

POWERHUB USER MANUAL

PRODUCT SPECIFICATIONS

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MADE IN THE USA

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Reference Documents

- Controls and Communication Manual

https://partners.teslamotors.com/en-us/EnergyDocs/Powerpack_System_Controls_and_Communication_Manual.pdf

- SCADA Design Manual

https://partners.teslamotors.com/en-us/EnergyDocs/SCADA_Design_Manual.pdf

1 General Information

1.1 Purpose

This document provides explanation and instruction on Tesla Powerhub Software. It is designed to inform users of Powerhub on what the software offers and how they can use it.

1.2 Scope

The Powerhub User Manual provides details on navigation, displays, configuration and overall product architecture. It describes how to use Powerhub and describes the various product packages available to customers.

1.3 Audience

This document is intended for all users of the Tesla Powerhub Software and any person seeking information on Tesla SCADA software solution.

1.4 Abbreviations, Acronyms, and Definitions

Explicit definitions for all acronyms and abbreviations used in this document are included here.

SCADA	Supervisory Control and Data Acquisition
HMI	Human Machine Interface
GUI/UI	Graphical User Interface
LAN1	Local Area Network 1
T&D	Transmission & Distribution
C&I	Commercial & Industrial
CSV	Comma separated values file format
HTTPS	HyperText Transfer Protocol Secure
SSL	Secure Sockets Layer
SSO	Single Sign-On
BESS	Battery Energy Storage System

1.5 Contact

Please submit any inquiries about Powerhub via the Online Support and Ticketing Portal at <https://energysupport.tesla.com/>. Account creation may be required to submit a ticket for resolution. Refer to [Tesla Energy Operations Contact List and Response Times](#) on Partner Portal for more information on accessing the Online Support and Ticketing Portal.

2 Overview

Powerhub is the Tesla SCADA software solution for monitoring, performance analytics, and real-time control of distributed energy assets. A Powerhub package includes a user interface, telemetry, historian and control options to meet varying customer and project needs. Powerhub provides a single user interface for all Tesla energy products and services, which enables a fully integrated experience that increases situational awareness and operational efficiency.

Powerhub provides advanced monitoring and control functionality and delivers real-time performance data for individual sites as well as groups of distributed sites, “Virtual Power Plants”. Powerhub includes performance metrics for batteries, solar, site loads, generators, net load at the grid connection, and non-Tesla assets (breakers, transformers, etc.).

2.1.1 Powerhub Packages

Powerhub packages offer standard combinations of telemetry, controls, user interface, and historian. The two options available today are Powerhub Plus and Powerhub Pro.

Figure 3 outlines the key features, supported energy assets, and customer types to which each of the packages applies. Tesla can provide further customization of standard packages to meet specific project needs through the inclusion of SCADA Adders.

	Powerhub Plus	Powerhub Pro
Use Case	Fleet management solution for remote monitoring distributed assets including storage, solar, and generators	Real-time control room solution for operating microgrids and power plants integrating storage, solar, generators, and other non-Tesla assets
UI Platform	Cloud-based	Local
Fleet	Multi-Site	Single Site
Customers	C&I and Microgrid developers	Utilities, Developers of large-scale storage projects and Microgrids
Features	Monitoring (Control in option)	Monitoring & Control

Figure 1: Powerhub Package Overview

3 Tesla Mobile App

The Tesla mobile app is offered to all customers. The mobile app fulfills the most basic monitoring needs and provides an easy way to check on system status and performance.

3.1 Overview

The Tesla mobile app allows customers to:

- View the current state of energy of the BESS.
- Check the current status of the batteries (Charging, Discharging, Standby)
- View real-time power flow visualization of solar, batteries, and site energy usage. This is not available for sites that only have a battery meter installed on site.
- Review historical performance data for the entire system (today, week, month, year)
- Understand the breakdown of the energy consumption across solar, the BESS, and the grid.

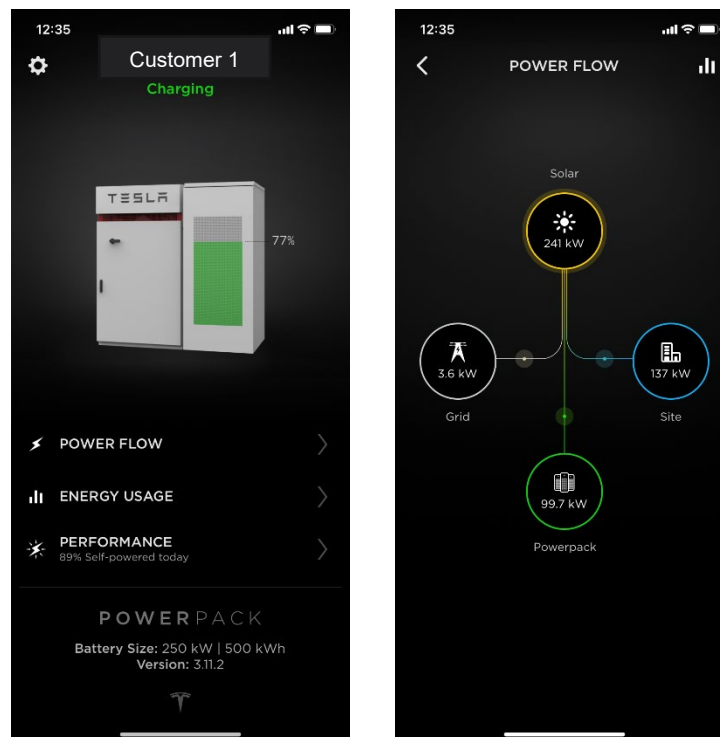


Figure 2: Home screen (left) and Power Flow view (right) in Tesla Mobile App

3.2 Downloads

Once the battery system is commissioned and running, the customer can download the Tesla app for iPhone or Android to remotely monitor their Tesla battery energy storage system with their phone. The customer will need to use their Tesla account email address and password to log in.



Figure 3: Stores to download the Tesla app

The Tesla app is the same for Tesla cars and Tesla energy systems (home solar, Powerwall system, Powerpack, etc).

For any questions about the Tesla app, contact our 24/7 Customer Support team by email at CustomerSupport@Tesla.com.

3.3 Features

Users can select any of their sites and access the following features:

Power Flow

Monitor the site solar, BESS, load and grid energy use in real time.

Energy Usage

View a live graph of the daily, weekly, monthly or annual energy generation and consumption, which gives you full visibility of the entire site.

Performance

View a percentage breakdown of how much of site load supplied by solar and storage over selectable timescales including: today, yesterday, current week, current month, and current year (only available for solar paired systems).

Power Outage Notifications

Where applicable users will be notified when Powerpack is powering their site during a grid outage.

4 Powerhub Plus

4.1 Overview

Powerhub Plus is a SCADA software package that increases visibility across a fleet of distributed energy resources for those who do not have an onsite presence or their own SCADA control room. Powerhub Plus enables remote monitoring and reporting on performance, increases operational efficiency and uptime, and presents aggregated data for groups of sites as a single resource (“virtual power plant”). Powerhub Plus allows users to analyze and trend data across all sites either in real-time or retroactively using advanced, intuitive visualizations. Real-time power flow visualizations are also provided on a site-specific basis to evaluate instantaneous site behavior. Performance data is backed up remotely and available for download or integration via API into external energy management systems.

4.2 Specifications and Features

4.2.1 Cloud User Interface

The cloud-based UI includes access to near real-time data for all sites in the fleet from anywhere with an internet connection.

The cloud-based UI is hosted on the Tesla Servers and can be accessed from remote locations over HTTP with SSL authentication. The Tesla Site Controller utilizes an internal cellular modem to communicate with the Tesla servers for logging and firmware updates.

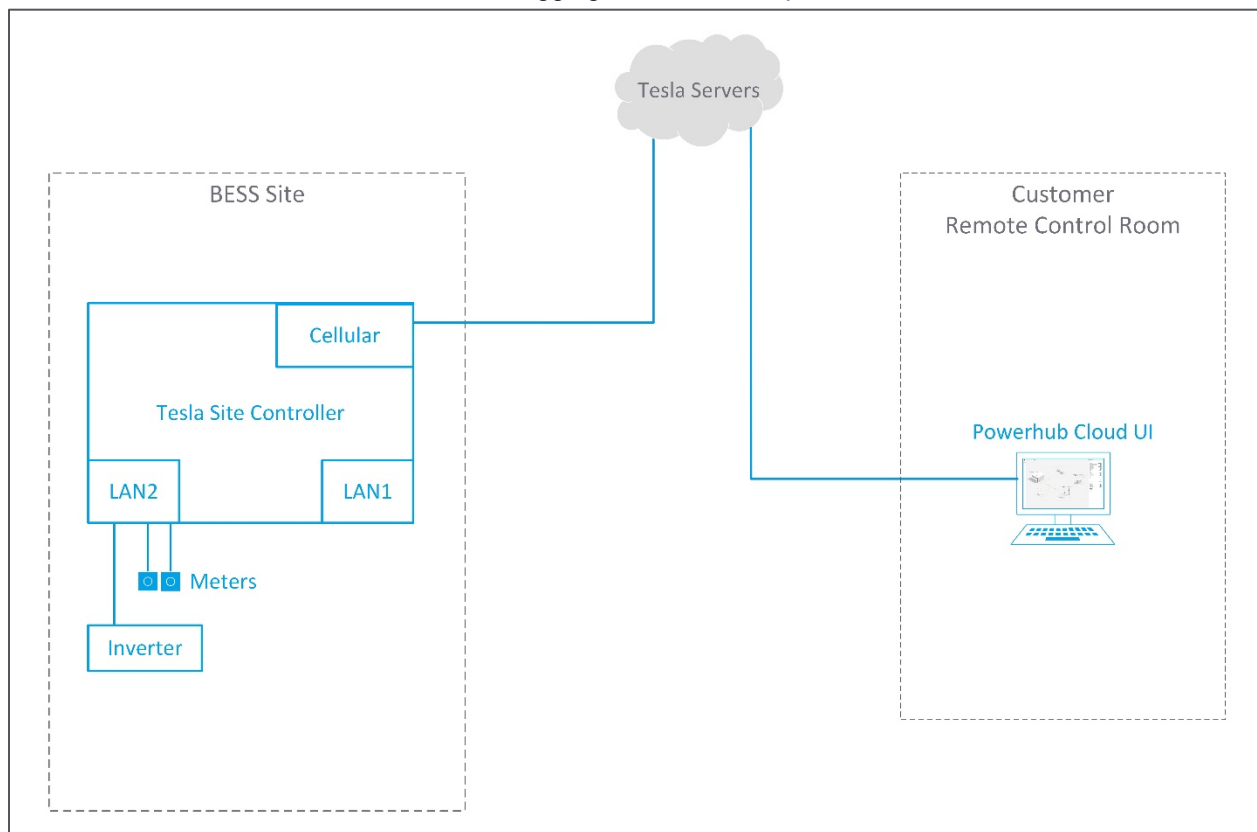


Figure 4: Site Architecture Overview with Powerhub cloud-based UI

4.2.2 Real-time Metrics

Performance metrics are presented to the user to monitor the site, in a side panel called the Mission Bar. The Metrics on the Mission Bar (right side panel) update as the user navigates to different levels of the hierarchy. At the instance or group level, the metrics represent a rollup, typically a summation, for the entire group or aggregation of sites. Voltage and Frequency are averaged rather than summed.

Metrics for the following asset types are included on the Mission Bar depending on assets installed at the site:

- Battery
- Load
- Diesel generator
- Grid
- Solar

For each equipment, the following signals are shown. Units are automatically scaled based on their magnitude. For example, Wh may be shown as kWh or MWh.

Table 1: Signals Available in the Mission Bar

Equipment	Signal	Unit	Measured	Calculated	Measured or Calculated
Battery	Real Power	W	●		
	Available Charge Power	W		●	
	Available Discharge Power	W		●	
	Reactive Power	VAr	●		
	Nominal Energy Remaining	Wh		●	
	Full Pack Energy	Wh		●	
	Today's Import Energy	Wh		●	
	Today's Export Energy	Wh		●	
Solar	Real Power	W			●
	Real Power Limit	W		●	
	Reactive Power	VAr			●
	Today's Production	W			●
Grid	Real Power	W			●
	Today's Import Energy	Wh		●	
	Today's Export Energy	Wh		●	
Load	Site Count (Configuration)	-			
	Real Power	W			●
	Today's Energy Consumption	Wh		●	
Diesel	Active Count	-	●		
	Real Power	W	●		
	Reactive Power	VAr	●		

All metrics on the Mission Bar are refreshed on the order of seconds.

4.2.3 Remote Data Storage

Performance data for the past 365 days at a 15 minutes timestamp is backed up to Tesla servers. The data can be accessed and retrieved through the Powerhub cloud UI. The user can download recorded signals through .csv files.

The available telemetry signals for data storage are listed in Appendix A.

4.2.4 Data Trending and Visualization

Real-time and historical data is available for trending from the cloud UI. The user can build custom views using a comprehensive dropdown list of signals and selectable timeframes.

4.2.5 Remote Control via Cloud User Interface

Premium Feature coming soon. Contact powerhub_support@tesla.com for further details and timing. Users would be able to send real and reactive power commands to the site from a remote location through the cloud user interface. It would enable users to configure and adjust control settings for Frequency Support and Volt-Var control.

4.3 Getting Started

This section provides quick steps to get started with using Powerhub Cloud UI.

4.3.1 Activation and Updates

The Powerhub Software is a cloud-based, browser-accessible UI, and doesn't require any initial installation by the user. Account activation is typically done by Tesla Engineers after project commissioning. However, if for some reason Powerhub access was not granted initially it can be activated at any time in the future.

Software updates are done regularly over-the-air and do not affect users. Updates do not require system shutdown, so there is no downtime impact.

Powerhub is accessible via Google Chrome web browser. Other web browsers are not supported.

4.3.2 User Permissions

User permissions are based on the Powerhub Package selected. Powerhub Plus provides read-only permission. There is no control enabled for the Plus package at the time of this publication, though this is subject to change as Tesla continues to improve the product offering. User authorization is on a per-instance basis, so specific instances are needed for each unique pairing of users and sites. Authorized users of Powerhub will always be able to specify permissions for other users within the constraints of a specific Powerhub license by submitting the request to Tesla at <https://energysupport.tesla.com>.

4.3.3 Add New Users and Sites

New user and new site requests can be submitted at any time, by submitting a request at <https://energysupport.tesla.com>. The request can be both for adding a new site and a new user at the same time. The following information needs to be provided in a new access request:

New site:

- First Name
- Surname
- Company
- Instance Name

New user:

Need all of the above information and:

- Email - used as a login to Tesla account and Powerhub. A corporate email is required for access. Personal email addresses will not be accepted.
- Site master VIN for the site(s) the new user should be able to access (format STST-SM-####). The user can request access to the site(s) belonging to an existing instance.

