Appendix A **Specifications**

Physical Characteristics

CompactFlash Card Size: 1.43 x 1.68 x 0.13 inches (36 x 42.7 x 3.3 mm)

Weight: 1.1 oz. (34 g)

RFID Reader Head Size: 1.76 x 1.93 x 0.82 inches (45 x 49 x 21 mm)

Power Consumption (3.3 V):

Idle: 11 mA

Read/Write: 52 mA

Also operates at 5 V

Environmental:

Operating Temperature: 10 to +50°C (-4 to +122°F)

Storage Temperature: -40 to +70°C (-40 to +158°F)

Humidity: 5-95% RH non-condensing

Frequency: 13.56 MHz (HF)

Maximum Read Range*:* 2.5 inches (6.35 cm), depending on tag antenna size

Compatibility*:* Windows COM port

HF RFID Tags Supported

ISO15693: ICode SL2, LRI512, my-d, Tag-It HF-I

Proprietary: ICode 1, PicoTag (tag ID only), Tag-It HF, GemWave (tag ID only)

ISO14443A: Mifare (tag ID only)

Operating System Support*:* Windows CE.NET v4.2 (Windows Mobile)

Certification*:* FCC: Part 15, Class B, CE: EN55024:1998, C-TICK: s.182

Appendix B **HF RFID Standards and Tag Descriptions**

ISO15693

The ISO/IEC 15693 standard was developed for "Contactless Vicinity Cards". Adopted in 1998, ISO15693 has significantly enabled global acceptance of 13.56MHz RFID technology. Based on contributions by Texas Instruments and Philips, ISO/IEC 15693 is largely a superset of the features and specifications of the Tag-it HF and I·Code1 products, respectively.

- **ISO15693-1:** Defines the physical characteristics of a credit card transponder.
- **ISO15693-2:** Specifies the 13.56MHz air interface and modulation methods that accommodate regulatory bodies worldwide.
- **ISO15693-3:** Specifies the command protocol and anti-collision method for data exchange between tags and readers.

The ISO15693 "standard" permits tags to be manufactured that support optional and custom commands, and that have custom memory structures, sizes and architectures. The SkyeRead family of RFID readers fully supports all four (4) IC manufacturers that offer ISO/IEC 15693 compatible tags.

Tag-It HF-I ISO15693 (Texas Instruments)

The complete Tag-It HF-I specification can be found in the Texas Instruments publication titled "Tag-It HF-I Transponder Inlays Reference Guide".

Figure 1 - Memory Structure of the Tag-It HF-I

2K bits (256 bytes) of user memory is available for read/write.

Block #	32 bits (4 bytes per block)			
0 (0x00)				
1 (0x01)				
2 (0x02)				
. . .	. . .	. . .	. . .	. . .
62 (0x3E)				
63 (0x3F)				

The user can permanently lock any block.

Once a block is locked it can not be unlocked.

A 64-bit ID (factory programmed) uniquely identifies each Tag-It HF-I chip.

TID	0xE0	0x07	Unique Tag ID - 48 bits (6 bytes)

I·Code SLI ISO15693 (Philips)

The complete I·Code SLI specification can be found in the Philips publication titled "I·Code SLI Smart Label IC SL2 ICS20 Functional Specification".

Figure 1 - Memory Structure of the I·Code SLI (version SL2 ICS20)

896 bits (112 bytes) of user memory is available for read/write.

Block #	32 bits (4 bytes per block)			
0 (0x00)				
1 (0x01)				
2 (0x02)				
. . .	. . .	. . .	. . .	. . .
26 (0x1A)				
27 (0x1B)				

The user can permanently lock any block.

Once a block is locked it can not be unlocked.

A 64-bit ID (factory programmed) uniquely identifies each I·Code SLI chip (SL2 ICS20).

TID	0xE0	0x04	0x01	Unique Tag ID 40 bits (5 bytes)

my-d SRF55VxxP ISO15693 (Infineon)

The complete my-d SRF55VxxP specification can be obtained from Infineon.

Figure 2 - Memory Structure of the my-d SRF55V02P

29 blocks of 8 bytes = 232 bytes (1856 bits) of user memory is available for read/write.

