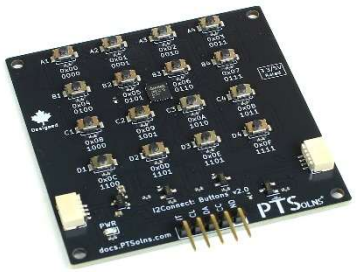
I2Connect: Buttons

Function: User Input

1 DESCRIPTION



The PTSolns I2Connect: Buttons is a compact 16 button keypad module. Designed as part of the I2Connect Series, the module provides a simple and reliable way to add physical user input to embedded systems. The 4 × 4 button matrix features clearly marked alphanumeric, hexadecimal, and binary labels, making it particularly useful for applications involving numerical input, hexadecimal values, binary operations, and interactive control.

Like all I2Connect modules, the I2Connect: Buttons is fully assembled and ready to use out of the box. Dual Qwiic® compatible connectors allow the module to be easily integrated into existing I2C systems without soldering, while the preinstalled right-angle header provides direct access to the I2C bus for breadboard-based prototyping. The module is compatible with both 3.3 V and 5 V systems, making it suitable for use with a wide range of popular microcontroller platforms.

The module features four configurable I2C address selections, allowing up to four I2Connect: Buttons modules to operate on the same I2C bus, providing a total of 64 individual buttons.

The I2Connect: Buttons is intended for applications requiring convenient and flexible user interaction. Typical uses include menu navigation, numerical data entry, hexadecimal input, binary logic demonstrations, password entry, equipment control, educational projects, and interactive embedded systems. Documentation, example programs, and software libraries can help users quickly integrate the module into their projects.

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2 DOCUMENT REVISION HISTORY

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3 PRODUCT FEATURES

This section highlights notable features of the *I2Connect: Buttons.*

3.1 I2Connect Series

The PTSolns *I2Connect* Series is a family of plug and play expansion modules designed to simplify the integration of sensors, displays, user interfaces, and other peripherals into embedded systems. Built around the industry standard I2C communication protocol and featuring convenient Qwiic® compatible connectors (4 pin, 1 mm JST SH), *I2Connect* modules can be quickly connected without soldering or complex wiring.

Each module is fully assembled and includes a preinstalled male header that is compatible with standard solderless breadboards, enabling immediate use and rapid prototyping. Designed to work seamlessly with a wide range of microcontroller platforms, *I2Connect* modules combine compact hardware, comprehensive documentation, and easy-to-use software libraries. The *I2Connect* Series enables makers, students, educators, and professionals to rapidly prototype, evaluate, and develop reliable electronic systems.

The following modules are part of the *I2Connect* Series:

- AHT20: Temperature & Humidity
- VEML7700: Light & Lux
- EEPROM: 2Mbit Memory
- Buttons: User Input via 4x4 Matrix of Buttons
- Digit Display: 2x 7-Segment Displays
- ICP-20100: Pressure & Temperature
- KXTJ3-1057: 3-Axis Accelerometer
- MUX: 4-Channel I2C Multiplexer
- OLED: 0.96” 128x64 OLED Display
- I2C Doctor: Improve I2C Bus
- … and more!

3.2 What is I2C?

Inter Integrated Circuit, commonly abbreviated as I2C (or I²C, IIC), is a synchronous serial communication protocol widely used throughout the electronics industry for interfacing microcontrollers with peripheral devices such as sensors, displays, memory devices, real time clocks, and input/output expanders. The protocol utilizes two communication signals, Serial Data (SDA) and Serial Clock (SCL), in addition to power and ground, enabling multiple devices to communicate over a common bus architecture while minimizing wiring complexity.

Each device connected to an I2C bus is assigned a unique address, typically a 7 bit address. This addressing scheme allows a single bus master, generally a microcontroller, to selectively communicate with individual devices on the shared bus. Standard 7 bit I2C addressing provides up to 112 usable device addresses, permitting a large number of peripherals to coexist on a single communication interface. In applications requiring additional devices, bus multiplexers can be employed to further expand system capacity.

