



**ON Semiconductor®**

# Automotive Dual 100W USB-PD User Guide



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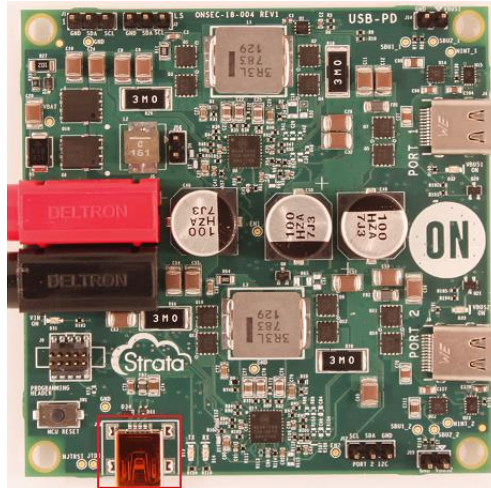
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## Startup Procedure

Note: Must have 'Strata.exe' installed, as well as an active internet connection to download USB Serial Port drivers if necessary.

Step 1: Apply 5V to 32V to the input Banana Connectors.

- Recommend > 200W input capability for max output testing



Step 2: Open the 'Strata' application and press 'Continue'

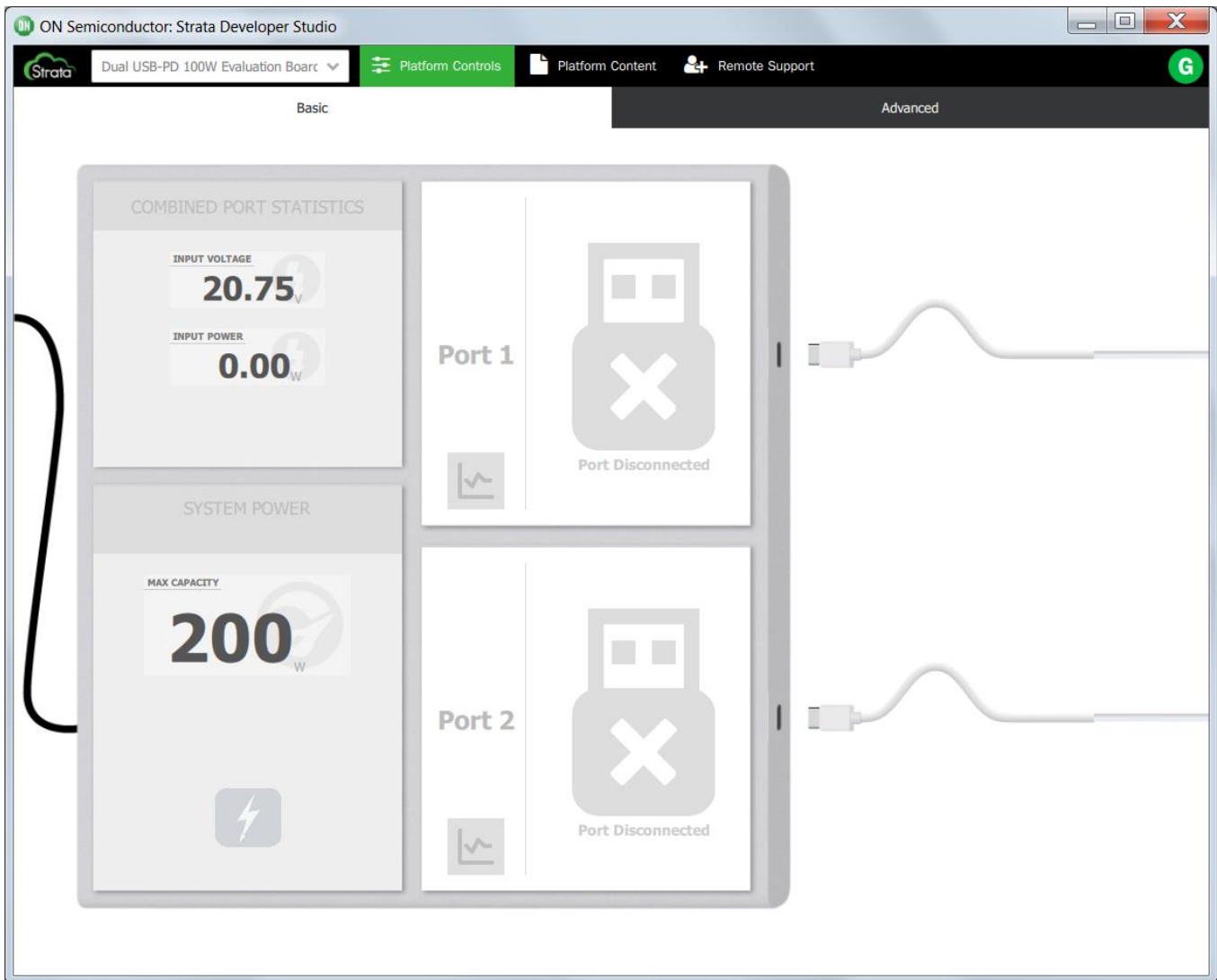


Step 3: Login to Strata as a Guest.



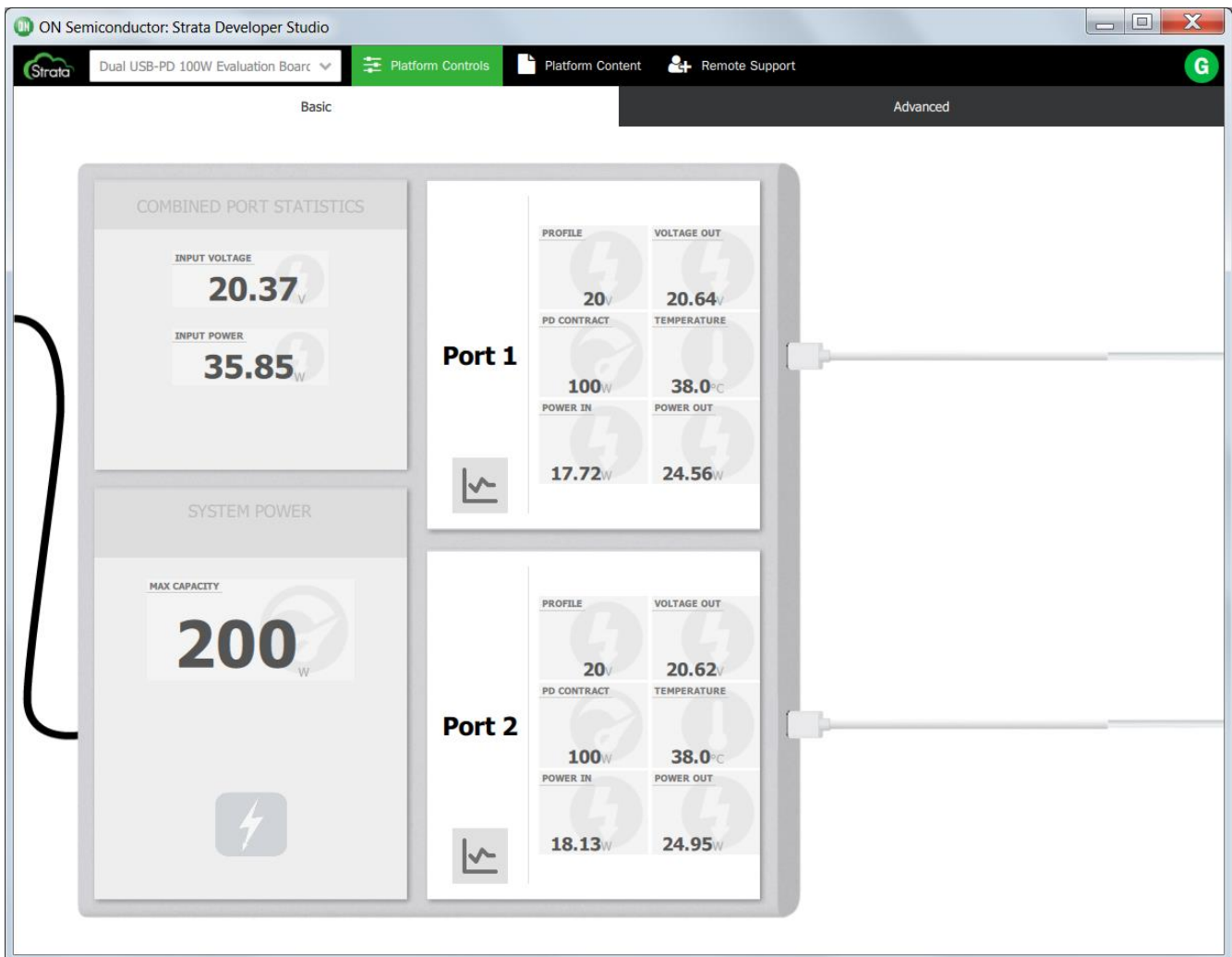
Step 4: Plug USB Mini-B into the EVK and PC.