Block #	64 bits (8 bytes per block)							
3 (0x03)								
4 (0x04)								
5 (0x05)								
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
30 (0x1E)								
31 (0x1F)								

The user can permanently lock any block

Once a block is locked it can not be unlocked.

A 64-bit ID (factory programmed) uniquely identifies each my-d SRF55V02P chip.

TID	0x60	0x05	0x02	Unique Tag ID - 40 bits (5 bytes)

Figure 4 - Memory Structure of the my-d SRF55V10P

125 blocks of 8 bytes = 1000 bytes (8000 bits) of user memory is available for read/write.

Block #	64 bits (8 bytes per block)
3 (0x03)	
4 (0x04)	
5 (0x05)	
. . .	. . .
126 (0x7E)	
127 (0x7F)	

The user can permanently lock any block

Once a block is locked it can not be unlocked.

A 64-bit ID (factory programmed) uniquely identifies each my-d SRF55V10P chip.

TID	0x60	0x05	0x00	Unique Tag ID - 40 bits (5 bytes)

LRI512 ISO15693 (ST Microelectronics)

The complete LRI512 specification can be found in ST Microelectronics' publication titled "LRI512 Memory TAG IC 512 bit High Endurance EEPROM 13.56MHz, ISO 15693 Standard Compliant with E.A.S.".

Figure 5 - Memory Structure of the STM LRI512

512 bits (64 bytes) of user memory is available for read/write.

Block #	32 bits (4 bytes per block)
3 (0x03)	
4 (0x04)	
5 (0x05)	
. . .	. . .
14 (0x0E)	
15 (0x0F)	

The user can permanently lock any block.

Once a block is locked it can not be unlocked.

A 64-bit ID (factory programmed) uniquely identifies each STM LRI512 chip.

TID	0xE0	0x02	Unique Tag ID 48 bits (6 bytes)

Tag-it HF

The first 13.56MHz RFID IC that Texas Instruments developed was the Tag-it HF. Still in high volume production, Tag-it HF is widely used in applications globally and has an existing installed base of millions of tags. The Tag-it HF uses a protocol air interface that is proprietary to Texas Instruments.

By contrast, the Tag-it HF-I was released by Texas Instruments in 2001 is compatible with ISO/IEC 15693 parts -2 and -3. The host application developer should be aware of the distinction between the Tag-it HF and the Tag-it HF-I.

Figure 6 - Memory Structure of the Tag-it HF

256 bits (32 bytes) of user memory is available for read/write.

Block #	32 bits (4 bytes per block)			
0 (0x00)				
1 (0x01)				
2 (0x02)				
. . .	. . .	. . .	. . .	. . .
6 (0x06)				
7 (0x07)				

The user can permanently lock any block.

Once a block is locked it can not be unlocked.

A 32-bit ID (factory programmed) uniquely identifies each Tag-it HF chip.

TID	Unique Tag ID 32 bits (4 bytes)

The complete Tag-it HF specification can be obtained from Texas Instruments.

I·Code1

The first long range 13.56MHz RFID IC that Philips released was the I·Code1 (SL1). Still in high volume production, I·Code1 (SL1) is still widely used in applications globally and has an existing installed base of millions of tags. The I·Code1 (SL1) uses a protocol and air interface that is proprietary to Philips.

By contrast, the I·Code SLI (SL2), released by Philips in 2002, is fully compatible with ISO/IEC 15693 parts -2 and -3. The host application developer should be explicitly aware of the distinction between the I·Code1 (SL1) and the I·Code SLI (SL2).

Figure 7 - Memory Structure of the I·Code1 (version SL1 ICS30 01)

512 bits (64 bytes) of user memory is available for read/write.

Block #	32 bits (4 bytes per block)			
3 (0x03)				
4 (0x04)				
5 (0x05)				
. . .	. . .	. . .	. . .	. . .
14 (0x0E)				
15 (0x0F)				

The user can permanently lock any block.

Once a block is locked it cannot be unlocked.

A 64-bit ID (factory programmed) uniquely identifies each I·Code1 chip.