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The I2C specification defines several operating speeds, including Standard Mode (100 kHz), Fast Mode (400 kHz), and Fast Mode Plus (1 MHz). Support for these modes varies by device and application. While I2C was originally intended for communication between devices located on the same printed circuit board, it is commonly used for short cable connections between modules and development boards. Practical cable lengths depend on bus speed, pull up resistor values, wiring quality, and overall bus capacitance. In most embedded applications, cable lengths ranging from a few centimeters to approximately one meter can be achieved reliably, with shorter cable lengths generally permitting higher communication speeds.

The combination of a simple two wire interface, multi device capability, and widespread industry adoption has established I2C as one of the most commonly implemented communication protocols in embedded systems. As a result, I2C is natively supported by the vast majority of modern microcontrollers, development platforms, and peripheral devices.

The oscilloscope capture in Figure 1 shows a typical I2C communication transaction operating at a clock frequency of 100 kHz. The upper trace (purple) represents the SDA (Serial Data) signal, while the lower trace (yellow) represents the SCL (Serial Clock) signal. During communication, the bus master generates the clock pulses on the SCL line, and data is transferred on the SDA line one bit at a time. In accordance with the I2C specification, the state of the SDA signal remains stable while SCL is high and is permitted to change only when SCL is low. Each clock pulse corresponds to the transfer of a single data bit, allowing addresses, commands, and measurement data to be exchanged between the microcontroller and peripheral device. This two wire communication method enables reliable data transfer while maintaining a simple and efficient electrical interface.

