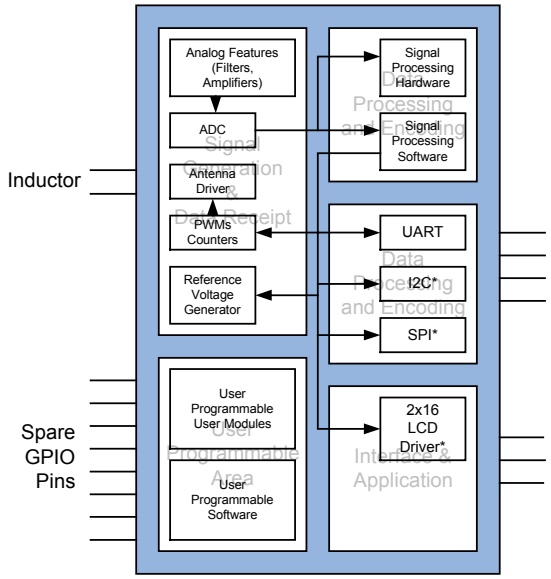
PSoC 125 kHz RFID Preliminary Data Sheet

CY8C0104 and CY8C0105

CY8C0104, CY8C0105 Features

- **General**
  - 100-150 kHz Programmable Carrier Frequency
  - Manchester RF/32 and RF/64 Compatible
  - Decodes and Processes Data
  - Ready-to-use with Atmel/Temic T55xx and EM Microelectronic SA EM4100/02 transponder chips
  - Supports Sequential Terminators
  - Supports Byte Tracking
  - Low Power Consumption in Sleep Mode
  - UART, I2C* and SPI* Compatible
- **Upgradeable**
  - Software Included in Evaluation Kit
  - Further Expansion Available through SonMicro
- **Programmable and Customizable**
  - Customizable Code
    - No need for external MCU
  - Programmable Watchdog and Sleep Timers
  - Programmable Read Sequence
  - Programmable byte tracking settings
- **Easily Calibrated**
  - Programmable drive frequency and gain amplifiers
  - Optimize reading/writing distance
- **Complete Evaluation Tools**
  - Evaluation Board
  - Evaluation and Programming Software
  - Complete RFID Unit



Functional Diagram

*Available as custom option by SonMicro.

RFID Functional Overview

Built on a PSoC (Programmable System-on-Chip) platform, the RFID Chip and ChipModule eliminate the need for external components such as filters, amplifiers and microcontrollers. Approximately 4k of Flash is available for customization to allow designers to personalize operations.

The RFID chip and ChipModule work with both Manchester RF/32 and Manchester RF/64 modulations Supporting Atmel/Temic T55xx transponders and EM Microelectronic SA EM4100/02 transponder chips.

Modulation Decoding

The RFID chip and ChipModule generate a 100-150 kHz RFID field, decode the transponder return signal, and store data to be processed or sent. The RFID chip and ChipModule are pre-programmed. In cases where users desire a custom decoding algorithm or to decode the signal with other modulations (e.g., bi-phase), the un-decoded signals are available on pins of the RFID chip.

The pre-programmed decoding algorithm supports a sequential terminator, compatable with Atmel/Temic T55xx transponders.

Byte Tracking

The decoding algorithm supports programmable byte tracking. A read can start after the tracking byte(s) has been detected. This feature can be used with read-only transponders (most T5530 transponders start with a 0xE6 header). It can also be used for security because another reader may not read correct data from a transponder if it does not know which tracking system is being used.

Flash Programmability

The RFID Chip and ChipModule are programmable with SMRFID (SonMicro RFID) software through the UART pins. A user can program assembly code to the available Flash memory providing access to control APIs and hardware. This eliminates the need for an external microcontroller. Because of the programmability of Flash in the RFID Chip and ChipModule, new features and modifications are easily implemented in user-specific applications.

Additional Features

- Parameters such as RFID tag programming period, internal amplifier gain, and carrier frequency are programmable through the UART and SMRFID software. This allows the user to adjust the carrier frequency and baud rate for specific applications.
- Calibration of the RFID Chip and ChipModule is performed through the UART interface.
- General Purpose Input Output (GPIO) pins are available to expand the functionality of the devices and to control custom design elements.

Development Tools

Evaluation Kit

The RFID Evaluation Kit (CY3220SMRFID-RD) is a complete short-range 125 kHz RFID reader. The RFID Evaluation Kit includes a ChipModule (CY8C0105) equipped with an RS232 serial communication chip to perform all RFID functions including reading and writing to tags, calibration, and communication to a user interface (PC).

SMRFID (SonMicro RFID) Software

The SMRFID Software included in the RFID Evaluation Kit is a Microsoft Windows-based interface for testing, programming, and calibrating a ChipModule with the Evaluation Board. Complete software instructions and programming steps are described in the Getting Started Guide and Programming Guide on the Evaluation Kit CD.

RFID Evaluation Kit (CY3220SMRFID-RD)

Document Conventions

Acronyms Used

The following table lists the acronyms that are used in this document.

Acronym	Description
API	Application Programming Interface
CPU	Central Processing Unit
DAC	Digital-to-analog Converter
DC	Direct Current
GPIO	General Purpose IO
IO	Input/Output
LCD	Liquid Crystal Display
PC	Personal Computer
PSoC	Programmable System-on-chip
PWM	Pulse-width Modulator
RAM	Random Access Memory
RFID	Radio Frequency Identification
SMP	Switch Mode Pump
SPI	Serial Peripheral Interface
UART	Universal Asynchronous Receiver-transmitter

Units of Measure

A units of measure table is located in the Electrical Specifications section. Table 3-1 lists all the abbreviations used to specify PSoC devices and the RFID in particular.

Numeric Naming

Hexidecimal numbers are represented with all letters in upper case with an appended lower case ‘h’ (for example, ‘14h’ or ‘3Ah’). Hexidecimal numbers may also be represented by an ‘0x’ prefix, the C coding convention. Binary numbers have an appended lowercase ‘b’ (e.g., ‘01010100b’ or ‘01000011b’). Numbers not indicated by an ‘h’, ‘b’, or 0x are decimal.

