

**Product Specification
MP-5000**

MP-5000 Panel

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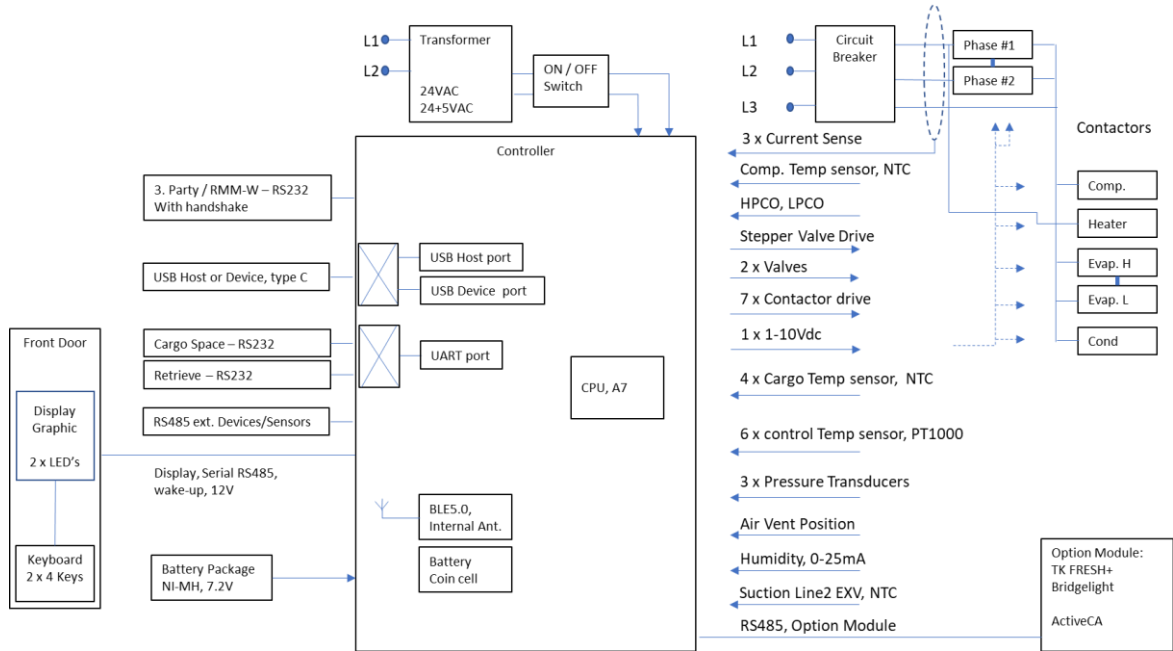
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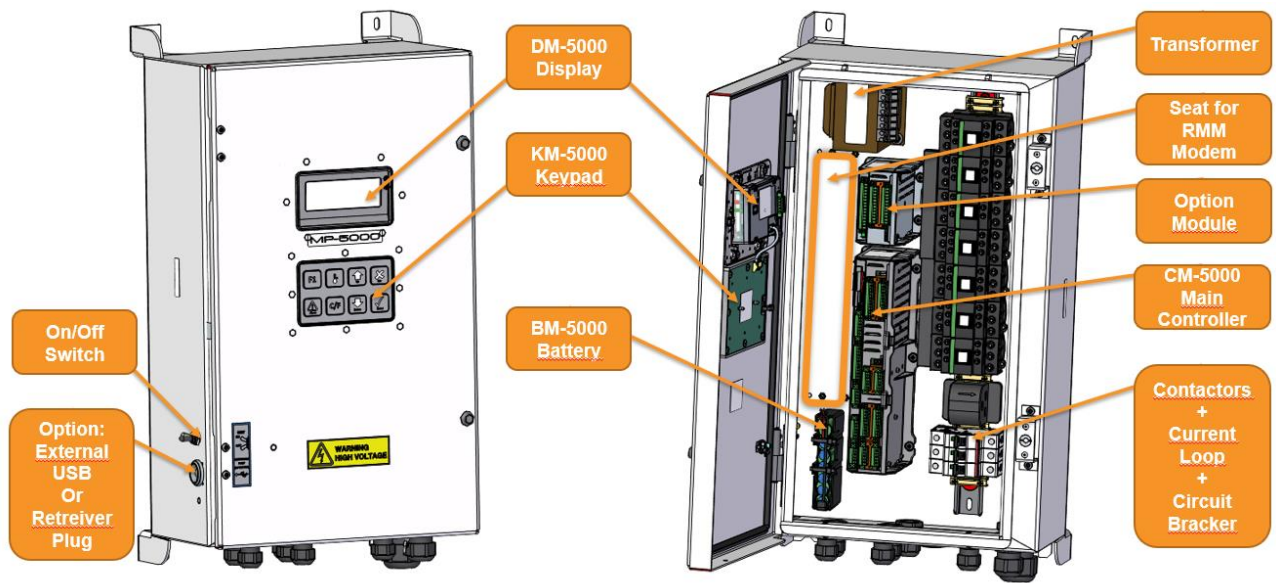
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1 SYSTEM OVERVIEW



The cabinet with

- Panel Side mounted
 - ON / OFF switch
 - Retriever port (USB, Deutch, or Bridgelight (4 pole Canon), option)
- Panel Front / Door mounted
 - Display
 - Keyboard
 - Signal LED's
- Panel Inside mounted
 - Transformer
 - Main Controller
 - Battery Package
 - Main Circuit breaker
 - 3 Current-Loop coils.
 - Contactors for driving the 460VAC components, w/Interlock
 - RS232 extension cable Cargo space
 - Optional
 - Option module for extension possibilities.
 - Copeland Modem and or RMM (ISO 10368 powerline)
 - 3-party modem
 - 3-part exterior power handling. (3-DIN Space)



Concept of the MP5000

2 ENVIRONMENTAL

Operating				
	Min.	Max.	Units	Method of compliance
Ambient temperature, Refrigeration Unit full operation	-30	60	°C	
Ambient temperature, Refrigeration Unit in standby mode. No power consumption.	-30	70	°C	
Relative humidity		95	%	Condensing
Salt mist, internal components	700		hours	According to SWAAT (ASTM G85 A3)
Salt mist, Panel	1500		hours	According to SWAAT (ASTM G85 A3)
Vibration				IEC 61373:1999- Category 1, Class B per Simulated Long-Life Test
Frequency range	2-150Hz			
Total RMS level	1.2			
Duration	100 min per axis			
Shock	5g @ 10ms			According to TKS60002, IEC 61373:1999- Category 1, Class B
UV Resistance ¹				According to TKS 28-020, ASTM G155-05a Cycle 7 ASTM G151-10
IP Rating ²	IP56			IEC529
Component inside Panel	IP20			IEC529

Storage				
	Min.	Max.	Units	Method of compliance
Ambient temperature ³⁴	-40	70	°C	
Relative humidity		95	%	Condensing
Shock	5g @ 10ms			According to 60068-2-27 Ca

¹ Only valid for Front Door, Front foil, and display.

² Testing with drain holes closed

³ The display is only guaranteed down to -30°C, but experience from the field shows that LCD displays can survive in the environment.

⁴ Battery concern

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Transportation Solutions

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3 CONFORMANCE

3.1.0 ISO 1496-2:2018

A Thermal Freight Container is specified according to ISO 1496-2:2018 series1 freight containers – Specification and testing – Part2: Thermal containers.

Relevant for the MP-5000 Panel this standard ISO 1496-2 is referring to the electrical aspects (section 9) and IEC 60947-1:2020 Low-voltage switchgear and control gear - Part 1: General rules. Also linking to

Circuit breakers: IEC 60947-2

Switches/Disconnects: IEC 60947-3

Contactors and Motor Starters: IEC 60947-4

This standard classifies the various Thermal Containers where the outside ambient temperature is 50°C. This ambient temperature will be used for the ambient temperature specification of the MP-5000 Panel. This standard also specifies the voltage range, tolerance, frequency, and load capacity as well.

This standard does not exclude other relevant standards.

3.1.1 ISO Standards

The MP-5000 Panel shall adhere to the Voltage Outlet of generators complying with ISO 8528-5: 2018 class G1.

The EN60204 make references to the following ISO Standards.

EN ISO 12100:2010

EN ISO 13854:2019

EN ISO 13857:2019

3.1.2 CE Marking

The MP-5000 Panel shall have CE marking.

The MP-5000 Panel must meet the essential requirements of the following Directives:

- RED Directive 2014/53/EU
- EMC Directive 2014/30/EU
- Low Voltage Directive 2014/35EU
- RoHS Directive 2011/65/EU
- WEE Directive 2002/96/EU

Based on parts of the following specifications applied:

Radio	EN 300 328 V2.2.2 (2019-07)	
EMC	Draft EN 301 489-1 V2.2.3 (2019-11), Draft EN 301 489-17 V3.2.2 (2019-12) EN 61000-6-2:2019, EN 61000-6-4:2019⁽¹⁾	
Safety	EN 62368-1:2014+AC: 2015+A11:2017 EN 60204-1:2018	
Health	EN 62311:2008	

(1) Use Severity level 4 for Immunity against surges in EN 61000-4-5:2014.

3.1.3 CCC

Not a requirement for the product. But for one or some components inside.
There will be extra cost attached to the Contactors for sale in China since they have CCC marking.

3.1.4 USDA CERTIFICATION

The CM-5000 Controller must be approved by USDA for cold treatment cargo temperature logging.

Link to cold treatment requirements:

[USDA Animal and Plant Health Inspection Service - Treatment Manual](#)

3.1.5 Shipping

The MP-5000 Panel can be shipped by air freight and as such shall meet the International Civil Aviation Organization (ICAO) standards where relevant.

The MP-5000 Panel will contain a coin cell Lithium-ion battery and a NI-MH Battery Pack.

Using coin cells and NI-MH battery packs will not cause difficulties when shipping.

3.1.5.1 Aftermarket

Anti-static packaging shall be used for aftermarket.

4 QUALITY AND RELIABILITY

The requirements according to request section 9.1:

The system has 90% confidence to operate over a 15-year period with an 86% reliability and 99% over first 5 years, under the following assumption:

Analytics tells us YITL = 4,000 hours Total Operation per annum (i.e. Controller operating)

Several initiatives must be made to reach this target with a clear understanding of the conditions for the request. There must be an alignment between the application profile and the specification. The reliability acceleration model need input from time to failure data, which takes time to collect. Hence, we will have a baseline and evolve the confidence and reliability numbers in parallel.

4.1 Baseline

Initially quality and reliability is built upon a base line:

- Transfer of quality and reliability knowledge from the MP-4000. Improve the MP-5000 design based on lessons learned / known major quality issues.
- DFMEA
- PFMEA
- Testing of MP-5000 according to test standards from the specification

4.1.0 Improvement MP-4000 vs MP-5000

The table below reflect major subjects where a design change is made to improve quality or reliability aspects.

	MP-4000	MP-5000
Front Door material	Plastic	Metal
Front Door Lock	Plastic/Metal	Metal, like MP-3000
Display	5 inches	Half size
Front Foil	Large Front Foil with glue	Smaller Foil(s) made as sticker label(s)
Power Outputs	Integrated into one Power Module	Individual contactors
Spare parts	Integrated modules	Individual modules easier to replace
Mains voltage range vs Contactor Coil voltage range	Special contactor and operation to limits on contactor coil	Contactors coil voltage range can be adjusted to compensate for wide Mains voltage range
Battery Pack	Integrated Li-Ion Battery Pack	Standard Ni-MH Battery Pack

4.2 Reliability Framework

With TK we agree to the (99R/90C) requirements at 5G with the following caveats:

- 1) TK agrees to provide all system level qualification results especially shock / vibration sensed testing or field trial results.
- 2) We work with TK Engineering / Reliability to confirm acceleration factors to establish test sample quantity and duration.
- 3) We launch testing ASAP but inform them it is unlikely it will conclude before product launch due to high number of hours required. Test results will establish the 1st iteration on Crow-AMSAA chart.

