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Applications of Embedded - Microcontroller,

Details	
Product Status	Obsolete
Module/Board Type	MPU Core
Core Processor	Rabbit 3000
Co-Processor	-
Speed	29.4MHz
Flash Size	512KB
RAM Size	512KB
Connector Type	2 IDC Headers 2x17
Size / Dimension	1.85" x 1.65" (47mm x 42mm)
Operating Temperature	-40°C ~ 85°C
Purchase URL	https://www.e-xfl.com/product-detail/digi-international/101-0517

1. INTRODUCTION

The RCM3100 RabbitCore module is designed to be the heart of embedded control systems.

Throughout this manual, the term RCM3100 refers to the complete series of RCM3100 RabbitCore modules unless other production models are referred to specifically.

The RCM3100 has a Rabbit 3000 microprocessor operating at 29.4 MHz, static RAM, flash memory, two clocks (main oscillator and timekeeping), and the circuitry necessary for reset and management of battery backup of the Rabbit 3000's internal real-time clock and the static RAM. Two 34-pin headers bring out the Rabbit 3000 I/O bus lines, parallel ports, and serial ports.

The RCM3100 receives its +3.3 V power from the customer-supplied motherboard on which it is mounted. The RabbitCore RCM3100 can interface with all kinds of CMOS-compatible digital devices through the motherboard.

1.1 RCM3100 Features

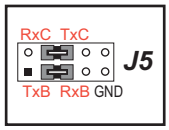
- Small size: 1.65" × 1.85" × 0.55"
  (42 mm × 47 mm × 14 mm)
- Microprocessor: Rabbit 3000 running at 29.4 MHz
- 54 parallel 5 V tolerant I/O lines: 46 configurable for I/O, 4 fixed inputs, 4 fixed outputs
- Two additional digital inputs, two additional digital outputs
- External reset input
- Alternate I/O bus can be configured for 8 data lines and 6 address lines (shared with parallel I/O lines), I/O read/write
- Ten 8-bit timers (six cascadable) and one 10-bit timer with two match registers
- 256K–512K flash memory, 128K–512K SRAM
- Real-time clock
- Watchdog supervisor
- Provision for customer-supplied backup battery via connections on header J2
- 10-bit free-running PWM counter and four pulse-width registers

3.2.1 Serial Communication

The following sample programs can be found in the **SAMPLES\RCM3100\SERIAL** folder.

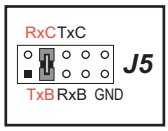
- **FLOWCONTROL.C**—This program demonstrates hardware flow control by configuring Serial Port C (PC3/PC2) for CTS/RTS with serial data coming from TxB at 115,200 bps. One character at a time is received and is displayed in the **STDIO** window.

  To set up the Prototyping Board, you will need to tie TxB and RxB together on the RS-232 header at J5, and you will also tie TxC and RxC together using the jumpers supplied in the Development Kit as shown in the diagram

  A repeating triangular pattern should print out in the **STDIO** window. The program will periodically switch flow control on or off to demonstrate the effect of no flow control.

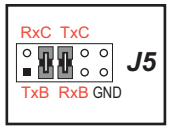
- **PARITY.C**—This program demonstrates the use of parity modes by repeatedly sending byte values 0–127 from Serial Port B to Serial Port C. The program will switch between generating parity or not on Serial Port B. Serial Port C will always be checking parity, so parity errors should occur during every other sequence.

  To set up the Prototyping Board, you will need to tie TxB and RxC together on the RS-232 header at J5 using the jumpers supplied in the Development Kit as shown in the diagram.

  The Dynamic C **STDIO** window will display the error sequence.

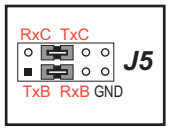
- **SIMPLE3WIRE.C**—This program demonstrates basic RS-232 serial communication. Lower case characters are sent by TxC, and are received by RxB. The characters are converted to upper case and are sent out by TxB, are received by RxC, and are displayed in the Dynamic C **STDIO** window.

  To set up the Prototyping Board, you will need to tie TxB and RxC together on the RS-232 header at J5, and you will also tie RxB and TxC together using the jumpers supplied in the Development Kit as shown in the diagram.

- **SIMPLE5WIRE.C**—This program demonstrates 5-wire RS-232 serial communication with flow control on Serial Port C and data flow on Serial Port B.

  To set up the Prototyping Board, you will need to tie TxB and RxB together on the RS-232 header at J5, and you will also tie TxC and RxC together using the jumpers supplied in the Development Kit as shown in the diagram.

