Chart MVE TS Controller (Touch Screen)

TECHNICAL MANUAL

PN 21081122 Rev A

Preface

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Read this manual. Failure to follow the instructions in this manual can result in damage to the unit, injury to personnel, and/or poor equipment performance.

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3. Safety

Symbols Used in this Manual

This manual includes the following symbols:

Symbol	Title	Description
	Caution	Signifies a CAUTION of potentially hazardous situation when operating the device that may result in minor to moderate injury or property damage.
	Warning	Signifies a WARNING of a potentially hazardous situation when operating the device that may result in serious injury or property damage.
	Warning; Low Temperature	Indicates low temperature or freezing conditions. Take care to avoid exposure to skin, eyes, and clothing.
	Warning; Asphixiating Atmosphere	Indicates the potential for an oxygen-depleted atmosphere due to nitrogen vapor. Take care to operate device in a well-ventilated area.
	Warning; Electricity	Indicates a potential electrical hazard. Take care to avoid contact with electricity.
	Warning; Explosive	Indicates a potential explosive hazard. The expansion ratio of liquid nitrogen to gas is 1:700 and can cause explosive conditions if placed into a sealed container.
	Wear Protective Gloves	Thermal gloves must be worn during indicated procedures.
	Wear a Face Shield	A face shield must be worn during indicated procedures.
	UL Listed Mark	Chart Cryogenic Freezers are conform to relevant UL safety standards.

- **WARNING: Do not modify this equipment without authorization of the manufacturer.**

Liquid Nitrogen Safety

Liquid nitrogen (LN2) is used in Chart Cryogenic Freezers as a refrigerant. Understanding potential hazards and following safety precautions is important when handling LN2 and these freezers.

Nitrogen is a colorless, odorless, and tasteless gas that makes up approximately 78.1% of the Earth's atmosphere in its gaseous state. LN2 becomes vapor at temperatures greater than -320.8°F (-196°C). In liquid state, nitrogen has a temperature range from -320.4°F to -346°F (-195.8°C to -210°C).

- **Nitrogen vapor is a potential asphyxiant as it displaces Oxygen (O_2) in confined spaces. Rapid suffocation can occur without warning in an Oxygen-deficient atmosphere (less than 19.5% O_2). Chart Cryogenic Freezers must be installed and operated in well-ventillated areas.**
- **DO NOT vent container in confined spaces.**
- **DO NOT enter confined spaces where excess nitrogen gas may be present.**
- **If exposure has occurred move to ventillated area or fresh air. If breathing is difficult, supplement oxygen may be required. If not breathing, give artificial respiration. SEEK IMMEDIATE MEDICAL ATTENTION.**

- **Contact with liquid nitrogen or uninsulated equipment containing nitrogen can result in cold contact burns or tissue damage. Nitrogen vapor can cause damage to skin or eyes.**
- **In case of frostbite, warm area with warm water not exceeding 105°F (40°C) and SEEK IMMEDIATE MEDICAL ATTENTION.**

- **Never place LN2 in a sealed container without a pressure relief device. The expansion ratio of liquid nitrogen to gaseous nitrogen is 1 to 700 (1 cubic foot of liquid nitrogen becomes 700 cubit feet of gaseous nitrogen when evaporated).**

Recommended protective clothing

- Cryogenic gloves (loose fitting)
- Full-face shield or chemical splash goggles
- Cryogenic apron
- Long sleeve shirt and cuffless pants
- Closed toe shoes (no sandals)

Equipment Usage

Cryogenic containers must be operated in accordance with the manufacturer/supplier instructions. Safety instructions will also be posted on the side of each Dewar. Cryogenic Dewars must be kept in a well-ventilated area protected from weather and away from heat sources. In applications that use a modular liquid cylinder as a source of LN2, the supply will need to be replenished at regular intervals to ensure proper operation of the freezer. When exchanging liquid cylinders, follow the below procedure:

1. Allow all plumbing components to warm to room temperature before attempting to change supplies.
2. Close all valves associated with the liquid supply cylinder.
3. Relieve pressure in the plumbing assembly by initiating a brief fill by either pressing “Start Fill”.
4. Loosen the plumbing connection for the transfer hose at the liquid cylinder.
5. Remove empty liquid cylinder and replace with full liquid cylinder pressurized to 22 - 35 psig (1.52 - 2.41 bar).
6. Attach the transfer hose to the plumbing connection on the liquid cylinder. Ensure that the hose is connected to the connection labeled “LIQUID”.
7. Tighten the transfer hose plumbing connection at the liquid cylinder.
8. Open the liquid supply valve on the liquid cylinder.
9. Inspect plumbing for audible and visual leaks. Repair if necessary.
10. Manually initiate a fill to verify proper operation.

Recommended First Aid

Every site that stores and uses LN2 should have an appropriate Material Safety Data Sheet (MSDS) present. The MSDS may be obtained from the manufacturer/distributor. The MSDS will specify the symptoms of overexposure and first aid to be used. Here is a typical summary.

- If symptoms of asphyxia such as headache, drowsiness, dizziness, excitation, excess salivation, vomiting, or unconsciousness are observed, remove to fresh air. If breathing has stopped, give artificial respiration. **CALL A PHSYICIAN IMMEDIATELY.** If breathing is difficult, supplemental oxygen maybe required.
- If exposure to cryogenic liquids or cold vapor occurs, restore tissue to normal, body temperature (37°C) as rapidly as possible, and then protect the injured tissue from further damage and infection. Rapid warming of the affected areas is best achieved by bathing it in warm water. The temperature of the water used should not exceed 40°C. Under no circumstances should the frozen part be rubbed either before or after warming. If the eyes are involved, flush them thoroughly with warm water for at least 15 minutes. In case of massive exposure, remove clothing while showering with warm water. The patient should not drink alcohol or smoke. **CALL A PHYSICIAN IMMEDIATELY**.

4. Product Information

This section will give an overview of Chart MVE cryogenic freezers and components.

Chart MVE offers a wide range of LN2 freezers with Chart MVE TS controllers that can accommodate a variety of inventory systems designed to meet all of your cryogenic storage needs. Each freezer is a hand-made, double-walled, vacuum insulated stainless steel Dewar designed to maintain temperature with minimal LN2 evaporation.

Intended Use
Chart Cryogenic Freezers that have "MDD" in the model name are certified medical devices according to the Medical Device Directive (93/42/EEC) and are intended to maintain cryogenic temperatures for the purpose of storing blood, other body liquids, organs, parts of organs, or body tissues. This equipment has been tested and found to comply applicable safety and performance standards.
The general purpose cryogenic storage models are intended for professional use in research applications.

4.1. MVE Freezer Models

There are several series, or groups, of freezers, each of which offer specialized features and functionality. Each freezer has a descriptive name from which the highlighted features and performance specifications can be determined.

MVE (Series)(Capacity)(Turn-tray?)-(Temp?)(Full Auto?)-(Gas Bypass?)-(Battery Backup?)

Series	MVE Freezer Series (i.e. 800, 1500, 1800)
Capacity	Approximate 1.2 or 2.0 mL vial capacity in thousands
Turn-tray?	Shape of turn-tray dividers, if applicable; P = pie-shaped, R = rectangular
Temp?	"Top box" temperature rating, if applicable; -150°C or -190°C
Full Auto?	AF = Automatic Filling, if applicable
Gas Bypass?	GB = Hot Gas Bypass, if applicable
Touchscreen?	TS = Chart MVE TS controller
Battery Backup?	BB = Batter Backup, if applicable

Example: MVE 1536P-190AF-GB-TS

MVE 1500 Series freezer with capacity for approximately 36,000 vials, pie-shaped turn-tray dividers, -190°C temperature rating, equipped with a Chart MVE TS, and Hot Gas Bypass.

4.1.1. MVE High Efficiency / Vapor Series

The MVE High Efficiency / Vapor Series freezers will maintain a vapor storage temperature of either -150°C or -190°C with minimal LN2 evaporation. while accommodating a wide variety of inventory systems.

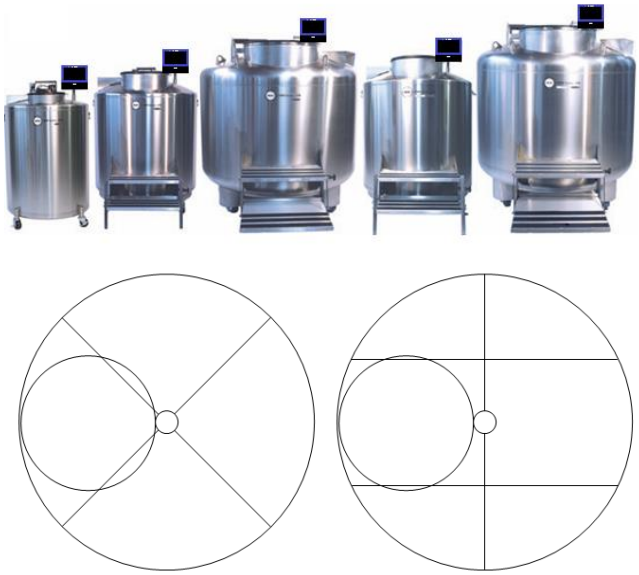


Figure 1: Top-view of HE Freezer showing offset neck and P and R turn-trays

Freezer Model	Minimum Door Width in. (mm)	Minimum Ceiling Height	Liftover Height in. (mm)	Turn-tray Platform Height In (mm)	Weight Empty lbs. (kg)	Weight Liquid Full lbs. (kg)	Qty of Casters	Direct Load per Caster (Full) lbs. (kg)
MVE 815P-150	32 (813)	75.1 (1908)	47.3 (1202)	6 (152)	475 (215)	1134 (514)	4	284 (129)
MVE 815P-190	32 (813)	75.1 (1908)	47.3 (1202)	6 (152)	475 (215)	1134 (514)	4	284 (129)
MVE 818P-190	32 (813)	84.2 (2138)	51.6 (1310)	6 (152)	495 (225)	1168 (530)	4	292 (133)
MVE 819P-190	32 (813)	90.1 (2289)	55.3 (1405)	6 (152)	515 (234)	1340 (608)	4	335 (152)
MVE 1536P-150	42 (1066)	83.2 (2115)	37.1 (944)	9 (228)	690 (313)	2037 (924)	4	509 (231)
MVE 1536P-190	42 (1066)	83.2 (2115)	37.1 (944)	9 (228)	690 (313)	2037 (924)	4	509 (231)
MVE 1539P-190	42 (1066)	87.8 (2230)	39.2 (995)	9 (228)	720 (327)	2140 (971)	4	535 (243)
MVE 1879P-150	60 (1524)	88.8 (2256)	38.7 (983)	9.5 (242)	1585 (719)	4458 (2022)	4	1115 (506)
MVE 1879P-190	60 (1524)	90.3 (2294)	40.2 (1021)	9.5 (242)	1721 (781)	4830 (2191)	4	1146 (520)
MVE 1892P-190	60 (1524)	100 (2540)	45.2 (1146)	9.5 (228)	1721 (781)	4875 (2211)	4	1219 (553)
MVE 1539R-150	42 (1066)	83.2 (2115)	37.1 (944)	9 (228)	690 (313)	2037 (924)	4	509 (231)
MVE 1542R-150	42 (1066)	87.8 (2230)	39.2 (995)	8 (203)	720 (327)	2140 (971)	4	535 (243)
MVE 1542R-190	42 (1066)	87.8 (2230)	39.2 (995)	9 (228)	720 (327)	2140 (971)	4	535 (243)
MVE 1881R-150	60 (1524)	88.8 (2256)	38.7 (983)	9.5 (242)	1606 (728)	4479 (2032)	4	1120 (508)
MVE 1881R-190	60 (1524)	88.9 (2257)	38.8 (985)	9.5 (242)	1721 (781)	4830 (2192)	4	1208 (548)
MVE 1894R-150	60 (1524)	98.6 (2504)	43.8 (1112)	9.5 (242)	1721 (781)	4875 (2211)	4	1219 (553)
MVE 1894R-190	60 (1524)	98.6 (2504)	43.8 (1112)	9.5 (242)	1721 (781)	4875 (2211)	4	1219 (553)

4.1.2. MVE Series

The MVE Series freezers are designed primarily for liquid phase storage, but can be used for vapor phase storage with the vapor storage accessory package. The wide neck opening allows easy access to stored samples. In vapor phase storage, these freezers will maintain a top box temperature of -125°C.

Freezer Model	Minimum Door Width in. (mm)	Minimum Ceiling Height in. (mm)	Liftover Height in. (mm)	Weight Empty lbs. (kg)	Weight Liquid Full lbs. (kg)	Qty of Casters	Direct Load per Caster (Full) lbs. (kg)
MVE 205	20.4 (518)	71.1 (1806)	41 (1041)	195 (88)	365 (166)	4	91 (42)
MVE 510	23.9 (606)	71.7 (1822)	41.6 (1057)	281 (127)	577 (262)	4	144 (66)
MVE 616	27.4 (696)	71.5 (1816)	41.4 (1051)	310 (145)	748 (339)	4	187 (85)
MVE 1426	33.8 (858)	70.1 (1781)	40 (1016)	490 (222)	1181 (536)	4	295 (134)
MVE 1839	46.1 (1171)	92.3 (2345)	47.3 (1202)	750 (341)	1950 (885)	6	325 (148)

4.1.3. MVE Stock Series

The MVE Stock Series freezers are designed primarily for storage of either vials or straws on canes in liquid nitrogen, but can also be used for vapor phase storage with the vapor storage accessory package. Dual lids on the MVE 1318 and two-tier turn-trays in the MVE 816P-2T-190 and the MVE 1877P-2T-150 are example features of these freezers built for durability and ergonomic sample retrieval.

Freezer Model	Minimum Door Width in.	Minimum Ceiling Height in. (mm)	Liftover Height in. (mm)	Weight Empty lbs. (kg)	Weight Liquid Full lbs. (kg)	Qty of Casters	Direct Load per Caster (Full) lbs. (kg)
MVE 808	31 (787)	65.1 (1653)	39.1 (992)	250 (114)	660 (300)	3	220 (100)
MVE 816P- 2T-190	32 (813)	59.5 (1512)	48.3 (1227)	475 (215)	1155 (524)	4	288.75 (131)
MVE 1318	42 (1067)	62.8 (1595)	43.6 (1107)	469 (213)	1328 (602)	3	332 (201)
MVE 1842P-150	60 (1524)	73 (1853)	42.5 (1078)	1167 (530)	2798 (1270)	4	699.5 (317.5)
MVE 1877P-2T-150	60 (1524)	67.5 (1716)	36.3 (923)	1600 (726)	4094 (1857)	4	1023.5 (464.25)

4.1.4. MVE HEco Series

The MVE HEco Series freezers will maintain a vapor storage temperature of -190°C with minimal LN2 evaporation while accommodating a wide variety of inventory systems. This freezer is designed for easier access to the plumbing stack. This also allows for lower height clearance. The HEco is available only in the automatic fill version.

CAUTION: Pinch hazard, use caution when opening and closing the plumbing and electrical enclosures.

MVE HEco 800 Series

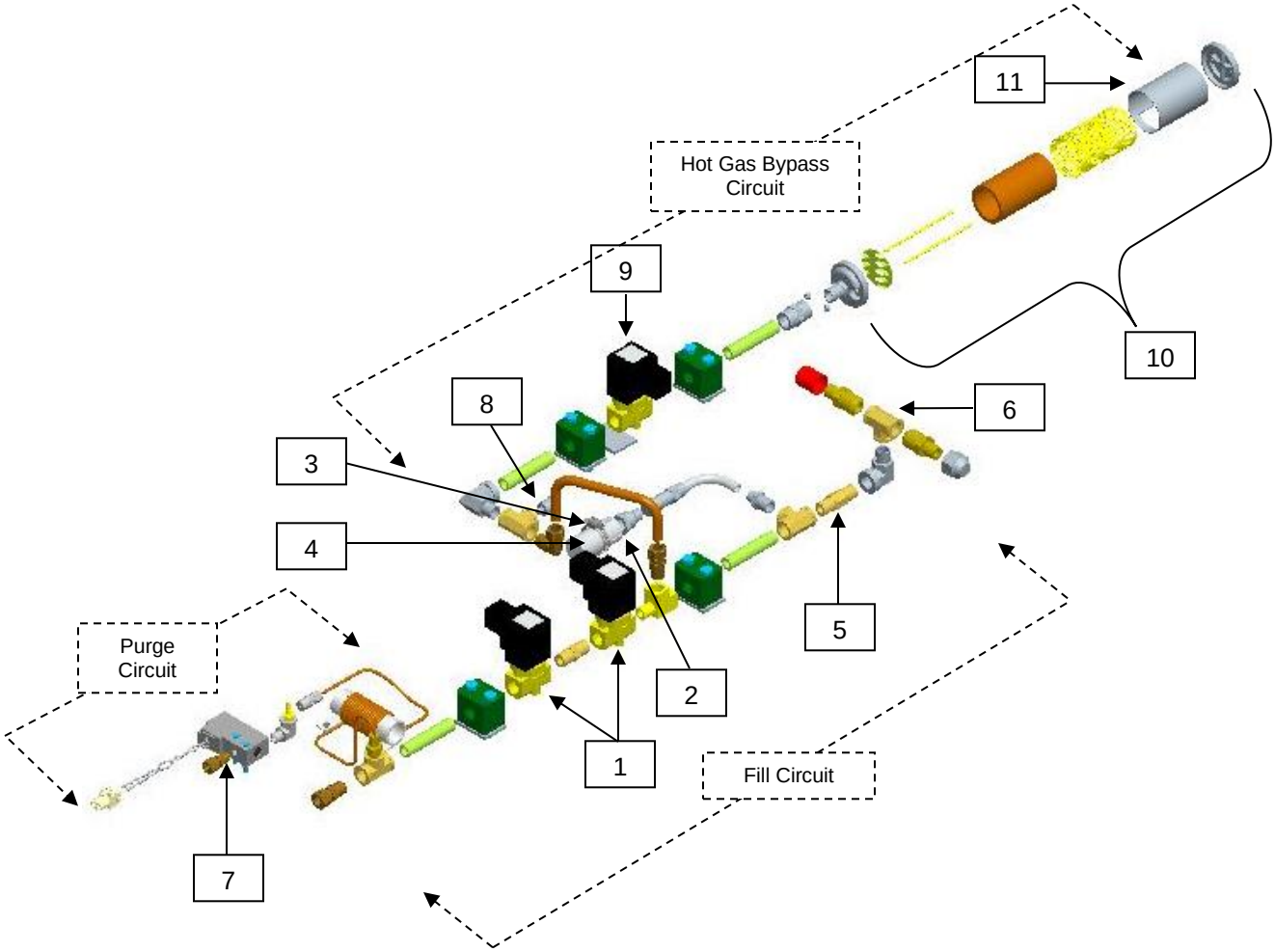
MVE HEco 1500 Series

MVE HEco 1800 Series

4.2. Plumbing Assembly

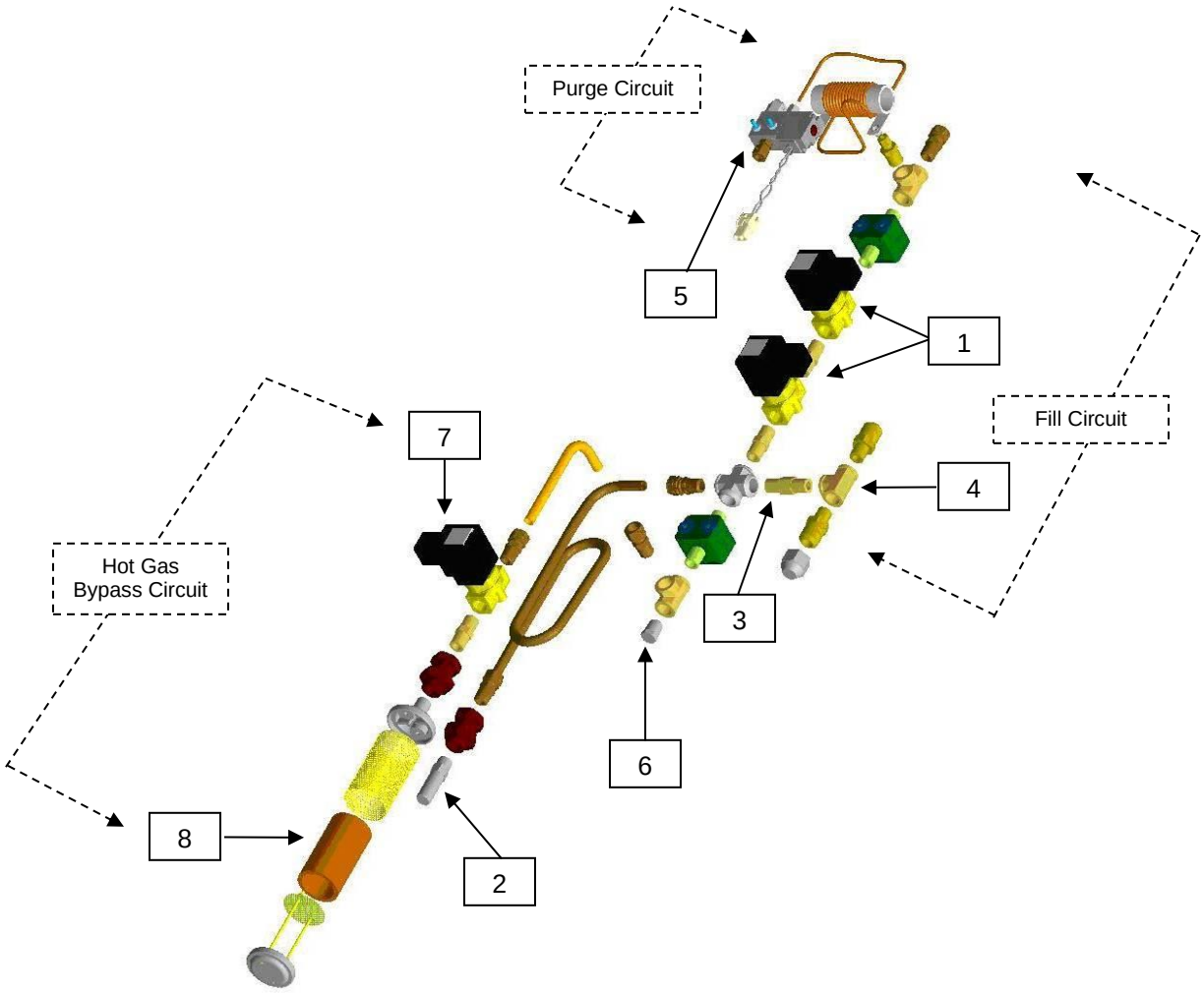
The plumbing assembly carries and regulates the flow of LN2 from the liquid supply through the annular fill line, and into the freezer. The plumbing system is comprised of three main circuits: fill circuit, purge circuit, and gas bypass circuit.

HE Series Plumbing Assembly



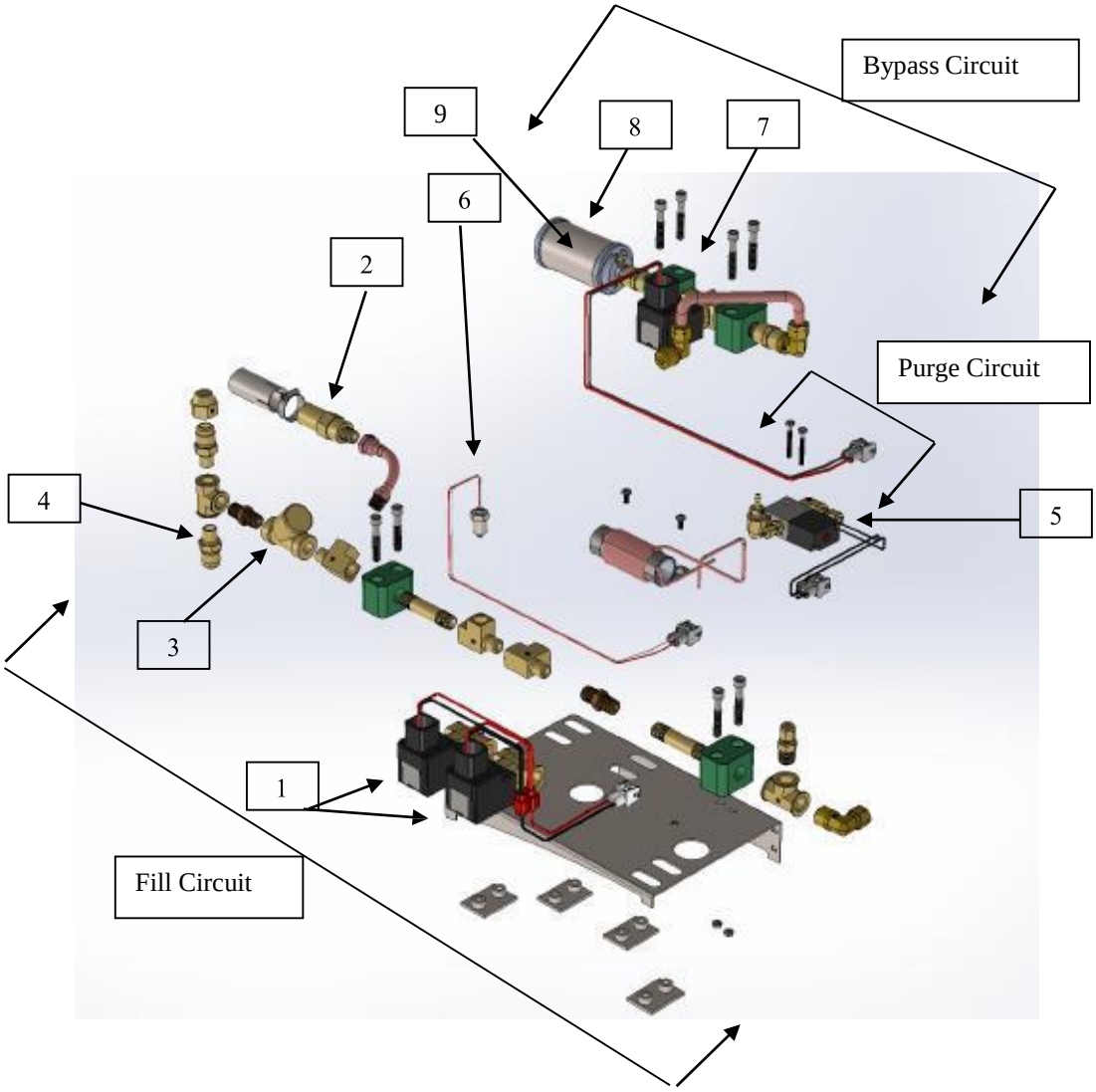
Key	Part Number	Component	Spec Details
1	14224611S	Fill Solenoid Valve	24 VDC, R ≈ 70 Ω (single), 35 Ω (dual)
2	1810032	Pressure Relief Valve (Without Deflector)	50 PSI (3.45 bar)
3	11885431	Hose Clamp (to attach Pressure Relief Valve Deflector)	-
4	11885422	Pressure Relief Valve Deflector	-
5	11648945	Inline Filter	40-micron
6	n/a	Fill Tee – Transfer Hose Connections	½ in. ODT, 45° flare, ¼ in. MPT
7	13284954S	Purge (3-way) Solenoid Valve	24 VDC, R ≈ 140 Ω
8	10713400	Inlet Temp Sensor	Pt-1000 RTD
9	14224611S	Gas Bypass Solenoid Valve	24 VDC, R ≈ 70 Ω
10	11499812	Gas Bypass Muffler (Without Deflector)	-
11	11885449	Gas Bypass Muffler Deflector	-

MVE Series Plumbing Assembly



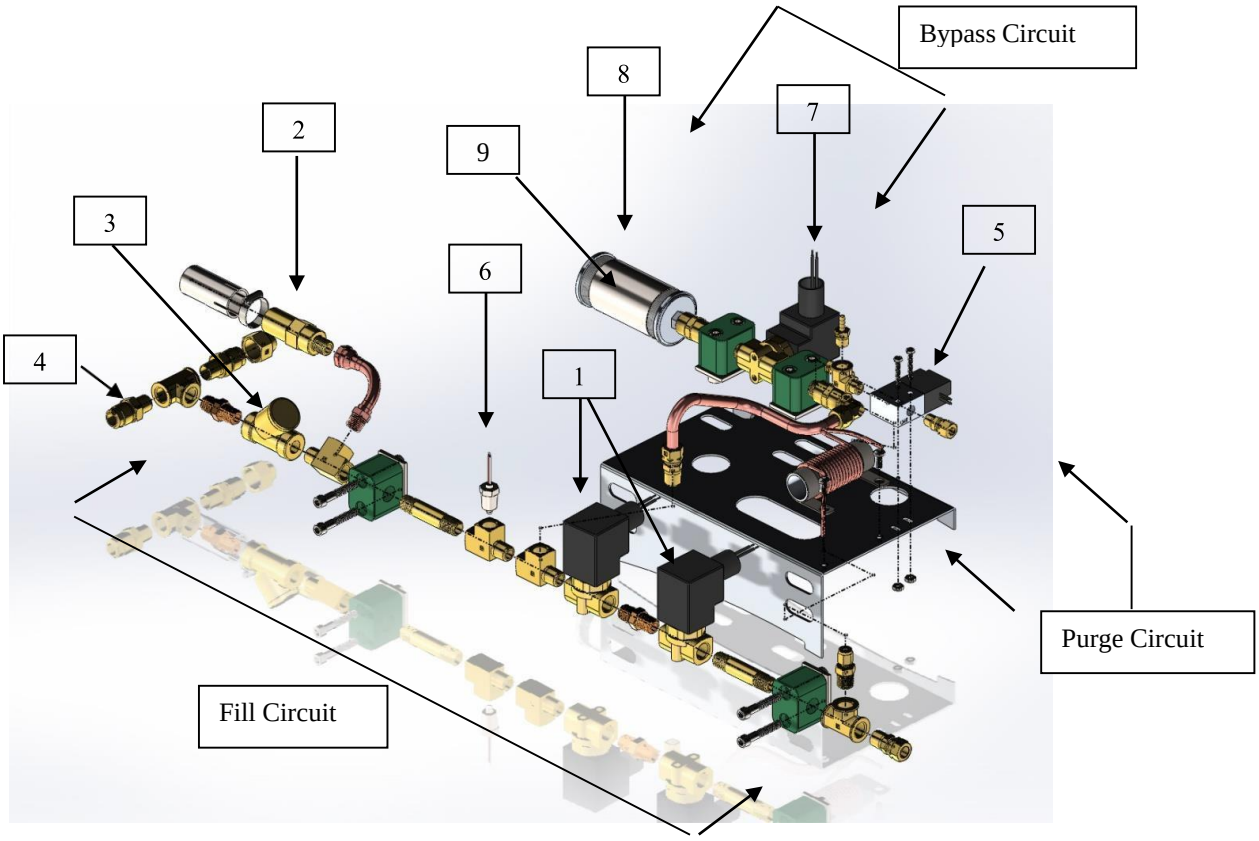
Key	Part Number	Component	Spec Details
1	14224611S	Fill Solenoid Valve	24 VDC, R ≈ 70 Ω (single), 35 Ω (dual)
2	1810032	Pressure Relief Valve	50 PSI (3.45 bar)
3	11648945	Inline Filter	40-micron
4	n/a	Fill Tee – Transfer Hose Connections	½ in. ODT, 45° flare, ¼ in. MPT
5	13284954	Purge (3-way) Solenoid Valve	24 VDC, R ≈ 140 Ω
6	10713400	Inlet Temperature Sensor	Pt-1000 RTD
7	14224611S	Gas Bypass Solenoid Valve	24 VDC, R ≈ 70 Ω
8	11499812	Gas Bypass Muffler	-

HEco 800 Series Plumbing Assembly



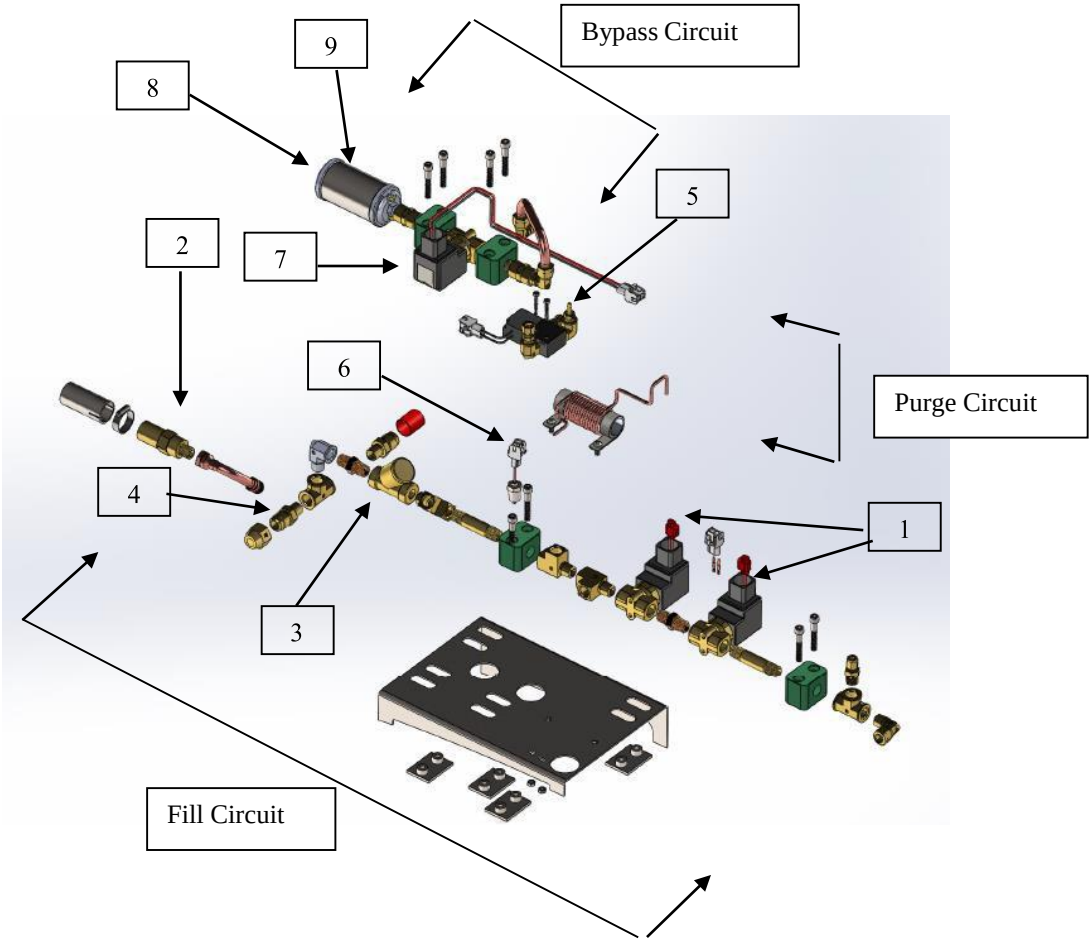
Key	Part Number	Component	Spec Details
1	14224611S	Fill Solenoid Valve	24 VDC, R ≈ 70 Ω (single), 35 Ω (dual)
2	1810032	Pressure Relief Valve	50 PSI (3.45 bar)
3	20669243	Y Strainer (Filter)	40-micron
4	1110052	Fill Transfer Hose Connections	½ in. ODT, 45° flare, ¼ in. MPT
5	13284954S	Purge (3-way) Solenoid Valve	24 VDC, R ≈ 140 Ω
6	10713400	Inlet Temperature Sensor	Pt-1000 RTD
7	14224611S	Gas Bypass Solenoid Valve	24 VDC, R ≈ 70 Ω
8	11499812	Gas Bypass Muffler	-
9	11885449	Gas Bypass Muffler Deflector	-

HEco 1500 Series Plumbing Assembly



Key	Part Number	Component	Spec Details
1	14224611S	Fill Solenoid Valve	24 VDC, R ≈ 70 Ω (single), 35 Ω (dual)
2	1810032	Pressure Relief Valve	50 PSI (3.45 bar)
3	20669243	Y Strainer (Filter)	40-micron
4	1110052	Fill Transfer Hose Connections	½ in. ODT, 45° flare, ¼ in. MPT
5	13284954S	Purge (3-way) Solenoid Valve	24 VDC, R ≈ 140 Ω
6	10713400	Inlet Temperature Sensor	Pt-1000 RTD
7	14224611S	Gas Bypass Solenoid Valve	24 VDC, R ≈ 70 Ω
8	11499812	Gas Bypass Muffler	-
9	11885449	Gas Bypass Muffler Deflector	-

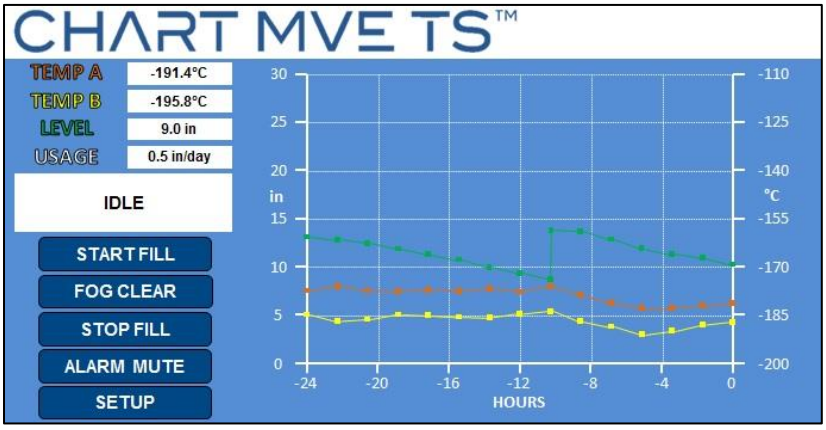
HEco 1800 Series Plumbing Assembly



Key	Part Number	Component	Spec Details
1	14224611S	Fill Solenoid Valve	24 VDC, R ≈ 70 Ω (single), 35 Ω (dual)
2	1810032	Pressure Relief Valve	50 PSI (3.45 bar)
3	20669243	Y Strainer (Filter)	40-micron
4	1110052	Fill Transfer Hose Connections	½ in. ODT, 45° flare, ¼ in. MPT
5	13284954S	Purge (3-way) Solenoid Valve	24 VDC, R ≈ 140 Ω
6	10713400	Inlet Temperature Sensor	Pt-1000 RTD
7	14224611S	Gas Bypass Solenoid Valve	24 VDC, R ≈ 70 Ω
8	11499812	Gas Bypass Muffler	-
9	11885449	Gas Bypass Muffler Deflector	-

4.3. Chart MVE TS Display

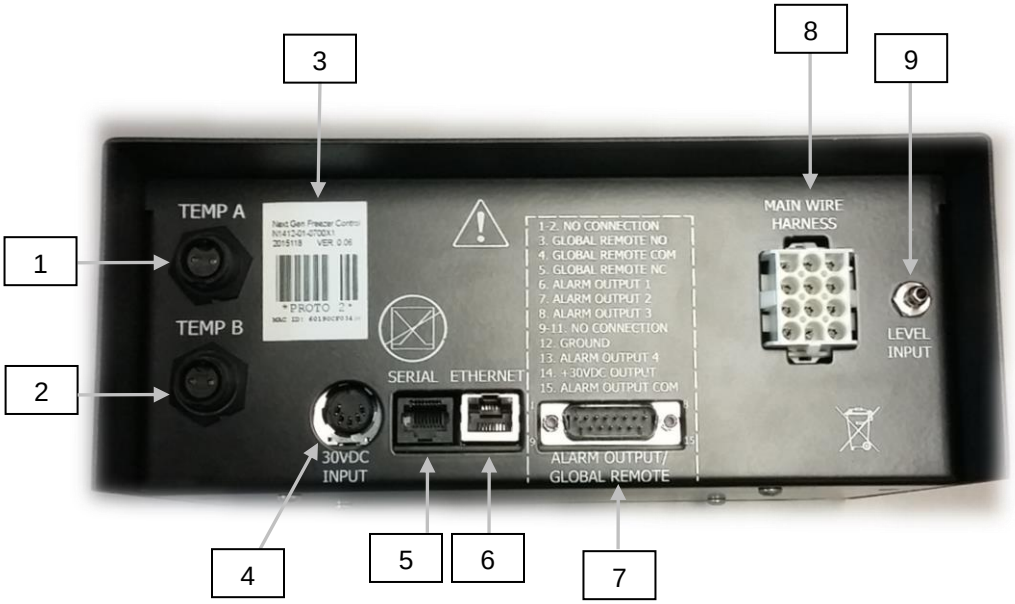
The Chart MVE TS front panel display is the primary user interface for the controller.



Display	7” touchscreen, backlight
START FILL Key	Used to manually initiate a fill
FOG CLEAR Key	As long as this button is held down, the fill solenoid valves are activated. This serves to clear fog from the freezer immediately after opening the lid.
STOP FILL Key	Used to manually terminate a fill – Disables Auto Fill for 30 minutes
SETUP Key	Used to access Setup Menus and parameters
ALARM MUTE Key	Used to silence the audible alarm. Will reset the latching alarm once it has been corrected

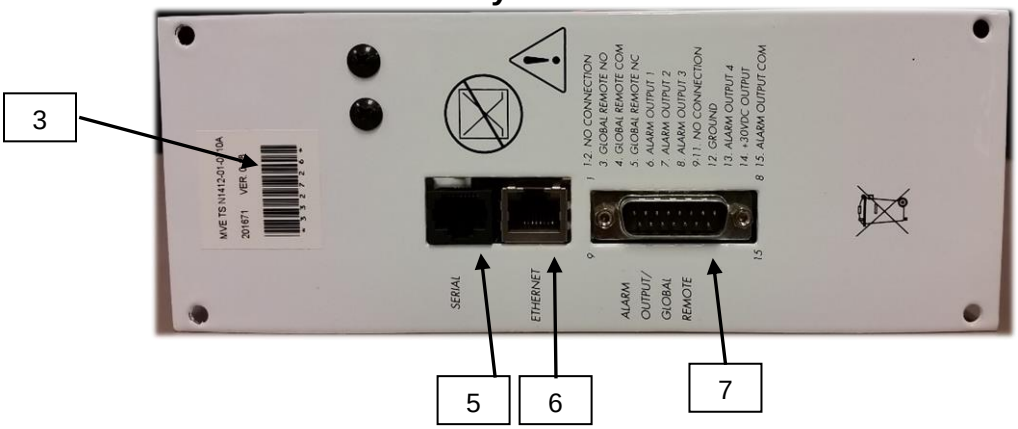
4.4. Chart MVE TS Stand Alone Physical Connections

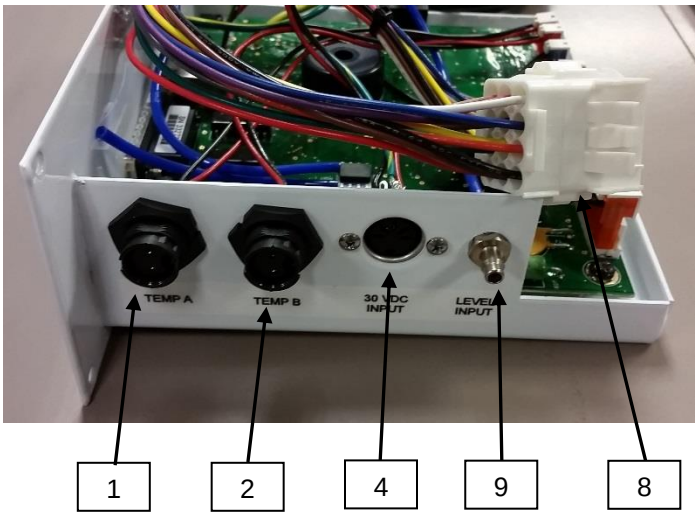
The Chart MVE TS physical and electrical connections are located on the bottom of the stand-alone controller and on the back panel of the HEco controller.



1	Temp A Port	Connection for Temp A probe
2	Temp B Port	Connection for Temp B probe
3	Serial Number Barcode	Chart MVE TS serial number written below barcode
4	30 VDC Power Input	Main power supply connection
5	Serial Port	RJ-45 connection for Serial/COM
6	Ethernet Port	Ethernet connection for networking
7	Alarm Contacts	15 pin alarm output
8	Wire Harness Connection	12-pin wire harness connection to plumbing assembly, lid switch, and battery backup
9	Level Connection	Level signal input. Clear, vinyl tube connects to hose barb

4.4.1. MVE TS HEco Physical Connections




TEMP A
TEMP B
30 VDC INPUT
LEVEL INPUT
1
2
4
9
8

4.4.2. Chart MVE TS 12-Pin Wiring Harness Connections

POSITION	DESCRIPTION	WIRE COLOR	WIRE GAUGE	LENGTH
1	+24VDC BATTERY BACKUP	DARK BLUE	18	50"
2	-24VDC BATTERY BACKUP	ORANGE	18	50"
3	+ LID SWITCH	BLACK WHITE STRIPE	22	96"
4	+ FILL VALVE	BROWN	18	82"
5	- FILL VALVE	PURPLE	18	82"
6	- LID SWITCH	RED GREEN STRIPES	22	96"
7	+ PURGE VALVE	YELLOW	20	48"
8	- PURGE VALVE	RED	20	48"
9	+ IINLET TEMP SENSOR	RED	22	67"
10	+ BYPASS VALVE	BLACK	18	75"
11	- BYPASS VALVE	GRAY	18	75"
12	- INLET TEMP SENSOR	WHITE	22	67"

4.5. Specifications

Chart MVE TS Dimensions (stand-alone)	
Length	9.2 in. (233 mm)
Width	3.6 in. (92 mm)
Height	8.0 in. (203 mm)
Weight	5.5 lbs. (2.5 kg)
Display	
Type	Color LCD touch panel
Size	7” diagonal
Resolution	800 x 480 pixels
Keypad	Resistive Touch Panel
Electrical – Chart MVE TS Only	
Input Voltage	30 VDC
Input Current (max)	2 A
Input Current (continuous)	300 mA
Power Consumption (max)	60 W
Power Consumption (continuous)	9 W
Fill Valve Output Voltage	24 VDC
Short Protection	Current limiting, automatic reset
Electrical – Jerome Power Supply (WSL530M)	
Input Voltage	110 – 240 VAC
Input Frequency	50 – 60 Hz
Output Voltage	30 VDC
Max Current Capability	2 A
Input Current	1.27 A @ 110 VAC 0.61 A @ 230 VAC
Chart MVE TS Physical Connections	
Temperature Probes	2-pin mini-con-x, threaded coupling
Input Power	5-pin DIN
Output Power / Sensors / Battery Backup	12-pin Tyco MATE-N-Lock Receptacle with Pin contacts
Serial Port	RJ-45, 4-pin RS-485
Ethernet Port	RJ-45
Global/Discrete Alarm Output	15-pin D-sub
Temperature Sensor	
Type	2-wire Platinum RTD (Pt-1000)
Quantity	2
Resistance	1000 Ω @ 0°C
Sensitivity	3.85 Ω / °C
Temperature Measurement	
Resolution	0.1°C (0.2°F)
Accuracy – Single Point Calibration *	± 1.0°C (1.8°F)
– Double Point calibration **	± 2.0°C (3.6°F)
Range	- 200°C to 70°C (- 328°C to 158°F)
Level Measurement	
Type	Differential Pressure Sensor
Accuracy	± 0.5 in. (13 mm) LN2
Resolution	0.1 in. (2.5 mm)
Range	3.0 in. to 48 in. (76 mm to 1219 mm)

* Accuracy determined over range of -200°C to -135°C. Accuracy decreases slightly as range increases
** Accuracy determined over a range of -200°C to 0°C. Accuracy decreases slightly as range increases

4.6. Operating Environment

Ambient Temperature and Relative Humidity

MVE cryogenic freezers are designed to be operated in environments near room temperature (65°F – 80°F, 18°C – 27°C) and relative humidity below 50%. Due to the large gradient between LN2 and ambient temperatures, an additional change of a few degrees will not have a significant impact on the freezer performance. Although temperature changes will affect the open top MVE and MVE Stock series freezers to a greater degree, it again will not be a significant effect. The relative humidity should be maintained low enough so that condensation does not form on the Chart MVE TS. Elevated humidity levels can lead to excessive condensation and frost on and around the lid. In situations where the relative humidity is high and uncontrollable, the lid should be routinely wiped dry to prevent ice formation. Should significant ice formation develop, thaw as necessary. Refer to the Preventative Maintenance procedures for details.

Atmospheric Pressure

MVE cryogenic freezers are designed to be operated in environments with atmospheric pressure range of 8.2 psi (57.2 kPa) to 14.7 psi (101 kPa).

Thermal Load

Since MVE Freezers use LN2 as the refrigerant and do not employ any type of mechanical refrigeration, the thermal load will be negligible to negative.

5. Installation and Startup

This section will review the basic receiving, installation, and startup procedures for MVE Freezers. Always inspect the bill of lading for accuracy and external crate/packaging for damage before accepting the shipment.

Included with each full auto freezer:

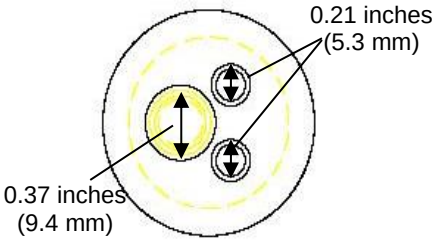
- Literature Packet
  - Chart MVE TS Quick Start Reference Guide – PN 21081123
  - Manual Freezer Status Log – PN 10936355
  - Warranty Statement / Registration / Certificate
- Chart MVE TS – Packaged in box separately for non-HEco models
- Transfer hose – 6 ft. – PN 9713109 – Inside freezer
- MVE Dipstick – Inside freezer
- Desiccant bag – To be removed and discarded – Inside freezer
- Liquid Nitrogen handling instructions
- MVE Certificate of Quality

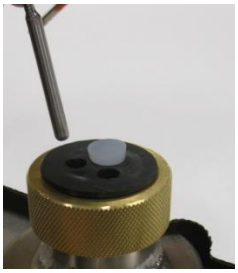
Installation

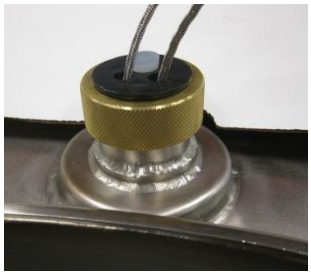
NOTE: Do not apply power to the Chart MVE TS controller or connect an LN2 supply until later in this procedure to avoid injury or damaging the equipment.

Following the careful uncrating and unpacking of the freezer, install using these basic instructions. HEco Series freezers will be shipped with some of the connections described below already installed.

- Locate the temperature sensor tube assembly that will house the two temperature probes. For HE, HEco, and some Stock Series freezers, a three-tube temperature sensor assembly will be installed in the center of the top of the freezer. The two smaller tubes are designed to house the included temperature probes. The third, larger tube is designed to accommodate a third-party temperature probe. A silicone plug will be installed in this third tube. If the third tube is going to be used, simply remove the silicone plug. For the other freezer models, a dual sensor tube will be installed along the inside wall of the freezer storage space.







- Insert the two temperature probes into the sensor tubes and position the sensors at the preferred height in the freezer space. Selecting probe A and B as well as the sensor placement is adjustable and completely up to the user. MVE does recommend placing one sensor at the “top box” level. This refers to the level in the freezer space where the highest sample is being stored. If storing vials in boxes, then this would be at the level with the top box. This is recommended as it will be the warmest temperature experience by samples being stored in the freezer space.
- Connect the temperature probes to the Chart MVE TS temperature ports using the twist lock connectors.

- For HEco models, once the temperature probes are in the desired position the freezer is ready to be filled. Connect transfer hose to its fill source and proceed to step 2 of the first fill start up procedure.
- For HE models, once the temperature probes are in the desired position, apply a small amount of the silicone sealant, included with the freezer, around the temperature probes where they enter the sensor tubes. This will help maintain their positioning as well as keep moisture from entering the freezer storage space through these tubes.
- Connect the clear vinyl tubing to the Chart MVE TS Level Input hose barb.
- Ensure all of the plumbing assembly connections to the Chart MVE TS wire harness are secure.

NOTE: Do not connect the battery backup (if equipped) to the wire harness until later in the installation procedure.

- Connect the 12-pin wire harness to the Chart MVE TS wire harness connection.

- If the freezer is equipped with battery backup measure the voltage at the end connector for approximately 24VDC to 27VDC; if no voltage is present, the included battery fuse must be installed before connecting the battery to the main wire harness. Open the battery enclosure and unscrew the fuse harness. Install the fuse; close the fuse harness

and the battery enclosure. (This is done at the factory but should be verified at installation)

NOTE: Do not connect the battery backup to the main wire harness until the power supply has been verified to power up the controller.

- Plug in the power supply to an appropriate wall outlet with the proper AC voltage. Avoid wall outlets that are connected to emergency generator power if possible. Although an uninterruptible power supply (UPS) is ideal, a surge protector or power conditioner is recommended.
- Plug the power supply into the Chart MVE TS 30 VDC power input. The Chart MVE TS display should illuminate and begin the startup sequence.

- To Avoid risk of electrical shock, this equipment must only be connected to properly grounded power source or outlet
- Following the startup sequence, the Chart MVE TS will start to alarm and initiate a fill. This is normal.
- Press “Alarm Mute” to silence the audible buzzer for 30 minutes. For installation and startup purposes, the alarm buzzer can be disabled; however, be sure to enable it when installation is complete. For instructions, see the Alarm Buzzer page in Section 6 of this manual.
- Connect the battery backup to the main wiring harness. While running on outlet power, the Chart MVE TS supplies a steady 27 VDC trickle charge to the battery backup. The battery backup may need to be charged for several hours before it is able to power the Chart MVE TS.

- Remove a caplug from the fill tee on the plumbing assembly in order to connect the LN2 supply. If using an LN2 cylinder as the liquid supply, securely connect and tighten the transfer hose to both the fill tee connection and the supply connection labeled “LIQUID”. If using a bulk LN2 supply system, securely connect and tighten the supply connection to the freezer fill tee connection.

  NOTE: The recommended LN2 supply pressure is 22-35 psig (1.52 - 2.41 bar).

First Fill Startup

- Once the freezer has been properly installed, begin the first fill procedure.
- Open or remove the lid for the first fill due to the accelerated LN2 evaporation rate when filling a warm freezer. If the freezer is equipped with a lid switch, engage the manual override (see the Lid Switch section of this manual for more info).
- Open the LN2 supply valve and press “Start Fill” to begin filling the freezer.
- The first fill will take significantly longer than subsequent fills due to the freezer being warm.
- It is recommended to place empty inventory system components such as racks, boxes, frames, or canisters in the freezer during the first fill. This will cool the inventory system as well as help the freezer reach its top box temperature rating faster.
- It is normal for some condensation or frost to develop around the neck opening during the initial fill.
- Once the freezer LN2 level has reached the High Fill Setpoint, close or replace the lid and allow the freezer to equilibrate and reach its temperature rating.
- It is recommended that biological samples are not introduced into the freezer until several days after the top box temperature has stabilized at or below the freezer’s temperature rating.
- Refer to the Operations section of this manual for further instructions.

6. Operation

This section of the manual will detail the functions and features of the Chart MVE TS and demonstrate how to access and adjust the various user settings and options.

All MVE Freezers utilize LN2 as the means of refrigeration. Under atmospheric conditions, the temperature of LN2 is -196°C (-320°F, 77 K). Depending on the model, the LN2 resides either in or below the freezer storage space. Through normal usage and time, the LN2 will naturally boil off reducing the amount of refrigerant in the freezer. It is imperative that the LN2 level be properly maintained in order for the storage space temperature to be maintained. This, along with monitoring and recording temperature, is the main function of the Chart MVE TS.

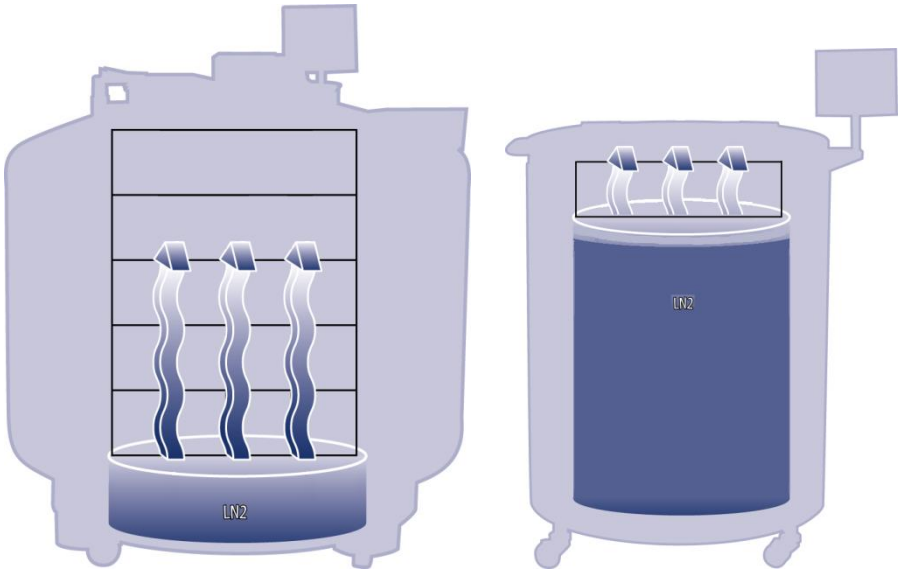


Figure 3: Illustration showing LN2 as the refrigerant. Left: LN2 below the storage space naturally boils off and cools the freezer. Right: LN2 resides in the freezer storage space.

6.1. Functions and Features

The Chart MVE TS utilizes a variety of functions and features that enables it to closely monitor and control the environment inside a cryogenic freezer. This section will give an overview of the following features and their functionality:

- Liquid Nitrogen Level Measurement
- Automatic Liquid Nitrogen Level Control
- Liquid Nitrogen Usage
- Temperature Measurement
- User Defined Alarms
- Passwords/Security
- Communication Capabilities
- Lid Switch
- Hot Gas Bypass
- Battery Backup (Optional)

6.1.1. Liquid Nitrogen Level Measurement

The LN2 level in the Dewar is determined through the use of a differential pressure sensor. This sensor operates on the physical principle of imposed head pressure. The pressure generated by a column of fluid is proportional to the height, or depth, of the fluid column. In this application, the pressure generated by the LN2 at the bottom of the freezer will increase as the LN2 level increases. This differential pressure system allows the controller to measure the exact LN2 level accurately.

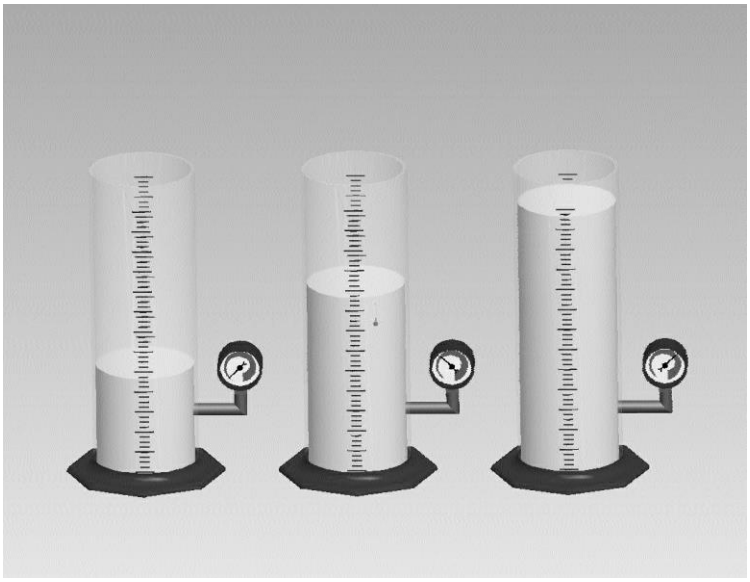


Figure 4: As the fluid level in the cylinder increases, the imposed head pressure at the bottom of the cylinder increases proportionally. The pressure gauges measure this increase in level.

This pressure signal generated by the LN2 is transmitted from the bottom of the inner vessel through the freezer's annular line to the differential pressure sensor inside the Chart MVE TS controller. The Chart MVE TS controller then compares this pressure signal to its atmospheric pressure readings and is then able to determine the exact LN2 level. The term "differential pressure" refers to the fact that the level is determined from the difference between the imposed head pressure of the fluid column and atmospheric pressure. The measured LN2 level is displayed in inches or millimeters.

Unlike alternative level sensing systems, such as thermocouple based systems, differential pressure allows the exact level to be measured and displayed, not just a level range. This completely enclosed system requires minimal maintenance and is not affected by humidity, moisture, or other environmental variables. Also, the differential pressure system allows the automatic level settings and alarms to be set and adjusted electronically instead of having to physically move sensors.

For more details on the liquid level measurement system, see the Specifications section of this manual.

6.1.2. Automatic Liquid Nitrogen Level Control

The Chart MVE TS is equipped with a fully automated LN2 level control system. This level control system is based on user-defined parameters that can be adjusted to maintain a LN2 level in a freezer over a range of 3.0 inches (76 mm) up to 48.0 inches (1219 mm). Since this control system utilizes the differential pressure system described previously, these parameters can be adjusted electronically using the Chart MVE TS keypad or remotely through a networked computer. This automatic fill control feature can be disabled. Below is a brief explanation of the four user-defined level control parameters. For instructions on accessing and adjusting the level control settings, see the Liquid Level Setpoints and Alarms section.

- **High Level Alarm** – If the LN2 level in a freezer reaches or exceeds this setting, a High Level Alarm will result. This will cause an audible/visual alarm on the display and cause the global remote contacts to switch to alarm state. If one of the programmable alarm outputs is assigned to this alarm condition, this contact will switch to alarm state.
- **High Level Setpoint –** When the LN2 level in a freezer reaches this setting (with or without automatic fill enabled) the controller will close the fill valves and terminate the fill.
- **Low Level Setpoint** – When the LN2 level is at or below this setting (with automatic fill enabled) the controller will initiate a filling cycle.
- **Low Level Alarm** – If the LN2 level in a freezer is at or below this setting, a Low Level Alarm will result. This will cause an audible/visual alarm on the display and cause the global remote contacts to switch to alarm state. If one of the programmable alarm outputs is assigned to this alarm condition, this contact will switch to alarm state.

