CHAPTER 5

RFID Guidelines

This chapter provides an overview of how RFID works and the ZPL commands used to create RFID labels.

Contents

Overview

The R4Mplus "smart" label printer-encoder serves as a dynamic tool for both printing and encoding RFID labels, tickets, and tags. The printer encodes information on ultra-thin UHF RFID transponders embedded in "smart" labels. It then immediately verifies proper encoding and prints bar codes, graphics, and/or text on the label's surface. For more information about RFID media, see *RFID "Smart" Labels* on page 17.

Function of an encoded "smart" label depends on factors such as where the label is placed on an item as well as on the contents of the item (such as metals or liquids). Contact the supplier of your RFID reader for assistance with these types of issues.

Transponder Placement

Communication between the "smart" label and the printer is established when the transponder lines up with the printer's antenna. The optimal transponder position varies with the transponder size, its configuration, and the type of RFID IC chip used.

Print quality may be affected by printing directly over the transponder. In particular, there is an area on each label immediately around the location of the IC chip where the printer may print with low quality. Design your printed label around the location of the chip in the type of approved "smart" label that you select. For the list of approved transponders and related placement specifications, go to http://www.rfid.zebra.com/r4m.htm.

! **Important •** It is important to use transponders that have been specifically approved for use in the R4Mplus printer. Failure to do so may result in the inability to read or write to the embedded RFID tags. As new transponders become commercially available, Zebra will evaluate them for compatibility with this printer. For the list of approved transponders, go to http://www.rfid.zebra.com/r4m.htm.

ZPL II Commands for RFID

Printing and encoding (writing) of "smart" labels is handled through the use of Zebra Programming Language (ZPL). Each transponder has memory that can be read from through ZPL commands, and most transponders have memory that can be written to. The printer divides the ZPL commands that it receives into two categories: RFID and non-RFID (such as the printing commands for bar codes or human-readable text). RFID commands are executed first.

ZPL commands also provide for exception handling, such as setting the number of read/write retries before declaring a transponder defective. For example, if an RFID transponder fails to program correctly or cannot be detected, the printer ejects it and prints the word "void" across the label. This process continues for the number of RFID tags specified by the `^RS` command using the same data and format. If the problems persist, after the specified number of tags are ejected, the printer removes the customer format from the print queue and proceeds with the next format (if one exists in the buffer).

The following pages provide the ZPL II commands that can be used for RFID applications.

! **Important •** If a parameter is designated as *not applicable*, any value entered for the parameter will be ignored, but the place holder for the field is required.

^WT

Write Tag

Note • Check the amount of data memory available for the tag that you will be using. If more is sent than the memory can hold, the data will be truncated.

Description The ^WT command allows you to program the current RFID tag.

Format ^WTb,r,m,w,f,v

Table 8 identifies the parameters for this format.

Table 8 • ^WT Parameters

Parameters	Details
b = block number*	*Accepted values:* 0 to *n*, where *n* is the maximum number of blocks for the tag. *Default value:* 0
r = number of retries	*Accepted values:* 0 to 10 *Default value:* 0
m = motion	*Accepted values:* • 0 (Feed label after writing.) • 1 (No Feed after writing. Other ZPL may cause a feed.) *Default value:* 0
w = write protect	*Accepted values:* • 0 (Not write protected.) • 1 (Write protect.) *Default value:* 0
f = data format	*Accepted values:* • 0 (ASCII) • 1 (Hexadecimal) *Default value:* 0
v = verify valid data	*Default value:* y *Accepted values:* • n (Do not verify) • y (Verify valid data [Hex A5A5 in the first two bytes] before writing)

*Not applicable for R4Mplus

Example • This sample encodes data "RFIDRFID" and will try writing up to five times, if necessary.

```
^XA
^WT,5^FDRFIDRFID^FS
^XZ
```

^RT

Read Tag

Description The ^RT command tells the printer to read the current RFID tag data. The data can be sent back to the host via the ^HV command.

Format ^RT#,b,n,f,r,m,s

Table 9 identifies the parameters for this format.

Table 9 • ^RT Parameters

Parameters	Details
# = number to be assigned to the field	*Accepted values:* 0 to 9999 *Default value:* 0
b = starting block number*	*Accepted values:* 0 to *n*, where *n* is the maximum number of blocks for the tag. *Default value:* 0
n = number of blocks to read*	*Accepted values:* 1 to *n*, where *n* is the maximum number of blocks minus the starting block number. For example, if the tag has 8 blocks (starting with block 0) and you start with block 6, *n* can be 2. This would give you block 6 and block 7 information. *Default value:* 1
f = format	*Accepted values:* • 0 (ASCII) • 1 (Hexadecimal) *Default value:* 0
r = number of retries	*Accepted values:* 0 to 10 *Default value:* 0
m = motion	*Accepted values:* • 0 (Feed label after writing.) • 1 (No Feed after writing. Other ZPL may cause a feed.) *Default value:* 0
s = special mode	For EPC Class 1 (Alien reader) only. Not applicable for EPC class 0. *Default value:* 0 (Do not read if mismatched checksum.) *Accepted values:* 1 (Read even if mismatched checksum.)

*Not applicable for R4Mplus

Example • This sample reads a tag, prints the data on a label, and sends the string
Tag Data:*xxxxxxxx* back to the host. The data read will go into the ^FN1 location of the
format. The printer will retry the command five times, if necessary.

```
^XA
^FO20,120^A0N,60^FN1^FS
^RT1,,,,5^FS
^HV1,,Tag Data:^FS
^XZ
```

^HV

Host Verification

Description This command is used to return data from specified fields, along with an optional ASCII header, to the host. It can be used with any field that has been assigned a number with the `^RT` command.

Format `^HV#,n,h`

Table 10 identifies the parameters for this format.

Table 10 • ^HV Parameters

Parameters	Details
# = field number specified with another command	The value assigned to this parameter should be the same as the one used in the `^RT` or `^RI` command. *Accepted values:* 0 to 9999 *Default value:* 0
n = number of bytes to be returned	*Accepted values:* 1 to 256 *Default value:* 64
h = header	Header (in uppercase ASCII characters) to be returned with the data. *Acceptable values:* 0 to 3072 characters *Default value:* none

^RS

RFID Setup

> **Note •** Use care when using this command in combination with `^RT` (reading tag data). Problems can occur if the data read from the tag is going to be printed on the label. Any data read from the transponder must be positioned to be printed above the read/write position. Failure to do this will prevent read data from being printed on the label.

Description The `^RS` command is used to set up for RFID operation. Specifically, it moves the tag into the effective area for reading or writing or for possible error handling if there is an error.

Format `^RSt,p,v,n,e`

Table 11 identifies the parameters for this format.

Table 11 • `^RS` Parameters

Parameters	Details
t = tag type	*Accepted values:* • 3 = EPC Class 1 64 bit • 4 = EPC Class 1 96 bit *Default value:* 4
p = read/write position of the transponder in the vertical (Y axis) in dot rows from the top of the label	Set to 0 (no movement) if the transponder is already in the effective area without moving the media. *Accepted values:* 0 to label length *Default value:* label length minus 8 dot rows
v = length of void printout in vertical (Y axis) dot rows	*Default value:* label length *Accepted values:* 0 to label length
n = number of labels to try in case of read/encode failure	*Default value:* 3 *Accepted values:* 1 to 10 (number of labels)

Table 11 • `^RS` Parameters (Continued)

| Parameters	Details
e = error handling	Send an error message to the host as an unsolicited message for each failure and set the printer in error mode. *Accepted values:* • N = No action • P = Place printer in Pause • E = Place printer in Error *Default value:* N **Note •** To enable or disable the unsolicited error message, refer to the `^SX` and `^SQ` commands. The parameter for the RFID error in these commands is V.

