

# Chillgard® VRF

*Refrigerant Monitor for Occupied Spaces*



# VRF Systems

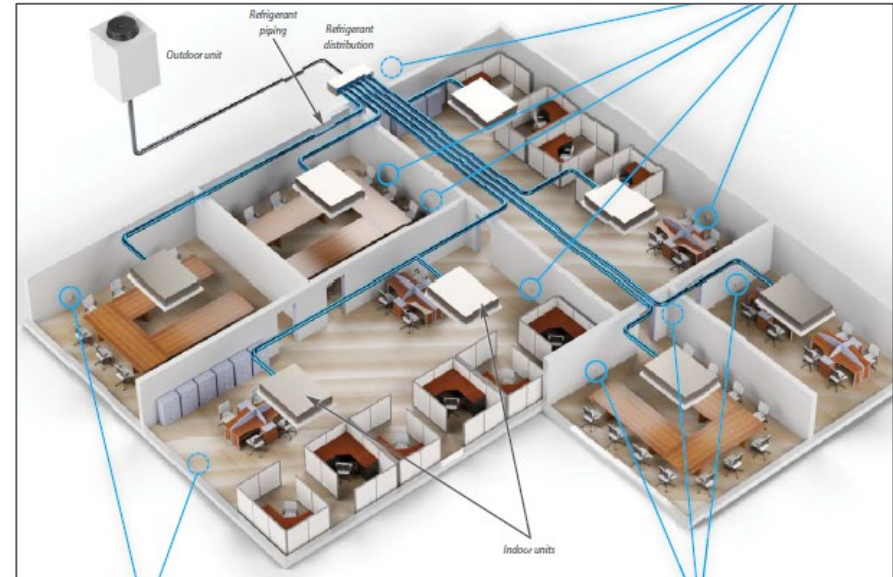
# What is a VRF System?

- VRF= “Variable Refrigerant Flow”
- Refrigerant is conditioned by a condensing unit and circulated within the building to multiple indoor units
- VRF units work only at the needed rate allowing substantial energy savings
- VRF technology allows individual indoor units to heat or cool as required, while the compressor load benefits from the internal heat recovery
- Uses pure refrigerant piped throughout the space versus a chilled water system



# Benefits of a VRF System

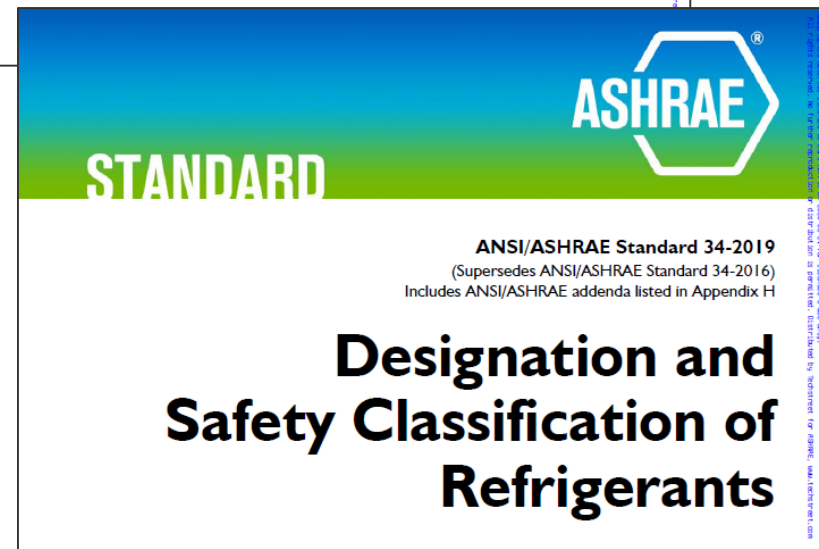
- VRF systems are becoming more popular as they can be more efficient and more flexible
  - Energy savings of up to 55% are predicted\*
- VRF systems act as multi-split systems, connecting multiple indoor units
- Best suited for buildings with multiple spaces, e.g. hotels



\*Thornton, Brian (December 2012). [Variable Refrigerant Flow Systems](#) (pdf). General Services Administration (Report). US Federal Government. Retrieved 2013-08-06.

