



Section 5

SCHEMATICS

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HYDRAULIC SCHEMATICS TABLE

Callout	Description
CBV1, CBV2	Counterbalance Valve, Drive
CV1	Check Valve
CV2	Check Valve
CV4	Check Valve
CYL1	Cylinder, Upper Lift
CYL2	Cylinder, Lower Lift
CYL3-CYL4	Cylinder, Steer
CYL5-8	Cylinder, Outtrigger
EP1	Pilot Operated Valve, Mid Speed
EP2	Pilot Operated Valve, Low Speed
FD1	Flow Divider, Drive Mid & Low
FD2	Flow Divider, Drive Mid & Low
FR1	Flow Regulator Valve, Brake Apply
HLS1	Shuttle Valve, Brake Release
HP1	Hand Pump, Brake Release
MLF	Motor, Left Front
MLR	Motor, Left Rear
MP1	Manual Operated Valve, Brake Release
MRF	Motor, Right Front
MRR	Motor, Right Rear
ORF1	Orifice, Steer Speed .063
ORF3	Orifice, Flow Divider Bypass.025

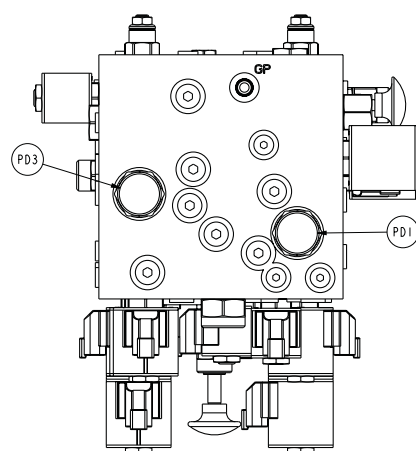
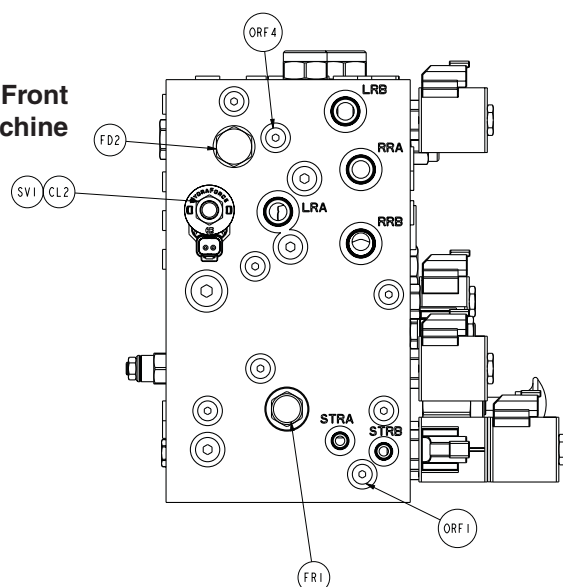
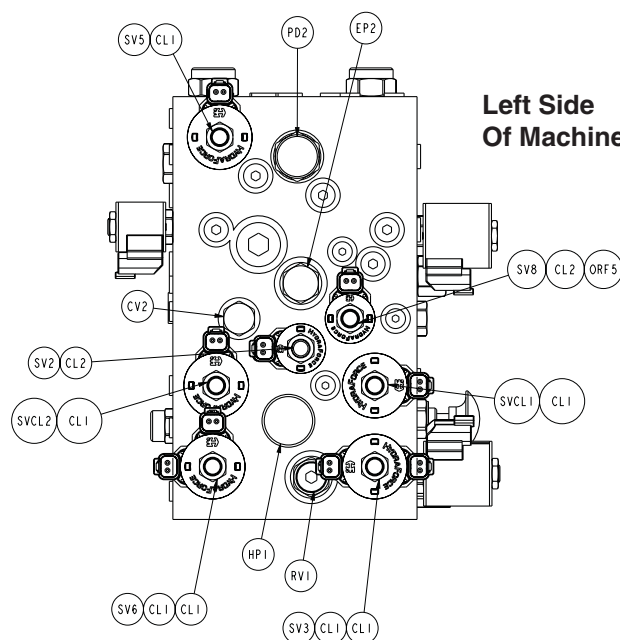
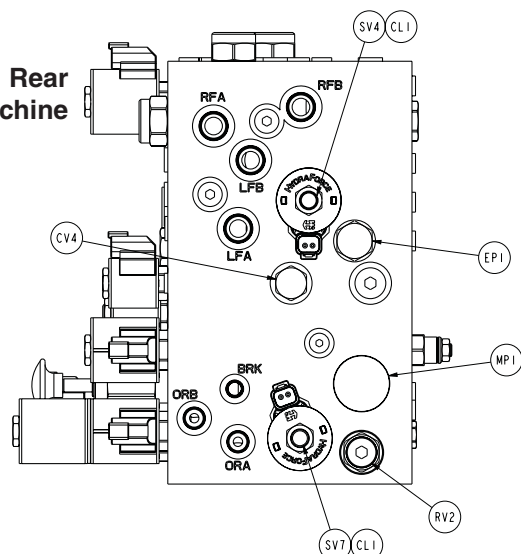
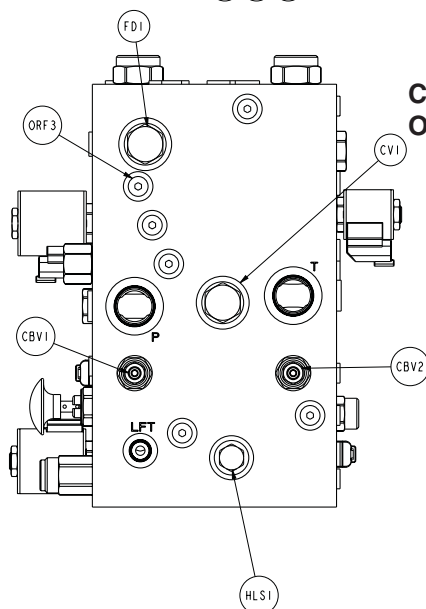
Callout	Description
ORF4	Orifice, Flow Divider Bypass.025
ORF5	Orifice, Bypass Control .060
P1	Pump
PD1	Pilot Operated Valve, High Torque Shift
PD2	Pilot Operated Valve, Mid Range Shift
PD3	Pilot Operated Valve, High Torque Shift
RV1	Relief Valve, Main
RV2	Relief Valve, Lift
SV1	Solenoid Valve, High Speed
SV10-SV17	Solenoid Valve, Outtrigger
SV18	Solenoid Valve, Down Valve, Upper Lift Cyl
SV2	Solenoid Valve, High Torque
SV3	Solenoid Valve, Outtrigger Directional
SV4	Solenoid Valve, Rear Wheel Bypass
SV5	Solenoid Valve, Rear Wheel Bypass
SV6	Solenoid Valve, Steer Directional
SV7	Solenoid Valve, Platform Lift
SV8	Solenoid Valve, Rear Wheel Bypass
SV9	Solenoid Valve, Down Valve, Lower Lift Cyl
SVCL1	Solenoid Valve, Drive Forward
SVCL2	Solenoid Valve, Drive Reverse

 ILLUSTRATION No.
ART_4508

Figure 5-2: Functions Manifold

CL2	COIL #10
CL1	COIL #8
CV1	CHECK VALVE - ANTI CAVITATION
CV2	CHECK VALVE - ANTI CAVITATION
CV4	CHECK VALVE - ANTI CAVITATION
HP1	HAND PUMP - BRAKE RELEASE
SV1	SOLENOID VALVE - HIGH SPEED
SV2	SOLENOID VALVE - HIGH TORQUE
SV3	SOLENOID VALVE - OUTRIGGER DIRECTIONAL
SV4	SOLENOID VALVE - REAR WHEEL BYPASS
SV5	SOLENOID VALVE - REAR WHEEL BYPASS
SV6	SOLENOID VALVE - STEER DIRECTIONAL
SV7	SOLENOID VALVE - PLATFORM LIFT
SV8	SOLENOID VALVE - REAR WHEEL BYPASS
FD1	FLOW DIVIDER VALVE - DRIVE MID & LOW
FD2	FLOW DIVIDER VALVE - DRIVE MID & LOW
MP1	MANUAL OP. VALVE - BRAKE EMR. RELEASE

SVCL1	SOLENOID VALVE - DRIVE FORWARD
SVCL2	SOLENOID VALVE - DRIVE REVERSE
EP1	PILOT OP. VALVE - MID SPEED
EP2	PILOT OP. VALVE - LOW SPEED
RV1	RELIEF VALVE - MAIN
RV2	RELIEF VALVE - PLATFORM LIFT
FR1	FLOW REGULATING VALVE - BRAKE APPLY
HLS1	SHUTTLE VALVE - BRAKE RELEASE
ORF1	ORIFICE - STEER SPEED CONTROL
ORF3	ORIFICE - FLOW DIVIDER BYPASS
ORF4	ORIFICE - FLOW DIVIDER BYPASS
ORF5	ORIFICE - BYPASS CONTROL
PD1	PILOT OP. VALVE - HIGH TORQUE SHIFT
PD2	PILOT OP. VALVE - MID RANGE SHIFT
PD3	PILOT OP. VALVE - HIGH TORQUE SHIFT
CBV1	COUNTERBALANCE VALVE - DRIVE
CBV2	COUNTERBALANCE VALVE - DRIVE

