

Users Manual

BCT-100 Digital Fingerprint Sensor Controller

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1. Features

- Contoroller 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

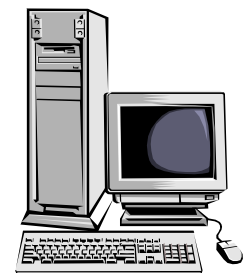
2. Product Description

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

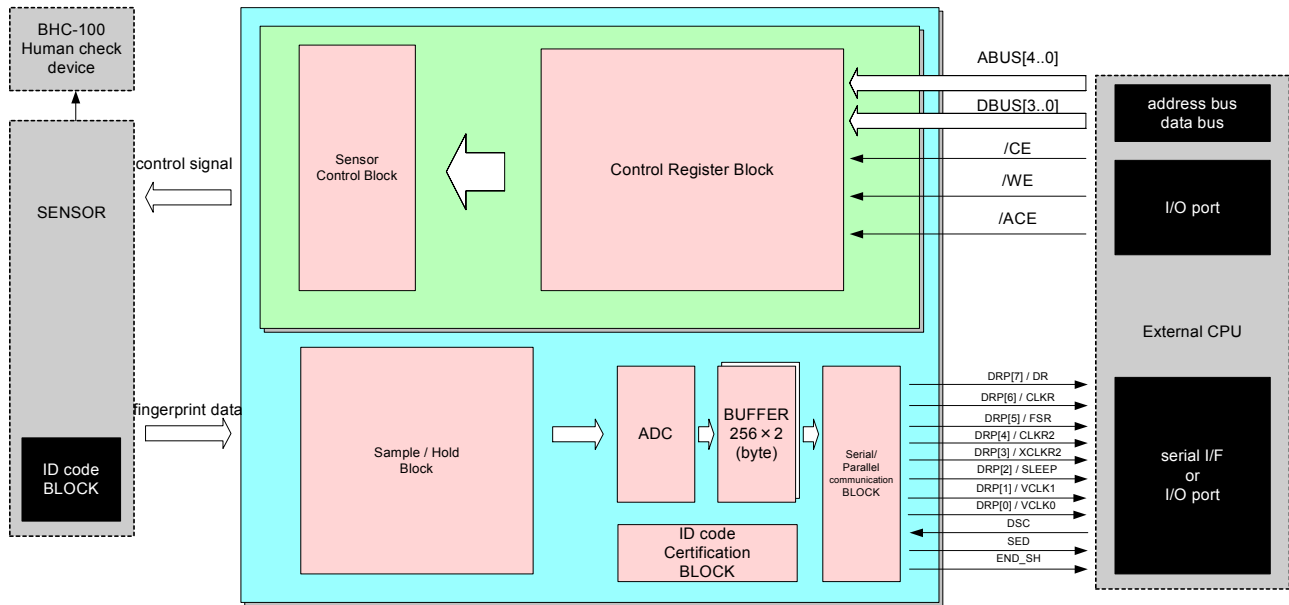
Applications using BMF fingerprint sensor.

- 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

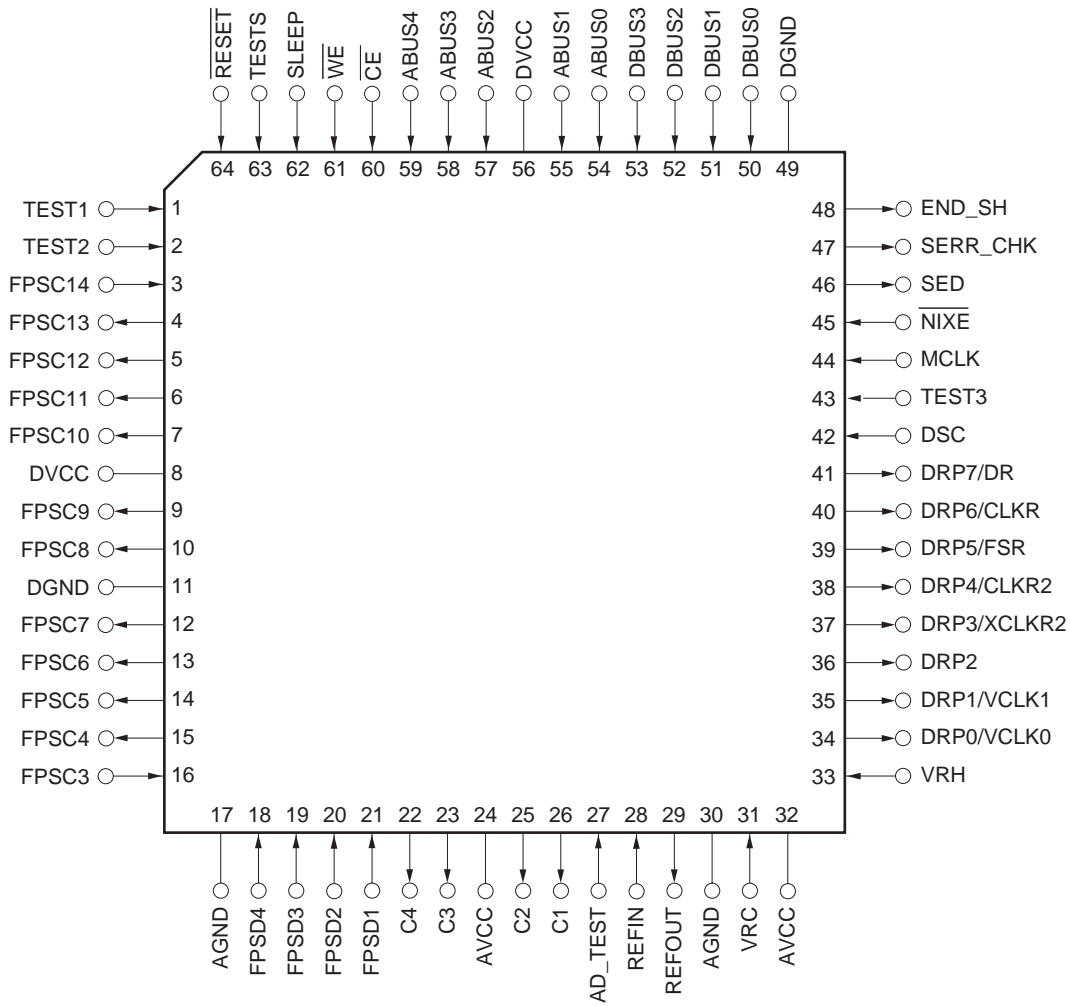


*BCT-100 operates normally without connecting BHC-100

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	I	42	Synchronization signal of sampling data output. Only for parallel output.
DRP0/VCLK0	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	O	36	Sampling data output Pin. SDOUT=0: Parallel data bus (bit2). SDOUT=1: Output 1
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]	I	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.
SLEEP	O	62	Sleep Mode check Pin. SLEEP=0: Sleep Mode. SLEEP=Hi-Z: Running.
/RESET	I	64	Reset Pin.
MCLK	I	44	Master Clock input Pin. Input 12MHz.
/NIXE	I	45	Boost clock enable Pin. NIXE=0: Boost clock enable (VCLK1,VCLK2). NIXE=1: Boost clock disenable.
C1	O	26	Condenser connect Pin for S/A circuit. Connect the 20pF Condenser.
C2	O	25	Condenser connect Pin for S/A circuit. Connect the 20pF Condenser.
C3	O	23	Condenser connect Pin for S/A circuit. Connect the 20pF Condenser.
C4	O	22	Condenser connect Pin for S/A circuit. Connect the 20pF 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	Error detecting Pin. SERR_CHK=0: Sampling error. SERR_CHK=1: Normal operation.

