# GPS and SLICE

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# SLICE GPS Accessory Kit – Why GPS?

- **Precision Time and Location**

  - **Alignment of events to real world locations**

  - **Time synchronization across multiple systems**

- **Who's Interested?**

  - **Bicycle Manufacturer: Materials and Design Verification**

    - **Characterize stresses/strains from a known track environment**

  - **Rail Company: Catastrophic Coupler Failure**

    - **Locate failure point(s) along 1,000+ miles of track**

  - **Numerous Aerospace Companies**

    - **Characterization of blast events from multiple locations**

    - **Identify timing and location (altitude/velocity) of specific events during parachute deployment**
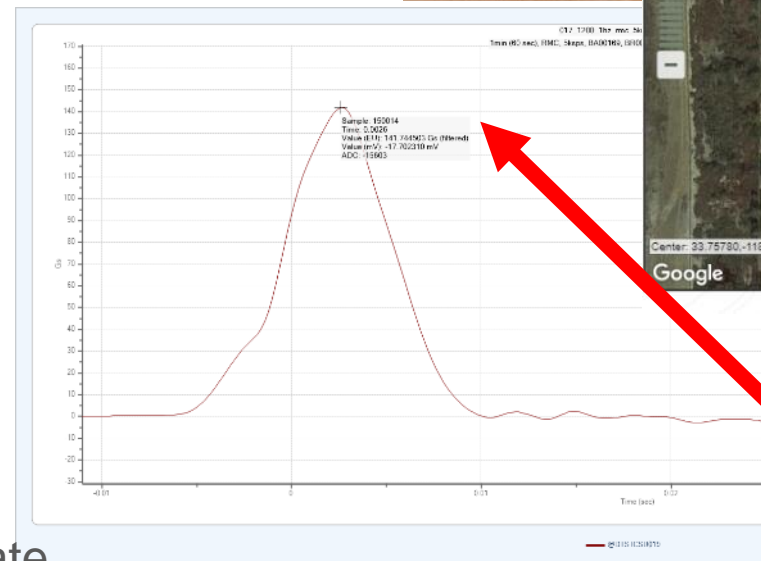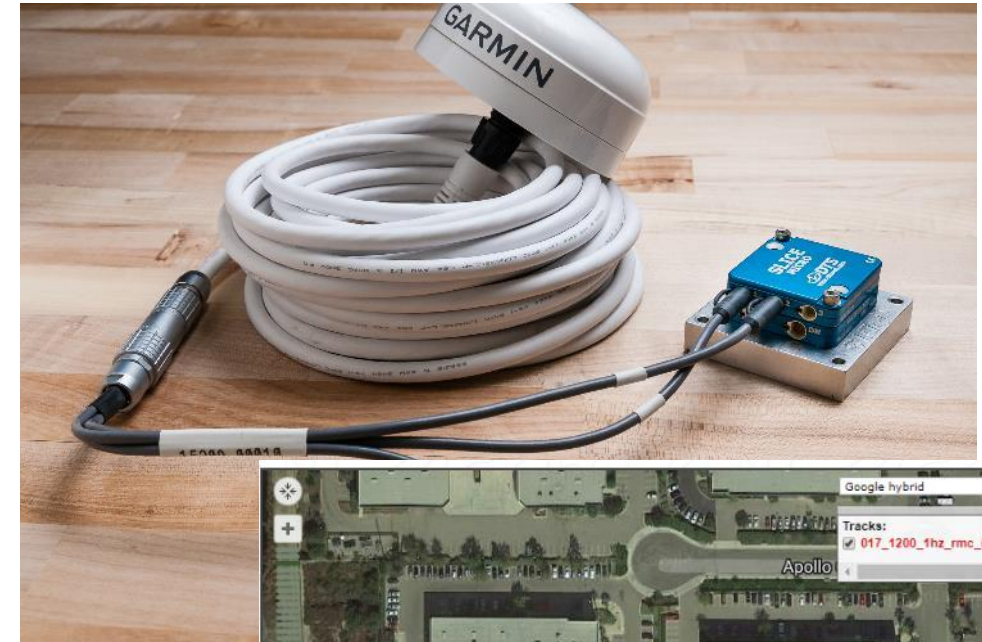
DTS

