCLK=1: Sleep mode *See section 7.5.
2	CRST	BCT-100/Fingerprint sensor initialization flag. *See section 7.1.
1	Reserved	Reserved bit. *It is not possible in this Bit to set value. As for value uncertainty.
0	Reserved	Reserved bit. *It is not possible in this Bit to set value. As for value uncertainty.

8.2.2. FRL

Table 4 FRL function list

Bit	Name	Function
3	CST	1 picture data sampling start flag. *See section 7.2.
2	NHST	Data sampling permission flag for Fingerprint sensor. *See section 7.3.
1	Reserved	Reserved bit. *It is not possible in this Bit to set value. As for value uncertainty.
0	Reserved	Reserved bit. *It is not possible in this Bit to set value. As for value uncertainty.

8.2.3. VRLO, VRL1

These two registers are reference setting register for the A/D conversion.

- The reference voltage of A/D conversion is variable in order to accommodate the variance in fingerprint sensor and changes over an extended period.
- Reference voltage of Low side can be modified. Reference voltage of HI side is fixed at 3.3 V.

The min voltage value is decided by the VRL and following calculation.

$$\text{Reference voltage (Smallest value)} = V_{cc} \times (VRL / 3 Fh)$$

***However, 0.5 V < reference voltage < 2.0 V**

At the time of BCT-100 initialization, the VRL=11h (0.87 V) it is pre-set.

8.2.4. Reserved Register

【Importance】

The value that was adjusted beforehand the pre-setting being completed. It is not necessary for the user to change the value. Normal operation is not guaranteed when these values has changed.

8.3. Writing to BCT-100 Register

【Summary and feature】

- In order to use BCT-100, it is necessary to control initiation such as parameter setting and initialization from external CPU.
- BCT-100 has prepared the parallel bus I/F for connecting direct to external CPU.
It does not correspond to reading.

8.3.1. Bus I/F connected method

As for the parallel bus I/F, connected method changes according to how it accesses from the external CPU.

Connect directly to the external bus I/F or the port of external CPU.
Address bus (ABUS [4..0]), Data bus (DBUS [3..0]), Chip enable (CE)

[*See figure 10, 11, 12.](#)

【ACE】

Address Chip Enable (ACE Pin).

Each register of BCT-100 cannot be decoded with only the address value of 5 bit when address value of each of the BCT-100 register is assigned to the address map of external CPU. Therefore, it is necessary to create an enable signal for determining the access to BCT-100. To create the signal decode the address (except the lower 5 bit) with external CPU. The ACE pin is used for inputting this enable signal. Using the general I/O port of external CPU and connect this signal to the ACE pin, will allow you to access each register of BCT-100 from an external CPU.

【Note】

When the ACE pin is not used, connect to the GND.

