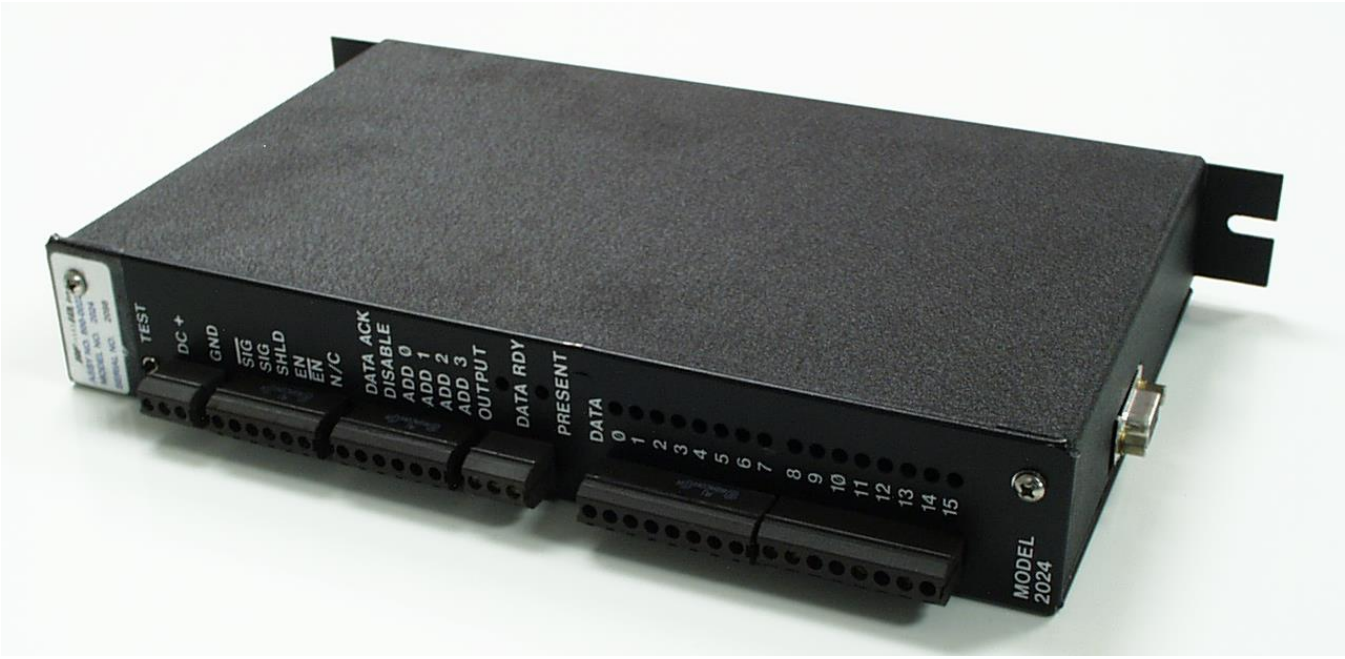
Installation & Operations Manual

Parallel BCD Interface

Model 2024E

Part Number 800-0022-01



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R^3 148 KHz Model 2024E

Product Description

The Model 2024E acts as an Interface multiplexing up to 16 RFID, Inc. Addressable 148 KHz low frequency RFID Readers and outputs Transponder (Tag) data via parallel 24-volt logic (PNP transistor) outputs, also termed presenting the Tag data in a BCD (binary coded digital) format. These outputs interface directly to the 24-volt inputs used by many common Programmable Logic Controllers (PLCs). Additional 24-V logic control lines provide for data transfer control (handshaking) with the PLC. Each logic output state is indicated by an LED on the front panel. There is a total of 16 Tag data bits arrayed into 4 hex bytes (characters 0-9 + A-F) when used with non-addressable Readers and 12 Tag data bits arrayed into 3 hex bytes when used with addressable Readers plus 4 bits (1 hex byte) for Reader address. An RS-232 port is available for off-line use to set up the operating mode and other nonvolatile system parameters.