NOTE: Certain events can temporarily disable Auto Fill Control. Pressing “Stop Fill” will disable Auto Fill Control for 30 minutes. In the event of a Fill Time Alarm, Auto Fill Control will be disabled until the respective alarm is cleared by pressing “Alarm Mute” or restarting the controller.

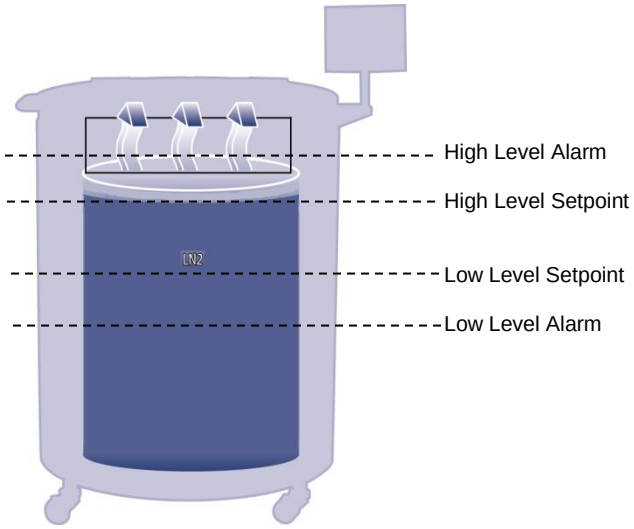


Figure 5: Example of automatic level control parameters

6.1.3. Liquid Nitrogen Usage

The Chart MVE TS controller is able to calculate and display an estimated rate of LN2 evaporation inside a freezer. This liquid usage is displayed in inches or millimeters per day. It takes time for the real-time data to accumulate in order for the liquid usage rate to be calculated.

The liquid usage is calculated by measuring the time it takes the LN2 level in a freezer to decrease 0.5 inches (12.7 mm) and then extrapolating that value out to a 24 hour period in order to obtain a per day liquid usage.

For example:
If it takes 12 hours for the LN2 level to decrease 0.5 inches, then the displayed liquid usage will be 1.0 inch/day.

$$Liquid\ Usage = \left(\frac{0.5\,inches}{12\,hours} \right) \times 2 = \frac{1.0\,inch}{24\,hours} = 1.0\,inch/day$$

This calculation is suspended during fills and will resume 15 minutes after a fill to allow the LN2 in the freezer to settle and approach equilibrium. The liquid usage calculation can be reset by restarting the controller or cycling the power. For liquid usage display options, refer to the Liquid Nitrogen Level Options section.

NOTE: Several scenarios can lead to a temporarily exaggerated liquid usage:

- If the level abruptly decreases 0.5 inches
- Having the freezer lid off for an extended period of time
- Adding or removing samples and racks
- Attempting to fill from an empty LN2 supply
- Moving the freezer

All of these scenarios can lead to an accelerated evaporation rate. Although the liquid usage is an accurate estimate of the daily evaporation rate, it can be temporarily skewed by certain events; however, because of method used to calculate the usage, it will recover as more data is acquired.

6.1.4. Temperature Measurement

The Chart MVE TS is equipped with two independent temperature measurement channels. They are designed to be used with 1000 ohm platinum RTD temperature probes, also referred to as Pt-1000 RTDs. The electrical resistance of the very fine platinum wire in these probes changes linearly with temperature. Platinum's very linear relationship between resistance and temperature makes Pt-1000 RTDs ideal for temperature measurement in cryogenic environments. The temperatures displayed on the Chart MVE TS LCD are not real-time readings, but rather a running average of the previous few measurements. The Chart MVE TS takes temperature measurements several times a second and then averages the previous few measurements while updating the displayed temperature every second. The optional inlet temperature sensor is also a Pt-1000 RTD.

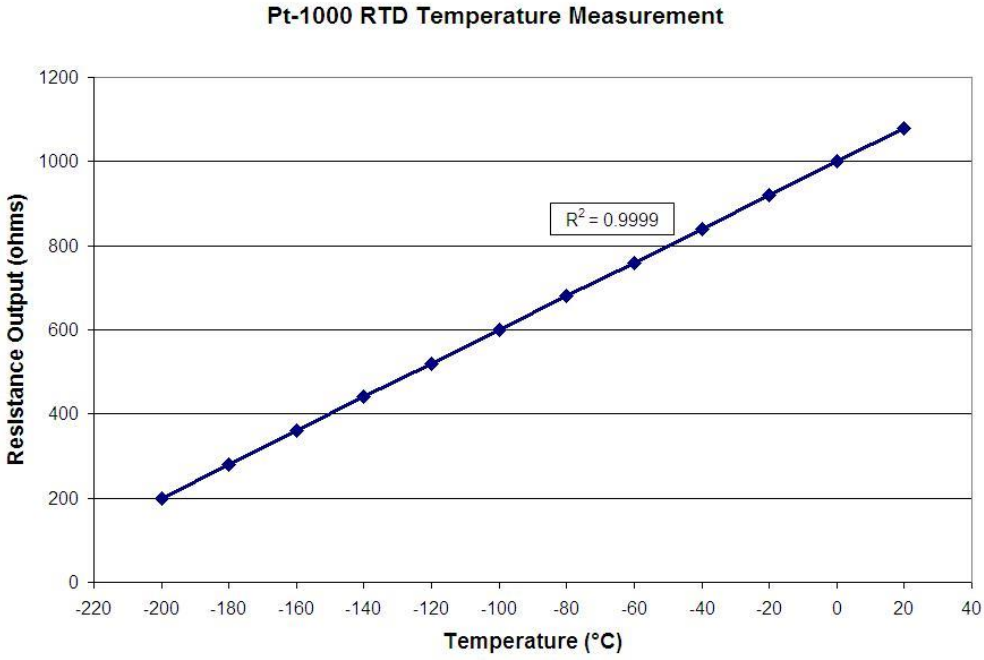


Figure 6: Platinum's linear relationship between temperature and resistance

6.1.5. Alarms

The Chart MVE TS employs 17 different audible/visual alarms. These alarms are designed to alert the user to possible problems with the freezer temperature, LN2 level, controller power, and LN2 supply. In the event that a condition triggers an alarm, an audible buzzer will sound, that particular alarm will appear on the Chart MVE TS LCD display, and the global remote alarm contacts will switch to alarm state.

To clear an alarm, first correct the condition and then press the “Alarm Mute” key. If the alarm condition is still present, then pressing the “Alarm Mute” key will only mute the audible buzzer for 30 minutes. The condition must be corrected in order to clear the alarm.

NOTE: Most Chart MVE TS alarms have a one minute delay to avoid false positive or nuisance alarms. * denotes alarms that do not have a one minute time delay.

Table 1: Chart MVE TS alarms and descriptions

Alarm Display	Description
High Temp A*	Temperature A is reading at or above the Temp A High Alarm setting
High Temp B*	Temperature B is reading at or above the Temp B High Alarm setting
Low Temp A	Temperature A is reading at or below the Temp A Low Alarm setting
Low Temp B	Temperature B is reading at or below the Temp B Low Alarm setting
High Level	LN2 level is at or above the High Level Alarm setting
Low Level	LN2 level is at or below the Low Level Alarm setting
Usage Warning	Liquid Usage rate doubles within a 24 hour period (only shown in the event log)
Usage Alarm	Liquid Usage increases by a factor of 5 within a 24 hour period
Fill Time	Fill cycle has not completed within the Maximum Fill Time setting (Auto fill is disabled until this alarm is cleared)
Bypass Time Alarm*	Hot Gas Bypass cycle has not completed within the Bypass Alarm Time Delay setting (Once the subsequent fill has ended, auto fill will be disabled until this alarm is cleared)
Temp A Calibration*	Temperature A is reading lower than absolute zero (-273°C / -460°F / 0 K)
Temp B Calibration*	Temperature B is reading lower than absolute zero (-273°C / -460°F / 0 K)
Bypass Calibration*	Bypass Temperature sensor is reading lower than absolute zero (-273°C / -460°F / 0 K)
Low Battery	Backup Battery voltage has dropped below 21 VDC
Power Failure	Chart MVE TS main power has been disconnected and it has been running on battery power for 30 minutes
Lid Open	Freezer lid has been open longer than Lid Open Alarm Time setting
Communication Loss	Chart MVE TS controller has lost communication with the LCD display
*Stuck Valve Alarms	When the freezer is supposed to be filling, if the controller does not see an appropriate decrease in temperature, within the delay time entered in the menu, a stuck closed valve alarm will be initiated. After the freezer is supposed to have stopped filling, if the controller does not see an appropriate increase in temperature, within the delay time entered in the menu, a stuck open valve alarm will be initiated. *(Feature is only available on HEco Models)

If any alarms occur, contact your authorized MVE Distributor or Technical Service.

6.1.6. Remote Alarm Monitoring

The Chart MVE TS is equipped with a global remote alarm relay and four programmable alarm outputs that allow remote monitoring of alarm conditions. These contacts are in the form of a male 15-pin D-sub connection on the controller panel. Once activated, these latching contacts will retain their alarm state until the alarm condition is corrected and cleared. Although Chart MVE does not provide remote monitoring or programmable logic controller (PLC) systems, these devices can be easily connected to the Chart MVE TS. For example, it is possible to setup a Chart MVE TS so that if a Low Level Alarm is triggered, the remote monitoring system will automatically send an email or place a call to alert the necessary individuals of the freezer's status. For alarm contact test procedures, refer to the Remote Alarm Tests section. Below are the remote alarm contact specifications and a typical remote monitoring setup schematic.

Figure 7: Chart MVE TS remote alarm contacts

Table 2: Chart MVE TS remote alarm contact specifications

Programmable Alarm Outputs	Global Remote
Normally Open or Normally Closed	Normally Open or Normally Closed
Dry Contact Relay	Dry Contact Relay
Latching	Latching
Non-Polarity Sensitive	Non-Polarity Sensitive
24 VDC max at 100 mA max per channel	24 VDC at 1 A max

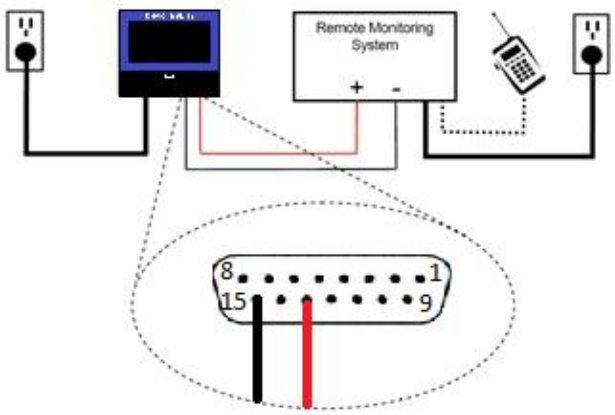
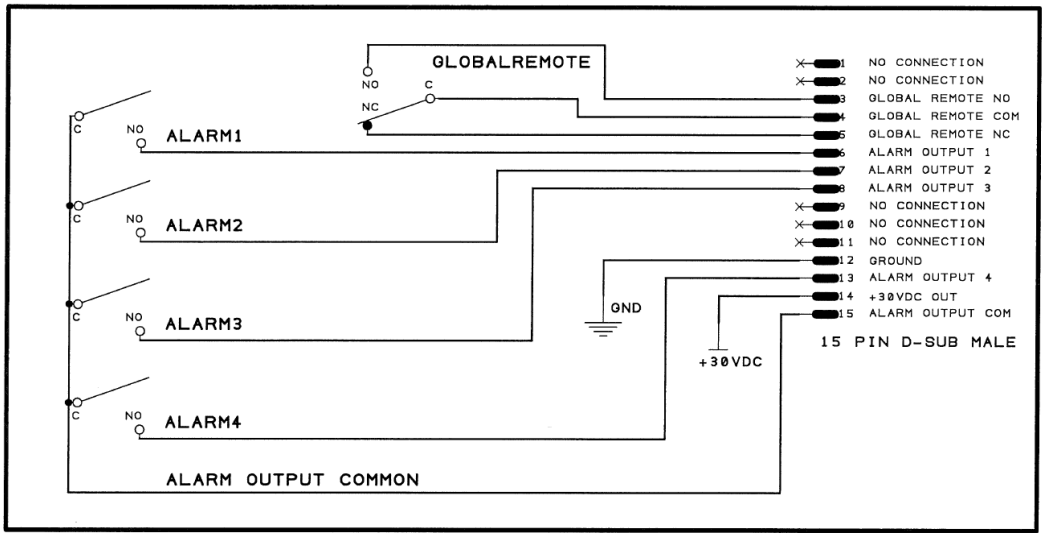


Figure 8: Typical remote alarm monitoring setup schematic. Programmable Alarm Output 4 monitoring shown.



The Global Remote activates a signal when any alarm state is active, allowing the user to trigger an external device. It consists of three connections: Common (COM), Normally Open (NO), and Normally Closed (NC). The user may connect an external signal (0-24 VDC, < 100 mA) to the Common terminal. When there are no active alarms, the Common terminal is connected to the Normally Closed terminal. If any alarms are active, an internal relay switches to connect the Common terminal to the Normally Open terminal instead.

The four programmable alarm outputs may be configured by the user. One ALARM OUTPUT COMMON signal is shared by these four alarms. The user may connect an external signal (0-24 VDC, < 100 mA) to the ALARM OUTPUT COMMON signal. This voltage is connected and disconnected from the four Alarm Output terminals depending on the user-programmable settings. Each of the four alarm outputs may be assigned to one of seven possible alarm conditions:

- High Temp A
- High Temp B
- High Level
- Low Level
- Lid Open
- Usage
- Stuck Valve

Each of the four programmable alarms may be set to either Active Open or Active Closed logic.

Active Open:

The alarm output is disconnected from the ALARM OUTPUT COMMON while the alarm is active.

The alarm output is connected to ALARM OUTPUT COMMON while the alarm is not active.

Active Closed:

The alarm output is connected to ALARM OUTPUT COMMON while the alarm is active.

The alarm output is disconnected from the ALARM OUTPUT COMMON while the alarm is not active.

6.1.7. Passwords / Security

The Chart MVE TS has a multilevel security system that can be customized to meet your security needs. Four different levels of security can be assigned to 10 passwords allowing users to control which users have the ability to change specific settings as well as to what extent these settings may be altered.

For example, in a tissue bank or repository that employs many technicians, the facility manager may want to restrict the technicians' access to allow them to view alarm settings, but not have the ability to adjust the settings. In this situation, the technicians would be assigned a password with low level security privileges. Conversely, if the shift manager wants to have complete access to all menus and settings, then he/she would be assigned a password with high level security privileges.

Password entry mode can be disabled in the Password Menu. For more information on passwords and security, refer to the Passwords / Security Setup section.

Table 3: Password security levels and descriptions. X denotes access to adjust setting.

Feature	Not Password Protected	Level 1	Level 2	Level 3	Level 4
Start Fill	X				
Stop Fill	X				
Alarm Mute	X				
Quick Reference Settings	X				
Temp and Level Display Units		X	X	X	X
Display Liquid Usage		X	X	X	X
Enable / Disable Temp Sensors			X	X	X
Temp Alarm Settings			X	X	X
High Temp Alarm Test			X	X	X
Lid Switch Settings			X	X	X
Hot Gas Bypass Settings			X	X	X
Enable / Disable Alarm Buzzer			X	X	X
Level Control / Alarm Settings			X	X	X
Date/Time			X	X	X
Language Settings			X	X	X
Printer Settings			X	X	X
Temp Calibration			X	X	X
Level Calibration				X	X
Enable / Disable Auto Fill				X	X
Timed Fill Settings				X	X
OFAF Settings				X	X
Communication Settings				X	X
Reset to default settings				X	X
Password Settings					X

Forgot your password? Contact your authorized MVE Distributor or Technical Service.

6.1.8. Communication / Networking Capabilities

The Chart MVE TS RS-485 Serial interface offers several advanced communication capabilities. The Chart MVE TS is equipped with one RJ-45 serial port for connection to another MVE controller, PC, serial printer, or other RS-485 device. Up to 100 Chart MVE TS controllers can be successfully networked.

The Chart MVE TS is equipped with an Ethernet port for connection to a local area network (LAN).

NOTE: The Chart MVE TS should never be connected directly to a public telecommunications network.

Below is a summary of the different communication / networking capabilities:

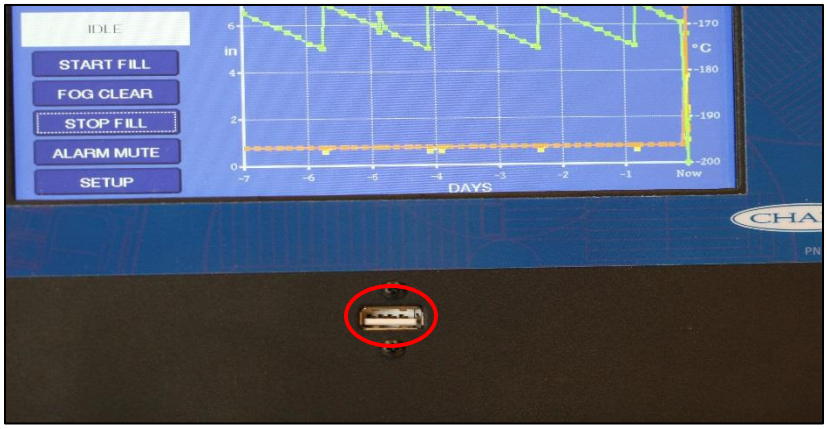
- **Host Computer –** The Chart MVE TS can communicate with a computer via an RS-485 converter and TEC Connect. Through the use of simple ASCII commands, all Chart MVE TS settings and functions can be monitored and adjusted with these software programs. In addition to ASCII communication, TEC Connect also offers a user-friendly event log downloader. The event log is downloaded as a comma separated variable (.csv) file that can be opened in EXCEL. Either a single controller or a network of controllers may be connected to a host computer. For more information on computer communication capabilities, refer to the Communication / Networking section.
- **Serial Printer –** The Chart MVE TS can be connected directly to a serial printer via an RS-485 converter. This allows controller events to be printed as they occur. This gives users the opportunity to keep hard-copy records of the freezer's status in addition to the standard event log saved in the controller's memory. This printed data bypasses the controller memory and is not given the opportunity to be altered electronically. For more information on the printer interface, refer to the Communication / Networking section.
- **MODBUS –** The Chart MVE TS has RS-485 MODBUS communication capabilities. This will not be extensively covered in this manual. Please contact your MVE Distributor or Chart MVE Technical Service for more information.
- **One Fill All Fill (OFAF) –** A group of Chart MVE TS's can be networked in order to coordinate fill cycles and reduce LN2 transfer losses. For locations with multiple freezers, this function will increase the filling efficiency and drastically reduce LN2 consumption over time. A sequential or simultaneous OFAF network is possible. For more information on OFAF networking, refer to the Advanced Filling Options section.

6.1.9. Event Log

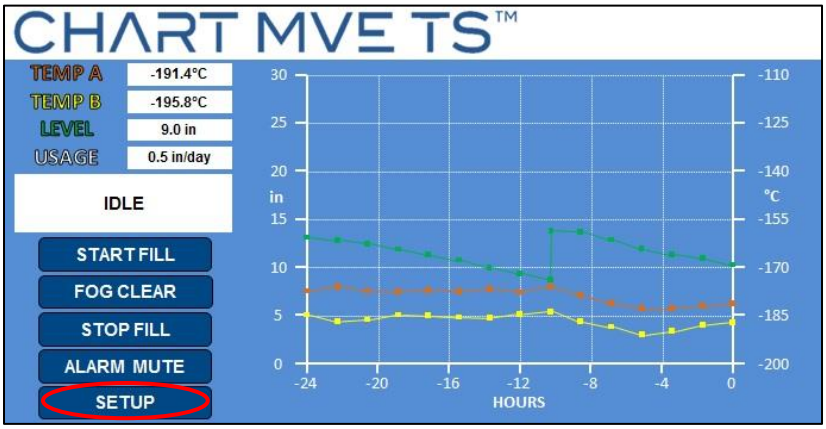
The Chart MVE TS has a built-in data logging feature that automatically stores vital, time-stamped information including temperatures, LN2 level, liquid usage, and any alarms. Data is logged at a user-defined interval and anytime an event or alarm status changes. The default log interval is 4 hours. The Chart MVE TS is able to store up to 30,000 events in its non-volatile memory. With the default 4 hour log interval, the Chart MVE TS is able to store approximately 10 years worth of data. This event log can be easily downloaded from the controller using the USB port on the front of the controller or via TEC Connect. This downloaded file is a .csv file that can be opened, analyzed, and plotted in EXCEL. Besides being a record of the freezer status, the event log is a vital tool for diagnosing problems or detecting potential problems with a freezer. Directions for downloading the event log directly to a USB drive are shown below. For instructions on how to download the event log with TEC Connect, refer to the Communication / Networking section of this manual.

Downloading the event log via USB:

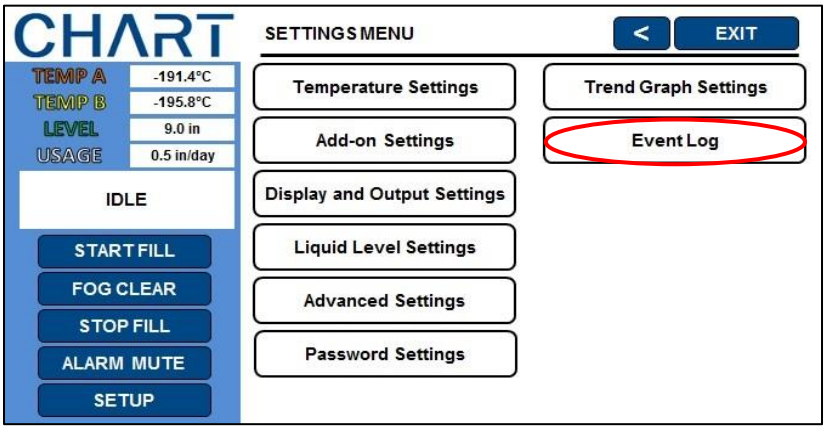
1. Insert a USB drive with sufficient space into the USB port on the front of the controller.



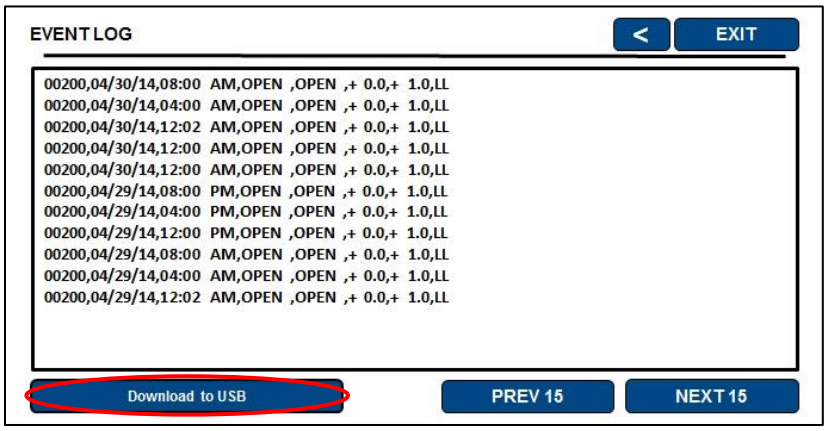
2. Press “Setup” form the main menu. The user may be prompted to enter a password to continue.



3. Navigate to the “Event Log” menu on the controller.



4. Press “Download to USB”. Saving the event log may take several minutes. Once the transfer is complete the USB can be removed. The first 6 digits of the filename will be the controller SN, followed by a two digit placeholder number.



NOTE: Since the event log is stored in non-volatile memory, it will be retained when the controller loses power, is restarted, if the firmware is updated, or when the event log is downloaded. If the event log memory is exceeded, the oldest event will be deleted to make space for the most recent event.

Below is a sample event log and a list of event codes. The events are logged so that Record #1 is the most recent event logged. The event parameters are logged in the units and format of that respective category. For example, if the Chart MVE TS temperature units are set to be in degrees Celsius, then the temperature will be logged in degrees Celsius. If the time is set to a 24 hour clock, then the event log times will be in that format. Parameter changes will be logged as a string such as "Parameter number 126 changed from 60 to 180." Contact your MVE Distributor or Chart MVE Technical Service for information regarding these parameter changes.

Event	Unit ID	User	Date	Time	Temp A	Temp B	Level	Usage	Status
105	200	0	06/29/16	12:02 PM	-197.5°C	-197.5°C	3.8 in	1.1 in/day	BY
106	200	0	06/29/16	12:00 PM	-197.5°C	-197.5°C	5.5 in	1.1 in/day	
107	200	0	06/29/16	08:00 AM	-197.5°C	-197.5°C	5.7 in	1.3 in/day	
108	200	0	06/29/16	04:00 AM	-197.5°C	-197.6°C	6.0 in	1.3 in/day	
109	200	0	06/29/16	12:00 AM	-197.5°C	-197.5°C	6.2 in	1.3 in/day	
110	200	0	06/29/16	12:00 AM	-197.5°C	-197.5°C	6.1 in	1.3 in/day	ZO
111	200	0	06/29/16	12:00 AM	-197.5°C	-197.5°C	6.1 in	1.3 in/day	
112	200	0	06/28/16	08:00 PM	-197.5°C	-197.5°C	6.3 in	0.0 in/day	
113	200	0	06/28/16	04:00 PM	-197.5°C	-197.5°C	6.5 in	0.0 in/day	
114	200	0	06/28/16	12:41 PM	-197.5°C	-197.6°C	6.7 in	0.0 in/day	
115	200	0	06/28/16	12:36 PM	-197.5°C	-197.5°C	6.7 in	0.0 in/day	PF
116	200	0	06/28/16	10:11 AM	Parameter 40104 changed from 4 to 6				
117	200	0	04/28/16	10:11 AM	Parameter 40105 changed from 27 to 28				
118	200	0	04/27/16	10:11 AM	Parameter 40103 changed from 65 to 16				

Figure 7: Sample event log download

Table 4: Chart MVE TS Event Log Codes

Event Code	Description
AM	Alarm Mute
AH	Temp A High Alarm
AL	Temp A Low Alarm
BB	Running on battery power
BH	Temp B High Alarm
BL	Temp B Low Alarm
BP	Bypass Sensor Open
BV	Low Battery Voltage Alarm
BY	Hot Gas Bypassing
CA	Temp A Calibration Alarm
CB	Temp B Calibration Alarm
CG	Bypass Sensor Calibration Alarm
CL	OFAF Network Communication Loss
F	Filling
FD	Fill Disabled
FT	Fill Time Alarm
HG	Hot Gas Bypass Time Alarm
LH	High Level Alarm
LL	Low Level Alarm
LO	Lid Open Alarm
PF	Power Failure
US	Liquid Usage Alarm
ZO	Level Zeroing

6.1.10. Lid Switch

The Chart MVE TS has the ability to support a lid switch. This additional feature allows the user to disable filling while the lid is open, utilize the Lid Open Alarm, or initiate an automatic fog clear. A lid switch comes standard on all MVE Series freezers. There are two variations of the lid switch: the standard UL lid switch and the optional fog clear lid switch. The difference in their functionality is based on how they are wired to the Chart MVE TS.

- **Standard UL Lid Switch –** The UL lid switch, which comes standard on MVE Series freezers, is wired directly in series with the fill valves. With this arrangement, when the lid is open and the lid switch is disengaged, the fill valves cannot be energized. When the lid is down and the lid switch is engaged, the fill valve circuit is closed and the valves can be energized. The functionality of the UL lid switch is independent of the settings in the lid switch menu of the Chart MVE TS since it is hardwired into the fill valve circuit. MVE's UL listing stipulates that the models in these two series must have the lid switch hardwired in series with the fill valves when it leaves the factory to be compliant. The fog clear and lid open alarm features are not available with the UL lid switch. It is available for users to easily adapt their UL lid switch to a fog clear lid switch and acquire these features. Contact your MVE Distributor or Chart MVE Technical Service for instructions.

  NOTE: The standard UL Lid Switch is not controlled by the Chart MVE TS Lid Switch Menus and the Lid Switch Installed option should be set to "NO".

- **Optional Fog Clear Lid Switch –** The optional fog clear lid switch is connected directly to the Chart MVE TS wire harness lid switch connector and is not wired in series with the fill valves. This lid switch arrangement is controlled by the settings in the lid switch menu of the Chart MVE TS, which include the fog clear feature and the Lid Open Alarm. With the fog clear feature enabled, the freezer will fill for 30 seconds each time the lid is opened, which clears the fog and improves visibility. The Lid Open Alarm feature allows the user to set a maximum time that the lid can remain open before an alarm is triggered. For instructions on adjusting the lid switch settings, refer to the Optional Features section.

  NOTE: Converting from the standard UL Lid Switch to the optional Fog Clear Lid Switch voids the UL compliance and requires that the UL mark be removed from the freezer.

  NOTE: The optional Fog Clear Lid Switch is controlled by the Chart MVE TS Lid Switch Menus.

NOTE: Both lid switch arrangements do have an override feature. Simply pull up on the lid switch until it clicks to engage the manual override.

6.1.11. Hot Gas Bypass

The Hot Gas Bypass is able to vent the warm nitrogen gas from the supply line before initiating a fill cycle. This prevents warm gas from entering the freezer space. The bypass system helps to maintain a stable temperature gradient inside the freezer and increases the efficiency by preventing excess LN2 evaporation while filling. This feature is advantageous for any freezer setup and is especially ideal for sites where longer transfer hoses cannot be avoided.

The Hot Gas Bypass system consists of these components:

- Solenoid Valve (24 VDC)
- Temperature sensor (Pt-1000 RTD)
- Muffler
- Plumbing and electrical connections

Freezers with the Hot Gas Bypass installed and enabled will complete a bypass cycle prior to filling. When a fill is initiated, the bypass solenoid valve will open first and begin venting nitrogen gas from the supply line through the muffler. The Chart MVE TS monitors and displays the temperature in the plumbing system throughout the bypass cycle. As LN2 begins flowing, the temperature in the plumbing system will decrease. Once the bypass temperature sensor readings reach the user-defined Inlet Temperature Setpoint, the bypass solenoid valve will close terminating the bypass cycle. The fill solenoid valves will then open and the freezer will begin filling. The default Inlet Temperature Setpoint is -70°C and can be adjusted.

The Bypass Alarm Time Delay is the maximum allowable bypass time. If the temperature in the plumbing system does not reach the Inlet Temperature Setpoint within the Bypass Alarm Time Delay setting, the Chart MVE TS will terminate the bypass cycle, initiate the fill cycle, and trigger a Hot Gas Bypass Time Alarm. Once the immediate fill cycle is complete, auto fill will be disabled until the Hot Gas Bypass Time Alarm is acknowledged. This feature prevents a freezer from continuing to attempt to fill from an empty supply. A Hot Gas Bypass Time Alarm could be a sign of an empty supply, a supply with too low of pressure, or it could mean that the Bypass Alarm Time Delay needs to be increased in order to effectively purge the supply line of nitrogen gas. The default Bypass Alarm Time Delay is 5 minutes, but should be adjusted based on the freezer setup. It should be arranged so that the Inlet Temperature Setpoint is easily reached within the Bypass Alarm Time Delay setting. Refer to Inlet Temp Settings 7.2.4 (page 64 to adjust the Hot Gas Bypass settings.

6.1.12. Stuck Valve Alarm

This feature requires that the bypass sensor be relocated into the main plumbing assembly instead of in the bypass plumbing branch so that it can monitor the temperature of the incoming supply stream when the bypass is not active. The controller will monitor the gas bypass sensor during and after filling.
When the freezer is supposed to be filling, if the controller does not see an appropriate decrease in temperature, within the delay time entered in the menu, a stuck closed valve alarm will be initiated. After the freezer is supposed to have stopped filling, if the controller does not see an appropriate increase in temperature, within the delay time entered in the menu, a stuck open valve alarm will be initiated.
These alarms are enabled together. They cannot be selectively enabled / disabled.
Refer to the Inlet Temp Settings 7.2.4 (page 64) to change Stuck Valve Alarm settings.

6.1.13. Battery Backup (Optional)

The Battery Backup is an optional feature on all MVE freezers equipped with a Chart MVE TS. The Chart MVE TS is able to run seamlessly on power from this external battery system when the primary power source is interrupted. The Chart MVE TS is able to run fully functional on the Battery Backup for approximately 48 hours in the event of a power failure. Non-essential circuits are disabled first to conserve power.

The battery status can be viewed in the Add-on Menus. With a Battery Backup connected while the controller is running on main power, the battery status screen will read enabled. While running on Battery Backup, the battery status screen will display the current battery voltage. With no Battery Backup connected, the battery status screen will display disabled.

The Battery Backup system consists of these components:

- Two, 12 VDC lead acid batteries wired in series
- Inline fuse (4A 250V)
- Battery housing
- Electrical connections

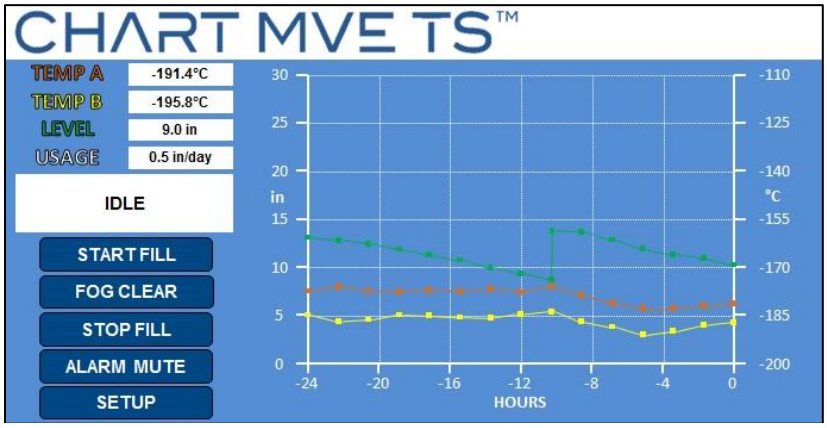
NOTE: The amount of time that a freezer will operate on power from the Battery Backup will vary depending on the fill status, the fill intervals, and the size of the freezer.

6.2. Adjusting Settings and Options

This section describes how to access the Chart MVE TS menus and adjust the various settings and options. With password entry enabled, the controller will prompt for a password anytime a user attempts to access the setup menus. These instructions will start from the main monitoring display screen, assume password entry mode is enabled, and the user has Security Level 4 clearance. Once in the setup menus, the user can press "**<**" to exit that menu level or press "Exit" to return to the main monitoring screen. After a short time of inactivity, the display will automatically return to the main monitoring display screen.

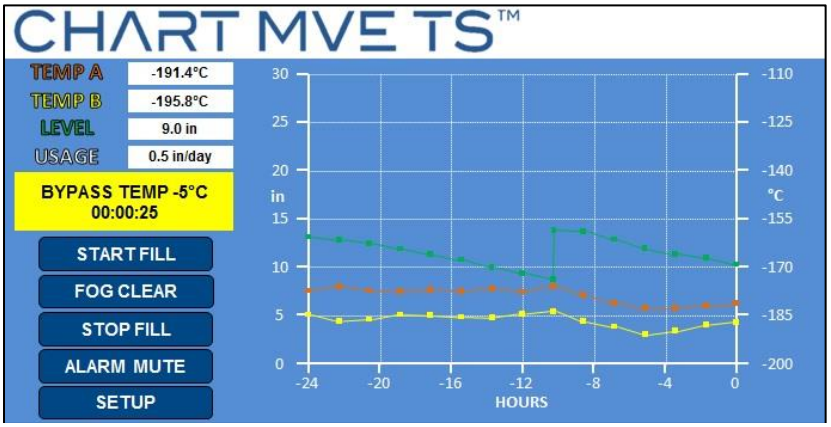
Temp A, Temp B, Level, Usage, Freezer Status, Start Fill, Stop Fill, Alarm Mute, and Setup are always displayed during menu navigation. Freezer Status displays "Idle" when the freezer is not filling.

Main Monitoring Display Screen



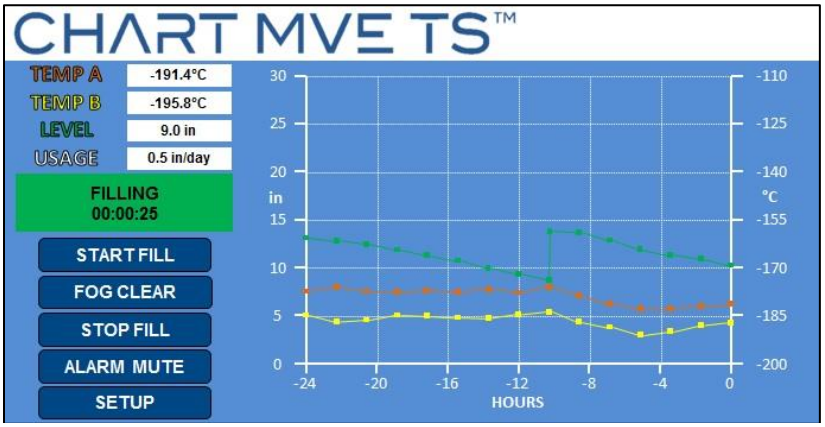
Bypassing

Freezer Status displays the bypass temperature and elapsed bypass time while the freezer is bypassing hot gas in the transfer line prior to filling.



Filling

Freezer Status displays the elapsed fill time while the freezer is filling.



6.2.1. Temperature Settings

This section describes how to access and adjust the various temperature settings on the Chart MVE TS.

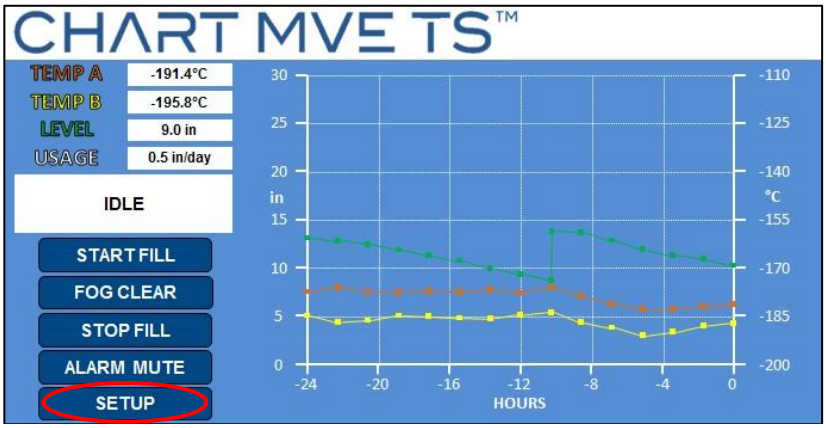
NOTE: Security Level 2 or higher is required to adjust the Temperature Settings.

6.2.1.1. Enable / Disable Sensors

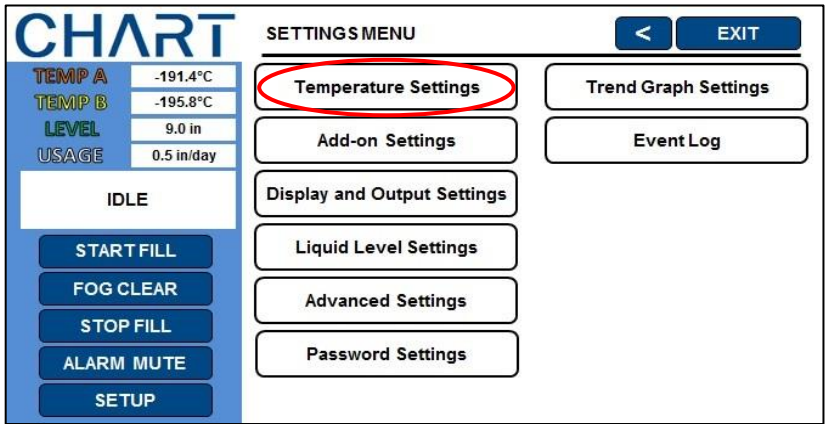
The default setting for both Temp A and Temp B sensors is enabled.

1. Press "Setup"

Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".

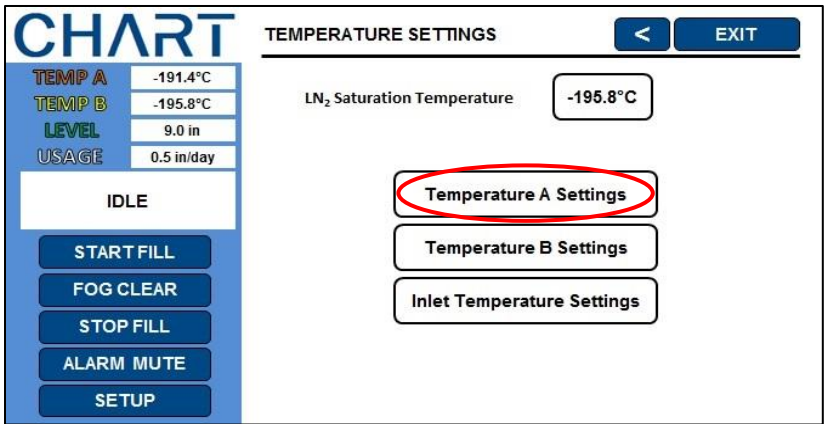


2. Press "Temperature Settings"



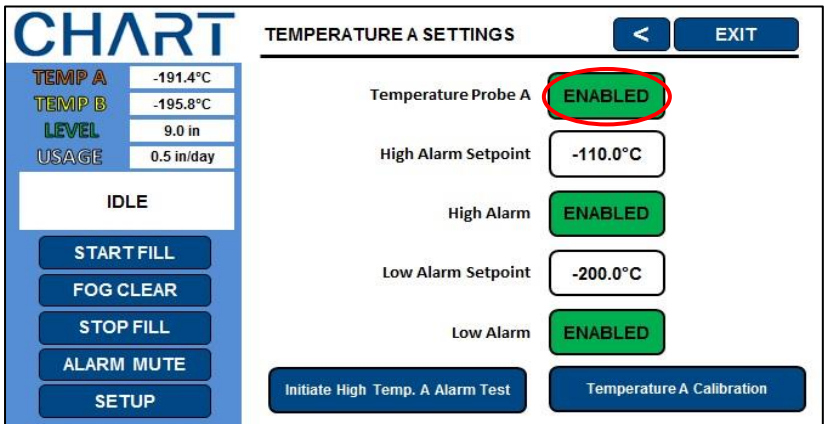
3. Press “Temperature A Settings”

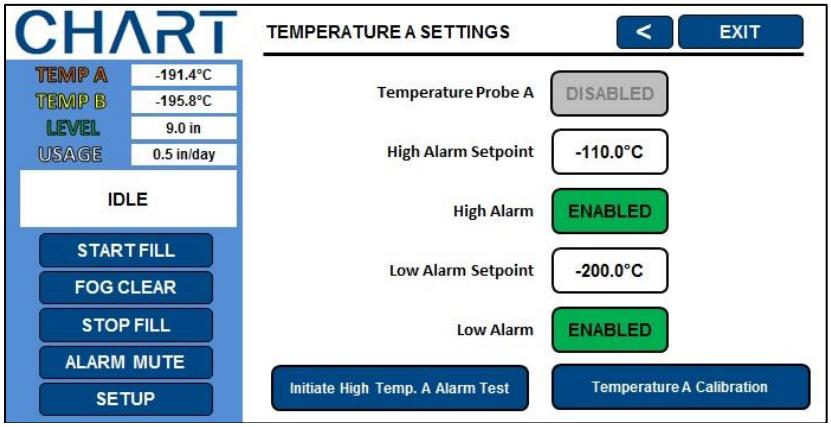
NOTE: To access Temperature B Settings select “Temperature B Settings” instead.



4. Press “ENABLED” or “DISABLED” next to “Temperature Probe A”

This will enable or disable the selected temperature probe. Pressing “ENABLED” will change the probe status to “DISABLED” and pressing “DISABLED” will change the probe status to “ENABLED”.





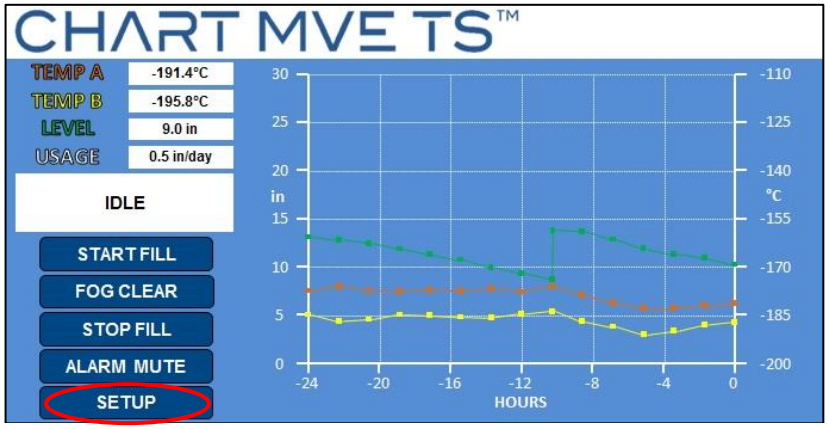
6.2.1.2. High Temperature Alarm Test

The high temperature alarm test allows a user to simulate a high temperature alarm without having to remove a temperature probe from the freezer. Once initiated, the Chart MVE TS will apply a small voltage to the sensor, which causes the sensor to heat up. The Chart MVE TS will continue to heat the sensor until it exceeds the High Temp Alarm setting. Once surpassed, a High Temp Alarm will result and the sensor readings will begin to decrease. The alarm buzzer will sound and the remote alarm contacts will switch to alarm state until the simulated alarm is cleared.

NOTE: The heat generated by the sensor during the High Temperature Alarm Test is NOT enough to affect the actual temperature in the freezer storage space. If the sensor is submerged in LN2, the heat generated by the sensor may not be sufficient to initiate a high temperature alarm.

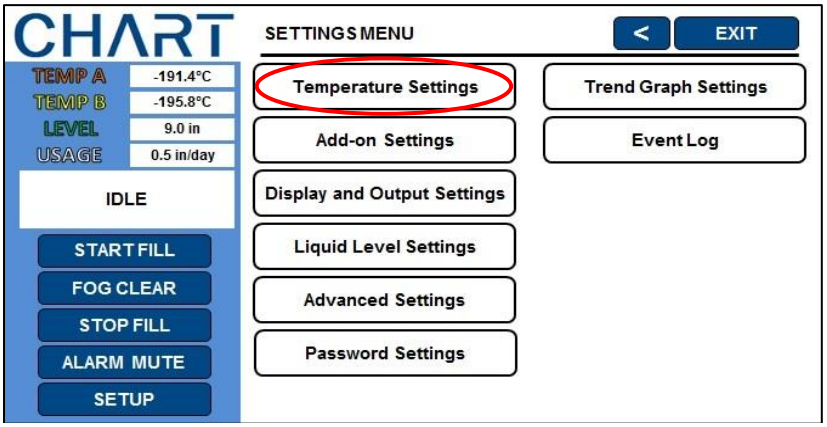
1. Press "Setup"

Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



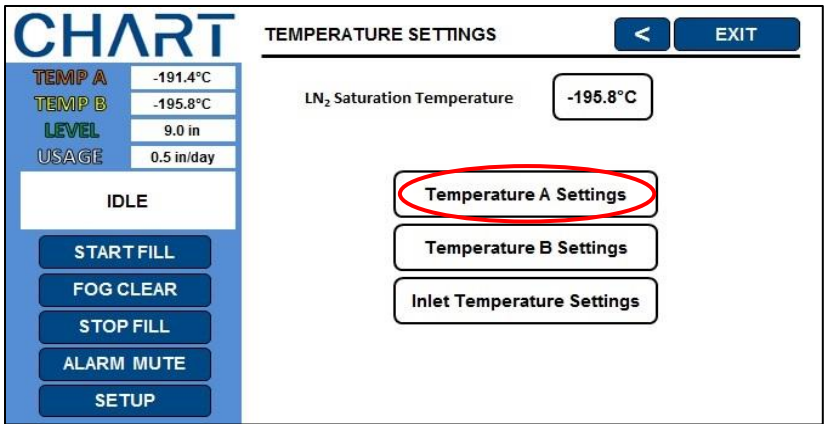
2. Press "Temperature Settings"

Controller may prompt for a password. Type in the password and press "Enter".



3. Press “Temperature A Settings”

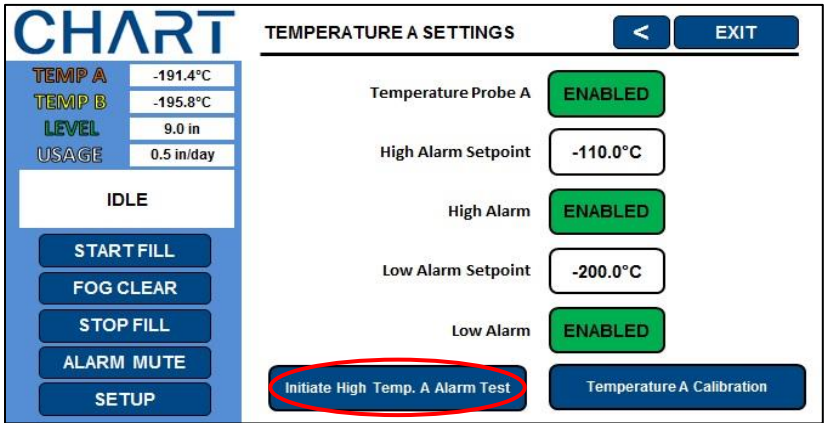
NOTE: To access Temperature B Settings select “Temperature B Settings” instead.



4. Press “Initiate High Temp. A Alarm Test”

The temperature probe reading will increase on the display once the test has initiated. Verify that the alarm occurs after the temperature probe reaches the high temperature setpoint. Once the test is initiated, pressing “<”, “Exit”, or “Setup” will not interrupt the test.

Note: If the temperature probe is open or no probe is connected the controller will not initiate the high temperature alarm test.



6.2.1.3. Temperature Alarm Settings

This section describes how to navigate and adjust the temperature alarm settings.

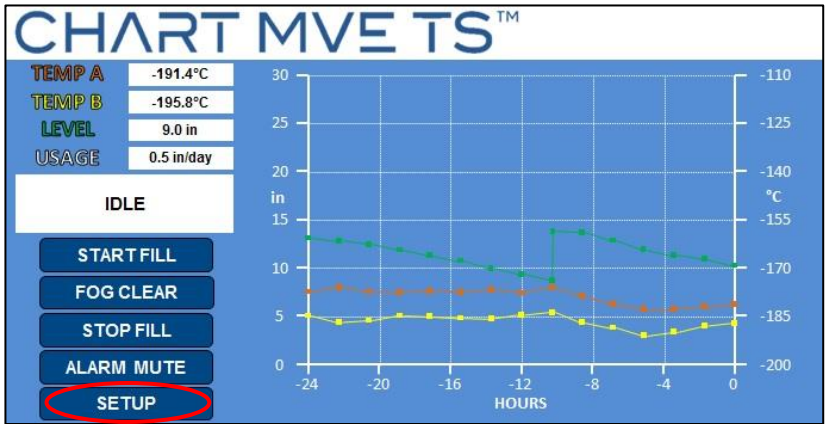
The high temperature alarm is used to alert the user when the temperature in the freezer space has risen above the set threshold. The low temperature alarm can be used as a calibration error or redundant overfill indicator.

To be used as a calibration error indicator, the low temperature alarm would be set to a temperature slightly colder than the LN2 saturation temperature. Since the temperature in the freezer storage space can never be colder than LN2, if this alarm is triggered, it is an indication that the sensor requires recalibration.

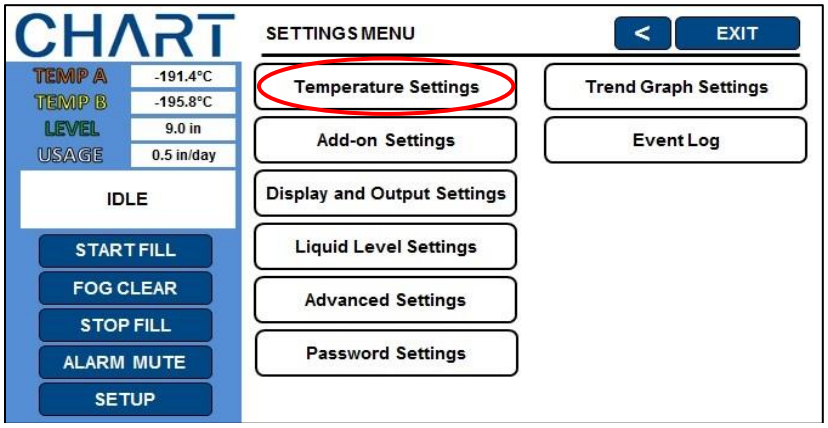
To be used as a redundant overfill, or high level alarm, the low temperature alarm would be set to a temperature slightly warmer than the LN2 saturation temperature and the sensor placed higher than the desired liquid level in the freezer. If the low temperature alarm is triggered, then it is an indication that sensor is submerged in LN2 and the liquid level is higher than desired.

1. Press “Setup”

Controller may prompt for a password. Type in the password using the number pad that appears and press “Enter”.

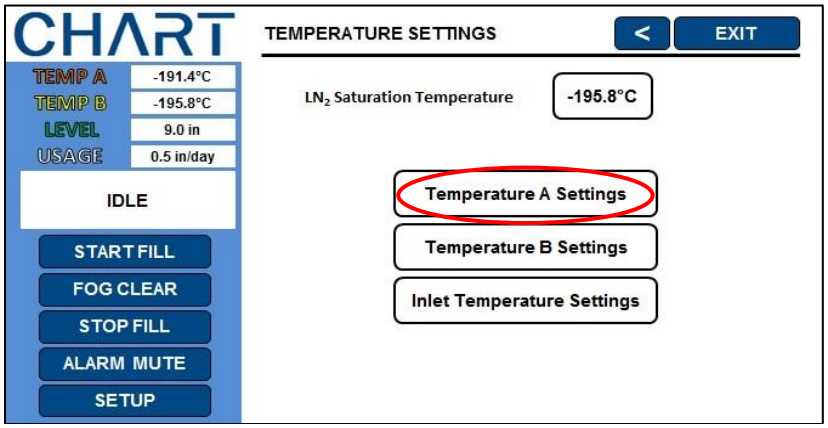


2. Press “Temperature Settings”



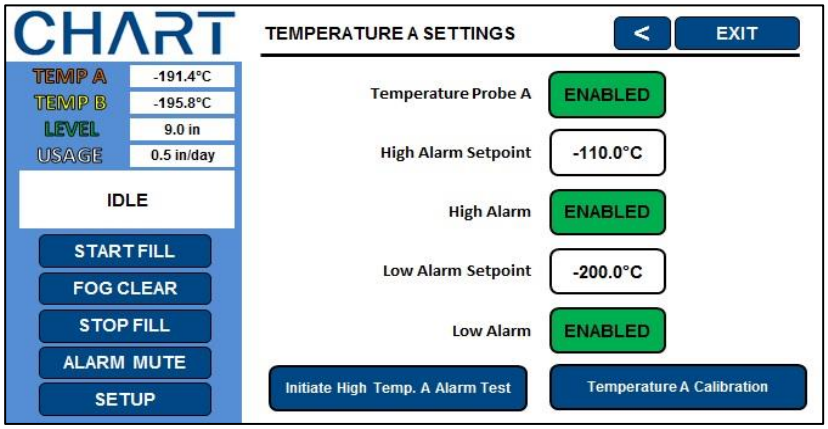
3. Press “Temperature A Settings”

NOTE: To access Temperature B Settings select “Temperature B Settings” instead.



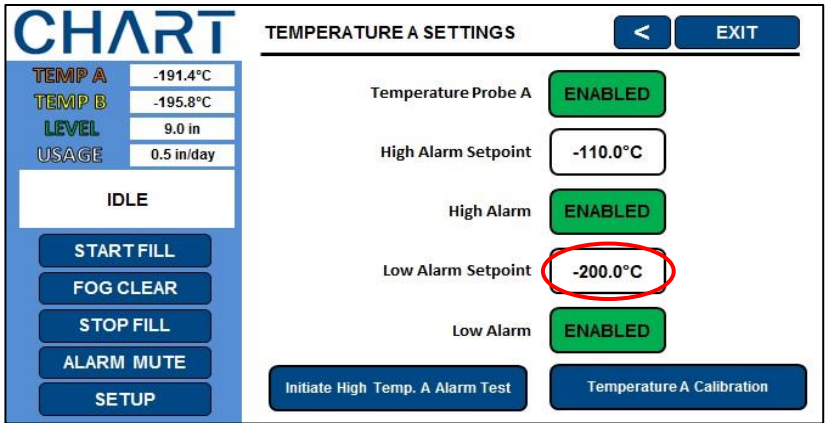
4. Press the value displayed next to “High Alarm Setpoint”

The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the High Alarm Setpoint using the number pad that appears on screen and then press “Enter” to save the new value. Be sure to include “-“ when entering negative values.



5. Press the value displayed next to “Low Alarm Setpoint”

The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the Low Alarm Setpoint using the number pad that appears on screen and then press “Enter” to save the new value. Be sure to include “-“ when entering negative values.

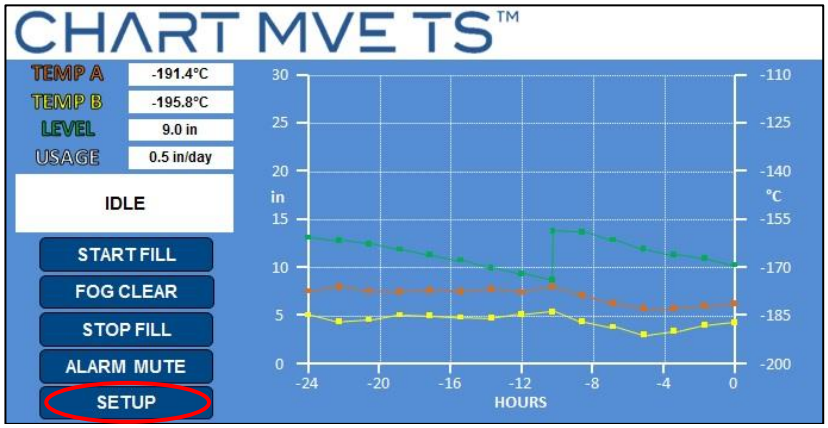


6.2.1.4. Liquid Nitrogen Saturation Temperature

This section shows how to adjust the LN2 saturation temperature. This temperature is altitude dependent. The default LN2 saturation temperature is -195.8°C (-320.4°F, 77.4 K). This value is accurate for altitudes ranging from sea level to 500 feet (152 m). For the appropriate saturation temperature, refer to Table 5: LN2 Saturation Temperatures.

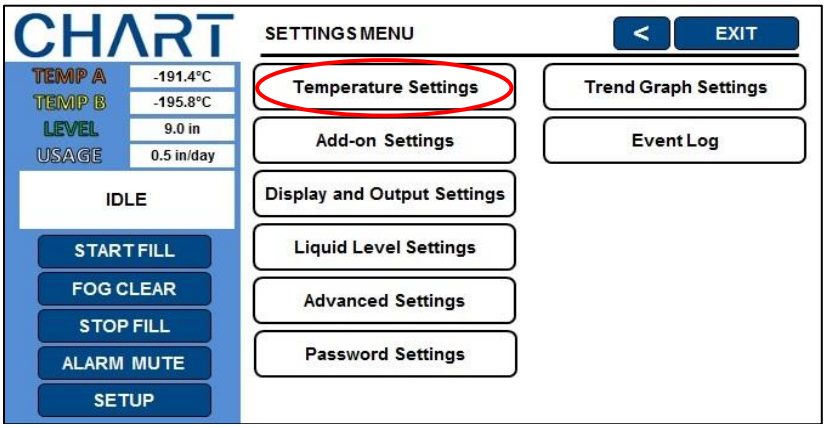
1. Press "Setup"

Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



2. Press "Temperature Settings"

Controller may prompt for a password. Type in the password and press "Enter".



3. Press the value displayed next to “LN2 Saturation Temperature”

The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the LN2 saturation temperature using the number pad that appears on screen and then press “Enter” to save the new value. Be sure to include “-“ when entering negative values.

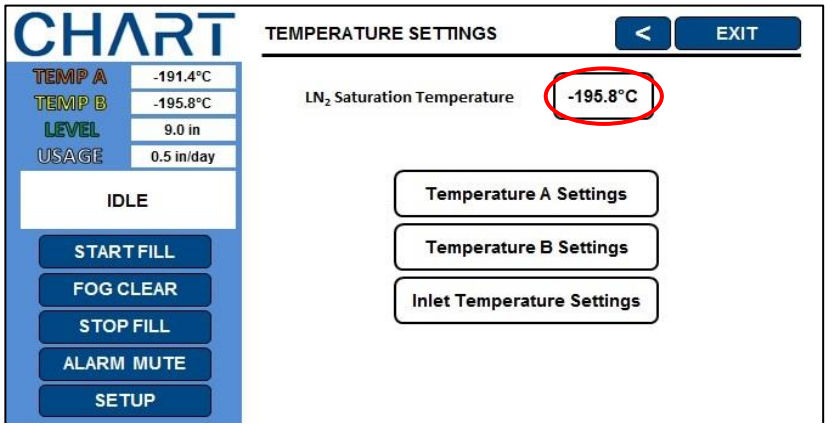


Table 5: LN2 Saturation Temp vs. Altitude

Altitude		LN2 Saturation Temperature		
Feet	**Meters**	**°C**	**°F**	**K**
Sea Level – 500	Sea Level – 152	-195.8	-320.4	77.4
501 -1000	152 -305	-196.0	-320.7	77.2
1000 – 1500	305 – 457	-196.2	-321.1	77.0
1501 – 2000	457 – 610	-196.4	-321.5	76.8
2001 – 5000	610 – 915	-196.6	-321.9	76.6
3001 – 4000	915 – 1220	-196.9	-322.4	76.3
4001 – 5000	1220 – 1524	-197.2	-322.9	76.0
5001 – 6000	1524 – 1829	-197.5	-323.5	75.7
6001 – 7000	1829 – 2134	-197.8	-324.0	75.4
7001 – 8000	2134 – 2439	-198.1	-324.6	75.1
8001 – 9000	2439 – 2744	-198.4	-325.1	74.8
9001 – 10000	2744 – 3049	-198.7	-325.7	74.4

6.2.2. Liquid Level Settings

This section demonstrates how to adjust the LN2 level settings.

