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OHIO MAGNETICS 24 V LSM for TRUCK BOX & ESCAVATOR CONTROLLER

Figure 1. Main Control module for Box

DESCRIPTION

The 24 V LSM Magnet Controller and the Truckbox magnet controller are heavy-duty controllers used for magnets whose cold current ranges from 0 to 100 A @ 24 V. Cold current references the current flowing through the magnet when the magnet temperature is 25°C throughout. As the magnet temperature increases, the current decreases.

The magnet controller is housed in an enclosure. The enclosure can either be surface mounted or top mounted or in other instances, (below a truck bed). The enclosure is sealed to prevent corrosion for on highway use. The enclosure houses the controller panel, an equalizer, two AGM deep cycle batteries, a battery convertor for 12/24 V operation and a disconnect for disabling the controller for service and storage.

For general lifting the 24 V mode will be selected. For sweeping, the magnet power can be switched to 12 V mode.

On 24 V electrical systems, the 24 V alternator directly powers the magnet when 24 V mode is selected(IF APPLICABLE). If the alternator current is not sufficient, the batteries will provide the additional current. When 12 V mode is selected(IF APPLICABLE), the magnet current is provided by the batteries. The alternator will maintain the battery charge level any time the master switch is ON and the magnet is OFF. The alternator must have a

maximum of 100 A over typical capacity for the magnet system and it is recommended to utilize the high idle request signal to ensure the alternator has adequate cooling during magnet operation.

On 12 V electrical systems, the 12 V alternator directly powers the magnet when 12 V mode is selected. If the alternator current is not sufficient, the batteries will provide the additional current. When 24 V mode is selected, the magnet current is provided by the batteries. The alternator will maintain the battery charge level any time the master switch is ON and the magnet is OFF. The alternator must have 50 A of extra capacity for the magnet system. Use of the high idle request is optional – review your total alternator demand and utilize it if required by your application. The 12 V system also includes an ignition input which prevents parasitic losses from the converter when the vehicle engine is off.

SAFETY

This system and its installation have been designed with safety considerations in mind. It is up to the installer to ensure the final installation meets any local, state, country or other code required by the end user.

Safety features provided:

- Lock Out / Tag Out capable main disconnect: This switch completely isolates the control unit and breaks all input and output power.
- Female connectors are provided on all OUTPUT power connections to prevent live wires from contacting metal components when disconnected.
- Fused cabinet to help prevent fire from overload or short circuits.
- A sealed, vented cabinet (to spray) to help prevent corrosion and water intrusion to the electrical components.
- The magnet will stay energized during the following events:
  - Vehicle engine turned off. Magnet will stay energized if the cabinet battery voltage > 18 V.
- The magnet will turn off if:
  - Any Magnet Power cable is disconnected or cut during operation.
  - The control box cable is cut or disconnected during operation.
  - The main disconnect switch is turned OFF during operation.

As with any magnet system, it is not designed to transport people. It should NEVER be with personnel underneath the magnet system. Reference local site safety plans for lifting devices and cranes before use.

INSTALLATION PROCEDURES

1. Mounting Controller under a vehicle:
   - Mount the controller in a location convenient for accessing the internal and external components. Try to mount the box in a location outside of the direct path of tire spray. A mud guard / splash guard is recommended if the box is subject to direct tire spray.
   - The controller must be mounted vertically with the TOP up to operate properly.
   - Mount the controller away from sources of heat and direct exhaust of engines.
   - Allow enough room around the controller for air circulation.

2. Electrical Connections are made via the attached plugs and connectors which are located on the back of the unit. Utilize the schematics below to ensure proper wiring connections are made. There are individual connections for:
    - Power In using a Connomac polarized connector. Be sure to wire the Negative (-) to the white conductor and Positive (+) to the black conductor.
    - Power Out using a Connomac non-polarized connector.
    - Magnet Controls (12/24 V Selector, Lift/Drop if applicable) via an IP67 4 pin connector.
    - Vehicle Interface (High Idle, Ignition if applicable) via an IP67 3 pin connector.
        - o Both 12 V & 24 V signals are available in the enclosure.

    Wiring from the vehicle power, wiring to the magnet and high idle / ignition wires are not included with the system. Our system includes just pigtails which you can connect user provided #2 (35 mm²) wire. This size of cable will be sufficient to reduce voltage drop.
3. A magnet control box is provided with each unit which has maintained switches. It is possible to eliminate this box and utilize existing crane controls or joystick buttons with momentary switches.

4. It is optimal to connect the system directly to the alternator output (either on alternator or inside fuse box). If access to the alternator terminals are not possible, connection to the vehicle batteries is permissible. Connecting to the vehicle batteries will give extra capacity to this system but will also cause additional cycles on typically starting type batteries – not made for deep cycling.

    For ON-ROAD VEHICLES - An inline fuse is required (not supplied) at the power source. It should be sized at 50 A @ 12 V or 100A @ 24 V. This will protect the vehicle in the event of a cut and/or damaged wire between the power source and the control box. The fuse is recommended for other types of vehicles.

5. Connect the high idle output from the controller to the high idle request switch on the vehicle utilizing a minimum 18-gauge (1.0 mm²) wire. This is typically inside the vehicle fuse box. The high idle selection is via a relay contact in the controller. The connection is made via the 3 pin WSC connector. A 12 or 24 V source from the engine (Wire designation P) is required to be fed to the contact pin 1 and the return to the high idle input (Wire designation Q) is on pin 3.

6. Connect the ignition source (12 V Systems Only) to the Ignition Power of the vehicle with an 18-gauge (1.0 mm²) wire. This is typically inside the vehicle fuse box. The ignition selection is via a terminal on the voltage converter/equalizer. The connection is made via the 3 pin WSC connector on pin 2. This connection is labelled as wire designation S.

CONNECTING THE MAGNET SYSTEM

1. Ensure the master switch is in the OFF position.
2. Plug in the Vehicle Power to the Power In (Polarized Connector) 3. Plug in the Magnet to the Power Out (non-Polarized Connector)
4. Connect the 2 pin High Idle / Ignition plug.
5. Connect the Magnet Controls to the 4 Pin plug.