  Once you have compiled and run this program, you can test flow control by disconnecting TxC from RxC while the program is running. Characters will no longer appear in the **STDIO** window, and will display again once TxC is connected back to RxC.

The two startup mode pins determine what happens after a reset—the Rabbit 3000 is either cold-booted or the program begins executing at address 0x0000.

The status pin is used by Dynamic C to determine whether a Rabbit microprocessor is present. The status output has three different programmable functions:

1. It can be driven low on the first op code fetch cycle.
2. It can be driven low during an interrupt acknowledge cycle.
3. It can also serve as a general-purpose output.

The /RESET_IN pin is an external input that is used to reset the Rabbit 3000 and the RCM3100 onboard peripheral circuits. The serial programming port can be used to force a hard reset on the RCM3100 by asserting the /RESET_IN signal.

Refer to the ***Rabbit 3000 Microprocessor User's Manual*** for more information.

4.3 Serial Programming Cable

The programming cable is used to connect the serial programming port of the RCM3100 to a PC serial COM port. The programming cable converts the RS-232 voltage levels used by the PC serial port to the CMOS voltage levels used by the Rabbit 3000.

When the **PROG** connector on the programming cable is connected to the RCM3100 serial programming port at header J3, programs can be downloaded and debugged over the serial interface.

The **DIAG** connector of the programming cable may be used on header J3 of the RCM3100 with the RCM3100 operating in the Run Mode. This allows the programming port to be used as a regular serial port.

4.3.1 Changing Between Program Mode and Run Mode

The RCM3100 is automatically in Program Mode when the **PROG** connector on the programming cable is attached, and is automatically in Run Mode when no programming cable is attached. When the Rabbit 3000 is reset, the operating mode is determined by the status of the SMODE pins. When the programming cable's **PROG** connector is attached, the SMODE pins are pulled high, placing the Rabbit 3000 in the Program Mode. When the programming cable's **PROG** connector is not attached, the SMODE pins are pulled low, causing the Rabbit 3000 to operate in the Run Mode.

5.2 Dynamic C Function Calls

5.2.1 I/O

The RCM3100 was designed to interface with other systems, and so there are no drivers written specifically for the I/O. The general Dynamic C read and write functions allow you to customize the parallel I/O to meet your specific needs. For example, use

```
WrPortI(PEDDR, &PEDDRShadow, 0x00);
```

to set all the Port E bits as inputs, or use

```
WrPortI(PEDDR, &PEDDRShadow, 0xFF);
```

to set all the Port E bits as outputs.

When using the auxiliary I/O bus on the Rabbit 3000 chip, add the line

```
#define PORTA_AUX_IO    // required to enable auxiliary I/O bus
```

to the beginning of any programs using the auxiliary I/O bus.

The sample programs in the Dynamic C **SAMPLES/RCM3100** directory provide further examples.

5.2.2 Serial Communication Drivers

Library files included with Dynamic C provide a full range of serial communications support. The **RS232.LIB** library provides a set of circular-buffer-based serial functions. The **PACKET.LIB** library provides packet-based serial functions where packets can be delimited by the 9th bit, by transmission gaps, or with user-defined special characters. Both libraries provide blocking functions, which do not return until they are finished transmitting or receiving, and nonblocking functions, which must be called repeatedly until they are finished. For more information, see the ***Dynamic C User's Manual*** and Technical Note 213, ***Rabbit 2000 Serial Port Software***.

5.2.3 Prototyping Board Functions

The function described in this section is for use with the Prototyping Board. The source code is in the **RCM3100.LIB** library in the Dynamic C **SAMPLES\RCM3100** folder if you need to modify it for your own board design.

Other generic functions applicable to all devices based on Rabbit microprocessors are described in the ***Dynamic C Function Reference Manual***.

5.2.3.1 Board Initialization

```
void brdInit (void);
```

Call this function at the beginning of your program. This function initializes Parallel Ports A through G for use with the RCM3000/31/32XX Prototyping Board.

This function also sets any unused configurable port pins as outputs with a high output, and assumes that only one RCM3100 module is installed in the **MASTER** position on the Prototyping Board.

RETURN VALUE

None.

Figure A-4 shows a typical timing diagram for the Rabbit 3000 microprocessor external I/O read and write cycles.

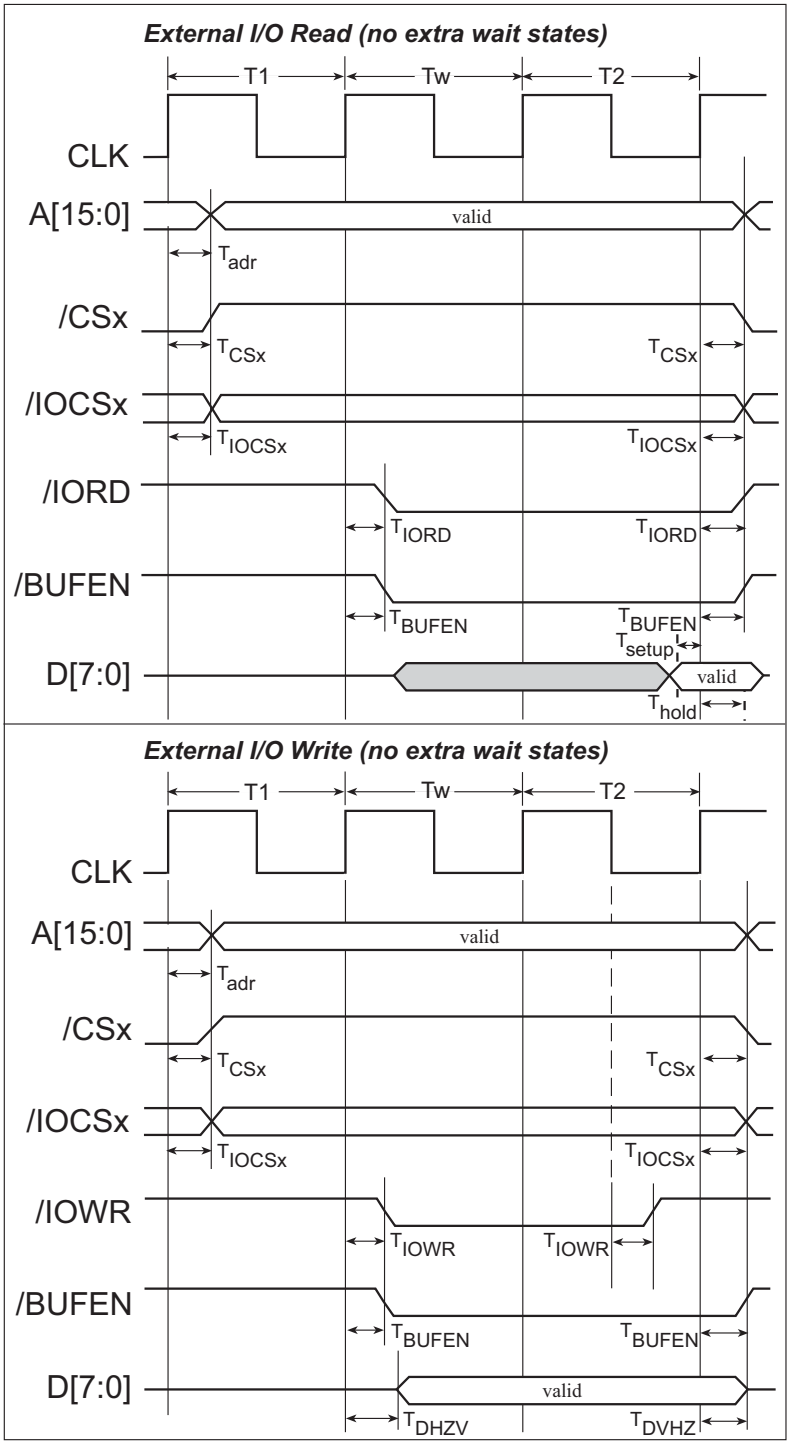


Figure A-4. External I/O Read and Write Cycles—No Extra Wait States

NOTE: /IOCSx can be programmed to be active low (default) or active high.

A.3 Rabbit 3000 DC Characteristics

Table A-5 outlines the DC characteristics for the Rabbit 3000 at 3.3 V over the recommended operating temperature range from T_a = –55°C to +125°C. Note that while the Rabbit 3000 is rated to operate over a voltage range from 3.0–3.6 V, the RCM3100 has a more restrictive operating voltage range of 3.15–3.45 V DC.

