Level 1	Level 2	Level 3	Level 4	Parameter	Range	Default Value	Units	Description
User Settings								
	Speed Settings							
				Max Motor Speed	200 to 8000	6000	RPM	Defines the maximum requested motor rpm at full throttle.
	Analog Gauge Setup							
				Tach Output Frequency	0 to 4000	495	Hz	Controller output frequency that drives an analog type tachometer. 4 cyl = 266, 6 cyl = 495, 8 cyl = 512.
		Speedo Calibration						Used to calibate the enGage 7 speedometer.
				Zero MPH Cal	0 to 1024	250	N/A	Adjust as needed
				10 MPH Cal	0 to 1024	272	N/A	Adjust as needed
				15 MPH Cal	0 to 1024	304	N/A	Adjust as needed
				20 MPH Cal	0 to 1024	355	N/A	Adjust as needed
				25 MPH Cal	0 to 1024	385	N/A	Adjust as needed
				30 MPH Cal	0 to 1024	499	N/A	Adjust as needed
				40 MPH Cal	0 to 1024	505	N/A	Adjust as needed
		Fuel Gauge						
				Calibrate	on/off	off	N/A	on = Used in conjunction with BDI Cal Signal to calibrate min and max range.
				Empty Output	0 to 32767	11000	N/A	Adjust to position needle on gauge to the minimum scale when BDI Cal signal is set to zero
				1/4 Output	0 to 32767	14250	N/A	Adjust to position needle on gauge to the 1/4 scale when BDI Cal signal is set to 25%.
				1/2 Output	0 to 32767	18100	N/A	Adjust to position needle on gauge to the 1/2 scale when BDI Cal signal is set to 50%.
				3/4 Output	0 to 32767	21750	N/A	Adjust to position needle on gauge to the 3/4 scale when BDI Cal signal is set to 75%.
				Full Output	0 to 32767	28100	N/A	Adjust to position needle on gauge to the full scale when BDI Cal signal is set to 100%.

Level 1	Level 2	Level 3	Level 4	Parameter	Range	Default Value	Units	Description
		Fuel Gauge Continued						
				BDI Calibration Signal	0 to 100	0	%	Percentage sent to mimick a certain battery state of charge percentage so that the gauge being utilized for battery state of charge can be calibrated.
				SOC at Minimum Output	0 to 100	20	%	Battery state of charge at minimum output
				SOC at Maximum Output	0 to 100	100	%	Battery state of charge at maximum output
		Temperature Gauge Setup						
				Calibrate	on/off	off	N/A	on = Used in conjunction with Temperature Cal Signal to calibrate min and max range.
				Minimum Output	0 to 32767	5500	N/A	Adjust to position needle on gauge to the minimum scale when Temp Cal signal is set to zero
				1/4 Scale Output	0 to 32767	10650	N/A	Adjust to position needle on gauge to 1/4 scale when Temp Cal signal is set to 25%.
				1/2 Scale Output	0 to 32767	15700	N/A	Adjust to position needle on gauge to 1/2 scale when Temp Cal signal is set to 50%.
				3/4 Scale Output	0 to 32767	20750	N/A	Adjust to position needle on gauge to 3/4 scale when Temp Cal signal is set to 75%.
				Full Scale Output	0 to 32767	25800	N/A	Adjust to position needle on gauge to full scale when Temp Cal signal is set to 100%.
				Temperature Calibration Signal	0 to 200	0	°C	Percentage sent to mimick a certain motor temperature so that the gauge being utilized for temperature can be calibrated.
				Temp at Min Output	0-200	40	°C	temperature variable to be used to assist in setting scale outputs for minimum temperature
				Temp at Max Output	0-200	120	°C	temperature variable to be used to assist in setting scale outputs for maximum temperature

Level 1	Level 2	Level 3	Level 4	Parameter	Range	Default Value	Units	Description
	enGage 7 Parameters							
				E7 Installed	on/off	off	N/A	on = enGage VII is present
				Number of Gauges	3, 6 or 9	9	N/A	Number of gauges to display on the Engage VII
		Gauge One Setup						
				UoM	1 to 255	23	N/A	Information to display desired gauge is located on the Gauges Unit of Measure (UoM) tab below
				Minimum Scale	-32768 to 32767	0		Minimum scale to be displayed on gauge
				Maximum Scale	0 to 32767	6000		Maximum scale to be displayed on gauge
		Gauge Two Setup						
				UoM	1 to 255	99		Information to display desired gauge is located on the Gauges Unit of Measure (UoM) tab below
				Minimum Scale	-32768 to 32767	0		Minimum scale to be displayed on gauge
				Maximum Scale	0 to 32767	100		Maximum scale to be displayed on gauge
		Gauge Three Setup						
				UoM	1 to 255	21		Information to display desired gauge is located on the Gauges Unit of Measure (UoM) tab below
				Minimum Scale	-32768 to 32767	0		Minimum scale to be displayed on gauge
				Maximum Scale	0 to 32767	40		Maximum scale to be displayed on gauge
		Gauge Four Setup						
				UoM	1 to 255	46		Information to display desired gauge is located on the Gauges Unit of Measure (UoM) tab below
				Minimum Scale	-32768 to 32767	0		Minimum scale to be displayed on gauge
				Maximum Scale	0 to 32767	500		Maximum scale to be displayed on gauge

Level 1	Level 2	Level 3	Level 4	Parameter	Range	Default Value	Units	Description
	enGage 7 Parameters Continued							
		Gauge Five Setup						
				UoM	1 to 255	73		Information to display desired gauge is located on the Gauges Unit of Measure (UoM) tab below
				Minimum Scale	-32768 to 32767	0		Minimum scale to be displayed on gauge
				Maximum Scale	0 to 32767	170		Maximum scale to be displayed on gauge
		Gauge Six Setup						
				UoM	1 to 255	57		Information to display desired gauge is located on the Gauges Unit of Measure (UoM) tab below
				Minimum Scale	-32768 to 32767	0		Minimum scale to be displayed on gauge
				Maximum Scale	0 to 32767	60		Maximum scale to be displayed on gauge
		Gauge Seven Setup						
				UoM	1 to 255	100		Information to display desired gauge is located on the Gauges Unit of Measure (UoM) tab below
				Minimum Scale	-32768 to 32767	0		Minimum scale to be displayed on gauge
				Maximum Scale	0 to 32767	150		Maximum scale to be displayed on gauge
		Gauge Eight Setup						
				UoM	1 to 255	101		Information to display desired gauge is located on the Gauges Unit of Measure (UoM) tab below
				Minimum Scale	-32768 to 32767	0		Minimum scale to be displayed on gauge
				Maximum Scale	0 to 32767	90		Maximum scale to be displayed on gauge