# SLICE GPS Accessory Kit – What It Does

- **GPS Location, Velocity and Time Accessory for SLICE DAS**

  - **NANO, MICRO, IP68 and SLICE PRO**

  - **± 1 µs fundamental timing accuracy possible \*\***

  - **Standard NMEA format for GPS data**

  - **Rugged mounting options for GPS receiver**

  - **12VDC operation**

- **Application Examples**

  - **Automotive / Bicycle**

  - **Railroad**

  - **Aerospace**

Sample: 150,014
Date: 02-04-2018
UTC: 20:13:54
LAT: 33' 45.4623" N
LONG: 118' 05.3535 W

\*\* DAS timing resolution depends on sampling rate

# SLICE GPS Accessory Kit – How It Works

- **Capture two important GPS Signals along with sensor data**
  - **1PPS: Precision time pulse**
  - **NMEA: Date and time, locations, velocity, etc.**

- **Post-Processing**
  - **Software Utility extracts location and time information from channel data**

- **Visualization using 3rd party tools**
  - **DIADem, MATLAB, Google Maps, etc.**

# SLICE GPS Accessory Kit – What's Included

- **Garmin 19X GPS Receiver and mounting kit**

- **Accessory Cables**
  - **GPS Configuration Cable**
  - **GPS Break-out Cable**
  - **(2) Power Option Cables**
    - **Pigtail and Molex**

- **User-Modifiable Software**
  - **Source Code, Executable, and Documentation**
    - **Windows Executable (.exe), MATLAB Source Code, C# Project Solution (.sln) and Source Code**

- **User's Manual and Test Examples**

# Technical Overview

## Readily available off-the-shelf GPS devices provide:

- NMEA serial data stream that contains location and time of day information.

- 1 PPS (pulse per second) digital data. The "edge" of this square wave signal provides very precise timing information.

- NMEA + 1PPP data provide complete location and timing information.

## Recording on SLICE

- NMEA and 1PPS "digital" signals can be recorded on SLICE analog channels with the proper connection cables and sensor settings.

- Sampling rate must be at least 5k sps (samples per second).

- Recorded data are post-processed to create a simple CSV file with location and time of day correlated to specific samples numbers in SLICE data.

- User's Manual and MATLAB utility available on the DTS Help Center.

# Recording

- Connect GPS signals to SLICE by following instructions in User's Manual.

- Connect sensors to other channels on SLICE Stack(s).

- Record data at 5k sps or higher for any length desired.

- Use provided utility to generate location, date and time CSV file.

- Correlate location/time data with SLICE data as needed.

