

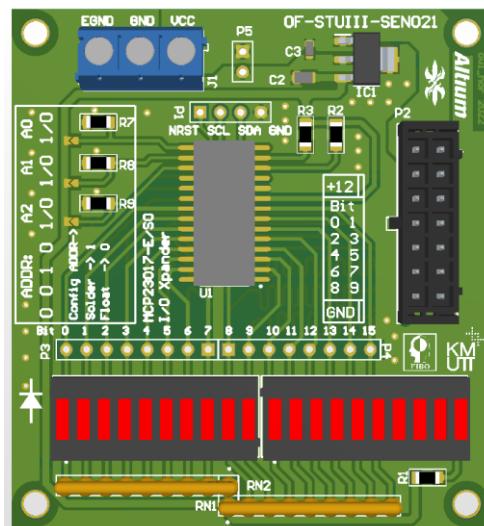


OF-STUIII-SEN021

I/O Xpander circuit, I2C

This is 16 pin I/O expander circuit. This circuit is designed specifically to interface with 10-bit resolution, NPN open-collector output absolute encoder (use TRD-NA1024RNW, Koyo electronics as reference).

This circuit is the improve version of [OF-STUIII-SEN011] 16-bit shift register circuit. I2C is selected instead of shift-register.



Contents

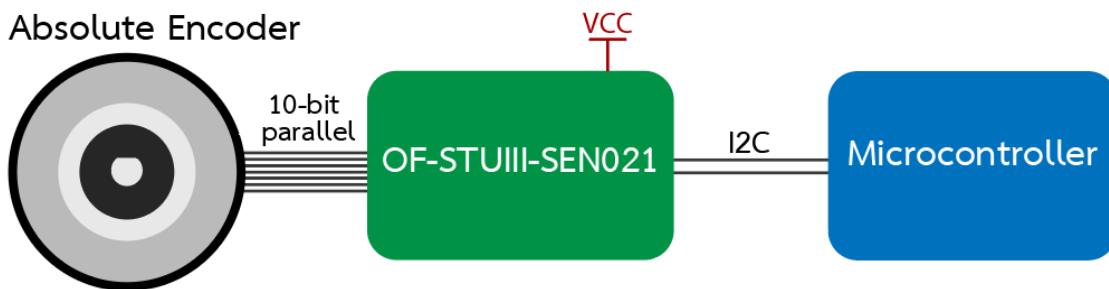
Contents	1
Features	1
Hardware Diagram	2
General Information	2
Encoder's type	2
Communication & Address Select	2
Circuit pinout	3
Terminal & Wire, Connector Information	4
Cabinet connect option	4
Schematics	5
Dimensions	5
Bill of Materials	6
Disclaimer	7

Features

- 10-bit NPN parallel open-collector absolute encoder Interface.
- 16-Segment LED for each bit.
- 16-pin I/O expander (MCP23017-E/SO, MICROCHIP)
- Communication: I2C



Hardware Diagram



General Information

	Min	Typ	Max	Unit
Voltage Rating ^[1]	10.8	12	24	V
Data Bit		10	16	Bit

[1] Please consider with Encoder's power rating.

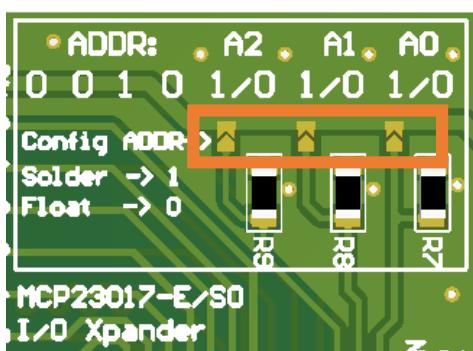
Encoder's type

Absolute NPN Open Collector 10-bit (Max 16-bit), no built in protocol.

Sample: TRD NA-Series, Koyo electronics

Communication & Address Select

OF-STUIII-SEN021 uses [MCP23017-E/SO] as the main IC. More information about pin connection are available in the schematic section. The protocol can be found at MCP23x17, MICROCHIP's datasheet.