Example • This example sets the printer to move the media to 800 dots from the top of the media [or label length minus 800 from the bottom (leading edge) of the media] and voids the rest of the media in case of an error. The printer will try to print two labels, then will pause the printer if printing and encoding fail.

```
^XA
^RS,800,,2,P^FS
^XZ
```

Figure 31 shows the resulting voided label. Note where the void starts. The media has been moved 800 dot rows from the top of the label (label length minus 800 dot rows from the bottom (leading edge) of a label) to bring the transponder into the effective area to read/write a tag. If the printer fails the operation, the rest of the media is voided.

Figure 31 • Sample Voided Label 1
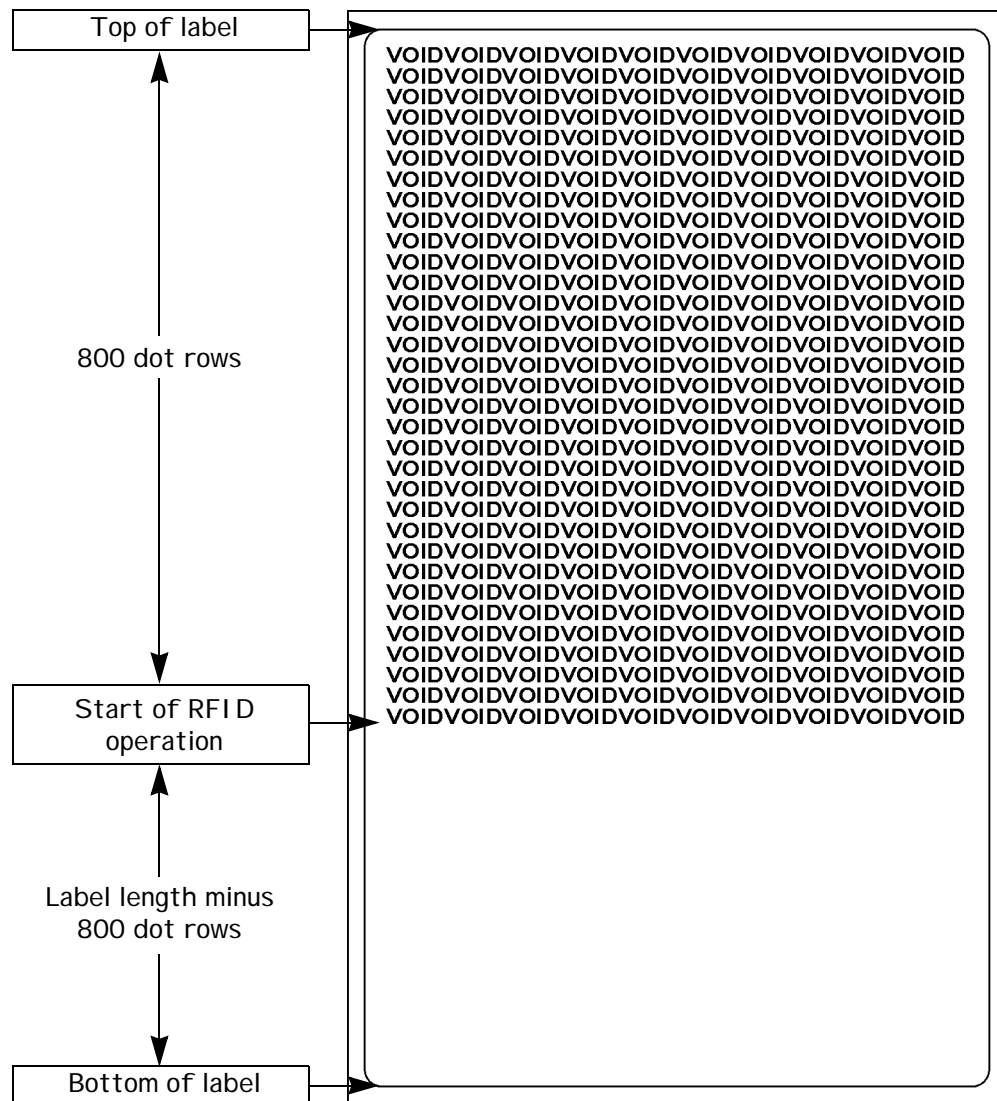
Example • This example sets the printer to move the media to 800 dots from the top of the media [or label length - 500 from the bottom (leading edge) of the media] and prints "void" 500 dots in vertical length (Y axis) in case of an error.

```
^XA
^RS,800,500,2,P^FS
^XZ
```

Figure 32 shows the resulting voided label. Note where the void starts. The media has been moved 800 dot rows from the top of the label [label length minus 800 dot rows from the bottom (leading edge) of a label] to bring the transponder into the effective area to read/write a tag. If the printer fails the operation, an area that is 500 dot rows of the media is voided instead of the entire rest of the media as in Figure 31.

Figure 32 • Sample Voided Label 2
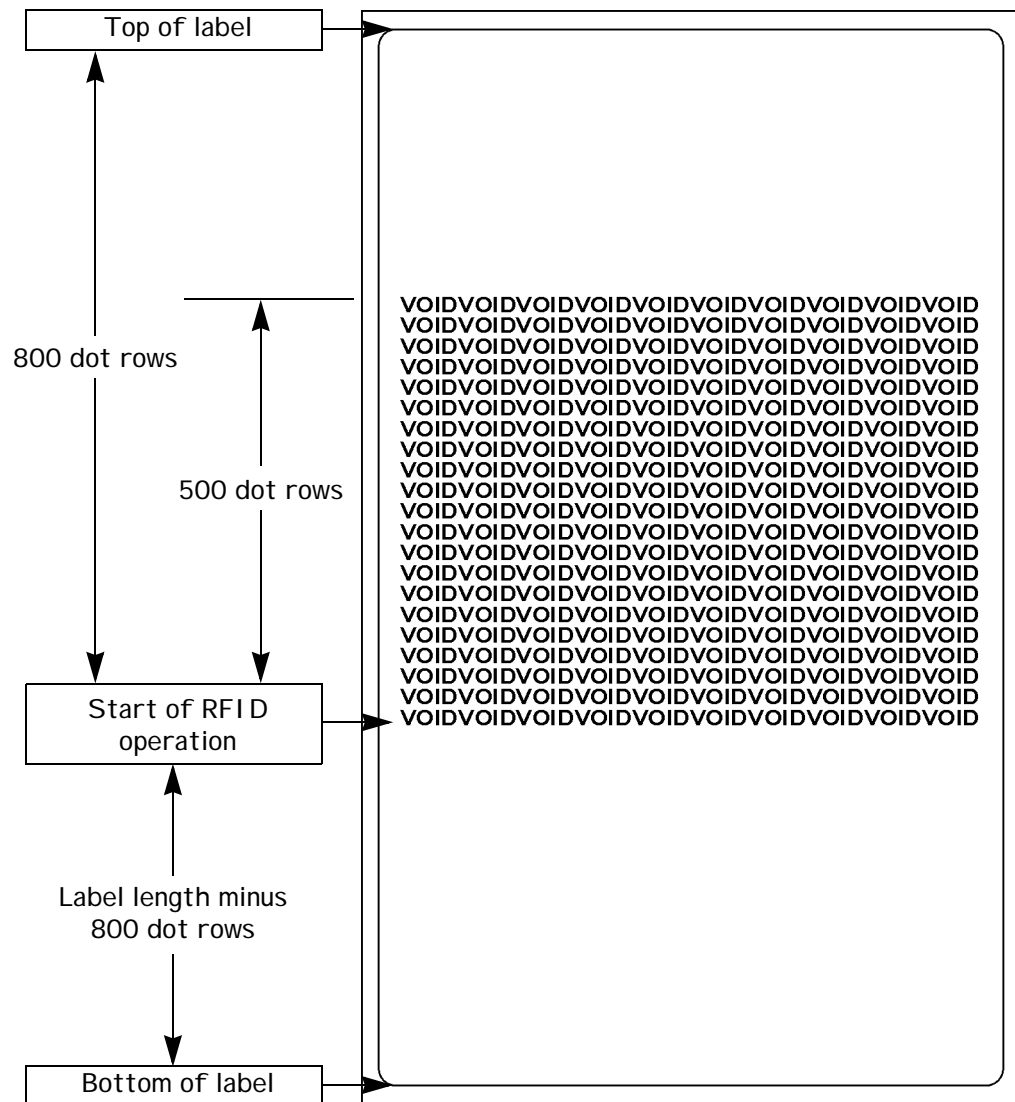
Sample of RFID Programming

ZPL II is Zebra's label design language. ZPL II lets you create a wide variety of labels from the simple to the very complex, including text, bar codes, and graphics.