Once added to the Tesla database, the new user will receive a product welcome email with instructions to create their Tesla account and to log in to Powerhub. See the Getting Started section below for more details.

NOTE: Welcome emails with instructions for creating a new Tesla account and logging into the Powerhub (and Tesla Mobile App) application for the first time are sent to new users once credentials are provisioned and sites are commissioned. Allow up to one business week for processing new user requests.

4.3.4 Login

Once the new user account is provisioned by Tesla, the user will receive a welcome email with instructions to create their Tesla account and log into Powerhub.

Sign up

Navigate to <https://powerhub.energy.tesla.com> for the first time will redirect the user to Tesla SSO at <https://auth.tesla.com/login>. The user will need to click on the button to create an account and fill in the information listed below. The same email address should be used here that was initially provided to Tesla when requesting access.

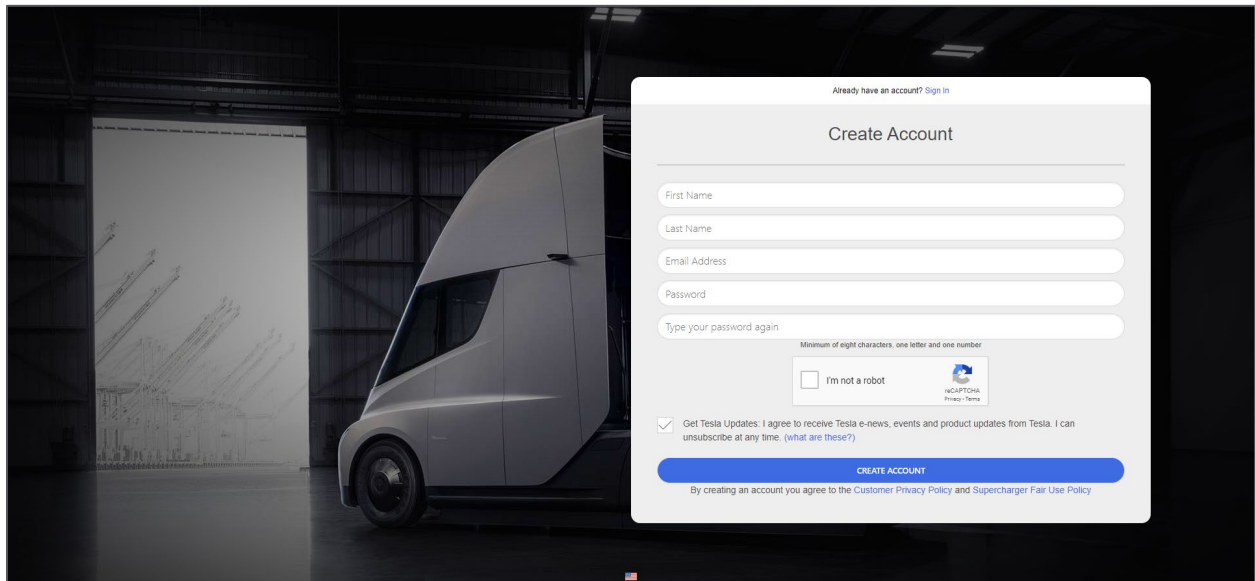


Figure 5: Tesla Account Creation Page

Sign in

After a Tesla account is created, the user may be redirected to the Tesla account home page as shown in Figure 6.

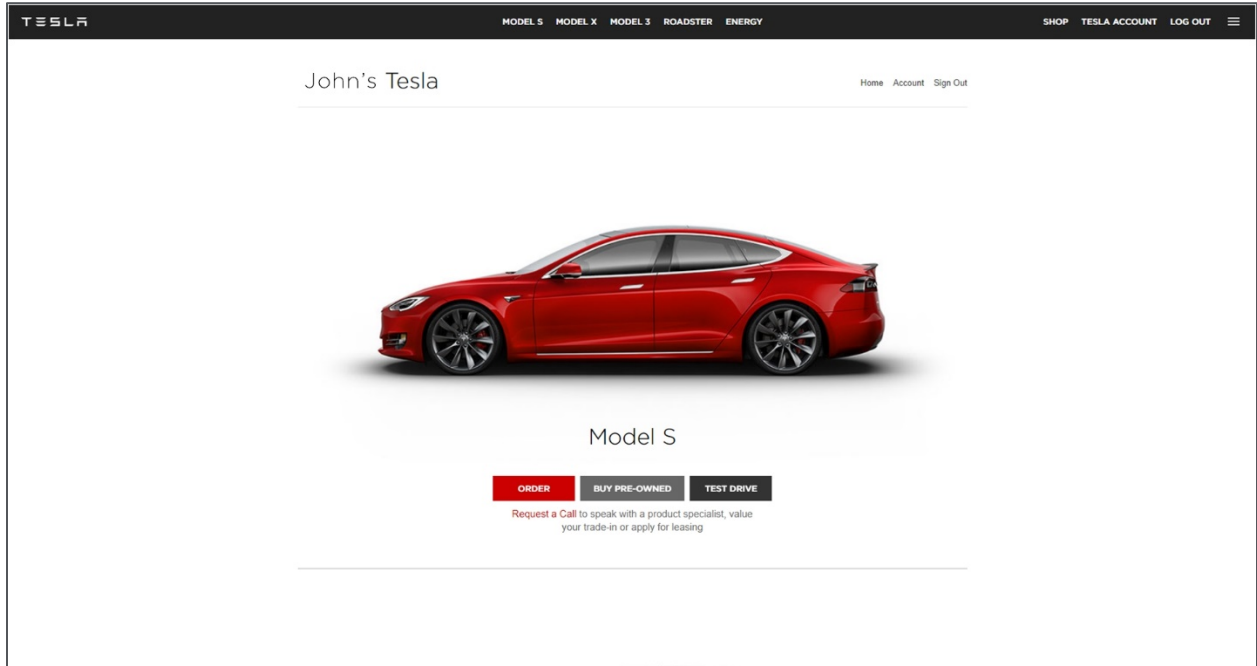


Figure 6: Tesla Account Home Page

Ignore the redirection after login in and navigate to <https://powerhub.energy.tesla.com> from the Google Chrome web browser to begin using Powerhub. If for some reason the user is logged out of the application, or the session times out, simply login in again as shown in Figure 7.

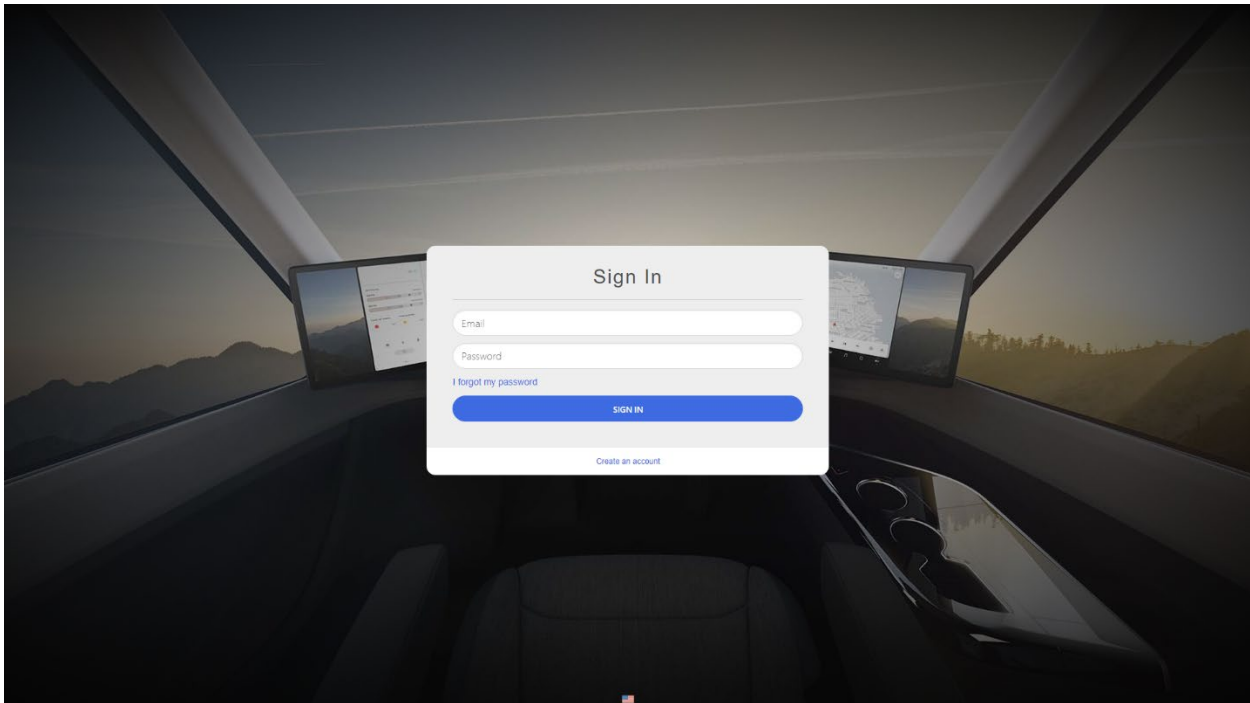


Figure 7: Powerhub Login Page

Upon successful login, the user arrives on their system’s Powerhub landing page, as shown below. The landing page is referred to as List View, as shown in Figure 8, which lists a hierarchy of sites that belong to a particular instance, as well as the Mission Bar to the right of the screen.

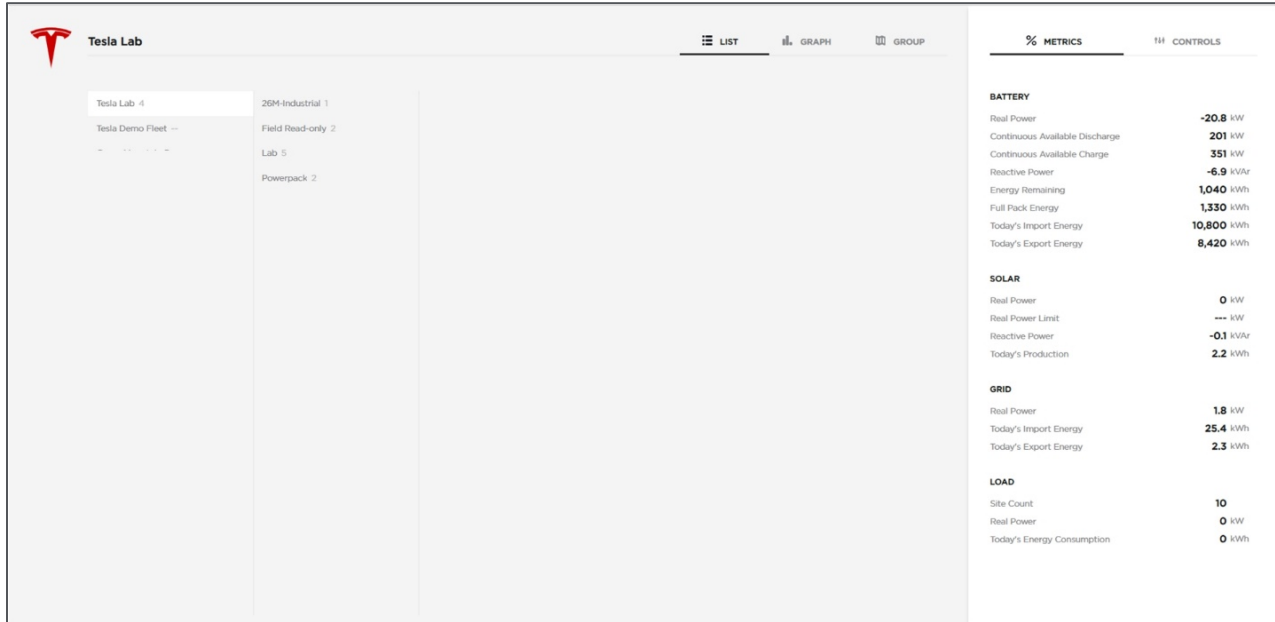


Figure 8: Powerhub List View

NOTE: After 10 hours of continuous login, the user will be automatically logged out and will need to re-authenticate with Tesla SSO as shown in Figure 7.

4.3.5 Powerhub terminology

The Powerhub cloud user interface is organized and displayed using instances, groups, and sites.

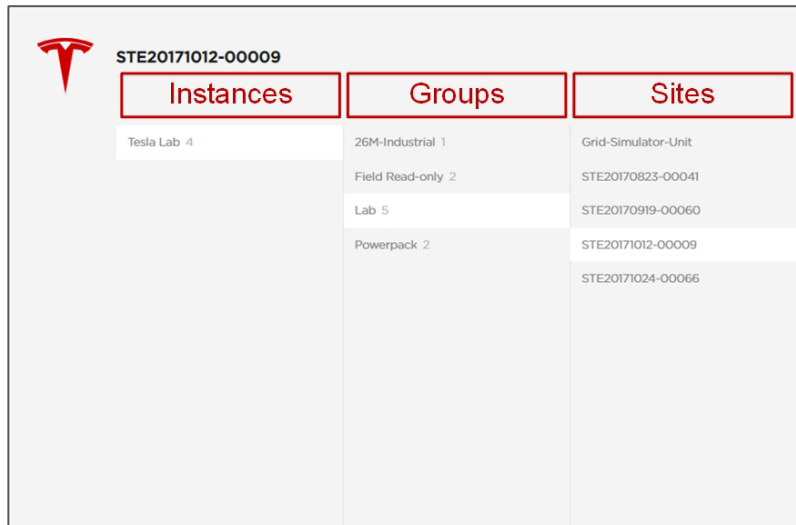


Figure 9: Powerhub Instances, Groups, Sites

Instances: Customer name.

Groups (optional): Several sites can be grouped. Customers can make a request to Tesla to create and/or change groups.

Sites: A site might include batteries, solar, diesel generators, site load, and non-Tesla assets such as transformers.

4.4 Navigation and Procedures

The following section provides detailed procedures for using Powerhub's main functionalities.