# Sample Data – Recorded at 5k sps for 30 seconds

## Channel 1

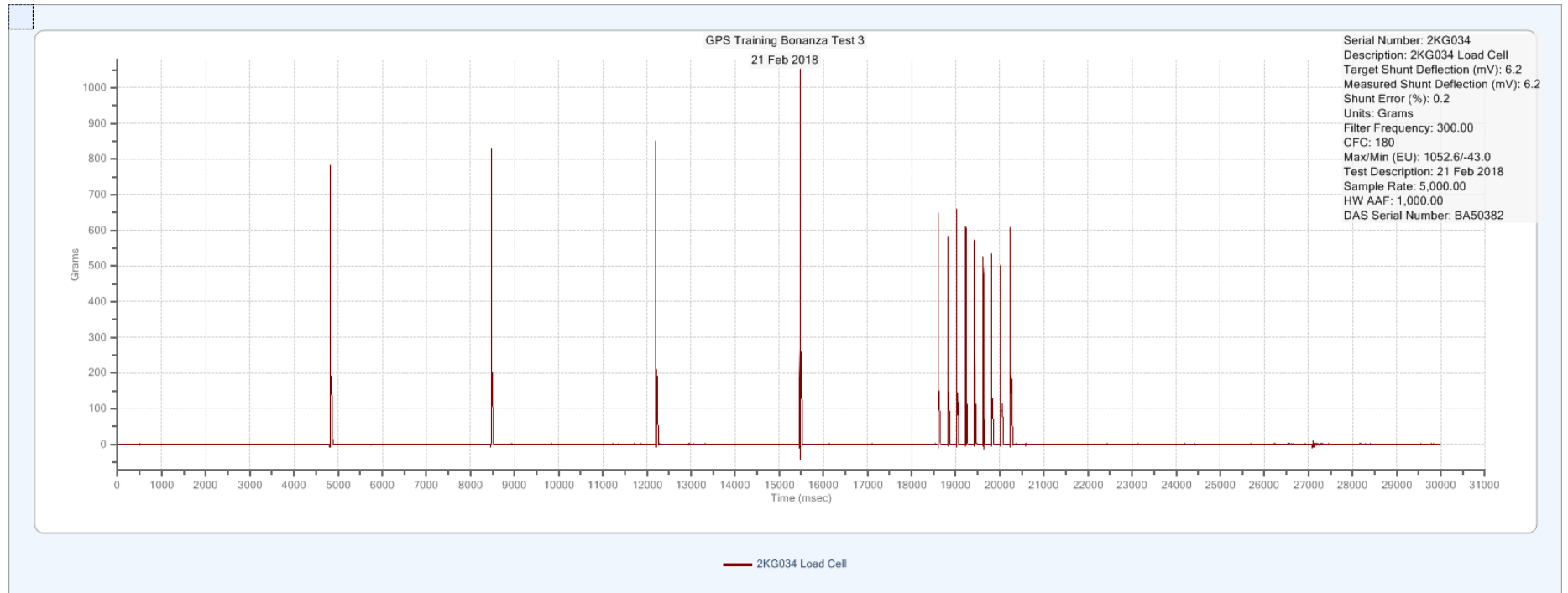## 1 PPS Data
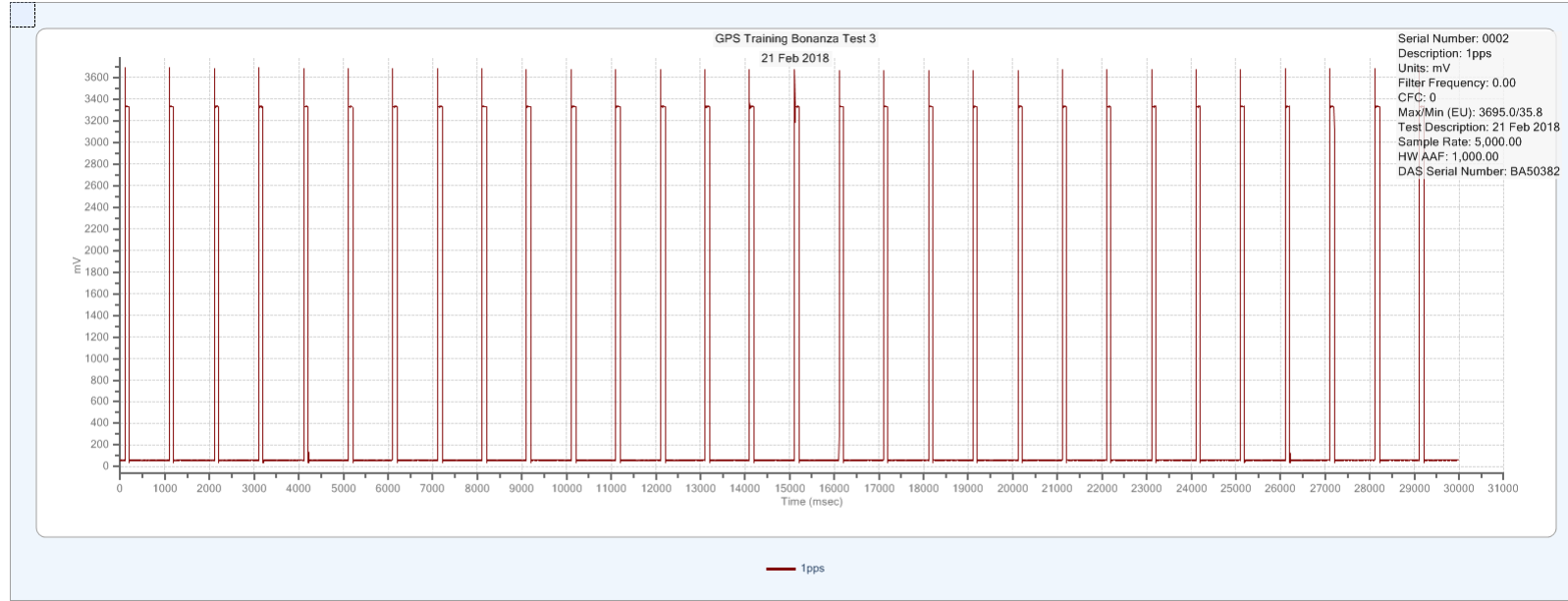