6.2.2.1. Level Setpoints and Alarms

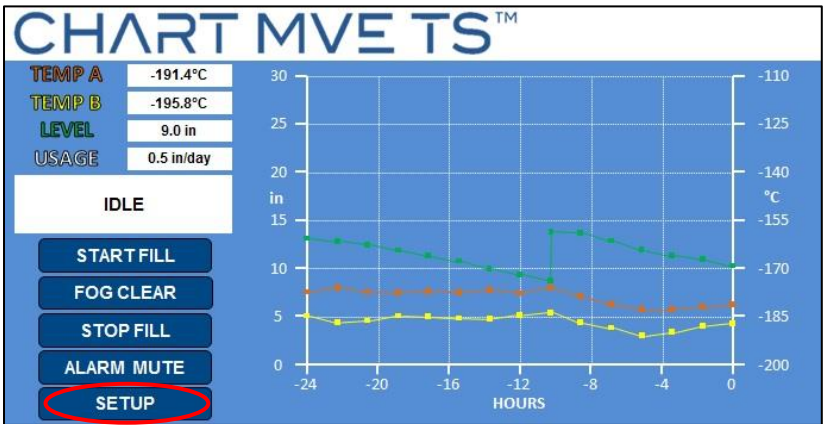
The auto fill settings can be adjusted in the Liquid Level Menus. With auto fill enabled, the Chart MVE TS will initiate an auto fill when the level is at or below the Low Level Setpoint and terminate a fill when the level reaches the High Level Setpoint. If the level is at or below the Low Level Alarm or at or above the High Level Alarm, the Chart MVE TS will initiate that respective alarm.

NOTE: There must be a minimum of 0.5 inches between each of setpoint and alarm. For example, if the Low Level Alarm is set to be 4.0 inches, then the Low Level Setpoint would have to be set at least 4.5 inches. The Low Level Alarm can be set to a minimum value of 3.0 inches and the High Level Alarm can be set to a maximum value of 48.0 inches.

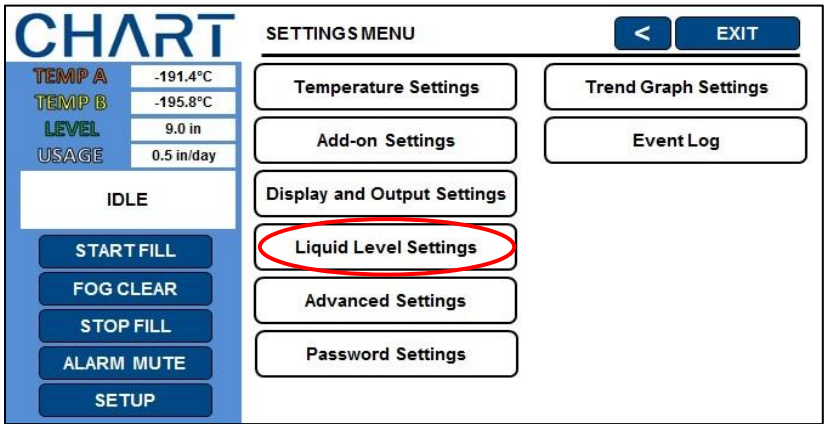
NOTE: Security Level 2 or higher is required to adjust the Liquid Level Settings.

1. Press "Setup"

Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".

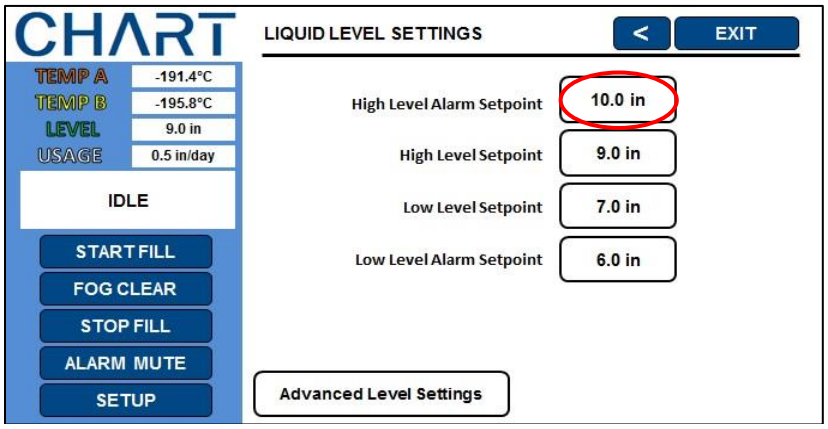


2. Press “Liquid Level Settings”

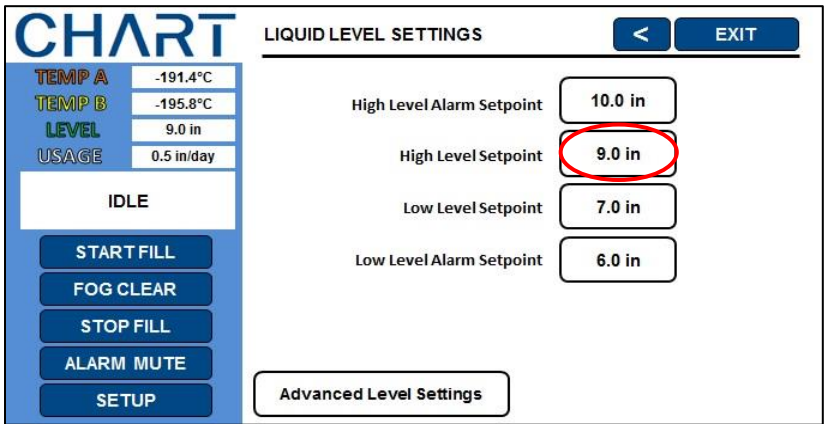


3. Press the value displayed next to “High Level Alarm Setpoint”

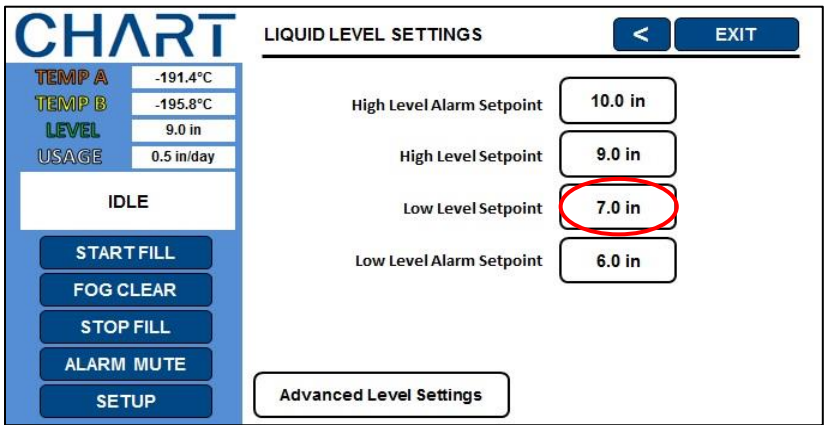
The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the High Level Alarm Setpoint using the number pad that appears on screen and then press “Enter” to save the new value.



4. **Press the value displayed next to "High Level Setpoint"**
   The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the High Level Setpoint using the number pad that appears on screen and then press "Enter" to save the new value.

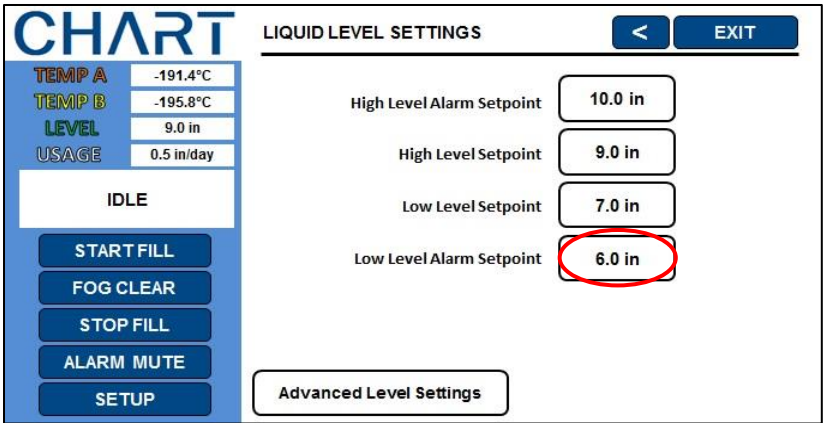


5. **Press the value displayed next to "Low Level Setpoint"**
   The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the Low Level Setpoint using the number pad that appears on screen and then press "Enter" to save the new value.



6. Press the value displayed next to “Low Level Alarm Setpoint”

The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the Low Level Alarm Setpoint using the number pad that appears on screen and then press “Enter” to save the new value.



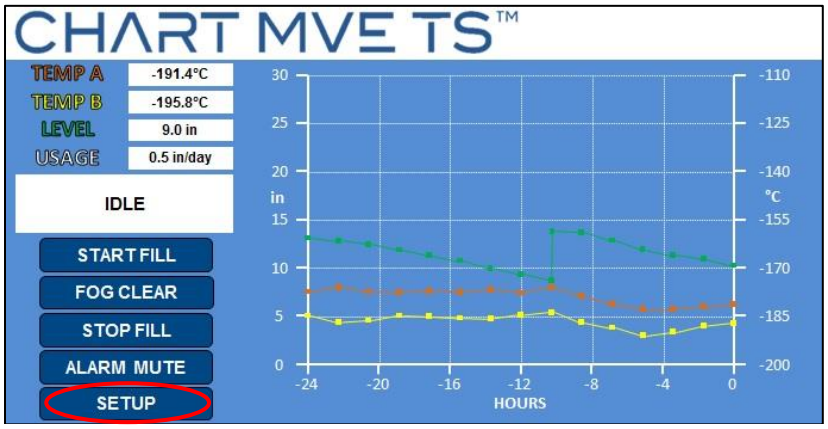
6.2.2.2. Enable / Disable Auto Fill Control

Auto Fill Control can be enabled or disabled in the Advanced Level Menus.

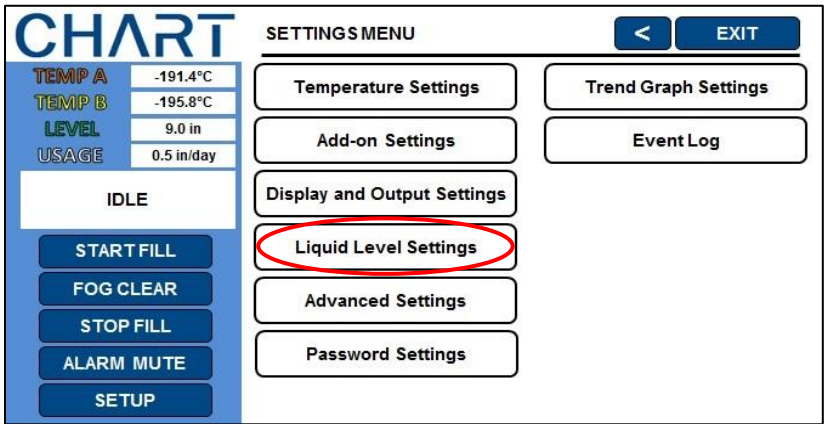
NOTE: Security Level 3 or higher is required to enable/disable Auto Fill.

1. Press "Setup"

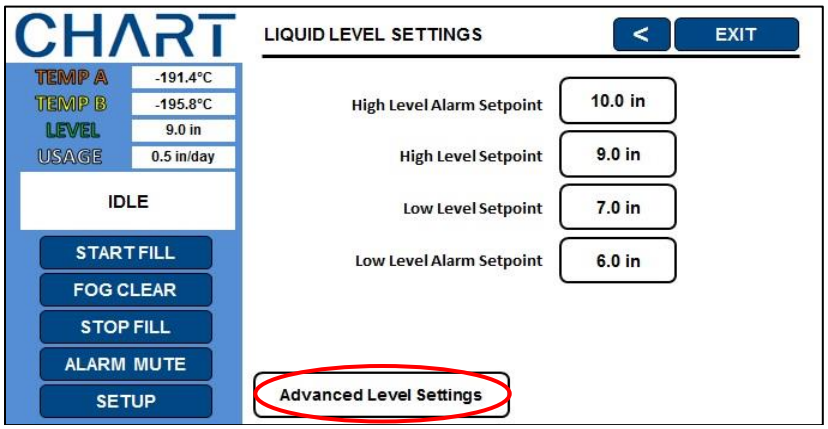
Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



2. Press "Liquid Level Settings"

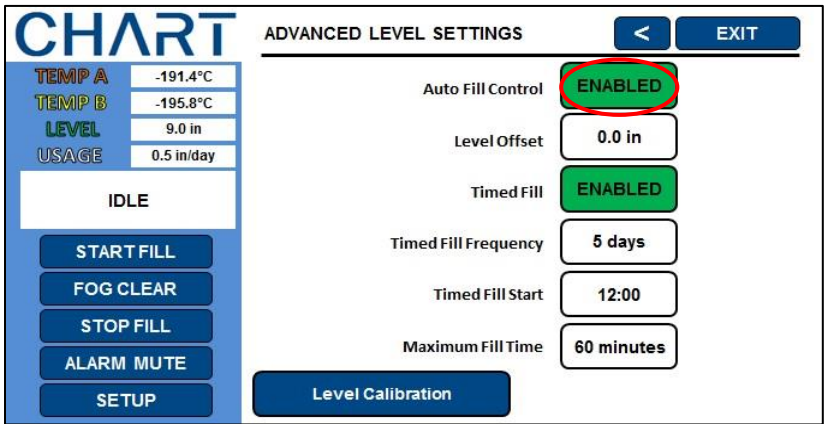


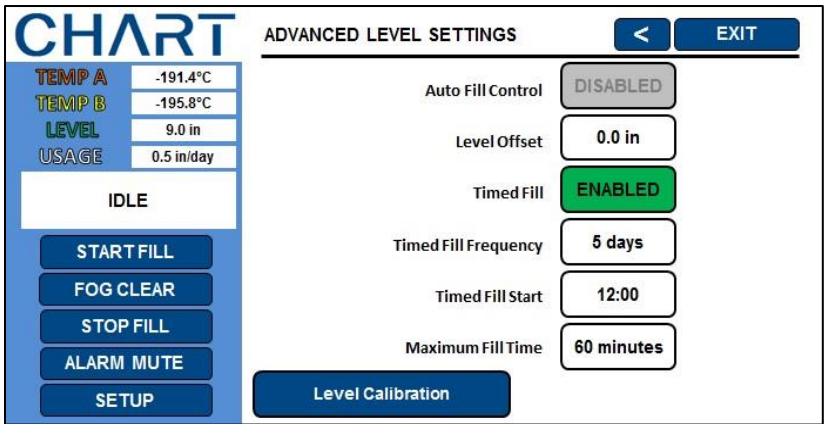
3. Press “Advanced Level Settings”



4. Press “ENABLED” or “DISABLED” next to “Auto Fill Control”

This will enable or disable the auto fill feature. Pressing “ENABLED” will change the status to “DISABLED” and pressing “DISABLED” will change the status to “ENABLED”.





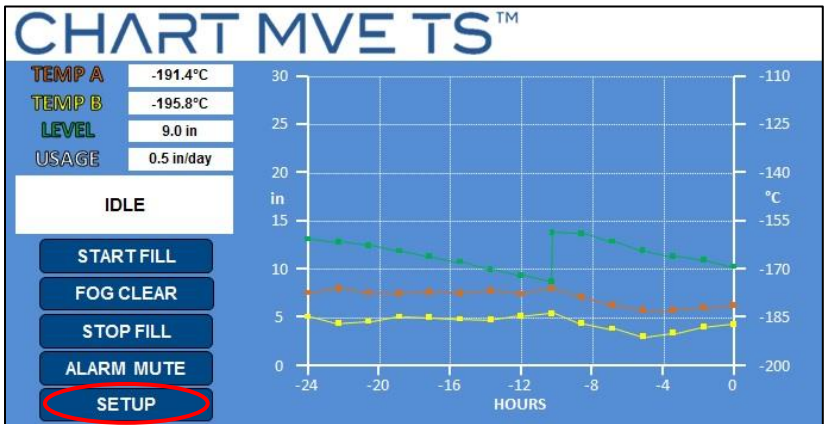
6.2.2.3. Level Offset

Since the annular line that carries the pressure level signal to the Chart MVE TS is not located at the very bottom of the LN2 column, a Level Offset is needed. This value is determined and set at the factory and should not be adjusted to fix an inaccurate level reading unless instructed to do so by an authorized MVE Distributor or Technical Service.

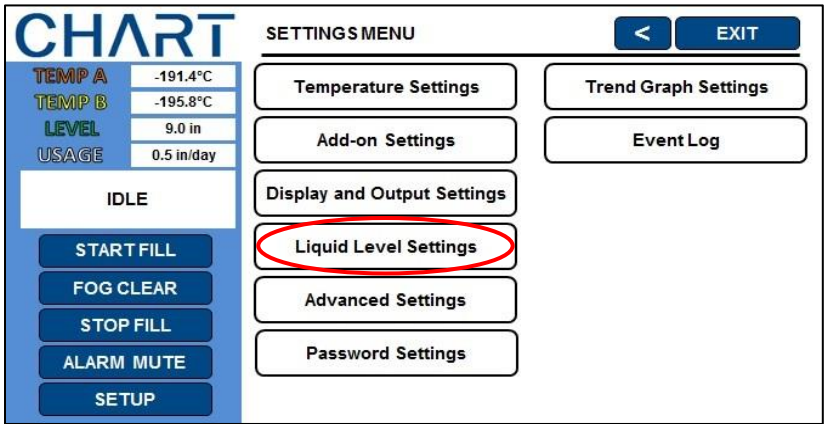
NOTE: Security Level 3 or higher is required to adjust the Level Offset.

1. Press "Setup"

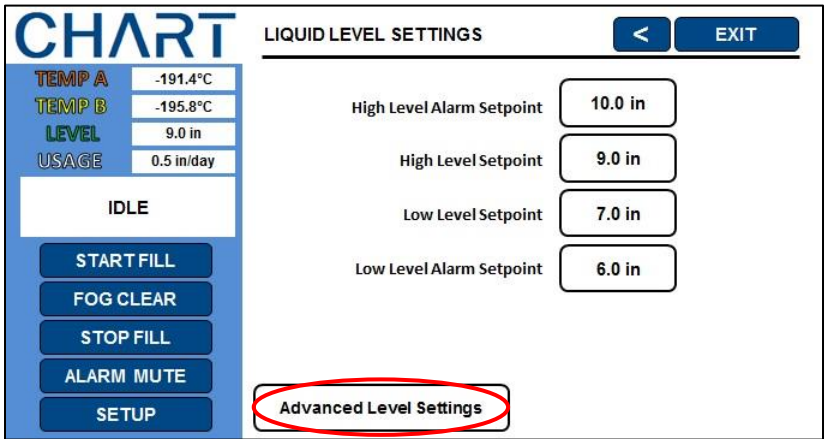
Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



2. Press "Liquid Level Settings"

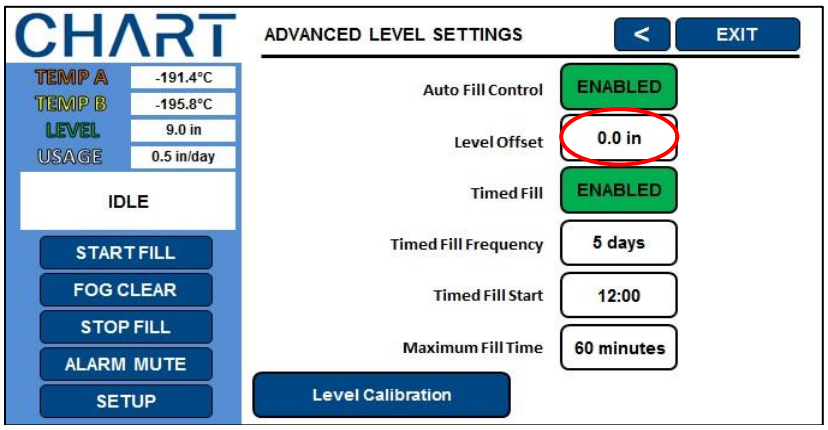


3. Press “Advanced Level Settings”



4. Press the value displayed next to “Level Offset”

The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the level offset using the number pad that appears on screen and then press “Enter” to save the new value.

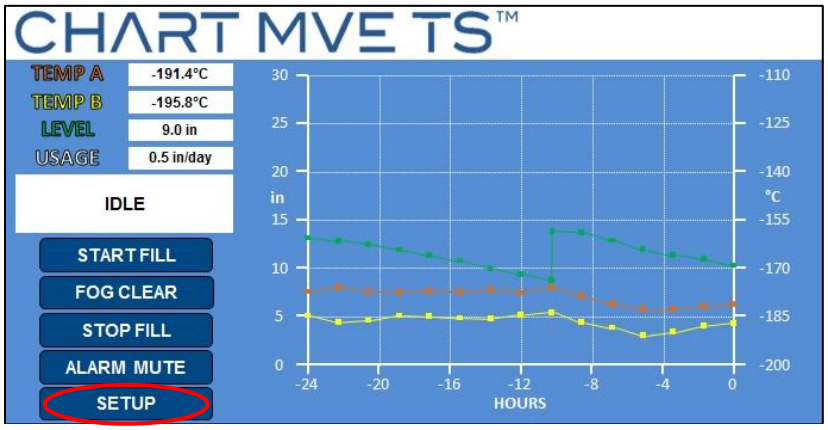


6.2.3. Battery Backup Status

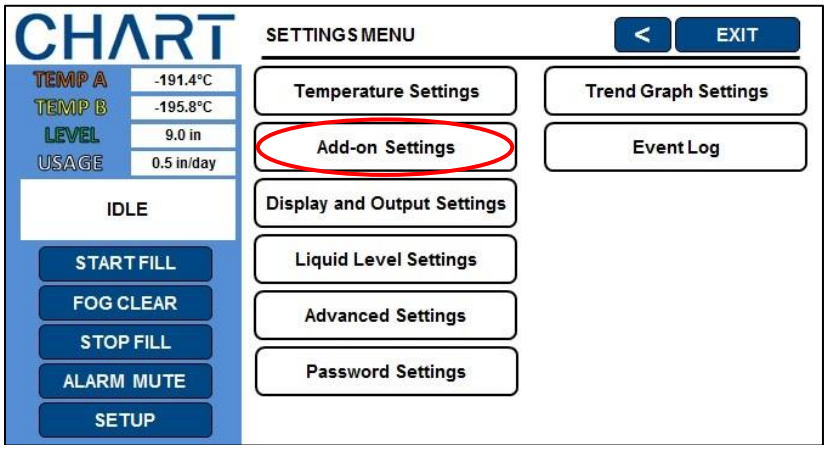
This section details how to view and adjust the settings for the optional Battery Backup.

NOTE: Security Level 2 or higher is required to adjust the Add-on Settings.

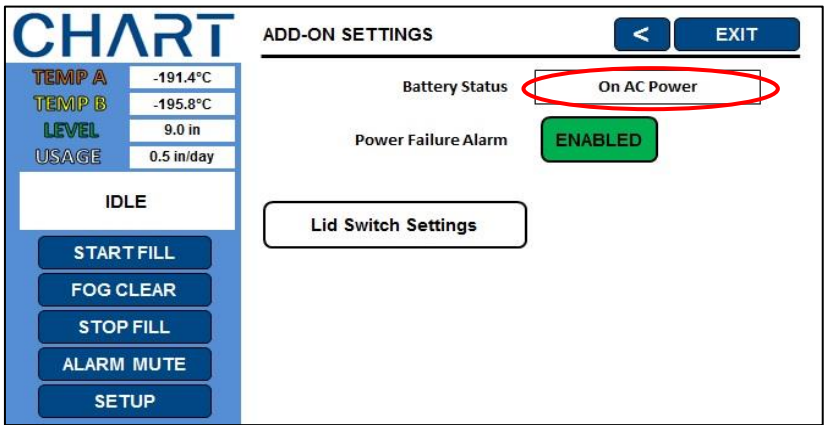
1. **Press "Setup"**
   Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



2. **Press "Add-on Settings"**

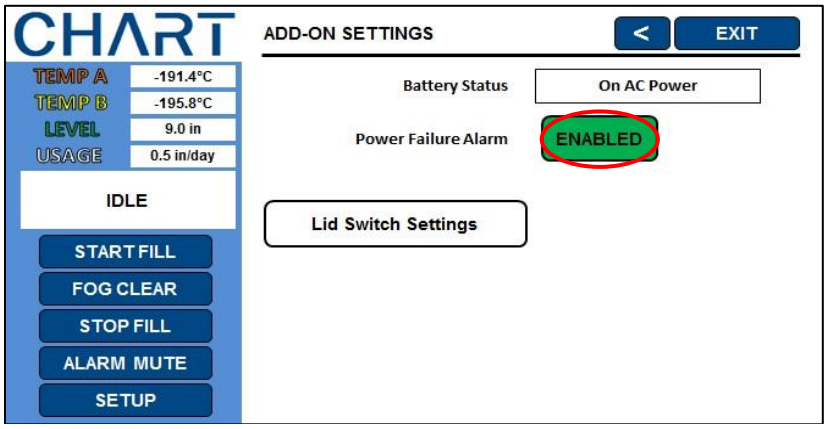


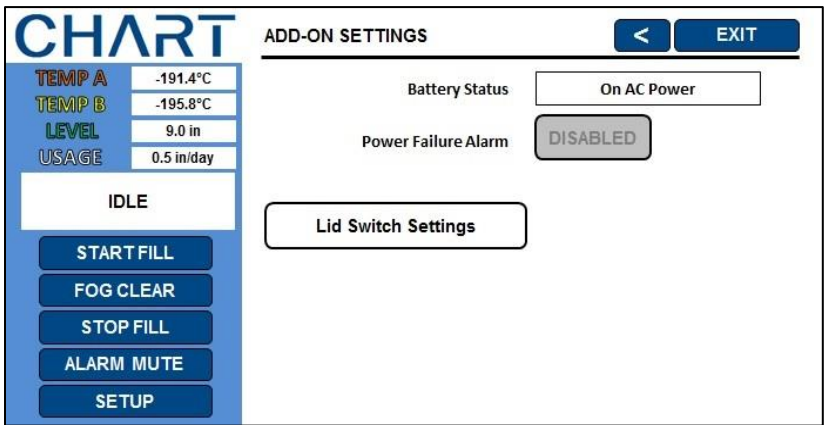
3. The current battery status will be displayed



5. Press “ENABLED” or “DISABLED” next to “Power Failure Alarm”

This will enable or disable the power failure alarm. Pressing “ENABLED” will change the status to “DISABLED” and pressing “DISABLED” will change the status to “ENABLED”.



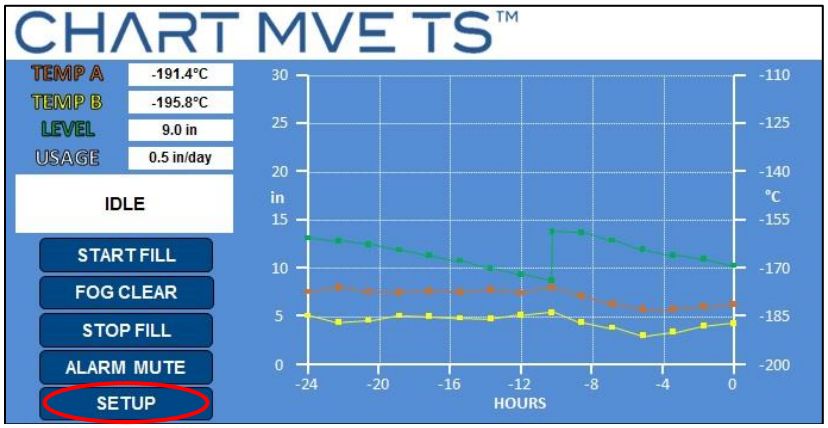


6.2.4. Inlet Temperature Settings

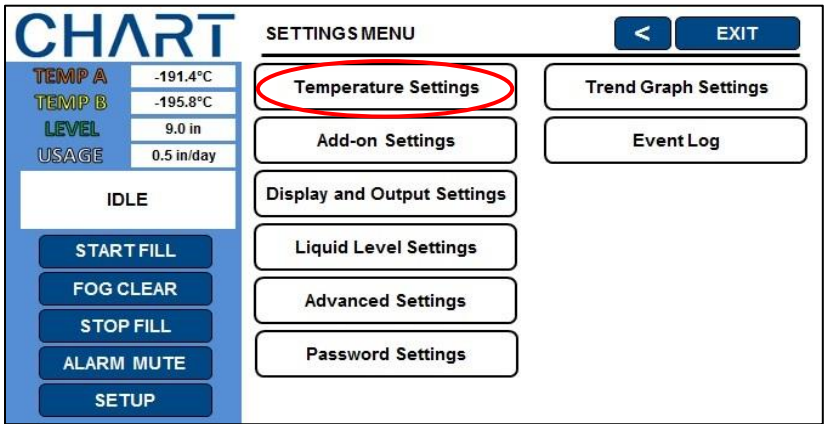
This section describes how to access and adjust the inlet temperature (hot gas bypass) settings on the Chart MVE TS.

NOTE: Security Level 2 or higher is required to adjust the Inlet Temperature Settings.

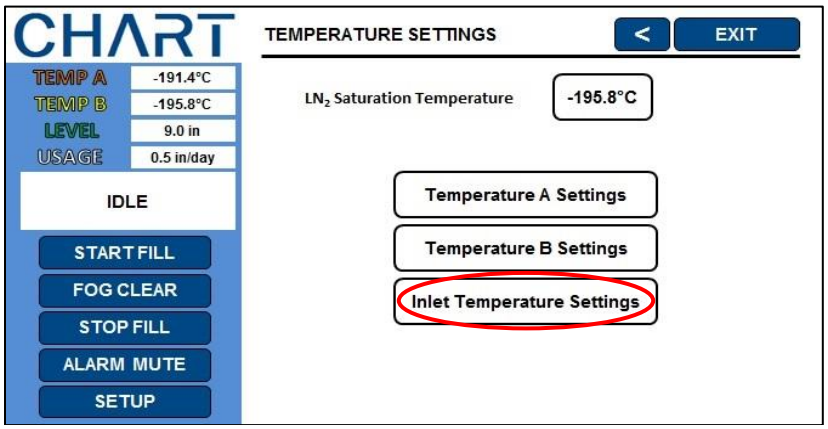
1. **Press "Setup"**
   Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



2. **Press "Temperature Settings"**

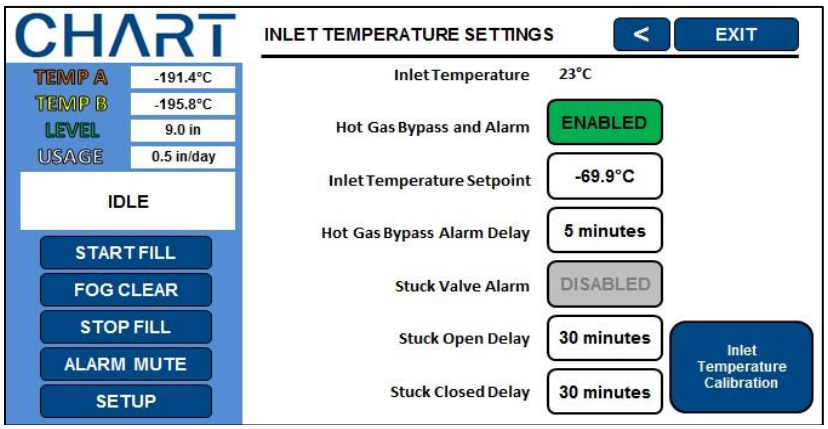


3. Press “Inlet Temperature Menus”



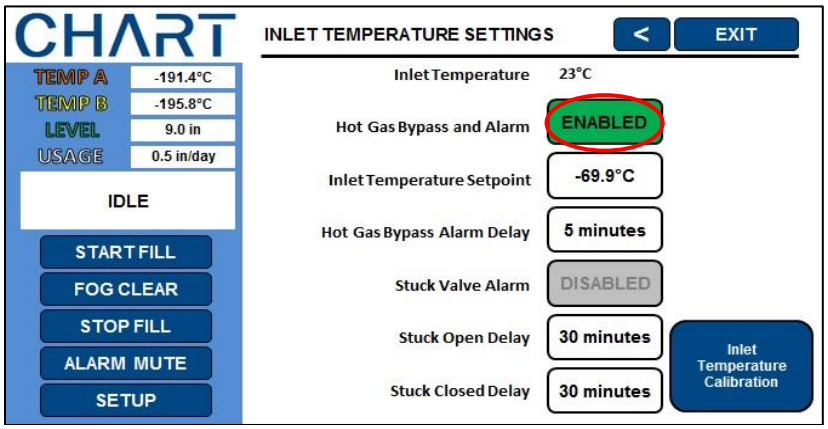
4. The current Inlet Temperature settings will be displayed

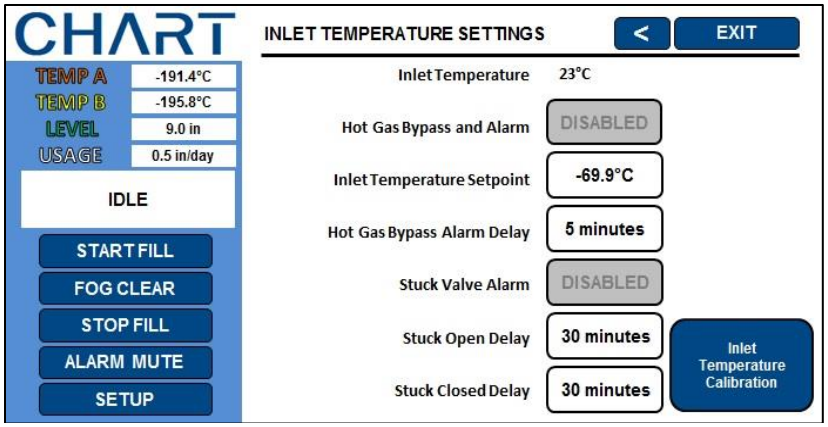
The current inlet temperature is displayed, along with the hot gas bypass setpoints.



5. Press “ENABLED” or “DISABLED” next to “Hot Gas Bypass and Alarm”

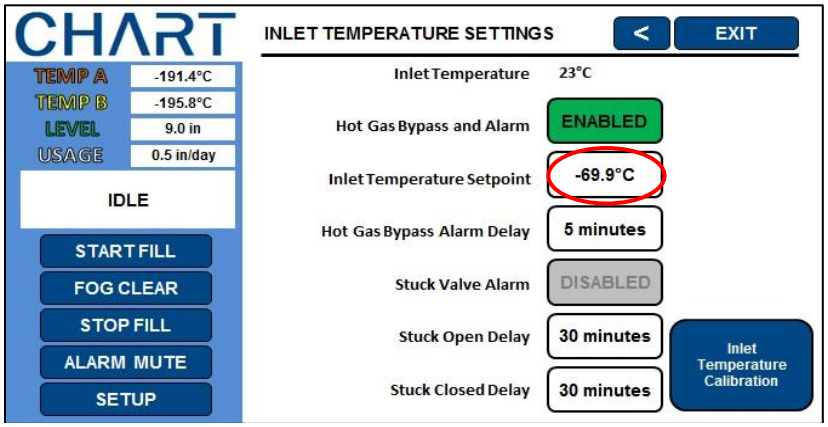
This will enable or disable the Hot Gas Bypass feature. Pressing “ENABLED” will change the hot gas bypass status to “DISABLED” and pressing “DISABLED” will change the hot gas bypass status to “ENABLED”.





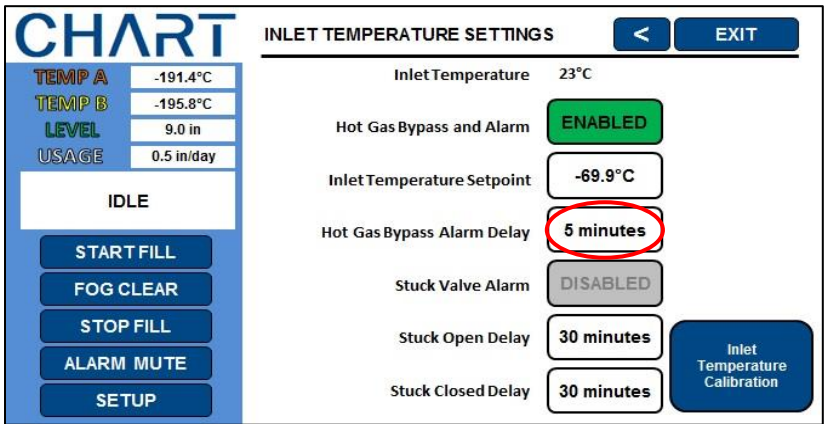
6. Press the value displayed next to “Inlet Temperature Setpoint”

The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the inlet temperature setpoint (if desired) using the number pad that appears on screen and then press “Enter” to save the new value.



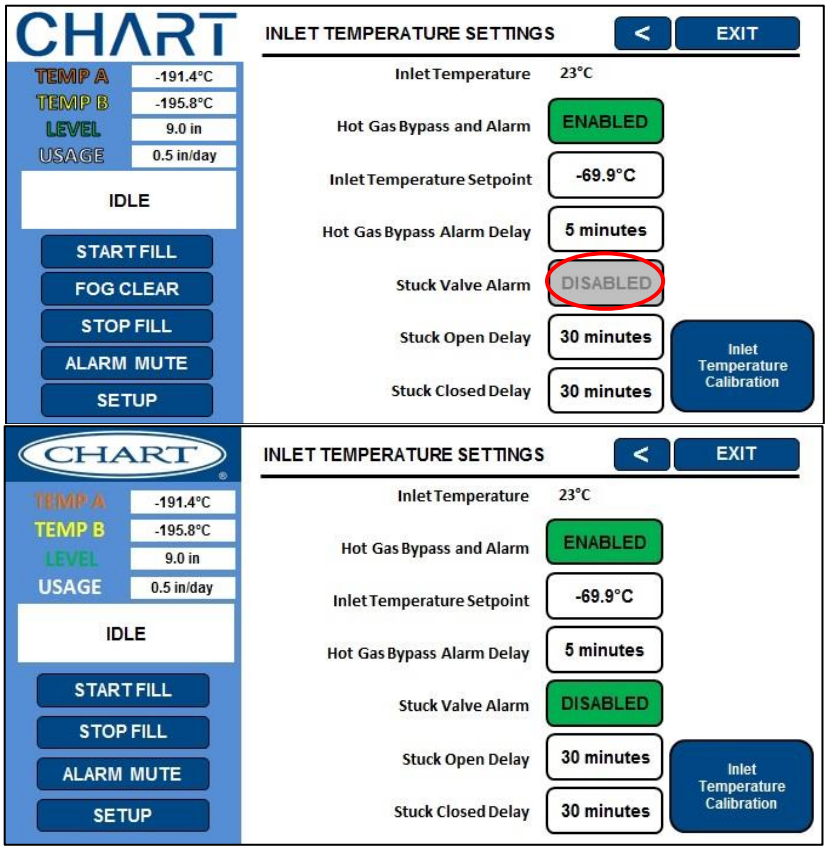
7. Press the value displayed next to “Hot Gas Bypass Alarm Delay”

The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the hot gas bypass alarm delay (if desired) using the number pad that appears on screen and then press “Enter” to save the new value.



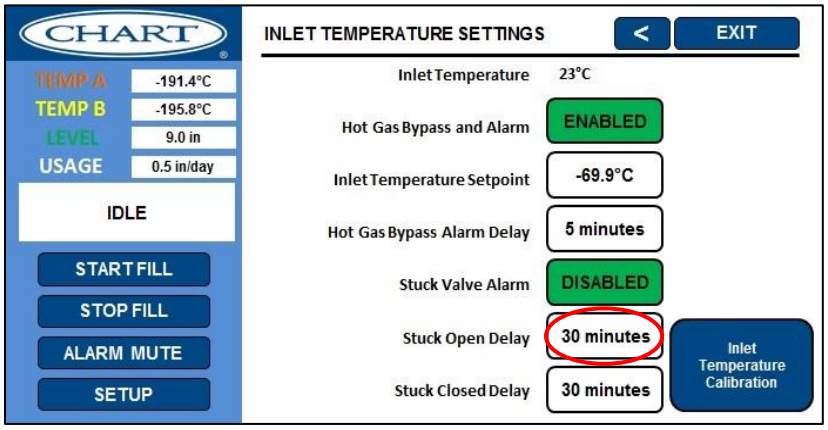
8. Press “ENABLED” or “DISABLED” next to “Stuck Valve Alarm”

This will enable or disable the Stuck Valve Alarm feature. Pressing “ENABLED” will change the stuck valve alarm status to “DISABLED” and pressing “DISABLED” will change the stuck valve alarm status to “ENABLED”.



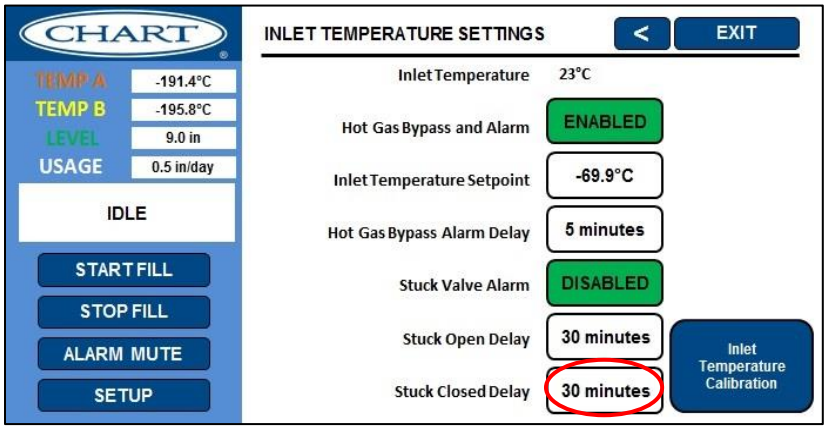
9. Press the value displayed next to “Stuck Open Delay”

The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the stuck open delay (if desired) using the number pad that appears on screen and then press “Enter” to save the new value.



10. Press the value displayed next to “Stuck Closed Delay”

The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the stuck closed delay (if desired) using the number pad that appears on screen and then press “Enter” to save the new value.

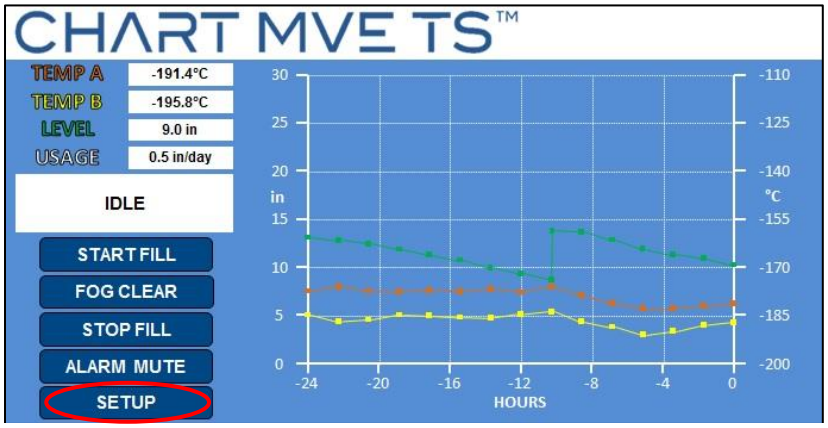


6.2.5. Lid Switch Settings

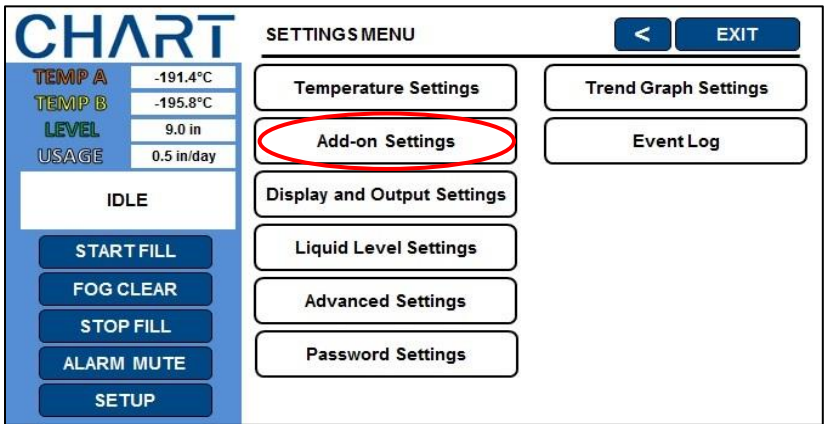
This section describes how to access and adjust the lid switch settings on the Chart MVE TS. To use these lid switch settings the lid switch must be installed in the Fog Clear configuration (not the standard UL configuration).

NOTE: Security Level 2 or higher is required to adjust the Inlet Temperature Settings.

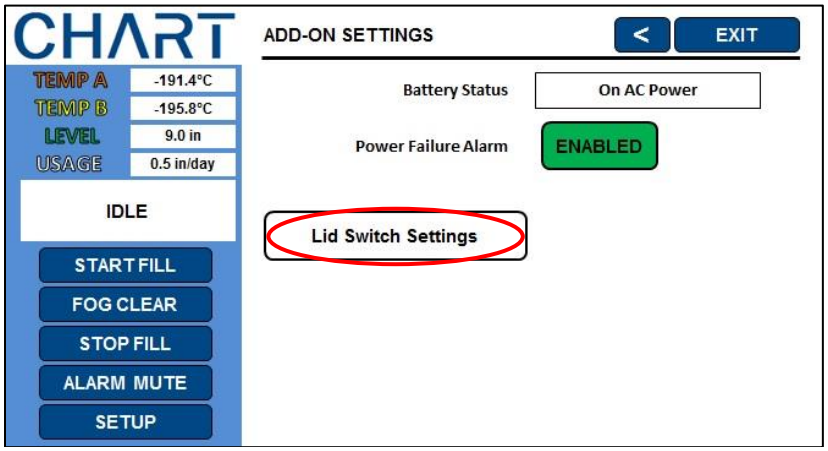
1. **Press "Setup"**
   Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



2. **Press "Add-on Settings"**

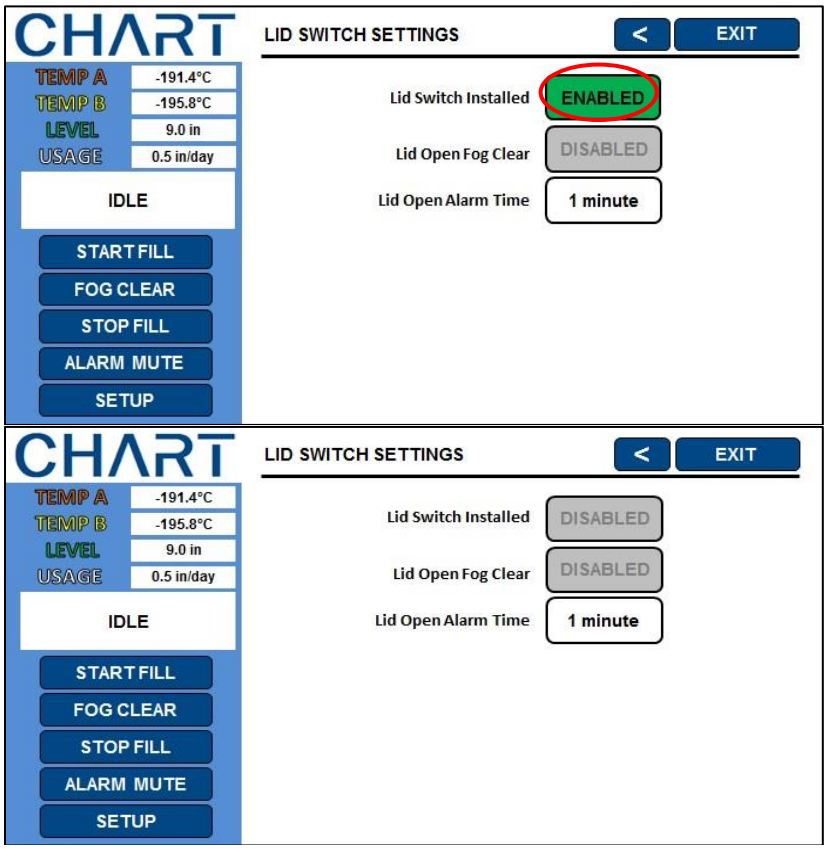


3. Press “Lid Switch Settings”



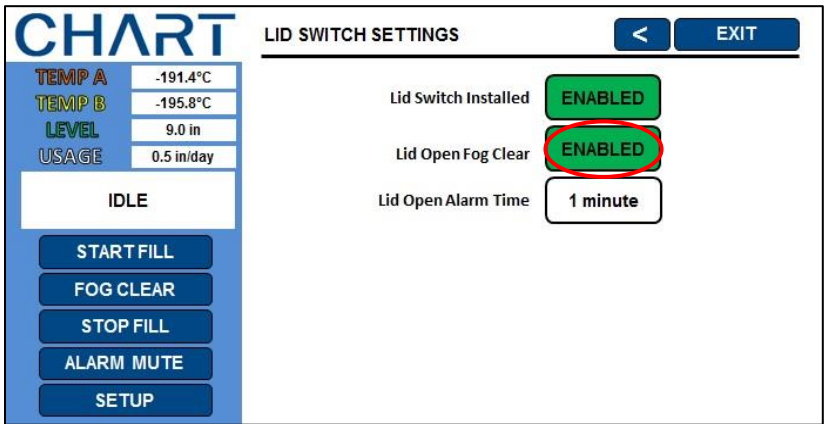
4. Press “ENABLED” or “DISABLED” under “Lid Switch Installed”

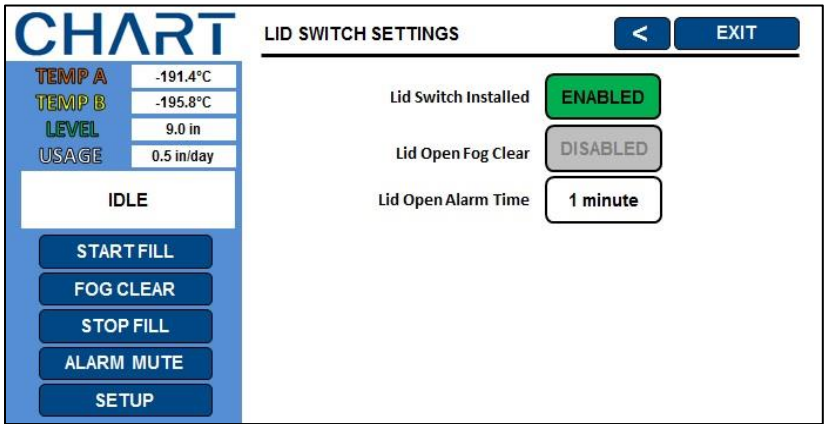
This will enable or disable the lid switch feature. Pressing “ENABLED” will change the lid switch status to “DISABLED” and pressing “DISABLED” will change the lid switch status to “ENABLED”.



5. **Press “ENABLED” or “DISABLED” next to “Lid Open Fog Clear”**

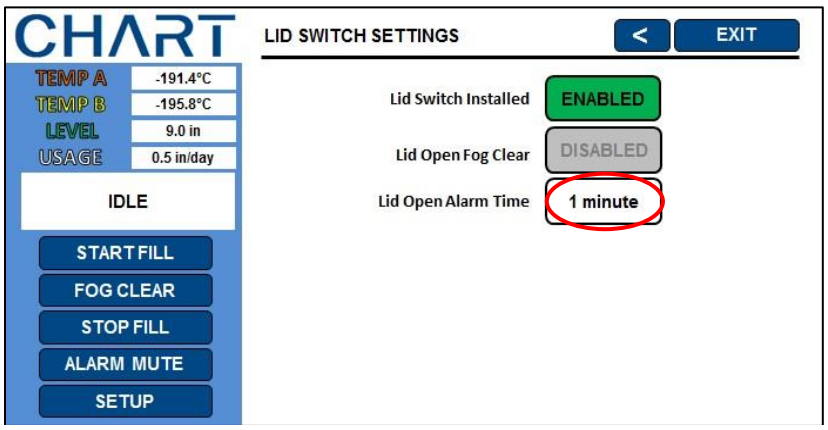
This will enable or disable the lid switch feature. Pressing “ENABLED” will change the lid open fog clear status to “DISABLED” and pressing “DISABLED” will change the lid open fog clear status to “ENABLED”.





6. Press the value displayed next to “Lid Open Alarm Time”

The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the lid open alarm time (if desired) using the number pad that appears on screen and then press “Enter” to save the new value.

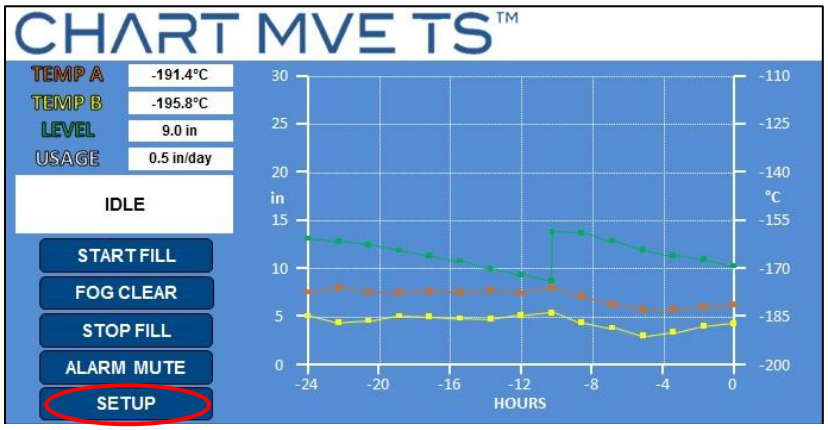


6.2.6. Trend Graph Settings

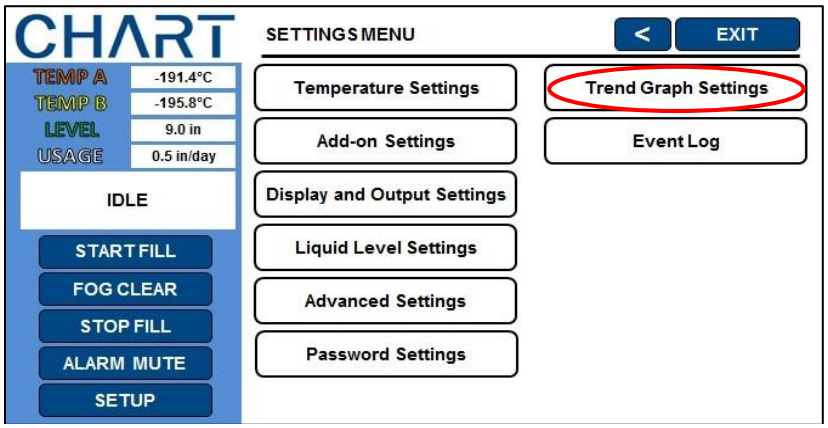
This section describes how to adjust the values on the x and y axis in the Trend Graph Settings.

NOTE: Security Level 1 or higher is required to change the values on the x and y axis in the Trend Graph Settings.

1. **Press "Setup"**
   Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".

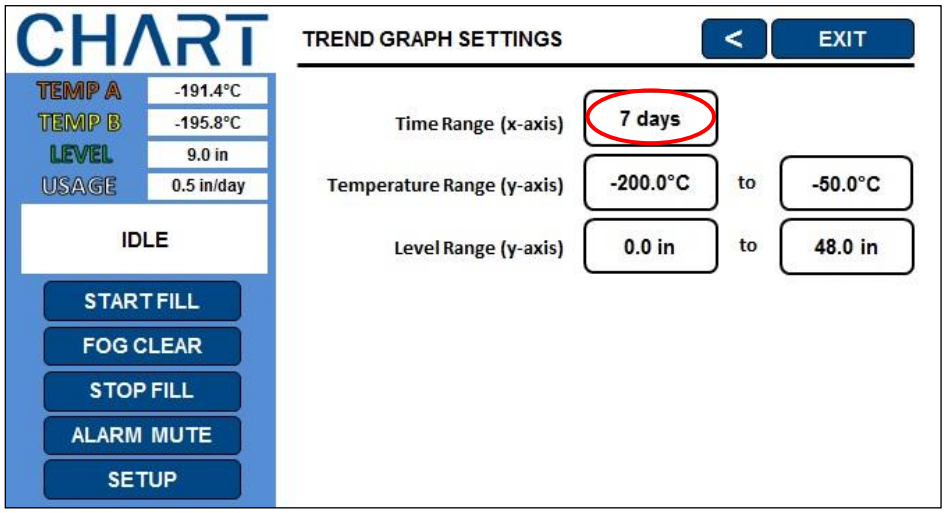


2. **Press "Trend Graph Settings"**



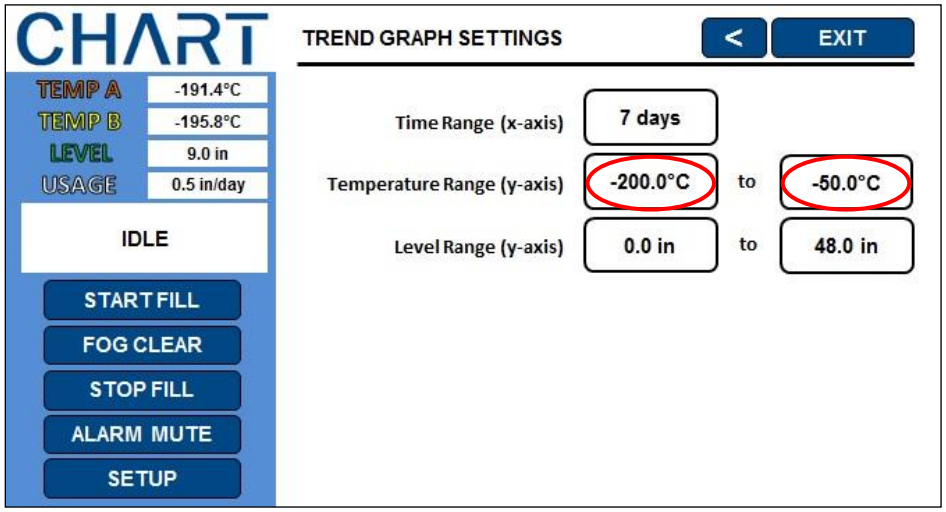
3. Press “Time Range (x- axis)”

The number pad will be displayed. There will be three options to choose from: 24 hours, 7 days, and 30 days. Select a new value (if desired) using the number pad that appears on screen and then press “Enter” to save the new value.



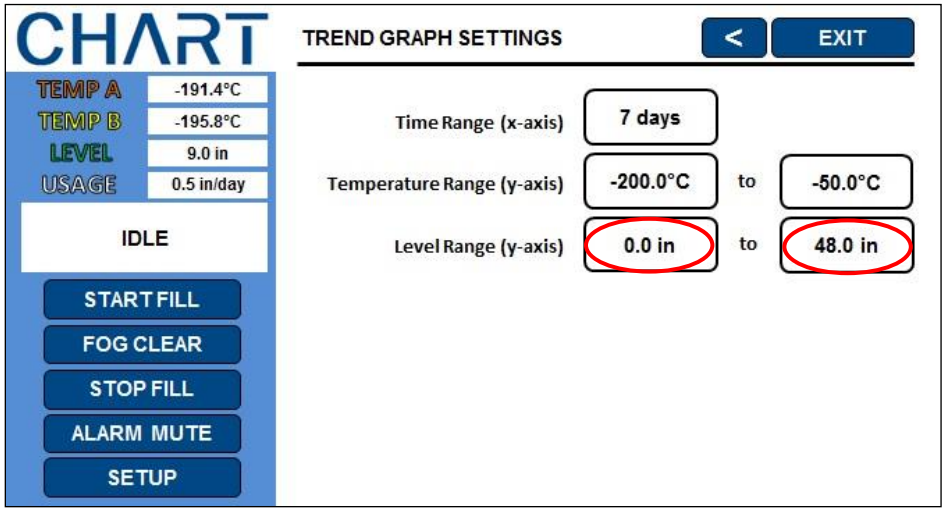
4. Press “Temperature Range (y-axis)”

The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the Temperature range (if desired) using the number pad that appears on screen and then press “Enter” to save the new value.



5. Press “Level Range (y-axis)

The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the Temperature range (if desired) using the number pad that appears on screen and then press “Enter” to save the new value.



6.2.7. Display and Output Settings

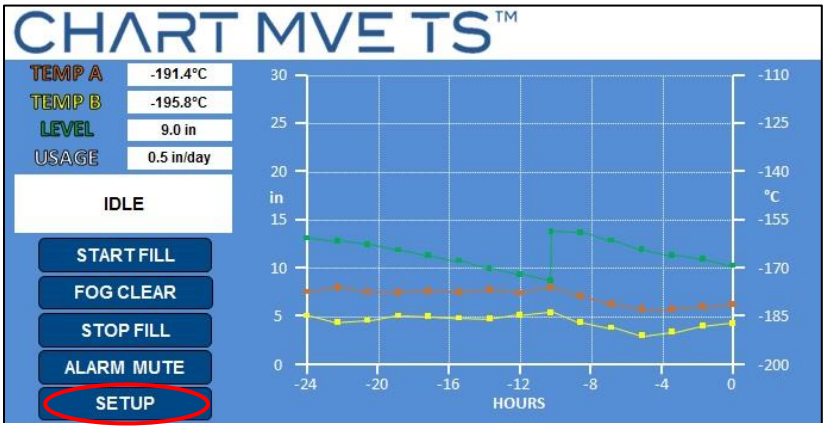
This section describes how to adjust the Display and Output Settings.

