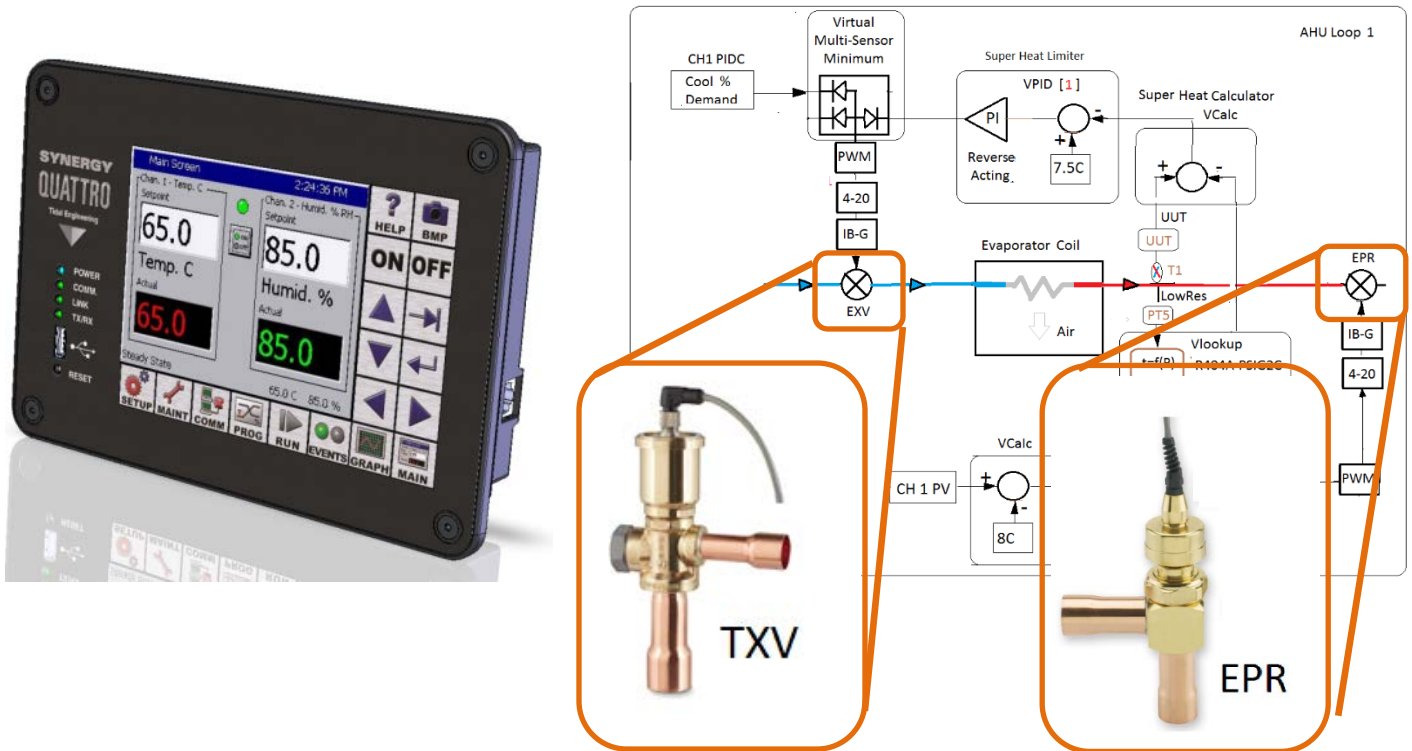


Synergy Electronic Refrigeration Valve Control Features



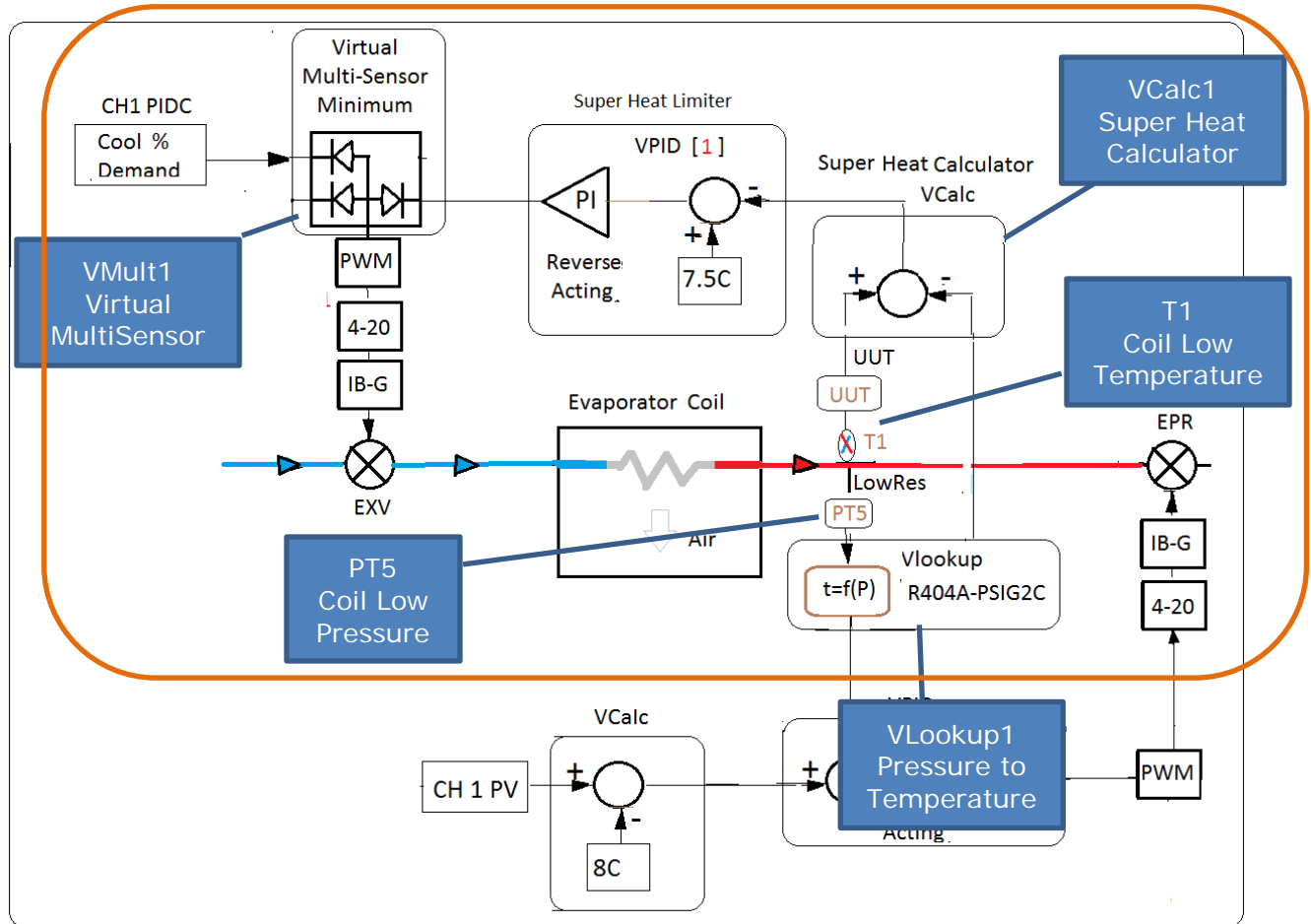
Introduction

Tidal Engineering's Synergy Controller is a family of process control systems designed to drop into virtually any environmental test chamber and provide state-of-the-art usability and operating efficiency.

In the newest software version, the capability to control Electronic Refrigeration Valves; EXV, EPR, and HGB provides unique opportunities to improve test chamber performance as well as efficiency and reliability. This application note describes the implementation of a control system to handle the DX coil of a test chamber using Electronic EXV and EPR Valves. The super heat, load control, pump-down and defrost features are included. In addition, Appendix A includes links to Sporlan Bulletins describing the refrigeration components.