4.4.1 Navigation Basics

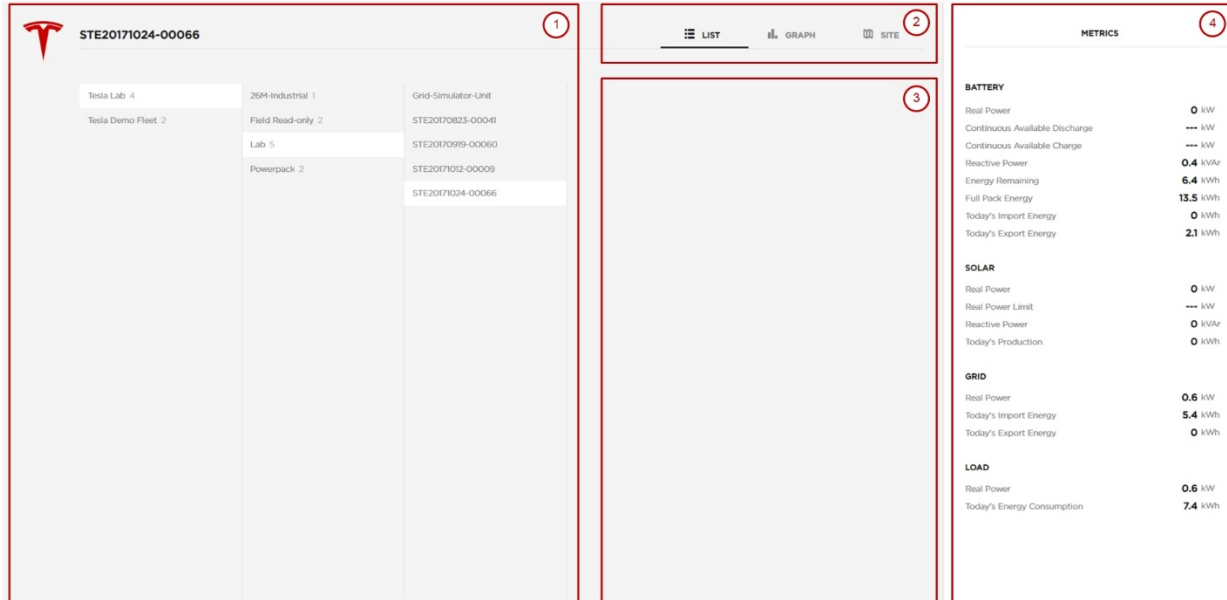


Figure 10: Powerhub Display Sections

1. The left panel provides a list of instances and allows the user to navigate from instances to groups, and finally groups to sites.
2. The tabs let the user select different views including list, graph or site view.
3. This section shows either a configurable graph (Graph View) or an isometric rendering of site-level assets and real-time power flows (Site View) for a selected site or group of sites.

In the far right section, there is the Mission Bar. The user gets real-time system metrics of their batteries and other assets on site.

4.4.2 Use the Mission Bar

In the Mission Bar, the user can review the site real-time metrics for all the site assets. Values on the mission bar are updated on the order of seconds.

METRICS	
BATTERY	
Real Power	0 kW
Continuous Available Discharge	5 kW
Continuous Available Charge	5 kW
Reactive Power	0 kVAr
Energy Remaining	3.4 kWh
Full Pack Energy	13.4 kWh
Today's Import Energy	2.1 kWh
Today's Export Energy	1.5 kWh
SOLAR	
Real Power	5.7 kW
Real Power Limit	---
Reactive Power	0 kVAr
Today's Production	11.8 kWh
GRID	
Real Power	0 kW
Today's Import Energy	31.9 kWh
Today's Export Energy	0.3 kWh
LOAD	
Real Power	5.8 kW
Today's Energy Consumption	42.8 kWh

Figure 11: Mission Bar

4.4.3 Select Site in List View

For portfolios, List View enables the user to view each site, and associated metrics, individually or in aggregate at each level of the hierarchy. Sites can be grouped to the user's preference to reflect installation type (behind-the-meter vs front-of-the-meter) or geography (US vs. Australia); the desired grouping should be specified at the time of project commissioning. If a change is needed to site grouping, a request should be submitted to <https://energysupport.tesla.com>.

US				LIST	GRAPH	GROUP	METRICS	CONTROLS
Tesla Demo Fleet 2	Grid Services Fleet 4	AU 1	STE20170407-00002				BATTERY	
Tesla Lab 4	telemetry Fleet	DE	STE20170426-00001				Real Power	-3.9 kW
Tesla Supercharger 2		UK	STE20170428-00002				Continuous Available Discharge	15 kW
Init		US 3					Continuous Available Charge	15 kW
							Reactive Power	-0.2 kVAr
							Energy Remaining	32.1 kWh
							Full Pack Energy	40.5 kWh
							Today's Import Energy	20.1 kWh
							Today's Export Energy	9 kWh
							SOLAR	
							Real Power	8.8 kW
							Real Power Limit	---
							Reactive Power	-0.6 kVAr
							Today's Production	31.2 kWh
							GRID	
							Real Power	-4.1 kW
							Today's Import Energy	58.5 kWh
							Today's Export Energy	7.8 kWh
							LOAD	
							Site Count	3
							Real Power	0.8 kW
							Today's Energy Consumption	70.9 kWh

Figure 12: List View

Users have the ability to navigate through their portfolio and monitor sites using the Metrics in the Mission Bar, the Graph View or the Site View.

1. On the main Powerhub page, select an instance.
2. List of the groups or the sites under the selected Instance will be shown, select a group if it exists, otherwise select a site.
3. Once the site is selected, its name appears in the top left corner. The user can navigate to the different tabs to review the site's real-time data, power flows, etc.

The Metrics on Mission Bar update as the user navigates to different levels of the hierarchy. The aggregated metrics are expressed as a summation across sites.

The advanced hierarchical navigation allows the user to navigate through its portfolio, representing each level of the hierarchy as its own Virtual Power Plant. The user can get a global overview of the system performance, or decide to deep dive into an individual site.



Figure 13: Portfolio Navigation Banner

4.4.4 Data Trending in Graph View

Graph view provides historical data for pre-defined groups of telemetry data, which can be viewed over configurable timeframes. All telemetry signals can be easily exported to CSV for extended analysis.



Figure 14: Graph View

Users can plot several system signals using the Graph view. One can observe the evolution of signals in real-time and see the trend of historical data using the available granularity. The data channels listed in Table 1 below are available for trending and export. The signals source can be metered or calculated. Some of the signals would be either measured or calculated depending on the meter availability.

Table 2: Signals Available in the Graph View

Equipment	Signal	Unit	Measured	Calculated	Measured or Calculated
Battery	Real Power	W	●		
	Available Charge Power	W		●	
	Available Discharge Power	W		●	
	Reactive Power	VAr	●		
	Nominal Energy Remaining	Wh		●	
	Full Pack Energy	Wh		●	
	State of Energy	%		●	
	Target Power	W		●	
	Target Reactive Power	VAr		●	
	Frequency	Hz	●		
	Voltage	V	●		
Solar	Real Power	W			●
	Real Power Limit	W		●	
	Reactive Power	VAr			●
Grid	Real Power	W			●
Diesel	Real Power	W	●		
	Reactive Power	VAr	●		
Load	Real Power	W			●

4.4.4.1 Plot *Historical Data Signals* in Graph View

After selecting an instance, a group or a site, and navigating to the Graph View, the user can select a signal to plot using the dedicated drop-down list. Each asset type has specific signals available for plotting and export as shown in Figure 15.

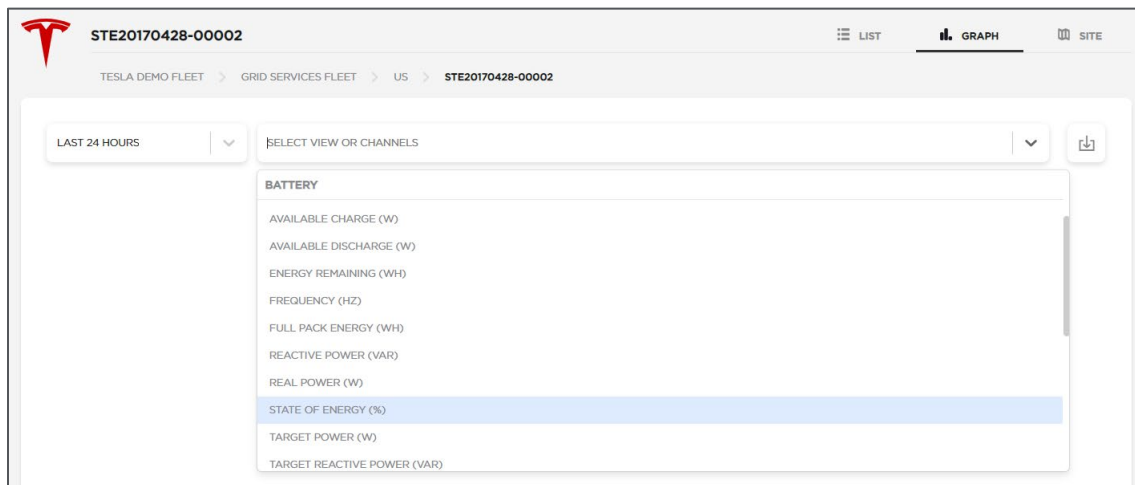


Figure 15: Signal Selection in Graph View

Once selected, the signal will show as a line chart.

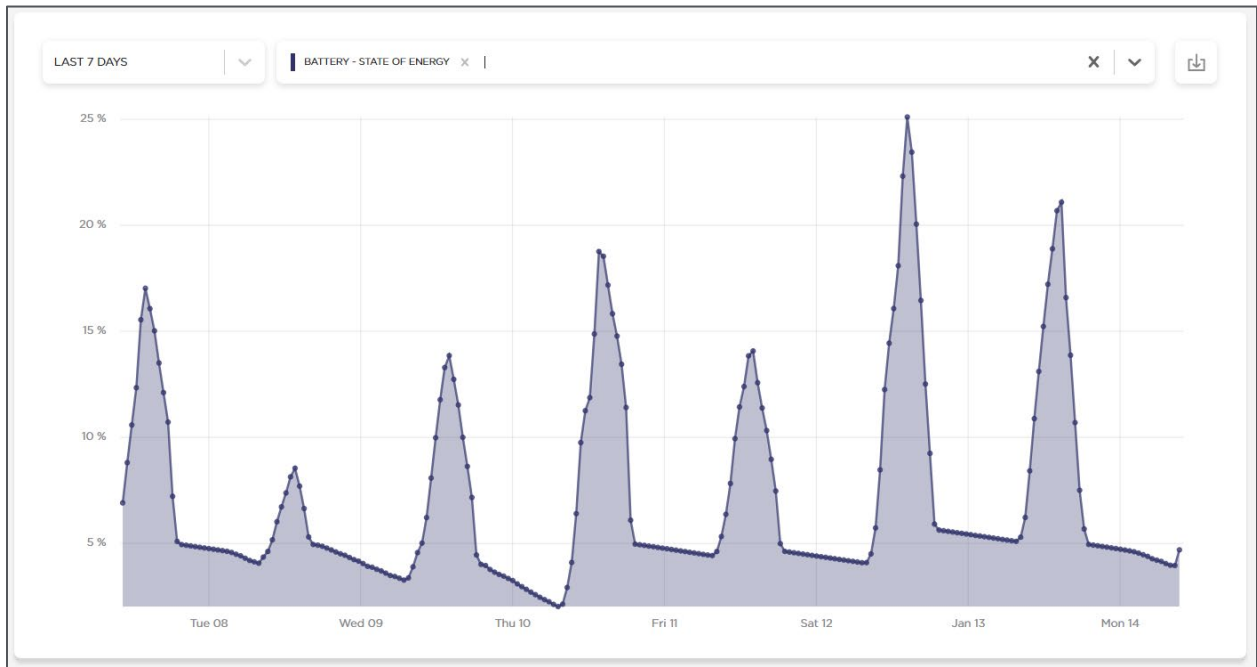


Figure 16: Line Chart Graph View

Several time ranges are available for the user to chart the selected data. One can choose from the last 15 minutes to the last 365 days.

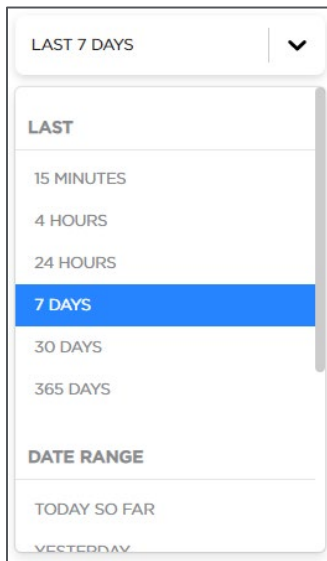


Figure 17: Time Range Drop-down Menu in Graph View

The user can also select a date range among the following options:

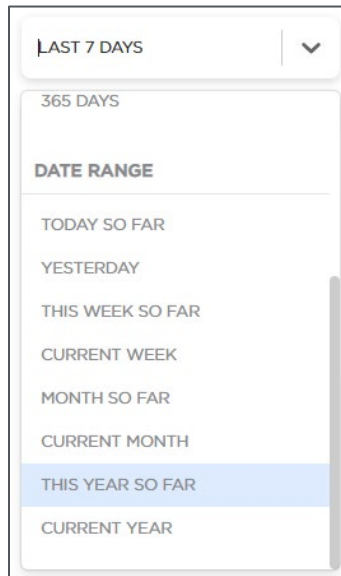


Figure 18: Date Range Drop-down Menu in Graph View

4.4.4.2 Plot multiple Channels

The user can chart as many channels as needed, with a maximum of two units supported at any time on the same graph. After signals of two different units are selected, all remaining signals of a different (third) unit type will be greyed out from the dropdown list. The procedure for selecting multiple signals is the same as the one described in the previous section, except that the user will repeat the data selection steps multiple times.

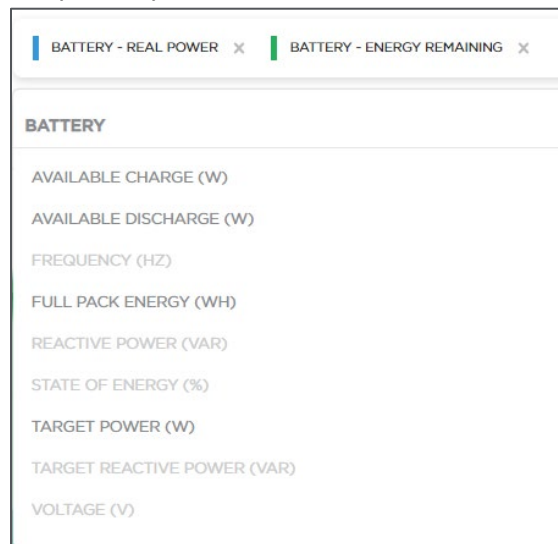


Figure 19: Conditional signal list based on unit types

The chart will be shown in different colors. When hovering a certain time point of the curve on the chart, a panel highlights the selected signals' values. The hovering feature is also available when plotting a single signal.