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 DCI flag.

【Initialization method】

Set '1' to the LDS flag of the CRL register then set '1' to the DCI flag of the CRH register. Wait for over 100 us, and start initialization by clearing the CRST to '0'.

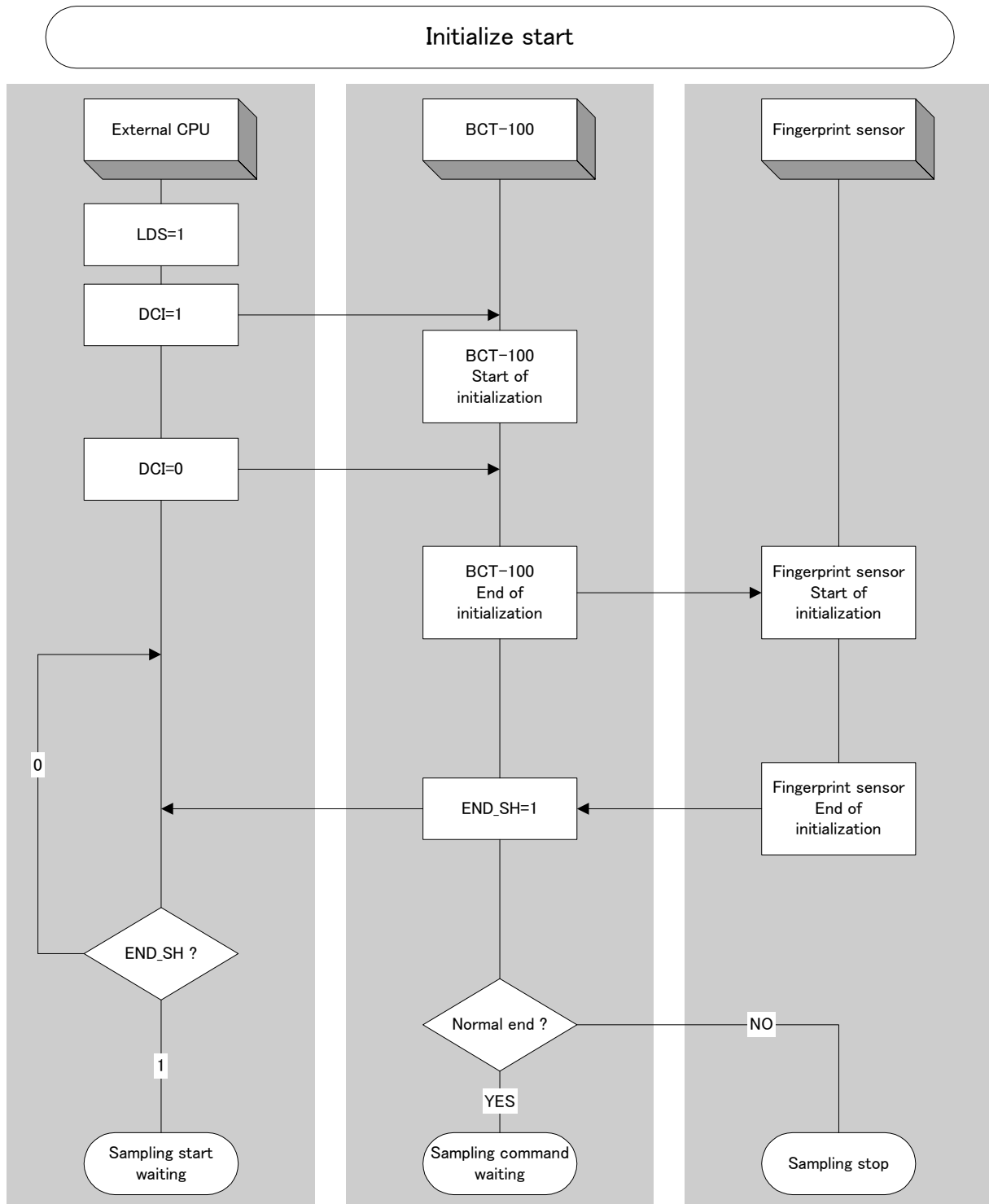
【Note】

When initialization attempt fails, sampling will not start even if start command. It needs hardware reset when restart the system after initialization failing.

- * 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](#)
- * Set /CE Pin enable in advance. If it set disenable then fingerprint data output and Sampling state Pin (END_SH) will output Hi-Z (DPRn, SED, END_SH, SERR_CHK).

