Testing and Commissioning Report

For who, what project, which date

**REVISION STATUS SHEET**

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| --- | --- | --- | --- | --- |
| Revision Number | Effective Date | Description / Summary of Revision | Copy updated by  Initials Date | |
| 00 | 28-Jun-2023 | Initial version | Gabriel Chen | 28-Jun-2023 |
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# EXECUTIVE SUMMARY

## Project background

PV System and BESS installation in 3 Holland Grove Avenue, Bukit Timah 278921, Singapore;

## Objective

* + 1. Installing Edge Gateway hardware and make connection to three Modbus devices (Huawei Data Logger, Janitza Smart Meter, Rainwise Weather Station) via connecting to Modbus network;
    2. Transmitting acquired data to LITEON cloud platform;

## Approach

* + 1. Installing Edge Gateway, including making AC power connection and Modbus connections;
    2. Ensuring the Modbus connection was made properly via test polling at least 1 data point per device;
    3. Confirming the IO mapping via cross checking acquired data with other data displaying devices (such as target device LCD display or SCADA);
    4. Confirming data transmission channel establishment via checking the acquired data been displayed on LITEON cloud platform correctly;
    5. Confirming remote accessibility to Edge Gateway via accessing the Edge Gateway via external network (e.g. LITEON personnel phone’s personal hotspot);

# CHECKLIST (SEVERS AS A REMINDER, IGNORE NOT APPLICABLE ITEMS)

## If going overseas

* eFlow approval
* VISA application and readiness 🡺 Not sure? Check [CIBTvisas](https://cibtvisas.sg/);
* Passport with at least 6 month validity;
* Universal power adapter;
* Foreign currency;
* Universal power adapter;
* Mobile phone power plug;
* Mobile phone charging cable;
* Overseas data plan / local SIM card;
* Flight ticket and accommodation booking 🡺 [LITEON Admin (sharepoint.com)](https://liteon.sharepoint.com/sites/Singapore-data/StrategicResourceManagement/SitePages/Admin.aspx);
* (If by land) Land transportation arrangement (private charted, coach or taxi etc.)
* (If bringing any component) Component custom letter
* (If handing over any component to external party) Component DO (Delivery Order)

## Site accessibility

* Arrangement with counterpart (when, where, who, qualification requirement);
* Local basic safety certificate 🡺 Reference : [BCSS or CSOC](https://www.mom.gov.sg/faq/training-eservices/what-are-the-equivalent-wsq-courses-with-reference-to-wshc-courses);
* (If Work-At-Height) Local WAH safety certificate 🡺 Reference : [WAH : MOM publish, No. 25, 26](https://www.mom.gov.sg/-/media/mom/documents/safety-health/lists/mom-accredited-courses.pdf);
* PPE (Personal Protection Equipment) 🡺 Not sure? Check [illustration here](https://www.anbusafety.com/wp-content/uploads/2022/05/PPE-1.jpg);
  + Helmet;
  + Protection goggles;
  + Ear plug;
  + High-visibility vest;
  + Coverall / Jumpsuit;
  + Gloves;
  + Safety boots;
  + (If Work-Ay-Height) Full body harness
  + (If outdoor) Sun glasses and hat;
* Door or panel key (if needed, could request from counterpart);

## Items to be brought

* Water supply and (optional) snack;
* IC or Passport or Safety certificate;
* Administrative document (site access form, DO etc.), if any;
* Edge Gateway DO for installer to sign off;
* Drawings or other design document, ideally with all existing field devices IP address, and communication parameters;
* Engineer laptop;
* Camera (or phone with camera);
* Sample component (for sizing or demo purpose);
* Measurement tape;
* Laser measurement device (optional, for unreachable or long distance measurement) 🡺 [Bosch Professional GLM40 Laser Rangefinder [Genuine] Measuring Tool (70 SGD)](https://www.amazon.sg/Professional-GLM40-Rangefinder-Genuine-Measuring/dp/B00NS6ISKM/ref=asc_df_B00NS6ISKM/?tag=googleshoppin-22&linkCode=df0&hvadid=606472356386&hvpos=&hvnetw=g&hvrand=4599104143439453614&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9062523&hvtargid=pla-441069130968&psc=1);
* Laser pointer (optional if has Laser measurement device);
* (If has Laser measurement device) one set of Battery for Laser measurement device;
* Multi-meter;
* Current meter (aka Clamp meter);
* 1 or 2 units of tested working LAN cable (preferred at least 2 meter length) for network testing;
* 2 meter RS485 cable;
* 1 unit of RS485 adaptor;
* Any hand-tools (test pen, screw driver etc.);

# FIELD DEVICE INSTALLATION

## Installation position final view

(Photos to show installation position, for LITEON Device 1, Device 2 …, including server or workstation too, if applicable)

(Also specify the securing method : wall mount, DIN rail mount etc.)