6.2.7.1. Temp and Level Display Units

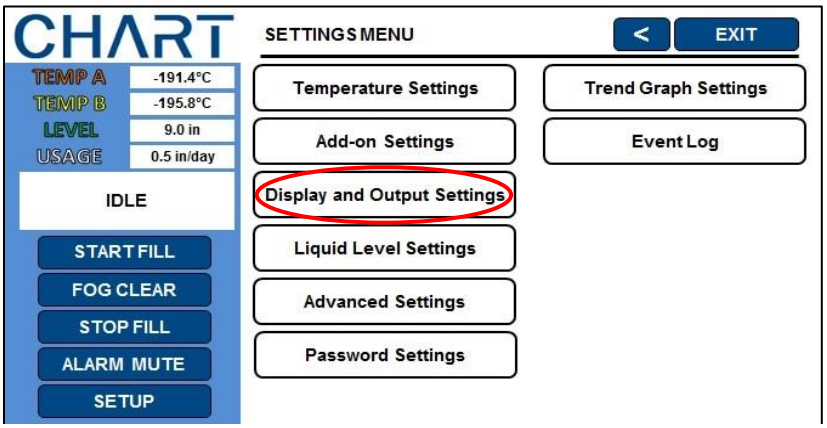
NOTE: Security Level 1 or higher is required to change the display units.

1. Press "Setup"

Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".

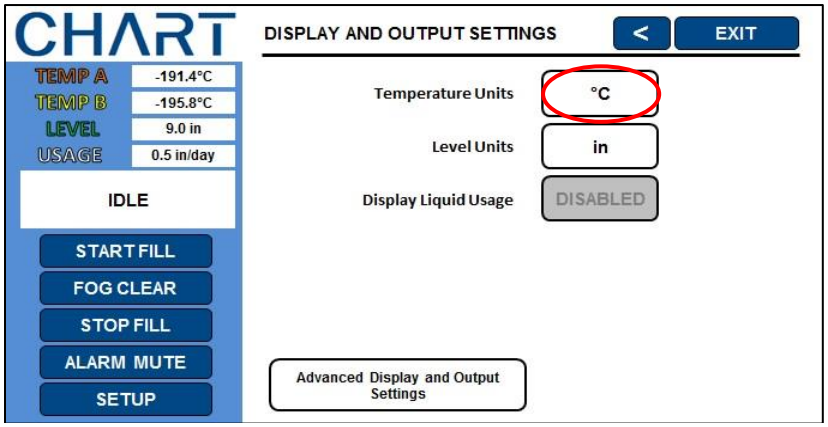


2. Press "Display and Output Settings"



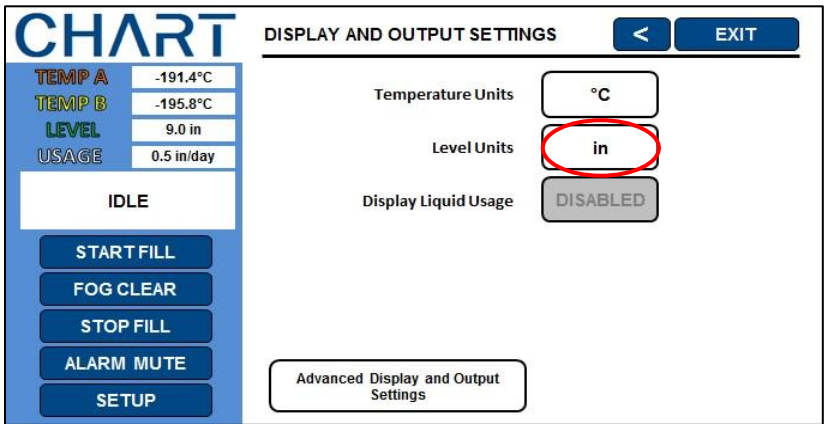
3. Press the units displayed next to “Temperature Units”

Press the “°C”, “°F”, or the “K” option for “Temperature Units”.



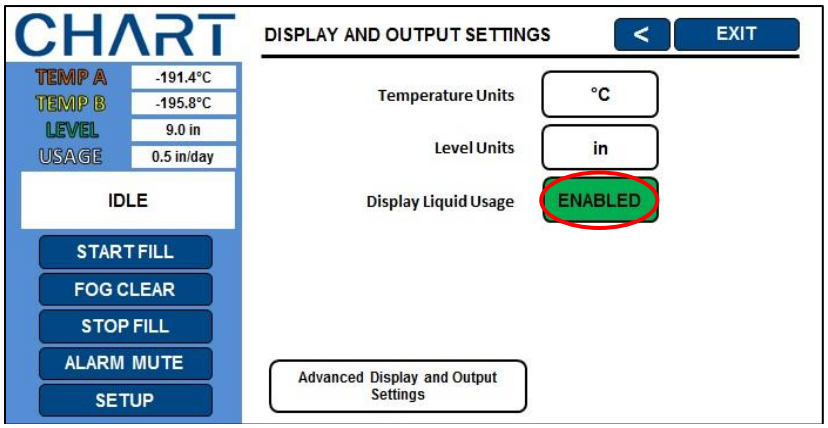
4. Press the units displayed next to “Level Units”

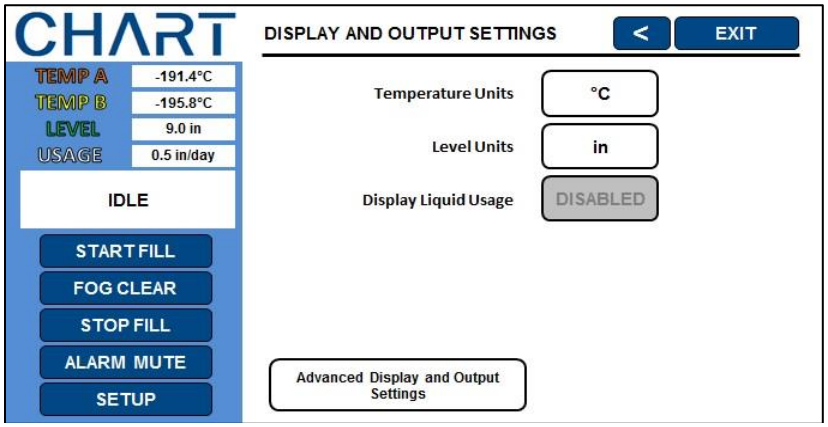
Press the “in” or “mm” option for “Level Units”.



5. **Press “ENABLED” or “DISABLED” next to “Display Liquid Usage”**

This will enable or disable the liquid usage feature. Pressing “ENABLED” will change the liquid usage status to “DISABLED” and pressing “DISABLED” will change the liquid usage status to “ENABLED”.



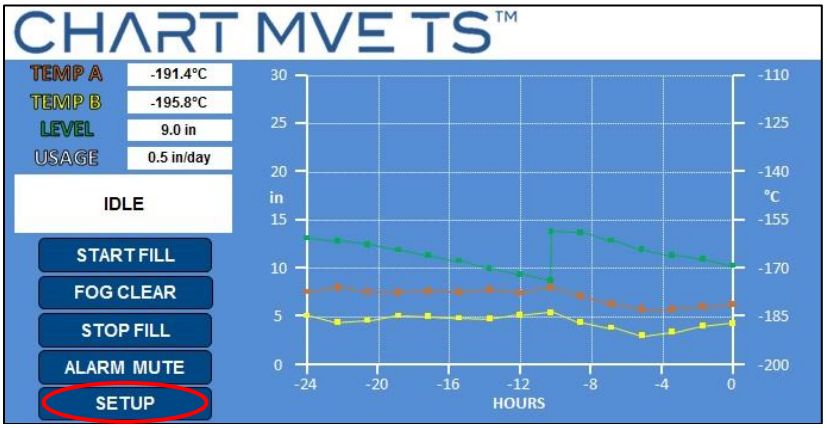


6.2.7.2. Alarm Buzzer

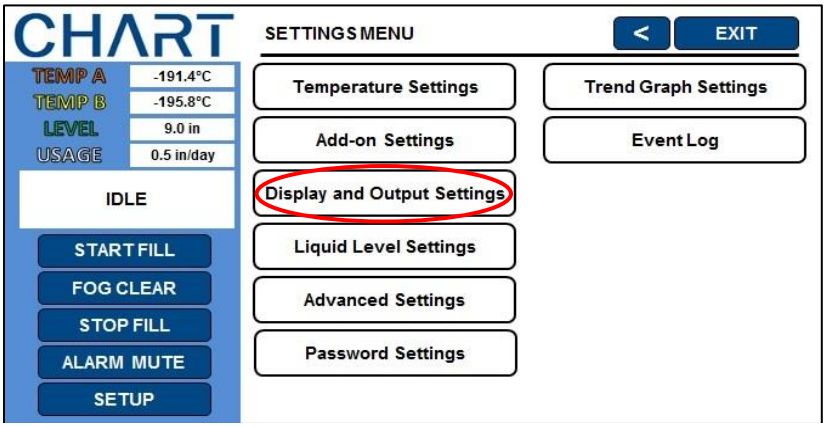
The audible alarm buzzer can be disabled. This will not disable the alarms, only the audible buzzer.

NOTE: Security Level 2 or higher is required to enable/disable the alarm buzzer.

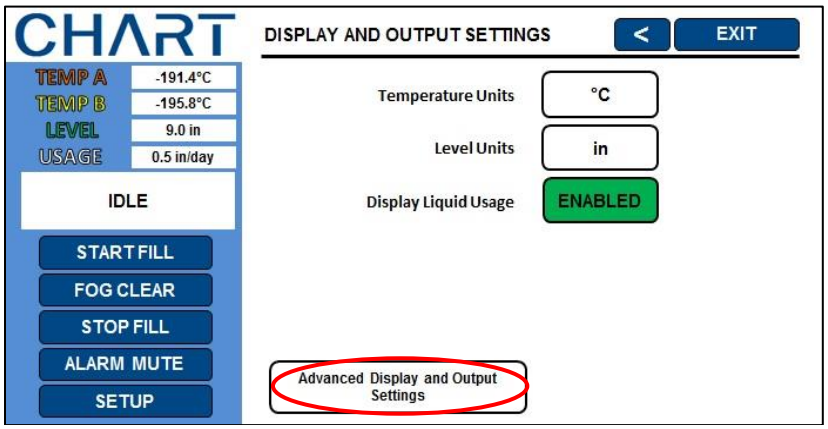
1. **Press "Setup"**
   Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



2. **Press "Display and Output Settings"**

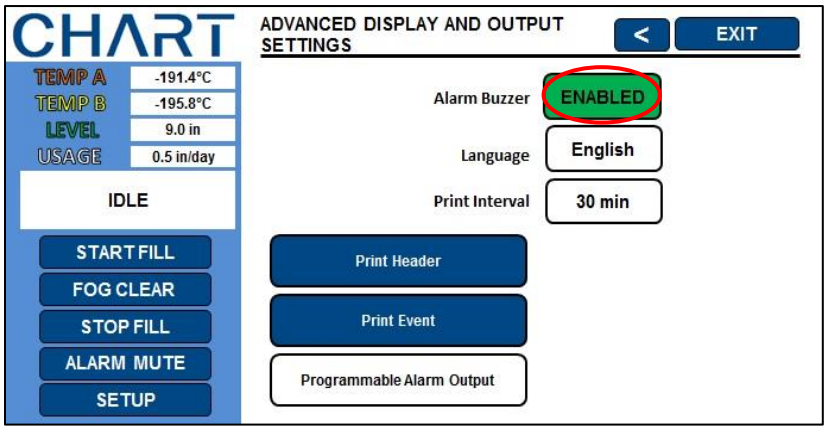


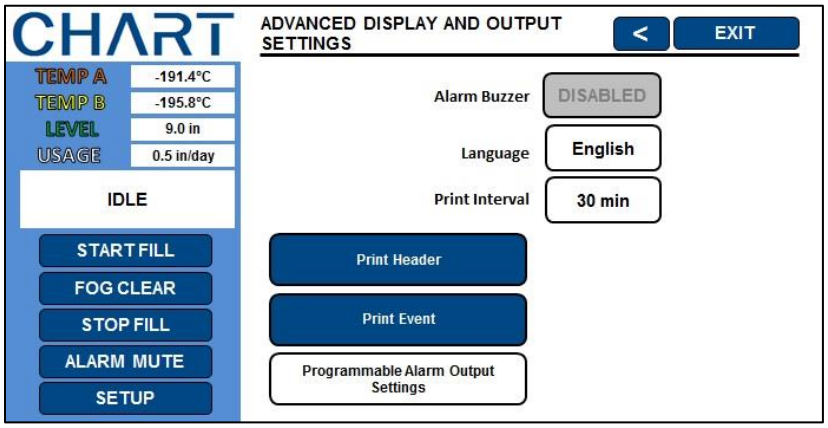
3. Press “Advanced Display and Output Settings”



4. Press “ENABLED” or “DISABLED” next to “Alarm Buzzer”

This will enable or disable the alarm buzzer. Pressing “ENABLED” will change the alarm buzzer status to “DISABLED” and pressing “DISABLED” will change the alarm buzzer status to “ENABLED”.



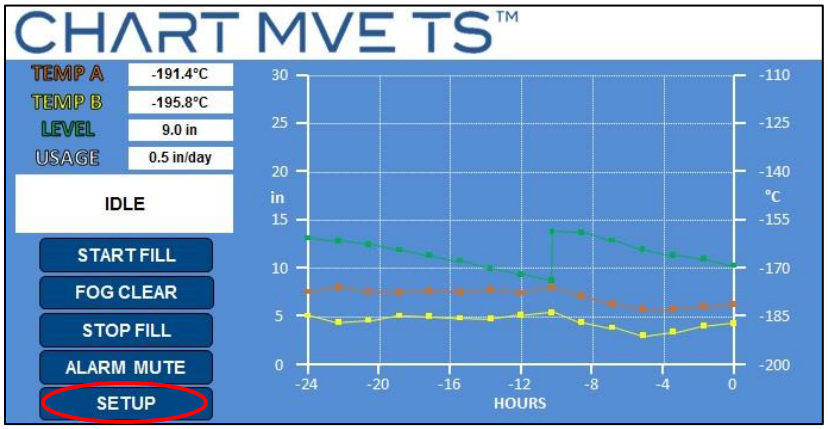


6.2.7.3. Printer

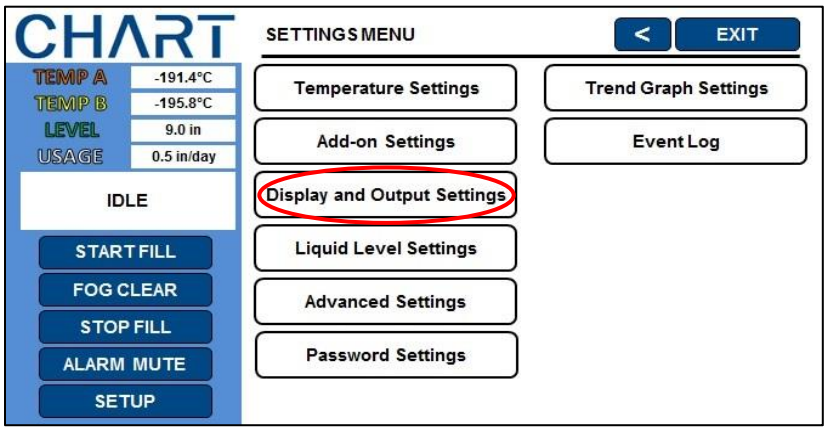
This section describes how to adjust the Printer settings. For instructions on how to connect a printer, see the Communication / Networking section.

NOTE: Security Level 2 or higher is required to adjust the Printer settings.

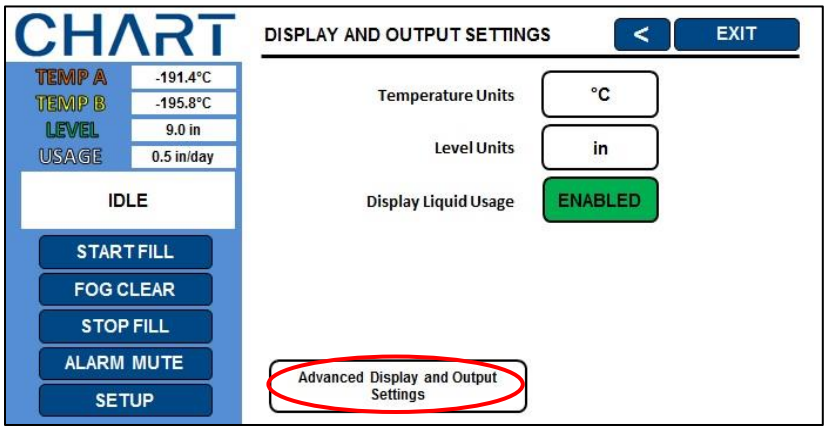
1. **Press "Setup"**
   Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



2. **Press "Display and Output Settings"**

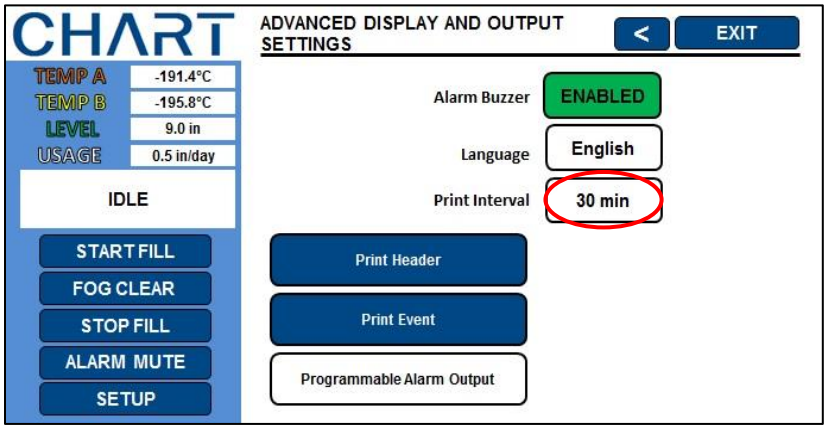


3. Press “Advanced Display and Output Settings”



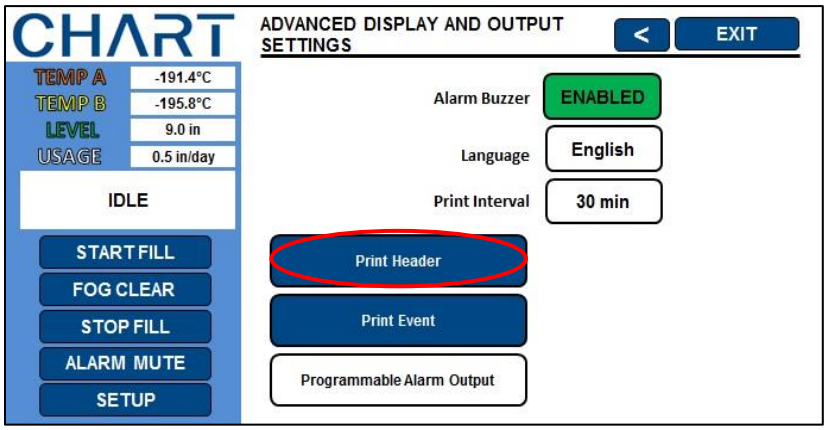
4. Press the value displayed next to “Print Interval”

The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the print interval (if desired) using the number pad that appears on screen and then press “Enter” to save the new value.



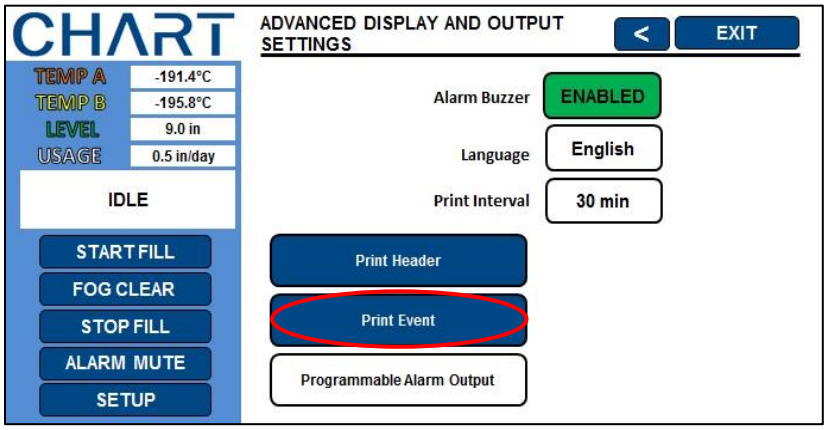
5. Press “Print Header”

This will print a new header line on the printer (if installed).



6. Press “Print Event”

This will print a new line on the printer (if installed) for the current liquid level and probe temperatures.



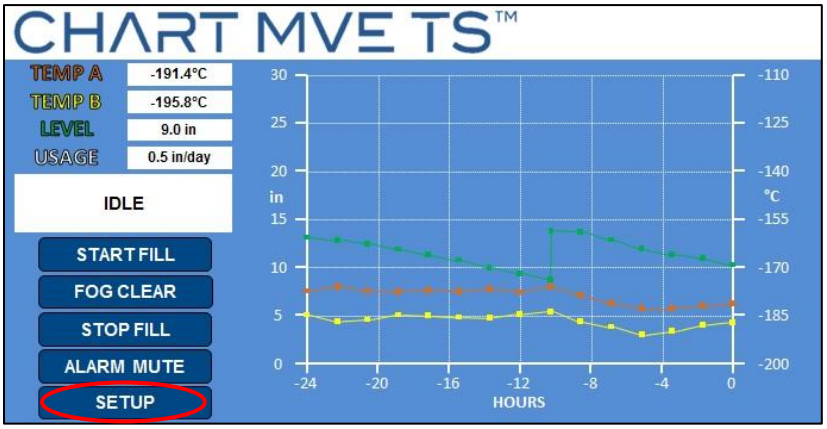
6.2.7.4. Programmable Alarm Output Settings

This section describes how to adjust the alarm output settings. For the alarm pin layouts, see section 5.4.

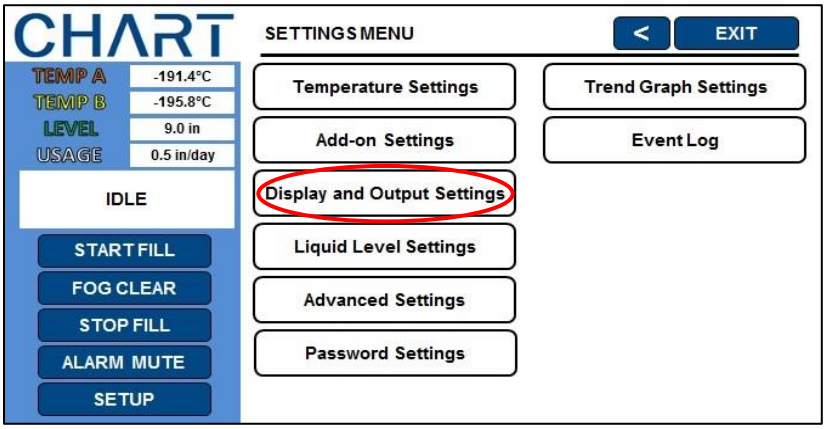
NOTE: Security Level 3 or higher is required to adjust the Programmable Alarm Output settings.

1. Press "Setup"

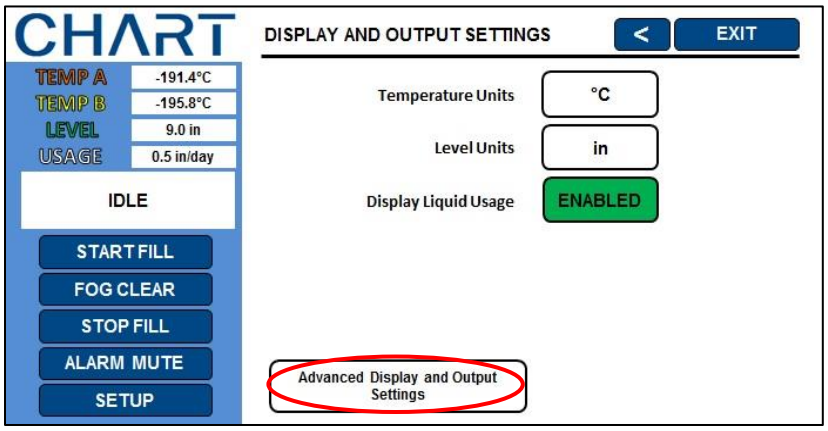
Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



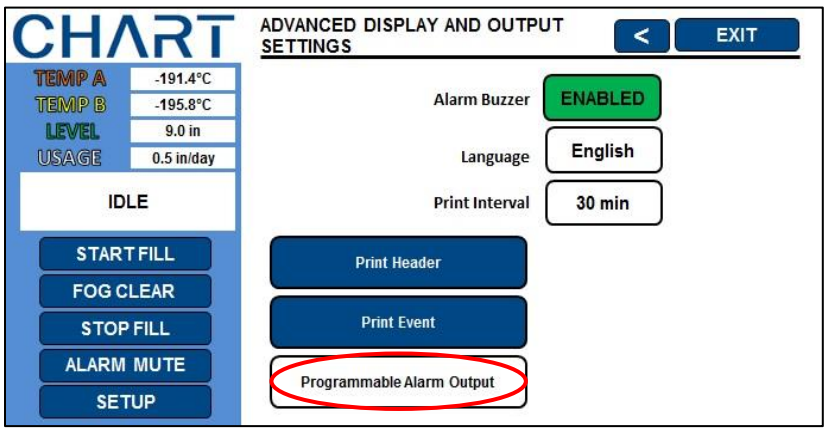
2. Press "Display and Output Settings"



3. Press “Advanced Display and Output Settings”

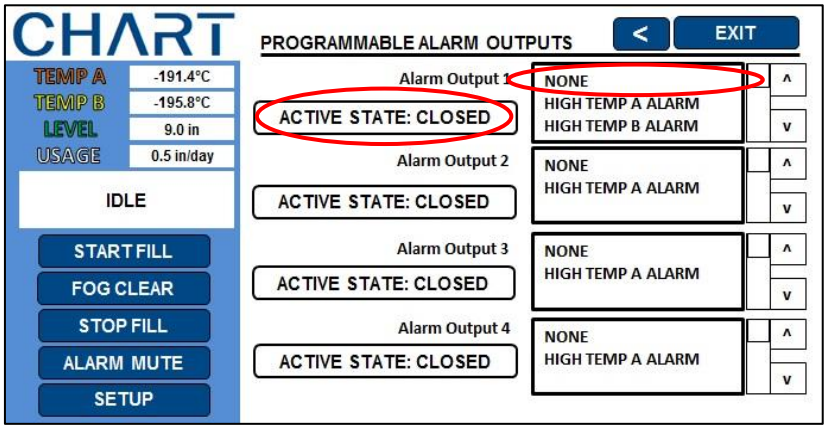


4. Press “Programmable Alarm Output Settings”



5. Select the Active state and Alarm Type for each Alarm Output

The active state can be set to “open” or “closed” for each output. The user can set each output to respond to a specific alarm. For more information on the programmable alarm outputs see section 7.1.6.



6.2.8. Advanced Settings

This section describes how to change the various Advanced Settings.

6.2.8.1. Timed Filling

The Chart MVE TS has several advanced filling options including Timed Filling. Timed Filling allows the user to set a regular filling schedule based on a fill start time and a fill frequency. If a facility staff would like the peace of mind of knowing that all the freezers are full of LN2 before leaving for the weekend, then they could set up a timed fill for every Friday afternoon. Even if the LN2 level in a freezer is above Low Level Setpoint, the Chart MVE TS will initiate a fill and top off the freezer to its High Level Setpoint. If the liquid level is at or above the High Level Setpoint, then the Chart MVE TS will skip that timed fill event and not initiate a fill.

A Chart MVE TS with a Timed Filling schedule will still maintain Auto Fill Control. If Timed Filling and Auto Fill Control are enabled, then the Chart MVE TS will still initiate a fill anytime the liquid level reaches the Low Level Setpoint.

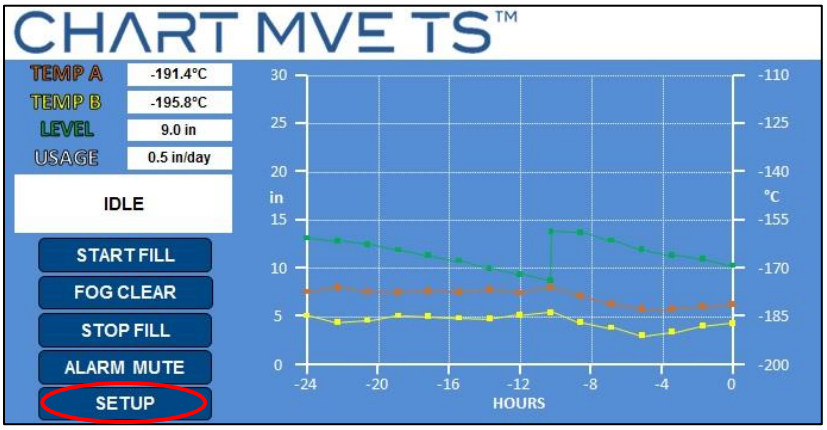
Timed Filling Setup

Enable Timed Filling and then select the number of days to elapse between timed fillings. Select a Timed Fill Start time that is later that same day. If Timed Filling is being enabled at 9:30 AM, then the Timed Fill Start should be set to 10:00 AM or later. This is recommended for simplicity. The Chart MVE TS will initiate a fill when the Timed Fill Start is reached later that day. From then on, each time the Timed Fill Frequency elapses, the Chart MVE TS will fill the freezer to its High Level Setpoint. The Timed Fill Frequency has a range of 1 to 28 days and the Timed Fill Start can be set to any hour except midnight. If midnight is selected, the controller will automatically change it 1:00 AM.

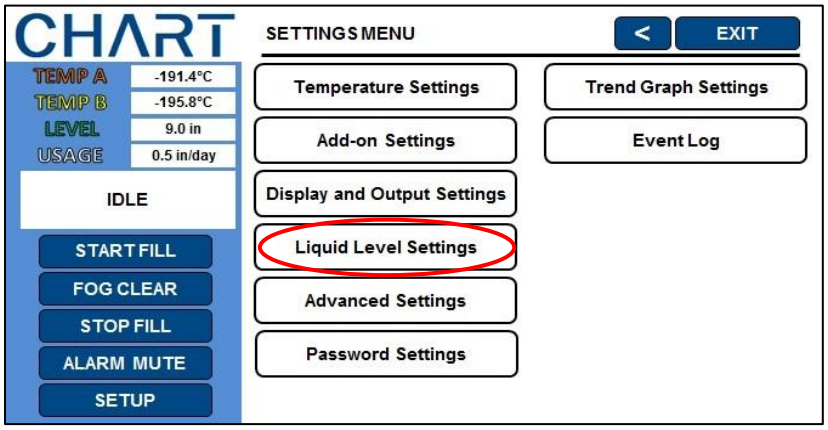
NOTE: Security Level 3 or higher is required to setup or change Timed Filling.

1. Press "Setup"

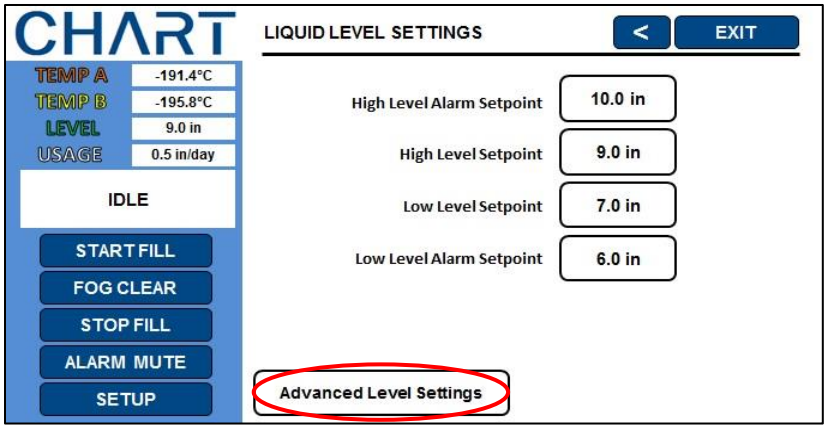
Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



2. Press “Liquid Level Settings”

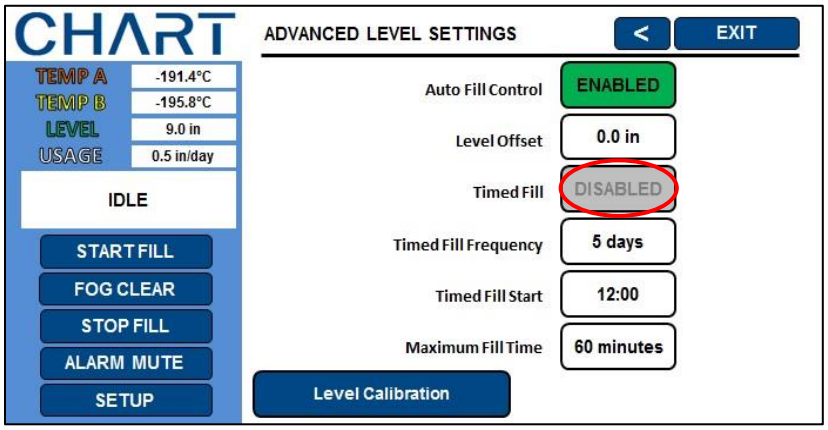


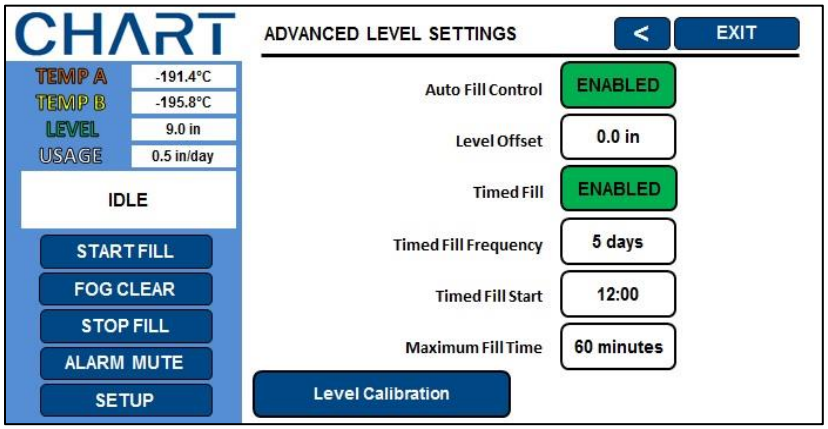
3. Press “Advanced Level Settings”



4. Press “ENABLED” or “DISABLED” next to “Timed Fill”

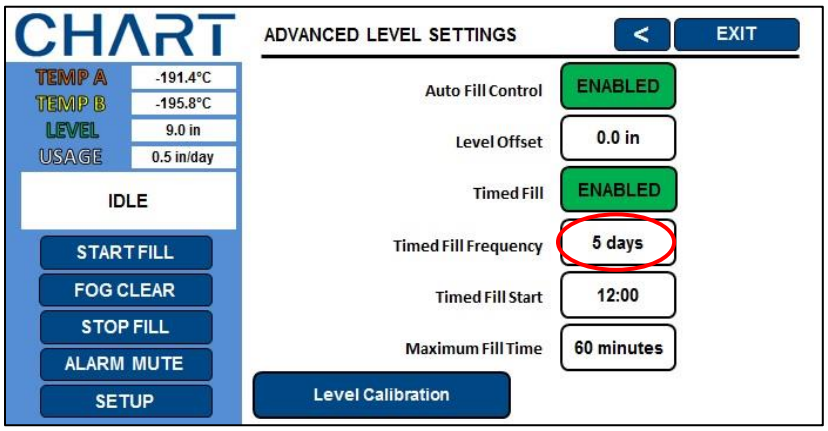
This will enable or disable the timed fill feature. Pressing “ENABLED” will change the timed fill status to “DISABLED” and pressing “DISABLED” will change the timed fill status to “ENABLED”.





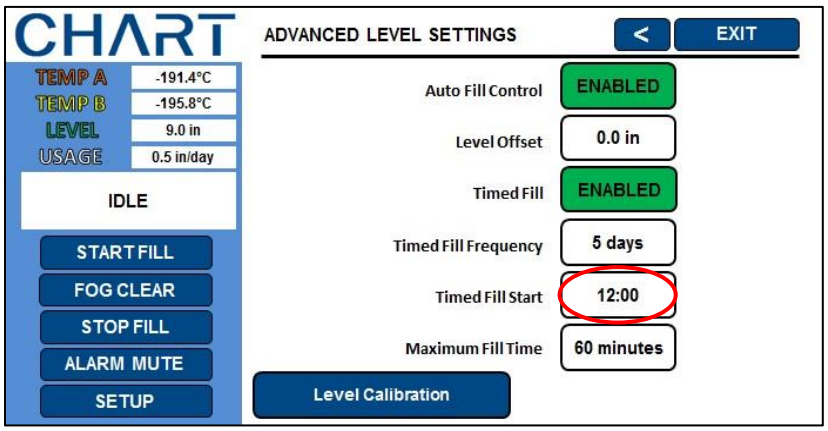
5. Press the value displayed next to “Timed Fill Frequency”

The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the timed fill frequency (if desired) using the number pad that appears on screen and then press “Enter” to save the new value.



6. Press the value displayed next to “Timed Fill Start”

The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the timed fill frequency (if desired) using the number pad that appears on screen and then press “Enter” to save the new value.

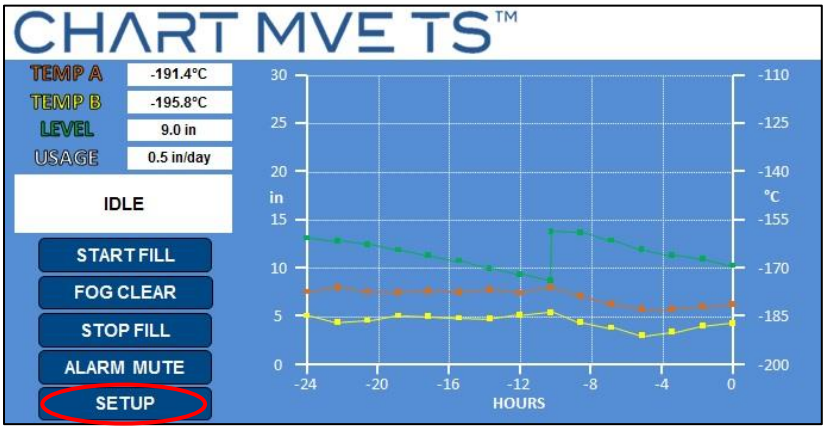


6.2.8.2. Maximum Fill Time

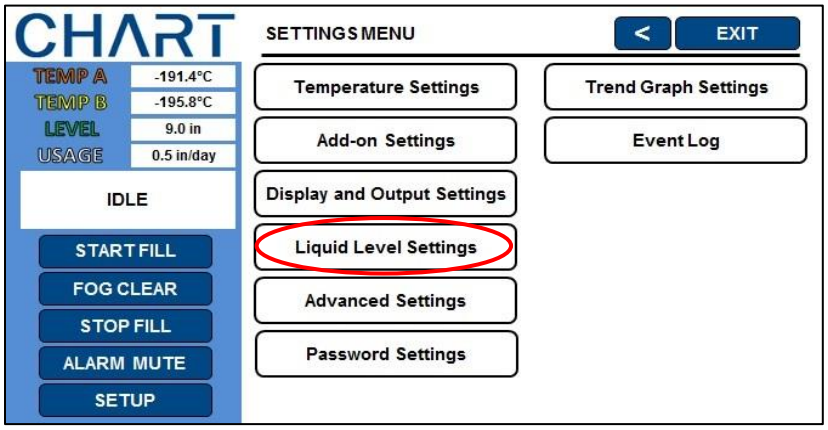
The maximum fill time can be adjusted in the Advanced Fill Menus. If a freezer begins filling but does not reach its High Level Setpoint within the maximum fill time, then the Chart MVE TS will terminate the fill and trigger a Fill Time Alarm. Auto Fill Control will then be disabled until the Fill Time Alarm is cleared. The maximum fill time has a range of 30 to 240 minutes.

NOTE: Security Level 3 or higher is required to adjust the maximum fill time.

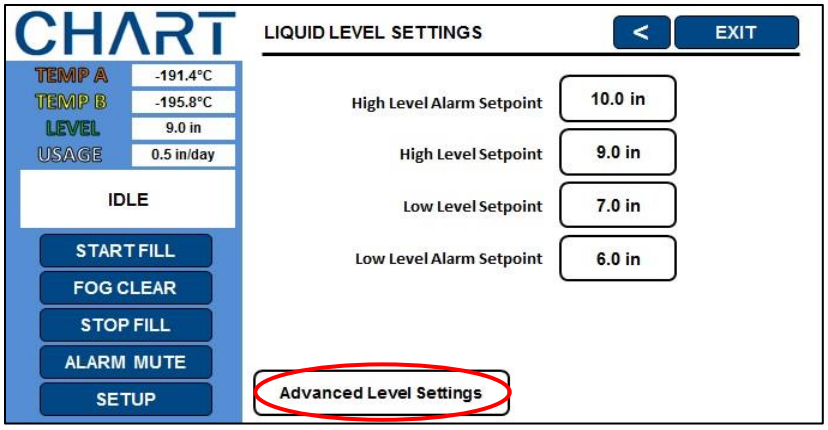
1. **Press "Setup"**
   Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



2. Press “Liquid Level Settings”

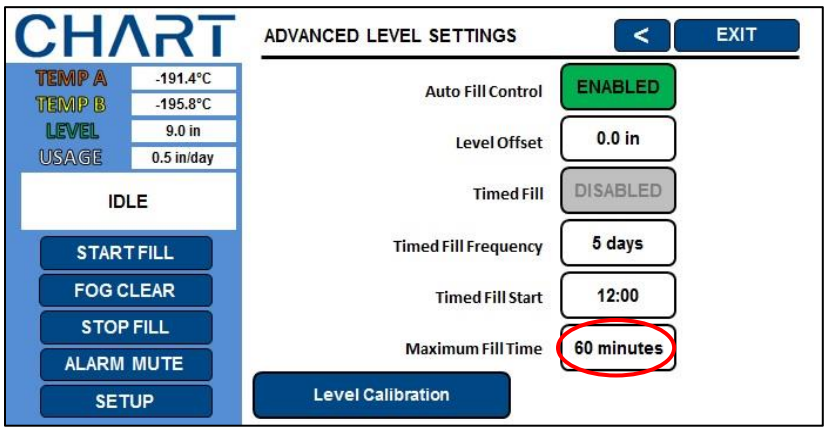


3. Press “Advanced Level Settings”



4. Press the value displayed next to “Maximum Fill Time”

The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the maximum fill time (if desired) using the number pad that appears on screen and then press “Enter” to save the new value.



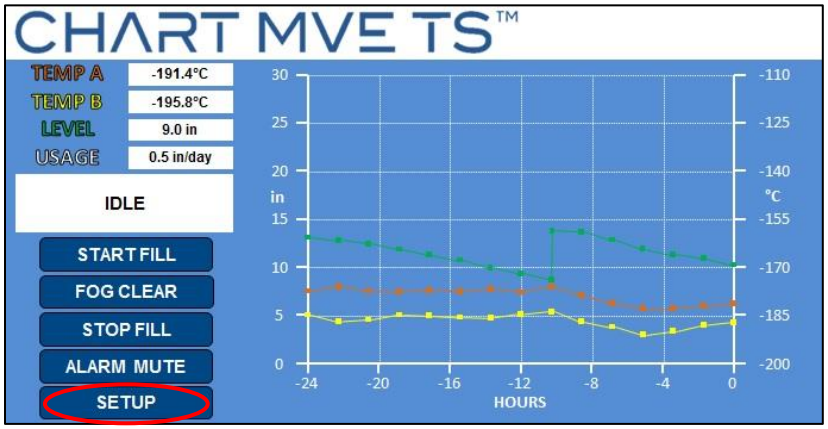
6.2.8.3. Time and Date

The time and date can be set in the Advanced Settings Menus. The user has the option of a 12 or 24 hour clock and a MM/DD/YY or DD/MM/YY date format.

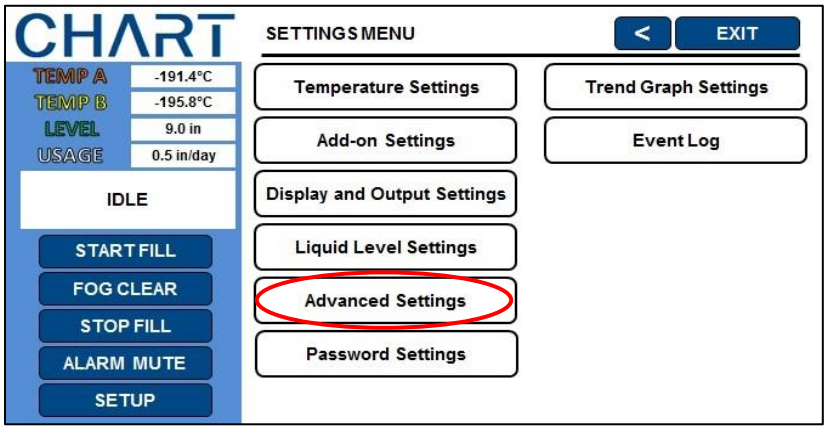
NOTE: Security Level 2 or higher is required to change the time and date.

1. Press "Setup"

Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".

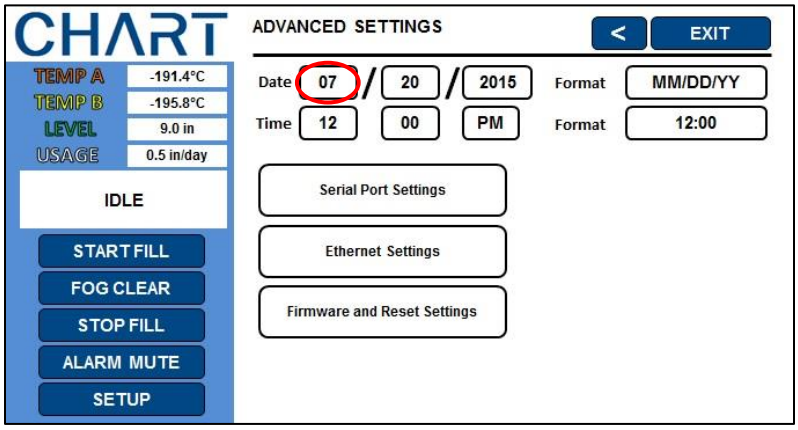


2. Press "Advanced Settings"



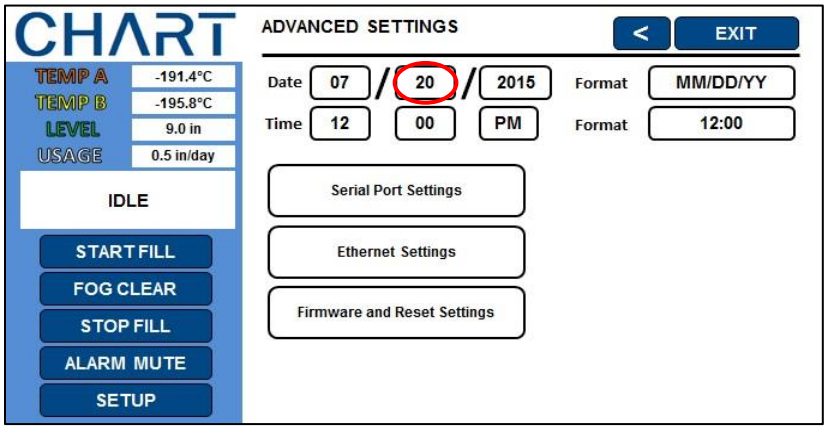
3. Press first value displayed next to “Date”

The number pad will be displayed once the value to be adjusted is selected. Type in the current month using the number pad that appears on screen and then press “Enter” to save the new value.



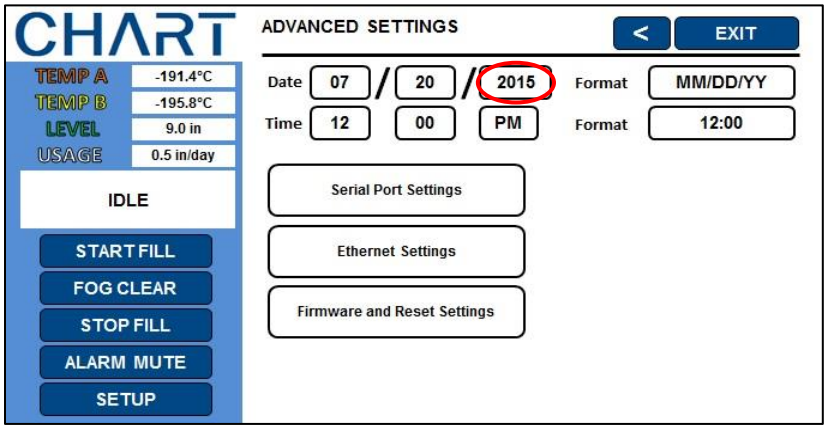
4. Press second value displayed next to “Date”

The number pad will be displayed once the value to be adjusted is selected. Type in the current day using the number pad that appears on screen and then press “Enter” to save the new value.



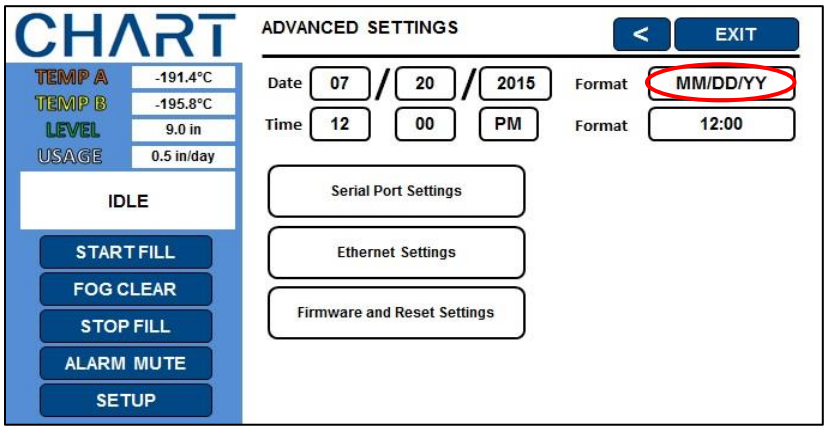
5. Press third value displayed next to “Date”

The number pad will be displayed once the value to be adjusted is selected. Type in the current year using the number pad that appears on screen and then press “Enter” to save the new value.



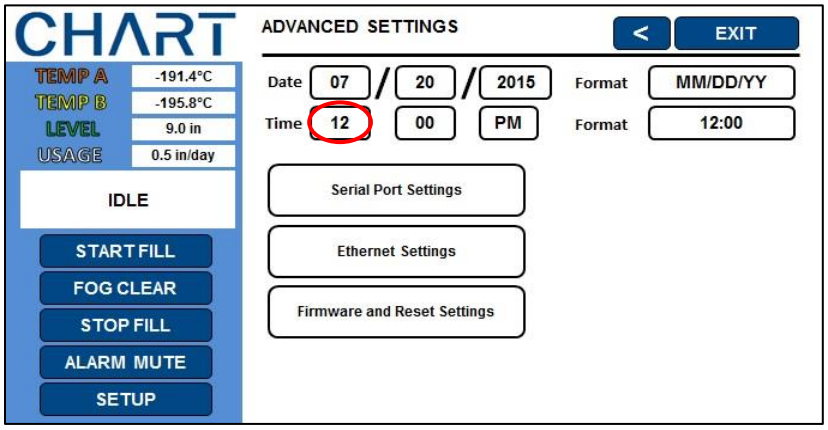
6. Press date format displayed next to “Format”

Select the desired date format and press “Enter” to save the new setting.



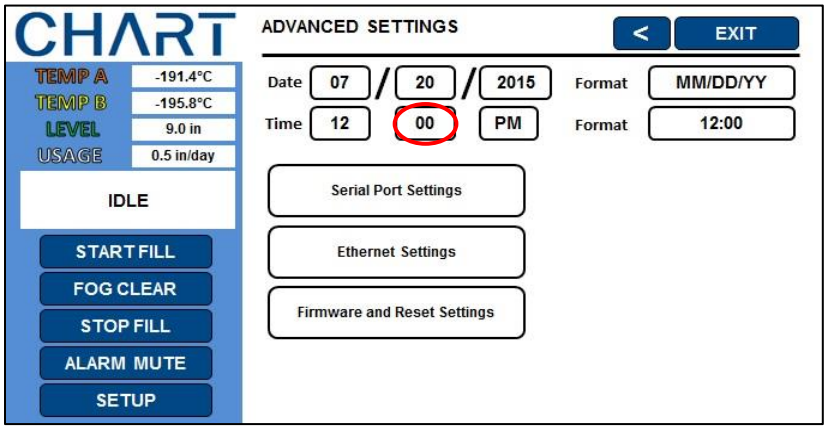
7. Press first value displayed next to “Time”

The number pad will be displayed once the value to be adjusted is selected. Type in the current hour using the number pad that appears on screen and then press “Enter” to save the new value.



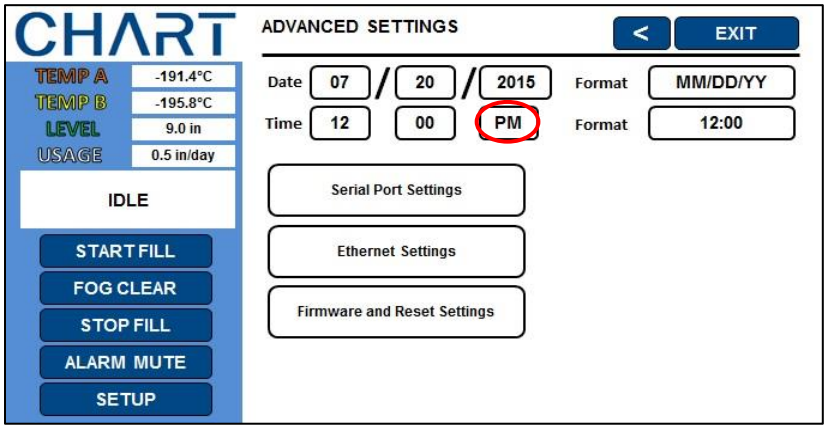
8. Press second value displayed next to “Time”

The number pad will be displayed once the value to be adjusted is selected. Type in the current minute using the number pad that appears on screen and then press “Enter” to save the new value.



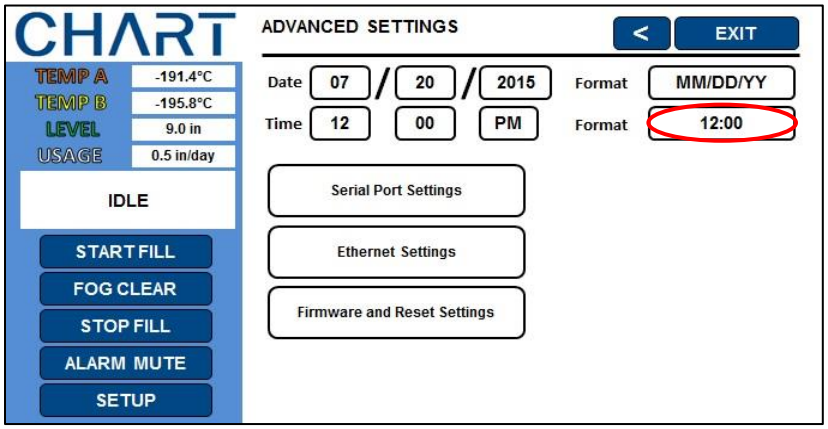
9. Press third value displayed next to “Time”

Select “AM” or PM” and then press “Enter” to save the new value.



10. Press the time format displayed next to “Format”

Select the desired time format and press “Enter” to save the new setting.



6.2.8.4. Communication Settings

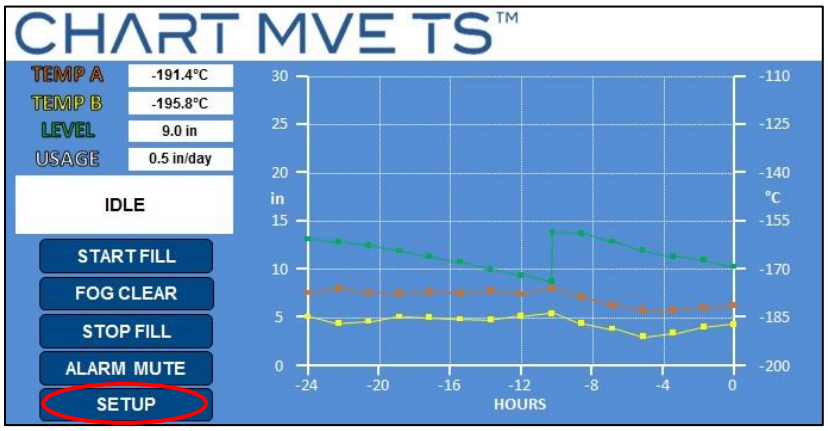
6.2.8.4.1. Serial Port Settings

The settings for the serial port can be adjusted in the Serial Port Settings. Networked controllers must be daisy chained together with RJ-45 splitters in order to communicate using the same COM Type.

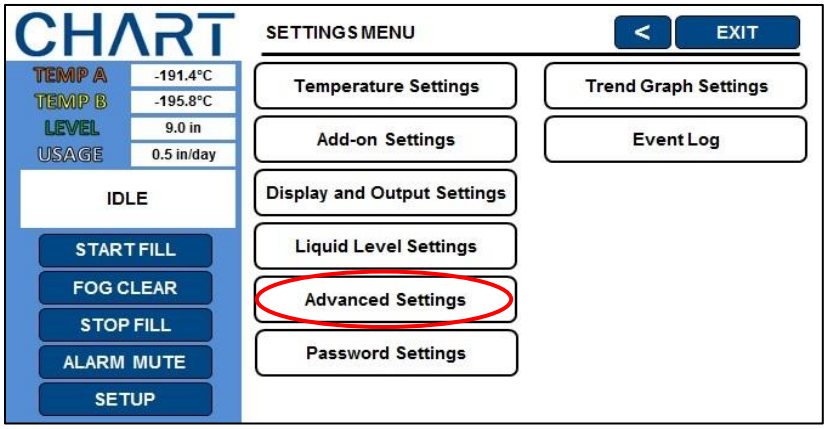
NOTE: Security Level 3 or higher is required to change the Communication Settings.

1. Press "Setup"

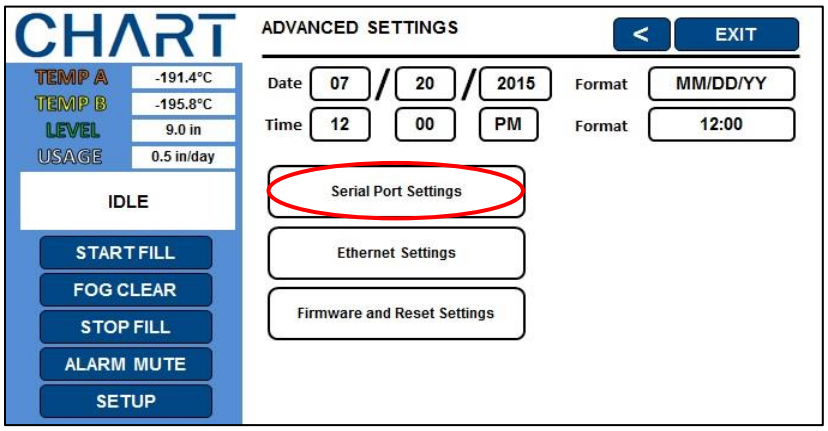
Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



2. Press "Advanced Settings"

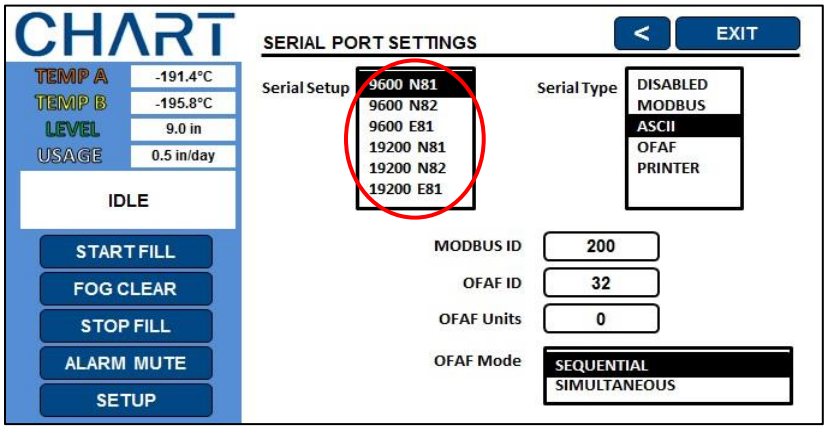


3. Press “Serial Port Settings”



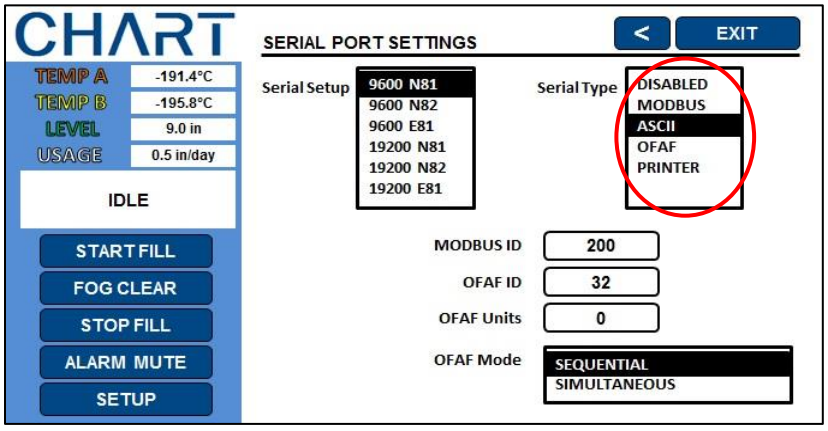
4. Press the desired serial port setup

The current setting will be highlighted once selected.