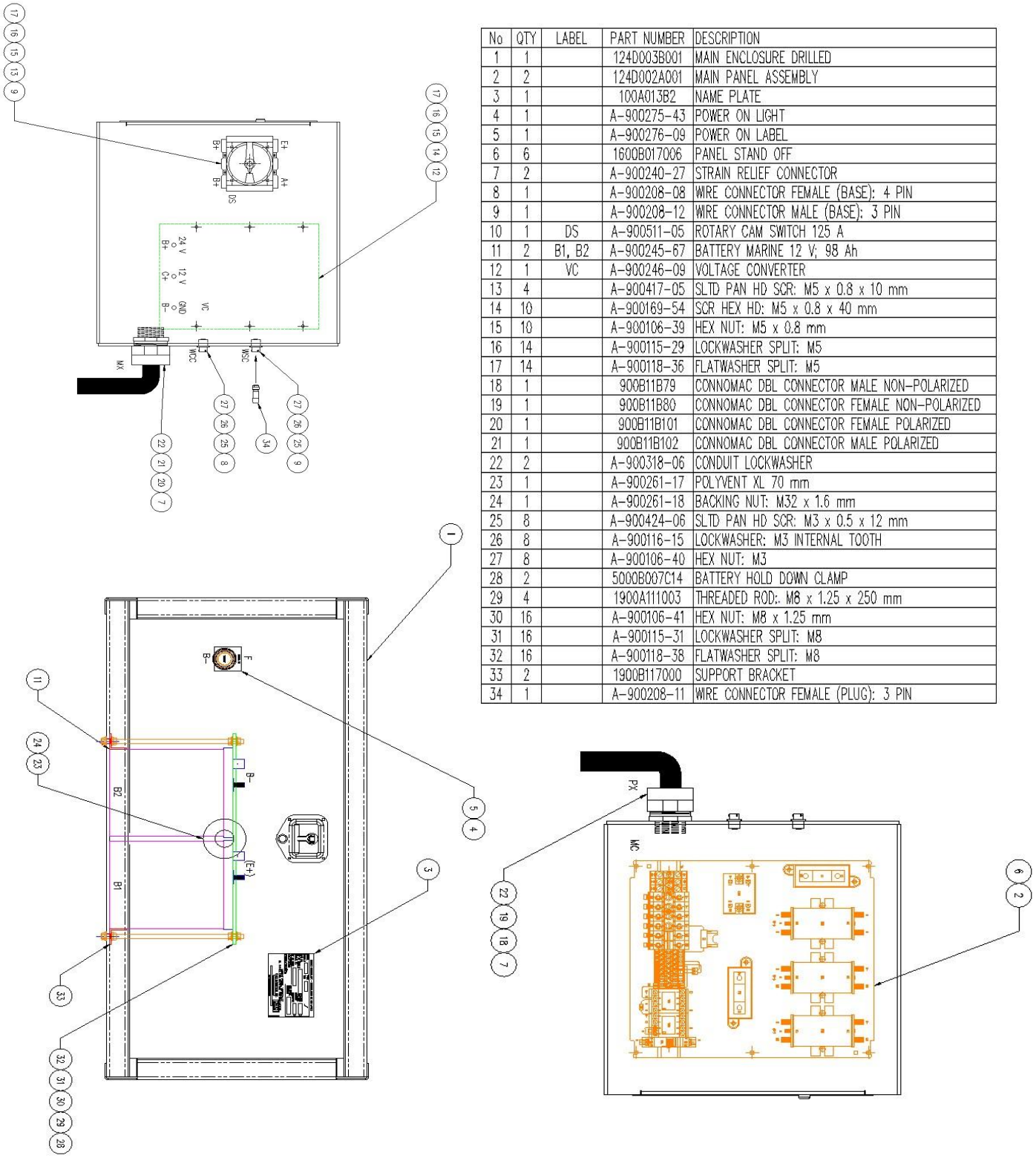
6. Turn on the master switch and ensure the yellow light is illuminated on the cabinet.
7. Test the magnet to ensure it lifts and drops properly. Ensure nobody is in the lift/drop area for safety.

8. See Troubleshooting section for more information if the light does not illuminate or the magnet does not lift.

9. The system is now ready for use.

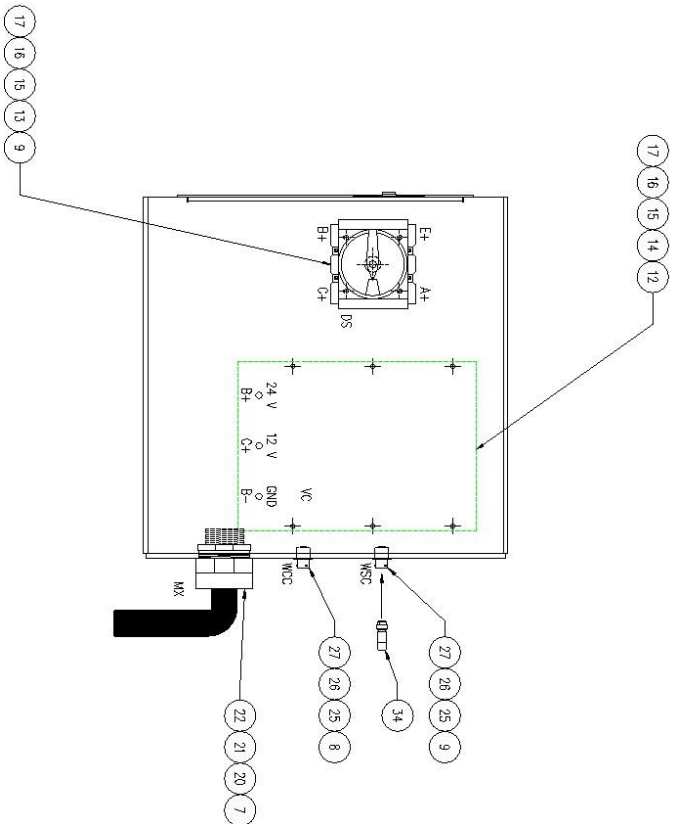
10. It is recommended to turn OFF the master switch when the vehicle is out of service (end of day, shift, maintenance) as the converter has some parasitic losses that will drain the vehicle batteries if left in the ON position.