This section is not intended as an introduction to ZPL II. If you are a new ZPL II user, order the *ZPL II Programming Guide* (part number 46530L) or go to http://support.zebra.com to download the guide.

For your programming, do the following:

1. Set up the printer and turn the power On (**l**).

2. Use any word processor or text editor capable of creating ASCII-only files (for example, use Microsoft® Word and save as a .txt file) and type in the label format exactly as shown in the sample label format that follows.

3. Save the file in a directory for future use. Use the ".zpl" extension.

4. Copy the file to the printer.

   From the DOS command window, use the "COPY" command to send a file to the Zebra printer. For example, if your file name is **format1.zpl** then type, COPY FORMAT 1.ZPL XXXX, where XXXX is the port to which your Zebra printer is connected (such as LPT1).

5. Compare your results with those shown. If your printout does not look like the one shown, confirm that the file you created is identical to the format shown, then repeat the printing procedure. If nothing prints, refer to

   • *Printer Setup* on page 7
   • *Printer Operation* on page 21
   • *Configuration* on page 45
   • *Troubleshooting* on page 93

   to make sure that your system is set up correctly.

Table 12 • Sample ZPL Code and Results

Line Number	Type This Label Format	Resulting Printout
1	^XA	ZEBRA
2	^RS,0^FS	5A65627261000000
3	^WT^FDZebra^FS	
4	^FO100,100^A0n,60^FN0^FS	
5	^FO100,200^A0n,40^FN1^FS	
6	^RT0^FS	
7	^RT1,,,1^FS	
8	^XZ	

Line 1 Indicates start of label format.

Line 2 Indicates no movement for media.

Line 3 Writes the data "Zebra" to the tag.

Line 4 Print field number '0' at location 100,100.^FN0 is replaced by what we read on line 6.

Line 5 Print field number '1' at location 100,200. ^FN1 is replaced by what we read on line 7.

Line 6 Read Tag into field number 0 in ASCII format (default).

Line 7 Read Tag into field number 1 in hexadecimal format.

Line 8 End of label format.

CHAPTER 6

Routine Care and Adjustments

This chapter discusses printer cleaning and minor adjustments.

Contents

Cleaning Procedures

Specific cleaning procedures are provided on the following pages. Table 13 shows a recommended cleaning schedule.

Table 13 • Recommended Cleaning Schedule

Area	Method	Interval
Printhead	Solvent*	**Direct Thermal Mode:** After every roll of media (or 500 feet of fanfold media). **Thermal Transfer Mode:** After every roll of ribbon or three rolls of media. These intervals are intended as guidelines only. You may have to clean more often, depending upon your application and media.
Platen roller	Solvent*	
Media sensors	Air blow	
Ribbon sensor	Air blow	
Media path	Solvent*	
Ribbon path	Solvent*	
Pinch roller. (Optional peel-off option required. Refer to *Clean the Peel-Off Assembly* on page 90.)	Solvent*	
Tear-off/peel-off bar	Solvent*	Once a month.
Take label sensor	Air blow	Once every six months.

* Zebra recommends using the Preventive Maintenance Kit, Part Number 47362 or a solution of 90% Isopropyl and 10% deionized water)

Note • Zebra Technologies Corporation will not be responsible for damage caused by the use of cleaning fluids on the R4Mplus printer.

Clean the Exterior

The exterior surfaces of the printer may be cleaned with a lint-free cloth. Do not use harsh or abrasive cleaning agents or solvents. If necessary, a mild detergent or desktop cleaner may be used sparingly.

Clean the Interior

Remove any accumulated dirt and lint from the interior of the printer using a soft bristle brush or vacuum cleaner.

Clean the Printhead and Platen Roller

You can minimize printhead wear and maintain print quality with regular preventive measures.

Over time, the movement of media/ribbon across the printhead wears through the protective ceramic coating, exposing and eventually damaging the print elements (dots). In order to avoid abrasion:

- Clean your printhead frequently and use well-lubricated thermal transfer ribbons with packagings optimized to reduce friction.
- Minimize printhead pressure and burn temperature settings by optimizing the balance between the two.
- Ensure that the thermal transfer ribbon is as wide or wider than the label media to prevent exposing the elements to the more abrasive label material.

For best results, perform the following cleaning procedure after changing every roll of ribbon. Inconsistent print quality, such as voids in the bar code or graphics, may indicate a dirty printhead.

Note • The printer can remain on while you are cleaning the printhead. In this way all label formats, images, and all temporary parameter settings stored in the printer's internal memory are saved. In addition, keep the peel engaged while cleaning the platen roller (media must be unloaded to do this) to reduce the risk of bending the tear-off/peel-off bar.

To clean the printhead and platen roller, refer to Figure 33 and complete these steps:

1. Open the printhead assembly.

Caution • Ensure that the printhead is fully open and engaged in the up position. If the printhead is not latched in the up position, it could fall on your hand during the procedure.

2. Remove the media and ribbon.
3. Use the Preventive Maintenance Kit (Zebra part number 47362) or a solution of 90% Isopropyl alcohol and 10% deionized water and swab. Wipe along the print elements from end to end. The print elements are on the brown strip just behind the chrome strip on the printhead. Allow the solvent to evaporate.
4. Manually rotate the platen roller and clean thoroughly with solvent and a pad.
5. Brush or vacuum any accumulated paper lint and dust away from the media and ribbon paths.
6. Reload media or ribbon, and close the printhead assembly.

Note • If print quality has not improved after performing this procedure, try cleaning the printhead with *Save-A-Printhead* cleaning film. This specially coated material removes contamination buildup without damaging the printhead. Call your authorized Zebra reseller for more information.

Figure 33 • Cleaning the Printhead and Platen Roller

1	Printhead Assembly
2	Transmissive Sensor
3	Platen Roller
4	Ribbon Sensor
5	Take-Label Sensor
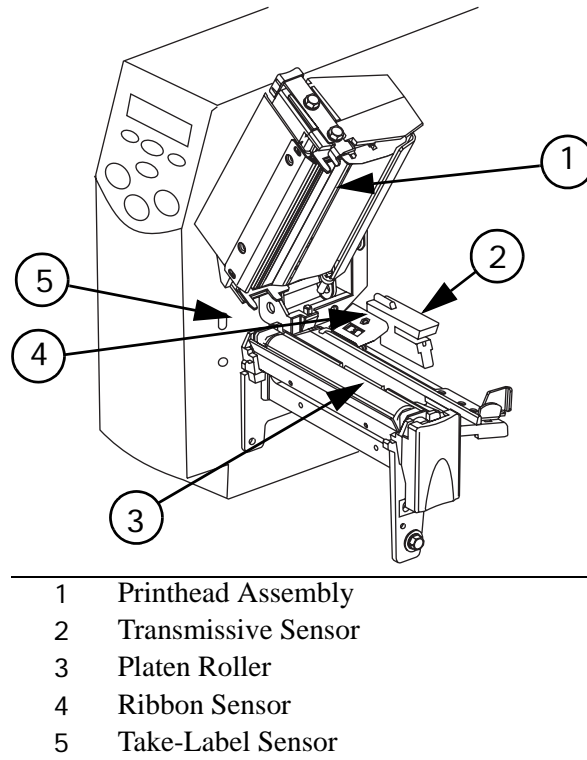
Clean the Sensors

Brush or vacuum any accumulated paper lint and dust away from the printer sensors. Refer to Figure 33. The transmissive sensor and ribbon sensor should be cleaned on a regular basis to ensure proper operation of the printer. For printers with the peel-off, liner take-up, and/or rewind option(s) installed, clean the take label sensor as well.

