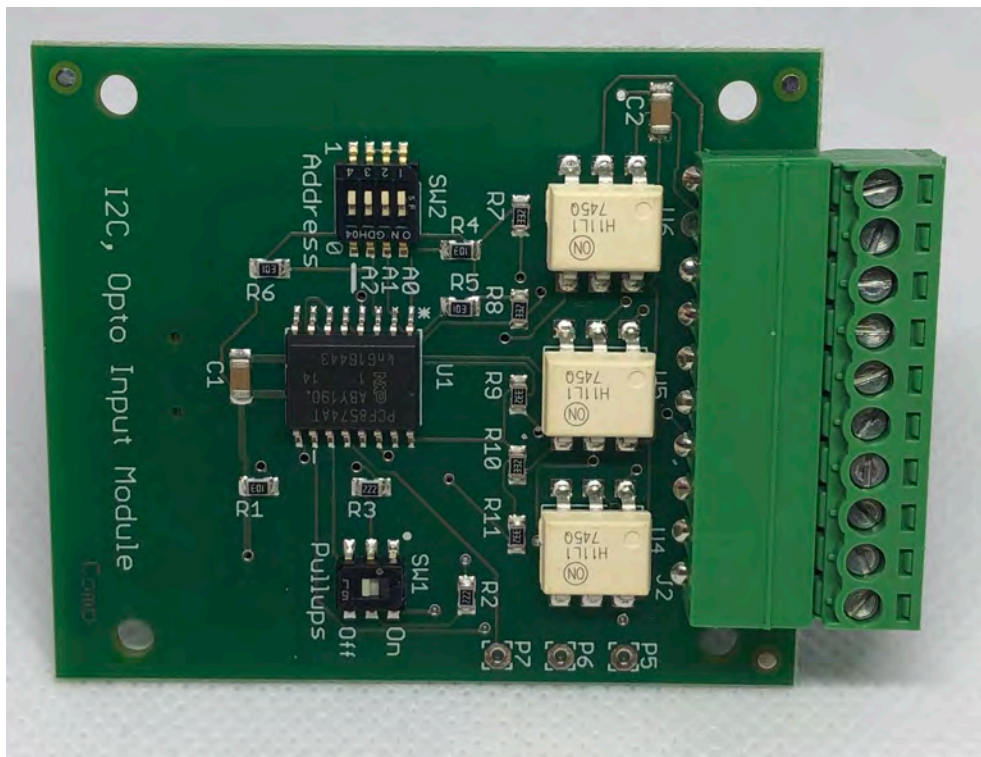

Opto1 Module

P/N: 81P-0130

Rev –
14 AUG 2019

Graves Electronics, LLC



Symbols used in this manual:



CAUTION: This indicates a situation where if certain requirements are not followed, damage or unsafe conditions may occur.



WARNING: This indicates a situation where if certain requirements are not followed, damage or unsafe conditions **WILL** occur.



If you are having problems getting the board to work properly, **BEFORE** calling the factory, please visit the FAQ page at <http://www.graveselectronicsapps.com/faqs.html>, and/or thoroughly read section 9.0 of this manual. If you are still having problems, please download the test code from <http://www.graveselectronicsapps.com/downloads-.html> and run the code. If you are still having issues after reading the help section and trying the test code, please contact the factory. We kindly ask that you please e-mail us at graveselectronics@gmail.com. Please clearly state your problem along with a call back phone number. One of our technicians will call you after we have reviewed your issue and have come up with some solutions.

This manual, as well as test code, can be downloaded at <http://www.graveselectronicsapps.com/downloads-.html>.

Contact Information:

Customer Service, Sales, Technical Assistance

graveselectronics@gmail.com or call us at 860-295-3074

Warranty & Legal:

Graves Electronics, LLC warrants that its products conform to the stated specifications. Graves Electronics, LLC warrants that its products will be free from material and manufacturing defects for the life of the product. Graves Electronics, LLC shall not be liable for any defects that are caused by neglect, misuse, or mistreatment by the customer, or third party, including improper installation or testing, or for any products that have been altered or modified in any way by the customer or a third party.

