



Specifications and Data Sheet



The R cubed products primarily serve 3 Industrial applications:

- Tote/Pallet/Carrier identification of your widgets through production
- Automated Guided Vehicles
- Truck/Fleet tracking





Certainly not limited to these 3 applications, the R cubed products excel at any industrial identification need where tough, 100% dependable systems are necessary. R cubed stands for [Rapid, Robust and Reliable](#).

This document contains:

1. Components of an RFID System
2. How to put a Read Station Together
3. Transponder Specifications
4. Read Head/Antenna Specifications
5. Reader Specifications
6. Interface Specifications
7. Programmer Specifications
8. Transponder Programming
9. Customer List
10. Y2K Compliant

The reader of this document need not have an in depth knowledge of Radio Frequency Identification technology as also contained herein is a basic tutorial and explanation as to how RFID, inc's particular technology operates.

1. Functional Summary – 4 Components of an RFID system.

1. a Tag or Transponder , carrying our proprietary EEPROM IC with 16 characters of memory. Once this passive device enters the Read Head's RF field it is powered up and begins transmitting its data.	
2. a Read Head/Antenna , powered by the Reader and linked via 12' of supplied cable, constantly broadcasts an RF signal and waits for a Tag's reply.	
3. a Reader , powering the Read Head, receives the digitally coded Tag data from the Read Head, filters, boosts and digitally transmits the data to the Interface up to 5000' away.	
4. an Interface , simply transfers the signal into an understandable computer language, like serial for a PC port or parallel (binary) for a PLC.	

A Typical RFID System

(To be scanned)

2. Putting Together a Read Station

Some of our products offer a combination of the four components summarized above in a single housing or PCB. For example the Read Head/Antenna and Reader can be combined (Models 1880 and 1885) needing only then to be linked to an Interface. Or the Reader and Interface can be combined (Model 400x series) needing only then to have a Read Head/Antenna attached.

The R cubed systems are also described as being configured either simplex or multiplex. Simplex being a single Read Head/Antenna and Reader per a single Interface, and multiplex being up to 16 addressable Read Heads/Antennas and Readers per a single Interface.

Determining which **Interface and Reader** best fits your needs?

1. What protocol do you desire (Parallel or Serial) from the Interface?

Parallel	Serial
2024E	2002E, 2022E, 3030E, 400xE

2. Do you want each individual Read Station cabled to a single port/computer or decision making device (Simplex)

Simplex	Multiplex
2024E, 2002E, 3030E, 400xE	2024E, 2022E

Determining which **Tag and Read Head** you would like:

1. Mounting Considerations, metallic or non-metallic.

Reader. There is a Read Head that can be mounted directly to metal, Model 5110. Flat Read Heads (5150, 5160, 5170) can be mounted directly to a metal post and still achieve maximum performance however avoid mounting a flat Read Head on a complete surface of metal, that is, covering its entire area. If necessary, space a flat Read Head half its diameter from the flat metal surface to re-achieve the full performance. Models 5100 and 5120 can also be mounted on metal but not screwed into a metal bracket.

Tag. Any Tag Model number followed by an "M" denotes Tags that can be mounted directly to metal. However, any Tag can be mounted to metal using the spacing rule of thumb, one half the Tag's diameter.

2. Read Range, the distance between the Tag and the Read Head. Your needs dictate your choice, but if your read range is needs are flexible and attachment is more important, go directly to Tag Specifications and view the photos. There are read range differences between Readers powered by 24 VDC and 12 VDC. These matrixes assist in defining that choice.

READ RANGES IN INCHES

(24 Volt Systems - 2002, 2022, 2024, 3030)

Read Head	5110	5100	5120	1880 1885	5150	5160	5170	5140
Tag								
1792 1796	4	4.5	5	6	6.5	7	5	--
1782M 1794	3.5	4.5	6	6	6.5	8.5	6.5	--
1781M 1787 1791M	5.5	6.5	9	10	10	13	14	10
1783 1785 1791 1786M	7.5	8.5	9.5	12	12	15	15.5	13
1795	11.5	13	17	18	19	24	26	37

(12 Volt Systems - 4000, 4001, 4002, 4003, 4039)

Read Head	5110	5100	5120	5150	5160	5170	
Tag							
1792 1796	3	3	2.5	4.5	3	--	
1782M 1794	2.5	3	4	4.5	3.5	--	
1781M 1787 1791M	4	4.5	6.5	7	8.5	7	
1783 1785 1791 1786M	5.5	6	6.5	9	10.5	9	
1795	8.5	--	--	--	--	--	

Read Stations Illustrated

It should be noted for Readers and Interfaces, any Model number consisting of only numerics is a PCB level component only with no housing or cabling. The addition of an “E” to any Model number then denotes Enclosure and appropriate cabling.

