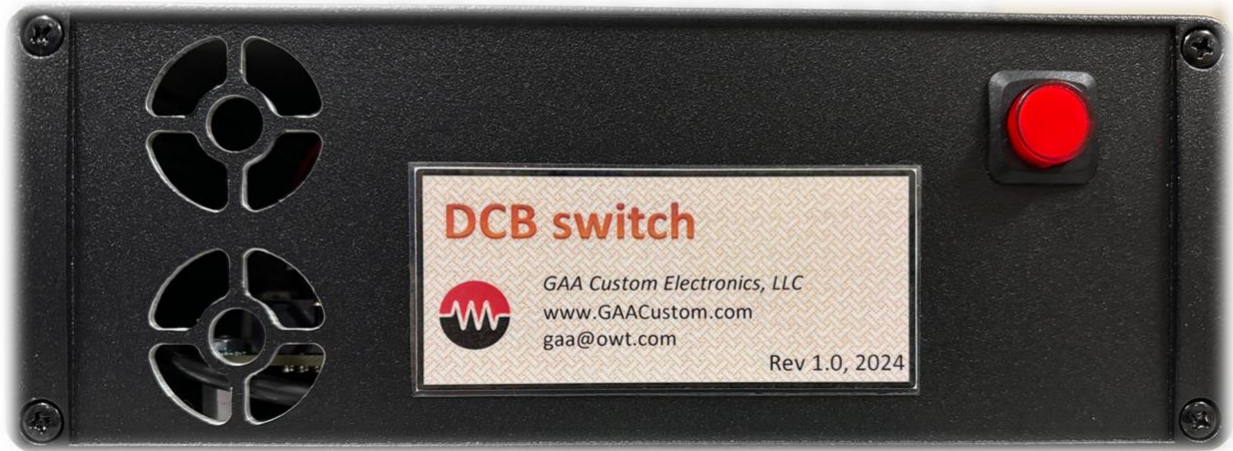


DCB Switch

DCB Switch System

Operations Manual
Rev 1.1, October 3, 2024



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WARNING
TO REDUCE THE RISK OF FIRE OR
ELECTRICAL SHOCK DO NOT EXPOSE THIS
EQUIPMENT TO RAIN OR MOSITURE.

WARNING

- Only qualified electrical workers should operate and install this system.
- Avoid spilling liquids onto/into the unit.
- Do not expose to excessive heat or moisture.
- Do not open – there are no user serviceable parts inside.
- Do not operate in an explosive environment.

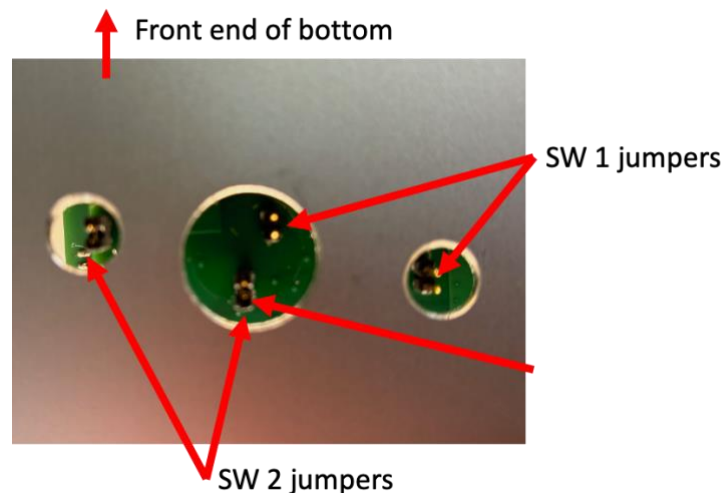
The DCB switch module contains 4 channels of +/- 250V DC bias voltage generation that are independently programmable and include output readbacks to allow you to monitor the actual voltage as well as providing system monitoring capability. These DC bias channels are labeled 1 thru 4.

The DCB switch module can be installed in a MIPS system or used in a standalone controller. This document covers both configurations. Up to two modules can be installed in a MIPS system. In both options the DCB switch module operation is controlled using the USB interface, or the Ethernet option can be used when the module is installed in a MIPS system.