**Front
Of Machine****Left Side
Of Machine****Rear
Of Machine****Center
Of Machine**

Functions Manifold
4069

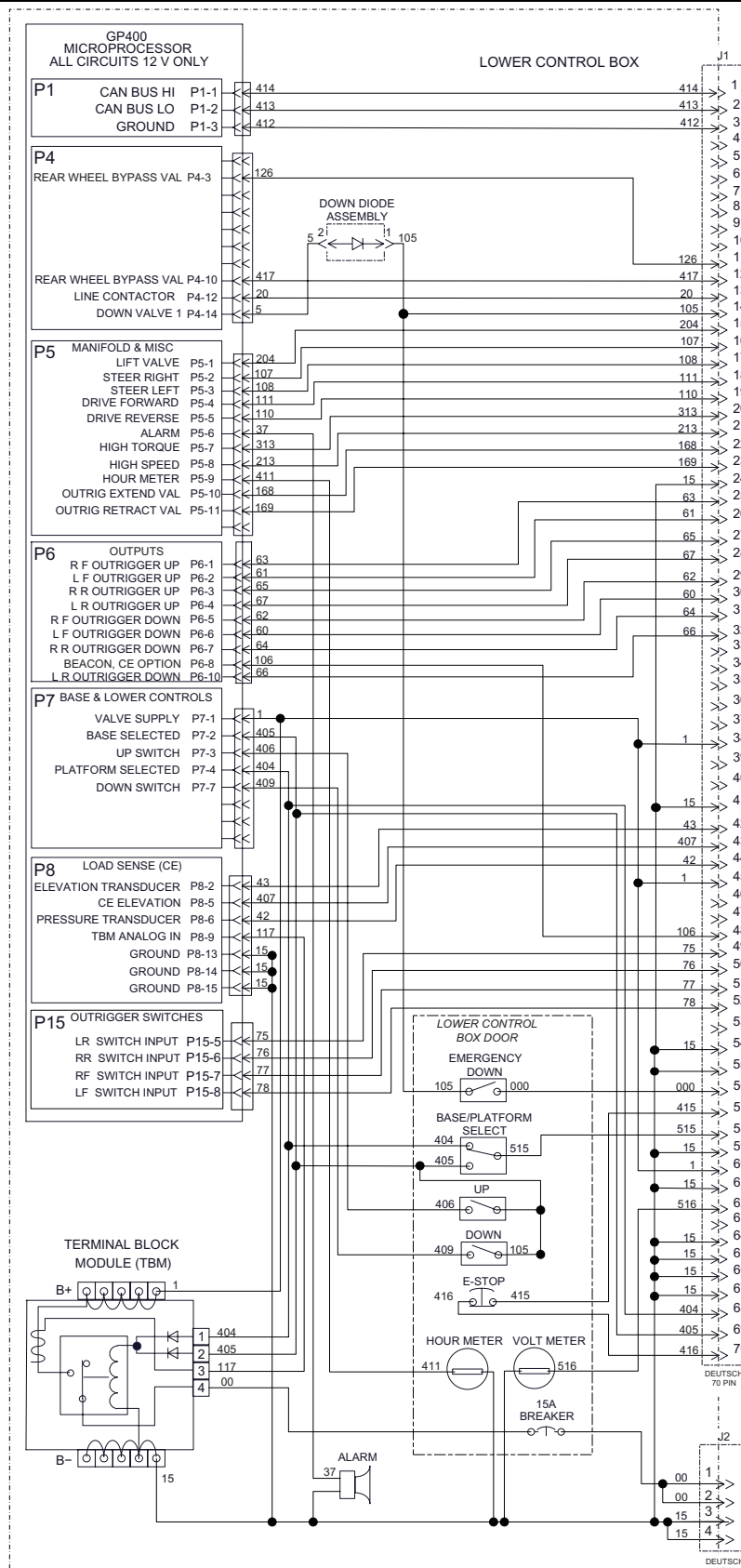
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NOTES:



ELECTRICAL SCHEMATICS

Figure 5-3: Electrical Schematic, 1 of 3

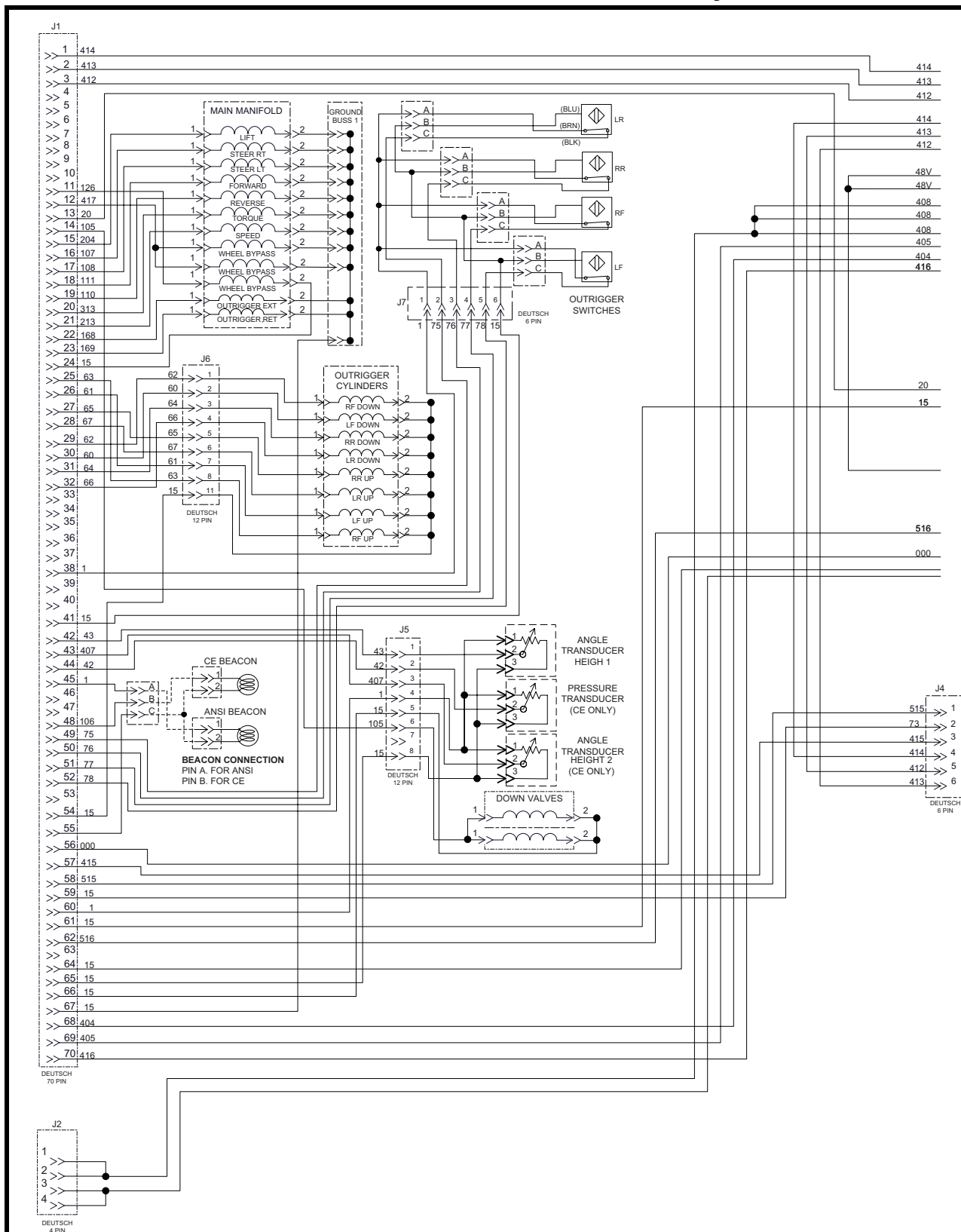


Electrical Schematic, 1 of 3

4069ERT

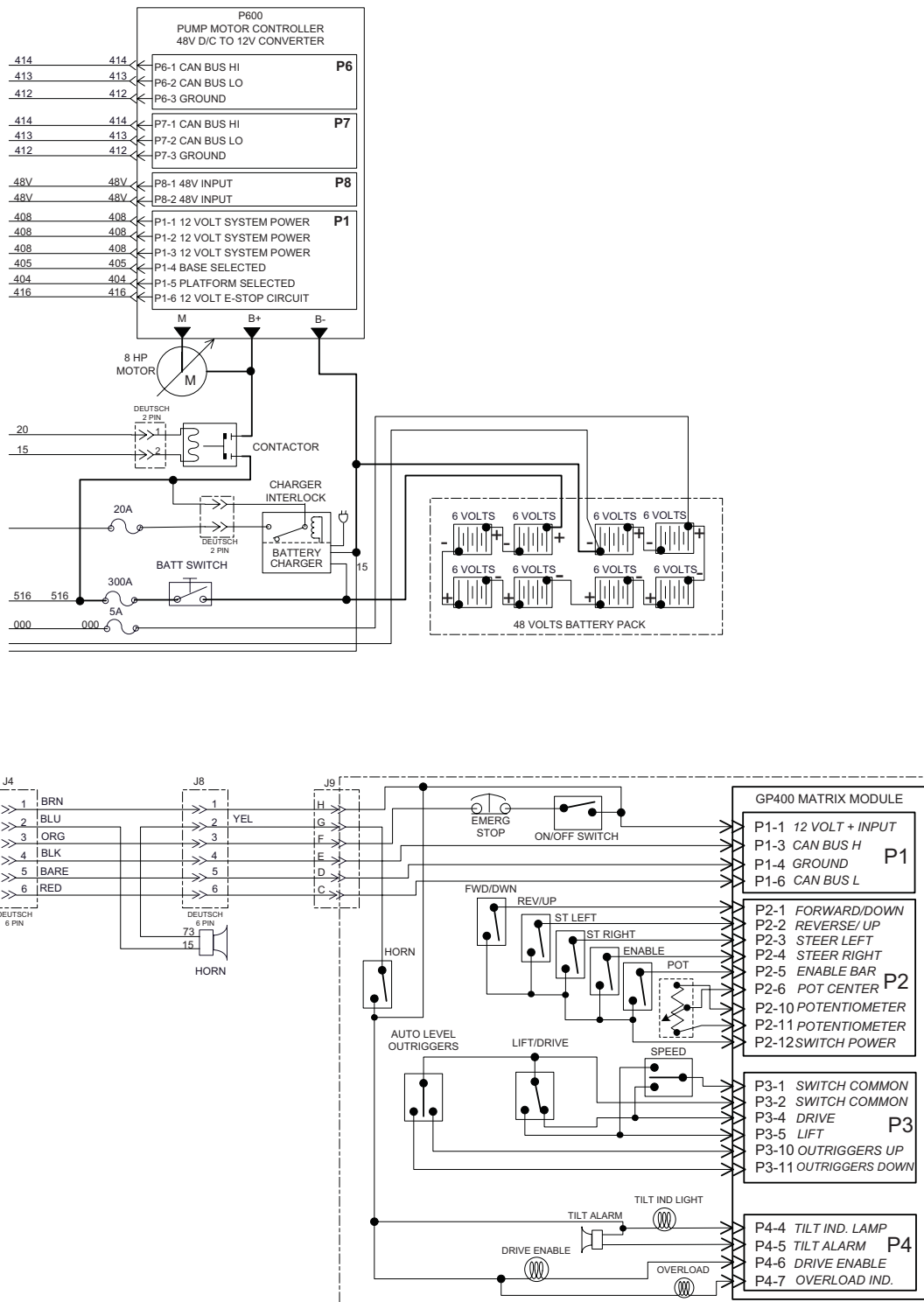
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Figure 5-4: Electrical Schematic, 2 of 3



Electrical Schematic, 2 of 3
4069ERT

MEC
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ART_4510



Electrical Schematic, 3 of 3
 4069ERT

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GENERAL TROUBLESHOOTING TIPS

HYDRAULIC FLUID PUMP

This machine operates on a “Motor Control” theory in which fluid flow volume is controlled by varying the speed of the DC electric motor driving a tandem fixed displacement pump. 100% of the fluid produced by the pump goes to the selected function.

