DigiLot

Elevator Information Convertor Card

Digital Input to Modbus RTU (RS485) Converter Module

User Guide

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Introduction

Features

- Modbus Slave Device on Half Duplex EIA RS485
  - Twisted Pair Cable with Shield
  - Maximum cable length dependent on Baud Rate
- Modbus RTU Protocol
- Digital Input Ports: 28 maximum
  - Channels for 8-bit BCD Digital Input: 1 (8 Inputs)
  - Channels for 4-bit BCD Digital Input: 1 (4 Inputs)
  - Channels for 1-bit Discrete Input: 16 Inputs

LED Status Indication - Communication, Power, Error

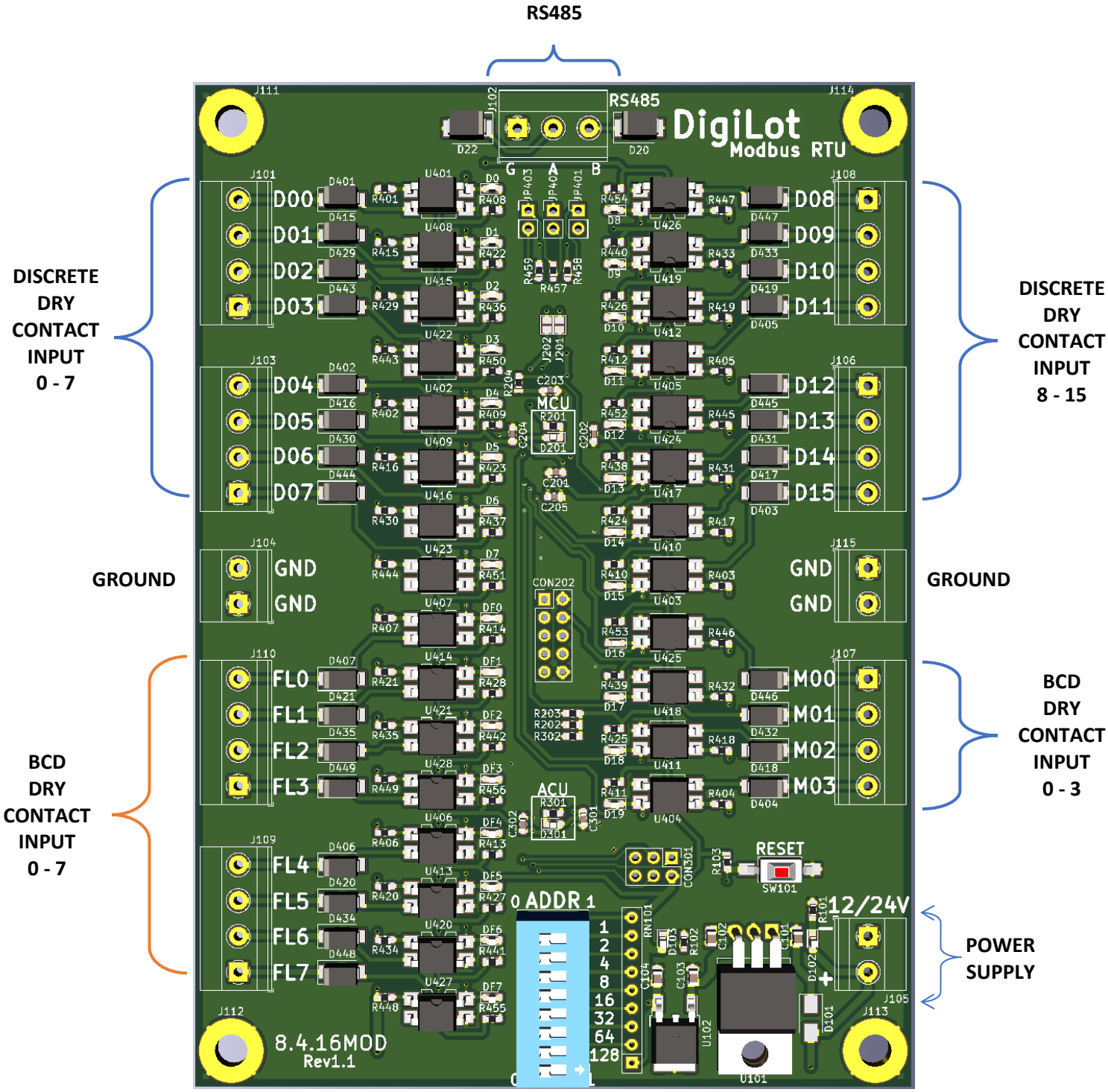
- Configurable Slave ID
- Configurable Baud Rate: 2400 - 38400
  - Default - 9600
- Reset Button
- System Watchdog Timer

