/ Descriptions

BRCM24C16SC SOP-8 16 Kbit I²C
The BRCM24C16SC is 16Kbit I^{2}C-compatible Serial EEPROM (Electrically Erasable Programmable Read-Only Memory) device in a SOP-8 Plastic Package. HF Product Code.

/ Features

1.7V 2.5~5.5V 1Mhz 1.7~2.5V
400Khz
CMOS 400uA 1.6mA

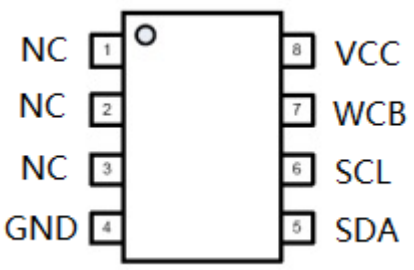
16

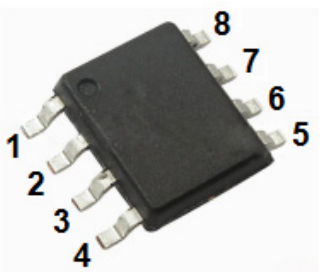
128
5ms
100 100 ESD HBM 6KV
+/-200mA;
Single Supply Voltage
Minimum operating voltage down to 1.7V 1 MHz clock from 2.5V to 5.5V 400kHz clock from 1.7V to 2.5V
Low power CMOS technology Read current 400uA, maximum Write current 1.6mA, maximum
Schmitt Trigger, Filtered Inputs for Noise Suppression
Sequential & Random Read Features
16-byte Page Write Modes
Write protect of the whole memory array
Additional Write Lockable Page and 128-bit Serial Number
Self-timed Write Cycle (5ms maximum)
High Reliability Endurance: > 1 Million Write Cycles Data Retention: > 100 Years HBM: 6KV
Latch up Capability: +/-200mA;

/ Applications

Household appliances, Network communications, Portable Bluetooth devices, Set-top boxes, Smart meters, Fingerprint unlocking devices

/ Pinning





/ Pinning

Pin	Name	Type	Description
1	NC	-	
2	NC	-	
3	NC	-	
4	GND	Ground	
5	SDA	I/O	/
6	SCL	Input	
7	WCB	Input	
8	VCC	Power	

/ Marking

/ See Marking Instructions

/ Absolute Maximum Ratings(Ta=25)

Parameter	Symbol	Rating	Unit
Storage Temperature	T_{stg}	-65~+150	
Operation Temperature	T_{opr}	-40~+85	
Maximum Operation Voltage	V_{cc}	6.25	V
Voltage on Any Pin with Respect to Ground	V_{pin}	-1.0~ Vcc+1.0	V
DC Output Current	I_{out}	5.0	
Electro-Static discharge HBM mode	ESD	6000	

/ Reliability Characteristic

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Endurance	EDR	25 3.3V Page mode	1,000,000			Write cycles
Data retention	DRET		100			Years

/ DC Electrical Characteristics(Unless otherwise specified, Vcc = 1.7V to 5.5V, T_A = –40°C to 85°C)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Supply Voltage	Vcc		1.7		5.5	V
Standby Current	Isb	Vcc = 3.3V, TA = 85°C			1.0	uA
		Vcc = 5.5V, TA = 85°C			3.0	uA
Supply Current	Icc1	Vcc=5.5V, Read at 400Khz		0.2	0.4	mA
Supply Current	Icc2	Vcc=5.5V,Write at 400Khz		0.8	1.6	mA
Input Leakage Current	ILI	VIN = Vcc or GND		0.1	1.0	uA
Output Leakage Current	ILO	VOUT = Vcc or GND		0.05	1.0	uA
Input Low Level	VIL		–0.6		0.3Vcc	V
Input High Level	VIH		0.7Vcc		Vcc+0.5	V
Output Low Level Vcc = 1.7V (SDA)	VOL1	IOL = 1.5 mA			0.2	V
Output Low Level Vcc= 3.0V (SDA)	VOL2	IOL = 2.1 mA			0.4	V

/ AC Electrical Characteristics(Unless otherwise specified, Vcc = 1.7V to 5.5V, T_A = –40°C to 85°)