Graves Electronics, LLC products are not authorized for use in safety-critical applications where a failure of the product would reasonably be expected to cause severe personal injury or death. Safety-critical applications include, without limitation, life support devices and systems, equipment or systems for the operation of nuclear facilities, and weapons systems. Graves Electronics, LLC products are neither designed nor intended for use in military, aerospace, or automotive applications or environments. The customer acknowledges that use of Graves Electronics, LLC products is entirely at the customer's risk, and the customer agrees to defend, indemnify and hold harmless Graves Electronics, LLC from any and all damages, claims, suits, or expenses resulting from such use. The customer acknowledges and agrees that the customer is solely responsible for compliance with all statutory, legal, regulatory, and safety related requirements in regards to the usage of Graves Electronics, LLC products. In no event shall Graves Electronics, LLC be liable to the customer or any third party for any special, collateral, indirect, punitive, incidental, consequential, or exemplary damage in connection with, or arising from, the customer's software. The customer agrees to defend, indemnify and hold harmless Graves Electronics, LLC from any and all damages, claims, suits, or expenses resulting from said customer's software. Customer acknowledges that Graves Electronics, LLC reserves the right to change specifications on any product at any time without notice.

This document, related documents, drawings, technical specifications, designs, or operational information is the property of Graves Electronics, LLC

Table of Contents

1.0	Overview	1
2.0	The I/O Chip.....	1
2.1	I/O.....	1
	<i>Table 2.1.</i>	1
2.2	Address.....	1
	<i>Table 2.2.</i>	2
2.3	I ² C.....	2
	<i>Table 2.3.</i>	2
2.3.1	I ² C Pull-Up Resistors.....	2
3.0	Interrupt Output Pin (/INT).....	3
	<i>Table 3.0.</i>	3
4.0	Optocoupler.....	3
	<i>Table 4.0.</i>	3
	<i>Table 4.1. Truth Table</i>	4
5.0	Installing the Module	4
5.1	Pluggable Terminal Block (J2).....	4
6.0	Electrical Specifications @ 25°C.....	4
7.0	Block Diagram	5
8.0	Mechanical	6

1.0 Overview

The Opto1 module is an easy to use optocoupler input module that increases the functionality of the 81 controller board. The module is designed so that it can accept a wide range of input voltages. It utilizes an ON Semiconductor optocoupler, part number H11L1M, which is a Schmitt trigger, inverting output chip. It plugs into either of the module ports on the 81 controller board. The Opto1 module uses the I²C bus to communicate with the microcontroller on the 81 board. It has DIP switches which enable address selection, as well as to engage or disengage pull-up resistors for the I²C bus. The module interfaces to the outside world via the 10-position pluggable terminal block.

2.0 The I/O Chip

The Opto1 module uses NXP's PCF8574A chip for the I/O functions. The chip contains eight, quasi-bidirectional ports, three addressing ports, and an active LOW interrupt output. For a further, in-depth explanation of the PC8574A chip, including its operation, how to read and write to the ports, how the interrupt output functions, and for timing diagrams, please consult the [PC8574A datasheet](#).

2.1 I/O

Each I/O pin from the PCF8574A is connected to the output of the optocoupler chip. Table 2.1 shows which optocoupler output is mapped to which I/O pin.

Table 2.1.

Optocoupler	I/O Pin
U2	P0
U3	P1
U4	P2
U5	P3
U6	P4
N.C.	P5
N.C.	P6
N.C.	P7

N.C. Stands for Not Connected.

2.2 Address

The PCF8574A has three ports dedicated to addressing it. The module provides an easy method of addressing by way of DIP switch SW2. On one side of the switch is V_{DD} (+5V), labeled as "1" and the other side is V_{SS} (GND), labeled as "0". A0, A1, and A2 are the three addressing ports and are labeled. SW2 is a four position DIP switch with the fourth position not being connected to anything. Table 2.2 shows the hexadecimal address obtained by the various address switch combinations.

Table 2.2.

Switch SW2			Address Byte Value	
A0	A1	A2	Write	Read
0	0	0	0x70	0x71
1	0	0	0x72	0x73
0	1	0	0x74	0x75
1	1	0	0x76	0x77
0	0	1	0x78	0x79
1	0	1	0x7A	0x7B
0	1	1	0x7C	0x7D
1	1	1	0x7E	0x7F

2.3 I²C

The module communicates with the 81 board microcontroller via the I²C bus. The SCL and SDA lines are mapped to J1, located on the underside of the module. Table 2.3 shows the pin configuration of J1. For more information on the I²C bus, please consult NXP document [UM10204](#).

Table 2.3.

J1	Function	J1	Function
1	V _{DD} (+5V)	6	N.C.
2	V _{SS} (Ground)	7	N.C.
3	N.C. (No Connect)	8	SDA
4	SCL	9	N.C.
5	/INT	10	N.C.