Table A-5. 3.3 Volt DC Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
I_{IH}	Input Leakage High	$V_{IN} = V_{DD}$, V_{DD} = 3.3 V			1	µA
I_{IL}	Input Leakage Low (no pull-up)	$V_{IN} = V_{SS}$, V_{DD} = 3.3 V	-1			µA
I_{OZ}	Output Leakage (no pull-up)	$V_{IN} = V_{DD}$ or V_{SS}, V_{DD} = 3.3 V	-1		1	µA
V_{IL}	CMOS Input Low Voltage				$0.3 \times V_{DD}$	V
V_{IH}	CMOS Input High Voltage		$0.7 \times V_{DD}$			V
V_T	CMOS Switching Threshold	V_{DD} = 3.3 V, 25°C		1.65		V
V_{OL}	Low-Level Output Voltage	I_{OL} = 6 mA			0.4	V
V_{OH}	High-Level Output Voltage	I_{OH} =6 mA	$0.7 \times V_{DD}$			V

- **RS-232**—Two 3-wire or one 5-wire RS-232 serial port are available on the Prototyping Board. Refer to the Prototyping Board schematic (090-0137) for additional details.

  A 10-pin 0.1-inch spacing header strip is installed at J5 to permit connection of a ribbon cable leading to a standard DE-9 serial connector.

- **Current Measurement Option**—Jumpers across pins 1–2 and 5–6 on header JP1 can be removed and replaced with an ammeter across the pins to measure the current drawn from the +5 V or the +3.3 V supplies, respectively.

- **Motor Encoder**—A motor/encoder header is provided at header J6 for future use.

- **LCD/Keypad Module**—Rabbit Semiconductor's LCD/keypad module may be plugged in directly to headers J7, J8, and J10.

B.2 Mechanical Dimensions and Layout

Figure B-2 shows the mechanical dimensions and layout for the Prototyping Board.

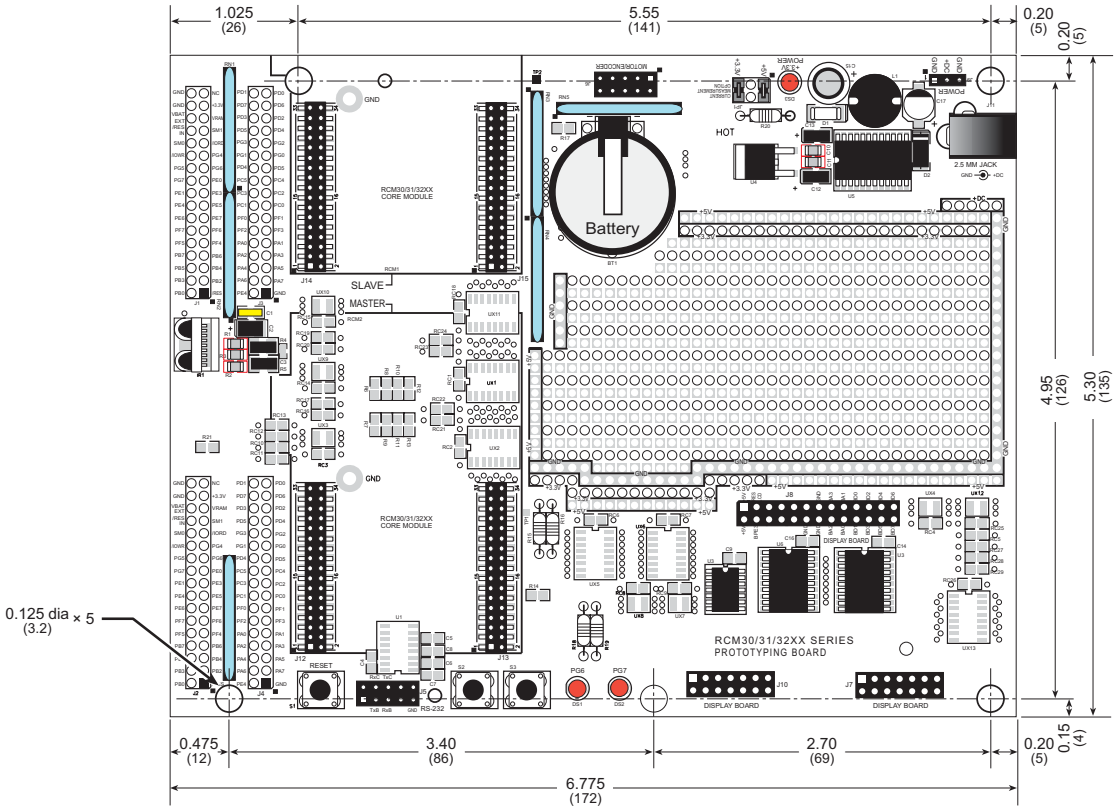


Figure B-2. RCM30/31/32XX Prototyping Board Dimensions

NOTE: All measurements are in inches followed by millimeters enclosed in parentheses. All dimensions have a manufacturing tolerance of ±0.01" (0.25 mm).

