

Mainstream Engineering Corporation

5-Ton Modular Lightweight Field-Deployable Environmental Control Unit (MECU)



Mainstream's MECU is designed to provide cooling, heating or ventilation of the Tent Extendable Modular Personnel (TEMPER), Modular General Purpose Tent System (MGPTS) and CP EMEDS shelter. A single MECU has sufficient capacity to provide thermal control of shelters as large as 1,000 square feet with ambient temperatures as high as 125°F. The MECU allows for air plenum configuration and installation requirements, without bends in the supply and return ducts. The MECU has been designed to replace both the FDECU and the LECU, with a smaller cube, improved performance, reduced weight, improved power-factor and improved maintenance/reliability. It has also been designed to exploit all the benefits of using high-efficiency, environmentally-safe Puron® Refrigerant (HFC-410A).

The MECU meets or exceeds all the requirements for Military shelter heating and cooling, and is compatible with current NBC protection equipment.

Physical Specifications

Dimensions:

Length..... X=52 inches
Width..... Y=42 inches
Height..... Z=32 inches
Cubic Volume..... 40.4 cu. ft.
Weight..... 564 lbs.

Center of Gravity: Measured from Front, Left, Bottom Corner of MECU

X.....27.4 inches
Y.....25.0 inches
Z..... 16.4 inches

Electrical Specifications:

Voltage..... 208VAC, 3-Phase, 50-60 Hz, 4 Pole,
5 Wire WYE Connection
Running Amperage..... 19.3 amps per phase
Required Power..... 7 kW
In Rush Current..... 56.2 amps for 1 millisecond

Motor Specifications:

Compressor Motor8 hp
Condenser Fan Motor.....1/4 hp
Evaporator Fan Motor.....2 hp

Refrigeration Specifications:

Refrigerant.....R-410A (Puron)
Refrigerant Capacity.....15 lbs

Summary of Performance Data

Cooling capacity, free air delivery at 3" wg:

60,000 Btu/hr @ 125°F db ambient temperature
with evaporator inlet temperature of 90°F db, 75°F
wb.

Heating capacity, free air delivery at 3" wg:

First Stage 6kW (< 5°F from set point)
Second Stage 12kW (> 5°F from set point)

Modes of operation

The ECU operates in either NBC or non-NBC mode without any degradation in performance. The MECU is compatible with the same NBC hardening kit utilized with the current FDECU's. The MECU has been configured to allow decontamination solutions to drain from the unit and thus simplify decontamination. The MECU is NBC contamination and decontamination survivable. Components required for mission essential functions are hardened to ensure that no degradation of protection will occur due to NBC contaminants, decontaminates, and standard decontaminating procedures.

Compatibility with Filtration Units

The Mainstream ECU can operate with either the FFA 400 filtration unit (400 cfm) or the M28 motor blower units (normally two are used each providing 200 cfm). There are three MS3474W14-S connectors that each supply single phase 110V to the external blowers or 208V three phase through a combination of the connectors.

Electrical Performance

The MECU requires a 208VAC, 50/60Hz, 4-pole, 5-wire, wye electrical power source. This power is supplied to the unit through a Mainstream provided power cable terminating in a MS90558C32412P connector. The MECU requires 19.3 Amps per phase @208VAC and was designed to operate with a powerfactor of 0.95 (using capacitive power factor correction), requiring 7 kW. The MECU requires an in-rush current of 56.2 Amps for 1 millisecond.

Inclined Operation

The MECU will operate on a 10 degree angle.

Refrigerant

The MECU uses R-410A (Puron) which is a new environmentally friendly refrigerant.

Controls

To simplify troubleshooting and maintenance, the Mainstream MECU utilizes commercially-available modular relay-based controls. All heating, air conditioning, and ventilation control relays were selected to be identical so that field swap-out of these relays would be possible. All wiring is clearly labeled, and all wiring harness are straightforward plug and play, thereby requiring no complex connections, soldering, or assembly. Since the electrical control package has the test points localized into a single location and uses no complex electronics, computer chips, or logic circuits, the entire electrical control package can be quickly and easily tested with only common maintenance tools such as a multi-meter and screw drivers. The wiring harness can actually be changed in the field, without any hand tools except a screw driver to remove the access panels.

Refrigeration System

The MECU refrigeration system is designed to be easily serviceable. All components are easily accessible. All plumbing runs are terminated with RotaLock® fittings allowing components to be changed without any brazing. A spin-off filter cartridge, means refrigerant filter-dryer changes can be performed quickly and without opening the system, they can even be performed while the system is operating.

Air filters

Washable and reusable heavy-duty aluminum air filters are used and provided by Mainstream. These filters are treated with a filter-enhancing spray electrostatic coating to increase dust collection effectiveness.