4.2.0 Lab test

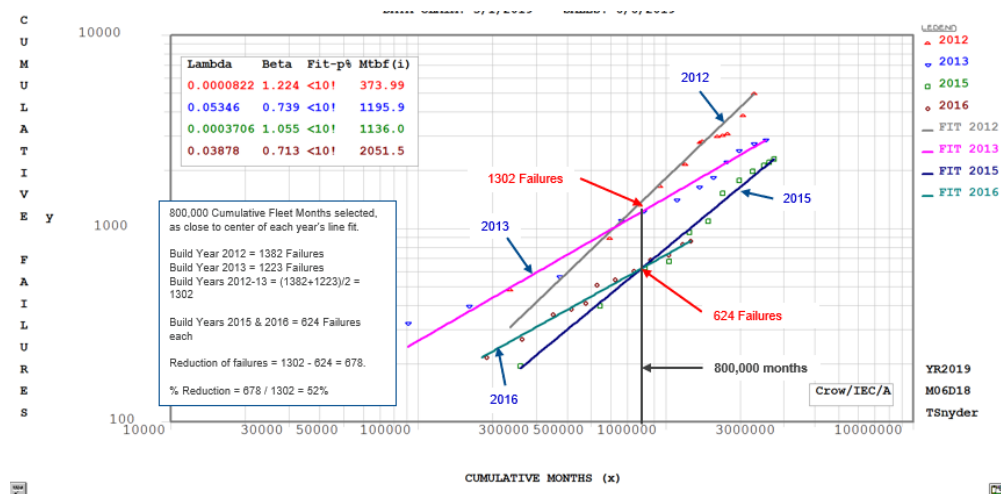
Lab tests to be performed based on calculated acceleration factors derived from mechanisms of physics calculations on Temperature, vibration, shock, Humidity and Corrosion. Establishing initial calculated reliability numbers to demonstrate 5 years @99%R/90%C, 5G

Mechanism	Failure Modes	Accel Factor	Test Plan			Conditions
			Total (21)	Complete (13)	Additional (8)	
Temperature	<ul style="list-style-type: none"> Low current connector degradation Component degradation Plated circuit board through-hole fatigue Chip on board & flex circuit for screens 	$AF_S = 33.7 X$	5	5	0	
Vibration	<ul style="list-style-type: none"> Leads & solder joints (higher-mass components) Connector fretting* Hardware loosening* 	$AF_S = 10.1 X$	2	2	0	
Shock	<ul style="list-style-type: none"> Loose contactors Mechanical overload of high-mass components* Cracked ceramic capacitors* Stress around mounting holes in PCB* Opto-couplers* 	$AF_S = 6.0 X$	5	2	3**	3 samples, step-stress test, 2 levels 30G & 40G (200 total shocks)
Humidity	<ul style="list-style-type: none"> Board leakage current Electrochemical migration Loss of silicone coating adhesion* LCD screen epoxy swell & corrosion* 	$AF_S = 6.8 X$	7	2	5**	5 samples, 75°C / 95% RH 814 hrs
Corrosion	<ul style="list-style-type: none"> Rust on mechanical components 	$AF_S = 1.0 X$	2	2	0	

4.3 Crow-AMSAA with Working Together Team

Launch sensored pilot fleet and begin Crow-AMSAA (CA) based reliability growth reviews by the Working Together Team (WTT). Include select end customers as possible to gain their input and data. The WTT reviews downloaded data logs, reviews failure tear downs, port / ship / depot visitation observances, etc. The CA chart is initiated with test results or actual fleet pilot performance. Beta values are monitored to ensure adequate reliability growth rate is attained.

Example of a CA chart:



5 DEDICATED IO LIST BASED ON UNIT TYPE

Type	Battery	Magnum, Roadrunner, EXV	Super freezer
Valve output	AC only	EVI valve Digital valve	Cooling 2 Liq Line
Digital output w/Safety DI	AC only	Compressor w/HPCO Switch EvaFanHigh ⁽¹⁾	Compressor 1 + HPCO1 Compressor 2 + HPCO2
Digital output wo/safety	AC only	Heater EvaFanLow ⁽¹⁾ ConFan	Heater EvaFanLow ConFanHigh
Digital output wo/safety	AC only	Phase Direction 1 ⁽¹⁾ Phase Direction 2 ⁽¹⁾	
Analog output	AC only	Compressor variable speed	
Stepper Motor Drive	AC only	Stepper Valve EXV	
Digital input	AC only	LPCO	
0-5V input	Bat/AC	AVL DischPrs SuctPrs SuctPrsEXV	DischPrs2 DischPrs1 SuctPrs1 SuctPrs2
4-20mA input	AC only	rH	
PT-1000	Bat/AC	Supply Air Return Air Evap Coil Condenser Coil Ambient Air Spare / Suction Line EXV	Supply Air Return Air Evap Coil Cargo1 Cargo2 Cargo3
NTC	Bat/AC	CompTemp USDA1 USDA2 USDA3 Cargo1 Suction Line2 EXV	Comp1Temp CompT2emp Ambient Air Condenser Coil(option)
BLE5.0	Bat/AC	Wireless connection	Wireless connection
RS-232	Bat/AC	COPELAND MODEM 3-party	COPELAND MODEM 3-party
RS-232	Bat/AC	Cargo space for USDA probe calibration	
RS485 Panel Ext+12VDC	Bat/AC	rH-digital	
TK FRESH+	Bat/AC	Motor + pos.FB + (RS485 w/pwr)	
CA Module	AC only	Compres + valve + temp + press	
Display	Bat/AC		
Keyboard	Bat/AC		
Signal LED's	AC only	Power, RESET, Status1, Status2, USB, Wireless Tx	

Note 1: PhaseDirSelection and EvaporatorSpeed contactors must be with mechanical interlock

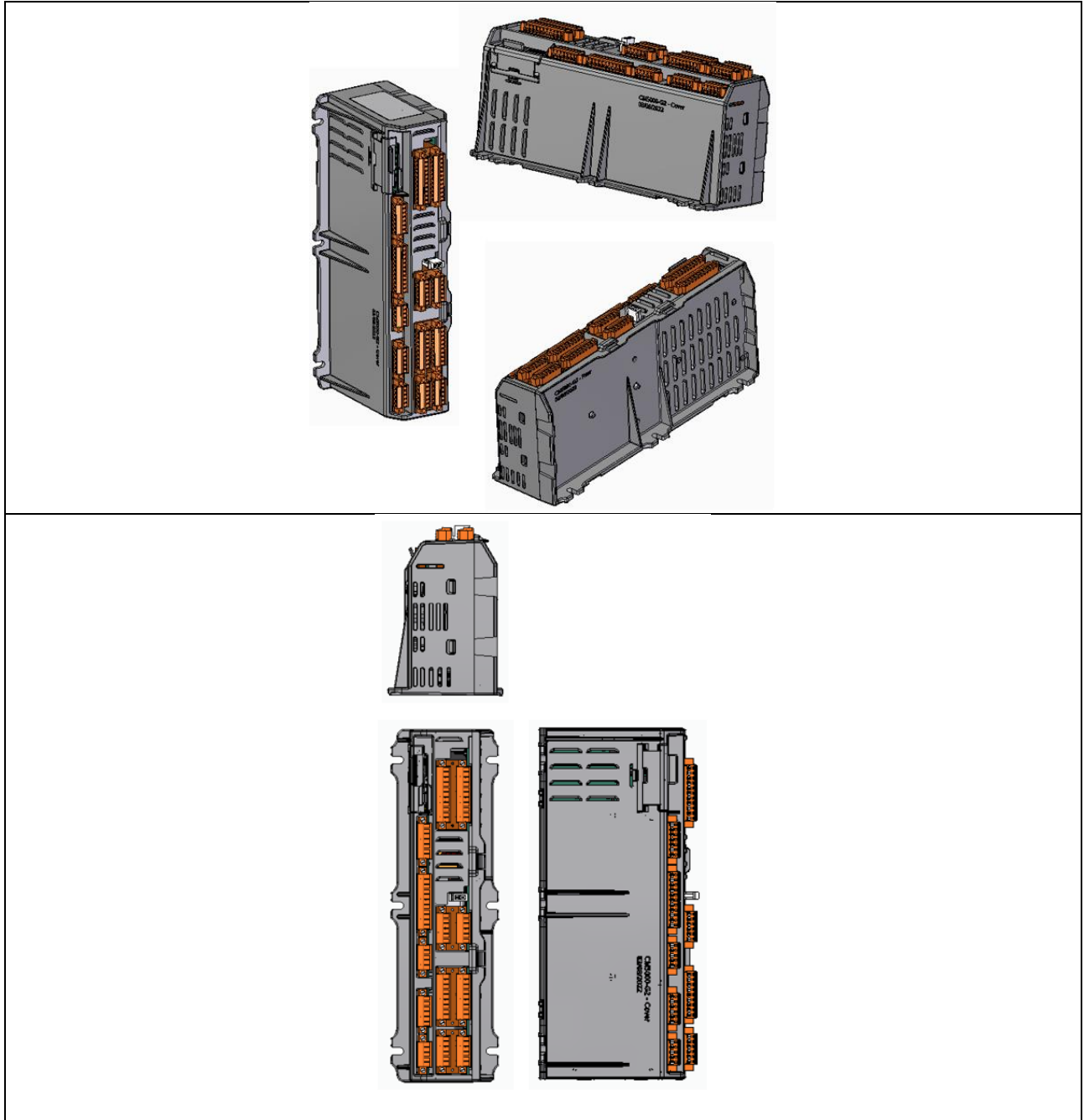
With **RED** additional to existing Magnum+ MP-4000

With **GREEN** additional to existing Magnum+ MP-4000 with option module mounted

With **ORANGE** addition for the future

?? how about A2L leak sensor?

6 CM-5000 CONTROLLER MODULE



Note: Preliminary Concept of the CM5000 Enclosure

Support for

- Magnum+ / CFF
- Roadrunner EXV
- Super freezer

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6.1 I/O List

CM-5000 Controller			
Type	Count	Function	Comments
BLE5.0	1	Wireless Connectivity	AC+Battery
USB Host and Device	1	Service / logs / update	AC+Battery
RS-232, w/Handshake	1	Communication to COPELAND MODEM or 3. party device	AC+Battery
RS-232, wo/Handshake	1	Communication to Cargo Space / Retriever port plug	AC+Battery
RS-485	1	Option Module communication interface	AC
RS-485 w/sensor power	1	Panel external com 12VDC 50mA	AC+Battery
RS-485 for Display/ Keyboard and wakeup	1	Serial IF to Display with LED's. 12Vdc supply and Wakeup	AC+Battery
Stepper Motor Drive	1	12VDC, Current detect, Unipolar	AC+Battery
Digital input	1	Switch Input	AC
Digital input	1	/Test Mode	AC
Analog Voltage input w/5VDC supply	3	0-5VDC input 3 wires GND, 5V, AI (100k sink)	AC
Analog Voltage input w/12VDC supply	1	0-5VDC input 3 wires GND, 12V/5V, AI (100k sink)	AC
Analog Current input w/12VDC supply	1	0-25mA input 2 wire. 12V, AI (2,5V@25mA to GND)	AC
PT-1000	6	Temperature probe 2 wire	AC+Battery
NTC	6	Temperature probe 2 wire	AC+Battery
Digital output Min. 5E6 operations/5yr	3	Valve Output 2 wire. (2 Valve+Condenser)	AC
Digital output w/DI for safety line	2	Contactora Output 2+2 wire for safety line circuit. (Comp1 + EvaHi / Comp2SF)	AC
Digital output	4	Contactora Output 2 wire	AC
Analog output	1	0-10VDC output 2 wire Output (10mA) VFD Compressor	AC
3-ph Current-Loop coil. With Zero Crossing.	3	0.1-32A	AC
Battery Package IF	1	2-wire connection to Battery	AC+Battery
AC Power Input	1	24VAC	AC
AC Power Input for DO	1	24/29VAC w/ GND reference (24V+5V)	AC
LED's		Power on 3.3V = Green USB = Yellow RESET = RED STATUS1 = Green STAUS2 = Yellow Wireless Tx = Blue	AC+Battery

6.2 Input / Output description

This section specifies the inputs and outputs, based on the function.
The specification may apply multiple times and for several modules.

6.2.0 NTC input

Typical used for cargo space temperature sensing and documentation.
Temperature probes connected to Deutsch plugs in cargo space and fed into the Panel.
With Super freezer configuration 3 PT1000 are used for the Cargo1-3 probes.

For Compressor, focus on accuracy at high temperature. For Cargo sensors, focus on the range -3°C to 15°C

Update frequency < 5 sec.

10k NTC input – Cargo Probe (excl. probe) ⁵					
	Min.	Typ.	Max.	Units	Range
Cargo probe measuring range (t _m)	-50		+50	°C	
Total measurement error USDA range			±0.1	°C	@ -3°C<t _m <+3°C
Total measurement error			±0.3	°C	@-35°C<t _m <+70°C
Total measurement error	±0.3		±4	°C	@-50°C<t _m <-35°C
Probe current			220	µA	

86k NTC Compressor probe input specification (excl. NTC probe).					
	Min.	Typ.	Max.	Units	Range
Compressor probe measuring range (t _m)	-25		+150	°C	
Total measurement error			±0.3	°C	@+100°C<t _m <+150°C
Total measurement error			±5	°C	@t _m <+100°C

6.2.1 PT-1000 input

PT-1000 input (excl. probe)					
	Min.	Typ.	Max.	Units	Range
Reefer probe measuring range (t _m)	-100		+100	°C	
Total measurement error			±0.1	°C	@-15°C<t _m <+15°C
Total measurement error			±0.3	°C	@-70°C<t _m <+70°C
Total measurement error			±0.5	°C	@-70°C>t _m , t _m >+70°C
Probe current			191	µA	@t _m =0°C

⁵ In this table the temperature ranges specified are relating to temperature of measurements.