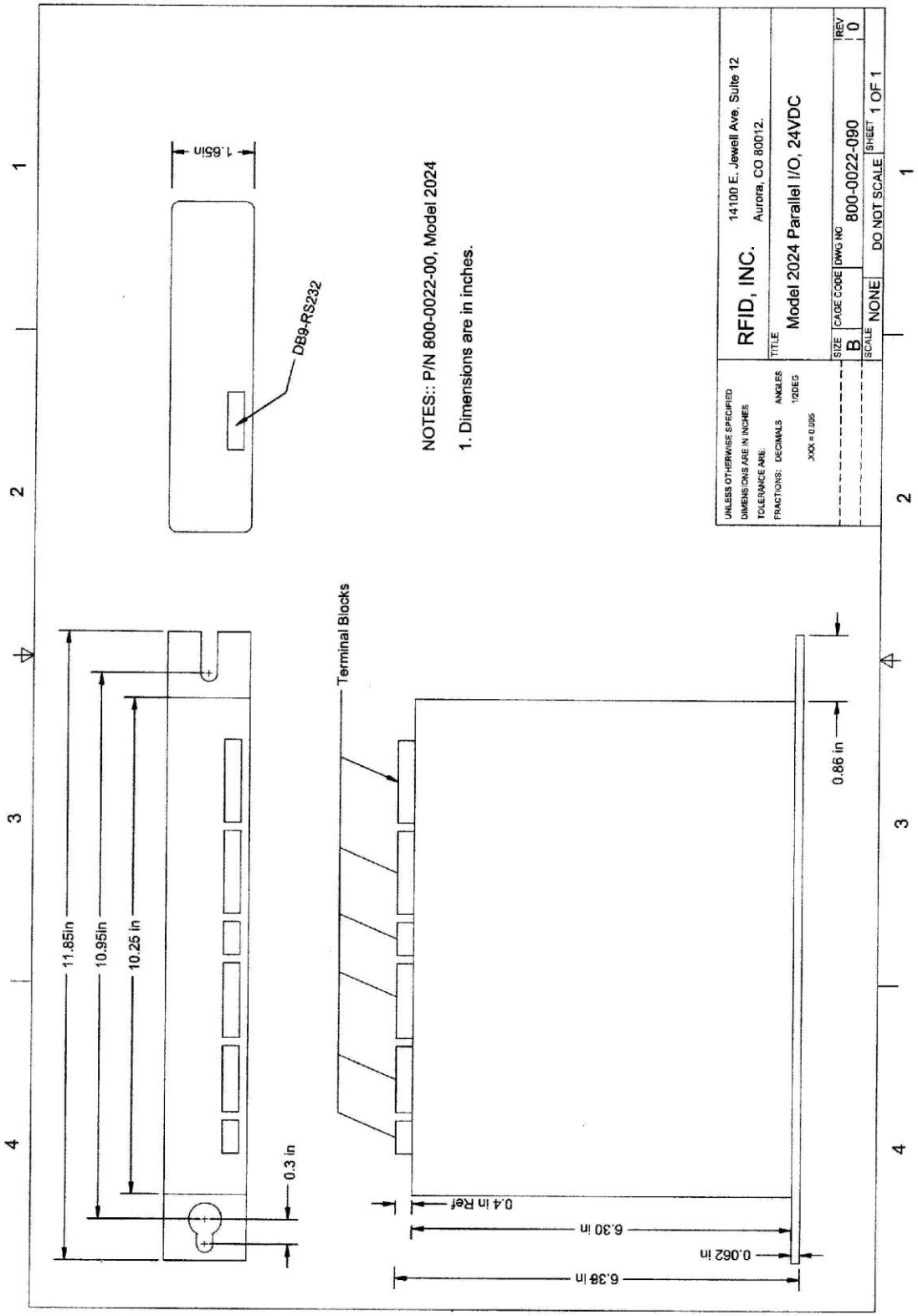
Product Part Numbers & Accessories

Part Number	Description
800-0022-01	Model 2024E Interface, supercedes as a drop in replacement for 800-0022-00
800-0005-00	Model 1840E Reader, non-addressable, necessitates an external Antenna
800-0018-00	Model 1845E Reader, addressable 0-15, necessitates an external Antenna
719-0013-00	Model 5100 Yellow Prox Tubular Antenna
719-0013-01	Model 5101 Small Yellow Prox Tubular Antenna
719-0015-00	Model 5110 Hockey Puck Antenna
719-0016-01	Model 5120 White PVC Tubular Antenna
719-0026-00	Model 5150 7” square Flat Pack Antenna
719-0027-00	Model 5160 12” square Flat Pack Antenna
800-0006-00	Model 1880E Reader/Antenna combo, non-addressable, does not necessitate an external Antenna
800-0011-01	Model 1885E Reader/Antenna combo, addressable 0-15, does not necessitate an external Antenna
720-0008-11	Model PS24PTR AC adaptable Power Supply w/10’ pigtail wiring, 24vdc, 500mA

Specifications

Enclosure	Carbon Steel, 0.062 wall w/mounting ears
Dimensions	11.85 in x 6.36 in x 1.65 in
Output Protocol:	Binary Coded Digital via 24v logic control lines
RS232 (setup only)	Half Duplex, DTE, 9600 baud, 8 data bits, parity - none, stop bits - 1, flow control - none