The DCB switch module contains 2 high speed FET switches. Switch 1's output is switched between DC bias channel 1 and 2 while switch 2's output is switched between DC bias channels 3 and 4. Jumpers are provided to disconnect the fast FET switches from the DC bias supply outputs. The documentation that came with your system will define the state of these jumpers, you can change the jumper positions as described later in this document. The switching performance of the DC bias channel is improved if these jumpers are removed, this is due to RC filters in the FET switches.

Jumper access on the standalone system:

On the bottom of the DCB switch are three hole plugs, if you removed these plugs you can gain access to the jumpers as shown below. Your system was shipped with the jumpers removed for SW 1 and installed for SW 2. The switch performance of the DC bias channels is improved if these jumpers are removed, this is due to RC filters in the FET switches.



Jumper access on MIPS system:

When the DCB switch module is installed in a MIPS system you will need to remove the MIPS chassis cover to gain access to the module. Please refer to the MetCaseRemoval.pdf document that describes the procedure for cover removal. With the cover removed you will need to locate the DCB switch module and locate the jumpers. The DCB switch module will always be located on the top of a board stack unless your system has more than one DCB switch module installed. Please refer to the documentation that came with your system for

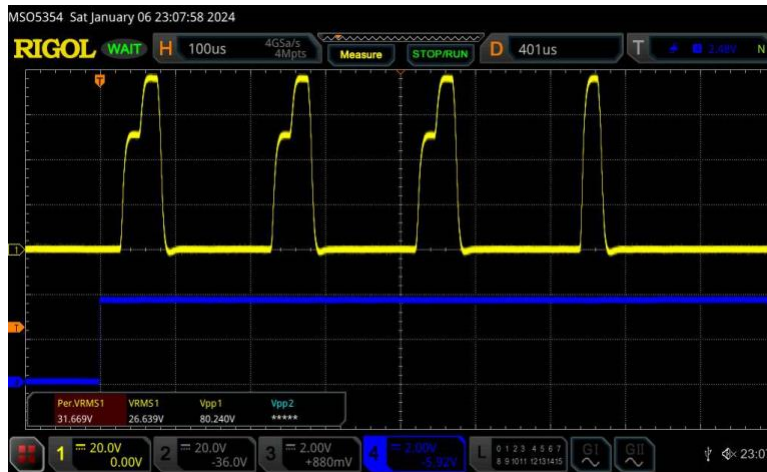
- A skip counter allows the pulse generator to skip or ignore a defined number of trigger signals before starting the pulse generation cycle. Setting the skip counter to 1 will cause the pulse generator to ignore the first trigger and start on the second.
- The delay parameter allows the pulse to be generated after a user defined delay in uS.
- The width parameter defines the width in uS of the output pulse.
- The pulse generator can generate multiple output pulses. The Pulse count parameter allows the user to define the number of pulses to generate and the period value is the time in uS between the series of pulses that will be generated.
- The pulse generator can be configured to re enable itself after a cycle has completed.
- The pulse generator has a number of output options:
 - o A user defined digital output pulse can be generated.
 - o The High-speed FET switch can be control by the pulse generator.
 - o A DC bias output channel can be switched from its current value to a user defined pulse voltage.

When a pulse generator is enabled and controlling one of the DC bias channels (1 thru 4) then the DC bias channel updates and readbacks are disabled. This is done to make sure there is no interference between the logic control the DC bias level and the pulse generators operation. When using the fast FET switches and digital output signals the DC bias channel updates and readbacks will remain enabled.

The pulse generators are independent and both channels can be enabled. It is possible to trigger both pulse generator channels from the same trigger and control the same output channels. This allows generation of pulse sequences with multiple output states. Below are a few examples of pulse sequences that can be generated using both output channels:



Simple pulse sequence using one pulse generator. Blue trace is trigger, yellow is DC bias CH1.