Common Causes of Electrical System Malfunctions:

- Battery connections are loose or corroded
- Battery is not fully charged.
- Emergency Stop buttons are pushed (OFF position).
- Circuit breaker is in the tripped (OFF position).

Common Causes of Hydraulic System Malfunctions:

- Hydraulic fluid level is too low.
- Mixed incompatible hydraulic fluids, destroying the additives and causing varnish build-up and sticking valves.
- Water in the hydraulic fluid due to damp climate.
- Improper hydraulic fluid. Viscosity too high in cold climates. Viscosity too low in warm climates.
- Hydraulic fluid contaminated with debris--filter change interval neglected, or debris introduced into the hydraulic system.



In machines equipped with the optional cold climate package, MEC uses a multiple viscosity fluid that is light enough for cold climates and resists thinning in warm climates. Use only the recommended hydraulic fluid. Substituting with a lower grade fluid will result in pump failure. Refer to Section 1 of this manual.

Contamination always causes failure in any hydraulic system. It is very important to be careful not to introduce any contamination into hydraulic system during the assembly procedures. Please make sure all ports and cavities of the manifold and cylinders are properly capped or plugged during maintenance activities.

ELECTRICAL SYSTEM TROUBLESHOOTING

The electronic control system used on this machine was designed for low maintenance and long trouble free operation. The system consists of two microprocessor based modules; The Matrix Module and the GP400 Processor. They communicate through a low voltage digital signal called Can-Bus communication.

To protect against part failure or incorrect plug connections, the modules are fully short circuit and reverse polarity protected. All electrical plug connections are waterproof to promote longer trouble free operation and to increase terminal life.



NEVER ATTEMPT TO SUPPLY BATTERY POWER, OR VOLTAGE HIGHER THAN 12 VOLTS TO ANY PART OR MODULE IN THIS SYSTEM, AS CATASTROPHIC FAILURE OF THE MODULES MAY RESULT.

USE OF HIGH PRESSURE WASHING EQUIPMENT DIRECTLY ON THE MODULES CAN FORCE WATER INTO SEALED CONNECTION AND CAN CAUSE A TEMPORARY SYSTEM SHUT-DOWN. HIGH PRESSURE WASHING WITHIN THE VICINITY OF THE MODULES IS HIGHLY DISCOURAGED.

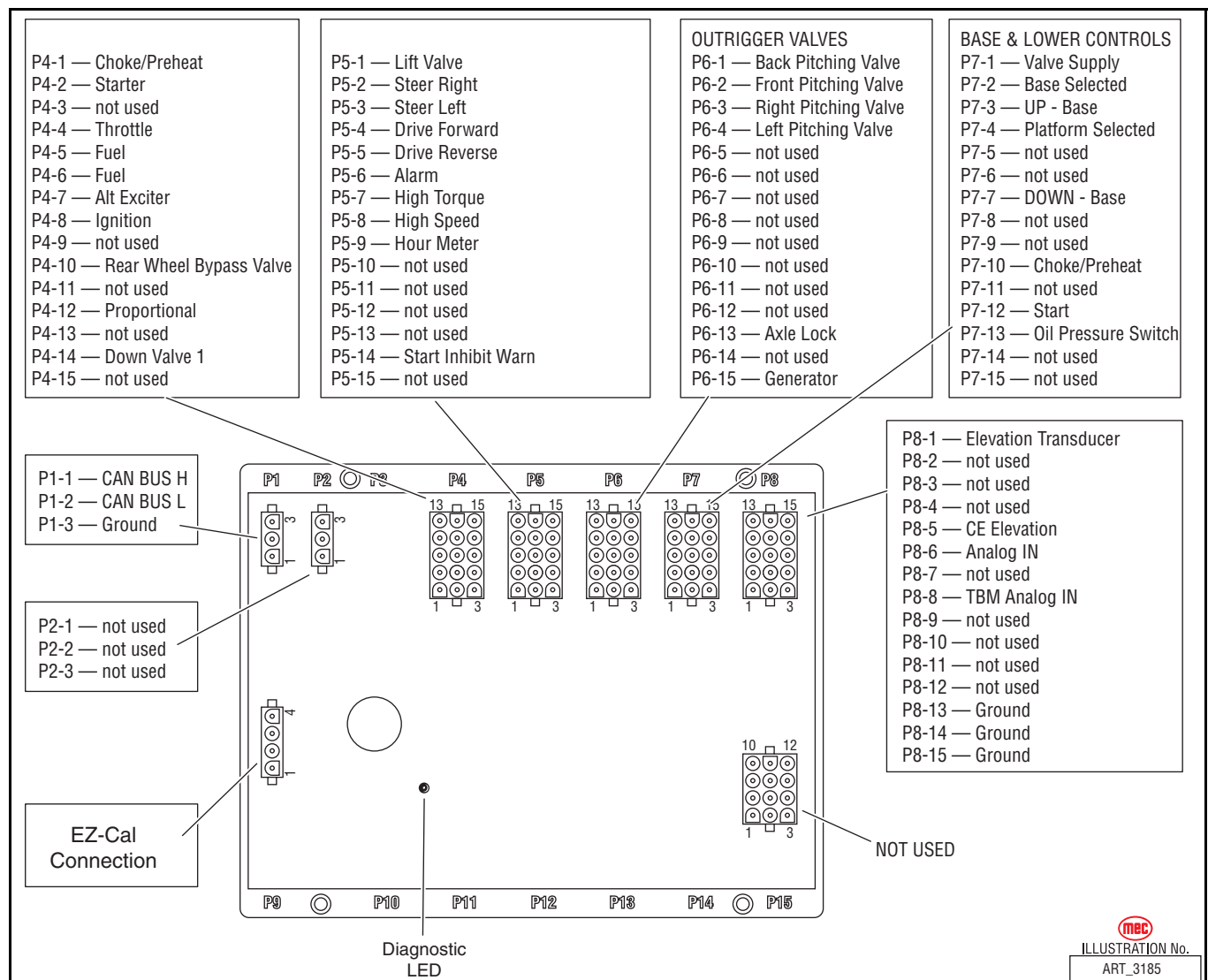
GP400 MODULE

The GP400 module is “the brains” of the system. It receives and processes a variety of inputs both from the machine and the operator, then controls all the operative functions of the machine. It also has a feature that allows the technician to access and monitor all functionality of the system, along with a technician-friendly series of fault messages that can be accessed through the use of the EZ-Cal scan tool. Flash codes are also provided in case an EZ-Cal scan tool is not available.

Such information can be used for preventative maintenance and troubleshooting should a problem arise. A comprehensive list of EZ-Cal accessible information can be found later in this section.

The GP400 operates on 12 volts DC and should never be probed or operated with voltage higher than 14 volts DC

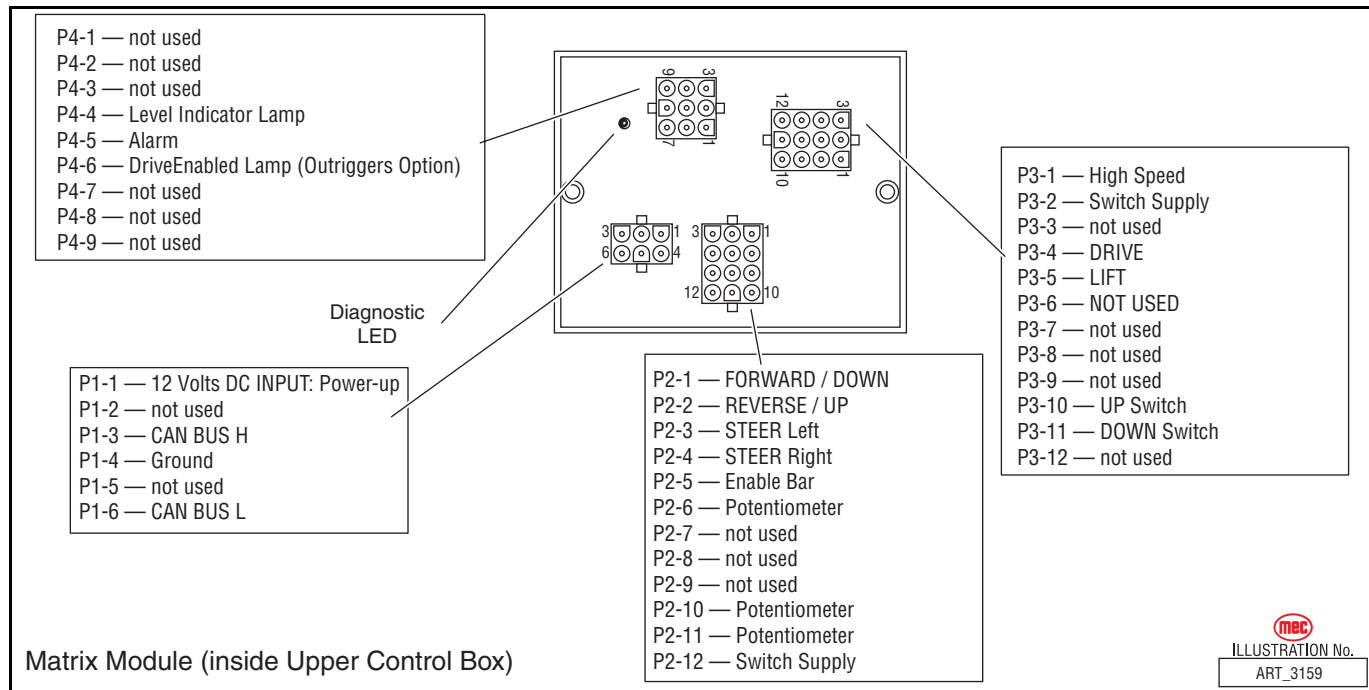
Figure 4a-1: GP400 Module



MATRIX MODULE

The Matrix Module is the remote module located inside the upper control box. It received inputs from the operator and relays them to the GP400.