(If different from the site survey report, specify the reason)

## AC power source connection (for LITEON field device(s))

(Also consider the AC power supply for LITEON field devices at targeted installation position)

## Network devices connection

(Identify the connection terminal or port on the existing network device(s) to be connected, applicable for LITEON Device 1, Device 2 ……, including server or workstation too, if applicable)

(If LAN network, identify whether the network switch is managed or unmanaged. Recommended to connect engineer laptop to the switch to test, such as Ping, Telnet etc. If could poll any data from the target network device that will be ideal);

(If RS485 network, pay attention to whether the 120 ohm termination resistor to be activated (or installed separately));

## Cable routing

(How the network and power cable to be routed?)

* Whether any drilling on any enclosure involved? If yes, consider :
  + IP degrading of LITEON enclosure;
  + MoS for taking care LITEON enclosure IP degrading;
  + IP degrading of Client enclosure;
  + Approval from asset owner for Non-LITEON asset;
* Whether any wall hacking involved?
  + Approval from facility owner’s management and facility management (Note : facility management may not under owner directly);
* Also consider whether network cable is exceeding maximum communication distance;

# DATA ACQUISITION

## Site condition

* <Architecture diagram / network connection diagram>
* Huawei Data Logger :
  + <model>
  + <user manual link>
  + <Modbus register table link>
  + <Modbus RS485 termination / wiring details>
  + <Communication parameter configuration>
    - Mode : TCP or RS485;
    - IP address :
    - COM port : 502?
    - Baud rate :
    - Data bit :
    - Parity :
    - Stop bit :
* Janitza Smart Meter :
  + <model>
  + <user manual link>
  + <Modbus register table link>
  + <Modbus RS485 termination / wiring details>
  + <Communication parameter configuration>
    - Mode : TCP or RS485;
    - IP address :
    - COM port : 502?
    - Baud rate :
    - Data bit :
    - Parity :
    - Stop bit :
* Rainwise Weather Station
  + Rainwise PVMet 200
  + Product page link : [PVMet 200 Commercial Solar Monitoring - RainWise](https://rainwise.com/pvmet-200-commercial-solar-monitoring)
  + PVMet 200 user manual and Modbus register table : [Microsoft Word - RainWise - PVmet-200 Instructions Rev. 2.doc (fondriest.com)](https://www.fondriest.com/pdf/rainwise_pvmet-200_manual.pdf)
  + Modbus RS485 termination / wiring details :
    - Interface Mode: 2-Wire Half Duplex
    - A (-) : Negative RS-485
    - B (+) : Positive RS-485
    - Gnd: Signal Ground
    - Shield: Cable Shield and Drain
  + Communication parameter configuration, factory default :
    - Mode : RS485;
    - IP address : NA;
    - COM port : NA;
    - Baud rate : 9600;
    - Data bit : ?? (should be 8)
    - Parity : None;
    - Stop bit : 1

## Communication testing

* Ping test : using engineer laptop simulates Edge Gateway. From the port where the Edge Gateway going to be connected, to the target field devices;
  + Command : prompt $D, $T$H$H$H$G
  + Changes prompt format to : 18-Mar-2021, 19:59:59
  + Command : ping <IP address of target device>
  + <Result screenshot>
  + (Repeat for all connected devices)
* Telnet test (Modbus TCP/IP default port 502 or others) : using engineer laptop simulates Edge Gateway. From the port where the Edge Gateway going to be connected, to the target field devices;
  + Command : telnet <IP address> <port number> (there is a white space between IP address and port number;
    - Example : telnet 192.168.10.71 502
  + <Result screenshot>
  + (Repeat for all connected devices)

## Data acquisition and commanding test;

(Once the communication is established successfully, verifying Modbus register table is feasible. Paste testing screenshots here)

* Data acquisition test : poll 1 or 2 data point according to the Modbus register table, verify whether the acquired data is meaningful;
* Commanding test : write data to control coil or other register, check whether the field devices reacts accordingly;
* This step is best with other UI display for verification purpose, it can be existing SCADA, or the LCE display on the field device itself;

# DATA TRANSMISSION

## Access LITEON cloud platform

(Once the data acquisition is done successfully, verifying Edge Gateway connection and data transmission to LITEON cloud is feasible)

(Paste the screenshot showing the transmitted data been received by LITEON cloud platform here)