This pulse sequence was generated using both pulse generators, both generators are triggered using the same input and control the same DC bias output channel. This illustrates how both generators can be used to create multi-state output signals. Blue trace is trigger and yellow is DC bias channel 1.



This example used the FET fast switch to generate the yellow waveform. The light blue trace is a digital output signal generated in sync with the FET fast switch output. The blue trace is the trigger signal.

Specifications

Physical:

- Size, 7.5" width, 9.5" depth, 2.75" height
- Weight, 4 pounds including power supply and cables

DC bias voltage outputs:

- 4 channels
- +/-250V range
- +/-5mA output current
- 8uS rise and fall times
- 0.125V output voltage resolution
- 0.5% accuracy

FET switch performance

- 20nS rise and fall times

Pulse generation

- 7uS minimum delay
- 7uS minimum pulse width
- 10uS minimum period

Rear Panel Connections

The DCB switch module is available in a standalone system or installed in a MIPS system. This section defines the rear panel connections for both configurations. When the DCB switch module is installed in a MIPS system the signal names are the same as the signal names used in the MIPS system. The rear panel connections highlight the DCB switch signals and warns the user about the duplicate names. Additionally, the MIPS control panel design has all the DCB switch control located in tabs that are specific to the DCB switch module. When the DCB switch module is installed in a MIPS system you can use MIPS DIO signal to trigger the DCB switch and use MIPS DC bias channels as float input to the DCB switch. This would be done by making the appropriate connections on the rear panel.

Standalone rear panel:



MIPS DCB switch rear panel connections:



Power Input

24VDC power input. The center pin is positive. Only use the 24VDC power supply provided with your system. In the MIPS case use the 24VDC supply that came with your MIPS system.

Ground

This is the chassis ground lug. This should be connected to ground on your system. This should be the first connection you make before using the system. Never operate the system without this ground connection.

USB

This is the USB host interface signal used to control the DCB switch system. Your system includes a USB micro to A connector to connect to your host computer.

Digital Outputs, A thru D

A thru D are digital output signals that can be controlled by host commands and the pulse sequence generators. These are 0-to-5-volt TTL level signals. Only A and B are available on BNC connector on the MIPS system.

Digital Inputs, Q thru T

Q thru T are digital input signals that can be read by host commands and can be used to arm and trigger the pulse generators. These are 0-to-5-volt TTL level signals. Only Q and R are available on BNC connector on the MIPS system.

SW 1, SW 2

These are the fast FET switch outputs. SW 1 will switch between DC bias channels 1 and 2 while SW 2 will switch between channels 3 and 4. These switches can be controlled by the pulse sequence generators or external input control signals.

DC Bias Channels, 1 thru 4

These are the four independent DC bias output channels. Each channel can be set between -250V to 250V. These channels can be controlled using commands sent over the host USB interface or controlled via the pulse generators.

Float

The DC bias outputs and the fast FET switch outputs are isolated from ground. This input allows you to apply a float voltage to offset all the outputs. This float voltage should be limited to +/-250V. Your system was shipped with a BNC shorting cap installed on this float input to reference all the outputs to ground.