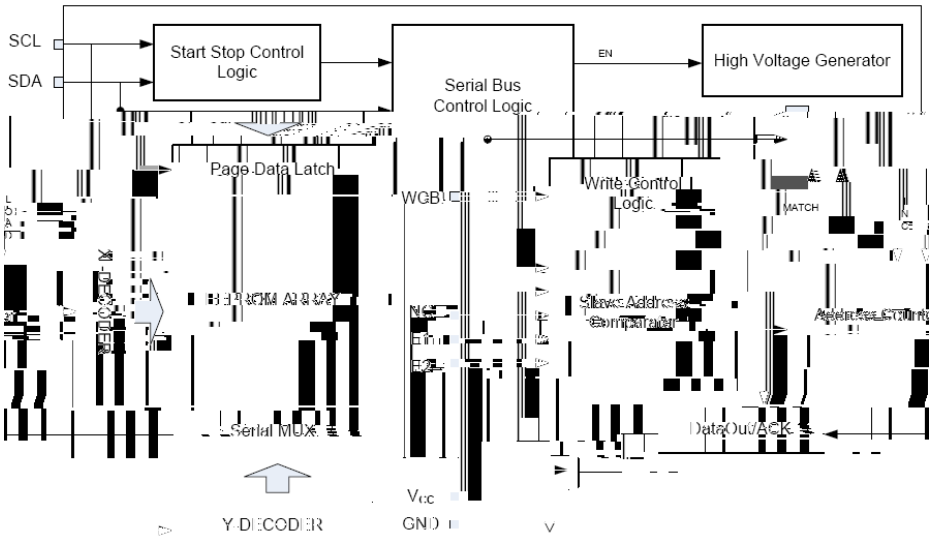
Parameter	Symbol	1.7V≤Vcc<2.5V			2.5V≤Vcc≤5.5V			Unit
		Min	Typ	Max	Min	Typ	Max	
Clock Frequency, SCL	f_{SCL}	-	-	400	-	-	1000	kHz
Clock Pulse Width Low	t_{LOW}	1.3	-	-	0.4	-	-	us
Clock Pulse Width High	t_{HIGH}	0.6	-	-	0.4	-	-	us
Clock Low to Data Out Valid	t_{AA}	0.05	-	0.9	0.05	-	0.55	us
Noise Suppression Time	t_I	-	-	0.1	-	-	0.05	us
Time the bus must be free before a new transmission can start	t_{BUF}	1.3	-	-	0.5	-	-	us
Start Hold Time	$t_{HD.STA}$	0.6	-	-	0.25	-	-	us
Start Setup Time	$t_{SU.STA}$	0.6	-	-	0.25	-	-	us

/ AC Electrical Characteristics(Unless otherwise specified, Vcc = 1.7V to 5.5V, T_A = –40°

Parameter	Symbol	1.7V≤Vcc<2.5V			2.5V≤Vcc≤5.5V			Unit
		Min	Typ	Max	Min	Typ	Max	
Data In Hold Time	$t_{HD.DAT}$	0	-	-	0	-	-	us
Data In Setup Time	$t_{SU.DAT}$	0.1	-	-	0.1	-	-	us
Inputs Rise Time[1]	t_R	-	-	0.3	-	-	0.3	us
Inputs Fall Time[1]	t_F	-	-	0.3	-	-	0.1	us
Stop Setup Time	$t_{SU.STO}$	0.6	-	-	0.25	-	-	us
Data Out Hold Time	t_{DH}	0.05	-	-	0.05	-	-	us
WCB pin Setup Time	$t_{SU.WCB}$	1.2	-	-	0.6	-	-	us
WCB pin Hold Time	$t_{HD.WCB}$	1.2	-	-	0.6	-	-	us
Write Cycle Time	t_{WR}	-	-	5	-	-	5	ms

Notes:AC measurement conditions:

1. RL (connects to Vcc): 1.3k (2.5V, 5.5V), 10k (1.7V)
2. Input pulse voltages: 0.3 Vcc to 0.7 Vcc
3. Input rise and fall times: ≤50ns
4. Input and output timing reference voltages: 0.5Vcc



/ Functional Description

/ Data Input

SDA SDA SCL (1) SCL
SDA (1)

The SDA pin is normally pulled high with an external device. Data on the SDA pin may change only during SCL low time periods (see to Figure 1). Data changes during SCL high periods will indicate a start or stop condition as defined below.