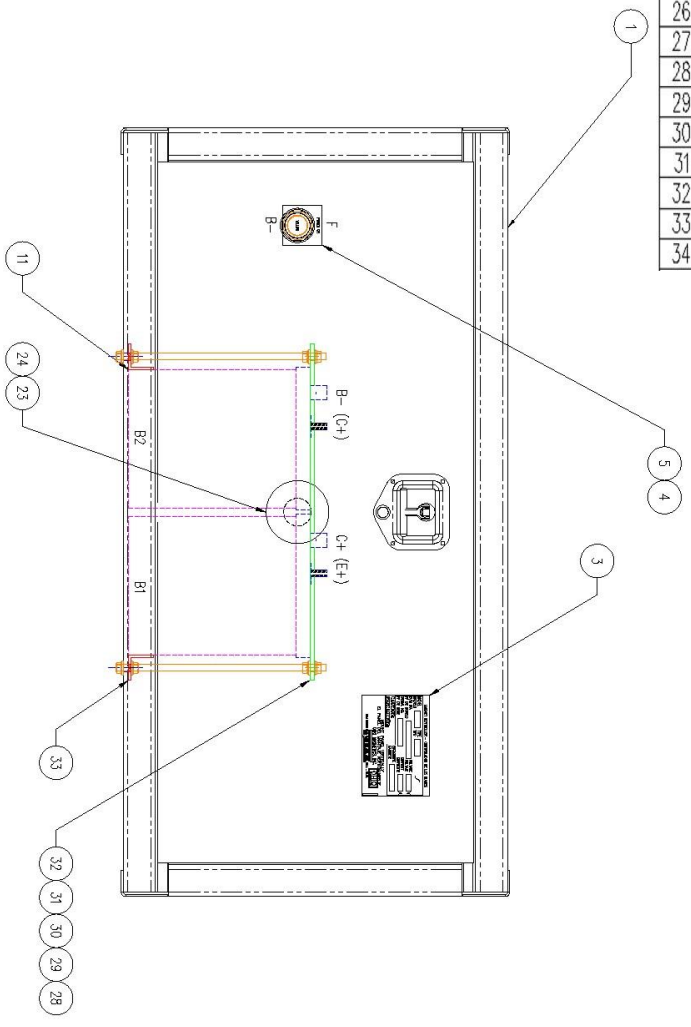
ENCLOSURE ASSEMBLY GUIDE TRUCKBOX (24 V source - 124D001B001):

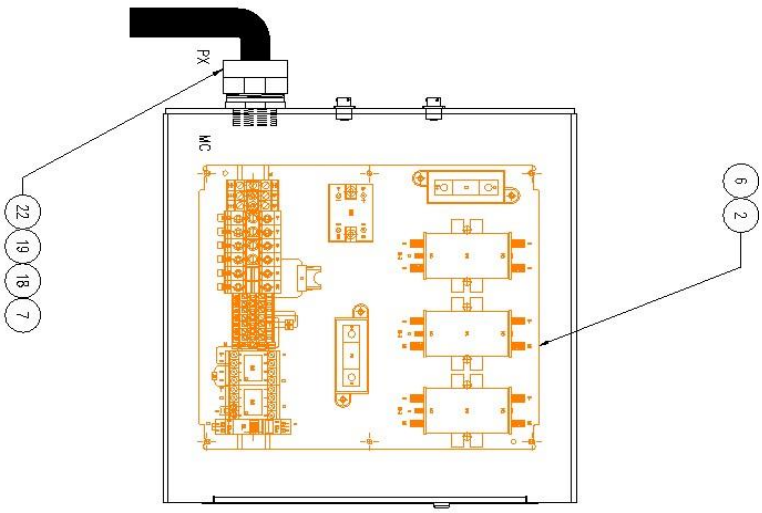


No	QTY	LABEL	PART NUMBER	DESCRIPTION
1	1		124D003B001	MAIN ENCLOSURE DRILLED
2	2		124D002A001	MAIN PANEL ASSEMBLY
3	1		100A013B2	NAME PLATE
4	1		A-900275-43	POWER ON LIGHT
5	1		A-900276-09	POWER ON LABEL
6	6		1600B017006	PANEL STAND OFF
7	2		A-900240-27	STRAIN RELIEF CONNECTOR
8	1		A-900208-08	WIRE CONNECTOR FEMALE (BASE): 4 PIN
9	1		A-900208-12	WIRE CONNECTOR MALE (BASE): 3 PIN
10	1	DS	A-900511-05	ROTARY CAM SWITCH 125 A
11	2	B1, B2	A-900245-67	BATTERY MARINE 12 V; 98 Ah
12	1	VC	A-900246-09	VOLTAGE CONVERTER
13	4		A-900417-05	SLTD PAN HD SCR: M5 x 0.8 x 10 mm
14	10		A-900169-54	SCR HEX HD: M5 x 0.8 x 40 mm
15	10		A-900106-39	HEX NUT: M5 x 0.8 mm
16	14		A-900115-29	LOCKWASHER SPLIT: M5
17	14		A-900118-36	FLATWASHER SPLIT: M5
18	1		900B11B79	CONNOMAC DBL CONNECTOR MALE NON-POLARIZED
19	1		900B11B80	CONNOMAC DBL CONNECTOR FEMALE NON-POLARIZED
20	1		900B11B101	CONNOMAC DBL CONNECTOR FEMALE POLARIZED
21	1		900B11B102	CONNOMAC DBL CONNECTOR MALE POLARIZED
22	2		A-900318-06	CONDUIT LOCKWASHER
23	1		A-900261-17	POLYVENT XL 70 mm
24	1		A-900261-18	BACKING NUT: M32 x 1.6 mm
25	8		A-900424-06	SLTD PAN HD SCR: M3 x 0.5 x 12 mm
26	8		A-900116-15	LOCKWASHER: M3 INTERNAL TOOTH
27	8		A-900106-40	HEX NUT: M3
28	2		5000B007C14	BATTERY HOLD DOWN CLAMP
29	4		1900A111003	THREADED ROD:. M8 x 1.25 x 250 mm
30	16		A-900106-41	HEX NUT: M8 x 1.25 mm
31	16		A-900115-31	LOCKWASHER SPLIT: M8
32	16		A-900118-38	FLATWASHER SPLIT: M8
33	2		1900B117000	SUPPORT BRACKET
34	1		A-900208-11	WIRE CONNECTOR FEMALE (PLUG): 3 PIN

TOOLBOX ENCLOSURE ASSEMBLY GUIDE (12 V source – 124D001B002):