## Channel 2

## NEMA Data

## Packets
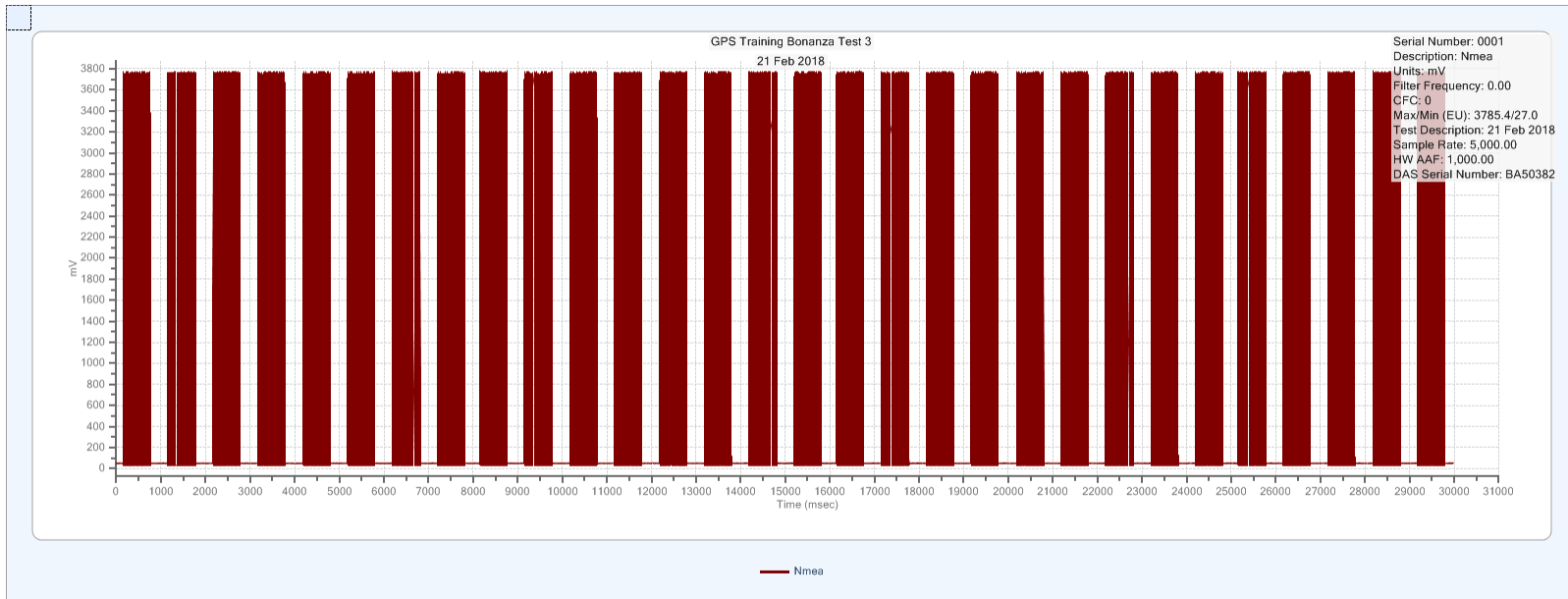