Data Storage:	1 Tag read within user defined Present timeout setting
Serial Connectors:	9 pin D-SUB Female
Power	24vdc nominal, maximum 30vdc, minimum 18vdc
Current	150 mA (outputs disconnected)
Operating Temperature	-20c to +55c
Non-operating Temp	-40c to +70c
Humidity	0 to 90% (non-condensing)

Model 2024E Drawing



Electrical Connections

In the following specifications, typical values are specified at 25 degrees Celsius. Unless otherwise noted, maximum and minimum values are specified over the operating temperature range.

Power Connections

Name	Description
DC+	24-V DC power input
GND	Ground, DC power return

Between Reader Interface

Name	Description
/SIG	Signal return from Reader
SIG	Signal from Reader
SHLD	Optional cable shield connection
EN	Reader enable +
/EN	Reader enable -
NC	Not connected

Volt Logic Control/Address Inputs

Name	Description
DATA ACK	Data acknowledge
DISABLE	Disable data outputs
ADD 0	Reader address bit 0 (lsb)
ADD 1	Reader address bit 1
ADD 2	Reader address bit 2
ADD 3	Reader address bit 3 (msb)

Input electrical characteristics:

Impedance:	10 Kohms (to GND)
Input Level “0”	0 to 0.4 Vsupply
Input Level “1”	0.65 Vsupply to Vsupply

