Features:

- SPI Bus Interface:
  - SPI compatible
  - SDI (dual) and SQI (quad) compatible
  - 20 MHz Clock rate for all modes
- Low-Power CMOS Technology:
  - Read Current: 20mA at 20MHz(Typical)
  - Deep Sleep Mode Current: 1mA(Typical)
- Unlimited Read and Write Cycles
- 256K x 8-bit Organization
- Byte and Sequential Mode for Reads and Writes
- Temperature Ranges Supported:
  - Industrial (I): -40°C to +85°C
- RoHS Compliant
- 8 Lead SOP, TSSOP Packages

Description:

This device is 2Mb serially accessed Static Random Access Memory, internally organized as256K words by 8 bits each. The device is designed and fabricated using state of the artadvanced CMOS technology to provide both high-speed performance and low power. Thedevice operate with a single chip select (/CS) input and are accessed by a simple serialinterface that is SPI-compatible. A single data in and data out line is used along with a clockto access data within this device. The device include a /HOLD pin that allows communicationwith the device to be paused without deselecting the device. While paused, input transitionsexcept /CS pin will be ignored. The device can operate over a temperature range of -40°C to +85°C (Industrial grade).

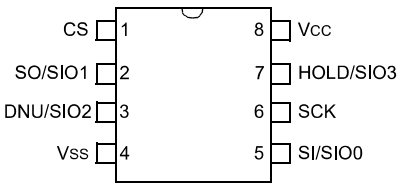
Order Information:

Part Number	Vcc Range	MHz (max)	Density	Temp. Ranges	Package
EMI7002WTMI	2.7 - 3.6V	20	2Mb	-40℃ to +85℃	TSSOP-8
EMI7002WSMI	2.7 - 3.6V	20	2Mb	-40℃ to +85℃	SOP-8
EMI7002LTMI	1.75 - 2.2V	20	2Mb	-40℃ to +85℃	TSSOP-8
EMI7002LSMI	1.75 - 2.2V	20	2Mb	-40℃ to +85℃	SOP-8

Pin Function Table

Name	Function
CS	Chip Select Input Pin
SO/SIO1	Serial Output/SDI/SQI Pin
DNU/SIO2	Do Not Use/SQI Pin
Vss	Ground Pin
SI/SIO0	Serial Input/SDI/SQI Pin
SCK	Serial Clock Pin
HOLD/SIO3	Hold/SQI Pin
Vcc	Power Supply Pin

Package Outline



DC CHARACTERISTICS T_A = -40°C to +85°C

DC Electrical Characteristics-I (Over the Operating Range)

Parameter	Description	Test Conditions	Min	Typ	Max	Unit
V_{OH}	Output HIGH Voltage	for 3.3 V I/O I_{OH} = -4.0 mA	2.4	-	-	V
		for 2.5 V I/O I_{OH} = -1.0 mA	2	-	-	V
		for 1.8 V I/O I_{OH} = -0.1 mA	1.4	-	-	V
V_{OL}	Output LOW Voltage	for 3.3 V I/O I_{OL} = 8.0 mA	-	-	0.4	V
		for 2.5 V I/O I_{OH} = 1.0 mA	-	-	0.4	V
		for 1.8 V I/O I_{OH} = 0.1 mA			0.2	V
V_{IH}	Input HIGH Voltage	for 3.3 V I/O	2.2	-	V_{CC} + 0.3	V
		for 2.5 V I/O	1.8	-	V_{CC} + 0.3	V
		for 1.8 V I/O	1.4		V_{CC} + 0.2	V
V_{IL}	Input LOW Voltage	for 3.3 V I/O	-0.3	-	0.8	V
		for 2.5 V I/O	-0.3	-	0.6	V
		for 1.8 V I/O	-0.2		0.4	V
I_X	Input Leakage	GND ≤ VI ≤ V_{CC}	-5	-	5	µA
I_{OZ}	Output Leakage Current	GND ≤ V_I ≤ V_{CC}, output disabled	-5	-	5	µA

DC Electrical Characteristics-II for Power (Over the Operating Range)

Symbol	Parameter	Test Conditions	-50ns		Unit
			Typ	Max	
I_{CC}	V_{CC} Dynamic Operating Supply Current	V_{CC} = Max, f = fMAX, CS = V_{IL} I_{OUT} = 0 mA	20	40	mA
I_{SB2}	CMOS Standby Current (CMOS Inputs)	V_{CC} = Max, f = 0 CS ≥ V_{CC} - 0.2V V_{IN} ≤ 0.2V or V_{IN} ≥ V_{CC} - 0.2V	20	35	mA
I_{DSM}	CMOS Deep Sleep Mode Current (CMOS Inputs)	V_{CC} = Max, f = 0 CS ≥ V_{CC} - 0.2V V_{IN} ≤ 0.2V or V_{IN} ≥ V_{CC} - 0.2V	1	2	mA

Absolute Maximum Ratings

Vcc.....-0.2V to Vcc +0.3V
All inputs and outputs relative to Vss ..... -0.2V to Vcc +0.3V
Storage temperature ..... -65℃ to 150℃
Operating temperature ..... -40℃ to 125℃
Soldering temperature and time ..... 260℃, 10sec
ESD protection on all pins..... 2kV

Note: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions outside those indicated in the operating section of this specification, is not implied. Exposure to absolutemaximum rating conditions for an extended period of time may affect device reliability.