# Sample Data – Recorded at 5k sps for 30 seconds
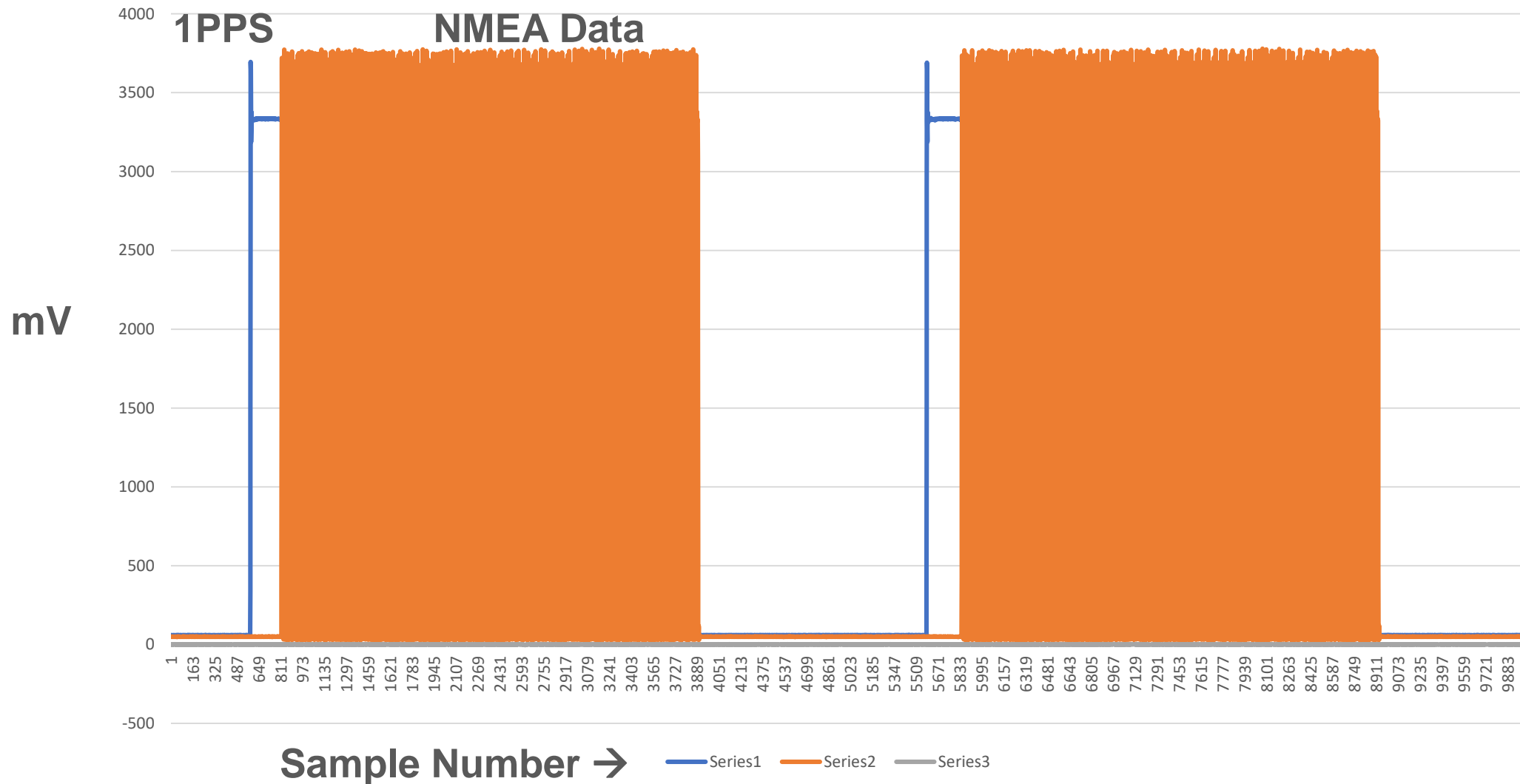
**Channel 3**

