CONTROL SIGNALS IN POWER SUPPLIES

INTRODUCTION

The CoolX series of power supplies use control signals to regulate on-board functions such as module voltage and enable/disable functions. These control signals can be sent via PMBus or by applying an analog signal to the relevant connector pins. Global signals can adjust all CoolX modules simultaneously and power pack functions such as fan speed and temperature can be monitored via PMBus on some CoolX models. Each CoolX power pack has a detailed desgners manual on the Advanced Energy website which details connector specifics including locations and part numbers as well as in-depth instructions for use. See 'https://www.advancedenergy.com/products/low-voltage-power-supplies/' for more details.

PMBUS

The Power Management Bus (PMBus) is an open standard which defines a means of communication for power conversion devices. It defines a full set of commands and data structures required by power control and management devices. The CoolX Series PMBus interface facilitates the communication of operating parameters such as output voltage, output current and internal temperature with other PMBus enabled devices. It also facilitates the remote adjustment of parameters such as output voltage level, current limit and enable status. Each CoolX power pack is equipped with a series of signal connectors which are numbered and explained in greater detail in both the product designers manual and PMBus manual.

PMBUs is a variant of SMBus (System Management Bus) which has been developed specifically for power supply management. Both PMBus and SMBus are two wire I2C based protocols. As a result many similarities exist between PMBus and I2C. A Clock, Data and Common pin are used for transmitting and receiving PMBUs data. These pins are available on the 'Global' header at the power pack output of each CoolX power supply. Location and numbering can vary between models.

PMBus control signals can be sent via custom software or via the CoolX PMBus GUI. A Pic MCP2221 is used to convert UART serial data to I2C when using a GUI . The CoolX PMBUs GUI is available from advanced energy on request and allows monitoring and control of CoolX power packs and modules on a Windows computer.

Custom software can be created using C++ or VB.NET GUIs which will allow customers to create their own control and monitoring systems using an off the shelf part. More advanced systems can be created by designing cutom I2C interfaces and embedded systems.

MCP2221 kits are available fron the Microchip website.

www.microchip.com

For information on integrating a GUI in your design contact Advanced Energy.
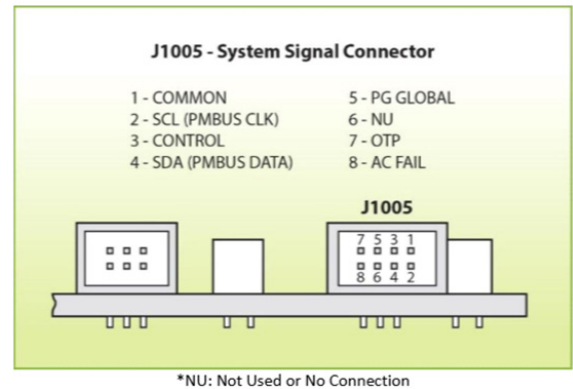

Fig 1. Example CoolX Global Signal Connector

ANALOGUE CONTROL SIGNALS

Modules can be controlled through the use of analog signals applied to onboard connectors situated on individual modules as well as globally via the Global signal connector. Location and numbering of connectors will vary between models.

The following functions are available using analogue control signals and are detailed in the following passage:

Global Enable/Disable
Enable/Disable
Vtrim
Itrim

GLOBAL INHIBIT/ENABLE

All CoolMod outputs may be enabled/inhibited simultaneously by means of an appropriate signal applied between the control and common pin of the global signal connector. Under normal conditions the control pin is pulled to 5V internally (logic high) and all modules are enabled. To disable all modules simply pull the control pin to Common (logic low). For more information see the CoolX designers manual.

ENABLE/INHIBIT

Each CoolMod may be enabled/inhibited by means of a logic level signal applied to the enable input on the relevant Output Signal Connector of the module. This logic level signal should be applied between the Enable pin and common. When there is no connection, the enable pin is HIGH (5V) and the module is enabled. Pulling Enable to Common will disable the module. For more information see the relevant CoolX designers manual.