The Synergy Controller features used in this implementation include:

- Six-Channel 4-20 mA Output Boards
- Virtual Lookup Tables, for Saturated Refrigerant Pressure to Temperature Conversion
- Virtual Calculation function used for Super Heat Calculation
- Virtual Multi-Sensor functions for control mode switching
- Virtual PID functions for valve control loops
- Selector Functions for mode switching
- Logic Functions for general control

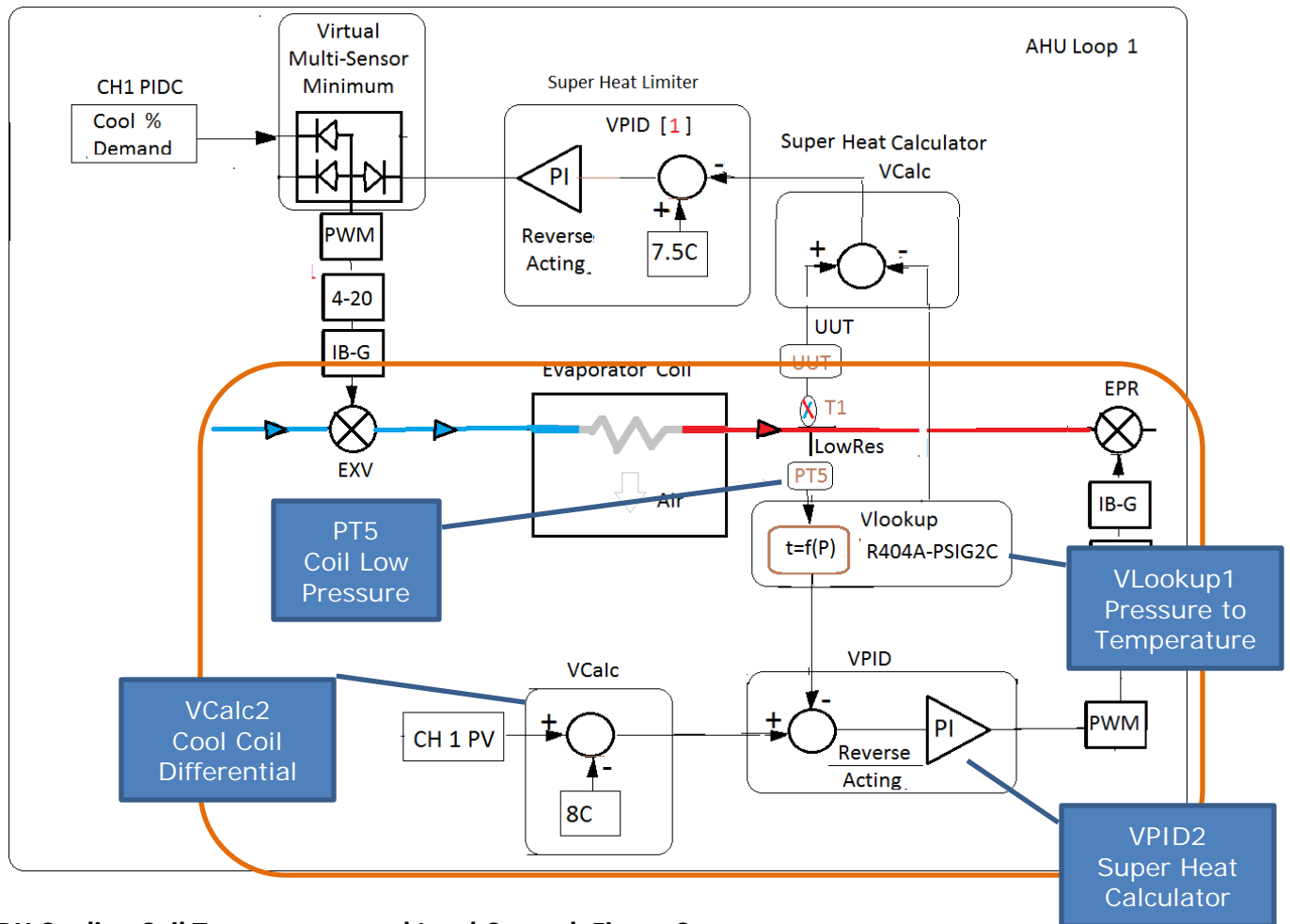


Super Heat and Cooling Throttle Control, Figure 1

- | | |
|---------------|---|
| PT5 | Pressure Transducer, Low Side |
| VLookup1 | Pressure to Temperature [C] Lookup for R404A |
| T1 | Temperature Sensor, Low Side |
| VCalc1 | Superheat Calculator |
| VPID1 | Superheat Control Loop |
| VMultiSensor1 | Virtual MultiSensor outputs the lowest of the input variables |

In Figure 1 above, the Super Heat and Cooling Throttle Control block diagram is highlighted. The control blocks used in this implementation are identified above.

