

***RoHS Compliant***  
**Industrial CompactFlash Series 5**  
**September 3<sup>rd</sup>, 2012**

Revision 1.2

***This Specification Describes the Features and Capabilities of  
the Commercial CompactFlash Cards***

***Please Contact Fortasa Sales for any Custom Features  
Required For Your Specific Application***



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# CompactFlash Card 5

## FMS-CFxxxxL9XS-XXXXXX



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- **CompactFlash Association Specification Standard Interface**

- ATA command set compatible
  - ATA mode support for up to:
    - PIO Mode-6
    - Multiword DMA Mode-4
    - Ultra DMA Mode-5

- **Connector Type**

- 50 pins female

- **Low power consumption (typical)**

- Supply voltage: 3.3V & 5V
- Active mode: 165 mA
- Sleep mode: 2 mA

- **Performance**

- Sustained read: up to 50 MB/sec
- Sustained write: up to 18 MB/sec

- **Capacity**

4, 8, 16, 32, 64 GB

- **NAND flash type: MLC**

- **Superior Reliability Through Built-in Hardware ECC**

- Corrects up to 24 single-bit errors per 1,024-byte sector

- **Temperature ranges**

- Operation:
  - Standard Temperature: 0 °C to 70 °C
  - Industrial Temperature: -40 °C to 85 °C
- Storage: -40 °C to 100 °C

- **Flash management**

- Intelligent endurance design
  - Advanced wear-leveling algorithms*
  - S.M.A.R.T. Technology*
  - Enhanced Data Integrity*
- Intelligent power failure recovery

- **RoHS Compliant**

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## 1. General Description

Fortasa's Industrial CompactFlash Card 5 (CFC5) offers the highest reliability and performance storage solution critical to most demanding OEM customers.

Fortasa's CFC5 provides complete PCMCIA - ATA functionality and compatibility. CFC5 complies with CompactFlash specification revision 4.1, supporting transfer modes up to Programmed Input Output (PIO) Mode 6, Multiword Direct Memory Access (DMA) Mode 4, Ultra DMA Mode 5, and PCMCIA Ultra DMA Mode 5.

Fortasa's CompactFlash technology is designed for use in Point of Sale (POS) terminals, telecom, IP-STB, medical instruments, surveillance systems, industrial PCs and handheld applications. Featuring advanced technologies such as Advanced Wear-leveling algorithms, S.M.A.R.T, Enhanced Data Integrity, Built-in Hardware ECC, and Intelligent Power Failure Recovery, Fortasa's CompactFlash Card offers the most cost effective solution for most critical applications.

Offered in standard and industrial temperature range, Fortasa's CompactFlash card 5 product is the most cost effective and trustworthy solution in the OEM memory system.

## 2. Functional Block

The CompactFlash Card (CFC5) includes a controller and flash media, as well as the CompactFlash standard interface. Figure 2-1 shows the functional block diagram.

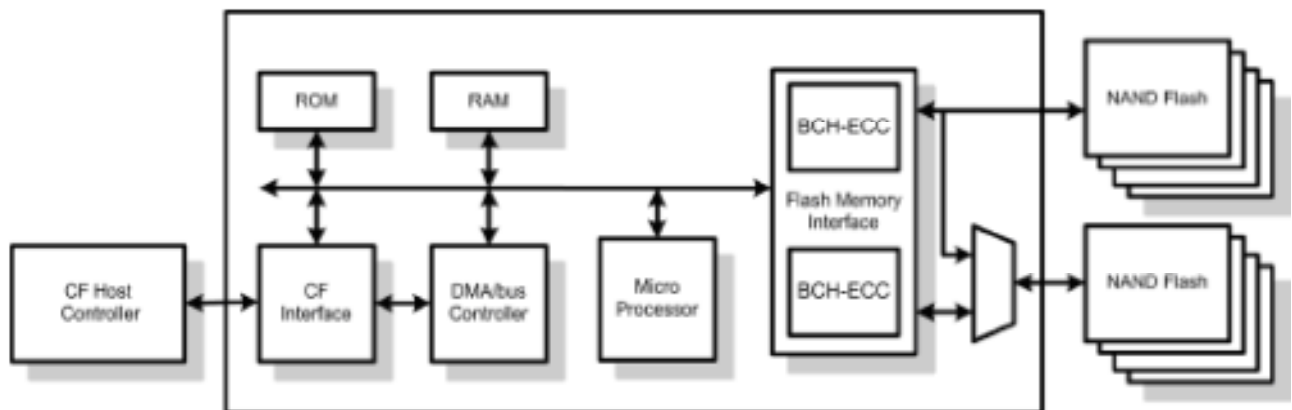


Figure 2-1: Functional Block Diagram

### 3. Pin Assignments

Table 3-1 lists the pin assignments with respective signal names for the 50-pin configuration. A “#” suffix indicates the active low signal. The pin type can be input, output or input/output.