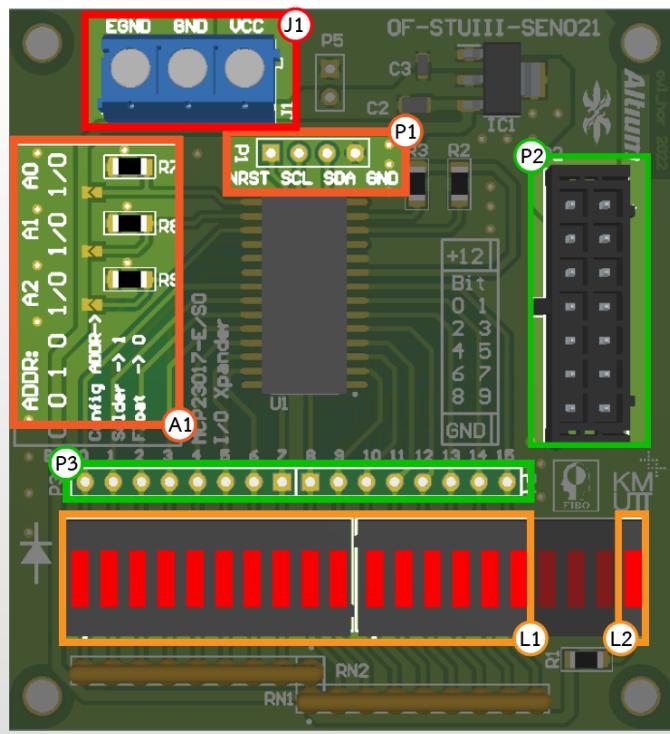


About the address select, the address of MCP23017 is [0010 A2 A1 A0]. [A2 A1 A0] are externally pulled down. That makes the address [0010000] by default.

[A2 A1 A0] can be changed to [1] by soldering the solder bridge or connect it with a 0 Ω resistor.



Circuit pinout



Terminal	Pin	Description
J1	VCC	Power Source
	GND	GND
	EGND	Earth Ground for encoder's shield
P1 ^[2]	NRST	Reset pin
	SCL	I2C Serial Clock
	SDA	I2C Data
	GND	Ground (Connect with the controller)
P2	Bit[0..9]	Terminal connect to the encoder. 10-bit only
	VCC, GND	Please visit : Terminal & Wire, Connector Information
P3	Bit[0..15]	Pin header for 16-bit.
L1	-	LED shows each bit's status.
L2	-	LED shows circuit power's status.
A1	-	Address select, Communication & Address Select

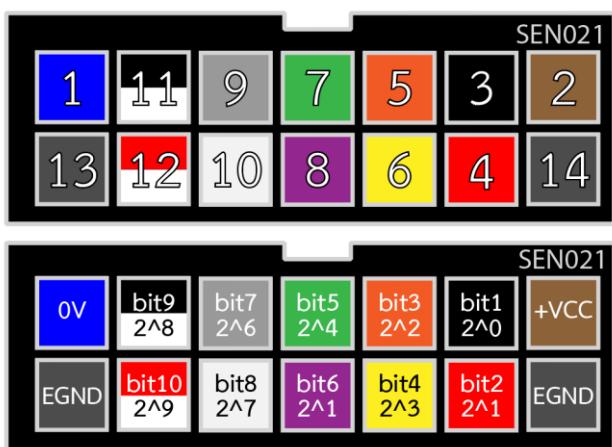
[2] More Information at MCP23017, MICROCHIP Datasheet.



Terminal & Wire, Connector Information

*** Warnings: Pin's positions are different from OF-STUIII-SEN011 ***

Connector	Crimp terminal
CP3514S0010	CP35TN21PES
Civilux corp.	Civilux corp.
14 pin, 3.00mm. pitch	

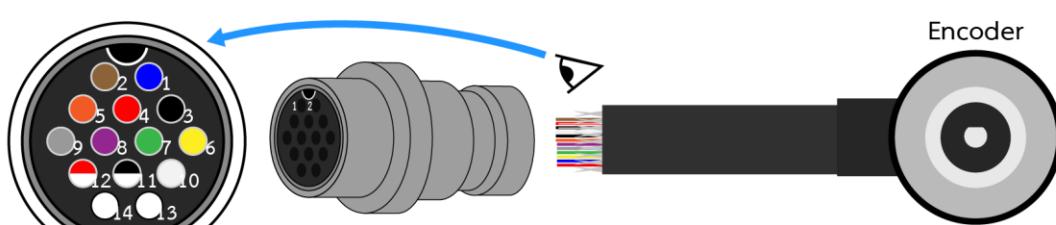
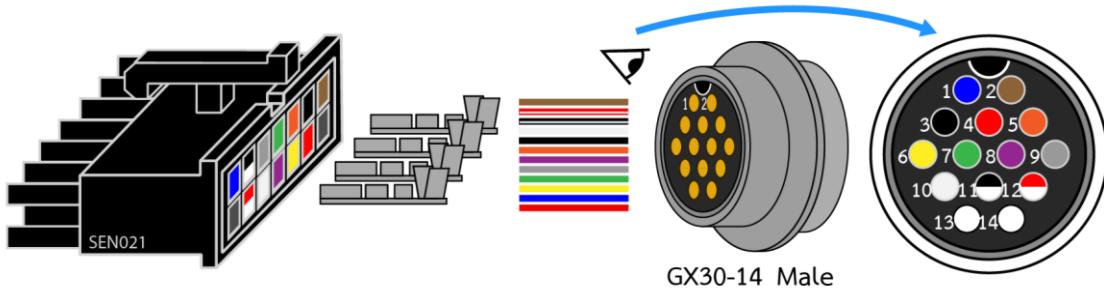