Level 1	Level 2	Level 3	Level 4	Parameter	Range	Default Value	Units	Description
	enGage 7 Parameters Continued							
		Gauge Nine Setup						
				UoM	1 to 255	106		Information to display desired gauge is located on the Gauges Unit of Measure (UoM) tab below
				Minimum Scale	-32768 to 32767	0		Minimum scale to be displayed on gauge
				Maximum Scale	0 to 32767	16		Maximum scale to be displayed on gauge
		Icon Test						
				Test Fault Icons	on/off	off	N/A	set to on to test fault icons on the eNgage VII display
	Idle Setup							
				Idle Enable	on/off	on	N/A	on = motor idle will be turned on
				Idle Speed Rough	300 to 1000	350	RPM	Rough motor idle speed
				Idle Speed Fine	0 to 100	0	%	Use to fine tune the idle RPM
				Idle Torque	0 to 100	25	%	percentage of available torque at idle speed
	Motor Tuning							
				Motor Type	9 70 77	35	N/A	Input motor type
	Main Contactor							
				Main Contactor Voltage	12 to 96	12	Volt	Main contactor coil voltage
				Main Holding %	0 to 100	80	%	percentage of main contactor voltage used to hold the main closed

Level 1	Level 2	Level 3	Level 4	Parameter	Range	Default Value	Units	Description
	840 Display Menu Items							
				Auto Scroll	on/off	off	N/A	ON = auto scoll through following listed items on the Curtis 840 Display. Any combination of items listed below can be turned on or off based on the users needs.
				Display SOC	on/off	on	N/A	Displays battery state of charge on Curtis 840 Display
				Display Motor RPM	on/off	on	N/A	Displays motor RPM on Curtis 840 Display
				Display Battery Amps	on/off	on	N/A	Displays battery amps on Curtis 840 Display
				Display Voltage	on/off	on	N/A	Displays voltage on Curtis 840 Display
				Display Motor Temp	on/off	on	N/A	Displays motor temperature on Curtis 840 Display
				Display Controller Temp	on/off	on	N/A	Displays controller temperature on Curtis 840 Display
				Display Minimum Voltage	on/off	on	N/A	Displays minimum voltage on Curtis 840 Display
				Display Maximum Current	on/off	on	N/A	Displays maximum current on Curtis 840 Display
	Acuity Parameters							
				Acuity Installed	on/off	on	N/A	on = a Curtis Acuity Battery Monitor is installed
				Lithium Battery	on/off	off	N/A	on = lithium batteries are being used
		Lithium Parameters						
				Amphour Capacity	0 to 1500	180.0	N/A	Amphour capacity of battery pack
				Number of Banks	1 to 4	4	N/A	Number of battery banks
				Nominal Cell Voltage	3.00 to 5.00	3.20	Volt	Nominal rated cell voltage
				Min Cell Voltage	0.00 to 7.00	2.3	Volt	
				Max Cell Voltage	0.00 to 7.00	3.55	Volt	
				Max Charge Voltage	140 to 180	170.0	Volt	Maximum target voltage for the battery pack

Level 1	Level 2	Level 3	Level 4	Parameter	Range	Default Value	Units	Description
		Lithium Parameters Continued						
				Charger Rated Max Current	5.0 to 60.0	20.0	Amp	Maximum current that the charger outputs
				Full Reset Voltage	0.00 to 180.00	165.00	Volt	Voltage for which the State of Charge displayed will reset to 100%.
			Bank 1					
				Number of Cells	1 to 24	12		Number of cells installed bank 1
				Max Bank Voltage	0 to 90	42.00	Volt	Calculated from Number of cells and Nominal cell voltage
				Min Bank Voltage	0 to 90	36.00	Volt	"
			Bank 2					
				Number of Cells	1 to 24	12		Number of cells installed bank 2
				Max Bank Voltage	0 to 90	42.00	Volt	Calculated from Number of cells and Nominal cell voltage
				Min Bank Voltage	0 to 90	36.00	Volt	"
			Bank 3					
				Number of Cells	1 to 24	12		Number of cells installed bank 3
				Max Bank Voltage	0 to 90	42.00	Volt	Calculated from Number of cells and Nominal cell voltage
				Min Bank Voltage	0 to 90	36.00	Volt	"
			Bank 4					
				Number of Cells	1 to 24	12		Number of cells installed bank 4
				Max Bank Voltage	0 to 90	42.00	Volt	Calculated from Number of cells and Nominal cell voltage
				Min Bank Voltage	0 to 90	36.00	Volt	"
			Cutbacks					
				Low Bank Begin Cutback	0 to 5.00	2.80	Volt	Voltage for which the system goes into drive current limit cutback. Used to protect the batteries

Level 1	Level 2	Level 3	Level 4	Parameter	Range	Default Value	Units	Description
			Cutbacks Continued					
				Low Bank Full Cutback	0 to 5.00	2.30	Volt	Voltage for which the system goes into full drive current limit cutback. Used to protect the batteries
				Max Current at Full Cutback	0 to 100	20	%	Percentage of available current from the batteries at full cutback
		Lead Acid Battery Setup						
				Battery Type	1 to 1024	256	N/A	Battery type based on the following battery profiles: 0 = Flooded E85 1= Flooded E100 2 = Flooded E110 3 = Flooded E125 4 = Flooded E140 5 = Flooded E155 6 = Trojan T 105 7 = Trojan T 890 256 = AGM 185 257 = AGM Discover GC8A
				5 Hour Rate	60 to 1500	150	N/A	Battery manufacturers stated 5 hour rate
		Cutbacks						
				User Undervoltage	50 to 90	80	%	The value of this parameter is a percentage of the Nominal Voltage setting. The User Undervoltage parameter can be used to adjust the undervoltage threshold, which is the voltage at which the controller will cut back drive current to prevent damage to the electrical system.
				Low SOC Cutback	0 to 100	20	%	Sets the SOC where the system goes into Limp Mode and cuts back motor current.
				Max Current at Low SOC	0 to 100	30	%	Sets the percentage of controller rated current allowed when Low SOC is activated.