DCB Switch IO

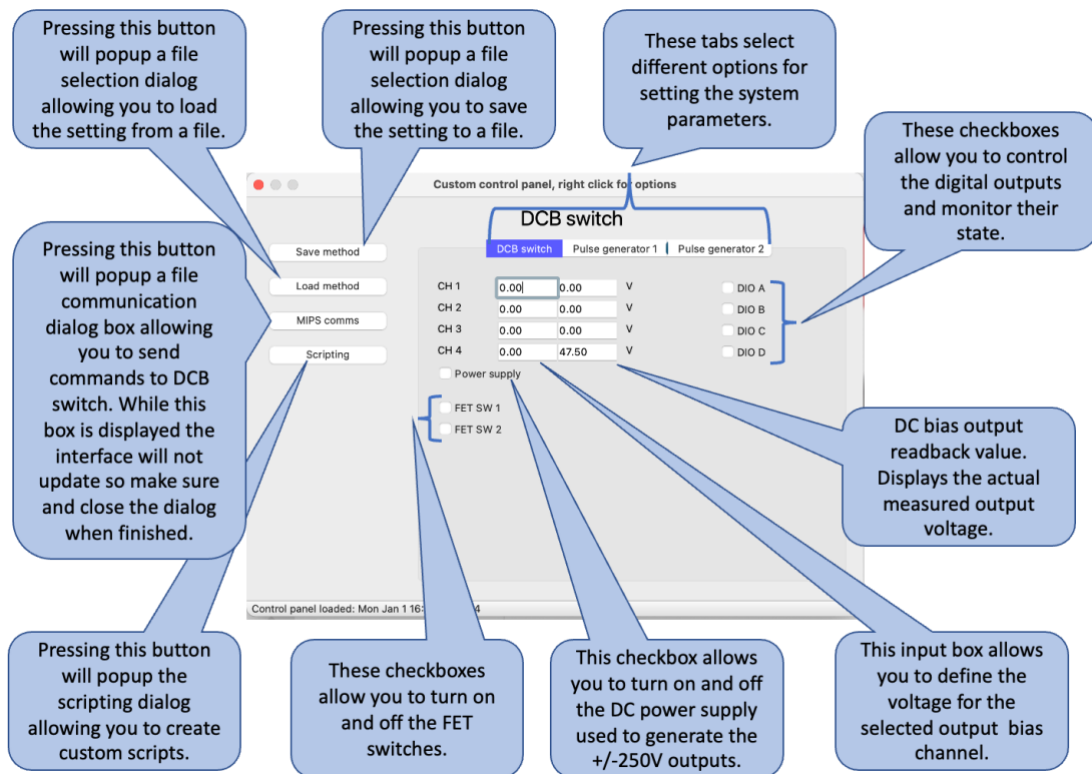
This D15 female connector is only available on the MIPS rear panel. This connector makes all the DIO signals available. Please note these are unbuffered 0 to 3.3V logic level signals.

D15 pin number	Function
1	DIO A
2	DIO B
3	DIO C
4	DIO D
5	DIO Q
6	DIO R
7	DIO S
8	DIO T
9-15	Ground

MIPS App Interface

Your system includes thumb drive that contains all the documentation files and the host application as well as a control panel file we developed for using your system. To install the host application just copy the MIPS folder and all its contents to the C drive on your PC, open the MIPS folder and double click on the MIPS application. Make sure the DCB switch system is powered up and attach the USB cables to your PC, you can then press the “Find MIPS and connect” button, the application will then connect to your systems. You can load the control panel using the tools->Load configuration... menu option and select the configuration file found on the thumb drive. You can automate this loading process using the properties dialog under the Help menu option. We can help setup the software and show you how to use its capability, just call or email and setup a time.

The pictures below show the control panel interface and describes the parameters you can control on the DCB switch system, the three tab sections will be identical if you have a standalone system or if the DCB switch is installed in a MIPS system, Your control panel will have additional controls if the DCB switch module is part of a MIPS system:



The image shows a control panel for a pulse generator with the following settings and callouts:

- Enable:** A checkbox that is currently unchecked. Callout: "Enables the pulse generator. Set all parameters while disabled."
- Re-trigger:** A checkbox that is currently unchecked. Callout: "Check this box to enable re-triggering of the pulse generator."
- Arm and trigger options:**
 - Arm input:** Set to 'Q'. Callout: "Select the input to arm the pulse generator and the active edge of the signal. Select 0 to disable"
 - Trig input:** Set to 'R'. Callout: "Select the trigger input and active edge. This trigger will start the pulse generator. Select 0 to disable."
 - Arm level:** Set to 'RISIN'. Callout: "Trigger input skip count. Defines the number of trigger signals to skip before starting the pulse sequence."
 - Trig level:** Set to 'RISIN'. Callout: "Delay in uS from the trigger to the start of the pulse."
 - Skip:** Set to '0'. Callout: "Pulse width in uS."
- Pulse timing parameters:**
 - Delay:** Set to '5' uS. Callout: "Delay in uS from the trigger to the start of the pulse."
 - Width:** Set to '15' uS. Callout: "Pulse width in uS."
 - Number:** Set to '3'. Callout: "Number of output pulses to generate when triggered."
 - Period:** Set to '100' uS. Callout: "Pulse sequence pulse period when generating multiple output pulses."
- Pulse output options:**
 - Trig out:** Set to 'A'. Callout: "Pulse digital output, 0 to disable."
 - FET SW:** Set to '0'. Callout: "FET switch control by the pulse generator. Select 0 to disable."
 - DCBS CH:** Set to '2'. Callout: "DC bias channel controlled by the pulse generator. Select 0 to disable."
 - Pulse V:** Set to '120.00' V. Callout: "Output pulse voltage when DC bias channel is defined."