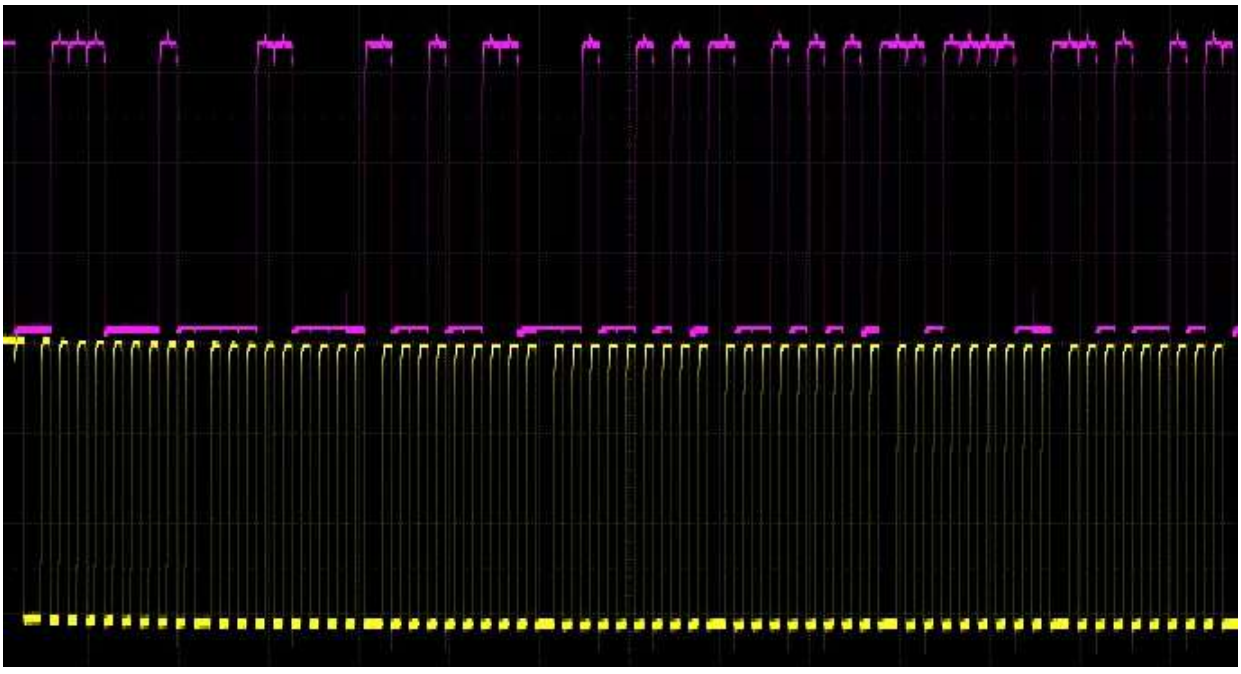


Figure 1: Oscilloscope capture of a typical SDA (top) and SCL (bottom) signal.

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3.3 Technical Features Diagram

The *I2Connect: Buttons* has several technical features depicted in Figure 2.

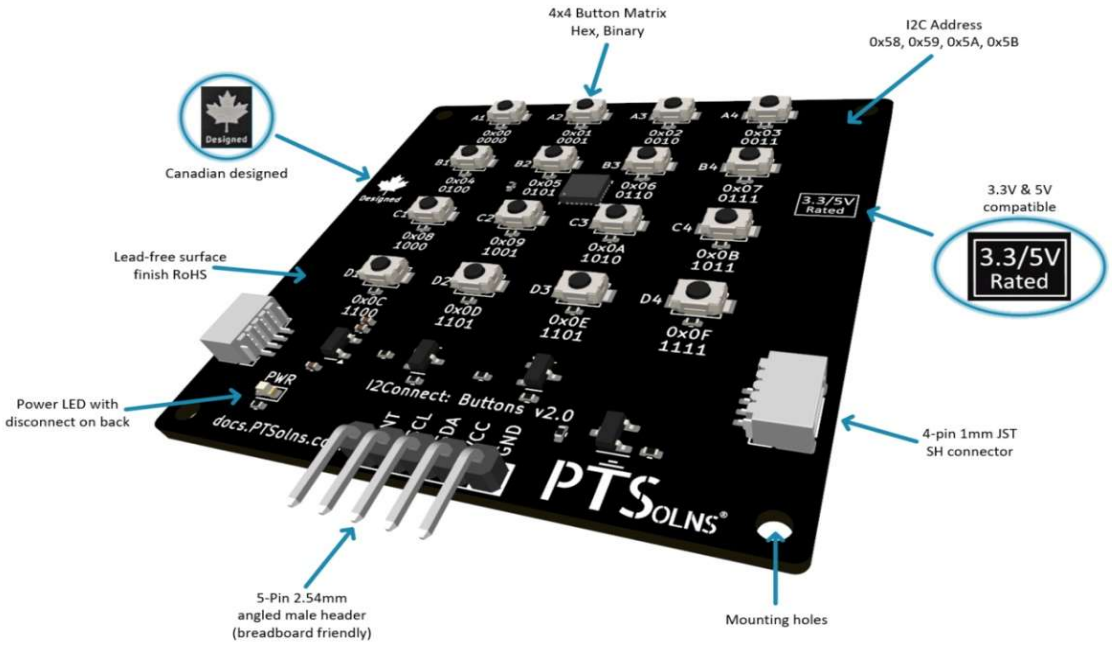


Figure 2: Technical Features Diagram for the I2Connect: Buttons.

3.4 I2C Address

The I2Connect: Buttons module uses a configurable I2C address determined by the AD0 and AD1 solder jumpers on the back of the PCB. The available addresses are:

0x58: AD1 Low, AD0 Low
0x59: AD1 Low, AD0 High
0x5A: AD1 High, AD0 Low
0x5B: AD1 High, AD0 High

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This configurable addressing allows up to four I2Connect: Buttons modules to be connected to the same I2C bus simultaneously. If more than four modules are required in the same system, an I2C multiplexer must be used. The PTSolns I2Connect: MUX module provides four independent I2C channels, allowing additional modules to be connected to a single microcontroller.

3.5 Wired Connection

The most common method of connecting the *I2Connect: Buttons* to a microcontroller is through the two onboard Qwiic® compatible connectors (4 pin, 1 mm JST SH). These connectors provide access to the I2C bus and allow modules to be easily connected without soldering. Both connectors are electrically identical, enabling multiple *I2Connect* modules to be daisy chained together using standard Qwiic® compatible cables. An example of three different *I2Connect* modules daisy-chained together is shown in Figure 3.

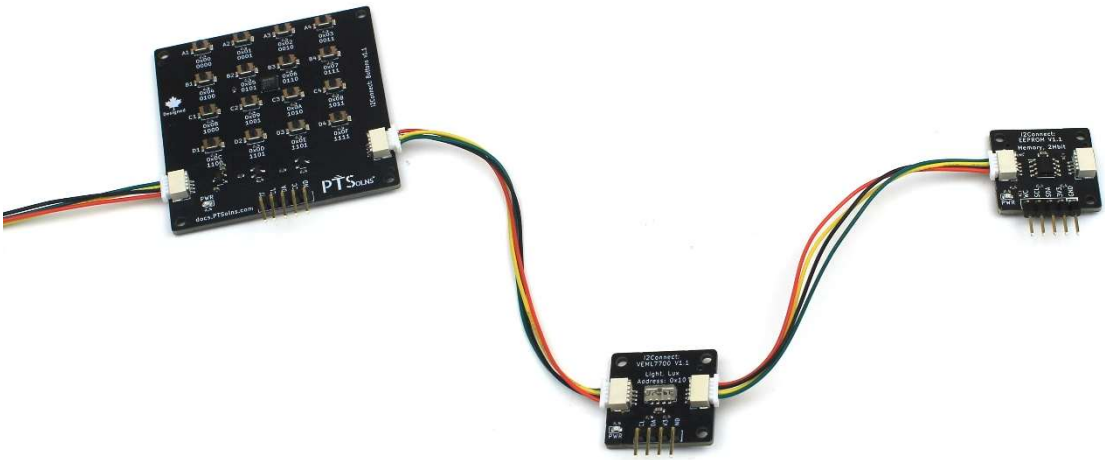


Figure 3: Daisy-Chain of different I2Connect modules.

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3.6 Breadboard Connection

All I2Connect modules are designed to be breadboard friendly and include a preinstalled right angle male header. For the I2Connect: Buttons, this is a 5-pin header exposing the INT, SCL, SDA, VCC, and GND pins. This allows the module to be easily connected to a microcontroller or prototype circuit using a standard solderless breadboard. Right angle headers are intentionally used so that modules stand upright when inserted into a breadboard, improving visibility, accessibility, and user interaction during development, testing, and demonstration.

Figure 4 shows two different *I2Connect* modules connected to a standard solderless breadboard. The modules are daisy chained together through the exposed I2C pins on the preassembled right angle male headers, allowing both devices to share the same I2C bus.