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

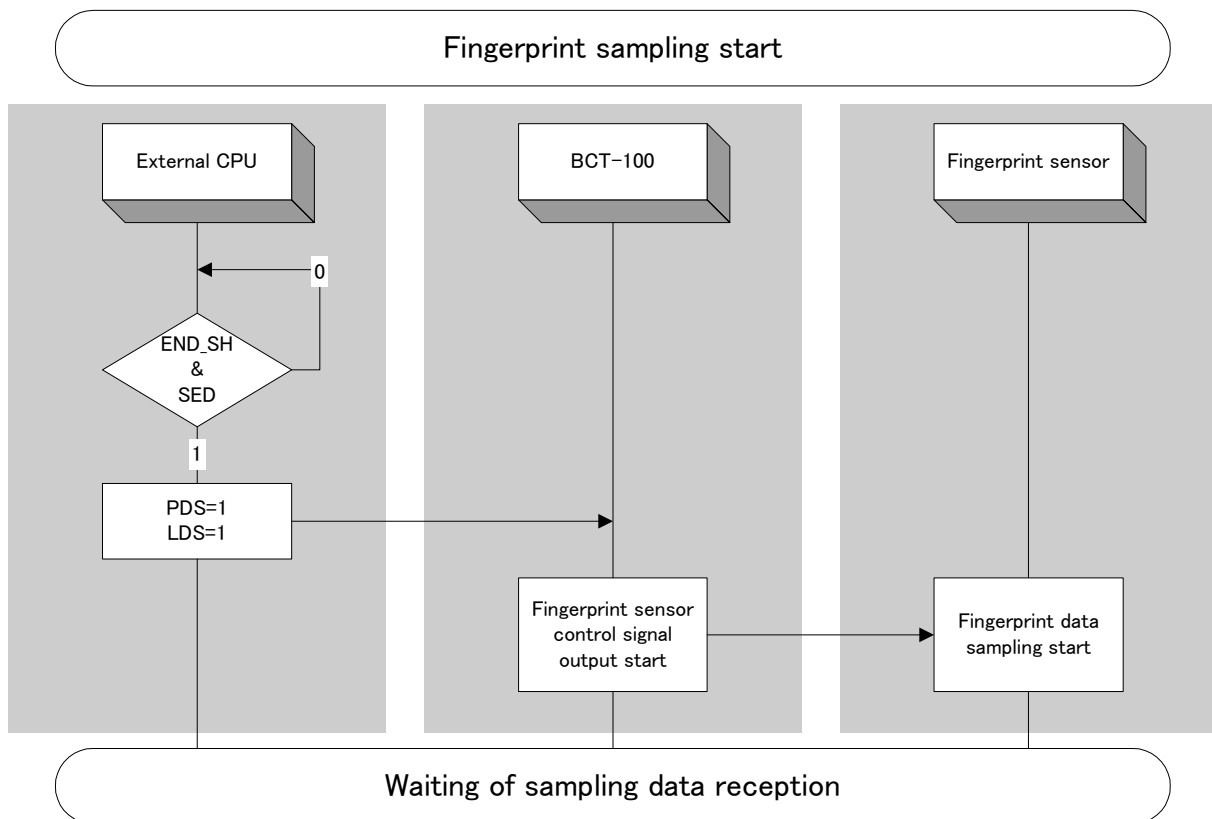
【Summary and feature】

- Set '1' to the PDS and the LDS flags, to start sampling.
- If initialization ends normally, sampling of the fingerprint data starts automatically.
- The PDS flag is cleared automatically to zero after the certain period.
- The LDS 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 or END_SH=0, normal operation is not guaranteed.
- * Sampling does not start normally, if LDS=0 at sampling start.
*See section 7.3.
- * Set /CE Pin enable in advance. If it set disable then fingerprint data output and Sampling state Pin (END_SH) will output Hi-Z (DPRn, SED, END_SH, SERR_CHK).

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 LDS to '1'.
- When the external CPU is not used for data processing, set LDS to '1' immediately after receipt of data.

【Note】

- * When setting '1' to the LDS, verify that SED=1.
- * When SED=0, normal operation for setting the LDS is not guaranteed.
- * The LDS is zero cleared when finish data output from BCT-100. The LDS is 1 line sampling start permission flag of Fingerprint sensor. If the LDS='0' then Fingerprint sensor does not start next sampling.
- * Keep /CE enable during sampling.

Figure 5 Image of Fingerprint data sampling and Output

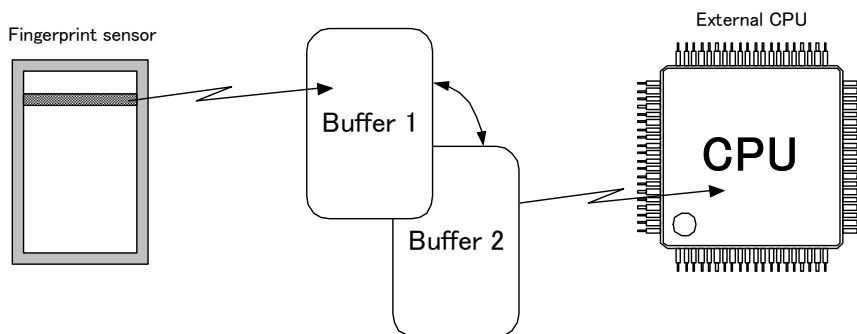


Figure 6 The flowchart of sampling data reception and processing (Serial communication)

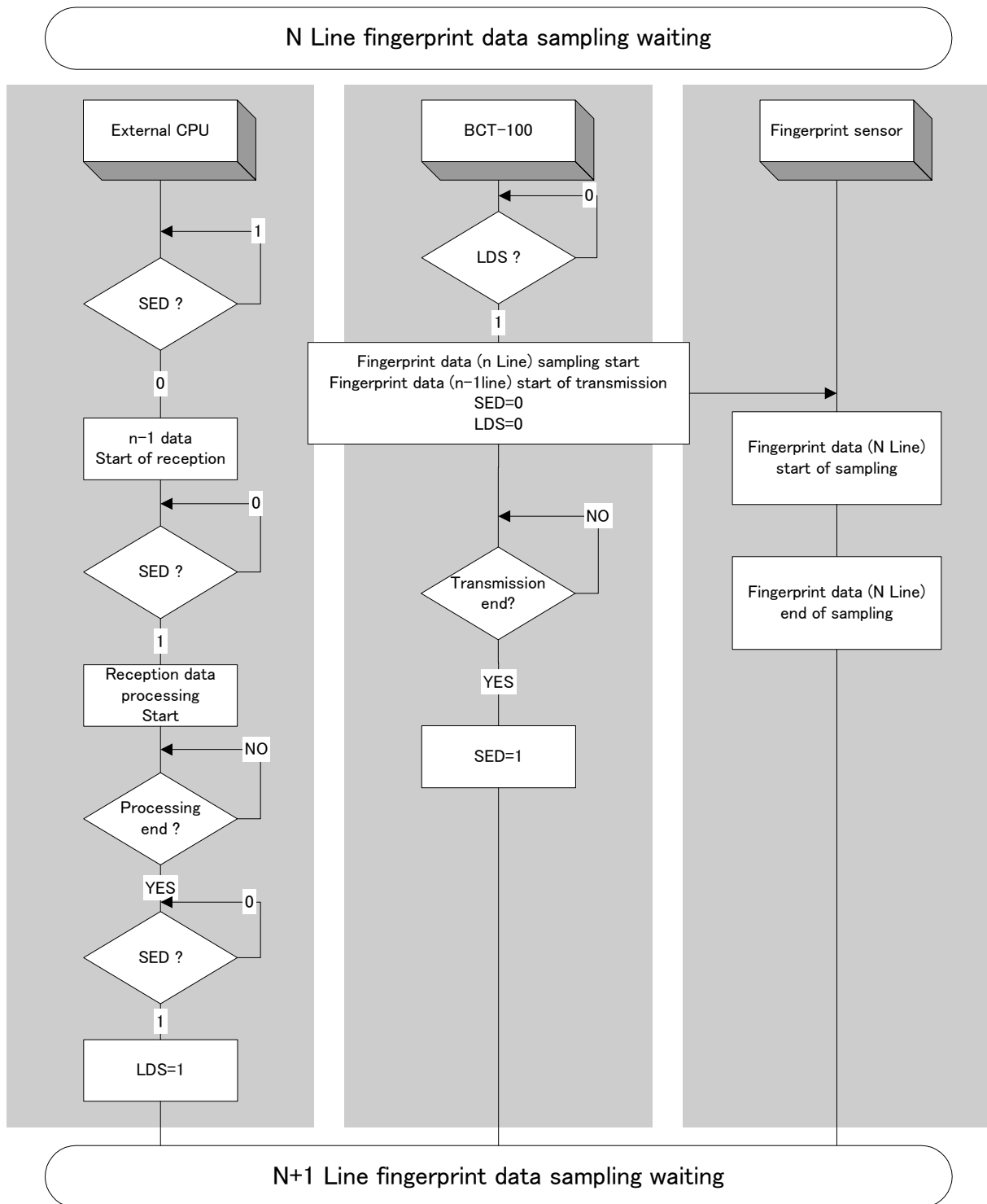
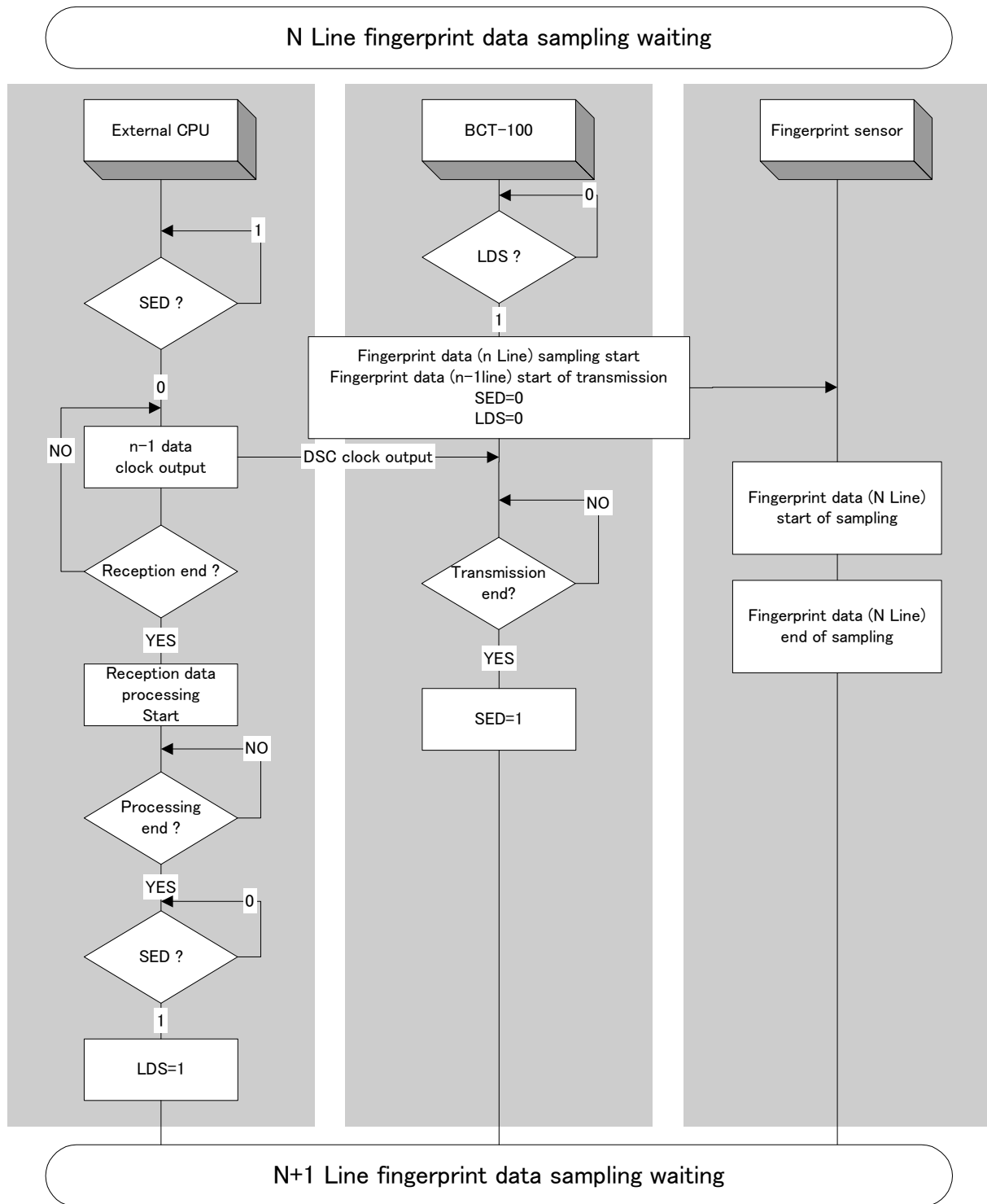