Specifications

- Power Supply: (12 - 24) VDC
  - Reverse Polarity Protection
- Digital Input Channels
  - Input Voltage - 30V Max
  - Connector Type - Screw Terminal
  - Input Isolation - 1500 V
  - Input Type - Dry Contact

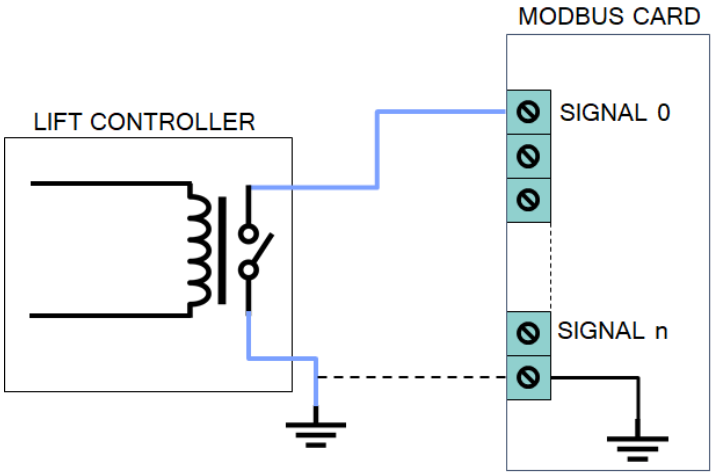
    Logic 0 - GND
    Logic 1 - Open
- Operating Temperature: (-10 to 60) °C
- RS485 Connector - 3 Pin Screw Terminal (D+, D-, GND)
- RS485 Cable Length - 500mts Max

Interface Diagram



Input Interface

The dry/potential free contact scheme is illustrated in the diagram below.



DRY CONTACT CONNECTION DIAGRAM

We assume that the lift controller has a relay, whose coils energize to open or close the relay contact. There is no power source on the relay contacts. The contact should be open (disconnected) which implies Logic 1 and closed (Connected to GND or COM of Modbus Card) which implies Logic 0.

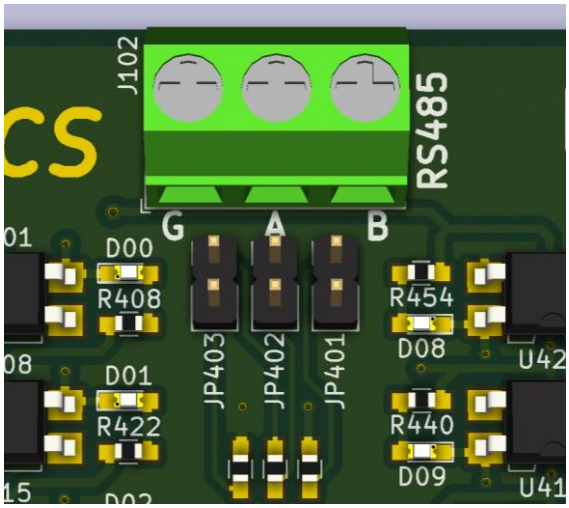
There is LED indication for each input channel in Active Low configuration. If the Signal is connected to Ground, the LED will glow.

RS485 Failsafe and Termination

Jumpers are provided to optionally connect resistors for failsafe operation and provide signal termination incase this is the last node in the bus.