Level 1	Level 2	Level 3	Level 4	Parameter	Range	Default Value	Units	Description
	Dual Drive							
				Dual Drive Mode	on/off	off	N/A	This parameter turns dual drive off or on. Turn on for a dual motor.
				Number of Secondary Controllers	1 to 3	1	N/A	This parameter advises the primary controller on the number of secondary controllers
				Response Timeout	50 to 10000	1000	ms	Time alloted for the secondary controller(s) to respond to the primary controller

Level 1	Level 2	Level 3	Level 4	Monitor	Range	Units	Description
Dual Drive							
				Dual Drive State	on/off	N/A	On = dual drive ON
	Secondary Monitoring						
				Secondary Not Communicating ID	0-3		Identifies which controller is not communicating.
		Secondary 1 Monitoring					
				Secondary Motor 1 Temp	-40 to 200	°C	Motor temperature
				Secondary Controller 1 Temp	-40 to 200	°C	Controller temperature
				Secondary Controller 1 Fault	0 to 99	N/A	Reported controller fault
				Controller Communicating	on/off	N/A	Reports if the controller is communicating. On = communicating
		Secondary 2 Monitoring					
				Secondary Motor 2 Temp	-40 to 200	°C	Motor temperature
				Secondary Controller 2 Temp	-40 to 200	°C	Controller temperature
				Secondary Controller 2 Fault	0 to 99	N/A	Reported controller fault
				Controller Communicating	on/off	N/A	Reports if the controller is communicating or not. On = communicating
		Secondary 3 Monitoring					
				Secondary Motor 3 Temp	-40 to 200	°C	Motor temperature
				Secondary Controller 3 Temp	-40 to 200	°C	Controller temperature
				Secondary Controller 3 Fault	0 to 99	N/A	Reported controller fault
				Controller Communicating	on/off	N/A	Reports if the controller is communicating or not. On = communicating

Level 1	Level 2	Level 3	Level 4	Monitor	Range	Units	Description
CAN Communication							
				Charger Communication	on/off		on = Charger is communicating to controller (Elcon only with Acuity's)
				enGage 7 Communicating	on/off		on = E7 is communicating with the motor controller.
				Acuity Communicating	on/off		on = Acuity(s) are communicating with the motor controller.
Performance Information							
				Vessel Speed MPH	0 to 60	MPH	Display vessel speed in Miles perHour (MPH)
				Vessel Speed KPH	0 to 60	KPH	Display vessel speed in Miles perHour (KPH)
				Vessel Speed Kts	0 to 60	N/A	Display vessel speed in Knots
Battery Information							
	Peak I&E						
				Peak Battery Current	0 to 1500	AMP	Peak battery current reported while the system since power was turned on.
				Peak RMS Current	0 to 5000	AMP	Peak RMS current reported while the system is under load
				Minimum Voltage	0 to 170	Volt	Minimum voltage reported while the system is under load
	General						
				Keyswitch Voltage	0 to 150	Volt	Voltage at Pin 1 (KSI)
			Acuity required for below monitor items to				
				Measured Current	-1600 to 1600	AMP	Measured system current
				Remaining Amphours	calculated	AMP	Remaining Amphours within the batteries
				Time Remaining	0 to 500	Hour	Run time left with the remaining Amphours and Amphour consumption
				State of Charge	0 to 100	%	Battery State of Charge
				Calculated Pack Voltage	0 to 180	Volt	Combined voltage of all battery banks
				Battery Temperature	variable	°C	Temperature of the batteries

				kW Draw	variable	kW	Power to or from batteries in kW
				kW Remaining	variable	kW	The amount of power remaining in batteries.
Level 1	**Level 2**	**Level 3**	**Level 4**	**Monitor**	**Range**	**Units**	**Description**
	Charging Info	**Elcon Charger only**					
				Charger Output Current	variable	AMP	Based on charger current output
				Charger Output Voltage	variable	Volt	Based on charger voltage output
				Time to Full Charge	variable	Hrs	Calculated amount of time it will take to reach a full charge.
				Charger Status	on/off	N/A	0 = Charger enabled, 1 = Charger not enabled
				Bank 1 Peak Voltage	0 to 180	Volt	The highest voltage that Bank 1 experienced
				Bank 2 Peak Voltage	0 to 180	Volt	The highest voltage that Bank 2 experienced
				Bank 3 Peak Voltage	0 to 180	Volt	The highest voltage that Bank 3 experienced
				Bank 4 Peak Voltage	0 to 180	Volt	The highest voltage that Bank 4 experienced
	Lithium Monitor	**Acuity Required**					
		High/Low Monitor					
				Highest Bank ID	1 to 4		Identification of the highest bank based on voltage
				Highest Bank Voltage	0 to 180	Volt	Voltage of the highest bank
				Lowest Bank ID	1 to 4		Identification of the lowest bank based on voltage
				Lowest Bank Voltage	0 to 180	Volt	Voltage of the lowest bank
				Bank Delta Voltage	0 to 180	Volt	Difference in voltage between highest bank voltage and lowest bank voltage
			Average Monitor				
				Highest Average Bank ID	1 to 4		Identification of the highest bank based on average voltage of all cells within the bank
				Highest Average Cell Voltage	0 to 15	Volt	Highest battery bank based on average battery voltage

				Lowest Average Bank ID	1 to 4		Identification of the lowest bank based on average voltage of all cells within the bank

Level 1	Level 2	Level 3	Level 4	Monitor	Range	Units	Description
			Average Monitor Continued				
				Lowest Average Cell Voltage	0 to 15	Volt	Lowest battery bank based on average battery voltage
				Cell Average Delta	0 to 5	Volt	Difference in voltage between the highest average battery bank and lowest average battery bank
		Bank Monitor					
				Bank 1 Voltage	0 to 180	Volt	Combined voltage contained within Bank 1
				Bank 1 Average Cell Voltage	0 to 15	Volt	Average cell voltage contained within Bank 1
				Bank 2 Voltage	0 to 180	Volt	Combined voltage contained within Bank 2
				Bank 2 Average Cell Voltage	0 to 15	Volt	Average cell voltage contained within Bank 2
				Bank 3 Voltage	0 to 180	Volt	Combined voltage contained within Bank 3
				Bank 3 Average Cell Voltage	0 to 15	Volt	Average cell voltage contained within Bank 3
				Bank 4 Voltage	0 to 180	Volt	Combined voltage contained within Bank 4
				Bank 4 Average Cell Voltage	0 to 15	Volt	Average cell voltage contained within Bank 4
				Bank Delta Voltage	0 to 180	Volt	Difference in voltage between the highest battery bank and lowest battery bank
				Calculated Pack Voltage	0 to 180	Volt	Total calculated battery voltage based on all battery banks