TID	Unique Tag ID 64 bits (8 bytes)

PicoTag

Inside Contactless (formerly Inside Technologies) makes a contactless RFID product series called the PicoTag. There are two different sizes of PicoTag memories, 2K and 16K. There are two different modes of operation, plain and secure.

Figure 8 - Memory Structure of the PicoTag 2K

29 blocks of 8 bytes = 232 bytes (1856 bits) of user memory is available for read/write.

Block #	64 bits (8 bytes per block)							
3 (0x03)								
4 (0x04)								
5 (0x05)								
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
30 (0x1E)								
31 (0x1F)								

The user can permanently lock any block

Once a block is locked it can not be unlocked.

A 64-bit ID (factory programmed) uniquely identifies each PicoTag chip.

TID	Unique Tag ID 64 bits (8 bytes)

ISO14443

ISO/IEC 14443 is a 4-part RFID standard for short-range “Contactless Proximity Cards”. Adopted in 1999 and 2000, ISO14443 has become the worldwide standard for cashless payment and contactless stored value applications.

- ISO14443-1 defines the physical characteristics of an RFID card.
- ISO14443-2 specifies two types (A and B) of 13.56MHz air interface and modulation methods used for communication between tags and readers.
- ISO14443-3 specifies the anti-collision method for selecting one tag among many.
- ISO14443-4 defines the high-level protocol and method for data exchange between tags and readers.

14443-A Mifare Standard 4K (Philips)

The Mifare chip from Philips is used in millions of secure contactless applications since it was introduced in 1995.

Figure 9 - Memory Structure of the Mifare Standard 4K (MF1 IC S70)

BLOCK	SECTOR	BYTE															
		15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
0	0	Serial Number				Check Byte	Manufacturer Data										
1		Data															
2		Data															
3		Key A						Lock Bits				Key B					
4	1	Data															
5		Data															
6		Data															
7		Key A						Lock Bits				Key B					
. . .	. . .	. . .															
60	15	Data															
61		Data															
62		Data															
63		Key A						Lock Bits				Key B					

The complete Mifare specification can be obtained from the Philips publication “Mifare Standard 4 kByte Card IC MF1 IC S70” dated October 2002.

Mifare Ultralight (Philips)

The complete Mifare Ultralight specification can be obtained from the Philips publication "Mifare Ultralight Contactless Single-trip Ticket IC MF0 IC U1 Functional Specification" dated March 2003.

Figure 10 - Memory Structure of the Mifare Ultralight (MF0 IC U1)

Block	Byte			
	00	01	02	03
0	SN0	SN1	SN2	BCC0
1	SN3	SN4	SN5	SN6
2	BCC1	Internal	Lock 0	Lock 1
3	OTP 0	OTP 1	OTP 2	OTP 3
4	Data 0	Data 1	Data 2	Data 3
. . .	. . .			
15	Data 44	Data 45	Data 46	Data 47

System Area

User Area

LTO CM 14443-A (LTO) The LTO-CM is compliant with ISO14443-A air interface.

Figure 12 - Memory Structure of the LTO CM

128 blocks of 32 bytes = 4096 bytes (32768 bits) of user memory is available for read/write.

	WORD (2 Bytes)								
BLOCK	0	1	2	3	4	5	6	7	08 … 15
0	Serial Number		Check Byte & LTO Size	Transponder Type	Manufacturer Data				
1	Last Write Inhibited Block & Block 1 Protection Flag		Reserved	Protected Page Table					
2	Cartridge Manufacturer's Information Page								
3									
4	Media Manufacturer's Information Page								
5									
6	Unprotected Page Table								
7									
8	Initialization Data Page								
9									
10	Tape Write Pass Page								
11	Tape Write Pass Page Cont..								Tape Directory Page
12	Tape Directory Page Cont								
...									
59	EOD Information Page								
60									
61	Cartridge Status and Tape Alert Flags Page								
62	Usage Information Page 1								
63									
64	Usage Information Page 2								
65									
66	Usage Information Page 3								
67									
68	Usage Information Page 4								
69									
70	Mechanism Related Page								
...									
82	Applications Specific Page								
...									
115									
116	Suspended Append Writes page								
...									
127									