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## **WIRING SCHEMATICS**

## ON-ROAD VEHICLE CONVERSION SINGLE AND DUAL MOTOR APPLICATION

### FOR SOFTWARE VERSIONS 5.30 AND HIGHER

FOR CURTIS CONTROLLERS 1232/1234/1236/1238

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### QUICK START GENERIC ELECTRICAL SCHEMATICS 1232-1238 CONTROLLERS

The following quick start electrical schematics for both single and dual motor configurations have been generated to assist in quickly getting the drive system connected and running.



## Quick Start Electrical Schematic Generic 530 Software Pin Out Specific for 1232-1238 Controllers Single Motor or Primary in Dual Motor Applications

| Pin #     | Name               | Function             | Terminations   | Wire color   | Detailed Description                          |
|-----------|--------------------|----------------------|----------------|--------------|---|
| 1         | KSI                | Keyswitch_Input      |                | Blue         | Keyswitch input. Provides logic power for     |
|           |                    |                      |                |              | the controller and power for the coil         |
|           |                    |                      |                |              | drivers.                                      |
| 6         | Driver 1           | Main_Contactor       |                | Orange/White | Main Contactor Coil Driver.                   |
| 9         | Switch 3           | Accel_Switch_Input   | Active high,   | Green        | Used as safety interlock; switch is open      |
|           |                    |                      | connect to 12  |              | when throttle switch is released. Type 2 & 3  |
|           |                    |                      | volts. See     |              | throttle only.                                |
|           |                    |                      | schematic      |              |   |
| 13        | Coil Return        | Coil Return          | Common to all  | Blue/White   | This is the coil return pin (at B+ potential) |
|           |                    |                      | relay coils    |              | for all the contactor and relay coils.        |
| <b>16</b> | Throttle Pot Wiper | Pot Wiper            |                | Yellow/White | Wiper or throttle input.                      |
| 22        | Switch 7           | Forward_Switch_Input | Active high,   | White        | Used by the Motor Control to select           |
|           |                    |                      | connect to KSI |              | forward direction                             |
|           |                    |                      | to activate.   |              |   |
| 25        | +12V Out           |                      |                | Red/Blue     | Unregulated low power +12V output.            |
| 33        | Switch 8           | Reverse_Switch_Input | Active high,   | Yellow       | Used by the Motor Control to select reverse   |
|           |                    |                      | connect to KSI |              | direction                                     |
|           |                    |                      | to activate.   |              |   |



| С     | Quick Start Electrical Schematic Generic Software Pin Out Specific for 1232-1238 Secondary Controller in Dual Motor Applications |                 |                           |              |   |  |  |  |
|-------|--|-----------------|---------------------------|--------------|---|--|--|--|
|       |  |                 |                           |              |   |  |  |  |
| Pin # | Name   | Function        | Terminations              | Wire color   | Detailed Description  |  |  |  |
| 1     | KSI  | Keyswitch_Input |                           | Blue         | Keyswitch input. Provides logic power for the controller<br>and power for the coil drivers. Connect to primary<br>harness at the Blue KSI wire. |  |  |  |
| 6     | Driver 1   | Main_Contactor  |                           | Orange/White | Main Contactor Coil Driver.   |  |  |  |
| 13    | Coil Return  | Coil Return     | Common to all relay coils | Blue/White   | This is the coil return pin (at B+ potential) for all the contactor and relay coils.  |  |  |  |

# **FULL ELECTRICAL SCHEMATICS CURTIS 1232-1238 CONTROLLERS**



|  |   |   |  | 230 Single M  | lotor or Primary in Dual Motor Applications  |
|--|---|---|--|---|--|
| Pin #  | Name  | Function  | Terminations                                       | Wire color  | Detailed Description   |
| 1  | KSI   | Keyswitch_Input   |  | Blue  | Keyswitch input. Provides logic power for the controller and power for the coil drivers.   |
| 2  | Prop. Driver  | Tachometer Driver   |  | Orange/Black  | Digital output used to drive a tachometer  |
| 3  | Driver 4  | Brake Light Relay   |  | Orange/Red  | Brake light relay driver   |
| 4  | N/C   |   |  | _   |  |
| 5  | Switch 10   | Clutch/Shift Switch   |  | Brown   | Switch input is used to reduce neutral braking while shifting  |
| 6  | Driver 1  | Main_Contactor  |  | Orange/White  | Main Contactor Coil Driver.  |
| /  | I/O Ground  |   |  | Black/Blue  | Input and output ground reference.   |
| 8  | Analog 2  | Motor_lemperature_Sensor  |  | Blue  | Used as the motor temperature analog input   |
| 9  | Switch 3  | Accel_Switch_Input  | Active high, connect to 12 volts. See schematic    | Green   | Used as safety interlock; switch is open when throttle switch is released. Type 2 & 3 throttle only.   |
| 10   | Menu  | Menu_Button   | Active high, connect to 12 volts. See schematic    | White/Red   | Momentary switch; used to scroll through 840 spyglass display  |
| 11   | Switch 5  | Start_Switch_Input  | Active high, connect to 12 volts. See schematic    | White/Blue  | Momentary switch; Enables drive system when Idle function is turned ON.  |
| 12   | Switch 6  | Economy_Mode_Switch_Input   | Active high, connect to 12 volts. See schematic    | Purple  | Switch input used to activate Economy Mode.  |
| 13   | Coil Return   | Coil Return   | Common to all relay coils                          | Blue/White  | This is the coil return pin (at B+ potential) for all the contactor and relay coils.   |
| 14   | N/C   |   |  |   |  |
| 15   | Throttle Pot High   | Pot High  |  | Black/White   | Pot high connection for a 3-wire throttle pot.   |
| 16   | Throttle Pot Wiper  | Pot Wiper   |  | Yellow/White  | Winor or throttle input  |
| 17   |   |   |  |   |  |
| 1/   | Pot2 Wiper  | Brake Pot Wiper   |  | Yellow/Red  | Brake input.   |
| 17   | Pot2 Wiper<br>Pot Low   | Brake Pot Wiper<br>Pot Low  |  | Yellow/Red<br>Purple/White  | Brake input.<br>Pot low connection for brake and throttle.   |
| 17<br>18<br>19   | Pot2 Wiper<br>Pot Low<br>N/C  | Brake Pot Wiper<br>Pot Low  |  | Yellow/Red<br>Purple/White  | Brake input.<br>Pot low connection for brake and throttle.   |
| 17<br>18<br>19<br>20   | Pot2 Wiper<br>Pot Low<br>N/C<br>N/C   | Brake Pot Wiper<br>Pot Low  |  | Yellow/Red<br>Purple/White  | Brake input.<br>Pot low connection for brake and throttle.   |
| 17<br>18<br>19<br>20<br>21   | Pot2 Wiper<br>Pot Low<br>N/C<br>N/C<br>CAN Term H   | Brake Pot Wiper<br>Pot Low<br>CAN Termination   | Active high compact to 12                          | Yellow/Red<br>Purple/White<br>Black   | Brake input.<br>Pot low connection for brake and throttle.<br>CAN termination jumper.  |
| 17<br>18<br>19<br>20<br>21<br>22   | Pot2 Wiper<br>Pot Low<br>N/C<br>N/C<br>CAN Term H<br>Switch 7   | Brake Pot Wiper<br>Pot Low<br>CAN Termination<br>Forward_Switch_Input   | Active high, connect to 12                         | Yellow/Red<br>Purple/White<br>Black   | Brake input.<br>Pot low connection for brake and throttle.<br>CAN termination jumper.  |
| 17<br>18<br>19<br>20<br>21<br>22<br>22   | Pot2 Wiper<br>Pot Low<br>N/C<br>N/C<br>CAN Term H<br>Switch 7   | Brake Pot Wiper<br>Pot Low<br>CAN Termination<br>Forward_Switch_Input   | Active high, connect to 12<br>volts. See schematic | Yellow/Red<br>Purple/White<br>Black<br>White  | Brake input.<br>Pot low connection for brake and throttle.<br>CAN termination jumper.<br>Used by the Motor Control to select forward direction<br>CAN bus high   |
| 17<br>18<br>19<br>20<br>21<br>22<br>23<br>24                                       | Pot2 Wiper<br>Pot Low<br>N/C<br>N/C<br>CAN Term H<br>Switch 7<br>CANH<br>N/C  | Brake Pot Wiper<br>Pot Low<br>CAN Termination<br>Forward_Switch_Input<br>CAN High   | Active high, connect to 12<br>volts. See schematic | Yellow/Red<br>Purple/White<br>Black<br>White<br>Orange  | Brake input.<br>Pot low connection for brake and throttle.<br>CAN termination jumper.<br>Used by the Motor Control to select forward direction<br>CAN bus high.  |
| 17<br>18<br>19<br>20<br>21<br>22<br>23<br>24<br>25                                 | Pot2 Wiper<br>Pot Low<br>N/C<br>N/C<br>CAN Term H<br>Switch 7<br>CANH<br>N/C<br>+12V Out  | Brake Pot Wiper<br>Pot Low<br>CAN Termination<br>Forward_Switch_Input<br>CAN High   | Active high, connect to 12<br>volts. See schematic | Yellow/Red<br>Purple/White<br>Black<br>White<br>Orange<br>Red/Blue  | Where of throttle input.   Brake input.   Pot low connection for brake and throttle.   CAN termination jumper.   Used by the Motor Control to select forward direction   CAN bus high.   Unregulated low power +12V output.  |
| 17<br>18<br>19<br>20<br>21<br>22<br>23<br>24<br>25<br>26                           | Pot2 Wiper<br>Pot Low<br>N/C<br>N/C<br>CAN Term H<br>Switch 7<br>CANH<br>N/C<br>+12V Out<br>+5V Out   | Brake Pot Wiper<br>Pot Low<br>CAN Termination<br>Forward_Switch_Input<br>CAN High   | Active high, connect to 12<br>volts. See schematic | Yellow/Red<br>Purple/White<br>Black<br>White<br>Orange<br>Red/Blue<br>Red/White   | When on throttle input.   Brake input.   Pot low connection for brake and throttle.   CAN termination jumper.   Used by the Motor Control to select forward direction   CAN bus high.   Unregulated low power +12V output.   Regulated low power +5V output.   |
| 17<br>18<br>19<br>20<br>21<br>22<br>23<br>24<br>25<br>26<br>27                     | Pot2 Wiper<br>Pot Low<br>N/C<br>N/C<br>CAN Term H<br>Switch 7<br>CANH<br>N/C<br>+12V Out<br>+5V Out<br>N/C  | Brake Pot Wiper<br>Pot Low<br>CAN Termination<br>Forward_Switch_Input<br>CAN High   | Active high, connect to 12<br>volts. See schematic | Yellow/Red<br>Purple/White<br>Black<br>White<br>Orange<br>Red/Blue<br>Red/Blue  | When on throttle input.   Brake input.   Pot low connection for brake and throttle.   CAN termination jumper.   Used by the Motor Control to select forward direction   CAN bus high.   Unregulated low power +12V output.   Regulated low power +5V output.   |
| 17     18     19     20     21     22     23     24     25     26     27     28    | Pot2 Wiper<br>Pot Low<br>N/C<br>N/C<br>CAN Term H<br>Switch 7<br>CANH<br>N/C<br>+12V Out<br>+5V Out<br>N/C<br>Serial TX   | Brake Pot Wiper<br>Pot Low<br>CAN Termination<br>Forward_Switch_Input<br>CAN High   | Active high, connect to 12<br>volts. See schematic | Yellow/Red<br>Purple/White<br>Black<br>White<br>Orange<br>Red/Blue<br>Red/Blue<br>Red/White                                   | Brake input.<br>Pot low connection for brake and throttle.<br>CAN termination jumper.<br>Used by the Motor Control to select forward direction<br>CAN bus high.<br>Unregulated low power +12V output.<br>Regulated low power +5V output.<br>Serial transmit line for display or flash update.  |
| 17   18   19   20   21   22   23   24   25   26   27   28   29                     | Pot2 Wiper<br>Pot Low<br>N/C<br>N/C<br>CAN Term H<br>Switch 7<br>CANH<br>N/C<br>+12V Out<br>+5V Out<br>N/C<br>Serial TX<br>Serial RX  | Brake Pot Wiper<br>Pot Low<br>CAN Termination<br>Forward_Switch_Input<br>CAN High   | Active high, connect to 12<br>volts. See schematic | Yellow/Red<br>Purple/White<br>Black<br>White<br>Orange<br>Red/Blue<br>Red/White<br>White<br>Green                             | Brake input.<br>Pot low connection for brake and throttle.<br>CAN termination jumper.<br>Used by the Motor Control to select forward direction<br>CAN bus high.<br>Unregulated low power +12V output.<br>Regulated low power +5V output.<br>Serial transmit line for display or flash update.<br>Serial receive line for display or flash update.  |
| 17   18   19   20   21   22   23   24   25   26   27   28   29   30                | Pot2 Wiper<br>Pot Low<br>N/C<br>N/C<br>CAN Term H<br>Switch 7<br>CANH<br>N/C<br>+12V Out<br>+5V Out<br>N/C<br>Serial TX<br>Serial RX<br>N/C   | Brake Pot Wiper<br>Pot Low<br>CAN Termination<br>Forward_Switch_Input<br>CAN High   | Active high, connect to 12<br>volts. See schematic | Yellow/Red<br>Purple/White<br>Black<br>White<br>Orange<br>Red/Blue<br>Red/White<br>White<br>Green                             | Brake input.<br>Pot low connection for brake and throttle.<br>CAN termination jumper.<br>Used by the Motor Control to select forward direction<br>CAN bus high.<br>Unregulated low power +12V output.<br>Regulated low power +5V output.<br>Serial transmit line for display or flash update.<br>Serial receive line for display or flash update.  |
| 17   18   19   20   21   22   23   24   25   26   27   28   29   30   31           | Pot2 Wiper<br>Pot Low<br>N/C<br>N/C<br>CAN Term H<br>Switch 7<br>CANH<br>N/C<br>+12V Out<br>+5V Out<br>N/C<br>Serial TX<br>Serial RX<br>N/C<br>Encoder Phase A                                | Brake Pot Wiper<br>Pot Low<br>CAN Termination<br>Forward_Switch_Input<br>CAN High   | Active high, connect to 12<br>volts. See schematic | Yellow/Red<br>Purple/White<br>Black<br>White<br>Orange<br>Red/Blue<br>Red/White<br>Green<br>White                             | When on throttle input.   Brake input.   Pot low connection for brake and throttle.   CAN termination jumper.   Used by the Motor Control to select forward direction   CAN bus high.   Unregulated low power +12V output.   Regulated low power +5V output.   Serial transmit line for display or flash update.   Serial receive line for display or flash update.   Quadrature encoder input phase A   |
| 17   18   19   20   21   22   23   24   25   26   27   28   29   30   31   32      | Pot2 Wiper<br>Pot Low<br>N/C<br>N/C<br>CAN Term H<br>Switch 7<br>CANH<br>N/C<br>+12V Out<br>+5V Out<br>Serial TX<br>Serial RX<br>N/C<br>Encoder Phase A<br>Encoder Phase B                    | Brake Pot Wiper<br>Pot Low<br>CAN Termination<br>Forward_Switch_Input<br>CAN High   | Active high, connect to 12<br>volts. See schematic | Yellow/Red<br>Purple/White<br>Black<br>White<br>Orange<br>Red/Blue<br>Red/White<br>Green<br>White<br>Green                    | When on throttle input.   Brake input.   Pot low connection for brake and throttle.   CAN termination jumper.   Used by the Motor Control to select forward direction   CAN bus high.   Unregulated low power +12V output.   Regulated low power +5V output.   Serial transmit line for display or flash update.   Serial receive line for display or flash update.   Quadrature encoder input phase A   Quadrature encoder input phase B  |
| 17   18   19   20   21   22   23   24   25   26   27   28   29   30   31   32   33 | Pot2 Wiper<br>Pot Low<br>N/C<br>N/C<br>CAN Term H<br>Switch 7<br>CANH<br>N/C<br>+12V Out<br>+5V Out<br>Serial TX<br>Serial RX<br>N/C<br>Encoder Phase A<br>Encoder Phase B<br>Switch 8        | Brake Pot Wiper<br>Pot Low<br>CAN Termination<br>Forward_Switch_Input<br>CAN High<br>CAN High<br>MotorspeedA_Input<br>MotorspeedB_Input<br>Reverse_Switch_Input | Active high, connect to 12<br>volts. See schematic | Yellow/Red<br>Purple/White<br>Black<br>White<br>Orange<br>Red/Blue<br>Red/White<br>Green<br>White<br>Green                    | When on throttle input.   Brake input.   Pot low connection for brake and throttle.   CAN termination jumper.   Used by the Motor Control to select forward direction   CAN bus high.   Unregulated low power +12V output.   Regulated low power +5V output.   Serial transmit line for display or flash update.   Serial receive line for display or flash update.   Quadrature encoder input phase A   Quadrature encoder input phase B  |
| 17   18   19   20   21   22   23   24   25   26   27   28   29   30   31   32   33 | Pot2 Wiper<br>Pot Low<br>N/C<br>N/C<br>CAN Term H<br>Switch 7<br>CANH<br>N/C<br>+12V Out<br>+5V Out<br>N/C<br>Serial TX<br>Serial RX<br>N/C<br>Encoder Phase A<br>Encoder Phase B<br>Switch 8 | Brake Pot Wiper<br>Pot Low<br>CAN Termination<br>Forward_Switch_Input<br>CAN High<br>MotorspeedA_Input<br>MotorspeedB_Input<br>Reverse_Switch_Input             | Active high, connect to 12<br>volts. See schematic | Yellow/Red<br>Purple/White<br>Black<br>White<br>Orange<br>Red/Blue<br>Red/White<br>Green<br>White<br>Green<br>Yellow<br>Black | When on throttle input.   Brake input.   Pot low connection for brake and throttle.   CAN termination jumper.   Used by the Motor Control to select forward direction   CAN bus high.   Unregulated low power +12V output.   Regulated low power +5V output.   Serial transmit line for display or flash update.   Serial receive line for display or flash update.   Quadrature encoder input phase A   Quadrature encoder input phase B   Used by the Motor Control to select reverse direction   CAN bus termination jumper |



|       | Generic So      | oftware 530 Switch Pin Out | Specific for for 1232-12   | 238 Secondary | Controller in Dual Motor Applications   |
|-------|-----------------|----------------------------|----------------------------|---------------|---|
|       |                 |                            |                            |               |   |
| Pin # | Name            | Function                   | Terminations               | Wire color    | Detailed Description  |
| 1     | KSI             | Keys witch_Input           |                            | Blue          | Reyswitch input. Provides logic power for the controller<br>and power for the coil drivers. Connect to primary<br>harness at the Blue KSI wire. |
| 2     | N/C             |                            |                            |               |   |
| 3     | N/C             |                            |                            |               |   |
| 4     | N/C             |                            |                            |               |   |
| 5     | N/C             |                            |                            |               |   |
| 6     | Driver 1        | Main Contactor             |                            | Orange/White  | Main Contactor Coil Driver.   |
| 7     | I/O Ground      |                            |                            | Black/Blue    | Input and output ground reference.  |
| 8     | Analog 2        | Motor Temperature Sensor   |                            | Blue          | Used as the motor temperature analog input  |
| 9     | N/C             |                            |                            |               |   |
|       |                 |                            | Active high, connect to 12 |               | Momentary switch; used to scroll through 840 spyglass   |
| 10    | Menu            | Menu_Button                | volts. See schematic       | White/Red     | display   |
| 11    | N/C             |                            |                            |               |   |
| 12    | N/C             |                            |                            |               |   |
| 13    | Coil Return     | Coil Return                | Common to all relay coils  | Blue/White    | This is the coil return pin (at B+ potential) for all the contactor and relay coils.  |
| 14    | N/C             |                            |                            |               |   |
| 15    | N/C             |                            |                            |               |   |
| 16    | N/C             |                            |                            |               |   |
| 17    | N/C             |                            |                            |               |   |
| 18    | N/C             |                            |                            |               |   |
| 19    | N/C             |                            |                            |               |   |
| 20    | N/C             |                            |                            |               |   |
| 21    | CAN Term H      | CAN Termination            |                            | Black         | CAN termination jumper.   |
| 22    | N/C             |                            |                            |               |   |
| 23    | CANH            | CAN High                   |                            | Orange        | CAN bus high.   |
| 24    | N/C             |                            |                            |               |   |
| 25    | +12V Out        |                            |                            | Red/Blue      | Unregulated low power +12V output.  |
| 26    | +5V Out         |                            |                            | Red           | Regulated low power +5V output.   |
| 27    | N/C             |                            |                            |               |   |
| 28    | Serial TX       |                            |                            | White         | Serial transmit line for display or flash update.   |
| 29    | Serial RX       |                            |                            | Green         | Serial receive line for display or flash update.  |
| 30    | N/C             |                            |                            |               |   |
| 31    | Encoder Phase A | MotorspeedA_Input          |                            | White         | Quadrature encoder input phase A  |
| 32    | Encoder Phase B | MotorspeedB_Input          |                            | Green         | Quadrature encoder input phase B  |
| 33    | N/C             |                            |                            |               |   |
| 34    | CAN Term L      | CAN Termination            |                            | Black         | CAN bus termination jumper.   |
| 35    | CANL            | CAN Low                    |                            | Grey          | CAN bus low.  |

#### THROTTLE CONFIGURATION

Depending on the type of throttle used for the application, the different types of throttle configurations are listed within the table below. Electrical schematics are also included within the following pages.

| THROTTLE CONFIGURATION   | ТҮРЕ              |
|--|-------------------|
| ELECTRONIC without SWITCH<br>CURTIS ET-126/ET-134 ELECTRONIC<br>THROTTLE ASSEMBLY without SWITCH | TYPE 1            |
| 2 WIRE with SWITCH 0-5k $\Omega$   | TYPE 2            |
| 3 WIRE with SWITCH 0-5k $\Omega$   | TYPE 3<br>Default |
| CURTIS PB8 THROTTLE ASSEMBLY   | TYPE 3            |
| CURTIS ET-126/ET-134 ELECTRONIC<br>THROTTLE ASSEMBLY WITH SWITCH                                 | TYPE 3            |













#### THROTTLE INTERLOCK CONNECTION

The pedal interlock connection is required for both 2 and 3 wire throttle pot assemblies. The Green wire is connected to the Normally Closed tab. The red/blue wire is connected to the common tab. See picture below.

NOTE: when the accelerator pedal <u>IS PRESSED</u> the interlock switch is released to its <u>NORMAL</u> position (switch not activated) thus completing the circuit since its green wire is connected to the normally closed (NC) connection.



#### BRAKE INPUT CONFIGURATION

Depending on the type of brake input used for the application, the different types of brake input configurations are listed within the table below. Electrical schematics are also included in the following pages.

| BRAKE INPUT<br>CONFIGURATION                                   | ТҮРЕ   |
|--|--------|
| PRESSURE TRANSDUCER/<br>ELECTRONIC 0-5V INPUT or<br>3-WIRE POT | TYPE 2 |
| 2 WIRE 0-5k Ω POT  | TYPE 3 |
| SWITCH   | TYPE 5 |





### OPTIONAL ACTIVE BRAKE LIGHT CONFIGURATIONS

These optional active brake light configurations are used to activate the brake lights during regenerative braking or when the vehicle brakes are being applied. Based on the brake type configuration that is being used in the application use one of the following wiring configurations.







| Program Entries Generic 530 (Parameters) |           |                      |                                |         |                 |                 |   |
|--|-----------|----------------------|--------------------------------|---------|-----------------|-----------------|---|
| Level 1                                  | Parameter | Level 2              | Parameter                      | Units   | Parameter Range | Default Setting | Notes   |
| User Settings                            |           |                      |                                |         |                 |                 |   |
|  |           | Speed Settings       |                                |         |                 |                 |   |
|  |           |                      | Ecoward Speed                  | PDM     | 200 to 8500     | 6500            | Defines the maximum requested mater ram at full throttle with feavord calacted  |
|  |           |                      | Forward Speed                  | RPIVI   | 200 10 8500     | 6500            | Dennes die maximum requested motor ipm at run throtde with forward selected.  |
|  |           |                      | Reverse Speed                  | RPM     | 200 to 8500     | 6500            | Defines the maximum requested motor rpm at full throttle with reverse selected.   |
|  |           |                      | Econo Speed                    | RPM     | 200 to 8500     | 6500            | Defines the maximum requested motor rpm at full throttle with econo mode on.  |
|  |           | Accel Rates          |                                |         |                 |                 |   |
|  |           |                      | Normal Accel Rate              | Seconds | 0.1 to 5.0      | 0.4             | Sets the rate (in seconds) at which the speed command increases when throttie is applied. Larger values<br>represent slower response.   |
|  |           |                      | Econo Accel Rate               | Seconds | 0.1 to 5.0      | 0.5             | Sets the rate (in seconds) at which the speed command increases in econo mode when throttle is applied. Larger<br>values represent slower response.   |
|  |           | Throttle Settings    |                                |         | -               |                 |   |
|  |           |                      | Throttle Type                  | N/A     | 1 to 4          | 2               | The Curtis controllers accept a variety of throttle inputs. The throttle type parameter can be programmed as follows:<br>1 = Electronic throttle (NO switch, 0-5 volt).<br>2: single-ended 3-wire 0-5kD potentiometer, or 0–5V voltage source (Default)<br>3: 2-wire rheostat, 0–5kD potentiometer, or 0–5V voltage source CLICK HERE TO SEE ADDITIONAL NOTES<br>Note: Do not change this parameter while the controller is powering the motor. Any time this parameter is<br>changed a Parameter Change Fault (fault code 49) is set and must be cleared by cycling power; this protects the<br>controller and the operator. |
|  |           |                      | Deadband                       | Volt    | 0.00 to 5.00    | .30             | Defines the wiper voltage at the throttle deadband threshold. Increasing  |
|  |           |                      | Throttle Max                   | Volt    | 0.00 to 5.00    | 3.5             | the throttle deadband setting will increase the neutral range.<br>Defines the wiper voltage required to produce 100% controller output.<br>Decreasing the throttle max setting reduces the wiper voltage and<br>therefore the full stroke necessary to produce full controller output.  |
|  |           |                      | Mapped Throttle                | %       | 0 to 100        | 50              | Modifies the vehicle's response to the throttle input. Setting the throttle<br>map at 50% provides a linear output response to throttle position. Values<br>below 50% reduce the controller output at low throttle settings, providing<br>enhanced slow speed maneuverability. Values above 50% give the vehicle a faster, more responsive feel at low<br>throttle settings.  |
|  |           | Brake Pedal Settings |                                |         |                 | -               |   |
|  |           |                      | Brake Type                     |         | 0 to 3          | 0               | Select the brake type that is being utilized for the application being installed. The selection availability is as follows:<br>a) Type 0= No Brake input used (Default)<br>b) Type 1= 3-wire pot or an electronic (includes transducer or hall sensor.)<br>c) Type 2= 2 wire 0 to 5k pot.<br>d) Type 3= Switch  |
|  |           |                      | Brake Deadband                 | Volt    | 0.00 to 5.00    | 0.30            | Defines the wiper voltage at the brake deadband threshold. Increasing<br>the brake deadband setting will increase the neutral range.  |
|  |           |                      | Brake Max                      | Volt    | 0.00 to 5.00    | 3.50            | Defines the wiper voltage required to produce 100% controller output.<br>Decreasing the brake max setting reduces the wiper voltage and<br>therefore the full stroke necessary to produce full controller output.   |
|  |           |                      | Regen Brake Light<br>Threshold | AMP     | 0 to 400        | 50              | [Allows for turning on the brake lamp based on the amount of regenerative braking that is taking place when off of<br>the throttle. A higher number to this parameter means that there has to be a high amount of regen to be taking<br>place to turn on the brake lamp   |
|  |           | Current Limits       |                                |         |                 | -               |   |
|  |           |                      | Normal Neutral Braking         | %       | 0 to 100        | 15              | This parameter will allow for adjustment to Neutral Braking.  |
|  |           |                      | Econo Neutral Braking          | %       | 0 to 100        | 25              | This parameter will allow for adjustment to Neutral Braking in economy mode.  |
|  |           |                      | Shift Neutral Braking          | %       | 0 to 100        | 7               | Adjustment to neutral braking while pressing the clutch to shift a manual transmission  |
|  |           |                      | Normal Drive Current<br>Limit  | %       | 5 to 100        | 100             | Normal Drive Current Limit sets the maximum RMS current the controller will supply to the motor during drive<br>operation, as a percentage of the controller's full rated current in normal operating mode. Reducing this value will<br>reduce the maximum drive torque.  |
|  |           |                      | Econo Drive Current<br>Limit   | %       | 5 to 100        | 60              | Sets the maximum RMNS current the controller will supply to the motor during drive operation, as a percentage of<br>the controller's full rated current in economy operating mode. Reducing this value will reduce the maximum drive<br>torque.   |
|  |           |                      | Brake Current Limit            | %       | 5 to 100        | 10              | Sets the maximum RMS regen current during braking when a brake<br>command is given, as a percentage of the controller's full rated current.<br>Typically the brake current limit is set equal to the regen current limit.<br>The brake current limit overrides the regen current limit when the brake<br>input is active.   |

| Level 1 | Parameter | Level 2            | Parameter                      | Units   | Parameter Range | Default Setting Notes |  |
|---------|-----------|--------------------|--------------------------------|---------|-----------------|-----------------------|--|
|         |           | Idle Setup         |                                |         |                 |                       |  |
|         |           |                    | Idle Enable                    |         | On/Off          | Off                   | on = motor idle will be turned on  |
|         |           |                    | Clutch Start Enable            |         | On/Off          | Off                   | Enables clutch switch so that clutch needs to be depressed to start vehicle  |
|         |           |                    | Idle Speed                     | RPM     | 300 to 1000     | 600                   | motor idle speed   |
|         |           |                    | Idle Torque                    | %       | 0 to 100        | 50                    | percentage of available torque at idle speed   |
|         |           |                    | Creep Torque                   | %       | 0 to 100        | 0                     | Creep torque available when Idle is set to OFF. Allows for the amount of torque applied when the vehicle when at<br>a stop and no throttle input   |
|         |           | Motor Tuning       |                                |         | Γ               | T                     |  |
|         |           |                    | Motor Type                     |         | 9 to 77         | Based on motor type   | Input motor type   |
|         |           |                    | Base Speed                     | RPM     | 200 to 6000     | 3500                  | The speed set point for which the motor goes into field weakening.   |
|         |           |                    | Field Weakening                | %       | 0 to 100        | 50                    | Determines the amount of high speed power the controller will allow, while still maintaining maximum effficiency<br>at the allowed power. Reducing this parameter effectively reduces controller current at high speeds, which can<br>reduce energy consumption and motor heating, but at the expense of reduced available torque from the motor.                        |
|         |           |                    | Econo Field Weakening          | %       | 0 to 100        | 0                     | Determines the amount of high speed power the controller will allow while in econo mode, while still maintaining<br>maximum effficiency at the allowed power. Reducing this parameter effectively reduces controller current at high<br>speeds, which can reduce energy consumption and motor heating, but at the expense of reduced available torque<br>from the motor. |
|         |           |                    | Weakening Rate                 | %       | 0 to 100        | 36                    | Determines the control loop gains for field weakening. Setting the rate too low may create surging in the vehicle<br>as it accelerates at mid to high speeds. Setting the rate too high may create high frequency oscillations<br>(usually audible) when the vehicle accelerates at mid to high speeds.  |
|         |           | Main Contactor     |                                |         |                 | -                     |  |
|         |           |                    | Main Contactor<br>Voltage      | Volt    | 12 to 96        | 24                    | Main contactor voltage that is used in the system  |
|         |           |                    | Main Holding %                 | %       | 0 to 100        | 80                    | The main contactor holding voltage parameter allows a reduced average voltage to be applied to the contactor<br>coil once it has closed. This parameter must be set high enough to hold the contactor closed   |
|         |           | Display Menu Items |                                |         | •               |                       |  |
|         |           |                    | Auto Scroll                    | N/A     | On/Off          | Off                   | Turn on auto scroll function on 840 display to show monitored items listed below   |
|         |           |                    | Scroll Delay Time              | Seconds | 1 to 10         | 4                     | Time that delays scroll function displaying the menu items below on the Spyglass 840   |
|         |           |                    | Display SOC                    | N/A     | On/Off          | Off                   | When turned on the State Of Charge (SOC) of battery pack will be displayed. Acuity required.   |
|         |           |                    | Display Motor RPM              | N/A     | On/Off          | On                    | When turned on the Motor RPM will be displayed   |
|         |           |                    | Display Battery Amps           | N/A     | On/Off          | On                    | When turned on, battery pack current will be displayed   |
|         |           |                    | Display Voltage                | N/A     | On/Off          | On                    | When turned on, battery pack voltage will be displayed   |
|         |           |                    | Display Motor Temp             | N/A     | On/Off          | On                    | When turned on, motor temperature will be displayed  |
|         |           |                    | Display Controller<br>Temp     | N/A     | On/Off          | On                    | When turned on, controller temperature will be displayed   |
|         |           |                    | Display Minimum<br>Voltage     | N/A     | On/Off          | On                    | When turned on, minimum voltage during operation will be displayed   |
|         |           |                    | Display Maximum<br>Current     | N/A     | On/Off          | On                    | When turned on, maximum current during operation will be displayed   |
|         |           | BMS                |                                |         |                 |                       |  |
|         |           |                    | BMS Installed                  |         | On/Off          | Off                   | When on can be used with Orion BMS. BMS must have CAN messages configured.   |
|         |           |                    | BMS Address                    |         | 768 to 1536     | 768                   | BMS Address range in decimal. Hex range = 0x300 to 0x600   |
|         |           |                    | User Undervoltage              | %       | 50 to 90        | 80                    | The value of this parameter is a percentage of the Nominal Voltage setting. The User Undervoltage parameter<br>can be used to adjust the undervoltage threshold, which is the voltage at which the controller will cut back drive<br>current to prevent damage to the electrical system.   |
|         |           |                    | Low Cell Begin Cutback         | Volt    | 0.000 to 4.000  | 2.800                 | Low cell cutback begin sets the voltage of the lowest cell where current limiting will begin   |
|         |           |                    | Low Cell Full Cutback          | Volt    | 0.000 to 4.000  | 2.300                 | Low Cell Full Cutback parameter sets the voltage of the lowest cell where full current limiting is in force  |
|         |           |                    | Max Current at Full<br>Cutback | %       | 0 to 100        | 50                    | Maximum Current Full Cutback parameter sets the maximum current allowed when low voltage full cutback is in<br>force   |
|         |           |                    | Maximum Cell Voltage           | Volt    | 2.000 to 4.000  | 3.700                 | Maximum cell voltage parameter sets the voltage at which regen is turned off to prevent overcharging   |
|         |           |                    | Low SOC Cutback                | %       | 0 to 100        | 20                    | Low SOC (State of Charge) Cutback parameter sets the SOC at which current limiting is in force   |
|         |           |                    | Max Current at Low<br>SOC      | %       | 0 to 100        | 30                    | Maximum Current Low SOC (State of Charge) parameter sets the maximum current allowed when SOC is lower<br>than Low SOC Cutback   |

| Level 1 | Parameter | Level 2          | Parameter                     | Units   | Parameter Range | Default Setting  | Notes  |
|---------|-----------|------------------|-------------------------------|---------|-----------------|--|--|
|         |           | Dual Drive       |                               |         |                 |  |  |
|         |           |                  | Dual Drive Mode               |         | On/Off          | Based on using<br>either single motor<br>or dual motor | This parameter turns dual drive off or on. Turn on for a dual motor.   |
|         |           |                  | Response Timeout              | ms      | 50 to 1000      | 200  | Time alloted for the secondary controller(s) to respond to the primary controller  |
|         |           | Misc             |                               |         |                 |  |  |
|         |           |                  | Max Output Frequency          | Hz      | 0 to 4000       | 266  | Tachometer frequency allows the user to set-up the vehicles tachometer to work correctly based on the number of<br>cylinders the original internal combustion engine had that was removed from the vehicle |
|         |           |                  | Prg Mode Step Timer           | Seconds | 1.0 to 10.0     | 4.0  | The time in seconds that the program steps through program mode.   |
|         |           |                  | Generic CAN Message<br>ID Dec |         | 1537 to 1616    | 1537   | CAN ID that the controller transmits. Hex range = 0x601 to 0x650   |
|         |           | Software Version |                               |         | _               |  |  |
|         |           |                  | VCL Version                   |         | 0 to 32767      | Based on VCL<br>software version                       | Software Version   |
|         |           |                  | OS Version                    |         | 0 to 32767      | Based on Operating<br>system installed                 | Version number of the operating system software that is loaded into the controller. This variable specifies the<br>major version number of the controller's operating system.                              |
|         |           |                  | OS Build Number               |         | 0 to 32767      | Based on software<br>OS Build system                   | Build number of the operating system software that is loaded into the controller.  |

|                          | Generic 530 Software  | e Monitor Items |                        |        |                 |   |
|--------------------------|-----------------------|-----------------|------------------------|--------|-----------------|---|
|                          |                       |                 |                        |        |                 |   |
| Level 1                  | Parameter             | Level 2         | Parameter              | Units  | Parameter Range | Notes   |
| Dual Drive               |                       | r               | r                      |        |                 |   |
|                          | Dual Drive State      |                 |                        |        | On/Off          | On = A secondary controller has been detected in a dual<br>drive system |
| <b>CAN Communication</b> |                       |                 |                        |        |                 |   |
|                          | BMS Communicating     |                 |                        |        | On/Off          | On = BMS is communicating to the controller through the CAN Bus         |
|                          | Charger Communicating |                 |                        |        | On/Off          | On = Charger is communicating to the controller through the CAN Bus     |
| Battery Information      |                       |                 |                        |        |                 |   |
|                          |                       | Peak I&E        |                        |        |                 |   |
|                          |                       |                 | Peak RMS Current       | AMP    | 0 to 1000       | Peak RMS current reported while the system is under load                |
|                          |                       |                 | Minimum Voltage        | Volt   | 0 to 170.0      | Minimum voltage reported while the system is under load                 |
|                          |                       | General         |                        |        |                 |   |
|                          |                       |                 | Keyswitch Voltage      | Volt   | 0 to 150        | Voltage at KSI (Pin 1)  |
|                          |                       |                 | Measured Current       | AMP    | -600 to 600     | The Measured System Current During Operation                            |
|                          |                       |                 | Remaining Amphours     | AMP    | 0 to 500        | Remaining Battery Amphours  |
|                          |                       |                 | BDI Percentage         | %      | 0 to 100        | Battery state of charge.  |
|                          |                       |                 | Aux Battery Voltage    | Volt   | 0 to 20         | Auxiliary battery voltage   |
|                          |                       | Charging Info   |                        |        |                 |   |
|                          |                       |                 | Charger Output Current | Ampere | 0 to 100        | Battery charger output current to the battery pack                      |
|                          |                       |                 | Charger Output Voltage | Volt   | 0 to 1400       | Battery charger output voltage to the battery pack                      |
|                          |                       |                 | Charger Status         | N/A    | 0 to 32         | Status of the charger.  |
|                          |                       | Cell Monitor    |                        |        |                 |   |
|                          |                       |                 | Highest Cell           |        | 0.1 4 5 0 0     | Identification of the battery with the highest voltage                  |
|                          |                       |                 | Highest Cells Voltage  | voit   | U to 4.500      | Highest pattery Cell Voltage  |
|                          |                       |                 | Lowest Cells Voltage   | Volt   | 0 to 4 500      | lowest battery cell voltage   |
|                          |                       |                 | Highest Temporature    | °C     | 0 10 4.500      | Highest batten, temperature within the batten, nack                     |
|                          |                       |                 | Lowest Temperature     | °C     |                 | Lowest battery temperature within the battery pack                      |

### **GLOSSARY OF TERMS**

- 1. Accel Rate: sets the rate (in seconds) at which the motor torque increases to full when full throttle is applied. Larger values represent slower response.
- 2. **Baud rate:** a unit used to measure the speed of electronic code transmission, equal to one-unit interval per second.
- 3. BMS: Battery Management System
- 4. **Brake Current Limit**: Sets the maximum RMS regen current during braking when a brake command is given, as a percentage of the controller's full rated current. The full rated current depends on the controller model.
- 5. **Brake Input Rate**: Sets the rate (in seconds) at which the vehicle slows down when brake is applied or when throttle is applied in the opposite direction. Larger values represent slower response.
- 6. **Brake Maximum:** Defines the input voltage required to produce 100% braking torque. Decreasing the brake max setting reduces the amount of voltage necessary to produce full braking torque.
- 7. Brake Type: Defines the brake input for the controller:
  - a. Type 2= 3 wire 0 to 5kohm pot or electronic 0-5v input or pressure transducer.
  - b. Type 3= 2 wire with switch; 0 to 5kohm.
  - c. Type 5= switch.
- 8. **CAN:** Controller Area Network. A vehicle bus standard designed to allow microcontrollers and devices to communicate with each other within a vehicle. All controllers on the CAN bus need to have the Baud Rate set the same.
- 9. **Creep Torque:** Determines the amount of torque applied to the vehicle at a stop with no throttle input, to emulate the feel of an automatic transmission automobile. WARNING! When interlock is engaged, creep torque allows vehicle propulsion if a direction is selected even though no throttle is applied. Care should be taken when setting up this parameter. If pedal braking is enabled, creep torque is progressively disabled as brake is applied so as to prevent the motor from driving into the brakes and thus wasting energy.
- 10. Deadband: is an area of a signal range or band where no action occurs (the system is dead).
- 11. EncA & B: two signals from the encoder for which the controller determines direction of rotation and speed of the motor.
- 12. Field Weakening Rate: Determines the control loop gains for field weakening. Setting the rate too low may create surging in the vehicle as it accelerates at mid to high speeds. Setting the rate too high may create high frequency oscillations (usually audible) when the vehicle accelerates at mid to high speeds.
- 13. Generic CAN Message: CAN message containing general information regarding the status of the motor and controller.
- 14. **Idle Torque**: Torque load delivered by the motor at idle. If the Idle for the motor is enabled, idle torque will equal creep torque.

- 15. Load Meter: The LED lights that are located on the bottom of the Spyglass represent how much of a load is exerted on the system.
- 16. Neutral Braking: Neutral braking occurs progressively when the throttle is reduced toward the neutral position or when no direction is selected. The neutral braking parameter is adjustable from 0 to 100% of the regen current limit.
- 17. Nominal Voltage: Battery pack voltage; not to exceed controller voltage ratings.
- 18. **Regenerative Braking**: Regenerative braking is used on electric vehicles to recoup some of the energy lost during stopping. This energy is saved to the batteries and used later to power the motor to put the car in motion.
- 19. **Shift Neutral Braking:** Adjustment to neutral braking while pressing the clutch to shift a manual transmission
- 20. **SOC**: State of charge.
- 21. Spyglass: Name given by Curtis Instruments to the 8 segment LCD, 5-LED display.
- 22. **Throttle Maximum**: Defines the wiper input voltage required to produce 100% controller output. Decreasing the throttle max setting reduces the amount of voltage necessary to produce full controller output.
- 23. Throttle Type: Defines the throttle input for the controller:
  - a. Type 1 = Electronic without switch
  - b. Type 2 = 0-5K ohm 2 wire pot with switch.
  - c. Type 3= 0-5K ohm 3-wire pot with switch. Electronic with switch.