AC Characteristics

Parameter	Symbol	Min	Max	Unit
Clock Frequency	FCLK	-	20	MHZ
CS Setup Time	tCSS	3	-	ns
CS Hold Time	tCSH	3	-	ns
CS Disable Time	tCSD	10	-	ns
Data Setup Time	tDS	3	-	ns
Data Hold Time	tDH	3	-	ns
Clock High Time	tCKH	9	-	ns
Clock Low Time	tCKL	9	-	ns
Clock Delay Time	tCLD	7	-	ns
Output Valid from Clock Low	tV	-	6.1	ns
Output Hold Time	tOH	0	-	ns
CS High to Output High -Z	tCHZ	-	10	ns
HOLD Setup Time	tHS	3	-	ns
HOLD Hold Time	tHH	3	-	ns
HOLD Low to Output High-Z	tHZ	-	9	ns
HOLD High to Output Valid	tHV	-	20	ns

AC Test Conditions

Parameter	Unit (1.75V~2.2V)	Unit (2.2V~2.7V)	Unit (2.7V~3.6V)
Input Pulse Level	0V to V_{CC}	0V to V_{CC}	0V to V_{CC}
Input Rise and Fall Time	1V/ns	1V/ns	1V/ns
Output Timing Reference Level	0.9V	½ V_{CC}	½ V_{CC}
R1	13500	16667	1103
R2	10800	15385	1554
V_{TM}	1.8V	V_{CC}	V_{CC}
Output Load Conditions		Refer to Figure 1 and 2	

Figure 1

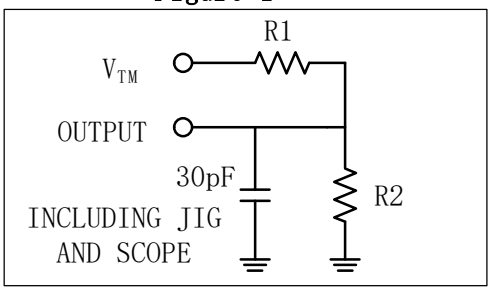
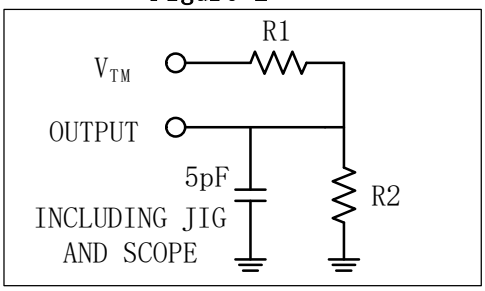
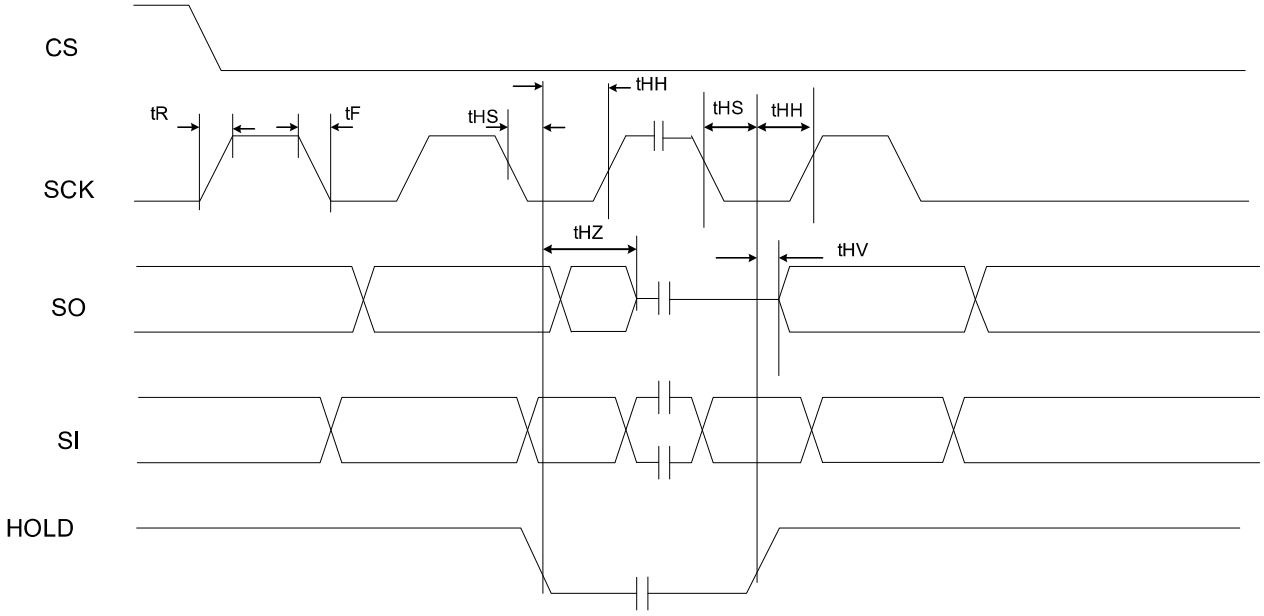


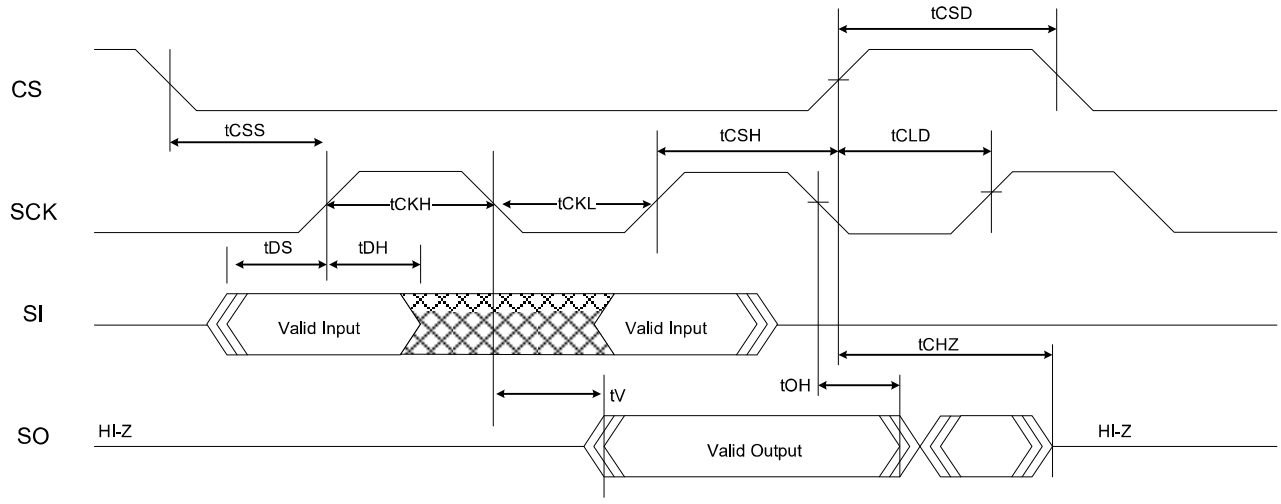
Figure 2



Hold timing (SPI Mode)