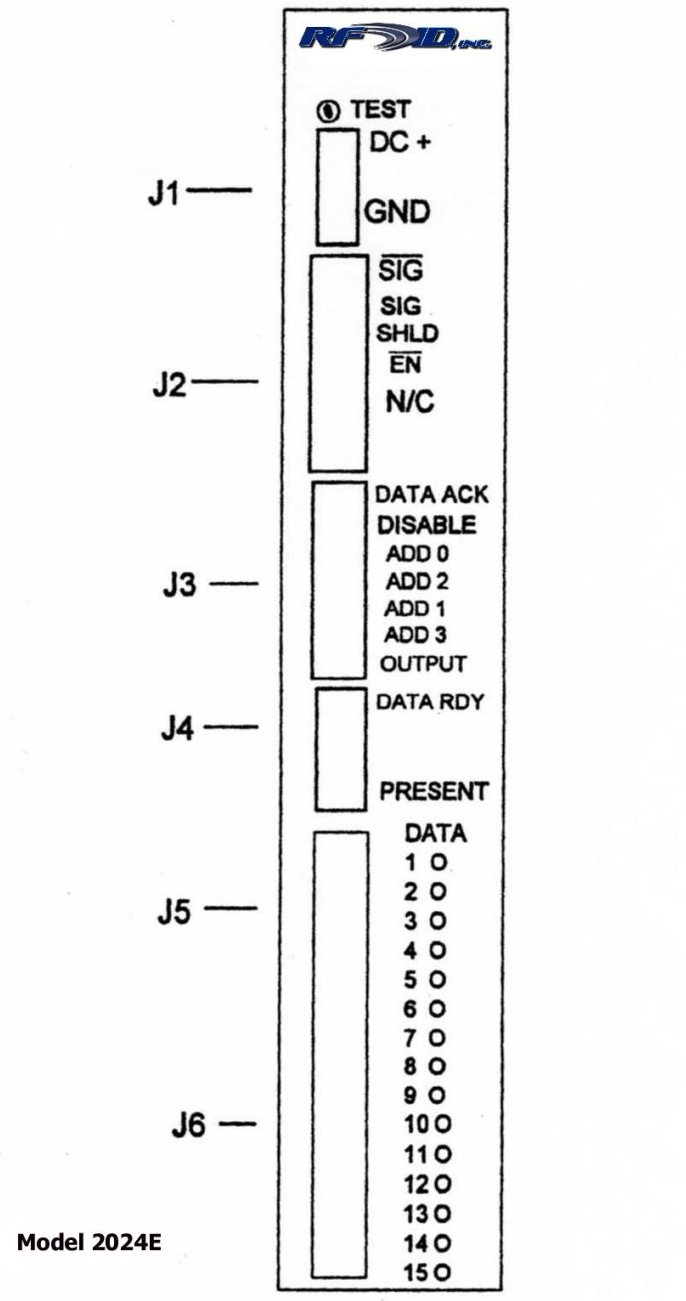
Logic Control Outputs

The outputs are open collector PNP Darlington transistors. (See Fig 6-1 next page).

Name	Description
DATA RDY	Data outputs ready
PRESENT	Transponder present at Reader

Output electrical characteristics:

State	Parameter	Condition	Value
Logic 1	Vout	I < 100 mA	Vsupply -1.5 V(min)
Logic 0	I	0.1 mA (max)	

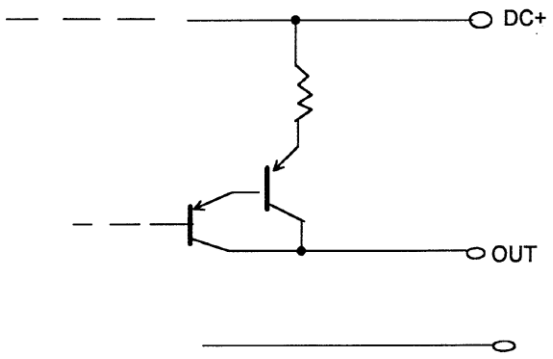


Logic Data/Address outputs (24-Volt)

The outputs are open collector PNP Darlington transistors. (See Fig 6-1)

Name	Description
DATA 0	Data bit 0 (least sig. bit)
DATA 1	Data bit 1
DATA 2	Data bit 2
DATA 3	Data bit 3
DATA 4	Data bit 4
DATA 5	Data bit 5
DATA 6	Data bit 6
DATA 7	Data bit 7
DATA 8	Data bit 8
DATA 9	Data bit 9
DATA 10	Data bit 10
DATA 11	Data bit 11
DATA 12	Data bit 12/Add bit 0 *
DATA 13	Data bit 13/Add bit 1 *
DATA 14	Data bit 14/Add bit 2 *
DATA 15	Data bit 15/Add bit 3 *

FIG 6-1



24 VOLT LOGIC OUTPUT

* DATA 12 - DATA 15 outputs are used for Reader Address when operating in modes which multiplex Readers.

Output electrical characteristics:

State	Parameter	Condition	Value
Logic 1	Vout	I < 100 mA	Vsupply - 1.5 V (min)
Logic 0	I	0.1 mA (max)	

RS-232 Port

An RS-232 interface is provided at the 9-position female D connector located at the bottom of the Interface. Signals are assigned as follows:

Pin	Signal	Direction
1	(open)	-
2	RX	input to Interface
3	TX	output by Interface
4	DTR	output by Interface
5	GND	-
6	(open)	-
7	RTS	output by Interface
8	CTS	input to Interface

The communications parameters are fixed and have the following values:

Half-duplex, DTE
9600 baud, 8 data bits, no parity, 1 stop bit
DTR output true when power applied to Interface
RTS output true when transmitting
CTS input ignored

Operating the Interface

Setup (Test) Mode

Setup mode provides a means to program the Interface operating mode and set other nonvolatile system parameters. In setup mode the Interface is assumed to be connected to a terminal program via the RS-232 port.