Host Computer Interface:

All commands are ASCII text.

All commands sent to the DCB switch are terminated with a carriage return (CR) or line feed (LF) character.

All messages sent from the DCB switch are terminated with a CR and LF.

After a command is received (after the CR or LF is received) DCB switch will respond with an ASCII ACK (0x06) then a CR or an ASCII NAK (0x15) then a “?” character and a finally a CR. A NAK indicates the command or its arguments was not understood.

When a NAK is sent the “?” character is sent to inform users communicating with a terminal emulator that the command was not understood.

The DCB switch module has a USB interface and connector on the PC board. This is the USB interface used in the DCB switch standalone system. When this module is installed in a MIPS system then the communications is from the MIPS system to the DCB switch module uses its TWI interface. In this case the MIPS command set used to communicate to the DCB switch mode has some changes. Below you will find both sets of commands.

Standalone DCB switch commands:

General Commands

GVER

Returns the current version string.

SNAME

This command will set the DCBswitch system name. The Name value is a user defined string. Make sure you issue a Save command to save the changes to flash memory or this name will be lost when power is cycled.

GNAME

Returns a string that contains the name of the DCBswitch system.

SAVE

This command will save the DCBswitch system parameters to the flash memory.

RESTORE

This command will read the current settings from the flash memory.

DCB Switch Commands

SDCBS,channel,value

GDCBS,channel

These commands will set (SDCBS) or return (GDCBS) the selected channel's DC voltage setpoint. The setpoint is the desired output voltage in volts, the range is -250 to 250 volts. The valid range for channel is 1 thru 4.

GDCBSV,channel

This command will return the actual measured output voltage for the selected DC output channel. The valid range for channel is 1 thru 4.

SDCPWR,ON|OFF

GDCPWR

These commands will turn ON or OFF (SDCPWR) the power supply used to power all 4 DC output channels. The GDCPWR will return the current status of the power supply.

SDIO,channel,value

This command will set the selected digital output channel's value to 0 or 1. The valid range for channel is A thru D.

GDIO,channel

This command will return the selected digital channel's value to 0 or 1. The valid range for channel is A thru D (output channels) or Q thru S (input channels).

SSW,channel,value

GSW,channel

These commands will set the selected FET switch state (SSW) or return the current switch state (GSW). Channel range is 1 or 2 to select FET switch 1 or 2, value is 0 for off or 1 for on.

PSW,channel,value

This command will generate a pulse on the selected FET switch channel. Channel is 1 or 2 to select FET switch 1 or 2 and value is the pulse width in uS. If the FET switch channel is off then a positive going pulse is generated and if it is on a negative going pulse is generated.

STRGSW,fet,value

GTRGSW,fet

This command allows you to assign an input DIO channel that will control the defined FET switch output. The FET switch output will follow the state of the defined DIO channel. The parameter fet defines the FET switch channel, 1 or 2. The value parameter defines the DIO input channel, 0,Q,R,T, or S. 0 will disable this feature.

SRBTST,TRUE|FALSE

GRBTST

These commands will set the readback voltage testing (SRBTST) procedure or return the current state (GRBTST). If TRUE then readback testing is enabled and the power supply will automatically shut off if an error is detected.

CALCH,channel

This command is used in the factory to calibrate the DC bias output channels. To use this command the power supply must be enabled and you will need a voltage meter to measure voltage outputs. Channel (1 thru 4) defines the channel you wish to calibrate. You will be asked to measure two voltages and the system will then calculate calibration coefficients.

Pulse Generator Commands

The following commands support the pulse generator feature. The system has two pulse generators and all of the following command have a channel argument, the value is 1 or 2 to select pulse generator 1 or 2. The follow commands are in pairs, the command starting with an S sets the parameter and the command starting with a G returns the current value.

SPGENA,channel,TRUE|FALSE

GPGENA,channel

These commands allow you to enable or disable a pulse generator channel. Note; all pulse generator parameters should be set before you enable a channel. The pulse generator setting should all be defined before enabling. TRUE enables a pulse generator channel.

Note, this enable state is automatically set to FALSE after e pulse generation sequence completes.

SPGRET,channel,TRUE|FALSE

GPGRET,channel

These commands allow you to enable the pulse generator re-trigger option. If re-trigger is enabled (TRUE) then the pulse generator will restart after it completes a pulse generator cycle.

SGPARMT,channel,value

GPGARMT,channel

These commands allow you to monitor and define an arm input for the pulse generator. If defined the pulse generator will wait for an arm signal before it starts accepting trigger signals. Valid range for value is 0,Q,R,S, or T. 0 will disable the arm feature while Q thru T select the arm input digital channel.

SPGARML,channel,value

GPGARML,channel

These commands allow you to monitor and define an arm input trigger level. You can define the active trigger edge, valid value range is FALLING, RISING, or CHANGE.

SPGTRG,channel

GPGTRG,channel

These commands allow you to monitor and define a trigger input for the pulse generator. If defined the pulse generator will wait for a trigger signal before it starts the pulse generation process. Valid range for value is 0,Q,R,S, or T. 0 will disable the trigger input while Q thru T select the trigger input digital channel.

SPGTRGL,channel

GPGTRGL,channel

These commands allow you to monitor and define a trigger input active level. You can define the active trigger edge, valid value range is FALLING, RISING, or CHANGE.

SPGSKIP,channel,value

GPGSKIP,channel

These commands allow you to monitor or define a trigger skip count. If value is greater than zero then the pulse generator will skip the number of triggers defined by value.

SPGDLY,channel,value

GPGDLY,channel

These commands allow you to monitor or define the delay, in uS, from the pulse generator trigger signal to the output pulse generation.

SPGWIDTH,channel,value

GPGWIDTH,channel

These commands allow you to monitor or define the pulse generator output pulse width in uS.

SPGTRGO,channel,value

GPGTRGO,channel

These commands allow you to monitor or define a digital output for the pulse signal. Value defines the output channel you wish to use, valid range is 0,A,B,C, or D. 0 will disable this option and if set to 0 no digital output will be used by the pulse generator.

SPGTRGF,channel,value

GPGTRGF,channel

These commands allow you to monitor or define a FET switch channel to be controlled by the pulse generator. Value defines the FET switch channel you wish to control, value range is 0,1, or 2. 0 will disable this feature.

SPGOUTCH,channel,value

GPGOUTCH,channel

These commands allow you to monitor or define a DC bias channel to be controlled by the pulse generator. Value defines the DC bias channel you wish to control, value range is 0,1,2,3, or 4. 0 will disable this feature.

SPGPV,channel,value

GPGPV,channel

These commands allow you to monitor or define the pulse voltage for the DC bias channel controlled by the pulse generator. Value defines the active pulse voltage; valid range is -250 to 250. The output channel will pulse from its current default value to this pulse voltage and then back to its default value.

SPGNUM,channel,value

GPGNUM,channel

These commands allow you to monitor or define the number of pulses that will be generated each time the pulse generator is triggered.

SPGPER,channel,value

GPGPER,channel

These commands allow you to monitor or define the pulse period in uS. This period defines the time between pulses when the number of pulses is greater than 1.

MIPS DCB switch commands:

DCB Switch Commands

SDCBEE,module,TRUE|FALSE

This command allows you to disable the MIPS system access to the EEPROM emulation that is located on the DCB switch module. This command is used in the factory for initial system testing and setup, the user should never need to use this feature.