JP402 – 120-ohm termination resistor

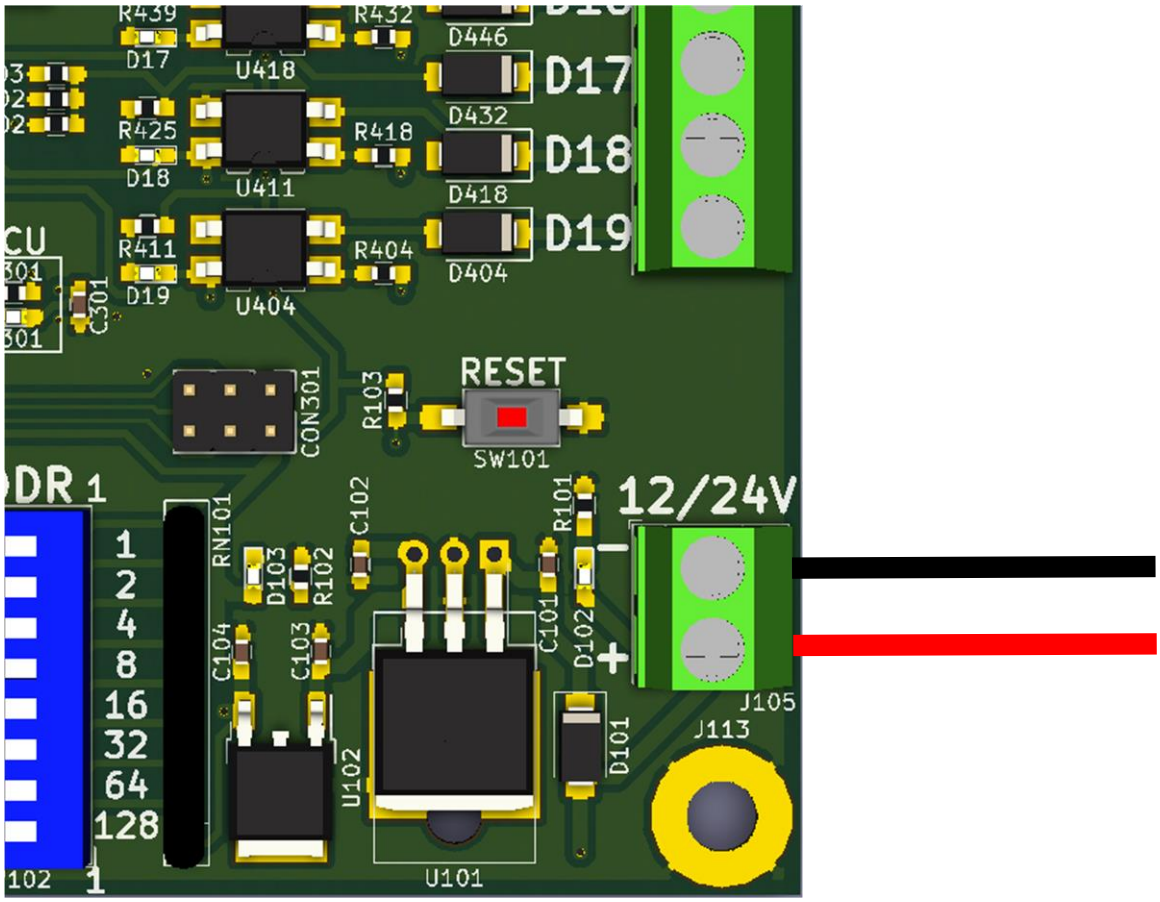
JP401 and JP403 – Failsafe resistors



Board Power Supply

DigiLot board needs an external DC power supply. The typical range is within range of (12 to 24V).

Ensure that the correct polarity is maintained while connecting the power supply. The board has reverse polarity protection.

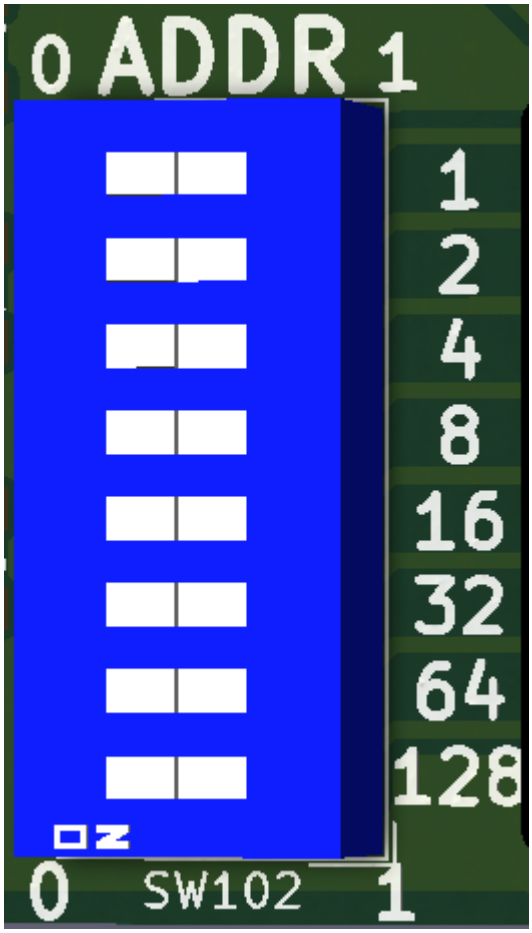


LED D102 will glow if power supply is connected to the board properly.

LED D103 will glow to indicate that power supply section is working.