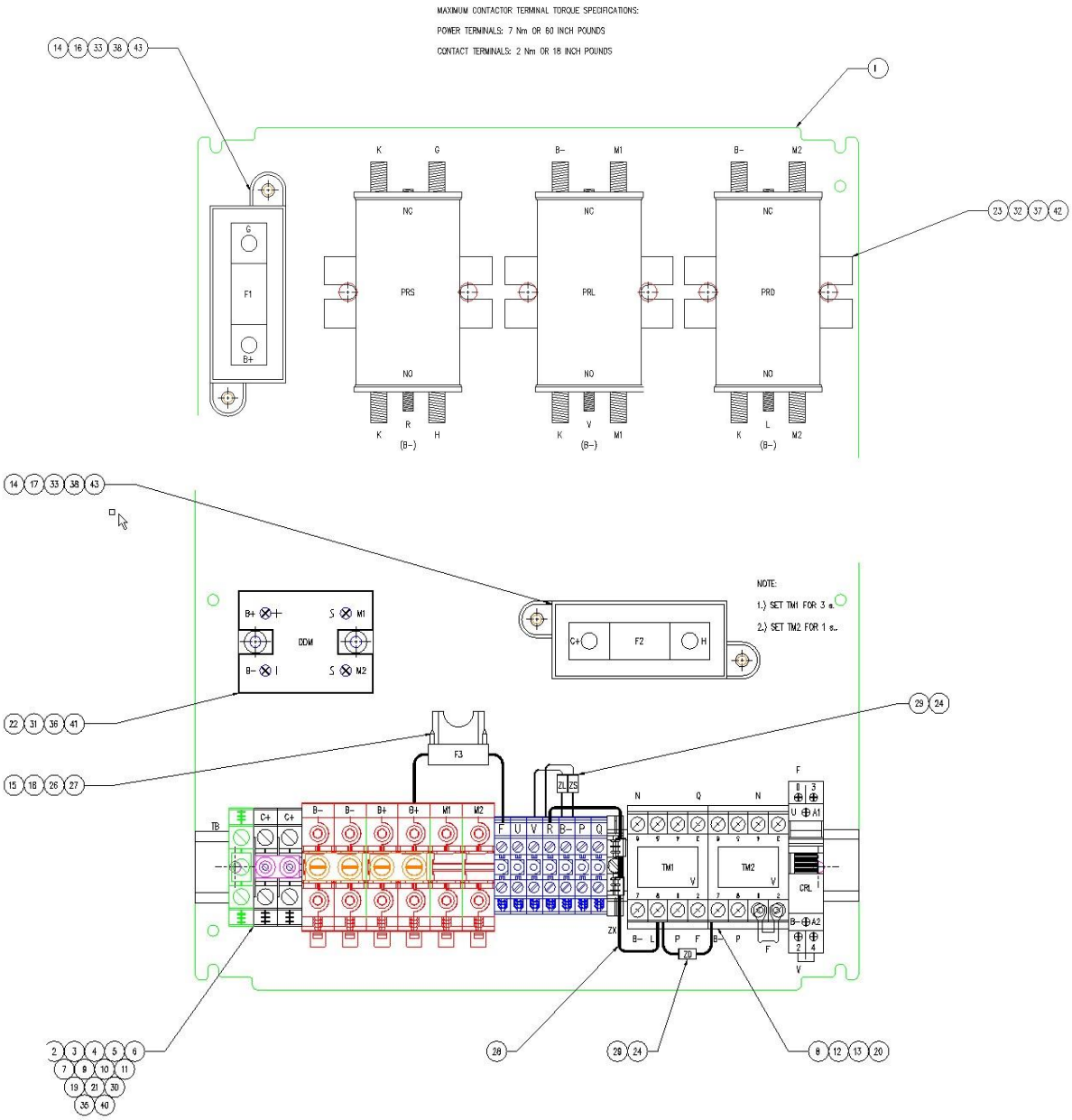






No	QTY	LABEL	PART NUMBER	DESCRIPTION
1	1		124D003B001	MAIN ENCLOSURE DRILLED
2	2		124D002A001	MAIN PANEL ASSEMBLY
3	1		100A013B2	NAME PLATE
4	1		A-900275-43	POWER ON LIGHT
5	1		A-900276-09	POWER ON LABEL
6	6		1600B017006	PANEL STAND OFF
7	2		A-900240-27	STRAIN RELIEF CONNECTOR
8	1		A-900208-08	WIRE CONNECTOR FEMALE (BASE): 4 PIN
9	1		A-900208-12	WIRE CONNECTOR MALE (BASE): 3 PIN
10	1	DS	A-900511-05	ROTARY CAM SWITCH 125 A
11	2	B1, B2	A-900245-67	BATTERY MARINE 12 V; 98 Ah
12	1	VC	A-900246-07	VOLTAGE CONVERTER
13	4		A-900417-05	SLTD PAN HD SCR: M5 x 0.8 x 10 mm
14	10		A-900169-54	SCR HEX HD: M5 x 0.8 x 40 mm
15	10		A-900106-39	HEX NUT: M5 x 0.8 mm
16	14		A-900115-29	LOCKWASHER SPLIT: M5
17	14		A-900118-36	FLATWASHER SPLIT: M5
18	1		900B11B79	CONNOMAC DBL CONNECTOR MALE NON-POLARIZED
19	1		900B11B80	CONNOMAC DBL CONNECTOR FEMALE NON-POLARIZED
20	1		900B11B101	CONNOMAC DBL CONNECTOR FEMALE POLARIZED
21	1		900B11B102	CONNOMAC DBL CONNECTOR MALE POLARIZED
22	2		A-900318-06	CONDUIT LOCKWASHER
23	1		A-900261-17	POLYVENT XL 70 mm
24	1		A-900261-18	BACKING NUT: M32 x 1.6 mm
25	8		A-900424-06	SLTD PAN HD SCR: M3 x 0.5 x 12 mm
26	8		A-900116-15	LOCKWASHER: M3 INTERNAL TOOTH
27	8		A-900106-40	HEX NUT: M3
28	2		5000B007C14	BATTERY HOLD DOWN CLAMP
29	4		1900A111003	THREADED ROD: M8 x 1.25 x 250 mm
30	16		A-900106-41	HEX NUT: M8 x 1.25 mm
31	16		A-900115-31	LOCKWASHER SPLIT: M8
32	16		A-900118-38	FLATWASHER SPLIT: M8
33	2		1900B117000	SUPPORT BRACKET
34	1		A-900208-11	WIRE CONNECTOR FEMALE (PLUG): 3 PIN

CONTROLLER PANEL PARTS LIST (12 & 24 VDC VERSIONS):