Customization

11 GPIO pins and program may be customized and programmed with the SMRFID software. For technical assistance, please reference SonMicro’s contact information in Section 6 of this document.

Table of Contents

For an in depth discussion and more information about the PSoC device, the platform of the RFID Chip and ChipModule, refer to the *PSoC Mixed Signal Array Technical Reference Manual*. The remainder of this document is organized into the following chapters and sections.

1. Pin Information

This chapter describes the CY8C0104/05 RFID device pins and pinout configurations.

1.1 Pinouts

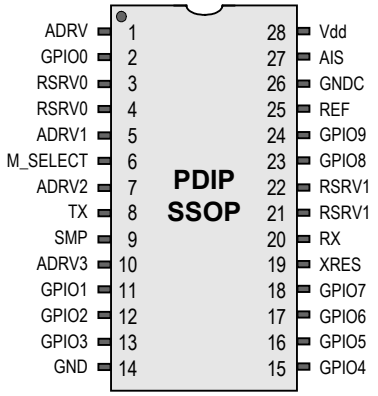
The CY8C0104 RFID device is available in a variety of packages, which are listed and illustrated in the following section. The pinout for the CY8C0105 RFID ChipModule is shown and described ahead. Please contact SonMicro at www.sonmicro.com regarding program customization and GPIO pins.

1.1.1. RFID Chip

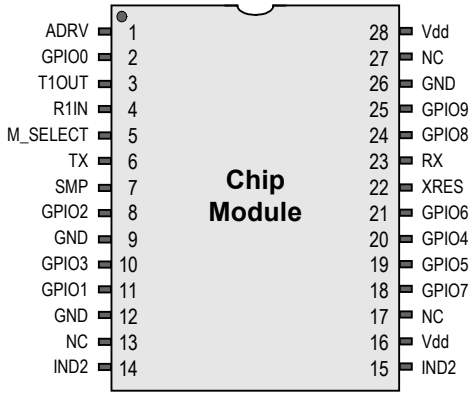
Table 1-1. CY8C0104 RFID Chip

Pin #	Pin Name	Description
1	ADRV0	**Antenna Drive Pin** When the RFID chip tries to read the transponder, a ~125 kHz square wave with a 50% duty cycle is output on this pin as well as at ADRV1, ADRV2 and ADRV3 pins to drive the antenna. These pins should be connected together externally to drive the antenna with more current.
2	GPIO0	**NC** Available for customization as GPIO pin
3	RSRV0	**Reserved 0** Connected externally to pin 4.
4	RSRV0	**Reserved 0** Connected externally to pin 3.
5	ADRV1	**Antenna Drive Pin** See Pin 1 description.
6	M_SELECT	**Mode Select** Used to select the mode of operation. Read Mode if pin is logic 1 (5V) after POR. Command Receive Mode if pin is logic low (0V) after POR. Use the XRES pin connection to reset the RFID Chip logic signals to change mode of operation.
7	ADRV2	**Antenna Drive Pin** See Pin 1 description.
8	TX	**UART Transmit, TX** Default communication rate = 19200 bps. Rate is available for customization.
9	SMP	**Switch Mode Pump** (SMP) connection to external components required.
10	ADRV3	**Antenna Drive Pin** See Pin 1 description.
11	GPIO1	**NC** Available for customization as a GPIO pin or for LCD control..
12	GPIO2	**NC** Available for customization as a GPIO pin or for LCD control..
13	GPIO3	**NC** Available for customization as a GPIO pin, external crystal connection or for LCD control..
14	GND	**Ground Connection**
15	GPIO4	**NC** Available for customization as a GPIO pin, external crystal connection or for LCD control..
16	GPIO5	**NC** Available for customization as a GPIO pin or for LCD control..
17	GPIO6	**NC** Available for customization as a GPIO pin or for LCD control..
18	GPIO7	**NC** Available for customization as a GPIO pin or for LCD control..
19	XRES	**External Reset** Active high pin reset with internal pull down.
20	RX	**UART Receive, RX** Default communication rate = 19200 bps. Rate is available for customization.
21	RSRV1	**Reserved 1** This pin is reserved and should be connected externally to pin 22.
22	RSRV1	**Reserved 1** This pin is reserved and should be connected externally to pin 21
23	GPIO8	**NC** Available for customization as a GPIO pin
24	GPIO9	**NC** Available for customization as a GPIO or for LED control.
25	REF	**Reference Voltage** This pin outputs a 2.6V reference voltage for the analog-front end.
26	GND	**Ground Connection**
27	AIS	**Analog Input Signal** Connected to analog front end
28	Vdd	**Supply Voltage** 5V Input

