

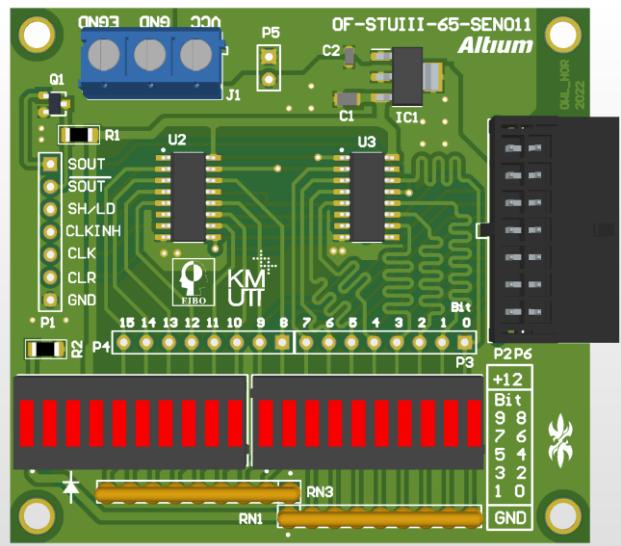


# OF-STUIII-SEN011

## 16-bit Shift Register Circuit

This is a 16-bit shift register circuit. This circuit is designed specifically for 10-bit resolution, NPN open-collector output absolute encoder (use TRD-NA1024RNW, Koyo electronics as reference).

However, this circuit can be used as general purpose 16-bit parallel shift register.



## Contents

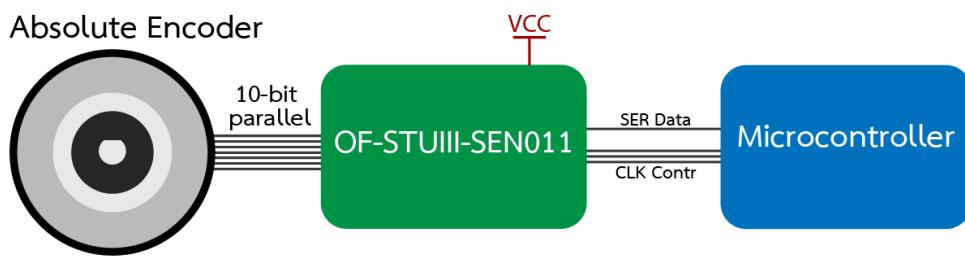
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### Features

- 10-bit NPN parallel open-collector absolute encoder Interface.
- 16-Segment LED for each bit.
- 16-bit general purpose Parallel-In Serial-Out shift register.
- Communication: State machine.

