System Board 6332

MAXREFDES130#: Building Automation Shield

MAXREFDES130# is an Arduino® form-factor shield compatible with ARM® mbed™ and Arduino platforms providing a complete reference for prototyping your next building automation design. This design includes eight 0VDC-10VDC analog outputs, one 4-20mA output, one 4-20mA input, eight nonlatching relays, three latching relays, an RTC, and 1-Wire® master. The MAXREFDES130# works well with one or more of the MAXREFDES131#, the 1-Wire®, Grid EYE® sensor, to make a complete building automation solution.

Features

- Analog IO
  - Eight OVDC-10VDC outputs
  - One 4-20mA Output
  - One 4-20mA Input
- Arduino compatible
- ARM mbed compatible
- AC load switching
- Latching relays for thermostat control
- RTC

Competitive Advantages

- Accelerated development time
- Flexible analog for multiple configurations
- Ease of use

Applications

- Building automation
- IoT
- Animatronics
- Holiday displays

Introduction

Buildings, the stages upon which we play out our personal and business lives, provide tremendous benefits with automation. Energy savings, comfort, and enhanced safety and security are a few of the substantial benefits. In order to maximize these benefits, legacy systems must be integrated with modern control and communications. Enter MAXREFDES130#. This unique design features multiple analog IO, matching the 0V to 10V and 4-20mA systems that are embedded in many buildings and control systems. In addition, both nonlatching and latching relays provide the ability to control multiple power lines and control temperature, both saving energy and ensuring a comfortable climate. Most importantly, MAXREFDES130# features a 1-Wire® master bus for use with MAXREFDES131#, the 1-Wire® Grid-EYE® sensor, bringing modern presence and gesture sensing feedback to the platform.

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Libraries supporting the MAX11300 or PIXI™, MAX4822, DS3231, and 1-Wire have been developed for both mbed and Arduino to support rapid prototyping with MAXREFDES130#. Demonstration programs for both Arduino and mbed are available at the following links respectively.

MAXREFDES130# Arduino Demo
https://github.com/MaximIntegratedRefDesTeam/MAXREFDES130_Demo

MAXREFDES130# mbed Demohttps://developer.mbed.org/teams/Maxim-Integrated/code/MAXREFDES130_Demo/

Figure 1 outlines the generation of the different voltage rails used in MAXREFDES130#.

A single 24VDC power supply, either the provided wall-adapter or a user-supplied bench power supply, provides power to the design through either J1 or TB11, respectively. Use JP1 to select either the wall adapter or the bench supply.

The dual output MAX17521 and single-output MAX15062 efficiently step down the 24V input to the following voltage rails;

- MAX17521, 5V at 0.5A for the 5V coils of the nonlatching relays K1-K9.
- MAX17521, 7.3V at 0.5A sourcing V_{IN} of the user-supplied mbed or Arduino platform.
- MAX15062, 12V AVDDIO positive supply for mixed signal IO of the PIXI.

The output of the MAX15062 is further converted to the following rails;

- MAX5091A, 5V AVDD analog supply of the PIXI.
- MAX5091B, 3.3V DVDD digital supply of PIXI, DS2484, DS3231, and logic-level translators.
- MAX889, -2V AVSSIO negative supply for mixed signal IO of the PIXI.

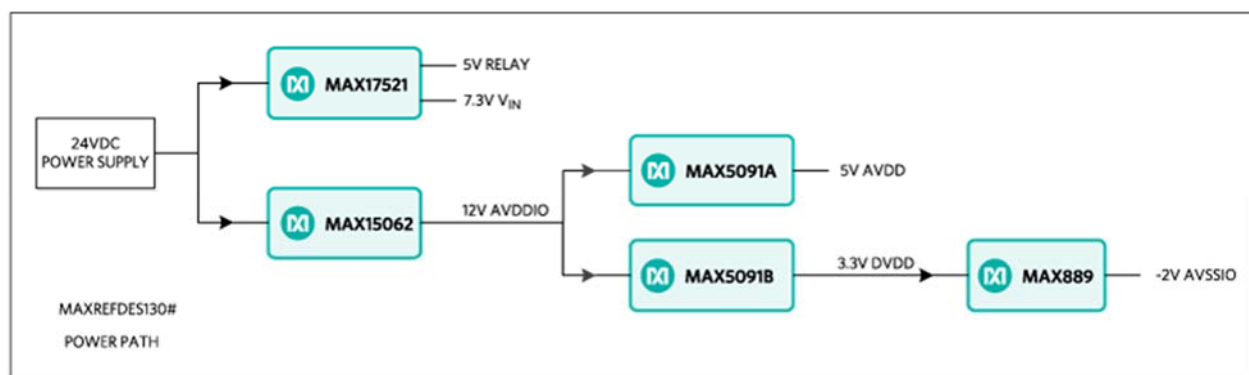All six voltage rails have LED indicators, D3-D8, providing visual indication of their operation.