To put the Interface in Setup mode, activate the "Test" switch while powering up the Interface. The Interface will send out the currently effective command string which is stored in the Interface's onboard nonvolatile EEPROM memory, followed by a question mark prompt. The prompt signifies that the RS-232 interface is enabled and a new command string may be entered.

The following command is available in Setup Mode:

Command: Assign Operation Configuration

Command:	<LF> M <mode> <present timeout> <address map> <CR>
Response:	M <mode> <present timeout> <address map> <LF> <CR>

<mode>	=	'1' '2',or '3'
<present timeout>	=	hh
<address map>	=	hhhh
h	=	h is a variable for any ASCII hexadecimal character 0-9 + A-F
<CR>	=	ASCII carriage return = OD (hex)
<LF>	=	ASCII line feed = OA (hex)

Definitions: (See operating mode descriptions for more details on the following.)

<mode>	The operating mode.
<present>	The time, in units of 25ms, for which the PRESENT output will remain true after transponder detection.
<address map>	Hexadecimal representation of a two-byte bit-mapped Reader activation specification. A logic "1" of a given binary weight instructs the unit to activate a Reader address. The most-significant bit corresponds to Reader address 15.

EXAMPLE: Program for Mode 2 operation, with a two-second PRESENT delay, in a system using Readers 0, 1, 2, 7, 12.

<mode>	=	2
<present>	=	(2 sec)/(0.025 sec) = 80 (decimal)
	=	50 (hexadecimal) since 80 = 5*16 + 0
<address map>	=	found by bit mapping the desired Reader status: (1 = on, 0 = off)

Reader #	15 14 13 12	11 10 9 8	7 6 5 4	3 2 1 0
Status:	0 0 0 1	0 0 0 0	1 0 0 0	0 1 1 1
(hexadecimal)	"1"	"0"	"8"	"7"

therefore <address map> = "1087"

Combining the above results, the command string is:

<LF>M2501087<CR>

and the response string from the unit is:

M2501087<LF><CR>?<LF><CR>

Operating Modes

The Interface operates in any of three modes: 1 2, or 3.

Mode 1: Single Reader Direct Report Mode. The Interface connects to a single Reader, and reports a 16-bit transponder number upon reading a Tag.

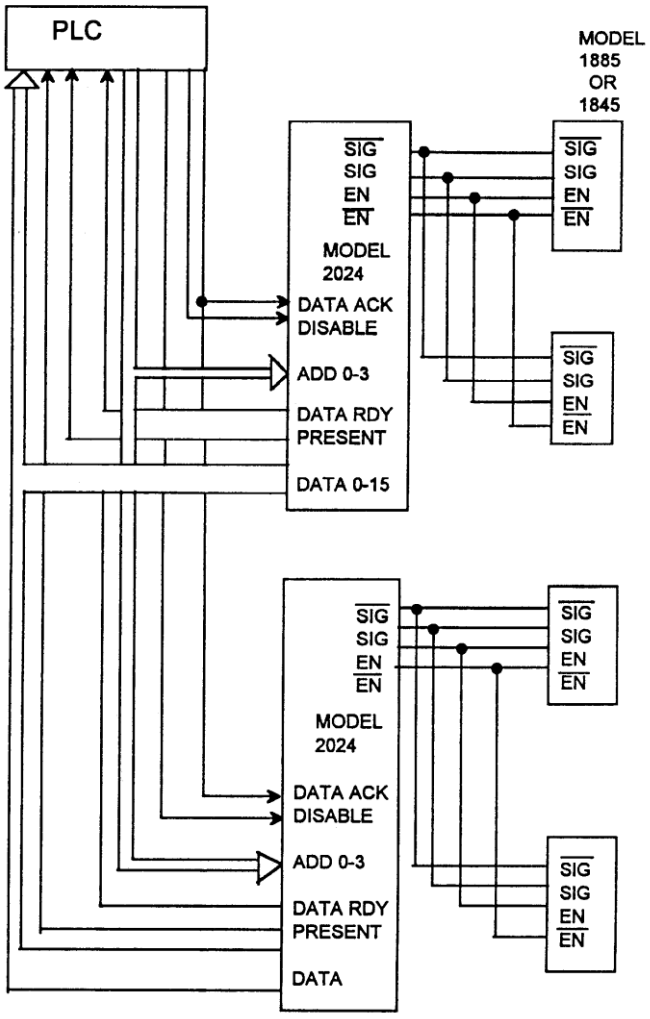
Mode 2: Multiple Reader Direct Report Mode. The Interface multiplexes up to 16 Readers, and reports a 12-bit transponder number and a 4-bit Reader address upon reading a Tag.