Gauge Units of Measure (UoM)	Input number to display UoM	Typical Minimum	Typical Maximum	Notes	Required to function
Vessel Speed (MPH)	**21**	0	40	Will display vessel speed in Miles Pre Hour (MPH) on the Engage VII. Input the UoM display number in the UoM parameter for the desired gauge located at User Settings-> enGage 7 Parameters	Pressure transducer connected to pitot pick up. See schematic.
RPM	**23**	0	6000	Will display the Motor RPM on the Engage VII. Input the UoM display number in the UoM parameter for the desired gauge located at User Settings-> enGage 7 Parameters	
Amps	**46**	0	500	Will display the Amp draw from the batteries on the Engage VII. Place the UoM display number in the UoM parameter entry located at User Settings-> enGage 7 Parameters	Acuity required
Volts	**47**	0	180	Will display the controller B+ terminal voltage on the Engage VII. Place the UoM display number in the UoM parameter entry located at User Settings-> enGage 7 Parameters	
RPM X 100	**57**	0	60	Will display Motor RPM with at a factor of 100 on the Engage VII. Input the UoM display number in the UoM parameter for the desired gauge located at User Settings-> enGage 7 Parameters	Alternate to RPM
Vessel Speed (KPH)	**72**	0	60	Will display vessel speed in Kilometers Pre Hour (KPH) on the Engage VII. Input the UoM display number in the UoM parameter for the desired gauge located at User Settings-> enGage 7 Parameters	Pressure transducer connected to pitot pick up. See schematic.
Kilowatt (KW)	**73**	0	170	Displays power (Kilowatt) being used by the total system on the Engage VII. Input the UoM display number in the UoM parameter for the desired gauge located at User Settings-> enGage 7 Parameters	Acuity required
State of Charge (SOC %)	**99**	0	100	Will display the battery pack State of Charge (SOC) on the Engage VII. Input the UoM display number in the UoM parameter for the desired gauge located at User Settings-> enGage 7 Parameters	Acuity required

Motor Temp	**100**	0	150	Will display the Motor Temperature on the Engage VII. Input the UoM display number in the UoM parameter for the desired gauge located at User Settings-> enGage 7 Parameters	
Controller Temp	**101**	0	190	Will display the controller temperature on the Engage VII. Input the UoM display number in the UoM parameter for the desired gauge located at User Settings-> enGage 7 Parameters	
KW Remaining	**102**	0	30	Will display the remaining Kilowatts in the battery pack on the Engage VII. Input the UoM display number in the UoM parameter for the desired gauge located at User Settings-> enGage 7 Parameters	Acuity required
Time Remaining	**103**	0	500	Will display the amount of time remaining until the batteries are depleated of power on the Engage VII. Input the UoM display number in the UoM parameter for the desired gauge located at User Settings-> enGage 7 Parameters	Acuity required
Auxiliary Voltage	**106**	0	16	Will display the auxiliary battery voltage on the Engage VII. Input the UoM display number in the UoM parameter for the desired gauge located at User Settings-> enGage 7 Parameters	
Vessel Speed (Knots)	**107**	0	40	Will display vessel speed in Knots on the Engage VII. Input the UoM display number in the UoM parameter for the desired gauge located at User Settings-> enGage 7 Parameters	Pressure transducer connected to pitot pick up. See schematic.

Code	Programmer Display (Effect or Fault)	Possible Cause	Set/Clear Conditions
12	**Controller Overcurrent**	1) External short of phase U, V, or W motor connections 2) Motor parameters are mis-tuned 3) Controller defective	**Set:** Phase current exceeded the current measurement limit **Clear:** Cycle KSI
13	**Current Sensor Fault**	1) Leakage to vehicle frame from phase U, V, or W (short in motor stator) 2) Controller defective	**Set**: Controller current sensors have invalid reading **Clear**: Cycle KSI
14	**Precharge Failed**	1) External load on capacitor bank (B+ connection terminal) that prevents the capacitor bank from charging 2) See Monitor menu >> Battery: Capacitor Voltage	**Set**: Precharge failed to charge the capacitor bank to KSI voltage **Clear**: Cycle Interlock input or use VCL function *Precharge()*
17	**Severe Undervoltage**	1) Battery Menu parameters are misadjusted 2) Non-controller system drain on battery 3) Battery resistance 4) Battery disconnected while driving 5) See Monitor Menu >> Battery: Capacitor voltage 6) Blown B+ fuse or main contactor did not close	**Set:** Capacitor bank voltage dropped below the Severe Undervoltage limit with FET bridge enabled **Clear**: Bring capacitor voltage above Severe Undervoltage limit
18	**Severe Overvoltage**	1) See Monitor menu >> Battery: Capacitor Voltage 2) Battery menu parameters are misadjusted 3) Battery resistance too high for given regen current 4) Battery disconnected while regen braking	**Set:** Capacitor bank voltage exceeded the Severe Overvoltage limit with FET bridge enabled **Clear**: Bring capacitor voltage below Severe Overvoltage limit and then cycle KSI

Code	Programmer Display (Effect or Fault)	Possible Cause	Set/Clear Conditions
22	**Controller Overtemp Cutback**	1) See Monitor menu >> Controller: Temperature 2) Controller is performance-limited at this temperature 3) Controller is operating in an extreme environment 4) Excessive load on vehicle 5) Improper mounting of controller	**Set**: Heatsink temperature exceeded by 85°C **Clear**: Bring heatsink temperature below 85°C
23	**Undervoltage Cutback**	1) Normal operation. Fault shows that the batteries need recharging. Controller performance is limited at this voltage. 2) Battery parameters are misadjusted 3) Non-controller system drain on battery 4) Battery resistance too high 5) Battery disconnected while driving 6) See Monitor Menu >> Battery: Capacitor voltage 7) Blown B+ fuse or main contactor did not close	**Set**: Capacitor bank voltage dropped below the Undervoltage limit with the FET bridge enabled **Clear**: Bring capacitor voltage below the undervoltage limit
24	**Overvoltage cutback**	1) Normal operation. Fault shows that regen braking currents elevated the battery voltage during regen braking. Controller is performance limited at this voltage. 2) Battery parameters are misadjusted 3) Battery resistance too high for given regen current 4) Battery disconnected while regen braking 5) See Monitor Menu >> Battery: Capacitor voltage	**Set:** Capacitor bank voltage exceeded the Overvoltage limit with the FET bridge enabled **Clear:** Bring capacitor voltage below the Overvoltage limit