## Live data transmission verification

* Change some site condition to make some changes to the data, such as disconnecting connectors, covering PV panels or write data to control coil or other register, check whether the onsite data and LITEON cloud data changes accordingly;
* This step is best with other UI display for verification purpose, it can be existing SCADA, or the LCD display on the field device itself;

# REMOTE ACCESS AND UPDATING VERIFICATION

## Remote access verification

(This step is to ensure LITEON is able to access the deployed Edge Gateway remotely for follow up actions)

* Engineer’s laptop should disconnect from any field network such as LAN, site WiFi;
* Engineer’s laptop should connects to external network such as personal hotspot, portable WiFi dongle;
* Launch remote access tool/software to establish remote access to Edge Gateway;
* <paste success remote access screenshot here>

## Remote updating verification

(This step is to ensure LITEON is able to update the configuration of the deployed Edge Gateway remotely. Do it only when remote access verification is passed)

* Launch remote access tool/software to establish remote access to Edge Gateway;
* <paste before updating screenshot here>
* <paste after updating screenshot here>
* <paste onsite device reaction such as LCD display or SCADA display here>

# TROUBLESHOOTING TIPS

## Common practice

* Power cycling resolves 80% of the unknown issue which is good for emergency matter but may lost the opportunity for root cause analysis;
* The common troubleshooting sequence should be : Power > Connection > Configuration > Hardware;
  + Power : whether target device has power?
  + Connection : whether the target device having loose connection?
  + Configuration : whether the target device was configured correctly?
  + Hardware : whether the target device is working well?

## Modbus communication error, aka cannot poll data from Modbus device

* Whether the field bus distance exceeds its maximum limit?
  + RS485 around 1km and Ethernet around 100 meters;
  + Moving Edge Gateway next to the target device to shorten the field bus communication distance and re-test;
  + If it works, then distance maybe a problem;
* Whether the RS485 120 ohm termination resistor is activated or installed?
  + Some device requires termination resistors; enabling termination resistor could help with site with harsh external condition;
  + Enabling or installing 120 ohm termination resistor and re-test. If it works, then this is the problem, note down and make it as a standard for future project installation;
* Whether Client and Server communication mode setting is the same?
  + It should be one to one match, TCP to TCP, RS485 to RS485, RS232 to RS232 etc.
  + Update configuration accordingly and re-test. If it works, then this is the problem;
* Whether the RS485 connection was done properly (loose connection)?
  + Apply little force (normally less than 5 N, around 0.5 KG) to pull the cables one by one, if any one dropped out, then this is the problem;
  + Alternatively, using multi-meter to verify intermittence connection is also another method;
* Whether the RS485 connection was done correctly?
  + A for negative and B for positive. Most manufacturers will instead use + and –, or some variation such as D+, D . Some manufacturers will label inputs as A and B but get the polarity backward, so A is positive. (Ref : [RS485 - WHAT ARE POSSIBLE RS485 POLARITY ISSUES](https://store.chipkin.com/articles/rs485-what-are-possible-rs485-polarity-issues#:~:text=RS485%20polarity%20labels%20differ%20between,backward%2C%20so%20A%20is%20positive.))
  + Isolate with other devices, establishing only one Master and one slave network. Swap the A or B, + or – and re-test. If it works, then this is the problem;
* Whether the RS485 cable is broken?
  + Using multi-meter to check voltage between terminal A and B (or + and -) it should be around 3 V to 5 V. If it shows as 0 V, then the RS485 cable maybe broken;
  + Replace the cable and re-test;
* Whether the component is faulty?
  + It requires cross check with other site conditions. Several factors to be considered :
    - All of the Modbus devices lost communication? If yes, check Modbus Client;
    - All of the same model of Modbus devices lost communication? If yes, check Server Modbus communication parameter configurations;
    - All of the Modbus devices after a point (from network connection diagram) lost communication? If yes, check whether the RS485 cable is broken between the last working device and the first lost-com device;
    - One or few Modbus device(s) having lost communication? If yes, check whether having loose connection or polarity issue or configuration issue. If all invalid, swap the target device with other working device or replace it with a new device to see whether can bring it back online;

## Data transmission issue, aka cannot received data from LITEON cloud platform

* Whether the Edge Gateway is powered?
* Whether the Edge Gateway has internet connection?
* Whether the Edge Gateway is able to establish communication with LITEON cloud platform via its internet connection?
* Whether the Edge Gateway itself is getting data from connected clients?
* Whether the LITEON cloud platform is accepting the data from this Edge Gateway?
* Whether the LITEON cloud platform log is showing any abnormality?

# REMARK (IF ANY)

## Finding 1

(Content of finding 1);

## Finding 2

(Content of finding 2);

## Finding 3

(Content of finding 3);