Figure 10 Connected methods when the ACE is used

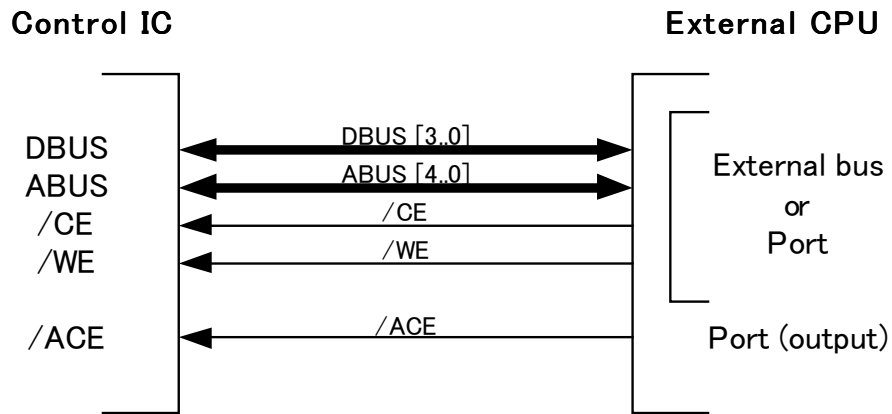


Figure 11 Connected methods when the ACE is not used

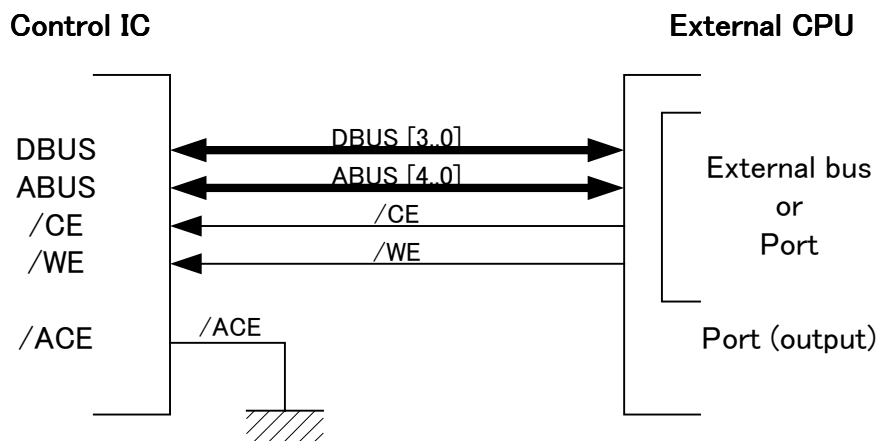
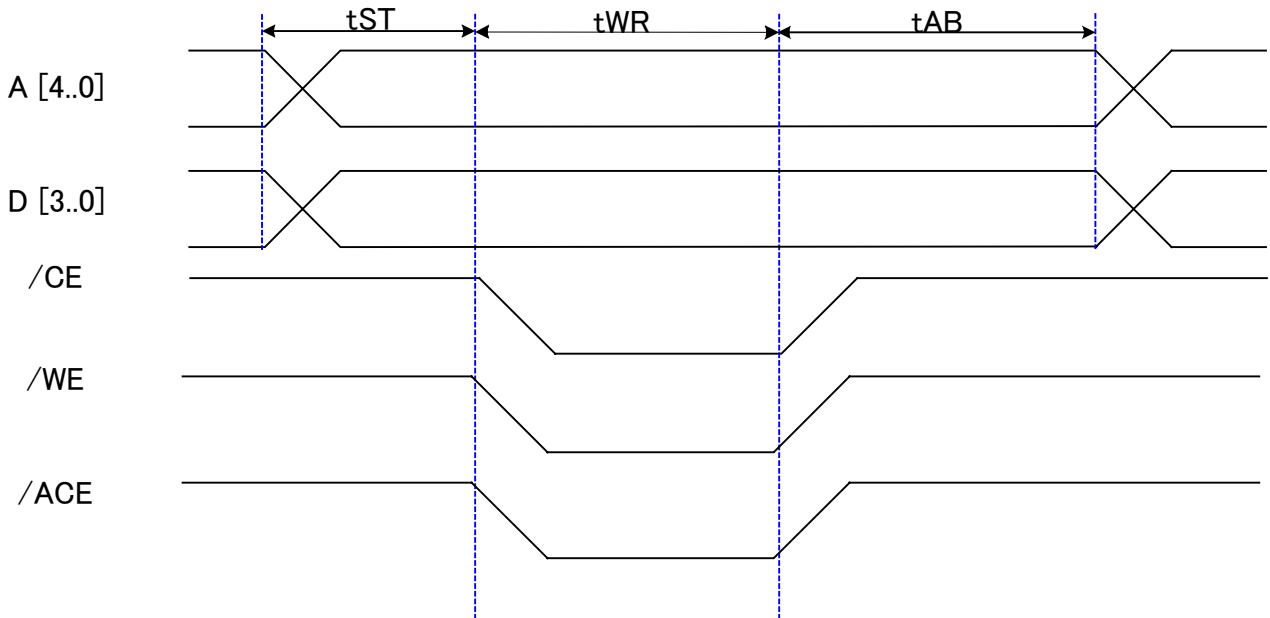


Figure 12 Bus I/F timing chart



Data/Address setup time	tST	min 84ns	
Data write time	tWR	min 126ns	max1024ns
Data/Address hold time	tHD	min 84ns	

9. External Communication I/F

【Summary and feature】

- It is possible to select the output protocol of the fingerprint data, serial or parallel.
- It is not possible to select 3-output protocol simultaneously.