**Tap check on load cell**

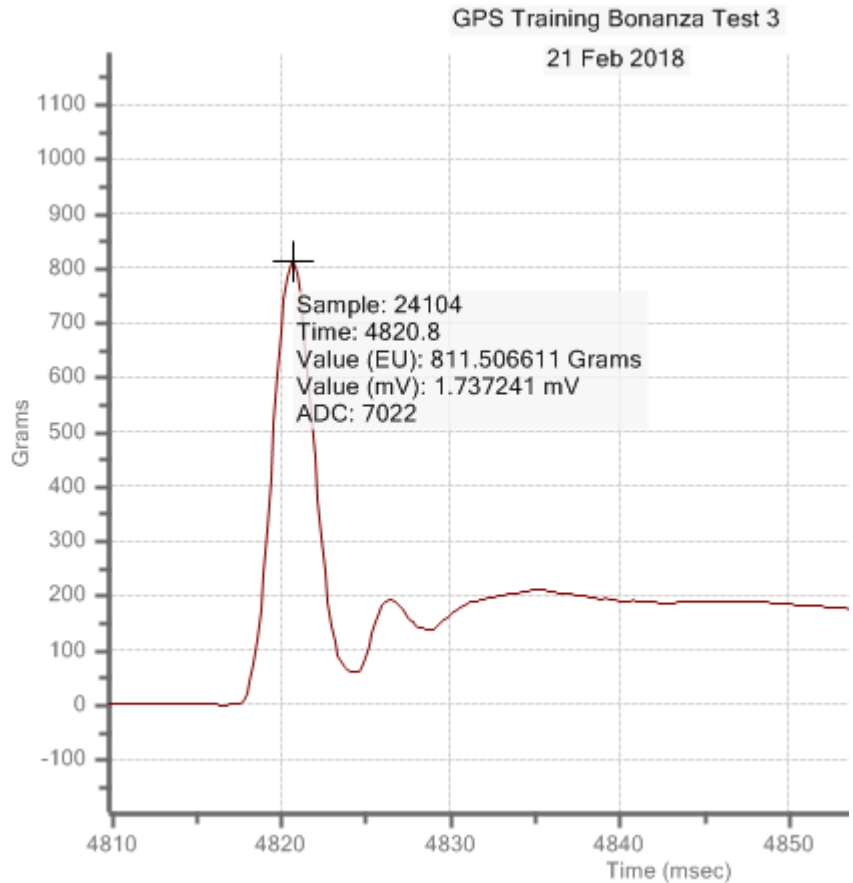# Sample Data (CSV) – Recorded at 5k sps for 30 seconds