Table 3-1: Pin assignments (1 of 2)

Pin No.	Memory card mode		I/O card mode		True IDE mode	
	Signal name	Pin I/O type	Signal name	Pin I/O type	Signal name	Pin I/O type
1	GND	-	GND	-	GND	-
2	D3	I/O	D3	I/O	D3	I/O
3	D4	I/O	D4	I/O	D4	I/O
4	D5	I/O	D5	I/O	D5	I/O
5	D6	I/O	D6	I/O	D6	I/O
6	D7	I/O	D7	I/O	D7	I/O
7	#CE1	I	#CE1	I	#CS0	I
8	A10	I	A10	I	A10 <sup>1</sup>	I
9	#OE	I	#OE	I	#ATA SEL	I
10	A9	I	A9	I	A9 <sup>1</sup>	I
11	A8	I	A8	I	A8 <sup>1</sup>	I
12	A7	I	A7	I	A7 <sup>1</sup>	I
13	VCC	-	VCC	-	VCC	-
14	A6	I	A6	I	A6 <sup>1</sup>	I
15	A5	I	A5	I	A5 <sup>1</sup>	I
16	A4	I	A4	I	A4 <sup>1</sup>	I
17	A3	I	A3	I	A3 <sup>1</sup>	I
18	A2	I	A2	I	A2	I
19	A1	I	A1	I	A1	I
20	A0	I	A0	I	A0	I
21	D0	I/O	D0	I/O	D0	I/O
22	D1	I/O	D1	I/O	D1	I/O
23	D2	I/O	D2	I/O	D2	I/O
24	WP	O	#IOStE	O	#OCStE	O
25	#CD2	O	#CD2	O	#CD2	O
26	#CD1	O	#CD1	O	#CD1	O
27	D11	I/O	D11	I/O	D11	I/O
28	D12	I/O	D12	I/O	D12	I/O
29	D13	I/O	D13	I/O	D13	I/O
30	D14	I/O	D14	I/O	D14	I/O
31	D15	I/O	D15	I/O	D15	I/O
32	#CE2	I	#CE2	I	#CS1	I
33	#VS1	O	#VS1	O	#VS1	O
34	#IORD	I	#IORD	I	#IORD	I
35	#IOWR	I	#IOWR	I	#IOWR	I
36	#WE	I	#WE	I	#WE	I
37	RDY-BSY	O	#IREQ	O	INTRQ	O
38	VCC	-	VCC	-	VCC	-
39	#CSEL	I	#CSEL	I	#CSEL	I
40	#VS2	O	#VS2	O	#VS2	O
41	RESET	I	RESET	I	#RESET	I

Table 3-1: Pin assignments (2 of 2)

Pin No.	Memory card mode		I/O card mode		True IDE mode	
	Signal name	Pin I/O type	Signal name	Pin I/O type	Signal name	Pin I/O type
42	#WAIT	O	#WAIT	O	!ORDY	O
43	#INPACK	O	#INPACK	O	DMARQ <sup>2</sup>	O
44	#REG	I	#REG	I	DMACK <sup>2</sup>	I
45	BVD2	O	#SPKR	O	#DASP	I/O
46	BVD1	O	#STSCHG	O	#PDIAG	I/O
47	D8	I/O	D8	I/O	D8	I/O
48	D9	I/O	D9	I/O	D9	I/O
49	D10	I/O	D10	I/O	D10	I/O
50	GND	-	GND	-	GND	-

1. The signal should be grounded by the host.
2. Connection required when UDMA is in use.

## 4. Capacity Specification

Standard capacity specification of the CompactFlash Card products are shown in Table 4-1. The table lists the specific capacity and the default numbers of heads, sectors and cylinders (CHS) for each product line.