9.1. Output protocol setting

Using the SDOUT pin, it sets output protocol.

Table 5 Fingerprint data output protocol setting list

Setting pin name	Pin state	Out put protocol
SDOUT	1	3 wire/2 wire Serial
	0	Parallel

9.2. Serial I/F

The serial I/F (1ch) is prepared in BCT-100. To use the serial I/F, select 2 wire serial or 3 wire serial.

FSR, CLKR, DR Pins are shared with parallel I/F (data bus). At the point in time when the serial communication is selected, it changes functionally as a pin for serial communication.

9.2.1. Feature

- 3 wire serial is supposing connected to TI DSP (TMS320VC series).
- 2 wire serial is supposing connected to general clocked serial I/F.
- Packet size of the data makes the 1 byte (8 bit). 1 transmit data quantity is 1 line data of the using fingerprint sensor.
- 1 line data of BLP-100 is 255byte for 3 wire serial and 256byte for 2 wire serial.
- The transmit data of sampling value is analog data of fingerprint sensor. Start pattern, End pattern, Error correct data (such as parity check) are not included.
- MSB first.
- As for 2 wire serial, it is possible to select the Clock output (CLKR2, XCLK mutual semi- phase it has slipped) according to external CPU specification.

9.2.2. Operational Summary

When data transmission is started, the NHST flag is cleared to zero automatically. After the data processing ends with the external CPU, by setting the NHST=1, sampling of the next line will start.

It is possible to stop the next line sampling, when you processing the data by external CPU.

* See section 7.3.

When transmission ends, SED=1. SED=1 until the next line data transfer has started.

External CPU can verify the 1 line data transmission state by watching the SED Pin.