No	QTY	LABEL	PART NUMBER	DESCRIPTION
1	1		124D003A001	MAIN PANEL DRILLED
2	2		A-900234-37	TERMINAL BLOCK SEGMENT: WKN 16
3	1		A-900234-40	TERMINAL GROUND BLOCK SEGMENT: WKN 16
4	7		A-900234-36	TERMINAL BLOCK SEGMENT: WK 6
5	6		A-900234-57	TERMINAL BLOCK SEGMENT: WKN 35
6	330		A-900235-03	MOUNTING RAIL
7	15		A-900236-11	MARKER PIECES
8	2		A-900254-12	RELAY SOCKET: 8 PIN
9	1		A-900269-08	END CLAMP
10	1		A-900269-07	END SEGMENT: AP 6
11	1		A-900269-10	END SEGMENT: AP 16N
12	2	TM1, 2	A-900573-38	TIMER - DELAY-OFF: 0.2 s - 30.0 min; 20...65 V
13	2	TM1, 2	A-900568-40	RELAY: ICE CUBE; DPDT; 24 V-dc COIL
14	2	F1, 2	A-900554-40	FUSE HOLDER: MEGA BOLT DOWN
15	1	F3	A-900554-43	FUSE HOLDER: ATO
16	4	F1	A-900555-211	FUSE MEGA: 32 V; 100 A
17	2	F2	A-900555-212	FUSE MEGA: 32 V; 60 A
18	1	F3	A-900555-213	FUSE ATO: 32 V; 5 A
19	2		A-900567-04	JUMPER
20	2		A-900567-07	JUMPER
21	2		A-900567-09	JUMPER
22	1		A-900550-36	PWR RECT BRIDGE: 107 A; 1.2 kV
23	3	PRS, L, D	A-900267-42	POWER CONTACTOR: 250 A; 32 V
24	3	ZD, L, S	A-900569-05	SUPPRESSOR DIODE

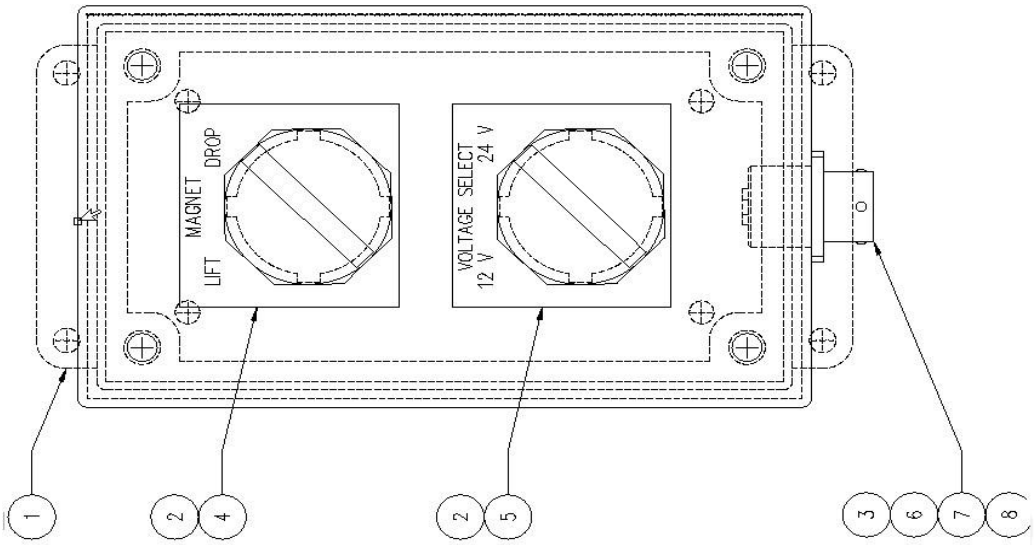
No	QTY	LABEL	PART NUMBER	DESCRIPTION
25	1		A-900568-48	STEP SWITCH: 24 V
26	6		A-900270-02	MOUNTING TAB
27	6		A-900244-15	TY-WRAP
28	1		1400A074004	DIODE ASSEMBLY
29	0.5		A-900250-26	HEAT SHRINK TUBING
30	2		A-900416-05	SCREW: M4 x 0.7 x 10 mm
31	1		A-900417-07	SCREW: M5 x 0.8 x 16 mm
32	4		A-900418-07	SCREW: M6 x 1.0 x 10 mm
33	4		A-900424-06	SCREW: M3 x 0.6 x 12 mm
34				
35	2		A-900118-35	FLATWASHER: M4
36	1		A-900118-36	FLATWASHER: M5
37	4		A-900118-37	FLATWASHER: M6
38	4		A-9001118-39	FLATWASHER: M3
39				
40	2		A-900115-28	SPLIT LOCKWASHER: M4
41	1		A-900115-29	SPLIT LOCKWASHER: M5
42	4		A-900115-30	SPLIT LOCKWASHER: M6
43	4		A-900115-33	SPLIT LOCKWASHER: M3

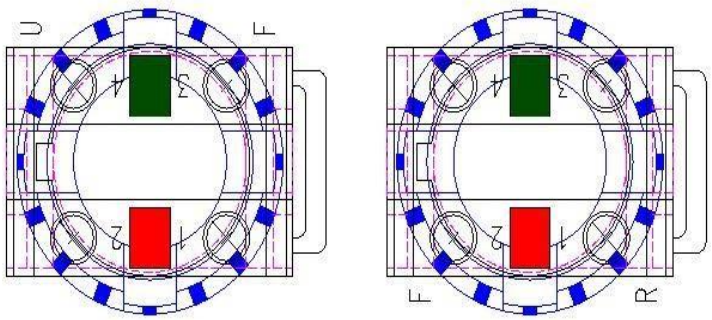
REMOTE SELECTOR SWITCH STATION PARTS LIST DEPENDING ON APPLICATION(124B001A003):

No	QTY	PART NUMBER	DESCRIPTION
1	1	124B003C001	ENCLOSURE: TWO HOLE
2	2	A-900237-12	SELECTOR SWITCH: 2 POSITION
3	1	A-900208-14	WIRE CONNECTOR MALE BASE: 4 PIN
4	1	A-900276-90	LABEL: MAGNET DROP LIFT
5	1	A-900276-110	LABEL: SELECT 12/25 V
6	4	A-900424-06	SLTD PAN HD SCR: M3 x 0.5 x 12 mm
7	4	A-900116-15	LOCKWASHER: M3 INTERNAL TOOTH
8	4	A-900106-40	HEX NUT: M3
9			
10			

FACTORY WIRING INSTRUCTIONS:

No.	PART NUMBER	LABEL	FROM	WIRE END	TO	WIRE END
1	A-950000-160	F	MAG LD-3	STRIP	VOLTSEL-2	CRIMP
2		F	VOLTSEL-2	STRIP	WCC-1	CRIMP
3		V	MAG LD-4	STRIP	WCC-3	CRIMP
4		R	VOLTSEL-1	STRIP	WCC-4	CRIMP
5						