Mode 3: Multiple Reader Polling Report Mode. The Interface multiplexes up to 16 Readers, and reports a 12-bit Tag number and a 4-bit Reader address. Reports are made in response to a poll generated by the host PLC.

If the Interface powers up with switch S1 not activated, it will begin operating in the previously assigned mode during Setup above or in the factory default mode if not yet set.

Figure 7-1 illustrates the signal wiring for one PLC connected to two Interfaces operating in Mode 3. In Mode 1 and 2 operation, the connections to the ADD 0 - ADD 3 lines may be omitted. In Mode 1, each Interface can only interface to one Reader. In any of the modes, if only one Interface is connected to the PLC, then the DISABLE connection may be omitted.

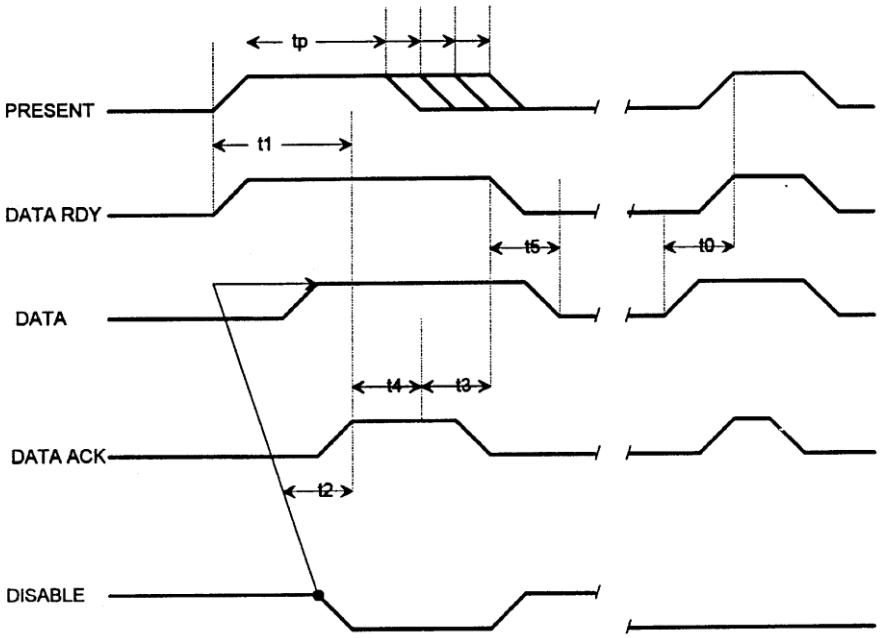
FIG 7 - 1



Mode 1 Operation: Single Reader Operation

In Mode 1, the Interface connects to a single Reader. The Interface continuously monitors the Reader's signal until a Tag is detected. When a valid Tag is detected, a counter (the "PRESENT" timeout) is initialized which decrements to zero in steps of 25 milliseconds from the initial value defined in SETUP mode. If the Tag data differs from the last previously reported Tag data, or if the PRESENT timeout from the previous detection of the same number has expired, then the Tag data is determined to be reportable, and a new data report is initiated by the Interface (see Fig 7-2. below). If the Tag data matches the last previously reported data and the timeout has not expired, no Tag report is generated.