**Table 4-1: Capacity specifications**

Capacity	Total Bytes <sup>1,2</sup>	Cylinders	Heads	Sectors	Max LBA
<b>4GB</b>	<b>4,110,188,544</b>	<b>7,964</b>	<b>16</b>	<b>63</b>	<b>8,027,712</b>
<b>8GB</b>	<b>8,195,604,480</b>	<b>15,880</b>	<b>16</b>	<b>63</b>	<b>16,007,040</b>
<b>16GB</b>	<b>16,391,340,032</b>	<b>16383<sup>3</sup></b>	<b>16</b>	<b>63</b>	<b>32,014,336</b>
<b>32GB</b>	<b>32,019,316,736</b>	<b>16383<sup>3</sup></b>	<b>16</b>	<b>63</b>	<b>62,537,728</b>
<b>64GB</b>	<b>64,030,244,864</b>	<b>16383<sup>3</sup></b>	<b>16</b>	<b>63</b>	<b>125,059,072</b>

1. Total bytes includes reserved system blocks.
2. Total bytes displayed varies depending on the operating system.
3. Cylinders, heads or sectors are not applicable for these capacities. Only LBA addressing applies.

\*\*\*Notes: 1 GB = 1,000,000,000 bytes; 1 sector = 512 bytes.

LBA count addressed in the table above indicates total user storage capacity and will remain the same throughout the lifespan of the device. However, the total usable capacity of the SSD is most likely to be less than the total physical capacity because a small portion of the capacity is reserved for device maintenance usages.

*Please contact Fortasa Memory System Sales for any non-listed CompactFlash Card capacity or custom CHS requirement.*

### 4.1 Performance Specification

Performances of the various capacities of the CompactFlash card are listed in Table 4-2.

**Table 4-2: Standard Performance specifications**

Capacity	4GB	8GB	16GB	32GB	64GB
Performance					
<b>Sustained read (MB/s)</b>	49	50	50	50	50
<b>Sustained write (MB/s)</b>	13	14	14	18	18

### 4.2 Environmental Specifications

Environmental specification of the CompactFlash Card series follows the MIL-STD-810F standard as shown in Table 4-3.

**Table 4-3: Environmental specifications**

Environment		Specification
Temperature	Operation	0°C to 70°C (standard) / -40°C to 85°C (industrial)
	Storage	-40°C to 100°C
Vibration		Sine wave: 10~2000Hz, 15G (X, Y, Z axes)
Shock		Half sine wave, Peak acceleration 50 G, 11 ms (X, Y, Z ; All 6 axes)
Humidity		5% to 95% RH (Non-condensing)

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## 5. Flash Management

The most critical attribute of a Fortasa CompactFlash Card is its inherent high level of reliability. This characteristic is achieved through unique technical features of Flash Controller and specific component selection that offer higher degree of reliability compared to the consumer grade components.

### 5.1 Intelligent Flash Controller Features

#### 5.1.1 Advanced wear-leveling algorithms

All NAND flash devices are limited by a finite number of write cycles. Under a standard file system, frequent file table updates are mandatory. As a painful side effect of OS file overhead, some areas of flash address space wear out faster than others. As these certain sections get a substantially higher write occurrence the whole CompactFlash card can wear out very quickly. This uneven wear would significantly reduce the lifetime of the whole device, even if majority of the Flash sectors are far from the write cycle limit. Fortasa's CompactFlash Card products offer advanced data wear leveling which distributes Flash writes evenly across the card memory space. By utilizing this advanced wear leveling feature, the lifetime of the media can be significantly extended.

#### 5.1.2 S.M.A.R.T. technology

S.M.A.R.T. is an acronym for Self-Monitoring, Analysis and Reporting Technology, an open standard allowing disk drives to automatically monitor their own health and report potential problems. It protects the user from unscheduled downtime by monitoring and storing critical drive performance and calibration parameters. Ideally, this should allow taking proactive actions to prevent impending drive failure. Fortasa SMART feature adopts the conventional SMART command B0h to read data from the drive. By having the Fortasa SMART Utility running on the host, the system can monitor and analyze the CompactFlash card status and determine the end of useful life for a graceful and scheduled maintenance and replacement.