5. Press the desired serial port type

The current setting will be highlighted.



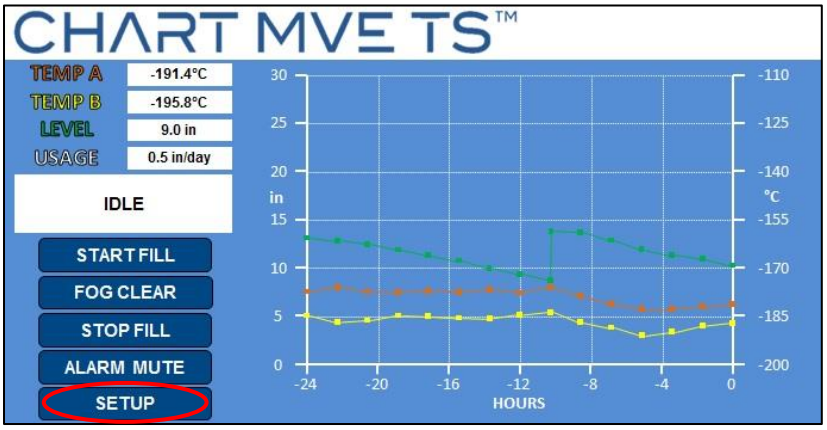
6.2.8.4.2. MODBUS ID

The Chart MVE TS MODBUS ID also serves as the ASCII Unit ID. This address can be adjusted in the Serial Port Settings and has a range of 1 to 200.

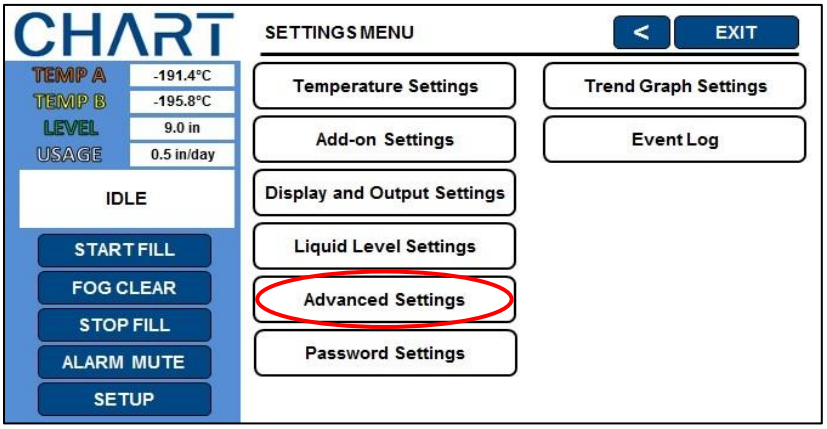
NOTE: Security Level 2 or higher is required to change the MODBUS ID.

1. Press "Setup"

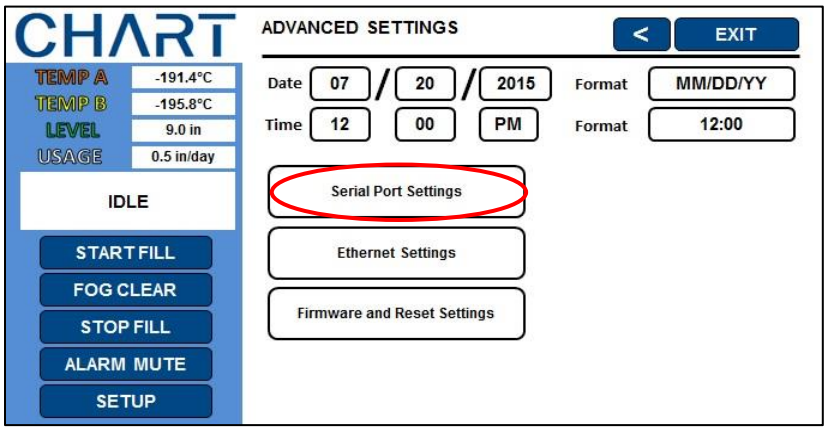
Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



2. Press "Advanced Settings"

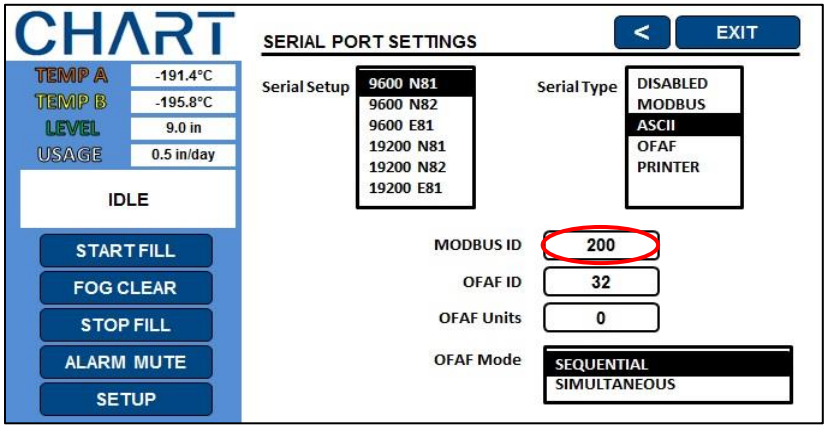


3. Press “Serial Port Settings”



4. Press the value displayed next to “MODBUS ID”

The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the MODBUS ID (if desired) using the number pad that appears on screen and then press “Enter” to save the new value.



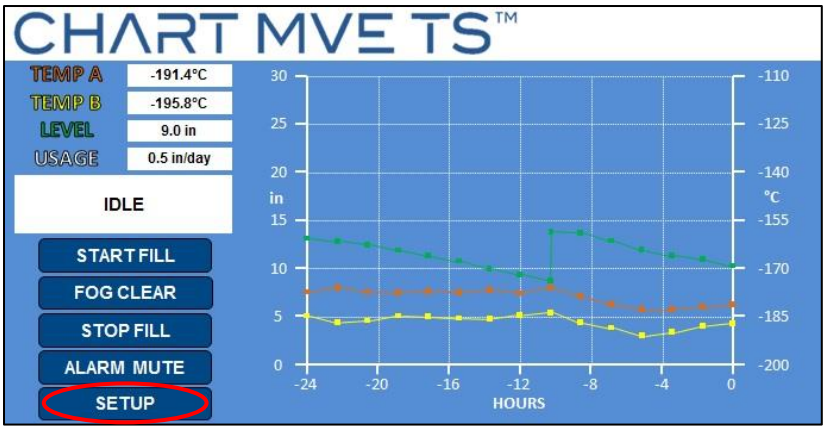
6.2.8.5. One Fill All Fill (OFAF)

This section describes how to adjust the various OFAF settings. For more information and instructions on how to setup an OFAF network, refer to the OFAF Network Setup section of this manual.

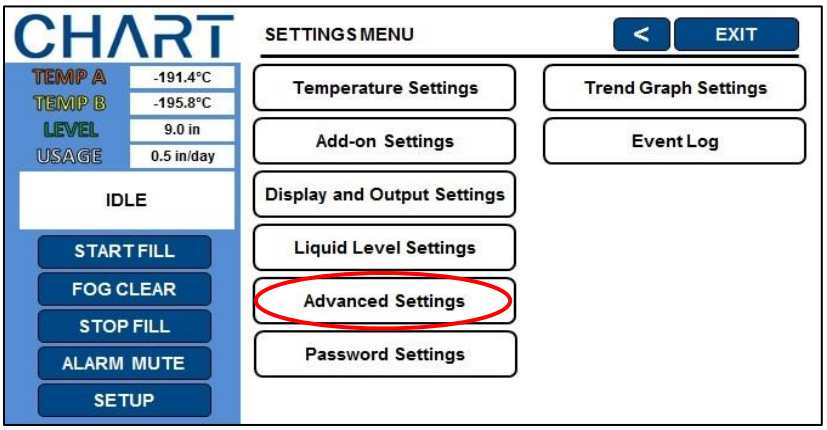
NOTE: Security Level 3 or higher is required to adjust the OFAF settings.

1. Press "Setup"

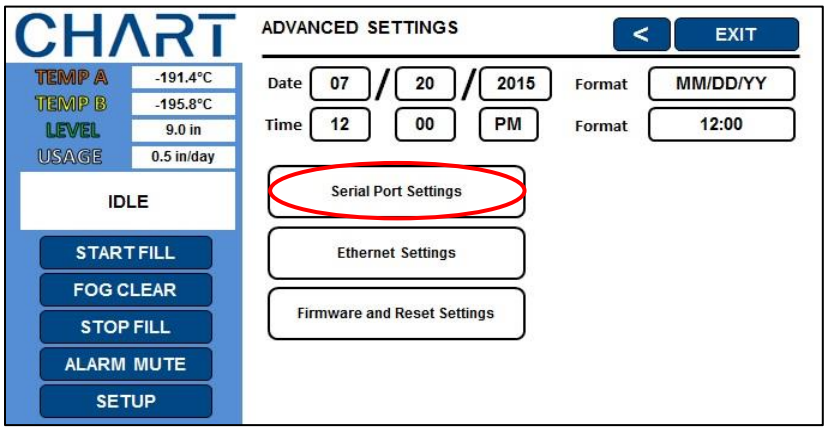
Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



2. Press "Advanced Settings"

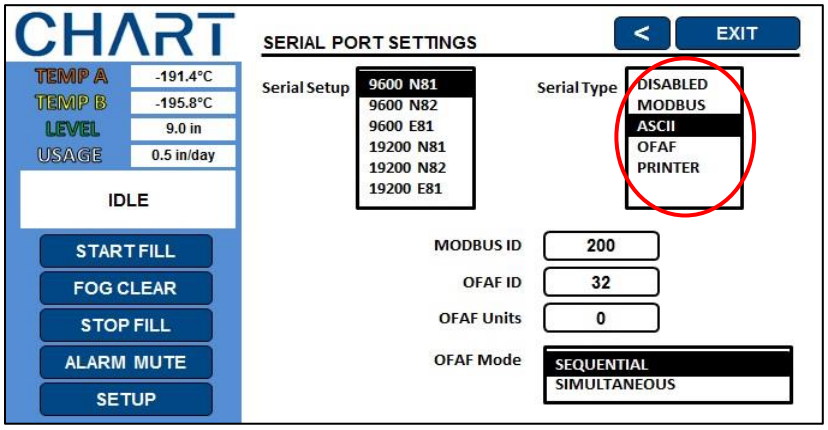


3. Press “Serial Port Settings”



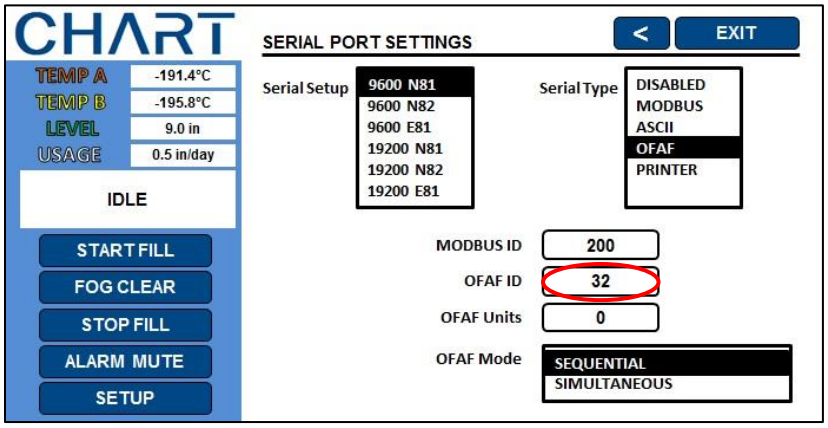
6. Press the desired serial port type

The current setting will be highlighted. Press “OFAF” to select this type for the serial port.



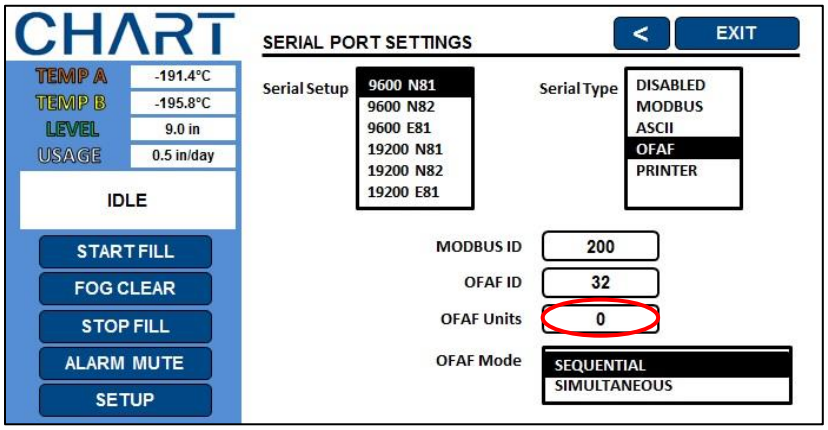
4. Press the value displayed next to “OFAF ID”

The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the OFAF ID using the number pad that appears on screen and then press “Enter” to save the new value.



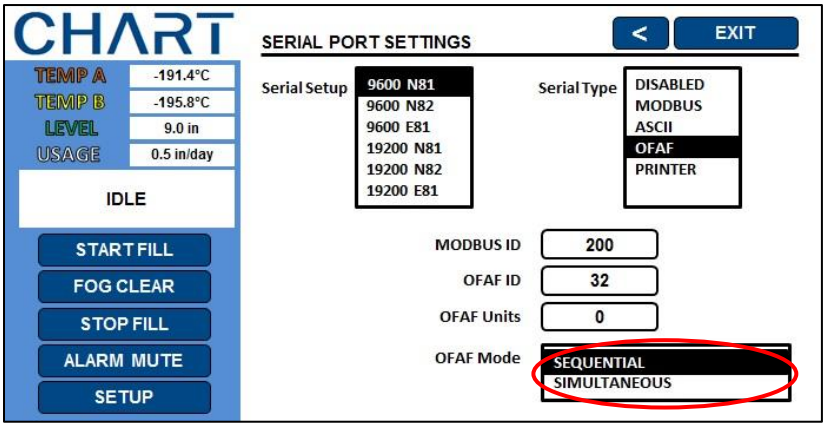
5. Press the value displayed next to “OFAF UNITS”

The number pad will be displayed once the value to be adjusted is selected. Type in a new value for the number of OFAF units using the number pad that appears on screen and then press “Enter” to save the new value. The number of OFAF units is equal to the total number of freezers in the OFAF network less one. See section 7.4.3 for more details on OFAF network setup.



6. Press the desired OFAF mode

The current setting will be highlighted once selected.



6.2.8.6. Ethernet Settings

The Chart MVE TS controller is equipped with an Ethernet port to enable the controller to be connected to a LAN or other network. Once the controller is connected via the Ethernet port to the desired network, follow the steps below to configure the controller for TCP/IP networking.

Media Access Control (MAC) Address – permanent device identifier used in some communication protocols.

Internet Protocol (IP) Address – identifier of an individual machine in a network.

Dynamic Host Configuration Protocol (DHCP) – protocol for distributing network parameters to machines on a network, such as IP addresses.

Domain Name Server – machine that resolves web addresses and network names into IP addresses.

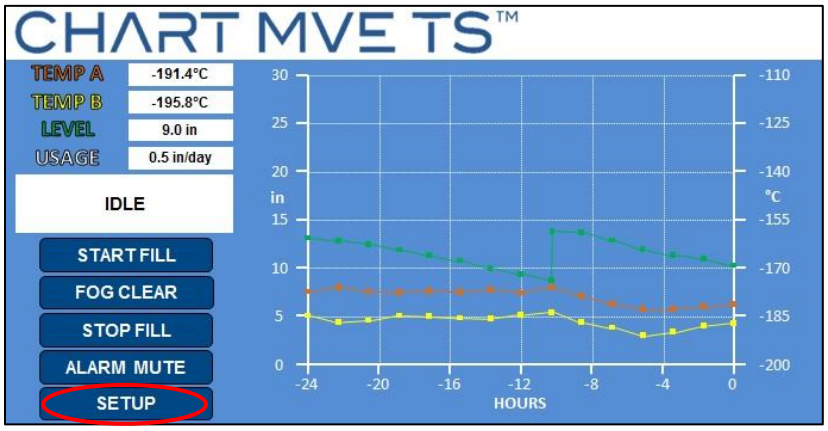
DHCP must be enabled on the controller in order to communicate via the Ethernet connection. When attempting to adjust settings via the Ethernet connection, the controller may prompt for a username and password. This username and password combination is separate from the passwords managed in the Password Settings menu.

IEEE 802.3 compatible Ethernet controller w/ 10Base-T PHY, compatible with 10/100/1000Base-T networks.

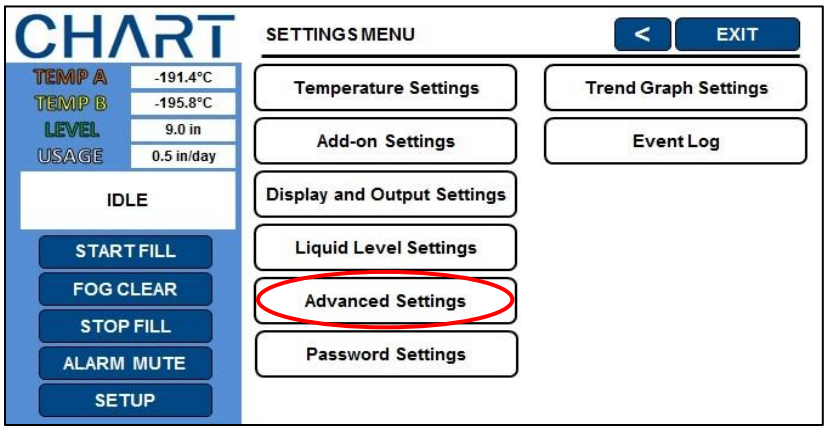
NOTE: Security Level 3 or higher is required to adjust the Ethernet settings.

1. Press “Setup”

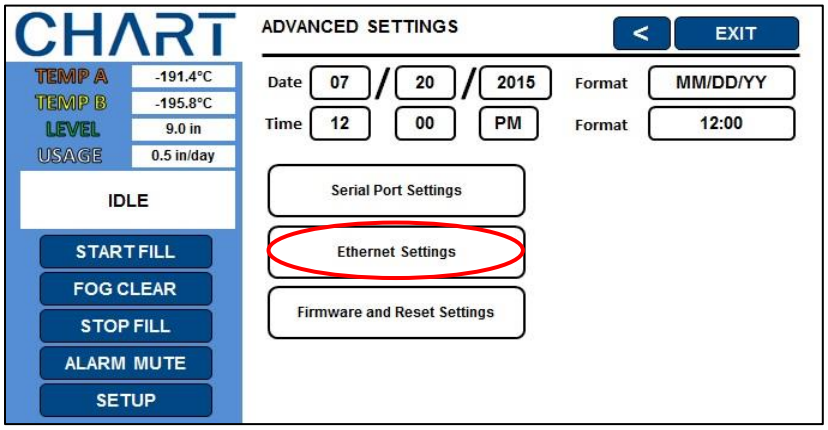
Controller may prompt for a password. Type in the password using the number pad that appears and press “Enter”.



2. Press “Advanced Settings”

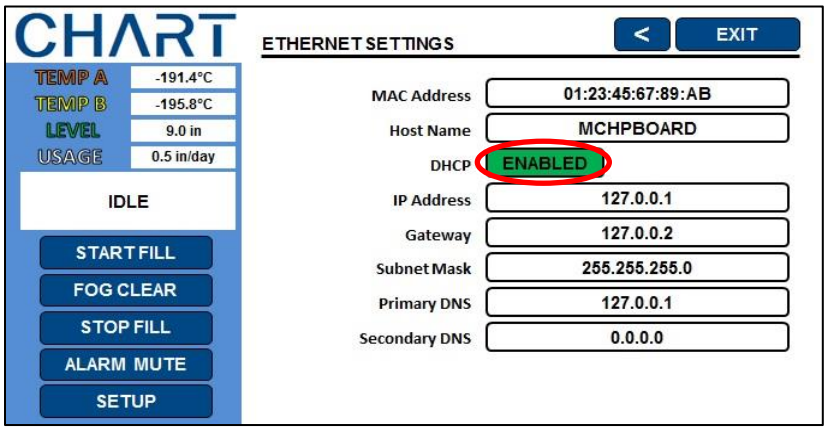


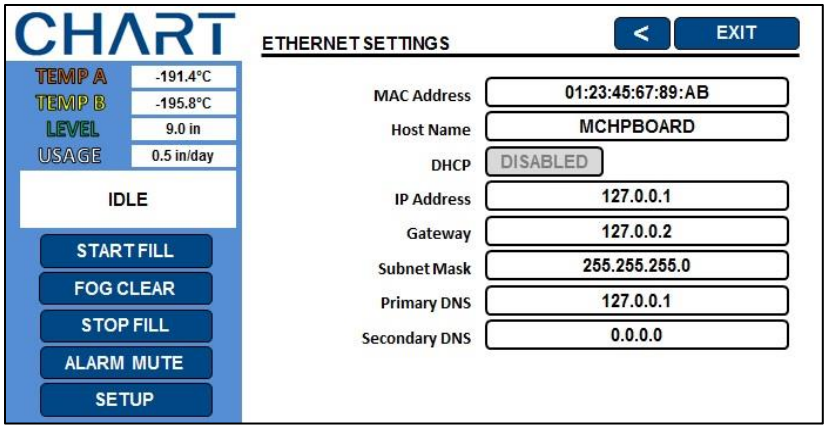
3. Press “Ethernet Settings”



4. Press “ENABLED” or “DISABLED” next to “DHCP”

This will enable or disable the DHCP. Pressing “ENABLED” will change the DHCP status to “DISABLED” and pressing “DISABLED” will change the DHCP status to “ENABLED”.





5. Navigate to the IP Address displayed under Ethernet Settings

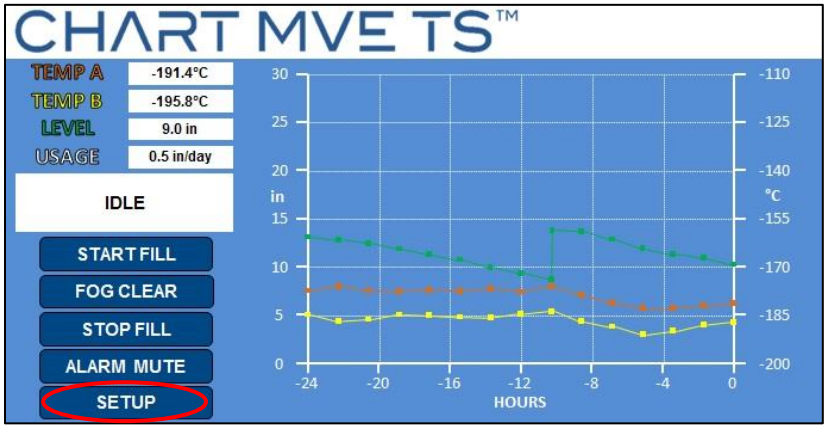
Navigate to the IP address of a given controller through a standard web browser. Settings, alarms, current temperatures, and current liquid level can be accessed through the Ethernet connection.

6.2.8.7. Restore Default Settings

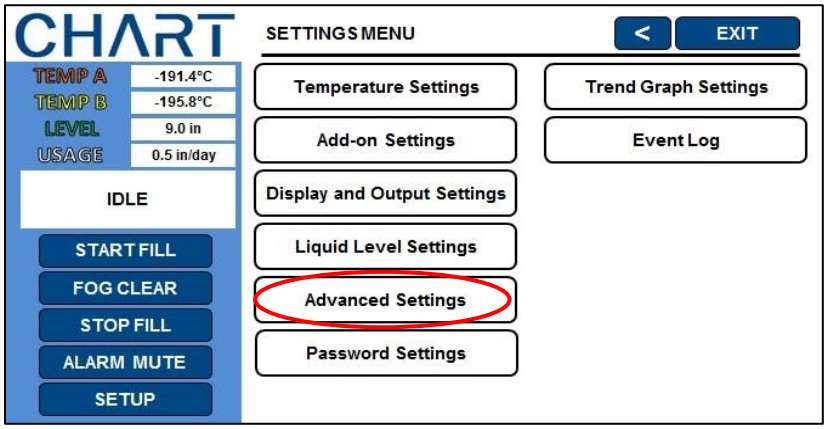
The Chart MVE TS can be reset to the factory defaults in the Advanced Settings Menu. This will also reset post-factory calibrations. The accuracy of the level and temperature measurements should be confirmed after resetting.

NOTE: Security Level 3 or higher is required to reset to factory default settings.

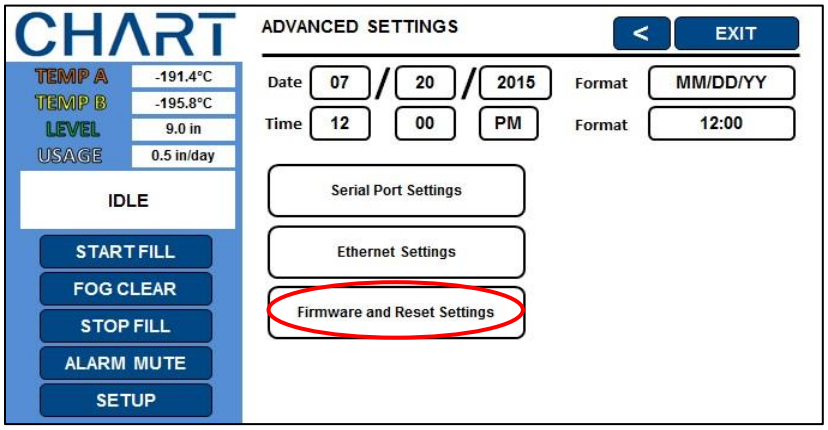
1. **Press "Setup"**
   Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



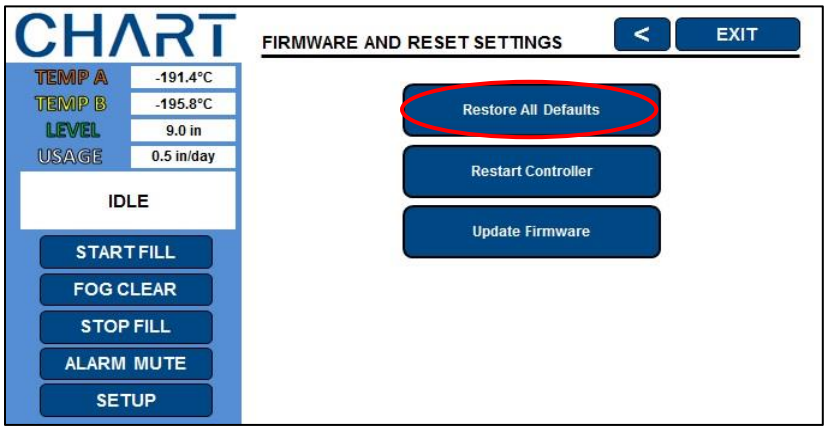
2. **Press "Advanced Settings"**



3. Press “Firmware and Reset Settings”



4. Press “Restore All Defaults”



Controller Defaults:

Parameter	Default Setting
High Temp Alarm	-110.0 °C / -166.0 °F / 163.2 K
Low Temp Alarm	-200.0 °C / -327.6 °F / 73.4 K
High Level Alarm	8.0 in / 205 mm
High Level Setpoint	7.0 in / 180 mm
Low Level Setpoint	5.0 in / 125 mm
Low Level Alarm	4.0 in / 100 mm
Level Offset	+1.3 in / +35 mm
Auto Fill	Enabled
Maximum Fill Time	60 minutes
Temperature Display Units	°C
Liquid Level Display Units	Inches
Inlet Temperature Setpoint	-70 °C
Hot Gas Bypass Alarm Time Delay	5 minutes
COM 1 Type	ASCII
Event Log Interval	240 minutes
Global Password	3 4 5 6

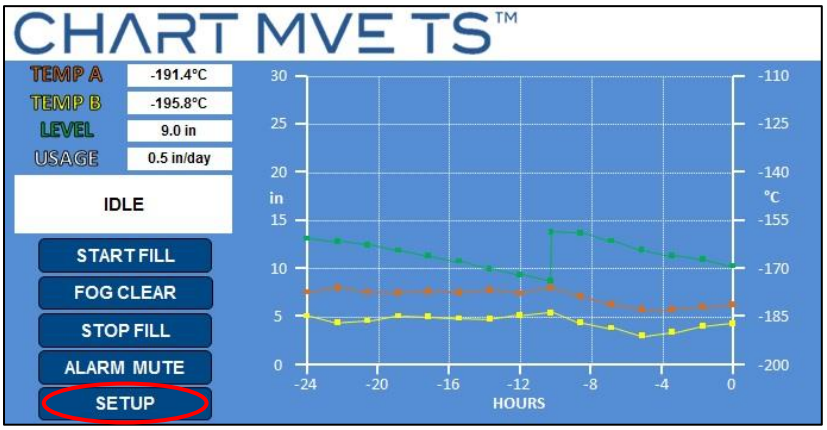
6.2.8.8. Restart Controller

The Chart MVE TS can be restarted in the Advanced Settings Menu. Restarting the controller and cycling the power are both safe ways to reboot the controller.

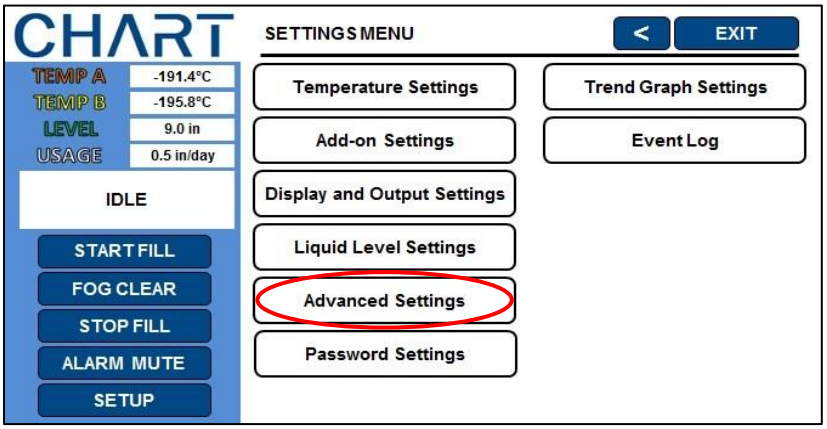
NOTE: Security Level 3 or higher is required to restart the controller from the Advanced Settings Menu.

1. Press "Setup"

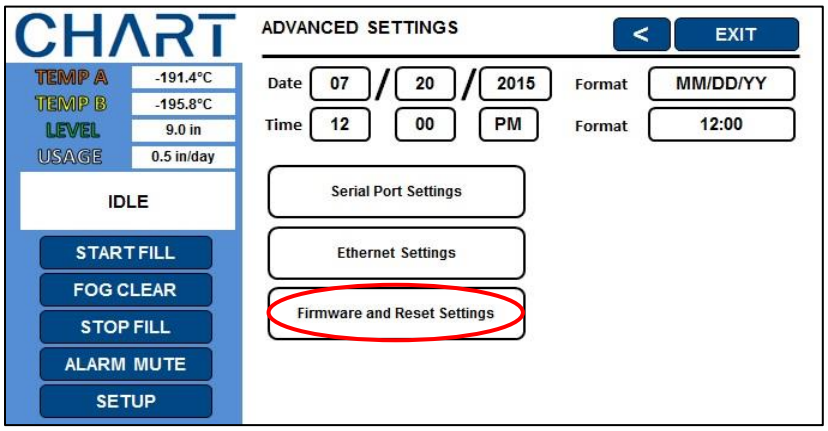
Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



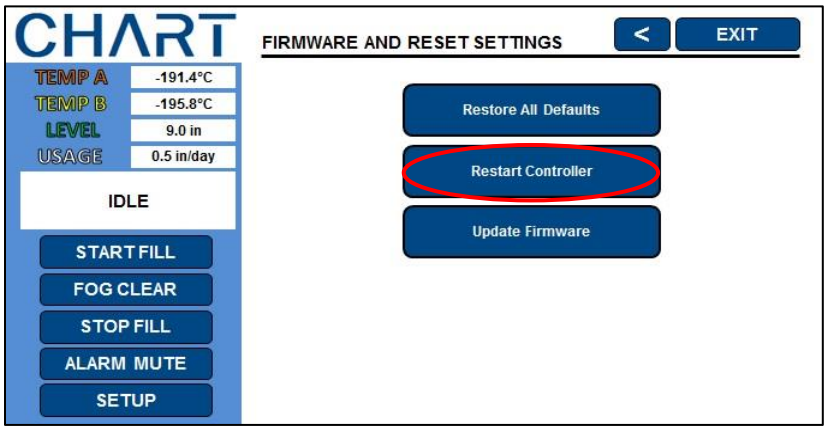
2. Press "Advanced Settings"



3. Press “Firmware and Reset Settings”



4. Press “Restart Controller”



5. Confirm Restart

Controller will restart as normal.

6.2.8.9. Firmware Update

NOTE: Chart MVE TS firmware should only be updated by authorized MVE Distributors or under the direction of Technical Service. Improper firmware updates can render the controller inoperable.

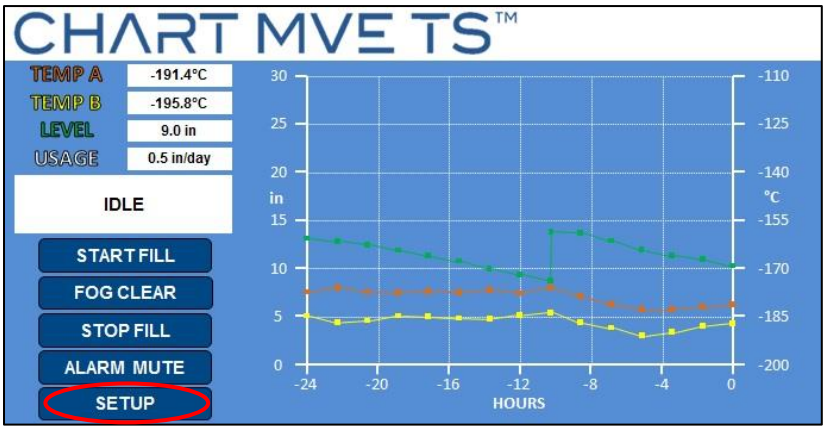
The firmware, or controller software, can be updated in the event that a new revision is released. A USB drive and the current firmware file(s) are required to perform a firmware upgrade. Contact your authorized MVE Distributor or Technical Service for more information.

NOTE: Security Level 3 or higher is required to update the firmware.

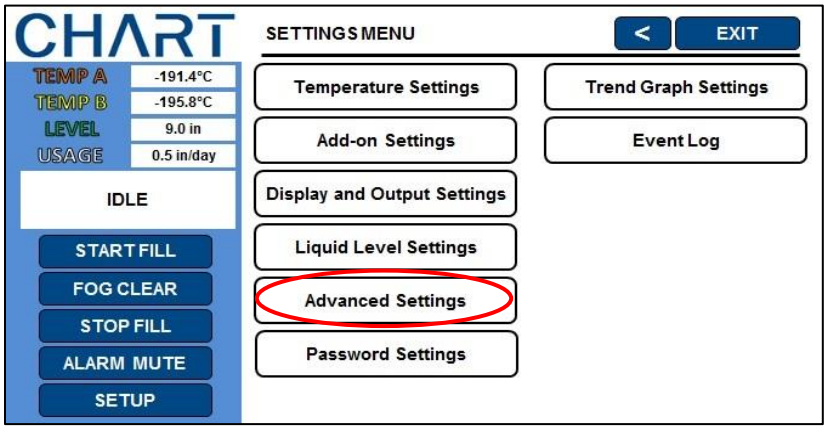
1. **Place firmware updater file(s) on the root level of a USB drive (i.e. not contained in a subfolder within the USB drive)**

2. **Plug the USB into the USB port on the front of the controller**

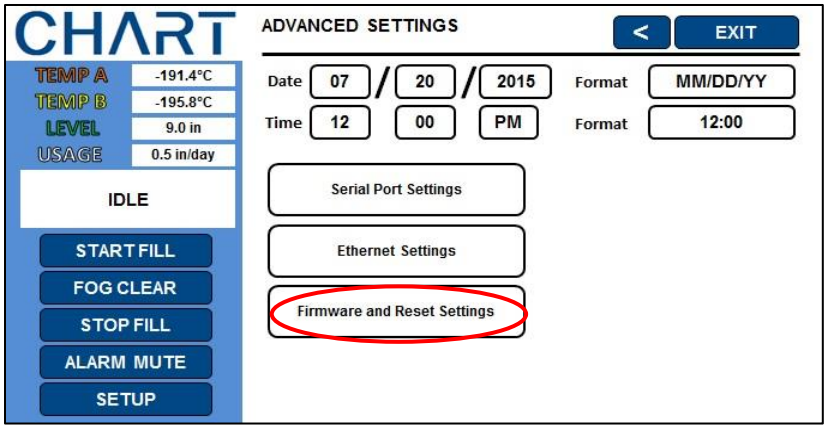
3. **Press "Setup"**
   Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



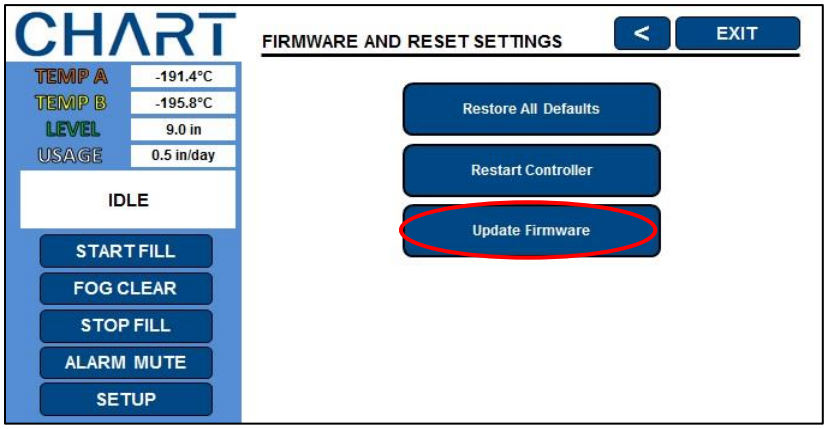
4. **Press "Advanced Settings"**



5. **Press "Firmware and Reset Settings"**



6. **Press "Update Firmware"**
   Wait for the controller to complete the firmware update. This may take several minutes. The controller may beep periodically during the firmware update.



6.2.9. Password / Security Setup

This section details how to enable / disable password entry mode as well as how to change and setup multilevel security passwords.

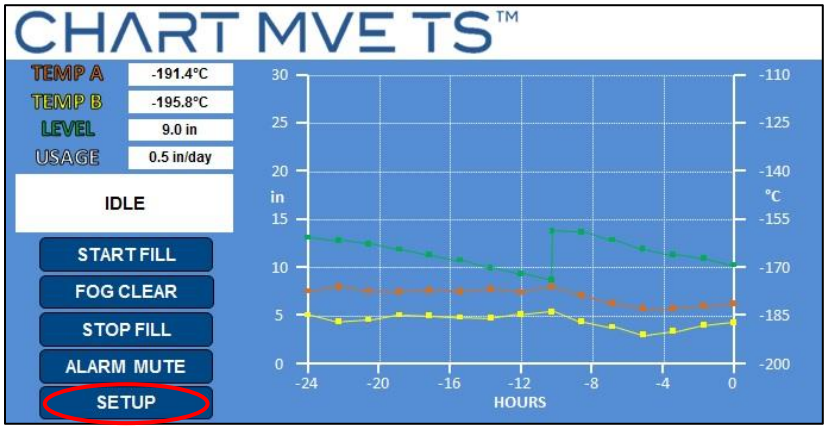
NOTE: Security Level 4 is required to setup or change passwords.

6.2.9.1. Password Entry Mode

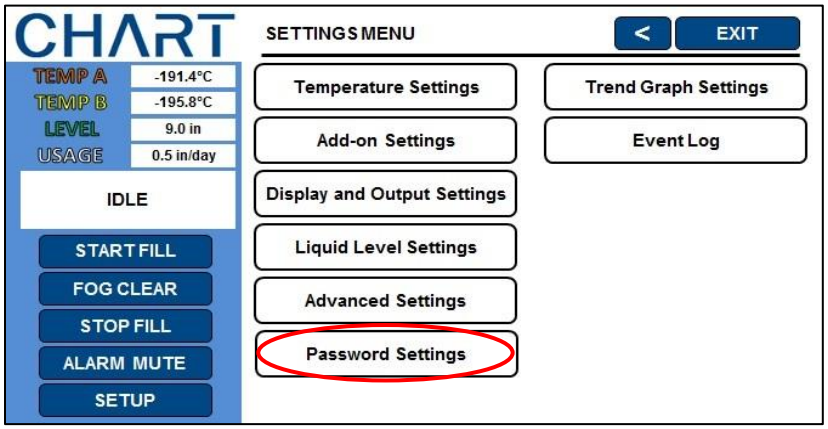
This section details how to enable / disable password entry mode. Disabling the password entry mode will remove all Chart MVE TS password protection.

1. Press "Setup"

Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".

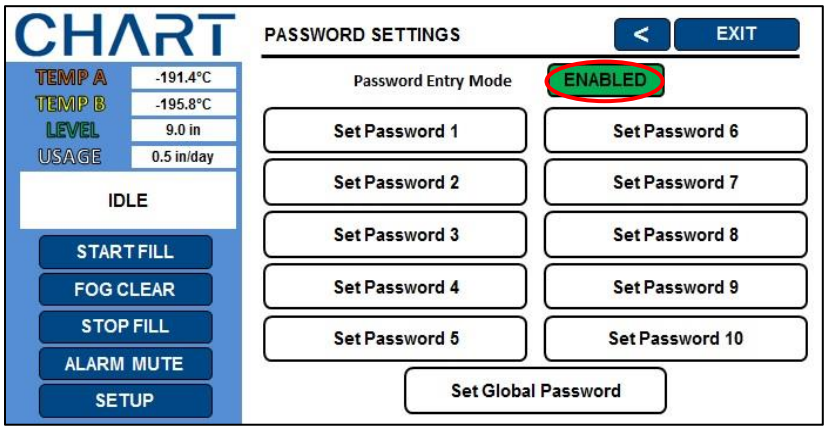


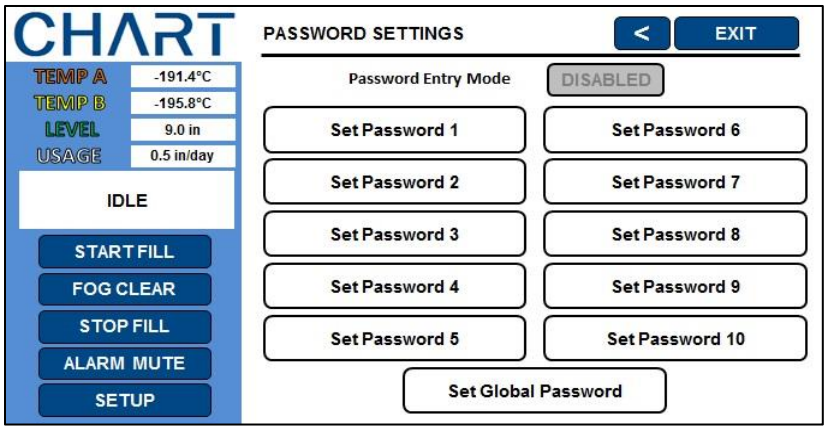
2. Press "Password Settings"



3. Press “ENABLED” or “DISABLED” next to “Password Entry Mode”

This will enable or disable the password entry mode. Pressing “ENABLED” will change the password entry mode to “DISABLED” and pressing “DISABLED” will change the password entry mode to “ENABLED”.





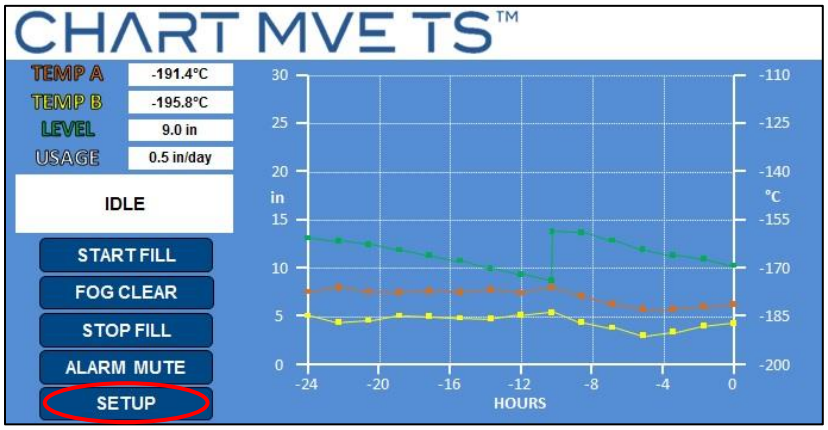
6.2.9.2. Global Password

This section describes how to change the Global Password.

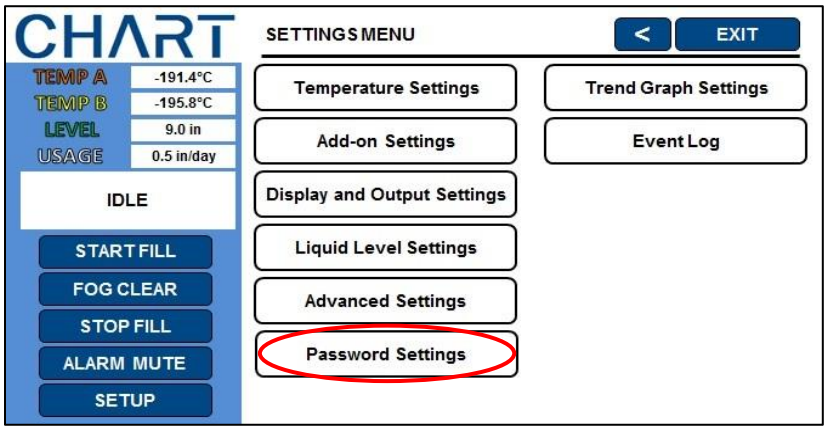
NOTE: Security Level 4 is required to setup or change passwords.

1. Press "Setup"

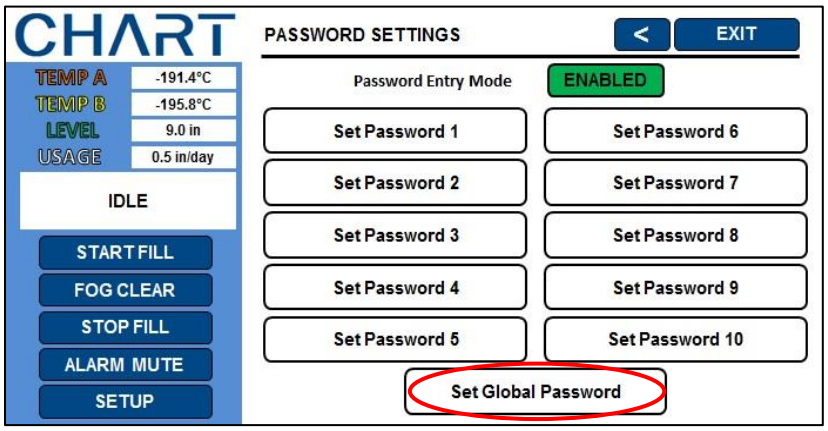
Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



2. Press "Password Settings"



3. Press “Set Global Password”



4. Enter a new Global Password

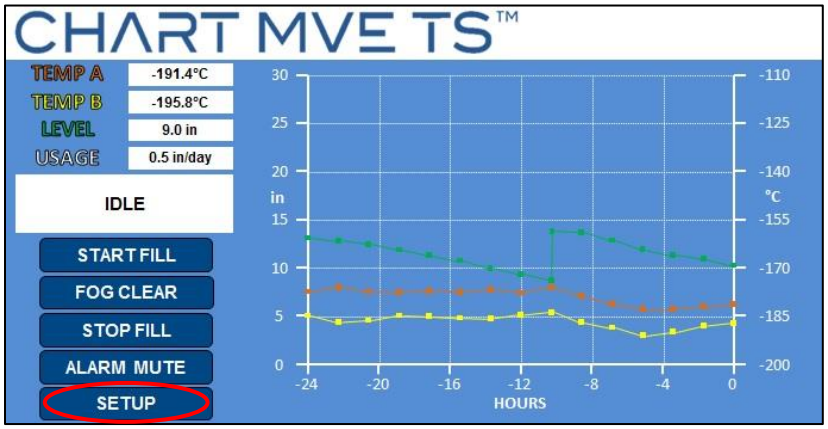
Use the number pad that appears on screen to enter a new password and press “Enter” to save.

6.2.9.3. Multilevel Passwords

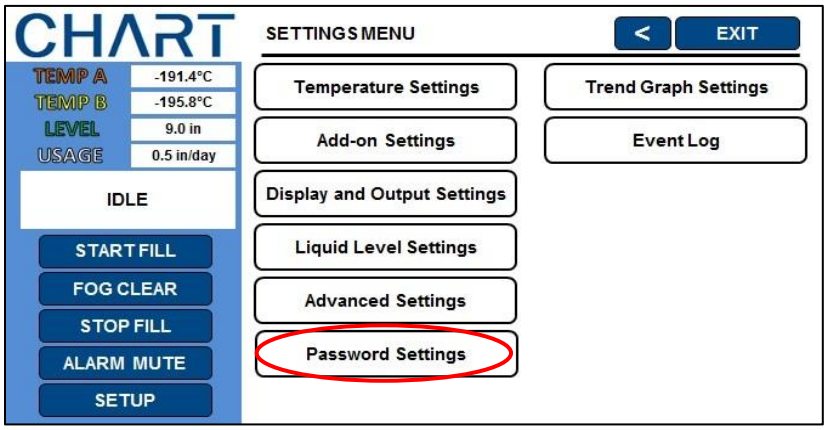
This section describes how to setup and change the 9 multilevel passwords.

1. Press "Setup"

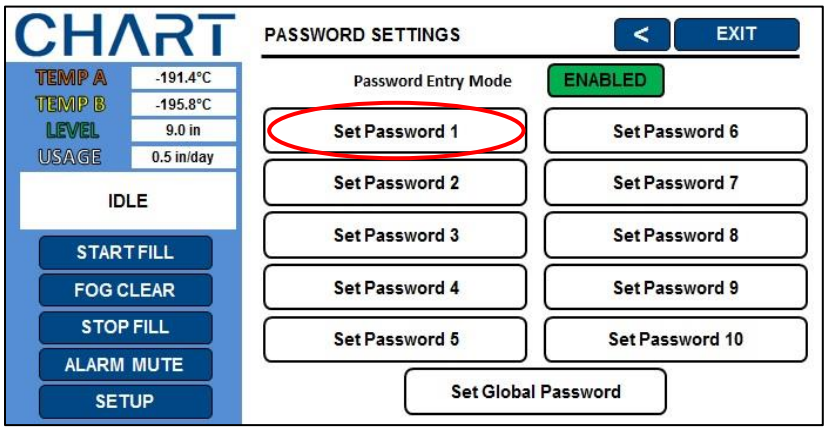
Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



2. Press "Password Settings"



3. **Press the desired password to setup or adjust.**



4. **Enter a new password and password level.**

6.3. Calibration Procedures

6.3.1. Temperature Sensor Calibration

This section describes how to calibrate the Chart MVE TS temperature sensors. There are two calibration procedures: single point and double point calibration. For single point calibration, the reference point is LN2. For double point calibration, the reference points are LN2 and ice water. Unless regulations require a double point calibration, the single point calibration procedure is recommended. The benefit of double point calibration is more accurate temperature measurement in near room temperature environments. The drawback is a longer, more complex calibration procedure. The benefit of a single point calibration is a simple calibration procedure. The drawback of single point calibration is less accurate temperature measurement in near room temperature environments.

All new freezers equipped with Chart MVE TS controllers have been calibrated at the factory. The temperature sensors should only be calibrated if faulty readings are suspected, a sensor or the Chart MVE TS itself has been replaced, following a firmware update, or as a part of a preventative maintenance schedule.

For an accurate calibration, the LN2 Saturation Temperature needs to be correctly set based on the altitude of the freezer location.

NOTE: Security Level 2 or higher is required to calibrate temperature sensors.

CAUTION: Always wear protective gloves and face shield when handling LN2. Refer to the Safety section of this manual.

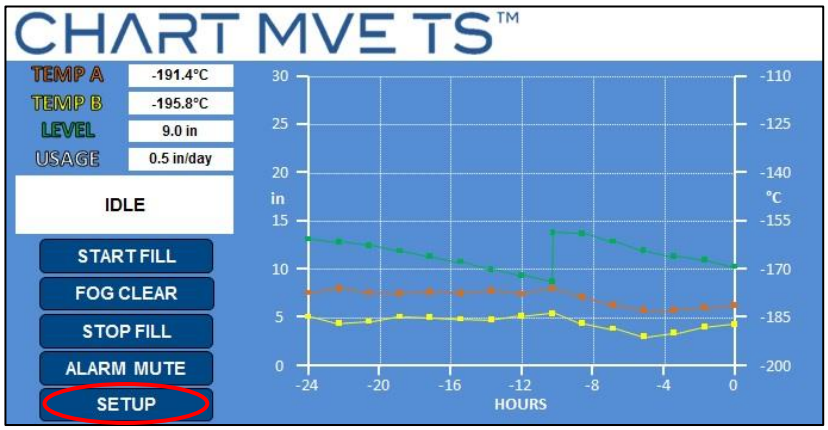
6.3.1.1. Single Point Calibration

The single point calibration procedure requires a small volume of LN2; enough to completely submerge the end of the temperature sensor. It may be possible to use the LN2 in the freezer space if the probe length permits.

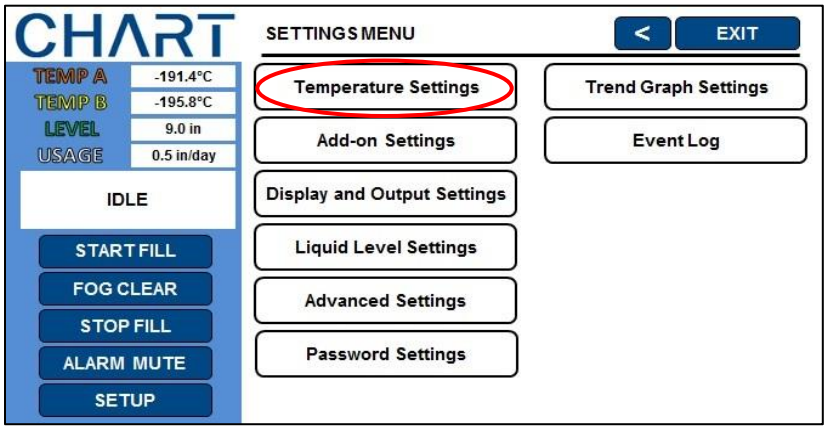
NOTE: Security Level 2 or higher is required to calibrate temperature sensors.

1. Press "Setup"

Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".

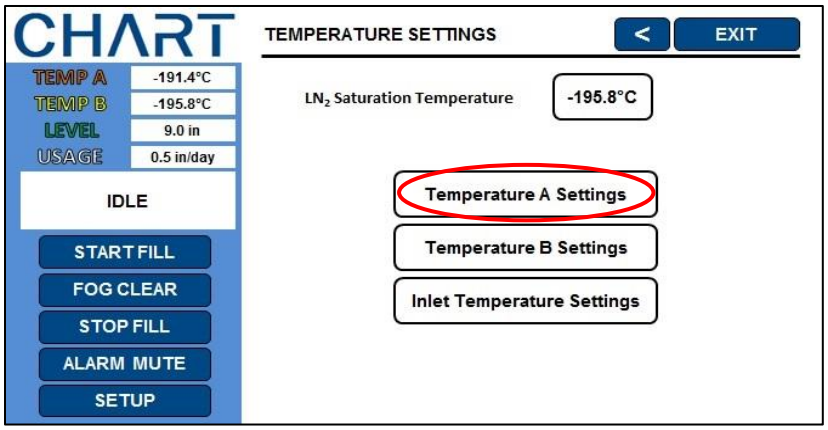


2. Press "Temperature Settings"

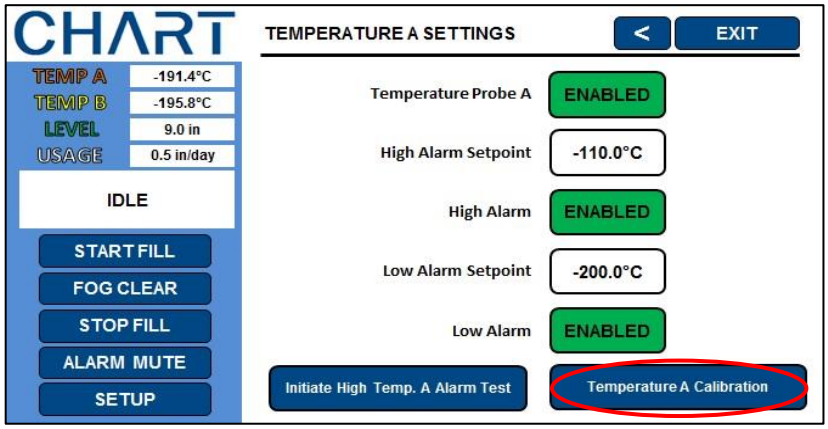


3. Press “Temperature A Settings”

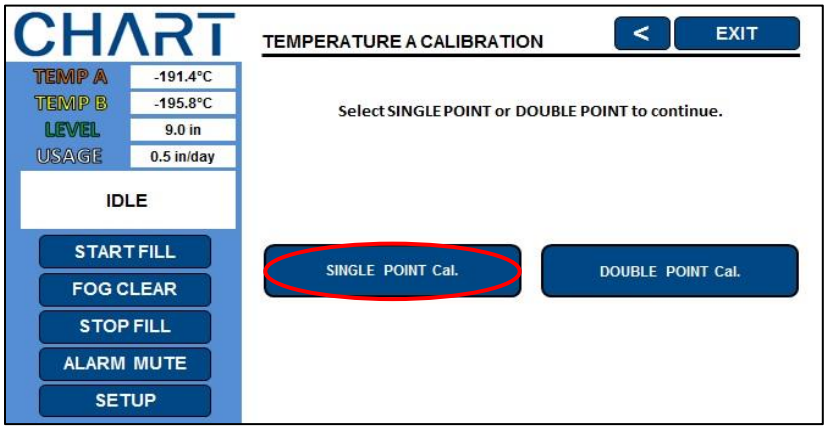
NOTE: To access Temperature B Settings select “Temperature B Settings” instead.



4. Press “Temperature A Calibration”

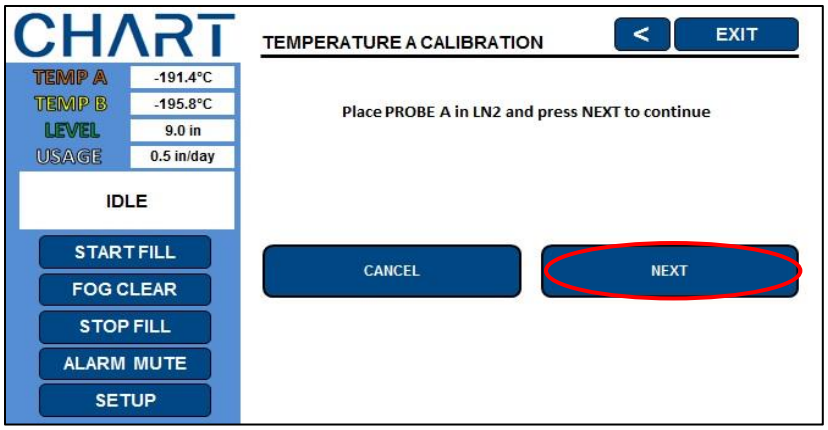


5. Press “Single Point Calibration”



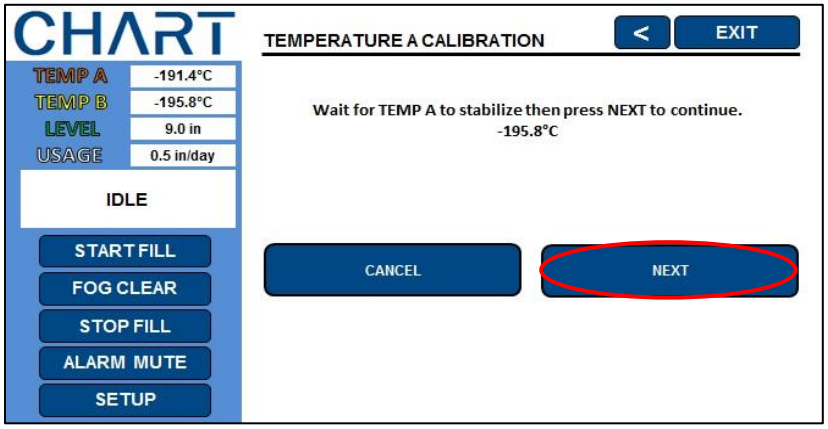
6. Submerge the temperature probe in LN2

Place the temperature probe in LN2 and then press “Next”.