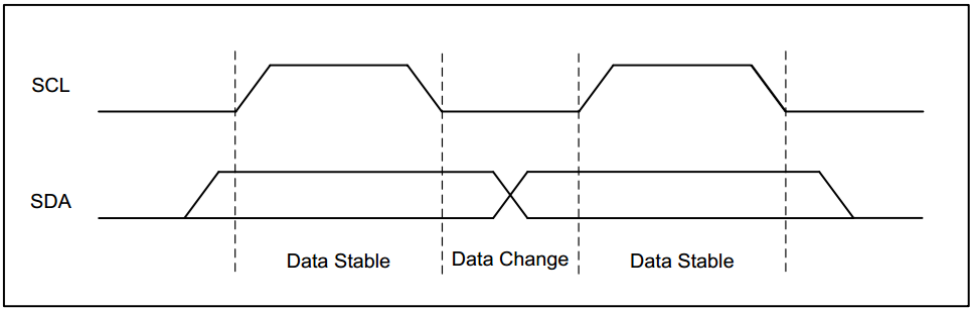
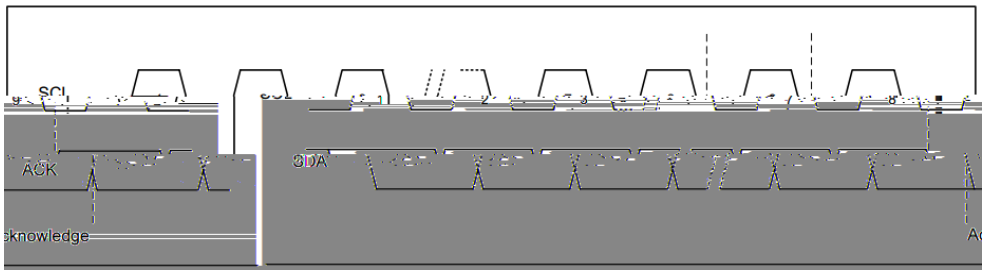


Figure 1 Data Validity

/ Start Condition

/ Functional Description

All addresses and data words are serially transmitted to and from the BRCM24C16SC in 8-bit words. The BRCM24C16SC sends a “0” to acknowledge that it has received each word. This happens during the ninth clock cycle.



/ Functional Description

Chip	Access area	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
BRCM24C16SC	Normal Area	1	0	1	0	P2	P1	P0	R/W
	ID Page	1	0	1	1	X	X	X	R/W
	Lock Bit	1	0	1	1	X	X	X	R/W
	Serial Number	1	0	1	1	X	X	X	1

Table 1 Device Address

Chip	Access area	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
BRCM24C16SC	Normal Area	A7	A6	A5	A4	A3	A2	A1	A0
	ID Page	0	0	A5	A4	A3	A2	A1	A0
	Lock Bit	X	1	X	X	X	X	X	X
	Serial Number	1	0	A5	A4	A3	A2	A1	A0

Table 2 Word Address

8 / 0 1

0

The eighth bit of the device address is the read/write operation select bit. A read operation is initiated if this bit is high and a write operation is initiated if this bit is low. Upon a compare of the device address, the Chip will output a zero. If a compare is not made, the device will return to a standby state.

/ Data Security

BRCM24C16SC WCB Vcc

BRCM24C16SC has a hardware data protection scheme that allows the user to write protect the whole memory when the WCB pin is at Vcc.

/ Byte Write

8

BRCM24C16SC “ 0 ” 8 8

BRCM24C16SC “ 0 ”

BRCM24C16SC BRCM24C16SC

(5)

A write operation requires one 8-bit data word address following the device address word and acknowledgment. Upon receipt of this address, the BRCM24C16SC will again respond with a “0” and then clock in the first 8-bit data word. Following receipt of the 8-bit data word, the BRCM24C16SC will output a “0” and the addressing device, such as a microcontroller, must terminate the write sequence with a stop condition. And then the BRCM24C16SC enters an internally timed write cycle, all inputs are disabled during this write cycle and the BRCM24C16SC will not respond until the write is complete (see Figure 5).

/ Functional Description

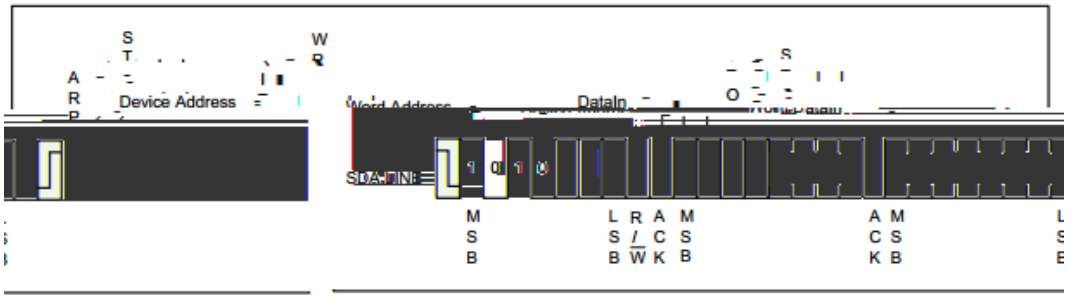


Figure 5 Byte Write

/ Page Write

BRCM24C16SC BRCM24C16SC

“ 0 ”

A page write is initiated the same as a byte write, but the master does not send a stop condition after the first data word is clocked in. Instead, after the BRCM24C16SC acknowledges receipt of the first data word, the master can transmit more data words. The BRCM24C16SC will respond with a “0” after each data word received. The microcontroller must terminate the page write sequence with a stop condition.