#### 5.1.3 Built-in hardware ECC

The Fortasa Flash Controller uses superior BCH Error Detection Code (EDC) and Error Correction Code (ECC) algorithm which can correct up to 24-bit errors per 1,024 byte data. This built-in hardware ECC performs parity generation and error detection/correction for data integrity.

#### 5.1.4 Enhanced data integrity

The properties of NAND flash memory make it ideal for applications that require high integrity while operating in challenging environments. The integrity of data to NAND flash memory is generally maintained through ECC algorithms and bad block management. Flash controllers can support up to 8 bits ECC capability for accuracy of data transactions, and bad block management is a preventive mechanism from loss of data by retiring unusable media blocks and relocating the data to the other blocks, along with the integration of advanced wear leveling algorithms, so that the lifespan of device can be expanded.

### 5.2 Intelligent Power Failure Recovery

The Low Power Detection on the Flash controller initiates cached data saving before the power supply to the device drops too low for operation. This feature prevents the device from system crash and ensures data integrity during an unexpected brownout. This feature makes sure that there are no catastrophic failures of the CompactFlash card due to system power glitches.



## 6. Software Interface

### 6.1 Command Set

Table 6-1 summarizes the command set with the paragraphs that follow describing the individual commands and the task file for each.

**Table 6-1:** Command set

Command	Code	FR <sup>1</sup>	SC <sup>2</sup>	SN <sup>3</sup>	CY <sup>4</sup>	DH <sup>5</sup>	LBA <sup>6</sup>
Check-Power-Mode	E5H or 98H	-	-	-	-	D8	-
Execute-Drive-Diagnostic	90H	-	-	-	-	D	-
Erase-Sector(s)	C0H	-	Y	Y	Y	Y	Y
Flush-Cache	E7H	-	-	-	-	D	-
Format-Track	50H	-	Y <sup>7</sup>	-	Y	Y <sup>8</sup>	Y
Identify-Drive	ECH	-	-	-	-	D	-
Idle	E3H or 97H	-	Y	-	-	D	-
Idle-Immediate	E1H or 95H	-	-	-	-	D	-
Initialize-Drive-Parameters	91H	-	Y	-	-	Y	-
NOP	00H	-	-	-	-	D	-
Read-Buffer	E4H	-	-	-	-	D	-
Read DMA	C8H or C9H	-	Y	Y	Y	Y	Y
Read-Long-Sector	22H or 23H	-	-	Y	Y	Y	Y
Read-Multiple	C4H	-	Y	Y	Y	Y	Y
Read-Sector(s)	20H or 21H	-	Y	Y	Y	Y	Y
Read-Verify-Sector(s)	40H or 41H	-	Y	Y	Y	Y	Y
Recalibrate	1XH	-	-	-	-	D	-
Request-Sense	03H	-	-	-	-	D	-
Seek	7XH	-	-	Y	Y	Y	Y
Set-Features	EFH	Y	-	-	-	D	-
SMART	B0H	Y	Y	Y	Y	D	-
Set-Multiple-Mode	C6H	-	Y	-	-	D	-
Set-Sleep-Mode	E6H or 99H	-	-	-	-	D	-
Stand-By	E2H or 96H	-	-	-	-	D	-
Stand-By-Immediate	E0H or 94H	-	-	-	-	D	-
Translate Sector	87H	-	Y	Y	Y	Y	Y
Write-Buffer	E8H	-	-	-	-	D	-
Write DMA	CAH or CBH	-	Y	Y	Y	Y	Y
Write-Long-Sector	32H or 33H	-	-	Y	Y	Y	Y
Write-Multiple	C5H	-	Y	Y	Y	Y	Y
Write-Multiple-Without-Erase	CDH	-	Y	Y	Y	Y	Y
Write-Sector(s)	30H or 31H	-	Y	Y	Y	Y	Y
Write-Sector(s)-Without-Erase	38H	-	Y	Y	Y	Y	Y
Write-Verify	3CH	-	Y	Y	Y	Y	Y

1. FR - Features register

2. SC - Sector Count register

3. SN - Sector Number register

4. CY - Cylinder registers

5. DH - Drive/Head register

6. LBA - Logical Block Address mode supported

7. Y - The register contains a valid parameter for this command

8. For the Drive/Head register:

Y means both the CFC and Head parameters are used

D means only the CFC parameter is valid and not the Head parameter

## 7. Electrical Specification

**Caution: Absolute Maximum Stress Ratings** – Applied conditions greater than those listed under “Absolute Maximum Stress Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these conditions or conditions greater than those defined in the operational sections of this data sheet is not implied. Exposure to absolute maximum stress rating conditions may affect device reliability.

