

# Download Diagnostic Data

Revision 0.4

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## Revision History

Version	Description of Versions / Changes	Updated by	Date
0.1	Initial version	Azam Khan	7/10/2012
0.2	Added information regarding CAN diagnostic data broadcast.	Azam Khan	8/7/2012
0.3	Formatting updates Add info on Diagnostic Viewer	Chris Brune	12/2/2020
0.4	Added information on CAN Diag. Data trigger. Replaced PWM frequency for 12V sense for 651E and newer.	Andrew Louie	2/21/2022

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# 1 Introduction

## 1.1 Purpose

The purpose of this document is to provide a process to the users of Cascadia Motion inverters to download the diagnostic data stored in the inverter memory after a fault occurs.

**IMPORTANT NOTE:** The Diag Data is lost/reset if the fault is cleared of low voltage power is cycled.

The intended audience of this document is end users and customers of Cascadia Motion.

## 1.2 Scope

The inverter software provides certain data via the GUI and also via CAN messages. However both CAN and the GUI do not provide data at a very high rate. For a PWM frequency of 12kHz and a CAN message rate of 10ms is still once every 120 PWM cycles. Sometimes it is necessary to be able to examine internal variables with a much finer resolution.

Cascadia Motion has implemented a feature into our software that keeps an ongoing record of certain internal variables (using a circular buffer). The data is referred to as the Diag Data. The variable set is recorded at every PWM cycle. The buffer length is subject to change but is currently 160 records long and 18 variables are stored. Each variable is internally stored in a 32-bit internal format. However, when the Diag Data is transmitted the data is sent in a 16-bit format converted into real world units like what is used with the RMS GUI and CAN broadcast messages.

The Diag Data is used to diagnose issues that happen in a very narrow window of time. Keep in mind that 160 records at 12kHz is only 13.3ms. Additionally, due to the limited amount of data that can be recorded items such as temperature are not recorded.

## 1.3 Definitions, Acronyms, and Abbreviations

Terms	Definitions
GUI	Graphical User Interface
CAN	Controller Area Networking
PWM	Pulse Width Modulation

## 1.4 References

- None

## 2 “Download Diagnostic Data” Feature

The internal circular buffer is updated at every PWM interrupt. The data is stored in the buffer at the end of the PWM interrupt. Thus it contains the feedback variables that were captured as well as the results of the internal control loop calculations. It also records the fault information, if any.

If a fault has occurred the buffer will continue to record 5 more records after the fault has occurred. It will then stop recording until the fault has been cleared.

The assignment of variables to the circular buffer is subject to change. Currently, it is set as follows:

Index	Variable	Multiplier	Description
1	Gamma_resolver	10	Instantaneous angle calculated from the resolver feedback. (0 = 0 degrees, 1.0 = 360 degrees).
2	Gamma_observer	10	Resolver feedback after filtering of observer.
3	Sin_corr	100	Resolver Sin input
4	Cos_corr	100	Resolver Cosine input
5	Ia_corr	10	Phase A adjusted current value
6	Ib_corr	10	Phase B adjusted current value
7	Ic_corr	10	Phase C adjusted current value
8	Vdc	10	DC Bus voltage
9	Iq_cmd	10	Q-axis current command
10	Id_cmd	10	D-axis current command
11	Modulation	10000	Modulation index
12	Flux_weakening_out	10	Amount of field weakening current
13	Vq_cmd	10	Q-axis voltage command
14	Vd_cmd	10	D-axis voltage command
15	Vqs_cmd	10	Q-axis voltage command in stationary reference frame.
16	12V Voltage	100	The measured value of the low voltage input voltage. Note this is typically only updated every 12ms.
	PWM Frequency	1	Starting with version 651E, PWM Frequency is logged instead of 12V Voltage.
17	Run_faults (lo word)	NA	Run faults low word. See user's manual.
18	Run_faults (hi word)	NA	Run faults high word. See user's manual.

## 2.1 Downloading Data using GUI

To capture the contents of the buffer press the “Download Diag Data” button on the GUI after a fault has occurred. If your version of the GUI software does not have this button please visit the Cascadia Motion website for the latest release of the GUI software.

You will be prompted for a filename to save the data to.

After selecting the file you will be prompted to press “OK” to start the download. After pressing “OK” it may take several minutes to download the data. When the download is complete the GUI software will prompt with a message.

With some versions of the RMS GUI and certain computers it is possible that the download might look frozen. Please continue to allow the download to continue till it is finished.

It is possible to download the Diag Data without a fault having occurred. The Diag Data will then represent a small snapshot of time at the time of download.

## 2.2 Downloading Data using CAN

Diagnostic data is broadcast over the message ID 0x0AF automatically after a fault has occurred and when CAN\_Diag\_Data\_Tx\_Active\_EEPROM is set to 1. Diagnostic data can also be triggered and broadcast by writing a non-zero value to address 31 using the parameter message (message ID 0x0C1). The default CAN\_ID\_Offset\_EEPROM parameter is assumed to be 0x0A0. In other words, add 0x00F to CAN\_ID\_Offset\_EEPROM to get the message ID that broadcasts diagnostic data and add 0x021 to CAN\_ID\_Offset\_EEPROM to get the parameter message ID.

The format for CAN broadcast is as follows:

CAN Msg ID = Offset + 0x00F	Byte							
	0	1	2	3	4	5	6	7
	Record #	0	gamma_resolver		gamma_observer		sin_corr	
	Record #	1	cos_corr		la_corr		lb_corr	
	Record #	2	lc_corr		Vdc		iq_cmd	
	Record #	3	id_cmd		modulation		flux_weak_out	

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	Record #	4	vq_cmd	vd_cmd	vqs_cmd
	Record #	5	12V voltage/PWM Frequency*	run_faults (lo)	run_faults (hi)

\* Starting with version 651E, PWM frequency is logged instead of 12V Voltage.

Each CAN message has 8 bytes. For CAN, each message includes an index byte, a sub-index byte, and 6 bytes for diagnostic parameters. Total number of CAN messages needed to send one complete record of 18 diagnostic parameters is 6.

Each message is sent at 10 milliseconds rate. It takes 60 milliseconds to send one complete data record. For 160 records, it will take 160 x 60 milliseconds = 9.6 seconds

## 2.3 Output File Format

Internally the software calculations are all done in per unit, that is, 32-bit fixed point format. However, the output format for each variable is 16-bits, that is, each variable is stored as a 16-bit decimal value in the output text file. For GUI, the data is stored in a comma delimited format with one line per record. The CAN output file format primarily depends upon the CAN data logger used. In general, CAN data is stored with one CAN message per line.

In order to convert the data to engineering unit, divide each parameter with its relevant multiplier factor.

Cascadia Motion has developed a data viewer for the Diag Data file format produced by the RMS GUI. The data viewer can be downloaded from the Cascadia Motion web site. See example screen shot below:



