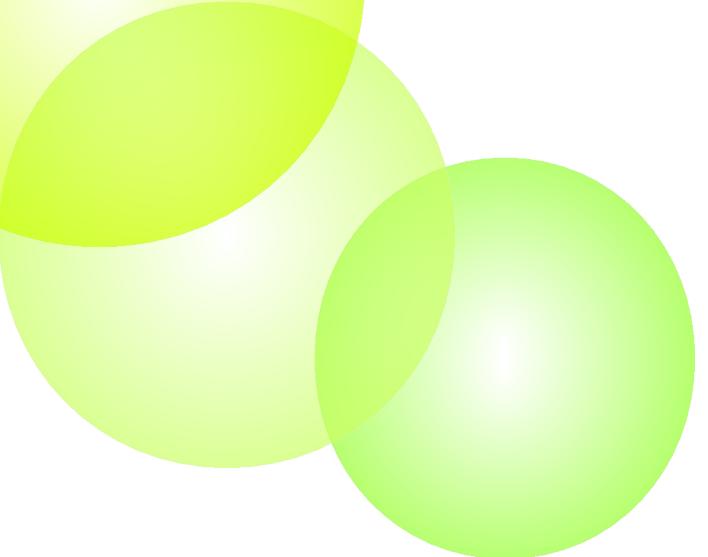




RadioStudio

Made in INDIA



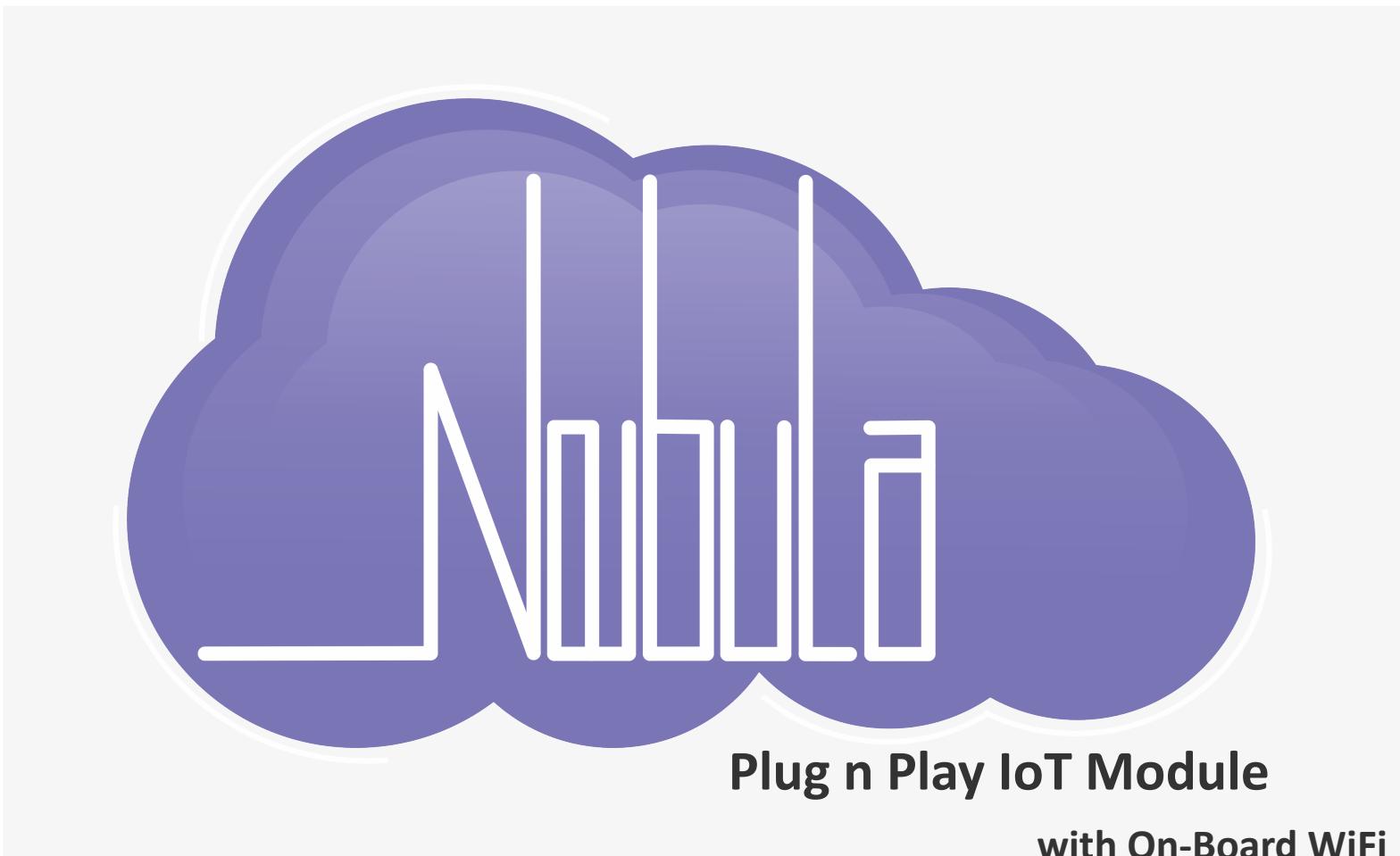
Designed & Manufactured by



RadioStudio

C6, Cee Dee Yes Guindy Enclave,
3/1, Angalamman Koil 2nd Street,
Velachery, Chennai – 600 042
TamilNadu, India

Contact : **ioelabs@radiostudio.biz**



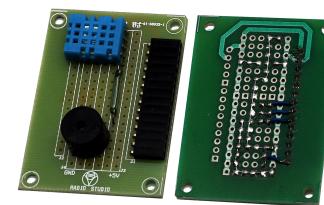
www.radiostudio.co.in

[Ordering Information](#)

Order Code	Dimensions	Descriptions
NEBULA - 01	88 mm x 60 mm	Nebula Board (with Right-Angled Interface Connector).
NEBSIF - 01	55 mm x 45 mm	Sensor Interface Board (without Sensors).
NEBMIF	63 mm x 73 mm	Nebula Mains Interface Board.
NEBLCD	36 mm x 80 mm	16x2 LCD. Blue Back-light & White Font.
NEBSIF - 02L	55 mm x 45 mm	Sensor Interface Board with DHT11- Temperature &Humidity Sensor on OW1 Pin, Reed Switch on IP1 Pin, Buzzer on OP1 Pin.
NEBSIF - 02R	55 mm x 45 mm	Sensor Interface Board with RGB LED - Green on PWM1 Pin, Red on PWM2 Pin & Blue on PWM3 Pin, Photo-Resistor on ADC1 Pin.
IOEKIT - 01	238 mm x 154 mm x 67 mm	IoT kit with one NEBULA, one NEBMIF, one NEBLCD & NEBSIF-02L and NEBSIF-02R interconnected and mounted on a protective Acrylic case.
NEBKIT - 01	-	Nebula Starter kit with one NEBULA, one NEBMIF, two NEBSIF-01, one NEBLCD & NEBSIF-02L and NEBSIF-02R.