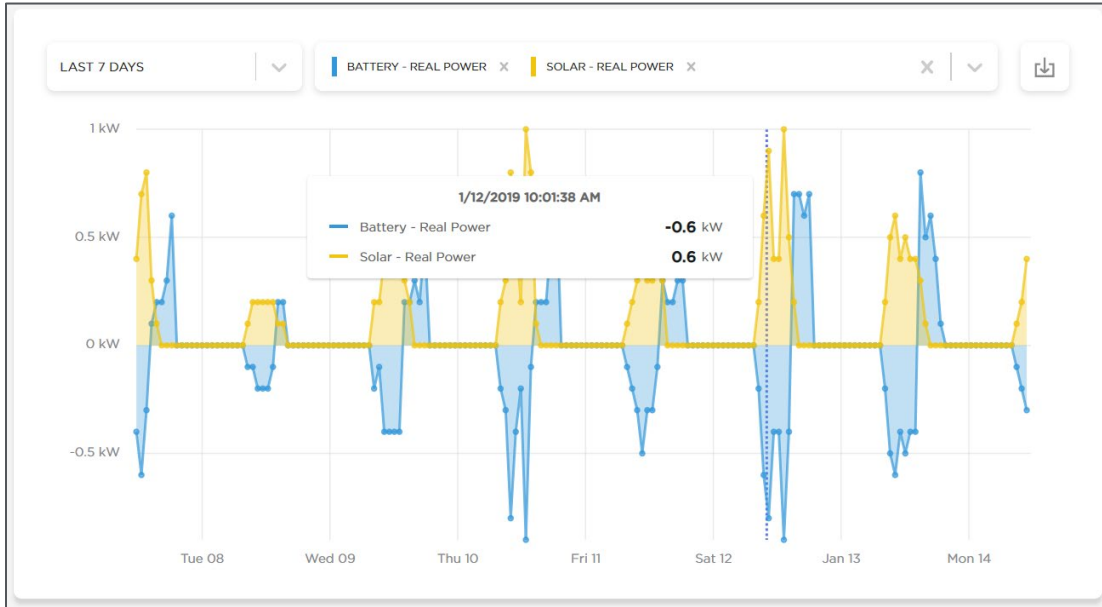


Figure 20: Multiple Signal Chart and Detail Time Point Panel

The user can simply click the grey close icon next to the channel name to discard the signal from showing. All signals may be removed by selecting the drop-down's close icon.

4.4.4.3 Plot data signals using pre-defined Channel Groups in Graph View

Two preset views allow quick charting of pre-defined channel groups. They are available in the same drop-down menu as the other channels:

Power Portfolio: includes all real power signals for battery, solar and point of utility interconnection (net site load).

Power vs. Energy: shows the battery real power and remaining energy signals.

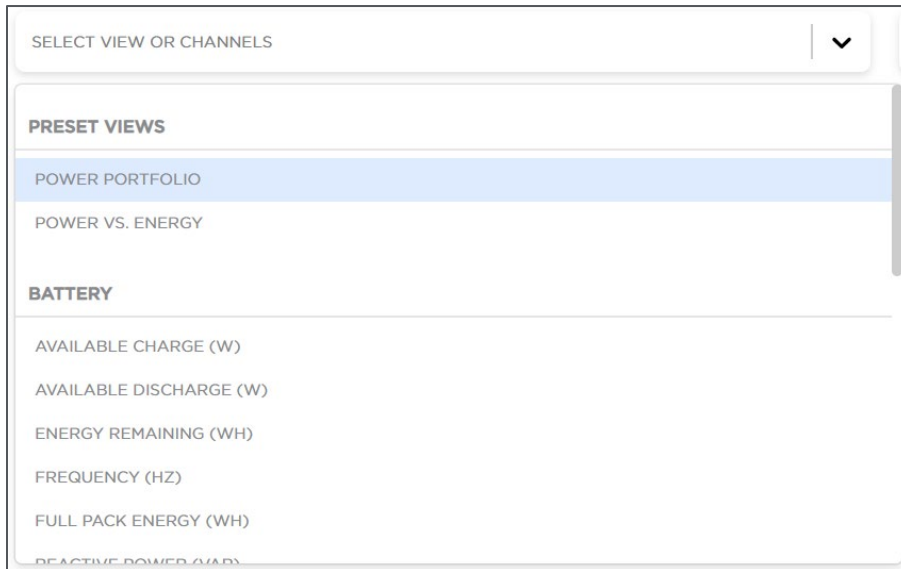


Figure 21: Preset Views Menu

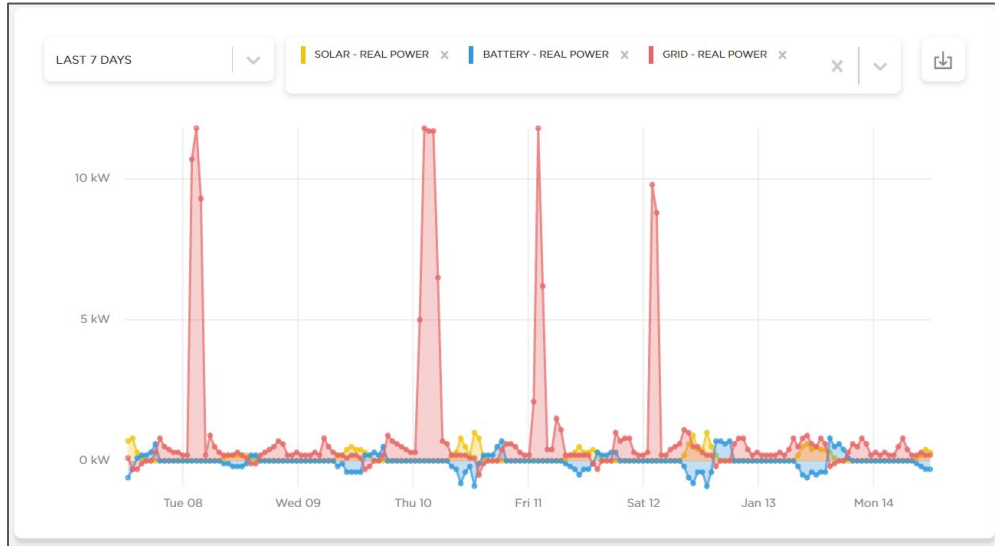


Figure 22: Preset Views Graph

When multiple channels are selected and shown, the user can either discard them one by one or clear out all of them at once using the big grey cross at the far right end of the channel's menu.

4.4.4.4 Search for a Channel in Graph View

The user can search a channel rather than go over the entire list of the signals. By simply typing text, the list of signals is automatically filtered down.



Figure 23: Channel Search Feature

4.4.5 Export Historical Data in Graph View

Once the desired signals with the desired timeframe are plotted, the user can easily export the data to a CSV file with the Download button. Two options are offered to the user. 'Download Data for Current Graph' will export the visualized data directly, including the corresponding granularity of data. 'Download Data for Last 365 Days' will provide data for the past year, specifically at a 15-minute interval. The latter is often useful for advanced reporting situations.

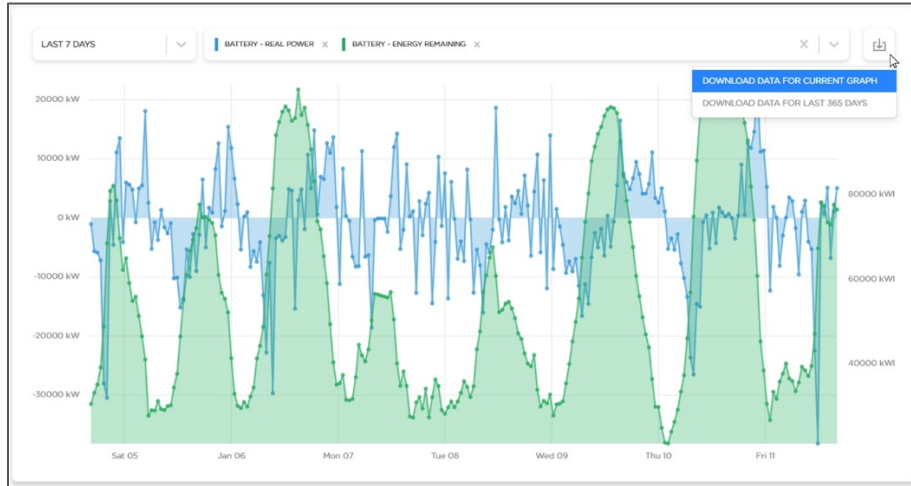


Figure 24: Historical Data Export

The granularity of the data exported changes depending on the timeframe selected and screen resolution. Exporting data when viewing the last 15 minutes timeframe will provide a timestamp on the order of seconds. Exporting data when viewing the last 24 hours will provide a timestamp on the order of minutes. Lastly, exporting data when viewing that last 30 days will provide a timestamp on the order of hours.

4.4.6 Visualize Real-Time Power Flows in Site View

Site View provides a site-specific system layout with a visualization of real-time power flows. The visualization exemplifies asset interaction and real-time site operation. In the future, alerts will be visualized on top of assets to indicate whether a specific solar inverter or storage inverter block is faulted, facilitating a quick resolution with the Tesla Service team.

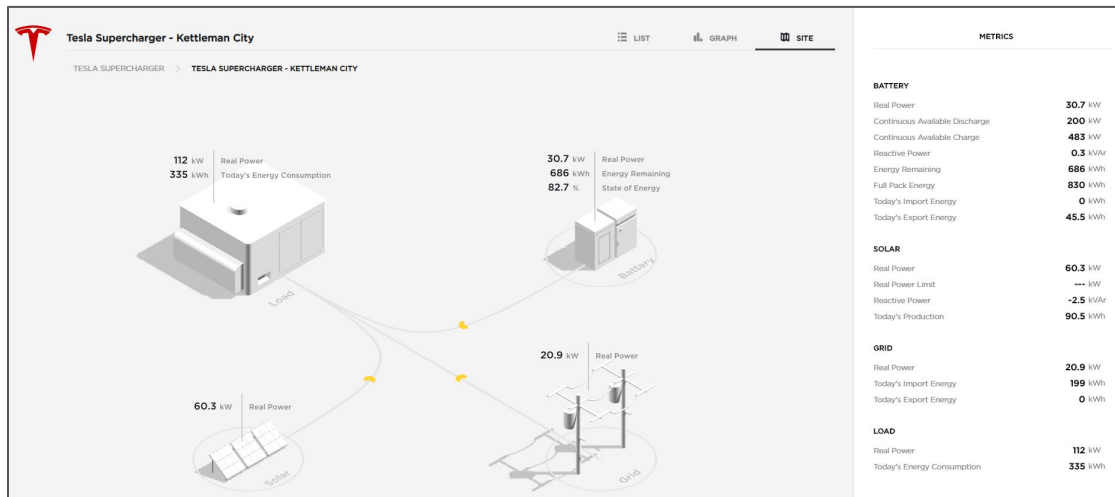


Figure 25: Site View

5 Powerhub Pro

5.1 Overview

Powerhub Pro is a SCADA software package that provides local monitoring and control of distributed energy resources for customers that require an onsite presence or a control room. Powerhub Pro delivers on-site real-time performance data and seamless real-time local controls for individual sites. Site real-time power flow visualizations are provided to easily evaluate instantaneous site behavior. The Real-time active alerts increase the operator situational awareness for faster and safer decision making.

5.2 Specifications and Features

5.2.1 Local User Interface

For customers that require an onsite presence or a control room, the Powerhub Pro SCADA package provides a Local UI with monitoring and control options. The Local UI is hosted on the Tesla Site Controller and is web-based. It can be accessed from a web browser using any computer (customer laptop or physical monitor in the battery control room provided by Tesla). If required, the Local UI can also be accessed from the customer remote control room.. The customer can decide to extend the connection to their control room. It is the customer responsibility to extend the connection to their control room using VPN and/or Firewall or other appropriate secure architecture. Tesla currently does not offer the service to remotely extend this connection.