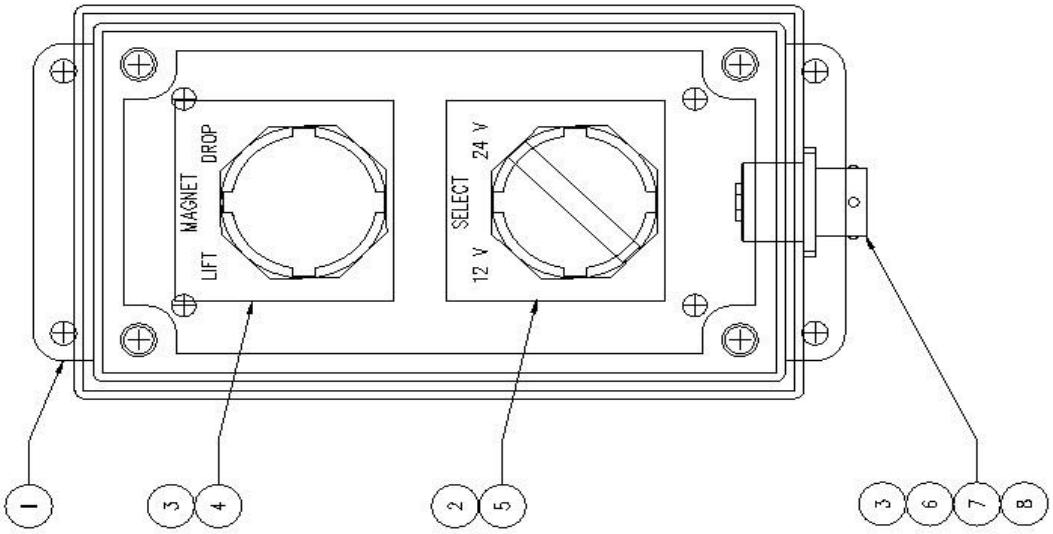


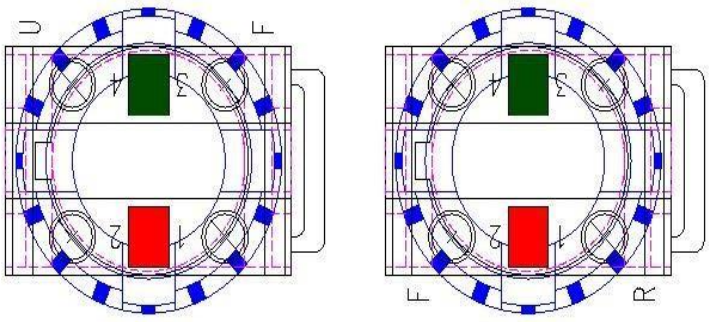
REMOTE CONTROL STATION WITH LIFT/DROP MOMENTARY PUSH-BUTTON (123B001A004):

No	QTY	PART NUMBER	DESCRIPTION
1	1	124B003C001	ENCLOSURE: TWO HOLE
2	2	A-900237-12	SELECTOR SWITCH: 2 POSITION
3	2	A-900237-10	SELECTOR SWITCH: 2 POSITION
4	1	A-900276-90	LABEL: MAGNET DROP LIFT
5	1	A-900276-110	LABEL: SELECT 12/25 V
6	1	A-900208-14	WIRE CONNECTOR MALE BASE: 4 PIN
7	4	A-900424-06	SLTD PAN HD SCR: M3 x 0.5 x 12 mm
8	4	A-900116-15	LOCKWASHER: M3 INTERNAL TOOTH
9	4	A-900106-40	HEX NUT: M3
10			

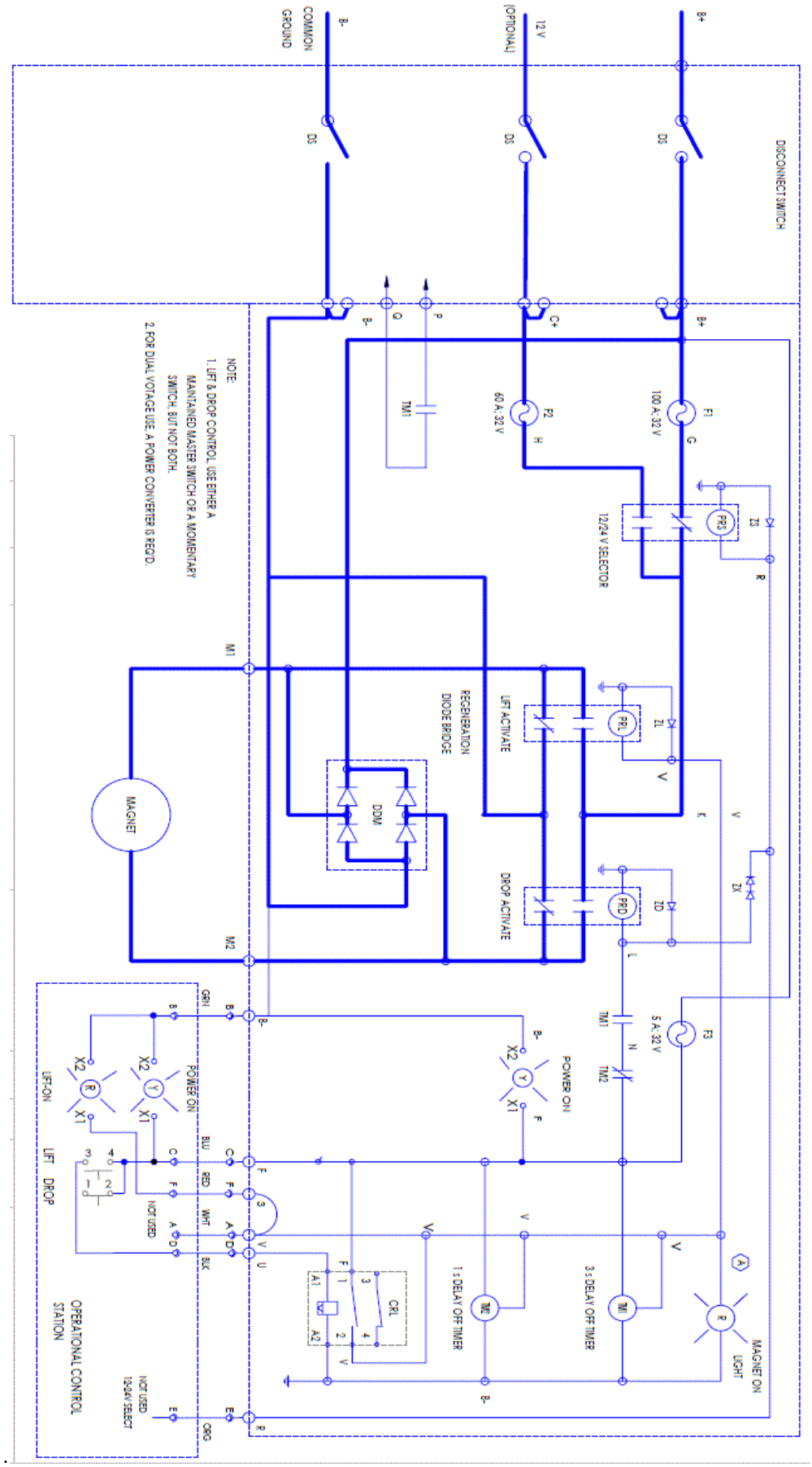
FACTORY WIRING INSTRUCTIONS:

No.	PART NUMBER	LABEL	FROM	WIRE END	TO	WIRE END
1	A-950000-160	F	MAG LD-3	STRIP	VOLTSEL-2	CRIMP
2		F	VOLTSEL-2	STRIP	WCC-1	CRIMP
3		U	MAG LD-4	STRIP	WCC-2	CRIMP
4		R	VOLTSEL-1	STRIP	WCC-4	CRIMP
5						

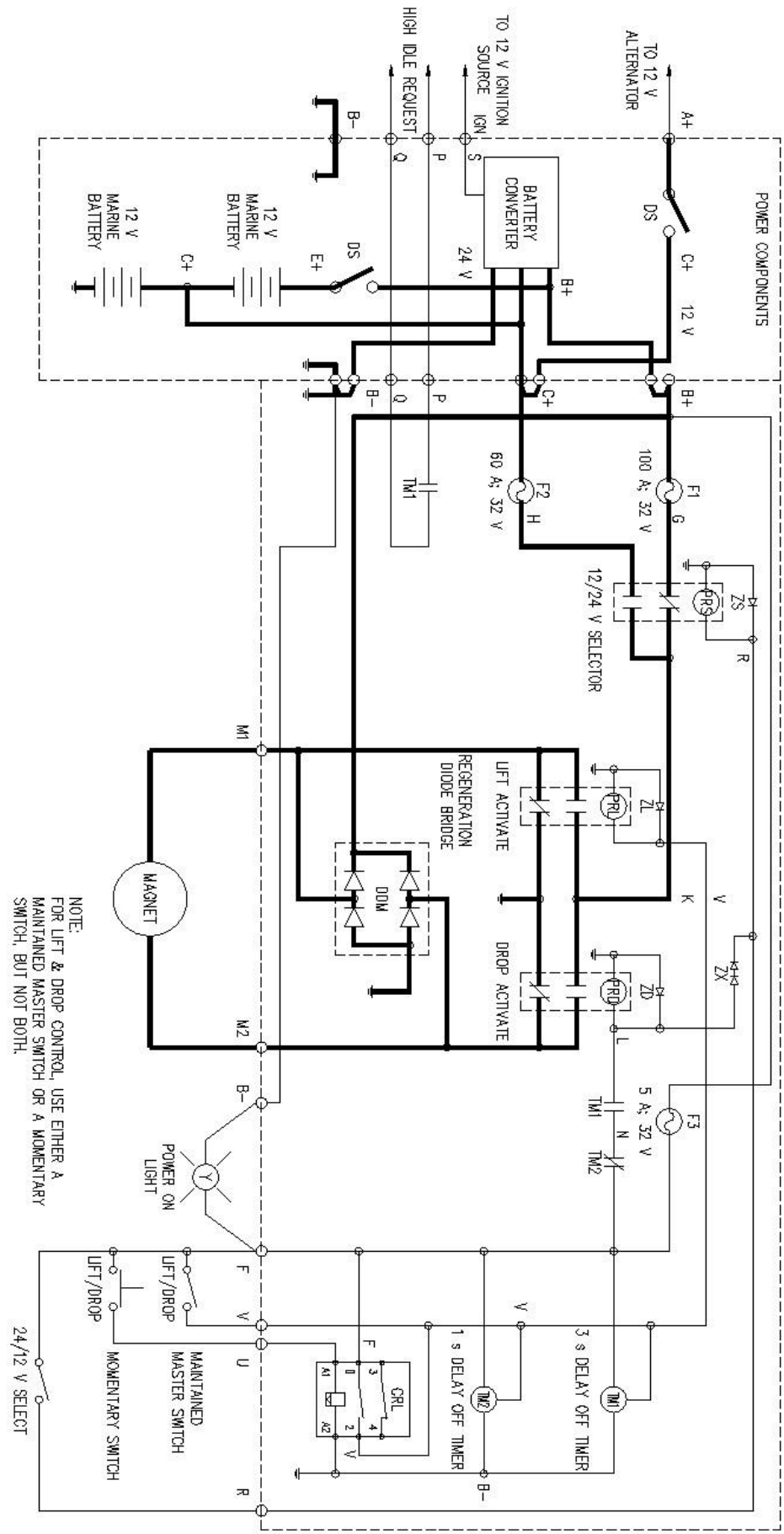




SYSTEM SCHEMATIC (24 V) SOURCE:



SYSTEM SCHEMATIC (12 V) SOURCE:


POWER COMPONENTS
TO 12 V ALTERNATOR
A+
DS
C+ 12 V
B+
TO 12 V IGNITION SOURCE
IGN
S
BATTERY CONVERTER
24 V
HIGH IDLE REQUEST
Q
P
B-
12 V MARINE BATTERY
C+
DS
E+
12 V MARINE BATTERY
TM1
60 A; 32 V
F2
H
100 A; 32 V
F1
G
12/24 V SELECTOR
ZS
CR3
R
M1
M2
REGENERATION DIODE BRIDGE
DDM
LIFT ACTIVATE
DROP ACTIVATE
ZL
CRL
ZD
CRD
ZX
K
V
L
MAGNET
NOTE:
FOR LIFT & DROP CONTROL, USE EITHER A MAINTAINED MASTER SWITCH OR A MOMENTARY SWITCH, BUT NOT BOTH.
POWER ON LIGHT
F3
5 A; 32 V
TM1
TM2
N
LIFT/DROP
MOMENTARY SWITCH
MAINTAINED MASTER SWITCH
24/12 V SELECT
F
V
U
R
CRL
A1
A2
1 s DELAY OFF TIMER
3 s DELAY OFF TIMER

STEP BY STEP CONTROLLER OPERATION

1.) Assure that the system **engine is running** and is supplying 12 or 24 V to the controller. The system will operate with the vehicle engine off for safety – but the batteries will drain at a higher rate.