CY8C0104 RFID Chip



CY8C0105 RFID ChipModule



1.1.2. RFID ChipModule

Table 2-1. CY8C0105 RFID ChipModule

Pin #	Pin Name	Description
1	ADRV	**Antenna Drive Pin.** When the RFID chip tries to read the transponder, a ~125 kHz square wave with a 50% DC signal is found on this pin. The other end of the antenna is connected to IND2.
2	GPIO0	**NC** Available for customization as a GPIO pin.
3	T1OUT	**RS232 TX** Signal present at this pin (±5V minimum). Do not connect this pin to TTL pins (5V). T1OUT is pin 14 of MAX232 IC. Designer may connect this pin to RX pin of PC COM port (DB9 Pin 2) in order to transmit data to PC.
4	R1IN	**RS232 RX (Receive)** Signal present at this pin (±30V maximum). Do not connect this pin to TTL pins (5V). R1IN is pin 13 of MAX232 IC. Designer may connect this pin to TX pin of PC COM port (DB9 Pin 3) in order to receive data from PC.
5	M_SELECT	**Mode Select** Used to select the mode of operation. Read Mode if pin is logic 1 (5V) after POR. Command Receive Mode if pin is logic low (0V) after POR. Use the XRES pin connection to reset the RFID Chip logic signals to change mode of operation.
6	TX	**UART Transmit, TX** UART communication pin. Connected to RS232 communication chip as well. Signal on T1OUT (pin 3). Default communication rate = 19200 bps. Rate is available for customization.
7	SMP	**Switch Mode Pump** (SMP) connection to external components required.
8	GPIO2	**NC** Available for customization as a GPIO pin or for LCD control..
9	GND	**Ground** Ground connection. Connect to pins 12 and 26.
10	GPIO3	**NC** Available for customization as a GPIO pin, for I2C, for external crystal connection or for LCD control..
11	GPIO1	**NC** Available for customization as a GPIO pin or for LCD control..
12	GND	**Ground** Ground connection. Connect to pins 9 and 26.
13	NC	**No Connect** This pin is not connected to anywhere and thus is not functional.
14	IND2	**Inductor Connection** The second end of the inductor is connected to this pin or pin 15 to complete the connection between the antenna driver and the analog-front end. Pins 14 and 15 are connected internally..
15	IND2	**Inductor Connection** The second end of the inductor is connected to this pin or pin 14 to complete the connection between the antenna driver and the analog-front end. Pins 14 and 15 are connected internally..
16	Vdd	**Supply Voltage** 5V Input
17	NC	**No Connect** No function.
18	GPIO7	**NC** Available for customization as a GPIO pin or for LCD control..
19	GPIO5	**NC** Available for customization as a GPIO pin or for LCD control..
20	GPIO4	**NC** Available for customization as a GPIO pin, for I2C, for external crystal connection or for LCD control..
21	GPIO6	**NC** Available for customization as a GPIO pin or for LCD control..
22	XRES	**External Reset** Active high pin reset with internal pull down.
23	RX	**UART Transmit, RX** UART communication pin. Connected to RS232 communication chip as well. Signal on R1IN (pin 4). Default communication rate = 19200 bps. Rate is available for customization.
24	GPIO8	**NC** Available for customization as a GPIO pin.
25	GPIO9	**NC** Available for customization as a GPIO pin or for LED control..

26	GND	**Ground** Ground connection. Connect to pins 9 and 12.
27	NC	**No Connect** No function.
28	Vdd	**Supply Voltage** 5V Input

2. Communication Protocol

2.1 UART

This chapter describes the UART communication protocol for communication between the CY8C0104/05 and an interface. Other communication methods can be implemented upon customer request. Please visit www.sonmicro.com for support in adding a different communication protocol.

The RFID ChipModule communicates with peripheral devices via 8-byte data packets at 19200 bps. This baud rate can be increased or decreased through firmware modification. Most commands consist of 8-byte packets but there are also 16-byte data packets.

The RFID ChipModule sends the received data back to an external device upon receipt of the UART signal. The external device checks that the data is the same as the previously sent data. If the data is the same, it sends an acknowledgement. If not, it sends a non-acknowledgement string message.

2.1.1 Read Tag Command

This command is used to start a read.

're**TWWXYZ**'

ASCII letters 're' start the read command. The following table lists the appropriate values for the other characters. It is not possible to read block 0.

Table 2-1. Read Tag Command Scheme

Letter	Description	Value	Result
T	Selects Read Method (string)	'0'	Byte Track Method
		'1'	Sequential Terminator Method
		'2'	EM4100/02 Method
		'3'	EM4100/02 (Decoded) Method
WW	Modulation Type (string)	'32'	Manchester RF/32
		'64'	Manchester RF/64
X	Power Mode (hex)	0x01	Eco Power Mode
		0x02	Full Power Mode
Y	Number of Reads (hex)	0x01	Read 1 Time
		0x02	Read 2 Times
		0x03	Read 3 Times
		0x04	Read 4 Times
		0x05	Read 5 Times
		0x06	Read 10 Times
		0x07	Read Always
Z*	Number of Blocks*	0x01	Read 1 Block
		0x02	Read 2 Blocks
		0x03	Read 3 Blocks
		0x04	Read 4 Blocks
		0x05	Read 5 Blocks
		0x06	Read 6 Blocks
		……	……
		0x31	Read 31 Blocks

*Most T55xx transponders consist of 8 blocks. T5552 transponders consist of 32 blocks. If EM4100/02 Read Methods are selected, the user does not need to program the number of blocks to be read.

2.1.1.1 Read Command Example

This example describe the commands necessary to read 4 blocks of a Q5 transponder 1 time with Manchester RF/64 modulation type in full power using the Byte Track Method. Table 4-2 shows the values that are used for the command. The code that is sent though the UART is shown below. Table 2-3 shows the steps in the read process.

Table 2-2. Example Read Tag Command Values

Letter	Description	Value	Result
T	Selects Read Method (string)	'0'	Byte Track Method
WW	Modulation Type (string)	'64'	Manchester RF/64
X	Power Mode (hex)	0x02	Full Power Mode
Y	Readtime (hex)	0x01	Read 1 Time
Z	Number of Blocks (hex) *	0x04	Read 4 Blocks

```
're064' + char(0x02) +char(0x01)+char(0x04)
```

= re064 + <0x02> + <0x01> + <0x04>

The designer must send the 're064□□□' string to RFID Chip

2.1.1.2 UART Read Tag Command Process

Table 2-3 shows an example command process for sending a read command to the RFID chip.

Table 2-3. Example Read Tag Command Process

Step	Process	Device	Messgae
1	Send Read Command	External	re064□□□*
2	RFID Chip Returns Read Command	RFID Chip	re064□□□*
3	Compare Sent Command to Returned Command	External	
4	Send Acknowledge	External	acknwlge
5	Return Acknowledge	RFID Chip	acknokok
6	Execute Read Command	RFID Chip	

*** This ' re064□□□' value appears in the text box when using the SMRFID Software.**

2.1.2 Write Tag Command

The RFID Chip and ChipModule use this command to start programming a byte (for blocks 0-7):

'bl**XY**lc**ZZ**'

ASCII letters 'bl' and 'lc' start the program command. The Table 2-4 lists the appropriate values for the other characters.