Clean the Rewind Option

The Rewind option is required. Refer to Figure 34 and perform the following procedure if adhesive buildup begins to affect peel performance.

To clean the Rewind option, complete these steps:

1. Open the printhead assembly.

Caution • Ensure that the printhead is fully open and engaged in the up position. If the printhead is not latched in the up position, it could fall on your hand during the procedure.

2. Close the peel assembly to prevent bending the tear-off/peel-off bar during cleaning.

3. Use the Preventive Maintenance Kit (Zebra part number 47362) or a solution of 90% Isopropyl alcohol and 10% deionized water and swab to remove excess adhesive from the tear-off/peel-off bar. Allow the solvent to evaporate.

Note • Apply minimum force when cleaning the tear-off/peel-off bar. Excessive force can cause the tear-off/peel-off bar to bend, which can have a negative effect on peel performance.

4. Open the peel assembly by pivoting the module toward you.

5. Manually rotate the pinch roller and clean thoroughly with solvent and a swab. Allow the solvent to evaporate.

6. Close the peel assembly.

7. Close the printhead assembly.

Figure 34 • Cleaning the Rewind Option
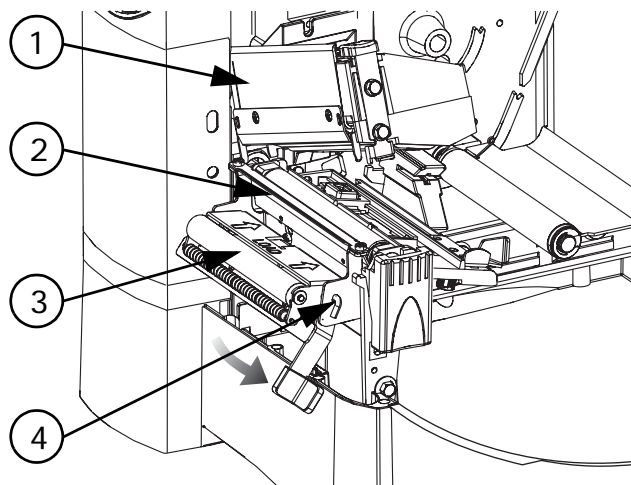
1	Printhead Assembly
2	Tear-Off/Peel-Off Bar
3	Pinch Roller
4	Peel Assembly

Clean the Peel-Off Assembly

The Peel-Off option is required.

If adhesive buildup affects peel-off performance, complete these steps:

1. Open the printhead assembly.

Caution • Ensure that the printhead is fully open and engaged in the up position. If the printhead is not latched in the up position, it could fall on your hand during the procedure.

2. Close the peel assembly to prevent bending the tear-off/peel-off bar during cleaning.

3. Use the Preventive Maintenance Kit (Zebra part number 47362) or a solution of 90% Isopropyl alcohol and 10% deionized water and swab to remove excess adhesive from the tear-off/peel-off bar. Allow the solvent to evaporate.

4. Open the peel assembly by pivoting the module toward you.

Note • Apply minimum force when cleaning the tear-off/peel-off bar. Excessive force can cause the tear-off/peel-off bar to bend, which could have a negative effect on peel performance.

5. Manually rotate the pinch roller and clean thoroughly with solvent and a swab.

6. Close the peel assembly.

Note • When cleaning the tear-off/peel-off bar or the pinch roller, remove excess solvent with a pad to ensure the solvent has dried before printing.

7. Close the printhead assembly.

Lubrication

No lubrication is needed for this printer.

Caution • Some commercially available lubricants will damage the finish and the mechanical parts if used on this printer.

Fuse Replacement

A user-replaceable AC power fuse is located just below the AC power switch at the rear of the printer. The replacement fuse is a 5 × 20 mm fast-blow style rated at 5 Amp/250 VAC.

Electric Shock Caution • Before replacing the fuse, turn off the AC power switch, and unplug the AC power cord.

To replace the fuse, complete these steps:

1. To replace the fuse, insert the tip of a flat blade screwdriver into the slot in the end of the fuse holder end cap.

2. Press in slightly on the end cap and turn the screwdriver slightly counter clockwise. This disengages the end cap from the fuse holder and permits removal of the fuse.

3. To install a new fuse, remove the old fuse and insert the new fuse into the fuse holder.

4. Push the end cap in slightly, then insert the tip of a flat blade screwdriver into the slot in the end cap and turn clockwise to engage it.

CHAPTER 7

Troubleshooting

This chapter discusses typical problems and their probable solutions.

Content

LCD Error Conditions and Warnings

The LCD displays error condition messages and warnings if the printer detects a problem. The messages, along with their causes and solutions, are listed in Table 14.

Table 14 • Error Conditions and Warnings

Error	Potential Problem	Recommended Solution
RIBBON OUT	In thermal transfer mode, the ribbon is not loaded *or* loaded incorrectly.	Load the ribbon correctly. See *Load the Ribbon* on page 38.
	In thermal transfer mode, the ribbon sensor is not sensing correctly loaded ribbon.	Perform the media and ribbon sensor calibration (see *Media and Ribbon Sensor Calibration (Manual Calibration)* on page 58).
RIBBON IN	In direct thermal mode, when ribbon is not used:	Remove the ribbon and set the printer to direct thermal mode. See *Selecting Print Method* on page 53.
		Ensure that the printer driver or software settings are correctly set.
PAPER OUT	The media is not loaded *or* loaded incorrectly.	Reload the media. See *Load Roll Media* on page 25.
	The printer is set for non-continuous media, but continuous media is loaded.	Either load the correct media or set the printer for the correct media type via the front panel.
		Ensure that the printer driver or software settings are correctly set.
		Calibrate the printer (see *Media and Ribbon Sensor Calibration (Manual Calibration)* on page 58).

Table 14 • Error Conditions and Warnings (Continued)

Error	Potential Problem	Recommended Solution
HEAD OPEN	The printhead is not fully closed.	Close the printhead.
	The ribbon is loaded incorrectly; it is covering the head open sensor.	Correctly align the ribbon with the guide mark on the strip plate before closing the printhead assembly.
	Print method is incorrectly set.	Via the front panel, locate the PRINT METHOD menu item and select thermal transfer mode. See *Selecting Print Method* on page 53.
		Ensure that the printer driver and/or software settings are correctly set.
	The ribbon is loaded.	Remove the ribbon and set the printer to direct thermal mode. See *Selecting Print Method* on page 53.
		Ensure that the printer driver and/or software settings are correctly set.
HEAD OVER TEMP	⚠	**Caution •** The printhead is hot and can cause severe burns. Allow the printhead to cool.
	The printhead is over temperature.	Allow the printer to cool. Printing automatically resumes when the printhead elements cool to an acceptable operating temperature.
HEAD UNDER TEMP	⚠	**Caution •** An improperly connected printhead data or power cable can cause this error message. The printhead can still be hot enough to cause severe burns. Allow the printhead to cool.
	The printhead is under temperature.	Continue printing while the printhead reaches the correct operating temperature.
		The environment may be too cold for proper printing. Relocate the printer to a warmer area.

Table 14 • Error Conditions and Warnings (Continued)

Error	Potential Problem	Recommended Solution
OUT OF MEMORY*	*There is not enough memory to perform the function shown on the second line of the error message.	Insufficient DRAM for the label length, downloaded fonts/graphics, and images.
		Ensure that the device, such as FLASH memory or PCMCIA card, is installed and not write protected or full.
		Ensure that the data is not directed to a device that is not installed or available.