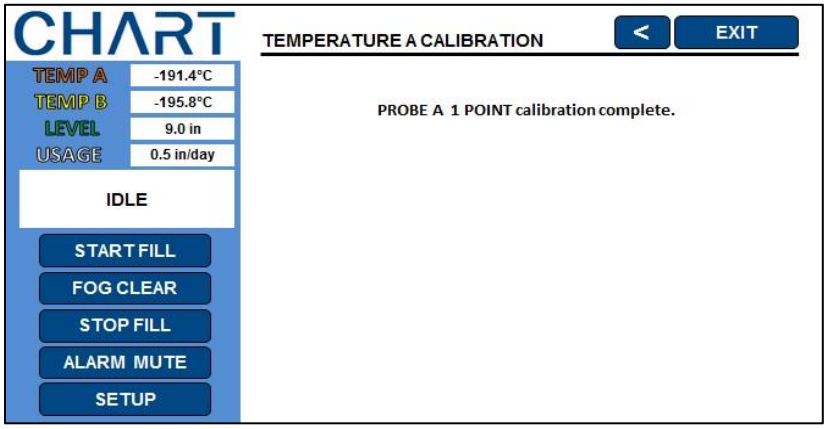
7. Wait for temperature reading to stabilize

Wait for the sensor to stabilize and then press “Next” to complete the calibration.



8. Screen will confirm calibration was successful.

If the calibration aborts, verify all electrical connections and that probe is properly submerged, then reattempt the calibration.



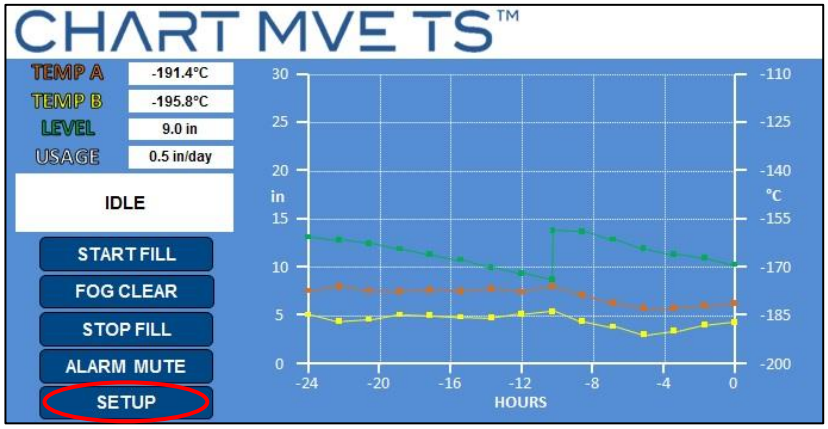
6.3.1.2. Double Point Calibration

The double point calibration procedure requires a small volume of LN2 and an ice water bath; enough to completely submerge the end of the sensor. Proper ice water bath preparation is imperative to ensure accuracy. It is best to add filtered water to a Styrofoam cup containing crushed ice. Allow the solution to stand at room temperature for five minutes prior to beginning procedure.

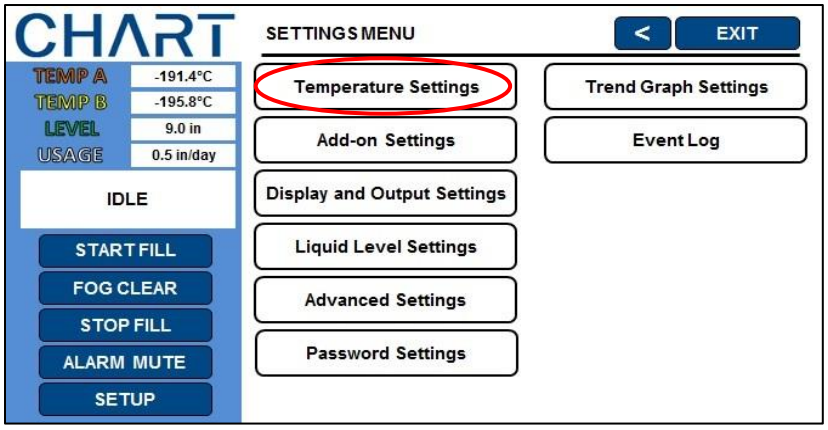
NOTE: Security Level 2 or higher is required to calibrate temperature sensors.

1. Press "Setup"

Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".

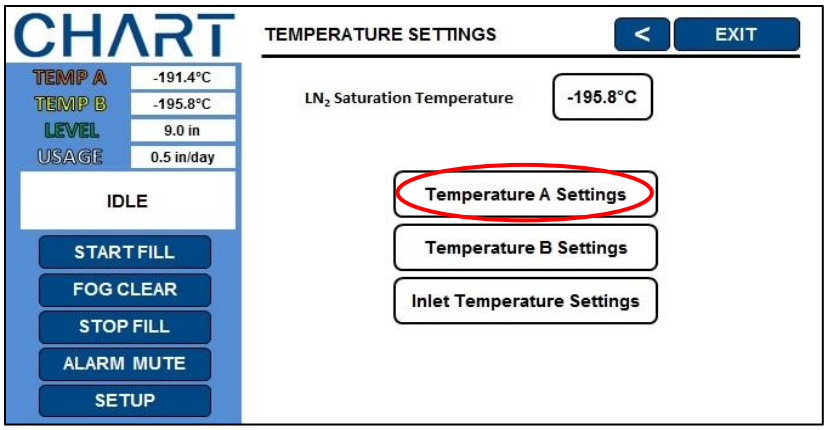


2. Press "Temperature Settings"

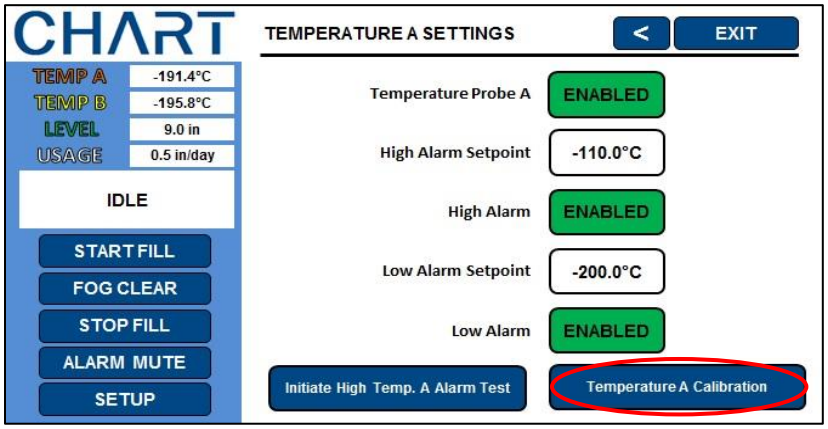


3. Press “Temperature A Settings”

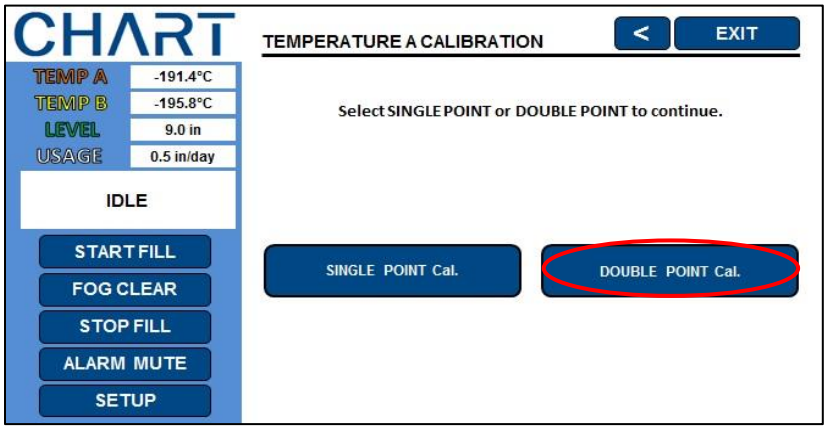
NOTE: To access Temperature B Settings select “Temperature B Settings” instead.



4. Press “Temperature A Calibration”

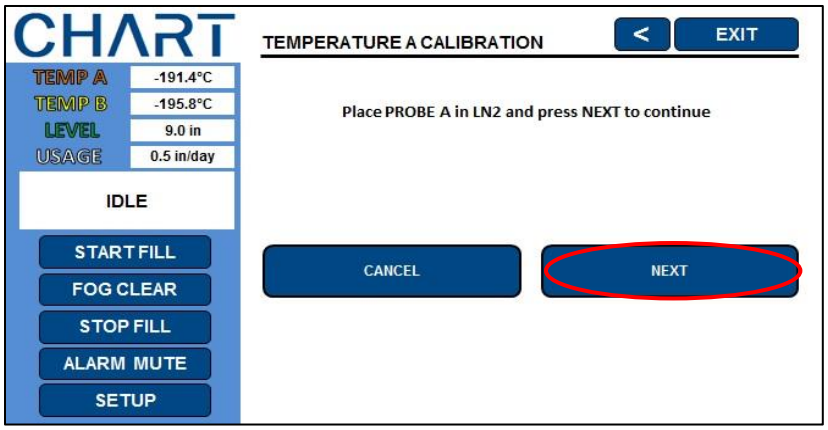


5. Press “Double Point Cal.”



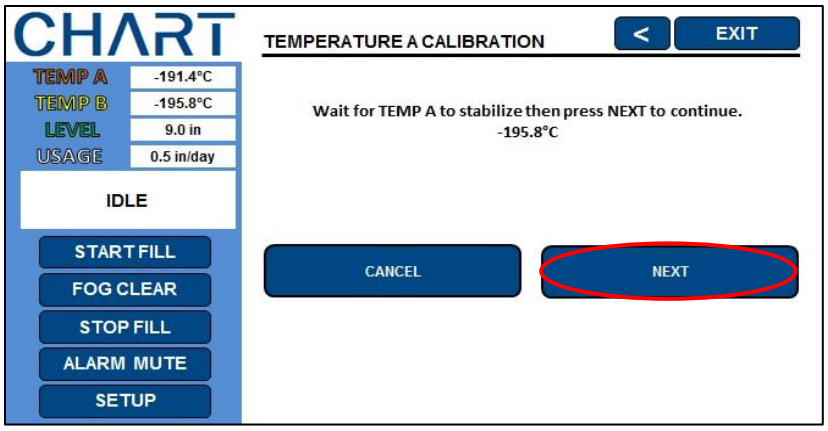
6. Submerge the temperature probe in LN2

Place the temperature probe in LN2 and then press “Next”.

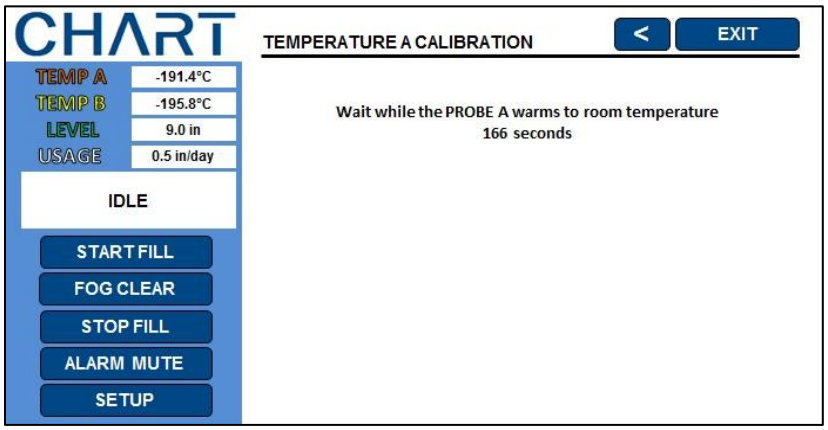


7. Wait for temperature reading to stabilize

Wait for the sensor to stabilize and then press “Next”.

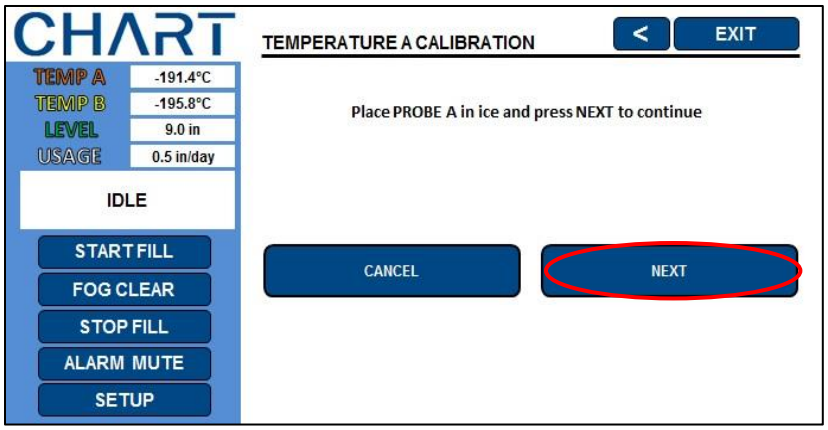


8. Wait for probe to warm to room temperature.



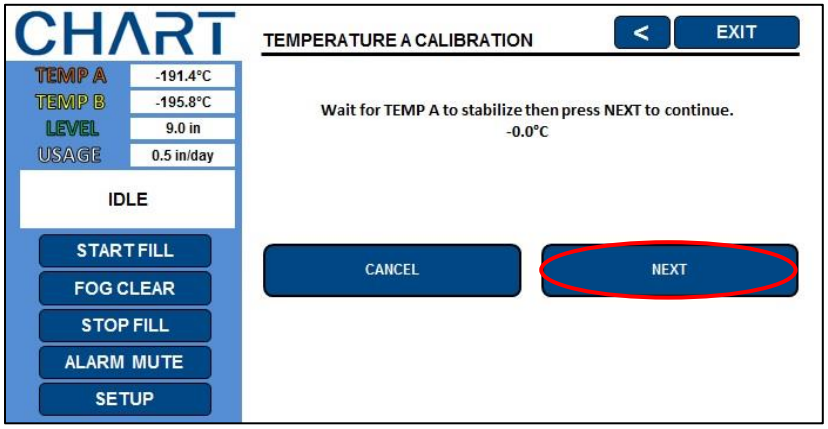
9. Submerge the temperature probe in ice water

Place the temperature probe in ice water and then press “Next”.



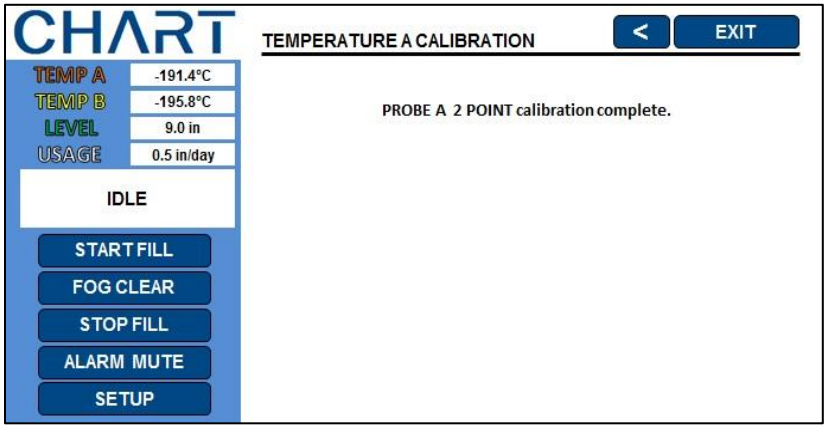
10. Wait for temperature reading to stabilize

Wait for the sensor to stabilize and then press “Next”.



11. Screen will confirm calibration was successful.

If the calibration aborts, verify all electrical connections and that probe is properly submerged, then reattempt the calibration.



6.3.2. Liquid Nitrogen Level Calibration

This section describes the procedure to calibrate the LN2 level. This procedure requires the cryogenic meter dip stick supplied with each MVE freezer. This calibration method provides level measurements with a ±0.5" (±13 mm) accuracy.

All new freezers equipped with Chart MVE TS controllers have been calibrated at the factory. The liquid level should only be calibrated if faulty readings are suspected, the Chart MVE TS itself has been replaced, following a firmware update, or as a part of a preventative maintenance schedule.

CAUTION: Always wear protective gloves and face shield when handling LN2. Refer to the Safety section of this manual.

Dip Stick Procedure

1. Open or remove the freezer lid to access the interior storage space.
2. Hold the meter dip stick vertically with the 0.0 inch end pointed down.
3. Lower the meter dip stick into the LN2 at the bottom of the freezer. Ensure the meter dip stick is vertical and touching the bottom of the inner Dewar. Some LN2 boiling will occur around the meter dip stick.
    a. MVE High Efficiency / Vapor Series Freezers:
        Insert meter dip stick into the rectangular channel on the turn tray in order to access the liquid below the tray.
    b. MVE Series Freezers:
        Lower the meter dip stick to the bottom of the freezer as close to the center as possible to obtain an accurate measurement.
4. Leave the meter dip stick in the LN2 for approximately 5 seconds.
5. Remove the meter dip stick from the liquid and immediately wave it back and forth in the air. A distinct frost line will begin to develop as moisture in the air condenses on the meter dip stick predominately where it was submerged.
6. Subtract 0.5 inches (13 mm) from the observed frost line to account for the LN2 boiling up around the meter dip stick while it was submerged. This resultant level measurement represents the actual liquid level inside the freezer. Once you have obtained the measured level, proceed to the liquid level calibration.

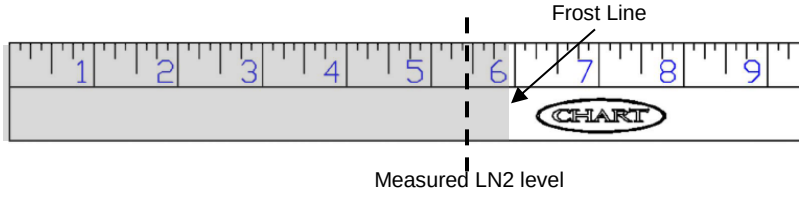


Figure 9: Meter dip stick showing example level frost line. The resultant measured level would be 5.5 inches after subtracting 0.5 inches from the frost line to account for the LN2 boiling.

Liquid Level Calibration

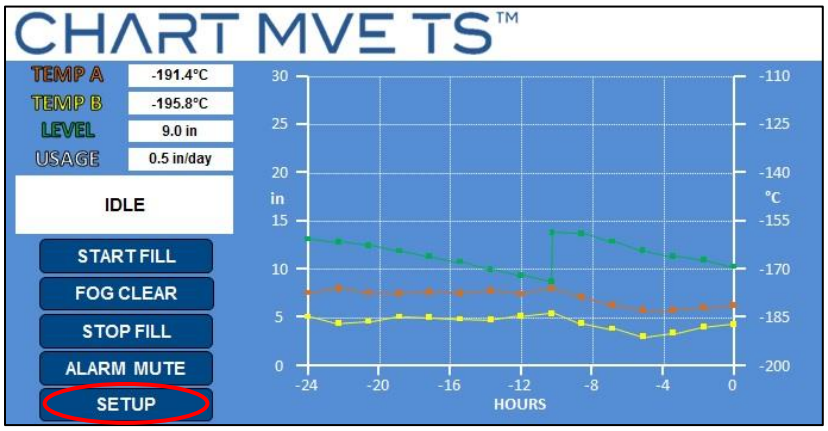
NOTE: Liquid level calibration cannot be performed while the Chart MVE TS is filling. If Chart MVE TS is filling, press “Stop Fill” and perform the calibration.

NOTE: Liquid level calibration is most accurate when calibrated at 10.0 inches (254 mm). Calibration must be performed above 3.0 inches (75 mm).

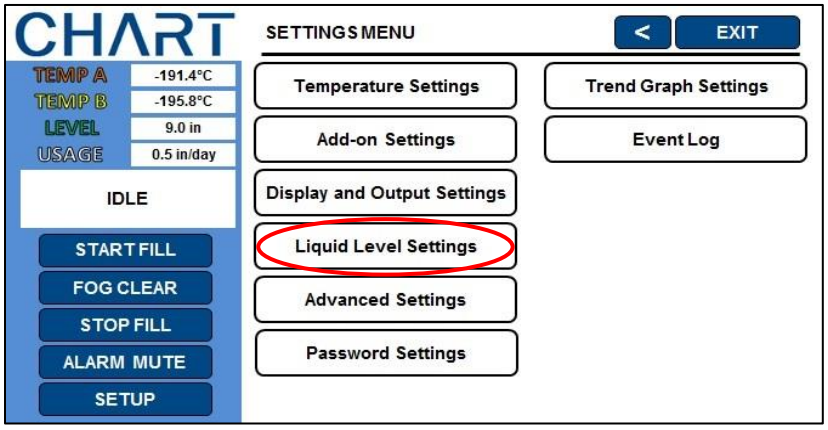
NOTE: Security Level 3 or higher is required to calibrate the liquid level.

1. Press “Setup”

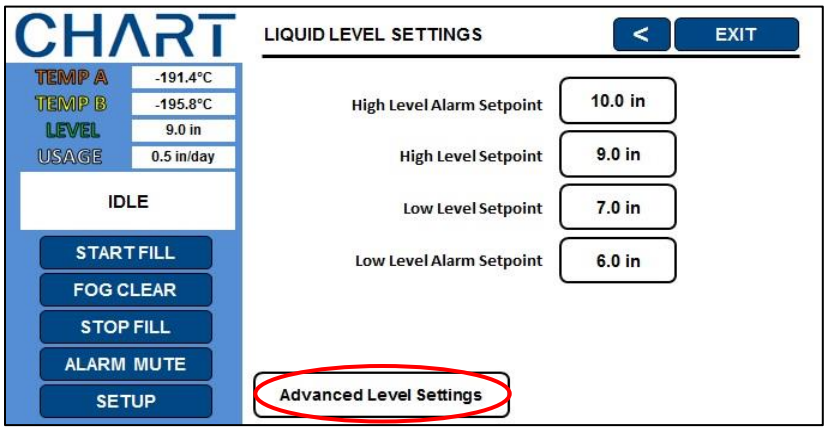
Controller may prompt for a password. Type in the password using the number pad that appears and press “Enter”.



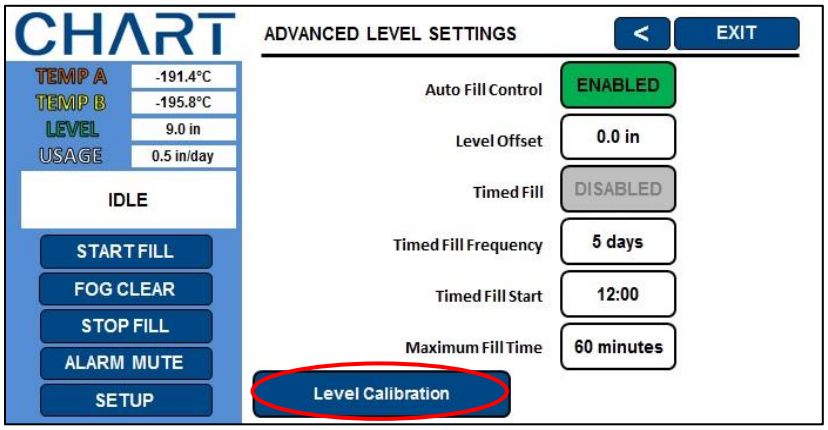
2. Press “Liquid Level Settings”



3. Press “Advanced Level Settings”

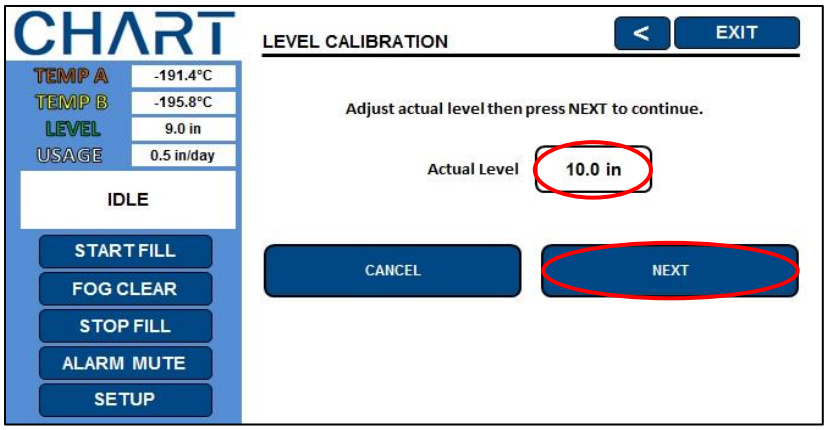


4. Press “Level Calibration”



5. Enter the current liquid level

The sensor will zero for approximately 1 minute. After this period, wait for the liquid level to stabilize and press “Next”. Type in the current liquid level with the number pad and press “Enter” to save the new value.



6.3.3. Inlet Temperature Sensor Calibration

This section describes how to calibrate the Chart MVE TS inlet temperature sensor. There are two calibration procedures: single point and double point calibration.
For single point calibration, the reference point is LN2. For double point calibration, the reference points are LN2 and ice water. Unless regulations require a double point calibration, the single point calibration procedure is recommended.

All new freezers equipped with Chart MVE TS controllers and hot gas bypass have been calibrated at the factory. The inlet temperature sensor should only be calibrated if faulty readings are suspected, inlet temperature sensor has been replaced, or as a part of a preventative maintenance schedule.

For an accurate calibration, the LN2 Saturation Temperature needs to be correctly set based on the altitude of the freezer location.

Both the single and double point calibration procedures require a small volume of LN2; enough to completely submerge the inlet temperature sensor. The double point calibration also requires an ice water bath. Proper ice water bath preparation is imperative to ensure accuracy. It is best to add filtered water to a Styrofoam cup containing crushed ice. Allow the solution to stand at room temperature for five minutes prior to beginning the calibration procedure.

NOTE: Security Level 2 or higher is required to calibrate the inlet temperature sensor.

Inlet Temperature Sensor Removal

CAUTION: Removing the inlet temperature sensor while a LN2 supply is connected to the freezer will cause the user to be exposed to LN2. Before beginning procedure, shut off and disconnect all LN2 supply sources. Always wear protective gloves and face shield when handling LN2. Refer to the Safety section of this manual.

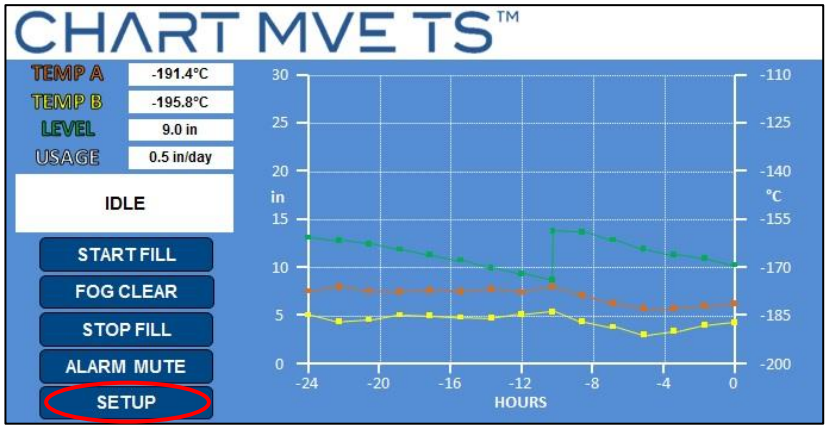
1. Ensure all LN2 supply sources are shut off and disconnected.
2. Remove plumbing shroud or rear panel to access the plumbing assembly.
3. Locate the inlet temperature sensor on the plumbing assembly. See section 5.2 for the location of the inlet temperature probe in the various plumbing configurations.
4. Using a 9/16” or small adjustable wrench, remove the sensor from the plumbing assembly. It may be necessary to temporarily disconnect the sensor from the wire harness to avoid over twisting of the wires. Following removal of the sensor, reconnect the sensor wires.
5. Perform the inlet temperature sensor calibration procedure.
6. Following calibration, reinstall the bypass sensor using new PTFE thread tape, ensure sensor wires are connected, reinstall plumbing shroud or rear panel, and reconnect the LN2 supply source.

6.3.3.1. Single Point Calibration

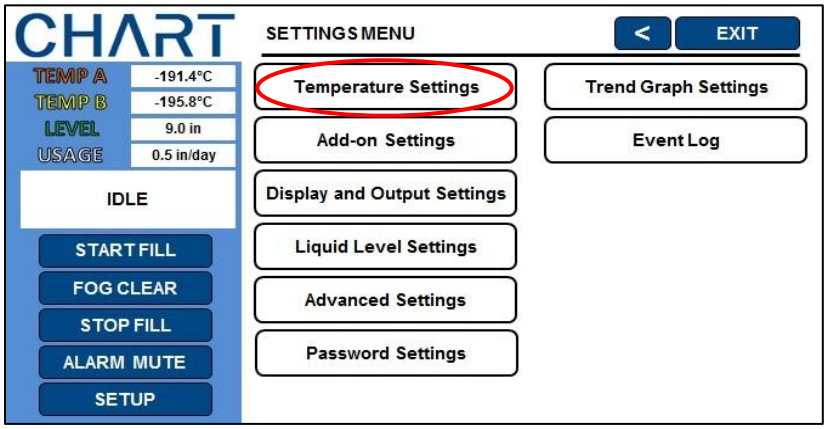
The single point calibration procedure requires a small volume of LN2; enough to completely submerge the end of the temperature sensor. It may be possible to use the LN2 in the freezer space if the probe length permits.

1. Press “Setup”

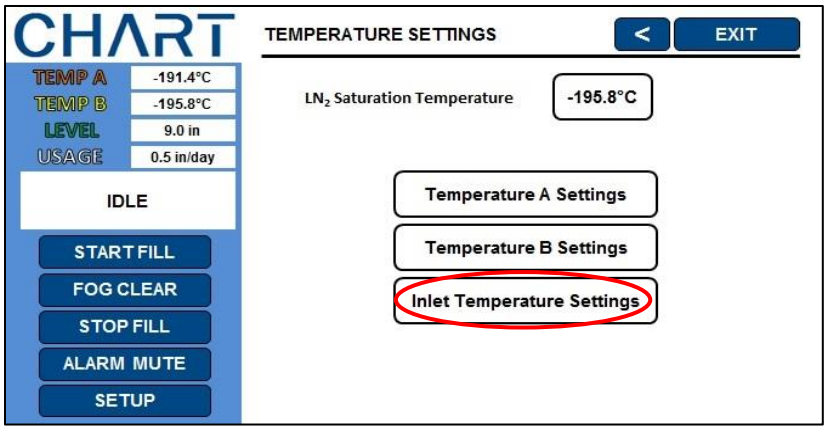
Controller may prompt for a password. Type in the password using the number pad that appears and press “Enter”.



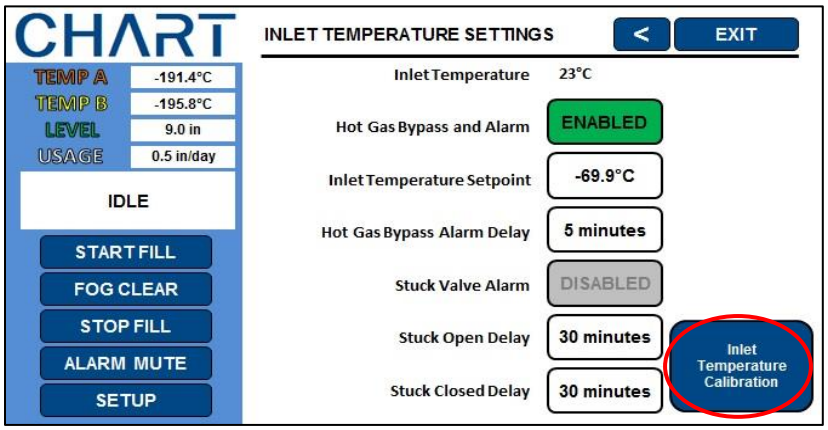
2. Press “Temperature Settings”



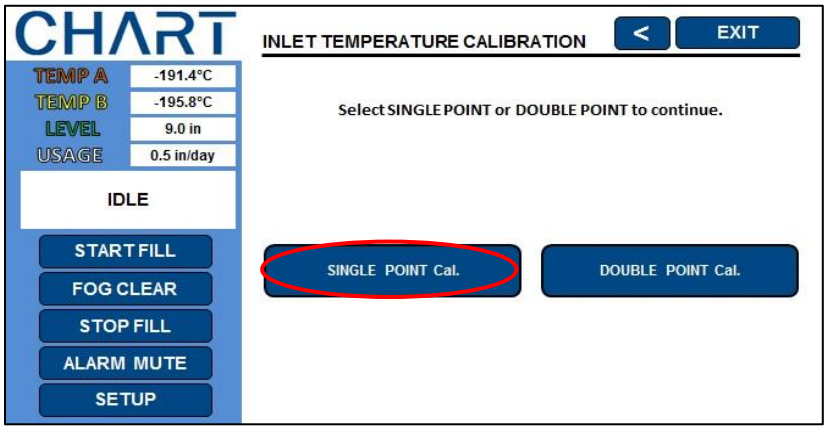
3. Press “Inlet Temperature Settings”



4. Press “Inlet Temperature Calibration”

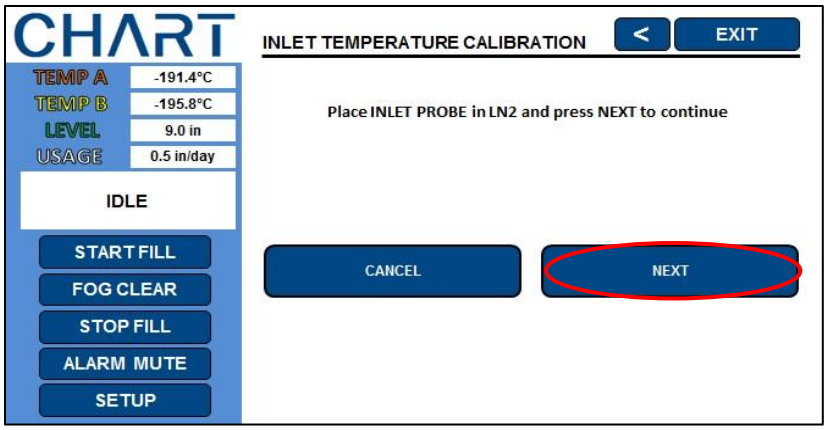


5. Press “Single Point Cal.”



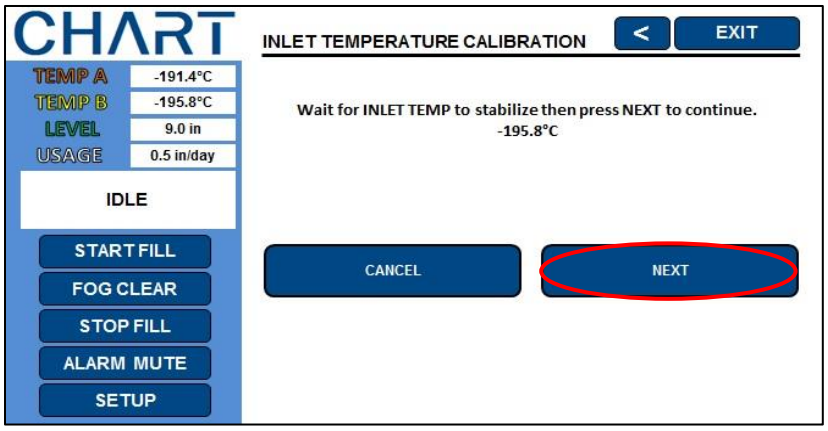
6. Submerge the temperature probe in LN2

Place the temperature probe in LN2 and then press “Next”.



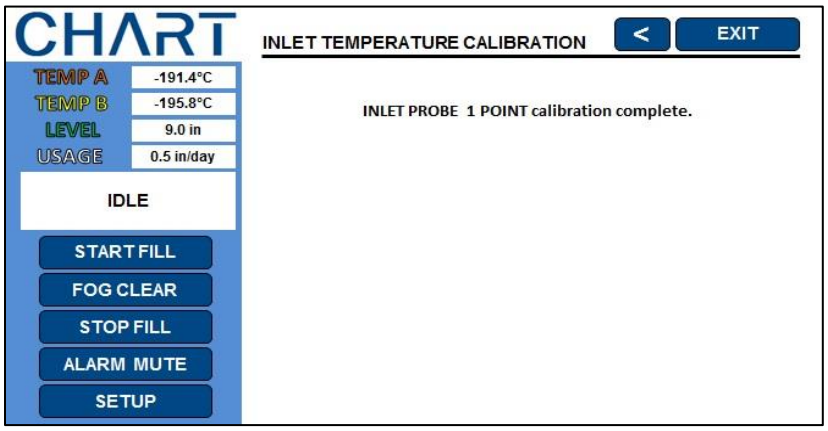
7. Wait for temperature reading to stabilize

Wait for the sensor to stabilize and then press “Next” to complete the calibration.



8. Screen will confirm calibration was successful.

If the calibration aborts, verify all electrical connections and that probe is properly submerged, then reattempt the calibration.

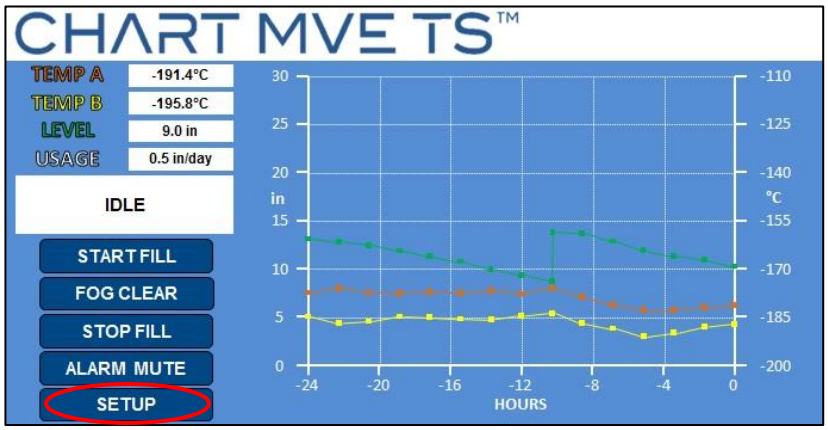


6.3.3.2. Double Point Calibration

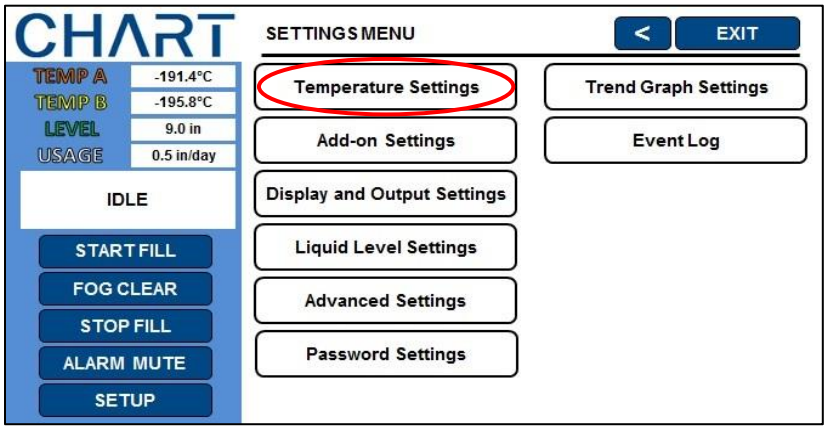
The double point calibration procedure requires a small volume of LN2 and an ice water bath; enough to completely submerge the end of the sensor. Proper ice water bath preparation is imperative to ensure accuracy. It is best to add filtered water to a Styrofoam cup containing crushed ice. Allow the solution to stand at room temperature for five minutes prior to beginning procedure.

1. Press "Setup"

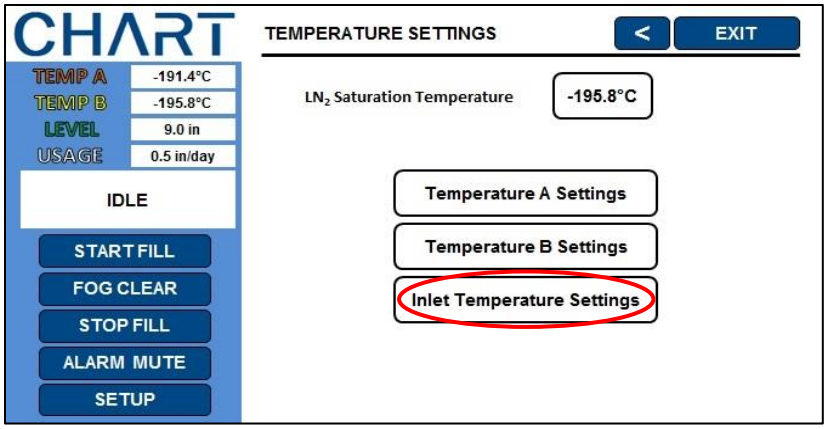
Controller may prompt for a password. Type in the password using the number pad that appears and press "Enter".



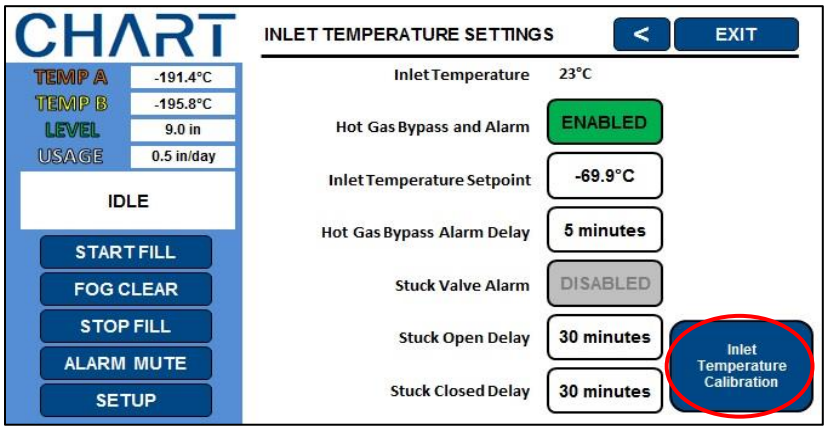
2. Press "Temperature Settings"



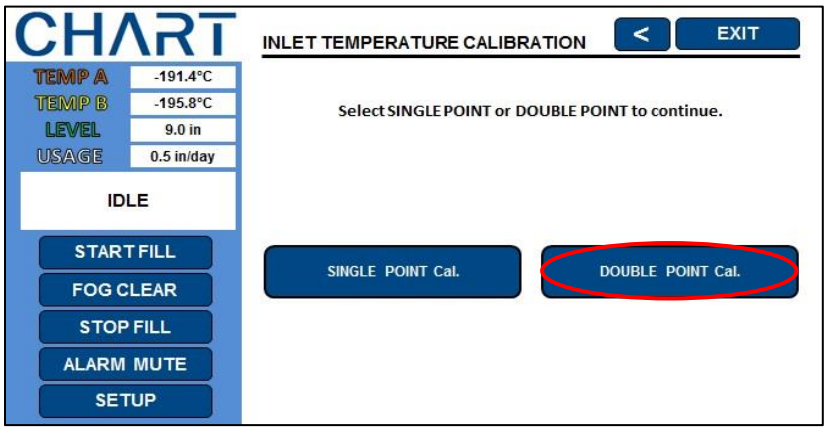
3. Press "Inlet Temperature Settings"



4. Press “Temperature A Calibration”

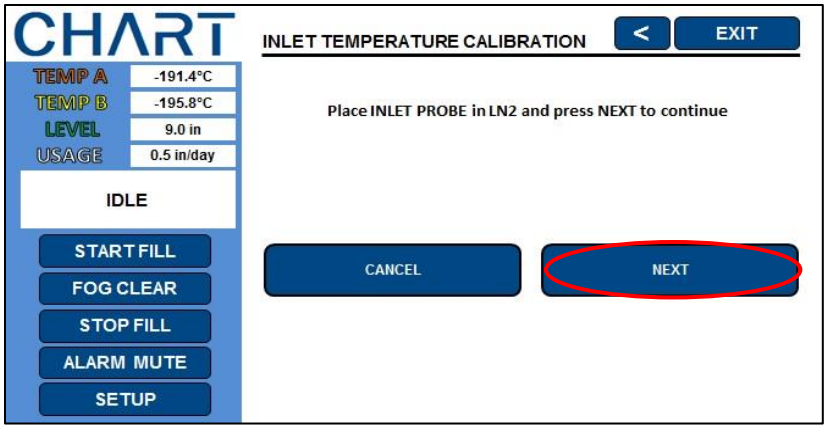


5. Press “Double Point Cal.”



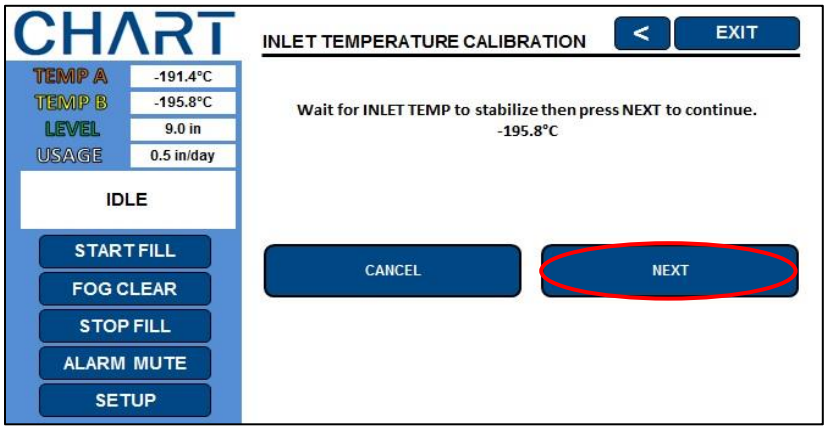
6. Submerge the temperature probe in LN2

Place the temperature probe in LN2 and then press “Next”.

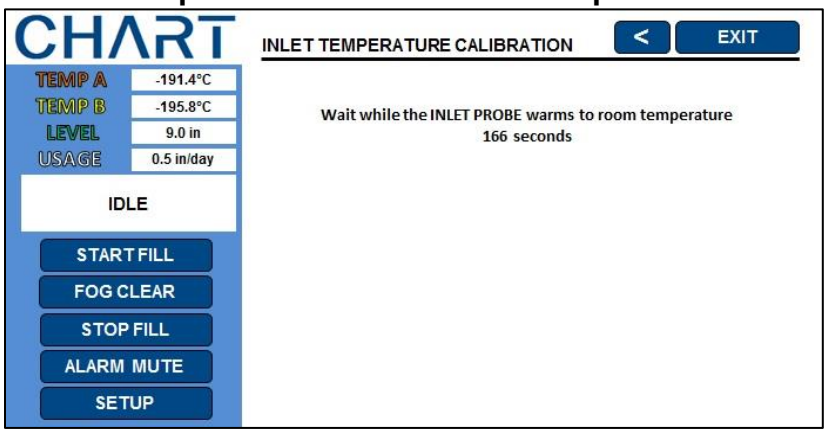


7. Wait for temperature reading to stabilize

Wait for the sensor to stabilize and then press “Next”.

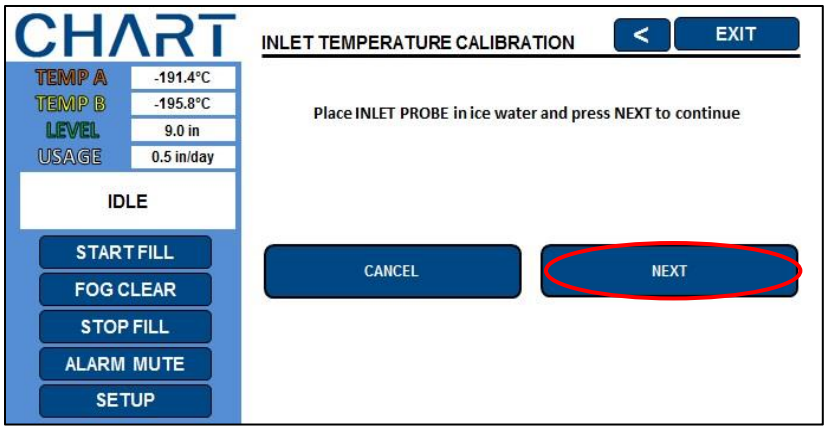


8. Wait for probe to warm to room temperature.



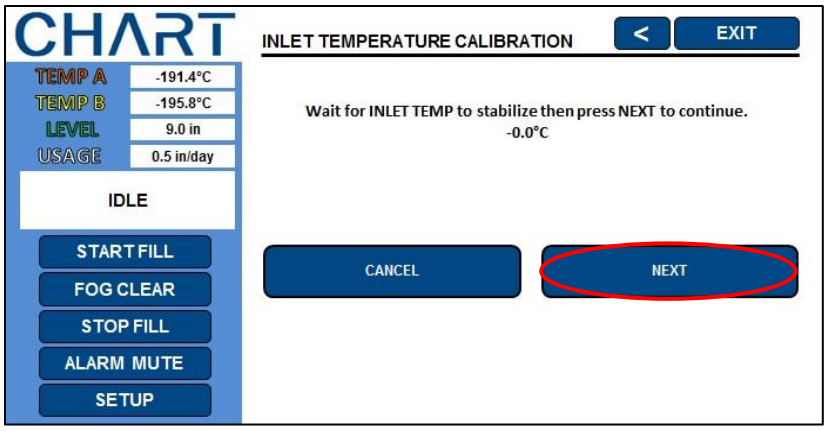
9. Submerge the temperature probe in ice water

Place the temperature probe in ice water and then press “Next”.



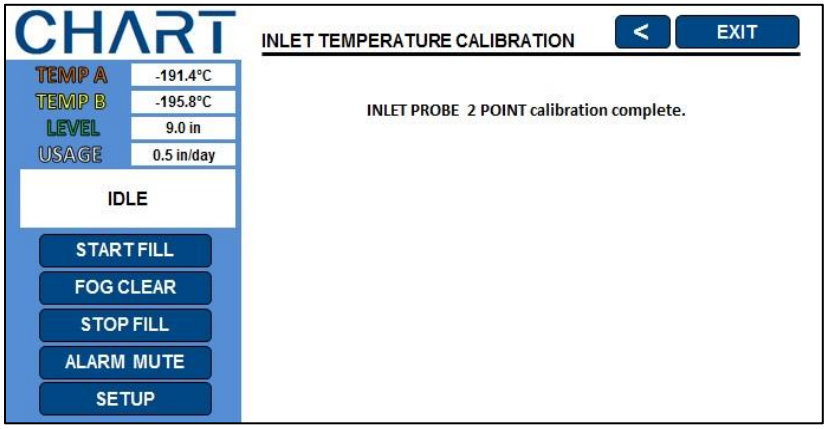
10. Wait for temperature reading to stabilize

Wait for the sensor to stabilize and then press “Next”.



11. Screen will confirm calibration was successful.

If the calibration aborts, verify all electrical connections and that probe is properly submerged, then reattempt the calibration.



6.4. Communication / Networking

The Chart MVE TS is equipped with an RJ-45 serial port and an Ethernet port. The serial port is intended for connection to another MVE controller, PC, serial printer, or other RS-485 device. Up to 100 Chart MVE TS controllers can be successfully networked. The Ethernet port is intended for connecting the controller to a Local Area Network (LAN).

NOTE: The Chart MVE TS should never be connected directly to a public telecommunications network.

Figure 10: Chart MVE TS serial port and RS-485 4-wire pin diagram

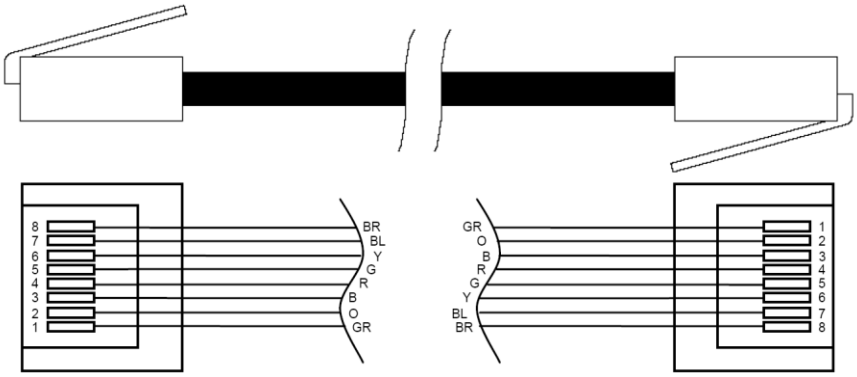


Figure 11: Standard RJ-45 cable assembly wiring details (PN 10740053). Wire colors may vary.

Table 6: RS-485 Interface Specifications

COM Setup	bits/sec	Parity	Data bits	Stop bits
9600 N81	9600	None	8	1
9600 N82	9600	None	8	2
19200 N81	19200	None	8	1
19200 N82	19200	None	8	2
COM Type				
ASCII	Printer	OFAF	MODBUS	Disabled
Transmission		**Mode**	**Terminator**	
4-wire		Asynchronous	CR, LF	

6.4.1. Ethernet Communication

The Chart MVE TS controller is equipped with an Ethernet port for LAN communication. Follow the steps below to setup and access the controller interface via the Ethernet connection.

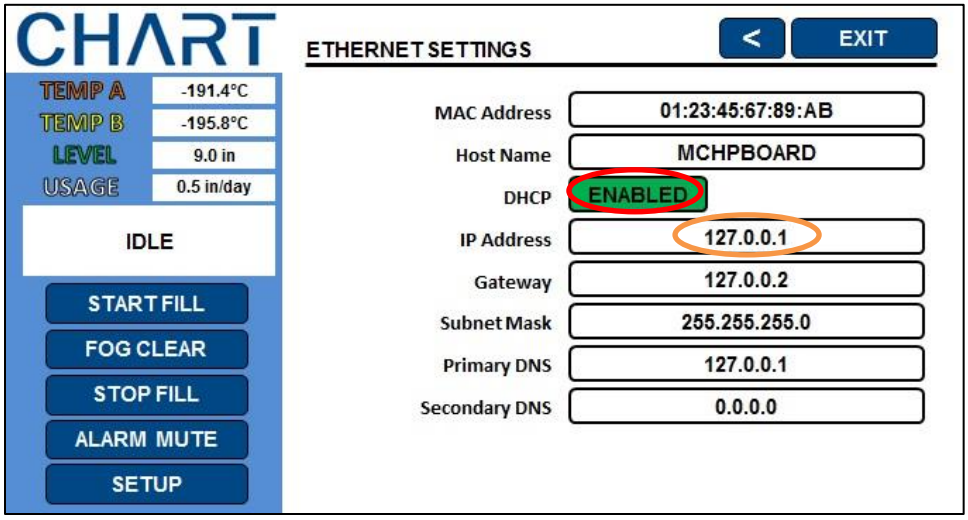
NOTE: The Chart MVE TS should never be connected directly to a public telecommunications network.

Ethernet Communication Setup

1. Ensure the controller is powered on.
2. Connect an Ethernet cable (that is connected to the desired network) to the Ethernet port on the bottom of the controller. CAT 5e or CAT 6 cable is recommended.

   NOTE: The Ethernet port is not interchangeable with the Serial port.

3. Navigate to the Ethernet Settings on the controller. Setup>Advanced Settings>Ethernet Settings.
4. Verify that the DHCP option is enabled (RED). If DHCP is not enabled, pressing "DISABLED" will change the status to "ENABLED" and vice versa.
5. Record the IP address for the controller (ORANGE). Note the IP address may change if DHCP is being enabled for the first time, DHCP is being re-enabled, or after the controller has restarted.



6. Open a web browser on a computer that is on the same network as the Chart MVE TS controller.
7. Type in the IP address for the controller into the URL address bar of the browser and hit "Enter".
8. The controller level, temperatures and alarm status will be displayed once connected.

6.4.2. TEC Connect (Computer Interface)

TEC Connect is a free, downloadable software program that enables a user to download the event log and query and adjust controller parameters. This easy-to-use computer interface is fully compatible with TEC 2000, TEC 3000, and Chart MVE TS controllers. Features include a user-friendly ASCII command window, real-time temperature and level monitoring, event log download button, fill control buttons, and a quick parameter setup table.

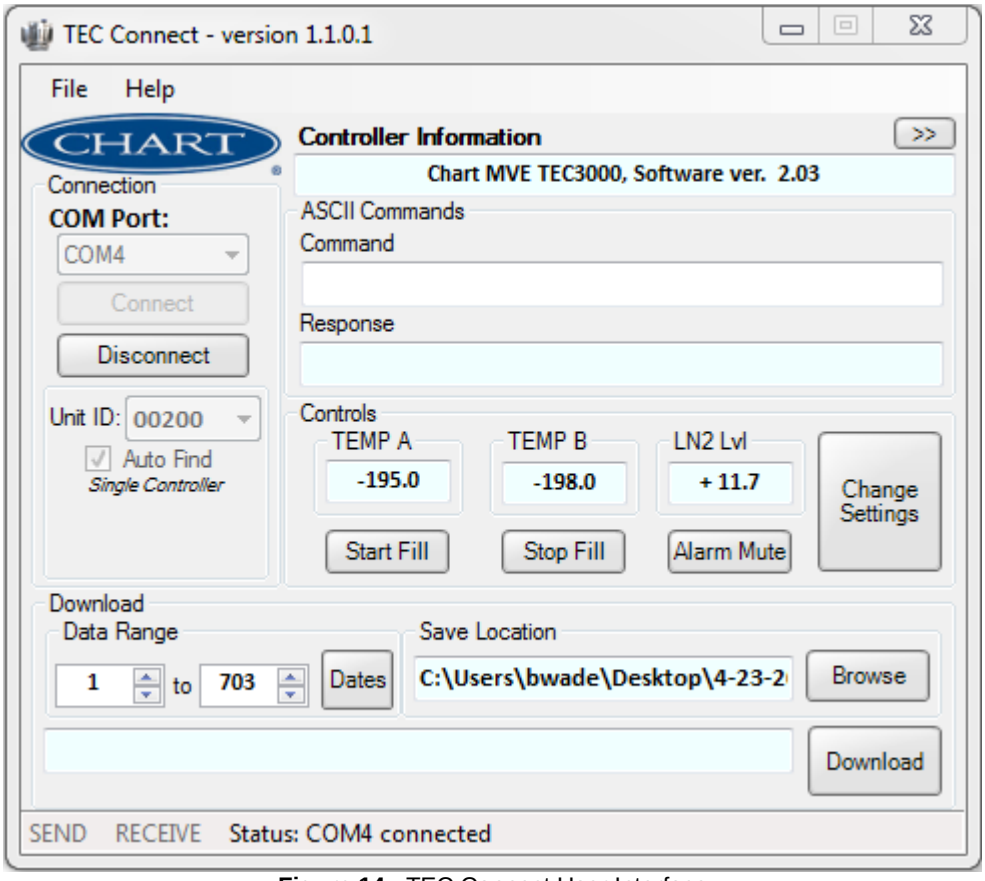


Figure 14: TEC Connect User Interface

Required Items

- Microsoft Windows (10, 7, Vista, XP, 2000)
- MVE TEC COM USB Kit (P/N 13376947)
- USB Port

Installing MVE TEC COM USB Kit

1. Insert the included USB to Serial Driver Disc into the PC CD-ROM
2. Plug the MVE TEC COM USB Kit into an open USB port
3. Follow the automatic installation prompts

Downloading and Installing TEC Connect

1. Uninstall in any previous TEC Connect versions
2. The latest version is available online at the Chart Industries website
3. Click the link and open the compressed folder
4. Extract all files from the compressed folder to a location on your hard drive
5. Open the extracted SETUP file
6. Follow the prompts to complete installation
7. A TEC Connect icon should appear on your programs list when complete

Connecting to Chart MVE TS

Chart MVE TS Settings

1. COM Setup: "9600 N81"
2. COM Type: "ASCII"
3. Select a unique MODBUS ID (Unit ID) for each controller involved

TEC Connect Settings

1. Connect Chart MVE TS serial port to PC with MVE TEC COM USB Kit.
2. Open TEC Connect
3. The TEC Connect program determines the Windows COM Port. If not, this can be accomplished manually by navigating to the device manager and locating the COM port labeled "RS-485 Isolated Port".
4. Note the COM number listed beside "RS-485 Isolated Port" in the Device Manager window.
5. Close Device Manager and click "OK"
6. Select the appropriate Windows COM Port from the drop down menu
7. Connect to Chart MVE TS
   - For a single controller:

     Check the "Auto Find" box or enter the MODBUS ID of the controller and click "Connect".

   - For networked controllers:

     Uncheck the "Auto Find" box, enter the Unit ID of the desired controller, and click "Connect". In order to connect to another controller on the network, click "Disconnect", change the Unit ID, and then click "Connect".

8. If the controller is successfully connected, the current temperature and level information from the controller will be displayed and "COMX connected" will be displayed under "Status", where X is the COM port the TEC COM kit is connected to on the PC.

NOTE: Contact your MVE Distributor or Technical Service if you experience problems connecting to a controller.

Downloading the Event Log

1. Connect to controller using TEC Connect
2. Select Event Download Range with Event 1 being the most recent logged event. The default download range includes all events.

3. Select the “Download” button. Once the event log has finished downloading, select “Open Download” button.

ASCII Command Interface

American Standard Code for Information Interchange (ASCII) commands can be used to query and adjust all Chart MVE TS settings and parameters. Commands must be entered in all capital letters just as they appear in the below tables. For a complete list of proper syntax and responses, refer to Section 10.2 in the Appendix.

CONTROL COMMANDS

*IDN?	ID Query	CODE?	Global Password Query
ALMS	Set Alarm Status	HITSTA	Initiate Temp A High Alarm Test
ALMS?	Alarm Status Query	HITSTB	Initiate Temp B High Alarm Test
CALTA	Calibrate Temp A in LN2	INITEE	Restore All Defaults
CALTB	Calibrate Temp B in LN2	LNSATP	Set LN2 Saturation Temp
CALVL	Set Level Offset	LNSATP?	LN2 Saturation Temp Query
CALVL?	Level Offset Query		

TEMPERATURE COMMANDS

BPTMP?	Bypass Temp Query	LOTAS?	Temp A Low Alarm Status Query
HITA	Set Temp A High Alarm	LOTAM	Set Temp A Low Alarm Mask
HITA?	Temp A High Alarm Query	LOTAM?	Temp A Low Alarm Mask Query
HITAS?	Temp A High Alarm Status Query	LOTB	Set Temp B Low Alarm
HITAM	Set Temp A High Alarm Mask	LOTB?	Temp B Low Alarm Query
HITAM?	Temp A High Alarm Mask Query	LOTBS?	Temp B Low Alarm Status Query
HITB	Set Temp B High Alarm	LOTBM	Set Temp B Low Alarm Mask
HITB?	Temp B High Alarm Query	LOTBM?	Temp B Low Alarm Mask Query
HITBS?	Temp B High Alarm Status Query	TEMPA?	Current Temp A Query
HITBM	Set Temp B High Alarm Mask	TEMPB?	Current Temp B Query
HITBM?	Temp B High Alarm Mask Query	TUNI	Set Temp Units
LOTA	Set Temp A Low Alarm	TUNI?	Temp Units Query
LOTA?	Temp A Low Alarm Query		

LEVEL COMMANDS

BPFIL?	Bypass Status Query	HILM	Set High Level Alarm Mask
FILAS?	Fill Time Alarm Status Query	HILM?	High Level Alarm Mask Query
FILL	Set Fill Status	LEVL?	Current LN2 Level Query
FILL?	Fill Status Query	LFIL	Set Low Level Setpoint
FILLM?	Auto Fill Status Query	LFIL?	Low Level Setpoint Query
FILT	Set Max Fill Time	LOLA	Set Low Level Alarm
FILT?	Max Fill Time Query	LOLA?	Low Level Alarm Query
FILTIM?	Current Fill Duration Query	LOLS?	Low Level Alarm Status Query
HFIL	Set High Level Setpoint	LOLM	Set Low Level Alarm Mask
HFIL?	High Level Setpoint Query	LOLM?	Low Level Alarm Mask Query
HILA	Set High Level Alarm	LUNI	Set Level Units
HILA?	High Level Alarm Query	LUNI?	Level Units Query
HILS?	High Level Alarm Status Query	RATE?	Current Liquid Usage Query

EVENT LOG COMMANDS

CLEVLG	Clear Event Log	LOGPER	Set Event Log Interval
DATE	Set Date	LOGPER?	Event Log Interval Query
DATE?	Date Query	TIME	Set Time
EVENT?	Last Event Query	TIME?	Time Query
EVNCT?	Number of Events Query	UNID	Set Unit ID
EVNLOG? n	Event Log [n] Query	UNID?	Unit ID Query

6.4.3. OFAF Network Setup

OFAF networking allows multiple controllers to be linked together such that all of the freezers will fill whenever any networked controller calls for a fill. When multiple freezers are connected to a common supply source, it is advantageous to fill all freezers at the same time. LN2 transfer losses are significantly reduced by filling all networked freezers while the supply system is primed and cold. Using and OFAF network is more efficient than cooling the supply system every time an individual freezer fills. This approach is also more efficient than employing a keep full / keep cold system. Up to 100 Chart MVE TS can be connected to an OFAF network. The network can be a mixture of Vario, MVE TS, and MVE TEC 3000 controllers, with any controller type being able to be the master controller in the circuit.

An OFAF network can be configured in two modes: "Sequential" or "Simultaneous." For both modes, when any controller in the network initiates a fill, the Master controller (OFAF ID 1) recognizes this and triggers all other controller to initiate fills as well.

In Sequential OFAF mode, once the controller that initiated the first fill has reached its High Level Setpoint, the Master will trigger the freezer with the next sequential OFAF ID to fill until it reaches its High Level Setpoint. The Master will then trigger the freezer with the next sequential OFAF ID to fill and this process will continue until all freezers in the network including the Master have reached their High Level Setpoints.

In Simultaneous OFAF mode, when any controller initiates a fill and fills for at least 60 seconds, the Master will then broadcast a signal for all freezers, including itself, to begin filling. Each freezer will continue to fill until its High Level Setpoint is reached.

A user would select sequential OFAF over simultaneous if their supply system is not able to maintain the proper filling pressure while multiple freezers filling at the same time. Sequential OFAF allows freezers to fill one at a time with a primed and cold supply system so that it is easier for the system to maintain the proper filling pressure.

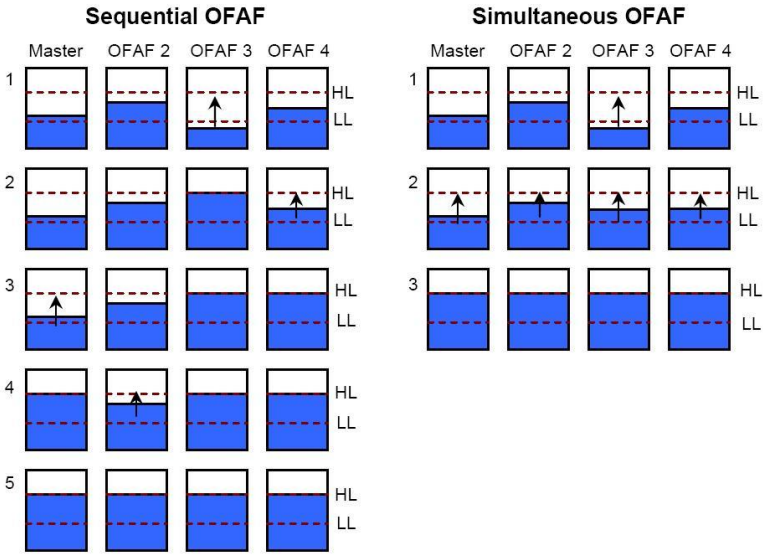


Figure 16: Diagram showing differences between Sequential and Simultaneous OFAF

OFAF Network Setup

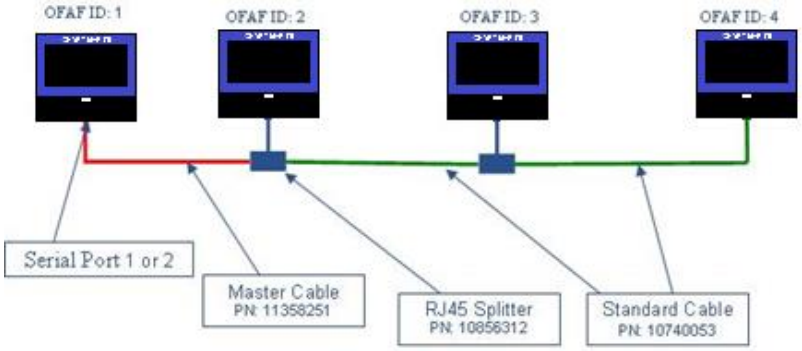


Figure 17: Diagram showing a typical OFAF network setup

Table 7: Required items for OFAF network

P/N	Description	Quantity needed
11358251	OFAF Master Cable	1
10740053	Standard CAT 5e Cable	# of controllers - 2
10856312	RJ-45 Splitter	# of controllers - 2

1. Designate the Master controller by setting its OFAF ID to “1”. Generally, this is the controller on the far end of the network from the LN2 supply.
2. Connect one end of the OFAF Master Cable to either Serial Port 1 or 2 of the Master controller.

NOTE: Either Serial Port 1 or 2 can be used for OFAF as long as the COM Types are in agreement.

3. Connect an RJ-45 splitter to the next controller in the network. Connect the free end of the OFAF Master Cable to this splitter.
4. Set the OFAF ID of this second controller to “2”.
5. Connect an RJ-45 splitter to the third controller in the network. Connect the splitters on the second and third controllers with a standard CAT 5e cable.
6. Set the OFAF ID of the third controller to “3”.
7. Continue this pattern until all controllers in the network are daisy chained and assigned sequential OFAF IDs.
8. Each controller in the network should also have the following settings:
    a. Auto Fill Control “Enabled”
    b. Serial Setup “9600 N81”
    c. Serial Type “OFAF”
    d. OFAF Type “Sequential” or “Simultaneous”. All controllers in a network must have the same OFAF Type.
    e. OFAF Units “# of controllers - 1”. The Master controller is not counted in the number of OFAF Units. All controllers in a network must have the same number of OFAF Units.

Cable Wiring

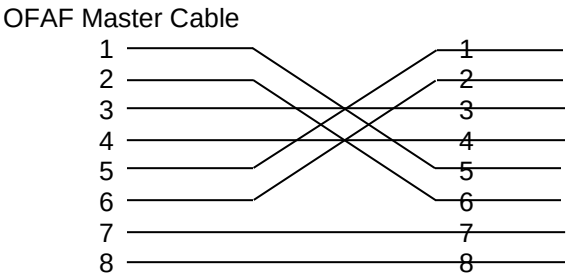


Figure 18: OFAF Master Cable wiring configuration. Numbering as viewed from side of RJ-45 connector opposite latch.

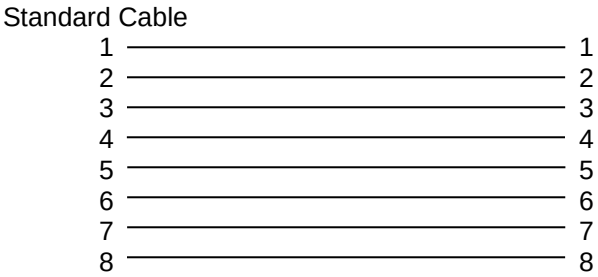


Figure 19: Standard reverse RJ-45 network cable configuration. Numbering as viewed from side of connector opposite latch.

6.4.4. Printer Setup

The Chart MVE TS compatible printer kit allows users to print a hard copy of the freezer's status at a set interval and as events occur. The Chart MVE TS will print the current status of the freezer in the event log format. The default print interval is 30 minutes.

NOTE: Adjusting the print interval will not affect the event log interval. These two parameters are independent. The event log interval can be adjusted using ASCII commands. All printed events are not necessarily logged in the event log; however, all the events in the event log are printed.

TEC 2000/3000/TS Printer Kit (PN 11544943)

- Epson LX-300+II Serial Dot Matrix Printer
- RS-485 Converter and Adapters
- User's Guide

Installation

1. Setup printer as described in the included user's guide
2. Assemble and connect RS-485 converter and adapters as shown below
3. Connect the printer to Chart MVE TS serial port 1 or 2 via the RS-485 converter assembly
4. Set the corresponding COM Setup to "9600 N81"
5. Set the corresponding COM Type to "Printer"
6. Adjust the Print Interval to the desired value
7. Test setup by forcing an event or printing a new header or event

6.5. Remote Alarm Tests

The Global Remote contacts and programmable alarm outputs can be checked for continuity using a digital multimeter or ohm meter.

6.5.1. Testing the Global Remote Contacts

- Normal State (No Alarms)
  - There should be continuity between the COM and NC terminals
  - The COM – NO circuit should be open
- Alarm State
  - There should be continuity between the COM and NO terminals
  - The COM – NC circuit should be open

6.5.2. Testing the Programmable Alarm Output Contacts

Each of the four programmable alarms may be set to either Active Open or Active Closed logic. See testing procedures below for the two different states.

Active Open:

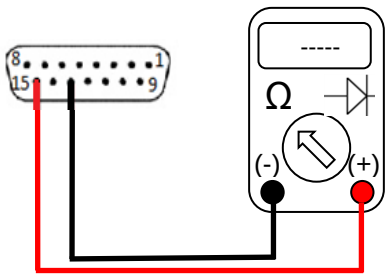
The alarm output is disconnected from the ALARM OUTPUT COMMON while the alarm is active.
The alarm output is connected to ALARM OUTPUT COMMON while the alarm is not active.

- Normal State (No Alarms)
  - There should be continuity between the ALARM OUTPUT COMMON and the alarm output contact being tested
- Alarm State
  - The circuit between the ALARM OUTPUT COMMON and the alarm contact to be tested should read open

Active Closed:

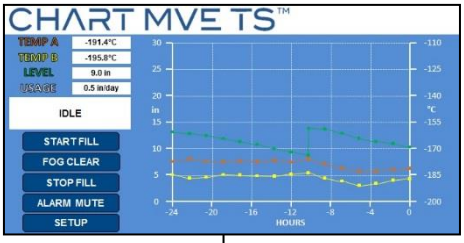
The alarm output is connected to ALARM OUTPUT COMMON while the alarm is active.
The alarm output is disconnected from the ALARM OUTPUT COMMON while the alarm is not active.

- Normal State (No Alarms)
  - The circuit between the ALARM OUTPUT COMMON and the alarm contact to be tested should read open
- Alarm State
  - There should be continuity between the ALARM OUTPUT COMMON and the alarm output contact being tested

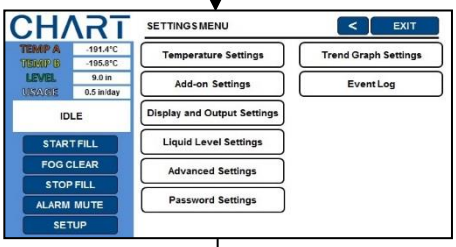


7. Chart MVE TS Menu Maps

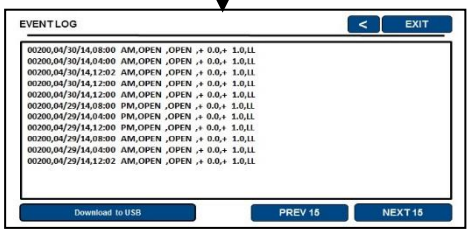
7.1. Main Setup Menus



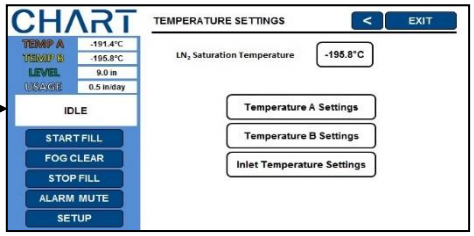
Setup



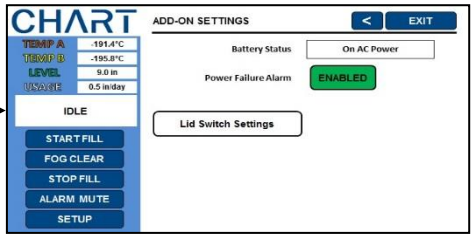
Event Log



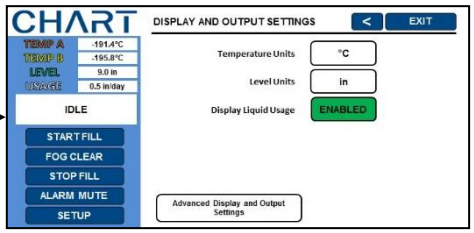
Temperature Settings



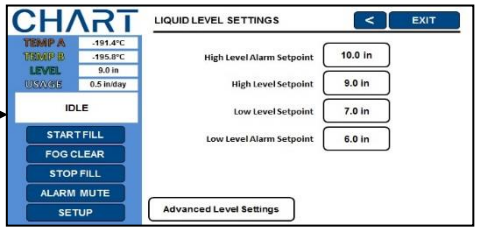
Add-on Settings



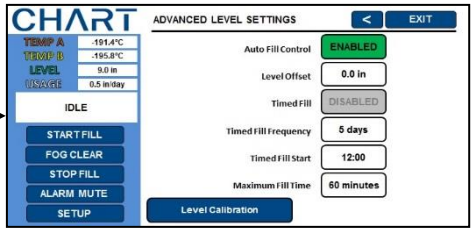
Display and Output Settings



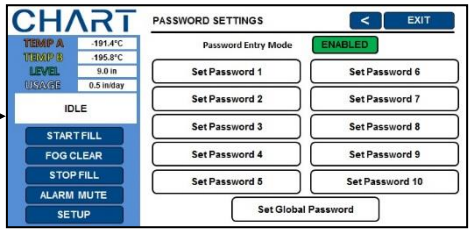
Liquid Level Settings



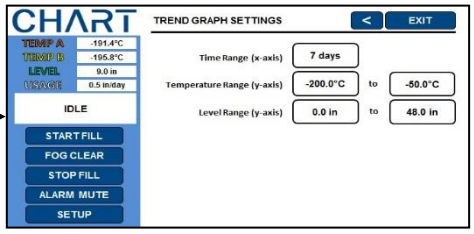
Advanced Settings



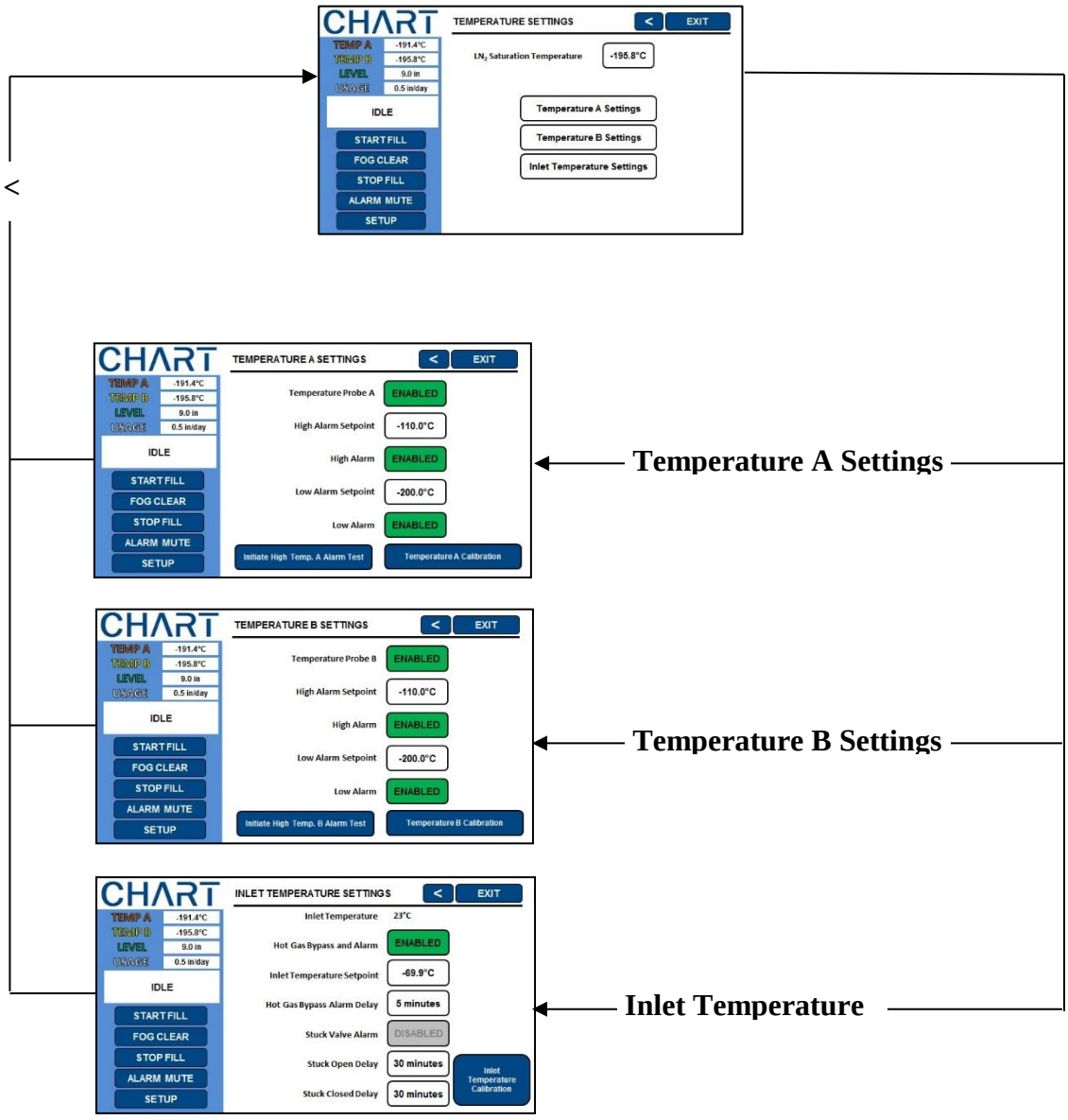
Password Settings



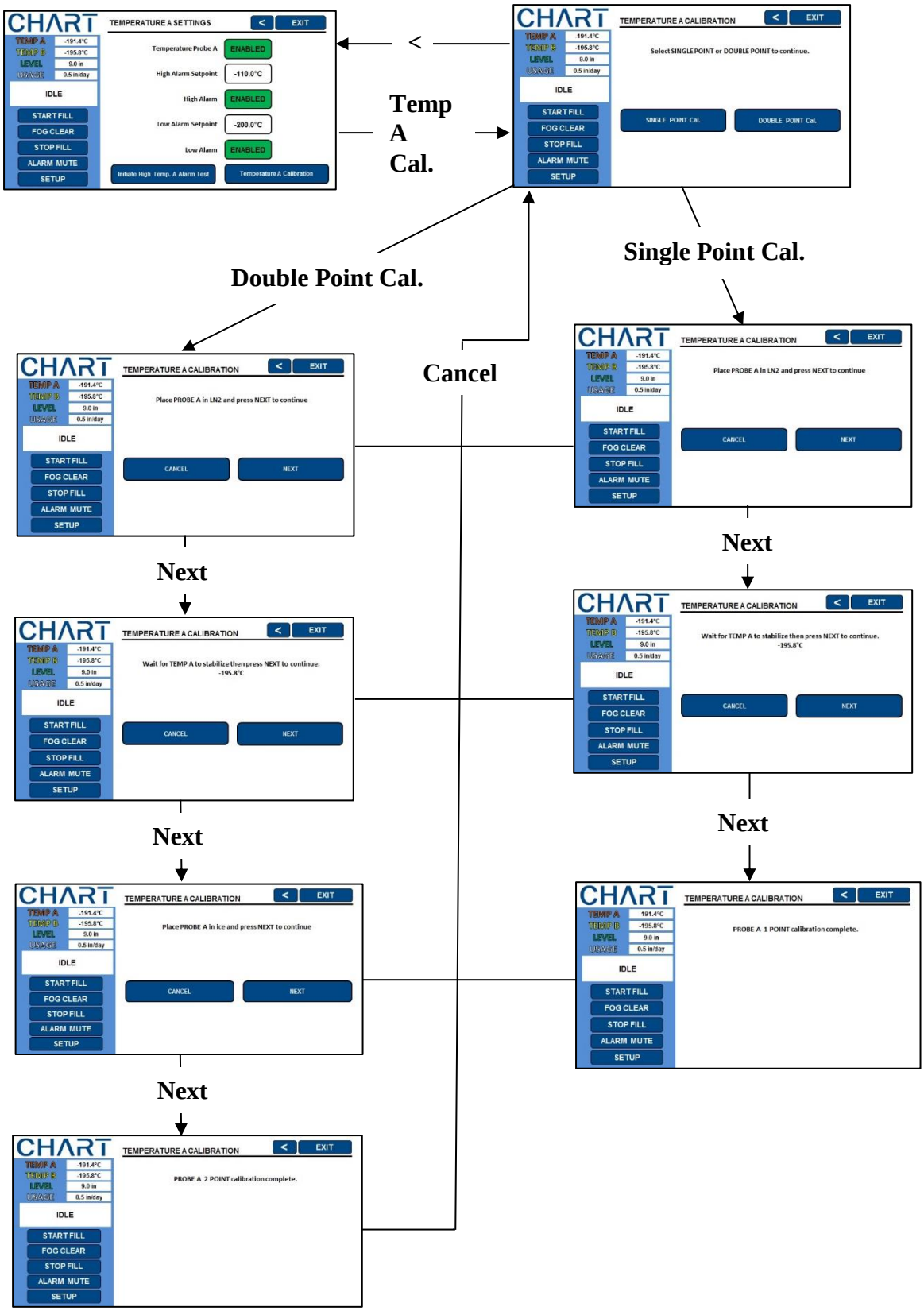
Trend Graph Settings



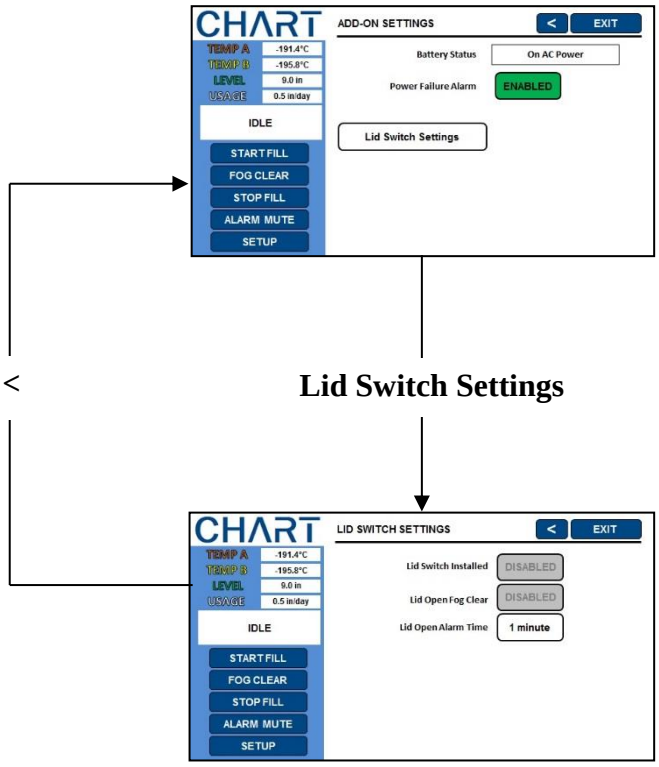
7.2. Temperature Setting Menus



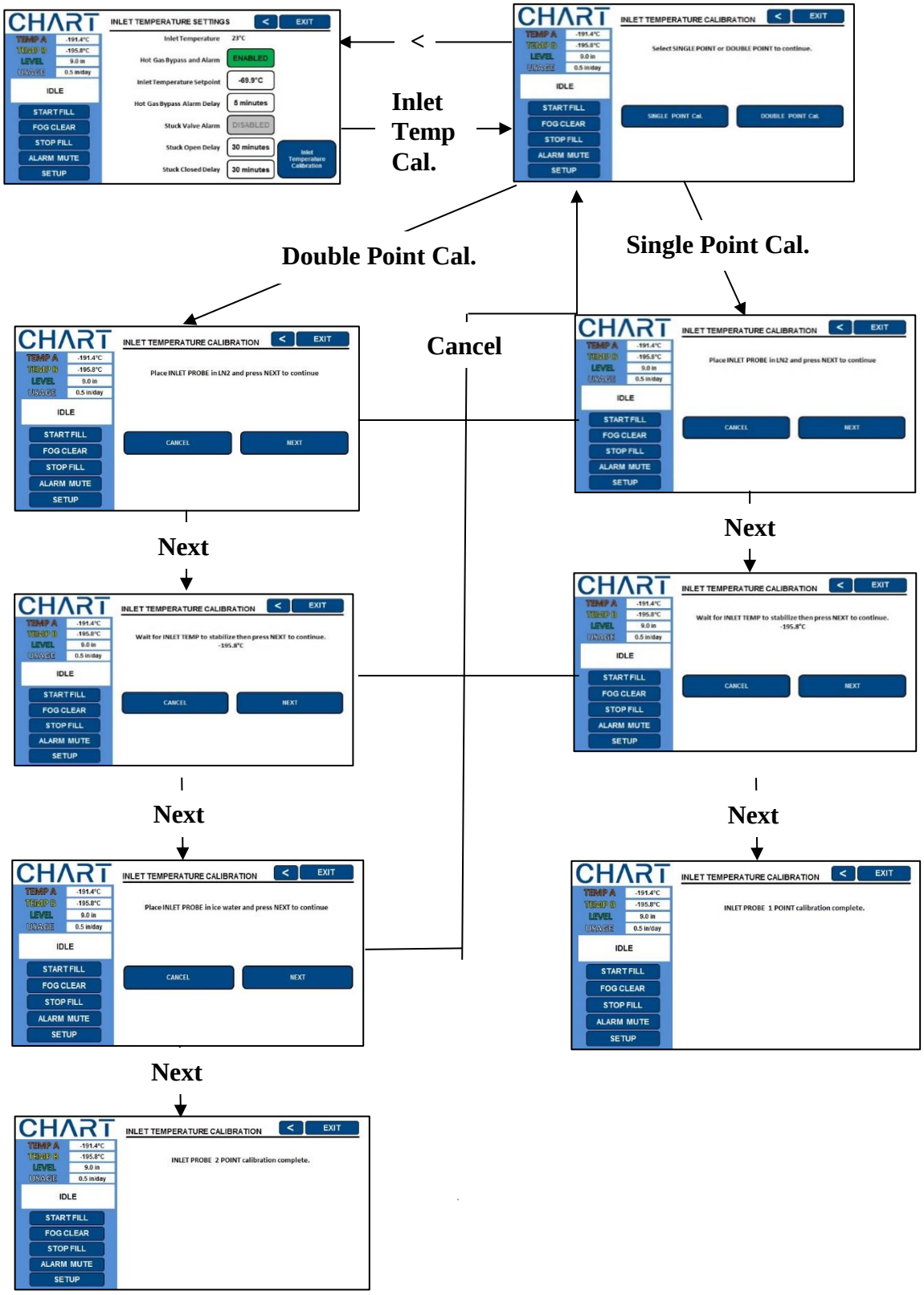
7.3. Temperature Calibration Menus



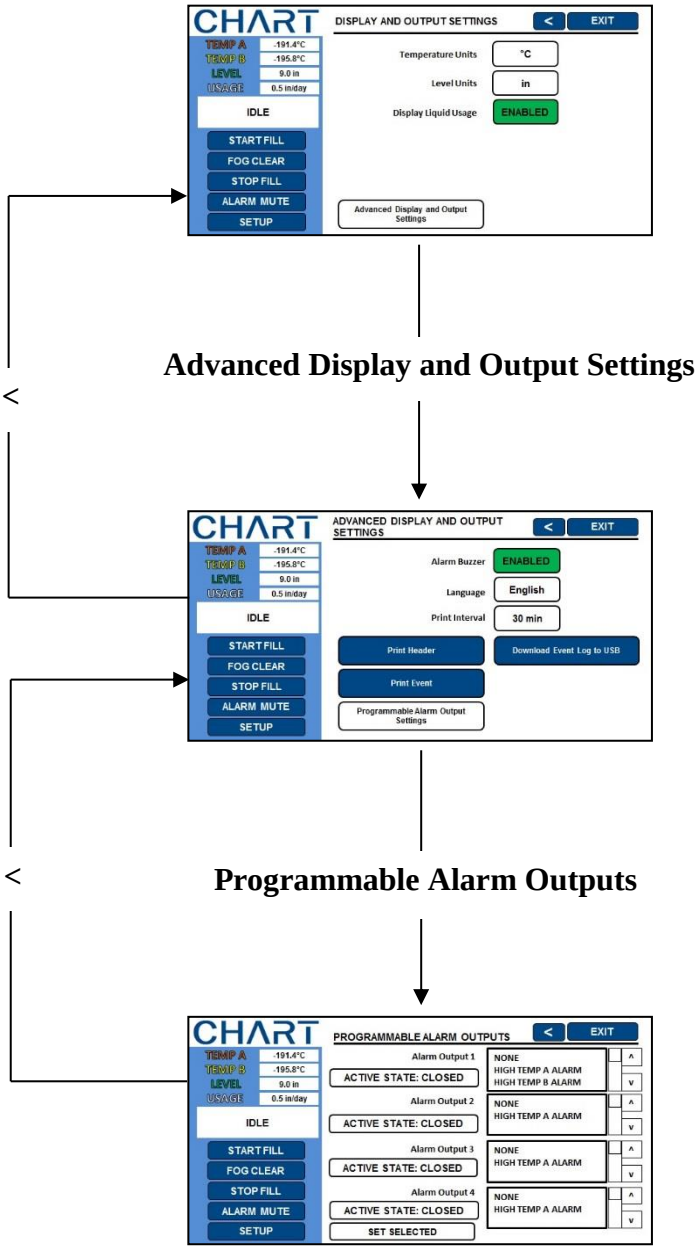
7.4. Add On Menus



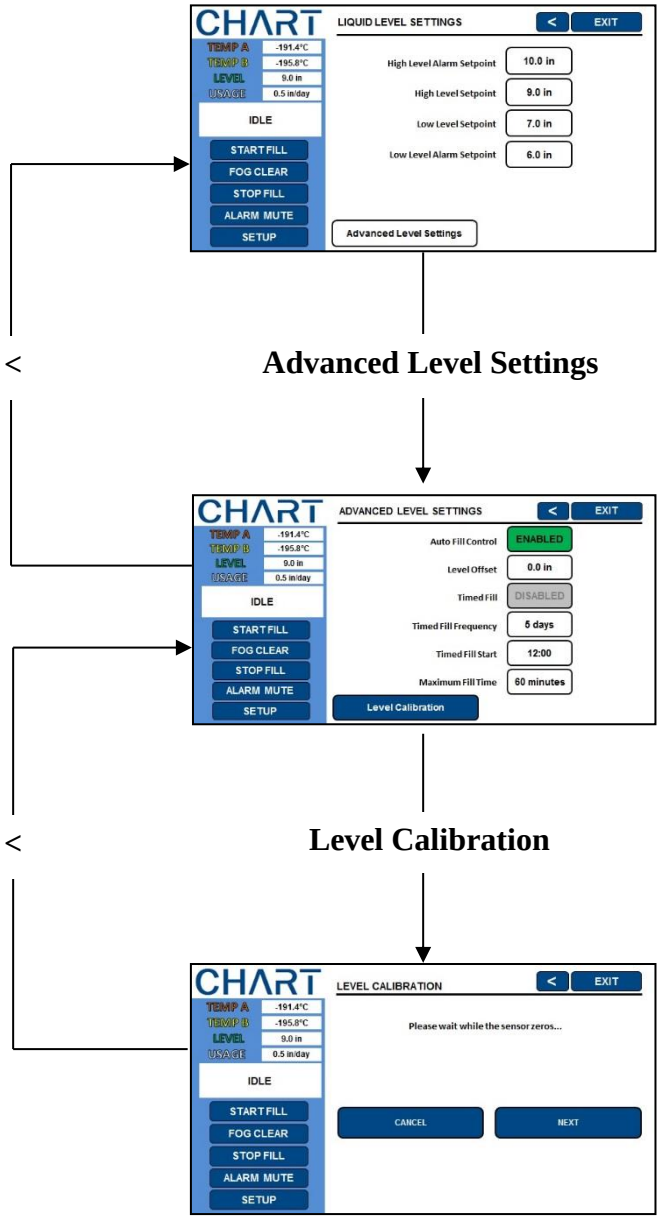
7.5. Inlet Temperature Sensor Calibration Menus



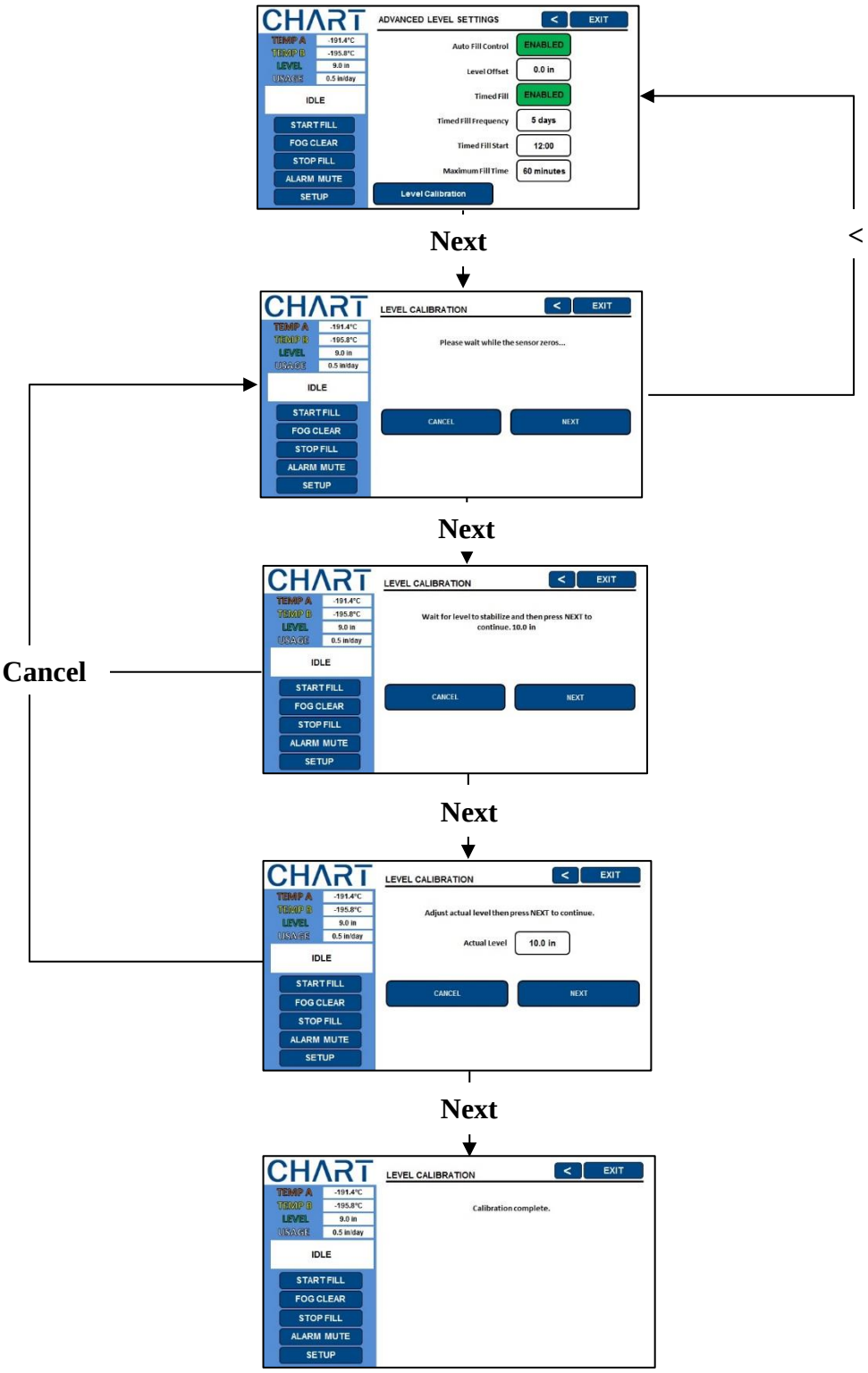
7.6. Display and Output Menus



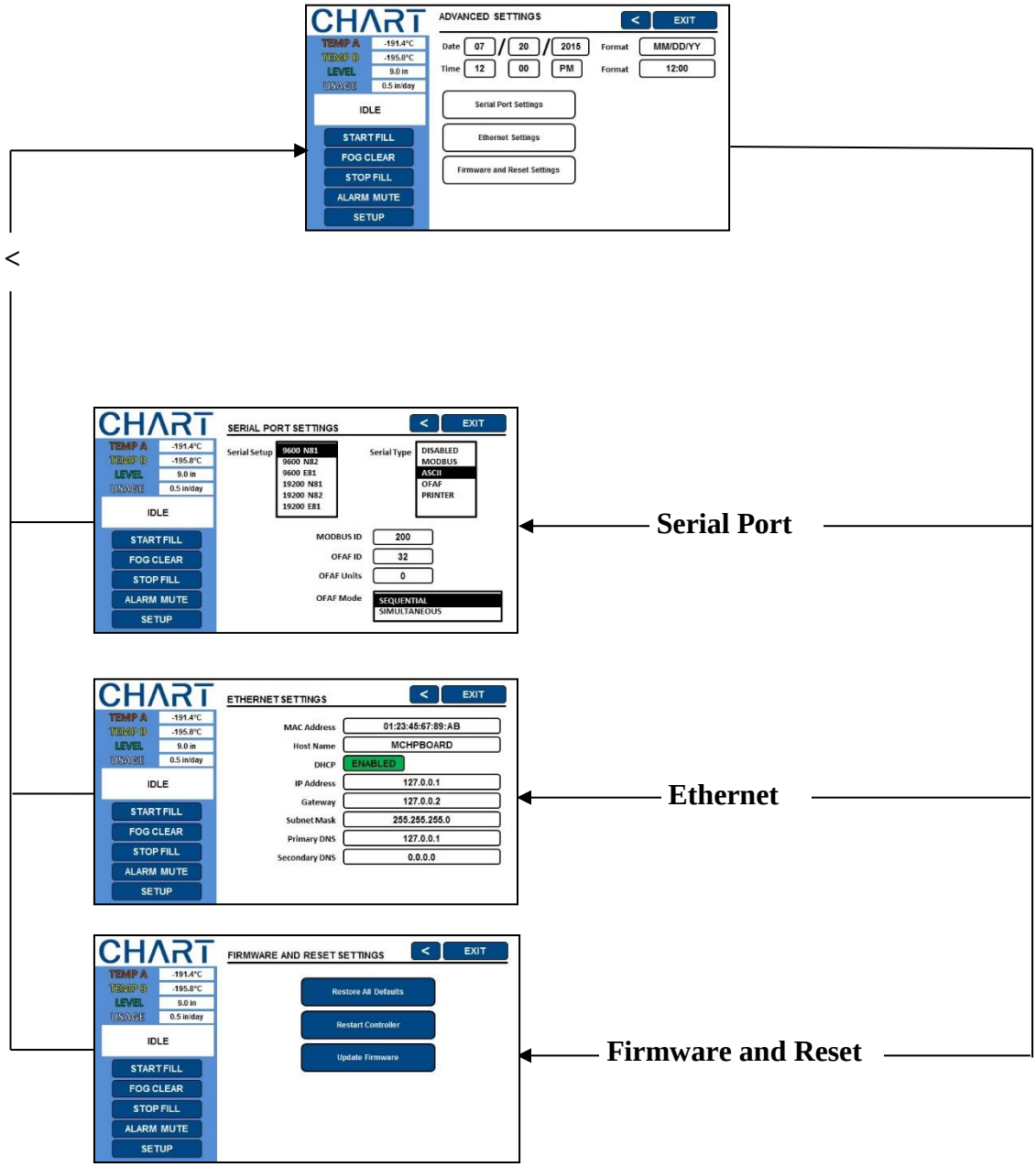
7.7. Liquid Level Menus



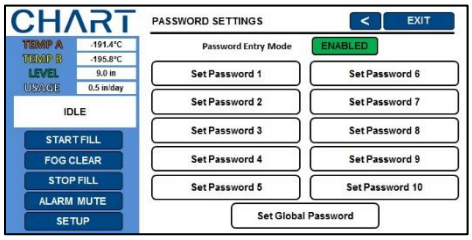
7.8. Liquid Level Calibration Menus



7.9. Advanced Settings Menus



7.10. Password Menus



8. Preventative Maintenance

8.1. Preventative Maintenance Schedule

This section describes the preventative maintenance that should be performed on MVE freezers to ensure optimum operation and performance, as well as maximum service life. As with any technical piece of laboratory equipment, preventative maintenance is key to equipment success.

NOTE: This is the MVE recommended preventative maintenance. MVE Distributors may have a more comprehensive maintenance/service plan. At the minimum, the below schedule should be followed.

Table 8: Periodic Preventative Maintenance Schedule

	Weekly	Monthly	6 Months	12 Months	24 Months	60 Months
Level Verification	X					
Verify Adequate Supply	X					
Plumbing Leak Check		X				
High Temp Alarm Test			X			
Level Alarm Test			X			
Thaw Freezer Lid			X			
Folding Step Inspection			X			
Lid Hinge Inspection			X			
Inline Filter Replacement				X		
Complete Function Test				X		
Solenoid Valve Replacement (Fill, Bypass, and Purge Valves)					X	
Relief Valve Replacement					X	
Lid gasket replacement					X	
Complete Freezer Thaw and Moisture Removal						X
Backup Battery Replacement						X

8.2. Preventative Maintenance Procedures

8.2.1. Level Verification

The differential pressure measurement system used on MVE freezers is nearly maintenance free. It provides a high level of accuracy and resolution to give the operator a precise indication of the exact amount of LN2 present in the freezer at all times. Despite its reliability, it is important that the accuracy of the level measurement system is verified on a weekly basis. This will prevent a control system malfunction from adversely affecting the temperature in the freezer storage space. Use the meter dipstick provided with every MVE freezer to manually measure the amount of LN2 in the freezer. Follow the "Dip Stick Procedure" listed in section 6.3.2 to properly measure the level. If the level is off by 1.0 inch (25mm) or more, follow the calibration procedure listed in the aforementioned section.

8.2.2. Verify Adequate Supply

Adequate LN2 supply pressure and flow is imperative to the proper operation of MVE freezers. Any LN2 supply whether from bulk tank or liquid cylinder must be able to maintain a pressure of 22-35 psi (1.52 – 2.41 bar) during a filling cycle, and must have enough liquid to ensure the completion of a fill cycle. The majority of nuisance alarms reported from MVE freezers are due to inadequate supply.

1. Observe the pressure of the supply source. Ideally, pressure should be 22 – 35 psi (1.52 – 2.41 bar).

   NOTE: It is very common for the pressure gauge on an industrial liquid cylinder to be inoperative. If you suspect this to be the case, install a pressure gauge inline between the liquid cylinder and the freezer for verification

2. Verify the amount of liquid in the supply source. Most bulk tanks have some method of digital or analog volume measurement. Liquid cylinders typically use a sight gauge. As with the pressure gauge on liquid cylinders, it is common for the sight gauge to be inoperative.
3. The minimum amount of liquid necessary in the supply should be enough to completely fill the number of freezers it is supplying. This amount can be determined from the LN2 inch to volume table in the Appendix.
4. Initiate a fill start on at least one freezer on the network. The supply system should be able to maintain appropriate pressure throughout the duration of the fill cycle.
5. If the supply is determined to be inadequate, have your gas supplier replenish/replace the supply.

8.2.3. Plumbing Leak Check

Leaky plumbing connections can create a host of problems including but not limited to:

- Slow fill times
- Nuisance Alarms
- High LN2 Consumption
- Inaccurate level readings
- Inaccurate liquid usage readings

Leaky plumbing connections are especially common on liquid cylinder supply systems, since the fittings are regularly loosened and tightened during liquid cylinder swap out.

1. With the supply system at operating pressure, thoroughly spray all transfer hose connections and freezer plumbing connections with leak detect solution
2. Allow leak detect solution to penetrate fittings for at least 30 seconds
3. large leaks will be immediately apparent with large bubble formations
4. Small leaks will take longer to detect, with small bubble formation in the appearance of “foam”
5. Most leaks can be repaired by tightening the suspect fitting with a crescent or appropriate sized wrench.
6. If tightening the fitting does not fix the leak, check the fitting for cracks and or galling. If the fitting is damaged, replace.
7. Recheck any replaced fittings for leaks.

8.2.4. High Temp Alarm Test

Please refer to Section 7.2.1.2 for details and instructions on the High Temp Alarm Test.

8.2.5. Level Alarm Test

The Chart MVE TS control system can trigger a high level or low level alarm if the LN2 level in the freezer exceeds the user defined parameters.

High Level Alarm Test:

1. Observe and record the current LN2 level
2. Record the current level settings. They may be accessed by pressing the "▲" and "▼" simultaneously to access the quick reference menu, or through the "Liquid Level Menus". The current LN2 level should be between the High Level Alarm setting and Low Level Alarm setting. If not, allow the freezer to fill until it reaches the High Level Fill setting.
3. Adjust the level offset so that the current level is a value that is greater than the High Level Alarm setting. For example, if the High Level Alarm setting is currently 10.0 inches, increase the offset value by at least 1.0 inch. This will "fool" the controller into thinking that the level inside the freezer is higher than actual. Reference Section 6.2.2.3 for offset adjustment procedure.
4. Observe the audible/visual alarm. Be aware that the level alarms have a one minute. This delay is intentional and is to prevent nuisance alarms.
5. If the alarm does not occur after one minute, verify that the audible alarm is turned on
6. Decrease the offset value to the original observed setting.

Low Level Alarm Test (Stand Alone Chart MVE TS configuration):

1. Observe and record the current LN2 level.
2. Remove the vinyl tube from the hose barb on the bottom of the Chart MVE TS. Be careful not to damage the tube
3. The displayed level should drop to 0.0 inches. The freezer may start a fill, press "Stop Fill" to terminate the fill
4. After one minute, the audible alarm should sound
5. If the alarm does not sound, verify that the audible alarm is turned on.
6. Reconnect the vinyl tube. If the tube is deformed at the end, it may be necessary to trim off ¼" of the tube to ensure a good connection.
7. Press "Fill Start" to purge the level sensing line. After 30 seconds, the level should gradually increase to actual.
8. After the fill cycle is complete, manually measure the level using the dipstick

Low Level Alarm Test (HEco model freezers):

1. Observe and record the current LN2 Level
2. Adjust the High Level Alarm setting to a value that is at least 5.0 inches higher than the current LN2 level. For example, if the current LN2 level is 5.0 inches, adjust the High Level Alarm setting to at least 10.0 inches.
3. Adjust the High Level Fill setting to a value that is at least 4.0 inches higher than the current LN2 level.
4. Adjust the Low Level Fill setting to a value that is at least 3.0 inches higher than the current LN2 level. If autofill is enabled, the freezer will begin filling automatically. Press "Stop Fill" to terminate the fill.
5. Adjust the Low Level Alarm setting to a value that is at least 2.0 inches higher than the current LN2 Level
6. After one minute, the Low Level Alarm should sound.
7. After alarm verification, return all level settings to their normal values.

8.2.6. Lid Thaw Procedure

1. Open or remove lid from freezer. Depending on the freezer model, it may be necessary to remove the lid from the hinges for it to completely warm to room temperature.
2. It is recommended that the freezer opening be covered with a spare lid or in another non-airtight manner to prevent moisture from entering the storage space and to minimize the top box temperature change while the lid is open.
3. Allow lid to sit at room temperature for approximately 30 minutes.
4. Once thawed, thoroughly dry lid, cork, and liner.
5. Inspect lid for damage and replace parts if necessary.

8.2.7. Folding Step Inspection

MVE 1500 and 1800 series freezers equipped with folding steps assemblies should be inspected for integrity at least every 6 months. Verify that hinges and free of cracks and all connections are secure. Check that the anti-slip strips on the steps are in good condition and replace if necessary (PN 4810179). Ensure the step locking strap is able to securely hold the steps in their folded position. If the pivot bolts continuously loosen, apply thread locker (PN 11087674) and retighten.

8.2.8. Lid Hinge Inspection

MVE freezers with hinged lids should be inspected for integrity at least every 6 months. Verify that the hinges are free of damage and securely attached to the freezer and lid. MVE hinged freezers are counterbalanced for easy opening and closing. Ensure the lid opens smoothly to a near 90° angle. The lid should remain completely open without assistance. Ensure lid closes smoothly and comes to rest centered on the freezer. Adjust hinges or replace as needed. For part numbers, contact Customer/Technical Service with the freezer serial number.

8.2.9. Inline Filter Replacement

CAUTION: Ensure that the LN2 supply valve is closed and the plumbing assembly is vented before removing the inline filter.

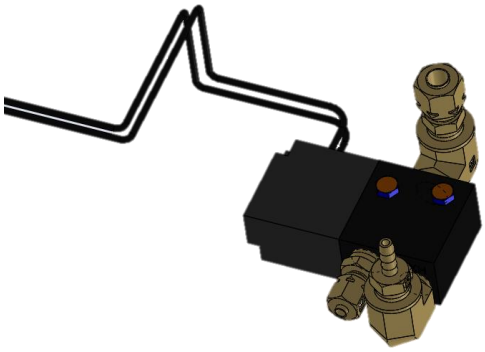
1. Close the LN2 supply valve and disconnect the LN2 transfer hose from the plumbing assembly fill tee.
2. Loosen and remove the fill tee and inline filter from the plumbing assembly.
3. Replace the inline filter (PN 11648945) and reassemble the fill tee and filter to the plumbing assembly using new Teflon tape if needed. Ensure the filter is oriented correctly so that the affixed arrow indicates the direction of LN2 flow.
4. Reconnect the LN2 transfer hose, open the LN2 supply valve and check fittings for any leaks.

8.2.10. Complete Function Test

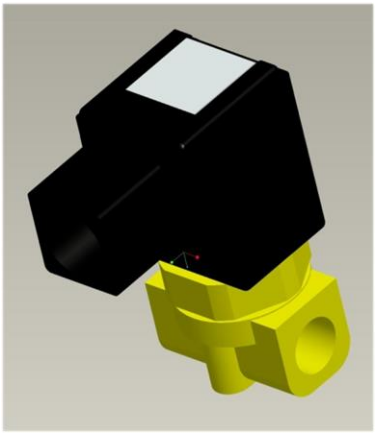
MVE recommends that freezers with Chart MVE TS controllers undergo a complete function test every 12 months to ensure correct functionality and identify potential problems before symptoms develop. Function test documents can be written based on this manual or this manual itself can be used to verify the function of MVE freezers with Chart MVE TS controllers.

8.2.11. Solenoid Valve Replacement

MVE freezers will have two types of solenoid valves. The purge valve is a 3 port solenoid valve. The two fill valves and the one gas bypass valve are 2 port, normally closed, inline solenoid valves.



3-Way Purge Valve



SMC Solenoid Valve
(current production)

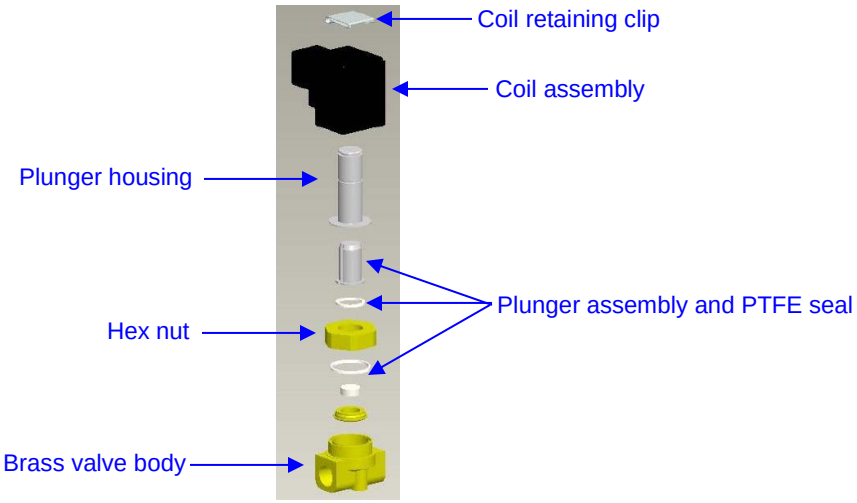
All MVE freezers are equipped with electromechanical solenoid valves that have been tested and approved by MVE for cryogenic use. These valves utilize a PTFE seal for optimal sealing in cryogenic environments. Over time, the normal thermal cycling that this seal is subject to will cause it to harden and lose its ability to seal completely. This will result in seepage past the sealing surface which can increase the LN2 consumption of the system, and in extreme cases result in an overfill situation. Thermal cycling through normal operation can also cause moisture ingress into the coil of the solenoid valve. Over time this may cause the connections and wiring in the coil to corrode and eventually fail. This will result in an inoperative solenoid valve. For normal preventative maintenance, it is only necessary to replace the components that are subject to wear. This includes the plunger and the coil assembly. See the exploded view below.

NOTE: Always use replacement solenoid valves from MVE. Substituting non MVE components may result in inoperable valves and even damage to the Chart MVE TS control system. Damage to the control system due to use of non MVE parts will not be covered by warranty.

8.2.11.1. SMC Solenoid Valve Replacement

CAUTION: Ensure that the LN2 supply valve is closed and the plumbing assembly is vented before removing the solenoid valves.

1. Remove plumbing shroud (on HE series) or rear access panel (on MVE series) to gain access to plumbing system
2. Remove coil retaining clip by inserting a flathead screwdriver between the clip and the edge of the coil body. Twist the screwdriver, and the clip should slide off
3. Remove and discard the coil assembly
4. Using a crescent wrench loosen hex nut and remove the plunger housing. Remove plunger housing and plunger assembly. Discard these parts
5. Remove any debris that may have collected in brass valve body
6. Inspect the brass valve body of the solenoid valve for nicks or damage. If the sealing surface appears to be in good condition, the valve body may be reused. If the sealing surface is damaged, the plumbing will need to be disassembled and the entire body will need to be replaced (this is not common).
7. Disassemble a new SMC valve (PN 14224611S) using the above procedure
8. Install the new plunger, plunger housing, and coil assembly onto the old valve body.
9. Assembly valve with new components in the reverse order.
10. Verify that no leaks are present using leak detect solution
11. Open the LN2 supply valve and initiate a fill cycle by pressing “Fill Start’. Allow the fill cycle to complete and verify that flow stops at the termination of the fill cycle.



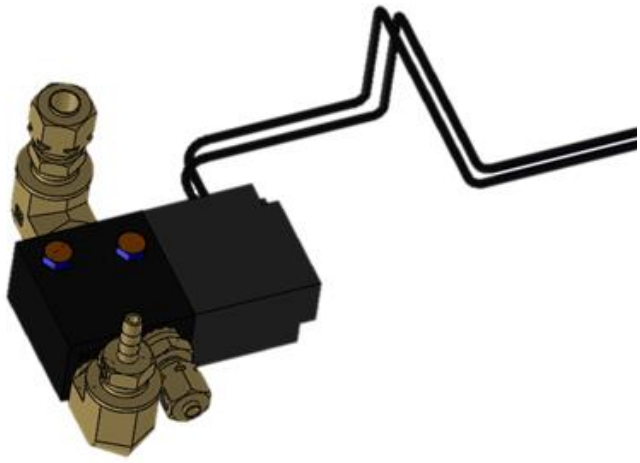
NOTE: If the brass valve body requires replacing, the freezer plumbing will need to be disassembled and the entire valve replaced (PN 14224611S). It is typically easier to start disassembling the plumbing assembly beginning at the fill tee for fill valve replacement or the gas bypass muffler for gas bypass valve replacement.

NOTE: When installing a complete new valve, ensure it is oriented correctly. An “N” is engraved on the side of the SMC brass valve body. The valve should be installed so that this “N” is on the inlet side of the valve.

8.2.11.2. 3-Way Purge Valve Replacement

CAUTION: Ensure that the LN2 supply valve is closed and the plumbing assembly is vented before removing the solenoid valves.

1. Remove plumbing shroud (on HE and HEco series) or rear access panel (on MVE series) to gain access to plumbing system.
2. Disconnect the Purge Valve wires from the Chart MVE TS wire harness.
3. Using an adjustable wrench, disconnect the copper tubing from the 2 fittings on the Purge Valve assembly.
4. Disconnect the clear vinyl tubing from the barbed fitting.
5. Remove the two bolts that mount the Purge Valve to the plumbing platform.
6. Repeat steps 1-5 in reverse order to install a new Purge Valve.



8.2.12. Relief Valve Replacement

CAUTION: Ensure that the LN2 supply valve is closed and the plumbing assembly is vented before removing the relief valve.

1. Remove plumbing shroud (on HE series) to gain access to plumbing system
2. If equipped with a relief valve deflector, loosen the deflector clamp and slide off the deflector.
3. Loosen the relief valve and remove it from the plumbing assembly. Be sure to support the attachment tube with wrench to prevent damage from twisting.
4. Install new relief valve (PN 1810032) applying new Teflon tape if needed. Ensure relief valve is rated to 50 PSI (3.4 bar).

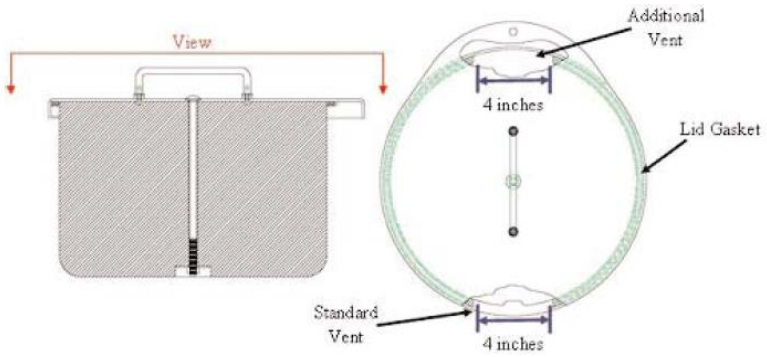
CAUTION: Installing a relief valve with a different pressure rating could prevent proper operation and lead to a dangerous over pressurized condition. Additionally, this will void any warranty

8.2.13. Lid Gasket Replacement

The lid gasket configuration and material will vary depending on the freezer model and vintage. For the correct part numbers, contact Customer/Technical Service with the freezer serial number. There are three main types of lid gaskets and the replacement instructions for each are given below.

8.2.13.1. MVE High Efficiency Series

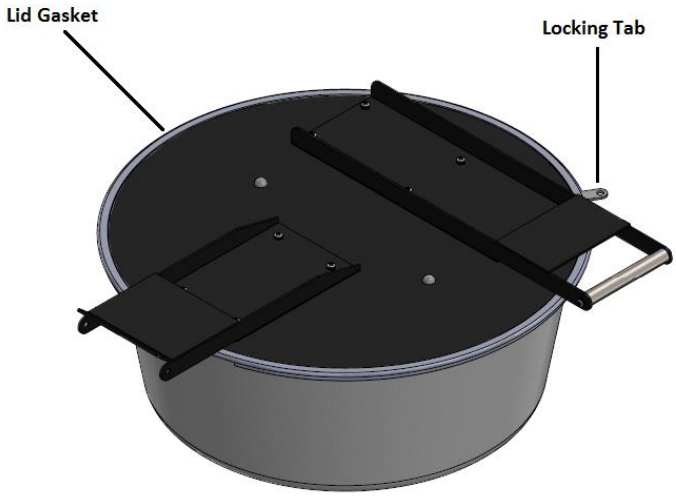
1. Depending on the condition of the current gasket, the gasket material can be removed and replaced or more material can simply be added to the existing gasket.
2. The replacement gasket material will be a neoprene tape.
3. Simply clean the surfaces, remove the tape back to expose the adhesive and install gasket material.
4. Trim to size as needed.
5. Cut a 4 inch gap in the gasket material on either side of the lid as shown below to allow sufficient venting of the freezer space



8.2.13.2. MVE Series/HEco and HE 1800 Series (Gasket with Trim Seal)

1. Clean the surfaces and remove the existing gasket.
2. Trim new gasket to size as needed.
3. Cut a horizontal slit into the gasket for the locking tab.
4. Push new gasket firmly into position around the lid assembly.