6.2.2 0-5V PRESSURE and AVL input

0-5V transducer input used for pressure measurements.

+12Vdc must be provided to supply the AVL transducer.

+5Vdc must be provided to supply the other three transducers. Supply for these inputs can re-configured for 12V in SW.

0-5V analog input (excl. transmitter)					
	Min.	Typ.	Max.	Units	Range
Transmitter supply voltage, 12Vdc	11	12	13.2	V	Max 50mA
Transmitter supply voltage, 5Vdc	4.5	5	5.5	V	
Input range, 12Vdc	0		5	V	
Input range, 5Vdc	0.5		4.5	V	
Input resistance		21		kohm	
Total measurement error ⁶			1	% FSR	0-5Vdc

6.2.3 0mA to 25mA

Analog Humidity Sensor input					
	Min.	Typ.	Max.	Units	Range
Supply voltage	11	12	13.2	V	Max 50mA
Input range:	0		25	mA	
Input resistance		100		Ohm	
Total measurement error			1	% FSR	4mA-25mA

6.2.4 3-ph Current-Loop coil with Zero Crossing Detection.

An external three phase current loop coil will be used to measure load current in the system. Placing it externally increase flexibility regarding mounting right after the Circuit Breaker.

Current measurements are used to get the maximum capacity out of the compressor, to identify correct load changes, calculate expected power consumption and determine the phase order.

Current on all three phases shall be measured. The zero crossing is extracted from the current measurement and used by the CPU to determine the frequency and the phase rotation.

Accuracy should be good enough to detect load changes and support power consumption calculation.

Current sense input					
	Min.	Typ.	Max.	Units	Range
Current input range	0.2		35	Aac	
Accuracy		3		%	@ up to 30A
Frequency range	45		65	Hz	

⁶ Pressure sensor: 0.5V = 0Bar; 25mBar error approx. 0.5°K error

6.2.5 Analog output

Analog output can be used to control VFD compressor drive.

Analog Output					
	Min.	Typ.	Max.	Units	Range
Analog output range	0		10	Vdc	
Output load			10	mA	

6.2.6 Main's Voltage measuring

Main's voltage is measured on the secondary side of the transformer and knowing the winding relationship the primary power is calculated.

The input voltage must generate a Power Good signal as a DI for the CPU, Response time < 50ms.

Mains Voltage sense input					
	Min.	Typ.	Max.	Units	Range
Main's voltage range	0		600	Vac	
Accuracy		3		%	
Frequency range	45		65	Hz	

6.2.7 Digital Input

Response time <100ms

Digital input⁷				
	Min.	Typ.	Max.	Units
Internal pull-up voltage		12	13.2	V
Input on current			11.5	mA
Input low voltage			3	V

Test mode input is used to bring the Controller in test mode state.

Digital input Test Mode				
	Min.	Typ.	Max.	Units
Internal pull-up voltage		3.3		V
Input low voltage			0.4	V

6.2.7.1 Digital Input - Safety line switch

The input is beside the reading used as a part of driving the corresponding digital output. When the input is short-circuited, correspond to the switch is closed and the signal is NORMAL.

This feature is typically used for safety precaution like HPCO

Response time <100ms, safety function <50ms.

⁷ Designed for usage with open collector NPN drive or relay contact.

Since the corresponding output activation current passes through this switch the current is defined from these.

6.2.8 Digital outputs

The Digital outputs are specified to activate valves, contactors, or other external devices. The drive power is AC.

Supply for ALL Digital Output is selected, in general, between the 2 input voltages AC1a or AC1b to compensate for wide input voltage range. The selection between a or b is based on the Mains voltage and frequency reading. Handled by a switch over relay.

General:

- Separate protection for each output.
- At Reset state or with power OFF the output must be off.
- Response time <100ms.
- Consider shock impacts on relay contact set.

Digital output				
	Min.	Typ.	Max.	Units
Short circuit protection		Yes		Multifuse
Continuous current limit per output			1	A @70°C

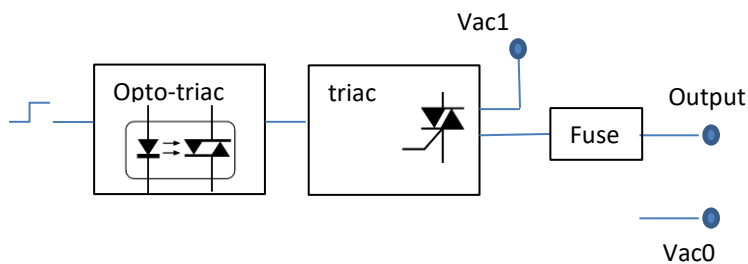
No of operations on the various digital outputs dictates the use of a relay or an SSD.

6.2.8.1 Digital output with frequent activation

Activations 1.500.000 / year.
 One Condenser fan modulates every 30 sec.
 Two Valves modulates every 20 sec.

SSD shall be used.

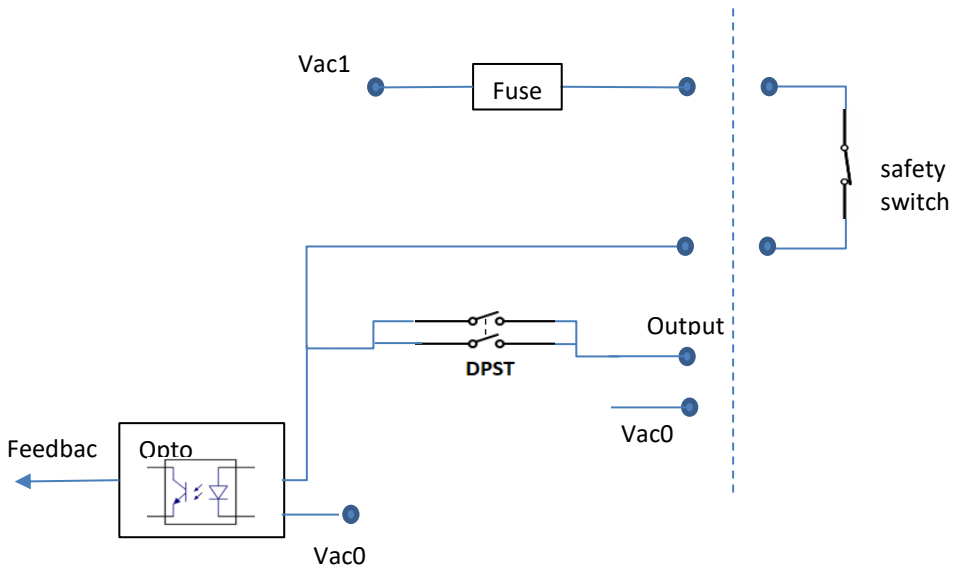
2 pin connection pr output, to fully support the connection to the valves.



6.2.8.2 Digital output w/DI for safety line

Contactor relay drive. < 150.000 / year.
NO DPST relay shall be used.

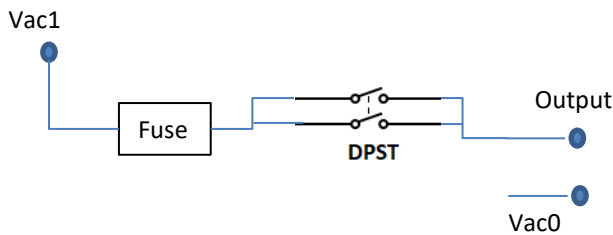
1 pin output to correspond to the function. A common connection within the harness to the ACgnd.
2 pins for connecting safety switch for each output.



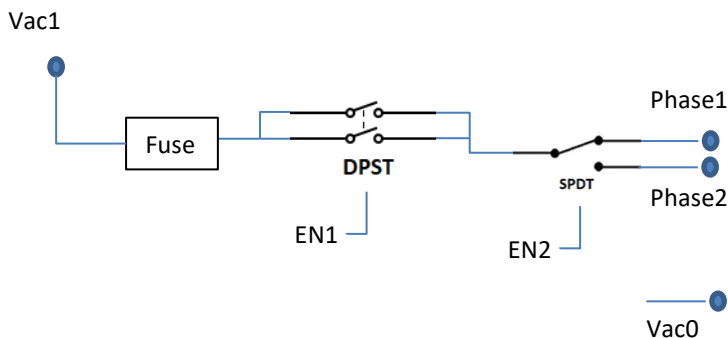
6.2.8.3 Digital output

Contactor relay drive. < 150.000 / year
NO DPST relay shall be used.

1 pin output to correspond to the function. A common connection within the harness to the ACgnd.



The two digital outputs for phase reversal:



6.2.9 Stepper Motor Drive

The attached stepper motor is expected to be of type Danfoss ETS 6.

Stepper valve, Danfoss ETS 6				
	Min.	Typ.	Max.	Units
Type, Danfoss ETS 6		Unipolar		
Connection		5pin, 4+common		
Resistance		46+/-3		Ohm / winding
Speed	30		90	Pulses/sec.
Phase		1-2		Phase
Supply		12		Vdc
Current		0.26		A/phase

Stepper Valve Output				
	Min.	Typ.	Max.	Units
Supply voltage	8	12	13.2	V
Output current, full scale			1.8	A
Output drive		2		H-bridge
Control mode, Serial		Yes		
Protection		Yes		
Open / short load detection		Yes		
Sleep current		2		µA

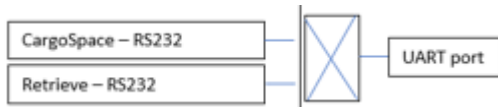
6.3 Serial Communication Interfaces

6.3.0 RS232

Interface to 3rd party Modem / COPELAND Modem will have handshake available.

For connection to cargo space there will be no handshake.

In addition, a RS232 is multiplexed with the RS232 port for cargo space. This port is acting as a retriever port and is the default connection. Any activity from the cargo space RS232 port will be detected and the port will be internally selected. This feature can support the eco-system for monitoring the Reefer.



RS232 interface				
	Min.	Typ.	Max.	Units
Input voltage swing	±3		±30	V
Output voltage swing	±5			V @ R _{LOAD} = 3kΩ
Slew rate			30	V/μs
Baud rate		19.2	115.2	Kbps
Handshake		RTS, CTS		

6.3.1 RS485

RS485 interface				
	Min.	Typ.	Max.	Units
Receive:				
Input common mode range	-7		12	V
Receiver threshold voltage			±0.2	V
Input impedance with termination		150		Ω
Receive data rate		19.2		Kbps
Transmit:				
Differential output voltage	1.5		5	V @ R _L =54Ω, C _L =50pF
Common mode output voltage			3	V
Output current	28			mA @ R _L = 54Ω
Short circuit current			250	mA
Transmit data rate		19.2		Kbps
Endpoint termination option:		Yes/Fixed		

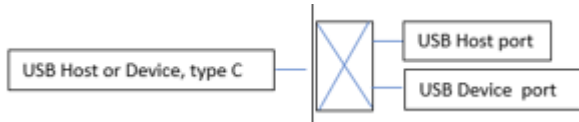
6.3.2 RS485 sensor power

Power for external sensors on the RS485 line.

RS485 Sensor Supply				
	Min.	Typ.	Max.	Units
Nominal supply voltage input	11,4	12	12,6	Vdc
Current load			100	mA
Fuse protection		100		mAdc@70°C

6.3.3 USB

The USB interface is based on a USB type C USB interface. With this type of interface, it is possible configure the interface as Host or as Device. Internally there is a multiplexer switching to the correct port (Host or Device) pending on the detections at the connection or internal System setup.



The USB type C connection can be extended from the Controller to the Panel side for external access without opening the Front Door.

Consider the reliability of an external connection and the additional cost.

6.3.3.1 USB Host

Host for USB Flash memory.

USB, Host				
	Min.	Typ.	Max.	Units
Speed		USB1.0		
Connector		Type C		
Protection		Yes		
Current load		500		mA

6.3.3.2 USB Device

Device used for PC connection.

USB, Device				
	Min.	Typ.	Max.	Units
Speed		USB1.0		
Connector		Type C		
Protection		Yes		
Current consumption		500		mA

6.4 Wireless Communication

The MP-5000 Panel will contain short range wireless communication in terms of Bluetooth LE 5.0.

The Radio is mounted in the CM-5000 and has an internal antenna. Range will be limited since it is inside the Panel, but within range for a user standing direct in front of the Refrigeration Unit. The goal is to reach Reefers stacked 3 in height.

The purpose is to increase serviceability for the User with a service App, without the use of a wired connection.

BLE Communication		
BLE version	5.0	
Operation frequency	2.402 – 2.480	GHz
Transmitter power, max	xx	dBm
Transmitter power, min	xx	dBm
Receiver sensitivity, min	-95	dBm (1Mbps)
Receiver sensitivity, min	-103	dBm (125kbps)
Antenna:	Internal	

xx: please reference test reports.

Notes:

Please take attention that changes or modification not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

- (1) this device may not cause interference, and
- (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radioexempts de licence.