Table 2-4. Write Tag Command Scheme (blocks 0- 7)

Letter	Description	Value	Result
XY	Determines the block to be programmed (0-7)	0x30 + 0x30	Program Block 0
		0x01 + 0x31	Program Block 1
		0x02 + 0x32	Program Block 2
		0x03 + 0x33	Program Block 3
		0x04 + 0x34	Program Block 4
		0x05 + 0x35	Program Block 5
		0x06 + 0x36	Program Block 6
		0x07 + 0x37	Program Block 7
ZZ	Locked / Unlocked	0x30 + 0x30	Locked
		0x31+ 0x31	Unlocked

Use the following command to program blocks higher than 7:

'bl**X**flc**ZZ**'

ASCII letters 'bl' and 'flc' start the program command. The following table lists the appropriate values for the other characters.

Table 2-5. Write Tag Command Scheme (blocks 8-31)

Letter	Description	Value	Result
X	Determines the block to be programmed (8-31)	0x08	Program Block 8
		0x09	Program Block 9
		0x0A	Program Block 10
		0x0B	Program Block 11
		……	……
		0x1D	Program Block 29
		0x1E	Program Block 30
		0x1F	Program Block 31
ZZ	Locked / Unlocked	0x30 + 0x30	Locked
		0x31+ 0x31	Unlocked

2.1.2.1 Write Tag Command Example 1

To program block 0 of a Q5 transponder with "6001F00E' and to lock the block, use the following command:

`'bl' + char(0x30) + char(0x30) +'lc' + char(0x31) + char(0x31)`

`= 'bl00lc11'` (send this string to the RFID chip)

Table 2-6 shows the values that are used for the command. Table 4-3 shows the steps in the read process.

Table 2-6. Write Tag Command values

Letter	Description	Value	Result
XY	Selects Block to Program (hex)	0x30 + 0x30	Program Block 0
ZZ	Modulation Type (hex)	0x31 + 0x31	Locked

2.1.2.2 UART Write Tag Command Example 2

To program block 1 of a Q5 transponder with '52588B45' without locking the block use the following command:

`'bl' + char(0x01) + char(0x31) +'lc' + char(0x30) + char(0x30)`

`= 'bl + <0x01> + 1lc00'` (send this string to the RFID chip)

Table 2-7 shows the values that are used for the command. Table 2-9 shows the steps in the read process.

Table 2-7. Example Program Command values

Letter	Description	Value	Result
XY	Selects Block to Program (hex)	0x01 + 0x31	Program Block 0
ZZ	Modulation Type (hex)	0x30 + 0x30	Unlocked

2.1.2.2 UART Write Tag Command Example 3

To program block 20 of a Q5 transponder with '30303030' without locking the block, use the following command:

'bl' + char(0x14) + 'flc' + char(0x30) + char(0x30)

= 'bl + <0x14> + 1lc00' (send this string to the RFID chip)

Table 2-8 shows the values that are used for the command. Table 2-9 shows the steps in the read process.

Table 2-8. Example Program Command Values

Letter	Description	Value	Result
X	Selects Block to Program (hex)	0x14	Program Block 0
ZZ	Modulation Type (hex)	0x30 + 0x30	Unlocked

2.1.3.4 UART Program Command Process

Table 2-9. Example Block Program Process

Step	Process	Device	Message
1	Send Program Command	External	bl□0lc00*
2	RFID Chip Returns Program Command	RFID Chip	bl□0lc00*
3	Compare Sent Command to Returned Command	External	
4	Send Acknowledge	External	acknwlge
5	Return Acknowledge	RFID Chip	acknokok
6	Send Program Value	External	'xxxxxxxx'
7	Return Program Value	RFID Chip	'xxxxxxxx'
9	Compare Sent Value to Returned Value	External	
10	Send Acknowledge	External	acknwlge
11	Return Acknowledge	RFID Chip	acknokok
12	Execute Write Command	RFID Chip	

*** This 'bl□0lc00' value appears in the text box when using the SMRFID Software.**

2.1.3 Byte Tracking

To select byte tracking, the following command is used:

'trackda**x**'

Table 2-10. Byte Tracking Values

Letter	Description	Value	Result
X	Determines the Number of Bytes to be tracked	0x01	Track One Byte
		0x02	Track Two Bytes
		0x03	Track Three Bytes
		0x04	Track Four Bytes

To program the RFID to track 0xE7 in an incoming data stream, send the following command.

'trackda' + char(0x01)

= 'trackda + <0x01' (send this string to the RFID chip)

= 'trackda□'

Next, send the Byte Track value

'E7303030'

Note, the transponder should have the value 0xE7 in its memory and Byte Track Mode should be used.

Table 2-11. Example Byte Track Command Process

Step	Process	Device	Message
1	Send Byte Track Command	External	'trackda□'
2	RFID Chip Returns Byte Track Command	RFID Chip	'trackda□'
4	Compare Sent Command to Returned Command	External	
5	Send Acknowledge	External	'acknwlge'
3	Wait for Acknowledge Message	RFID Chip	
6	Return Acknowledge	RFID Chip	'acknokok'
7	Wait for 'Acknowledge from RFID Chip	External	
8	Send Byte Track Value	External	'E7303030'
9	Return Byte Track Value	RFID Chip	'E7303030'
10	Compare Sent Value to Returned Value	External	
11	Send Acknowledge	External	'acknwlge'
12	Wait for Acknowledge Message	RFID Chip	
13	Return Acknowledge	RFID Chip	'acknokok'
14	Write New Value to Flash Memory	RFID Chip	

* This 'trackda□' value appears in the text box when using the SMRFID Software.

2.1.4 Calibration Commands

2.1.4.1 Programming Transponder Parameters

Transponder delay parameters P0, P1 and P2 determine the length of time for writing 0, 1 and a gap value to the transponder (T55XX) when the transponder is programmed. In the SMRFID software these parameters are entered in microsecond format. The software then automatically calculates the parameters that are necessary to be sent to the chip. Parameters are determined according to type of transponder used (T55xx) and the inductor. See individual transponder datasheets for more information.

These parameters determine the delays. The built-in delay function for each parameter is determined by the to following formula:

$$\frac{12KL + 20K + 8}{24000000} = Delay \qquad \textbf{(1)}$$

For a 100 μs delay, values of K = 26 and L = 6 work. First use the 'progrdly' command string to begin. Next use the following command to send parameter values to the RFID chip.