Print Quality Problems

Table 15 • Print Quality Problems and Solutions

Issue	Potential Problem	Recommended Solution
General print quality issues	You are using an incorrect media and ribbon combination for your application.	Consult your authorized reseller/distributor for information and advice.
	The printer is set at an excessive print speed to achieve optimal quality.	For optimal print quality, set the print speed to a lower setting via ZPL II, the driver, the software, or the front panel.
	The printer is set at an excessive darkness level to achieve optimal quality.	For optimal print quality, set the darkness level to a lower setting via the front panel, the driver, or the software.
	The printhead is dirty.	Clean the printhead according to the instructions in *Clean the Printhead and Platen Roller* on page 87.
	There is light printing (or no printing) on the left or right side of the label *or* the printed image is not sharp.	The pressure adjustment dials need to be adjusted. Follow the printhead pressure adjustment instructions on *Set Printhead Pressure* on page 43.
Gray lines on blank labels with no consistent pattern	The printhead is dirty.	Clean the printhead according to the instructions in *Clean the Printhead and Platen Roller* on page 87.
Light, consistent vertical lines running through all labels	The printhead or platen roller is dirty.	Clean the printhead, platen roller, or both according to the instructions in *Clean the Printhead and Platen Roller* on page 87.
Intermittent creases on the left and right edges of the label	There is too much pressure on the printhead.	Reduce the printhead pressure. See *Set Printhead Pressure* on page 43.
Wrinkled ribbon	The ribbon is not loaded correctly.	Load the ribbon correctly. See *Load the Ribbon* on page 38.
	The darkness setting is incorrect.	Set the darkness to the lowest possible setting for good print quality. See *DARKNESS* on page 51.
	Incorrect printhead pressure or balance.	Set the pressure to the minimum required for good print quality. See *Set Printhead Pressure* on page 43.
	The media is not feeding correctly. It is walking from side to side.	Make sure that the media guide and media supply guide touch the edge of the media.

Calibration Problems

Table 16 • Calibration Problems and Solutions

Problem	Recommended Solution
Loss of printing registration on labels.Excessive vertical drift in top-of-form registration.	Ensure that the media guides are properly positioned.
	Set the printer for the correct media type. See *MEDIA TYPE* on page 52.
	Reload the media.
	Clean the platen roller according to the instructions in *Clean the Printhead and Platen Roller* on page 87.
Auto Calibrate failed.	Perform a manual calibration (see *Media and Ribbon Sensor Calibration (Manual Calibration)* on page 58).
	Reload the media.

Communication Problems

Table 17 • Communication Problems and Solutions

Issue	Potential Problem	Recommended Solution
The printer does not respond to print requests. The Data light does not flash.	Loose or improperly connected cable.	Make sure that the communication cable is connected properly.
	The communication parameters are incorrect.	Check the printer driver or software communications settings.
		Confirm that you are using the correct communication cable. See *Cable Requirements* on page 14.
		Via the front panel, check the protocol setting. It should be set to the default None. See *Setting Protocol* on page 61.
		Ensure that the correct driver is being used.
Several labels print, then the printer skips, misplaces, misses, or distorts the image on the label after a label is sent to the printer.	The host is set to EPP parallel communications.	Change the settings on the computer host to standard parallel communications.
	The serial communication settings are incorrect.	Standard RS-232 cables are appropriate for lengths under 50 ft. (15.2 m); RS-422 and RS-485 cables allow serial transmission up to 4000 ft.(1.2 km). Check cable length and shielding, and confirm the appropriate RS-232, RS-422, or RS-485 setting is being used.
		Check the printer driver or software communications settings.
A label format was sent to the printer but not recognized. The DATA light flashes but no printing occurs.	The prefix and delimiter characters set in the printer do not match the ones in the label format.	Verify the prefix and delimiter characters. See *Selecting Prefix and Delimiter Characters (next three parameters)* on page 63.
	Incorrect data is being sent to the printer.	Check the communication settings on the computer. Ensure that they match the printer settings.

Printer Diagnostics

These self tests produce sample printouts and provide specific information that help determine the operating conditions for the printer.

Each self test is enabled by pressing a specific front panel key or combination of keys while turning the printer On (**l**). Press the key(s) until the DATA light turns off (approximately five seconds). When the Power-On Self Test is complete, the selected self test starts automatically.

> **Note •** Keep the following in mind while performing self tests:
>
> - When performing self tests, avoid sending a label format to the printer. In the case of a remote host, disconnect all data interface cables from the printer.
> - When cancelling a self test prior to its actual completion, always turn the printer Off (**O**) and then back On (**l**) to reset the printer.
> - When performing these self tests while in the Peel-Off Mode, you must remove the labels as they become available.
> - If your media is not wide enough or long enough, unexpected or undesired results may occur. Ensure that your print width is set correctly for the media you are using before you run any self tests, otherwise the test may print on the platen roller. See *PRINT WIDTH* on page 53 for information on setting the print width.

Power-On Self Test

A Power-On Self Test (POST) is performed automatically each time the printer is turned on. During this test sequence, the front panel lights and liquid crystal display (LCD) monitor the progress of the POST. If the printer fails any of these tests, the word FAILED is display. If this occurs, notify an authorized Zebra reseller.

CANCEL Self Test

This self test prints a listing of the configuration parameters currently stored in the printer's memory. See Figure 35. Depending on the options ordered, your label may look different.