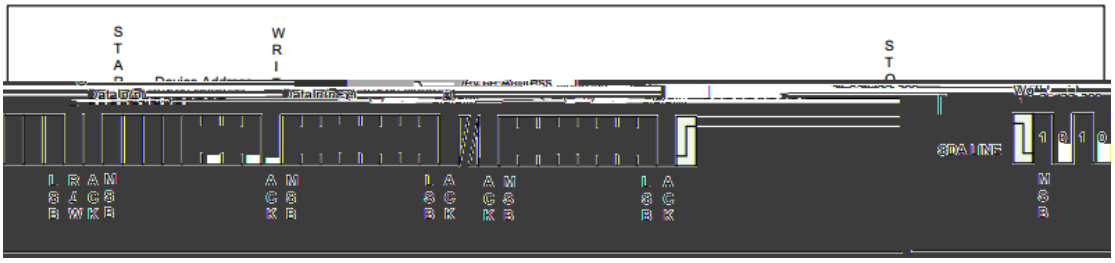


Figure 6 Page Write

4

BRCM24C16SC 16

/ Functional Description

/ Acknowledge Polling

BRCM24C16SC
/ BRCM24C16SC
“ 0 ”

Once the internally timed write cycle has started and the BRCM24C16SC inputs are disabled, acknowledge polling can be initiated. This involves sending a start condition followed by the device address word. The read/write bit is representative of the operation desired. Only if the internal write cycle has completed will the BRCM24C16SC respond with a “0”, allowing the read or write sequence to continue.

/ Write Identification Page

16

(a) 1011b
(b) A5 / A4 0 1 A7 / A6 “ 00 ”
(c) A3 / A0
NoACK

The Identification Page (16 bytes) is an additional page which can be written and (later) permanently locked in Read-only mode. It is written by the Write Identification Page instruction. This instruction uses the same protocol and format as Page Write (into memory array), except for the following differences:
(a)Device type identifier = 1011b.
(b)Address bits A5/A4 are don’t care while address bit A7/A6 which must be ‘00’.
(c)Address bits A3/A0 define the byte address inside the Identification page. If the Identification page is locked, the data bytes transferred during the Write Identification Page instruction are not acknowledged (NoACK).

/ Lock Identification Page

ID Lock ID

(a) 1011b;
(b) A6 1 ;
(c) xxxx xx1x x 0 1

The Lock Identification Page instruction (Lock ID) permanently locks the Identification page in Read-only mode. The Lock ID instruction is similar to Byte Write (into memory array) with the following specific conditions:
(a)Device type identifier = 1011b.
(b)Address bit A6 must be ‘1’ all other address bits are don’t care.
(c)The data byte must be equal to the binary value xxxx xx1x, where x is don’t care.

/ Functional Description

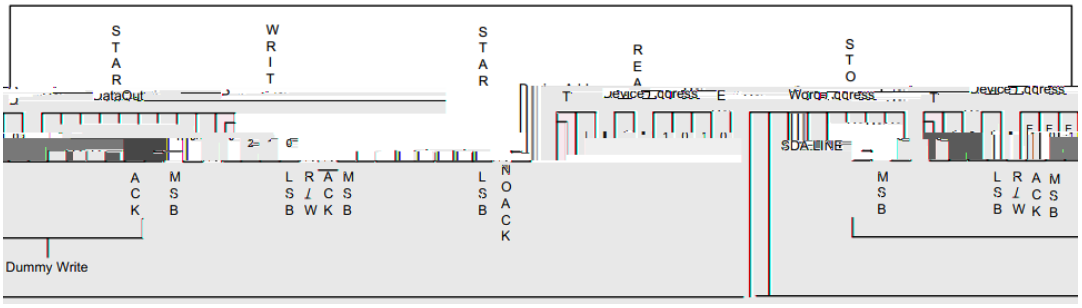


Figure 8 Random Address Read

/ Sequential Read

BRCM24C16SC

“ 0 ”

9

Sequential Reads are initiated by either a Current Address Read or a Random Address Read. After the microcontroller receives a data word, it responds with acknowledge. As long as the BRCM24C16SC receives acknowledge, it will continue to increment the data word address and serially clock out sequential data words. When the memory address limit is reached, the data word address will roll-over and the Sequential Read will continue. The Sequential Read operation is terminated when the microcontroller does not respond with a “0” but does generate a following stop condition (see Figure 9).

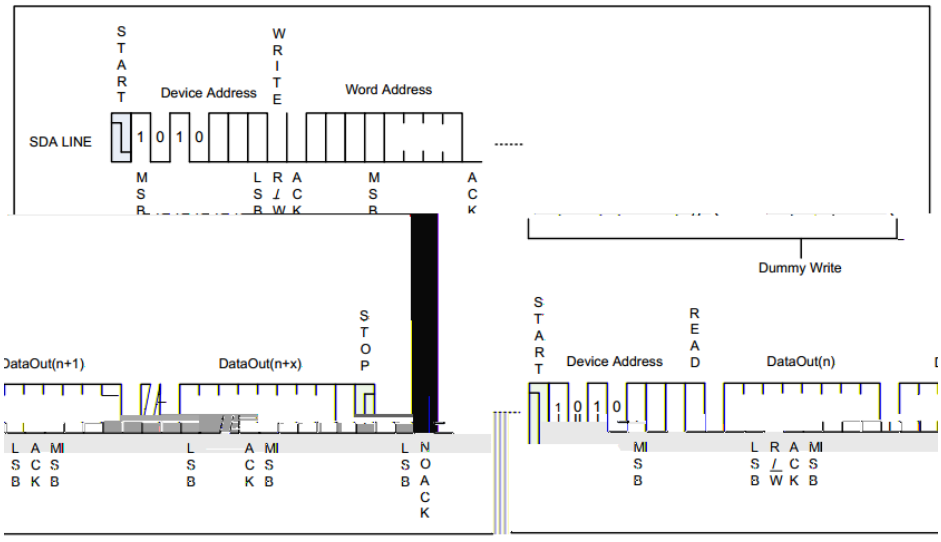


Figure 9 Sequential Read

/ Functional Description

/ Read Identification Page

16

1011b A7 / A6 0 A5 A4 / A0 ID
10d 6 ID

16

The Identification Page (16 bytes) is an additional page which can be written and (later) permanently locked in Read-only mode. The Identification Page can be read by Read Identification Page instruction which uses the same protocol and format as the Read Command (from memory array) with device type identifier defined as 1011b. The MSB address bits A7/A6 must be 0 while A5 is don't care, and the LSB address bits A4/A0 define the byte address inside the Identification Page. The number of bytes to read in the ID page must not exceed the page boundary (e.g. when reading the Identification Page from location 10d, the number of bytes should be less than or equal to 6, as the ID page boundary is 16 bytes).

/ Read the Lock Status

[+] /
ACK NoACK,(10)

The locked/unlocked status of the Identification page can be checked by transmitting a specific truncated command [Identification Page Write instruction + one data byte] to the device. The device returns an acknowledge bit if the Identification page is unlocked, otherwise a NoACK bit if the Identification page is locked (see Figure 10).

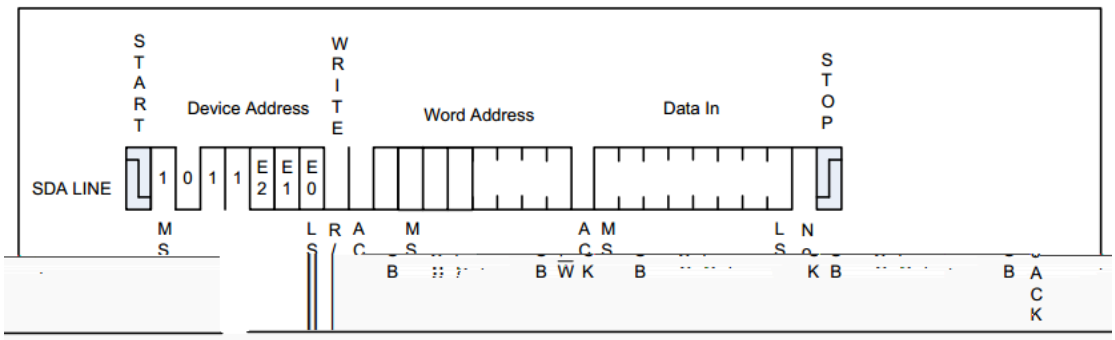


Figure 10 Lock Status Read (When Identification page locked, return NoACK after one data byte)

/ Read Serial Number

16

1

128

EEPROM “ ”

EEPROM

1

/ Functional Description

A7 A6 “ 10 ” 2 “ 10 ”

80h

128 16

128 ACK

7

The Identification Page (16 bytes) is an additional page which can be written and (later) permanently locked in Read-only mode.

Reading the serial number is similar to the sequential read sequence but requires use of the device address seen in Table 1 on page 9, a dummy write, and the use of a specific word address. The entire 128-bit value must be read from the starting address of the serial number block to guarantee a unique number.

Since the address pointer of the device is shared between the regular EEPROM array and the serial number block, a dummy write sequence, as part of a Random Read or Sequential Read protocol, should be performed to ensure the address pointer is set to zero. A Current Address Read of the serial number block is supported but if the previous operation was to the EEPROM array, the address pointer will retain the last location accessed, incremented by one. Reading the serial number from a location other than the first address of the block will not result in a unique serial number.

Additionally, the word address contains a „10□ sequence in bit A7 and A6 of the word address, regardless of the intended address as depicted in Table 2 on page 9. If a word address other than „10□ is used, then the device will output undefined data.

Example: If the application desires to read the first byte of the serial number, the word address input would need to be 80h.

When the end of the 128-bit serial number is reached (16 bytes of data), continued reading of the extended memory region will result in repeated serial number data readout for the data word address will roll-over back to the beginning of the 128-bit serial number. The Serial Number Read operation is terminated when the microcontroller does not respond with a zero (ACK) and instead issues a Stop condition (see Figure 11)

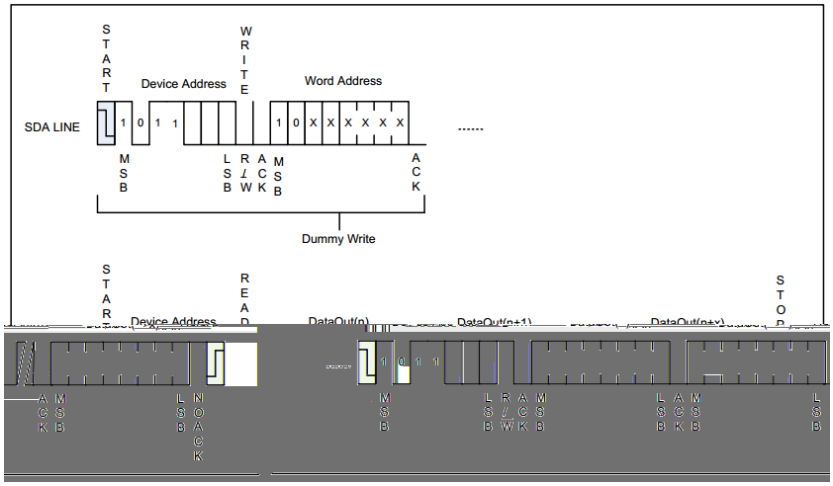
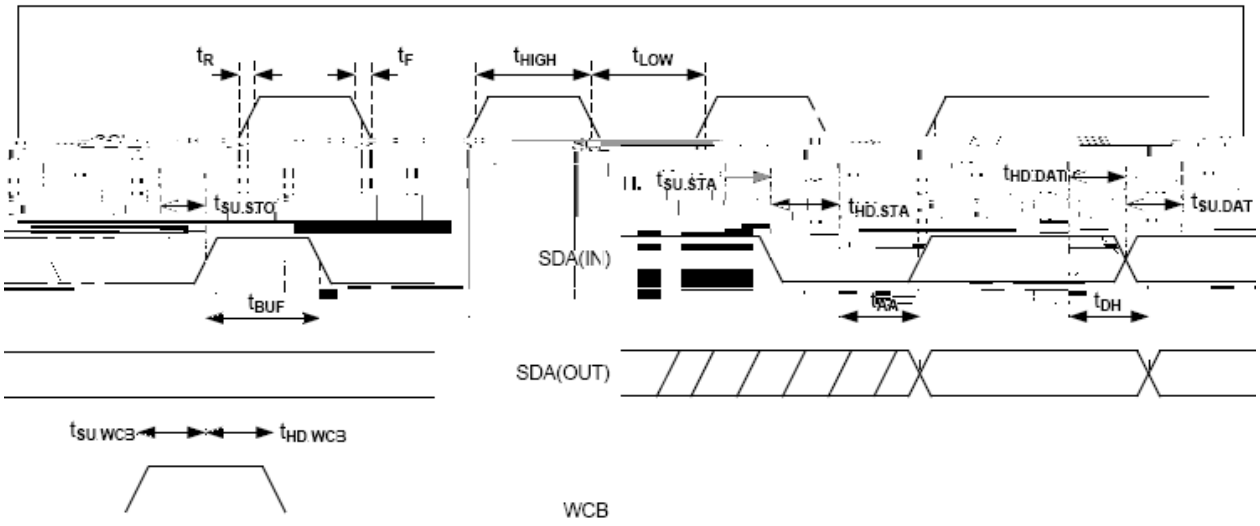