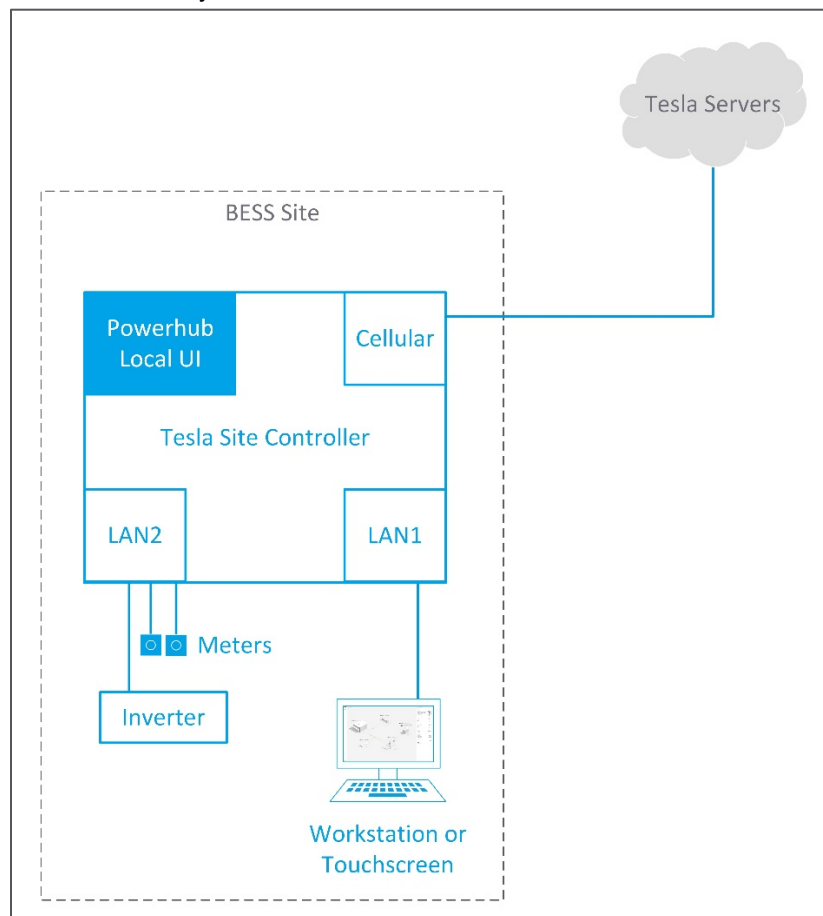


Figure 26: Site Standard Architecture Overview with Powerhub Local UI

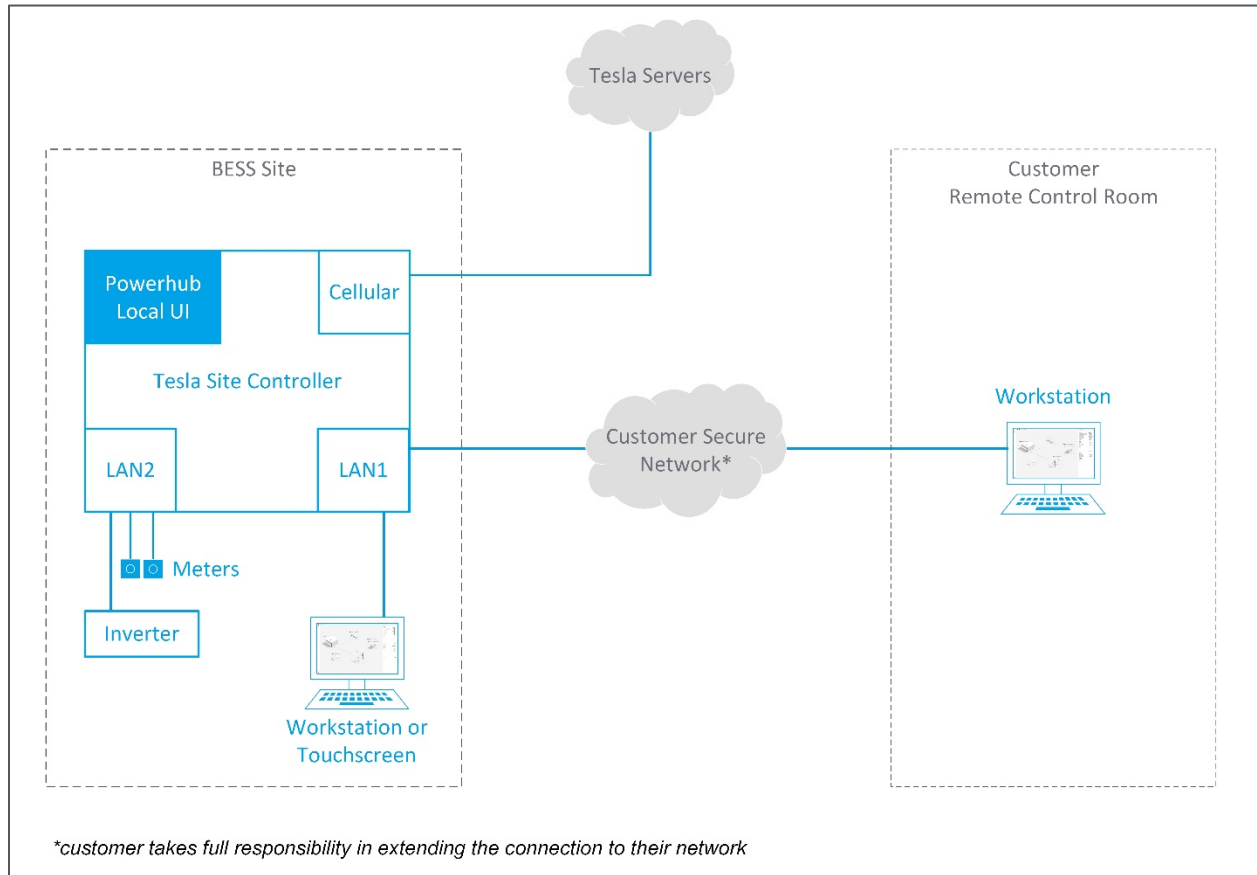


Figure 27: Site Architecture Overview with Powerhub Local UI and extended connection to the customer control room

5.2.2 Real-time Metrics

Performance metrics are presented to the user to monitor the site, in a side panel called the Mission Bar. The Metrics on the Mission Bar (right side panel) are refreshed on the order of seconds with the site measurements.

Metrics for the following asset types are included on the Mission Bar:

- Battery
- Load
- Grid
- Diesel generator
- Solar
- Breaker
- Contactor
- Switch

For each equipment, the following signals, listed in Table 3: Signals Available in the Mission Bar, are displayed in the Metrics Tab of the Mission Bar. The signal units are automatically scaled during commissioning based on their magnitude indicated by the system nameplate. For example, Wh may be shown as kWh or MWh.

Table 3: Signals Available in the Mission Bar

Equipment	Signal	Unit	Measured	Calculated	Measured or Calculated
Battery	Real Power	W	●		
	Continuous Available Charge Power	W		●	
	Continuous Available Discharge Power	W		●	
	Reactive Power	VAr	●		
	Apparent Power	VA		●	
	Energy Remaining	Wh		●	
	Full Pack Energy	Wh		●	
	Frequency	Hz	●		
Solar	Real Power	W			●
	Real Power Limit	W		●	
	Reactive Power	VAr			●
	Apparent Power	VA		●	
Grid	Real Power	W			●
Load	Real Power	W			●
Diesel	Active Count	-	●		
	Real Power	W	●		
	Reactive Power	VAr	●		
	Apparent Power	VA		●	
Breaker	Open/Close Status	-	●		
Contactactor	Open/Close Status	-	●		
Switch	Local On/Off	-	●		
	Remote On/Off	-	●		

5.2.3 Local Control via Local User Interface

The user can select the Tesla Site Controller modes of operation and send controls through the Local UI. The control features available are:

Real Power Mode

- **Direct:** Operational setpoints for direct real power command.

Reactive Power Mode

- **Direct:** Operational setpoints for direct reactive power command.

Switching Device Control

- **Breaker/Contactactor/Switch:** Switching devices Open/Close control.

Control Source Arbitration

- **Local/Remote:** Source arbitration command to switch between local operator control and remote third-party SCADA control.

NOTE: The future version of the Powerhub Local UI will include all Tesla controlling modes available that are listed in the Controls and Communication Manual.

In addition to the wide range of control modes, the user will be able to send breaker open/close controls to any configured switching devices on the site.

5.2.4 Local Data Storage

If the customer requires onsite storage of data, Tesla can provide a locally hosted 3rd party historian as an adder to the Powerhub Pro package. The user can configure up to 500 tags with a granularity of one second.

5.2.5 Active Alerts

Powerhub Pro brings valuable visibility and insight into the current system state. The alerts reported by the Tesla Site Controller are displayed in the Powerhub Pro UI, increasing the operator situational awareness and improving the site maintenance experience. The local UI will report the active alerts on the system. Additionally to the Tesla Site Controller alerts, Powerhub Pro supports alerts on Balance of Plant subsystems like - transformers, breakers, fire detection system and loss of communications to significant devices on site.

All the alerts supported are listed in the table below. For more information, please refer to the Tesla Communications and Controls Manual.

Table 4: Alerts List

Alert Source	Title	Description
Tesla Inverter	Battery Fault	Battery Block X is faulted
Tesla Inverter	Smart Inverter Active	Due to grid conditions, a Smart Inverter Feature is now in operation on Battery Block X
Tesla Site Controller	Site Meter Comms	Loss of communications with Site Meter X
Tesla Site Controller	Battery Meter Comms	Loss of communications with Battery Meter X
Tesla Site Controller	Load Meter Comms	Loss of communications with Load Meter X
Tesla Site Controller	Solar Meter Comms	Loss of communications with Solar Meter X
Tesla Site Controller	Busway Meter Comms	Loss of communications with Busway Meter X
Tesla Site Controller	Generator Meter Comms	Loss of communications with Generator Meter X
Tesla Site Controller	Frequency Meter Comms	Loss of communications with Frequency Meter X
Tesla Site Controller	Battery Comms	Loss of communication with Battery Block X
Tesla Site Controller	PV Inverter Comms	Loss of communications with Solar Inverter X.

Alert Source	Title	Description
Tesla Site Controller	External IO Comms	Loss of communications with X external I/O device
Tesla Site Controller	Battery Unexpected Power	Commanded real power does not match measured power from battery meter
Tesla Site Controller	Battery Unexpected Reactive Power	Commanded reactive power does not match measured power from battery meter
Tesla Site Controller	Battery Rx Latency	Intermittent communications to Battery Block X
Tesla Site Controller	Site Min Power Limited	Cannot meet command because the Site Minimum Power Limit has been set
Tesla Site Controller	Site Max Power Limited	Cannot meet command because the Site Maximum Power Limit has been set
Tesla Site Controller	Real Power Available Limited	The command is greater than the Available Battery Real Charge or Discharge Power
Tesla Site Controller	Reactive Power Limited	The command is greater than the Available Reactive Power
Tesla Site Controller	Backfeed Limited	The system is configured for inadvertent export and therefore will not further discharge to respect this limit
Tesla Site Controller	Ramp Rate Limited	The output does not currently match the commanded power because the system is ramping to its setpoint
Tesla Site Controller	Real Power Config Limited	The system is unable to meet the commanded power because of a limit that was configured during commissioning
Tesla Site Controller	Solar Charge Only Limited	The system has been configured to only charge from solar. Solar is not available, therefore the charge request cannot be met
Tesla Site Controller	Direct Real Command Timeout	The heartbeat has not been toggled within the specified timeout. The real power command is not longer active
Tesla Site Controller	Direct Reactive Command Timeout	The heartbeat has not been toggled within the specified timeout. The reactive power command is not longer active
Tesla Site Controller	Generator Breaker Timeout	A start command was sent to a generator but it did not report a closed breaker within the timeout period
Generator	Generator Faulted	Generator X is faulted
External I/O	Flame Detector Comms	Loss of Communications with Flame Detector X
External I/O	Flame Detector Alarm	Flame Detector X Alarm
External I/O	Flame Detector Trouble	Flame Detector X Trouble
External I/O	Transformer Comms	Loss of Communications with Transformer X
External I/O	Transformer High Temperature	Transformer X High Temperature

Alert Source	Title	Description
External I/O	Transformer Temperature Warning	Transformer X Temperature Warning
External I/O	Transformer Low Pressure	Transformer X Low Pressure
External I/O	Transformer Pressure Warning	Transformer X Pressure Warning
External I/O	Transformer Oil Level Low	Transformer X Oil Level Low
External I/O	RTU Comms	Loss of Communications with RTU
External I/O	Breaker Comms	Loss of Communications with Breaker X
External I/O	Breaker Open	Breaker X Open
External I/O	Contactactor Comms	Loss of Communications with Breaker X
External I/O	Contactactor Open	Contractor X Open
External I/O	Switch Comms	Loss of Communications with Switch X

5.3 Getting Started

This section provides quick steps to get started with using Powerhub Pro Local UI.

5.3.1 Activation and Updates

The Powerhub Pro Software is a local, browser-accessible UI, installed locally on the Tesla Site Controller. The configuration is typically done by Tesla Engineers at project commissioning but can be activated at any point throughout the project life. A static IP address for the access must be set up during commissioning, as specified by the customer, in order to access this view through the Chrome web browser.

Additional details and procedure on accessing the Powerhub Pro local UI are available in Section 5.3.4 of this document.

Software updates are done regularly and available to the customer on Tesla servers. If the site is connected to the Tesla servers, the Local UI will update along with the Tesla Site Controller firmware update. Updates do not require system shutdown, so there is no downtime impact.

The Powerhub Local UI included in the Powerhub Pro package is accessible through two methods:

1. By plugging in a computer provided by the customer on the LAN1 network as needed.
2. Tesla provided computer and monitor installed onsite.

The user can access the Local UI via Google Chrome. Please note that's the only browser supported at the moment.

5.3.2 User Permissions

User permissions are based on the Powerhub Package selected. Powerhub Pro provides read-write permission. Monitoring and control capabilities are enabled for the Powerhub Pro package.

5.3.3 Add new users

During site commissioning, Powerhub Local UI will be set up by Tesla. One account will be created in the commissioning UI for Powerhub Pro. The profile associated with the account will have read-write permissions with control and monitoring access to the site.

The commissioning UI and the Powerhub Pro UI share the same credentials. The account credentials are transmitted to the customer.

In a future version of Powerhub Pro, the customer will have the possibility to have two separated accounts with a different set of permissions and credentials. Each account will have its own Username and Password. One account will have read-only, monitoring only permissions and the second one will have read-write, control and monitoring access. It will be the customer responsibility to provide Operators the adequate credentials. Contact your Tesla representative for additional details.

5.3.4 Login

Once the new account is provisioned by Tesla and the credential are transmitted to the customer. The operator can log into Powerhub Pro.

Sign in

After the Powerhub Pro account is created, while on site, users can open a new window in Chrome and enter the appropriate URL with the Tesla Site Master IP, as follows, <https://XX.XX.XX.XX>. The user will be redirected to the Tesla Site Controller HMI home page as shown in Figure 29.



Figure 28: Tesla Site Controller HMI home page

The Tesla Site Controller HMI home page provides direct access to the Commissioning UI as well as Powerhub Local UI. To access Powerhub Local UI, the user clicks on the “Monitor and Control” button highlighted on the figure above. The Sign In page appears as shown in Figure 30 below.

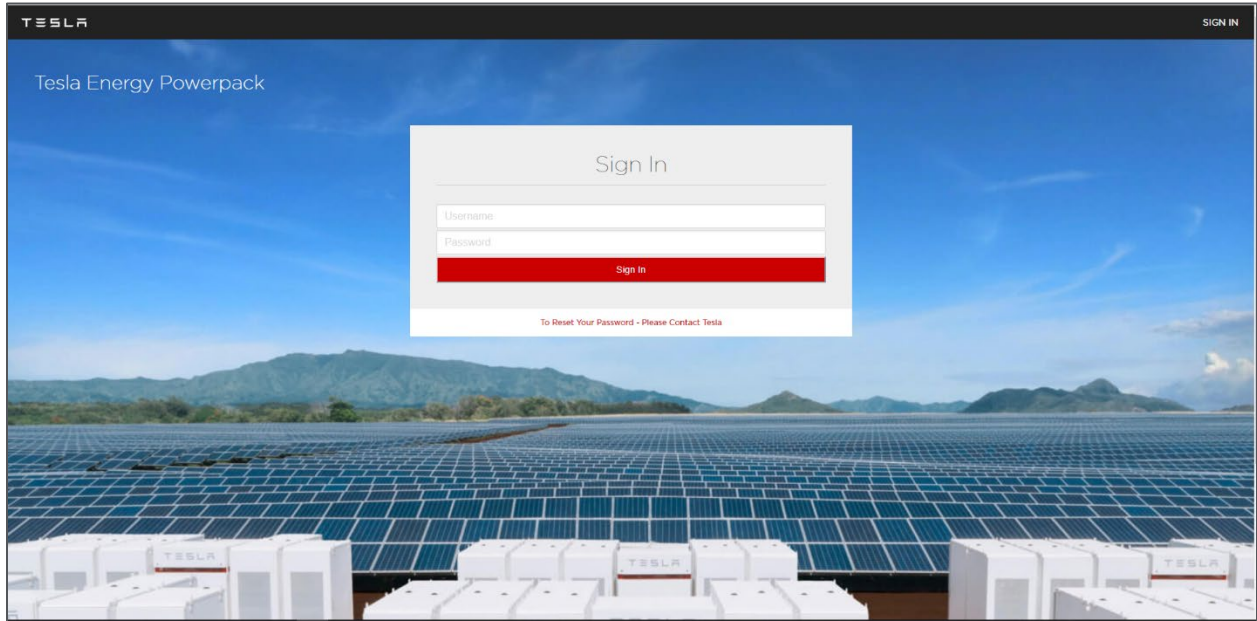


Figure 29: Powerhub Local UI Login Page

Once the user has entered the credentials and upon successful login, the users arrive on their system’s Powerhub Pro landing page.