'**TUWXYZ**fr'

Table 2-12. Transponder Delay Parameter Values

Letter	Delay Parameter	Variable	Format
T	P0	K	hex
U		L	hex
W	P1	K	hex
X		L	hex
Y	P2	K	hex
Z		L	hex

2.1.4.1.1 Delay Parameter Command Example

To program delay parameters of 100 ms, 300 ms, and 200 ms to P0, P1, and P2, respectively, first calculate the K and L values from equation (1).

Table 4-13. Example Delay Parameter Values

Delay Parameter	Variable	Decimal	hex

P0	K	26	0x1A
	L	06	0x06
P1	K	62	0x3E
	L	08	0x08
P2	K	2	0x02
	L	198	0xC6

Next, send the following command:

‘progrdly,’

then the following command:

char(0x1A) + char(0x06) char(0x3E) + char(0x08) char(0x02) + char(0xC6) + ‘fr’

= ‘bl + <0x14> + 1lc00’ (send this string to the RFID chip)

Table 2-14 shows the values that are used for the command. Table 2-15 shows the steps in the delay parameter command process.

Table 2-14. Example Delay Parameter Command Process

Step	Process	Device	Message
1	Send Change Delay Parameter Command	External	‘progrdly’
2	RFID Chip Returns Change Delay Parameter Command	RFID Chip	‘progrdly’
3	Compare Sent Command to Returned Command	External	
4	Send Acknowledge	External	‘acknwlge’
5	Return Acknowledge	RFID Chip	‘acknokok
6	Send Change Delay Parameter Value	External	‘□□>□□ÆÆfr’
7	Return Change Delay Parameter Value	RFID Chip	‘□□>□□ÆÆfr’
8	Compare Sent Value to Returned Value	External	
9	Send Acknowledge	External	‘acknwlge’
10	Return Acknowledge	RFID Chip	‘acknokok’
11	Write New Delay Values to Flash Memory	RFID Chip	

* This ‘□□>□□ÆÆfr’ value appears in the text box when using the SMRFID Software.

2.1.4.2 Internal Gain Amplifiers

There are two gain amplifiers inside the RFID chip. Amplifications values can be adjusted using the following command value:

'XYfreeee'

Table 4-15. Gain Parameters for Amplification

Letter	Description	Value	Amplification Result
X	Sets Gain Parameter for Amplifier 1	0x30	1.0
		0x31	1.3
		0x32	2.0
		0x33	3.2
		0x34	4.0
		0x35	5.3
		0x36	8.0
		0x37	16.0
		0x38	24.0
		0x39	48.0
Y	Sets Gain Parameter for Amplifier 2	0x30	1.0
		0x31	1.3
		0x32	2.0
		0x33	3.2
		0x34	4.0
		0x35	5.3
		0x36	8.0
		0x37	16.0
		0x38	24.0
		0x39	48.0

2.1.4.2.1 Internal Gain Amplifiers Example

To download a gain of 8 for amplifier 1 and a gain of 16 to amplifier 2, first send the 'gainsett' command. Next, send the following command:

char(0x36) + char(0x37) + 'freeee'

= '67freeee'

2.1.4.2.2 Internal Gain Amplifiers Command Process

Table 4-16 shows the steps involved in setting the gain amplifiers.

Table 4-16.

Step	Process	Device	Message
1	Send Set Gain Amplifier Command	External	'gainsett'
2	RFID Chip Returns Set Gain Amplifier Command	RFID Chip	'gainsett'
3	Compare Sent Command to Returned Command	External	
4	Send Acknowledge	External	'acknwlge'
5	Return Acknowledge	RFID Chip	'acknokok'
6	Send Gain Amplifier Value	External	'67freee'
7	Return Gain Amplifier Value	RFID Chip	'67freee'
8	Compare Sent Value to Returned Value	External	
9	Send Acknowledge	External	'acknwlge'
10	Return Acknowledge	RFID Chip	'acknokok'
11	Write New Gain Amplifier Value to Flash Memory	RFID Chip	

2.1.4.3 General System Parameters

There are four general system parameters for the RFID Chip and transponders:

- R-ADF
- P-ADF
- WDR
- FPAT.

They are listed and described below.

R-ADF : This value determines the frequency when antenna is being driven and attempting to read a transponder. The frequency is determined by a PWM. The input clock for the PWM is 24 MHz. For a desired output frequency, the following formulae should be applied.

$$OutputFrequency = \frac{24MHz}{OutputFrequency} - 1 \qquad \textbf{(2)}$$

$$PulseWidth = \frac{Period}{2} \text{ (integer part)} \qquad \textbf{(3)}$$

If a 125 KHz output frequency is desired, the period should be 191 and pulse width 96. These values are then converted into hexadecimal numbers and sent to the RFID chip.

P-ADF : This value determines the frequency when the antenna is being driven and attempting to write to a transponder. The frequency is determined by a PWM. The input clock for the PWM is 24MHz. For a desired output frequency, the following formulae should be applied.

$$OutputFrequency = \frac{24MHz}{OutputFrequency} - 1 \qquad \textbf{(4)}$$

$$PulseWidth = \frac{Period}{2} \text{ (integer part)} \qquad \textbf{(5)}$$

If output frequency of 125 KHz is desired, the period should be 191 and pulse width 96. These values are then converted into hexadecimal numbers and sent to the RFID chip

WDR: This value determines the period for a Watchdog reset. This value can be set to between 2 and 240 seconds. A hardware reset occurs after each period. Note, the accuracy of the WDR period is low.

FPAT: This values determines the period for driving time of antenna when low power read mode is used. There is an internal sleep timer adjusted to 1 second. When low power mode is selected, the reader is active. The antenna is driven in full power mode for the value of the FPAT parameter times 7.5 ms, then enters sleep again.

For example, if FPAT is 20, the reader will wake up for 150 ms then re-enter sleep if a transponder is not detected. This process occurs once per second. Current consumption is between 50 and 100 mA for the 150 ms period and between 20 and 70 uA during sleep.

The following command string should be sent to the RFID chip to program the four parameters listed above:

'TUWXYZfr.'

Table 4-17 lists the values for each parameter.