Connector's position	Encoder's wire
1	Blue 0V, GND
2	Brown 12-24V, VCC
3	Black Bit 1, 2 ⁰
4	Red Bit 2, 2 ¹
5	Orange Bit 3, 2 ²
6	Yellow Bit 4, 2 ³
7	Green Bit 5, 2 ⁴
8	Purple Bit 6, 2 ⁵
9	Gray Bit 7, 2 ⁶
10	White Bit 8, 2 ⁷
11	Black/White Bit 9, 2 ⁸
12	Red/White Bit 10, 2 ⁹
13	SHIELD Earth GND
14	SHIELD Earth GND

Cabinet connect option

This connection is for cabinet implementation. However, Connect encoder to OF-STUIII-SEN021 with CP35 connector directly like in SEN011 is also enable.

In GX30-14, Pin 13 and 14 are unconnected. Shield wire is connected to GX30's shield instead.

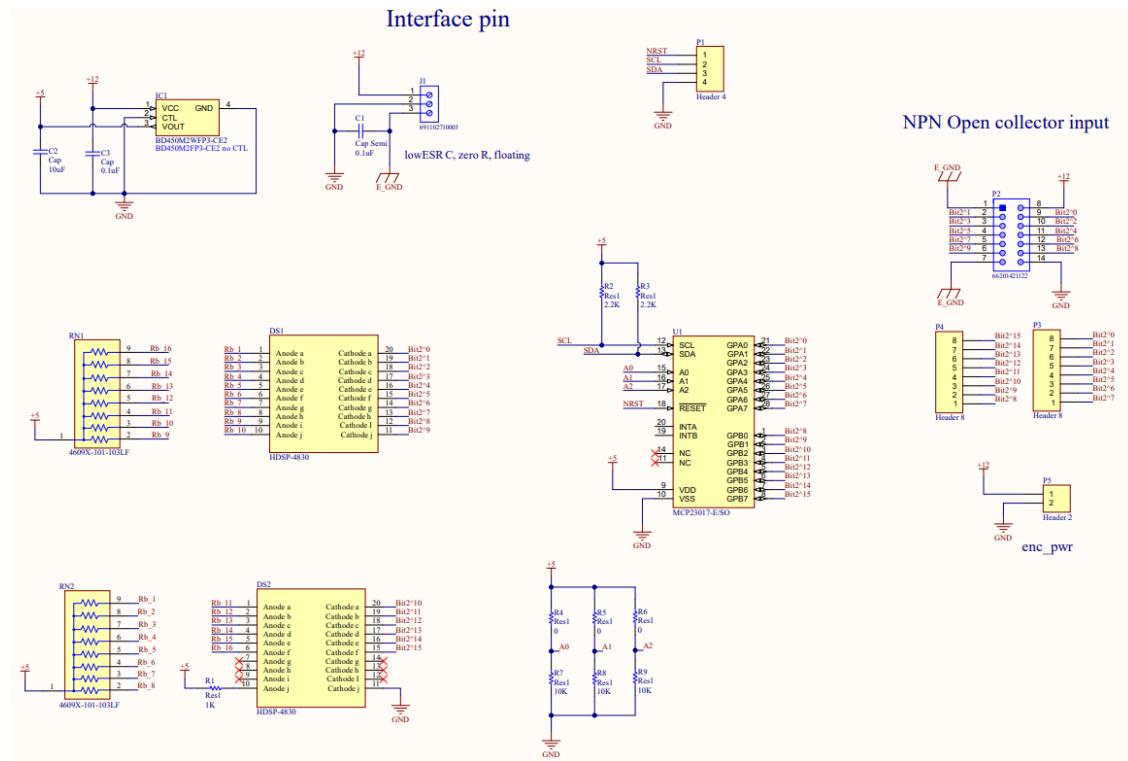


Pin position, seen from wiring side (back side).