The landing page for the Local UI is the Site View, as shown in Figure 31, which shows real-time animated power flows of all the site assets, in a 3D rendering and real-time metrics on the Metric bar <add the icon image of the metrics button>.

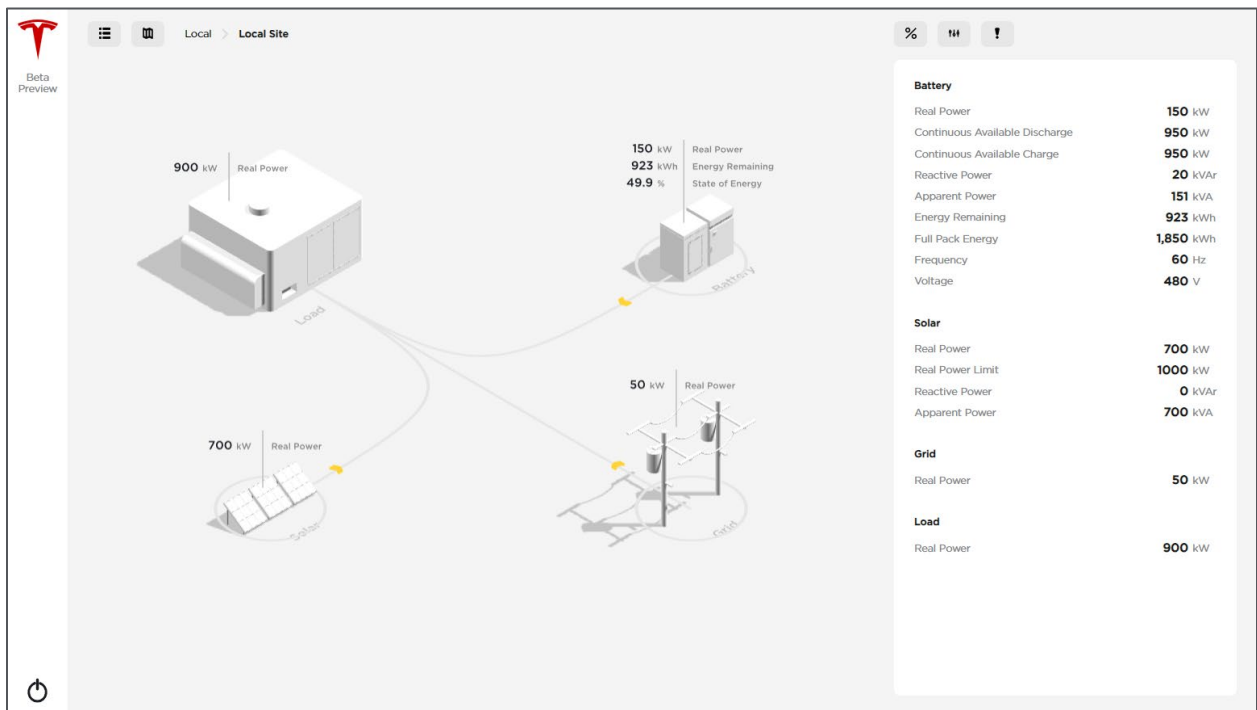


Figure 30: Powerhub Pro Site View

If users forget the account password, they can contact Tesla support team to reset the password. On Powerhub Local UI Sign In page, when clicking on “To Reset Your Password – Please Contact Tesla” link, under the Sign In button, a popup will be shown and display Tesla appropriate contacts (see Figure 32 below).

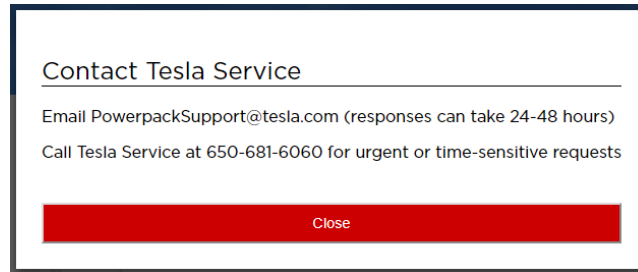



Figure 31: Tesla Service Contacts

Sign out

The users can sign out, at any time, by clicking on the on/off button  present on all the displays. The users are redirected to the Sign In home page of the Local UI.

5.4 Navigation and Procedures

The following section provides detailed procedures for using Powerhub Pro main functionalities.

5.4.1 Navigate the Powerhub Pro UI

Here are the different sections of the Powerhub Pro user interface.

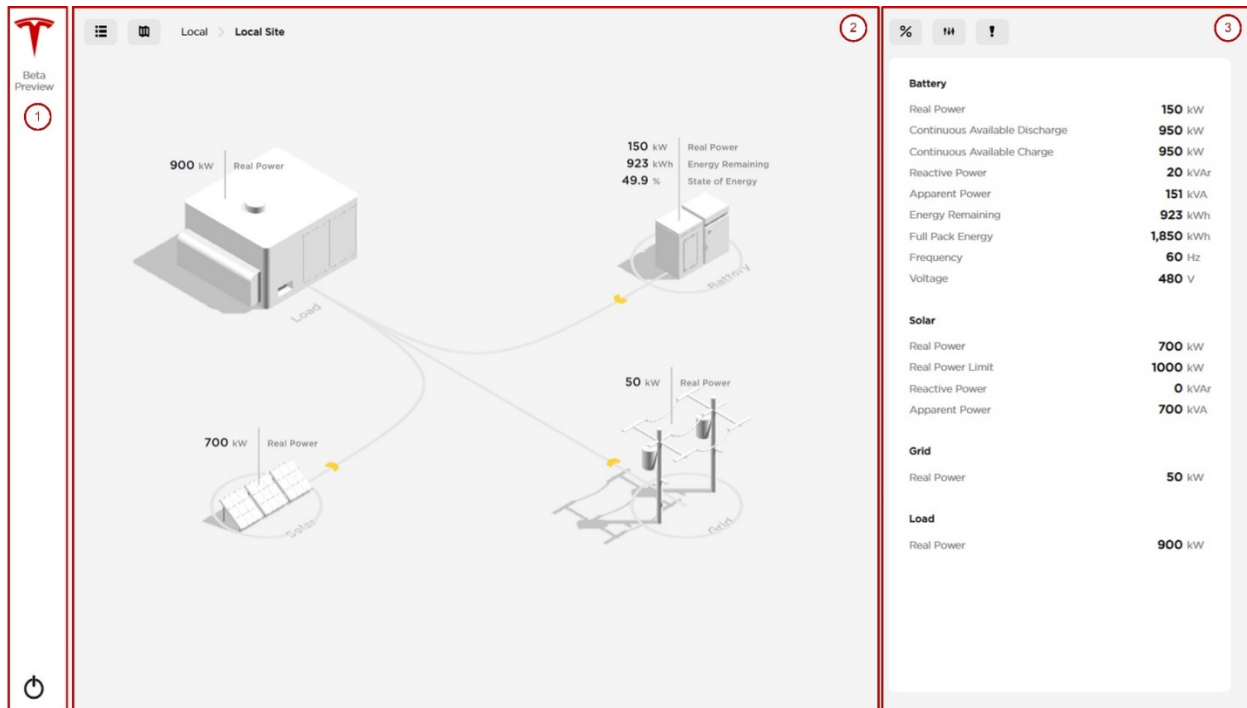


Figure 32: Powerhub Pro Display Sections

1. The left panel allows the user to log out from the Local UI. The user will be redirected to the Tesla Site Controller HMI home page.

2. The icons on the upper left of the display, let the users select different views of the site, either as a list or a site view. Finally, the main section of the display shows an isometric rendering of site-level assets and real-time power flows (Site View) when selected.
3. In the far right section, there is the Mission Bar. The user gets access of either real-time system metrics of their batteries and other assets part of the sites, the controlling features or the alerts list.

5.4.2 Use the Mission Bar

In the Mission Bar, highlighted in the previous section, the user can review the site real-time metrics for all the site assets, send controls to the site and check the current active alerts on the system. The user can navigate through the different views by clicking on the Mission Bar icons.

Three icons to switch views in the Mission Bar:

- Real-time Metrics View
- Controls View
- Alerts View

As the user is switching tabs in the Mission Bar, the List View or the Site View showing in the central part of the display is persistent. It allows the user to operate the system while monitoring the site power flows. The values on the Mission Bar are updated on the order of seconds.

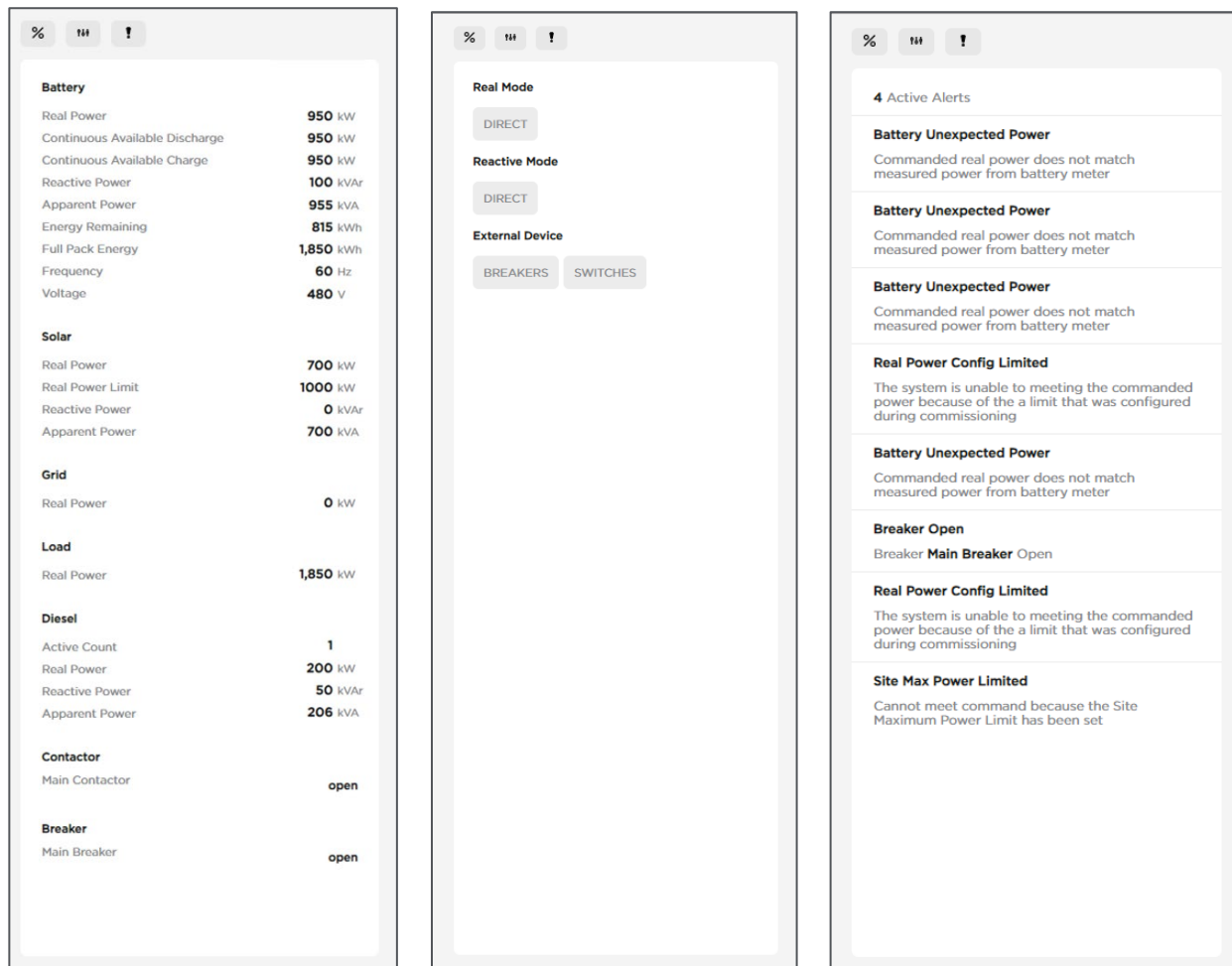


Figure 33: Mission Bar – Metrics (left), Controls (middle), Alerts (right)

5.4.3 Navigate the List View

List View allows the user to view the site and its associated metrics. The Powerhub Local UI list one instance and one site. In the future, the user will be able to navigate down through the assets composing the site, bringing a focus on the component level metrics.



Figure 34: List View

5.4.4 Visualize Real-Time Power Flows in Site View

Site View provides a site-specific system layout with a visualization of real-time power flows. The visualization exemplifies asset interaction and real-time site operation.

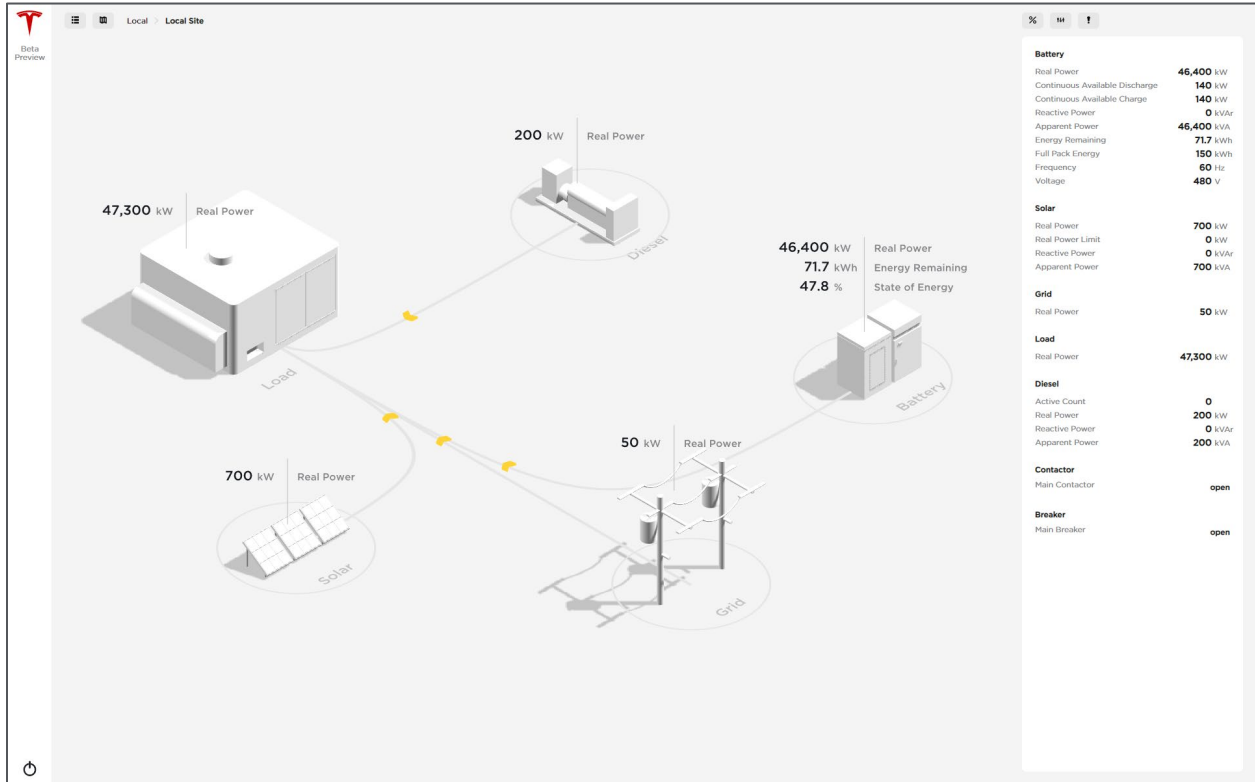


Figure 35: Site View

5.4.5 Dispatch Real and Reactive Power Direct Controls

From the Mission Bar, the user can click on the following icon to access the Control View, shown below in Figure 37.