Simplex Systems

Parallel, BCD protocols

1. Model 2024E Interface + Model 1880E
combo Reader/Read Head



5. Model 3030E Interface + Model 1880E
combo Reader/Read Head



2. Model 2024E Interface + Model 1840E Reader
+ any Model 51xx series Read Head



6. Model 3030E Interface + Model 1840E Reader
+ any Model 51xx series Read Head

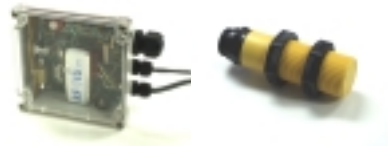


Serial Protocols

3. Model 200E Interface + Model 1840E
combo Reader/Read Head



7. Model 400x series combo Interface/Reader
+ any Model 51xx series Read Head



4. Model 2002E Interface + Model 1840E Reader
+ any Model 51xx series Read Head



Multiplex Systems

Parallel, BCD protocols

8. Model 2024E Interface + Model 1885E
combo addressable Reader/Read Head



Serial protocols

10. Model 2022E Interface + Model 1885E addressable
combo Reader/Read Head



9. Model 2024E Interface + Model 1845E addressable
Reader + any Model 51xx series Read Head







11. Model 2022E Interface + Model 1845E addressable
Reader + any Model 51xx series Read Head



3. General Specifications for all R³ Transponders:



Power:	Passive, no defined term of life
Memory:	8 or 16 alphanumeric characters, 96 bits of data in a hybrid 6 bit ASCII, 128 bits total
Programming:	R/O, WORM, R/W in Q2 2000
Frequency:	148 Khz receive, divide by 4 = 37 Khz return
Transmit Time:	12 to 24 ms
Temperatures:	-60 to +199 degrees C
Read Ranges:	Up to 1 meter, dependent on Tag and Read Head combination used. See the matrixes on page 2.
Packages:	Black Tags are usually potted epoxy in a polyurethane housing White Tags are usually hard plastic shell or laminate
Durability:	All are extremely durable, inert to practically every acid and solution Direct hits from hammers or forklift tong cannot break the potted units



	Model 1781M "Bar Tag" Maximum read range of 14" Potted Two mounting holes	(drawing) 3.5" x .90" x .90" Drawings did not transfer well into a pdf file, ask for drawings to be emailed to you.
	Model 1782M "Mini Tag" Maximum read range of 7" Potted Single mounting hole	(drawing) .73" x 1.72" x .34"
	Model 1783 "Tough Thin Tag" Maximum read range of 15.5" Credit card in size with thick plastic shell Optional 1783H attachment housing pictured	(drawing) 2.13" x 3.38" x .16"
	Model 1785 "Medium Round Tag" Maximum read range of 15.5" Potted Two mounting holes offer very secure attachment	(drawing) .53" x 3.375" diameter
	Model 1786M "Thick Round Tag" Maximum read range of 15.5" Potted Two mounting holes offer very secure attachment	(drawing) 1.19" x 3.35" diameter
	Model 1787 "Lipstick Tag" Maximum read range of 14" Potted Cylindrical housing for in floor mounting	(drawing) 2.3" x .75" diameter
	Model 1791 "Deck of Cards Tag" w/ read range of 15.5" or Model 1791M "Deck of Cards Tag w/read range of 14" Potted, Two mounting holes	(drawing) 2.17" x 4.05" x .55"

	<p>Model 1792 "Poker Chip Tag"</p> <p>Maximum read range of 7"</p> <p>Potted</p> <p>Center hole for mounting</p>	<p>(drawing) 1.25" diameter</p> <p>Drawings did not transfer well into a pdf file, ask for drawings to be emailed to you.</p>
	<p>Model 1794 "Wrist Tag"</p> <p>Maximum read range of 7"</p> <p>Potted</p> <p>Can be affixed to wrist strap</p>	<p>(drawing)</p>
	<p>Model 1795 "AVI Tag"</p> <p>Maximum read range of 37"</p> <p>Potted</p> <p>Two mounting holes</p>	<p>(drawing)</p> <p>6" diameter</p>
	<p>Model 1796 "Quarter Tag"</p> <p>Maximum read range of 7"</p> <p>Plastic shell</p> <p>Secure by epoxy or double sided tape</p>	<p>(drawing)</p> <p>1" diameter</p>