DigiLot Modbus Slave Address

Address is set using the onboard 8 position DIP Switch.



The switch is configured to accept a binary combination for the slave address.
For example,

If the first and last switch position is set to 1, then the slave address will be (1+128) = 129
If the second and third switch position is set to 1, then the slave address will be (2+4) = 6

The Convertor Card reads the Slave Address from the position of DIP switches in real-time. No power restart is necessary.

Note: Although the Digilot PCB supports certain commands in Broadcast Mode, it is advised not to use the same. In case its used, ensure SW position is set to 0.

RS485 Communication

Communication parameters (factory setting): 9600, N, 8, 2

Parameter	Description
9600	Baud rate
N (no parity)	Check digit
8	Data bit
2	Stop bit

RS485 communication parameters can be changed by the Modbus Master.

Baud Rate and Parity can be changed by writing to holding registers using the **Function Code 16.**

RS485 Connection

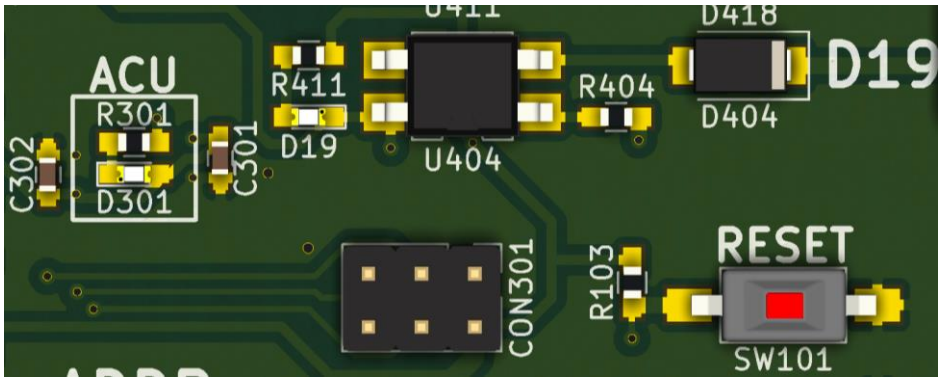
There is a dedicated 3 terminal connector for RS485 communications. There is A and B and Ground.

A shielded twisted pair cable is recommended for connecting the RS485 port to Master.

Reset Button

The DigiLot Modbus RTU card can be brought to default factory settings by pressing the RESET button for ~3 seconds.

On pressing the RESET, the LED D301 will blink rapidly for a few seconds to indicate successful reset.



Modbus Communication Format

Query Message Format

```
[Slave Address] [Function Code] [Data] [CRC]
```

Response Message Format

```
[Slave Address] [Function Code] [Data] [CRC]
```

If an error is detected in a valid message the response function code is modified by adding 80 (hex) and the function code dependent data is replaced by an exception response code

Modbus RTU function Codes

Function Code	Name	Usage
02	Read Input Status	Read the State of a Digital Input
03	Read Holding Register	Read Data in 16-bit Register Format (High/Low)
04	Read Input Register	
08	Loopback Test	Used for diagnostic testing of the communications port
16 (0x10)	Preset Multiple Holding Registers	Write Data in 16-bit Integer Format to multiple registers

Function Code 02 – Read Digital Input

Description

Function code 02 is used to read a Digital Input's (DI) ON/OFF status of the slave device in a binary data format. All binary data transferred using function code 02 is mapped into bytes.

Broadcast is not supported.

Query

The query message specifies the starting input and the quantity of inputs to read. Inputs are addressed starting at zero: Input 1 through 16 are addressed as 0 through 15 respectively

Slave Address	Function Code	Starting Address HIGH	Starting Address LOW	Number Input HIGH	Number Input LOW	CRC (16 bit)

Response

The input status in the response message is packed as one input per bit of the data field. Status is indicated as: 1 = ON; 0 = OFF. The LSB of the first data byte contains the input addressed in the query. The other inputs follow toward the high order end of this byte, and from low order to high order in subsequent bytes.

If the returned input quantity is not a multiple of eight, the remaining bits in the final data byte will be padded with zeros (toward the high order end of the byte). The byte count field specifies the quantity of data bytes returned.

Slave Address	Function Code	Byte Count	n x 8-bit Data	CRC (16 bit)

Example

This command is requesting the ON/OFF status of discrete inputs # 10003 to 10012 from the slave device with address 17.