Figure 7 Fingerprint data sampling and transmission timing chart (Parallel communication)

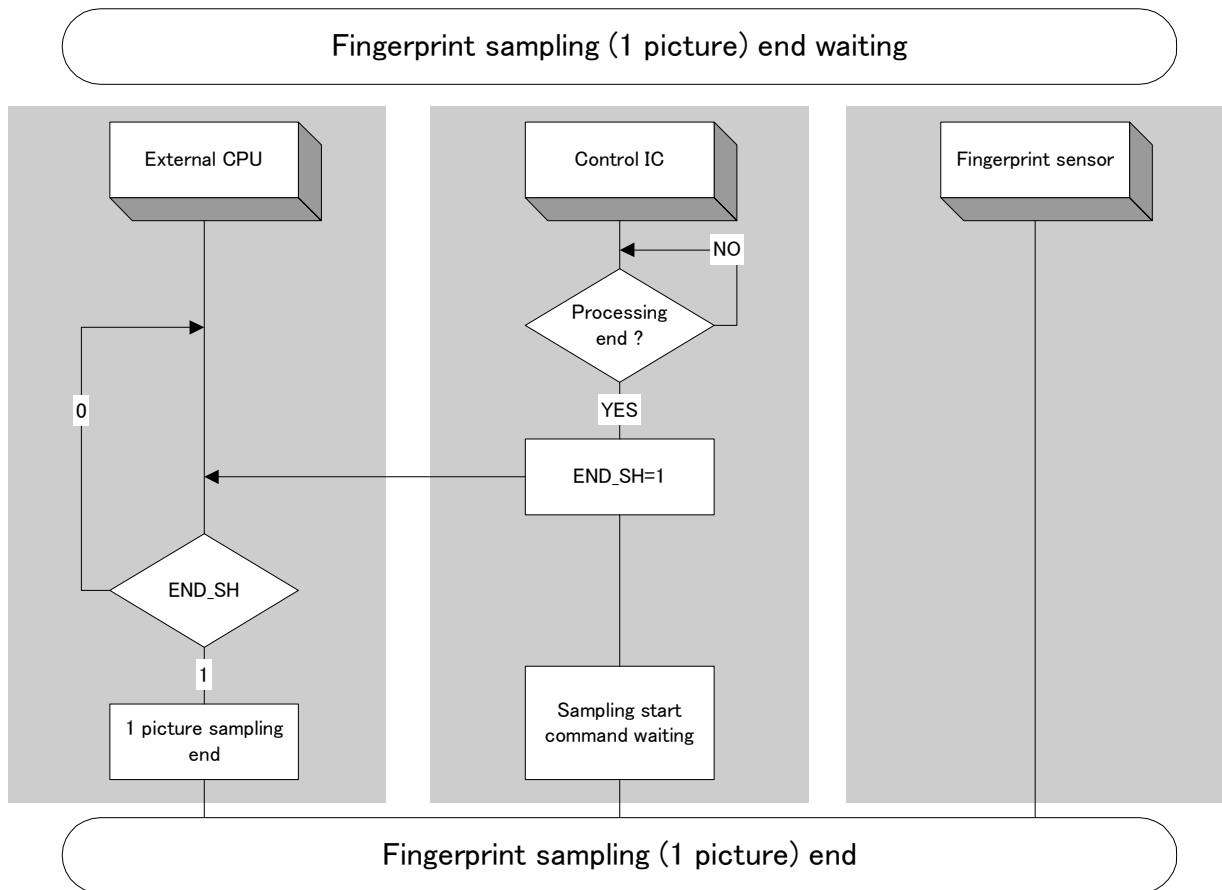


7.4. Sampling End Waiting

【Summary and feature】

When 1 picture sampling ends, the END_SH=1. END_SH=1 until the next 1 picture sampling (until PDS=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 the SLM is the only possible operation at the sleep mode.
- Output Pin connected to Fingerprint sensor is all '0' at the sleep mode.
- Clock signal for 12V charge pump circuit is stopped at sleep mode.
- It is possible to check sleep condition of BCT-100 use SLEEP Pin.

【Enabling sleep mode and wake up】

- SLM=0: Wake up from sleep mode.
- SLM=1: Sleep mode.

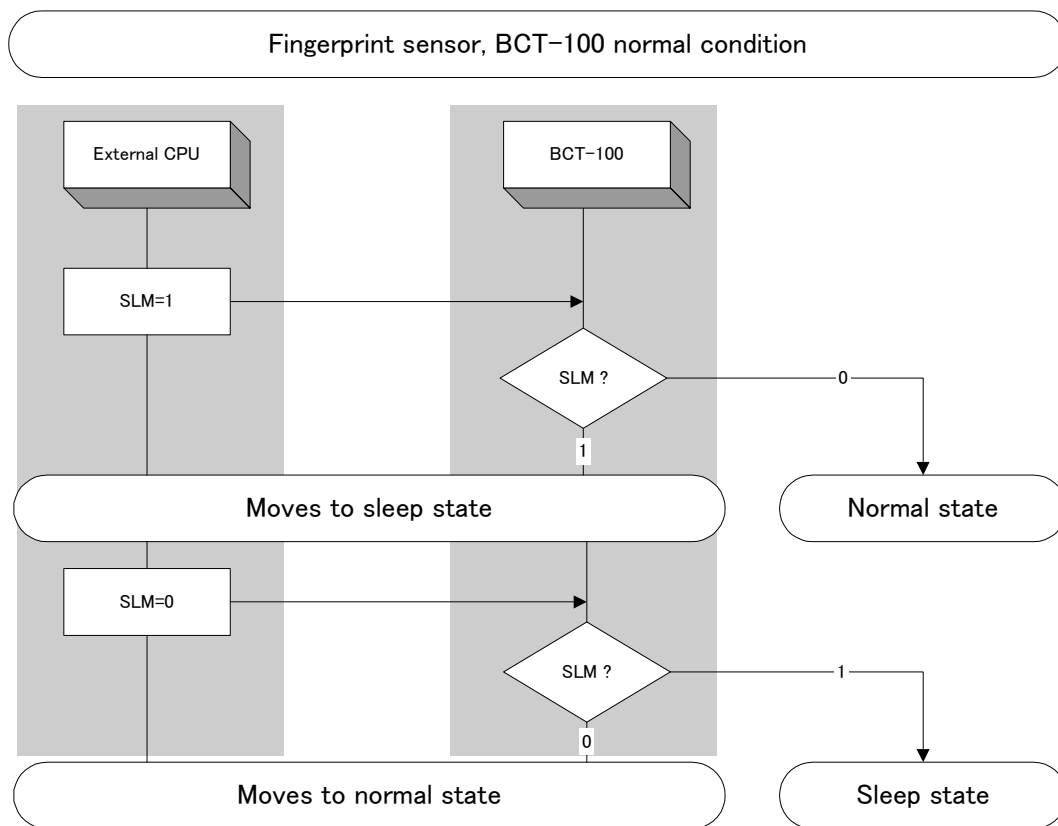
【Sleep mode check】

- SLEEP=0: Sleep mode.
- SLEEP=Hi-Z: Running

【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. BCT-100 Register

It shows the register that is used for BCT-100 control.

8.1. BCT-100 Register List

Table 2 BCT-100 register list

名称	Address	R/W	Bit 3	Bit 2	Bit 1	Bit 0	Initial Value
CRL	00h	W	PDS	LDS	-	-	00--b
CRH	01h	W	SLM	DCI	-	-	00--b
CSRL	02h	W	SOCK1	SOCK2	-	-	01--b
CSRH	03h	W	TXDR	SDOUT			01--b
VRLH	04h	W	VRL3	VRL2	VRL1	VRL0	0001b
VRLH	05h	W	VRL5	VRL4	-	-	01--b
Reserved	06h	-	-	-	-	-	-
Reserved	07h	-	-	-	-	-	-
Reserved	08h	-	-	-	-	-	-
Reserved	09h	-	-	-	-	-	-
Reserved	0Ah	-	-	-	-	-	-
Reserved	0Bh	-	-	-	-	-	-
Reserved	0Ch	-	-	-	-	-	-
Reserved	0Dh	-	-	-	-	-	-
Reserved	0Eh	-	-	-	-	-	-
Reserved	0Fh	-	-	-	-	-	-
Reserved	10h	-	-	-	-	-	-
Reserved	11h	-	-	-	-	-	-
Reserved	12h	-	-	-	-	-	-
Reserved	13h	-	-	-	-	-	-
Reserved	14h	-	-	-	-	-	-
Reserved	15h	-	-	-	-	-	-
Reserved	16h	-	-	-	-	-	-
Reserved	17h	-	-	-	-	-	-
Reserved	18h	-	-	-	-	-	-
Reserved	19h	-	-	-	-	-	-
Reserved	1Ah	-	-	-	-	-	-
Reserved	1Bh	-	-	-	-	-	-
Reserved	1Ch	-	-	-	-	-	-
Reserved	1Dh	-	-	-	-	-	-

【Note】

- * Bit access is not allowed for all register.
- * Set /CE enable in advance when write to all registers.

8.2. Register Function

8.2.1. CRL

Table 3 CRL function list

Bit	Name	Function
3	PDS	1 picture data sampling start flag. PDS=0: Zero cleared in automatically right after start sampling. PDS=1: Start sampling. *See section 7.2.
2	LDS	1 line data sampling start permission flag. LDS=0: Zero cleared in automatically right after start data transfer to external CPU. LDS=1: Sampling start permission. *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.

8.2.2. CRH

Table 4 CRH function list

Bit	Name	Function
3	SLM	Sleep mode flag. SLM=0: Running. SLM=1: Sleep mode *See section 7.5.
2	DCI	BCT-100 and 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.

8.2.3. CSRL

Table 5 CSRL function list

Bit	Name	Function
3	SOCK1	3 wire / 2 wire serial communication speed setting flag.
2	SOCK0	3 wire / 2 wire serial communication speed setting flag
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.

Table 6 CSRL setting list

SOCK1	SOCK0	3 wire / 2 wire serial communication clock
0	0	6MHz
0	1	3MHz (Initial setting)
1	0	1.5MHz
1	1	750KHz

8.2.4. CSRH

Table 7 CSRH function list

Bit	Name	Function
3	TXDR	3 wire / 2 wire serial data protocol setting flag. TXDR=0: MSB first (Initial setting) TXDR=1: LSB first
2	SDOUT	Communication protocol setting flag. SDOUT=0: 8bit parallel communication SDOUT=1: 3 wire / 2 wire serial communication (Initial setting)
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.

8.2.5. VRLL, VRLH

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.

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

***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.

8.2.6. 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

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.](#)

【Note】

- * Set /CE enable when set parameters to registers of BCT-100. It is impossible to set parameters to the registers when /CE is disenable.