# Refrigerant Monitoring in VRF Systems

- ASHRAE has two prevailing standards
  - ASHRAE 15 Defines Requirements under specific Occupancy uses;
  
- ASHRAE 34 defines Refrigeration Classifications





- ASHRAE 15 and ASHRAE 34 are evolving to address safety and environmentally conscious use of refrigerants.
- For VRF Monitoring a new term, *RCL* is used.

- ASHRAE 15 defers to ASHRAE 34 for definition:

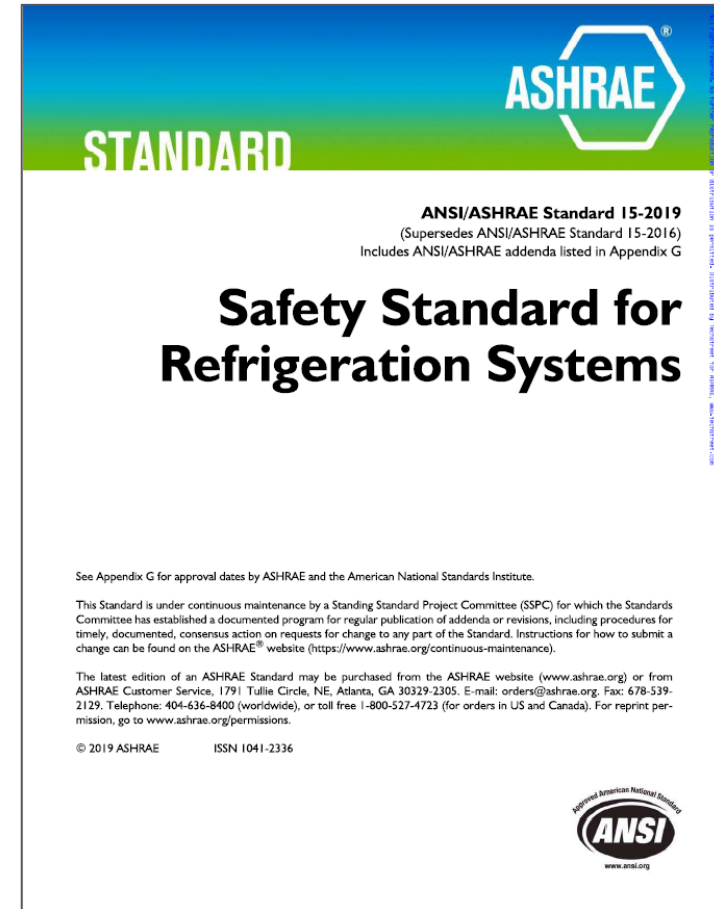
*refrigerant concentration limit (RCL): see definition in ANSI/ASHRAE Standard 34<sup>2</sup>.*

- ASHRAE 34 defines RCL as:

*refrigerant concentration limit (RCL): the refrigerant concentration limit, in air, determined in accordance with this standard and intended to reduce the risks of acute toxicity, asphyxiation, and flammability hazards in normally occupied, enclosed spaces.*



- ASHRAE Standard 15 changed in 2019, mentioning the need for VRF refrigerant detection
- Chapter 7:
  1. For *refrigerating systems* that are connected to the *occupied space* through ductwork, *refrigerant detectors shall be located within the listed equipment.*
  2. For *refrigerating systems* that are directly connected to the *occupied space* without ductwork, the *refrigerant detector shall be located in the equipment, or shall be located in the occupied space at a height of not more than 12 in. (30 cm) above the floor and within a horizontal distance of not more 3.3 ft (1.0 m) with a direct line of sight of the unit.*
- Project engineers are incorporating VRF detectors into building systems for safety and energy efficiency.



