

Configuration Tool Simplifies Testing and Management of Converter Power Stacks

Testing and managing converter power stacks can be a time consuming and laborious process. A new software tool allows the user to make changes in seconds, dramatically improving productivity.

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Introduction

Testing and commissioning a new converter power stack design can be a lengthy process due to the requirements to change the configuration of gate driver characteristics such as the turn on and turn off resistors (R_{gon} and R_{goff}) and the soft turn off resistor (R_{gsoft}). The usual method of changing the gate resistors requires the user to disassemble the converter power stack, unsolder and replace the gate resistors, reassemble and then re-run the test. For a large power converter with multiple gate drivers this process could take several hours if not days.

The associated tasks such as building a pulse generator to generate double pulses test or simple pulse trains can also be very time consuming.

The user also has to take the risk of working with high voltage equipment every time the converter power stack configuration needs to be changed.

The Power Insight Configurator has been designed to make the execution of these tasks faster and less error prone by taking advantage of Power Insight's two way communication protocol over the same fibre optic channels that are controlling the gate driver. Power Insight multiplexes data with the usual PWM and ACK (feedback) pulses to and from the gate driver.

The Power Insight Adapter

The Power Insight Adapter provides an interface between the ethernet or USB port on a Windows PC and the fibre optic channels that connect to the gate drivers. The Power Insight Adapter can be used in two different ways: i) direct mode, where the Windows PC is used to control the test pulses to the gate drives directly or, ii) gateway mode where the Power Insight Adapter will pass through PWM and ACK pulses from an existing central controller and Amantys gate drive but still allow communication using Power Insight with a Windows PC.

The Power Insight Adapter can control four gate driver channels directly or two gate driver channels in gateway mode. The Power Insight Adapter is extendable to control twelve gate drive channels directly or six gate drive channels in gateway mode.

Upgrading the software in the Power Insight Adapter is achieved by using the built in SD Card.

Figure [1] shows a picture of the standard Power Insight Adapter.

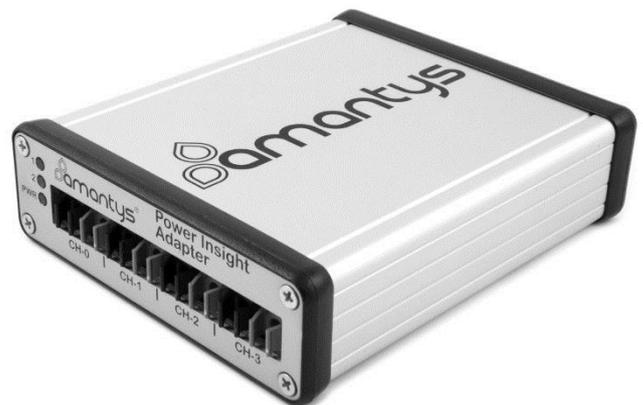


Figure [1] – Power Insight Adapter

Power Insight Configurator

The Power Insight Configurator is a Windows PC based application that will discover and communicate with Power Insight enabled gate drivers plugged into the fibre optic ports of the Power Insight Adapter. Each gate driver that the Power Insight Configurator finds is displayed as a button with the name of the gate driver, serial number and IPv6 address.

The Configuration Pane

Clicking the gate driver button will open the Configuration Pane for the associated gate drive. An example of the Configuration Pane is shown in Figure [2] below.

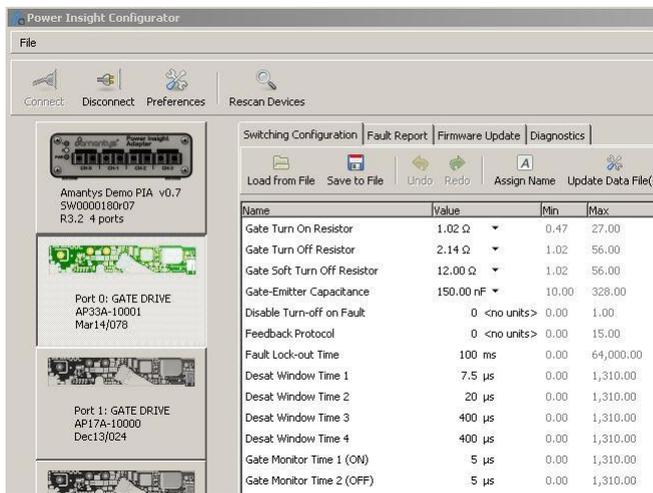


Figure [2] - Configuration Pane

The Configuration pane will show all of the parameters that can be configured on the gate driver. The standard parameters that can be configured by the user are shown in Figure [3] below.