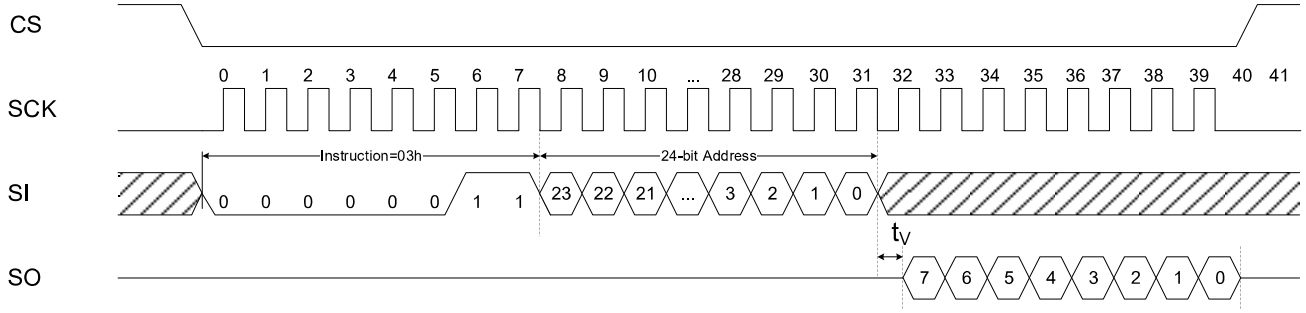
Serial Input/Outpu Timing(SPI Mode)



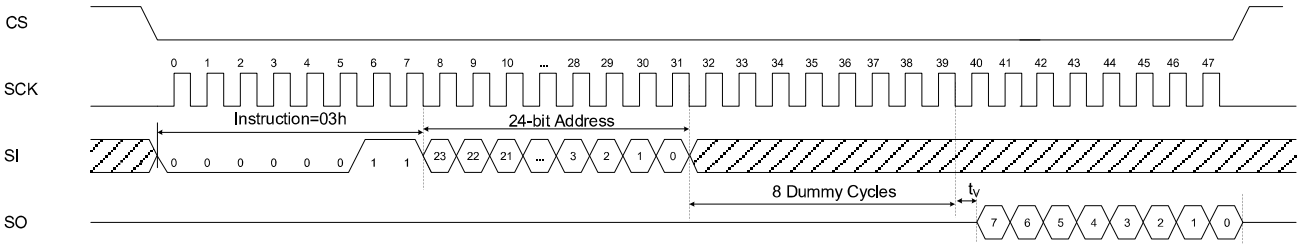
Instruction Set

Instruction Name	Instruction Format	Hex Code	Description
WRITE	0000 0011	0x03	Read data from memory array beginning at selected address
READ	0000 0010	0x02	Write data to memory array beginning at selected address
ESDI	0011 1011	0x3B	Enter SDI mode
ESQI	0011 1000	0x38	Enter SQI mode
RSTDQI	1111 1111	0xff	Reset SDI/SQI mode
RDMR	0000 0101	0x05	Read Mode Register
WRMR	0000 0001	0x01	Write Mode Register

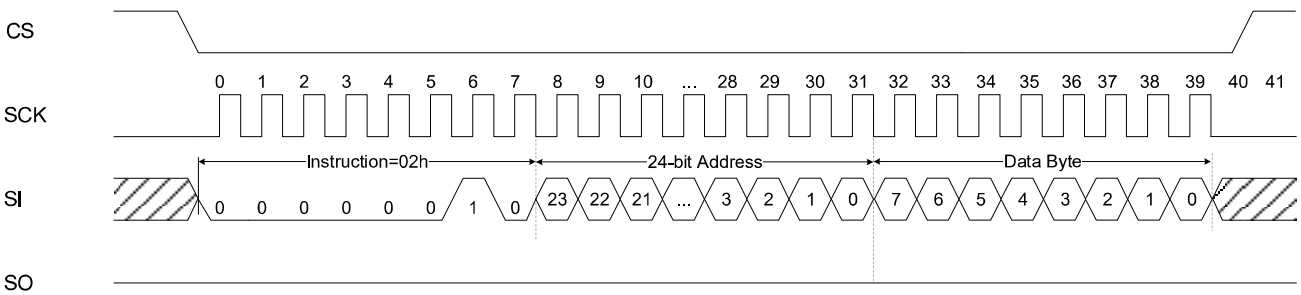
Byte Read Operation (SPI No Dummy Mode)



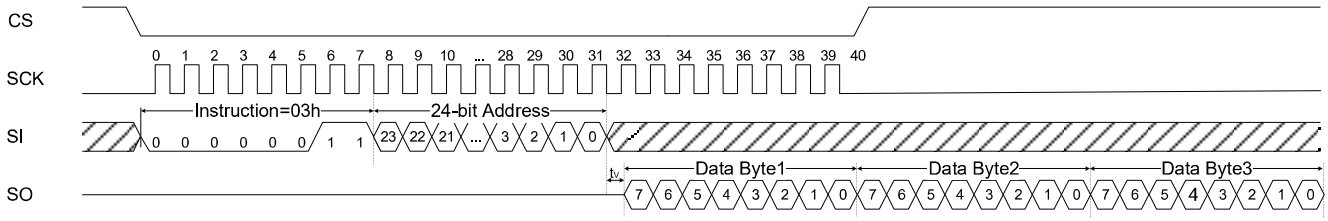
Byte Read Operation (SPI Dummy Mode)



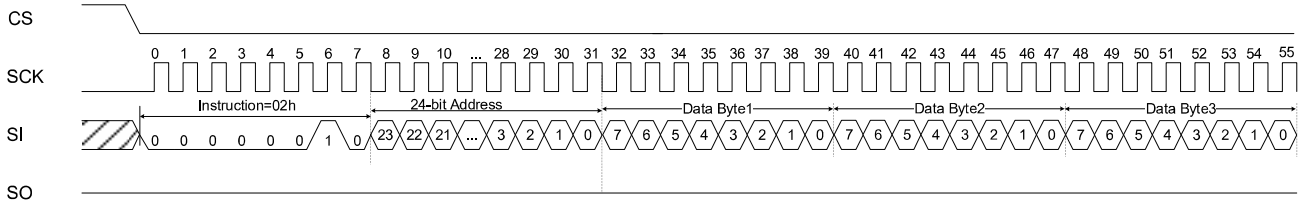
Byte Write Operation (SPI Dummy Mode)



Sequential Read Operation(SPI No Dummy Mode)



Sequential Write Operation(SPI Mode)



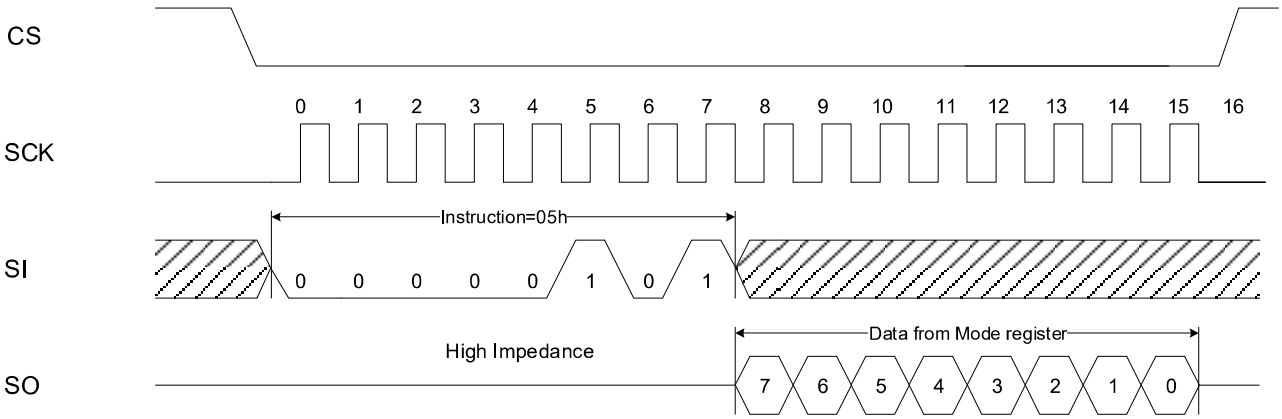
Read Mode Register Instruction(RDMR)

The Read Mode Register instruction (RDMR: 05h) provides access to the MODE register. The MODE register may be read at any time. The MODE register is formatted as follows:

7	6	5	4	3	2	1	0
W/R				W/R			W/R
MODE				DSM			DUMMY MODE
W/R = writable/readable							

The mode bits (7:6) indicate the operating mode of the SRAM. The possible modes of operation are:
0 0 = Byte mode
0 1 = Sequential mode (default operation)
1 0 = Sequential mode
1 1 = Reserved
The mode bits (3) indicate the work mode of the SRAM. The possible modes of operation are:
0 = normal mode
1 = deep sleep mode
The mode bits (0) indicate the dummy mode of the SRAM. The possible modes of operation are:
0 = no dummy byte mode
1= dummy byte mode
Other bits are reserved and should always be set to '0'.

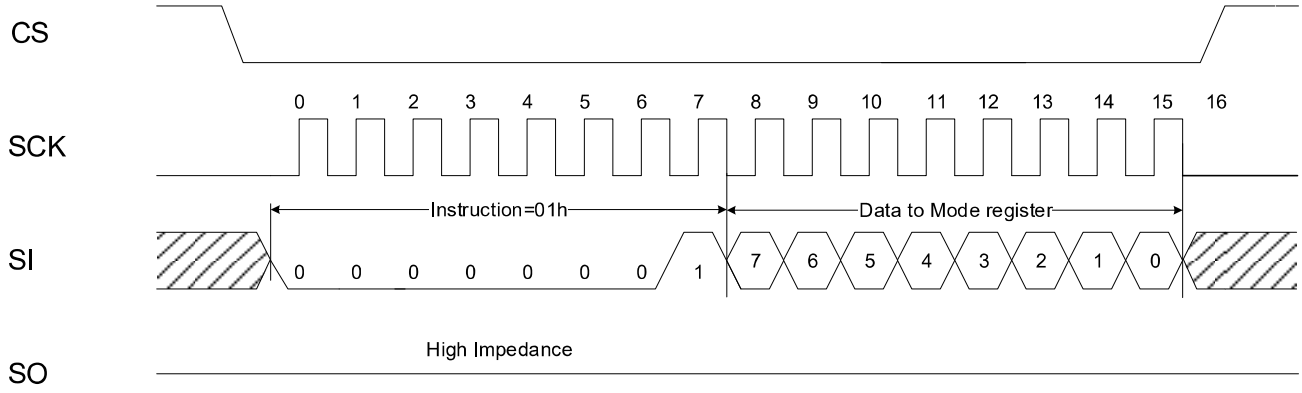
Read Mode Register Operation Timing



Write Mode Register Instruction (WRMR)

The Write Mode Register instruction (WRMR: 01h) allows the user to write to the bits in the MODE register. This allows for setting of the Device operating mode. Several of the bits in the MODE register must be cleared to '0'.

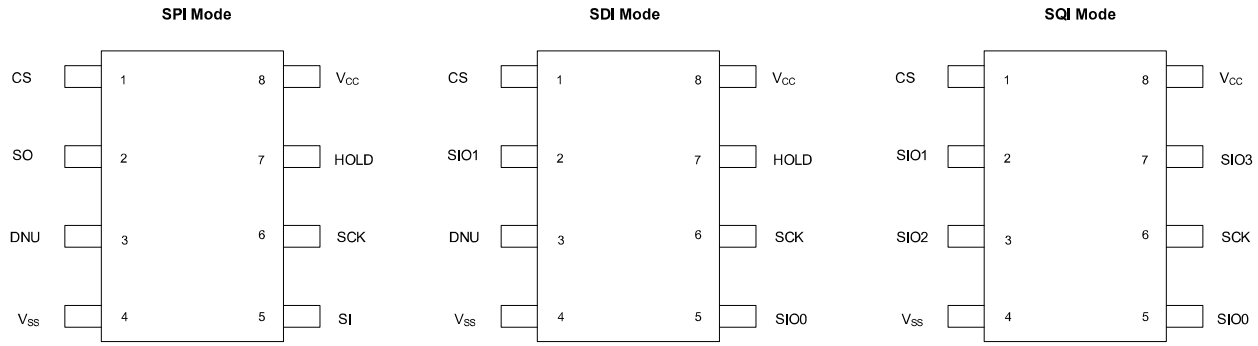
Write Mode Register Operation Timing



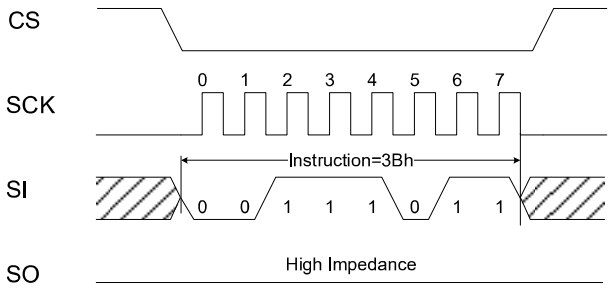
SDI Mode And SQI Mode Operation

The device also supports SDI (Serial Dual Interface) and SQI (Serial Quad Interface) mode of operation when used with compatible master devices. To enter SDI mode, the ESDI command (3Bh) must be clocked in. As a convention for SDI mode of operation, two bits are entered per clock using the SIO0 and SIO1 pins. Bits are clocked MSB first.

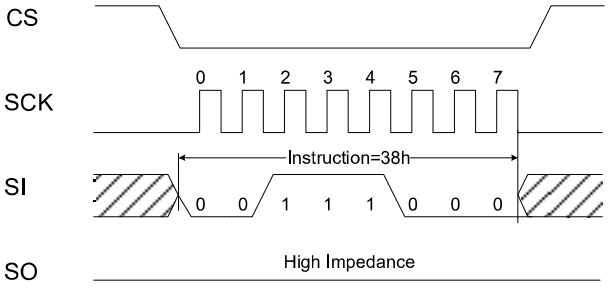
To enter SQI mode, the ESQI command (38h) must be clocked in. For SQI mode of operation, four bits of data are entered per clock, or one nibble per clock. The nibbles are clocked MSB first.



Enter SDI Mode

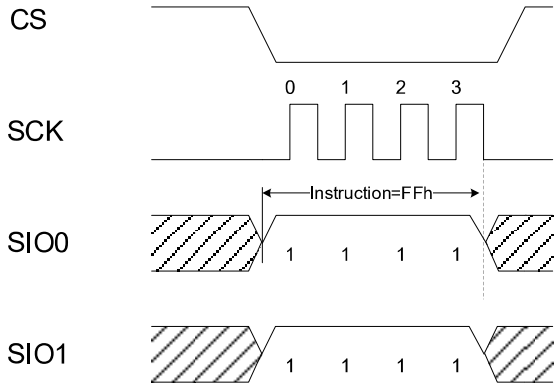


Enter SQI Mode

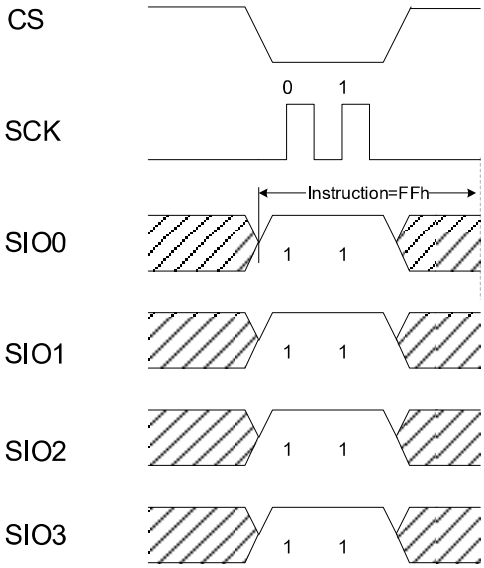


To exit from SDI mode, the RSTDQI command (FFh) must be issued. The command must be entered in the current device configuration, either SDI mode or SQI mode.