Figure 10 An example of bus I/F connecting

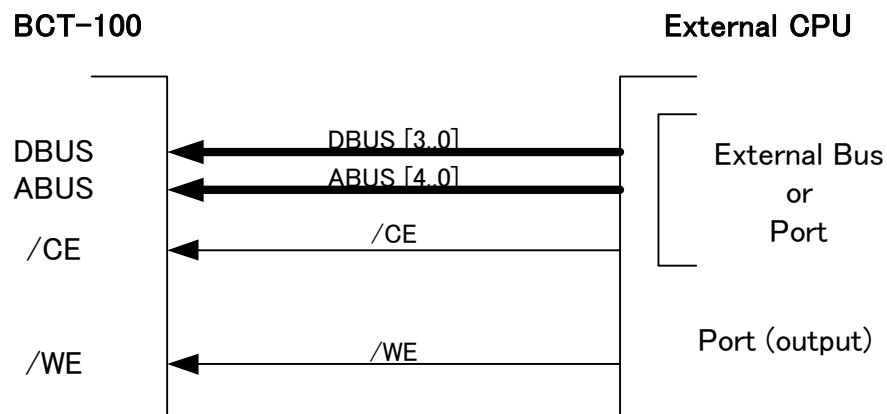
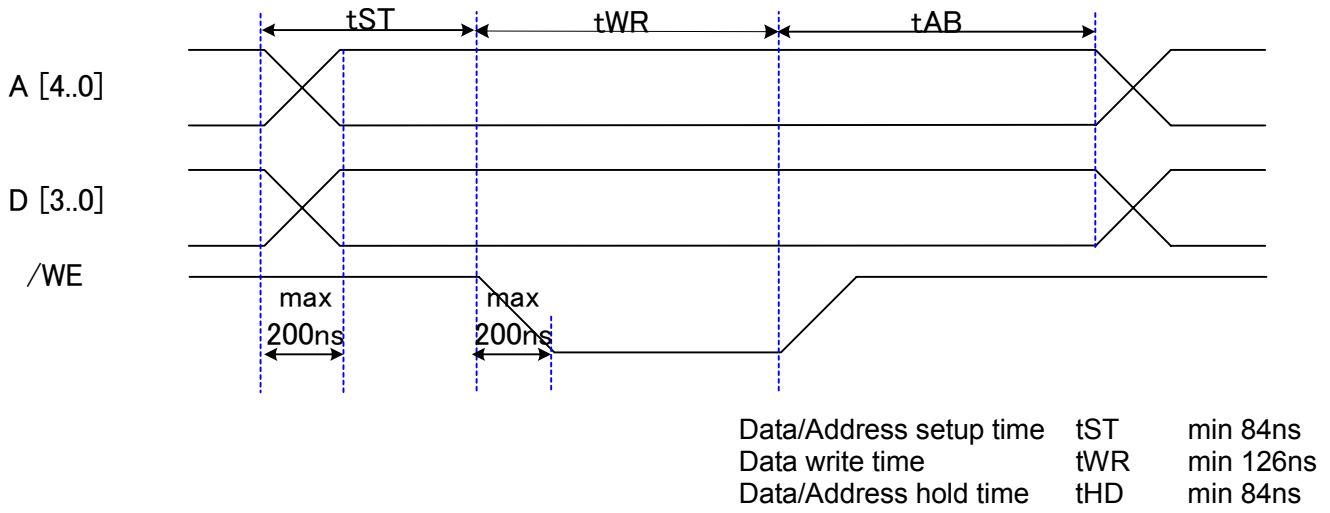


Figure 11 Bus I/F timing chart



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 flag of CSRH register, it sets output protocol.

Table 8 Fingerprint data output protocol setting list

Setting flag name	Flag state	Configuration
SDOUT	0	Parallel
	1	3 wire/2 wire Serial

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.
- It is possible to set communication speed and output data protocol. *See section [8.2.3](#) and [8.2.4](#)
- 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 256byte for 3 wire/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 LDS flag is cleared to zero automatically. After the data processing ends with the external CPU, by setting the LDS=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 12 3 wire serial communication data output timing (MSB first)

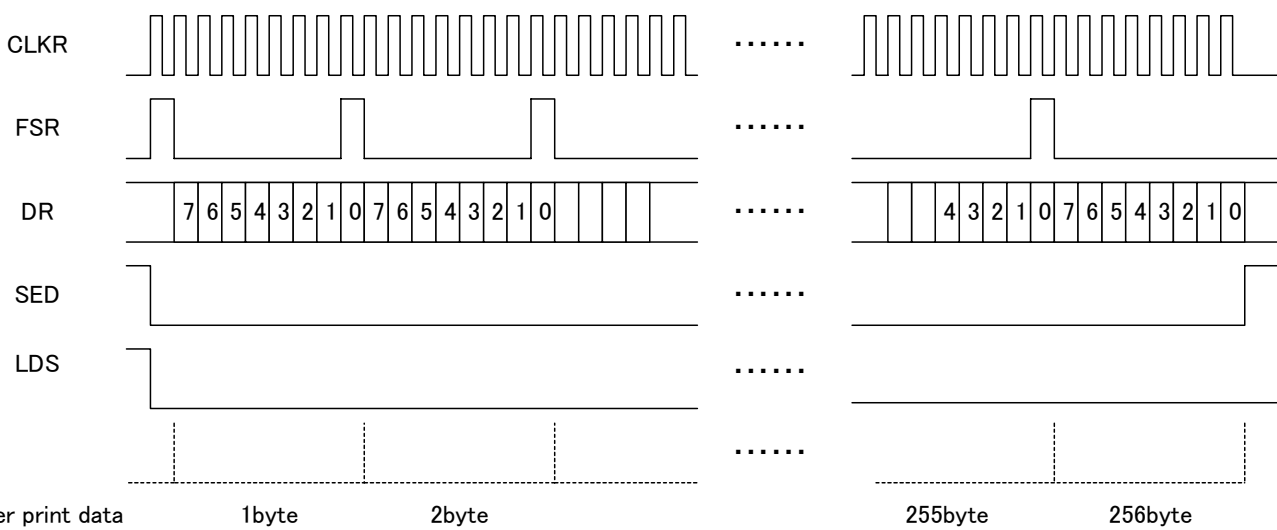


Figure 13 3 wire serial communication transfer timing chart (MSB first)

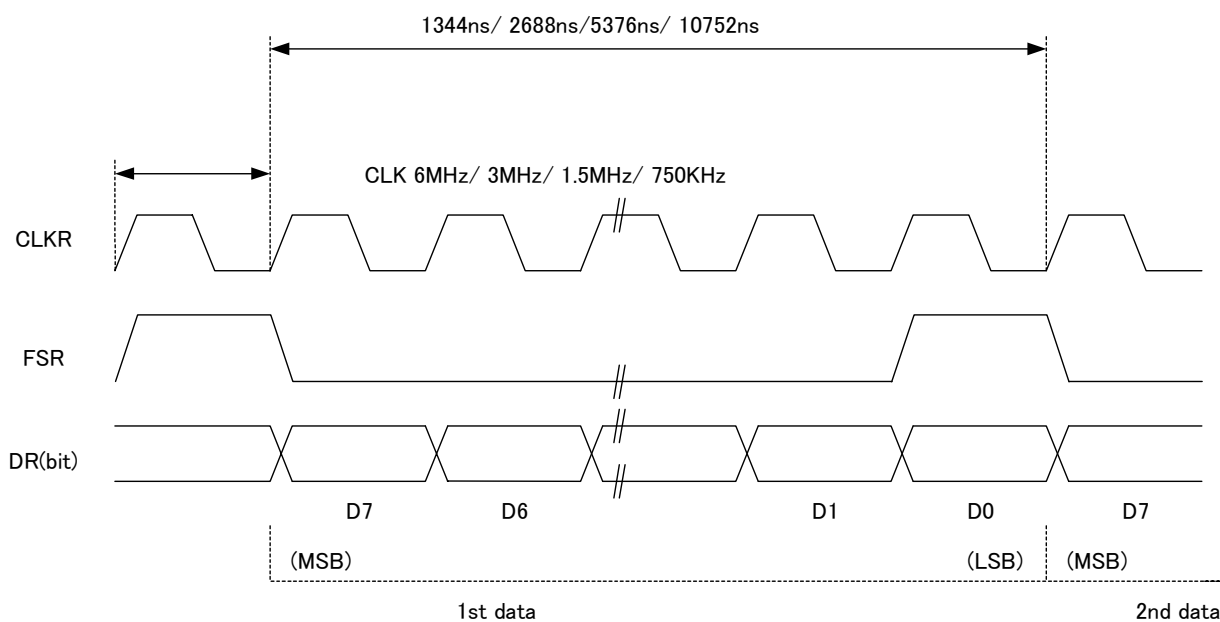


Figure 14 2 wire serial communication data output timing (MSB first)