FIG 7 - 2



MODE 1 AND MODE 2

Min	Max	Units
t0	---	250 microseconds
t1	---	---
t2	---	---
t3	---	1.0 milliseconds
t4	5.0	---
t5	---	1.0 milliseconds
tp	---	(programmable)

To initiate a report, the Interface first outputs the Tag data on the DATA lines. Only after all the DATA lines are stable is the DATA RDY signal asserted, indicating that data is available on DATA outputs. At the same time the PRESENT signal is output, indicating that the information is current. While waiting for the host to acknowledge the report, the Interface continues to count the elapsed time in units of 25 milliseconds. If the timeout expires before the DATA ACK line is raised, the PRESENT output is cleared to zero. Note that the Interface does NOT resume monitoring the Reader signal until the report is acknowledged by the host.

The Tag data reports consist of binary representations the last four hex (or Decimal) characters programmed into the Transponder.

Example: 16-character Tag programmed with following string:

Transponder data = "0000000000001B25"

DATA 0 - DATA 15 OUTPUTS

bit #	15 14 13 12	11 10 09 08	7 6 5 4	3 2 1 0
state	0 0 0 1	1 0 1 1	0 0 1 0	0 1 0 1
char.	"1"	"B"	"2"	"5"

Transponders must be programmed with hexadecimal numeric characters in the last four positions to produce meaningful outputs.

Summary of Mode 1 Control Signals:

Outputs:

DATA RDY: Set to Logic 1 immediately after a reportable Tag has been detected. Clear to Logic 0 after 1-to-O transition of DATA ACK (if DISABLE=0)

PRESENT: Set to Logic 1 with DATA RDY. Cleared to 0 after either a 1-to-O transition of DATA ACK (DISABLE=0) or the persistence timeout has elapsed (independent of DISABLE), whichever occurs first.

DATA n: Transponder data. Guaranteed stable while (DATA RDY=1) and (DISABLE=0). Hardware gated to Logic 0 when DISABLE=1. Software cleared to Logic 0 after 1-to-O transition of DATA ACK.

Inputs:

DATA ACK: Data strobe output by PLC in response to DATA RDY signal from Interface. Pulse width must exceed specified minimum duration. See timing diagram (Fig 7-2).

DISABLE: Directly disables DATA outputs of Interface in hardware. This may be left open circuited for single Interface Operation.

ADD n: (input) not used (ignored by Interface)

Mode 2 Operation: Multiplexed Readers, Sequential Transfer

In Mode 2, the Interface multiplexes up to 16 addressable Readers. The Interface time-share multiplexes Readers according to the Reader Address Map stored in its nonvolatile memory. Beginning with the lowest Reader address, each assigned Reader is activated in turn for a duration of approximately 50 milliseconds. The cycle repeats after the last Reader has been activated.

Data reports are initiated upon Transponder detection as in Mode 1, except that the Reader address at which the Transponder was detected is output as the four most significant bits of the DATA outputs. The PRESENT signal is set to Logic 1 when DATA RDY is set true, and remains true until the data is accepted with the DATA ACK signal, or the PRESENT timeout has elapsed, whichever occurs first. (A separate timeout is maintained for each Reader address.)

The Interface reports Transponder data in the order in which the transponders are read. The Interface halts reading operations on all Readers while the DATA RDY output is true.