4. Read Head/Antenna Specifications:

Inductance:	mH +/-2% @ 10 kHz
Temperature:	-60 to +199 degrees C
Resistance:	3 to 8 ohms max., dependent on Model
	Self Resonant
Frequency:	400 to 650 kHz, dependent on Model
Packages:	ABS, Ultradur, Noryl, PVC, Ployurethane Encapsulant
	All Read Heads are sealed and watertight
Connector:	3 pin male receptacle mates with Model 5100A1 Cable
Cabling:	12' recommended as attenuated with capacitance on Reader, 1' to 30' can be customized

	<p>Model 5100 "Medium Prox" Read Head</p> <p>Threaded proximity sensor type package</p> <p>Hex nuts for securing</p>	<p>(drawing)</p>
	<p>Model 5101 "Small Prox" Read Head</p> <p>Threaded proximity sensor type package</p> <p>Hex nuts for securing</p>	<p>(drawing)</p>

	<p>Model 5110 “Hockey Puck” Read Head</p> <p>Mountable on metal</p> <p>Several mounting holes</p> <p>Highly rugged</p>	<p>(drawing)</p> <p>Drawings did not transfer well into a pdf file, ask for drawings to be emailed to you.</p>
	<p>Model 5120 “10.5” Tubular” Read Head</p> <p>Highly rugged</p> <p>Potted in PVC</p>	<p>(drawing)</p>
	<p>Model 5140 “4’x2’ Extended Range” Read Head</p> <p>Sealed in PVC</p> <p>Bury in the ground or stand up at gate for use in Automatic Vehicle Identification applications</p>	<p>(drawing)</p>
	<p>Model 5150 “7x7 Flat Pack” Read Head</p> <p>Sealed in ABS plastic</p> <p>Multiple mounting possibilities</p>	<p>(drawing)</p>
	<p>Model 5160 “12x12 Flat Pack” Read Head</p> <p>Sealed in ABS plastic</p> <p>Multiple mounting possibilities</p>	<p>(drawing)</p>
	<p>Model 5170 “21x17 Flat Pack” Read Head</p> <p>Sealed in ABS plastic</p> <p>Multiple mounting possibilities</p> <p>Perfect for underside of Forklift</p>	<p>(drawing)</p>

5. Reader Specifications

Connectors:	Angle entry terminal strips on PCB Cable glands on Enclosure	Current:	Simplex: 200 mA (max) 150 mA (typ) Multiplex: Enabled 200 mA (max), 150 mA (typ) Disabled 30 mA (max)
Voltages	Simplex: Regulated DC Supply +18 to +32 V Regulated AC Supply 24V (+10/-20%) RMS 47-63 Hz Multiplex: Regulated DC Supply +18 to +32 V	Output:	75 ohms, balanced
		Temperature:	Operating -40 to +55 degrees C Non-Operating -55 to +85 degrees



Model 1840E Simplex Reader
FCC Approved
Approximate size is 4.75" x 4.75" x 2"



Model 1845E Multiplexing Reader
FCC Approved
Addressable
Approximate size is 4.75" x 4.75" x 2"



Model 1841E Dual Reader (handles 2
non-addressable Read Heads)
FCC Approved
Approximate size is 8" x 6" x 3"

Combination Read Head and Reader

These "combo" Readers offer a Read Head etched into their PCB, negating the need for an external Read Head. Needing to be linked only to an Interface this forms a two piece Read Station Solution.



Model 1880E Combo Simplex Reader/Read Head
FCC Approved



Model 1885E Combo Multiplex Reader/Read Head
FCC Approved
Addressable

6. Interface Specifications

Model 2002E Simplex serial Interface

Model 2022E Multiplex serial Interface

Full-duplex, asynchronous data stream

RS-232-C, RS-422-A, configured DTE

Stop and parity bits selectable

110-19,200 baud rate

Three Operating Modes

Mode 1 Direct Single Report upon read

Mode 2 Polled for read data

Mode 3 Direct Multiple Report upon read

Buffered read storage:

4 readings for the 2002E, 2 reading for the 2022E

Protocols and modes selectable through commands

or via pins and shunts on PCB

Many other commands available

Connectors DB-25S, DIN 41612 Type C

Control Signals DSR, CTS, DTR

Compatible to all Readers, wired via twisted pair

Temperature range -40 to +55 degrees C operating

-55 to +85 degrees C non-operating

Power: 2002E = 5VDC (+/-5%) @ 250 mA maximum

2022E = 5VDC (+/-5%) @ 350 mA maximum

CRC algorithm allows 1 in 10 to the 14th errors



Packaged in a finned metal enclosure

Model 2024E Simplex or Multiplex BCD/Hex Interface

Addressable, ideal for use with a PLC

Binary coded decimal (BCD) or hexadecimal

Sixteen 24 volt data lines, current-sourcing

LED's for each line indicate signal status

Hand shaking lines

Three Operating Modes for Tag reporting

Mode 1 Simplex, 16 bits data in 4 hex characters

Mode 2 Multiplex, 12 bits data in 4 hex characters + a 4 bit address

Mode 3 Multiplex polling, 12 bits data in 4 hex characters + a 4 bit address

Stores up to 8 readings

Connection by Screw Terminals, 9 pin RS-232-C

Compatible to all Readers via twisted pair

CRC algorithm allows only 1 in 10 to the 14th errors

Power by 24 VDC +/-25% @ 150 mA max

Input impedance 10 Kohms

Input level low of 0 to 10 volts

Input level "high" of 15 to 24 volts

Protected against polarity reversal

Output leakage current level "low" of 0.1 mA max

Output voltage "high" of Vsupply -1.5 V minus (I_L <=100 mA)

Output current level "high" is current limited, 100 mA (max, single line)

Protected against load short circuit

Packaged in hardened sheet metal

Mountable into standard industrial racks

Temperature: -40 to +55 degrees C operating

-55 to +85 degrees C non-operating



Model 3030E Simplex LCD Interface
Specifications same to Models 2002E and 2022E except:
Connectors:
 6 pin circular DIN for Reader (included)
 5 pin circular DIN for power (included)
 DB25 pin serial port
Power: 110 VAC wall mount supply
Temperature: -40 to +55 degrees C operating
 -55 to +85 degrees C non-operating



Note: Power wiring for Models 2002E, 2022E, and 3030E;
 5 VDC can be wired directly to Interfaces and 24 VDC directly to Readers OR
 a dual power supply can be used to wire 5 VDC to Interface and 24 VDC through the Interface to Readers.
Power wiring for all Models requires use of regulated power supplies for maximum results, linear power supplies are rated as acceptable. Linear power supplies may not be used.

Model 3035E Hand Held Reader

This very basic piece is designed for testing Tags, displaying Reads on its high resolution display, when tags cannot be removed or brought to a Read Head. It operates stand alone with no memory.

5 pin DIN serial port
9.6 VDC Internal NiCad battery allows 10 hours continuous use
AC charger included plugs into serial port charges in 4 hours
“Power On” and “Valid Read” LED’s, Audio signal upon read
Protocol of Half-duplex, 8, N, 1, 9600
DTE configured, signal lines of Tx/D, Rx/D, GND
Temperature: -40 to +55 degrees C operating
 -55 to +85 degrees C non-operating



Combination Interface and Reader Model 400x (four thousand) series

This Interface/Reader combo unit requires only a Read Head to complete the system. Operating at 12 VDC these do offer a slightly lesser read range in a more convenient 2 piece Read Station solution. Although Models 4003E and 4004E operate on an input of 24 VDC, this is ramped down to 12 VDC for operation and thus mimics the read range specifications of its sister units.

Model Number	Distinguishing Features
4000E	RS-232-C, 16 character standard Tag, 12 VDC (8-14 VDC) @ 350 mA max
4001E	RS-422-A, 16 character standard Tag, 12 VDC (8-14 VDC) @ 500 mA max
4002E	RS-232-C, for 8 character Tag, 12 VDC (8-14 VDC)
4003E	RS-232-C, for 8 character Tag, 24 VDC (18-28 VDC) with automatic reset fuse and voltage protection
4004E	RS-422-A, 4 character Tag, 24 VDC
4039E	Bar Code Emulator, Code 39, UPS-A, EAN-8 & 13, Interleaved 2 of 5 12 VDC (8-14 VDC) @ 350 mA max



The 4 and 8 character Models 4002E and 4003E are designed to achieve reads at very high speeds, actual Tag speeds to 100 mph. Processing speeds from Tag to serial port are:

Models 4002E, 4003E, 4004E worst case is 23.4 ms and best case is 11.7 ms

Models 4000E, 4001E, 4039E worst case is 46.7 ms and best case is 23.4 ms

Common specifications:

Half-duplex asynchronous with or w/o handshaking, DTE configure

110-9600 selectable data rate, to 19,200 for Model 4004E

Single read or Multiple reads Direct Report Modes

7 bits with even or odd parity, 7 or 8 bits with no parity selectable

Protocols selectable via pins/shunts on PCB or through commands

Signal lines of TxD, RxD, CTS, RTS, DTR

Connection via angle entry terminal strip

Temperature:

RS-232-C operating -40 to +55 degrees C

RS-422-A operating 0 to +55 degrees C

Both non-operating -55 to +85 degrees C

Packaged by watertight polycarbonate

CRC algorithm allows only 1 in 10 to the 14th errors

Automatic power up and self test message

Approximate size is 4.75" x 4.75" x 2"



7. Specifications for Programmer/Hand Held Reader Model 3036E

This Programmer operates stand alone, without the use of a PC, via AC connection or by use of batteries.