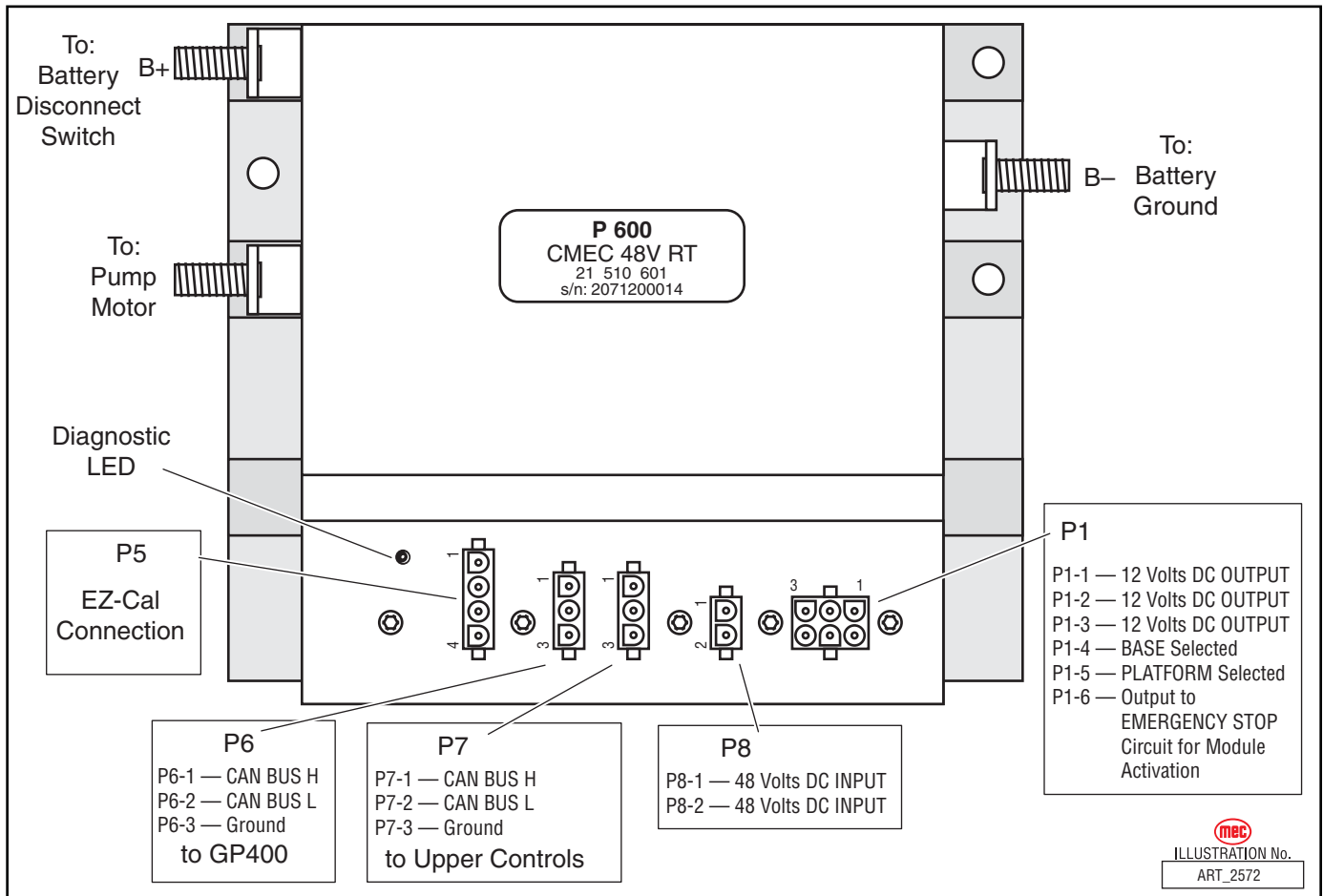
Figure 4a-2: Matrix Module



P600 Motor Control Module

The Motor Control Module operates the electric pump motor with varied speeds depending on operator commands. Pulse-width Modulation provides smooth and controlled operation with maximum battery efficiency. The Motor Controller also converts battery voltage (48 volts DC) to 12 volts DC for use throughout the rest of the control system.

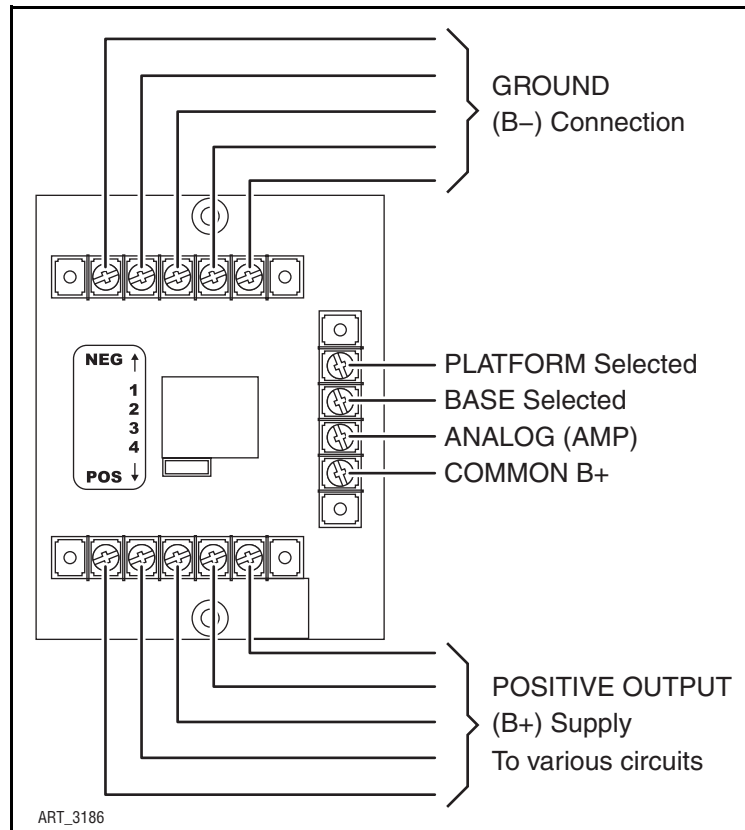
Figure 4b-3: P600 Motor Control Module



TERMINAL BLOCK MODULE (TBM)

There is a module inside the lower control box, called a TBM (Terminal Block Module) that provides terminal point connections for both positive and ground circuits. A signal from the Emergency Stop circuit activates a load-reduction relay within the TBM that provides ample power to the B+ (positive) terminal strip. This arrangement protects the system against voltage drop conditions that can be detrimental to the electrical system.

Figure 4a-4: Terminal Block Module (TBM)



EZ-CAL SCAN TOOL

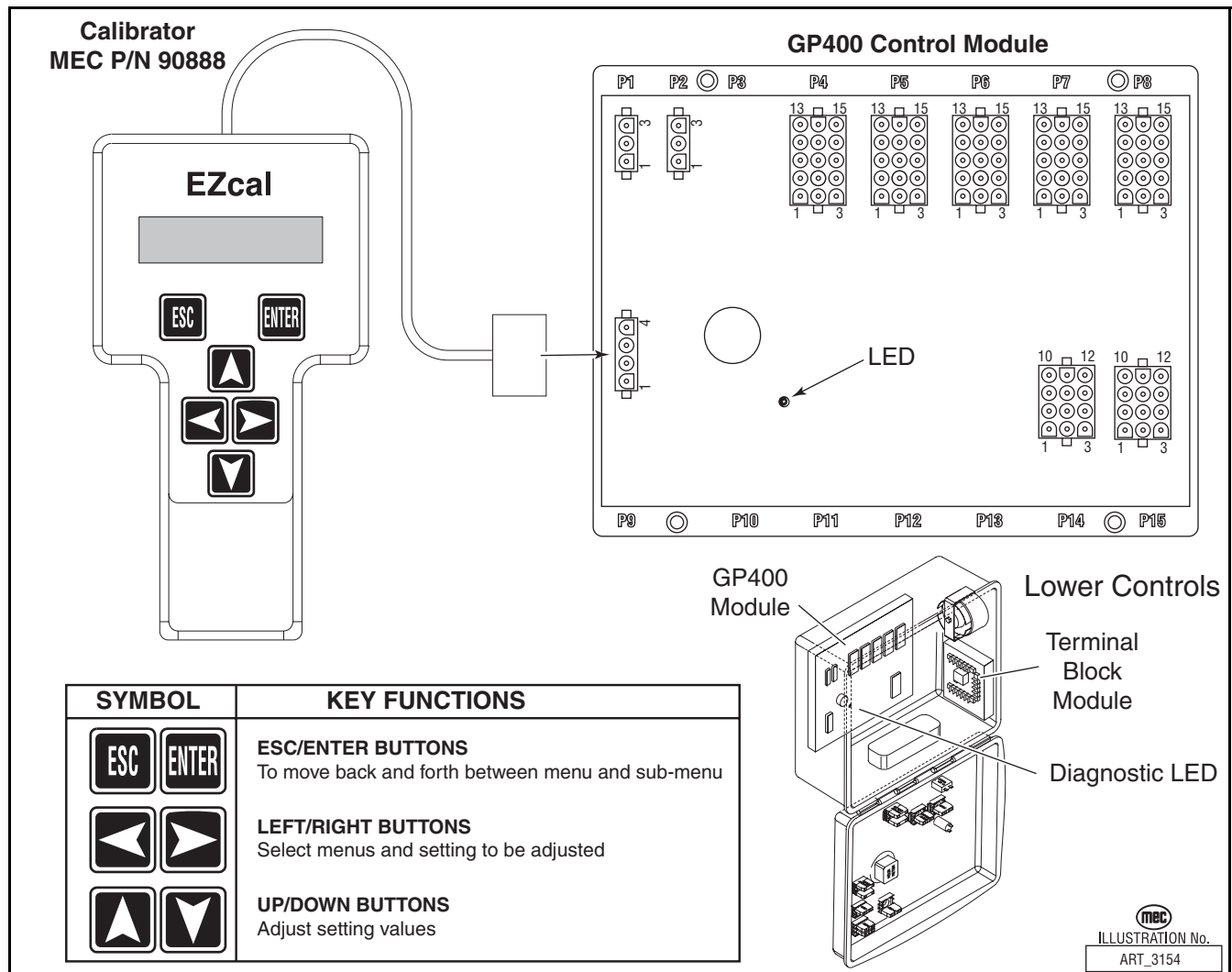
The EZ-Cal (MEC part # 90888; not part of the machine) is a hand-held scan tool that interfaces with the system to provide various information and adjustments. The EZ-cal receives its power from the GP400 when connected. The system must be powered up by closing the Battery disconnect switch and pulling both emergency stop switches. You must also select Base or Platform depending on the station you will operate from.

USING THE EZ-CAL SCAN TOOL

To operate the EZ-cal, plug the cable into the 4-terminal receptacle P9 on the GP400 and power the system up.