L'exploitation est autorisée aux deux conditions suivantes :

- (1) l'appareil ne doit pas produire de brouillage, et
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

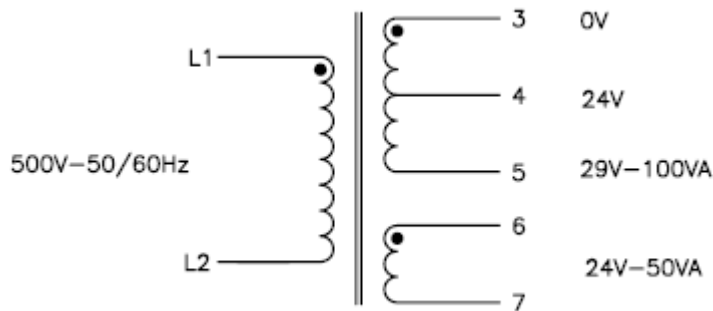
This equipment complies with IC RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

ce matériel est conforme aux limites de dose d'exposition aux rayonnements, CNR-102 énoncée dans un autre environnement.cette equipment devrait être installé et exploité avec distance minimale de 20 entre le radiateur et votre corps.

6.5 Power Input / Output

6.5.0 AC Power Input for DO outputs

Nominal the power provided to DO will be 24Vac+5Vac. One end of the supply will have reference to Earth/chassis of the Panel. To compensate for wide input voltage, range a step-up winding can be switched in/out pending on the voltage measured by the system. The winding will be switched in when power input voltage is low. The threshold limits for switching and time before switching will be set by SW. The position will be decided based on the power up voltage / frequency condition



24Vac+5Vac Supply Input				
	Min.	Typ.	Max.	Units
Nominal supply voltage input		24	26.1	Vac @ 500Vac Mains
24Vac+5Vac		29	30.8	Vac @ 500Vac Mains
Power consumption, total			100	VA
Frequency	45		65	Hz

6.5.1 24VAC Power Supply Input

This supply is for the controller internal use only. This supply input shall have double fuses avoiding false current flow.

24Vac Supply Input				
	Min.	Typ.	Max.	Units
Nominal supply voltage input	15.36	22.08	28.7	VAC (24ac@500Vac)
Supply current		2,1		Aac@70°C
Power consumption, total			50	VA

6.6 Battery Pack Interface and Capacity

6.6.0 Battery pack interface

A battery package is required for data logging and housekeeping of the Controller in power off mode. The Controller is prepared for interface to a NIMH nominal 7.2V battery pack. The Battery pack must be replaceable.

System leakage current must be kept at minimum level to save battery capacity.

Battery pack Interface				
	Min.	Typ.	Max.	Units
Battery voltage input range to Controller	6		8.7	Vdc
Supply voltage for Charging			8.7	Vdc, @ 1.45/cell
Charging current #1		70		mA
Charging current #2		200		mA

6.6.1 Battery charge

The controller will perform the battery charging based on voltage and charge current only.

Charging the battery will be done with respect to the lifetime of the battery.

6.6.2 Battery discharge

The controller will be able to discharge the battery through a software controlled passive load. The discharge feature is used for detection of presence of a battery pack and capacity evaluation.

The discharge load will not drain the battery when not in use.

6.6.3 Battery capacity

To accommodate different use cases different capacity sizes of the Battery pack can be defined if it is aligned with the charging capabilities.

The Battery interface is designed to handle capacities up to 2000mAh @ 7.2V

The NiMH battery capacity depends on temperature range during operation and storage.

Battery pack				
	Min.	Typ.	Max.	Units
Data-logging cycles between recharging	120			cycles
Battery type		NiMH		
Battery capacity	700		2000	mAh
Battery voltage output range to Controller	6		8.4	Vdc
Operating temperature range:				
Charge ⁸	-20		40	°C
Discharge ⁹	-30		60	°C
Capacity left vs storage temperature:	-20		40	°C
One Month -20°C ~ +20°C		70		%
Two Weeks +40°C		50		%
Mechanical outline		6s		AA size
AA: 85x15x52mm				000000----
Approvals				
By ship		UN3496		
By Air, IATA DGR		A199		

6.7 Features in Battery Mode and Wakeup

6.7.0 Battery Run

When active running on battery, with no Main’s power applied, the following features must be active.

- All Analogue inputs for sensors, i.e. pt1000, NTC, 0-5V, 0-25mA.
- All communication interfaces, including the USB interfaces.
- Power supply for 0-5V, 0-25mA, RS485
- Display and keyboard
- Stepper Motor operation
- All parts of software including “software update”.

⁸ Above max charge temperature the battery will not be charged.

⁹ Low temperatures will by nature reduce the amount of battery capacity and will affect the number of data logging cycles.

6.7.1 Battery Wakeup and hold

The enabling of battery run must be available by:

- Key Press (just one key)
- RTC alarm
- RS232 RX activity from Cargo space or Modem
- Software (To catch Mains short drop out)

Software must be able to read who caused the wakeup.

The disabling of battery must be software controllable. It must, from software be possible to disable future battery wakeup. (Draining battery)

6.8 Display interface

The CM-5000 has a Display interface with RS485 communication. Termination is fixed internally on the CM-5000.

/Key_wakeup is an input to the CM-5000. The input is always active and is pulled up to 3.3V level. When a specific key is pressed on the front door keypad this input is pulled low and a wakeup of the Controller is initiated.

Display Interface				
	Min.	Typ.	Max.	Units
Voltage output range to display	5	12	15	Vdc
Supply current			150	mA
RS485		Yes		
Termination		Fixed		
/Key_wakeup		Yes		3.3V, pull-up 330kOhm

6.9 Watchdog

The system must hold an external watchdog circuit.

6.10 Battery Coin Cell

The CM-5000 contain a Lithium coin cell battery for Real Time Clock power backup. Battery size is CR2032 with a capacity of 210mAh.

6.11 LED indications

The five LED indications are showing basic quick status of the CM-5000.

- System RESET will be lid if the supply to the CPU system is too low or if the external Watch Dog is activated.
- USB LED will show activity when connected.
- The Status LED 1 and LED 2 are used to indicate activity.
- Bluetooth LE transmit shows then wireless transmission is active.

LED indications	
	Color Units
System RESET	Red
USB LED	Yellow
Status LED1	Yellow
Status LED2	Green
Bluetooth LE Transmit	Blue

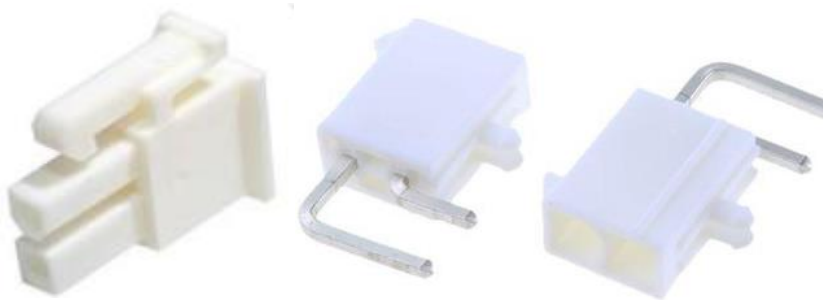
6.12 Connectors,

6.12.0.1 Dual level with crimp and locking connector.

For the battery interface this connection shall be used to avoid wrong connection of plus and minus wires on the battery pack.

A 4.2mm double level high density connector one position (two poles) will be used.

The male and female part must be like Molex Mini-Fit Jr. series, Dual Row, 4.2mm with flammability class UL94-V0.



6.12.0.2 Screw connectors

A 3.81 mm connector series will be used for general interface.

The parts must be like Weidmüller SC 3.81/90F, SCD 3.81/90F, SCZ 3.81/180F.



Use coding to avoid wrong connections:

Accessory coding plugs must be used and inserted into the base male connectors and corresponding notch/tab on

Female connector must be cut off to fit coding.



6.13 Connection list

CM-5000 PIN SETUP		
Pin#		Connector type
J6.1	Stepper Motor VCC	Stepper Motor
J6.2	Stepper Motor coil A+	
J6.3	Stepper Motor coil B+	
J6.4	Stepper Motor coil C+	
J6.5	Stepper Motor coil D+	
J10.1	Current sense coil P1+	Loop Coil P1
J10.2	Current sense coil P1-	
J10.3	Current sense coil P2+	Loop Coil P2
J10.4	Current sense coil P2-	
J10.5	Current sense coil P3+	Loop Coil P3
J10.6	Current sense coil P3-	
J11.1	RS-485 VCC	Display interface
J11.2	RS485 D+	
J11.3	RS485 D-	
J11.4	/Key_Wakeup	
J11.5	GND	
J7.1	RS-232 TXD2	Monitoring, Cargo space
J7.2	RS-232 RXD2	
J7.3	RS-232 GND	
J7.4	RS-232 TXD1	Monitoring, Retrieve
J7.5	RS-232 RXD1	
J7.6	RS-232 GND	
J7.7	RS-232 RXD	COPELAND Modem, RMM,
J7.8	RS-232 RTS	
J7.9	RS-232 TXD	

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J7.10	RS-232 CTS	Third party Modem
J7.11	RS-232 GND	
J9.1	RS-485 VCC	External Sensor
J9.2	RS-485 D+ 2	
J9.3	RS-485 D- 2	
J9.4	RS-485 GND	
J9.5	RS-485 D+ 1	Interconnect CM-OM
J9.6	RS-485 D- 1	
J9.7	RS-485 GND	
J12	USB-C Host or Device interface	USB-C
J3A.1	Pt1000_1+	Pt1000
J3A.3	Pt1000_1-	
J3A.5	Pt1000_2+	Pt1000
J3A.7	Pt1000_2-	
J3A.9	Pt1000_3+	Pt1000
J3A.11	Pt1000_3-	
J3B.2	Pt1000_4+	Pt1000
J3B.4	Pt1000_4-	
J3B.6	Pt1000_5+	Pt1000
J3B.8	Pt1000_5-	
J3B.10	Pt1000_6+	Pt1000
J3B.12	Pt1000_6-	
J1A.1	12V_Supply5	0-25mA
J1A.3	0-25mA_AI5	
J1A.5	Supply1	Transducer
J1A.7	0-5V_AI1	
J1A.9	GND	
J1A.11	AO 0-10V	AO
J1A.13	GND	DI
J1A.15	DIG_IN	
J1A.17	GND	
J1B.2	12V_Supply4	
J1B.4	0-5V_AI4	
J1B.6	GND	
J1B.8	Supply3	Transducer
J1B.10	0-5V_AI3	
J1B.12	GND	
J1B.14	Supply2	Transducer
J1B.16	0-5V_AI2	
J1B.18	GND	
J2A.1	NTC1-C	NTC USDA
J2A.3	NTC1-GND	
J2A.5	NTC2-C	NTC USDA
J2A.7	NTC2-GND	

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J2A.9	NTC3-C	NTC USDA
J2A.11	NTC3-GND	
J2B.2	NTC4-C	NTC USDA
J2B.4	NTC4-GND	
J2B.6	NTC5-C	NTC
J2B.8	NTC5-GND	
J2B.10	NTC6-C	NTC
J2B.12	NTC6-GND	
J5.1	GND	Battery Package IF
J5.2	VBAT+	
J4A.1	24Vac	0-24-29VAC
J4A.3	29Vac	
J4A.5	29Vac_0	
J4A.7	HPCO1_A	Safety switch
J4A.9	HPCO1_B	
J4A.11	DO1	Coil
J4A.13	HPCO2_A	Safety switch
J4A.15	HPCO2_B	
J4A.17	DO2	Coil
J4A.19	Digi_out_1	Coil
J4A.21	29Vac_0	
J4B.2	24Vac1	0-24VAC
J4B.4	24Vac0	
J4B.6	/TESTMODE	
J4B.8	DO3	Coil
J4B.10	DO4	Coil
J4B.12	DO5	Coil
J4B.14	DO6	Coil
J4B.16	29Vac_0	Coil
J4B.18	Digi_out_2	
J4B.20	Digi_out_3	Coil
J4B.22	29Vac_0	
J23	29Vac_0	Reference to Earth

6.14 Enclosure of CM5000

6.14.0 Position inside the BOX

Positioned in Vertical

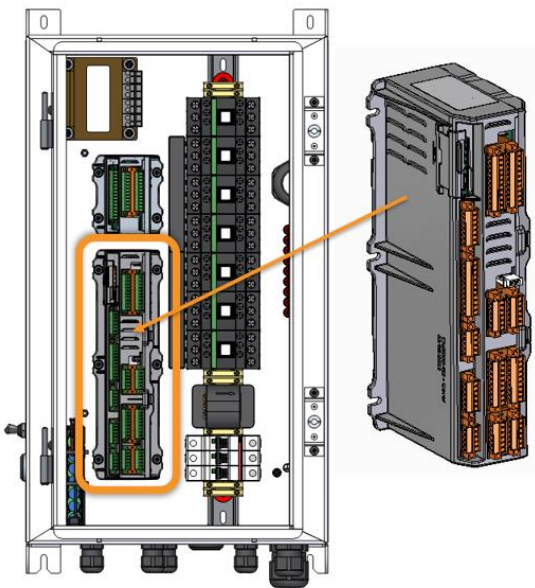
Fixed on the bottom of the Metal Bottom Box