No software is required to program Tags

No future software upgrades are needed

No Y2K concerns

Saves the cost of a PC dedicated to programming

Large programming pad area

LCD screen

Automatic number generator for sequential programming

Temperature: -40 to +55 degrees C operating

-55 to +85 degrees C non-operating



8. Tag Data and Programming

With the serial Interfaces, data is sent back to a serial port in the following format: <LF>n<CR>, where variable n represents data. If a multiplex system is being used the Tag data is preceded by a hexadecimal character indicating the Read Station and a space character. If you intend to have Tags programmed at our factory, please fill out a programming sheet, contained herein with instructions. Tag orders cannot be accepted until this sheet has been filled out and submitted. This sheet can also be accessed on our web site under the R³ link.

With the parallel Interfaces, data is sent back in a binary format: 0000 0001 0111 1111 represents 17F as the first 4 digits are reserved for multiplex addresses if applicable.

These instructions have been made for the purpose of helping our users to order the correct programming information on their RFID Tags. When you order a Tag from us we will ask you to supply the programming numbers you wish to be encoded into the Tag's memory.

Tags have a memory that contains 16 characters. All 16 of those characters must be used. It is a common misbelief that if you want the identification number 99 (ninety-nine) all you need to tell us is “99.”

Not so. We need to know how to fill in the remaining 14 characters. Most users simply desire zeros to be filled into the unused characters. Others require dashes. We also need to know whether or not you desire e number 99 to be right, left or center justified.

For example, right justified is:

000000000000000099

Left justified is:

990000000000000000

Center justified is:

0000000990000000

Tags intended for use with our Model 2024E Parallel Interface must be right justified and limited to 4 characters in the simplex mode and 3 characters in the multiplex mode, 0 thru 9 and A thru F.

If you are a current user and do not know the exact programming format your company uses, ask an engineer or technician who works with our equipment. Once you learn this, please keep it in min or noted somewhere for future orders. If you have ordered direct from RFID before, our customer service department can look up your last order and help you determine what programming format to use.

Following is a programming sheet you also need to fill out, sign, and remit with your order.

Note, users of 8 character Tags, please specify on your order that you require 8 character programming by adding a “(8)” to the end of our Model Number or Part Number. For example, our Model 1792 Tag should be ordered as a 1792(8). Also please fill out the programming sheet filling in only 8 characters. For example the number 99 right justified would be 00000099.

Transponder Programming Sheet

Customer name: _____ P.O # _____

Completed by: _____

Unspecified characters filled with: _____ Tag Model # _____

[illegible]

Customer Signature: _____ Date: _____

9. Customer List

We are proud to disclose the following as current and satisfied users of our R³™ products.

Alcoa	Magic Chef
Amana	Maytag
AT&T/Lucent	Motorola
BAE Automation	Nippon Steel
Boeing Corporation	Osh Kosh B'Gosh
Cal Poly State University	Penn State University
Caterpillar	Sandia National Labs
CEI Automation	Schick Shaving Products
Charbroil	Sears
Cutler Hammer	SI/Baker & SI/Handling Systems
Eastman Kodak	Square D Company
Eckard Drug	Stanley Tools
Eglin AFB	Sunx
EI DuPont	TAVA/Topro Technologies
Estee Lauder	Toyota
Ford Motor Company	Texas Instruments
Frigidaire	The Denver Post
General Electric	The Boston Globe
General Motors	TRW
Georgia Tech. University	Veteran's Administration
Inland Steel	Walgreens
Kellogg's Cereal	Walt Disney amusement parks
Los Angeles Times	Whirlpool
London Heathrow Airport	

10. Year 2000 Compliant

RFID, inc. warrants its Radio Frequency Identification products are free and unencumbered by the year 2000 issue. RFID, inc. agrees to indemnify and hold harmless its buyers or their customers for any losses or damages caused by our systems and related to the year 2000 issue.

All of our Readers/Interfaces output up to 16 alphanumeric characters (transponder data), led by a line feed and followed by a carriage return. No time and date data is carried in our transmissions, ergo the year 2000 issue is a moot concern for our systems.



3538 Peoria Street Suite 505 Aurora, CO 80010
p 303-366-1234 f 303-366-1222 www.rfidinc.com email: info@rfidinc.com