Figure 13 3 wire serial communication data structure

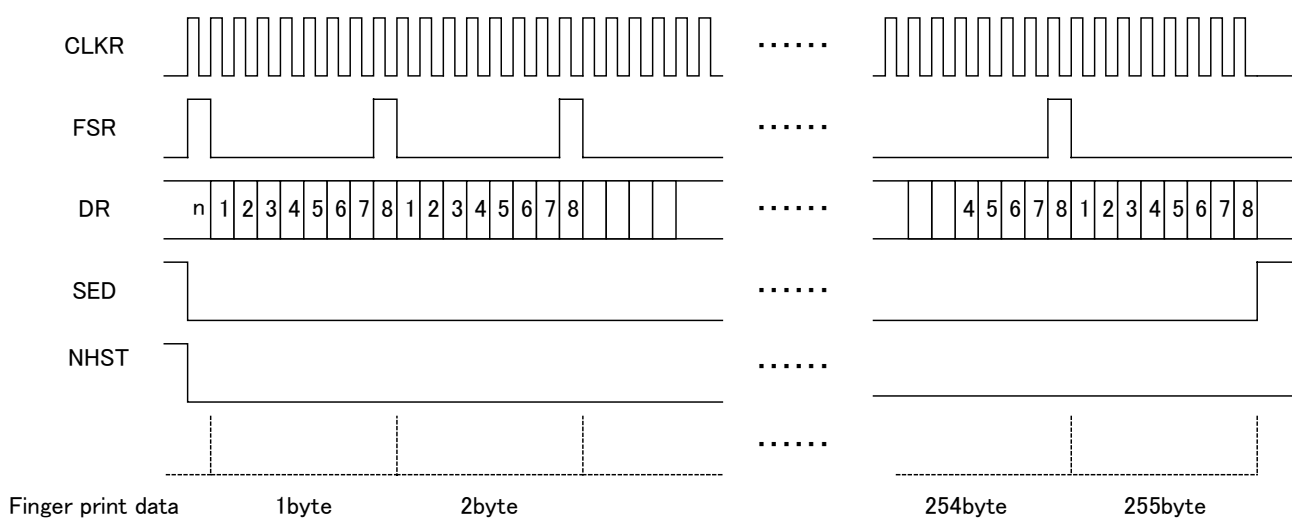


Figure 14 3 wire serial communication transfer timing chart

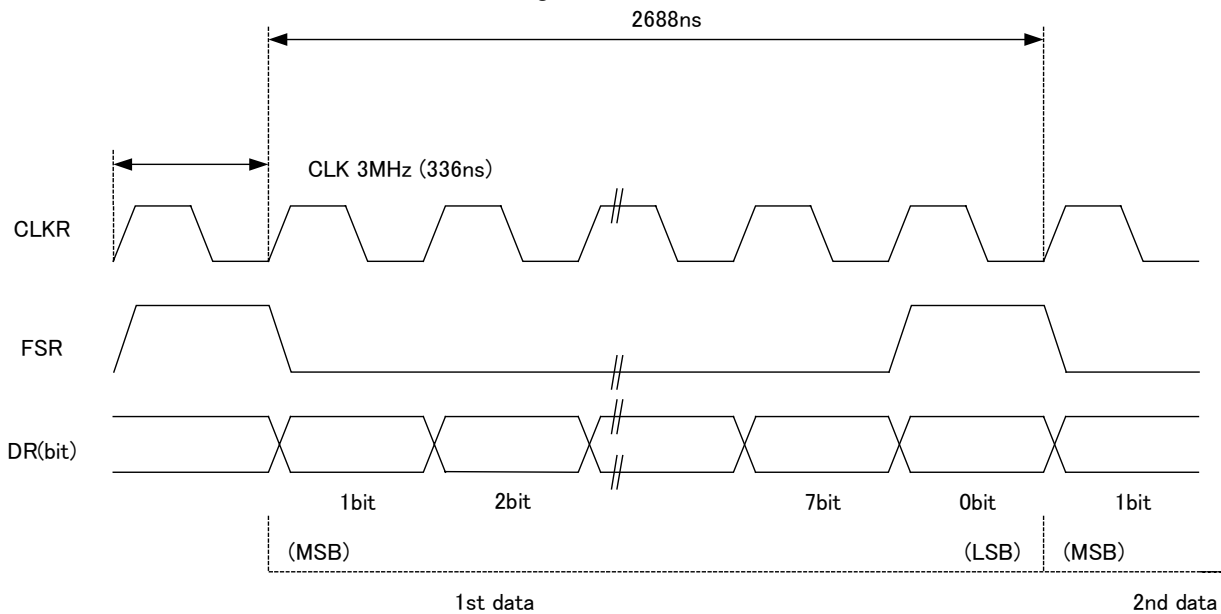


Figure 15 2 wire serial communication data structure

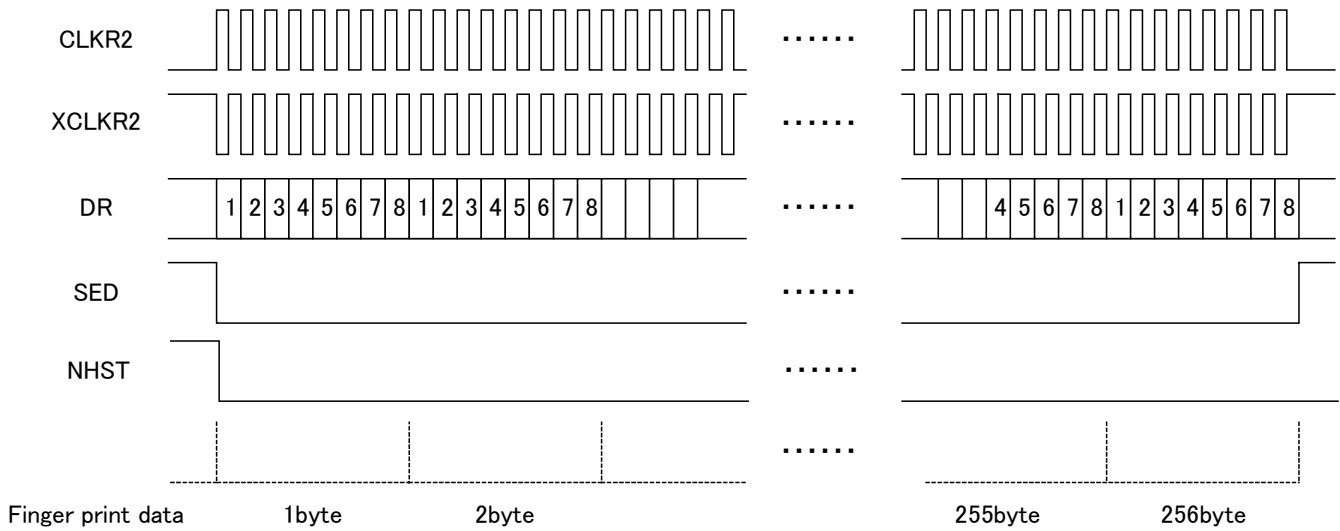
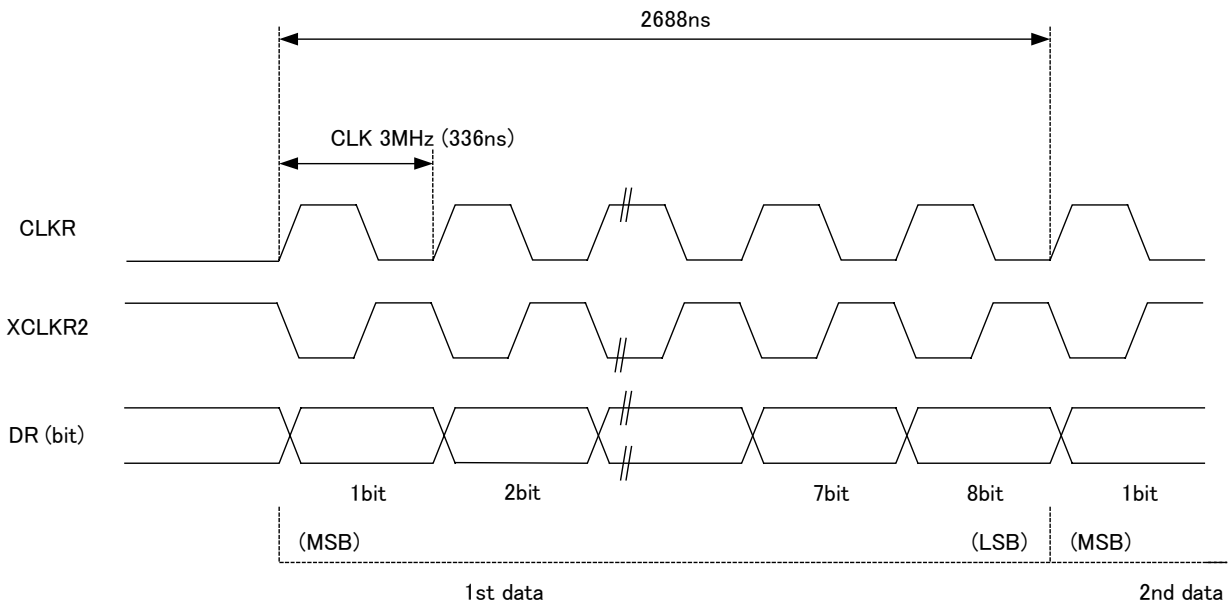


Figure 16 2 wire serial communication transfer timing chart



9.3. Parallel I/F

, The flag that watches the Pin and the register is prepared for synchronizing.

- DSC : Data sampling control signal
- DRP [7..0] : Parallel data output pin (8 bit)
- SED : Communication end signal Pin
- NHST : Data processing end flag

DRP [7..5] are shared with serial I/F. At the point in time when the parallel communication is selected, it changes functionally as a Pin for parallel communication.

9.3.1. Feature

- 8 bit parallel
- In Parallel communication, handshake of I/O port and interruption of external CPU is assumed.
- The data outputs an interruption signal for sampling every 2688ns, and the parallel data is output to the bus every 2688ns.
- The transmit data contains only sampling value of the analog data of sensor output. Start pattern, End pattern, Error correct data (such as parity check) are not included.