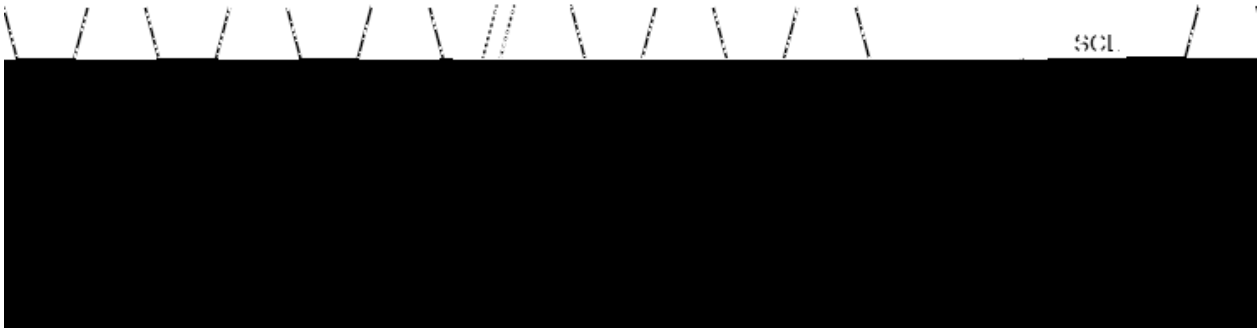
Figure 11 Sequential Read

/ Time Sequence Diagram

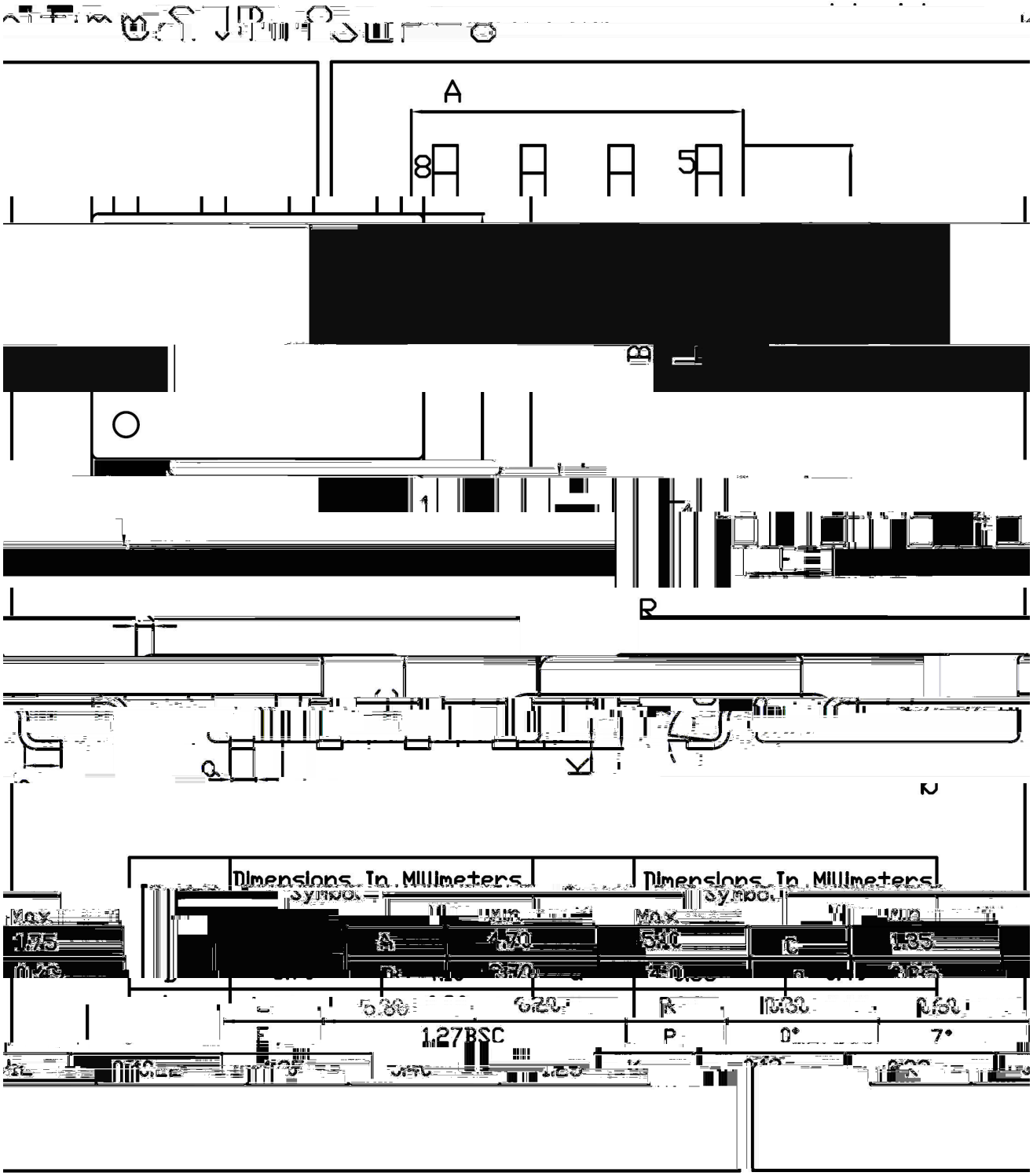
Bus Timing



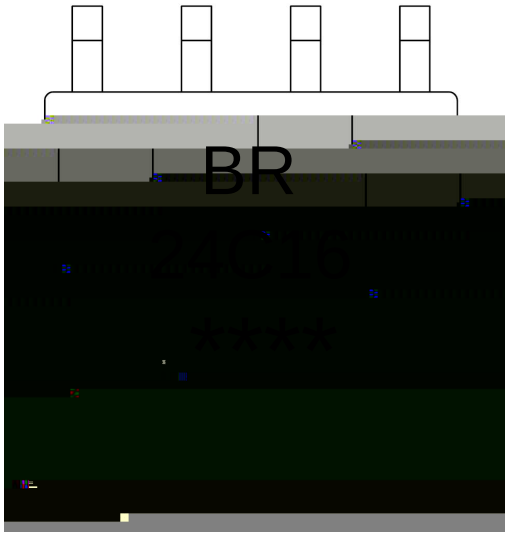
Write Cycle Timing



/ Package Dimensions



/ Marking Instructions



BR

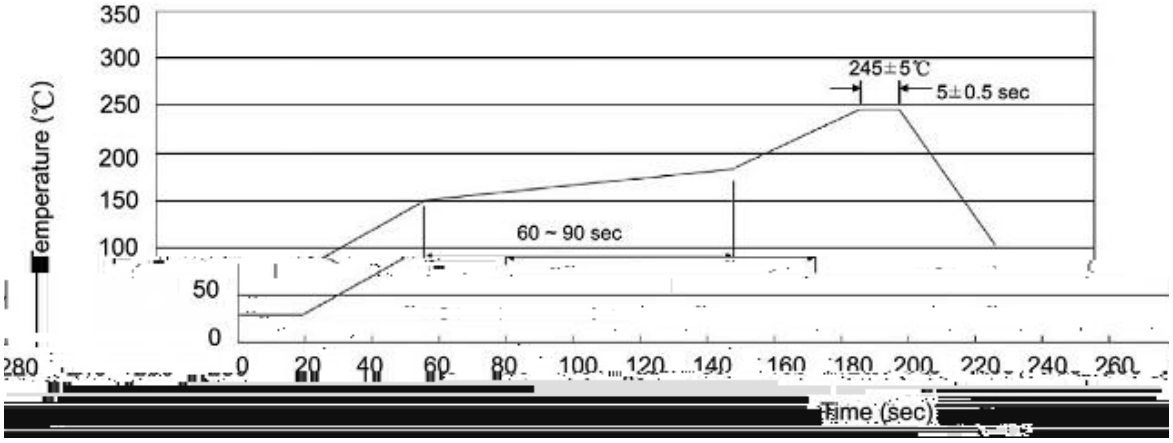
24C16

****

Note:

BR:	Company Code.
24C16:	Product Type.
****:	Lot No. Code, code change with Lot No.

( ) / Temperature Profile for IR Reflow Soldering(Pb-Free)



		Note:
1	150 180 60 90sec;	1.Preheating:150~180 , Time:60~90sec.
2	245±5 5±0.5sec;	2.Peak Temp.:245±5 , Duration:5±0.5sec.
3	2 10 /sec.	3. Cooling Speed: 2~10 /sec.

/ Resistance to Soldering Heat Test Conditions

260±5	10±1 sec.	Temp.:260±5	Time:10±1 sec

/ Packaging SPEC.

/ REEL

Package Type	Units					Dimension		(unit mm^3)

/ Notices