Table 4-17. General Parameter Values

Letter	Delay Parameter	Variable	Value	Result	Format
T	R-ADF	Period			hex
U		Pulse Width			hex
W	R-ADF	Period			hex
X		Pulse Width			hex
Y	WDR	Period	0x01	Disables WDR	hex
			0x02	2-second period for WDR	hex
			0x03	2-second period for WDR	hex
			……	……	……
			0xF0	240-second period for WDR	hex
Z	FPAT	Period			hex

2.1.4.3.1 General Parameters Example

To program the RFID chip with a R-ADF of 122448Hz, a P-ADF of 125654Hz, a 2-second WDR, and an FPAT of 60, first send the 'systmset' command, then the following data:

char(0xC3) + char(0x62) + char(0xBE) + char(0x5F) + char(0x02) + char(0x3C) + 'fr'

= 'Ãb□<¾_fr' (This is what the designer sees in the text box).

Table 4-18 shows the steps involved in setting the general parameters.

Table 4-18. Setting the General Parameters.

Step	Process	Device	Message
1	Send Set General Parameters Command	External	'systmset'
2	RFID Chip Returns Set General Parameters Command	RFID Chip	'systmset'
3	Compare Sent Command to Returned Command	External	
4	Send Acknowledge	External	'acknwlge'
5	Return Acknowledge	RFID Chip	'acknokok'
6	Send General Parameters Values	External	'Ãb□<¾_fr'
7	Return General Parameters Values	RFID Chip	'Ãb□<¾_fr'
8	Compare Sent Value to Returned Value	External	
9	Send Acknowledge	External	'acknwlge'
10	Return Acknowledge	RFID Chip	'acknokok'
11	Write New General Parameters Values to Flash Memory	RFID Chip	

4.1.4.4 Default Parameter Values

Table 4-19 lists the default values for each of the above parameters. For more information on these parameters, how to change them, and what they mean, please reference Sections 4.1.4.1 through 4.1.4.3 of this document and the SMRFID Software Guide.

Table 4-19. Default Parameter Values

Parameter	Default Values
P0	50
P1	300
P2	300
Gain 1	3.2
Gain 2	16
R-ADF	Adjusted for optimal distance in factory
P-ADF	Adjusted for optimal distance in factory
WDR	Disabled
FPAT	20

3. Electrical Specifications

This chapter presents the electrical and performance specifications of the CY8C0104 and CY8C0105 devices. For the most up-to-date electrical and performance specifications, confirm that you have the most recent datasheet by going to the web at http://www.cypress.com/psoc.

Table 3-1. Units of Measure

Acronym	Description	Acronym	Description
°C	degree Celcius	mVrms	microvolts root-mean-square
bps	bits per second	mW	microwatts
dB	decibels	ma	milliampere
fF	femtofarad	ms	millisecond
Hz	hertz	mV	millivolts
KB	1024 bytes	nA	nanoampere
kbit	1024 bites	ns	nanosecond
kHz	kilohertz	nV	nanovolts
kΩ	kilohm	Ω	ohm
MHz	megahertz	pA	picoampere
MΩ	megaohm	pF	picofarad
µA	microampere	pp	peak-to-peak
µF	microfarad	ppm	parts per million
µH	microhenry	ps	picosecond
µs	microsecond	sps	samples per second
µV	microvolts	V	volts

3.1 Absolute Maximum Ratings

Table 3-2. Absolute Maximum Ratings

Symbol	Description	Min	Typ	Max	Units	Notes
T_{STG}	Storage Temperature	-55	-	+100	°C	Higher storage temperatures will reduce data retention time.
T_A	Ambient Temperature with Power Applied	-40		+85	°C	
Vdd	Supply Voltage	-0.5		+6.0	V	
V_{ID}	DC Input	Vss-0.5		Vdd+0.5	V	
-	DC Voltage Applied to Tri-state	Vss-0.5		Vdd+0.5	V	
I_{MIO}	Maximum Current into an Port Pin	-25		+50	mA	
I_{MAIO}	Maximum Current into an Port Pin Configured as Analog Driver	-50		+50	mA	
-	Static Discharge Voltage	2000			V	
-	Latch			200	mA	

Table 3-3. Operating Temperatures

Symbol	Description	Min	Typ	Max	Units	Notes
T_A	Ambient Temperature	-40	-	+85	°C	
T_J	Junction Temperature	-40	-	+100	°C	The temperature rise from ambient to junction is package specific.

3.2 DC Characteristics

3.2.1 DC Chip-Level Specifications

The following table lists guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75V to 5.25V and -40°C <T_A < 85°C, respectively. Typical parameters apply to 5V and are for design guidance only or unless otherwise specified

Table 3-4. DC Operating Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
Vdd	Supply Voltage	3.3	5.00	5.25	V	
Full Power Read Mode						
Io	Supply Current	-	32.6	40	mA	Without Max232, Coil not connected.
Io	Supply Current	-	50	100	mA	Without Max232, Coil connected.[a]
Io	Supply Current	-	38	45	mA	With Max232, Coil not connected.
Io	Supply Current	-	55	100	mA	With Max232, Coil connected.[a]
Power Save Read Mode						
Is	Sleep Current	-	20	60	uA	When low power read mode is used, full power will be active once a second. Other times total supply current will be sleep current.[b]
Programming Mode						
Io	Supply Current		25	35	mA	

[a] This may vary according to inductor type/value and size.

[b] Using low power mode reduces the average current consumption. The period for the full power active time is programmable. Sleep current value is measured without MAX232 and without other peripheral devices connected (e.g., LED). For programming information, please see the RFID Programming Guide or contact SonMicro.

3.2.2 DC General Purpose IO Specifications

The following table lists guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75V to 5.25V and -40°C < T_A < 85°C, respectively. Typical parameters apply to 5V at 25°C and are for design guidance only or unless otherwise specified.