As shown in this diagram, the controller senses the cooling coil low side Pressure (PT5) and converts it to the saturated Temperature for R404A Refrigerant using a lookup table (VLookup1). The controller senses the cooling coil low side temperature (T1) and subtracts the saturated temperature from VLookup1 to calculate the Superheat (VCalc1). The PID Output required to control superheat at 7.5C is calculated (VPID1). The VMult1 selects the lower of the Superheat output from VPID1 (0..100%) and the PID Cool throttle from the main temperature loop (0..100%) and drives the EXV (Electric Expansion Valve) accordingly.

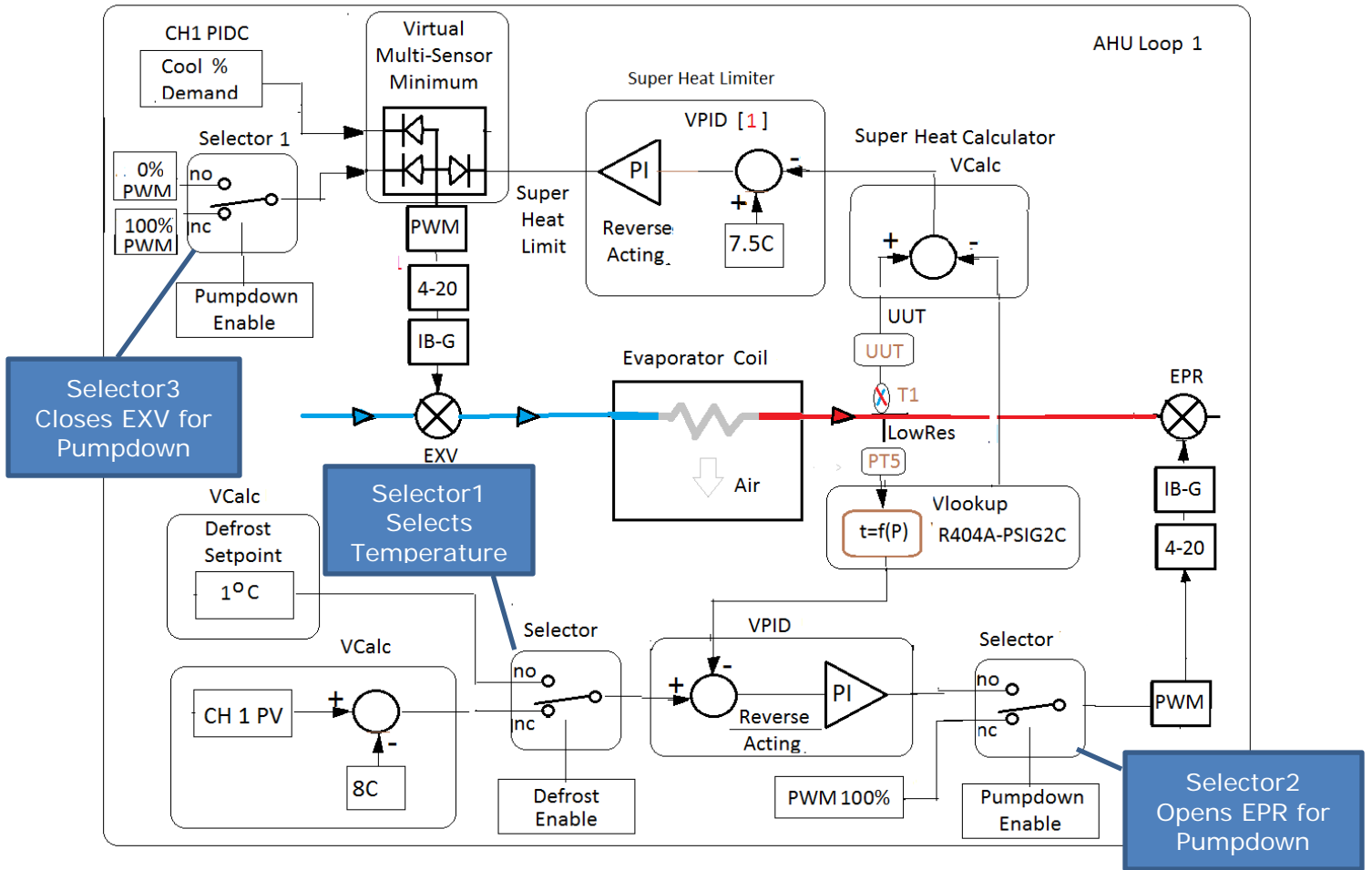


DX Cooling Coil Temperature and Load Control, Figure 2

- PT5 Pressure Transducer, Low Side
- Vlookup1 Pressure to Temperature [C] Lookup for R404A
- VCalc2 Cooling Coil Differential Temperature Load Control
- VPID2 Evaporator Pressure Temperature Control loop

In Figure 2 above, the DX Cooling Coil Temperature and Load Control block diagram is highlighted. The control blocks used in this implementation are identified above.

The controller senses the cooling coil low side Pressure (PT5) and calculates the saturated Temperature for R404A Refrigerant using Vlookup1. The controller calculates the delta-T for the optimal temperature control and compressor load limiting at VCalc 2. The PID control loop (VPID2) drives the Electronic Evaporator Pressure Regulator (EPR) to control the back pressure and coil temperature.



Pump-down and Defrost Features, Figure 3

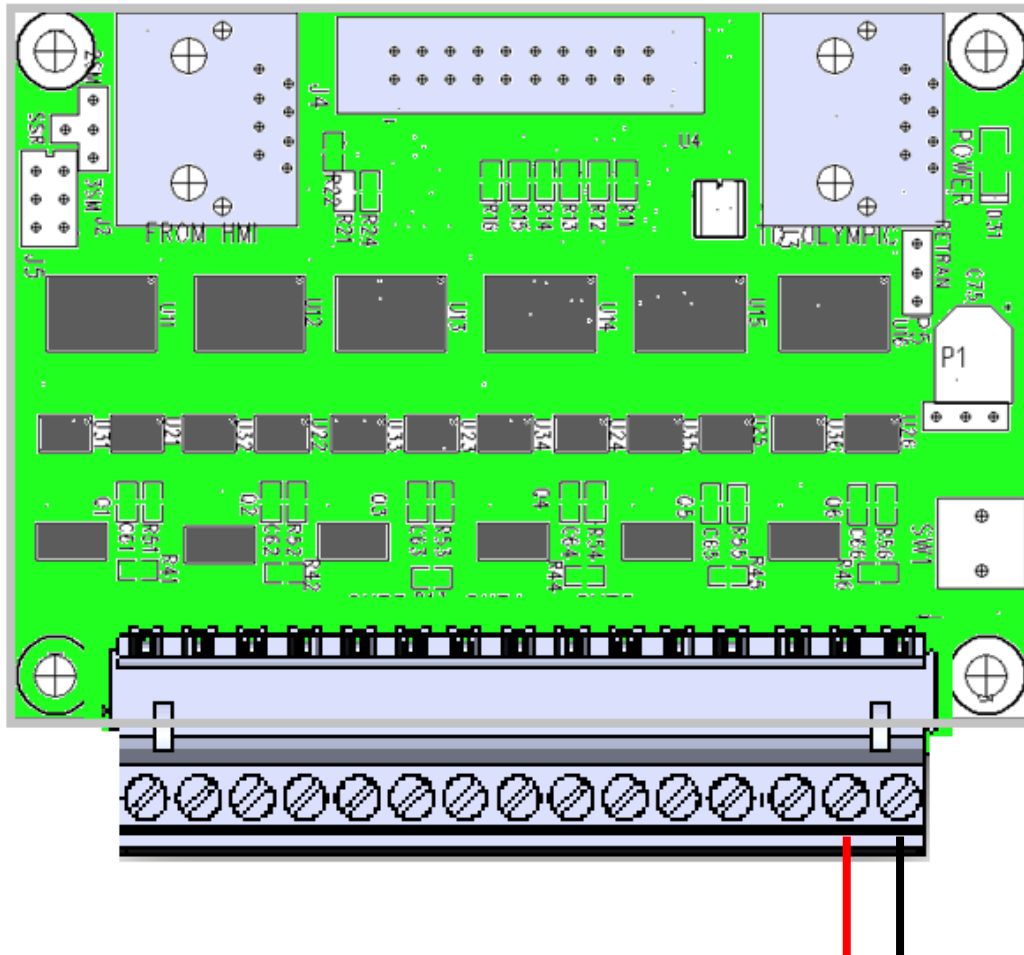
- Selector 1 Coil Temperature Setpoint Mode Selector for Defrost Mode
- Selector 2 Pump-down Control for EPR Valve
- Selector 3 Pump-down Control for EXV Valve