**Table 7-1:** Operating range

Range	Ambient Temperature	3.3V	5V
Commercial	0°C to +70°C	3.135-3.465V	4.75-5.25V
Industrial	-40°C to +85°C		

### 7.1 Power Consumption

Table 7-2 lists the CompactFlash Card 5 power consumption.

**Table 7-2** CompactFlash 5 power consumption (typical)

Performance \ Capacity	4GB	8GB	16GB	32GB	64GB
	<b>Active Mode (mA)</b>	150	155	165	165
<b>Idle Mode (mA)</b>	5	5	5	5	5

**Table 7-3:** Absolute maximum power pin stress ratings

Parameter	Symbol	Conditions
Input Power	$V_{DD}$	-0.3V min to 6.5V max -0.3V min to 4.0V max
Voltage on any flash media interface pin with respect to GND	V	-0.5V min to $V_{DD} + 0.5V$ max

**Table 7-4:** Recommended system power-up timing

Symbol	Parameter	Typical	Maximum	Units
TPU-READY <sup>1</sup>	Host Power-up/Reset to Ready Operation	200	1000	ms
TPU-WRITE <sup>1</sup>	Host Power-up/Reset to Write Operation	200	1000	ms

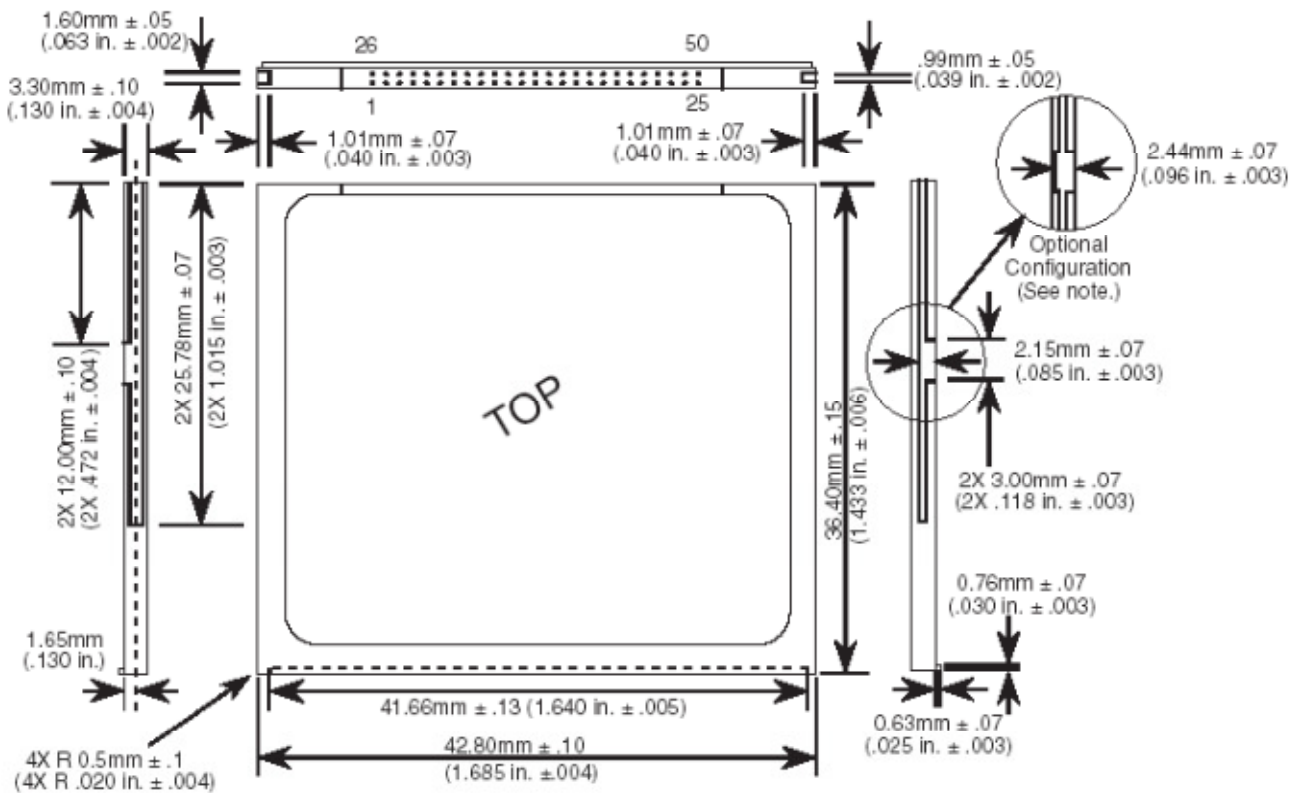
1. This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.