Example: 16-character tag programmed with the following string is detected at Reader #7:

Transponder data = "0000000000000B25"

DATA 0 - DATA 15 OUTPUTS

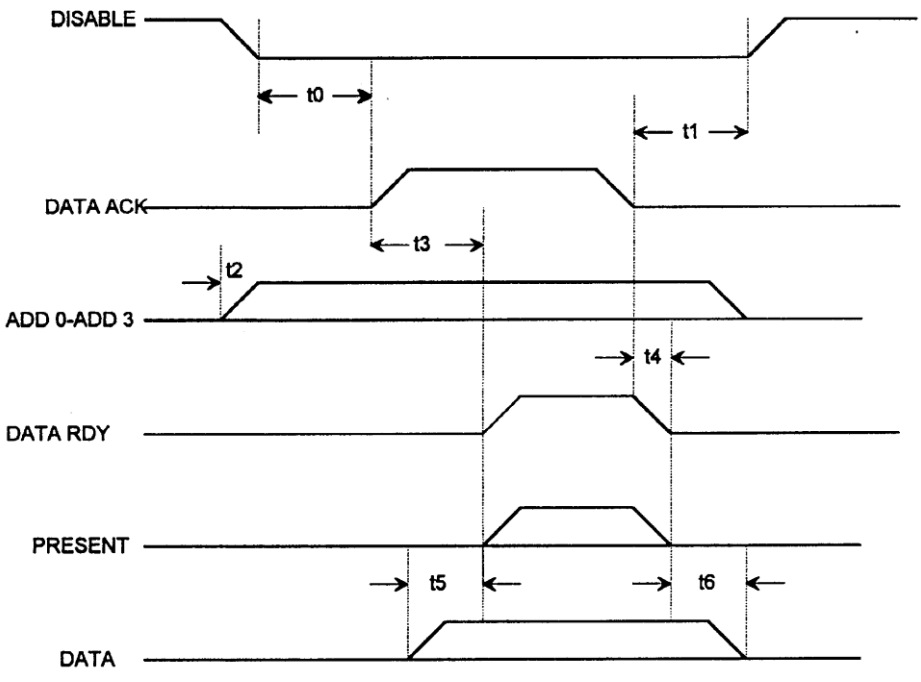
bit #	15 14 13 12	11 10 09 08	7 6 5 4	3 2 1 0
state	0 1 1 1	1 0 1 1	0 0 1 0	0 1 0 1
char.	(READER 7)	"B"	“2”	“5”

Transponders must be programmed with hexadecimal numeric characters in the last four positions to produce meaningful outputs.

Mode 3 Operation: Multiplexed Readers, Requested Transfer

In Mode 3, the Interface multiplexes addressable Readers as in Mode 2. Readers are polled by the Interface sequentially. Transponder reports are generated in response to address information presented to the Interface's ADDRESS inputs and a strobe signal sent to the Interface's DATA ACK input. Data outputs are assigned as in MODE 2: DATA 0 - DATA 11 are binary Transponder data, while DATA 12 - DATA 15 echo the Reader Address input from the host PLC. Refer to Fig 7-1 for interface wiring diagram. Refer to Fig 7-3 for timing.

FIG 7-3



MODE 3

Min	Max	Units
t0	2.0	--- microseconds
t1	---	--- ---
t2	1.0	--- milliseconds
t3	---	25 milliseconds
t4	---	--- ---
t5	10	500 microseconds
t6	10	500 microseconds

Unlike Modes 1 and 2, in Mode 3 the Interface continues to monitor Reader signals during the data exchange on the Interface with the host.

Outputs:

DATA RDY:	Set to Logic 1 under following conditions: (DISABLE=0) and (DATA ACK=1)
PRESENT:	Set to Logic 1 if DATA RDY=1 and the reported Transponder at the requested Reader had been detected within the timeout period. Not affected by DISABLE input.
DATA n:	Transponder data. Guaranteed stable while (DATA RDY=1) and (DISABLE=0). Hardware gated to Logic 0 when DISABLE=1. This is cleared to Logic 0 after 1-to-O transition of DATA ACK.

Inputs:

DATA ACK:	Polling signal from PLC. Set to Logic 1 to request Transponder data from the Reader with address equal to that presented to the ADD 0 - ADD 3 inputs. Clear to Logic 0 after inputting DATA 0 -DATA 15.
DISABLE:	Directly disables DATA 0 - DATA 15 outputs of Interface in hardware. This inhibits the Interface software from activating DATA RDY. This may be left open-circuited for single Interface operation.
ADD n:	Host-generated Reader address (binary). This must be stable while DATA ACK strobe is true.

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