Figure 1. MAXREFDES130# power path.

Figure 2 provides a block diagram of MAXREFDES130# sub-systems.

The MAX3392, MAX3393, and MAX3394 provide logic-level translation between the host platform and MAXREFDES130#. The platform side of the LTs use IOREF of the platform as a reference. The other side is 3.3V logic. All DIO of the Arduino pin configuration, D0-D15, is used for the reference design except for D0-D3. D0 and D1 are broke out to 0.1in male header H6.

The MAX4822 relay driver interfaces to the host controller over the SPI bus and controls nonlatching relays K1-K8. The contacts of K1-K8 are rated for 250VAC/100VDC 10A max. The MAX11300, PIXI, also interfaces to the host controller over the SPI bus and is configured for nine DAC outputs, three GPO, and one ADC. The first eight DAC outputs source the 0V-10V analog outputs at TB9. The ninth DAC output provides the control signal for the MAX44244 op-amp configured as a difference amplifier, which drives Q1

pass transistor for sourcing the 4-20mA output AIO at TB12. The three GPO configured ports drive the coils of the latching relays K9-K11. The ADC-configured port senses the 4-20mA input AII using a sense resistor.

The DS3231 RTC and DS2484 1-Wire master both interface to the host controller over the I²C bus. A DS2431 1-Wire EEPROM allows for saving calibration data for the 4-20mA loop. Additional 1-Wire slaves can be accessed with the 6P6C RJ-11 jack J2. 3.3V limited to 0.1A is available at pin 1 of J2.