Reset SDI Mode



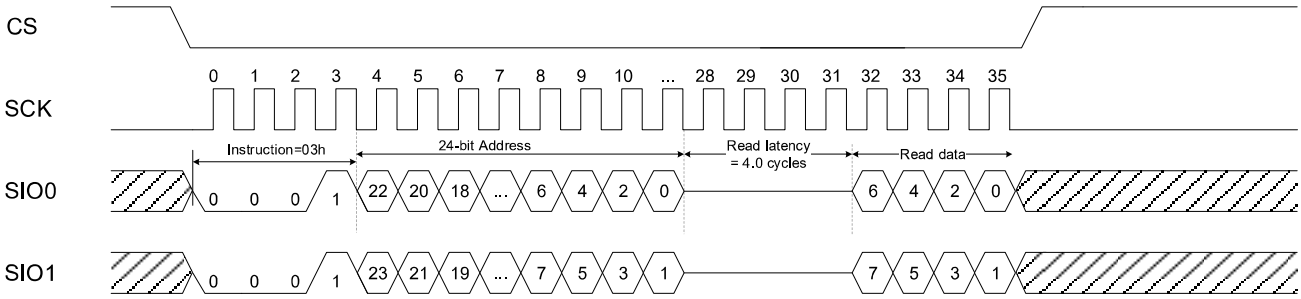
Reset SQI Mode



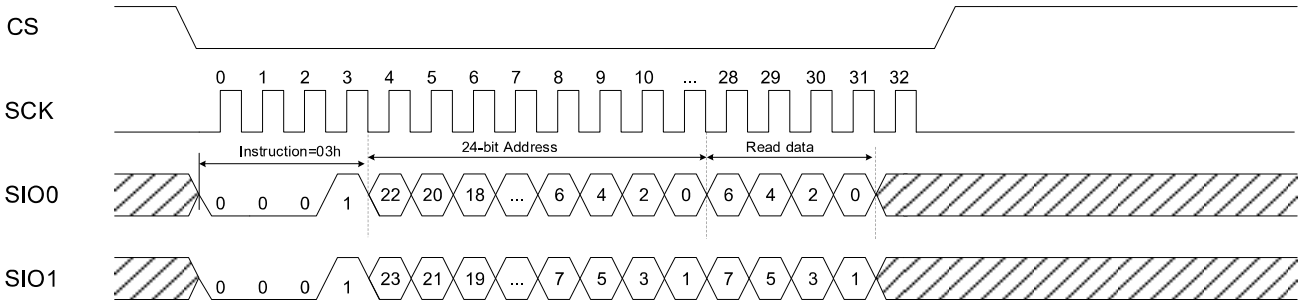
SDI (Serial Dual Interface) Mode Operation

The device supports Serial Dual Interface (SDI) mode of operation. There are 4.0 clock cycles (Dummy Byte) of Read Latency in SDI dummy mode Byte Read Operation. No Write Latency in SDI Write Operation. It should be noted that if the MCU resets before the SRAM, the user will need to determine the serial mode of operation of the SRAM and reset it accordingly.

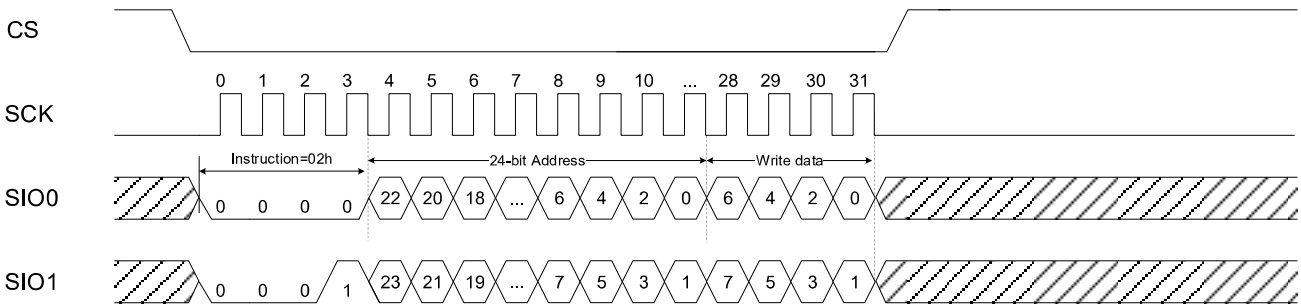
Byte Read Operation in SDI Dummy Mode



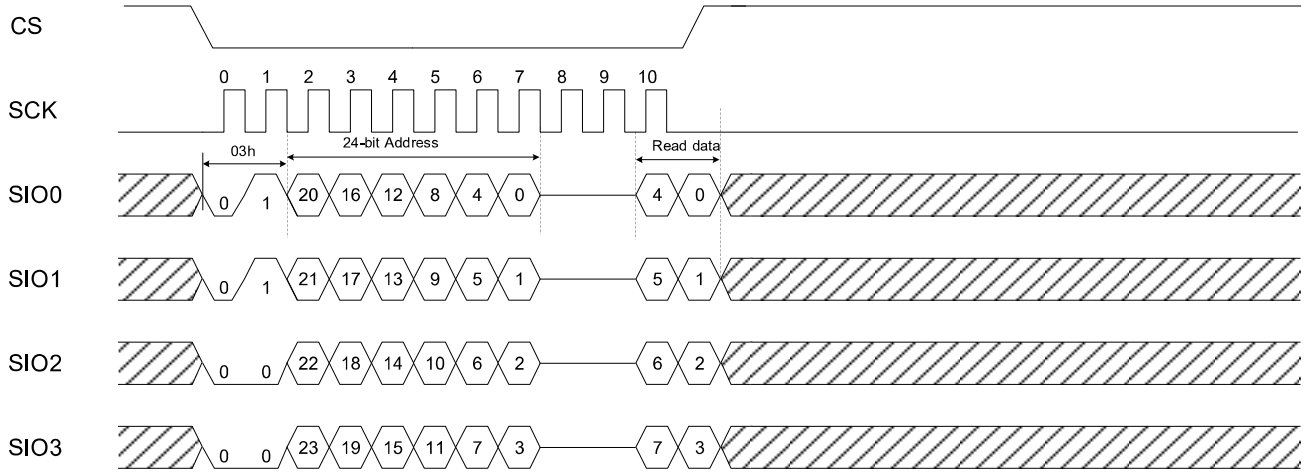
Byte Read Operation in SDI No Dummy Mode