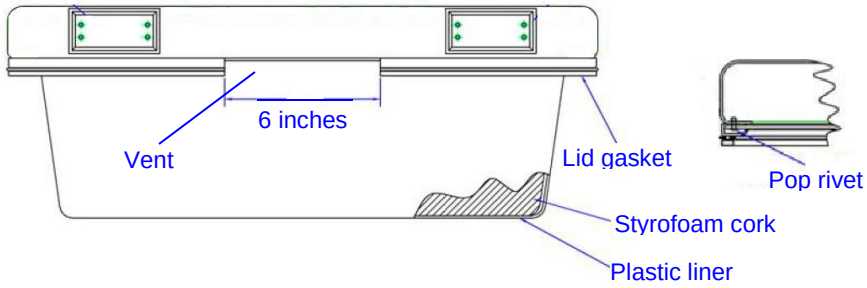
*Note: This gasket is also used on older XLC Freezers (230, 810, 1520).



8.2.13.3. MVE and MVE Stock Series – Riveted gasket

1. Note how the current gasket is attached to the lid. The replacement gasket will be installed the same manner.
2. If applicable, remove lid from hinges.
    a. Place the lid in the closed position.
    b. Remove spring pressure from the hinge by loosening the ½ inch nut on the rod inside the hinge body.
    c. Remove screws securing the hinges to the freezer lid.
3. Remove lid assembly, and place it upside down either on top of the freezer opening or on flat surface.
4. Using a 1/8 inch drill bit, carefully drill off the heads of the existing rivets holding the gasket to the lid.
5. Remove gasket.
6. Inspect plastic lid liner and Styrofoam cork for damage and replace if necessary.
7. Install new gasket so that it lays flat and the flange is between the lid and the lid liner.
8. Properly align lid liner so that the existing rivet holes can be reused.
9. Insert 1/8 inch pop rivets into the existing liner holes, through the gasket, and then through the lid holes so that the fat part of the rivet is exposed. Sometimes it is easier to carefully drill through the gasket then inserting the rivets instead of attempting to puncture the gasket with the rivet.
10. Using a pop rivet gun, securely rivet the liner and gasket to the freezer lid.
11. Cut a 6 inch (150 mm) gap in the gasket at the rear of the freezer lid to allow the freezer space to vent.
12. Reinstall lid.
13. If applicable, reinstall lid hinges.
    a. With the lid closed, install and tighten screws securing hinges to the lid

b. Using the ½ inch deep well socket, increase spring pressure until the hinges will hold the lid at approximately a 45° angle.



8.2.14. Complete Freezer Thaw and Moisture Removal

1. Remove freezer LN2 supply.
2. Unplug Chart MVE TS main power and battery backup if equipped.
3. Open or remove lid from freezer.
4. Allow LN2 to completely evaporate and the freezer space to warm to room temperature. Placing a fan blowing into the freezer will accelerate this process.
5. After it has reached ambient temperature, thoroughly remove any moisture from the freezer space. This can be done with a wet/dry vacuum and towels. For High Efficiency models, open the hinged hatch on the bottom of the turn-tray to access the bottom of the freezer.
6. Once moisture has been removed from the freezer space, purge the plumbing assembly and annular lines with nitrogen gas. Compressed nitrogen or the gas use valve on a LN2 cylinder work best. The LN2 cylinder vent valve can also work, but will deplete the cylinder head pressure quickly. Ensure the nitrogen gas pressure does not exceed 50 PSI (3.4 bar).
7. Plug in the Chart MVE TS main power and connect the freezer plumbing via transfer hose to a compressed nitrogen supply or the gas use valve on a LN2 cylinder. Ensure gas bypass is disabled if equipped.
8. Press “Start Fill” and allow the freezer to fill for 30 seconds.
9. Press “Stop Fill”
10. Press “Start Fill” and allow the freezer to fill for 30 seconds.
11. Continue cycling fills for 30 seconds until the plumbing assembly and annular lines are clear and completely dry.

In some cases, it may be necessary to purge the level sensing annular line separately. This can be done by connecting pressurized nitrogen gas directly to the freezer annular line fitting.

CAUTION: Ensure that the LN2 supply valve is closed and the plumbing assembly is vented before loosening the compression fittings and removing the annular line tube.

1. Loosen and remove the 1/4 inch compression fittings from the purge valve and the freezer annular line fitting.
2. Remove 1/4 inch copper tube and purge to clear any moisture.
3. Connect nitrogen gas source directly to the freezer’s 3/8 inch FPT annular line connection.
4. Purge annular line with nitrogen gas, maintaining a pressure below 50 PSI (3.4 bar), until the line in clear and completely free of any moisture.

NOTE: If moisture is not completely removed for the freezer space and annular lines, ice will form when LN2 is reintroduced into the freezer. Ice blockage in the freezer space or annular lines will interfere with proper function of the freezer and level sensing system.

ENSURE ALL MOISTURE IS COMPLETELY REMOVED PRIOR TO INTRODUCING LN2

8.2.15. Backup Battery Replacement

General
The freezer backup batteries (BB) can be replaced every five years or if the BB voltage has dropped below 21 VDC. The Chart MVE TS will start to lose functionality when the BB is below 18 VDC. To test any suspect BB, disconnect the AC power and allow freezer to run for 30 minutes; the power failure (PF) alarm should trigger. While it is still in PF alarm allow the freezer to perform a fill still using the BB, and once it has reached its high level set point measure the BB voltage. If the voltage measures 24 to 27 VDC the batteries are good. In any case, the best approach is to always replace a suspect battery or if the battery age is more than five years old.

> **Note:** New batteries may need to be charged for several hours before it is able to power the Chart MVE TS. The Chart MVE TS will constantly monitor, charge, and sense the current in its battery circuit. With its main power connected, the Chart MVE TS will constantly produce a 27 VDC trickle charge to keep the batteries fully charged.

This installation procedure applies to the following models:
HEco Series and MVE (Open Tops) Series -- Use Battery Backup PN: **11864171**
Varió Series, Stock Series, and High Efficiency Series -- Use Battery Backup PN: **12885791**

TOOLS REQUIRED

Phillips Screwdriver	Small Flat Head Screwdriver
Volt/Ohm Meter	Wire Ties

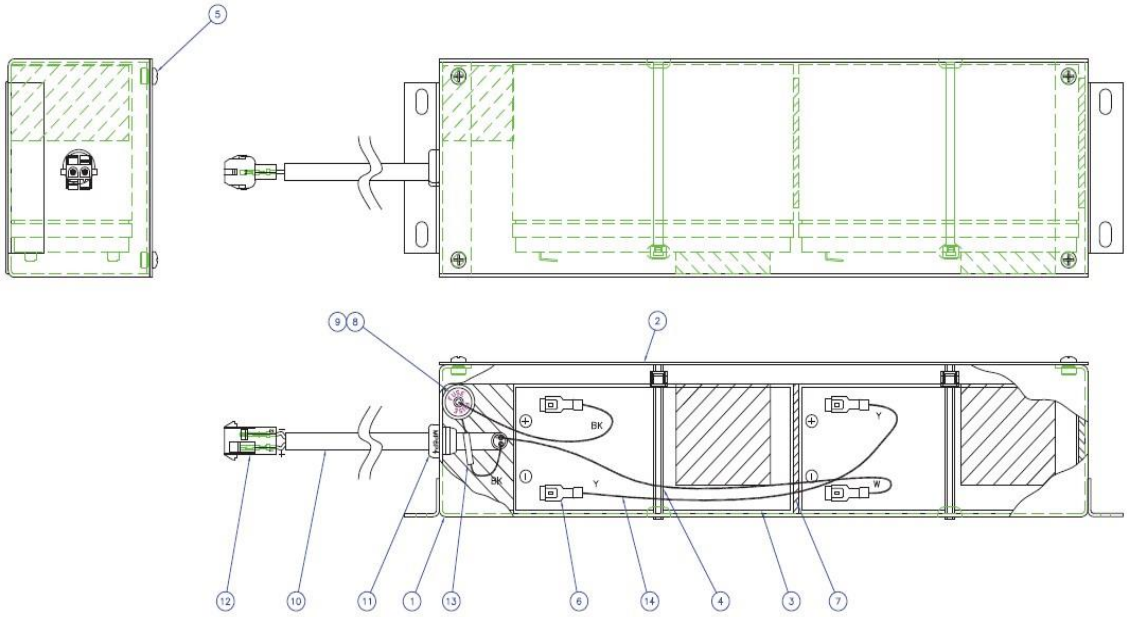
UNPACKING
Unpack the assembly and inspect for damage. If any damage is found, a freight claim should be filed with the carrier as soon as possible. Inspect to insure that all parts of the assembly are included.

Part Number: 11864171 includes the following items listed below.

ITEM #	PART NUMBER	DESCRIPTION	QTY	U/M
1	14122210	BATTERY BACKUP ENCLOSURE	1	EA
2	14122228	BATTERY BACKUP ENCLOSURE COVER	1	EA
3	21081273	BATTERY 12 VDC 9 AMP-HR	2	EA
4	10560431	CABLE TIE 15"L X 5/16"W	2	EA
5	10491780	PHILLIPS HEAD SCREW #8-32X3/8"	4	EA
6	4613809	CONNECTOR SPADE FEMALE .187W	4	EA
7	20535153	TAPE NEOPRENE CLOSED CELL	0.02	RL
8	11858475	FUSE HOLDER IN-LINE 5MMX20MM	1	EA
9*	11858467	FUSE 4A 250V	2	EA
10	14037103	POWER CORD 18GA	3	FT
11	14061533	STRAIN RELIEF 5/8 HOLE	1	EA
12	13284962	CONNECTOR HOUSING 2 PIN FEMALE	1	EA

13	15064293	SPLICE 22-18GA CRIMP ON SEALED	2	EA
14	10692830	WIRE CU 18GA TINNED YELLOW	1	FT
16**	2913851	PHILLIPS HEAD SCREW SS #10-32X1/4"LG	4	EA
16**	2915841	PHILLIPS HEAD SCREW SS #10-32X1/2"LG	4	EA
17**	2914931	WASHER FLAT SS 13/64IDX7/16"OD	4	EA
18**	2911071	WASHER SPLIT SS #10 18-8	4	EA

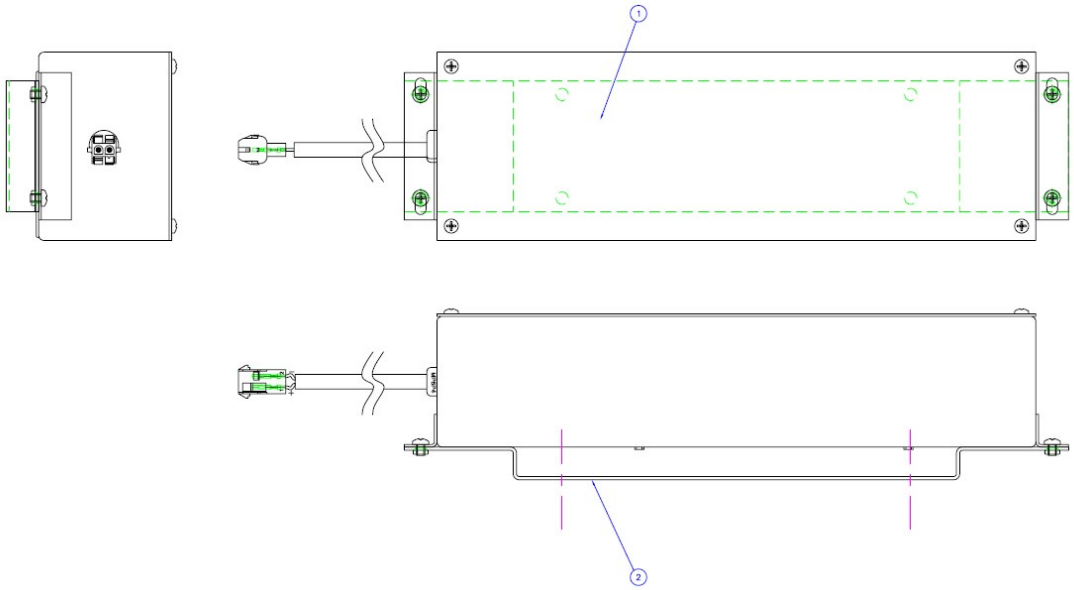
*Fuses item 9 should be taped to battery when battery enclosure cover is removed. One fuse is a spare to remain taped inside the enclosure after installation.
**Mounting hardware items 16, 17 and 18 should be in a plastic bag tied to the cable.



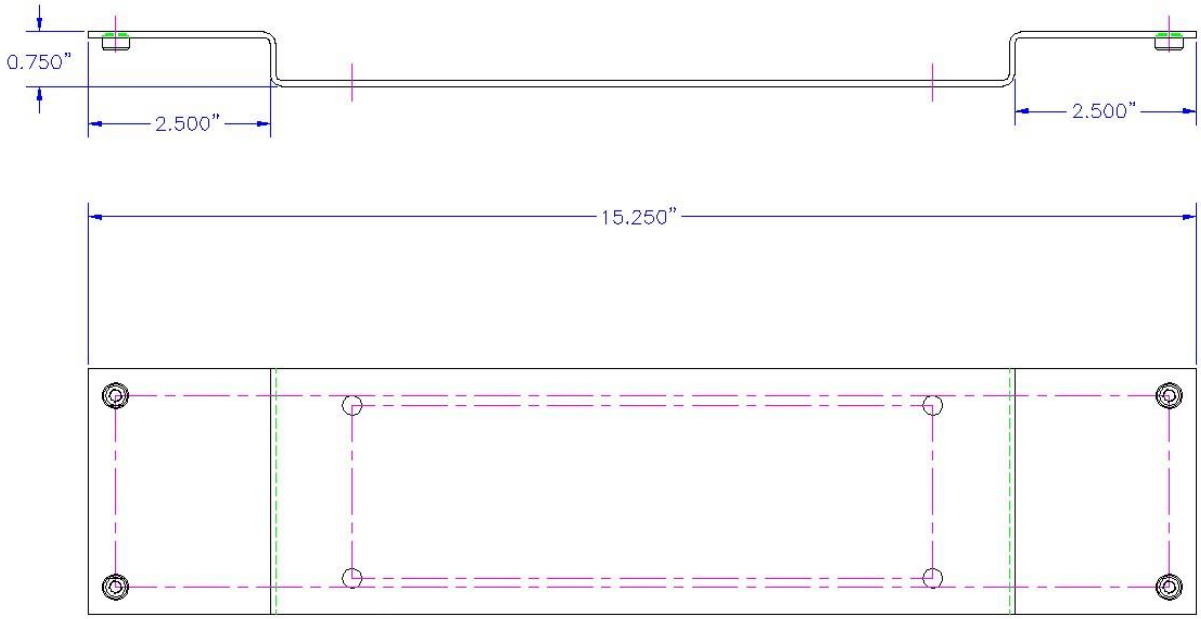
Internal View of Battery Backup

Part Number: 12885791 (Pictured Below) includes everything included with PN 11864171 in addition to the item listed below.

ITEM #	PART NUMBER	DESCRIPTION	QTY	U/M
2	14122236	BRACKET STAND ALONE	1	EA
N/A	2912191	PHILLIPS HEAD SCREW SS #10-32X3/8"LG	4	EA



External View of Battery Backup

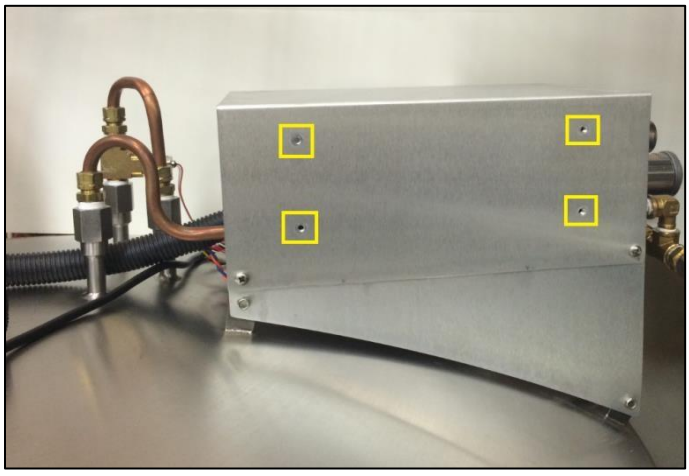


Bracket (Part Number: 14122236) Specifications

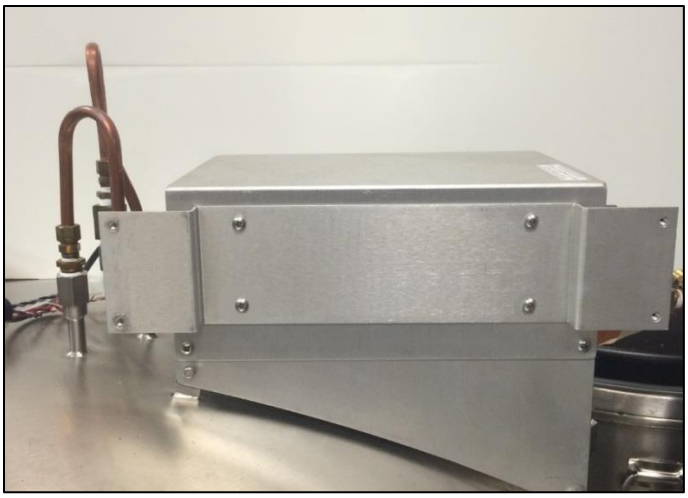
8.2.15.1. Stock Series and High Efficiency Series Battery Backup Installation

1. Installing the Bracket for the Battery Backup – Follow these instructions for the Stock Series and High Efficiency Series. These are instructions for mounting the bracket included with PN: 12885791. If PN: 11864171 was ordered, it will not come with a bracket. Please skip to Section 2 for Battery Backup Installation Instructions.

1.1. Disconnect main power cord.
1.2. Disconnect LN2 supply.
1.3. Use the 10-32 screws to install the bracket to the freezer on the plumbing stack cover.



Screw Location on the Plumbing Stack Cover



Battery Backup Bracket Installed

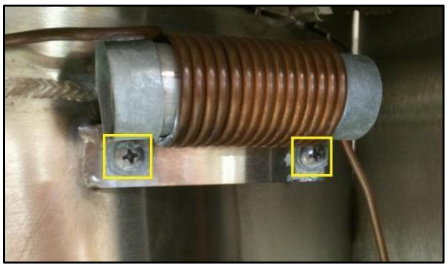
8.2.15.2. HEco Series and MVE Series (Open Top Freezers) Battery Backup Installation

2. Installing the Battery Backup Follow these instructions for the HEco Series and MVE Series (Open Tops). These are instructions for mounting the Battery Backup either to the bracket previously installed in Section 9.2.15.1 using PN: 12885791 or to the freezer itself if PN: 11864171 was ordered.

   2.1 Disconnect main power cord.
   2.2 Disconnect LN2 supply.
   2.3 Before installing the battery backup on the freezer, measure the voltage at the end connector for approximately 24VDC to 27VDC.
      2.3.1 If no voltage is present, the included fuse must be installed before connecting the battery to the main wire harness.
      2.3.2 Open the battery enclosure and unscrew the fuse harness.
      2.3.3 Install the fuse
      2.3.4 Close the fuse harness and the battery enclosure.

Battery Backup Fuse

   2.4 With the fuse installed and the battery backup reading approximately 24-27VDC, locate the battery backup mounting location.
      2.4.1 For MVE (Open Top) Series freezers, this will be on the back of the freezer. Remove the rear panel of the freezer. Remove screws securing purge coil clamps at the upper battery backup mount inside the rear enclosure.



Purge Coil Screws

2.4.2 For HEco Series Freezers, the battery backup is located under the work platform. If needed, please see Section 3 for detailed instructions.

2.4.3 For Varió Series, Stock Series, and High Efficiency Series, the battery will be mounted to the bracket installed previously.

2.5 For all freezers (excluding HEco Series), fasten the battery backup to the mounting location using the screws included with the battery backup.

2.6 Verify that the Chart MVE TS Controller will power on using the AC Power Supply only.
NOTE: Do not connect the battery backup to the main wire harness until the AC Power Supply has been verified to power up the controller.

2.7 Connect the battery backup to the proper connector on the Chart MVE TS Wiring Harness.

Battery Backup Connector. [Black – From the Battery Backup. Dark Blue/Orange – From the Chart MVE TS Wiring Harness]

8.2.15.3. HEco 800 Series

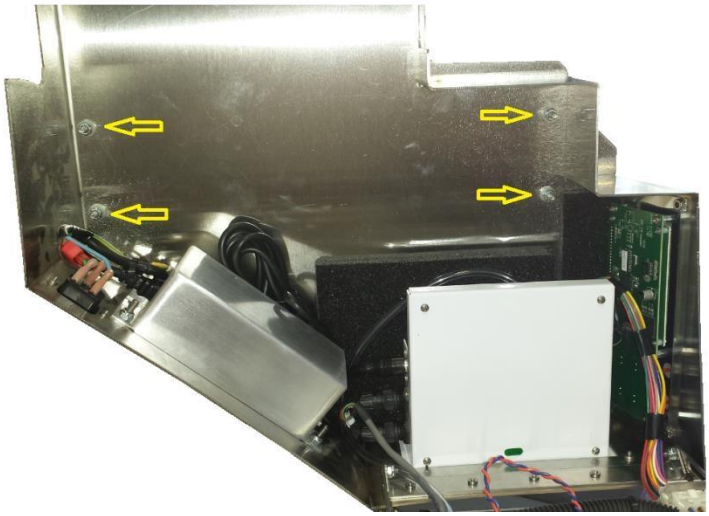
3.1.1. The battery backup will be placed on the 4 studs already located on the freezer. These are located on the bottom side of the workstation platform.

3.1.1.1. Open the workstation platform. First, loosen the Phillips head screws that fasten it to the freezer.

Phillips Head Screws to Remove

Note: This picture is for reference only. This is the 1800 Series Freezer.

Locate the mounting location for installing the battery backup. It will mount to the studs shown below.



Location to mount the battery backup

3.1.1.3. Remove nuts from studs.
3.1.1.4. Place the battery backup on the studs with the washers between the battery backup and the platform. Position the battery backup with the pigtail facing towards the front of the freezer. **Note:** The battery backup is capable of being positioned with the pigtail facing forwards or backwards. It is recommended that the pigtail faces forward so the batteries inside the housing remain in an upright position.
3.1.1.5. Fasten nuts to studs. This will secure the battery backup to the workstation on the freezer.

8.2.15.4. HEco 1500 Series

3.2.1. The battery backup will be placed on the 4 studs already located on the freezer. These are located on the side of the workstation platform.
3.2.1.1. Open the workstation platform where the controller panel is located by loosening the two Phillips head screws. This is the panel on the right when facing front of the freezer.

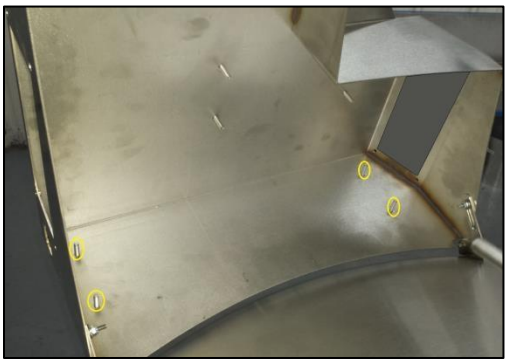
Phillips Head Screws to Remove

Note: This picture is for reference only. This is the 1800 Series Freezer.

3.2.1.2. Remove the back control panel by removing the 4 screws holding it in place on the back of the workstation (white).

Back Control Panel

3.2.1.3. Find the mounting location to install the battery backup. It will mount to the studs shown below. This is on the side of the Plumbing Stack Cover.



Location to mount the battery backup

3.2.1.4. Remove nuts from studs.
3.2.1.5. Place the battery backup on the studs with the washers between the battery backup and the platform. Position the battery backup with the pigtail facing towards the front of the freezer. Note: The battery backup is capable of being positioned with the pigtail facing forwards or backwards. It is recommended that the pigtail faces forward so the batteries inside the housing remain in an upright position.
3.2.1.6. Fasten nuts to studs. This will secure the battery backup to the workstation on the freezer.
3.2.1.7. Reinstall the back control panel.

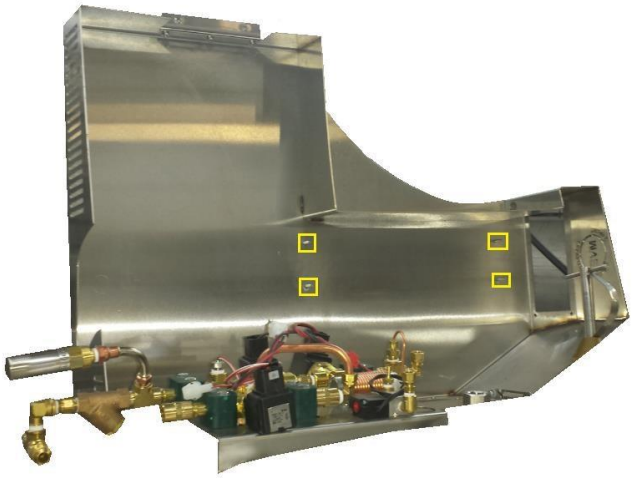
8.2.15.5. HEco 1800 Series

3.3.1. The battery backup will be placed on the 4 studs already located on the freezer. These are located on the side of the workstation platform.

3.3.1.1. Open the workstation platform. First, loosen the Phillips head screws that fasten it to the freezer.

Phillips Head Screws to Remove

3.3.1.2. Locate the mounting location for installing the battery backup. It will mount to the studs shown below.



Mounting Location for the HEco 1800 Series

3.3.1.3. Remove nuts from studs.
3.3.1.4. Place the battery backup on the bolts with the washers between the battery backup and the platform. Position the battery backup with the pigtail facing towards the front of the freezer. Note: The battery backup is capable of being positioned with the pigtail facing forwards or backwards. It is recommended that the pigtail faces forward so the batteries inside the housing remain in an upright position.
3.3.1.5. Fasten nuts to studs. This will secure the battery backup to the workstation on the freezer.

3.4. Verify that the Chart MVE TS Controller will power on using the AC Power Supply only. **NOTE:** Do not connect the battery backup to the main wire harness until the AC Power Supply has been verified to power up the controller.

3.5. Connect the battery backup to the proper connector on the Chart MVE TS Wiring Harness.

Battery Backup Connector. [Black – From the Battery Backup. Dark Blue/Orange – From the Chart MVE TS Wiring Harness]

8.2.16. HEco MVE TS (Back and Front Panel) Replacement

Back Panel

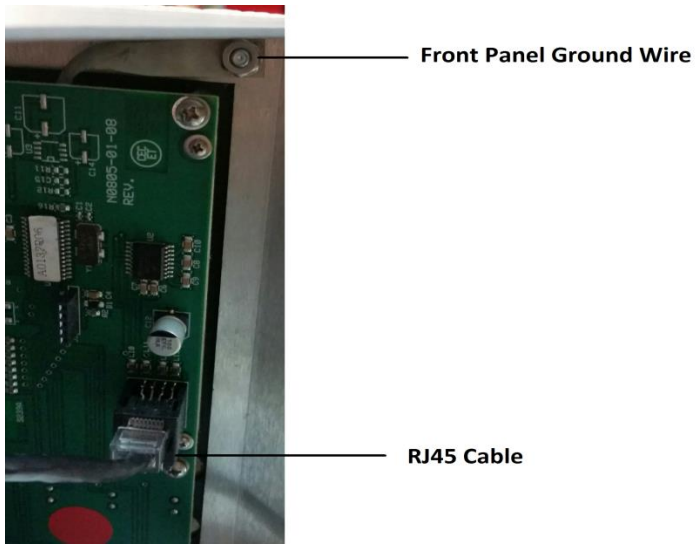
1. Disconnect the AC power cord from the back panel.
2. Open the working platform.
3. Disconnect the wiring harness from the plumbing connection interface.
4. Disconnect Temp A and Temp B probes along with the power input cable from the back panel.
5. Disconnect RJ45 cable from the front panel.
6. Remove 4 phillips head screws from the faceplate of the back panel

*Note: The power supply connection port will be grounded to one of the phillips head screws.

7. Remove the clear vinyl tubing from the back panel.
8. Gently remove the back panel from the working platform.
9. To install a new back panel, repeat steps 1-8 in reverse order; ensuring that the power supply is grounded properly.

Front Panel

1. Disconnect the AC power cord from the back panel.
2. Open the working platform.
3. Disconnect the wiring harness from the plumbing connection interface.
4. Disconnect RJ45 cable from the front panel.
5. Disconnect the front panel ground wire from the working platform and remove the 4 phillips head screws.



6. Gently remove the front panel.
7. To install a new front panel, repeat steps 1-6 in reverse order, ensuring that the front panel is grounded properly.

8.3. Replacement Parts and Accessories

Replacement Parts	
Part Number	**Description**
11648945	Inline Filter – 40 micron mesh
1810032	Relief Valve – 50 PSI (3.4 bar)
14224611S	SMC Solenoid Valve – Fill and Gas Bypass
13390992	Alcon Solenoid Valve Refurb Kit – Includes plunger, plunger housing, spring, and seals
13284954S	Purge/3-way Solenoid Valve
10713400	Gas Bypass Temperature Sensor – Pt-1000 RTD
11499812	Gas Bypass Muffler
11885449	Gas Bypass Muffler Deflector
10713354	Temperature Probe – 96 inch (2438 mm)
10713418	Temperature Probe – 44 inch (1118 mm)
14248744	HE Series 3-Tube Temperature Sensor Assembly – 26 inch (660 mm)
14248816	HE Series 3-Tube Temperature Sensor Assembly – 39 inch (990 mm)
14248752	HE Series 3-Tube Temperature Sensor Assembly – 44 inch (1118 mm)
20965617	Jerome Power Supply – Input: 110-230 VAC; Output: 30 VDC (2 AMP)
14010103	Power Outlet Cord – 110 VAC (The Americas)
10995363	Power Outlet Cord – 230 VAC (Europe)
11858467	Battery Backup Fuse – 4A 250V
20965615	Chart MVE TS Controller
21086734	Chart MVE Touch Screen Controller Cabinet Back Panel
21079369	Chart MVE Touch Screen Controller Cabinet LCD Display
Accessories	
Part Number	**Description**
10883361	MVE LN2 Level Meter Stick
13376947	TEC COM USB Kit – TEC 2000/3000 – PC interface kit
10856321	Daisy Chain Kit – Network TEC 2000/3000 – One network cable and splitter
10740053	RJ-45 Network Cable
10856312	RJ-45 Jack Splitter
11358251	OFAF Master Cable
10784443	Fill Valve Tee Assembly – Tee two freezer to one LN2 supply connection
1611592	Relief Valve Pipe Away Adapter – 3/8 inch NPT Outlet
1810092	Relief Valve Pipe Away Adapter – ½ inch NPT Outlet
13051579	Cool Reach Cryogenic Claw
9713159	LN2 Transfer Hose – 4 ft (1220 mm), ½ inch (12.7 mm) ODT
9713109	LN2 Transfer Hose – 6 ft (1829 mm), ½ inch (12.7 mm) ODT
1110862	LN2 Transfer Hose Coupler – Daisy chain two transfer hoses
11544943	Printer Kit – Includes serial printer and cables
9717119	Cryo Gloves – Size: Medium; Length: Mid-arm
9717129	Cryo Gloves – Size: Large; Length: Mid-arm
9717139	Cryo Gloves – Size: X-Large; Length: Mid-arm
9717149	Cryo Gloves – Size: Medium; Length: Elbow
9717159	Cryo Gloves – Size: Large; Length: Elbow
9717169	Cryo Gloves – Size: X-Large; Length: Elbow
10464394	Cryo Apron

9. Troubleshooting Quick Reference

Symptom	Possible Causes	Fixes	Instructions
Freezer not filling	Improperly connected LN2 supply	Verify LN2 connections	Equipment Usage Page 5
	Inadequate LN2 supply volume or pressure	Verify adequate supply	Verify Adequate LN2 Supply Page 160
	Fill solenoid valves not opening	Verify fill solenoid resistance	Solenoid Valve Replacement Page 164
		Check fill solenoid valves for debris	
	Lid switch not engaged	Verify lid switch settings and functionality	Lid Switch Settings Page 70
	Current LN2 level at or above the high level setpoint	Verify current LN2 level and level control settings	Liquid Level Settings Page 55
	Auto Fill disabled	Press Start Fill to verify manual operation. Confirm auto fill settings	Auto Fill Control Page 59
Slow fills or Long fill times	Inadequate LN2 supply	Verify adequate supply	Verify Adequate LN2 Supply Page 160
	Clogged inline filter	Clean/replace inline filter	Inline Filter Replacement Page 163
	Fill solenoid valves not opening all the way	Verify fill solenoid resistance	Solenoid Valve Replacement Page 164
		Check fill solenoid valves for debris	
	Leak in plumbing or LN2 supply connection	Check for leaks	Plumbing Leak Check Page 161
Incorrect temperature readings	Reset to defaults, improperly calibrated or requires recalibration	Recalibrate temperature sensor	Temperature Sensor Calibration Page 117
	Incorrect LN2 saturation temperature for altitude	Verify and adjust LN2 saturation temperature	LN2 Saturation Temperature Page 53
	Faulty temperature probe	Confirm resistance values and replace if necessary	Resistance Table Page 32
Incorrect LN2 level readings	Disconnected clear vinyl tube	Check clear vinyl tube connections and integrity	Plumbing Leak Check Page 161
	Leak in level sensing line	Perform leak test on purge valve, vinyl tube, and fittings	
	Obstruction in level sensing line	Purge level sensing annular line and clear any debris in the bottom of freezer. Complete freezer thaw and moisture removal may be necessary	Complete Freezer Thaw and Moisture Removal Page 170
	Requires calibration	Perform LN2 level calibration	LN2 Level Calibration Page 127
	Insufficient freezer venting	Increase lid gasket vent. Replace gasket/lid if necessary	Lid Gasket Replacement Page 167
Consistent power failure alarms	Non-uniform AC voltage (dirty power)	Install uninterruptable power supply (UPS), Battery Backup, or quality surge protector	
	Transition to generator power		

Short cycle fills	Insufficient freezer venting	Increase lid gasket vent. Replace gasket/lid if necessary	Lid Gasket Replacement Page 167
	Obstruction in level sensing line	Purge level sensing annular line and clear any debris in the bottom of freezer. Complete freezer thaw and moisture removal may be necessary	Complete Freezer Thaw and Moisture Removal Page 170
High liquid usage	Insufficient venting	Increase lid gasket vent. Replace gasket/lid if necessary	Lid Gasket Replacement Page 167
	Introduction/retrieval of racks or samples	Liquid usage value should return to normal as more data is acquired	
	Lid open for extended period of time		
	Inadequate LN2 supply	Verify adequate LN2 supply	Verify Adequate LN2 Supply Page 160
	Obstruction in level sensing line	Purge level sensing annular line and clear any debris in the bottom of freezer. Complete freezer thaw and moisture removal may be necessary	Complete Freezer Thaw and Moisture Removal Page 170
Consistently high and increasing liquid usage	Potential vacuum failure	Contact your authorized MVE Distributor or Technical Service	

10. EN Compliance Tables

Table 1: Guidance and manufacturer's declaration – electromagnetic emissions for all Chart MVE TS's (See 5.2.2.1 C).

Guidance and Manufacturer's Declaration - Electromagnetic Emissions		
The Chart MVE TS is intended for use in the electromagnetic environment specified below. The customer or the user of the Chart MVE TS should assure that it is used in such an environment.		
Emissions Test	Compliance	Electromagnetic Environment – Guidance
RF emissions CISPR 11	Group 1	The Chart MVE TS uses RF energy only for its internal functions. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class A	The Chart MVE TS is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations / Flicker emissions IEC 61000-3-3	Complies	

Table 2: Guidance and manufacturer's declaration – electromagnetic immunity – for all Chart MVE TS's (See 5.2.2.1 F)

Guidance and Manufacturer's Declaration – Electromagnetic Immunity			
The Chart MVE TS is intended for use in the electromagnetic environment specified below. The customer or the user of the Chart MVE TS should assure that it is used in such an environment.			
Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment – guidance
Electromagnetic Discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±6 kV contact ±8 kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/output lines	±2 kV for power supply lines ±1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV line(s) to line(s) ±2 kV line(s) to earth	±1 kV line(s) to line(s) ±2 kV line(s) to earth	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5% UT (>95% dip in UT) For 0,5 cycle 40% UT (60% dip in UT) For 5 cycles 70% UT (30% dip in UT) For 25 cycles <5% UT (>95% dip in UT) For 5 seconds	<5% UT (>95% dip in UT) For 0,5 cycle 40% UT (60% dip in UT) For 5 cycles 70% UT (30% dip in UT) For 25 cycles <5% UT (>95% dip in UT) For 5 seconds	Mains power quality should be that of a typical commercial or hospital environment. If the user of the Chart MVE TS requires continued operation during power mains interruptions, it is recommended that the Chart MVE TS be powered by an uninterruptible power supply or battery.
Power frequency (50/60 Hz) Magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE: U_T is the AC mains voltage prior to application of the test level			

Table 3: Guidance and manufacturer's declaration – electromagnetic immunity – for all Chart MVE TS's (See 5.2.2.2).

Guidance and Manufacturer's Declaration – Electromagnetic Immunity			
The Chart MVE TS is intended for use in the electromagnetic environment specified below. The customer or the user of the Chart MVE TS should assure that it is used in such an environment.			
Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment – guidance
Conducted RF IEC 61000-4-6 Radiated RF IEC 61000-4-3	3 Vrms 150 kHz to 80 MHz 3 V/m 80 MHz to 2,5 GHz	3 V_{rms} 3 V/m	Portable and mobile RF communications equipment should be used no closer to any part of the Chart MVE TS including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance $d = 1,2\sqrt{P}$ $d = 1,2\sqrt{P}$ $d = 2,3\sqrt{P}$ where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m). Field strengths from fixed RF transmitter as determined by an electromagnetic site survey[a], should be less than the compliance level in each frequency range[b]. Interference may occur in the vicinity of equipment marked with the following symbol:

NOTE 1: At 80 MHz and 800 MHz the higher frequency range applies

NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

[a] Field strengths from fixed transmitters such a s base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM, and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the Chart MVE TS is used exceeds the applicable RF compliance level above, the Chart MVE TS should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the Chart MVE TS.

[b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Table 4: Recommended separation distances between portable and mobile RF communications equipment and the Chart MVE TS – for Chart MVE TS systems that are not life supporting (See 5.2.2.2).

Recommended separation distances between portable and mobile RF communications equipment and the Chart MVE TS			
The Chart MVE TS is intended for use in the electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the Chart MVE TS can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the Chart MVE TS as recommended below, according to the maximum output power of the communications equipment.			
Rated maximum output power of transmitter (W)	**Separation distance according to frequency of transmitter (m)**		
	150 kHz to 80 MHz $d = 1,2\sqrt{P}$	80 MHz to 800 MHz $d = 1,2\sqrt{P}$	800 MHz to 2,5 GHz $d = 2,3\sqrt{P}$
0,01	0,12	0,12	0,23
0,1	0,38	0,38	0,73
1	1,2	1,2	2,3
10	3,8	3,8	7,3
100	12	12	23
For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer. NOTE 1: At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.			

NOTE: Medical Electrical Equipment needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided in this manual.

NOTE: Portable and mobile RF communications equipment can affect Medical Electrical Equipment.

NOTE: The use of accessories, transducers and cables other than those specified, with the exception of transducer and cables sold by the manufacturer of this device as replacement parts for internal components, may result in increased emissions or decreased immunity of the Chart MVE TS Controller

NOTE: The Chart MVE TS Controller should not be used adjacent or stacked with other equipment and that if adjacent or stacked use is necessary, the Chart MVE TS Controller should be observed to verify normal operation in the configuration in which it will be used.

DISPOSAL OF PRODUCT:

Stainless Steel Freezer:
Freezers used to store biological materials require decontamination prior to disposal. Contact CHART
MVE for decontamination information or reference page 147.

Chart MVE TS Controller:
Local or national environmental laws and regulations may prohibit disposal of electrical and/or electronic equipment such as the Chart MVE TS controller. Contact the local city or town offices for instructions on proper disposal of electrical or electronic equipment. Alternately, CHART MVE may be contacted for disposal information.

11. Appendix

11.1. Reference Tables

Temperature vs. Resistance Output (ohms) for Pt-1000 Temperature Sensors

Temp°C	-0	-1	-2	-3	-4	-5	-6	-7	-8	-9
-200	185.201									
-190	228.255	223.965	219.672	215.376	211.076	206.772	202.465	198.154	193.840	189.522
-180	270.964	266.708	262.449	258.186	253.920	249.651	245.379	241.103	236.824	232.541
-170	313.350	309.126	304.898	300.667	296.434	292.197	287.956	283.713	279.467	275.217
-160	355.433	351.238	347.040	342.839	338.635	334.429	330.219	326.006	321.791	317.572
-150	397.232	393.064	388.894	384.721	380.545	376.367	372.186	368.002	363.815	359.626
-140	438.764	434.622	430.478	426.331	422.182	418.030	413.876	409.719	405.559	401.397
-130	480.048	475.930	471.810	467.688	463.563	459.436	455.307	451.175	447.040	442.904
-120	521.098	517.003	512.906	508.806	504.705	500.601	496.495	492.386	488.276	484.163
-110	561.930	557.856	553.780	549.702	545.622	541.540	537.456	533.370	529.281	525.191
-100	602.558	598.504	594.448	590.391	586.331	582.269	578.205	574.139	570.072	566.002
-90	642.996	638.960	634.923	630.884	626.843	622.800	618.756	614.709	610.661	606.611
-80	683.254	679.236	675.217	671.195	667.172	663.147	659.120	655.092	651.062	647.030
-70	723.345	719.344	715.340	711.335	707.328	703.320	699.310	695.299	691.286	687.271
-60	763.278	759.292	755.304	751.315	747.324	743.331	739.337	735.341	731.344	727.346
-50	803.063	799.091	795.117	791.143	787.166	783.189	779.210	775.229	771.247	767.263
-40	842.707	838.748	834.789	830.828	826.865	822.902	818.937	814.970	811.003	807.033
-30	882.217	878.271	874.325	870.377	866.428	862.478	858.526	854.573	850.619	846.663
-20	921.599	917.666	913.732	909.797	905.861	901.923	897.985	894.044	890.103	886.160
-10	960.859	956.938	953.016	949.093	945.169	941.244	937.317	933.390	929.461	925.530
0	1000.00	996.091	992.181	988.270	984.358	980.444	976.529	972.613	968.696	964.778
	+0	**+1**	**+2**	**+3**	**+4**	**+5**	**+6**	**+7**	**+8**	**+9**
0	1000.00	1003.91	1007.81	1011.72	1015.62	1019.53	1023.43	1027.33	1031.23	1035.13
10	1039.03	1042.92	1046.82	1050.71	1054.60	1058.49	1062.38	1066.27	1070.16	1074.05
20	1077.94	1081.82	1085.70	1089.59	1093.47	1097.35	1101.23	1105.10	1108.98	1112.86
30	1116.73	1120.60	1124.47	1128.35	1132.21	1136.08	1139.95	1143.82	1147.68	1151.55
40	1155.41	1159.27	1163.13	1166.99	1170.85	1174.70	1178.56	1182.41	1186.27	1190.12
50	1193.97	1197.82	1201.67	1205.52	1209.36	1213.21	1217.05	1220.90	1224.74	1228.58
60	1232.42	1236.26	1240.09	1243.93	1247.77	1251.60	1255.43	1259.26	1263.09	1266.92
70	1270.75	1274.58	1278.40	1282.23	1286.05	1289.87	1293.70	1297.52	1301.33	1305.15
80	1308.97	1312.78	1316.60	1320.41	1324.22	1328.03	1331.84	1335.65	1339.46	1343.26
90	1347.07	1350.87	1354.68	1358.48	1362.28	1366.08	1369.87	1373.67	1377.47	1381.26

11.2. LN2 Volume per Inch of Liquid in MVE Freezers

NOTE: The below values are accurate for the cylindrical portion of the freezer and do not take into account inventory components that will displace LN2.

Freezer Model	Inches	Liters
MVE 205	1	3.3
MVE 510	1	5.5
MVE 616 / 616C	1	8.1
MVE 1426 / 1426C	1	13.0
MVE 1839	1	20.0
MVE 808	1	10.3
MVE 816P-2T-190	1	10.1
MVE 1318	1	20.2
MVE 1842P-150	1	40.8
MVE 1877P-2T-150	1	40.8
MVE 815P-150	1	10.1
MVE 815P-190	1	10.1
MVE 818P-190	1	10.1
MVE 819P-190	1	10.1
MVE 1536P-150	1	19.3
MVE 1536P-190	1	19.3
MVE 1539P-190	1	19.3
MVE 1879P-150	1	40.8
MVE 1879P-190	1	40.8
MVE 1892P-190	1	40.8
MVE 1539R-150	1	19.3
MVE 1542R-150	1	19.3
MVE 1542R-190	1	19.3
MVE 1881R-150	1	38.9
MVE 1881R-190	1	38.9
MVE 1894R-150	1	38.9
MVE 1894R-190	1	38.9

11.3. Chart MVE TS ASCII Interface

American Standard Code for Information Interchange (ASCII) is a standard code used in data transmission, in which 128 numerals, letters, symbols, and special control codes are represented by a 7-bit binary number. Below is a chart for these binary codes.

USASCII code chart

Bits b_7 b_6 b_5 →	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
b_4 b_3 b_2 b_1 ↓ Row / Column →	0	1	2	3	4	5	6	7
0 0 0 0	0	NUL	DLE	SP	0	@	P	`	p
0 0 0 1	1	SOH	DC1	!	1	A	Q	a	q
0 0 1 0	2	STX	DC2	"	2	B	R	b	r
0 0 1 1	3	ETX	DC3	#	3	C	S	c	s
0 1 0 0	4	EOT	DC4	$	4	D	T	d	t
0 1 0 1	5	ENQ	NAK	%	5	E	U	e	u
0 1 1 0	6	ACK	SYN	&	6	F	V	f	v
0 1 1 1	7	BEL	ETB	'	7	G	W	g	w
1 0 0 0	8	BS	CAN	(	8	H	X	h	x
1 0 0 1	9	HT	EM	)	9	I	Y	i	y
1 0 1 0	10	LF	SUB	*	:	J	Z	j	z
1 0 1 1	11	VT	ESC	+	;	K	[	k	{
1 1 0 0	12	FF	FS	,	<	L	\	l	|
1 1 0 1	13	CR	GS	-	=	M	]	m	}
1 1 1 0	14	SO	RS	.	>	N	^	n	~
1 1 1 1	15	SI	US	/	?	O	_	o	DEL

Chart MVE TS ASCII Command List

Control Commands

***IDN?** Identification Query
Input: *IDN?
Returned: MVE Chart MVE TS, Software ver. X.XX
Comments: Used to query the controller ID. Command must include "*" preface. Returns controller model and firmware version.

ALMS Set Alarm Status
Input: ALMS 0 or ALMS 1
Returned: No response
Comments: Used to set the audible alarm status where 0 = Off and 1 = On. Has same function as the Alarm Mute key.

ALMS? Alarm Status Query
Input: ALMS?
Returned: 0 or 1
Comments: Used to query the current audible alarm status where 0 = Off and 1 = On.

CALTA Calibrate Temp A in LN2 (Single Point)
Input: CALTA
Returned: No response
Comments: Used to perform a single point calibration of Temp A. Temp A sensor must be submerged in LN2. See the Temperature Calibration section of this manual.

CALTB Calibrate Temp B in LN2 (Single Point)
Input: CALTB
Returned: No response
Comments: Used to perform a single point calibration of Temp B. Temp B sensor must be submerged in LN2. See the Temperature Calibration Section of this manual.

CALVL Set Level Offset
Input: CALVL ±XXX.X
Returned: No response
Comments: Used to set the liquid level offset.

CALVL? Level Offset Query
Input: CALVL?
Returned: ±XXX.X
Comments: Used to query the current level offset value.

CODE? Global Password Query
Input: CODE?
Returned: XXXX
Comments: Used to query the current global password.

HITSTA Temp A High Alarm Test
Input: HITSTA
Returned: No response
Comments: Used to initiate the High Temp A Alarm Test. See the High Temperature Alarm Test section for more information.

HITSTB Temp B High Alarm Test
Input: HITSTB
Returned: No response
Comments: Used to initiate the High Temp B Alarm Test. See the High Temperature Alarm Test section for more information.

INITEE Restore All Defaults
Input: INITEE
Returned: No response
Comments: Used to restore all factory default settings.

LNSATP? LN2 Saturation Temperature Query
Input: LNSATP?
Returned: ±XXX.X
Comments: Used to query the LN2 saturation temperature for single point calibration reference point.

LNSATP Set LN2 Saturation Temperature
Input: LNSATP ±XXX.X
Returned: No response
Comments: Used to set the LN2 saturation temperature for single point calibration reference point.

Temperature Commands

BPTMP? Bypass Temp Query
Input: BPTMP?
Returned: ±XXX.X
Comments: Used to query the current bypass temp sensor reading.

HITA Set Temp A High Alarm
Input: HITA ±XXX.X
Returned: No response
Comments: Used to set the Temp A High Alarm value.

HITA? Temp A High Alarm Query
Input: HITA?
Returned: ±XXX.X
Comments: Used to query the current Temp A High Alarm value

HITAS? Temp A High Alarm Status Query
Input: HITAS?
Returned: 0 or 1
Comments: Used to query the Temp A High Alarm status where 0 = Off and 1 = On.

HITAM Set Temp A High Alarm Mask
Input: HITAM 0 or HITAM 1
Returned: No response
Comments: Used to enable or disable the Temp A High Alarm where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

HITAM? Temp A High Alarm Mask Query
Input: HITAM?
Returned: 0 or 1
Comments: Used to query the Temp A High Alarm Mask status where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

HITB Set Temp B High Alarm
Input: HITB ±XXX.X
Returned: No response
Comments: Used to set the Temp B High Alarm value.

HITB? Temp B High Alarm Query
Input: HITB?
Returned: ±XXX.X
Comments: Used to query the current Temp B High Alarm value

HITBS? Temp B High Alarm Status Query
Input: HITBS?
Returned: 0 or 1
Comments: Used to query the Temp B High Alarm status where 0 = Off and 1 = On.

HITBM Set Temp B High Alarm Mask
Input: HITBM 0 or HITBM 1
Returned: No response
Comments: Used to enable or disable the Temp B High Alarm where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

HITBM? Temp B High Alarm Mask Query
Input: HITBM?
Returned: 0 or 1
Comments: Used to query the Temp B High Alarm Mask status where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

LOTA Set Temp A Low Alarm
Input: LOTA ±XXX.X
Returned: No response
Comments: Used to set the Temp A Low Alarm value.

LOTA? Temp A Low Alarm Query
Input: LOTA?
Returned: ±XXX.X
Comments: Used to query the Temp A Low Alarm value.

LOTAS? Temp A Low Alarm Status Query
Input: LOTAS?
Returned: 0 or 1
Comments: Used to query the Temp A Low Alarm status where 0 = off and 1 = on.

LOTAM Set Temp A Low Alarm Mask
Input: LOTAM 0 or LOTAM 1
Returned: No response
Comments: Used to enable or disable the Temp A Low Alarm where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

LOTAM? Temp A Low Alarm Mask Query
Input: LOTAM?
Returned: 0 or 1
Comments: Used to query the Temp A Low Alarm Mask status where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

LOTB Set Temp B Low Alarm
Input: LOTB ±XXX.X
Returned: No response
Comments: Used to set the Temp B Low Alarm value.

LOTB? Temp B Low Alarm Query
Input: LOTB?
Returned: ±XXX.X
Comments: Used to query the Temp B Low Alarm value.

LOTBS? Temp B Low Alarm Status Query
Input: LOTBS?
Returned: 0 or 1
Comments: Used to query the Temp B Low Alarm status where 0 = off and 1 = on.

LOTBM Set Temp B Low Alarm Mask
Input: LOTBM 0 or LOTBM 1
Returned: No response
Comments: Used to enable or disable the Temp B Low Alarm where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

LOTBM? Temp B Low Alarm Mask Query
Input: LOTBM?
Returned: 0 or 1
Comments: Used to query the Temp B Low Alarm Mask status where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

TEMPA? Temp A Current Data Query
Input: TEMPA?
Returned: ±XXX.X
Comments: Used to query the current Temp A sensor reading.

TEMPB? Temp B Current Data Query
Input: TEMPB?
Returned: ±XXX.X
Comments: Used to query the current Temp B sensor reading.

TUNI Set Temp Units
Input: TUNI C, TUNI F, or TUNI K
Returned: No response
Comments: Used to set the Temp units where C = Celsius, F = Fahrenheit, and K = Kelvin. Default setting is degrees Celsius.

TUNI? Temp Units Query
Input: TUNI?
Returned: C, F, or K
Comments: Used to query the Temp units where C = Celsius, F = Fahrenheit, and K = Kelvin. Default setting is degrees Celsius.

Level Commands

BPFIL? Bypass Status Query
Input: BPFIL?
Returned: 0 or 1
Comments: Used to query the current hot gas bypass status where 0 = not bypassing and 1 = bypassing.

FILAS? Fill Time Alarm Status Query
Input: FILAS?
Returned: 0 or 1
Comments: Used to query the Fill Time Alarm Status where 0 = off and 1 = on.

FILL Set Fill Status
Input: FILL 0 or FILL 1
Returned: No response
Comments: Used to set the current Fill Status where 0 = Stop Fill and 1 = Start Fill

FILL? Fill Status Query
Input: FILL?
Returned: 0 or 1
Comments: Used to query the current Fill Status where 0 = not filling and 1 = filling.

FILLM? Auto Fill Status Query
Input: FILLM?
Returned: 0 or 1
Comments: Used to query the Auto Fill Status where 0 = disabled and 1 = enabled.

FILT Set Max Fill Time
Input: FILT XXX
Returned: No response
Comments: Used to set the maximum fill time in minutes from 30 to 240 minutes.

FILT? Max Fill Time Query
Input: FILT?
Returned: XXX
Comments: Used to query the maximum fill time. Value returned in minutes.

FILTIM? Fill Duration Query
Input: FILTIM?
Returned: XXX
Comments: Used to query the duration of the current fill. Value returned in seconds.

HFIL Set High Level Setpoint
Input: HFIL XXX.X
Returned: No response
Comments: Used to set the High Level Setpoint. Input value uses the current level units, either inches or millimeters. There must be at least a 0.5 inch interval between each level setting and alarm.

HFIL? High Level Setpoint Query
Input: HFIL?
Returned: XXX.X
Comments: Used to query the High Level Setpoint. Value returned in either inches or millimeters depending on the current level units. There must be at least a 0.5 inch interval between each level setting and alarm.

HILA Set High Level Alarm
Input: HILA XXX.X
Returned: No response
Comments: Used to set the High Level Alarm value. Input value uses the current level units, either inches or millimeters. There must be at least a 0.5 inch interval between each level setting and alarm.

HILA? High Level Alarm Query
Input: HILA?
Returned: XXX.X
Comments: Used to query the High Level Alarm value. Value returned in either inches or millimeters depending on the current level units. There must be at least a 0.5 inch interval between each level setting and alarm.

HILS? High Level Alarm Status Query
Input: HILS?
Returned: 0 or 1
Comments: Used to query the High Level Alarm Status where 0 = off and 1 = on.

HILM Set High Level Alarm Mask
Input: HILM 0 or HILM 1
Returned: No response
Comments: Used to enable or disable the High Level Alarm where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

HILM? High Level Alarm Mask Query
Input: HILM?
Returned: 0 or 1
Comments: Used to query the High Level Alarm Mask status where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

LEVL? Current LN2 Level Query
Input: LEVEL?
Returned: XXX.X
Comments: Used to query the current LN2 Level reading.

LFIL Set Low Level Setpoint
Input: LFIL XXX.X
Returned: No response
Comments: Used to set the Low Level Setpoint. Input value uses the current level units, either inches or millimeters. There must be at least a 0.5 inch interval between each level setting and alarm.

LFIL? Low Level Setpoint Query
Input: LFIL?
Returned: XXX.X
Comments: Used to query the Low Level Setpoint. Value returned in either inches or millimeters depending on the current level units. There must be at least a 0.5 inch interval between each level setting and alarm.

LOLA Set Low Level Alarm
Input: LOLA XXX.X
Returned: No response
Comments: Used to set the Low Level Alarm value. Input value uses the current level units, either inches or millimeters. There must be at least a 0.5 inch interval between each level setting and alarm.

LOLA? Low Level Alarm Query
Input: LOLA?
Returned: XXX.X
Comments: Used to query the Low Level Alarm value. Value returned in either inches or millimeters. There must be at least a 0.5 inch interval between each level setting and alarm.

LOLS? Low Level Alarm Status Query
Input: LOLS?
Returned: 0 or 1
Comments: Used to query the Low Level Alarm Status where 0 = off and 1 = on.

LOLM Set Low Level Alarm Mask
Input: LOLM 0 or LOLM 1
Returned: No response
Comments: Used to enable or disable the Low Level Alarm where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

LOLM? Low Level Alarm Mask Query
Input: LOLM?
Returned: 0 or 1
Comments: Used to query the Low Level Alarm Mask status where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

LUNI Set Level Units
Input: LUNI E, LUNI M, or LUNI
Returned: No response
Comments: Used to set the LN2 level units where E = English (inches), M = Metric (millimeters)

LUNI? Level Units Query
Input: LUNI?
Returned: E or M
Comments: Used to query the current LN2 level units E = English (inches), M = Metric (millimeters)

RATE? Current Liquid Usage Query
Input: RATE?
Returned: XXX.X
Comments: Used to query the current LN2 liquid usage rate.

Event Log Commands

CLEVLG Clear the Event Log
Input: CLEVLG
Returned: No response
Comments: Used to clear all data from the event log. Data will be permanently lost when the event log is cleared.

DATE Set the Date
Input: mm/dd/yy
Returned: No response
Comments: Used to set the current date in the format: mm/dd/yy (month/day/year).

DATE? Date Query
Input: DATE?
Returned: mm/dd/yy
Comments: Used to query the current date.

EVENT? Last Event Query
Input: EVENT?
Returned: XXXXX, MM/DD/YY, HH:MM, XXX.X, XXX.X, XXX.X, XXX.X
Comments: String returned: Date, Time, TempA, Temp B, LN2 Level, Liquid Usage, Event Codes

EVNCT? Event Log Count Query
Input: EVNCT?
Returned: XXXXX
Comments: Used to query the number of event log records.

EVNLOG? Event Log Record Query
Input: EVNLOG? N
Returned: XXXXX, MM/DD/YY, HH:MM, XXX.X, XXX.X, XXX.X, XXX.X
Comments: Used to query Event Record [n] where n = record number. String returned: Date, Time, TempA, Temp B, LN2 Level, Liquid Usage, Event Codes.

LOGPER Set Event Log Interval
Input: LOGPER XXX
Returned: No response
Comments: Used to set the event log interval between 1 and 240 minutes. Default setting is 240 minutes.

LOGPER? Event Log Interval Query
Input: LOGPER?
Returned: XXX
Comments: Used to query the current event log interval.

TIME Set the Time
Input: hh:mm:ss
Returned: No response
Comments: Used to set the controller Time in the format hh:mm:ss (hour:minute:second).

TIME? Time Query
Input: TIME?
Returned: hh:mm:ss
Comments: Used to query the current time.

UNID Set Unit ID
Input: UNID XXXXX
Returned: No response
Comments: Used to set the controller 5-digit Unit ID. Chart MVE TS Unit ID should be between 1 and 200.

UNID? Unit ID Query
Input: UNID?
Returned: XXXXX
Comments: Used to query the controller Unit ID.

11.4. Santizing and Decontaminating Chart Alumninum and Stainless Steel Products

MVE aluminum dewars are constructed with an aluminum inner, which utilizes a fiberglass neck support. The stainless units are constructed with an inner entirely fabricated from stainless steel sheets. Any cleaning solution that does not react with aluminum or stainless can be used in the sanitation process of these dewars. In most cases, any household detergent or mild soap solution is suitable. The U.S. Custom Service uses a solution called EXPOR for incoming shipments from abroad. This is mixed 9 parts water mixed with sodium chloride & lactic acid. As mentioned above, however, any household cleaning solution can be used. These include bleach, detergents, and mild soaps. Other cleaners and disinfectants that can be safely used include hydrogen peroxide, chlorine/water and denatured alcohol. NOTE: ***DO NOT USE ANY PETROLEUM BASED CLEANING SOLUTION***. It is important that the inner vessel is thoroughly rinsed with water and all cleaner residues have been removed. Spraying the solution into the inner vessel is preferred, although agitation of the solution inside the inner will suffice. Vapor shippers and Doble units will require filling the inner to its full capacity with cleaning mixture and then rinsing. Allow the unit to dry thoroughly before putting into service. With vapor shippers, we suggest setting dewar inverted to drain and dry. The process is not intended for use in older vapor shipper models manufactured prior to 1994. The generally accepted practice of using 10% chlorine bleach with 90% water solution still holds as the best method for decontamination. However, with some of the bovine and swine virus strains showing up today, it is the conclusion of the agricultural professors at the University of Minnesota and Texas A & M that an increased mixture of chlorine bleach to 30% and 70% water will kill all known viruses except BSE. To perform this sanitizing procedure, cover all inner surfaces with the solution, let stand for 30 minutes and remove. Rinse the decontaminated surfaces with clean water and remove rinse water. Allow dewar to dry before putting into service. For vapor shippers and Doble units, this means to place dewar on end (inverted) and allow drying. Note: Vapor dewars can be used immediately after rinsing but may take longer to recharge to 100% capacity If you have any questions concerning decontaminating dewar please contact Bio-Medical Technical Service.

Notes:

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