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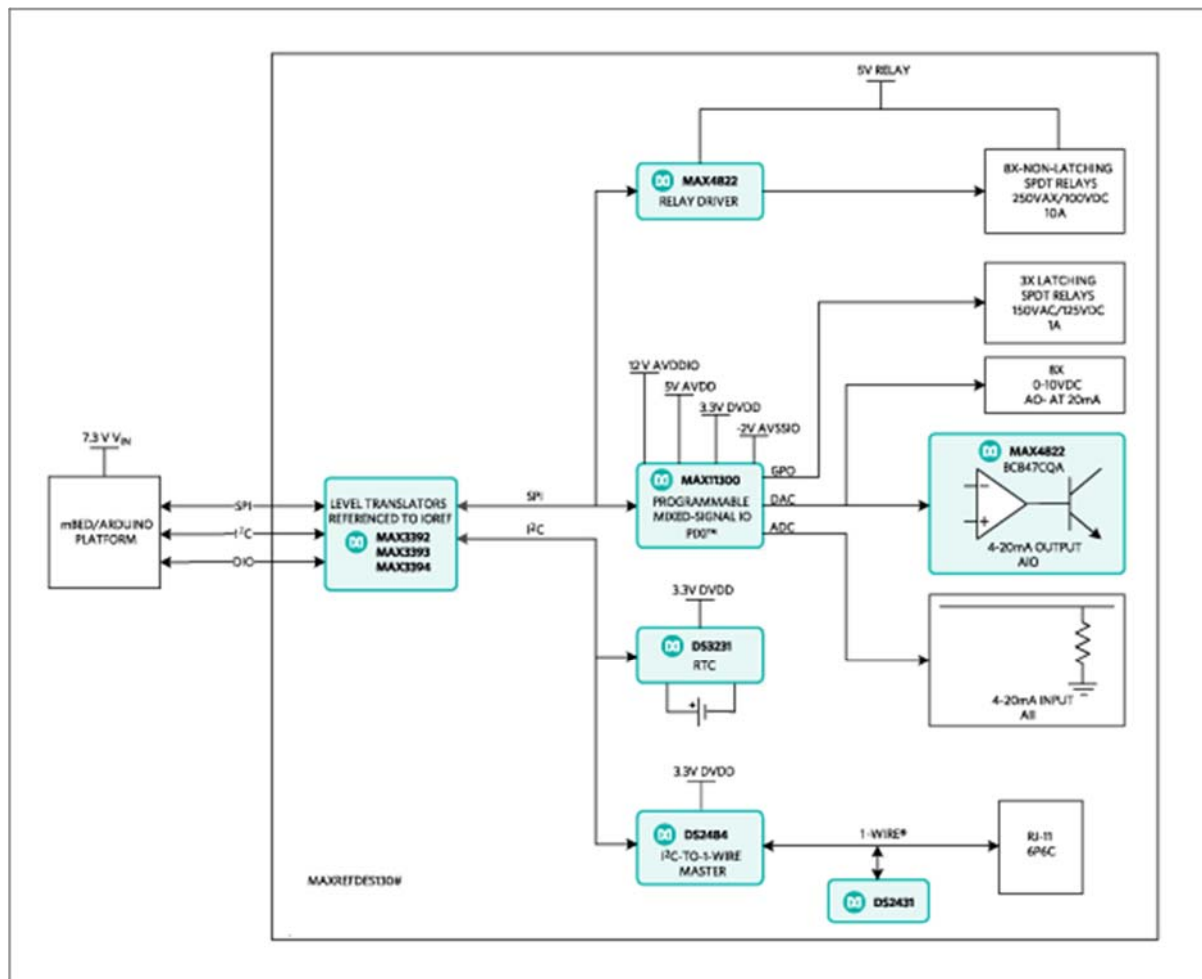

Figure 2. MAXREFDES130# block diagram.

Detailed Description of Firmware

A terminal based demonstration program providing menu options for exercising the features of the reference design has been developed for both Arduino and mbed platforms. The source code of the demo also provides a reference on how to use the

provided libraries for each of the following devices; DS3231 RTC, MAX4822 relay driver, MAX11300 mixed-signal IO, and the DS2484 1-Wire master.

Figure 3 provides a flow chart for the demo program.