BS EN 378-1:2016



**Refrigerating systems and heat pumps — Safety and environmental requirements**  
Part 1: Basic requirements, definitions, classification and selection criteria

DIN EN 378-1	<b>DIN</b>
ICS 01.040.27; 27.080; 27.200	Supersedes DIN EN 378-1:2012-08
<p><b>Refrigerating systems and heat pumps – Safety and environmental requirements – Part 1: Basic requirements, definitions, classification and selection criteria; English version EN 378-1:2016, English translation of DIN EN 378-1:2017-03</b></p> <p>Kälteanlagen und Wärmepumpen – Sicherheitstechnische und umweltrelevante Anforderungen – Teil 1: Grundlegende Anforderungen, Begriffe, Klassifikationen und Auswahlkriterien: Englische Fassung EN 378-1:2016, Englische Übersetzung von DIN EN 378-1:2017-03</p> <p>Systèmes frigorifiques et pompes à chaleur – Exigences de sécurité et d’environnement – Partie 1: Exigences de base, définitions, classification et critères de choix: Version anglaise EN 378-1:2016, Traduction anglaise de DIN EN 378-1:2017-03</p>	

## Detector Alarm Levels

EN378	Notes	Occupational Safety	Machinery Rooms	
		TWA / ATEL/ODL	Pre-Alarm	Main Alarm
		ppm	ppm	ppm
<b>AMMONIA</b>		25	500	30000
<b>HFC/HFO</b>		500	500	
<b>CARBON DIOXIDE</b>		5000	5000	
<b>A2L (HFC/HFO)</b>	25% LFL	500	500	

Acute-Toxicity Exposure Limit (ATEL) or Oxygen Deprivation Limit (ODL),



The requirement of the standard states that if the refrigerant concentration in a room can exceed a critical level due to the loss of the complete refrigerant charge of the system due to a leak, a fixed refrigerant leak detector must be installed to warn the occupant and the building management system.

*QLMV: Quantity Limit with Minimum Ventilation in kg/m<sup>3</sup>*

*QLAV: Quantity Limit with Additional Ventilation in kg/m<sup>3</sup>*

*RCL: Refrigerant Concentration Limit in kg/m<sup>3</sup>*

Refrigerant	Allowable concentration (kg/m <sup>3</sup> ) RCL	QLMV (kg/m <sup>3</sup> )	QLAV (kg/m <sup>3</sup> )
R-22	0.21	0.28	0.50
R-134a	0.21	0.28	0.58
R-407c	0.27	0.44	0.49
<b>R-410A</b>	<b>0.39</b>	<b>0.42</b>	<b>0.42</b>
R-744	0.072	0.074	0.18
R-32	0.061	0.063	0.15

Example:

Hotel room with ducted indoor unit attached to a R410A VRF

Rooms size: 6m x 3m x 2.4m

Gas: R410A

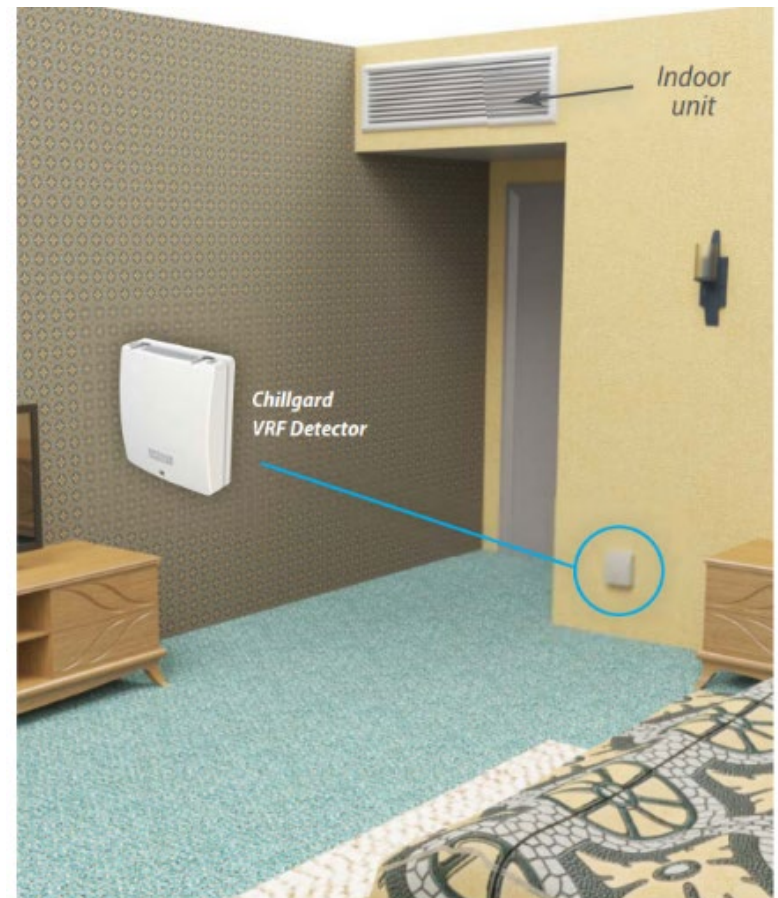
System charge: **50kg**

Room Volume = 43.2m<sup>3</sup>

QLMV= 0.42 kg/m<sup>3</sup> (From EN378)

Max system charge =  
43.2 x 0.42 = **18.14 kg**

If the R410A system has a total refrigerant charge above **18.14 kg** then a leak detector must be installed.



# The Chillgard VRF

- PAIR technology is designed to minimize cross-sensitivity through the use of specific optical filters
- The Chillgard VRF uses an optical filter specific to R410A
- Zero stability, or maintaining a stable baseline, is critical for low ppm detection to eliminate drift
- Instability can compromise low level detection by causing inaccuracy, false alarms, limited detection levels, and requiring frequent maintenance
- PAIR technology has the advantages of longer life and low cross-sensitivity (compared to semi-conductors)



## Chillgard VRF

- Photoacoustic Infrared (PAIR) Technology
- BACnet MS/TP output on board
- BTL listed
- Low level of detection
- Low maintenance
- Ease of use
- New: 80dB audible buzzer on board
- New: 2-year warranty



# Value and Benefits – Communications

- The Chillgard VRF offers multiple communication on board



BACNET MS/TP



MODBUS RTU




ANALOG 4-20MA



VISUAL INDICATION  
RED LED



ON BOARD RELAY



**COMMUNICATIONS**

Flexibility in communications offering 4-20mA and choice of digital communication: BACnet MS/TP or Modbus RTU.

On board relay allows for stand alone installation.