Table 3-5. DC GPIO Specifications

Symbol	Description	Min	Typ	Max	Units	Notes
R_{PU}	Pull up Resistor	4	5.6	8	kΩ	
R_{PD}	Pull Down Resistor	4	5.6	8	kΩ	
V_{OH}	High Output Level	Vdd - 1.0	-	-	V	IOH = 10 mA, Vdd = 4.75 to 5.25 (8 IO switching, 4 per side)
V_{OL}	Low Output Level	-	-	0.75	V	IOH = 25 mA, Vdd = 4.75 to 5.25 (8 IO switching, 4 per side)
V_{IL}	Input Low Level	-	-	0.8	V	Vdd = 4.75 to 5.25
V_{IH}	Input High Level	2.1	-	-	V	Vdd = 4.75 to 5.25
V_H	Input Hysterisis	-	60	-	mV	
I_{IL}	Input Leakage (Absolute Value)	-	1	-	nA	Gross tested to 1 mA
C_{IN}	Capacitive Load on Pins as Input	-	3.5	10	pF	Package and pin dependent. Temp = 25°C
C_{OUT}	Capacitive Load on Pins as Output	-	3.5	10	pF	Package and pin dependent. Temp = 25°C

3.2.3 RS232 IO Specifications

The following table lists guaranteed maximum and minimum specifications for the voltage and temperature ranges: 4.75V to 5.25V and -40°C < T_A < 85°C, respectively. Typical parameters apply to 5V at 25°C and are for design guidance only or unless otherwise specified.

Table 3-6. RS232 IO Specifications

Parameter	Conditions	Min	Typ	Max	Units
Output Voltage Swing	All transmitter outputs loaded with 3 kΩ to ground	4	5.6	8	kΩ
Logic Pull-up Current	No Load, T_A = +25°C		5	10	µA
Receiver Input Voltage Operating Range		-30	-	-30	V
Input Hysteresis	Vdd = 5V, no hysteresis in shutdown	0.2	0.5	1.0	V
Input Resistance	T_A = +25°C, Vdd = 5V	3	5	6	kΩ
Propagation Delay	Normal Operation		0.5	10	µS
Transition Region Slew Rate	T_A = +25°C, Vdd = 5V, R_L – 3 kΩ, C_L = 50 pF to 2500 pF, measured from +3V to ¯3V or ¯3V to +3V.		4	30	V/µS
Transmitter Output Resistance	Vdd = V+ = V- = 0V = ±2V	300			Ω
Transmitter Output Short-circuit Current			±10		MA

3.3 Performance Specifications

Table 3-3. Performance Specifications

Modulation	Min	Typ	Max	Units	Notes
Manchester 32	-	6.5	10	cm	Depends on internal gain, antenna-driving frequency, inductor size, Q, series capacitance, transponder size.
Manchester 64	-	8	10	cm	Depends on internal gain, antenna-driving frequency, inductor size, Q, series capacitance, transponder size.
Data Read Rate					
Manchester 32	-	240	-	Byte/second	Decoded byte.
Manchester 64	-	120	-	Byte/second	Decoded byte.

Reading Distances are measured with ISO CARDS. Smaller tags/transponders have smaller reading distances.

4. Packaging Information

4.1 Packaging Dimensions

This chapter illustrates the packaging specifications for the CY8C0104 device, along with the thermal impedances for each package and the typical package capacitance on crystal pins.