Query: 11 02 0002 000A (CRC)

11: The Slave Address (11 hex = address17)
02: The Function Code 2 (read Input Status)
0002: The Data Address of the first input to read.
(0002 hex = 2, + 10001 offset = input #10003)
000A: The total number of coils requested. (0A hex = 10, inputs 003 to 012)
(CRC): The CRC (cyclic redundancy check) for error checking.

Response: 11 02 02 AC03 (CRC)

11: The Slave Address (11 hex = address17)
02: The Function Code 2 (read Input Status)
02: The number of data bytes to follow (10 Inputs / 8 bits per byte = 2 bytes)
AC: Discrete Inputs 10010 -10003 (1010 1100)
03: 6 space holders & Discrete Inputs 10012 - 10011 (0000 0011)
(CRC): The CRC (cyclic redundancy check).

The more significant bits contain the higher Discrete inputs. This shows that input 10003 is off (0) and 10012 is on (1). Due to the number of inputs requested, the last data field 03 contains the status of only 2 inputs. The six most significant bits in this data field are filled in with zeroes.

Function Code 03/04 – Read Registers

Description

Function code 03 or Function code 04 is used to read the binary contents of input registers. Function code 04 is used to read Digital Input Registers (read only). Function Code 03 is used to read Holding Registers (read/write).

Query

The query message specifies the starting register and quantity of registers to be read. Registers are addressed starting at zero: registers 1-16 are addressed as 0-15.

Slave Address	Function Code	Starting Address HIGH	Starting Address LOW	Number Address HIGH	Number Address LOW	CRC (16 bit)

Response

The register data in the response message are packed as two bytes per register. For each register, the first byte contains the high order bits and the second contains the low order bits.

Slave Address	Function Code	Byte Count	n x 8-bit Data	CRC (16 bit)

Example

This command is requesting the content of input register # 30001 from the slave device with address 17.

Query: 11 04 0000 0001 (CRC)

11: The Slave Address (11 hex = address17)
04: The Function Code 4 (Read Input Registers)
0000: The Data Address of the first register requested.
(0000 hex = 0, + 30001 offset = input register #30001)
0001: The total number of registers requested. (read 1 register)
(CRC): The CRC (cyclic redundancy check) for error checking.

Response: 11 04 02 000A (CRC)

11: The Slave Address (11 hex = address17)
04: The Function Code 4 (Read Input Registers)
02: The number of data bytes to follow (1 registers x 2 bytes each = 2 bytes)
000A: The contents of register 30001
(CRC): The CRC (cyclic redundancy check).

Function Code 16 (0x10) – Write Multiple Holding Register

Description

Function code 16 writes or presets an integer value into multiple holding registers.

Query

The query message specifies the register references to be preset. Registers are addressed starting at zero: Register 1 is addressed as 0.

Slave Address	Function Code	Address HIGH	Address LOW	Num Registers HIGH	Num Registers LOW	Byte Count	Data (ByteCount * 8-bit)	CRC (16 bit)

Response

The normal response is an echo of the query returned after the register contents have been preset.

Slave Address	Function Code	Address HIGH	Address LOW	Num Registers HIGH	Num Registers LOW	CRC (16 bit)

Example

This command is writing the contents of analog output holding register # 40002 to the slave device with address 17.

Query: 11 10 0001 0001 02 0003 (CRC)

11: The Slave Address (11 hex = address17)
10: The Function Code 6 (Preset Single Register)
0001: The Data Address of the register.
(0001 hex = 1, + 40001 offset = register #40002)
0001: Number of Registers to Write
02: Number of Bytes (1 Register * 2 Bytes)
0003: The value to write
(CRC): The CRC (cyclic redundancy check) for error checking.

Response: 11 10 0001 0001 0003 (CRC)

11: The Slave Address (11 hex = address17)
06: The Function Code 6 (Preset Single Register)
0001: The Data Address of the register. (# 40002 - 40001 = 1)
0001: Number of Registers Written
0003: The value written
(CRC): The CRC (cyclic redundancy check) for error checking.