SDCBS,channel,value

GDCBS,channel

These commands will set (SDCBS) or return (GDCBS) the selected channel's DC voltage setpoint. The setpoint is the desired output voltage in volts, the range is -250 to 250 volts. The valid range for channel is 1 thru 4 if one DCB switch module is installed or 1 thru 8 if two are installed.

GDCBSV,channel

This command will return the actual measured output voltage for the selected DC output channel. The valid range for channel is 1 thru 4 if one DCB switch module is installed or 1 thru 8 if two are installed.

SDCPWR,module,ON|OFF

GDCPWR,module

These commands will turn ON or OFF (SDCPWR) the power supply used to power all DC output channels for the select module, 1 or 2. The GDCPWR will return the current status of the power supply.

SDCBSIO,module,channel,value

This command will set the selected digital output channel's value to 0 or 1 for the selected DCB switch module 1 or 2. The valid range for channel is A thru D.

GDCBSIO,module,channel

This command will return the selected digital channel's value to 0 or 1 for the selected DCB switch module 1 or 2. The valid range for channel is A thru D (output channels) or Q thru S (input channels).

SDCBSSW,channel,value

GDCBSSW,channel

These commands will set the selected FET switch state (SDCBSSW) or return the current switch state (GDCBSSW). The channel parameter selects the FET channel you wish to change, channel range is 1 or 2 if one module is installed or 1 to 4 if two modules are installed. The value parameter is 0 for off or 1 for on.

PDCBSSW,channel,value

This command will generate a pulse on the selected FET switch channel. The channel parameter selects the FET channel you wish to change, channel range is 1 or 2 if one module is installed or 1 to 4 if two modules are installed. The value parameter is the pulse width in uS. If the FET switch channel is off then a positive going pulse is generated and if it is on a negative going pulse is generated.

SDCBSTRGSW,fet,value

GDCBSTRGSW,fet

This command allows you to assign an input DIO channel that will control the defined FET switch output. The FET switch output will follow the state of the defined DIO channel. The parameter fet defines the FET switch channel, 1 or 2 if one DCB switch module is installed, 1 thru 4 if two modules are installed. The value parameter defines the DIO input channel, 0,Q,R,T, or S. 0 will disable this feature. Note the selected DIO channel must be on the referenced module, i.e. with two modules channel

3 and 4 reference the second DCB switch module and must use its DIO channels.

SDCBSRBTST,module,TRUE|FALSE

GDCBSRBTST,module

These commands will set the readback voltage testing (SDCBSRBTST) procedure or return the current state (GDCBSRBTST). The module parameter selects the DCB switch module, 1 or 2. If TRUE then readback testing is enabled and the power supply will automatically shut off if an error is detected.

Pulse Generator Commands

The following commands support the pulse generator feature. Each DCB switch module has two pulse generators, and all the following command have a channel argument, the value is 1 or 2 if one DCB switch module is installed or 1 to 4 if two modules are installed. The follow commands are in pairs, the command starting with an S sets the parameter and the command starting with a G returns the current value.

SPGENA,channel,TRUE|FALSE

GPGENA,channel

These commands allow you to enable or disable a pulse generator channel. Note; all pulse generator parameters should be set before you enable a channel. The pulse generator setting should all be defined before enabling. TRUE enables a pulse generator channel.

Note, this enable state is automatically set to FALSE after a pulse generation sequence completes.

SPGRET,channel,TRUE|FALSE

GPGRET,channel

These commands allow you to enable the pulse generator re-trigger option. If re-trigger is enabled (TRUE) then the pulse generator will restart after it completes a pulse generator cycle.

SGPARMT,channel,value

GPGARMT,channel

These commands allow you to monitor and define an arm input for the pulse generator. If defined the pulse generator will wait for an arm signal before it starts accepting trigger signals. Valid range for value are 0,Q,R,S, or T. 0 will disable the arm feature while Q thru T select the arm input digital channel. Note the selected DIO channel must be on the referenced module, i.e. with two modules channel 3 and 4 reference the second DCB switch module.

SPGARML,channel,value

GPGARML,channel

These commands allow you to monitor and define an arm input trigger level. You can define the active trigger edge, valid value range is FALLING, RISING, or CHANGE.

SPGTRG,channel

GPGTRG,channel

These commands allow you to monitor and define a trigger input for the pulse generator. If defined the pulse generator will wait for a trigger signal before it starts the pulse generation process. Valid range for value is 0,Q,R,S, or T. 0 will disable the trigger input while Q thru T select the trigger input digital channel. Note the selected DIO channel must be on the referenced module, i.e. with two modules channel 3 and 4 reference the second DCB switch module.

SPGTRGL,channel

GPGTRGL,channel

These commands allow you to monitor and define a trigger input active level. You can define the active trigger edge, valid value range is FALLING, RISING, or CHANGE.

SPGSKIP,channel,value

GPGSKIP,channel

These commands allow you to monitor or define a trigger skip count. If value is greater than zero then the pulse generator will skip the number of triggers defined by value.

SPGDLY,channel,value

GPGDLY,channel

These commands allow you to monitor or define the delay, in uS, from the pulse generator trigger signal to the output pulse generation.

SPGWDTH,channel,value

GPGWDTH,channel

These commands allow you to monitor or define the pulse generator output pulse width in uS.

SPGTRGO,channel,value

GPGTRGO,channel

These commands allow you to monitor or define a digital output for the pulse signal. Value defines the output channel you wish to use, valid range is 0,A,B,C, or D. 0 will disable this option and if set to 0 no digital output will be used by the pulse generator. Note the selected DIO channel must be on the referenced module, i.e. with two modules channel 3 and 4 reference the second DCB switch module.

SPGTRGF,channel,value

GPGTRGF,channel

These commands allow you to monitor or define a FET switch channel to be controlled by the pulse generator. Value defines the FET switch channel you wish to control, value range is 0,1 or 2 for DCB switch module 1 and 0,3 or 4 for module 2. 0 will disable this feature.

SPGOUTCH,channel,value

GPGOUTCH,channel

These commands allow you to monitor or define a DC bias channel to be controlled by the pulse generator. Value defines the DC bias channel you wish to control, value range is 0,1,2,3, or 4 for DCB switch module 1 or 0,5,6,7, or 8 for module 2. 0 will disable this feature.

SPGPV,channel,value

GPGPV,channel

These commands allow you to monitor or define the pulse voltage for the DC bias channel controlled by the pulse generator. Value defines the active pulse voltage; valid range is -250 to 250. The output channel will pulse from its current default value to this pulse voltage and then back to its default value.

SPGNUM,channel,value

GPGNUM,channel

These commands allow you to monitor or define the number of pulses that will be generated each time the pulse generator is triggered.

SPGPER,channel,value

GPGPER,channel

These commands allow you to monitor or define the pulse period in uS. This period defines the time between pulses when the number of pulses is greater than 1.

Warranty

GAA Custom Electronics, LLC warrants the MIPS system to be free from defects in materials and workmanship and will repair or replace the unit for a period of one year. This warranty assumes the system is operated in compliance with the procedures and recommendation outlines in this document. GAA Custom Electronics, LLC will also provide free phone support and firmware bug fixes for up to one year. The addition of new features is not covered in this warranty.

Liability

The liability of GAA Custom Electronics, LLC hereunder or otherwise is solely and exclusively limited to replacement, repair or credit at the purchase price, as GAA Custom Electronics, LLC may elect, for any product which is returned by Buyer during the applicable warranty period, or services for which timely notice of defect has been given by Buyer, and which are found by GAA Custom Electronics, LLC to be subject to adjustment under this warranty. IN NO EVENT SHALL GAA Custom Electronics, LLC BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSS OF ANTICIPATED PROFIT OR OTHER ECONOMIC LOSS OR FOR ANY DAMAGES ARISING IN TORT WHETHER BY REASON OF STRICT LIABILITY, NEGLIGENCE OR OTHERWISE.