- The EZ-Cal display will illuminate and read "HELP: PRESS ENTER". From this point, use the right and left arrows to scroll through the base menus.
- Once the desired base menu is obtained (i.e. *ADJUSTMENTS*) press Enter to access sub menus.
- Use the right and left arrows to scroll through sub menus, press Enter again.
- The up/down arrows are used to change settings only.
- Press ESC to back up one level.

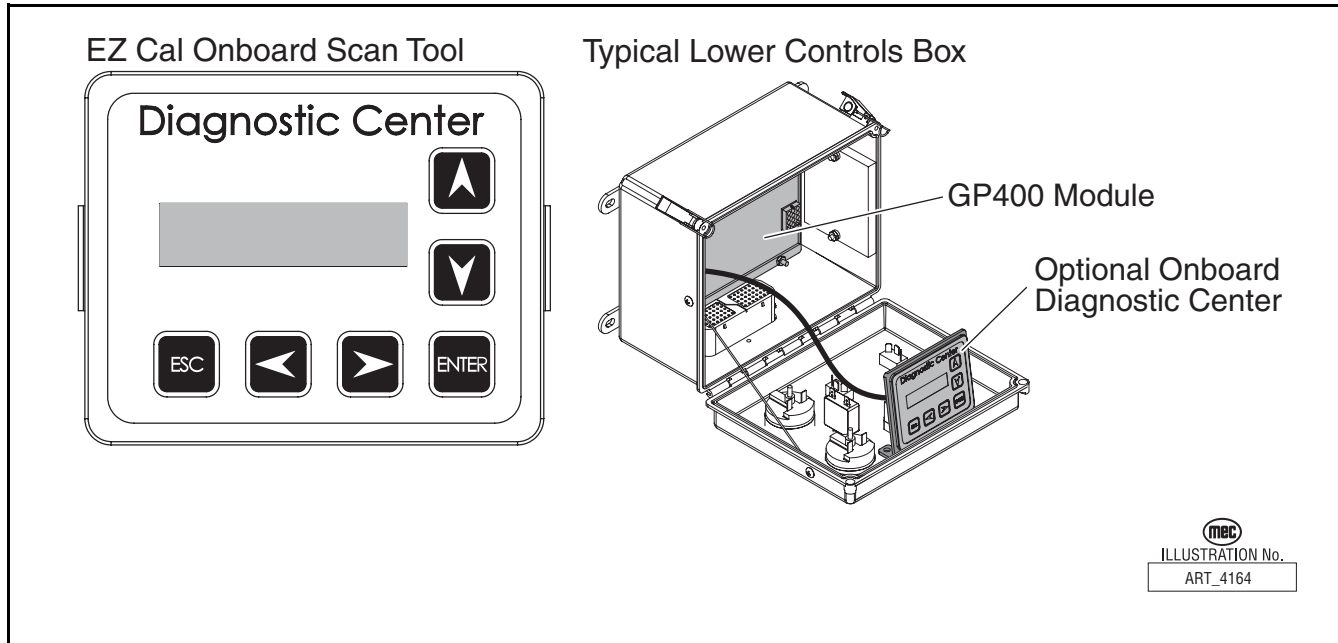
Figure 4a-5: EZ-Cal Scan Tool Connections - GP400 Module



OPTIONAL ONBOARD EZ-CAL

To use and operate the onboard EZ-Cal, set the Base/Platform Key switch to Base or Platform, then open the door to the Lower Controls Box. The onboard EZ-Cal scan tool provides the same functionality as the hand-held unit.

Figure 4-6: Onboard EZ-Cal Scan Tool & GP400 Module









USING THE EZ-CAL SCAN TOOL

- Once, powered up, the EZ-Cal display will illuminate and read “HELP: PRESS ENTER”. From this point, use the right and left arrows to scroll through the base menus.
- Once the desired base menu is obtained (i.e. *ADJUSTMENTS*) press Enter to access sub menus.
- Use the right and left arrows to scroll through sub menus, then press Enter again to choose a sub menu.
- The up/down arrows are used to change settings only.

Press ESC to back up one level.

Figure 4-7: EZ-Cal Buttons

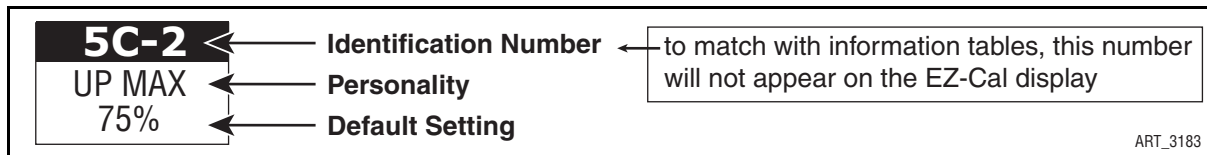
SYMBOL	KEY FUNCTIONS
 	ESC/ENTER BUTTONS To move back and forth between menu and sub-menu
 	LEFT/RIGHT BUTTONS Select menus and setting to be adjusted
 	UP/DOWN BUTTONS Adjust setting values

ART_3710

USING THE EZ-CAL WITH THE FLOW CHARTS

Use the EZ-cal Flow Charts as a guide to locate diagnostic information and make adjustments. Each box in the flow chart will have 3 bits of information.

Figure 4-8: EZ-Cal Display Example



The IDENTIFIER (5c2): – Used to locate this specific personality in the informational charts. Here you can obtain specific information on the individual personalities.

The PERSONALITY (Up Max): – Identifies the individual personalities.

The DEFAULT SETTING: – The factory setting. If adjustments are made, they must be returned to default setting.



ACCESS LEVEL 1 PROVIDES ACCESS TO CHANGE PERSONALITIES NORMALLY PRESET AT THE FACTORY TO PROVIDE PROPER MACHINE MOVEMENT AT SAFE SPEEDS. PERSONALITIES MUST NOT BE CHANGED WITHOUT PRIOR AUTHORIZATION FROM MEC AND MAY ONLY BE RETURNED TO FACTORY SPECIFICATION AS LISTED IN THE FOLLOWING TABLES.

FLASH CODES

Flash Codes, provided from the GP400 red LED, will also assist in the event an EZ-cal is not available. However, the EZ-cal yields considerably more relevant information. Refer to *"EZ-Cal HELP Messages"* on page 4-18 for flash coded error messages.

Figure 4-9: EZ-Cal Flow Chart: Adjustments and Setup

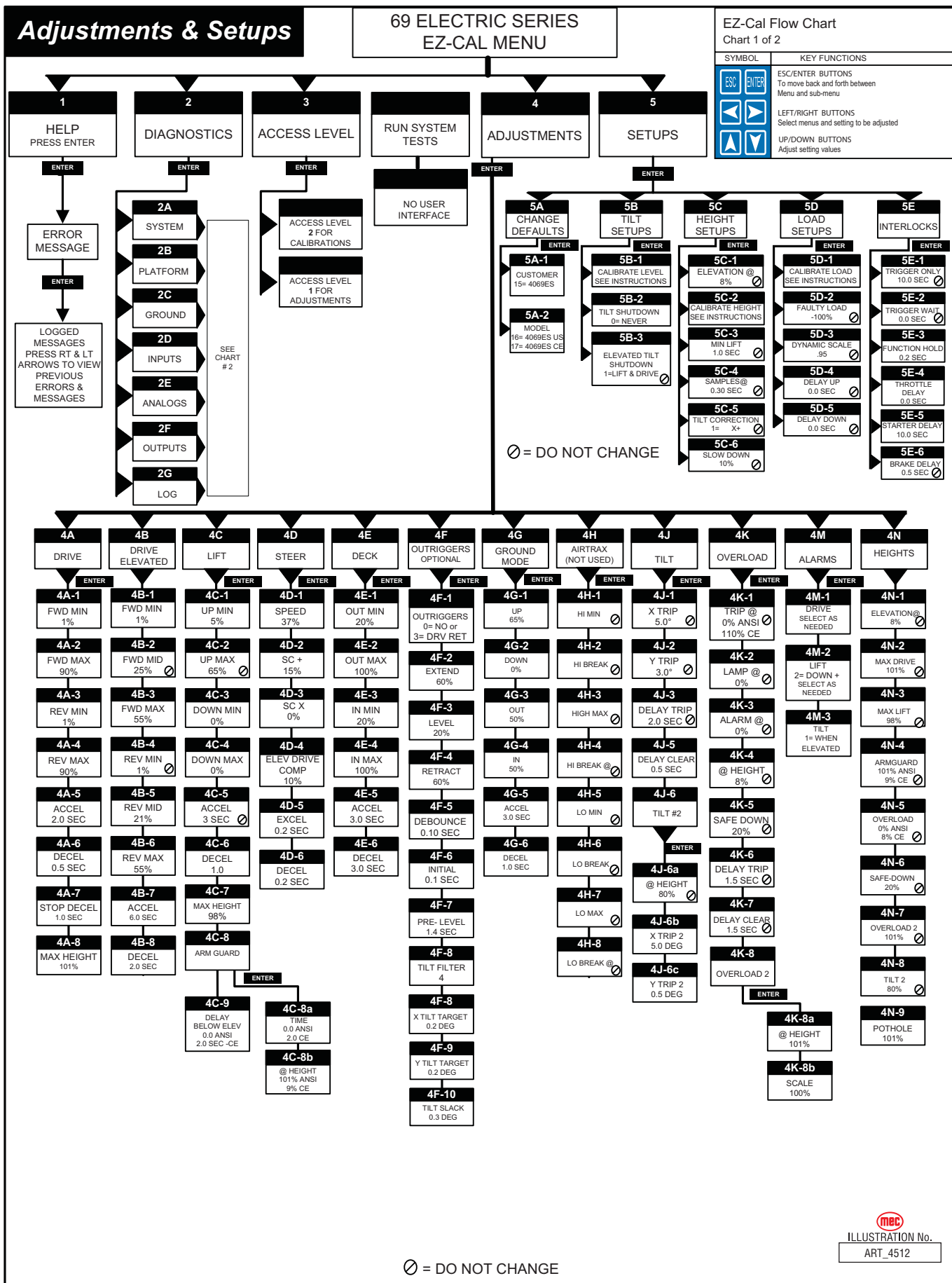
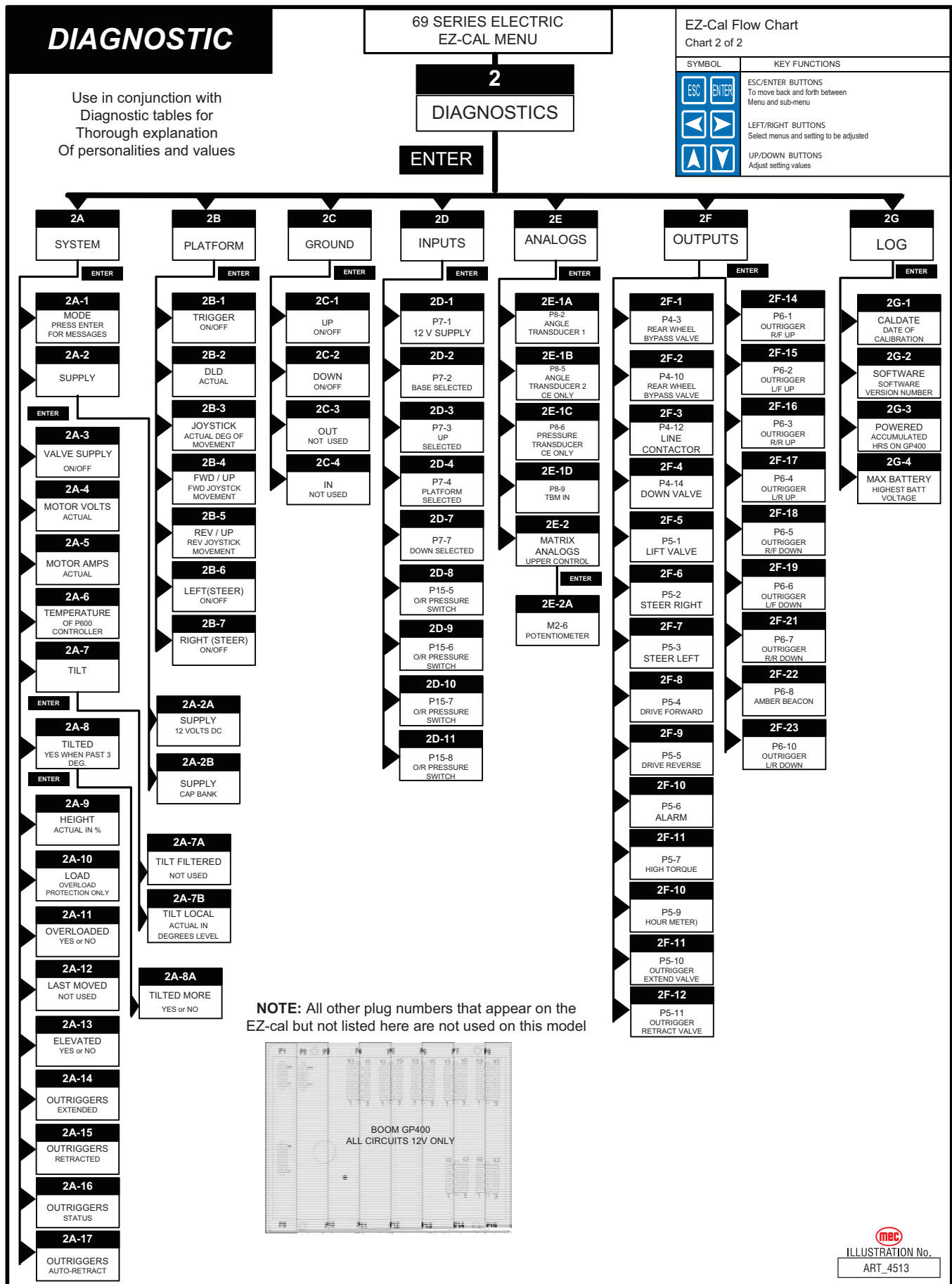