Function Code 08 – Loopback Message

Description

Function Code 08 echoes received query message

Query

Slave Address	Function Code	n x 8-bit Data	CRC (16 bit)

Loopback message payload length is restricted to less than or equal to 4 bytes

Response

Slave Address	Function Code	n x 8-bit Data	CRC (16 bit)

Modbus Register Map

Data is arranged as

Digital Input				
Address (Hex)	**Register (Decimal)**	**Parameter name**	**Access**	**Description**
0000	10001	D00 – Digital Input	R	Pin state for respective terminal, 1 by default, 0 when connected to GND
0001	10002	D01 – Digital Input	R	
0002	10003	D02 – Digital Input	R	
0003	10004	D03 – Digital Input	R	
0004	10005	D04 – Digital Input	R	
0005	10006	D05 – Digital Input	R	
0006	10007	D06 – Digital Input	R	
0007	10008	D07 – Digital Input	R	
0008	10009	D08 – Digital Input	R	
0009	10010	D09 – Digital Input	R	
000A	10011	D10 – Digital Input	R	
000B	10012	D11 – Digital Input	R	
000B	10013	D12 – Digital Input	R	
000D	10014	D13 – Digital Input	R	
000E	10015	D14 – Digital Input	R	
000F	10016	D15 – Digital Input	R	

Input Register				
Address (Hex)	**Register (Decimal)**	**Parameter name**	**Access**	**Description**
0000	30001	(FL 0-7) BCD Input	R	BCD value for the combined pin status of FL0 to FL7 By default, if nothing is connected, all pins will be high so the readout will be 255
0001	30002	(MO 0-3) BCD Input	R	BCD value for the combined pin status of MO0 to MO3 By default, if nothing is connected, all pins will be high so the readout will be 15

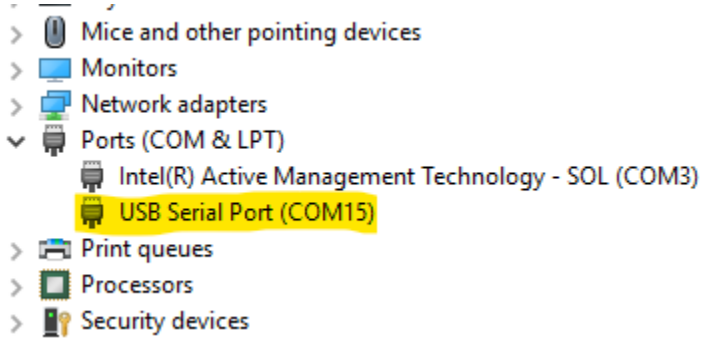
Holding Register				
Address (Hex)	**Register (Decimal)**	**Parameter name**	**Access**	**Description**
0000	40001	Device Address	R/W	Read/Write if DIP SW position is for Address 255
0001	10002	Baud Rate	R/W	2400 – 0x00 4800 – 0x01 9600 – 0x02 14400 – 0x03 19200 – 0x04 38400 – 0x05
0002	10003	Parity	R/W	None – 0x00 Even – 0x01 Odd – 0x02

Testing the DigiLot Modbus Card

Requirements

Hardware

Along with a Test PC a USB to RS-485 Convertor is needed.
Ensure that it is enumerated as a COM port in the Device Drivers and note the port number.

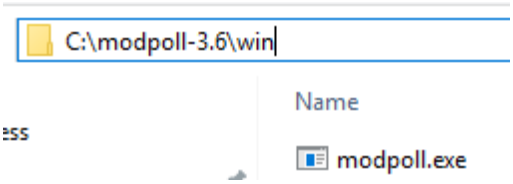


Software

The recommended PC based tool used for testing is **modpoll**.
Any other tool can also be used but modpoll is an open-source, free version and is supported for both Windows and Linux systems. This makes it an optimal choice.

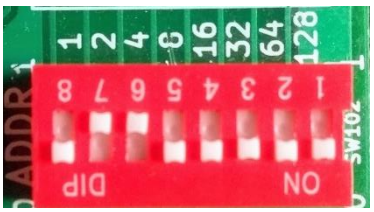
Download modpoll from here (https://www.modbusdriver.com/modpoll.html)
Both Windows and Linux versions are available. This document will cover the steps in Windows.

Download and extract the ZIP folder in C: Drive. No installation is needed. There is just one modpoll.exe file which is needed.

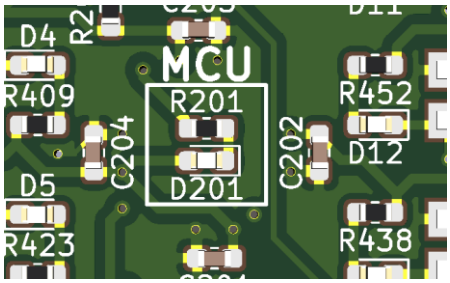


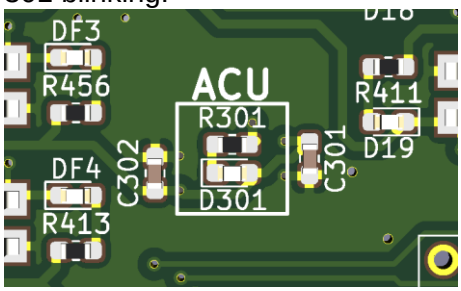
Test Procedure

Set Address on the Card using DIP Switch
In this sample image the Address has been set to 6.