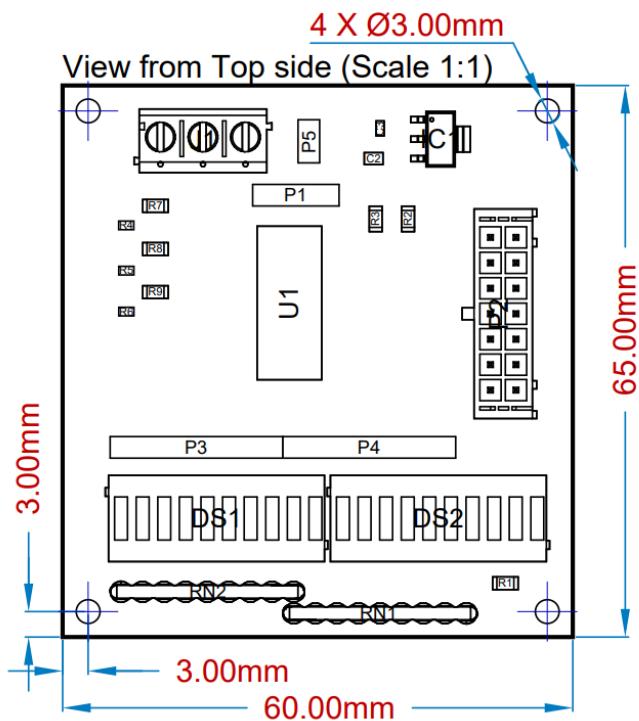


Schematics

Full version: <https://kmutt.me/ofcircuit.sen021sch>



Dimensions





Bill of Materials

Designator	Description	Footprint	Value	Quantity
C1	Capacitor (Semiconductor SIM Model)	C1206	0.1uF	1
C2	Capacitor	1608 [0603]	10uF	1
C3	Capacitor	2029	0.1uF	1
DS1, DS2	10 Segments LED Array	Broadcom_HDSP-4830_0		2
IC1	BD450M2WFP3-CE2, 5V LDO	SOT230P700X170-4N		1
J1	Series 102 - 5.00 mm Horizontal Entry Modular with Pressure Clamp WR-TBL, 3 pin			1
P1	Header, 4-Pin	HDR1X4		1
P2	THT Male Header WR-MPC3, Vertical, Dual Row, pitch 3 mm, 14 pins	66201421122		1
P3, P4	Header, 8-Pin	HDR1X8		2
P5	Header, 2-Pin	HDR1X2		1
R1	Resistor	Res_1206_3mm	1K	1
R2, R3	Resistor	Res_1206_3mm	2.2K	2
R4, R5, R6	Resistor	Solder-bridge	0	3
R7, R8, R9	Resistor	Res_1206_3mm	10K	3
RN1, RN2	RES ARRAY 8 RES 10K OHM 9SIP	FP-4609X-MFG		2
U1	MCP23017-E/SO 16-Bit I/O Expander with Serial Interface, 28-Pin SOIC, Extended Temperature	SOIC-SO28_N		1



Disclaimer

This circuit board is a part of “FRA262 Robotics Studio 3: Industrial topic”. Which is a 2nd-year university student project of the Institute of Field Robotics, King Mongkut’s University of Technology Thonburi, Thailand. This circuit is designed by Altium Designer (Student License). Academic use purpose. Commercial use is prohibited.

This circuit board is a student project design. So, some usage problems might have occurred. Such as error concept design, transmission line length, ground plane, etc. Industrial standards are unclaimed in this model.

Using a power source which not in the range of recommended rating is a risk to get dangerous, breaking components, or underrating power.

Using different components, and parameters from specifying in this datasheet might cause altered voltage or unusable circuits. More Information about electrical characteristics for each IC is available on each own datasheet.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

Drawn & Designed: owl_hor, Wipop Panyatipsakul, FRAB#7, FIBO, KMUTT

Mail: wipop.owlhor@mail.kmutt.ac.th

Project: FRA262 Robotics Studio 3: Industrial topic

Affiliation: Institute of Field Robotics

King Mongkut’s University of Technology Thonburi

126 Pracha Uthit Rd., Bangmod, Thung Khru, Bangkok, 10140, Thailand.

PCB Design Software: Altium Designer 22 (Student License)

Datasheet Last update: 28/5/2022