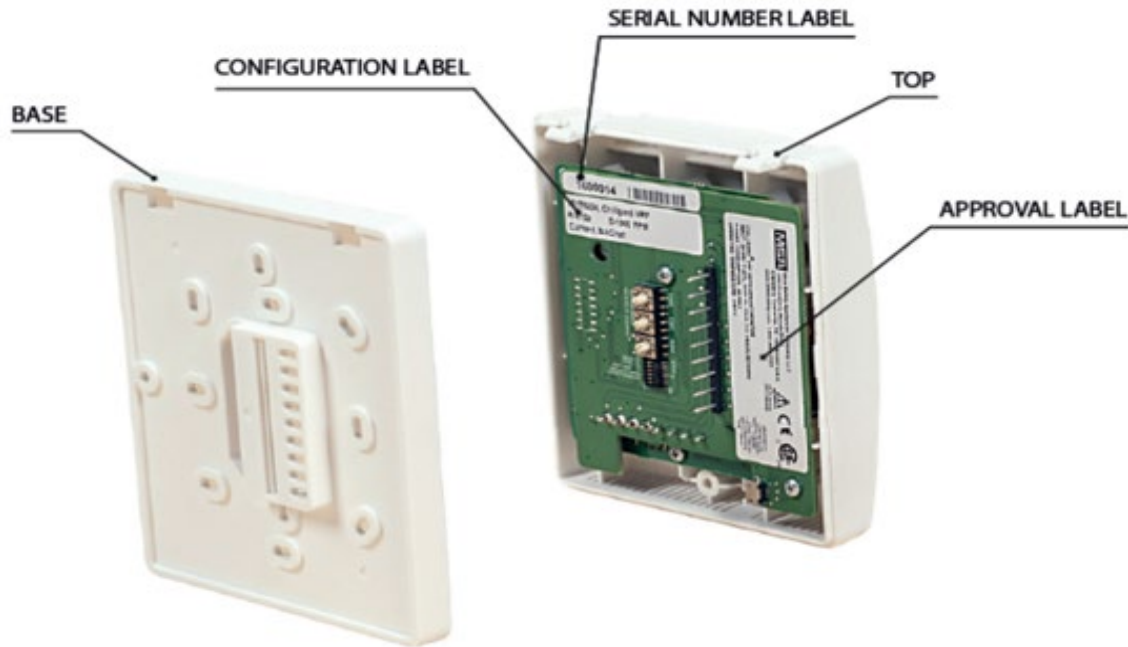


*BACnet® is a registered trademark of ASHRAE*



# Operating the Chillgard VRF - Mounting

- Discreet and small for ceiling mount or wall mount installations
- Two basic parts, base and cover
- Mounts to Standard Double-Gang electrical box.



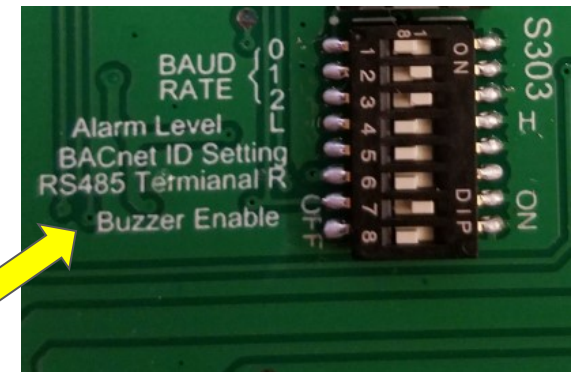
# Operating the Chillgard VRF - Alarm Levels & Buzzer

- Range: 0-1000 ppm
- Min Det: 25 ppm
- Min Alarm: 50 ppm
  - Factory default 750 ppm

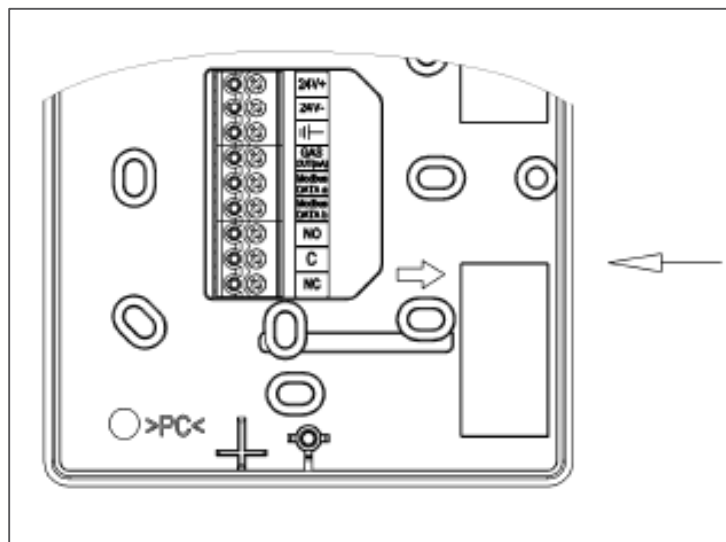


Figure 2: Connecting Wires to Terminal Connector

- Dip-switch for changing factory settings
- Audible Buzzer: max. of 80 dB at 12"
  - Factory default switched ON



- Electrical Connection



Terminal connection	Description
24V+	24V DC+ or AC Line
24V-	24V DC- or AC Neutral
—	Circuit common/analog signal reference
GAS OUT (mA or V)	For (mA) - Gas reading as current (4 - 20 mA = 0 - 1000 ppm) For (V) - Gas reading as voltage (2 - 10 V = 0 - 1000 ppm)
DATA a (BACnet or Modbus)	For BACnet - RS485 BACnet MSTP (a) connection For Modbus - RS485 Modbus RTU (a) connection
DATA b (BACnet or Modbus)	For BACnet - RS485 BACnet MSTP (b) connection For Modbus - RS485 Modbus RTU (b) connection
NO	Relay - normally open
C	Relay - common
NC	Relay - normally closed

