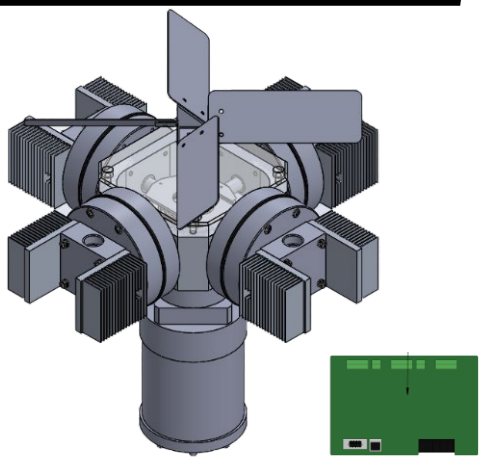
Ultra-Low Power Vapor Recovery Unit (VRU)

Introduction



The LCO Technologies *CROSSFIRE* Vapor Recovery Unit is an ultra-low power device that is designed to use solar power to capture and compress vent gas from the top of storage or production tanks for use or destruction. This technology allows oil and gas producers to eliminate Methane emissions that historically vent directly to the atmosphere from tanks, while automatically maintaining the pressure below tank set point and maintaining regular site operation.

Features and Specifications

- Capture up to 2.519 scfm (3627 scfd) with input pressure of 15” water column and output pressure of 5-10 psid
- Precise pressure control to maintain tank pressure
  - Modulate RPM automatically to collect the gas that that varies in release magnitude
- Tightly control the backpressure while ensuring no vacuum conditions are present
- Maintain blanket gas by maintaining a set pressure that can be customized with our CROSSFIRE app in minutes
- Oil filled topworks for lubrication
  - Quarterly oil changes required for regular maintenance (~5 minutes of work)
- User friendly operator and technician interface for configuration and monitoring
  - Mobile (Apple and Android) and desktop applications
  - Bluetooth accessories available for wireless connection and control
- CSA Certified Class 1 Division 1 Motor Assembly
  - Efficient variable speed drive permanent rare earth magnet motor
  - Lifetime lubrication, no maintenance required
- CSA Certified Class 1 Division 2 Controller
  - Complete with serial (RS232 or RS485) and Ethernet MODBUS communications
  - Ethernet 124 registers per poll for quick, efficient communications
  - Standalone automation capabilities with multiple analog and digital inputs/outputs

Hazardous Area Certifications

The *CROSSFIRE* has the following hazardous certifications:

- The Explosion Proof Motor Assembly (Model **LCOM-1000**)
  - CSA certified to Class 1 Division 1 Groups CD T6
    Rated input 24 VDC, 9.9 Amps, 750 rpm maximum, Class B, Continuous Stall Current 11 A, Rated Output Power 190W
    Ambient Temperature -40°C to +60°C
- The Smart Controller (Model **LCOC-1000-A** and **Model LCOC-1000-B**)
  - CSA certified to Class 1, Division 2, Groups CD T4
    Rated Input 24 VDC, Vac, 9.9 Amps
    Rated Output 24 VDC, 9.9 Amps
    Ambient Temperature: -40°C to +60°C

Ultra-Low Power Vapor Recovery Unit (VRU)

Energy Efficiency

- The LCO patented design is extremely energy efficient
- Assuming that a standard horsepower motor uses 750 Watts of power, our CROSSFIRE 1/4 horsepower motor and VRU uses 3.5A-4A of current at 24 VDC, yielding 84-96 W of power at full load.
- It will use significantly less power on a slower RPM, and is almost entirely linear in consumption as the unit is a brushless, contactless, in-rush free motor.
- Compared to a standard ¼ horsepower motor at 186.4 W, it is 54.9% more efficient per SCF
- Viable solar technology

Materials

- The following materials are used in the VRU:
  - Top Works: Aluminum
  - Cylinders: 316 SS
  - Heads: Aluminum
  - Diaphragm: Santoprene
  - Diaphragm Plates: Aluminum
  - Piston: Delrin
  - Tubing: 316 SS

Smart Controller Features

- Sophisticated Field Oriented Control (FOC) scheme used to drive the 3-phase rare earth permanent magnet BLDC motor for maximum performance and power efficiency
- Only 3 (plus ground) standard conductor flex armour cables required to power the motor
  - Cable length: maximum 60ft long (gauge 10)
- Permanent record of operating data (time and date stamped)
- Onsite firmware updates available for controller version V38 or later
  - Firmware downloadable off the LCO Technologies website
- Built in protection schemes to protect equipment