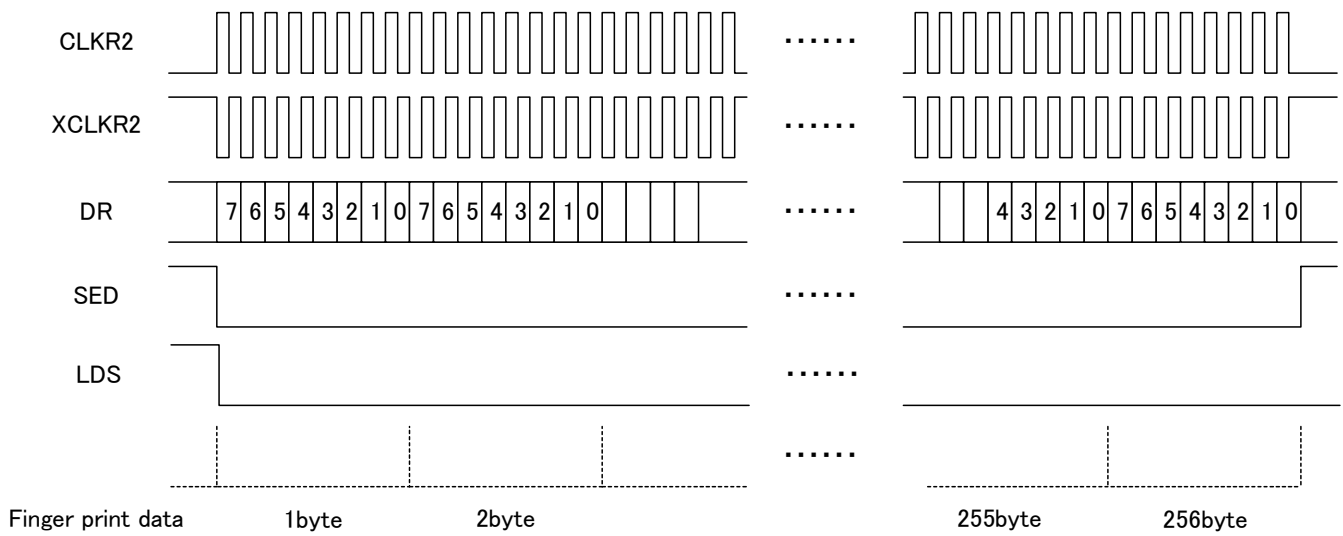
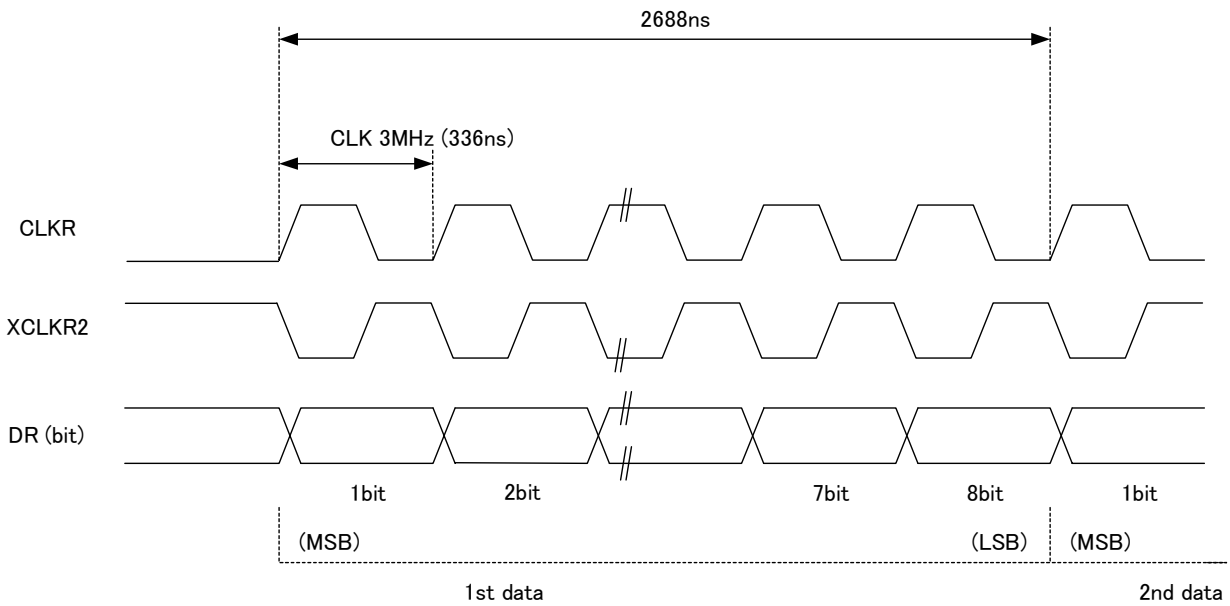


Figure 15 2 wire serial communication transfer timing chart (MSB first)



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
- LDS : 1 line data sampling start permission flag (CRL register bit2).

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
- Output data of BCT-100 is synchronized with clock signal from external CPU.
- 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 16 Parallel communication data output timing