### Hardware Diagram



### General Information

	Min	Typ	Max	Unit
Voltage Rating <sup>[1]</sup>	10.8	12	24	V
Data Bit		10	16	Bit

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

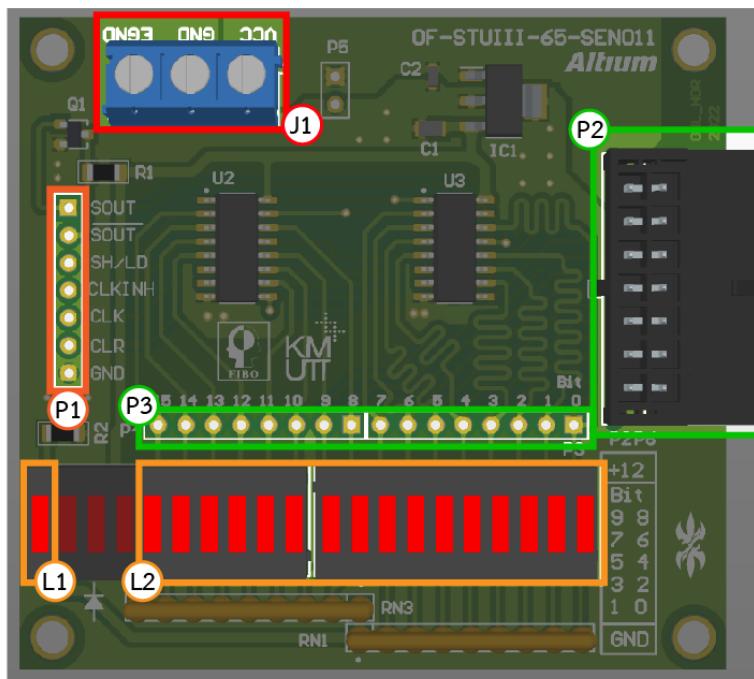
### Encoder's type

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

Sample: TRDNA-Series, Koyo electronics



#### Circuit pinout

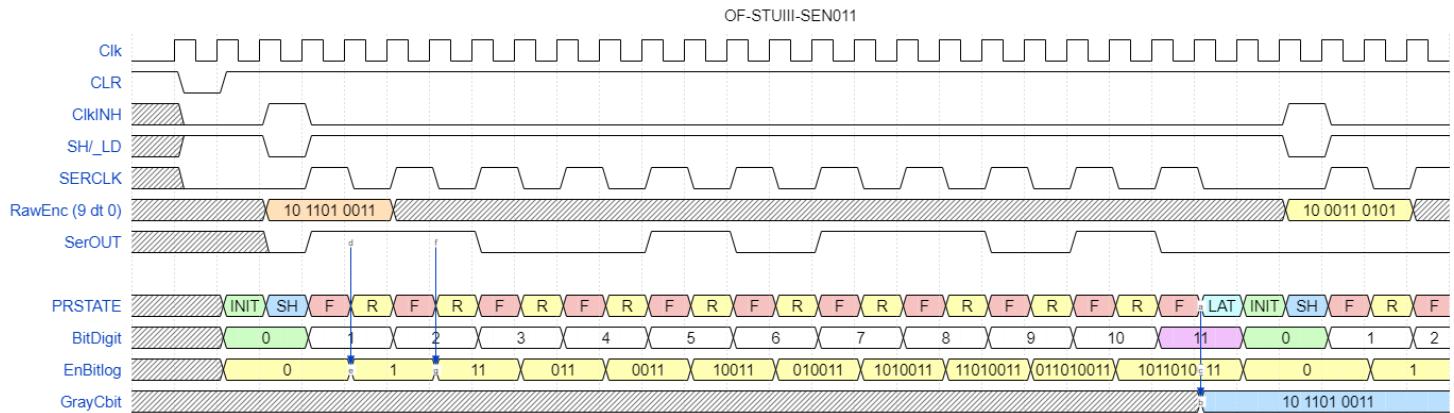


Terminal	Pin	Description
J1	VCC	Power Source
	GND	GND
	EGND	Earth Ground for encoder's shield
P1 <sup>[2]</sup>	SOUT	Serial Data Out
	<u>SOUT</u>	Serial Data Out (Invert from SOUT)
	SH/LD	Shift Load register
	CLKINH	Inhibit Clock
	CLK	Serial Clock
	CLR	Clear data
	GND	Ground (For connect with the controller)
P2	Bit[0..9]	Terminal connect to the encoder. 10-bit only Please visit : <a href="#">Terminal &amp; Wire, Connector Information</a>
P3	Bit[0..15]	Pin header for 16-bit.
L1	-	LED shows circuit power's status.
L2	-	LED shows bit's status.

[2] More Information at [Timing Diagram](#) and SN CD 74HC166, TI Datasheet.



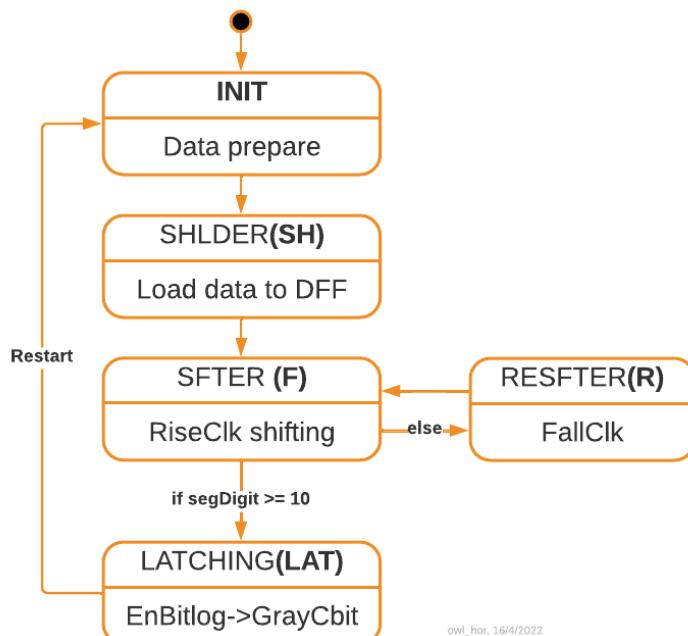
### Timing Diagram



This Timing diagram represents the process happened while 10-bit data are shifted from the encoder [RawEnc (9 dt0)] and become to [SerOut] which will be decoded in microcontroller. However, the amount of bit can be increased up to 16-bit. The above set of clock diagram are clocks set in 166IC, More information can be found at SN, CD 74HC166, Texas Instrument's Datasheet.

The lower set of clock diagram are clocks set idea in microcontroller. [PRSTATE] is state machine which use to communicate with SEN011, [BitDigit] is the counter that count bit which come into the controller. [Enbitlog] is the logger that log input bit data bit by bit. [GrayCbit] is the result of finished shift 10-bit data that represented in graycode.