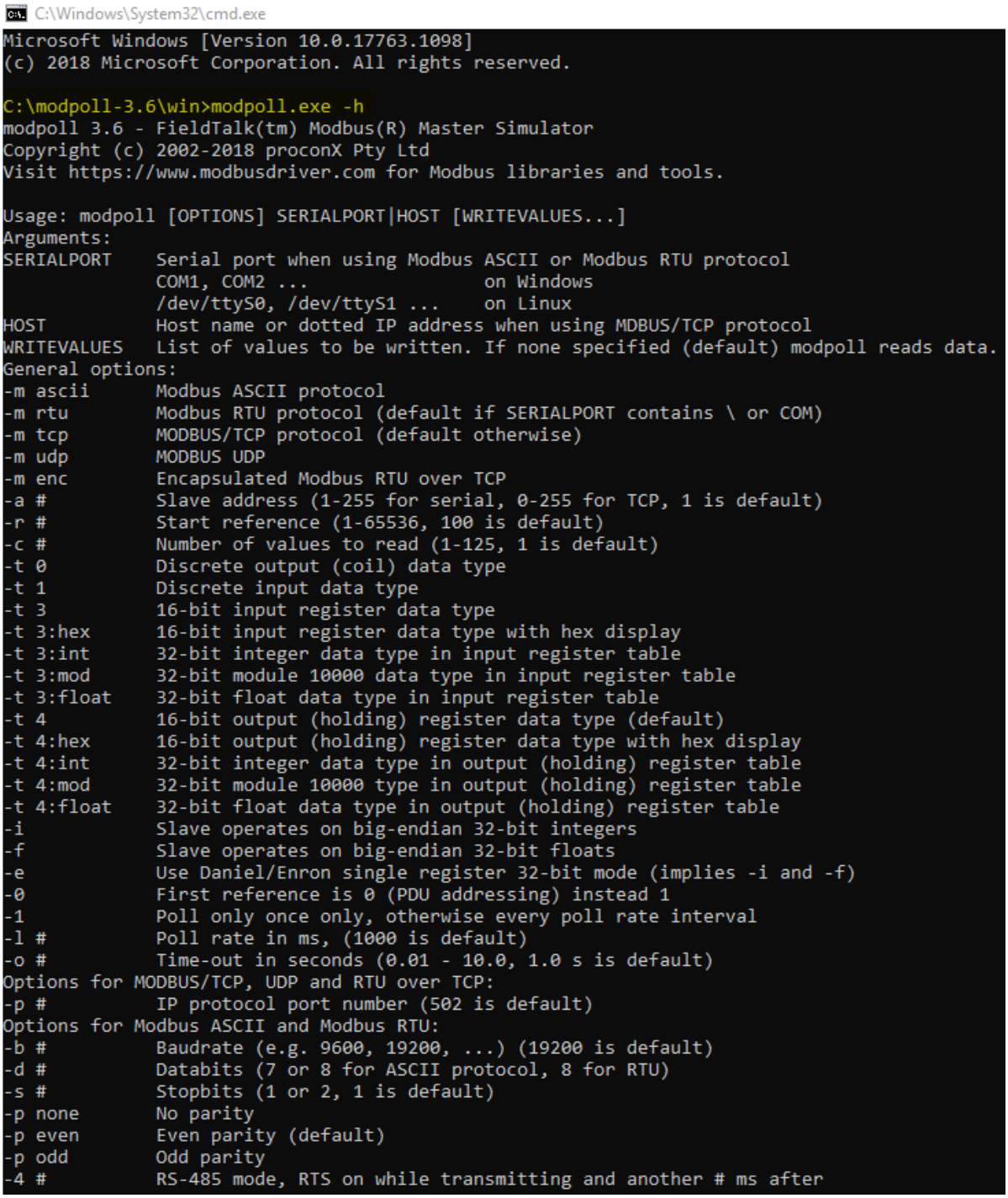


Turn ON the DigiLot Card.
You should see the LEDs D201 and D301 blinking.





Open the command prompt in this folder and type `modpoll -h` to check if the tool is working. This also lists the help and argument options for the tool.