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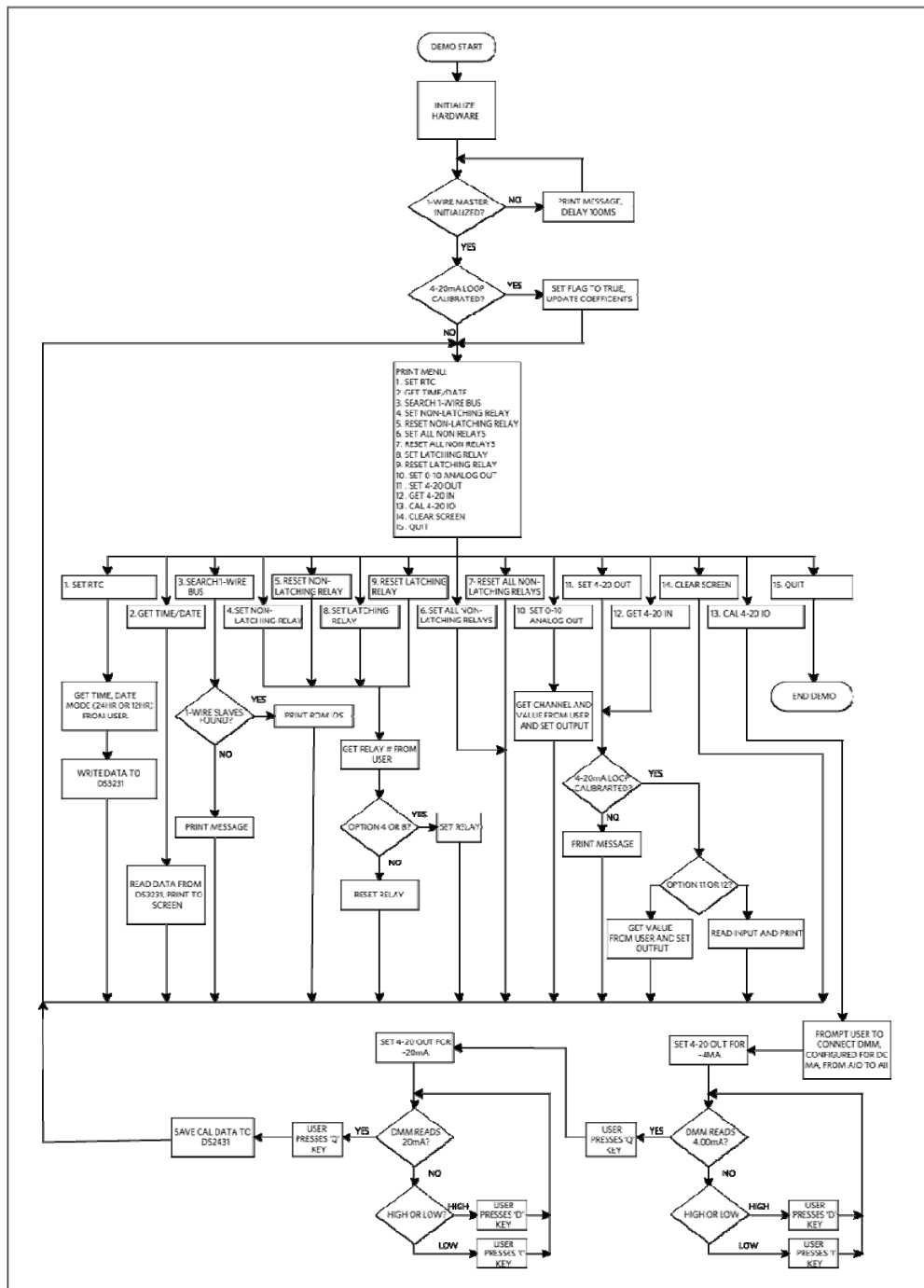

Figure 3. MAXREFDES130# firmware flow chart.

Quick Start

Required equipment:

- Windows® PC with a USB port
- MAXREFDES130#
- Arduino or mbed platform

Procedure:

1. Connect MAXREFDES130# to your platform board.
2. Ensure JP1 is installed on pins 1-2.
3. Connect the appropriate USB cable for your platform from the PC to your platform.
4. Plug the provided wall adapter into the wall and connect to J1 of MAXREFDES130#.

mbed.org

5. If you have never used mbed, set up an account and add your platform to your online compiler per the instructions on your platform's product page.
6. If you are using Windows and have never used serial communications between your PC and your mbed platform, follow the instructions here.
https://developer.mbed.org/handbook/Windows-serial-configuration
7. Navigate your browser to this link. https://developer.mbed.org/teams/Maxim-Integrated/code/MAXREFDES130_Demo/
8. Click the 'Import this program' button and import the demo as a 'program.
9. Compile and download the resulting binary to your platform.
10. Open Hyperterminal, or your favorite terminal emulator, find the appropriate COM port for your platform, and configure the connection for 57600bps, 8-N-1 with no flow control.
11. Ensure the terminal is configured for 'Auto' receive and 'CR+LF' transmit.

Press the reset button on your platform and exercise the demo.

Arduino

5. Download the firmware files for Arduino from the design resources tab of MAXREFDES130#.
6. Install the libraries following the directions here.
https://www.arduino.cc/en/Guide/Libraries
7. Add the demo program to your 'sketches' folder.
8. Ensure that you have the COM port your Arduino board is connected to selected in the Arduino IDE.
9. Download the example program to your Arduino board.
10. Open Hyperterminal, or your favorite terminal emulator, find the appropriate COM port for your platform, and configure the connection for 57600bps, 8-N-1 with no flow control.

11. Ensure the terminal is configured for 'Auto' receive and 'CR+LF' transmit.
12. Select 'local echo' for your terminal emulator.

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https://www.maximintegrated.com/en/design/reference-design-center/system-board/6332.html/tb_tab0