C.4 Header Pinouts

Figure C-6 shows the pinouts for the LCD/keypad module.

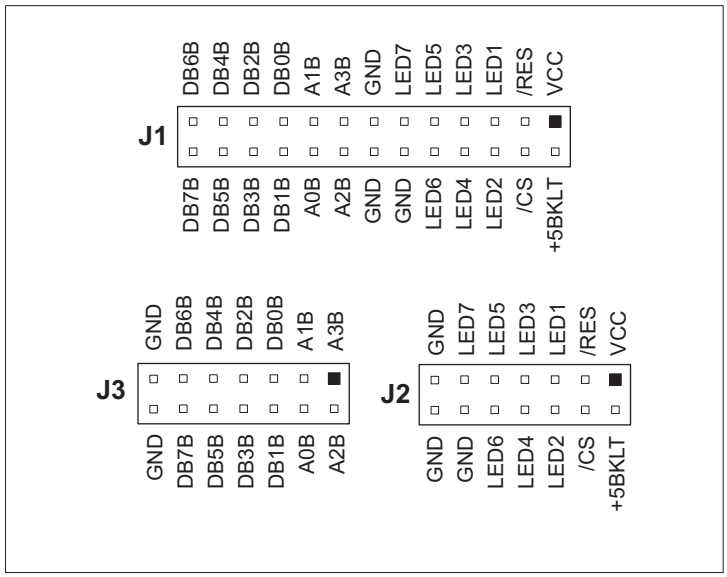


Figure C-6. LCD/Keypad Module Pinouts

C.4.1 I/O Address Assignments

The LCD and keypad on the LCD/keypad module are addressed by the /CS strobe as explained in Table C-2.

Table C-2. LCD/Keypad Module Address Assignment

Address	Function
0xC000	Device select base address (/CS)
0xCxx0–0xCxx7	LCD control
0xCxx8	LED enable
0xCxx9	Not used
0xCxxA	7-key keypad
0xCxxB (bits 0–6)	7-LED driver
0xCxxB (bit 7)	LCD backlight on/off
0xCxxC–CxxF	Not used

C.7.3 LCD Display

The functions used to control the LCD display are contained in the **GRAPHIC.LIB** library located in the Dynamic C **DISPLAYS\GRAPHIC** library directory.

void glInit(void);

Initializes the display devices, clears the screen.

RETURN VALUE

None.

SEE ALSO

glDispOnOFF, glBacklight, glSetContrast, glPlotDot, glBlock, glPlotDot, glPlotPolygon, glPlotCircle, glHScroll, glVScroll, glXFontInit, glPrintf, glPutChar, glSetBrushType, glBuffLock, glBuffUnlock, glPlotLine

void glBackLight(int onOff);

Turns the display backlight on or off.

PARAMETER

onOff turns the backlight on or off

1—turn the backlight on
0—turn the backlight off

RETURN VALUE

None.

SEE ALSO

glInit, glDispOnoff, glSetContrast

void glDispOnOff(int onOff);

Sets the LCD screen on or off. Data will not be cleared from the screen.

PARAMETER

onOff turns the LCD screen on or off

1—turn the LCD screen on
0—turn the LCD screen off

RETURN VALUE

None.

SEE ALSO

glInit, glSetContrast, glBackLight

void glSetContrast(unsigned level);

Sets display contrast.

NOTE: This function is not used with the LCD/keypad module since the support circuits are not available on the LCD/keypad module.

void glFillScreen(char pattern);

Fills the LCD display screen with a pattern.

PARAMETER

The screen will be set to all black if **pattern** is 0xFF, all white if **pattern** is 0x00, and vertical stripes for any other pattern.

RETURN VALUE

None.

SEE ALSO

glBlock, glBlankScreen, glPlotPolygon, glPlotCircle

void glBlankScreen(void);

Blanks the LCD display screen (sets LCD display screen to white).

RETURN VALUE

None.

SEE ALSO

glFillScreen, glBlock, glPlotPolygon, glPlotCircle

void glBlock(int x, int y, int bmWidth, int bmHeight);

Draws a rectangular block in the page buffer and on the LCD if the buffer is unlocked. Any portion of the block that is outside the LCD display area will be clipped.

PARAMETERS

x is the *x* coordinate of the top left corner of the block.

y is the *y* coordinate of the top left corner of the block.

bmWidth is the width of the block.

bmWidth is the height of the block.

RETURN VALUE

None.