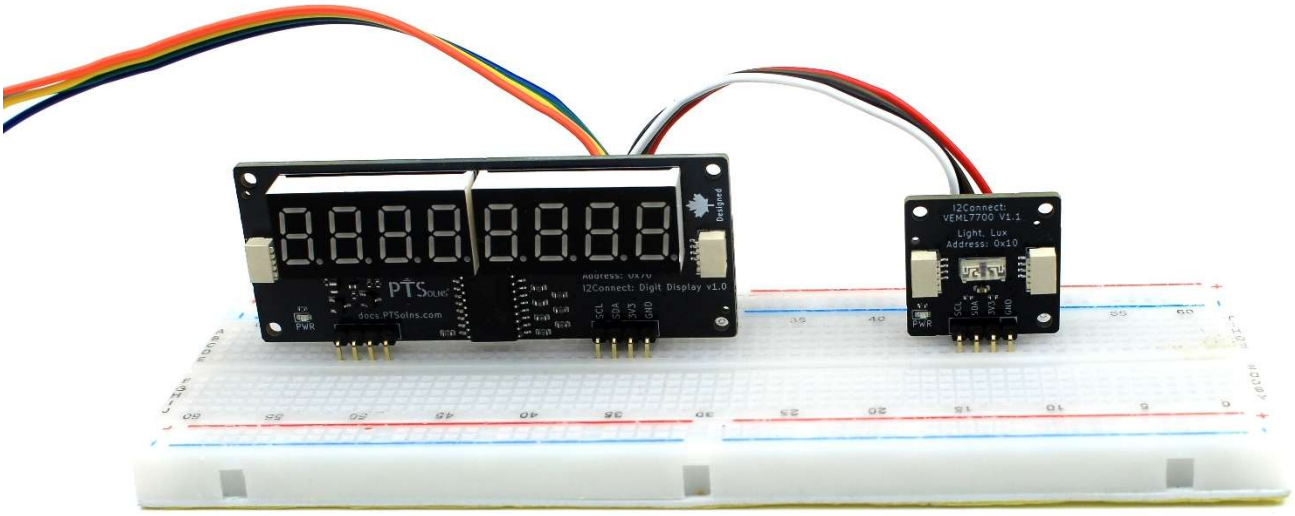


Figure 4: I2Connect modules plugged into standard breadboard.

3.7 Compatibility

All *I2Connect* modules are designed to operate with both 3.3V and 5V microcontroller systems. This flexibility allows the modules to be used with a wide range of popular development platforms without requiring additional level shifting hardware. Modules that support both operating voltages are identified by the “3.3/5V Rated” marking shown in Figure 5.

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Figure 5: The "3.3/5V Rated" compatibility marking found on all I2Connect modules.

The *I2Connect* Series utilizes a 4 pin JST SH connector with a 1.0 mm pitch, following the industry standard Qwiic® pinout. The four connections consist of GND, VCC, SDA, and SCL, providing power and I2C communication through a single compact connector. By adhering to the Qwiic® standard connector and pin ordering, I2Connect modules are electrically compatible with a wide range of Qwiic® and STEMMA QT based devices. Additionally, each module includes a preinstalled angled male header that exposes the same signals (along with the hardware INT pin), allowing the module to be connected directly to virtually any 3.3V or 5V microcontroller system that supports I2C communication, even if a Qwiic® compatible connector is not available.

3.8 Programming & Custom Library

The *I2Connect* Series is designed to integrate seamlessly with all PTSolns microcontroller development boards. Depending on the specific microcontroller, modules can be connected either through onboard Qwiic® compatible connectors or directly through the exposed I2C pins. Since I2C is a widely supported communication standard, *I2Connect* modules can also be used with many third-party development platforms and microcontrollers.

The choice of development environment is entirely up to the user. PTSolns microcontrollers can be programmed using the *PTSolns IDE*, the Arduino IDE, and many other compatible development tools. As long as the selected environment supports the target microcontroller and provides access to the I2C peripheral, it can generally be used with *I2Connect* modules.

To simplify development, the I2Connect: Buttons module is supported by a dedicated software library. This library provides an easy-to-use interface for configuring the AW9523B IC and reading button matrix states. The library can be downloaded directly from GitHub (https://github.com/PTSolns/I2Connect_Buttons) or installed through the Library Manager available in both the PTSolns IDE and Arduino IDE by searching for:

I2Connect_Buttons

Example programs are included with the library and demonstrate common tasks such as device initialization, polling button presses, and handling hardware interrupts. Users are encouraged to review these examples as a starting point for integrating the I2Connect: Buttons module into their own applications.

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3.9 Mark of Authenticity

Authentic PTSolns PCBs have a black solder mask color and are marked with the “PTSolns” logo in white silkscreen printing. The “Canadian Designed” symbol, consisting of the Canadian Maple Leaf with the word “Designed” underneath, can also be found on the PCB in white silkscreen printing. The “PTSolns” trademark and the “Canadian Designed” symbols are shown in Figure 6.