Code	Programmer Display (Effect or Fault)	Possible Cause	Set/Clear Conditions
25	**(+) 5V Supply Failure**	1) External load impedance on the +5V supply (pin 26) is too low 2) See Monitor menu >> outputs: 5 Volts and Ext Supply Current	**Set**: +5V supply (pin 26) outside the +5V +/- 10% range **Clear**: Bring voltage within range
28	**Motor Temp Hot Cutback**	1) Motor temperature is at or above the programmed Temperature Hot setting, and the requested current is being cut back 2) Motor Temperature Control Menu parameters are mis-tuned 3) See Monitor Menu >> Motor: Temperature and >> Inputs: Analog2 4) If the application doesn't use a motor thermistor, Temp Compensation and Temp Cutback should be programmed Off.	**Set**: Motor temperature is at or above the Temperature Hot parameter setting. **Clear**: Bring the motor temperature within range
29	**Motor Temp Sensor Fault**	1) Motor thermistor is not connected properly 2) If the application doesn't use a motor thermistor. Motor Temp Sensor Enable should be programmed OFF 3) See Monitor Menu >> Motor: Temperature and >> Inputs: Analog2	**Set**: Motor thermistor input (pin 8) is at the voltage rail (0 or 10V) **Clear**: Bring the motor thermistor input voltage within range
31	**Coil1 Driver Open/Short**	1) Open or short on driver load 2) Dirty connector pins 3) Bad crimps or faulty wiring	**Set:** Driver 1 (pin 6) is either open or shorted. This fault can be set only when Main Enable = OFF **Clear**: Correct open or short and cycle driver
31	**Main Open/Short**	1) Open or short on driver load 2) Dirty connector pins 3) Bad crimps or faulty wiring	**Set:** Main contactor driver (pin 6) is either open or shorted. This fault can be set only when Main Enable = ON **Clear:** Correct open or short, and cycle driver

Code	Programmer Display (Effect or Fault)	Possible Cause	Set/Clear Conditions
37	**Motor Open**	1) Motor phase is open 2) Bad crimps or faulty wiring	**Set**: Motor phase U, V or W detected open **Clear**: Cycle KSI
38	**Main Contactor Welded**	1) Main contactor tips are welded closed 2) Motor phase U or V is disconnected or open 3) An alternative voltage path (such as an external precharge resistor) is providing a current to the capacitor bank (B+ connection terminal)	**Set**: Just prior to the main contactor closing, the capacitor bank voltage (B+ connection terminal) was loaded for a short time and the voltage did not discharge **Clear**: Cycle KSI
39	**Main Contactor Did Not Close**	1) Main contactor did not close 2) Main contactor tips are oxidized, burned, or not making good contact 3) External load on capacitor bank (B+ connection terminal) that prevents capacitor bank from charging 4) Blown B+ fuse	**Set:** With the main contactor commanded closed, the capacitor bank voltage (B+ connection terminal) did not charge to B+ **Clear**: Cycle KSI
41	**Throttle Wiper High**	1) See Monitor Menu >> Inputs: Throttle Pot 2) Throttle pot wiper voltage too high	**Set:** Throttle pot wiper (pin 16) voltage is higher than the high fault threshold (can be changed with the VCL function *Setup_Pot_Faults()*) **Clear**: Bring throttle pot wiper charge below the fault threshold
42	**Throttle Wiper Low**	1) See Monitor Menu >> Inputs: Throttle Pot 2) Throttle pot wiper voltage too low	**Set:** Throttle pot wiper (pin 16) voltage is lower than the low fault threshold (can be changed with the VCL function Setup_Pot_Faults()) **Clear:** Bring throttle pot wiper charge above the fault threshold

Code	Programmer Display (Effect or Fault)	Possible Cause	Set/Clear Conditions
43	**Pot2 Wiper High**	1) See Monitor Menu >> Inputs: Pot2 Raw 2) Pot2 wiper voltage too high	**Set**: Pot2 wiper (pin 17) voltage is higher than the high fault threshold (can be changed with the VCL function *Setup_Pot_Faults()*) **Clear:** Bring Pot2 wiper voltage below the fault threshold
44	**Pot2 Wiper Low**	1) See Monitor Menu >> Inputs: Pot2 Raw 2) Pot2 wiper voltage too low	**Set:** Pot2 wiper (pin 17) voltage is lower than the low fault threshold (can be changed with the VCL function Setup_Pot_Faults()) **Clear**: Bring Pot2 wiper voltage above the fault threshold
45	**Pot Low Overcurrent**	1) See Monitor Menu >> Outputs: Pot Low 2) Combined pot resistance connected to pot low is too low	**Set**: Pot low (pin 18) current exceeds 10mA **Clear**: Clear pot low overcurrent condition and cycle KSI
46	**EEPROM Failure**	1) Failure to write to EEPROM memory. This can be caused by EEPROM memory writes initiated by VCL, by the CAN bus, by adjusting parameters with the programmer, or by loading new software into the controller	**Set**: Controller operating system tried to write to EEPROM memory and failed. **Clear**: Download the correct software (OS) and matching parameter default settings into the controller and cycle KSI

Code	Programmer Display (Effect or Fault)	Possible Cause	Set/Clear Conditions
49	**Parameter Change Fault**	1) This is a safely fault caused by a change in certain parameter settings so that the vehicle will not operate until KSI is cycled. For example, if a user changes the Throttle Type this fault will appear and require cycling KSI before the vehicle can operate.	**Set:** Adjustment of a parameter setting that requires cycling of KSI **Clear:** Cycle KSI
51	**Acuity Communication Fault**	1) This is a communication fault from the Acuity Battery Monitoring System	**Set:** Acuity not powered. Acuity not plugged into CAN BUS. Broken wire in CAN BUS wiring or power wiring. Acuity Baud rate incorrect. Acuity failed. Plug into the Acuity to verify Baud rate is set correctly. **Clear:** Check to see that the Acuity is plugged into the CAN Bus and is connected to power. Check wiring for breaks/continuity. Check for Acuity operation.
52	**Fault from Secondary**	1) The secondary controller that is used in a dual motor configuration has a fault.	**Set**: Fault from Secondary **Clear**: Check and clear fault that exists on secondary controller
54	**Secondary Communication Error**	1) No power to secondary controller. 2) Broken wire in the CAN BUS wiring. 3) Faulty secondary controller.	**Set**: Secondary controller not powered. Broken wire within the CAN BUS wiring harness. Faulty secondary controller. **Clear:** Check wiring and the fuse. Check the CAN BUS wiring for continuity. Replace the secondary controller.