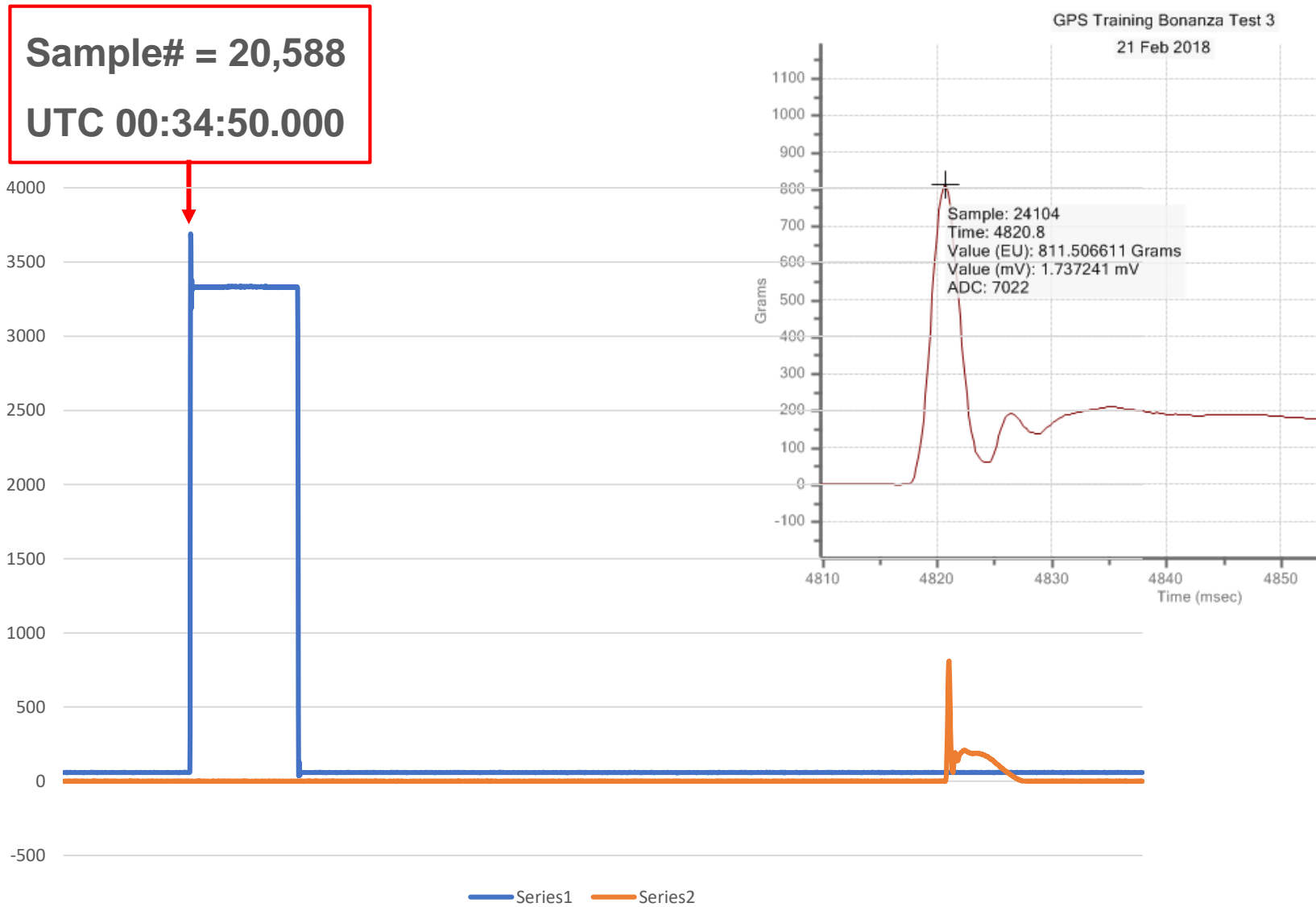**First 2 seconds of SLICE data showing 1PPS and NEMA packets plotted versus sample number**

# Sample Data – MATLAB Conversion Utility

**Generates a CSV that correlates data sample numbers in SLICE Data to UTC date/time and location.**



GPS Training Bonanza Test 3
21 Feb 2018

Sample: 24104
Time: 4820.8
Value (EU): 811.506611 Grams
Value (mV): 1.737241 mV
ADC: 7022