- This should bring up the 'Basic' view within Strata



## Step 5: Connect a USB-C device

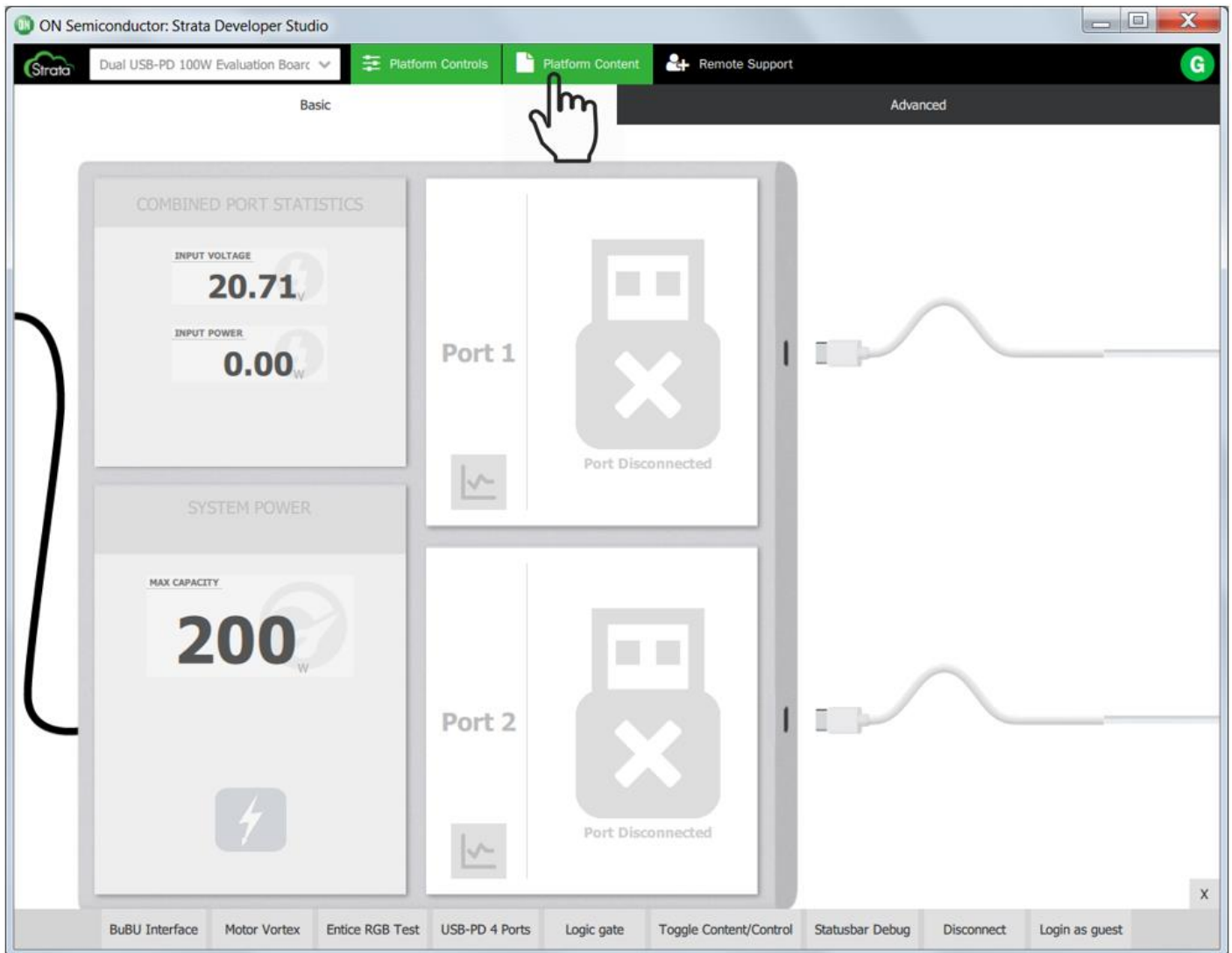
- There should be a connection within Strata on the corresponding port
- Strata will show the PD contract, voltage profile and actual output value, temperature, and input and output powers for each port.