Compressor

The Mainstream MECU utilizes a nominal 5-ton Copeland 410A scroll compressor model ZP54K3E-TF5. This compressor has an internal high-temperature motor protector and internal high-pressure bypass.

Vibration

The ECU can operate without degradation of performance after being subjected to shock and vibration profiles of common military wheeled/tracked vehicles, aircraft, and ships.

Compressor and Condenser Access and Component Storage

A hinged top covers the condenser section of the MECU for easy access. After disengaging the quick connectors, the top can be opened for full access to the storage compartment for the flexible ducts, duct adapters and rings, electrical and remote cables, condensate drain hose, and the fan and duct covers.

Storage Requirements

The Mainstream MECU has a positive means of preventing nesting insects, wasps, vermin, birds, etc. from entering, fouling, or preventing the proper operation of the ECU after storage. All openings to the outside are sealed. The Mainstream MECU is designed for a safe storage of 20 years without any degradation in performance.

Electrical System

All components in the electrical system are UL approved. All wiring is labeled for easy troubleshooting and maintenance. Replaceable wiring harnesses are used throughout.

Safety

The Mainstream MECU contains all the safety controls needed to protect system components and personnel from the hazards normally associated with high voltage electrical service and with packaged ECUs. These controls include low-voltage (24 V) control wiring, high- and low-pressure refrigerant cut-outs, compressor over-current and compressor thermal control cut-outs and overheat protection while in heating mode.

Lift Provisions and Tie-Down

Two 4-inch by 12-inch nominal forklift channels are provided at the bottom of the ECU on 38" centers. These forklift channels are replaceable and have a means for stacking and fastening the ECU during transportation and storage.

Flexible Duct

The return air and supply air passage is equipped with duct rings to attach the Mainstream provided five-foot-long sixteen-inch-diameter flexible ducts. The MECU is compatible with the FDECU NBC adapter ring.

Reliability and Maintainability

Mainstream's MECU has been designed to maximize reliability, availability, and maintainability. Mainstream's MECU has been designed to support a mean-time-between-failure (MTBF) rate of 5202 hours; and a 1-year continuous cyclical operation without critical failure (MTBCF) of 15,761 hours. Mainstream's MECU shall also

provide a 20-year storage life without performance degradation or 20 deployment cycles within its 20-year service life, whichever comes first. Operational availability is at least 95%. The system is capable of being installed in less than 15 minutes by two personnel. The MECU is operable by a soldier outfitted in all levels of Mission Oriented Protective Posture (MOPP) equipment. Mainstream's MECU requires less than 90 minutes Mean Time To Repair (MTTR) including evacuation and recharging using standard, commercial support and test equipment.

Interchangeability and Maintenance

Mainstream has provided a configuration that is modular in design and maximizes the use of interchangeable parts that are easily replaceable at the module level. The MECU is 100% maintainable at the organizational level of maintenance.

Comparison of ECU Configurations

Table 1 contains a comparison of ECU configurations. Information for the FDECU and the A/E32C-39 was obtained from the Field Deployable Environmental Control Unit Qualification Test and Evaluation Final Report, TEAS Reference Number 9700214-60U, Sverdrup Technology Inc., Eglin AFB, March, 1997.

Table 1. A Comparison of ECU Configurations

	HECU Propane Refrigerant	ECU with HFC- 410A Refrigerant	FDECU with HFC-134a Refrigerant*	A/E32C-39 HCFC-22*
Current Draw [amps]	18.4 Amps	19.3 Amps	26 Amps	21.9 Amps
Max Current Draw at Start Up	56.2 Amps	56.2 Amps	170 Amps	Not Available
COP _c 85° F ambient	2.5	2.3	2.0	Not Available
COP Improvement Compared to FDECU	25%	15%	0%	Not Available
Refrigerant Charge [Pounds]	5.5 Lbs.	15.0 Lbs.	14.0 Lbs.	10.0 Lbs.
Operating Pressures [PSIG] @ 125° F/40° F	High: 243 psig Low: 64 psig	High: 448 psig Low: 118 psig	High: 184 psig Low: 35 psig	High: 278 psig Low: 68 psig
Ozone Depletion Potential	0	0	0	0.07
Global Warning Potential	11	1890	1725	1500
Total Weight [Lbs.]	555 Lbs.	564 Lbs.	833 Lbs.	Not Available

*Magnusson, G.J., "Field Deployable Environmental Control Unit Qualification Test and Evaluation Final Report," TEAS Reference Number 9700214-60U, Sverdrup Technology Inc., Eglin AFB, March, 1997.