Figure 4-10: EZ-Cal Flow Chart: Diagnostics



EZ-CAL ADJUSTMENTS

Refer to "Using the EZ-Cal Scan Tool" on page 4-10.

Adjustments are possible **only** in Access Level 1.

Before changing personalities, ensure that the Correct Customer and Model have been selected in the SETUPS menu. Any changes to settings will be lost when the model or customer is changed.

To reach ADJUSTMENTS, first access Level 1, then press --> for ADJUSTMENTS.

Press Enter, then press --> to scroll through the sub-menus.

Once the desired sub-menu is found, press Enter again, then --> to scroll through the personalities. Press the Up or Down arrows to change the personality. Press ESC to go back one or more levels to reach other sub-menus.

EZ-CAL SETUP

Only authorized personnel may have access to and may make changes to personalities.

The Setups Menu is where machine and model settings may be changed. It is also the location where calibrations are performed.

Refer to "Using the EZ-Cal Scan Tool" on page 4-10.

EZ-CAL DIAGNOSTICS

The EZ-Cal Diagnostics menu provides the ability to view and test individual circuits for irregularities. Whether diagnosing a failure or testing functions during preventative maintenance, the *Diagnostics Menu* provides a quick view at the inputs and outputs as registered by the GP400 Control Module **in real time**.

To reach DIAGNOSTICS menu from HELP;

- Press the right arrow and scroll to DIAGNOSTICS and press ENTER.
- Locate the desired sub menu and press ENTER.
- Press the right arrow to scroll through the test points.

NOTE: The ID number will not appear on the EZ-Cal display. It is shown in the *Diagnostics Menu* for reference only.

Press **ESC** to go back one level (necessary to change selection).

EZ-CAL RETRIEVE MODE AND HELP MESSAGES

NOTE: *It is important to understand that an error message will only be available if the red Diagnostic LED is flashing. If the machine is not operating properly and the red Diagnostic LED is not flashing, the trouble may lie with something not monitored by the electronic control system, i.e. a switch, hydraulic valve or wiring damage.*

There are two different menus that you can access for message retrieval; MODE and HELP.

MODE MENU

Allows the technician to see the current state of the controller interlocks with a short description. Go to, DIAGNOSTICS/SYSTEM/MODE (EZ-Cal Flow Chart 2, ID# 2a1). Pressing ENTER a second time will provide additional information with certain messages.

HELP MENU

Provides various HELP messages to identify failure modes.

Some error messages may also be identified by counting the number of times the red LED flashes on the controller so that even without access to an EZ-Cal, some simple diagnostics are possible. However, the EZ-Cal provides a much higher level of diagnostic information. Do not rely on the LED alone.

MODE MESSAGE

- Connect the EZ-Cal (see illustration).
The display will read, "HELP: PRESS ENTER".
- Press the Right Arrow once, then press ENTER twice.
- Refer to the following list of messages to better understand the nature of the message or fault.
- If the GP400 does not register a fault, the display will read EVERYTHING OK.

LOGGED MESSAGE

Pressing ENTER twice will provide the current message, followed by a log of previous operations and/or errors that occurred immediately prior, starting with most recent.

Press the Right and Left Arrows to view all logged messages.

Other helpful menus available include **DIAGNOSTICS** which allows the technician to monitor specific plug input/output information. Refer to EZ-Cal Flow Chart 2 – Diagnostics.

MODE MESSAGES

The purpose of **MODE** is to indicate, in real time, the current state of the controller with a short description.

INITIALIZING

- The system is preparing to operate, immediately after power-on.

SHUTDOWN!

- The system cannot operate – for example both the PLATFORM & GROUND inputs are active together.

CHECK CANBUS

- The system cannot operate – CANBUS communications is not successful (for example wire damage to the platform)

PLATFORM, GROUND

- The system is ready to operate, from the upper or lower controls as indicated (selected by the Base/Platform selector switch)

GROUND UP, GROUND DOWN,

- A ground function is operating normally

GROUND UP LOCKED, GROUND DOWN LOCKED,

- A ground function is selected but not allowed (for example, the function switch was closed at power-on)

GROUND FAULTY

- Multiple ground function inputs are active at the same time

WAITING FOR TRIGGER

- A platform function is selected, but the joystick trigger switch is not closed (close the trigger switch to proceed)

TRIGGER CLOSED

- The joystick trigger switch is closed, but no function is selected (select a function to proceed)

TRIGGER LOCKED

- The joystick trigger switch was closed at power-on, or closed for too long with no function selected (check trigger switch)

FORWARD, REVERSE

- A platform drive function is operating normally

FORWARD (LEFT), FORWARD (RIGHT), REVERSE (LEFT), REVERSE (RIGHT)

- A platform drive function is operating normally, with steer also active

STEER LEFT, STEER RIGHT

- A platform steer function is operating normally (without drive)

UP, DOWN

- A platform lift/lower function is operating normally

FORWARD LOCKED, REVERSE LOCKED

- A platform drive function is selected but not allowed (for example, the switch was closed at power-on)

LEFT LOCKED, RIGHT LOCKED

- A platform steer function is selected but not allowed (for example, the switch was closed at power-on)

UP LOCKED, DOWN LOCKED

- A platform lift/lower function is selected but not allowed (for example, the switch was closed at power-on)

CHECK DRIVE/LIFT

- Neither platform drive nor platform lift select is active, or both are active at the same time

CHECK JOYSTICK

- Both platform joystick directions are active at the same time

STEER FAULTY

- Both platform steer directions are active at the same time

EXTENDING LEGS

- Outrigger legs are extending normally

RETRACTING LEGS

- Outrigger legs are extending normally

OUTRIGGERS LOCKED

- An outrigger function is selected but not allowed (for example, the switch was closed at power-ON)

INTERLOCKED**

- An interlock shutdown is active, preventing one or more functions. The interlock can be due to many different causes ...

Press <ENTER> from the **MODE display to see the precise cause of the interlock (listed below) – press <ESC> from that display to return to the **MODE** display:

TEST MODE

- The system test mode is active – switch power off and on again to clear

TILTED

- The vehicle is tilted beyond limits, descend, then move vehicle to a more level location

TOO HIGH

- The vehicle platform is too high to allow some functions – descend first

TOO HOT

- The EZLIFT heatsink has reached 75°C, preventing all functions except lowering. Functions will be allowed again when the heatsink cools to below 70°C.
- The heatsink temperature can be viewed in the DIAGNOSTICS/SYSTEM/ TEMPERATURE display, ID # 2a5.
- The heatsink must be bolted to a significant metal panel of the vehicle, capable of dissipating heat to the environment.

UNCALIBRATED

- The height and/or pressure sensors have not been calibrated see CALIBRATION OF OVERLOAD SYSTEM (**CE option only**).
- If machine is not equipped with Overload system, refer to SETUPS table and change those personalities that do not match the figure listed in the table.

EXTERNAL ALL, EXTERNAL DRIVE, EXTERNAL LIFT

- An external cutout input is preventing functions – determine the cause of the external cutout (for example, a limit switch)

EZ-CAL HELP MESSAGES

In addition to the **MODE** messages detailed above, the GP400 provides a **HELP** message to identify failure modes. Some error messages may also be identified by counting the number of times the red LED flashes on the controller so that even without access to an EZ-Cal, some simple diagnostics are possible. However, it is recommended to use an EZ-Cal to diagnose problems, and not rely on the LED! The EZ-Cal provides a much higher detail of information.