## Collateral Viewing

Click the “Platform Content” Button at the top of Strata to view system content.

Note: An internet connection is required to download platform content



## Advanced Control

Provides advanced systems controls, telemetry and operation modes for in-depth evaluation of the system capabilities.

Click the 'Advanced' button to bring up the Advanced Control Interface. See explanation of 'Protection' features, below.

The screenshot displays the ON Semiconductor Strata Developer Studio interface for a Dual USB-PD 100W Evaluation Board. The interface is split into 'Basic' and 'Advanced' tabs, with 'Advanced' selected. The 'System Settings' section includes:

- Faults:** Fault Protection (Shutdown, Retry, None), Fault when input below (0V to 20V, 0), and Fault when temperature above (-40°C to 135°C, 135).
- Input Foldback:** On/Off toggle, Limit below (0V to 20V, 5), and Limit output power to (45).
- Temperature Foldback:** On/Off toggle, Limit above (-40°C to 135°C, 150), and Limit output power to (45).

The 'Port 1' section shows:

- Telemetry:** Profile (20V), Voltage Out (20.62V), PD Contract (100W), Temperature (30.0°C), Power In (23.83W), Power Out (23.30W).
- Advertised Voltages:** 5V/5A, 7V/5A, 8V/5A, 9V/5A, 12V/5A, 15V/5A, 20V/5A.
- Show Graphs:** Vout, Iout, Iin, Pout, Pin.
- Controls:** Max Power Output (100), Current limit (0A to 6A), Cable Compensation (For every increment of: .25A to 1A, 0.3), Bias output by (0mV to 50mV, 50).

The 'Port 2' section shows:

- Telemetry:** Profile (20V), Voltage Out (20.62V), PD Contract (100W), Temperature (30.0°C), Power In (16.95W), Power Out (23.51W).
- Advertised Voltages:** 5V/3A, 7V/3A, 8V/3A, 9V/3A, 12V/3A, 15V/3A, 20V/3A.
- Show Graphs:** Vout, Iout, Iin, Pout, Pin.
- Controls:** Max Power Output (100), Current limit (0A to 6A), Cable Compensation (For every increment of: .25A to 1A, 0.3), Bias output by (0mV to 50mV, 50). A 'DEBUG' button is visible.