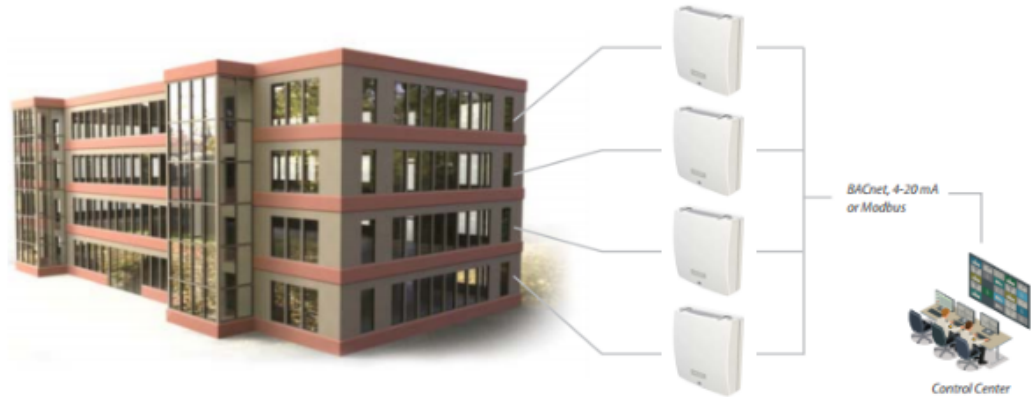
- Visual LED Functionality

- ACCEPTED WIRE SIZE: 14-26 AWG (SINGLE WIRE ONLY), TO CONNECT UNITS IN SERIES, THE CONNECTOR TERMINALS WILL EXCEPT UP TO TWO WIRES BETWEEN 18-26 AWG.
- POWER REQUIREMENTS:  
24 VAC ±20%, 50/60 HZ, CLASS 2 TRANSFORMER OR 24VDC ±20%, CLASS 2 POWER SUPPLY.
- LED INDICATION:  
NORMAL - FLASH ONCE PER 60 SECS  
STARTUP - FLASH 1 HZ (ONCE PER SEC)  
CAL CHECK - SLOW FLASH 0.5 HZ (ONCE EVERY 2 SECS)  
ALARM - FAST FLASH AT 3 HZ (3 TIMES PER SEC)  
FAULT - SOLID ON
- WEIGHT: 230g (0.5 LBS).
- FOR RS485: ENABLE THE TERMINATION RESISTOR ONLY IN THE UNIT THAT IS FURTHEST FROM THE CONTROLLER. ENSURE THAT ONLY ONE UNIT ON THE BUS HAS THIS ENABLED. USE SWITCH S303-6 ('ON' POSITION ADDS RESISTOR).

# Chillgard VRF – BACnet Communications

## DIGITAL COMMUNICATION

The following parameters must be set properly in order to communicate with a BACnet controller



### BACNET

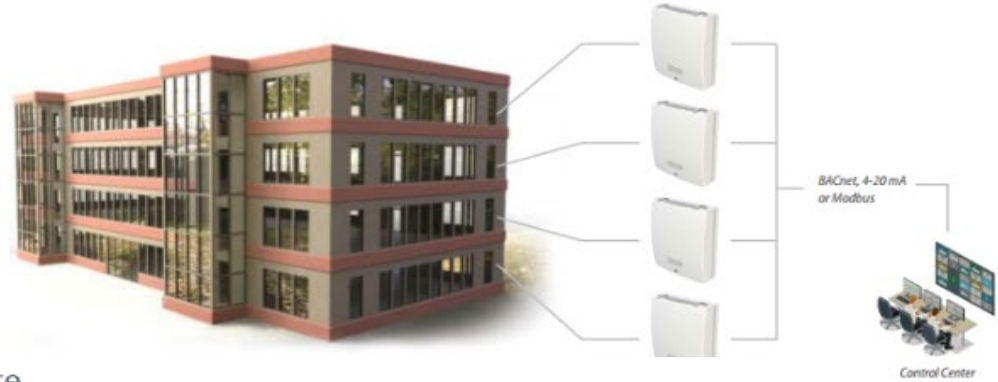
MAC Address, Instance ID and Baud Rate

Object Name	Instance Number (default)	Property	Range
Gas Concentration	1	Read	0-1000 (ppm)
Gas Number	2	Read	R-410A
Active Alarm Level	3	Read	(ppm)
Device State	4	Read	Device Fault 80 (MSB)
			Address Fault 8 (MSB)
			Concentration Alarm 10 (LSB)
			Warm Up Complete 0 (LSB)
High Alarm Level	5	Read/Write	750 default range = 25-1000
Low Alarm Level	6	Read/Write	50 default range = 25-1000
Instance Number	7	Read/Write	Default value: Serial Number Label (Figure 1) Range: 0~4194302
Room Temp	8	Read	