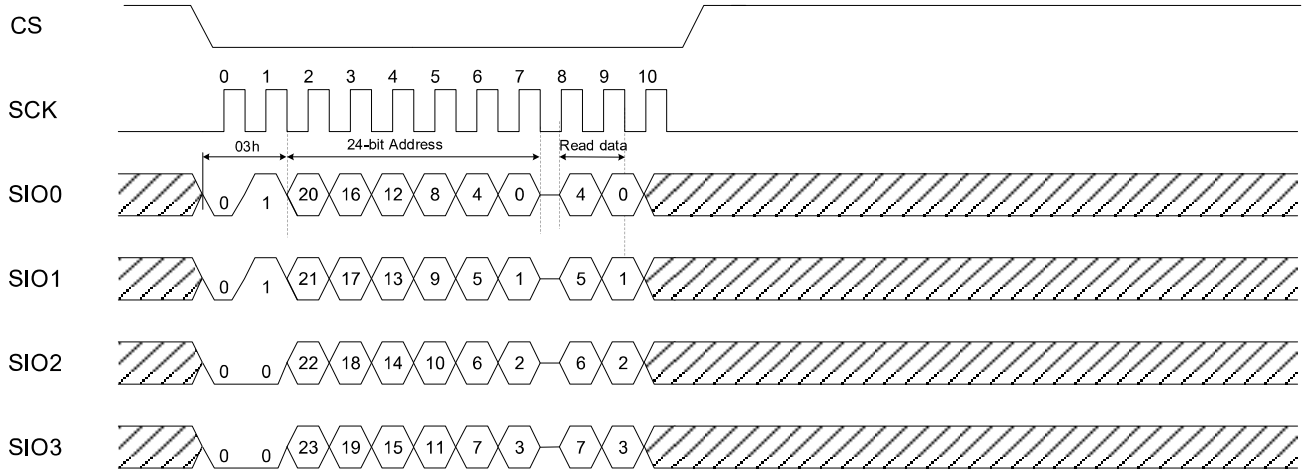
Byte Write Operation in SDI Mode



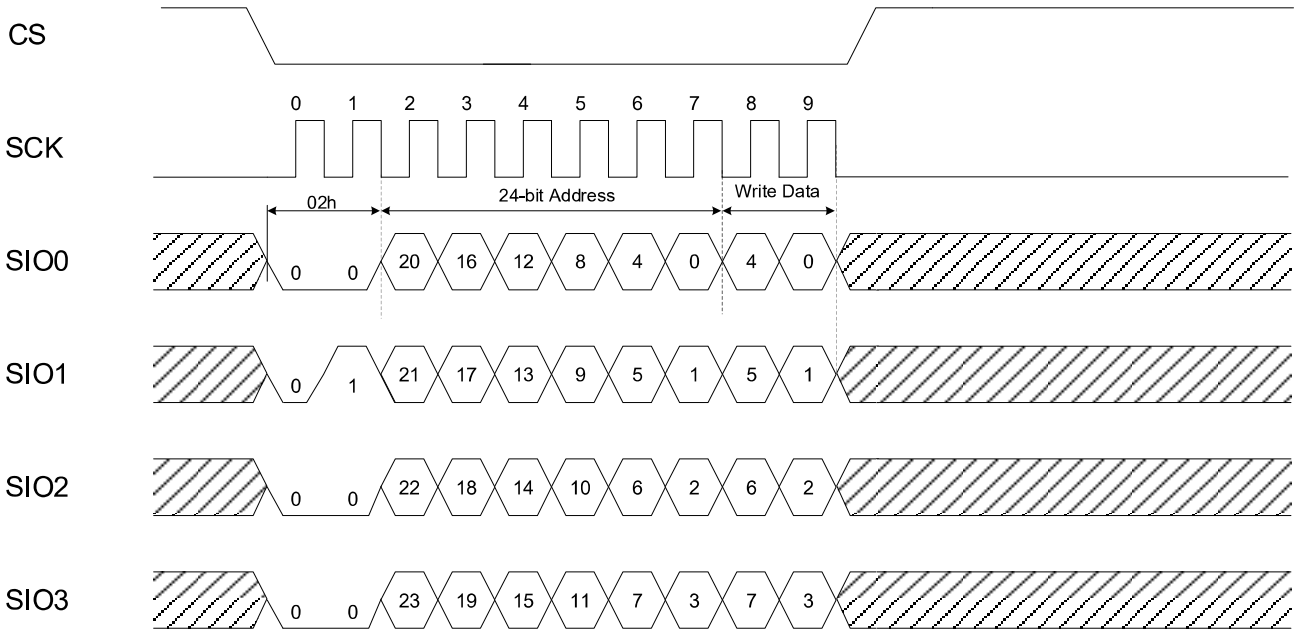
Byte Read Operation in SQI Dummy Mode



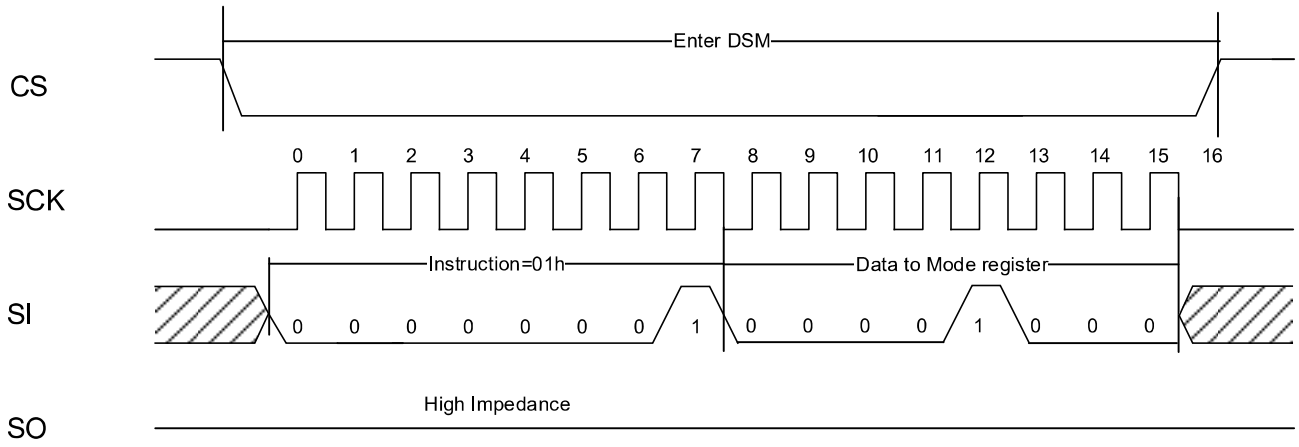
Byte Read Operation in SQI No Dummy Mode