## USB-PD Dual Port 100W Power Management

### Available Power Levels

- 100W if a 5A capable cable is attached
- 60W if a standard type-C cable is attached (3A max)
- May be limited by user adjustable thresholds/limits
  - Host/user power limit setting
  - Over temperature
  - Input under voltage
  - Output over current conditions (foldback)

### Available Voltages for each Power Level

These voltages and currents are offered to the sink device via the *Source Capabilities* message.

100W = 5V, 7V, 8V, 9V, 12V, 15V or 20V @ 5A

60W = 5V, 7V, 8V, 9V, 12V, 15V or 20V @ 3A

45W = 5V, 7V, 8V, 9V, 12V or 15V @ 3A

36W = 5V, 7V, 8V, 9V or 12V @ 3A

27W = 5V, 7V, 8V or 9V @ 3A

15W = 5V @ 3A

### Fault Protection

**Retry** will cause the board to start back up once the fault is removed. **None** will disable the fault and no action will occur when the temperature threshold is met. This button affects **Thermal Fault** and individual port **Current Limit**.

### Thermal Fault Protection

The first fault control will determine how the board will respond to an over-temperature condition.

Note: The UI fault protection is based on the readings from each port's temperature sensors. Individual parts may have their own over temperature protection. Hysteresis exists on this setting of 2°C.

### Thermal Foldback Protection

Thermal Foldback Protection is used to force a port to renegotiate the PD contract with the sink device to the % power of that port's total available power. Hysteresis exists on this setting of 2°C.

### Input Voltage Fault

No controls are available to the user for this fault. If AC power is removed from the board (or 24V is no longer present on the main DC rail) the board will shut down until mains is reapplied. Hysteresis exists on this setting of 0.5V that is unobservable to the user.

## Individual Port Controls

### Max Port Power

The port power of each port can be artificially limited by selecting an option in the drop down box. Once this is set, no contract will be offered on that port that exceeds the chosen max port power limit.

### Current limit

The port current limit can be set in Strata to trigger from 0A to 6A. When tripped, the buck controller will be disabled and will hiccup in an attempt to restart until the current limit is increased or the requested current by the sink device decreases to an acceptable value. In addition to the software current limit, there is a hardware 6A current limit that exists due to the FPF2895 load switch.

### Cable compensation

The cable compensation feature is intended to reduce voltage droop at the sink device when sourcing higher currents. Cable compensation is set on default to increase the output voltage by 50mV per increment of 0.5A. The maximum voltage that can be added onto the expected VBUS voltage is 1V (50mV for each increment of 0.25A).

Warning: It is possible to exceed the voltage of downstream devices by reducing the current slider and increasing the voltage slider. Care must be taken by the user to ensure the voltage does not violate the specifications of the downstream device.

### Advertised Voltages

At the bottom of each port's controls there are a number of boxes showing voltage and current. These default to 20W, 3A maximum until a device is plugged in. Once a device is plugged in, the maximum contract will be what the device requested.

### Power Variables (Fusb302 class)

- *m\_commanded\_max\_power* – the maximum power set by the host
  - configured via 'Pmax' on the Advanced Controls tab
- *m\_default\_max\_power* – the maximum power setting unconstrained by foldback settings
  - Default Limited to 60W if a 3 amp cable is attached, or 100W if a 5 amp cable is attached.
- *m\_current\_max\_power* – the current maximum power setting constrained by cable-type, foldback, or overcurrent settings.
- *m\_cable\_max\_current* – the maximum current in amps allowed by the cable type

### Power Rules

$m\_commanded\_max\_power \geq m\_default\_max\_power \geq m\_current\_max\_power$

When '*m\_current\_max\_power*' changes, a USB-PD negotiation is performed between the USB-PD-100W board and the attached sink device.

### References

1. Universal Serial Bus Power Delivery Specification, Revision 3.0
2. Universal Serial Bus 3.2 Specification

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