Code	Programmer Display (Effect or Fault)	Possible Cause	Set/Clear Conditions
56	**Engage VII Communication Error**	1) Engage VII not powered. 2)Engage VII not connected to CAN Bus system. 3)Broken wire (power of CAN Bus). 4)Plug located at back of Engage VII loose.	**Set:** Lost power to Engage VII. Lost CAN Bus communication to the Engage VII. Broken wires **Clear:** Check power, CAN Bus and wires leading to and from Engage VII.
57	**Motor Over Temperature**	1) A motor within the system is over define maximum temperature	**Set:** Defines the temperature at which current is cut back to zero. **Clear:** Allow the motors to cool and decipher the issue that is causing the hot condition.
58	**Charger plugged in**	1) The charger is plugged into the vehicle. This code is set to advise and is not an actual controller fault.	**Set:** The charger is plugged into the vehicle. **Clear:** Remove plug.
68	**VCL Run Time Error**	1) VCL code encountered a runtime VCL error 2) See Monitor Menu >> Controller: VCL Error Module and VCL Error. This error can then be compared to the runtime VCL module ID and error code definitions found in the specific OS system information file.	**Set:** Runtime VCL code error condition **Clear**: Edit VCL application software to fix this error condition; flash the new complied software and matching parameter defaults; cycle KSI

Code	Programmer Display (Effect or Fault)	Possible Cause	Set/Clear Conditions
69	**External Supply Out of Range**	1) External load on the 5V and 12V supplies draws either too much or too little current 2) Fault Checking Menu parameters Ext Supply Max and Ext Supply Min are mis-tuned 3) See Monitor Menu >> Options: Ext Supply Current	**Set:** The external supply current (combined current used by the 5V supply [pin 26] and the 12V supply [pin 25]) is either greater than the upper current threshold or lower than the lower current threshold. The two thresholds are defined by the External Supply Max and External Supply Min parameter settings. **Clear:** Bring the external supply current within range
71	**OS General** *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *ShutdownInterlock;* *ShutdownDriver1;* *ShutdownDriver2;* *ShutdownDriver3;* *ShutdownDriver4;* *ShutdownPD;* *FullBrake;* *ShutdownPump.*	1. Internal controller fault.	**Set**: Internal controller fault detected. **Clear**: Cycle KSI.
72	**PDO Timeout** *ShutdownThrottle;* *CAN NMT State set to Pre-operational.*	1. Time between CAN PDO messages received exceeded the PDO Timeout Period.	**Set:** Time between CAN PDO messages received exceeded the PDO Timeout Period. **Clear:** Cycle KSI or receive CAN NMT message.

Code	Programmer Display (Effect or Fault)	Possible Cause	Set/Clear Conditions
73	**Stall Detected**	1)Stalled Motor 2) Motor encoder failure 3) Bad crimps or faulty wiring 4) Problems with power supply for the motor encoder 5) See Monitor Menu >> Motor: Motor RPM	**Set:** No motor encoder movement detected **Clear**: Either cycle KSI or detect valid motor encoder signals while operating in LOS mode and return Throttle Command = 0 and Motor RPM = 0
74	**Fault On Other Traction Controller**	Dual Drive fault: see Dual Drive manual.	
75	**Dual Severe Fault**	Dual Drive fault: see Dual Drive manual.	
77	**Supervisor Fault** *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *ShutdownInterlock;* *ShutdownDriver1;* *ShutdownDriver2;* *ShutdownDriver3;* *ShutdownDriver4;* *ShutdownPD;* *FullBrake;* *ShutdownPump.*	1. The Supervisor has detected a mismatch in redundant readings. 2. Internal damage to Supervisor microprocessor. 3. Switch inputs allowed to be within upper and lower thresholds for over over 100 milliseconds.	**Set:** Mismatched redundant readings; damaged Supervisor; illegal switch inputs. **Clear:** Check for noise or voltage drift in all switch inputs; check connections; cycle KSI.

Code	Programmer Display (Effect or Fault)	Possible Cause	Set/Clear Conditions
78	**Supervisor Incompatible** *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *ShutdownInterlock;* *ShutdownDriver1;* *ShutdownDriver2;* *ShutdownDriver3;* *ShutdownDriver4;* *ShutdownPD;* *FullBrake;* *ShutdownPump.*	1. The main OS is not compatible with the Supervisor OS.	**Set:** Incompatible software. **Clear:** Load properly matched OS code or update the Supervisor code; cycle KSI.
82	**Bad Calibrations** *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	1. Internal controller fault.	**Set:** Internal controller fault detected. **Clear:** Correct fault; cycle KSI.
83	**Driver Supply Fault** *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	1. Internal controller fault in the voltage supply for the driver circuits.	**Set:** Internal controller fault detected. **Clear:** Cycle KSI.
84	**Driver Supply Fault** *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	1. Motor speed was detected not following the commanded speed trajectory within the programmed limits. 2. See Program menu » 1-Speed Mode » Speed Controller »Following Error Limit and Following Error Time. 3. See Monitor menu » Motor Tuning » Speed Error.	**Set:** With Control Mode Select = 0 or 1 (Speed Mode Express or Speed Mode), motor speed error detected outside the the programmed limits. **Clear:** Cycle KSI.