## DIGITAL COMMUNICATION

The following parameters must be set properly in order to communicate via Modbus



### MODBUS

Modbus Address and Baud Rate

Register Name	PDU Address	Logical Address	Property	Range	
Gas Concentration	0x0000	1	Read	0-1000 (ppm)	
Gas Number	0x0001	2	Read	R-410A	
Active Alarm Level	0x0002	3	Read	(ppm)	
Fault and Device State	0x0003	4	Read	Device Fault	80 (MSB)
				Address Fault	8 (MSB)
				Concentration Alarm	10 (LSB)
				Warm Up Complete	0 (LSB)
High Alarm Level	0x0004	5	Read/Write	750 default range = 25-1000	
Low Alarm Level	0x0005	6	Read/Write	50 default range = 25-1000	
Room Temp	0x0010	9	Read		



## • Calibration check

A calibration check of the sensor requires a supply of:

- ZERO GAS (air or nitrogen). It may be possible to use ambient air if user is certain it does not contain refrigerant gas or an interfering component
- SPAN GAS Cylinder comprised of refrigerant gas of appropriate concentration

### 6.1 Calibration Check Procedure

To verify proper sensor operation:

1. If the active alarm level is lower than the concentration of calibration gas, please be aware that the relay may activate. You may modify the active alarm level via Modbus or BACnet or you may switch to the alternate alarm level using switch S303-4 (refer to Alarm Level section above).
2. If appropriate, deactivate any equipment connected to the outputs, or disconnect the wiring of the outputs.

#### CAUTION

If any control instruments connected to this detector are wired to external devices (e.g., horns, exhaust fans, and fire suppression systems), these devices may activate during the following procedures. To prevent activating these devices while adjusting this monitor, disconnect the wiring to the control device. Return all wiring to the control device when the calibration procedure is completed.

3. With the tubing connected to the regulator and cylinder, place tubing in the opening at the bottom of this unit (see Figure 6).
4. Open the regulator and apply gas. This process may take up to five minutes.
5. If the unit is operating properly:
  - The Red LED:
    - illuminates when concentration level > Calibration Check level or Active Alarm level
    - is visible through the upper and lower enclosure vents.
  - the relay will activate if the Active Alarm level is exceeded.
6. Turn off regulator and remove tubing from opening.
7. Allow gas level to return to normal.
8. Reactivate any equipment connected to the outputs or reconnect the wiring to the outputs.
9. Remember to restore any alarm level settings that may have been changed for the Calibration Check.