## 8. Physical Characteristics

### 8.1 Dimensions

**TABLE 8-1:** Type I CFC physical specification

Length:	36.40 +/- 0.15mm (1.433+/- 0.06 in.)
Width:	42.80 +/- 0.10mm (1.685+/- 0.04 in.)
Thickness (Including Label Area):	3.3mm+/-0.10mm (0.130+/-0.04in.)

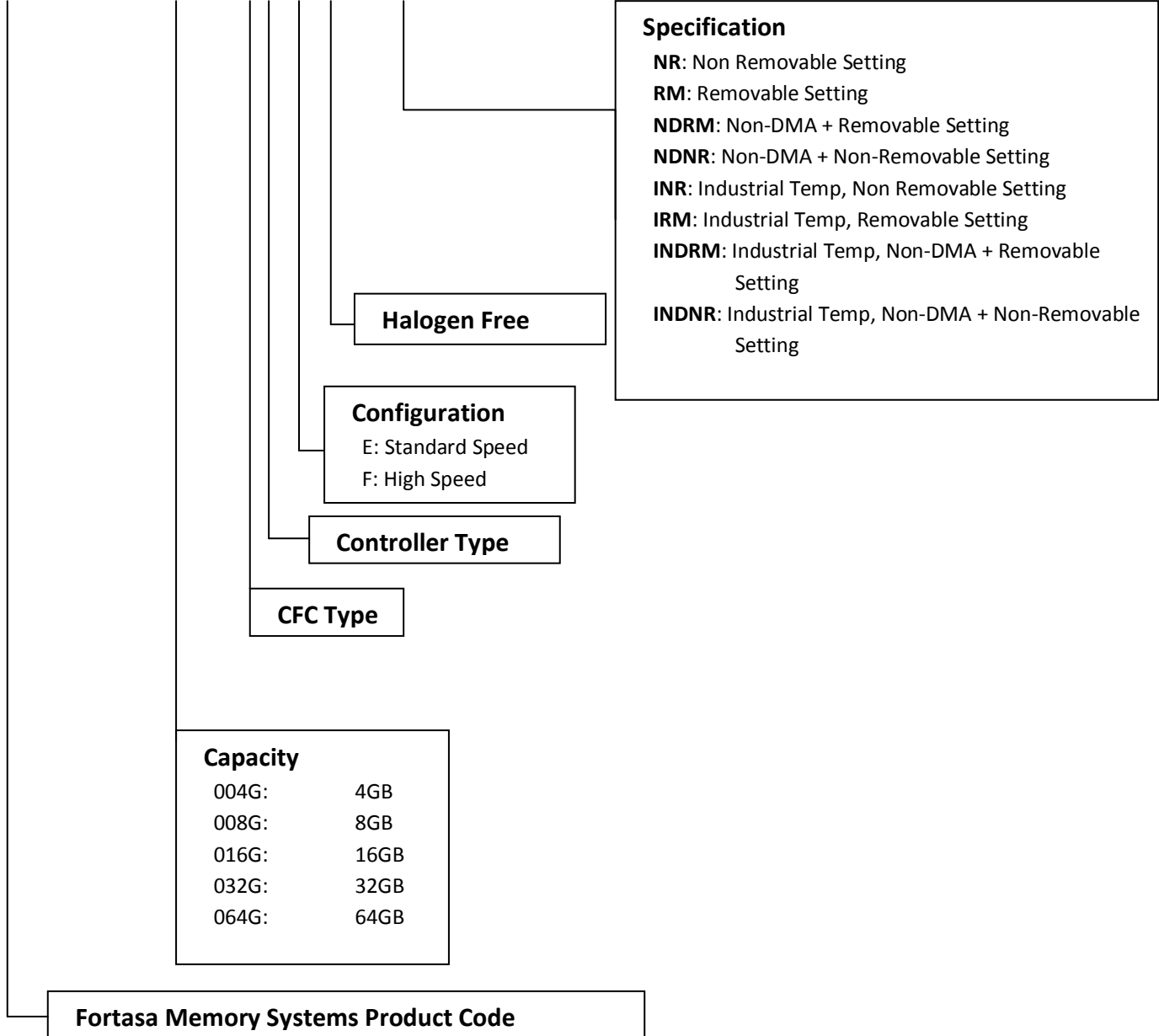


**FIGURE 8-1:** Physical dimension

## 9. Product Ordering Information

### 9.1 Product Code Designations

FMS – C F x x x x L9 X S – XXXX



## 9.2 Valid Combinations

### 9.2.1 Standard Temperature

#### 9.2.1.1 Non-Removable Configuration

Capacity	Model Number
4GB	FMS-CF004GL9FS-NR
8GB	FMS-CF008GL9FS-NR
16GB	FMS-CF016GL9FS-NR
32GB	FMS-CF032GL9FS-NR
64GB	FMS-CF064GL9FS-NR

#### 9.2.1.2 Removable Configuration

Capacity	Model Number
4GB	FMS-CF004GL9FS-RM
8GB	FMS-CF008GL9FS-RM
16GB	FMS-CF016GL9FS-RM
32GB	FMS-CF032GL9FS-RM
64GB	FMS-CF064GL9FS-RM

#### 9.2.1.2 Non-DMA + Removable Configuration

Capacity	Model Number
4GB	FMS-CF004GL9FS-NDRM
8GB	FMS-CF008GL9FS-NDRM
16GB	FMS-CF016GL9FS-NDRM
32GB	FMS-CF032GL9FS-NDRM
64GB	FMS-CF064GL9FS-NDRM

#### 9.2.1.3 Non-DMA + Non-Removable Configuration

Capacity	Model Number
4GB	FMS-CF004GL9FS-NDNR
8GB	FMS-CF008GL9FS-NDNR
16GB	FMS-CF016GL9FS-NDNR
32GB	FMS-CF032GL9FS-NDNR
64GB	FMS-CF064GL9FS-NDNR

### 9.2.2 Industrial Temperature

#### 9.2.2.1 Non-Removable Configuration

Capacity	Model Number
4GB	FMS-CF004GL9FS-INR
8GB	FMS-CF008GL9FS-INR
16GB	FMS-CF016GL9FS-INR
32GB	FMS-CF032GL9FS-INR
64GB	FMS-CF064GL9FS-INR

#### 9.2.2.2 Removable Configuration

Capacity	Model Number
4GB	FMS-CF004GL9FS-IRM
8GB	FMS-CF008GL9FS-IRM
16GB	FMS-CF016GL9FS-IRM
32GB	FMS-CF032GL9FS-IRM
64GB	FMS-CF064GL9FS-IRM

#### 9.2.2.2 Non-DMA + Removable Configuration

Capacity	Model Number
4GB	FMS-CF004GL9FS-INDRM
8GB	FMS-CF008GL9FS-INDRM
16GB	FMS-CF016GL9FS-INDRM
32GB	FMS-CF032GL9FS-INDRM
64GB	FMS-CF064GL9FS-INDRM

#### 9.2.2.3 Non-DMA + Non-Removable Configuration

Capacity	Model Number
4GB	FMS-CF004GL9FS-INDNR
8GB	FMS-CF008GL9FS-INDNR
16GB	FMS-CF016GL9FS-INDNR
32GB	FMS-CF032GL9FS-INDNR
64GB	FMS-CF064GL9FS-INDNR

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## 10. Revision History

Revision	Date	Description	Comments
1.0	04/12/2012	Initial Release	
1.1	07/23/2012	Updated Product Ordering Information (with the addition of standard operating temperature models)  Added 64GB capacity	
1.2	09/03/2012	Added industrial operating temperature specifications  Updated Product Ordering Information due to the addition of standard temperature specifications  Added 4GB capacity model	