NEBULA



NEBSIF



NEBMIF



NEBLCD



IOEKIT-01

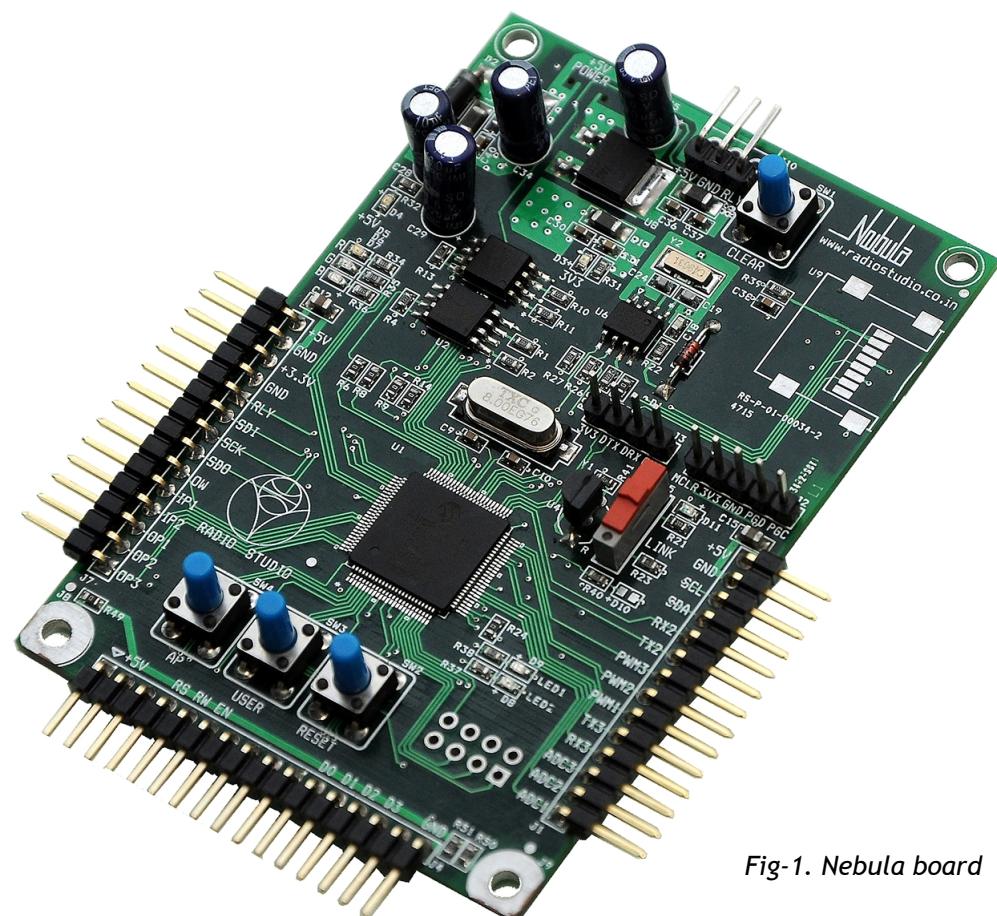


Fig-1. Nebula board

[Features](#)

- Upload sensor data to cloud in minutes
- Embedded programming expertise not needed
- Ideal for rolling out custom products
- Easy WiFi configuration through web interface
- Process data at server side
- Actuation can be performed from server
- Powered from smart phone charger
- Supporting hardware available for AC mains control and for sensor interfacing
- True sensor and actuator plug and play
- Data with time stamp
- Unique ID per module
- LCD interface for status reporting
- Onboard external RTC
- On-board 1 Mega Bit EEPROM and 16 Mega Bit FLASH
- On-board SD card Interface (Reserved for future use)
- 2 UARTs provide extensible interface (Reserved for future use)
- Server interface through configuration. Nebula can be attached to any server

Related Hardware

- Sensor Interface Boards for soldering sensors
- Mains Interface board for powering the board from AC mains supply. The output is fully isolated. The mains interface board also has a relay for controlling power to downstream appliances

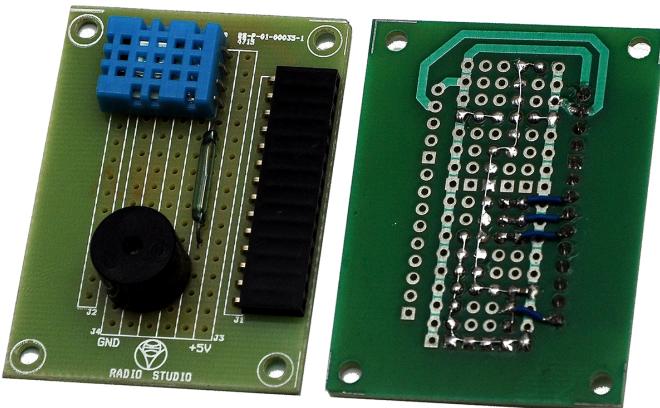


Fig-2. Sensor Interface boards enable sensors to be interfaced easily and reliably to the Nebula board.

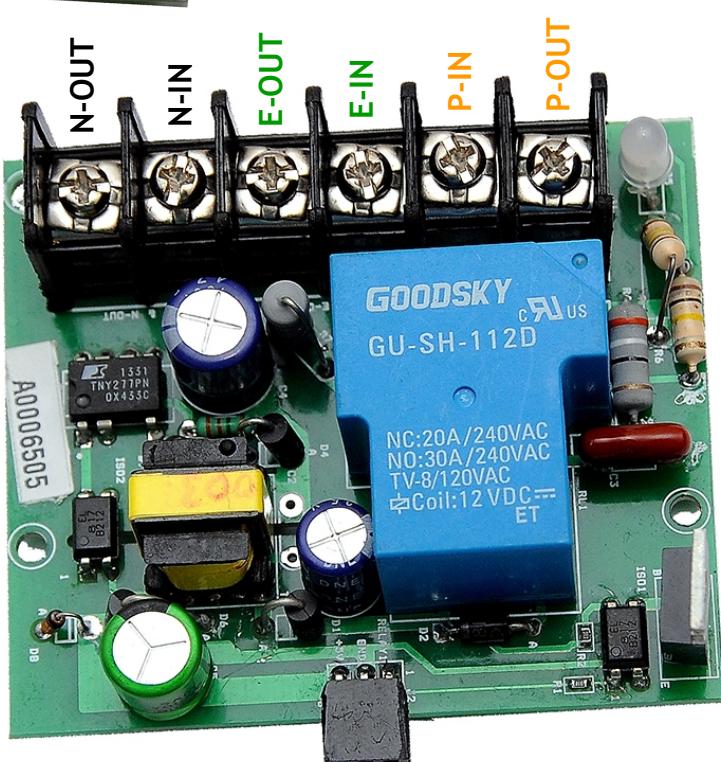


Fig-3. Mains Interface Board on the extreme left and sensor interface boards with sample sensors soldered - both top side and bottom side are shown.

The bottom connector(J2) in the Mains Interface Board connects directly to the Nebula board and provides supply to the Nebula from the mains and also provides a logic pin for controlling the relay from the Nebula board facilitating control of mains powered appliances. The terminal block on the top side is for mains inlet and outlet. Appropriate safety precautions need to be observed when using the Mains Interface board. A simple solution is to have an enclosure so that accidental contact with high voltage circuitry is eliminated.

Description

With Nebula, sending data from sensors to the cloud becomes a breeze. Simply power the board from a smart phone mobile charger, setup the WiFi configuration and the input ports come alive, and data is sent to the DataGlen server by default (after successful registration at DataGlen).

There is no need for embedded expertise when working with Nebula. Nebula abstracts away all the programming and reports the voltage values at input ports and sets the default values at the output ports. The default values and sensor configuration is done at the server.

Since Nebula comes with a WiFi interface by default, custom applications with sensors and actuators can be implemented easily, paving way for innovations and new products to be built. Decision making and control is made at the server side enabling complex decisions to be made based on multiple inputs with or without data analytics. Supporting hardware like sensor interface boards for Nebula is available for connecting sensors and actuators. For mains powered and mains control applications, a Mains Interface Board is also available .

Nebula is envisaged for enabling end-products on the IoT framework to be built with relative ease. The WiFi interface is robust and accurate external RTC provides network synchronised time stamp. Nebula has an SNTP client that automatically updates the RTC and provides accurate timestamp for the data. The on-board EEPROM and Flash stores configuration parameters so that there is no need to reconfigure WiFi for the same network once configuration has been done previously. The EEPROM and Flash will also support Over The Air programming in future (Currently OTA programming is not available).

With the Nebula, the voltage values at the input ports are sent by default. Nebula has two general purpose digital input ports for interfacing to switches or sensors that provide a digital output. There are three ADC input ports for sensors that provide proportional voltage output. The ADC inputs have a full-range of 2.5V. An on-board voltage reference provides stable reference voltage independent of the device power supply and enables greater accuracy of conversion.

Nebula provides 3 PWM output ports and 3 digital output ports for controlling actuators like relays, buzzers and LEDs. The action to be taken for actuation can be controlled from the server. A specially designated RLY port is for control of a relay in the Mains Interface Board. This enables easy control of mains appliances.

Nebula provides a 16x2 LCD interface for status reporting like registration with the web server, WiFi connection and data posting status etc,. Push button switches on the board enable reconfiguration to different WiFi network and erase configuration parameters from the memory.

A One Wire Interface is also provided. Currently only DHT11 and DHT12 temperature and humidity sensors are supported. Two UARTs are also available which are reserved for future use. These UARTs will enable interfacing of UART based sensors, serial communication devices.

Nebula Interfaces(Contd)

J7 pin description

#	Pin Name	Description
1	OP3	Output from Nebula for connection to an actuator like Relay, Buzzer or LED. VOH = 3 V min, VOL = 0.4V max, Imax = 5mA
2	OP2	Output from Nebula for connection to an actuator like Relay, Buzzer or LED. VOH = 3 V min, VOL = 0.4V max, Imax = 5mA
3	OP1	Output from Nebula for connection to an actuator like Relay, Buzzer or LED. VOH = 3 V min, VOL = 0.4V max, Imax = 5mA
4	IP1	Input to Nebula from a sensor that gives a digital output. Switches and PIR motion sensors for example. VIH = 2.7V min, 5V max. VIL = 0.7V max
5	IP2	Input to Nebula from a sensor that gives a digital output. Switches and PIR motion sensors for example. VIH = 2.7V min, 5V max. VIL = 0.7V max
6	OW	One Wire - Currently supports only DHT-11 humidity and temperature sensor
7	SDO	Serial Data Out of SPI Bus - Not supported currently, Reserved for future use
8	SCK	Serial Clock Input of SPI Bus - Not supported currently, Reserved for future use
9	SDI	Serial Data In of SPI Bus - Not supported currently, Reserved for future use
10	RLY	Output from Nebula. Also connected to pins 5 and 6 of J10 for controlling relay on mains interface board. VOH = 3 V min, VOL = 0.4V max, Imax = 5mA
11	GND	Ground
12	+3.3V	3.3V output for powering sensors. Nominal Voltage = 3.3V. Max Current = 250mA
13	GND	Ground
14	+5V	5V output for powering sensors. Nominal Voltage = 5V, Max Current = 250mA

J10 pin description

#	Pin Name	Description
1	+5V IN	5V input supply from Mains Interface Board
2	+5V IN	5V input supply from Mains Interface Board
3	GND	Ground
4	GND	Ground
5	RLY	Relay output from the board for controlling relay in the Mains Interface Board
6	RLY	Relay output from the board for controlling relay in the Mains Interface Board

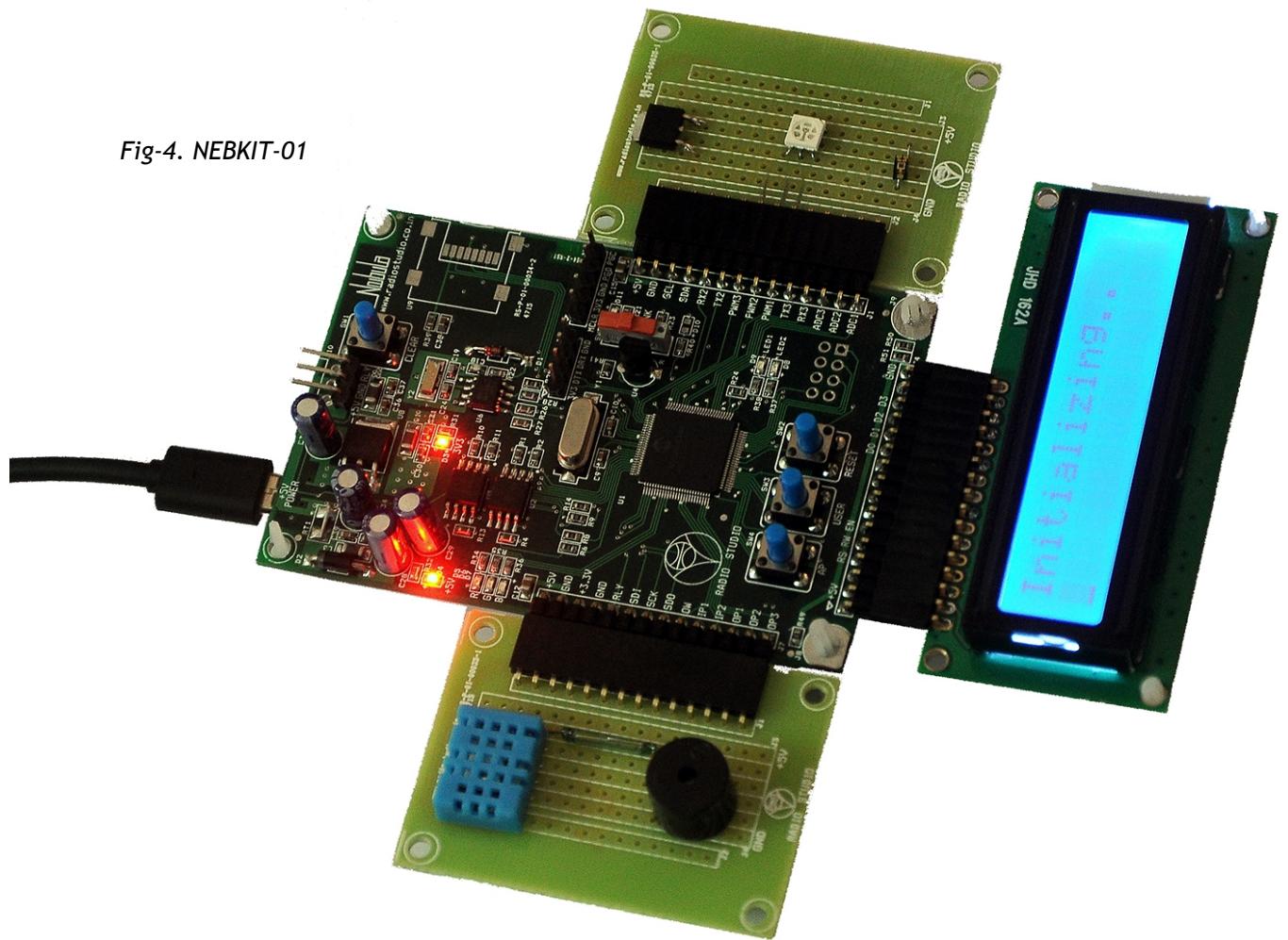
Powering the Board for the first time

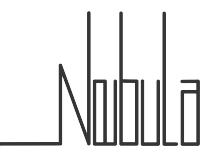
The picture shows the Nebula board powered from a smart phone charger through the micro USB power interface. Sensor interface boards are attached to the J1 and J7 interfaces. The sensor board attached to the J7 interface carries a humidity and temperature sensor, a reed switch and a buzzer while the one connected to J1 (farther end) has an LED connected to the PWM input.

The LCD shows that the board is getting setup. Message displayed on LCD: "**Initialising**". The WiFi interface needs to be configured before data can be uploaded.

(Note: The Nebula can also be powered from the Mains Interface Board J10. Power should be applied only from either connector – J5 or J10 but not both)

Fig-4. NEBKIT-01





[WiFi Configuration \(With a PC, tablet or mobile\)](#)

- Press AP Switch (SW4) on the board. The display will now show “SoftAP Mode”. After few seconds, display will show UID and MACID on the first line and second line respectively. The Nebula board will now come up as an access point with the SSID – RS_xxxxxx where xxxxxx is the MACID shown in the display. The password is rsyyyyyy where yyyy is the last six digits of the UID. Both the MACID and UID can be readout from the LCD display
- Open a browser and enter the IP address 192.168.4.1. The display on the browser is shown in IoT Board Configuration shown in the picture at the bottom of the page. The SSID and PASSWORD is now entered. The e-mail id of the user also needs to be provided. Press the SUBMIT soft-key on the browser page
- On successful configuration, a pop-up will appear on the browser showing that the configuration is saved successfully as shown in figure below
- Press EXITAPMODE soft-key on the browser. A message “*****Plug Disconnected AP Mode exited****” will be displayed on the browser page
- The next step is the initiation of registration process with DataGlen server. The user will get an e-mail to the given e-mail id from DataGlen which contains a link for registration. After successful registration, the display changes to “Registered To User” and the user can view the data at DataGlen website
- Data is then processed at the server side and actuation is performed from the server using soft-keys or API calls

IoT Board Configuration

SSID	<input type="text" value="RadioStudio"/>
PASSWORD	<input type="password"/>
EMAILID	<input type="text" value="ioelabs@radiostudio.biz"/>
<input type="button" value="Submit"/> <input type="button" value="EXITAPMODE"/>	

Fig-5. SoftAP Web-page

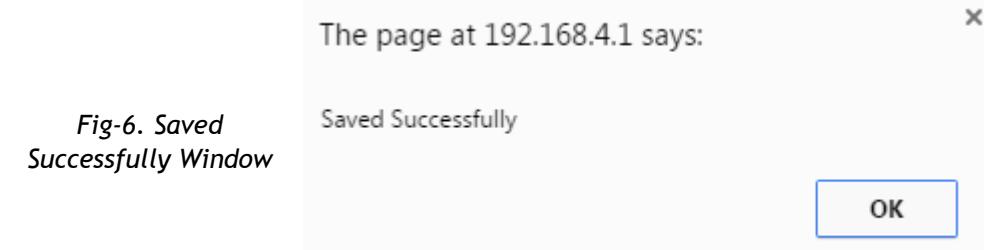
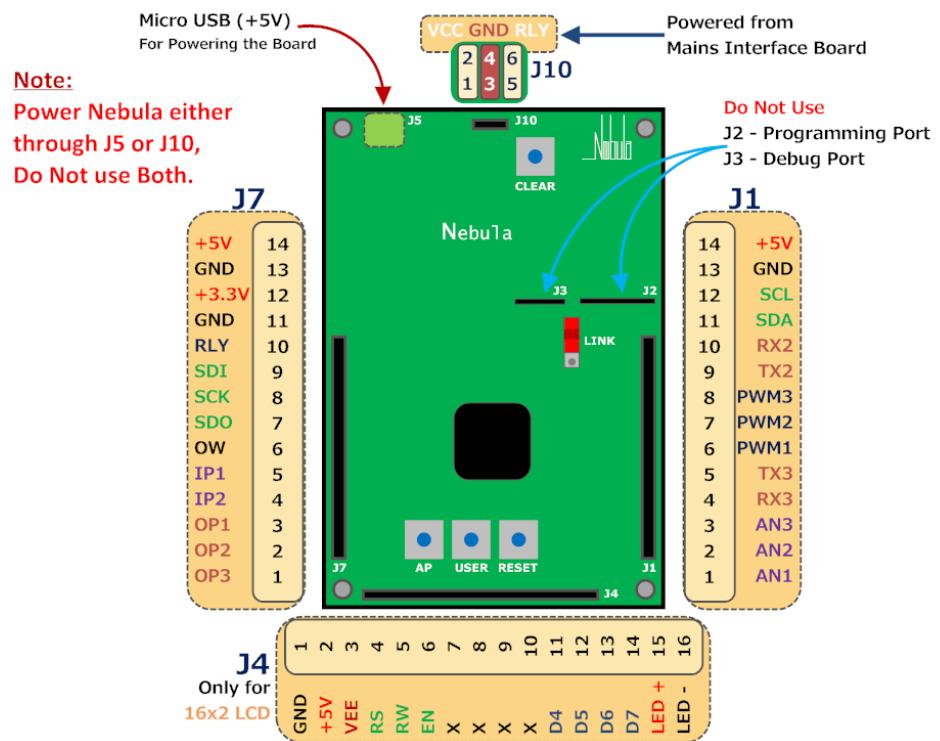


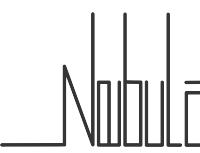
Fig-6. Saved Successfully Window

Nebula Interfaces

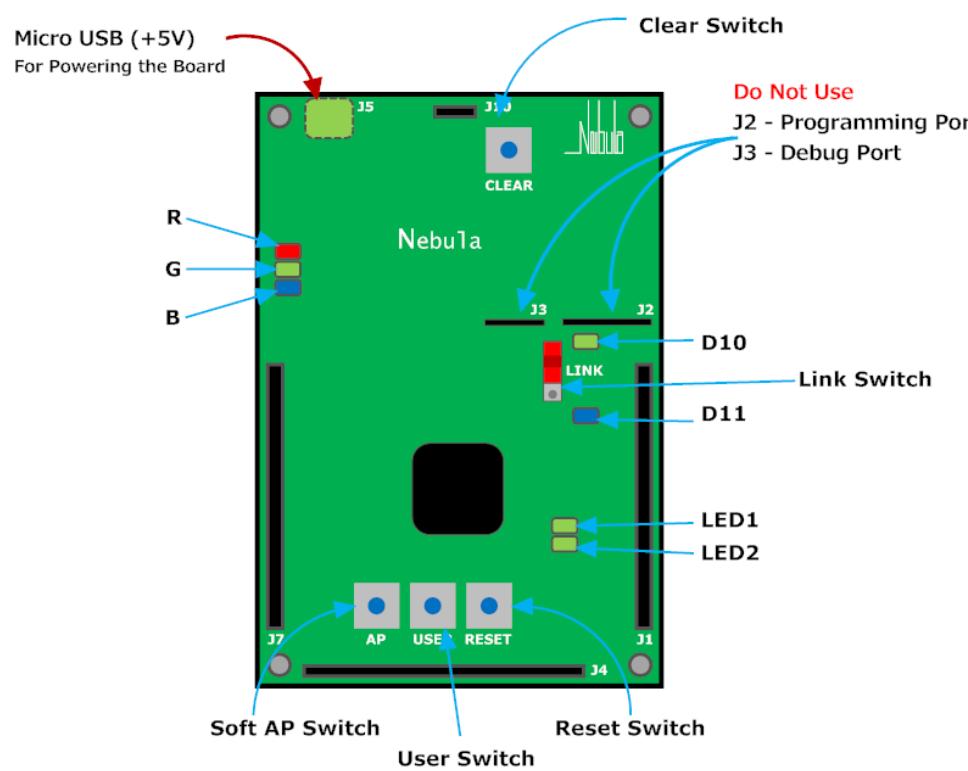


J1 pin description

#	Pin Name	Description
1	AN1	Analog Input for ADC. Full scale voltage range 0-2.5V. Resolution: 10 bit Maximum input voltage = 3.3V
2	AN2	Analog Input for ADC. Full scale voltage range 0-2.5V. Resolution: 10 bit Maximum input voltage = 3.3V
3	AN3	Analog Input for ADC. Full scale voltage range 0-2.5V. Resolution: 10 bit Maximum input voltage = 3.3V
4	RX3	UART receive input. Reserved for future use
5	TX3	UART transmit output. Reserved for future use
6	PWM1	Pulse Width Modulation Output. Parameters configurable from the server
7	PWM2	Pulse Width Modulation Output. Parameters configurable from the server
8	PWM3	Pulse Width Modulation Output. Parameters configurable from the server
9	TX2	UART transmit output. Reserved for future use
10	RX2	UART receive input. Reserved for future use
11	SDA	Serial Data - I2C bus. Reserved for future use
12	SCL	Serial Clock - I2C Bus. Reserved for future use
13	GND	Ground
14	+5V	5V output for powering sensors. Nominal Voltage = 5V, Max Current = 250mA



[Push-button Switches Assignment and LED indications](#)



[Push-button Switch Assignment](#)

SOFT AP SWITCH	Nebula becomes a WiFi Access Point (AP) for WiFi configuration
USER SWITCH	Configurable by user. Reserved for future use
RESET SWITCH	Resets the Nebula board. All configuration parameters are retained
LINK SWITCH	Toggle Switch that displays the UID and MACID on the LCD when set to ON. Switch OFF to go back to normal display
CLEAR SWITCH	For loading factory default configuration in conjunction with RESET switch - Hold CLEAR SWITCH down while giving a RESET to the board to load factory defaults. WiFi configuration to be done after this.

[LED Indications](#)

R LED	Red LED for health indication. Toggles every second
G LED	Toggles whenever sensors are polled
B LED	Toggles whenever sensor data is posted to server
D11	Displays Link Switch Status (ON/OFF)
D10, LED1 and LED2	LEDs that can be controlled from the server.
D4	5V Power LED - Always ON
D3	3.3V Power LED - Always ON

[LCD Message Description](#)

Initializing..	Hardware Interface Initialization
WiFiModule ERR..	Some Error with WiFi Module Contact Vendor
WiFi Module OK..	WiFi Module Initialization OK
No WiFi Link..	Not Connected to Any WiFi Network, Wait for few seconds for this status to change. If this persists for a long time(more than 1 minute) check the WiFi configuration of the board through SoftAP web-page (Refer to SoftAP configuration procedure)
WiFi Connected..	Connected to the configured SSID
IP:192.168.0.12	IP Address assigned to the board
Post Success	The Board is Posting the sensor data to the configured server
Post Fail	The Board is not posting data, internet could be down/server could be down/not registered properly with the server. Check internet connection.
Post Count,Actuation Count	Post Count is the number of sensor data hits to the server
EmailID Empty	During the registration process with the DataGlen server if the emailID field in the SoftAP WebPage is empty this message is displayed
EmailID Wrong	If the EmailID entered by the user in the SoftAP configuration page is not in a valid EMAILID format, this message is displayed In the LCD
Enter EmailID	During the registration process with the server, this is displayed as an intermediate message to convey to the user to enter EMAIL ID, ignore if the email ID is entered. If this message persists for more than a minute, Check the SoftAP web-page and enter the corrected emailID.

LCD Message Description (Contd)

Register Unit	If this message persists, then it means the UID is not recognized by the server. Follow the procedure to default Load the board. If the problem persists contact the Vendor
Not Registered	The Registration with DataGlen server is not complete. Look for additional message in the second line
Check VendorMail	After a default Load, the device defaults the emailID to ioelabs@radiostudio.biz and a registration mail is sent to this emailID. The user can now go to SoftAP web page and change the emailID field to configure the device to user's emailID
Check User Mail	After the User saves his EMAILID, an email from the DataGlen server is sent to this address. This message confirms that.
Registered to Vendor	This message is displayed when the device is registered to the vendor(RadioStudio). The user then should configure the device to his emailid through SoftAP web-page.
Registered to User	This message is displayed when the device is successfully registered to the user emailid
SoftAP Mode	This message is displayed when the SoftAP switch is pressed. Indicates that the board is in AP mode. It will exit the state when EXITAPMODE softkey is pressed in the web-page/ when the device is reset
Web Page Error	This message is displayed when the web-page in flash is erased/in error. Contact vendor when this error occurs
UID:294100XXYYZZ	Displays the UID (Unique ID)of the device
MACID:XXYYZZ	Displays Last six digits of the MACID of the device

Nebula IoT Kit

Nebula IoT kit provides the entire set of hardware, pre-connected and mounted in an acrylic enclosure. Mains power entry and outlet provide a safe and standardised mains interface. The mains portion is fully enclosed for safety reasons. This kit provides a jump-start to products that can enable appliance control based on sensory and non-sensory inputs.

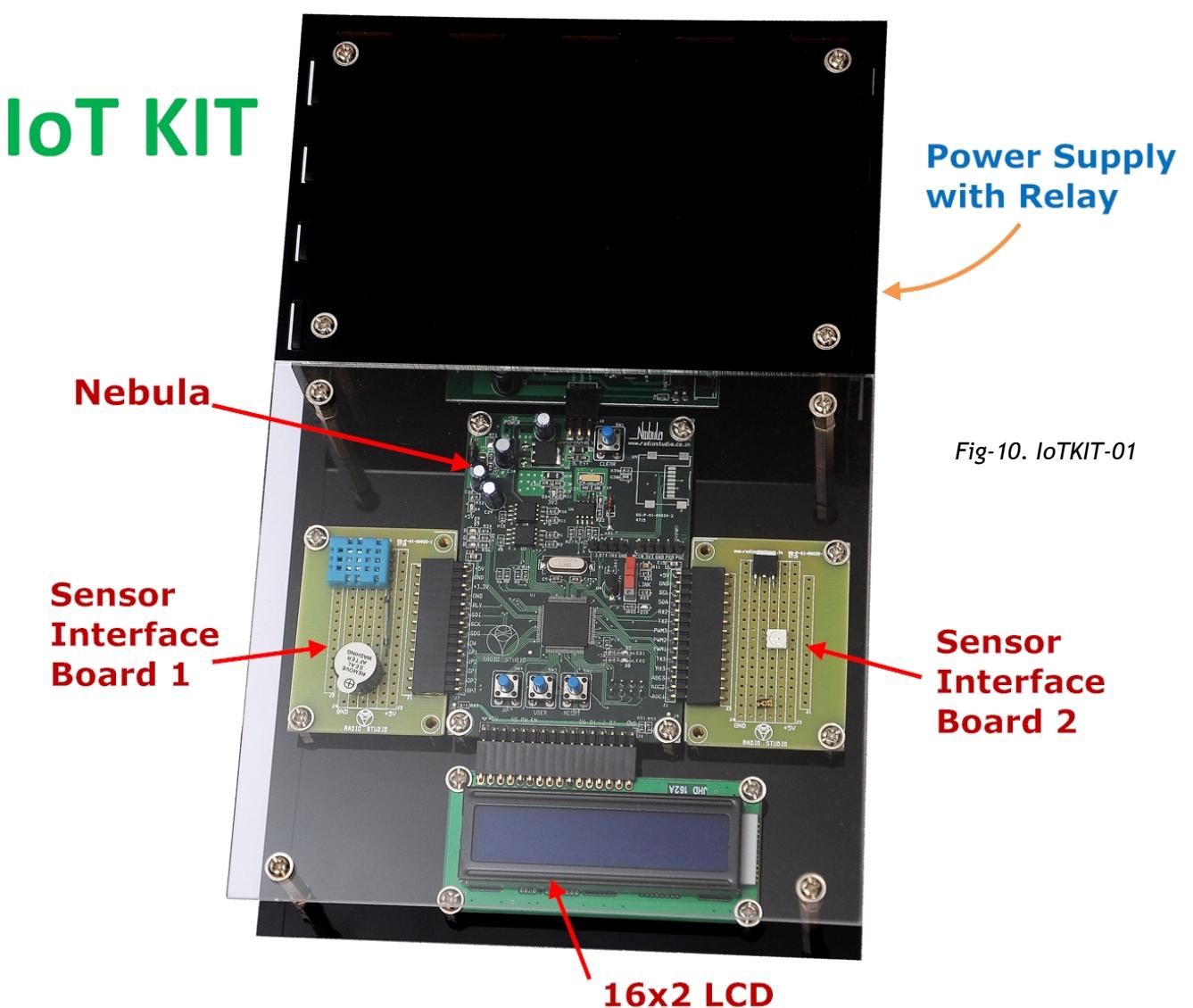


Fig-10. IoTKIT-01

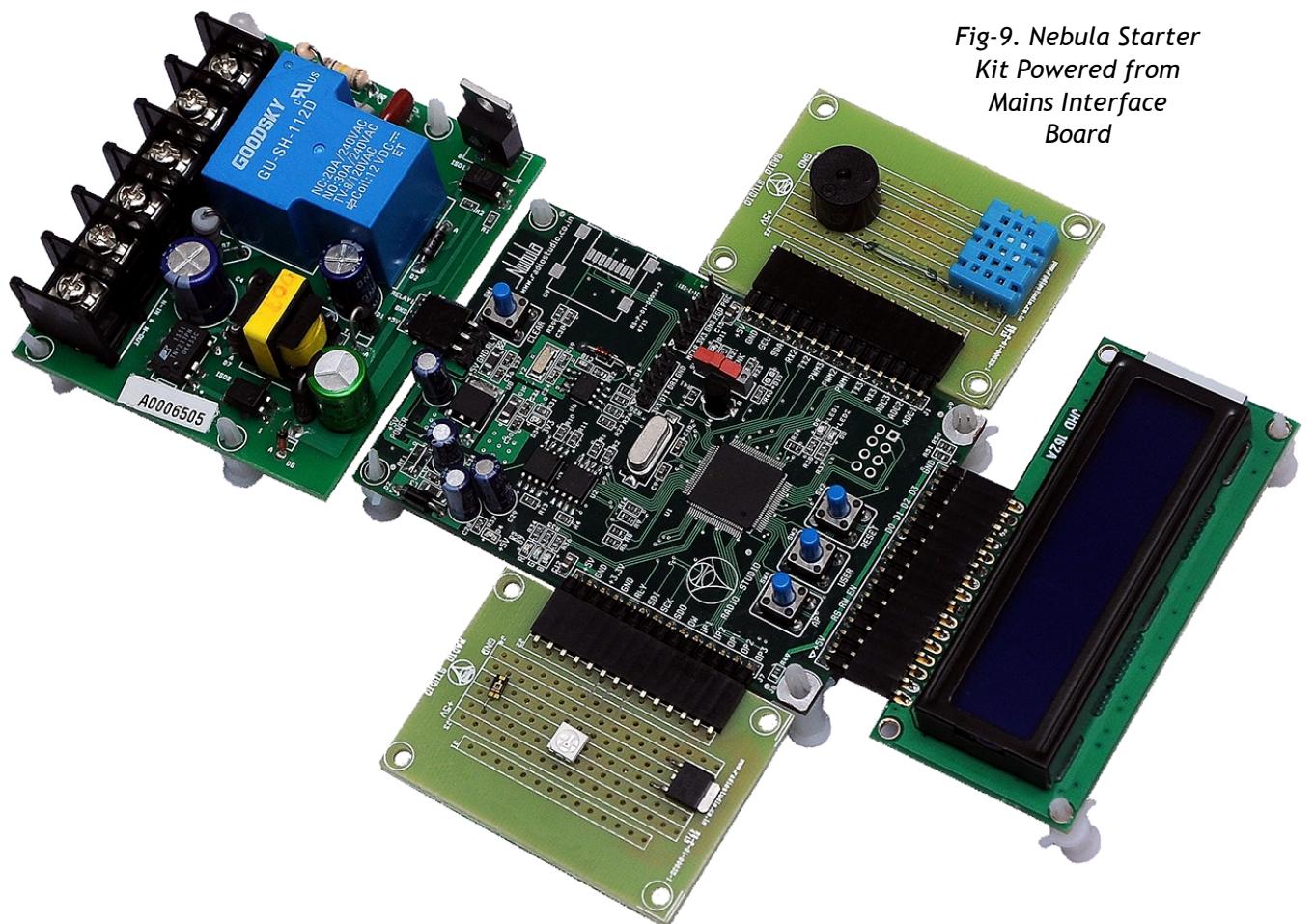


Powering Nebula from the AC Mains supply for controlling electrical appliances

Electrical appliances can be controlled with the Mains Interface Board. The Mains interface Board has an SMPS which provides isolated power to the Nebula board. The Mains Interface Board also has a relay which can be controlled from the Nebula Board. The Mains Interface Board interfaces to the Nebula through J10 connector. The setup is shown in the figure below. Also shown are the sensor interface boards and LCD. The mains interface is provided with a terminal block for reliable and safe mains connections.

CAUTION

Care must be exercised when using Mains Interface Board due to the lethal voltages present and it is recommended that suitable mechanical constraints (enclosures, for example) are provided to prevent accidental contact with high voltages.



NOTE: The above picture is for representation only.
The sensor boards have to be interchanged for proper operation.

User's Main Dashboard (@ www.dataglen.net)

- After Successful WiFi Configuration, user will get a Mail with Registration Link for DataGlen Website.
- Login to DataGlen Website after completing Registration. Fig-6, shows user's main dashboard.
- User must add their Nebula (using UID).

For further details,
Please log-on to
www.dataglen.net.