- Connect the EZ-Cal (see illustration).
The display will read, "HELP: PRESS ENTER".
- Press Enter to display the current message.
- Refer to the following list of HELP messages to better understand the nature of the message or fault.
- If the GP400 does not register a fault, the display will read EVERYTHING OK.

Pressing ENTER twice will provide a scrolling message of the current message (if one exists) followed by a log of previous operations and/or errors that occurred immediately prior, starting with most recent. **All messages are cleared whenever the system is powered down.**

NOTE: When using the LED to attempt diagnosis, please note that a **DUAL FLASH** code is indicated. The LED will flash on/off a certain number of times, pause off for a short delay, then flash on/off a second certain number of times, followed by a much longer pause off. The sequence will then repeat.

INFORMATION ONLY MESSAGES

The following are "information only" HELP messages which are not indicative of any possible problem – there is no LED flash code (the LED remains on steady):

STARTUP! _____ (no flash code)

- The system has just been powered on and is carrying out some initialization steps prior to being ready to operate. If you select a function during this time, it may be locked out until you release then re-select it.

EVERYTHING OK _____ (no flash code)

- There is no problem with the system – it is ready to operate in platform mode when a function is selected.

NOTE: If this is the HELP message when a function is selected, check for open-circuit switches or wiring.

GROUND MODE ACTIVE! _____ (no flash code)

- There is no problem with the GP400 – it is ready to operate in ground mode when a function is selected.

CLOSE TRIGGER _____ (no flash code)

- A platform function is selected but the trigger switch is not closed.

VEHICLE TILTED _____ (no flash code)

- The vehicle is tilted beyond the limits, some functions may be prevented.

FUNCTION ACTIVE MESSAGES

The following **HELP** messages indicate that there is no problem with the GP400 but that a function is active – the vehicle should be moving as requested by the operator.

DRIVING! _____ (no flash code)

LIFTING! _____ (no flash code)

LOWERING! _____ (no flash code)

STEERING! _____ (no flash code)

EXTENDING OUTRIGGERS! _____ (no flash code)

RETRACTING OUTRIGGERS! _____ (no flash code)

CALIBRATION MESSAGES

The following are “calibration” HELP messages – until the machine is properly calibrated for height and/or pressure (as required), many functions will not be available.

NOT CALIBRATED _____ **Flash Code: 1/1**

FUNCTIONS LOCKED - NOT CALIBRATED _____ **Flash Code: 1/1**

- The height and/or pressure sensors have not been calibrated and are required because of the setup of the GP400.
- Calibration procedures are accessible from the **SETUPS/HEIGHT SETUPS** and **SETUPS/LOAD SETUPS** menus.

FAULT: CUSTOMER _____ **Flash Code: 1/1**

- The system must be configured to the customer requirements – with the EZ-Cal in **SETUPS/CHANGE DEFAULTS** menu, scroll to the correct machine from this menu, the press Right Arrow to select the appropriate model.

NOTE: Selecting the incorrect customer or model will cause the machine to operate incorrectly or go into fault mode.

SHUTDOWN HELP MESSAGES

This section lists “shutdown” HELP messages – functions can be shut down to prevent them being used:

SHUTDOWN - CHECK EMS SWITCHES! _____ Flash Code: 2/1

- The Base/Platform selector switch position indicates the mode in which the system must operate if both are active together; the system does not know how to function

FUNCTIONS LOCKED - TEST MODE SELECTED _____ Flash Code: 2/2

- Test mode is not accessible with this system. Switch power off/on to reset to normal operation

FUNCTIONS LOCKED - TOO HIGH _____ Flash Code: 2/2

- The platform is raised too high to allow some functions. Certain functions may not be allowed above certain elevations.
- Check operator’s manual or ADJUSTMENTS/HEIGHTS/MAX DRIVE and MAX LIFT to see if drive and/or lift is allowed at all heights.

FUNCTIONS LOCKED - TILTED _____ Flash Code: 2/2

- The vehicle is tilted too much to allow some functions.
- Check operator’s manual or ADJUSTMENTS/TILT/Xtrip and Ytrip, which determine the maximum allowed vehicle tilt.
- Refer to EZ-Cal Flow Chart 1 – Adjustments and Setup.

FUNCTIONS LOCKED - EXTERNAL SHUTDOWN _____ Flash Code: 2/2

- An external shutdown is preventing functions – check DIAGNOSTICS/SYSTEM/ MODE/INTER-LOCK to see which external interlock is active.

CHECK GROUND INPUT SWITCHES! _____ Flash Code: 2/2

- There is a problem with the ground function select switches – more than one is active at the same time.

SELECT DRIVE/LIFT MODE! _____ Flash Code: 2/2

- There is a problem with the platform drive/lift select switch – neither mode is selected.

CHECK DRIVE/LIFT SELECT SWITCH! _____ Flash Code: 2/2

- There is a problem with the platform drive/lift select switch – both modes are selected together.

CHECK JOYSTICK SWITCHES! _____ Flash Code: 2/2

- There is a problem with the platform joystick switches – both directions are selected together.

RELEASE TRIGGER! _____ Flash Code: 2/2

- The trigger was closed at power-on, or closed for too long with no function selected.

RELEASE GROUND SWITCHES! _____ Flash Code: 2/2

- Ground function switches were closed at power-on.

RELEASE JOYSTICK SWITCHES! _____ Flash Code: 2/2

- Platform joystick switches were closed at power-on, or closed for too long without trigger switch (see **SETUPS/INTERLOCKS/TRIGGERwait**).

RELEASE OUTRIGGER SWITCHES! _____ Flash Code: 2/2

- Outrigger switches were closed at power-on.

WIRING MESSAGES

The following are “wiring” HELP messages – problems have been detected which are likely due to vehicle wiring issues:

FAULT: ENERGIZED VALVE - CHECK P5 WIRING! _____ Flash Code: 3/2

FAULT: VALVE FEEDBACK HIGH - CHECK VALVE WIRING! _____ Flash Code: 3/2

- There is a voltage on one or more valve outputs, when all outputs are off.
- Check each valve output to trace where the invalid supply is coming from.

FAULT: CAPBANK VOLTAGE TOO HIGH - CHECK LINE CONT! __ Flash Code: 3/3

- The voltage on the B+ stud of the controller (connected to an internal voltage stabilization capacitor bank) is too high when the line contactor is off. B+ stud voltage should be approximately 32 volts at idle.
- Check the line contactor tips are not welded, and check the power wiring for errors.

FAULT: ENERGIZED LINE CONTACTOR - CHECK P5 WIRING! __ Flash Code: 3/4

- There is a voltage on the line contactor coil output, when it is off.
- Check wiring to the line contactor coil to trace where the invalid supply is coming from.

FAULT: MOTOR OVERLOAD! _____ Flash Code: 3/5

- The power protection circuits in the controller have activated to protect from extreme overload.
- Check for short-circuit power wiring; check for a seized or shorted motor.

SUPPLY MESSAGES

The following are “supply” HELP messages – problems have been detected which are likely due to supply issues:

FAULT: LOW OIL PRESSURE! _____ Flash Code: 4/1

- Engine oil pressure switch open after start sequence initiated. Engine stalled or unable to start.

FAULT: BAD INTERNAL 5V! _____ Flash Code: 4/2

- The internal “5V slave” supply is out of range; if the fault remains, the controller may have to be replaced.

FAULT: BAD INTERNAL SLAVE! _____ Flash Code: 4/2

- The internal “slave” is not operating correctly; if the fault remains, the controller may have to be replaced.

FAULT: BAD INTERNAL 12V! _____ Flash Code: 4/3

- The internal “12V” supply is out of range;
- 12V Supply is generated by the Motor control module and supplied to the GP400. Check for wiring errors between the two modules. If the fault remains, the Motor Controller may have to be replaced.

FAULT: BATTERY VOLTAGE TOO LOW! _____ Flash Code: 4/4

- The battery supply is too low – the batteries must be re-charged.

FAULT: BATTERY VOLTAGE TOO HIGH! _____ Flash Code: 4/4

- The battery supply is too high – check that the correct battery and charger are installed.

FAULT: BAD 5V SENSOR SUPPLY - CHECK P2-1 WIRING! _____ Flash Code: 4/5

- The “5V sensor” supply is out of range; this supply is available to power external 5V-powered sensors – check that it has not been overloaded or short-circuited to other wiring (CE models).

CANBUS MESSAGES

This section lists “CANBUS” HELP messages – problems have been detected with CANBUS communications between different modules (of course, only applicable if more than one module is connected together via CANBUS):

FAULT: CANBUS! _____ **Flash Code: 6/6**

- There are problems with CANBUS communications between the different modules; messages expected from one or more module are not being received, or messages intended to one or more module cannot be transmitted.
- Check for open- and short- circuit problems with CANBUS wiring; ensure that the CANBUS is wired correctly pin-to-pin; ensure that the vehicle chassis is not erroneously shorted to the chassis (for example, due to insulator breakdown in the motor).

POWER WIRING MESSAGES

The following are “power wiring” HELP messages – problems have been detected which are likely due to power wiring errors:

FAULT: CAPBANK VOLTAGE TOO LOW - CHECK STUD WIRING! **Flash Code: 7/7**

- The voltage on the B+ stud of the controller (connected to an internal voltage stabilization capacitor bank) is too low (a pre-charge circuit in the module normally applies approximately 32 volts to the capacitor bank and B+ stud).
- Check the 300 amp fuse, line contactor or power wiring for errors. Also check DC motor for internal grounding. Possible motor controller failure.

OTHER MESSAGES

The following are other HELP messages:

SOME BIG BAD PROBLEM! _____ **Flash Code: 9/9**

- This message should not occur!

FACTORY OVERRIDE _____ **Flash Code: (fast flashing)**

- When the controller is first shipped, prior to initial calibration, it is configured in a special “factory override” state. In this state, none of the normal shutdowns or interlocks will occur – the vehicle can be freely lifted/lowered and driven irrespective of any calibration needs, vehicle tilt, etc.
- As soon as an EZ-Cal is connected to the controller, the factory override state is ended.
- If calibration does not occur, then the factory override state will recur if the EZ-Cal is disconnected and power is switched off/on.

IMPORTANT: – Never use a vehicle in factory override; this state is **ONLY** intended for use during manufacture! While factory override is active, the LED is rapidly flashed on/off.