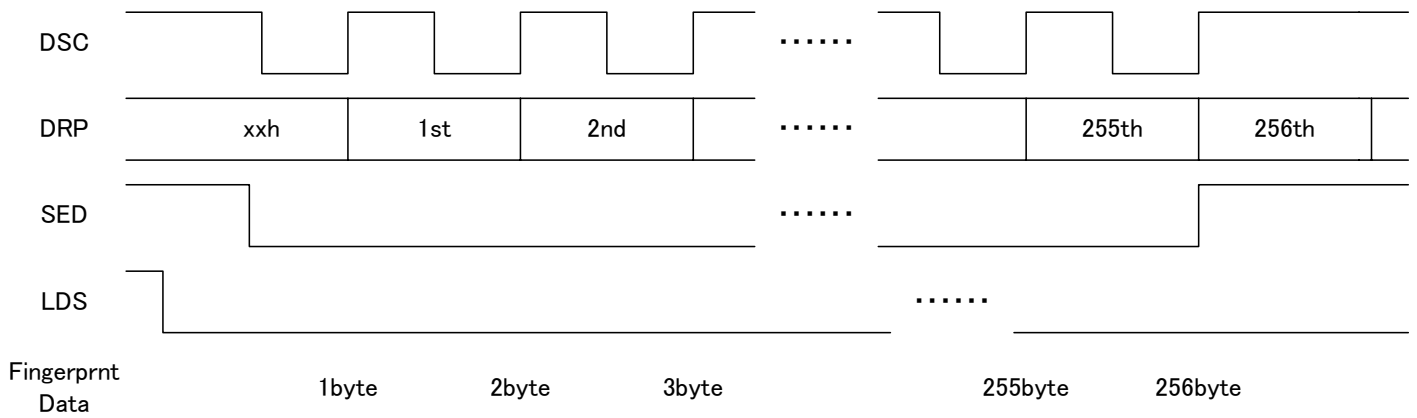
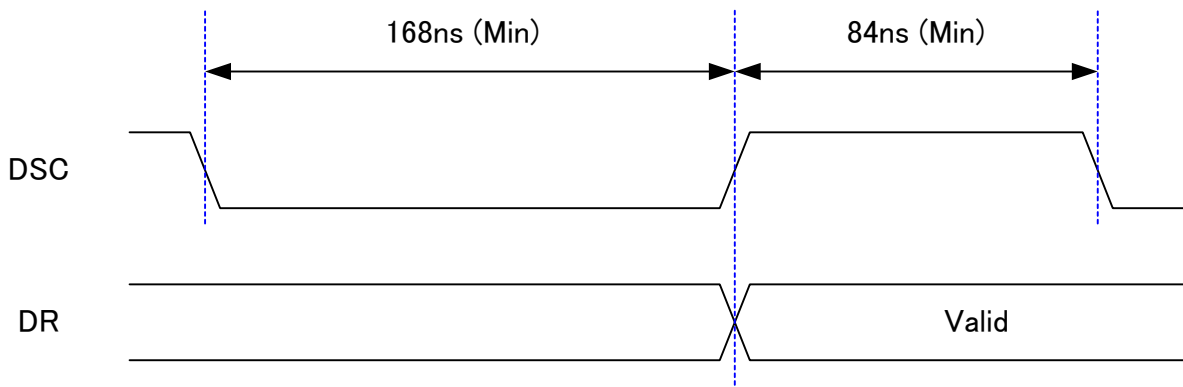


Figure 17 Parallel communication timing chart



10. Clock for charge pump circuit

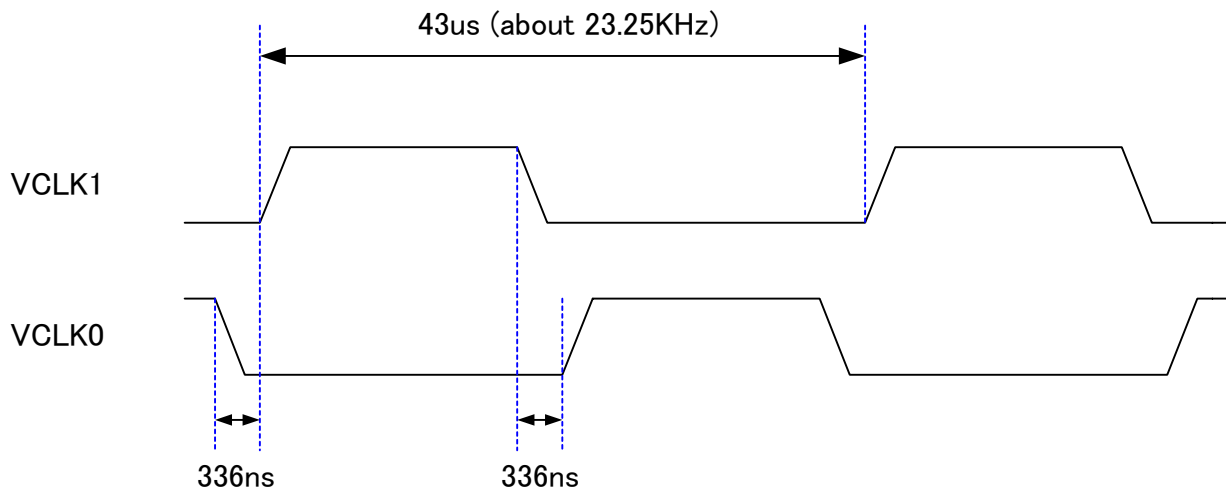
【Summary and Feature】

- Fingerprint sensor requires 12V power supply. BCT-100 can output clock signal for charge pump circuit.
- Clock signal frequency is about 23.25KHz. It is made from two different signals. The signals are in different phase.

【Note】

- It is possible to use in 3 wire / 2 wire serial communication only.
- Set /NIXE and /CE enable to output clock signal. It is possible to control clock signal output from outside by controlling /NIXE.
- When BCT-100 is set sleep mode, the clock signal is stopped.

Figure 18 Charge clock timing chart



11. Electrical characteristics

Table 9 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	-55 ~ +125	°C

Table 10 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

12. External Dimensions (Units: mm)

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

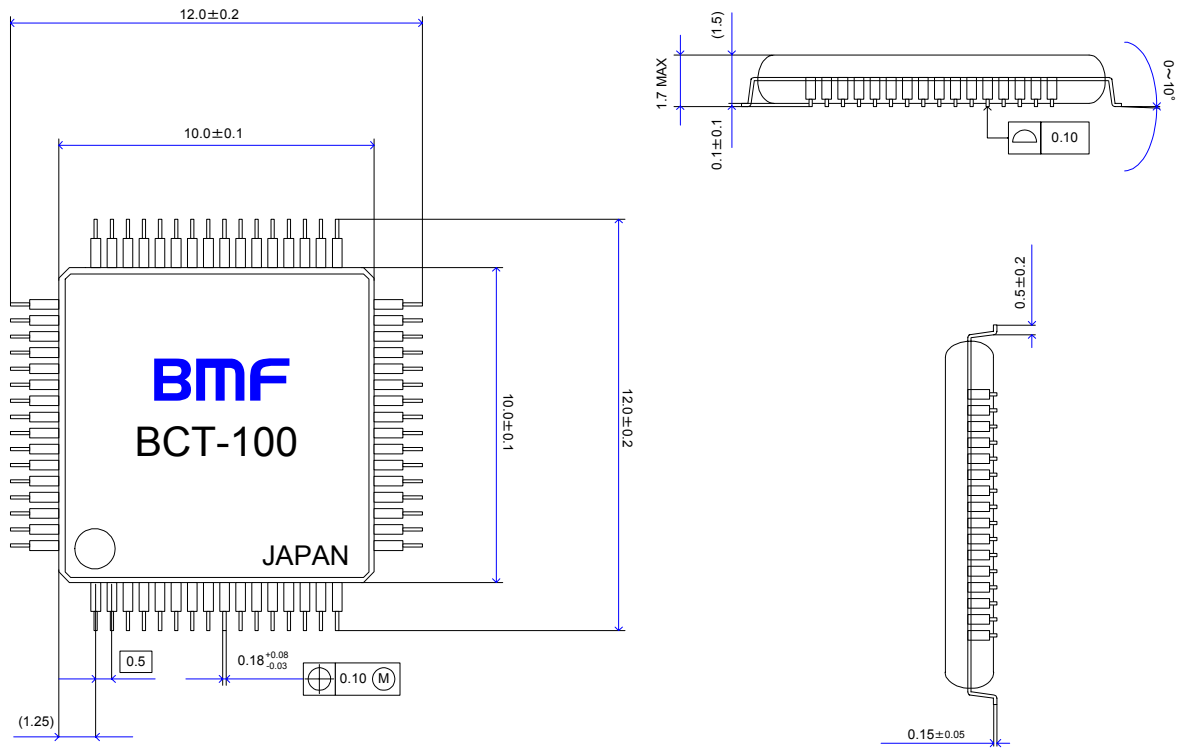


Figure 20 Recommend pad mounting sketch