Figure 35 • Sample Configuration Label


```
          PRINTER CONFIGURATION

Zebra Technologies
ZTC R4MPlus-200 dpi

+27................ DARKNESS
2 IPS............. PRINT SPEED
+000.............. TEAR OFF
TEAR OFF.......... PRINT MODE
NON-CONTINUOUS.... MEDIA TYPE
THERMAL-TRANS..... PRINT METHOD
104 0/8 MM........ PRINT  WIDTH
1242.............. LABEL LENGTH
39.0IN   988MM.... MAXIMUM LENGTH
BIDIRECTIONAL..... PARALLEL COMM.
RS232............. SERIAL COMM.
115200............ BAUD
8 BITS............ DATA BITS
NONE.............. PARITY
XON/XOFF.......... HOST HANDSHAKE
NONE.............. PROTOCOL
000............... NETWORK ID
NORMAL MODE....... COMMUNICATIONS
<~>  7EH.......... CONTROL PREFIX
<^>  5EH.......... FORMAT PREFIX
<,>  2CH.......... DELIMITER CHAR
ZPL II............ ZPL MODE
NO MOTION......... MEDIA POWER UP
NO MOTION......... HEAD CLOSE
DEFAULT........... BACKFEED
+000.............. LABEL TOP
+0000............. LEFT POSITION
039............... WEB S.
079............... MEDIA S.
068............... RIBBON S.
029............... TAKE LABEL
035............... MEDIA LED
104............... RIBBON LED
+10............... LCD ADJUST
DPSWFXM........... MODES ENABLED
.................. MODES DISABLED
832 8/MM FULL..... RESOLUTION
SP920C    <-...... FIRMWARE
V23.0.0.54........ HARDWARE ID
CUSTOMIZED........ CONFIGURATION
3584k...........R: RAM
0512k...........E: ONBOARD FLASH
NONE.............. FORMAT CONVERT
000 DISPLAY....... P30 INTERFACE
NONE.............. OPTION
FW VERSION........ IDLE DISPLAY
15/27/00.......... RTC DATE
00:00............. RTC TIME
NONE.............. ZEBRA NET II
Alien : 00.00.88.. RFID VERSION
ePC Class 1....... RFID TAG TYPE
GL12472.03JDR060127.79000.1.VH1.....

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The configuration shown on the label may be changed either temporarily (for specific label formats or ribbon and label stock) or permanently (by saving the new parameters in memory). See *Basic Configuration* on page 48 for further information about the configuration procedure.

To perform the CANCEL Self Test, complete these steps:

1. Turn the printer Off (**O**).
2. Press and hold CANCEL while turning On (**I**) the printer.
3. Release CANCEL after the DATA light turns off (approximately five seconds).

PAUSE Self Test

This self test can be used to provide the test labels required when making adjustments to the printer's mechanical assemblies or parameter settings. See the sample printout in Figure 36.

Figure 36 • PAUSE Test Label

To perform the PAUSE Self Test, complete these steps:

1. Turn the printer Off (**O**).

2. Press and hold PAUSE while turning On (**I**) the printer.

3. Release PAUSE after the DATA light turns off (approximately five seconds).

    The printer prints 15 labels at 2 in. (51 mm) per second, then automatically pauses. If PAUSE is pressed, an additional 15 labels print.

4. Press CANCEL while the printer is paused to alter the self test, then press PAUSE.

    The printer prints 15 labels at 6 in. (152 mm) per second, then automatically pauses.

5. Press CANCEL again while the printer is paused to alter the self test again, then press PAUSE.

    The printer prints 50 labels at 2 in. (51 mm) per second, then automatically pauses.

6. Press CANCEL again while the printer is paused to alter the self test a third time, then press PAUSE.

    The printer prints 50 labels at 6 in. (152 mm) per second, then automatically pauses.

7. Press CANCEL again while the printer is paused to alter the self test a fourth time, then press PAUSE.

    The printer prints 15 labels at the printer's maximum speed.

8. To exit this self test at any time, press and hold CANCEL.

FEED Self Test

See Figure 37. The FEED Self Test prints labels at various darkness settings above and below that of the darkness value currently stored in the printer (shown on the first line of the configuration label). The relative darkness value printed on the best FEED Self Test label is added to or subtracted from the darkness value. The resulting numeric value (0 to 30) is the best darkness value for that specific media and ribbon combination.

For example, if the darkness value on a printer is 10 and the best relative darkness value is zero, leave the darkness setting as is. If the best relative darkness value is –1, change the darkness setting on your printer to 9 (10 – 1). If the best relative darkness value is 2, change the darkness setting to 12 (10 + 2).

Figure 37 • FEED Self Test Label, Relative Darkness Value Zero

To perform the FEED Self Test, complete these steps:

1. Turn the printer Off (**O**).
2. Press and hold FEED while turning On (**I**) the printer.
3. Release FEED after the DATA light turns off (approximately five seconds).
4. Find the label that has the best darkness setting for your application.
5. If the relative darkness value on this label is a number other than zero (values range from –3 to 3), adjust the darkness setting on your printer by adding or subtracting that relative darkness value from the current darkness setting. See *Adjusting Print Darkness on page 51* for more information.

Communication Diagnostics Test

This test is controlled from the front panel display (see *Setting Communication Diagnostics Mode* on page 62). A typical printout from this test is shown in Figure 38. Turn the printer Off (**O**) to exit this self test.

Note • This label is inverted when printed (prints upside down).

Figure 38 • Communication Diagnostics Test Printout
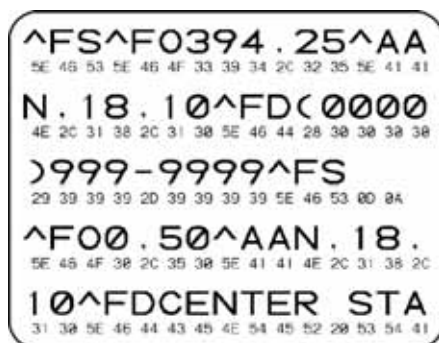
RFID Test

The RFID test is controlled from the front panel display (see *RFID Test* on page 69). If the printer fails the test, the front panel displays an error message.

You have the option of running the RFID test in two ways: quick or slow. In both versions of this test, the printer attempts to read and write to a transponder. In the slow test, the printer also checks the reader version number and displays the tests on the LCD as it runs through them.

To perform the RFID Test, complete these steps:

1. See Figure 39. Place an RFID label in the printer so the embedded transponder is over the open area behind the platen roller (no movement occurs with the test).

Figure 39 • Label Placement for RFID Test
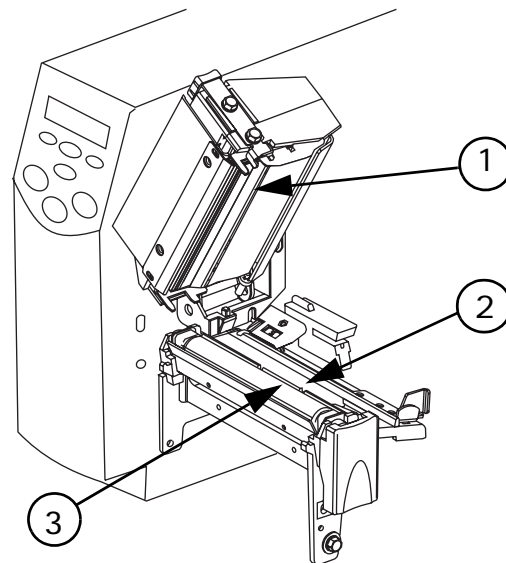
1	Printhead Assembly
2	Open Area
3	Platen Roller

2. From the front panel, press SETUP/EXIT.

3. Press PLUS (**+**) or MINUS (**–**) until you reach RFID TEST.