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | sample# | hour | minute | second | day | month | year | lat deg | lat min | lat hemisp | long deg | long min | long hemisphere | |
| 2 | 588 | 0 | 34 | 46 | 22 | 2 | 18 | 33 | 45.4768 | N | 118 | 5.3322 | W | |
| 3 | 5588 | 0 | 34 | 47 | 22 | 2 | 18 | 33 | 45.4769 | N | 118 | 5.3321 | W | |
| 4 | 10588 | 0 | 34 | 48 | 22 | 2 | 18 | 33 | 45.4769 | N | 118 | 5.3321 | W | |
| 5 | 15588 | 0 | 34 | 49 | 22 | 2 | 18 | 33 | 45.4769 | N | 118 | 5.3321 | W | |
| 6 | 20588 | 0 | 34 | 50 | 22 | 2 | 18 | 33 | 45.4769 | N | 118 | 5.332 | W | |
| 7 | 25588 | 0 | 34 | 51 | 22 | 2 | 18 | 33 | 45.4769 | N | 118 | 5.332 | W | |
| 8 | 30588 | 0 | 34 | 52 | 22 | 2 | 18 | 33 | 45.477 | N | 118 | 5.332 | W | |
| 9 | 35588 | 0 | 34 | 53 | 22 | 2 | 18 | 33 | 45.477 | N | 118 | 5.332 | W | |
| 10 | 40588 | 0 | 34 | 54 | 22 | 2 | 18 | 33 | 45.477 | N | 118 | 5.332 | W | |
| 11 | 45588 | 0 | 34 | 55 | 22 | 2 | 18 | 33 | 45.477 | N | 118 | 5.3319 | W | |
| 12 | 50588 | 0 | 34 | 56 | 22 | 2 | 18 | 33 | 45.4771 | N | 118 | 5.3319 | W | |
| 13 | 55588 | 0 | 34 | 57 | 22 | 2 | 18 | 33 | 45.4771 | N | 118 | 5.3319 | W | |
| 14 | 60588 | 0 | 34 | 58 | 22 | 2 | 18 | 33 | 45.4771 | N | 118 | 5.3319 | W | |
| 15 | 65588 | 0 | 34 | 59 | 22 | 2 | 18 | 33 | 45.4772 | N | 118 | 5.3318 | W | |
| 16 | 70588 | 0 | 35 | 0 | 22 | 2 | 18 | 33 | 45.4772 | N | 118 | 5.3318 | W | |
| 17 | 75588 | 0 | 35 | 1 | 22 | 2 | 18 | 33 | 45.4772 | N | 118 | 5.3318 | W | |
| 18 | 80588 | 0 | 35 | 2 | 22 | 2 | 18 | 33 | 45.4772 | N | 118 | 5.3318 | W | |
| 19 | 85588 | 0 | 35 | 3 | 22 | 2 | 18 | 33 | 45.4773 | N | 118 | 5.3318 | W | |
| 20 | 90588 | 0 | 35 | 4 | 22 | 2 | 18 | 33 | 45.4773 | N | 118 | 5.3318 | W | |
| 21 | 95588 | 0 | 35 | 5 | 22 | 2 | 18 | 33 | 45.4774 | N | 118 | 5.3318 | W | |
| 22 | 100588 | 0 | 35 | 6 | 22 | 2 | 18 | 33 | 45.4774 | N | 118 | 5.3318 | W | |
| 23 | 105588 | 0 | 35 | 7 | 22 | 2 | 18 | 33 | 45.4774 | N | 118 | 5.3318 | W | |
| 24 | 110588 | 0 | 35 | 8 | 22 | 2 | 18 | 33 | 45.4775 | N | 118 | 5.3318 | W | |
| 25 | 115588 | 0 | 35 | 9 | 22 | 2 | 18 | 33 | 45.4775 | N | 118 | 5.3318 | W | |
| 26 | 120588 | 0 | 35 | 10 | 22 | 2 | 18 | 33 | 45.4776 | N | 118 | 5.3318 | W | |
| 27 | 125588 | 0 | 35 | 11 | 22 | 2 | 18 | 33 | 45.4776 | N | 118 | 5.3318 | W | |
| 28 | 130588 | 0 | 35 | 12 | 22 | 2 | 18 | 33 | 45.4777 | N | 118 | 5.3317 | W | |
| 29 | 135588 | 0 | 35 | 13 | 22 | 2 | 18 | 33 | 45.4777 | N | 118 | 5.3317 | W | |
| 30 | 140588 | 0 | 35 | 14 | 22 | 2 | 18 | 33 | 45.4778 | N | 118 | 5.3317 | W | |

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# Sample Data – Correlating data/time samples



Sample# = 20,588

UTC 00:34:50.000

GPS Training Bonanza Test 3
21 Feb 2018

Sample: 24104
Time: 4820.8
Value (EU): 811.506611 Grams
Value (mV): 1.737241 mV
ADC: 7022

Series1    Series2

# THANK YOU