Description	Use	Comments
Gate On Resistor	Adjust timing, dv/dt and di/dt during turn on	Existing 1200/1700V 15 values. New gate drives 63 values
Gate Off Resistor	Adjust timing, dv/dt and di/dt during turn on	As above
Gate Soft Turn Off Resistor	Select speed of turn off after short circuit fault	Typically 10Q+, but select from list of turn-off resistors
Feedback protocol	Choose Amantys signalling (compatible with other third party drivers) or a custom feedback protocol	Used in retro-fit applications
Fault Lock-out time	After a fault condition the gate driver prevents turn-on for this time	Typically 100ms – 3s
Desat Detection Time High	Time at which the high level (or single) desaturation comparator is enabled	Typically 7-9us
Desat Detection Time Low	Time at which the low level desaturation comparator is enabled (generally only used on 3300V+ IGBTs)	Typically 10-20us
Level Mode	2 level mode means the gate drive will turn-off after a fault. 3 level mode means the gate drive will signal a fault, but not turn off	Used to control the behaviour of inner and outer IGBTs in 3 level converters.
Type 2 short circuit turn-off delay	Time to allow current to settle before turning off after a type 2 short circuit	This setting is IGBT dependant

Figure [3] – Standard Configuration Parameters

The user can select a parameter and enter a new value which will be displayed in red until it has applied as the new configuration to the gate driver. Programming a new configuration into the target gate drive takes a few seconds.

The user also has the option to programme the same configuration into all of the attached gate drives or revert to the original configuration and start again.

Configurations can be stored to a file and retrieved at a later date by using the “Save to File” and “Load from File” buttons. The user can develop the optimum configuration for the target converter power stack and

send the configuration file to Amantys for programming into a production batch of gate drivers.

The Fault Report Pane

The Fault Report Pane shows the status of the fault counters on the gate driver. Amantys gate drives record the following faults:

- Short Circuit Type 1
- Short Circuit type 2
- Under voltage event
- Clamping event

If one of these faults occurs during operation, it is recorded in the memory on the gate driver. The Power Insight Configurator can download these fault counter values for examination, for example, at a regular maintenance interval. The counters can be reset and the fault counts tracked from maintenance event to maintenance event to look at the occurrence of these faults over time. Customers have asked for this kind of information to support a condition based maintenance strategy for the power converter. Figure [4] shows the fault reporting pane.

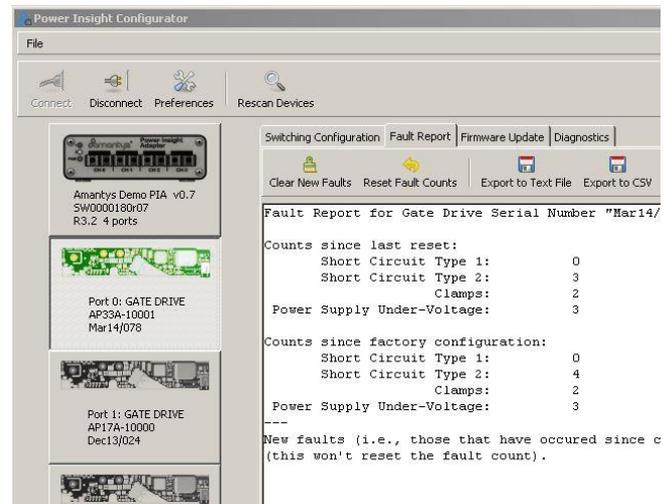


Figure [4] – Fault Report Pane

The Power Insight Configurator can export the fault report to a comma separated variable (CSV) file or Excel file for inclusion into maintenance or test reports at a later date.

The Measurement Pane

Amantys gate drives have on board measurement circuits that can be used to track the performance of the gate drive in operation. The measurements can be streamed from the gate drive using the Power Insight Configurator or stored on the SD card contained in the Power Insight Adapter.

Typically the measurements can be used to aid in the diagnosis of problems encountered in the power stack commissioning or to look at the long term effects of running the gate drive in the power stack.

The measurements that can be taken are shown below in Figure[5].

Measurement	Function
3V Reference	3V rail reference
Board Temperature	Temperature on NTC mounted on gate drive
Gate Turn off time	
Gate Turn on time	
PWM High Time	
PWM Low Time	
Supply Voltage	Input supply voltage
Vce turn off time	
Vce turn on time	
Vce(off)	Voltage across IGBT when off
Vce(on)	Saturation voltage of the IGBT
Vge(off)	Gate voltage when IGBT off
Vge(on)	Gate voltage when IGBT on

Figure [5] – Measured Values on Gate Drive

Diagnostics and Firmware Update

Amantys gate drives are fully configurable over the PWM fibre. This can be done in situ without removing the gate drive from the power stack.