Modpoll Test Commands

Reading Discreate Inputs

```
modpoll -m rtu -a 6 -c 16 -t 1 -b 9600 -d 8 -l 2000 -s 2 -p none COM15
```

```
C:\modpoll-3.6\win>modpoll -m rtu -a 6 -c 16 -t 1 -b 9600 -d 8 -l 2000 -s 2 -p none COM15
modpoll 3.6 - FieldTalk(tm) Modbus(R) Master Simulator
Copyright (c) 2002-2018 proconX Pty Ltd
Visit https://www.modbusdriver.com for Modbus libraries and tools.

Protocol configuration: Modbus RTU
Slave configuration...: address = 6, start reference = 1, count = 16
Communication.........: COM15, 9600, 8, 2, none, t/o 1.00 s, poll rate 2000 ms
Data type.............: discrete input

-- Polling slave... (Ctrl-C to stop)
[1]: 1
[2]: 1
[3]: 1
[4]: 1
[5]: 1
[6]: 1
[7]: 1
[8]: 1
[9]: 1
[10]: 1
[11]: 1
[12]: 1
[13]: 1
[14]: 1
[15]: 1
[16]: 1
-- Polling slave... (Ctrl-C to stop)
```

Reading 16-bit Input Register

```
modpoll -m rtu -a 6 -c 1 -t 3 -b 9600 -d 8 -l 2000 -s 2 -p none COM15
```

```
C:\modpoll-3.6\win>modpoll -m rtu -a 6 -c 1 -t 3 -b 9600 -d 8 -l 2000 -s 2 -p none COM15
modpoll 3.6 - FieldTalk(tm) Modbus(R) Master Simulator
Copyright (c) 2002-2018 proconX Pty Ltd
Visit https://www.modbusdriver.com for Modbus libraries and tools.

Protocol configuration: Modbus RTU
Slave configuration...: address = 6, start reference = 1, count = 1
Communication.........: COM15, 9600, 8, 2, none, t/o 1.00 s, poll rate 2000 ms
Data type.............: 16-bit register, input register table

-- Polling slave... (Ctrl-C to stop)
[1]: 255
-- Polling slave... (Ctrl-C to stop)
```

In HEX Format

```
C:\modpoll-3.6\win>modpoll -m rtu -a 6 -c 1 -t 3:hex -b 9600 -d 8 -l 2000 -s 2 -p none COM15
modpoll 3.6 - FieldTalk(tm) Modbus(R) Master Simulator
Copyright (c) 2002-2018 proconX Pty Ltd
Visit https://www.modbusdriver.com for Modbus libraries and tools.

Protocol configuration: Modbus RTU
Slave configuration...: address = 6, start reference = 1, count = 1
Communication.........: COM15, 9600, 8, 2, none, t/o 1.00 s, poll rate 2000 ms
Data type.............: 16-bit register (hex), input register table

-- Polling slave... (Ctrl-C to stop)
[1]: 0x00FF
-- Polling slave... (Ctrl-C to stop)
```

Troubleshooting Steps

Reply time-out!

```
Protocol configuration: Modbus RTU
Slave configuration...: address = 5, start reference = 1, count = 2
Communication.........: COM15, 9600, 8, 2, none, t/o 1.00 s, poll rate 1000 ms
Data type.............: 16-bit register (hex), input register table

-- Polling slave... (Ctrl-C to stop)
Reply time-out!
-- Polling slave... (Ctrl-C to stop)
Reply time-out!
```

- Check if the Board is powered and the LEDs D201 and D301 are blinking
- Check if the Slave Address is Correct (Use a multimeter to verify DIP switch contacts)
- Check if Baud Rate is correct (Reset Board to go back to default settings)
- Check for Modbus Wiring and GND connection

Port or socket open error!

```
Protocol configuration: Modbus RTU
Slave configuration...: address = 6, start reference = 1, count = 2
Communication.........: COM16, 4800, 8, 2, none, t/o 1.00 s, poll rate 1000 ms
Data type.............: 16-bit register (hex), input register table

Port or socket open error!
```

- Check if the COM Port is enumerated in Device Manager
- Check if correct COM Port is being used
- Ensure that the COM Port is not being used by any other tool

Illegal Data Address exception response!

```
Protocol configuration: Modbus RTU
Slave configuration...: address = 6, start reference = 1, count = 3
Communication.........: COM15, 9600, 8, 2, none, t/o 1.00 s, poll rate 1000 ms
Data type.............: 16-bit register (hex), input register table

-- Polling slave... (Ctrl-C to stop)
Illegal Data Address exception response!
```

- Check if the correct number of data points are being read.