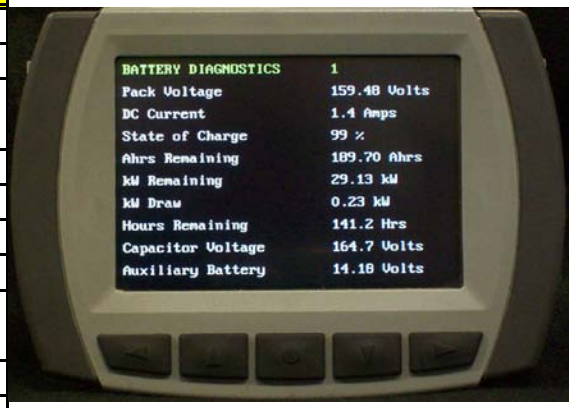
Code	Programmer Display (Effect or Fault)	Possible Cause	Set/Clear Conditions
87	**Driver Supply Fault** *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	1. Motor characterization failed during characterization process. See Monitor menu » Controller: Motor Characterization Error for cause: 0=sequencing error, normally caused by turning off Motor Characterization Test Enable before running the test. 1=encoder signal seen but step size not auto-detected; set up Encoder Steps manually. 2=motor temp sensor fault. 3=motor temp hot cutback fault. 4= controller overtemp cutback fault. 5=controller undertemp cutback fault. 6=undervoltage cutback fault. 7=severe overvoltage fault. 8=encoder signal not seen, or one or both channels missing. 9=motor parameters out of characterization range. 20=sin/cos sensor not found. 21=phasing not detected. 22=sin/cos sensor characterization failure. 23=started characterization procedure while motor rotating.	**Set:** Motor characterization failed during the motor characterization process. **Clear:** Correct fault; cycle KSI. **Notes:** Errors 1 and 8 apply to ACIM motors only. Errors 20, 21, and 23 apply to SPMSM motors only. Errors indicate the motor characterization data is invalid, except in the case of Error 1.
88	**Encoder Steps Count Fault** *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *ShutdownInterlock;* *ShutdownDriver1;* *ShutdownDriver2;* *ShutdownDriver3;* *ShutdownDriver4;* *ShutdownPD;* *FullBrake;* *ShutdownPump.*	1. Encoder Steps parameter does not match the actual motor encoder.	**Set:** Motor lost IFO control and accelerated without throttle command. **Clear:** Ensure the Encoder Steps parameter matches the actual encoder; cycle KSI.

Code	Programmer Display (Effect or Fault)	Possible Cause	Set/Clear Conditions
89	**Motor Type Fault** ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.	1. The Motor_Type parameter value is out of range.	**Set:** Motor_Type parameter is set to an illegal value. **Clear:** Set Motor_Type to correct value and cycle KSI.
91	**VCL/OS Mismatch** *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *ShutdownInterlock;* *ShutdownDriver1;* *ShutdownDriver2;* *ShutdownDriver3;* *ShutdownDriver4;* *ShutdownPD;* *FullBrake;* *ShutdownPump.*	1. The VCL software in the controller does not match the OS software in the controller.	**Set:** VCL and OS software do not match; when KSI cycles, a check is made to verify that they match and a fault is issued when they do not. **Clear:** Download the correct VCL and OS software into the controller.
92	**EM Brake Failed to Set** *ShutdownEMBrake;* *ShutdownThrottle;* *Position Hold is engaged when Interlock=On.*	1. Vehicle movement sensed after the EM Brake has been commanded to set. 2. EM Brake will not hold the motor from rotating.	**Set:** After the EM Brake was commanded to set and time has elapsed to allow the brake to fully engage, vehicle movement has been sensed. **Clear:** Activate the throttle.

Code	Programmer Display (Effect or Fault)	Possible Cause	Set/Clear Conditions
93	**Encoder LOS (Limited Operating Strategy)** *Enter LOS control mode.*	1. Limited Operating Strategy (LOS) control mode has been activated, as a result of either an Encoder Fault (Code 36) or a Stall Detect Fault (Code 73). 2. Motor encoder failure. 3. Bad crimps or faulty wiring. 4. Vehicle is stalled.	**Set:** Encoder Fault (Code 36) or Stall Detect Fault (Code 73) was activated, and Brake or Interlock has been applied to activate LOS control mode, allowing limited motor control. **Clear:** Cycle KSI or, if LOS mode was activated by the Stall Fault, clear by ensuring encoder senses proper operation, Motor RPM = 0, and Throttle Command = 0.
94	**EMR Rev Timeout** *ShutdownEMBrake;* *ShutdownThrottle;*	1. Emergency Reverse was activated and concluded because the EMR Timeout timer has expired. 2. The emergency reverse input is stuck On.	**Set:** Emergency Reverse was activated and ran until the EMR Timeout timer expired. **Clear:** Turn the emergency reverse input Off.
98	**Illegal Model Number** *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	1. Model_Number variable contains illegal value. For 1234E/36E/38E models, a value other than 1234, 1236, 1238, or 1298 is illegal. For 1232E models, a value other than 1232 is illegal. 2. Software and hardware do not match. 3. Controller defective.	**Set:** Illegal Model_Number variable; when KSI cycles, a check is made to confirm a legal Model_Number, and a fault is issued if one is not found. **Clear:** Download appropriate software for your controller model.

Code	Programmer Display (Effect or Fault)	Possible Cause	Set/Clear Conditions
99	**Parameter Mismatch Fault** *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	1. Dual Motor Enable parameter set On and Control Mode Select parameter not set to 1 (Speed Mode Express) or 2 (Speed Mode). 2. Motor Technology and Feedback Type parameters do not match.	**Set:** When the Dual Drive software is enabled, the controller must be set to either Speed Mode Express or Speed Mode; otherwise this fault is set. Motor Technology=0 must be paired with Feedback Type=1, and Motor Technology=1 must be paired with Feedback Type=2; otherwise this fault is set. **Clear:** Adjust parameters to appropriate values and cycle KSI.

BATTERY DIAGNOSTICS 1		Page available only if Acuity is installed
Pack Voltage		Displays actual pack voltage measured by the Acuity
DC Current		DC Battery Current measured by the Acuity
State of Charge	Lithium	Uses amp hours remaining to calculate the battery state of charge
	Lead Acid	Acuity internally calulates
Ahrs Remaining		Amp hours remaing in the battery pack
kW Remaining		Killowatts of energy remaining in the battery pack
kW Draw		Killowatts of energy being consummed
Hours Remaining		Hours remaining or current charge based on average current draw
Capacitor Voltage		Voltage of capacitor bank inside the controller
Auxiliary Battery		Voltage of Auxiliary battery voltage measured at pin 2 of the enGage 7



BATTERY DIAGNOSTICS 2		Page available only if Lithium Battery parameter is turned ON
High Bank Voltage		Displays Bank with the highest voltage
High Bank ID		Displays ID of the highest bank based on the highest voltage
Low Bank Voltage		Displays Bank with the lowest voltage
Low Bank ID		Displays ID of the lowest bank based on the lowest voltage
Bank Delta		Displays the voltage difference between the highest bank voltage and the lowest bank voltage
Highest Avg Voltage		Identification of the highest bank based on average voltage of all cells within the bank
Highest Avg Bank ID		Highest battery bank based on average battery voltage
Lowest Avg Voltage		Identification of the lowest bank based on average voltage of all cells within the bank
Lowest Avg Bank ID		Lowest battery bank based on average battery voltage