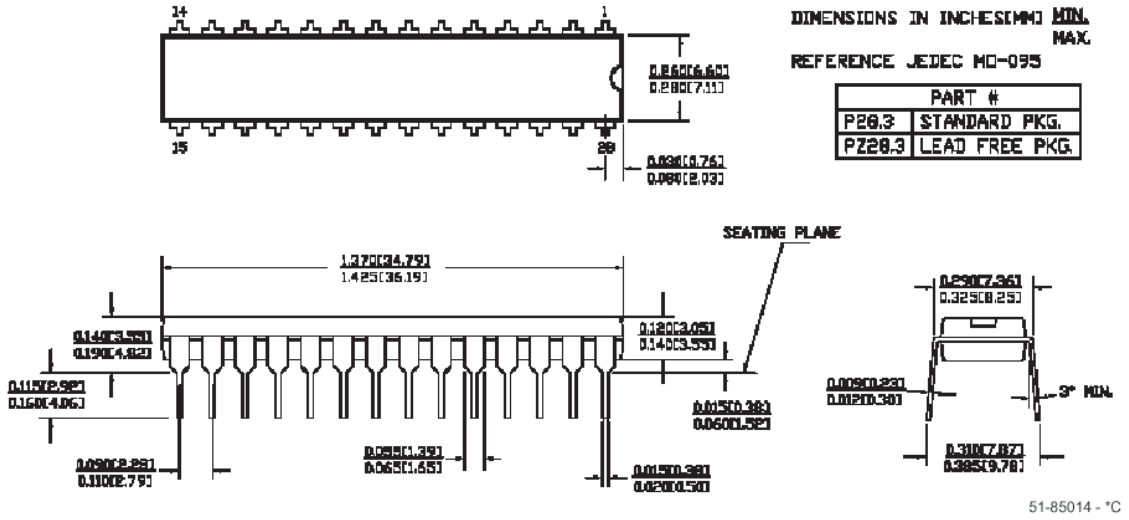


Figure 3-1. Molded DIP

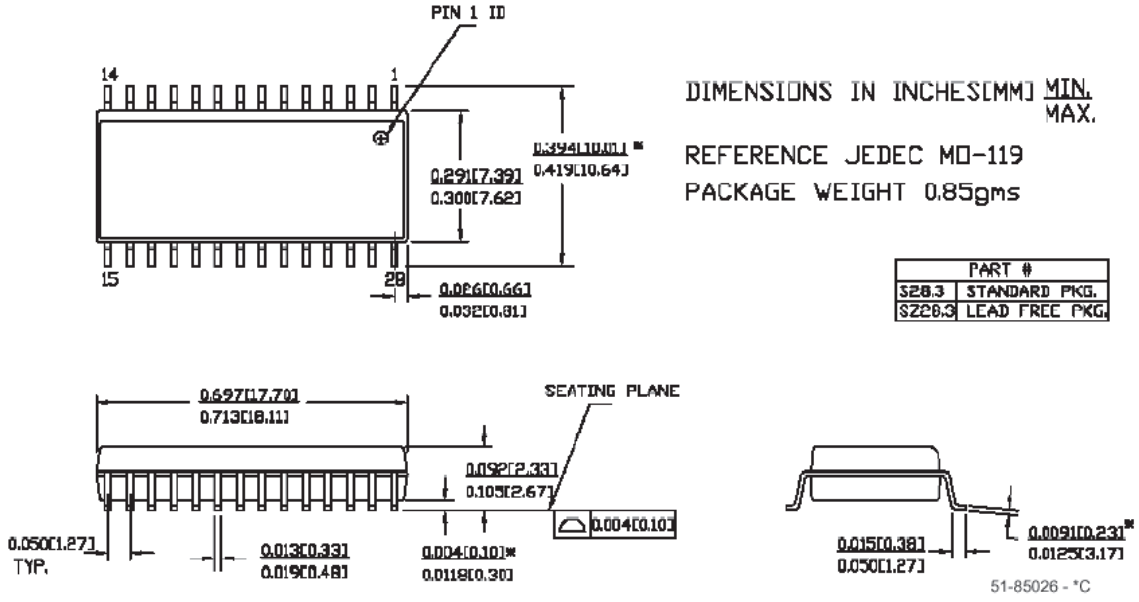


Figure 3-2. SOIC

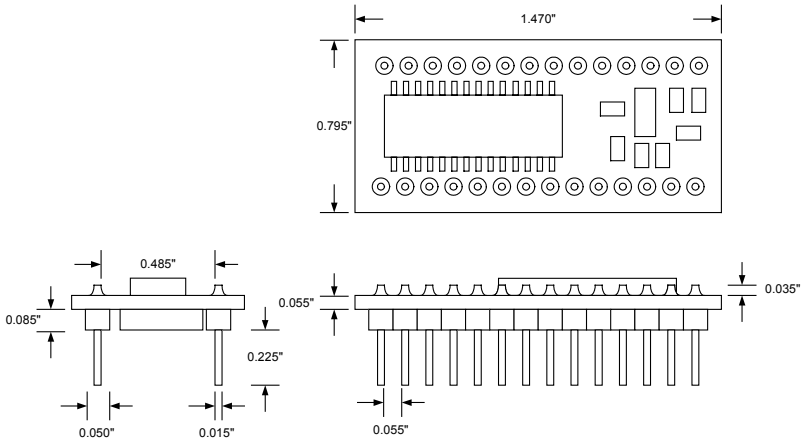


Figure 3-3. ChipModule

4.2 Thermal Impedances

Table 4-1. Thermal Impedances per Package

Package	Typical θ_{JA}*
PDIP	69°C/W
SSOP	96°C/W

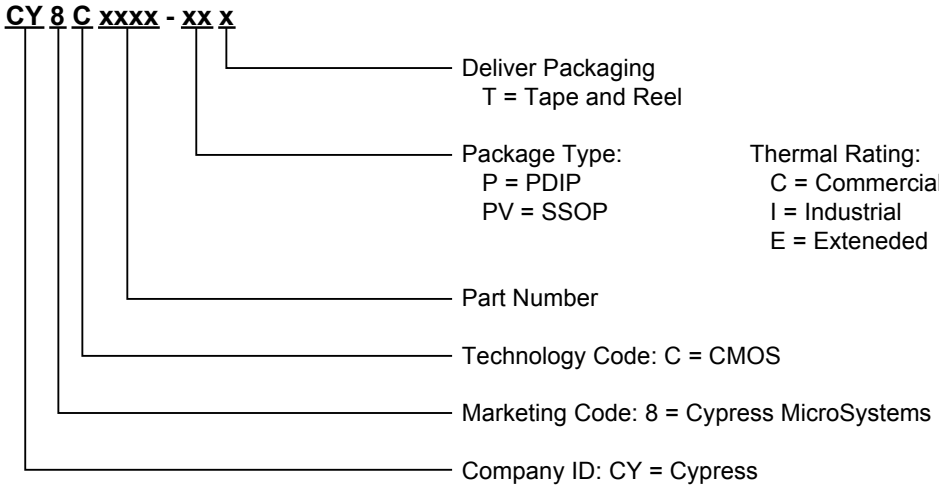
5. Ordering Information

The following table lists the CY8C0104/05 RFID device family features and ordering codes.

Table 5. CY8C0104/05 RFID Device Family Features and Ordering Information

Package	Ordering Code	Flash (Kbytes)	SMP	Temperature Range	Extra GPIO Pins	XRES
DIP	CY8C0104-PI	4	Yes	-40 °C to +85 °C	11	Yes
SOIC (Tape & Reel)	CY8C0104-SIT	4	Yes	-40 °C to +85 °C	11	Yes
SOIC	CY8C0104-SI	4	Yes	-40 °C to +85 °C	11	Yes
SSOP (Tape & Reel)	CY8C0104-PVIT	4	Yes	-40 °C to +85 °C	11	Yes
SSOP	CY8C0104-PVI	4	Yes	-40 °C to +85 °C	11	Yes
ChipModule	CY8C0105	4	Yes	-40 °C to +85 °C	11	Yes

5.1 Ordering Code Definitions



6. Sales and Service information

To obtain information about Cypress MicroSystems or PSoC Sales and technical support, reference the following information.

Cypress MicroSystems
2700 162nd Street SW, Building D
Lynnwood, WA 98037

Phone: 800.669.0557 or 425.787.4800
Facsimile: 425.787.4641
Web Sites: Company Information – http://www.cypress.com
Sales – http://www.cypress.com/aboutus/sales_locations.cfm
Technical Support – http://www.cypress.com/support/login.cfm

SONMicro ELECTRONICS LTD.
Soda Fab yolu.
Sonmez Mer. Fab. Kazanli
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Web Site: Company Information – http://www.sonmicro.com
Support – http://www.sonmicro.com/ask.php
Products – http://www.sonmicro.com/ask.php

6.1 Revision History

Document Title: CY8C0104, CY8C0105 Preliminary Data Sheet				
Revision	**ECN#**	**Issue Date**	**Origin of Change**	**Description of Change**
**		7/23/2004	OJMTMP.	New.
Distribution: External/Public **Posting**: None				

6.2 Copyrights