SEE ALSO

glFillScreen, glBlankScreen, glPlotPolygon, glPlotCircle

void glFillVPolygon(int n, int *pFirstCoord);

Fills a polygon in the LCD page buffer and on the LCD screen if the buffer is unlocked. Any portion of the polygon that is outside the LCD display area will be clipped. If fewer than 3 vertices are specified, the function will return without doing anything.

PARAMETERS

n is the number of vertices.

***pFirstCoord** is a pointer to array of vertex coordinates: **x1,y1, x2,y2, x3,y3,...**

RETURN VALUE

None.

SEE ALSO

glFillPolygon, glPlotPolygon, glPlotVPolygon

void glFillPolygon(int n, int x1, int y1, int x2, int y2, ...);

Fills a polygon in the LCD page buffer and on the LCD if the buffer is unlocked. Any portion of the polygon that is outside the LCD display area will be clipped. If fewer than 3 vertices are specified, the function will return without doing anything.

PARAMETERS

n is the number of vertices.

x1 is the *x* coordinate of the first vertex.

y1 is the *y* coordinate of the first vertex.

x2 is the *x* coordinate of the second vertex.

y2 is the *y* coordinate of the second vertex.

... are the coordinates of additional vertices.

RETURN VALUE

None.

SEE ALSO

glFillVPolygon, glPlotPolygon, glPlotVPolygon

void glPlotCircle(int xc, int yc, int rad);

Draws the outline of a circle in the LCD page buffer and on the LCD if the buffer is unlocked. Any portion of the circle that is outside the LCD display area will be clipped.

PARAMETERS

xc is the *x* coordinate of the center of the circle.

yc is the *y* coordinate of the center of the circle.

rad is the radius of the center of the circle (in pixels).

RETURN VALUE

None.

SEE ALSO

glFillCircle, glPlotPolygon, glFillPolygon

void glPutFont(int x, int y, fontInfo *pInfo, char code);

Puts an entry from the font table to the page buffer and on the LCD if the buffer is unlocked. Each font character's bitmap is column major and byte-aligned. Any portion of the bitmap character that is outside the LCD display area will be clipped.

PARAMETERS

x is the *x* coordinate (column) of the top left corner of the text.

y is the *y* coordinate (row) of the top left corner of the text.

***pInfo** is a pointer to the font descriptor.

code is the ASCII character to display.

RETURN VALUE

None.

SEE ALSO

glFontCharAddr, glPrintf

void glSetPfStep(int stepX, int stepY);

Sets the **glPrintf()** printing step direction. The *x* and *y* step directions are independent signed values. The actual step increments depend on the height and width of the font being displayed, which are multiplied by the step values.

PARAMETERS

stepX is the **glPrintf** *x* step value

stepY is the **glPrintf** *y* step value

RETURN VALUE

None.

SEE ALSO

Use **glGetPfStep()** to examine the current *x* and *y* printing step direction.

int glGetPfStep(void);

Gets the current **glPrintf()** printing step direction. Each step direction is independent of the other, and is treated as an 8-bit signed value. The actual step increments depends on the height and width of the font being displayed, which are multiplied by the step values.

RETURN VALUE

The *x* step is returned in the MSB, and the *y* step is returned in the LSB of the integer result.

SEE ALSO

Use **glGetPfStep()** to control the *x* and *y* printing step direction.

void glLeft1(int left, int top, int cols, int rows);

Scrolls byte-aligned window left one pixel, right column is filled by current pixel type (color).

PARAMETERS

left is the top left corner of bitmap, must be evenly divisible by 8, otherwise truncates.

top is the top left corner of the bitmap.

cols is the number of columns in the window, must be evenly divisible by 8, otherwise truncates.

rows is the number of rows in the window.

RETURN VALUE

None.

SEE ALSO

glHScroll, glRight1

void glRight1(int left, int top, int cols, int rows);

Scrolls byte-aligned window right one pixel, left column is filled by current pixel type (color).

PARAMETERS

left is the top left corner of bitmap, must be evenly divisible by 8, otherwise truncates.

top is the top left corner of the bitmap.

cols is the number of columns in the window, must be evenly divisible by 8, otherwise truncates.

rows is the number of rows in the window.

RETURN VALUE

None.

SEE ALSO

glHScroll, glLeft1

void glUp1(int left, int top, int cols, int rows);

Scrolls byte-aligned window up one pixel, bottom column is filled by current pixel type (color).

PARAMETERS

left is the top left corner of bitmap, must be evenly divisible by 8, otherwise truncates.

top is the top left corner of the bitmap.

cols is the number of columns in the window, must be evenly divisible by 8, otherwise truncates.

rows is the number of rows in the window.

RETURN VALUE

None.