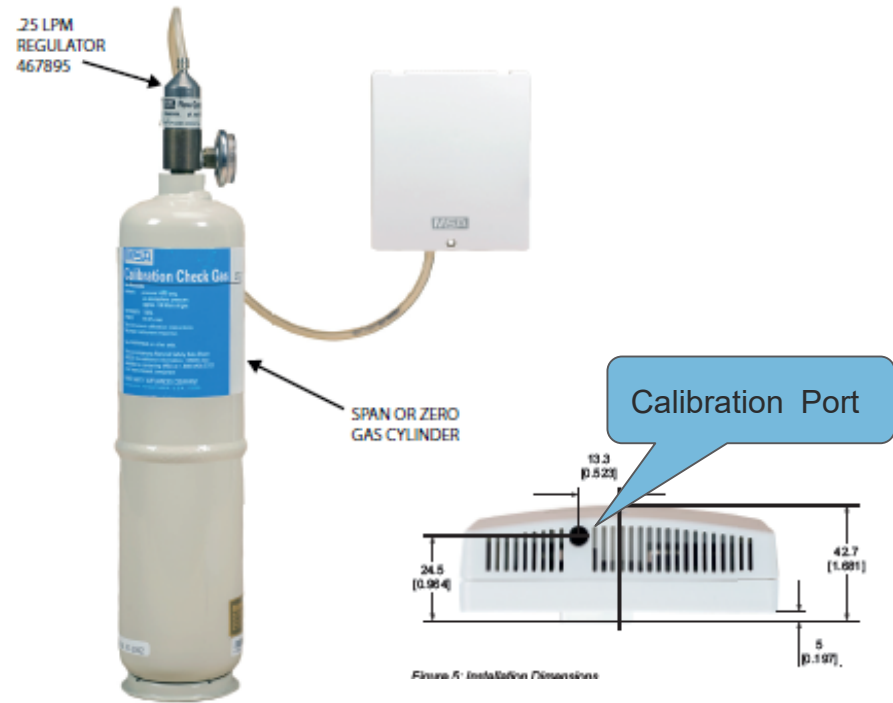


Figure 6: Applying Calibration Gas

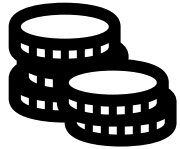
## 4 OUTPUT ACTION

This detector is factory calibrated and ready for immediate use. Once power is applied, the Red LEDs located at the top and bottom of the unit indicate status.

	START-UP	NORMAL STATE	ALARM	CALIBRATION CHECK	FAULT
LED STATE	Flash at 1 Hz	Flash every 60 seconds	Flash fast at 3 Hz	Flash slow at 0.5Hz (>=50 ppm fixed)	SOLID ON



## Lowest Cost of Ownership



- ✓ The Chillgard VRF needs no calibration
  - ✓ Recommended annual bump check to verify response
  
- ✓ PAIR technology provides:
  - ✓ No need for a zero calibration
  - ✓ Minimizes cross-sensitivities compared to other technologies
    - *Competition uses semi-conductors which are more vulnerable to cross-sensitivity and require replacement*
  - ✓ Minimal maintenance with no moving parts



## Chillgard VRF



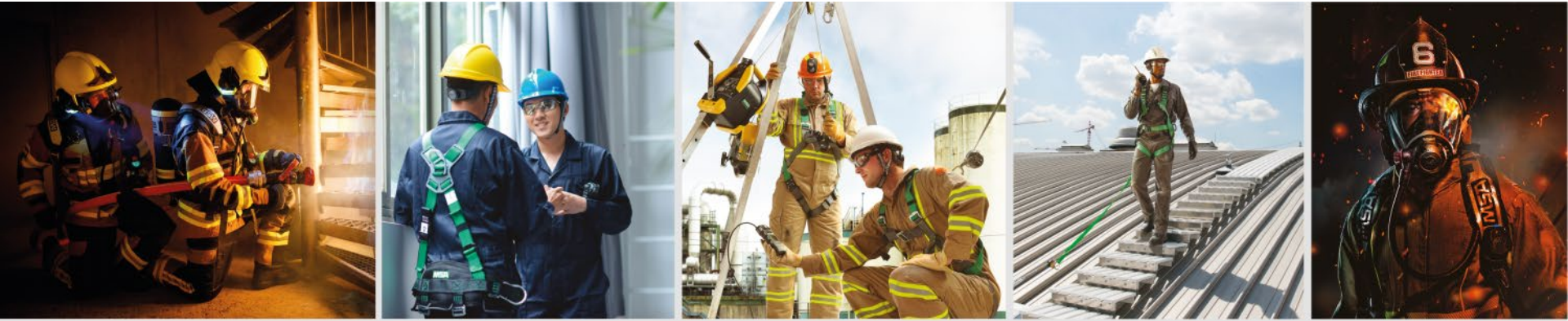
Part Number	Description
10175201	Chillgard VRF, Voltage, Modbus
10175202	Chillgard VRF, Current, Modbus
10175203	Chillgard VRF, Voltage, BACnet
10175204	Chillgard VRF, Current, BACnet



# Questions??

*Email us at [FGFD@MSAsafety.com](mailto:FGFD@MSAsafety.com)*





# THANK YOU!

*Send questions to [FGFD@MSAsafety.com](mailto:FGFD@MSAsafety.com)*