PRIMARY SYS DIAGNOSTICS		
Motor Temp		Displays current temperature of drive motor
Controller Temp		Displays current temperature of motor controller
Motor RPM		Displays the RPM of the motor as measured by the motors encoder
Encoder A		Displays the RPM of the encoders A phase
Encoder B		Displays the RPM of the encoders B phase
Throttle 1 Voltage		Displays the voltage of the throttle pot input at pin 16 of the controller
Throttle Command		Dispalys the percentage of throttle command after the controller processes the signal

SECONDARY SYS DIAGNOSTICS		Used only in a mutliple drive system
Motor Temp		Displays current temperature of drive motor
Controller Temp		Displays current temperature of motor controller
Motor RPM		Displays the RPM of the motor as measured by the motors encoder
Throttle Command		Dispalys the percentage of throttle command after the controller processes the signal
Active		If Active = ON, the Secondary controller is active and communicating

SOFTWARE		
OS		Displays the Operating System version installed in the controller
Build Number		Displays the Operating Systems Build Number
VCL Version		Displays the VCL version installed in the controller
Date Code		Dispalys the date the controller was manufactured
Serial Number		Displays the controllers unique serial number

Main Screen

Press Sys Info Button (right arrow) to toggle between sys information scree
Press the down arrow to return to the Main Screen

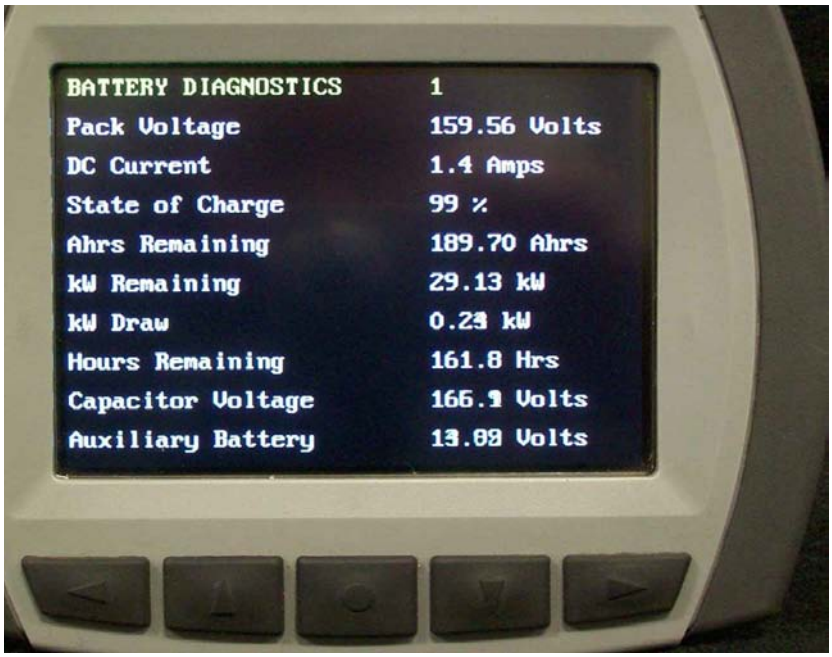
Press Page Button (down arrow) to toggle between display screen

Press Video ON Button (left arrow) to toggle video screen ON. Press Video OFF B
video screen OFF.

Page available only if Acuity is installed

Page available only

is



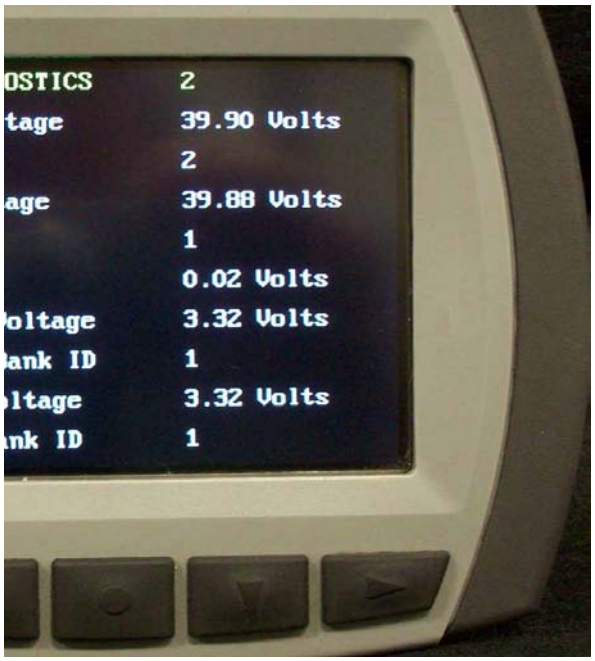
ns

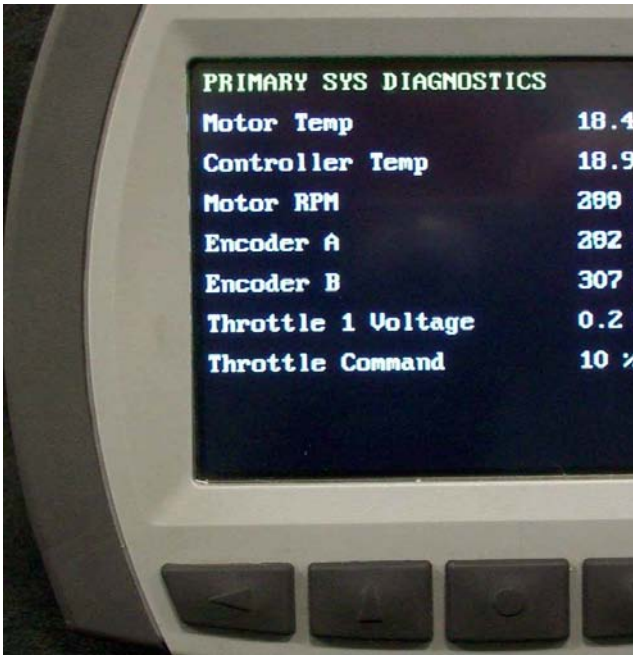
s. Up to 3 screen (9 Displays)

utton (UP arrow) while on the video screen to toggle

if Lithium Battery parameter

turned ON





Visible ONLY with a dual motor system


SOFTWARE
OS 29
Build Number 18
VCL Version 320.45
Date Code 14198
Serial Number 1101