SEE ALSO

glVScroll, glDown1

```
void glXPutFastmap(int left, int top, int width,
   int height, unsigned long bitmap);
```

Draws bitmap in the specified space. The data for the bitmap are stored in **xmem**. This function is like **glXPutBitmap**, except that it is faster. The restriction is that the bitmap must be byte-aligned.

Any portion of a bitmap image or character that is outside the LCD display area will be clipped.

PARAMETERS

left is the top left corner of the bitmap, must be evenly divisible by 8, otherwise truncates.

top is the top left corner of the bitmap.

width is the width of the bitmap, must be evenly divisible by 8, otherwise truncates.

height is the height of the bitmap.

bitmap is the address of the bitmap in **xmem**.

RETURN VALUE

None.

SEE ALSO

glXPutBitmap, glPrintf

```
int TextWindowFrame(windowFrame *window,
   fontInfo *pFont, int x, int y, int winWidth,
   int winHeight)
```

Defines a text-only display window. This function provides a way to display characters within the text window using only character row and column coordinates. The text window feature provides end-of-line wrapping and clipping after the character in the last column and row is displayed.

NOTE: Execute the **TextWindowFrame** function before other **Text...** functions.

PARAMETERS

***window** is a window frame descriptor pointer.

***pFont** is a font descriptor pointer.

x is the *x* coordinate of where the text window frame is to start.

y is the *y* coordinate of where the text window frame is to start.

winWidth is the width of the text window frame.

winHeight is the height of the text window frame.

RETURN VALUE

0—window frame was successfully created.
-1—*x* coordinate + width has exceeded the display boundary.
-2—*y* coordinate + height has exceeded the display boundary.

APPENDIX D. POWER SUPPLY

Appendix D provides information on the current requirements of the RCM3100, and includes some background on the chip select circuit used in power management.

D.1 Power Supplies

The RCM3100 requires a regulated 3.3 V ± 0.15 V DC power source. The RabbitCore design presumes that the voltage regulator is on the user board, and that the power is made available to the RCM3100 board through header J2.

An RCM3100 with no loading at the outputs operating at 29.4 MHz typically draws 75 mA. The RCM3100 will consume an additional 10 mA when the programming cable is used to connect the programming header, J3, to a PC.

D.1.1 Battery-Backup Circuits

The RCM3100 does not have a battery, but there is provision for a customer-supplied battery to back up SRAM and keep the internal Rabbit 3000 real-time clock running.

Header J2, shown in Figure D-1, allows access to the external battery. This header makes it possible to connect an external 3 V power supply. This allows the SRAM and the internal Rabbit 3000 real-time clock to retain data with the RCM3100 powered down.

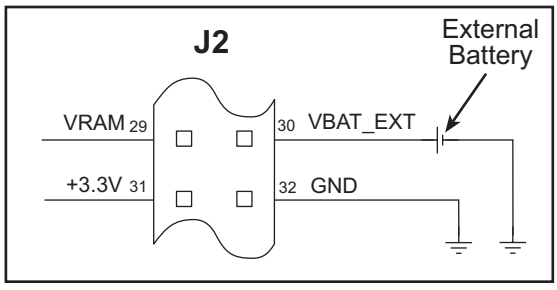


Figure D-1. External Battery Connections at Header J5

A lithium battery with a nominal voltage of 3 V and a minimum capacity of 165 mA·h is recommended. A lithium battery is strongly recommended because of its nearly constant nominal voltage over most of its life.

APPENDIX E. MOTOR CONTROL FEATURES

The RCM30/31/32XX Prototyping Board has a header at J6 for a motor control connection. While Rabbit Semiconductor does not have the drivers or a compatible stepper motor control board at this time, this appendix provides additional information about Parallel Port F on the Rabbit 3000 microprocessor to enable you to develop your own application.

E.1 Overview

The Parallel Port F connector on the Prototyping Board, J6, gives access to all 8 pins of Parallel Port F, along with +5 V. This appendix describes the function of each pin, and the ways they may be used for motion-control applications. It should be read in conjunction with the ***Rabbit 3000 Microprocessor User's Manual*** and the RCM3100 and the RCM3000/RCM3100/RCM3200 Prototyping Board schematics.