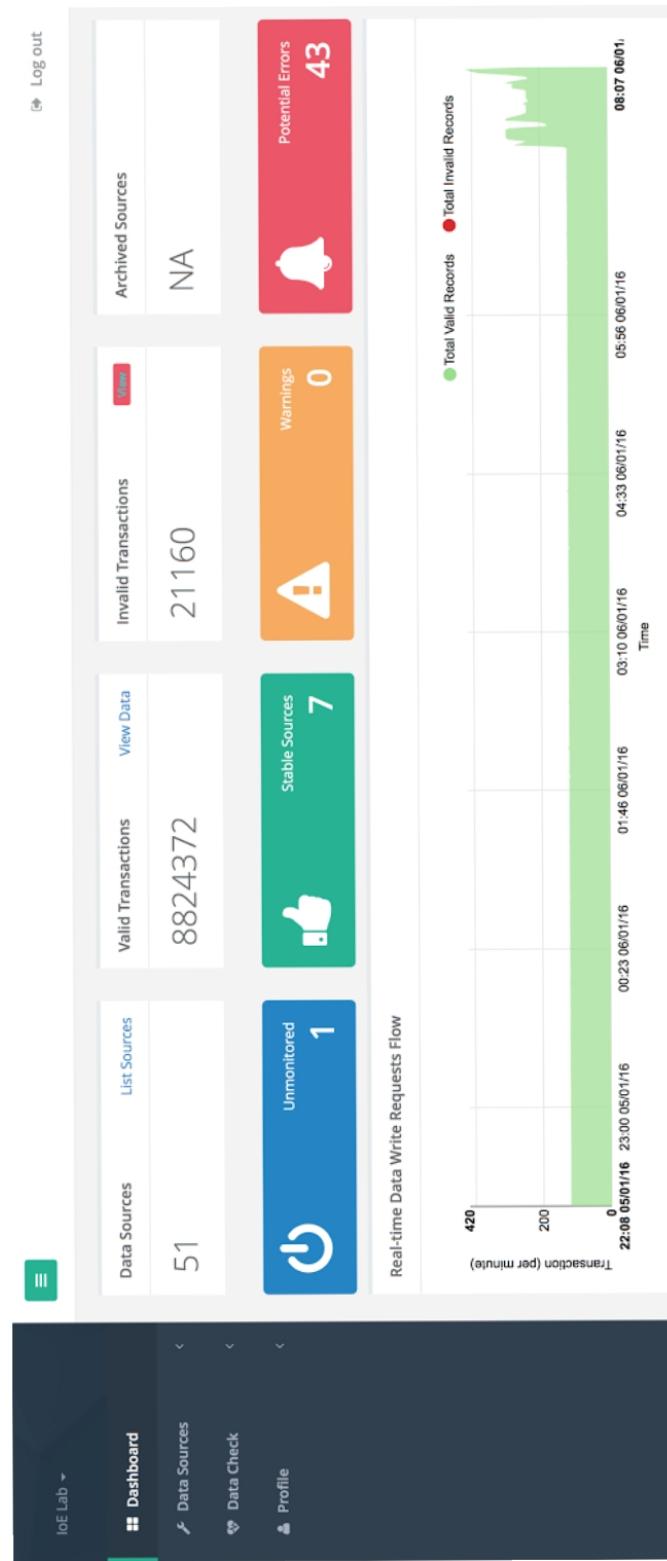


Fig-6. User's Main Dashboard

Fig-9. Nebula Starter Kit Powered from Mains Interface Board

Nebula Main Page (@ www.dataglen.net)



Fig-7. Nebula Main Dashboard.

Click on “Nebula Page” (next to UID) to view the Nebula Dashboard

Nebula Dashboard (@ www.dataglen.net)

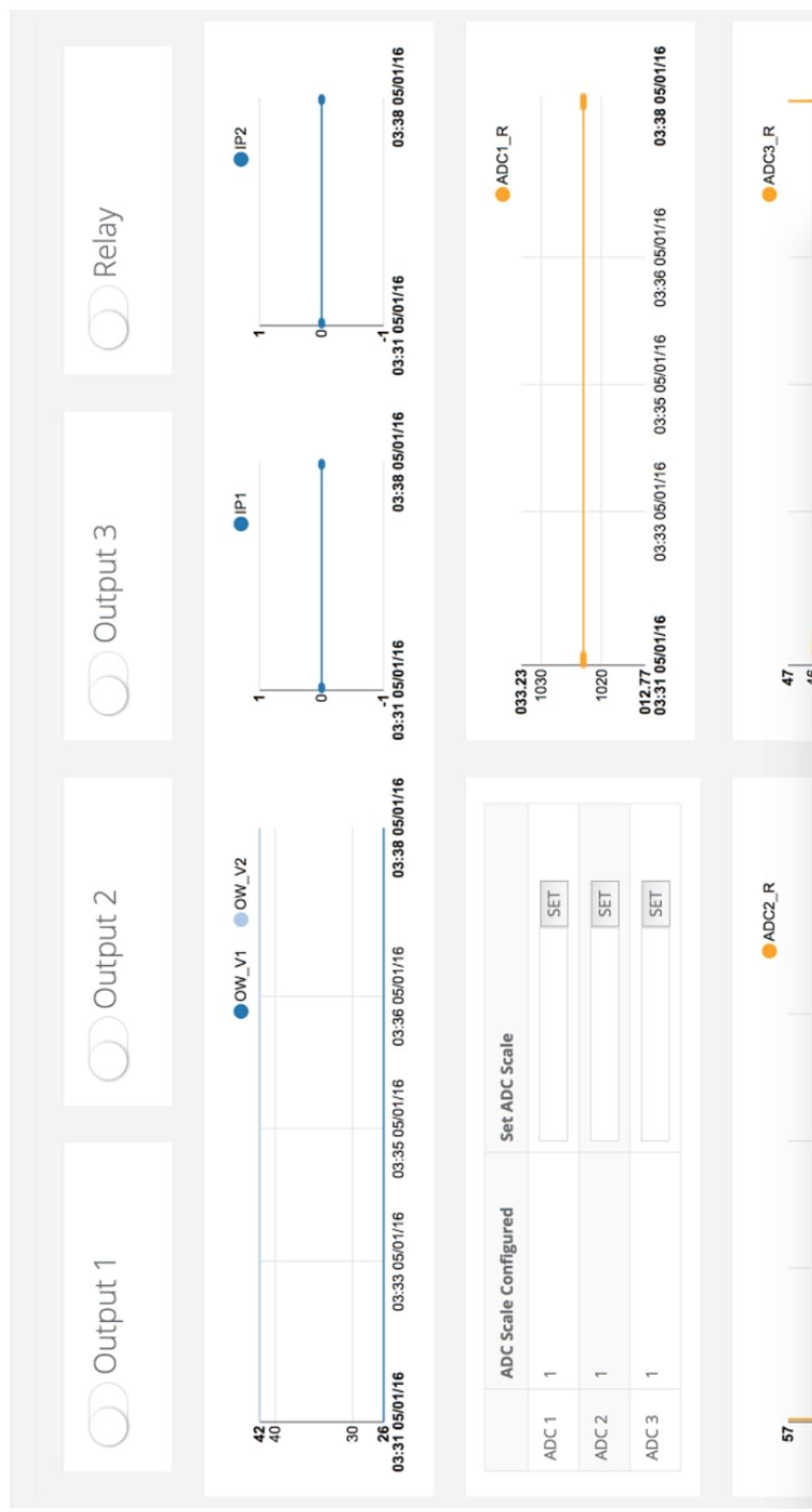


Fig-8. Nebula Dashboard.

Simple Dashboard to view sensor input data and control actuators