In Figure 3 above, the control blocks for the Pump-down and Defrost modes are identified above.

When Defrost is engaged, Selector 1 sets the evaporator temperature control loop setpoint to 1 Degree C.

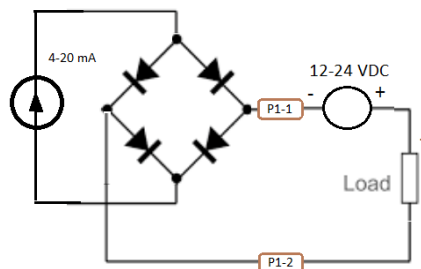
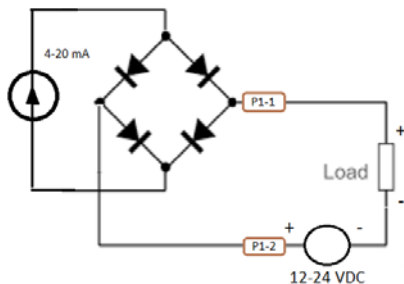
When Pump-down is engaged, the Selector 2 switches the EPR to fully open (100%), and the Selector 3 switches EXV to fully closed (0%).

The TE2420-6, six channel 4..20 mA output board is compatible with Synergy Nano, Nano 2, Synergy Quattro, and Quattro 2 controllers. For systems that require two or fewer 4..20 mA outputs, two single channel signal conditioners can be used to drive Electrical Valves from the controller's two Analog Retransmit outputs.



The six TE2420-6 output channels can be wired in either arrangement shown below.

Note that the two terminals of each output can be wired without regard to polarity because of the rectifier bridge on each channel but the polarity of the load and DC power should be arranged correctly to avoid damage.



Appendix A Sporlan Reference Materials - Download the Bulletins for Electric Refrigeration Valves here:

[Sporlan IB-G Interface Board Bulletin 100-50-2.1](#)

[Sporlan Electric Expansion Valves Bulletin 100-20](#)



[Sporlan Electric Pressure Regulating Valves Bulletin 100-40](#)

[Sporlan Electric Hot Gas Bypass Valves Bulletin 100-60](#)



Appendix B Synergy Controller Reference Materials

Download the Synergy Controller data sheets, technical manual, and installation guide here:

https://tidaleng.com/techmans/Synergy_Controller_Unified_Technical_Manual_Rev_H.pdf

https://tidaleng.com/datasheets/Synergy_Quattro_2_data_sheet.pdf

https://tidaleng.com/datasheets/Synergy_Nano_2_data_sheet.pdf

https://tidaleng.com/techmans/TE2281_REV_C_Synergy_Quattro_Installation_Manual.pdf

You can access our YouTube channel to see demonstrations of some of the unique features and benefits of our controllers here: <https://www.youtube.com/channel/UCxJF1O5aUDzcpdICCoCKh6w>

Appendix B Synergy Controller Application Notes

The application notes on these topics can be accessed using the links below.