4. Press SELECT to select the parameter.

5. Press MINUS (**–**) to select QUICK.
or
Press PLUS (**+**) to select SLOW.

• For the quick test, the results are PASSED and FAILED. Press PLUS (**+**) to continue.

• For the slow test, a pass result returns you to the RFID TEST menu item. A failed result returns the message WRITE ERROR. Press PLUS (**+**) to continue.

6. Press SELECT to deselect the parameter.

Loading Factory Defaults

Use care when loading defaults. You will need to reload all settings that you changed manually.

To load the factory defaults, complete these steps:

1. Press **SETUP/EXIT** two times.
2. Use **PLUS** (+) or **MINUS** (–) to scroll through the SAVE CHANGES choices.
3. When LOAD DEFAULTS displays, press **SETUP/EXIT**.

APPENDIX A

Data Connections

This appendix provides details about the serial port and parallel port data connections.

Content

Serial Data Port

Hardware Control Signal Descriptions

For all RS-232 input and output signals, the R4Mplus printer follows both the Electronics Industries Association (EIA) RS-232 and the Consultative Committee for International Telegraph and Telephone (CCITT) V.24 standard signal level specifications.

When DTR/DSR handshaking is selected, the Data Terminal Ready (DTR) control signal output from the printer controls when the host computer may send data. DTR ACTIVE (positive voltage) permits the host to send data. When the printer places DTR in the INACTIVE (negative voltage) state, the host must not send data.

Note • When XON/XOFF handshaking is selected, data flow is controlled by the ASCII Control Codes DC1 (XON) and DC3 (XOFF). The DTR Control lead has no effect.

Request to send (RTS) is a control signal from the printer that is connected to the clear to send (CTS) input at the host computer. RTS is always active (positive voltage) when the printer is on.

RS-232 Serial Data Port

The connection for this standard interface is made through the female DB-9 connector on the rear panel. A DB-9 to DB-25 interface module is required for all RS-232 connections through a DB-25 cable (see page 110 for details).

For all RS-232 input and output signals, the printer follows both the Electronics Industries Association's (EIA) RS-232 specifications and the Consultative Committee for International Telegraph and Telephone (CCITT) V.24 standard signal level specifications.

Table 18 shows the pin configuration and function of the rear panel serial data connector on the printer.

Table 18 • Serial Data Connector Pin Configuration

Pin Number	Name	Description
1	—	Not connected
2	RXD	Receive data—data input to printer
3	TXD	Transmit data—data output from printer
4	DTR	Data terminal ready—output from printer
5	SG	Signal ground
6	DSR	Data set ready—input to printer
7	RTS	Request to send—output from printer

Table 18 • Serial Data Connector Pin Configuration (Continued)

Pin Number	Name	Description
8	CTS	Clear to send—input to printer
*9	+5 V DC	+5 VDC

* This pin is also available as a +5 VDC power source at 750 mA. To enable this capability, a jumper on the computer's main logic board needs to be installed on JP1, pins 2 and 3.

Note • An interface module is required for RS-422/RS-485 interface support (refer to).

RS-232 Interface Connections

The printer is configured as Data Terminal Equipment (DTE). Figure 40 shows the internal connections of the printer's RS-232 connector.

Figure 40 • RS-232 Internal Connections
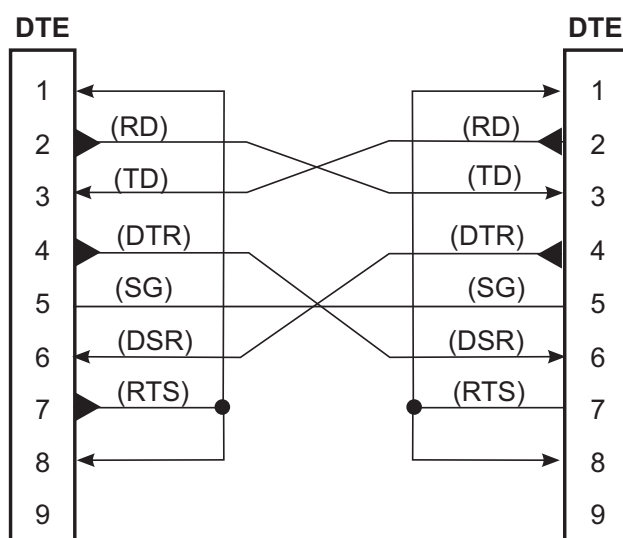
Note • You must use a a null modem (crossover) cable to connect the printer to a computer or any other DTE devices.

When the printer is connected via its RS-232 interface to Data Communication Equipment (DCE) such as a modem, use a standard RS-232 (straight-through) interface cable. Figure 41 illustrates the connections required for this cable.

Figure 41 • RS-232 to DCE Internal Connections

DTE (Printer)	Signal	DCE (Modem, etc.)
2	← RXD (receive data)	2
3	TXD (transmit data) →	3
4	DTR (data terminal ready) →	4
5	← SG (signal ground) →	5
6	← DSR (data set ready)	6
7	RTS (request to send) →	7
8	← CTS (clear to send)	8
9	+5 VDC signal source →	9
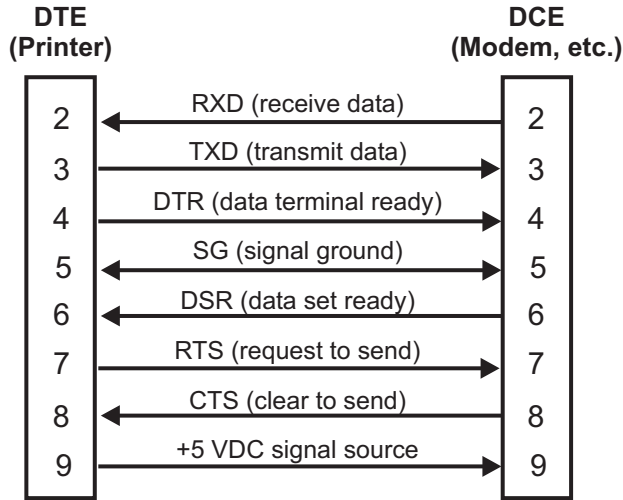
NOTE • Pin 1 is unused and unterminated at the printer.

RS-232 Interconnections Using a DB-25 Cable

To connect the printer's RS-232 DB-9 interface to a DB-25 connector, an interface adapter is required (Zebra part number 33138). A generic DB-25 adapter may also be used, however, the +5 VDC signal source would not be passed through. Figure 42 shows the connections required for the DB-9 to DB-25 interface.

Note • You must use a a null modem (crossover) cable to connect the printer to a computer or any other DTE devices.

Figure 42 • DB-9 to DB-25 Internal Connections

Male DB-9 Adapter
Connector
(plugs into printer)

Female DB-25 Adapter
Connector
(plugs into cable)

2	RXD		FG	1
3	TXD		TXD	2
4	DTR		RXD	3
5	SG		RTS	4
6	DSR		CTS	5
7	RTS		DSR	6
8	CTS		SG	7
9	+5 VDC SIGNAL		+5 VDC SIGNAL	9
			DTR	20
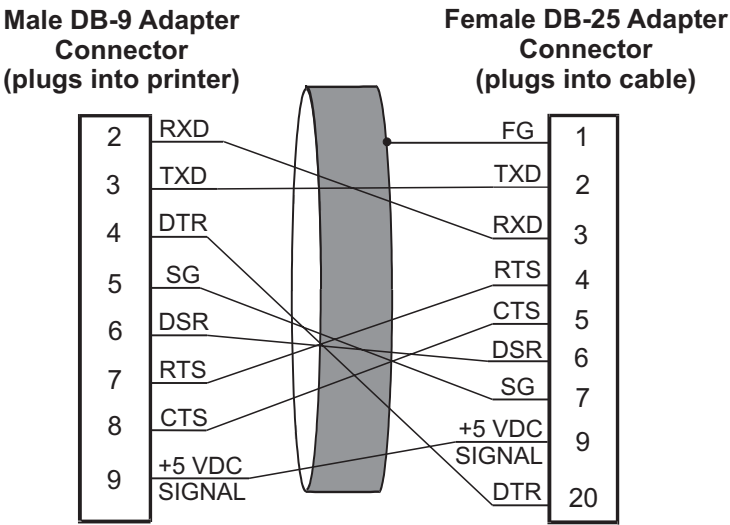
Note • Pin 1 of DB-9 connector is unused and unterminated.

RS-422/RS-485 Interconnections

Note • A jumper on the computer's main logic board needs to be installed on JP1, Pins 2 and 3, for the RS-422/RS-485 interface adapter to function properly.

To connect the printer's RS-232 DB-9 interface to a host computer through an RS-422 or an RS-485 interface, an interface adapter is required (Zebra part number 33130). Figure 43 shows the required cable wiring for interconnecting to the interface adapter's DB-25 female connector.

Figure 43 • RS-422 and RS-485 Adapter Internal Connections

DB-25P
Connector
to Printer

Shield	1
Signal Ground	11
Data Input A (−)	13
Data Output A (−)	14
Data Input B (+)	16
Data Output B (+)	19
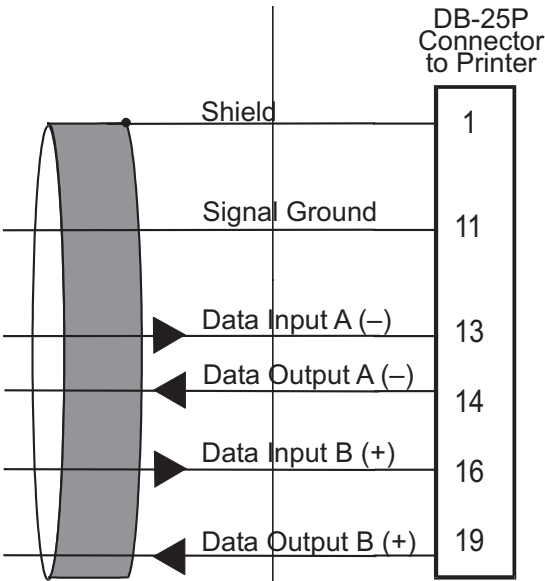
Parallel Data Port

The 8-bit parallel data interface supports IEEE 1284 bidirectional parallel communications in nibble mode. The parallel interface provides a means of communication that is typically faster than the previously mentioned serial interface methods. In this method, the bits of data that make up a character are sent all at one time over several wires in the cable, one bit per wire.

Parallel Cabling Requirements