From time to time it may be necessary to update the PLD code or the software on the gate drive. For example, to add new features. Using the Power Insight Configurator and the Power Insight Adapter the PLD code and the software on the gate drive can be updated without removing the gate drive from the power stack.

Amantys has included a Diagnostic Pane in the Power Insight Configurator that can be used to quickly take a snapshot of the PLD code, software revisions and configuration of the gate drive. The information is useful to Amantys when supporting customers. An example of the Diagnostics Pane is shown in Figure [6] below.

The Diagnostics and the Firmware update can all be performed by the customer on site without the need for on site support from Amantys. This greatly accelerates the turn around time for support questions and field updates.

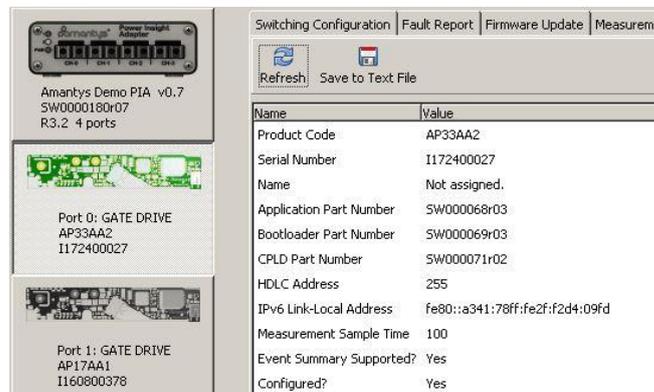


Figure [6] – Diagnostics Pane

The Pulse Generator Pane

The Power Insight Configurator is used to control the pulse generation function of the Power Insight Adapter. Clicking on the Power Insight Adapter button will show the pulse generator pane. Each gate drive channel attached to the Power Insight Adapter is shown with up to five options to generate the pulses on each channel. The options are shown in Figure [5] below:

Pulse Type	Function
Disabled	No pulses will be generated on the gate driver channel
Single Pulse	Single pulse only
Double Pulse	Double pulse only
Double Pulse (Master)	Double pulse with synchronised single pulse (Slave) on another channel
Double Pulse (Slave)	Single pulse synchronised to the first falling edge of the double pulse (Master)

Figure [7] - Pulse Generator Options

Entering the offset and period values in μs will set up the test pulses on the Power Insight Configurator pulse generator pane. An example is shown below in Figure [7].

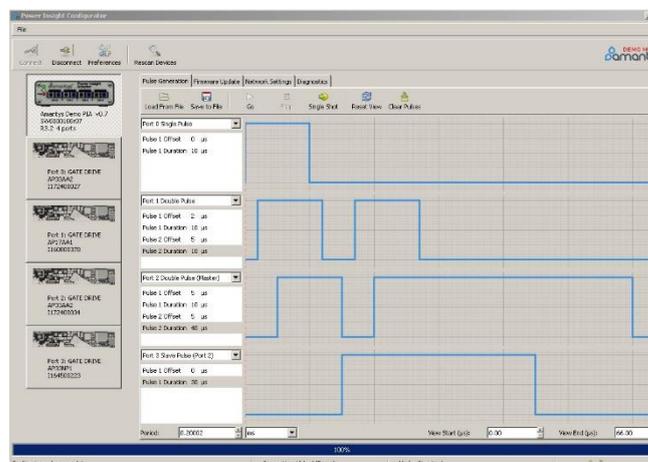


Figure [8] - Pulse Generator Pane

The Double Pulse Master / Slave configuration allows the user to vary the current in an inductor by changing

the width of the first pulse in the double pulse whilst keeping the rest of the double pulse and a single pulse on a second channel synchronised. This is useful for quickly making tests at different current levels.

The user also has the option to generate the pulses as a single shot or by pressing the “go” button to generate the pulses at a period specified by the user in the Period parameter.

Pulse configurations can be saved to a file as <filename>.pul and reloaded at a later date to avoid the need to set up the required pulses again.

Integration with other Software Tools

The Power Insight Adapter supports the use of the Standard Commands for Programmable Instrumentation (SCPI) interface language allowing the Power Insight Adapter to be controlled from another programme such as LabView or MATLAB.

Conclusion

The Power Insight Configurator tool when used with the Power Insight Adapter and Amantys gate drivers provides the user a quick and efficient way to test the converter power stack without building additional test equipment. The capability of the Power Insight Configurator to allow the user to modify gate drive configuration parameters without the need to touch the converter power stack makes the testing of the converter power stack safer, simpler, less prone to error and faster.

During operation in the field the Power Insight Configurator contributes to the information available to the maintenance engineer by providing the fault counters for off line analysis of the health of the power converter.