V TRIM

Voltage can be adjusted using the Vtrim pin of the Output Signal Connector with an external voltage source or resistor. To set output voltage using an external voltage source, a control voltage is applied across the Output Signal Connector pins of the repsective module. Connector location and pin numbering varies between models. See the relevant CoolX designers manual for full details.

The Vtrim voltage required for the users desired output voltage can be calculated using the formula published in the CoolX designers manual found on the Advanced Energy website:

https://www.advancedenergy.com/products/low-voltage-power-supplies/

Similarly the output voltage of the CoolMod can be set by placing a resistor Rtrim across the Output Signal Connector pins Vtrim and Common. The Rtrim resistance required for the users desired output voltage can be calculated using a formula and chart in the CoolX designers manual.

I TRIM

A variety of over current protection methods are possible with CoolX power packs. The default current limit characteristic is Straight Line Current Limit. Simple external application circuits may be used to achieve programmable fold-back current and user programmable reduced current limit levels.

Current Limit can be adjusted using the Itrim pin of the Output Signal Connector with an external voltage source or resistor. To set current limit using an external voltage source, a control voltage is applied across the Output Signal Connector pins of the repsective module. Connector location and pin numbering varies between models. See the relevant CoolX designers manual for full details.

The Itrim voltage required for the users desired current limit can be calculated using the formula published in the CoolX designers manual found on the Advanced Energy website:

https://www.advancedenergy.com/products/low-voltage-power-supplies/

PMBUS CONTROL SIGNALS

The full list of commands currently supported by the CoolX Series PMBus interface follows accompanied by a a brief description:

Control Commands

PAGE
OPERATION
VOUT COMMAND
1 ILIMIT TRIM*
PMBUS STANDBY

Identification Commands

MFR ID
MODULE ID*
MFR MODEL

Some CoolX models do not support all commands. See The PMBus manual for your chosen CoolX model for full details.

Monitoring Commands

VOUT MODE
Returns a byte value which contains the exponent for the selected (paged) module.

READ VOUT
The READ VOUT command is used to return the output voltage measurement of the selected (paged) module.

READ IOUT
The READ IOUT command is used to return the output current measurement of the selected (paged) module.

READ TEMPERATURE 1
The READ TEMP1 command is used to return the temperature measurement of the selected (paged) module in degrees Celsius.

STATUS WORD
To STATUS WORD command is used to check for the presence of fault conditions such as OTP (Over Temperature Protection) and PG (Power Good) fail

READ VIN
The READ VIN command is used to return the input voltage measurement mains input voltage

Control Commands

PAGE
The PAGE command is used to select a particular module or to select the power pack for monitoring or control purposes.

OPERATION
The operation command is used to enable or disable the output of any module.

VOUT COMMAND
The VOUT COMMAND command is used to explicitly set the output voltage of the selected (paged) module to the commanded value.

ILIMIT TRIM
The ILIMIT TRIM command is used to explicitly set the current limit of the selected (paged) module to the commanded value.

PMBUS STANDBY
Changes Global disable behaviour.

Identification Commands

MFR ID
The MFR ID command is used to return a text string which identifies the manufacturer of the system

MODULE ID*
The MFR MODEL command is used to return a text string which identifies the model number/ name of the system

MFR MODEL
The MODULE ID command is used to return a code representing the model type of the selected (paged) CoolMod.

SUMMARY

CoolX power packs and modules offer both analog and digital control and monitoring options. This versatility lends itself to both cutting edge digital system design and integration of existing and long term systems. While Digital control via PMBus offers a wide variety of possible control and monitoring options, tried and tested voltage control is fast and widely adopted. This world leading combination of flexibility and future proof integration makes CoolX the power supply of choice for modern demanding applications requiring complex control.

LINKS

- [Advanced Energy Low Voltage Product Range](#)

REFERENCES

- https://pmbus.org/Specifications/CurrentSpecifications
- https://i2c.info/i2c-bus-specification
- Blum, Jeremy. (2019). The I2C Bus. 10.1002/9781119405320.ch10.
- Wilson, Peter. (2007). Serial Communications. 10.1016/B978-075066845-3/50012-4.

Advanced Energy

For international contact information,
visit advancedenergy.com.

sales.support@aei.com
+1 970 221 0108

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