E.6 Quadrature Decoder

The two-channel Quadrature Decoder accepts inputs via Parallel Port F from two external optical incremental encoder modules. Each channel of the Quadrature Decoder accepts an in-phase (I) and a quadrature-phase (Q) signal, and provides 8-bit counters to track shaft rotation and provide interrupts when the count goes through the zero count in either direction. The Quadrature Decoder contains digital filters on the inputs to prevent false counts and is clocked by the output of Timer A10. Each Quadrature Decoder channel accepts inputs from either the upper nibble or lower nibble of Parallel Port F. The I signal is input on an odd-numbered port bit, while the Q signal is input on an even-numbered port bit. There is also a disable selection, which is guaranteed not to generate a count increment or decrement on either entering or exiting the disable state. The operation of the counter as a function of the I and Q inputs is shown below.

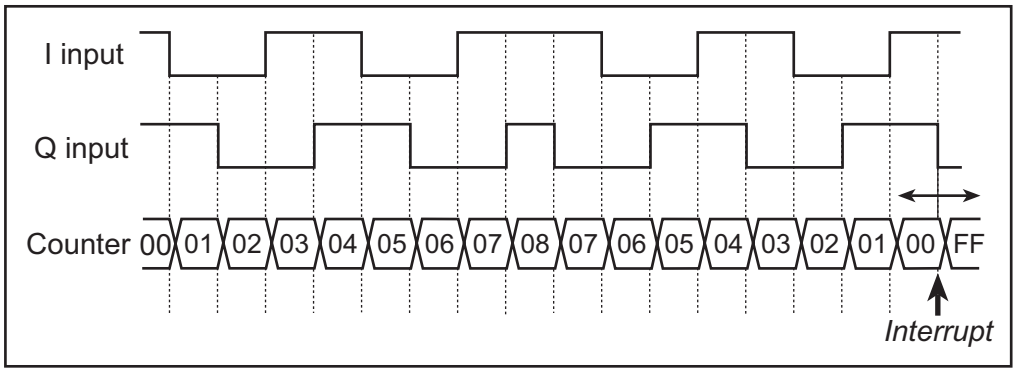
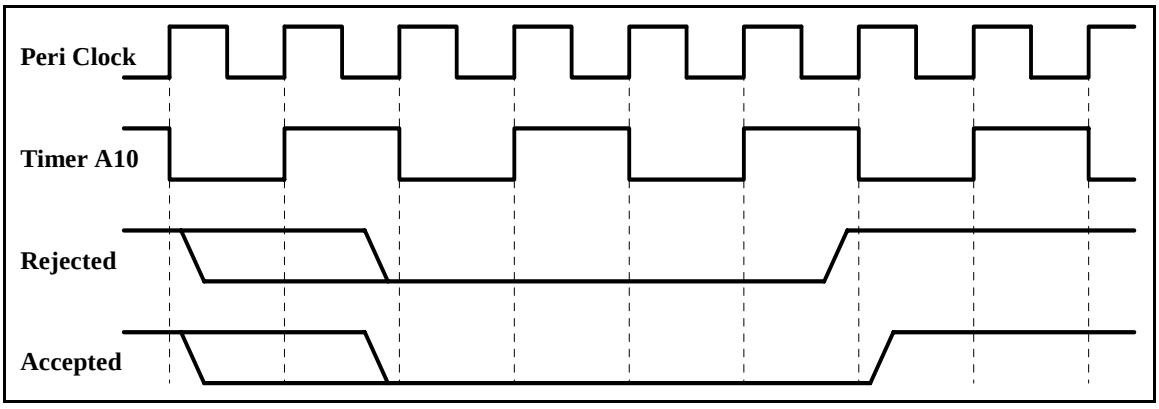


Figure E-2. Operation of Quadrature Decoder Counter

The Quadrature Decoders are clocked by the output of Timer A10, giving a maximum clock rate of one-half of the peripheral clock rate. The time constant of Timer A10 must be fast enough to sample the inputs properly. Both the I and Q inputs go through a digital filter that rejects pulses shorter than two clock periods wide. In addition, the clock rate must be high enough that transitions on the I and Q inputs are sampled in different clock cycles. The Input Capture (see the ***Rabbit 3000 Microprocessor Users Manual***) may be used to measure the pulse width on the I inputs because they come from the odd-numbered port bits. The operation of the digital filter is shown below.



SCHEMATICS

090-0144 RCM3100 Schematic

www.rabbit.com/documentation/schemat/090-0144.pdf

090-0137 RCM3000/RCM3100/RCM3200 Prototyping Board Schematic

www.rabbit.com/documentation/schemat/090-0137.pdf

090-0156 LCD/Keypad Module Schematic

www.rabbit.com/documentation/schemat/090-0156.pdf

090-0128 Programming Cable Schematic

www.rabbit.com/documentation/schemat/090-0128.pdf

You may use the URL information provided above to access the latest schematics directly.