2.3.1 I²C Pull-Up Resistors

In order for the I²C bus to work correctly, it must have pull-up resistors on the SDA and SCL lines. The module makes that easy through the use of switch SW1. When the switch is in the “On” position (as labeled on the module), two 2.2K Ohm resistors are switched in to the I²C bus; one on the SDA line and one on the SCL line. When the switch is in the “Off” position, the pull-up resistors are switched out of

the circuit. If only one module is being used, it must have the pull-up resistors switched on. If two modules are being used, only one module needs to have the I²C pull-up resistors switched on. It does not matter which module has the resistors switched on.



CAUTION: Failure to switch on the I²C pull-up resistors could result in erratic operation of the I²C bus, and consequently, erratic operation of the module!



CAUTION: If using two modules, switching on the I²C pull-up resistors on BOTH modules could result in erratic operation of the I²C bus, and consequently, erratic operation of the module! When using two modules, switch on only ONE I²C pull-up!

3.0 Interrupt Output Pin (/INT)

The PCF8574A has an open-drain output interrupt (/INT) pin that is mapped to pin 5 on J1 (see Table 2.3). This output is active LOW. It is held high by a 10K Ohm pull-up resistor on the module. Table 3.0 shows how pin 5 is mapped to the 81 board microcontroller.

Table 3.0.

Module Port	Microcontroller Port
Module 1	RC3
Module 2	RC2

4.0 Optocoupler

The module uses On Semiconductor’s H11L1M optocoupler chip. The input is a high-speed detector with a gallium-arsenide infrared emitting diode. It has an inverting, open-collector, Schmitt trigger output. For maximum flexibility, no bias resistors have been added to the inputs. These must be provided by the user. The truth table is provided in Table 4.1.



CAUTION: Bias resistors **MUST** be added to the input of the optocoupler, or erratic operation and/or damage to the optocoupler is possible.

The anode and cathode of each detection diode is connected to pluggable header J2. Table 4.0 shows how the anodes and cathodes are mapped to J2.

Table 4.0.

Relay	Pin	J2	Relay	Pin	J2	Relay	Pin	J2
U2	Anode	1	U4	Anode	5	U6	Anode	9
	Cathode	2		Cathode	6		Cathode	10
U3	Anode	3	U5	Anode	7			
	Cathode	4		Cathode	8			

Table 4.1. Truth Table

Input	Output
H	L
L	H

5.0 Installing the Module

Installation of the Opto1 module is extremely easy. First, decide which module port on the 81 board the module will plug into. The module communicates over I²C to the microcontroller, so for communications purposes, it does not matter which module port is utilized. Pick the port that is most convenient for mechanical or aesthetic reasons. Remove the black protective header cap off of the header on the main board. Carefully align J1 of the module with the header on the module port. Push down until the module is fully seated onto the header. The module is fully seated when the module is touching the four standoffs on the module port. Use the four 4-40 x ¼ Philips pan head screws supplied with the module to secure the module. The tightening torque is a minimum of 2.6 in.-lbs. and a maximum of 16.6 in.-lbs. **DO NOT EXCEED 16.6 IN-LBS!**