9.3.2. Operational Summary

When transmission is started, the SED=0. After the transmission end the SED=1. SED=1 until the next line data transfer started, so external CPU can verify the state of 1 line data transmission by watching the SED Pin. When the transmit data are processed with the external CPU, sampling of the next line can be stopped. [* See section 7.3.](#)

Figure 17 Parallel communication data structure

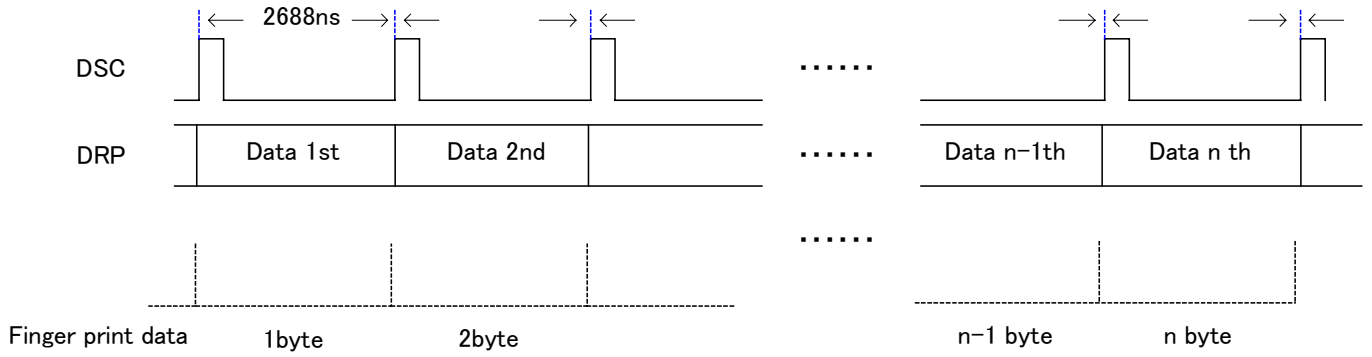
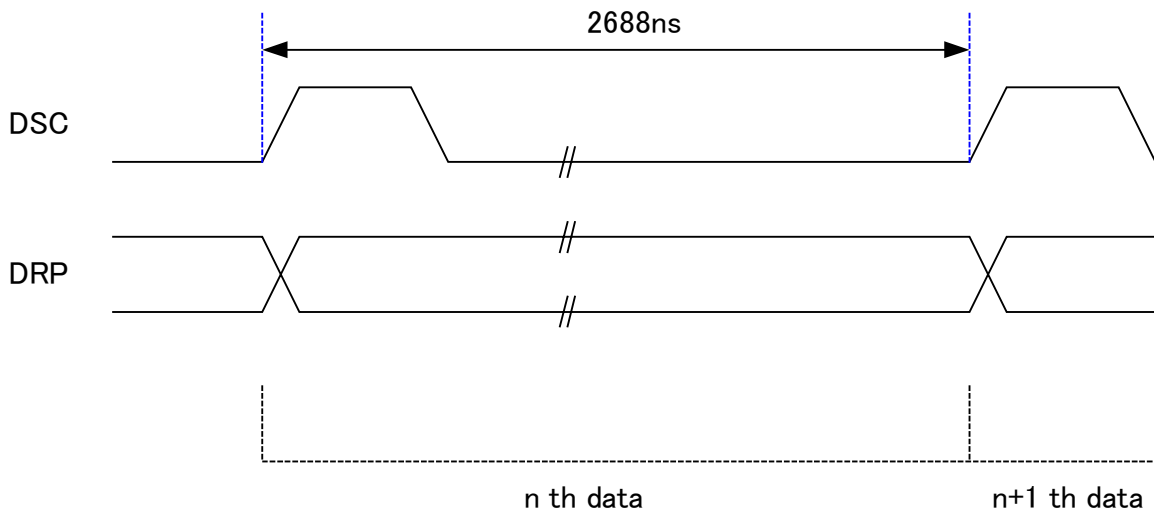