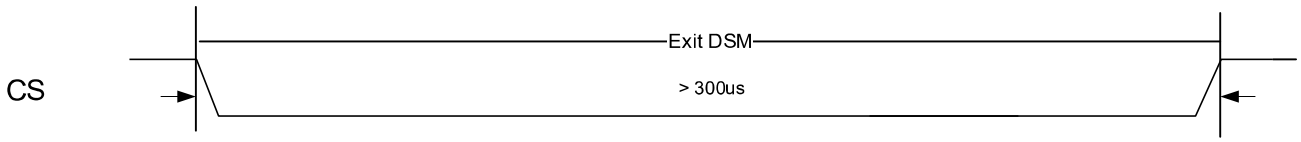
Byte Write Operation in SQI Mode



Enter DSM Mode Operation in SPI Mode

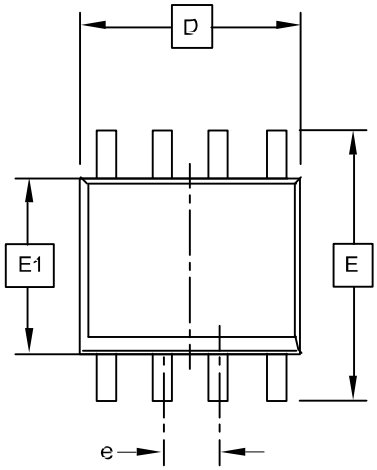


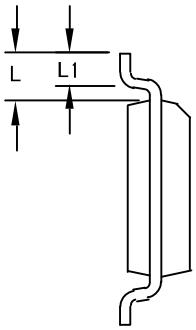
Exit DSM Mode Operation in SPI Mode



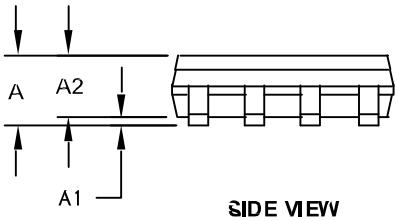
Packaging information

8 – Lead Plastic SOP





TOP VIEW

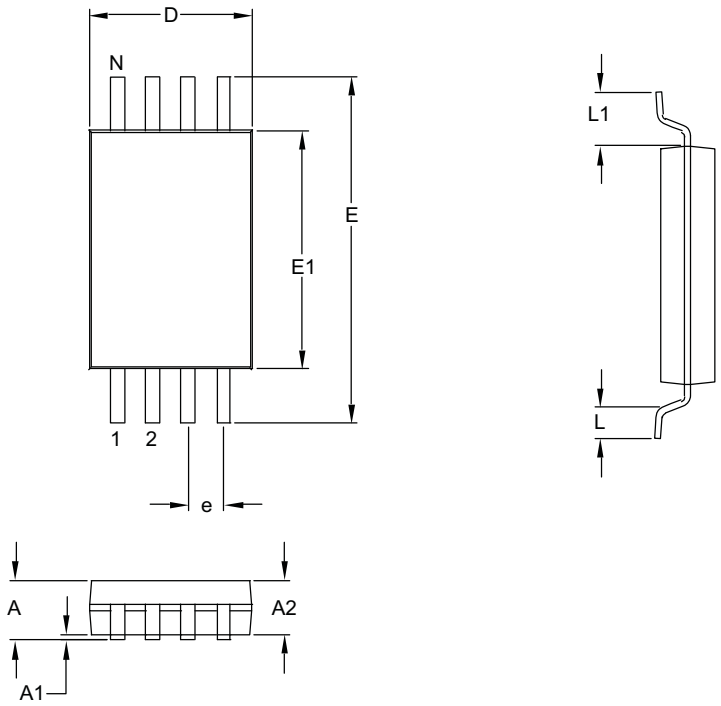


SIDE VIEW

ITEM	SYM.	MIN	NOM	MAX	UNIT
Pitch	e		1.27 BSC		mm
Overall Height	A	–	–	1.75	mm
Molded Package Thickness	A2	1.25	–	–	mm
Standoff	A1	0.10	–	0.25	mm
Overall Width	E		6.00 BSC		mm
Molded Package Width	E1		3.90 BSC		mm
Molded Package Length	D		4.90 BSC		mm
Foot Length	L	0.40	0.60	1.27	mm
Footprint	L1		1.04 REF		mm

Packaging information

8 – Lead Plastic Thin Shrink Small Outline



ITEM	SYM.	MIN	NOM	MAX	UNIT
Pitch	e		0.65 BSC		mm
Overall Height	A	–	–	1.20	mm
Molded Package Thickness	A2	0.80	1.00	1.05	mm
Standoff	A1	0.05	–	0.15	mm
Overall Width	E		6.40 BSC		mm
Molded Package Width	E1	4.30	4.40	4.50	mm
Molded Package Length	D	2.90	3.00	3.10	mm
Foot Length	L	0.45	0.60	0.75	mm
Footprint	L1		1.00 REF		mm

Code information

E	M	I	X	X	X	X	X	X	X	X	X	X	X
1	2	3	4	5	6	7	8	9	10	11	12	13	14

Digit-No.	Remark		Code
1,2,3	Energeic Microelectronic Inc. Product		EMI
4	Serial SRAM		7
5،6،7	Density	128Kbit	128
		256Kbit	256
		512Kbit	512
		1Mbit	001
		2Mbit	002
		8Mbit	008
		16Mbit	016
		32Mbit	032
		64Mbit	064
8	Vcc	1.8V	L
		3.0V	M
		3.3V	N
		2.5~5.5V	W
9	Package	8 SOIC	S
		8 TSSOP	T
		8 DIP	D
10	Die Version	Monther Die	M
		2nd Generation	A
		3rd Generation	B
		4th Generation	C
		5th Generation	D
11	Temperature range	-25℃ to 85℃	E
		-40℃ to 85℃	I
		-40℃ to 125℃	A
12	Packing type	Tube	Blank
		Tape and Reel	T
13，14	Special function	TBD	TBD