[AppNote 1 - Replacing a VersaTenn III Controller](#)

[AppNote 2 - Synergy Controller Data Logging Capacity Calculations](#)

[AppNote 3 - Retrofitting a Qualmark HALT/HASS Chamber :](#)

[AppNote 4 - Configuring the Synergy Controller to Read from a Bar Code scanner :](#)

[AppNote 5 - Synergy Controller vs. VersaTenn III :](#)

[AppNote 7 - Synergy Controller WebTouch Remote Feature](#)

[AppNote 8 - Using SimpleComm application to communicate with the Synergy Controller](#)

[AppNote 10 - Synergy Controller Retransmit Signal Conditioner :](#)

[AppNote 20 - Using the TE1908 Single Channel Thermocouple Signal Conditioner.](#)

[AppNote 25 - Using the Synergy Controller with Space Chamber applications.](#)

[AppNote 26 - Using the programmable User Alarms with the Synergy Controller.](#)

[AppNote 40 - Two Point Calibration.](#)

[AppNote 45 - Using the Synergy Controller's ftp server.](#)

[AppNote 49 - Synergy Controller Security Enhancements.](#)

[AppNote 56 - Using the Synergy Controller Watchdog Timers.](#)

[AppNote 58 - Synergy Controller Wet-Bulb/Dry-Bulb Humidity Measurements.](#)

[AppNote 59 - Synergy Controller Wireless Network Setup.](#)

[AppNote 60 - Graphing Synergy Log Files in Microsoft Excel.](#)

[AppNote 67 - Synergy Controller Mounting Options.](#)

[AppNote 71 - Synergy Controller PWM Retransmit Feature](#)

[AppNote 72 - Synergy Controller Thermocouple Data Acquisition with Synergy UUT Modules](#)

[AppNote 74 - Synergy Controller LED Backlight Retrofit Kit](#)

[AppNote 77 - Synergy Controller Remote Start/Stop Feature](#)

[AppNote 84 - Synergy Controller E-Mail Feature](#)

[AppNote 85 - Synergy Controller Logging Features and Applications](#)

[AppNote 89 - Synergy Controller Loop-Back Setup](#)

[AppNote 90 - Synergy Controller Network Printing Feature](#)

[AppNote 91 - Synergy Controller Built-In Alarms](#)

[AppNote 95 - Synergy Controller Kft and other Pressure Display](#)

[AppNote 96 - Synergy Controller Analog Retransmit Applications](#)

[AppNote 99 - Synergy Server Feature](#)

[AppNote 102 - Synergy Certified OEM and Installer Training](#)

[AppNote 106 - Synergy Controller Cascade Loop \(Part Temperature\) Control Feature](#)

[AppNote 107 - Synergy Controller Programming with Python](#)

[AppNote 109 - Synergy488 Kit Setup for Synergy Nano and Synergy Quattro GPIB](#)

[AppNote 112 - General Purpose Logic Programming for OEMS and Integrators](#)

[AppNote 113 - Main Screen Display Setup Options](#)

[AppNote 116 - Synergy Controller Pressure Applications](#)

[AppNote 117 - Synergy Controller Help System Video QR Codes.](#)

[AppNote 121- Synergy Controller Ramp Rate Control](#)



About the Synergy Controller Family

Tidal Engineering's Synergy Controllers; the Synergy Micro 2, Synergy Quattro, and the 1/4 DIN Synergy Nano provide state-of-the-art usability and connectivity for environmental test control and data acquisition and combine the functions of a chamber controller and a data logger and are designed to improve test efficiency by supporting both factory automation and test and measurement protocols and standards.

Synergy Controller feature highlights includes:

- ➔ Color touch screen
- ➔ Ethernet, RS-232 and GPIB communications
- ➔ Built in 100 MB Data logger with USB drive support
- ➔ Data Acquisition, up to 64 T-type thermocouples (Optional)
- ➔ Built-in Web Server for remote control; WebTouch Remote™
- ➔ Compatible with Synergy Manager for PC based control, monitoring and programming.
- ➔ Built-in FTP Server for factory automation and test and measurement applications

For more information regarding these controllers please visit <http://www.tidaleng.com/synergy.htm>

About Tidal Engineering

Headquartered in Randolph, NJ, Tidal Engineering Corporation has been designing and building award-winning embedded hardware and software for test and measurement and data acquisition applications since 1992. The company is recognized for technical expertise in such areas as Embedded IEEE 488, and turnkey SCADA (Supervisory Control and Data Acquisition) systems.

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