5.1 Pluggable Terminal Block (J2)

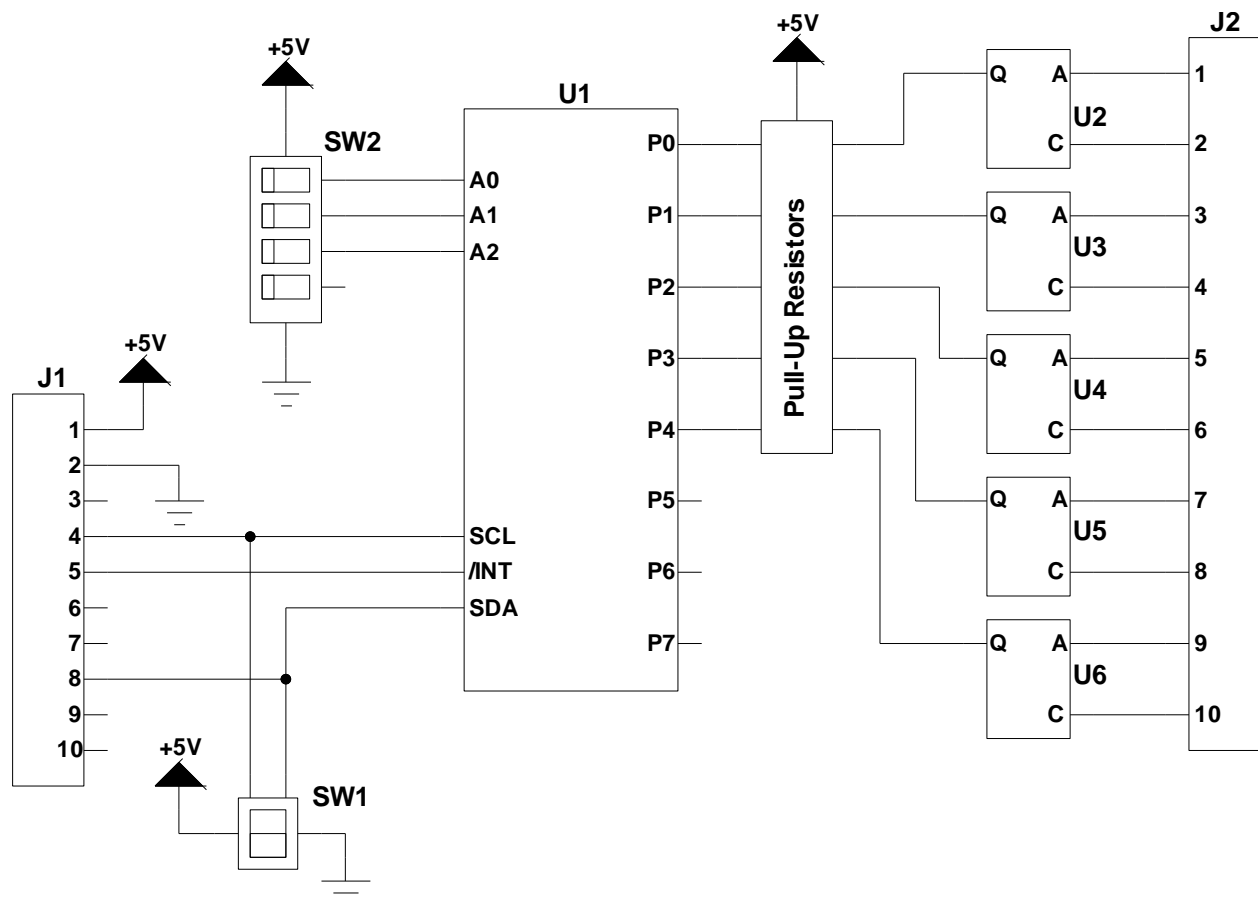
The pluggable terminal block, J2, is how the module interfaces to the outside world. The pluggable block is Phoenix Contact part number 1840447. The plug can accept wire from 30 to 14 AWG. The screw is a M2 and tightening torque is 1.95 to a maximum of 2.21 in.-lbs.

6.0 Electrical Specifications @ 25°C

Symbol	Parameter	Condition	Min	Typ	Max	Unit
I _F	Continuous Forward Current	Input	-	-	30	mA
V _R	Reverse Voltage	Input	-	-	6	V
I _{F(PEAK)}	Peak Forward Current	1µs pulse, 300 pps	-	-	100	mA
P _D	LED Power Dissipation	Input	-	-	60	mW
V _F	Forward Voltage	Input, I _F = 10 mA	-	1.2	1.5	V
DC Characteristics						
I _{F(ON)}	Turn-On Threshold Current	R _L = 270 Ω	-	-	1.6	mA
I _{F(OFF)}	Turn-Off Threshold Current	R _L = 270 Ω	0.3	1.0	-	mA
I _{F(OFF)} /I _{F(ON)}	Hysteresis Ratio	R _L = 270 Ω	0.50	0.75	0.90	
AC Characteristics						
t _{ON}	Turn-On Time	R _L = 270 Ω, I _F = I _{F(ON)}	-	1.0	4.0	µs
t _F	Fall Time	R _L = 270 Ω, I _F = I _{F(ON)}	-	0.1	-	µs

t_{OFF}	Turn-Off Time	$R_L = 270 \Omega, I_F = I_{F(ON)}$	-	1.2	4.0	μs
t_r	Rise Time	$R_L = 270 \Omega, I_F = I_{F(ON)}$	-	0.1	-	μs
	Data Rate	-	-	1.0	-	MHz
Isolation Characteristics						
V_{ISO}	Input-Output Isolation Voltage	T = 1 Minute	4170	-	-	$V_{AC_{RMS}}$
C_{ISO}	Isolation Capacitance	$V_{I-O} = 0 V, f = 1 MHz$	-	0.4	0.6	pF
R_{ISO}	Isolation Resistance	$V_{I-O} = \pm 500 VDC$	10^{11}			Ω
$TEMP_{OP}$	Operating Temperature	-	-40	-	+85	$^{\circ}C$

7.0 Block Diagram



8.0 Mechanical