### Communication: State machine Idea



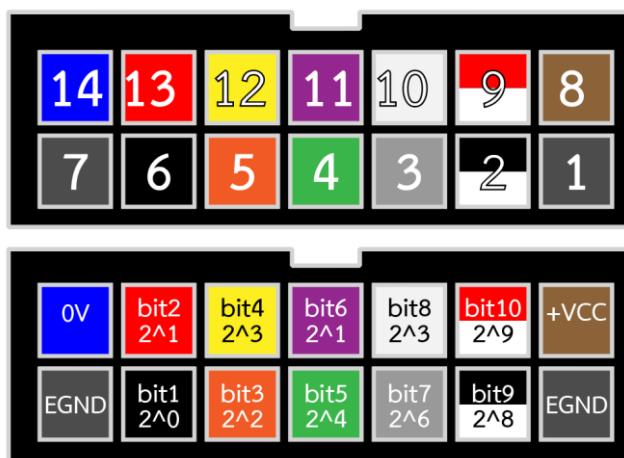
For Sample code, please visit:

<https://github.com/owlhor/FRA222MCCstm32/blob/main/AbsEncParraRegis/Core/Src/main.c>

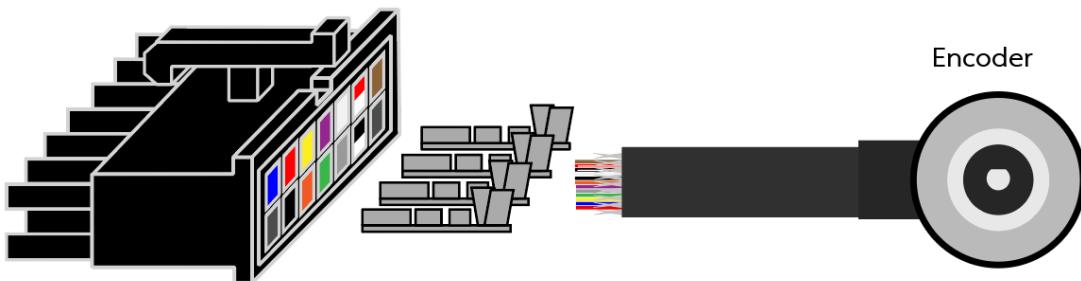


### Terminal & Wire, Connector Information

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



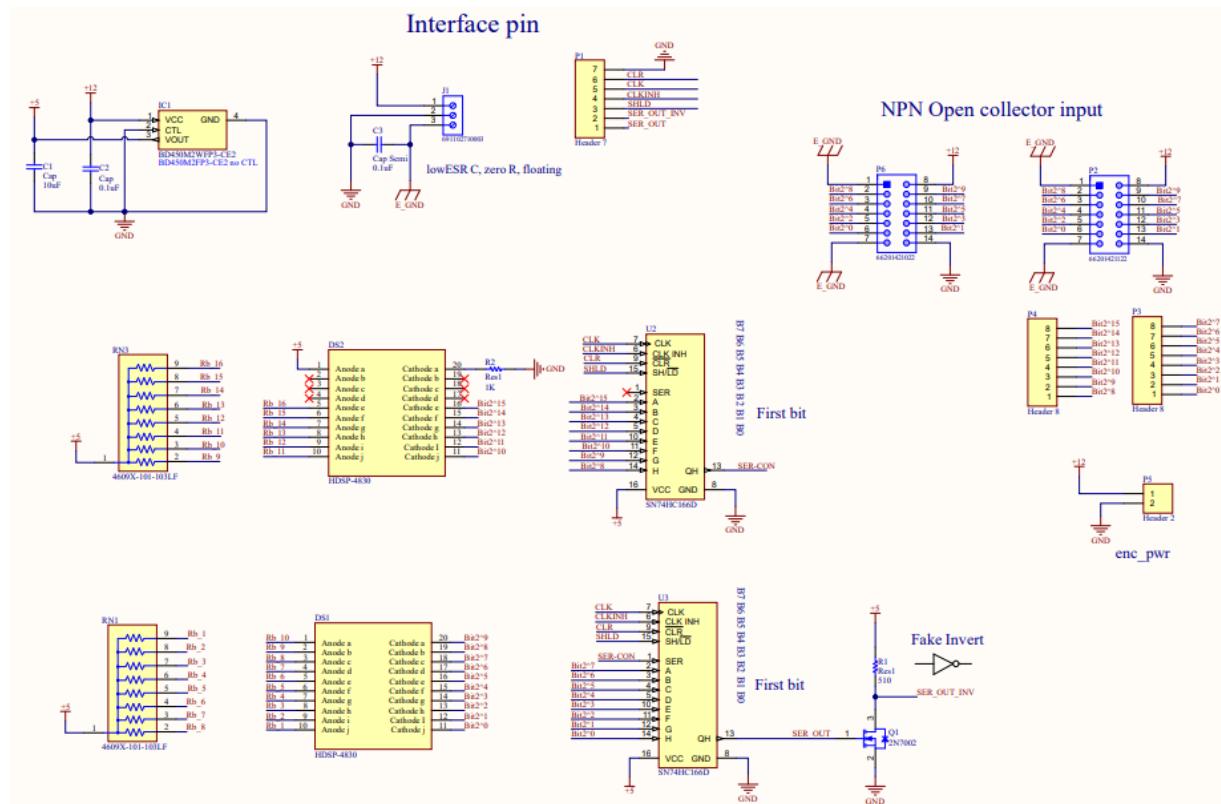
Connector's position	Encoder's wire <sup>[3]</sup>	
14	Blue	0V, GND
8	Brown	12-24V, VCC
6	Black	Bit 1, $2^0$
13	Red	Bit 2, $2^1$
5	Orange	Bit 3, $2^2$
12	Yellow	Bit 4, $2^3$
4	Green	Bit 5, $2^4$
11	Purple	Bit 6, $2^5$
3	Gray	Bit 7, $2^6$
10	White	Bit 8, $2^7$
2	Black/White	Bit 9, $2^8$
9	Red/White	Bit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



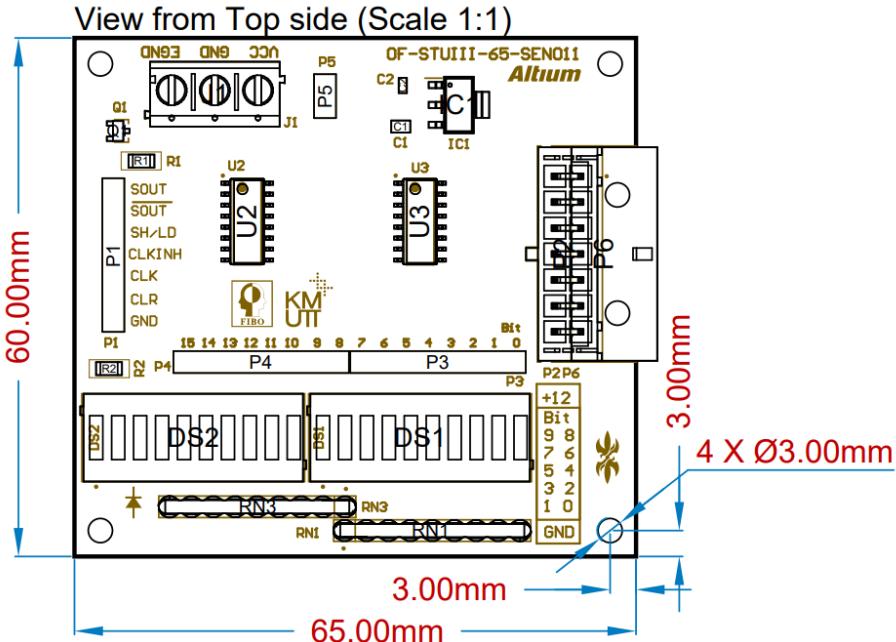
[3] Reference from TRDNA-1024RNW Absolute Encoder



## Schematics



## Dimensions





## Bill of Materials

Designator	Description	Footprint	Value	Quantity
C1	Capacitor	2029	10uF	1
C2	Capacitor	1608[0603]	0.1uF	1
C3	Capacitor (Semiconductor SIM Model)	J1-0603	0.1uF	1
DS1, DS2	10 Segments LED Array	Broadcom_HDSP-4830_0		2
IC1	Integrated Circuit	SOT230P700X170-4N		1
J1	Series 102 - 5.00 mm Horizontal Entry Modular with Pressure Clamp WR-TBL, 3 pin		691102710003	1
P1	Header, 7-Pin	HDR1X7		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
P6	THT Male Header WR-MPC3, with Snap-in Plastic Pegs, Right Angled, Dual Row, pitch 3 mm, 14 pins		66201421022	1
Q1	N-channel 60 V, 1.8 Ohm, 0.35 A STripFET(TM) II Power MOSFET, SOT23	STM-SOT-23-3_V		1
R1	Resistor	Res_1206_3mm	510	1
R2	Resistor	Res_1206_3mm	1K	1
RN1,RN3	RES ARRAY 8 RES 10K OHM 9SIP	FP-4609X-MFG		2
U2, U3	8-Bit Parallel-Load Shift Registers, D0016A, TUBE	D0016A_M		2



### Disclaimer

This circuit board is a part of "FRA262 Robotics Studio 3: Industrial topic". Which is a 2<sup>nd</sup> year's university student project of 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 unacceptable.

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

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

Using different components, 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](mailto: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)

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