

## CART2 Data Sampler – Instructions for Use

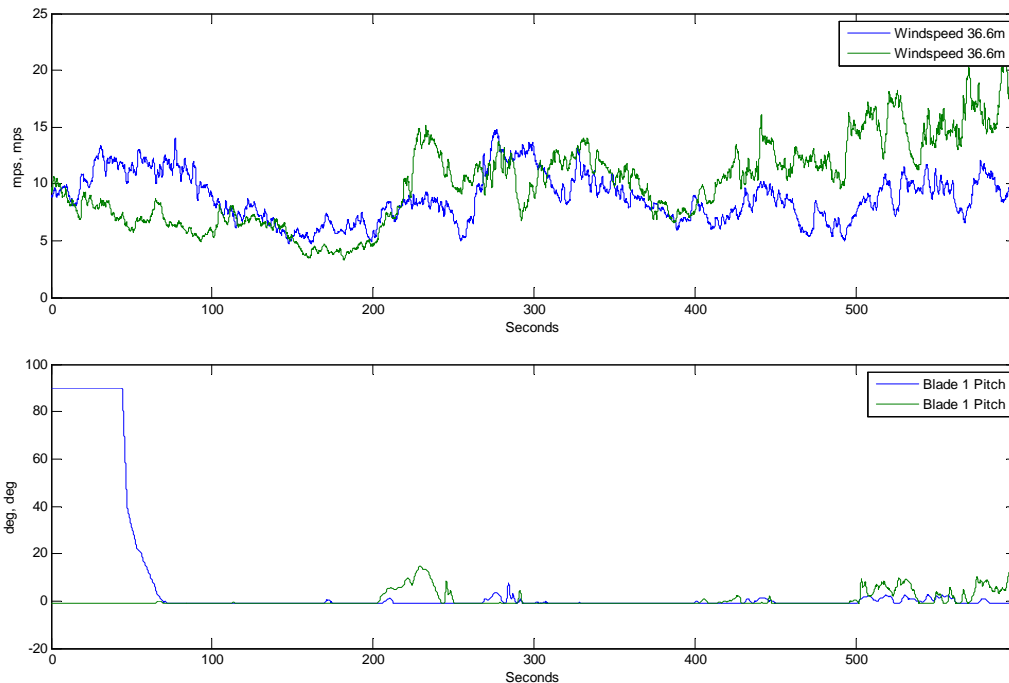
**Table 1: List of Files**

<b>File Name</b>	<b>Description</b>
cartplotU.m	GUI for loading, plotting, and processing CART2 data
all other .m files	used for processing CART2 data within cartplotU
*****.dat	CART2 data
Warning&Fault bits.doc	lists warning and fault (normal stop and emergency stop) bits (may be incomplete)

### Sample usage<sup>†</sup>

```
>> cartplotU
```

opens a GUI that can be used to load and plot two data sets. Use File → Open 1<sup>st</sup> (2<sup>nd</sup>) data set to select the data. For example, loading 04271824.DAT and 04271834.DAT then plotting the wind speed and blade 1 pitch angle for each results in the following plot:



Note that plots can be exported from the cartplotU GUI using Data → Export plots.

### Reading a CART2 data set name:

- First two digits indicate month (01 = January)
- Next two digits indicate date
- Final four digits indicate time in 24-hour format in GMT at the start of the 10-min data set (1342 means data set runs from 13:42 GMT to 13:52 GMT)

<sup>†</sup> Please see comments in individual .m files for more use instructions and options

## Note on warnings and faults

To determine warning and fault information, look at

- channel 85 for normal stops,
- channel 86 for emergency stops, and
- channels 87-88 for warnings.

Convert numbers to binary (Matlab *dec2bin*) and count from the right to left, where the farthest right bit is bit 1. Bits that equal 1 correspond to the list given in “Warning&Fault bits.doc.” For example,

channel 86 = 4096 = 1 0000 0000 0000

indicates that the fault associated with bit 13 occurred. If multiple normal or emergency stop faults occur, only the first is recorded. All warnings that do not shut down the turbine are recorded.

## Abbreviations and Acronyms

LSS	Low-speed shaft (rotor)
HSS	High-speed shaft (generator)
IMU	Inertial Measurement Unit (type of accelerometer including X, Y, Z, roll, pitch, and yaw)
PE	Power electronics
E/W	East/West (indicates placement on tower)
N/S	North/South
Sonic U	Sonic anemometer reading in the streamwise (fastest) wind direction
Sonic V	Sonic anemometer reading in the cross-stream wind direction (orthogonal to U)
Sonic W	Sonic anemometer reading in the up-down wind direction
GPS	Global positioning system, used to time and date stamp to the 0.1 millisecond

## CART2 Control and Additional Information

The following papers are freely available online and describe CART2 commissioning, baseline data collection, control, and a number of problems encountered.

- Fingersh, L. and Johnson, K., 2002, *Controls Advanced Research Turbine (CART) Commissioning and Baseline Data Collection*, NREL Report No. TP-500-32879. <http://www.nrel.gov/docs/fy03osti/32879.pdf>.
- Fingersh, L. and Johnson, K., 2004, “Baseline Results and Future Plans for the NREL Controls Advanced Research Turbine,” *Proceedings of the 23<sup>rd</sup> ASME Wind Energy Symposium*, Reno, NV, pp. 87-93. <http://www.nrel.gov/docs/fy04osti/35058.pdf>.
- Johnson, K., Fingersh, L., Balas, M., and Pao, L., 2004, “Methods for Increasing Region 2 Power Capture on a Variable Speed HAWT,” *Proceedings of the 23<sup>rd</sup> ASME Wind Energy Symposium*, Reno, NV, pp. 103-113. <http://www.nrel.gov/docs/fy04osti/34979.pdf>.
- Johnson, K., Fingersh, L., and Wright, A., 2005, *Controls Advanced Research Turbine: Lessons Learned During Advanced Controls Testing*, NREL Report No. TP-500-38130. <http://www.nrel.gov/docs/fy05osti/38130.pdf>.