Figure 18 Parallel communication timing chart



10. Electrical characteristics

Table 6 Absolute maximum rating

VSS=0V

Parameter	Symbol	Rating	Unit
Power source voltage	VCC	-0.3 ~ +4.6	V
Input Output voltage	VI, VO	-0.3 ~ VCC+0.3	V
Operating temperature range	Topg	-30 ~ 70	°C
Storage temperature range	Tstg	-40 ~ 80	°C

Table 7 Electrical characteristics

VSS=0V

Parameter	Symbol	Min	Typ	Max	Unit
Power source voltage	VCC	3.0	3.3	3.6	V
Low level input	VIL	-	-	0.2VCC	V
Hi level input	VIH	0.7VCC	-	-	V
Low level output	VOL	-	-	0.4	V
Hi level output	VOH	VCC-0.8	-	-	V
Operational frequency	MCLK	-	12M	-	Hz

11. External Dimensions (Units: mm)

Figure 19 External dimensions (Units: mm) - Package: 64pin SQFP (10 × 10)

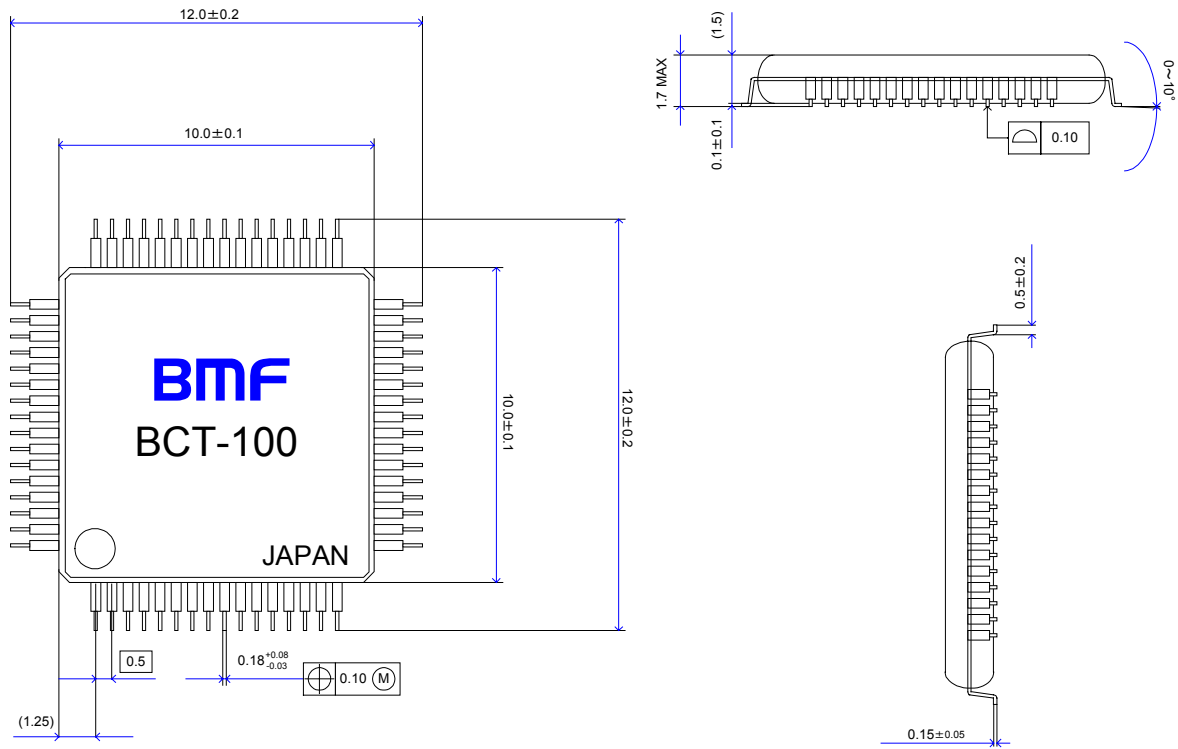


Figure 20 Recommend pad mounting sketch