Figure 6: The "Canadian Designed" symbol and "PTSolns" trademark found on authentic PTSolns PCBs.

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4 PHYSICAL PROPERTIES

The physical properties of the *I2Connect: Buttons* are outlined in Table 1.

Table 1: Physical Properties.

	Quantity	Value	Reference
PCB	Length	53.4 mm	Figure 7
	Width	54.8 mm	Figure 7
	Thickness	1.6 mm	--
	Weight (with header, without wire)	12 g	--
	Color	Black	--
	Silkscreen	White	--
Material	Lead free HASL-RoHS surface finish		--
	FR-4 base		--
Mounting Holes	4x each with 2.2 mm diameter		Figure 7

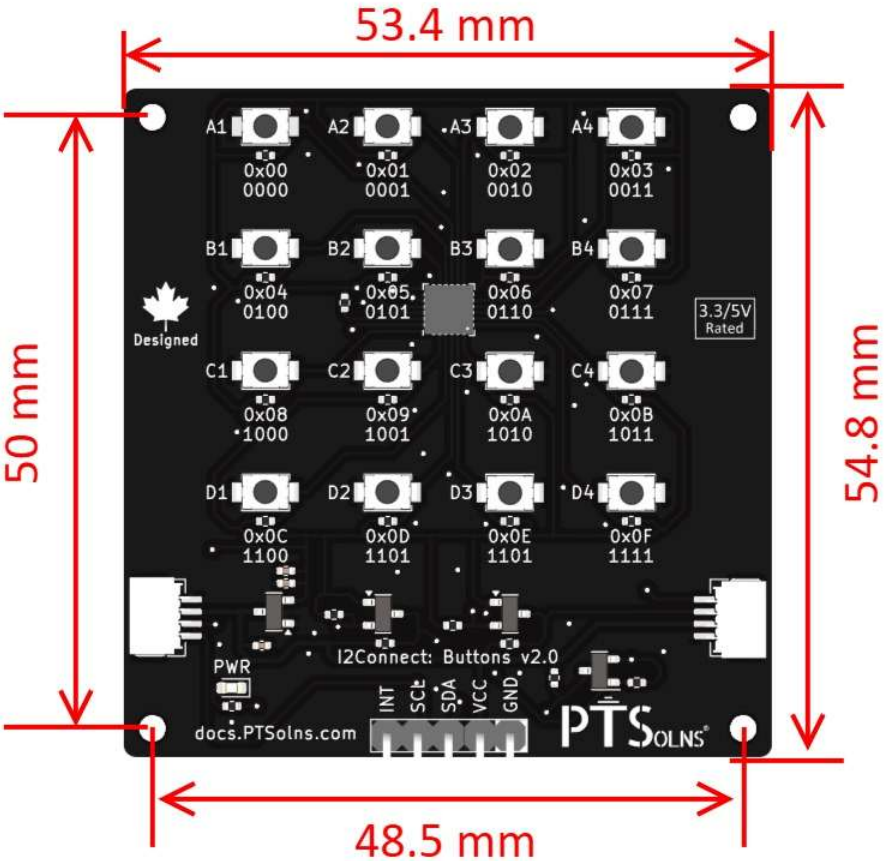


Figure 7: Dimensions of the I2Connect: Buttons.

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REFERENCES

This section lists relevant references.

- *I2Connect: Buttons* Library:
  https://github.com/PTSolns/I2Connect_Buttons

  Or download directly from within *PTSolns IDE* & Arduino IDE using the Library Manager and search:

  I2Connect_Buttons

- PTSolns website:
  https://PTSolns.com

- PTSolns Documentation Repository:
  https://docs.PTSolns.com

- *PTSolns IDE* software:
  https://PTSolns.com/IDE

- PTSolns support:
  https://PTSolns.com/contact-us

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