An IEEE-1284 compatible bi-directional parallel data cable is required when this communication method is used. The required cable must have a standard 36-pin parallel connector on one end that is plugged into the mating connector located at the rear of the printer. The other end of the cable connects to the printer connector at the host computer. Port selection for status information is determined each time the printer is turned on.

Parallel Port Interconnections

Table 19 shows the pin configuration and function of a standard computer-to-printer parallel cable.

Table 19 • Parallel Cable Pin Configuration

36-Pin Connectors	Description
1	nStrobe/HostClk
2 to 9	Data Bits 1 to 8
10	nACK/PtrClk
11	Busy/PtrBusy
12	PError/ACKDataReq
13	Select/Xflag
14	nAutoFd/HostBusy
15	Not used
16 and 17	Ground
18	+5V @ 750 mA The maximum current draw may be limited by option configuration.
19 to 30	Ground
31	nInit
32	nFault/NDataAvail
33 and 34	Not used
35	+5V through a 1.8KΩ Resistor
36	NSelectin/1284 active

APPENDIX B

Specifications

This appendix contains specifications for the R4Mplus printer.

Contents

General Specifications

Table 20 • R4Mplus General Specifications

General Specifications			
Height		13.3 in.	338 mm
Width		10.9 in.	277 mm
Depth		18.7 in.	475 mm
Weight (without options)		32.4 lbs.	14.7 kg
Electrical		90-265 VAC, 48-62 Hz, 5 Amps (fused)	
Agency Approvals		• UL 60950-1 • CAN/CSA - C22.2 NO. 60950-1-03 • FCC Part 15.107 and 15.109 Class B • FCC Part 15.247 • Canadian ICES-003, Class B • IC RSS-210	
Temperature	Operating	40° to 104°F	5° to 40°C
	Storage	–40° to 140°F	–40° to 60°C
Relative Humidity	Operating	20% to 85%, non-condensing	
	Storage	5% to 85%, non-condensing	
Communication Interface		RS-232/CCITT V.24 serial data interface; 110 to115000 baud, parity, bits/character, 7 or 8 data bit, and XON-XOFF, RTS/CTS or DTR/DSR handshake protocol required. 750mA at 5 V from pin 9.	
		8-bit parallel data interface; supports IEEE 1284 bidirectional parallel, ECP and nibble mode compliant. Error detection CRC protocol.	

Printing Specifications

Table 21 • R4Mplus Printing Specifications

Printing Specifications			
Print resolution		203 dots/inch	8 dots/mm
		300 dots/inch	12 dots/mm
Dot size (width x length)	203 dpi	0.00492 in. x 0.00492 in.	0.125 mm x 0.125 mm
	300 dpi	0.0033 in. x 0.0039 in.	0.084 mm x 0.099 mm
Maximum print width	203 dpi	4.09 in.	104 mm
	300 dpi	4.1 in.	106 mm
Minimum print length		1 dot row	
Maximum print length	203 dots/inch	105 in.	2667 mm
	300 dots/inch	45 in.	1143 mm
Bar code modulus (X) dimension	203 dots/inch	5 mil to 50 mil	
	300 dots/inch	3.3 mil to 33 mil	
Programmable constant print speeds	203 dots/inch	Per second: 7 in. 8 in. 9 in. 10 in.	Per second: 178 mm 203 mm 229 mm 254 mm
	300 dots/inch	Per second: 2 in. 3 in. 4 in. 5 in. 6 in.	Per second: 51 mm 76 mm 102 mm 127 mm 152 mm
Thin film printhead with energy control			

Media Specifications

Table 22 • R4Mplus Media Specifications

Media Specifications				
Label length	Minimum	Tear-off	0.5 in.*	13 mm*
		Peel-off	1 in.*	25.4 mm*
		Rewind	0.5 in.*	13 mm*
		RFID "Smart" labels	**	
	Maximum	Tear/Peel/Rewind	39 in.*	991 mm*
		RFID "Smart" labels	**	
Label width	Minimum	Tear/Peel/Rewind	1 in.*	25.4 mm*
		RFID "Smart" labels	**	
	Maximum	Tear	4.5 in.	114 mm
		Peel/Rewind	4.25 in.	108 mm
Total thickness (includes liner, if any)	Minimum		0.0023 in.	0.058 mm
	Maximum		0.010 in.	0.25 mm
Core size			3 in.	76 mm
Maximum roll diameter			8 in.	203 mm
Inter-label gap	Minimum		0.079 in.*	2 mm*
	Preferred		0.118 in.*	3 mm*
	Maximum		0.157 in.*	4 mm*
	RFID "Smart" labels		**	
Ticket/tag notch size (width x length)			0.236 in. $\times$ 0.12 in.	6 mm $\times$ 3 mm
Hole diameter			0.125 in.	3 mm
Notch or hole position (Centered from inner media edge)	Minimum		0.15 in.	3.8 mm
	Maximum		2.25 in.	57 mm
Density, in Optical Density Units (UDO)			> 1.0 ODU	
Maximum media density			$\leq$ 0.5 ODU	
Transmissive Sensor	Fixed		7/16 in. (11 mm) from inside edge	

* Does not apply to RFID "smart" labels.

** This parameter varies for each transponder type. For the list of approved transponders and related placement specifications, go to http://www.rfid.zebra.com/r4m.htm.

Ribbon Specifications

Table 23 • R4Mplus Ribbon Specifications

Ribbon Specifications			
Ribbon must be wound with the coated side out			
Ribbon width (Zebra recommends using ribbon at least as wide as the media to protect the printhead from wear.)	Minimum*	>2 in.**	51 mm**
	Maximum	4.3 in.	109 mm
Standard lengths	2:1 media to ribbon roll ratio	984 ft.	300 m
	3:1 media to ribbon roll ratio	1476 ft.	450 m
Ribbon core inside diameter		1 in.	25.4 mm

* For RFID "smart" labels, the minimum ribbon width is determined by the minimum label width for the transponder being used. For the list of approved transponders and related size and placement specifications, go to http://www.rfid.zebra.com/r4m.htm.

** Depending on your application, you may be able to use ribbon narrower than 2 in. (51 mm), as long as the ribbon is wider than the media being used. To use a narrower ribbon, test the ribbon's performance with your media to assure that you get the desired results.

Printer Options

- Peel-off
- Liner take-up
- PCMCIA card socket (supports Zebra Rapid Flash and ATA formats)
- Linear Memory Card: (Zebra Rapid Flash) 8MB and 32MB
- Compact Flash: 32MB, 64MB, 128MB, and 256MB
- 300 dpi printhead
- Rewind
- Adjustable transmissive sensor
- External PrintServer
- Internal PrintServer

Zebra Programming Language (ZPL II) Features

- Downloadable graphics (with data compression)
- Bit image data transfer and printing, mixed text/graphics
- Format inversion
- Mirror image printing
- Four-position field rotation
  (0°, 90°, 180°, 270°)
- Slew command
- Programmable quantity with print pause
- Communicates in printable ASCII characters
- Controlled via mainframe, mini, PC, portable data terminal
- In-Spec OCR-A and OCR-B
- UPC/EAN
  (nominal 100% magnification 6 dots/mm printheads only)
- Serialized fields

Supported Bar Codes

Table 24 • Supported Bar Codes

R4Mplus Bar Code Features	
Code 11	LOGMARS
Code 39 (supports ratios of 2:1 to 3:1)	Plessey
Code 49 (2-dimensional bar code)	EAN-8, EAN-13, EAN EXTENSIONS
Code 93	UPC-A, UPC-E, UPC EXTENSIONS
Code 128 (supports serialization in all subsets and UCC case codes)	MSI
Codabar (supports ratios of 2:1 to 3:1)	PDF-417 (2-dimensional bar code)
Codablock	Micro-PDF-417
Interleaved 2 of 5 (supports ratios of 2:1 to 3:1; modulus 10 check digit)	POSTNET
Industrial 2 of 5	MaxiCode
Standard 2 of 5	Datamatrix
QR Code	Check digit calculation where applicable

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