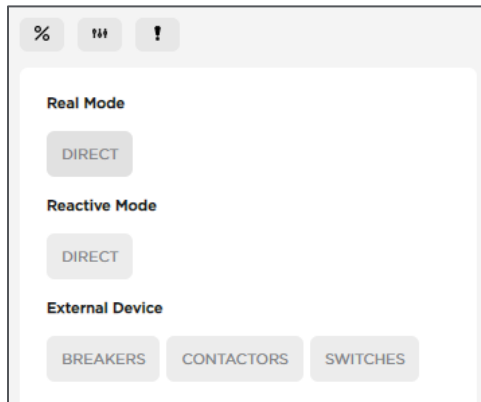


Figure 36: Controls View

The Control View shows the available controlling modes, to the customer, for the site.

In the Real Power Mode section, click on the DIRECT button to setup the real power setpoint. Enter the desired setpoint in kW.

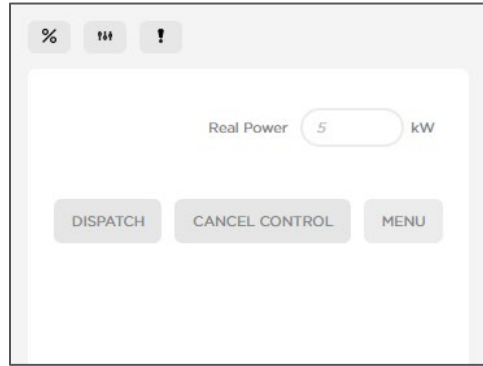


Figure 37: Real Power Command Setpoint Setup

Click the DISPATCH button to send the real power command to the site.

Clicking on the CANCEL CONTROL button will cancel the current active real power command. The system switched to Real Power OFF mode. The user can choose to abandon process by clicking on the MENU button to go back to the main Controls view.

The process for sending reactive power direct controls is similar to the process for sending real power command.

5.4.6 Check Current Active Controls

The operator can review the current active controlling modes of the site. In the Controls View, each control mode button will have a pulsing red dot when the controlling mode is active as shown in Figure 39, below.

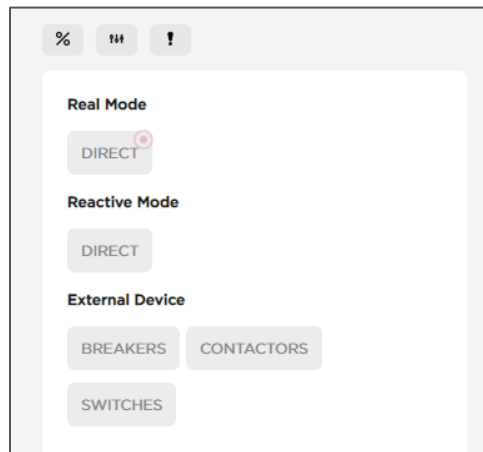


Figure 38: Active Direct Real Power Control Indication

5.4.7 Open/Close Switching Devices

With Powerhub Pro, the users can control the site switching devices, if configured. The available switching devices are breakers, contractors, and switches.

On the Controls View, if configured, the switching devices available for control appear under the external device section.

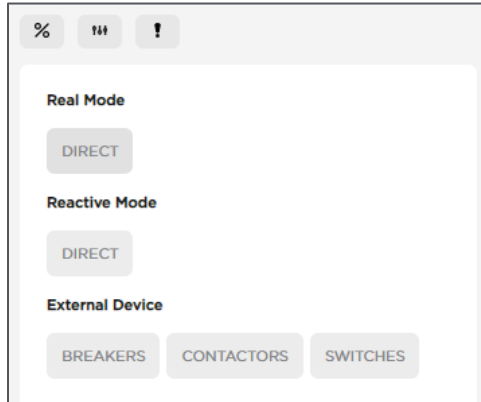


Figure 39: Controls View with Switching Devices

Clicking on BREAKERS, the user will be able to send a control to either open or close the selected breaker.

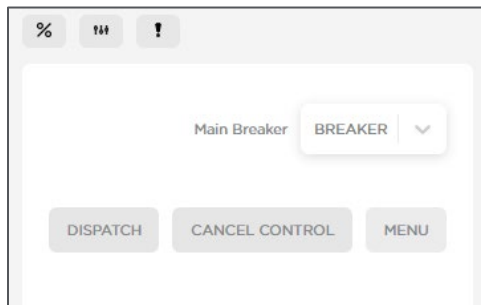


Figure 40: Breaker Control Setting

The user, first selects, the OPEN or CLOSE control to be sent from the drill down list.

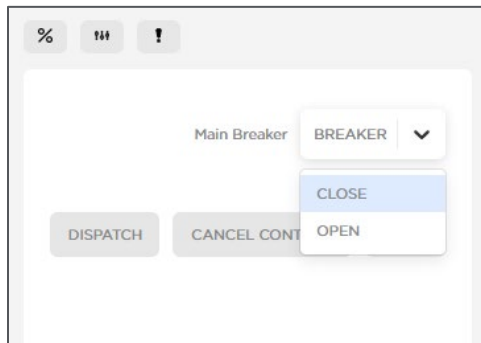


Figure 41: Breaker Control Option Drill Down List

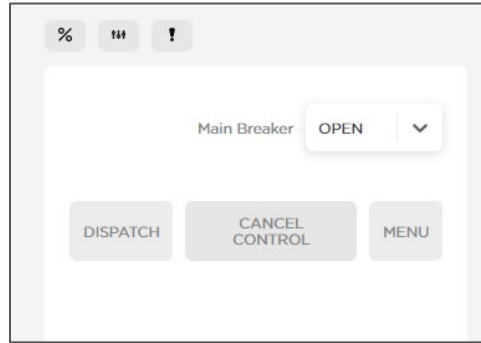


Figure 42: Breaker Control Set To Open Command

Once selected, click the DISPATCH button to send the breaker control.

Clicking on the MENU button will cancel the breaker control dispatch procedure started by the user. The user will be redirected to the main Controls View.

On the real-time Metrics View, the breaker current status is displayed and reflect the command sent by the user.



Figure 43: Breaker Status in Real-time Metrics View

The procedure for operating contactors is similar to the steps for sending breaker controls.

5.4.8 Change the Control Source

The local operator has the ability to change the real-time control source for the site. The Tesla Site Controller can receive commands from the Local UI operated by the onsite operator or can receive commands from a third-party SCADA/RTU system. The real-time setpoint from the selected control source (Local or Remote) will be sent to the Tesla Site Controller. The user should not enable Local and Remote control at the same time, otherwise it could led to erroneous behavior.

On the Controls View, if configured, the SWITCHES button, under the External Device section, enables access to the source control arbitration.

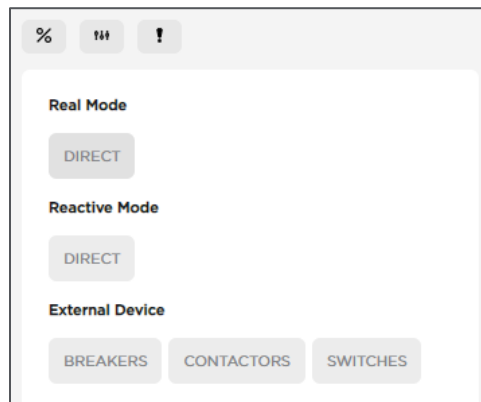


Figure 44: Controls View with source control arbitration enabled

Clicking on SWITCHES, the user will be able to switch between local or remote operation of the site.

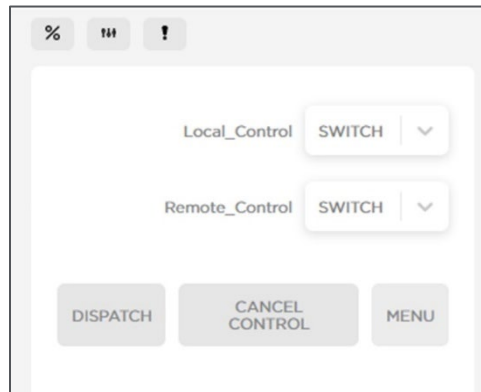


Figure 45: Breaker Control Setting

For example to set the site in Local Mode the user should select the dropdown “SWITCH” for Local_Control and select “ON”, and select “OFF” for the Remote_Control “SWITCH”.

Similarly to enable Remote Control for the external SCADA/RTU to be able to command the site select “OFF” for Local_Control and “ON” for Remote_Control.

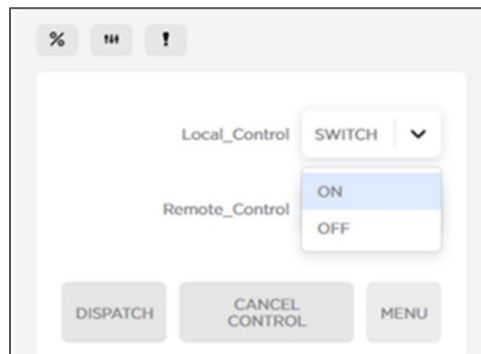


Figure 46: Control Source Option Drill Down List

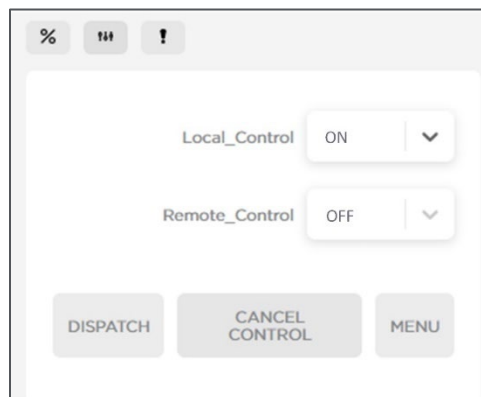


Figure 47: Source Control Set To Local (ON) and Remote (OFF) Commands

Once both Local_Control and Remote_Control status are selected, click the DISPATCH button to send the command (Local in this example).

Clicking on the MENU button will cancel the source control dispatch procedure started by the user. The user will be redirected to the main Controls View.

On the real-time Metrics View, the control source current status is displayed and reflect the command sent by the user.

Switch	
Local_Control	on
Remote_Control	off

Figure 48: Breaker Status in Real-time Metrics View



CAUTION

In the current implementation when both Local and Remote Control are set to “ON”, the commands sent from the different source will compete and could result in erroneous behavior of the site. The user is responsible for setting the controlling sources properly.

5.4.9 Review Current Active Alerts of the Site

Powerhub Pro has an alert feature to report any active alerts reported by the Tesla Site Controller and other external (non-Tesla) devices directly in the UI.

The list of the active alerts are available in the Mission Bar and the total number of active Alerts is also displayed at the top.

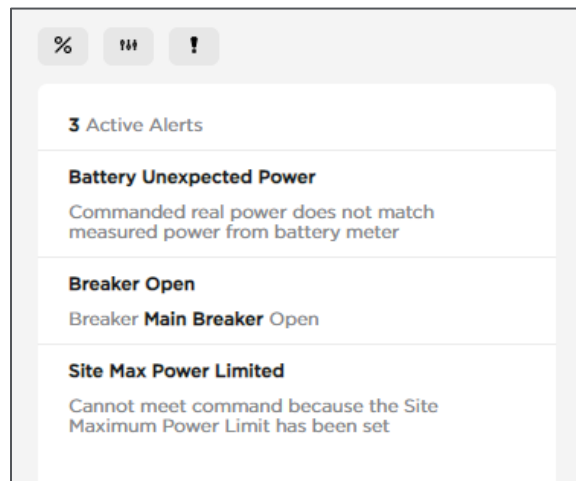


Figure 49: Active Alerts In The Mission Bar

The user can stay on the Site View while navigating to the alerts tab. As the user is reviewing the current active alerts in the system, he or she can simultaneously keep an overview of the entire site.

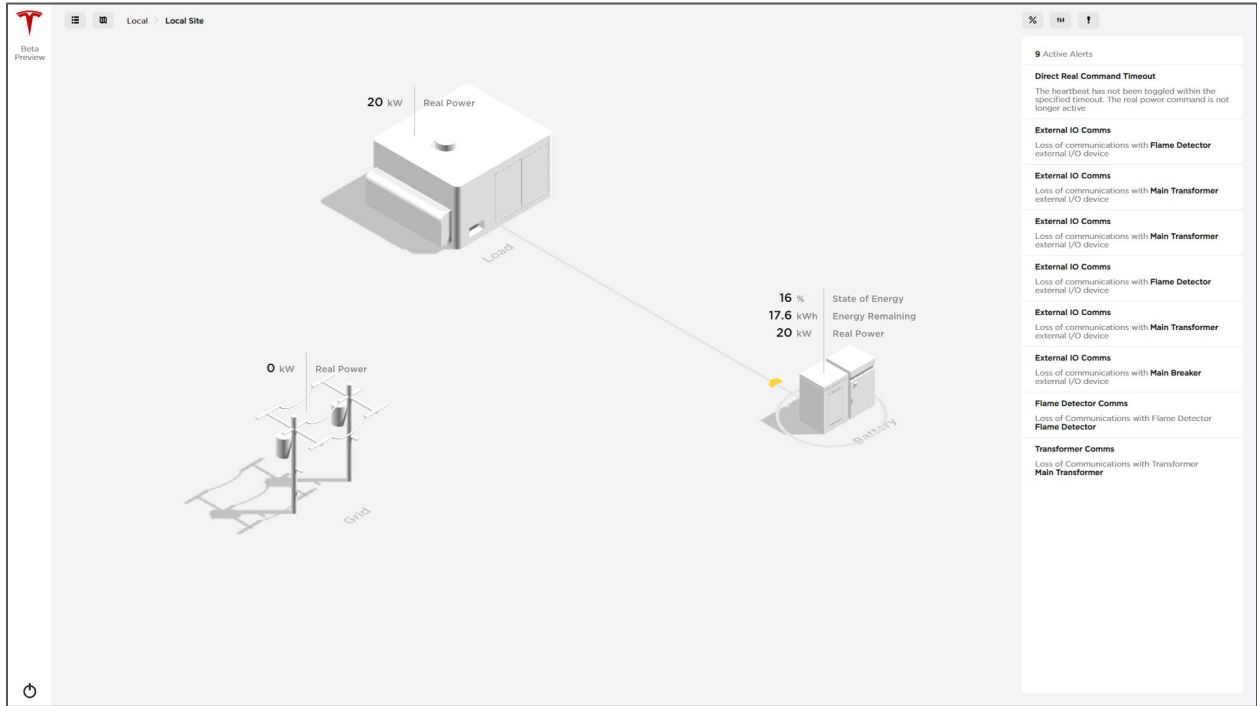


Figure 50: Site Active Alerts In The Mission Bar While On Site View

Appendix A: Powerhub Package

The following summarizes the supported assets, views, and signals available in the Powerhub different packages.