TROUBLESHOOTING CHART

The following chart is a guide to help the technician find the area of a problem. In order to benefit from the information, you are advised to fully assess the symptoms by operating all machine functions. There may be some functions that operate while others may not. Record this information and proceed down the left-hand column until you find the failure scenario that best fits the problem. Refer to the information provided to the right for possible causes and remedies. This unit contains a Microprocessor based control system which contains various safety features designed to protect itself and the operator in the event of a failure.

The EZ-Cal scan tool will provide the technician with detailed information related to the failure. ***It is strongly recommended that the technician use the EZ-Cal to read any displayed messages before proceeding to use this Troubleshooting chart.***

Information on the use of the EZ-cal tool plus helpful Flow Charts and graphs can be found earlier in this troubleshooting section. Please read and familiarize yourself with all of the information provided in the troubleshooting section before attempting to diagnose or repair the machine.

Table 4-1: Troubleshooting Chart

Problem	Possible Cause	Remedy/Solution
General Power Issue		
No operation from upper or lower control station; no red LED at GP400.	Main battery switch turned off	Located left of lower control box.
	Emergency switch pushed in or ignition switch turned off or defective	Upper or lower e-stop switch will cut all power, as will the ignition switch in the platform control box.
	Batteries discharged	Will receive 4-4 or 7-7 flash on GP400. Clean, service and charge batteries. Battery charger may not operate if battery voltage drops below 20 volts.
	Blown 30 amp fuse	Located just below the battery cutoff switch
	Circuit breaker tripped	Located in lower control box panel
No functions; LED illuminated or flashing on GP400	Blown 300 amp fuse	Located just to the left of lower control station. Check for excessive motor amperage draw. Will receive a 7-7 flash code on GP400.
	Batteries discharged	Will receive 4-4 or 7-7 flash on GP400. Clean, service and charge batteries. Battery charger may not operate if battery voltage drops below 20 volts
	Damaged upper control box harness	Inspect from harness plug to terminal strip under platform. May receive 6-6 flash code on GP-400 (CAN bus)
	Other fault in system monitored by GP400	Check Help message on EZ-Cal or check flash code for error
Functions from lower controls but not from upper controls	Interlock switch (joystick)	Check power to red wire (power to switch) and power to purple wire (power out of switch) at joystick plug
	Loose plug connections on Matrix module	Check plug connections
	Damaged upper control box harness	Inspect from harness plug to terminal strip under platform. May receive 6-6 flash code on GP-400 (CAN bus)
	System interlock	Check HELP messages using EZ-Cal

LIFT/LOWER		
Platform will not raise; electric motor operating.	Excessive weight on platform	Reduce weight to rated platform capacity
	Lift Relief Valve out of adjustment	Adjust relief valve to rated platform capacity
	Lift Valve not energized	Check wiring to lift valve. Check for EZ-Cal message or flash code
	Lowering Valve SV-5 stuck open (located at base of lift cylinder)	Check and remove contamination from valve
	Main system pressure inadequate	Check pump output pressure
Platform will not raise; electric motor NOT operating.	Level sensor out of level (platform elevated above 10')	Reposition machine to firm level surface. Check level sensor function using EZ-Cal See Diagnostic chart 2e1
	Batteries discharged	Will receive 4-4 or 7-7 flash on GP400. Clean, service and charge batteries Battery charger may not operate if battery voltage drops below 20 volts
	System interlock	Check HELP messages using EZ-Cal
Platform raises uncommanded when operating other functions	Lift Valve sticking	Clean or replace valve
	Shuttle Valve damaged or contaminated	Clean or replace valve. See hydraulic diagram for location
Platform will not lower or lowers slowly	Maintenance lock in maintenance position	Return maintenance lock to the stowed position
	Lowering valve not energized	Check wiring to lowering valve located on Lift Cylinder. Check for EZ-Cal message or Flash code
	Lowering valve not shifting	Clean debris. Check for damage, replace
	Lowering orifice plugged	Clean orifice located inside hose fitting on lift cylinder
	System interruption	Check HELP messages using EZ-Cal
Platform lowers uncommanded (drift down)	Lowering Valve sticking or contaminated	Deploy Maintenance Lock! Remove and clean or replace lowering valve SV5
	Cylinder internal seal failure	Check, repair seals
Emergency lowering not working	Lowering valve not shifting	Clean debris, check for damage, replace
	Lowering Orifice plugged	Clean orifice, located in Lift cylinder hose port.
	Emergency Down battery discharged	Charge, check charge diode & connections
	Emergency Down supply fuse blown	Replace fuse, check for shorts in wire and coil
	Valve coil failed on cylinder	Test, replace
DRIVE:		
No drive function	Drive Valve not shifting	Check electrical connections at drive valve, check drive valve for contamination.
	Lift/Drive select switch malfunction	Check continuity through switch
	Drive system interlock	Check HELP and MODE messages on EZ-Cal
Drive operates uncommanded when operating other functions	Drive Valve sticking or damaged	Clean, replace valve. See hydraulic diagram.
	Shuttle Valve damaged or contaminated	Clean or replace valve. See hydraulic diagram for location

No drive elevated	Unit out of level	Lower and re-position the machine.
	Batteries discharged	Will receive 4-4 or 7-7 flash on GP400. Clean, service and charge batteries. Battery charger may not operate if battery voltage drops below 20 volts
	System interlock	Check HELP messages using EZ-Cal
Slow drive with platform in stowed position	High torque enabled	Check Speed/Torque Switch at platform controls
	Elevation sensor out of calibration	Use EZ-Cal to monitor platform state of elevation. See Diagnostic chart I.D. 2a13 for elevated status and 2e1 for platform % of elevation input. Failure of the angle transducer will trigger a fault code.
	Malfunctioning rear wheel bypass valve	Located on rear wheel motors only. Check by replacing valves.
	Wheel motor/s not functioning correctly	Inspect wheel motors for excessive bypass
Poor gradability performance	High or Mid Speed enabled	Check Speed/Torque Switch
	Batteries discharged	Will receive 4-4 or 7-7 flash on GP400, Clean, service and charge batteries. Battery charger may not operate if battery voltage drops below 20 volts
	Wheel motor/s not functioning correctly	Inspect wheel motors for excessive bypass
	Malfunctioning Rear wheel bypass valve	Located on rear wheel motors only. Check electrical by disconnecting valves or function by replacing valves
	Malfunctioning Series/Parallel Valves	Located on top of main hydraulic Manifold
	Worn hydraulic pump	Check with flow meter or replace pump
Drive in one direction only	Drive Valve not energizing in one direction	Check 12 volts to appropriate coil, check coil, check valve function
	Counterbalance Valve malfunction	Swap counterbalance valves to see if functioning direction changes.
	No output from GP400	Scan using EZ-Cal and troubleshooting charts. EZ-cal chart I.D 4f-7 - Fwd or 2f-9 - Reverse
No Low Speed (high torque mode)	Speed/torque selector switch inoperative	Check continuity of Speed/Torque switch in platform control box
	Valve SV3 not functioning	Check for 12 volts and ground to valve check for faulty valve spool
	Poppet valve not functioning	Check or replace valve
No Mid Speed	Valve powered and/or shifted	These valves should not have 12 volts, in mid-speed, check valve function
	Speed/torque selector switch malfunction	Check continuity through switch
No High Speed	Speed/torque selector switch inoperative	Check continuity of Speed/Torque switch in platform control box
	Valve not functioning	Check voltage and ground to valve check for faulty valve spool
	EP2 poppet valve not functioning	Check or replace valve
No brake effectiveness	Brake Orifice obstructed	Remove, clean orifice. See hydraulic diagram for location in manifold.
	Brake discs worn past service limit	Replace brake discs located inside rear wheel motors.

LIFT AND DRIVE		
No drive or lift operation motor operates	Main Relief Valve out of adjustment	For test purposes, swap relief valves.
	Pump or pump coupler failure	Inspect, replace as necessary
	Diverter Valve malfunction	Inspect, replace as necessary
	Hydraulic tank empty	Check, fill with approved oil
No drive or lift operation motor does not operate	Motor malfunction	Inspect, replace as necessary
	System interlock	Check HELP messages using EZ-Cal
	Battery discharged	Will receive 4-4 or 7-7 flash on GP400. Clean, service and charge batteries. Battery charger may not operate if battery voltage drops below 20 volts.
STEER		
No steer in either direction	Joystick rocker switch inoperative	Check rocker switch output on green and yellow wires, input on blue wire.
	Steering Valve inoperative	Check steering valve for power or damage.
	System interlock	Check HELP messages using EZ-Cal
	Hoses connected incorrectly	See hydraulic section for correct connection.
	Steer Relief Valve set too low	Adjust steer relief valve
Steers in one direction only	Steering Valve inoperative or stuck	Inspect; replace steering valve
	No power to steering coil	Check for power and ground in both directions, repair wiring
	System interlock	Check HELP messages using EZ-Cal
Steers but not fully or steers slowly	One or both steering cylinder internal seal failure	Check steering cylinder seals, replace
	Steer Relief Valve set too low	Adjust steer relief valve
	King pin/s seizing in the bore	Disassemble and inspect, repair, replace bushings
Wheels do not stay in position while driving	One or both steering cylinder internal seal failure	Check steering cylinder seals, replace
Steers uncommanded	Steering Valve sticking or damaged	Remove and inspect for visible debris and stem straightness, clean with solvent and air
	Check Valve damaged or contaminated with debris	Remove and clean or replace check valves see hydraulic diagram for manifold location
No auto-level operation; manual level operates	Switch or switch wiring problem. Located inside upper control box	Check switch and wiring
	Level Sensor not calibrated	See Tilt Sensor Calibration instructions found earlier in this section.
	System Interlock	Check HELP messages using EZ-Cal

Unit will not accurately level platform	Unit on too extreme an angle	Relocate unit to more level ground
	Level valve sticking	Inspect/replace valves located behind lower control box
	Excessive weight on platform	Reduce weight to 1500 lbs max (680Kg)
	Pressure relief valve out of adjustment	Set steering relief valve SV-2 to 2000 PSI (138 bar)
	Tilt sensor not calibrated or not calibrated properly	See Tilt Sensor Calibration instructions found earlier in this section.
	Level cylinder valves wired incorrectly	Refer to schematic diagram for correct wiring.
	Level cylinder hoses connected incorrectly	See Hydraulic section for hose routing detail
Will not stay level; drifts down	Counterbalance valve adjustment or failure	Located on the outrigger cylinder, not adjustable. If valve is suspect it must be replaced
	Failure of cylinder internal seals	Inspect and repair as necessary