2.) Turn the disconnect switch to **on**. This connects the power to the controller components.

3.) If it is desired to operate the magnet at 24 V, make sure the voltage selector is set to the 24 V position. If it is desired to operate the magnet at 12 V, turn the selector dial to the 12 V setting. The voltage selection can be switched while the magnet is in operation.

4.) To energize the magnet, move the selector switch from “drop” to “lift”, which will energize the magnet.

5.) To deenergize the magnet, move the selector switch from “lift” to “drop”. The magnet will deenergize and discharge into the batteries.

6.) High Idle Request: The system will request high idle (if connected) during LIFT mode only in the system’s native voltage (ie. 12 V System, High Idle with LIFT and 12 V). It will be normal to have the vehicle cycle between high idle and normal idle. To prevent the cycling, it is advisable to have the operator set the high idle switch on the vehicle prior to magnet use. High idle is not required if using the non-native system voltage as the alternators generally have enough capacity to charge the batteries at their maximum charge rate on the normal idle setting.

GENERAL MAINTENANCE

- DAILY (EACH SHIFT) o CHECK FOR WATER INTRUSION IN CONTROL BOX BEFORE USE. o CHECK FOR DAMAGE CONTROL WIRE INSULATION OR CONNECTORS. o CHECK FOR DAMAGED CONTROL SWITCHES.
    - o CHECK FOR MISSING CONTROL LABELS. o CHECK FOR DAMAGE TO LOCK OUT / TAG OUT MAIN DISCONNECT.
    - o CHECK MAGNET WIRE FOR DAMAGE OR INSULATION CUTS.
- MONTHLY
    - o CHECK CONDITION OF BREATHERS Replace as necessary.
    - o CHECK CONDITION OF THE BATTERY VOLTAGE USING A LOAD TESTER.
        - Alternately, this can be done by connecting a magnet, disconnect the truck input power, set the control voltage to 24 V, engage the load button and then test voltage on each battery (independently). Both batteries should be equal and above 10 V per battery.
- Depending on control box installation location, putting a rubber flap over the main disconnect switch may be necessary to protect it from snow/salt/road spray and mud.

BATTERY LIFE

This system is designed to utilize a Group 31 marine deep cycle battery or EV Traction Battery with a **minimum capacity of 98 Ah**.

The following chart provides normal operational time for the system when AMBIENT Temperature is above 25°C (77°F):

ALTERNATOR VOLTAGE (V)	ENGINE CONDITION	VOLTAGE SELECTOR (V)	75 % DUTY CYCLE TIME (min)	50 % DUTY CYCLE TIME (min)
12	RUNNING (NORMAL)	12	CONTINUOUS	CONTINUOUS
12	RUNNING (NORMAL	24	>150	>223
12	OFF	12	300	446
12	OFF	24	150	223
24	RUNNING (NORMAL)	12	CONTINUOUS	CONTINUOUS
24	RUNNING (NORMAL)	24	CONTINUOUS	CONTINUOUS
24	OFF	12	300	446
24	OFF	24	150	223

- Please note – the length of time the system will operate on batteries alone will vary depending on:
    - Initial state of charge. o Condition of the battery. o Age of the battery. o Operational (ambient) temperature range is -10°C (-14°F) – 50°C (122°F). If the site conditions have a temperature lower than this, an AC powered **battery heater is highly recommended**.
    - For 12 V alternators, the operation time on 24 V will vary based on the duty cycle. The batteries will only charge when the system is in DROP.

- Battery Replacement:
    - Batteries should be replaced as a pair. o Replacement batteries must be of the same type and Ah rating.

To get a full eight hours of work out of the system, it will be necessary to recharge the batteries as needed. Battery charge life can be extended only if the duty cycle of the magnet is reduced or if part of the operation is running on 12 V. Also, using the alternator to run the magnet will increase battery operation life. Allowing the engine to idle during work rest periods will ensure the batteries remain fully charged.

For optimal battery life, the main disconnect should be left **ON** anytime the engine is running to ensure the batteries are maintained in the full state of charge. The main disconnect should be turned **OFF** only when the vehicle is out of service or shut off for more than 30 min as the converter will drain the vehicle batteries.

If the vehicle is to be parked for an extended period (> 1 month), the batteries should be stored in a fully charged state and the main disconnect should be turned OFF.

TROUBLESHOOTING

Manet system problems will eventually occur. Most can be remedied via standard methods of troubleshooting. To troubleshoot, it would be best to reference the system schematic and panel layout provided in this bulletin.

Required Tools: Multi-meter, Screwdriver Set, Metric and English Wrenches / Sockets.

PROBLEM	POSSIBLE CAUSE	REMEDY
MAGNET DOES NOT OPERATE	MAGNET PLUG DISCONNECTED	CONNECT DISCONNECTED PLUGS, CHECK FOR BROKEN CABLES.
	DISCONNECT SWITCH TURNED OFF	TURN DISCONNECT TO THE ON POSSITION
	MAGNET CONTROL CONNECTOR DISCONNECTED	CHECK PLUG ON MAGNET CONTROLS. USE MULTIMETER TO VERIFY SWITCHES ARE WORKING AND/OR CABLES ARE INTACT.
	NO BATTERY VOLTAGE; BATTERIES DISCHARGED	RECHARGE BATTERIES
	BLOWN FUSE(S)	REPLACE BLOWN FUSE(S)
	WORN RELAYS AND CONTACTORS	REPLACE BAD COMPONENTS
YELLOW LIGHT NOT ILLUMINATED	VEHICLE WIRING ERROR	CHECK ALTERNATOR CONNECTIONS
	VEHICLE POWER CONNECTOR NOT PLUGGED IN	CHECK POLARIZED PLUG ON BACK OF ENCLOSURE – PLUG IN OR TEST FOR VEHICLE POWER.
	ENCLOSURE BATTERIES ARE NOT CHARGED	CHECK STATE OF CHARGE OF ONBOARD BATTERIES, CHARGE IF NECESSARY
	LOOSE BATTERY OR CONVERTER CONNECTION IN ENCLOSURE	CHECK ALL BATTERY TERMINAL AND CONVERTER CONNECTIONS, CLEAN AND TIGHTEN.
	LACK OF VOLTAGE AT TERMINAL F & B-	CHECK SCHEMATIC AND UTILZE MULTIMETER TO DETERMINE SOURCE OF POWER LOSS.

With the aid of the schematic, proper voltages can be traced through the system from source to load. Loss of voltage at points where voltage should be will usually indicate a bad component. All failed components encountered should be replaced.