Powerhub Plus

Powerhub Plus is Tesla's fleet management solution for those that need to monitor and manage a fleet of distributed Tesla energy assets. The Plus package provides a cloud-based user interface, telemetry through standard communication protocols locally or through Powerhub API, and access to historical data signals for up to one year. Historical data can be exported to .csv directly from the user interface for extended analysis.

See the following table for details.

Category	Description		
Customer Type	Portfolio customers (schools, solar developers, F1000 companies) that need to monitor and manage many distributed assets		
GUI Access	Cloud-based user interface (read-only)		
Supported Assets	<ul style="list-style-type: none"> • Solar • Storage • Grid • Load • Diesel (must be listed on Tesla AVL) 		
Views	<ul style="list-style-type: none"> • List View <ul style="list-style-type: none"> ○ Navigation across sites and groups of sites for an individual or aggregate view on fleet performance • Graph View <ul style="list-style-type: none"> ○ Configurable data trending and data export for extended analysis • Site View <ul style="list-style-type: none"> ○ Real-time power flow visualization for site-level asset 		
Signals available for trending in Graph View	<table style="width: 100%; border: none;"> <tr> <td style="vertical-align: top;"> <ul style="list-style-type: none"> • Battery <ul style="list-style-type: none"> ○ Real Power ○ Continuous Available Discharge ○ Continuous Available Charge ○ Energy Remaining ○ Full Pack Energy ○ Frequency ○ Reactive Power ○ State of Energy (%) ○ Target Power ○ Target Reactive Power ○ Voltage </td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> • Solar <ul style="list-style-type: none"> ○ Real Power ○ Reactive Power ○ Real Power Limit • Load <ul style="list-style-type: none"> ○ Real Power • Grid <ul style="list-style-type: none"> ○ Real Power • Diesel <ul style="list-style-type: none"> ○ Real Power ○ Reactive Power </td> </tr> </table>	<ul style="list-style-type: none"> • Battery <ul style="list-style-type: none"> ○ Real Power ○ Continuous Available Discharge ○ Continuous Available Charge ○ Energy Remaining ○ Full Pack Energy ○ Frequency ○ Reactive Power ○ State of Energy (%) ○ Target Power ○ Target Reactive Power ○ Voltage 	<ul style="list-style-type: none"> • Solar <ul style="list-style-type: none"> ○ Real Power ○ Reactive Power ○ Real Power Limit • Load <ul style="list-style-type: none"> ○ Real Power • Grid <ul style="list-style-type: none"> ○ Real Power • Diesel <ul style="list-style-type: none"> ○ Real Power ○ Reactive Power
<ul style="list-style-type: none"> • Battery <ul style="list-style-type: none"> ○ Real Power ○ Continuous Available Discharge ○ Continuous Available Charge ○ Energy Remaining ○ Full Pack Energy ○ Frequency ○ Reactive Power ○ State of Energy (%) ○ Target Power ○ Target Reactive Power ○ Voltage 	<ul style="list-style-type: none"> • Solar <ul style="list-style-type: none"> ○ Real Power ○ Reactive Power ○ Real Power Limit • Load <ul style="list-style-type: none"> ○ Real Power • Grid <ul style="list-style-type: none"> ○ Real Power • Diesel <ul style="list-style-type: none"> ○ Real Power ○ Reactive Power 		

Category	Description
Metrics on Mission Bar	<ul style="list-style-type: none"> • Battery <ul style="list-style-type: none"> ○ Real Power ○ Available Charge Power ○ Available Discharge Power ○ Energy Remaining ○ Full Pack Energy ○ Reactive Power ○ Today's Import Energy ○ Today's Export Energy • Solar <ul style="list-style-type: none"> ○ Real Power ○ Reactive Power ○ Real Power Limit ○ Today's Production • Grid <ul style="list-style-type: none"> ○ Real Power ○ Today's Import Energy ○ Today's Export Energy • Load <ul style="list-style-type: none"> ○ Site Count ○ Real Power ○ Today's Energy Consumption • Diesel <ul style="list-style-type: none"> ○ Active Count ○ Real Power ○ Reactive Power ○ Today's Production
Telemetry Access	<ul style="list-style-type: none"> • Local Modbus/DNP3/REST • Remote server TEAPI (read-only)
Historian	<ul style="list-style-type: none"> • Remote: historical data available for visualization and export through cloud-based user interface • Granularity of historical data for download to .csv <ul style="list-style-type: none"> ○ Fixed granularity: 365 day/15 min ○ Variable granularity: Varies based on screen resolution for selected timeframe. The shortest timeframe is the last 15 minutes. The longest timeframe is the last 365 days.

Powerhub Pro

Powerhub Pro is Tesla's solution for those that need an onsite HMI to monitor and control the Tesla energy assets on a single site. The Pro package provides local monitoring, control, telemetry, control and historian (optional).

See the following table for details.

Category	Description
Customer Type	Utilities, developers of large-scale storage projects and microgrids
GUI Access	Local Monitoring and Controls (read-write)
Supported Assets	<ul style="list-style-type: none"> • Solar • Storage • Grid • Load • Diesel (must be listed on Tesla AVL) • Transformer • Breaker

Category	Description		
Views	<ul style="list-style-type: none"> • List View <ul style="list-style-type: none"> ○ Display the Instance and Site name. In future versions, navigation across the assert composing the site, bringing a focus on the component level metrics. • Site View <ul style="list-style-type: none"> ○ Real-time power flow visualization for site-level asset • Real-time Metrics <ul style="list-style-type: none"> • Real-Time performance metrics of all site assets • Controls <ul style="list-style-type: none"> • Available and active controls for the site • Alerts <ul style="list-style-type: none"> • System active alerts 		
Signals available on Site View	<table style="width: 100%; border: none;"> <tr> <td style="vertical-align: top; width: 50%;"> <ul style="list-style-type: none"> • Battery <ul style="list-style-type: none"> ○ Real Power ○ Energy Remaining ○ State Of Energy • Solar <ul style="list-style-type: none"> ○ Real Power </td> <td style="vertical-align: top; width: 50%;"> <ul style="list-style-type: none"> • Grid <ul style="list-style-type: none"> ○ Real Power • Load <ul style="list-style-type: none"> ○ Real Power • Diesel <ul style="list-style-type: none"> ○ Real Power </td> </tr> </table>	<ul style="list-style-type: none"> • Battery <ul style="list-style-type: none"> ○ Real Power ○ Energy Remaining ○ State Of Energy • Solar <ul style="list-style-type: none"> ○ Real Power 	<ul style="list-style-type: none"> • Grid <ul style="list-style-type: none"> ○ Real Power • Load <ul style="list-style-type: none"> ○ Real Power • Diesel <ul style="list-style-type: none"> ○ Real Power
<ul style="list-style-type: none"> • Battery <ul style="list-style-type: none"> ○ Real Power ○ Energy Remaining ○ State Of Energy • Solar <ul style="list-style-type: none"> ○ Real Power 	<ul style="list-style-type: none"> • Grid <ul style="list-style-type: none"> ○ Real Power • Load <ul style="list-style-type: none"> ○ Real Power • Diesel <ul style="list-style-type: none"> ○ Real Power 		
Metrics on Mission Bar	<table style="width: 100%; border: none;"> <tr> <td style="vertical-align: top; width: 50%;"> <ul style="list-style-type: none"> • Battery <ul style="list-style-type: none"> ○ Real Power ○ Continuous Available Discharge ○ Continuous Available Charge ○ Reactive Power ○ Apparent Power ○ Energy Remaining ○ Full Pack Energy ○ Frequency ○ Voltage • Solar <ul style="list-style-type: none"> ○ Real Power ○ Reactive Power ○ Real Power Limit ○ Apparent Power </td> <td style="vertical-align: top; width: 50%;"> <ul style="list-style-type: none"> • Grid <ul style="list-style-type: none"> ○ Real Power • Load <ul style="list-style-type: none"> ○ Real Power • Diesel <ul style="list-style-type: none"> ○ Active Count ○ Real Power ○ Reactive Power ○ Apparent Power • Switch <ul style="list-style-type: none"> ○ Local On/Off ○ Remote On/Off • Contactor <ul style="list-style-type: none"> ○ Contactor Status • Breaker <ul style="list-style-type: none"> ○ Breaker Status </td> </tr> </table>	<ul style="list-style-type: none"> • Battery <ul style="list-style-type: none"> ○ Real Power ○ Continuous Available Discharge ○ Continuous Available Charge ○ Reactive Power ○ Apparent Power ○ Energy Remaining ○ Full Pack Energy ○ Frequency ○ Voltage • Solar <ul style="list-style-type: none"> ○ Real Power ○ Reactive Power ○ Real Power Limit ○ Apparent Power 	<ul style="list-style-type: none"> • Grid <ul style="list-style-type: none"> ○ Real Power • Load <ul style="list-style-type: none"> ○ Real Power • Diesel <ul style="list-style-type: none"> ○ Active Count ○ Real Power ○ Reactive Power ○ Apparent Power • Switch <ul style="list-style-type: none"> ○ Local On/Off ○ Remote On/Off • Contactor <ul style="list-style-type: none"> ○ Contactor Status • Breaker <ul style="list-style-type: none"> ○ Breaker Status
<ul style="list-style-type: none"> • Battery <ul style="list-style-type: none"> ○ Real Power ○ Continuous Available Discharge ○ Continuous Available Charge ○ Reactive Power ○ Apparent Power ○ Energy Remaining ○ Full Pack Energy ○ Frequency ○ Voltage • Solar <ul style="list-style-type: none"> ○ Real Power ○ Reactive Power ○ Real Power Limit ○ Apparent Power 	<ul style="list-style-type: none"> • Grid <ul style="list-style-type: none"> ○ Real Power • Load <ul style="list-style-type: none"> ○ Real Power • Diesel <ul style="list-style-type: none"> ○ Active Count ○ Real Power ○ Reactive Power ○ Apparent Power • Switch <ul style="list-style-type: none"> ○ Local On/Off ○ Remote On/Off • Contactor <ul style="list-style-type: none"> ○ Contactor Status • Breaker <ul style="list-style-type: none"> ○ Breaker Status 		
Telemetry Access	Local Modbus/DNP3/REST		
Historian	<ul style="list-style-type: none"> • Local (3rd Party Historian) • 500 tags with a granularity of historical data of 1s 		

Appendix B: Signal Glossary

The following provides a definition of the signals shown in the Powerhub UI.

Battery

- **Real Power (kW):** Instantaneous real power measured at the battery meter.
- **Continuous Available Discharge Power (kW):** Continuous power available to discharge the battery. Available discharge power will taper off as the battery reaches a fully depleted state. Otherwise, this should be equivalent to the nameplate power rating of the system.
- **Continuous Available Charge Power (kW):** Continuous power available to charge the battery. Available charge power will taper off as the battery reaches a fully charged state. Otherwise, this should be equivalent to the nameplate power rating of the system.
- **Energy Remaining (kWh):** Energy remaining in the battery if operated at a nominal temperature of 25°C.
- **Full Pack Energy (kWh):** Available energy of the batteries when fully charged and at nominal temperature of 25°C (affected by temperature, degradation, etc.).
- **Reactive Power (kVar):** Instantaneous reactive power measured at the battery meter.
- **Today's Import Energy (kWh):** Energy used to charge the battery (measured at the battery meter) since midnight.
- **Today's Export Energy (kWh):** Energy discharged from the battery (measured at the battery meter) since midnight.
- **Apparent Power (kVA):** Apparent power calculated from measured real and reactive power.
- **Frequency (Hz):** Frequency of the system.
- **Voltage (V):** Output AC Voltage of the inverters.
- **State of Energy (%):** Available energy of the system calculated as a percentage by dividing the nominal energy remaining by the full pack energy.
- **Target Power (kW):** Current real power command sent to the battery by the Tesla Site Controller.
- **Target Reactive Power (kVar):** Current reactive power command sent to the battery by the Tesla Site Controller.

Solar

- **Real Power (kW):** Instantaneous real power (AC) measured at the solar production meter.
- **Reactive Power (kVar):** Instantaneous reactive power measured at the solar production meter.
- **Apparent Power (kVA):** Apparent power calculated from measured real and reactive power.

- **Real Power Limit (kW):** Maximum real power output (AC) allowed. Anything exceeding the real power limit is curtailed.
 - **Today's Production (kWh):** Energy generated from the solar system since midnight.
- Grid**
- **Real Power (kW):** Instantaneous power (AC) measured at the point of interconnection. The meter installed here measures net site demand.
 - **Today's Import Energy (kWh):** Energy consumed by on-site loads from the grid since midnight.
 - **Today's Export Energy (kWh):** Energy exported to the grid since midnight. Energy exported to the grid is typically only allowed when solar generation exceeds on-site demand.
- Load**
- **Real Power (kW):** Calculated value indicating instantaneous power consumption based on measurements at solar, battery, and utility meters.
 - **Today's Energy Consumption (kWh):** Calculated value based on measured values at solar, battery, and utility meters since midnight.
- Diesel**
- **Active Count:** Number of generators running on site.
 - **Real Power (kW):** Instantaneous power (AC) measured at the generator.
 - **Reactive Power (kVar):** Instantaneous reactive power measured at the generator.
 - **Apparent Power (kVA):** Apparent power calculated from measured real and reactive power.
 - **Today's Production (kWh):** Energy generated from the generator since midnight.
- Switch**
- **Local_Control (on/off):** Local control On/Off status. When On, the site is controlled by the local operator from the Local UI.
 - **Remote_Control (on/off):** Remote control On/Off status. When On, the site is controlled remotely by a 3rd Party SCADA system.
- Contactors**
- **Contactors Status (open/close):** Current status of a contactor, shows open or close.
- Breaker**
- **Breaker Status (open/close):** Current status of a breaker, shows open or close.

Revision History

Revision #	Date	Description	Author
1.00	02-14-2019	Initial Release	JK
1.01	02-21-2019	Various updates	JC
2.00	06-18-2019	Included Powerhub Pro package details	PC / JK