Fixed by Screws

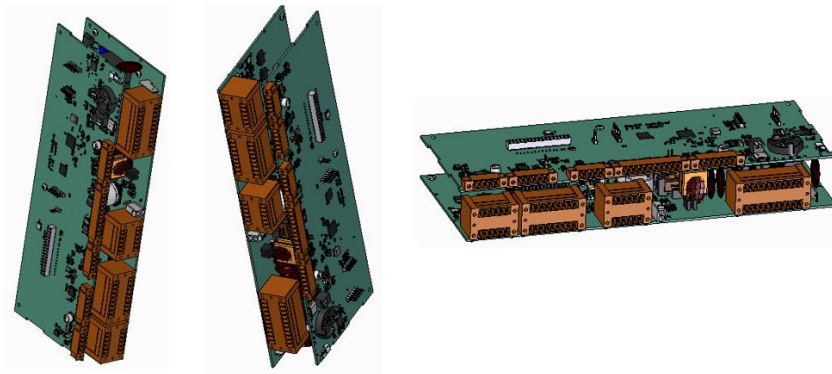
Main Controller shall be available as separate spare part

The fixing of the electronics inside the plastic container must consider facilitating the assembly in production and to guarantee the resistance to Vibrations and Shock (the values are described in other parts of this document)

Enclosure IP: IP20



6.14.1 Internal PCB Layout (Concept)



6.14.2 Material

Same used on similar EMR Main Controller = PC or PC-ASA

Unit is tested and passes with 30 Seconds with flaming drips allowed UL-94-HB (minimum), Better is to reach UL-94-V0

Shall be constructed of fire-retardant materials

The material must withstand the marine environment as described elsewhere in this document

6.14.3 Fixing into the Panel

It is preferable to use screws to allow quick assembly and quick replacement in case of failure

Use Phillips head self-tapping screws (standard)

6.14.4 Connectors

The connectors must be easily accessible both during the assembly phase in Production and in case of replacement (service) in the field.

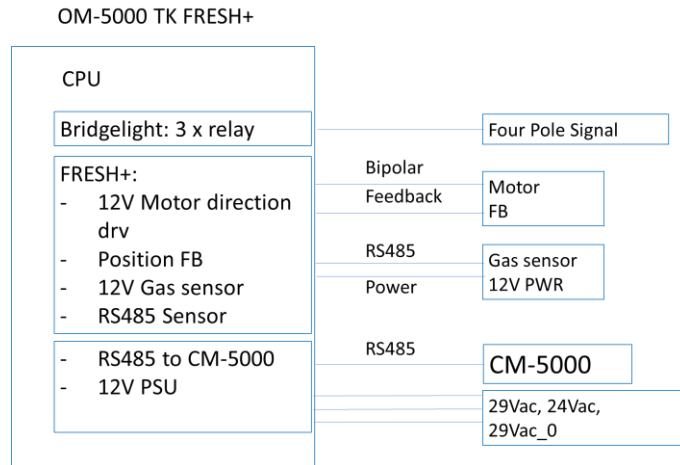
Connectors must have a mechanical retaining type to resist vibration and shock. It is preferable that the mechanical retention is with screws, latch retainers are also accepted if they are robust.

6.14.5 Labelling

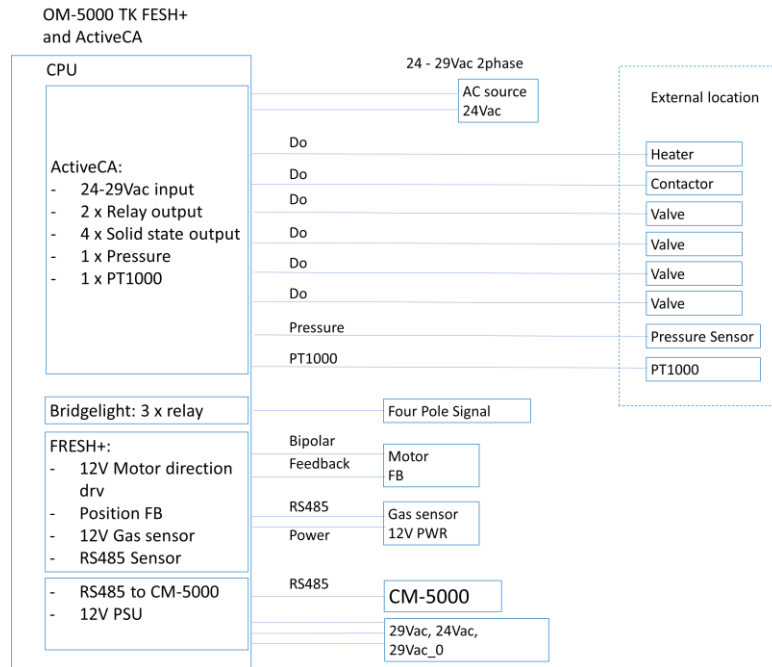
Outside the enclosure there must be a label showing the identification information and the main data of the product and which complies with the requirements of approvals.

7 OM-5000 OPTION MODULE

7.1 OM-5000 System Overview TK FRESH+

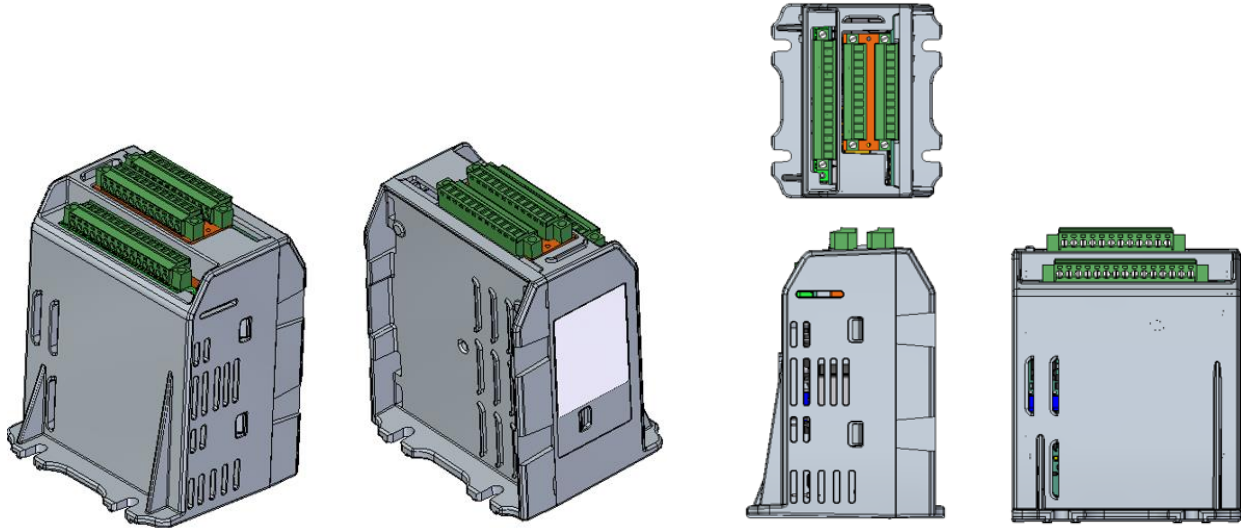


7.2 OM-5000 System Overview TK FRESH+ and ActiveCA



7.3 OM-5000 System Enclosure Outline and Mounting

Follow same concept as for the CM-5000.



Note: The size and shape of the module are only indicative

Support for

- TK FRESH+
- ActiveCA
- Optional RS-232
- Bridge light

7.4 I/O List

OM-5000 Option Module				
Type	Count	Function	Comments	Pins
RS-232, w/Handshake	1	Third part RS232	AC	5
RS-485	1	Option Module communication interface	AC	2
TK FRESH+				
- RS-485	1	Panel external com for sensors	AC	2
- sensor power	1	12VDC 500mA (4W)	AC	2
- Analog input	1		AC	1
				12
- Input Power	1	Power input 29ac_1 and 29ac_0	AC	2
- Motor driver	1	12VDC Output with reversal	AC	2
- Feedback	1	10kOhm pullup	AC	2
- 4 x LED	4	Power, RESET, Status1, Status2	AC	0
Bridge light				
Relays	3	NO relay output	AC	4
				10
ActiveCA – Module				
- 24 – 29Vac	1	Power input for Digital outputs	AC	3

- Digital output, relay	2	Contactora / Heater output	AC	2
- Digital output, Solid state	4	Valve outputs	AC	8
- Pressure sensor	1	Pressure sensor	AC	3
- PT-1000	1	Temperature probe 2 wire	AC	2
- 1 x LED	1	Status3	AC	0
				18
				40

7.5 Input / Output description

This section specifies the inputs and outputs, based on the function.

Where the specification is different from the CM-5000 Specification this will be specified in this section.

7.6 IO for General Functionality

7.6.0 29Vac input TK Fresh+

The 29Vac is used to power the OM-5000 TK FRESH+. The supply must support internal module power consumption, power for 12Vdc and Contactor drive. The internal supply is not used to supply the 24Vac loads in the ActiveCA option.

Estimated power consumption is 10W.

7.6.1 Master / Option Module communication

RS-485 line to the master controller (CM-5000).
The specification is described in the CM-5000 Controller section.

7.6.2 RS-232 w/ Handshake

RS-232 for external options – 3 part usage.
The specification is described in the CM-5000 Controller section.

7.6.3 RS-485 w/ sensor power

RS-485 Modbus with sensor power.

The RS-485 must be endpoint terminated at the option module.

In TK FRESH+ configuration the CO2 and O2 sensors consumes 12Vdc / 4W.

The supply must not be affected by a short of the DC motor drive.

7.7 IO for TK FRESH+

7.7.0 DC Motor drive

Output to drive a DC motor forward or backward, supplying the voltage as +VDC, -VDC or 0VDC

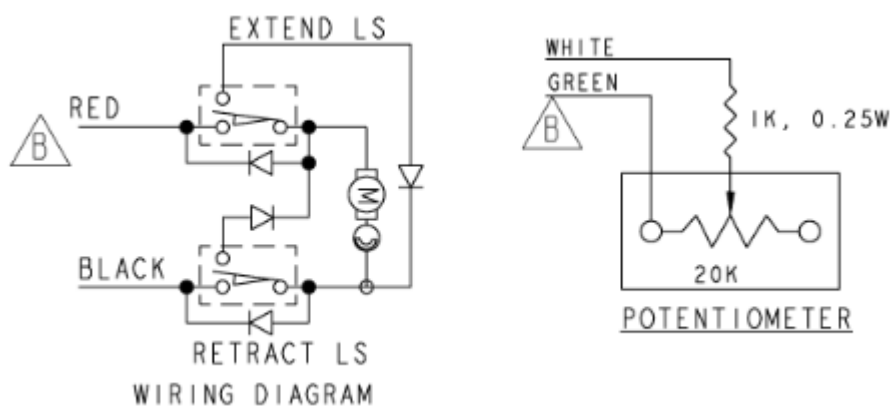
TK motor spec 1E25515G01

Base motor 36VDC/0.5Amp but operated at 12VDC.

Response time <50ms

The output amperage draw must not affect the remaining controller measurement, including the power for attached gas analyser.

H-bridge output				
	Min.	Typ.	Max.	Units
Voltage output	TBD	12	TBD	Vdc
Supply current		<0.2	TBD	Adc@50°C
Current and temperature limit protection		Yes		



7.7.1 TK FRESH+ Motor position Feedback

The feedback is represented in 2 wires holding a 1k + 20k variable resistor reflecting the position.

7.8 IO for ActiveCA

7.8.0 External 24/29Vac power source

External Power source must support power for digital outputs.
Input must be prepared for adjustment of wide input voltage range.

7.8.1 DO

Four Solid State Outputs are used for valve activation.

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Two Relay Outputs are used to activate external contactor and Heater.
If safety line is needed it must be wired in externally.

7.8.2 Pressure Sensor

One Pressure sensor input is specified.

7.8.3 PT1000 sensor

One PT1000 sensor input is specified.

The specifications must be like the ones used in CM-5000.

7.9 Connectors

Use the same connector type as specified for the CM-5000.

7.10 External PSU for ActiveCA

An external 50/60Hz transformer with two voltage outputs 24Vac+5Vac must be added to support operation of the digital outputs.

Mounting and Power size TBD.

7.11 OM-5000 Connection list

OM-5000 PIN SETUP		
Pin#		Connector type
J2A.1	/Test Mode	
J2A.3	RS232 GND	RS232 Option
J2A.5	RS-232 CTS	
J2A.7	RS-232 RTS	
J2A.9	RS-232 RXD	
J2A.11	RS-232 TXD	
J2A.13	RS-485-2 GND	To Controller
J2A.15	RS-485-2 D-	
J2A.17	RS-485-2 D+	
J2A.19	Analog input	
J2A.21	24Vac0	Input AC power
J2A.23	24Vac1	
J2B.2	GND Sensor	Sensor power and communication
J2B.4	12_Sensor	
J2B.6	RS-485-1 D-	
J2B.8	RS-485-1 D+	

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J2B.10	Position FB2	Stepper Motor
J2B.12	Position FB1	
J2B.14	Stepper Motor2	
J2B.16	Stepper Motor1	
J2B.18	RELAY4 OUT	4-pole
J2B.20	RELAY3 OUT	
J2B.22	RELAY2 OUT	
J2B.24	RELAY COM	
J1.15	Digi Out	
ActiveCA		
J1.1	24Vac	Power input for Digital Outputs
J1.2	29Vac	
J1.3	29Vac_0	
J1.4	Relay Output 2	Heater
J1.5	Relay Output 1	Compressor
J1.6	29Vac_0	Valve Outputs
J1.7	Digital Output 4	
J1.8	29Vac_0	
J1.9	Digital Output 3	
J1.10	29Vac_0	
J1.11	Digital Output 2	
J1.12	29Vac_0	
J1.13	Digital Output 1	
J1.14	GND	Pressure sensor
J1.15	Input	
J1.16	Supply	
J1.17	PT1000 1-	PT1000
J1.18	PT1000 1+	

8 OTHER PANEL COMPONENTS

8.1 Main Power Input

High supply voltage				
	Min.	Typ.	Max.	Units
3-phase supply voltage, 50Hz +/- 2.5%	335 ¹⁰		460	VAC; ISO1496-2
3-phase supply voltage, 60Hz +/- 2.5%	400		500 ¹¹	VAC; ISO1496-2

8.2 Mains Circuit Breaker

The Circuit Breaker is protecting against current overload and equipped with mechanical release so that it can work as Main switch as well.

The Circuit Breaker size is selectable between 25A and 32A with C characteristics to be able to handle maximum inrush current and current consumption for the Refrigeration applications covered by this specification. According to the safety standard Earth wire size must follow circuit breaker size.

Circuit Breaker specifications			Units
No of phases	3		
Rated voltage	380 - 690		Vac
Rated current ¹²	25 / 32		A
Tripping characteristic	C		
Mounting	DIN rail		
Wire size	Up to 6		mm2
Wire terminal type	With sleeve		

¹⁰ Min limit adjusted from xxxVac to xxxVac since under voltage lock out (UVLO) is specified at xxxVac.

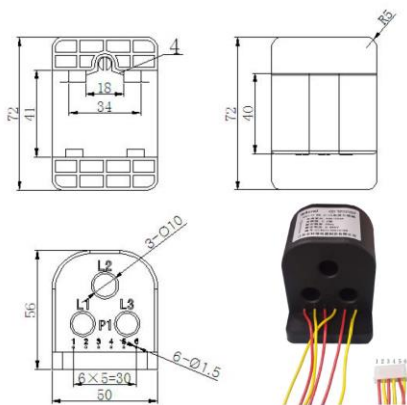
¹¹ Max limit adjusted from 500Vac to XXXVac to handle extreme conditions.

¹² Super Freezer option

8.3 Current Loop Coil

An external three phase current loop coil will be used to measure load current in the system. Placing it externally increase flexibility regarding mounting right after the Circuit Breaker.

Three Phase Current Loop Coil					
	Min.	Typ.	Max.	Units	Range
Current range, 3 phases			50	Aac	
Accuracy		0.2		Class	
Current ratio		50A/25mA			
Mounting		DIN rail			



8.4 Transformer

The mains transformer has two outputs for powering the system components. The wires from the transformer are labelled and internal connection is printed on top of the transformer as specified below together with output voltage and load capability:

Voltage transformer					
	Min.	Typ.	Max.	Units	
Input voltage			500	Vac	
0-24Vac-29Vac output		100		VA	
0-24Vac output		50		VA	
Frequency		50/60		Hz	
Dielectric, Pri/Sec and Pri+Sec to Core		4		kVac/60s	
Insulation Class		B			
Flammability		UL94-HB			
Impregnation and coating		Yes			
Terminals		Screw type			
Tambient +60°C load		150		VA	
Tambient +70°C load		120		VA	
Conform to		IEC61558-1			
		IEC61558-2-4			
Mounting holes 4 pcs		M5			

8.4.0 Label

L1 – L3: 500V
 x - x - x: 24Vac + 5Vac, 100VA
 x - x: 24Vac, 50VA
 Vender name
 Production year/week code
 Type number: TK part number

- Secondary fuse protection:
- Individual protection on digital outputs. 24Vac+5Vac
 - One fuse in each phase on 24Vac power supply.

Mounted on the backwall of the MP-5000 Panel.

8.5 ON/OFF Switch

The ON/OFF switch is used to manually control the power to the Controller. In OFF position the switch breaks the 24Vac and 24Vac +5Vac step-up supplies and the system is off. This means that no outputs related to high voltage components or safety can be activated. Exception is power to the OM-5000. OM-5000 need AC power to shut down Air inlet when the system is switched off. It must be easy for the user to see, access and operate the ON/OFF switch. Nevertheless, it must be located to avoid unintentional activation.

ON/OFF Switch specifications		
		Units
No of contacts/ switch type	DP/DT	
Rated voltage	250	Vac
Rated current	10	A
Mounting	Panel	
Connection	Screw lugs	
Toggle position	ON-None-Off	
IP rating	IP67	

8.6 Contactors

From cost perspective contactors are specified to activate high voltage outputs and phase reversal.

Compressor and Fan motors depend on correct phase sequence and therefor power is fed though the phase reversal contactors. Other outputs are not fed through the phase reversal contactor to avoid unnecessary load and power dissipation on the phase reversal contactors.

The phase reversal and Evap high/low speed contactors must have mechanical interlock function to avoid phase to phase short circuiting. The circuit is made so only one of the phase relay outputs can be activated at a time.

The contactors are mounted on DIN rail and must be orientated so that the movement of the contact sets are perpendicular to the vertical axis of the Reefer to reduce the impact of shocks.

As minimum 25A Contactors must be used for the Compressor and the Phase reversal.

25A contactors has been chosen for all outputs and phase reversal to optimize spare part handling and serviceability.

The voltage for activating the contactors is supplied by the transformer.

The controller does a selection based on the Mains Voltage and frequency, where it selects from the base or a step-up voltage winding on the transformer.

This selection is done to avoid overdrive and heat up the contactor coil during activation.

The contactor is a wearable component and lifetime should be considered with respect to number of operations.

Contactor specifications		
		Units
No of phases; NO	3	
AC-3 Load at Ue=380 – 690Vac	11	kW
Coil voltage; 50Hz/60Hz	24	Vac
Mounting	DIN rail	
Wire size	Up to 6	mm2
Terminal type should fit	Fork with sleeve or Busbar.	

8.7 Heater Element Wire Centre Point

There are no terminals in the MP-5000 Panel for the heater element wires center connection. Hence not part of the System delivery.

The center point for the heater element wires must be connected into a terminal butt splice with closed end and individual openings. The size must fit the Heater element wire sizes. The wires are fixed to the harness with strips.

10 HARNESS

10.1.0 Internal harness

- As minimum the wires must have numeric identification.
- The conductor material must be tinned copper.
- Colour, white
- Must adhere to environmental specification and system voltages regarding temperature and insulation capabilities and must be UL recognized.

Internal harness is very specific and not expected to be changed during lifetime.

Internal harness should use pluggable screw connectors with lock / fixing where relevant.

Internal harness shall use fork connections for high current connections on Contactors. Bus Bars are used to reduce handling, mounting time, save space in the Panel, increase reliability, and decrease heat dissipation. The drawback is a higher component cost.

10.1.1 External harness

External low voltage harness shall have pluggable connection interface inside the Panel.

External High voltage harness shall connect to already available terminals.

External harness shall use fork connections for Contactors.

10.1.2 Earth wire

For safety Earth must be wired internally in the Panel. The size of the Earth wire is pending on the selection of the size of the Circuit Breaker. Ground connection must follow safety regulation applied to this specification.

11 HMI

11.1 Display DM-5000

The DM-5000 consist of an enclosure with a PBA mounted with a 240x96 dot matrix display module. The PBA is mounted on the front door as depicted below. Two LEDs are indicating In Range (green) and Alarm (Red). The DM-5000 has a serial RS485 interface to the CM-5000. The DM-5000 is managing input from the keypad (KM-5000) and pass it on to the CM-5000.

Below is listed some of the basic specifications for the 240x96 dot matrix display module. The complete display will be tested according to environmental and electrical tests specified in this document.

Display Module Specifications		
		Units
LCD type	FSTN Transflective/Positive	
LCD view direction	12 O'clock	
Number of dots	240x96 dot matrix	
Temperature operating	-30 - +70	°C
Temperature storage	-30 - +85	°C
Backlight	White LED	
Connector	24 pin FPC	

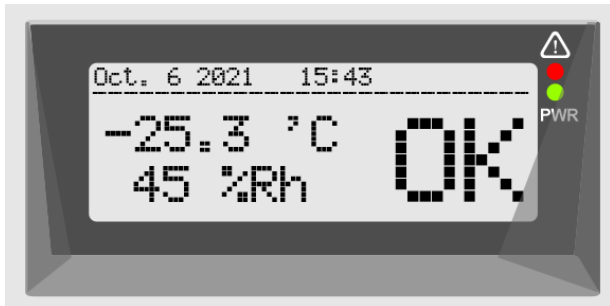
11.2 Connectors

For interface to the CM-5000 3.81 mm connector 5 pole with fixing is used.
For interface to the Keypad 2.5mm connector 7pole with lock is used.

11.3 Connection list

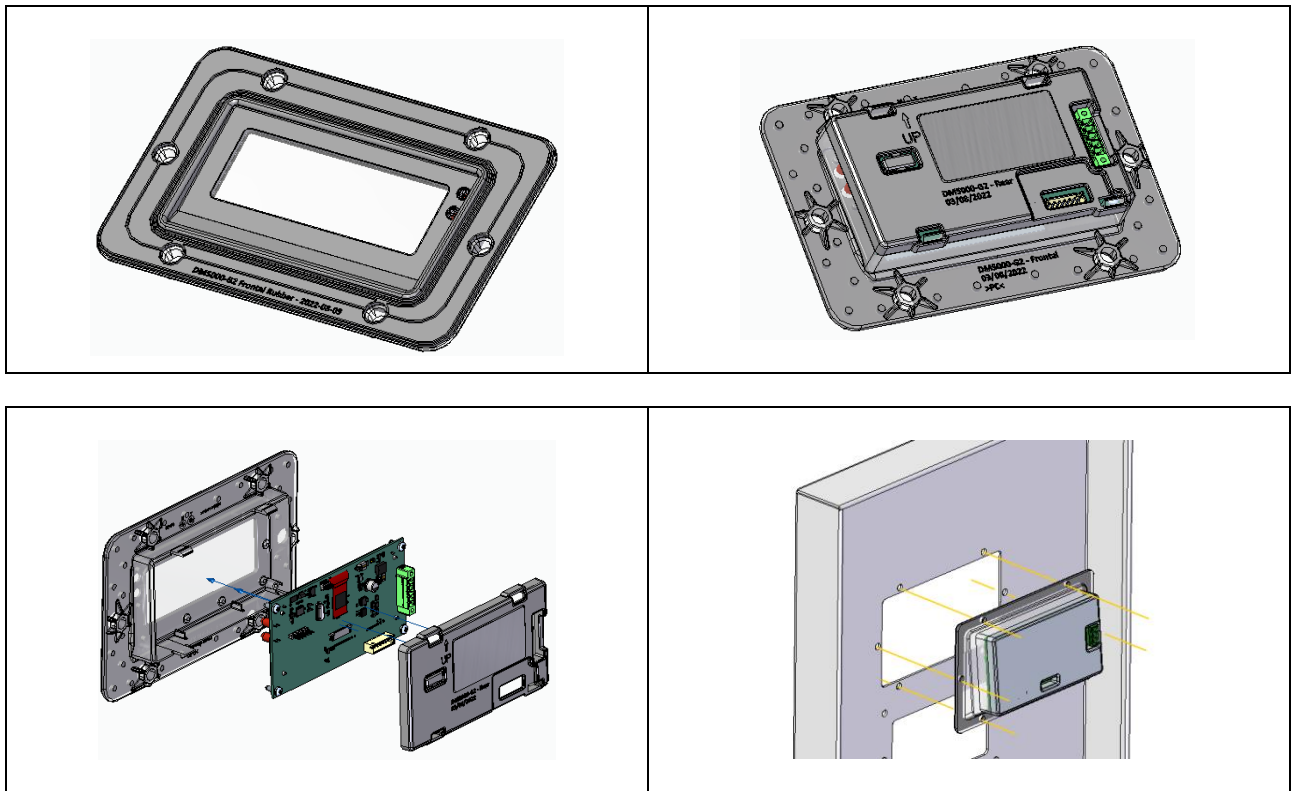
DM-5000 PIN SETUP		
Pin#		Connector type
J1.1	12V Voltage supply	Interface between display and controller
J1.2	Tx+/Rx+	
J1.3	Tx+/Rx-	
J1.4	/Wakeup	
J1.5	Ground	
J9.1	Row4	Interface between display and keypad
J9.2	Row3	
J9.3	Row2	
J9.4	Row1	
J9.5	Col2	

J9.6	Col1	
J9.7	/Wakeup	



(Note: the texts and information displayed are only an example, they don't represent the real UI) [update picture](#)

Based on the existing Visograf 2.0
Mount from backside of the Door



Keypad and Display shall be available as separate spare parts

11.3.0 Material:

Same as MP4000 = PC ASA (for the not transparent parts)

Same used on similar EMR Main Controller = Transparent PC

Unit is tested and passes with 30 Seconds with flaming drips allowed UL-94-HB (minimum), Better is to reach UL-94-V0

Shall be constructed of fire-retardant materials

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Transportation Solutions

Author: Jakob.Riis.Lorentsen@copeland.com

The material must withstand the marine environment as described elsewhere in this document
 Shall provide an interface that can be operated in wet weather.

Enclosure IP:

- From the Frontal Side (LCD Side) and the Metal Door: IP56
- Other Parts Inside the Metal Door: IP20

In front of the LCD must be present a "robust" transparent protection (like a transparent window)

11.3.1 Fixing into the Panel

It is preferable to use screws to allow quick assembly and quick replacement in case of failure
 Use Phillips head screws (standard)

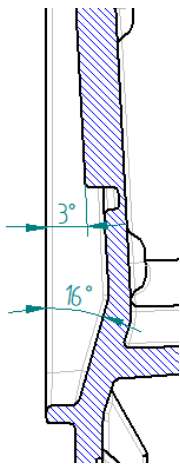
11.3.2 Labelling

Outside the enclosure there must be a label showing the identification information and the main data of the product
 and which complies with the requirements of approvals

11.3.3 Tilted position of the Display

The Display of the DM-5000 must be tilted to allow its view from the ground when the Reefer is positioned in the 3rd
 level (over other 2 Reefers) by 25 feet distance.

The display must be tilted 3° by the vertical surface of the Door.



11.4 Keypads

The Keypad area contains 8 function keys in a 2 x 4 arrangement. See concept as depicted below.

The function of the keys is:

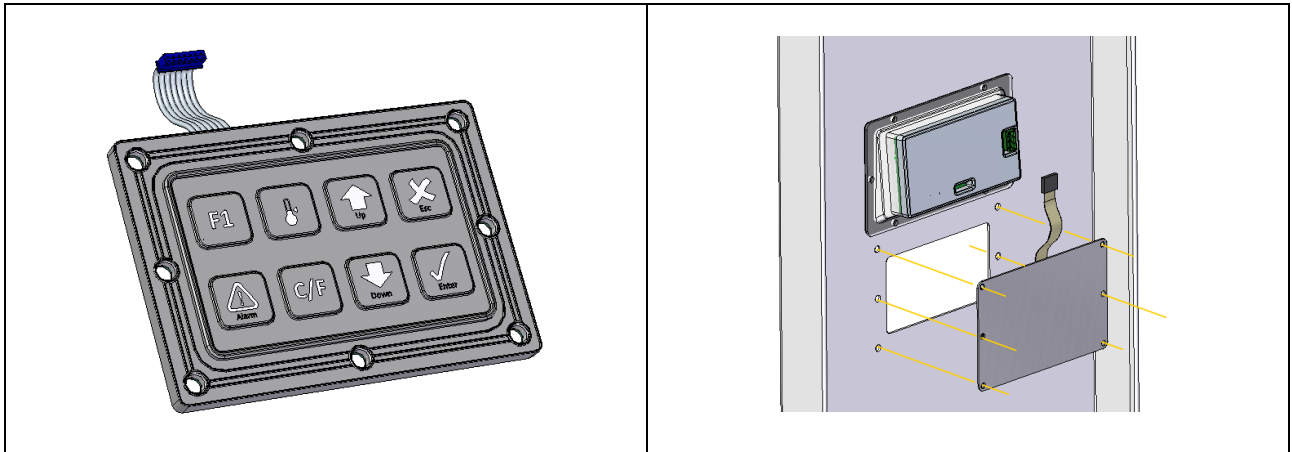
F1(/wakeup)	Symbol (setpoint)	UP	X - ESC
ALARM+ symbol	C/F	DOWN	ENTER

The Keypad is connected to the DM-5000.

In battery mode the F1 key can be used to wake up the system. If the wakeup does not happen it can indicate that the battery is deep discharged and must be charged.

The overlay is a silicone mold with symbols as shown below made with TK specified colors and symbols. The overlay also acts as gasket.

Mount from backside of the Door



Marine controller shall provide an interface that can be operated in freezing weather.

User can operate the unit (setup and monitoring) during periods of freezing weather (sleet, snow) without issue.

User can operate the unit with large or bulky gloves in all weather conditions.

Keypad and Display shall be available as separate spare parts

Keypad must be removed and substitute without "de-glue" the keypad

Enclosure IP:

- From the Frontal Side (Buttons Side) and the Metal Door: IP56
- Other Parts Inside the Metal Door: IP20

11.4.0 Fixing into the Panel

It is preferable to use screws to allow quick assembly and quick replacement in case of failure

Use Phillips head screws (standard)

11.5 LED indication

Green = In Range

Red = Alarm

Size = Ø5mm

Status LED's visible from 25 feet distance.

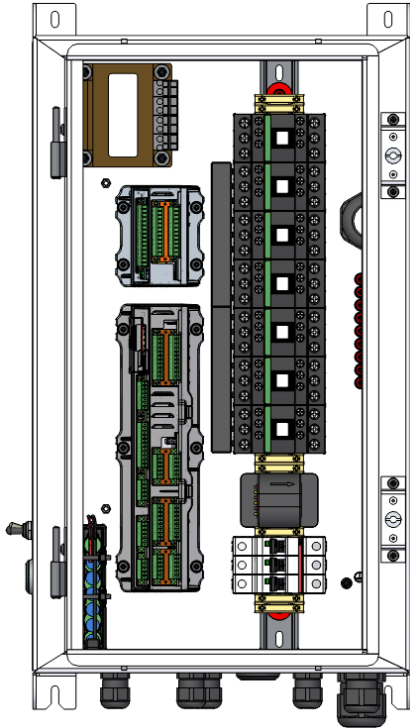
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12 PANEL BOX MECHANICAL

12.1 “Metal Bottom” rear Box



12.1.0 Outline

- Total height same as MP-3000
- Mounting on reefer; benchmark MP-3000 on distance to the Reefer backwall. The 4 mounting screws like used on the MP-3000.
- Widen the opening as much as possible to access the internal components like Contactors, Braker, Cables...
- The position of the outer surface of the Door cannot increase outwards from the current situation
- Maintain the inclination of the wall above 2.6 degrees as present in MP4000 and MP3000 (to facilitate water drainage)
- Mount the internal components of the Metal Bottom away from the bottom. The reason is to keep them away from the possible presence of condensation water
- The Controller shall be no more than 20% heavier than the current MP4000. (MP4000 control box is 14.5 kilograms)
- Shall provide an enclosure that is recessed from exterior plane of the reefer system by 40MM (+/- 5mm). Less is unacceptable due to the risk of impact damage. More is unacceptable due to the impact on visibility of screen at an angle.
- Panel shall be protected from a marine environment.
- Panel enclosure is constructed and coated to prevent corrosion.
- Position the Battery Pack close to the Controller to reduce the length of the wires.

12.1.1 Material

As MP-4000:

- Alu 5052, 2.0mm thickness, 2.0mm bending radius on the corners
- Stainless steel A4 (for example for the Hinges)
- Enclosure and components used shall be constructed of fire-retardant materials.
- Unit is tested and passes with 30 Seconds with flaming drips allowed UL-94-HB (minimum). Better to use UL-94-V0
- Enclosure colored in off-white RAL 9016 with gloss finish 90

12.1.2 Surface treatment

Pre-treated and top coated with polyester powder as on the MP-4000

12.1.3 Hinges

Hinges: Stainless steel A4 and mylar

Male Hinges on the Metal Bottom Box

Door closer receiving brackets will be easily replaced or repaired when damaged (e.g.: cross threaded closing screw) - like MP3000 control box

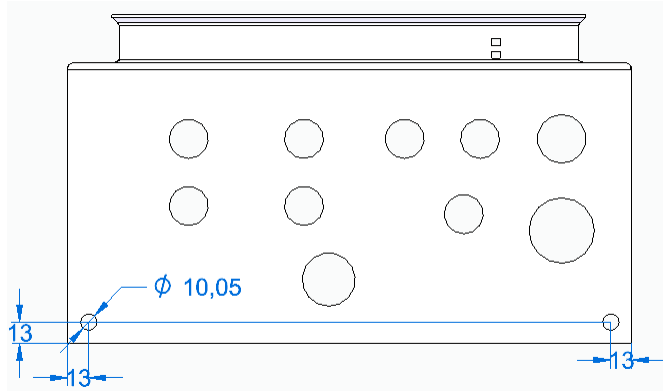
Shall not include any hinge design elements that require welding to replace.

Shall provide hinges mounts that are replaceable without the need for welding. Screw fastening is acceptable.

12.1.4 Drain holes

Same solution and position as for the MP-4000

(Only on the lower face of the Box)



12.1.5 Mounting holes

Same mounting as for the MP-3000.

12.1.6 Cable relief

Tie wrap anchors where relevant. Anchor + tie + rivet

12.1.7 Cable glands

Same numbers of cable glands as latest MP-4000. Metric types are used. Re-located the cable glands compared to a MP-4000 Panel to optimize cable routing inside the MP-5000.

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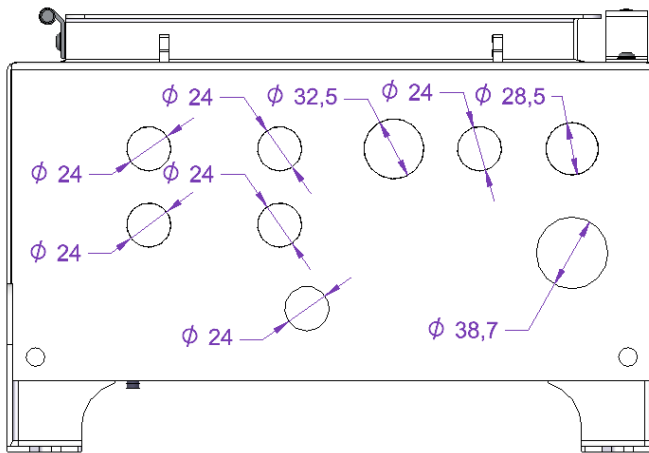
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Author: Jakob.Riis.Lorentsen@copeland.com

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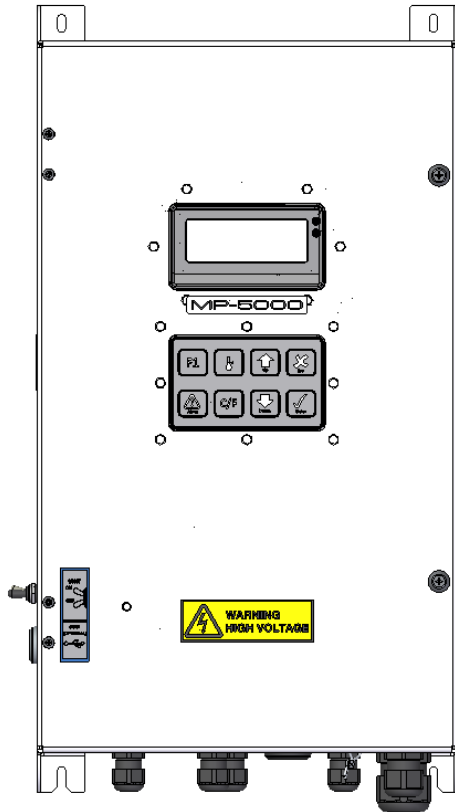
12.1.8 On/Off Switch location

The On/Off switch is located on the left side of the MP-5000 Panel. At this location it is relatively easy to see and operate the switch and it is also protected from unintentional impacts.

12.1.9 External USB connector location

The external USB connector is located on the left side of the MP-5000 Panel. Placed underneath the ON/OFF switch. This is an option and if not mounted the hole in the Panel must be blinded with plate for optional Deutch, Optional Bridgelight.

12.2 Front “Metal Door”



12.2.0 Outline

Plane door, display angle done on display enclosure part.

Keys mounted from behind as well.

Follow IP56.

The position of the outer surface of the Door cannot increase outwards from the current situation

Marine controller shall have enclosure branded with MP-5000 Brand Logo.

12.2.1 Material

As MP-4000:

- Alu 5052, 2.0mm thickness, 2.0mm bending radius on the corners
- Stainless steel A4 (for example for the Hinges)

Enclosure colored in off-white RAL 9016 with gloss finish 90

12.2.2 Surface treatment

Pre-treated and top coated with polyester powder as on the MP-4000

12.2.3 Hinges

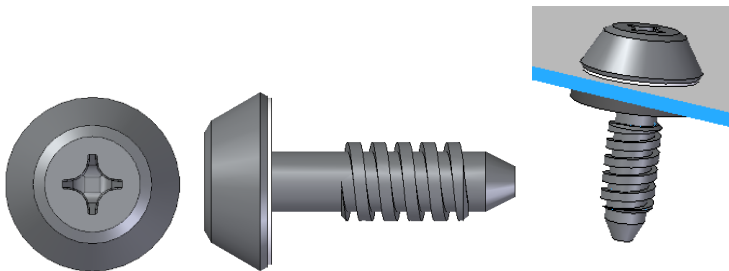
Hinges: Stainless steel A4+mylar
 Female Hinges on the Metal Door

Door closer receiving brackets will be easily replaced or repaired when damaged (e.g.: cross threaded closing screw) - like MP3000 control box

Door shall not include any hinge design elements that require welding to replace.

12.2.4 Locking screws

Philips screw with slot A4 with mylar washer and Nylon retainer for screw.



12.2.5 Front Door Gasket.

The Front Door gasket is dispensed on the Front Door as a form in place foam gasket. This approach gives an accurate uniform size and placement in an economical way.

The performance characteristics for the foam gasket:

RAKU-PUR® 32-3250-8 is a thixotropic, two-component polyurethane system. It consists of a filled resin component A and a hardener component B (MDI). The system contains no solvents, plasticizers or halogenated hydrocarbons. It is characterized by:

- high sealing performance high tensile strength
- very low foam density very short cure and assembly time
- very low water absorption good value / performance
- compact, hydrophobic integral skin good mounting adhesion to metal surfaces
- high mechanical strength / tear resistance listed UL 50, UL 94 Excellent compression recovery

Temperature resistance

long-term - 40 °C to + 100 °C
 short exposure up to + 160 °C

The mixing ratio of the two-component material shall fit shore 00 = 60 +/-5.

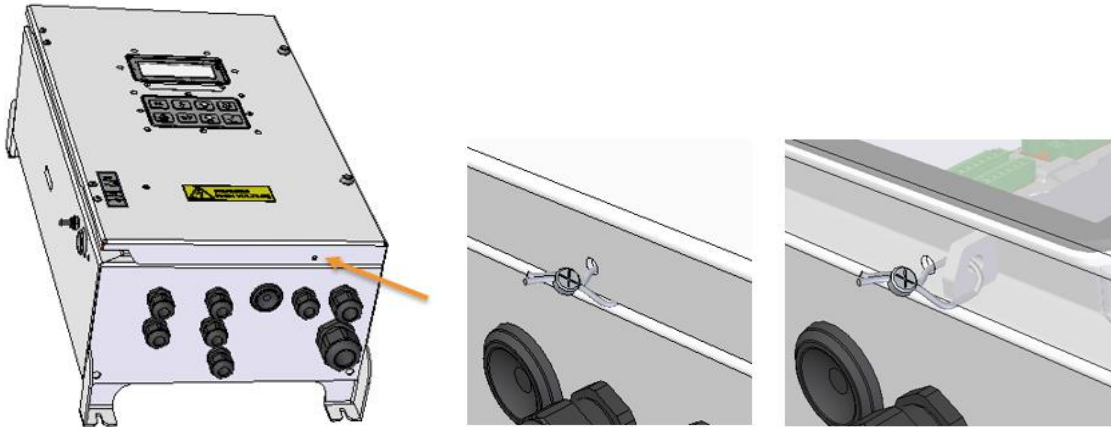
Geometry of the front door, hinges, and door lock must be designed to control and follow recommended compression of door gasket.

12.2.6 Logo

No need for customer logo on MP-5000

12.2.7 Customs Seal

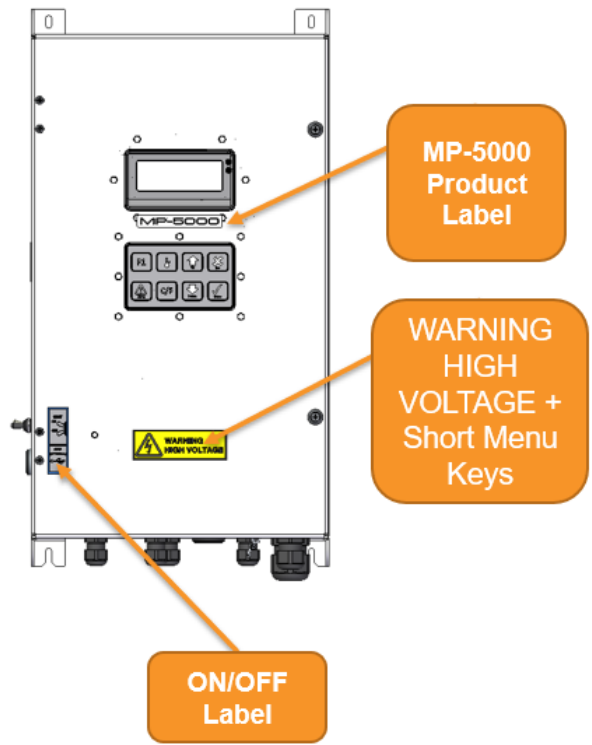
Wire through hole in retainer bracket and hole in the front door.



13 LABELING

13.1 External Label

- Proposal of the Labels and their position:



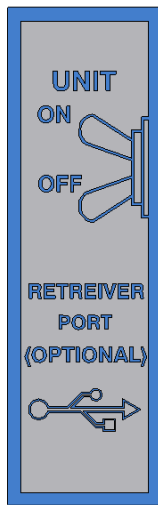
- o
- MP-5000 Product Label



- WARNING HIGH VOLTAGE



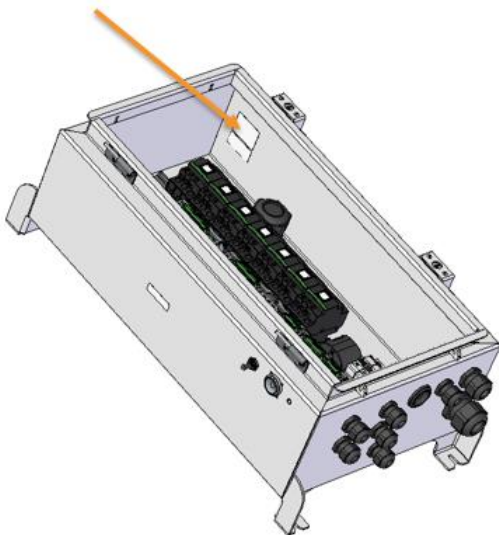
- ON/OFF Position



○

13.2 Internal Label

Product label for the MP-5000 Panel must be located inside the Panel protected from environmental damage. The label must show the identification information and the main data of the product, and which complies with the requirements of approvals.



14 OPTIONAL COMPONENTS

14.1 Copeland MODEM

Copeland Modem is a modem mounted externally. The modem relates to a serial line to the CM-5000.

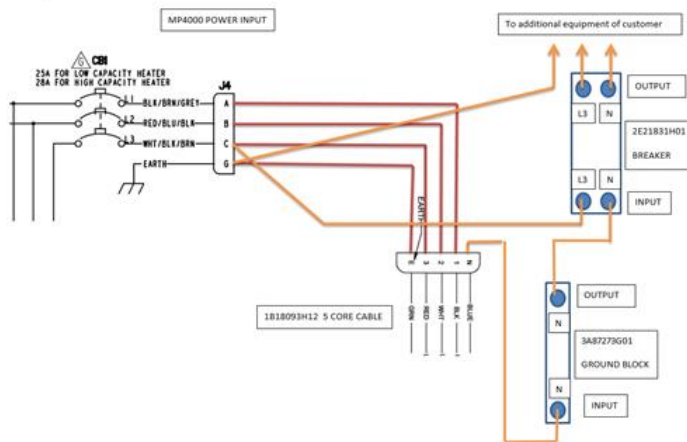
Alternative mounting must be made since ordinary mounting is not considered for combined application with RMM.

14.2 RMM Slave

Space is reserved for mounting RMM Slave inside MP-5000. The RMM is mounted with screws and optional harness is mounted to interface to the CM-5000 and the Main's.

14.3 External light

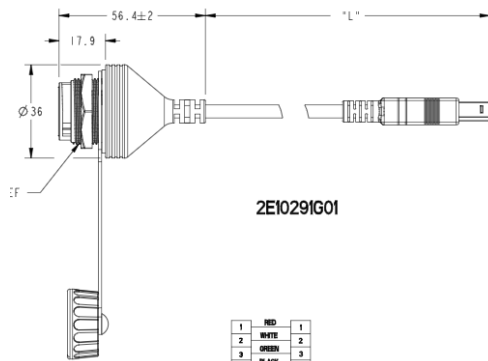
Option for applying external light is not in the MP-5000 Panel. Space is reserved for one 2 phase CB and one terminal block.



14.4 External USB C connection

The MP-5000 Panel is prepared for mounting an optional extension cable and make the USB type C interface accessible from outside without opening the front door.

TK specified extension cable appearance:



2E10291G01

1	RED	1
2	WHITE	2
3	GREEN	3
4	BLACK	4
WELL	DRUM	WELL
NEP		PLUG

WIRING DIAGRAM

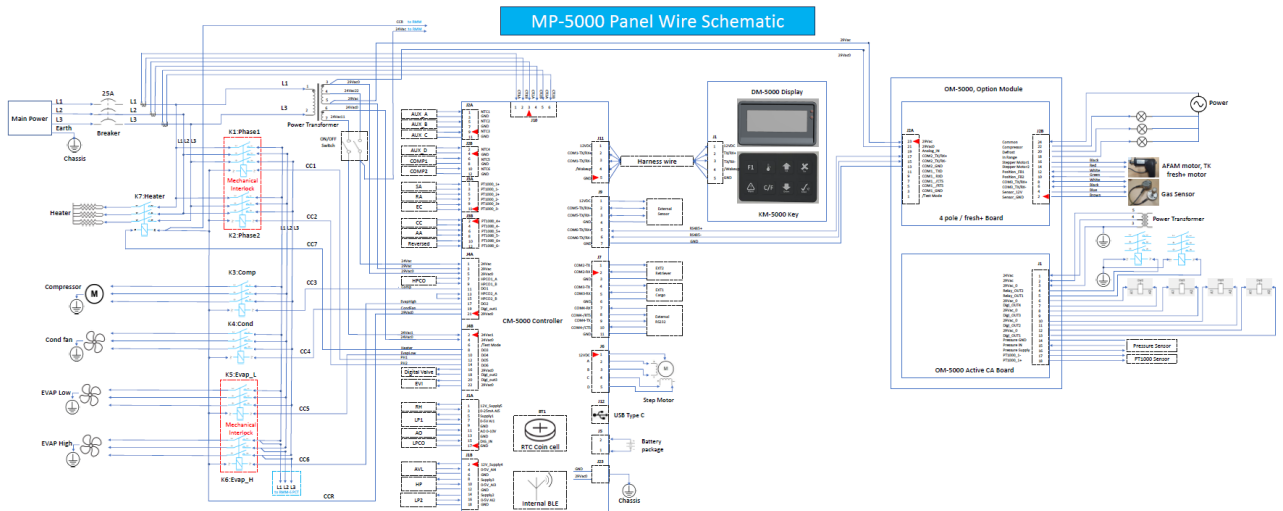
15 SUPPORTING EQUIPMENT

15.1 Field Test Kit

Test program using plugs and harness in a suitcase for field testing on a complete MP-5000 Panel mounted on the Unit.

16 MP-5000 PANEL WIRE SCHEMATIC

Wire schematic below shows internal wire harness and connection to external components.



Document Revision Record

Rev.	Date	Author	Brief description of change	Pages affected
0.0	210413	JRL/DVS	Original	All
0.2	210422	JRL/DVS	Changed into one common controller and option module	
0.3	210428	JRL/DVS		
0.4	210504	JRL/DVS	General update	All
0.7	220906	JRL/DVS	General update	All
0.8	220908	JRL	Section 12.2.4	52
0.9	221107	JRL	Section 4, 12.2.5, 13.1, 16	All
1.0	240716	JRL	Section 1,3,4, 5, 6.1, added 6.2.5, 6.2.8, 7, 14.1, 16	All
1.1	24xxxx	JRL	Section 1,3.1.0, 4, 6.4,6.14,7.3,12, 13 added 3.1.4	All