Software Interface

- Allows for easy configuration and monitoring of the controller for the *CROSSFIRE* platform
- Connect to the controller via the RS232 port to either a computer for hardwired connection or use a RS232 Bluetooth LE serial dongle for wireless connection to a laptop or mobile device
- Simple and intuitive, while allowing users to configure even the most advanced features The user experience is the same on both
- Identical user experience on desktop and mobile versions
- Software automatically pushes any changes made in the interface to the appropriate MODBUS registers
- Software requirements:
  - A computer with either Windows 10 or later, with 512 MB RAM and 500 MB hard drive space
  - Mobile devices:
    - iOS 12 or later
    - Android 7 or later

Ultra-Low Power Vapor Recovery Unit (VRU)

Controller Specifications

CPU Module		
Processor	Powerful microprocessor (8 nanosecond clock speed)	
Memory	SRAM – 64 KB	
	Flash: 512 KB	
	Onboard flash: 64MB (Advanced Model only)	
Clock	Crystal oscillator: 120 MHz	
	Battery backed Real-Time clock	
	Watchdog timer	
Communications		
Ports	**COM 1**	3-wire RS232 for data modem or Bluetooth pole-top module Maximum cable length: 130 ft.
	COM 2	RS232 DB9 connector
		Supports operator interface via a serial cable or with a Bluetooth dongle
		Maximum cable length: 25 ft. Maximum Bluetooth range: 50 ft.
	Modbus COM	2 or 3-wire RS485 for RTU, SCADA and HMI Maximum cable length: 4000 ft.
		Ethernet 10/100 - Maximum cable length: 350 ft (Advanced model only) MODBUS/TCP 124 Registers per poll MODBUS/RTU on RS485 = 8 registers per poll
Protocols	Serial Modbus/RTU slave support on the RS485 port	
	Serial communication in ASCII on COM1 and COM2	
LED		
Advanced	16 LED's to indicate system status, digital IO's and COM port traffic	
Reset Button		
1 reset button to reboot controller. Press with a pin		
IO Specs		
Controller	Advanced	4 Digital Inputs, 4 Digital Outputs, 3 Analog Inputs and 1 Analog Output
		DI1-DI3 are discrete DI4 is pulse count input (Advanced model only)
		All Digital Outputs are discrete
Digital Inputs	Input Type	DI1-DI3: Discrete level DI4: Pulse count input
	Isolation	Each channel is individually isolated
	Voltage	10-36 Vdc
	Scan Rate	100 ms for discrete level. 400 us interrupt for pulses

Ultra-Low Power Vapor Recovery Unit (VRU)

	Frequency	Maximum 10 KHz pulse input
	Loop Power	Externally sourced
	Input Resistance	20,000 Ohm
Digital Outputs	Output Type	Dry contact
	Isolation	Each channel ground is individually isolated
	Voltage	10 – 36 Vdc
	Scan Rate	100 ms for discrete level
	Loop Power	Externally sourced
	Output Current	Maximum 1.0 A at 24 Vdc
Analog Inputs	Input Type	4-20 mA on 250 Ohm resistor or 0 - 5 V direct, software selectable
	Isolation	All analog channels share the same ground
	Scan Rate	100 ms
	Loop Power	Externally sourced
Analog Outputs	Output Type	0 – 5 V
	Isolation	All channels share the same ground isolated
	Scan Rate	100 ms
	Loop Power	Internally sourced
Power		
External DC Power Supply: 24 VDC		
Controller Power consumption: 35 mA @ 24 Vdc		
Real-Time Clock battery: 3V Lithium button type CR2032		
Physical		
Controller	**Construction**	Fibre glass base plate and top cover
	Mounting	Bolt down to panel backplane with 4 screws or mount with 2 DIN-rail clips
	Dimensions	145 mm W by 240 mm L by 27.6 mm
	Weight	470 g
	Wiring	24 Vdc power supply: 10 AWG, Max 60 ft
		Motor power lines: 10 AWG, Max 60 ft
		Digital and Analog I/O: 20 AWG, Max 300 ft
	Wiring Access	Easy access from the top
	Sensor	Onboard temperature sensor for controllers with Firmware V38 and Hardware V2.2 or later
Environmental		
Operating Temperature: -40 C to +60 C		
Storage Temperature: -50 C to +85 C		
Operating Humidity: 5 to 95%, non-condensing		

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Dimensional Drawing: