SCOTT DRIVE

SD100

SD200

SD250

SD300

User Manual

Table of Contents

1 Introduction

The SD100, SD200, SD250 and SD300 are Three Phase AC Motor Controllers which can be used to control Brushless DC (BLDC), Permanent Magnet Synchronous motors (PMSM) or AC Induction (ACI) motors. The controllers are targeted for use in electric vehicles and include many features to simplify the conversion process and reduce the overall cost.

The Scott Drive line uses only the highest quality components carefully chosen for absolute durability. The IGBT's are Semikron SKiM modules which are sintered, not soldered, to greatly increase durability in extreme temperature cycles (-40C to +125C) and high vibration environments (shock rated to 50g). Integrated temperature sensing automatically prevents IGBT thermal damage.

1.1 Features

- SD100: 100 kW nominal output power
- SD200: 200 kW nominal output power
- SD250: 250 kW nominal output power
- SD300: 300 kW nominal output power
- Integrated Pre-Charge Circuit
- Integrated LEV200 Contactor
- External Coolant / Motor Temperature Monitoring
- Internal monitoring of IGBT temperature.
- Four 12V (10A) DC Motor Outputs
- Supports Encoder (QEP) or Hall Effect Sensor feedback from Motor
- Nine Digital Switch Inputs
- Regenerative Braking
- Liquid Cooling
- Integrated TCPIP Ethernet, RS485 and CAN communications ports
- Drive setup can be configured via Ethernet port
- Firmware upgradeable via Ethernet port
- Heavy-Duty industrial waterproof connectors (IP67)

2 Warning – Electricity can be dangerous

All AC and DC connections and cables above 48V should be considered potentially lethal. Only qualified individuals suitably trained and experienced with high voltages should be permitted to connect, disconnect, install, modify, or touch high-power wiring or connections.

2.1 Safety First!

Always take full precautions when dealing with electricity and utilize all necessary personal protective equipment. This may include, but is not limited to:

- **High-Voltage protective gloves**
- **Safety Goggles.**
- **Non-conductive and non-flammable protective clothing.**
- **Non-conductive footwear.**
- **Non-conductive tool handles and/or covers.**

Always disconnect the input power source (example: battery pack) to the greatest extent possible before connecting, disconnecting, installing, modifying, or touching the high-power wiring or connections on the electric drive system.

- Always verify the power has been successfully disconnected (and is guaranteed to remain disconnected) using appropriate metering equipment BEFORE performing any actions to the electric drive.

Scott Drive Limited and Scott Drive distributors/dealers are not liable for the use, misuse, or inability to use Scott Drive products or related hardware. It is your responsibility to take proper precautions deemed necessary and prudent by industry professionals when constructing, operating, maintaining, and modifying electric drive systems.

3 Mechanical Installation

3.1 Mounting Position

When determining the mounting position of the Scott Drive controllers the following factors should be considered:

- **Proximity**: The controller should be mounted in close proximity to the motor to minimize the length of the motor power cables. Mounting the controller above the motor generally works well. This will also minimize the length of the water cooling tubing if it is shared with the motor.
- **Clearance**: Careful attention should be paid to the clearance, support and protection of the electrical cables and liquid cooling hoses. The minimum bending radius of all cables and tubing must be followed.
- **Environment**: While Scott Drive Controllers are designed to be splash-proof the controller should be mounted in a position where is it protected from heavy rain and road dust. Please remember electricity and water don't mix!!!

3.2 Mechanical Mounting

It is recommended that the SD100/SD200/SD250/SD300 be mounted using rubber isolation mounts. The controller should be restrained using the four 8mm tapped holes on the bottom side of the controller. The mounting surface should be quite sturdy in order to support the Scott Drive without flex or vibration on rough roads.

4 Electrical Installation

4.1 12V Supply Connection

The 12V supply to the Scott Drive controllers is via a 50A Anderson connector. The nominal current required for operation is 2 Amps to power the Digital and Analogue circuits and also the LEV200 contactor. If any of the 4 Auxiliary channels are used then the 12V supply current will be higher. The drive is designed to operate in the voltage range of 11-16V. The controller is grounded internally, so the unit does not need an external ground to the chassis.

4.2 High Power Connections

The DC Power is provided to the Drive controller via flying leads which can be terminated with crimp lugs or an Anderson connector. The length of the cable can be specified. Please see ordering options for more information.

The AC Power connections to the motor are provided via 10mm studs. It is highly recommended to use 35mm (AWG 2) or larger cable for the Scott Drive 100 and to keep the motor leads as short as possible to avoid EMI problems. Please note that larger cables and connectors provide lower resistance and greater heat-sink capability for high-power applications. For the SD200, SD250 and SD300 it is recommended to use 50mm (AWG 1/0) or larger.

Warning! The high voltage lines must be isolated and never grounded. It is best practice to use protective conduit or similar means to ensure that high voltage wires cannot be chaffed and damaged from vibration, sharp edges, or exposure to the elements. It is recommended that a fuse of the appropriate rating be included into the battery circuit.

4.3 Driver Control Inputs

An EPIC H-DD24 connector is used for all Analog and Digital Driver control inputs. This provides protection from both dirt and EMI using the shield connection. For maximum protection it is recommended to use shielded cabling between the Controller and all sensors, switches and pots. Table 4.1 list the digital and analog connections provided through the Driver Control cable.

Pin Number	Function	Color Code
1	+5V SWITCH SUPPLY	White
2	REVERSE	Brown
3	BRAKE SWITCH	Green
4	FORWARD	Yellow
5	DRIVE MODE (KSI)	Grey
6	INTERLOCK (CFO)	Pink
7	EMERGENCY STOP	Blue
8	SPORT MODE	Red
9	REGEN DISABLE	Black
10	THROTTLE SWITCH	Violet
11	+5V THROTTLE POT SUPPLY	Grey/Pink
12	THROTTLE WIPER	Red/Blue
13	0V POT COMMON	White/Green
14	+5V BRAKE POT SUPPLY	Brown/Green
15	BRAKE WIPER	White/Yellow
16	0V POT COMMON	Yellow/Brown
17*	+5V SENSOR SUPPLY	White/Grey
18*	SENSOR INPUT	Grey/Brown
19*	0V SENSOR SUPPLY	White/Pink
20*	QEP I /Spare	Pink/Brown
21*	QEP A / Spare	White/Blue
22*	QEP B / Spare	Brown/Blue
23	CONTACTOR IN	White/Red
24	CONTACTOR OUT	Brown/Red
PE	SHIELD	

Table 4.1 Driver Control Connections

Depending on your hardware configuration not all inputs will be needed. The minimum set of required inputs includes the DRIVE MODE, FORWARD, REVERSE and E-STOP switch

and the THROTTLE POT. In addition the **Contactor In/Out** connections must be connected. All the digital inputs are internally tied low inside the Scott Drive controller and should only be connected to the supplied +5V switch supply (Pin 1) to activate the pin functionality.

4.3.1 Forward / Reverse Direction Inputs (Pin 4 & Pin 2)

The Forward and Reverse Direction inputs are active high and should not be active simultaneously.

4.3.2 Drive Mode (KSI) (Pin 5)

The Drive Mode input is active high and changes the internal mode of the Scott Drive controller. It is recommended to connect this input to a dedicated illuminated push button fitted in the dash rather than the key switch. When activated the internal mode of the controller changes from **Drive Standby** to **Drive Active** mode.

NOTE: There are two conditions that will stop the controller entering the Drive Active mode. The first condition is when the E-Stop input is open (E-Stop button activated). The second condition is when the Throttle level is positive (> 0.0). The resting throttle level should be adjusted to between -5 and -2% when not using the throttle to determine the regenerative braking level. If the throttle pot is used for regenerative braking then the resting throttle level should be adjusted to ~-20%.

4.3.3 Interlock (CFO) Input (Pin 6)

The Interlock (Charge Flap Open) input is tied low internally and must be connected high (+5V) for the drive to operate. This input can be connected to a micro switch on the charging flap/latch to automatically disable the drive when the car is being charged.

4.3.4 Emergency Stop Input (Pin 7)

The Emergency Stop input is tied low internally and must be connected high (+5V) for the drive to operate. For failsafe operation the input should be connected to the Normally Closed (NC) contacts when the Emergency Stop button is not active. When the Emergency Stop input is opened the Scott Drive controller will turn off all the IGBT

switches and disable all drive operation until the Emergency Stop input is again closed.

In addition to the digital Emergency Stop input the Scott Drive controller also provides access to the internal Kilovac solenoid leads (Pin 23 & Pin 24). These pins **MUST be connected together** to enable the software to close the main contactor after the DC Link pre-charging is complete. These pins may either be connected together permanently or may be connected to a second pair of Normally Closed (NC) contacts in your Emergency Stop button. The reason for direct access to the Contactor Coil leads is to comply with regulations in some countries that specify manual access to a direct mechanical or electromechanically disconnect option. The disadvantage of using the contactor to break the high voltage current is wear and tear on the contacts as the high voltage/high current arc dissipates under load.

Consequently Scott Drive provides the digital software sensed input as the primary Emergency stop method. The reaction time of the software to disable IGBT switching is less than 1ms. At the same time the Contactor solenoid coil supply is also disconnected by the software allowing the contacts to Open. As the typical KiloVac contact release time is 12ms the current draw should already be close to zero by the time the contacts open.

4.3.5 Sport Mode Input (Pin 8)

The Sport Mode input can be used to change to a second pre-defined Throttle Mapping sensitivity. The input should be connected high to activate the Sport Mode. See section 7.3.5 on how to set the Sport Mode Throttle sensitivity using the SEV View software.

4.3.6 Regenerative Brake Disable (Pin 9)

The Regenerative Brake Disable functions as an override to easily disable regenerative braking when road conditions become dangerous due to ice, rain or any other reasons.

4.3.7 Throttle Switch Input (Pin 10)

The throttle switch input is available if required for pot boxes the also supply a micro switch which is active (closed) when the throttle level (and pot) is engaged.

4.3.8 Unused Inputs

Currently Inputs 17 through to 22 are unused and reserved for future use or customised control features.

4.4 Auxiliary Motor Outputs

Four auxiliary 12V/10A outputs are provided through an eight pin EPIC HD8 style connector. These outputs can be used to control low power DC motors (up to ~120W) such as water pump or vacuum pump motors. The ON state of the outputs can be set to coincide with a number of drive controller states, most commonly to activate when the drive enters the Active mode. The Low side return is switched to 0V via Mosfets to activate the output. It is possible to PWM modulate the outputs if required.

Pin Number	Function
1	Channel One Return
2	Channel One +12V
3	Channel Two Return
4	Channel Two +12V
5	Channel Three Return
6	Channel Three +12V
7	Channel Four Return
8	Channel Four +12V

Table 4.2 Auxiliary Connector Pin Assignments.

4.5 Communication Interfaces

4.5.1 Ethernet TCPIP

A standard RJ45 Ethernet connection is provided for easy connection to any PC. The Ethernet port is AUTO-MDIX enabled meaning it can be connected directly to either a PC or network switch without using a cross-over cable. Scott Drive provides PC based application software (SEV Viewer) which can be used for initial setup, in-field firmware upgrade or to simply view to operating parameters of the Drive. Configuring the TCPIP port on your computer is detailed in Section 6. The SEV Viewer software is discussed in detail in Section 7.

4.5.2 CAN Bus

The CAN Bus port is provided primarily so the Drive controller can communicate with other Scott EV products such as the Battery Management System (BMS) and charging system. A 5-pole female M12 connector must be used to connect to the CAN port on the Scott Drive controllers. Table 4.3 list a selection of suitable cables available from LAPP KABEL.

UNITRONIC M12 Connectors With Leads
PUR OR PVC BLACK CABLE - DRAGCHAIN RATED - INCLUDES MARKER SLEEVES

UNITRONIC®

Lead Length	Male / Pin Straight PUR	Male / Pin Right Angle PUR	Female / Socket Straight PUR	Female / Socket Straight PVC	Female / Socket Right Angle	Female / Socket Right Angle PVC
4 POLE						
2m	22260320	22260301	22260322		22260324	22260841
5m	22260321	22260302	22260323	22260689	22260325	22260678
10m	22260342	22260303	22260343	22260685	22260341	22260683
5 POLE						
2m	22260400	22260402	22260404		22260406	
5m	22260401	22260403	22260405		22260407	
10m	22260414	22260417	22260415		22260418	
8 POLE						
2m	22260091	22260094	22260726		22260141	
5m	22260092	22260095	22260728		22260615	
10m	22260093	22260096	22260729		22260616	

Table 4.3 LAPP Unitronic M12 connectors

The default bit rate of the CAN port is 500 kbits/second. Contact Scott Drive directly if you wish to change the default baud rate.

The pinout of the M12 connector is listed in Table 4.4.

Pin	Description	Colour
1	+5V (not used except for BMS board supply)	Brown
2	CAN Hi	White
3	CAN Lo	Blue
4	0V Common for CAN	Black
5	Not Connected	Grey

Table 4.4 M12 CAN connector pinout

4.5.3 CAN Bus Messaging

Each Scott Drive controller is configured to respond to an 11-bit CAN Identifier (Identifier 0x19) with 1 data-byte. The value of the data-byte specifies the type of response data the controller will reply with. The Identifier of the response frame is also 0x19 and reply's with the same data type code in Bytes 1:2. Table 4.5 summarises the controller parameters that are available over the CAN port.

Data Type	Bytes 1:2	Bytes 3:4	Bytes 5:6	Bytes 7:8
Drive Status	1	Program Mode	Engine State	Switch State
Error Status	2	Error Code	Error Value	Mode Timer
Motor Data	3	Motor RPM	Motor Current	Motor Voltage
Analog Data	4	External ADC	Throttle Level	Brake Pressure
HV Bus Data	5	Frequency	Bus Current	Bus Voltage
Temp Data	6	Internal Temp	KTY1 Temp	KTY2 Temp
IGBT Temp	7	Leg A Temp	Leg B Temp	Leg C Temp
Aux Current	8	Aux 1 Current	Aux 2 Current	Aux 3 Current
Phase Voltage	9	Phase A Voltage	Phase B Voltage	Phase C Voltage

Table 4.5 List of Controller Parameters available over the CAN port.

4.5.4 RS485

The RS45 port is included for future expandability and custom interfaces if requested. Please contact your local distributor if you wish to customize setup, control or diagnostic functions via RS485.

5 Liquid Cooling System

Your Scott Drive controller is equipped with liquid cooling ports for efficient cooling under high-power conditions. The minimum recommended flow is 3 liters/minute (.8 gal/min) on the SD100 and 5 litres per minute (1.5 gal/min) on the SD200. The use of distilled water and an antifreeze additive is required. This not only prevents freezing in low temperatures, but also helps to prevent scale and rust build-up which reduce heat transfer.

If the controller is mounted vertically (such as on the fire-wall of a vehicle), the coolant ports must not be facing down. This could lead to an air bubble in the chill plate and inadequate heat removal. If the controller is oriented so that one coolant port is above the other, then cool liquid should enter the lower port and warm fluid should exit the upper port (radiators and coolant reservoirs are the opposite, the warm fluid enters the top and cool fluid exits the bottom). It is strongly recommended the pump be the lowest part of the system and located both below and close to the radiator or reservoir. This will prevent difficult priming due to an air pocket.

For longest life and highest performance the controller should have its own coolant system to prevent motor heat from affecting the controller. This is especially important in racing or other extreme high-power applications. If the controller is placed in the same coolant loop as a motor, the controller should be located before the motor in the coolant loop. This can be done for expediency in moderate power applications. Coolant temperature should be kept under 40 C (104 F) for maximum performance.

Coolant system flow and radiator sizing requirements can vary quite a bit in different vehicles. Variables such as vehicle weight, system voltage, motor model, driving habits, terrain, speed, air-flow, ambient temperature, tubing size, fan, etc., all affect the cooling system performance. It is important to consider these factors when choosing components or designing the system. In general, it is wiser to error on the side of too much cooling rather than too little.

The Scott Drive controller is made with the highest quality components and will automatically reduce power output in order to keep from overheating. However, it is always beneficial to keep electronic equipment as cool as possible to increase both power output and longevity. It is best practice to monitor the temperature of the coolant system by using

a temperature sensor which is accurate below 100 F (35C). Do not use standard automotive temperature switches which only activate above 180 F (65 C). The chart below shows the benefit of keeping the controller as cool as possible.

5.1 IGBT Rated Output at Various Temperatures

Temperature	SD100 IGBT Rated Output	SD200 IGBT Rated Output	SD250 IGBT Rated Output
25 C (77 F)	468 A	641 A	899 A
40 C (104 F)	430 A	600 A	830 A
50 C (140 F)	400 A	575 A	800 A
70 C (158 F)	374 A	512 A	715 A
100 C (212 F)	300 A	410 A	575 A

6 Drive Configuration

The Scott Drive Controller can be configured using the SEV View application software via a standard Ethernet port. The following section details how to setup your PC or Laptop so it can communicate with the Scott Drive Controller.

6.1 Ethernet Communication Setup

To communicate with the Scott Drive Controller your PC must be setup to use a compatible IP address. The TCP/IP settings can be adjusted from the **Internet Protocol (TCP/IP) Properties** window. The default IP address of all Scott Drive controllers is 10.1.1.100 when it leaves the factory. Consequently you should set the IP address of the PC to 10.1.1.x where x can be any number from 1 to 255 (except 100) and the subnet mask to 255.255.255.0. The DNS addresses do not affect communication with the SD100. In the examples below the PC address is being set to 10.1.1.5.

6.1.1 For Windows XP

From the **Control Panel** open up the Network Settings window and right click on your **Local Area Connection** icon and select **Properties.** Select the **Internet Protocol (TCP/IP)** from the list of available connections and click on the Properties button. This will bring up the window in Figure 6.1. Enter the new network address and click **OK** when you are done. You may need to reboot your PC for the settings to be updated.

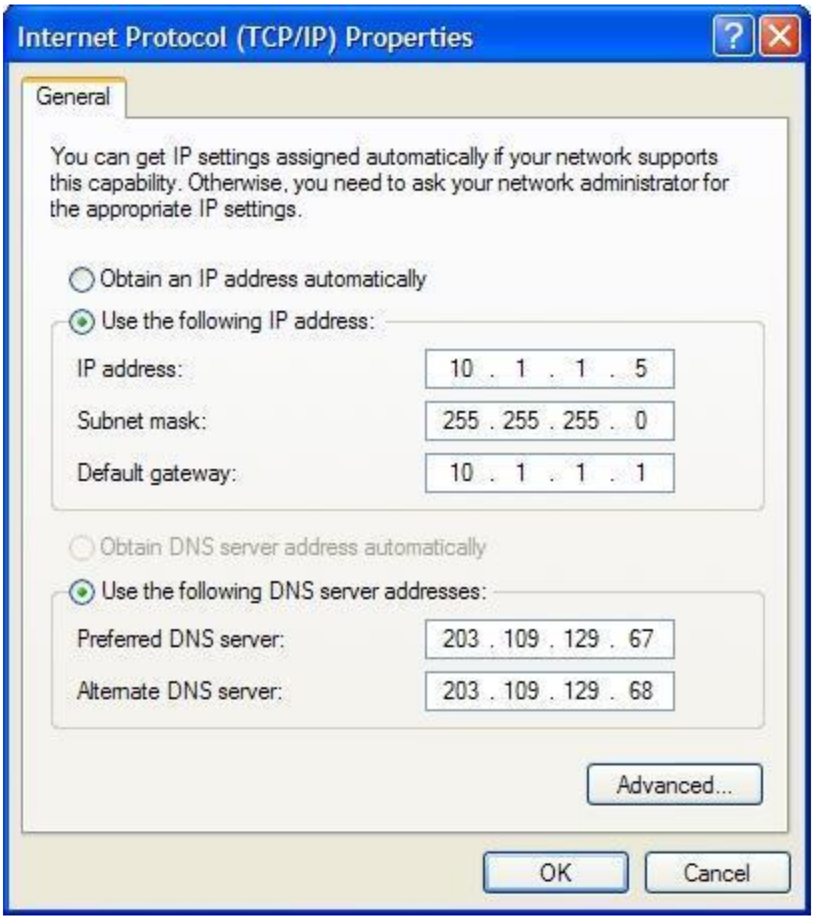

Figure 6.1 TCP/IP Properties Window (XP).

6.1.1 For Windows 7 & 10

From the **All Control Panel Items** open up the Network and Sharing Center window and left click on your **Local Area Connection** icon and select **Properties.** Select the **Internet Protocol Version 4 (TCP/IPv4)** from the list of available connections and click on the Properties button. This will bring up the windows in Figure 6.2. Enter the new network address and click **OK** when you are done. You may need to reboot your PC for the settings to be updated.

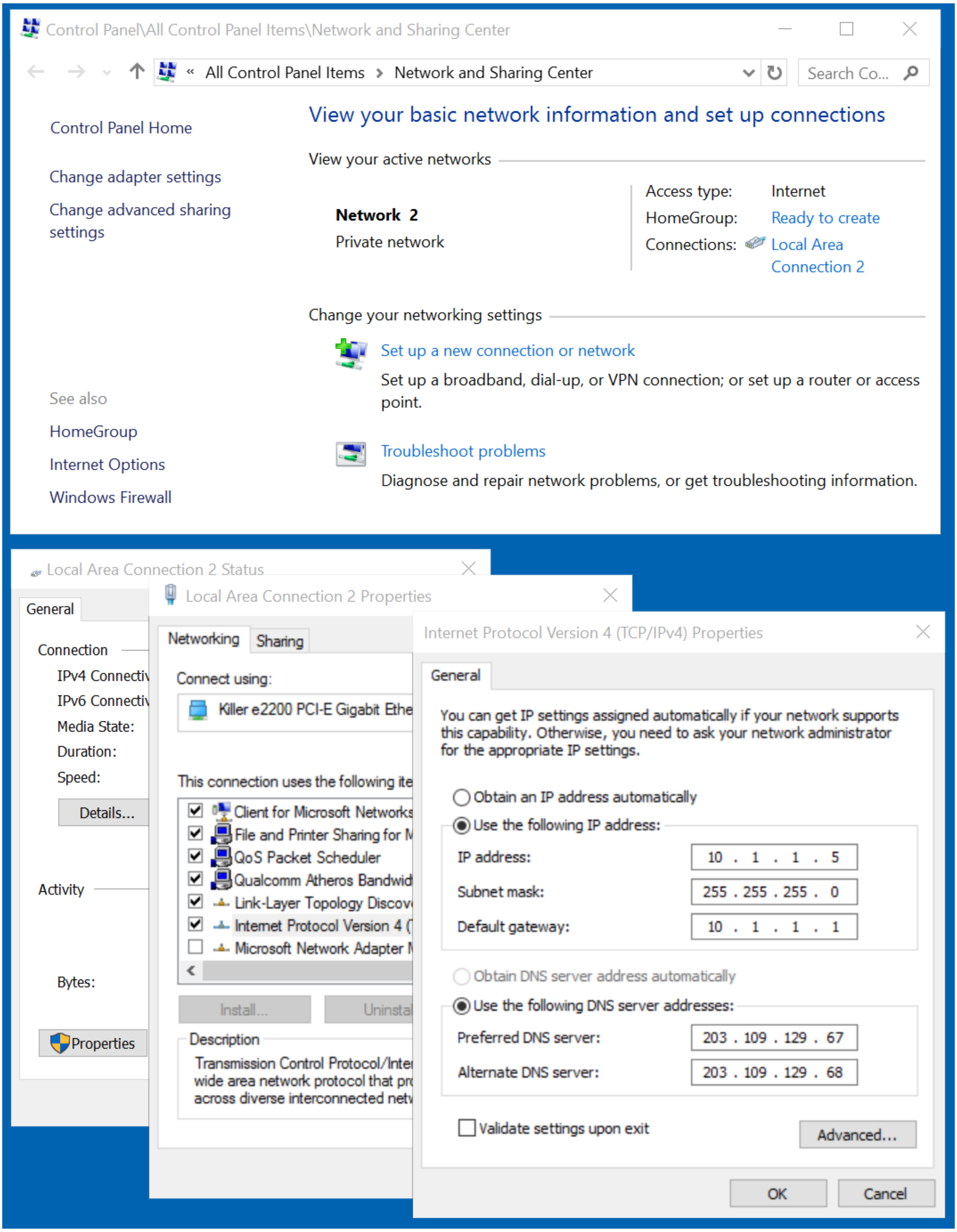

Figure 6.2 TCP/IP Properties Window (Windows 10).

7 SEV View Software

The Scott Electric Vehicle (SEV) Viewer software can be used to configure all aspects of your Scott Drive Controller. The main window contains a Tool bar at the top of the window and a Tab Control with multiple Tab Pages. When you are connected to a Scott Drive Controller then the SEV Viewer software should automatically display the **Drive Data** tab page (Figure 7.1) when the application is started. The individual features of the SEV software are described in the following sections.

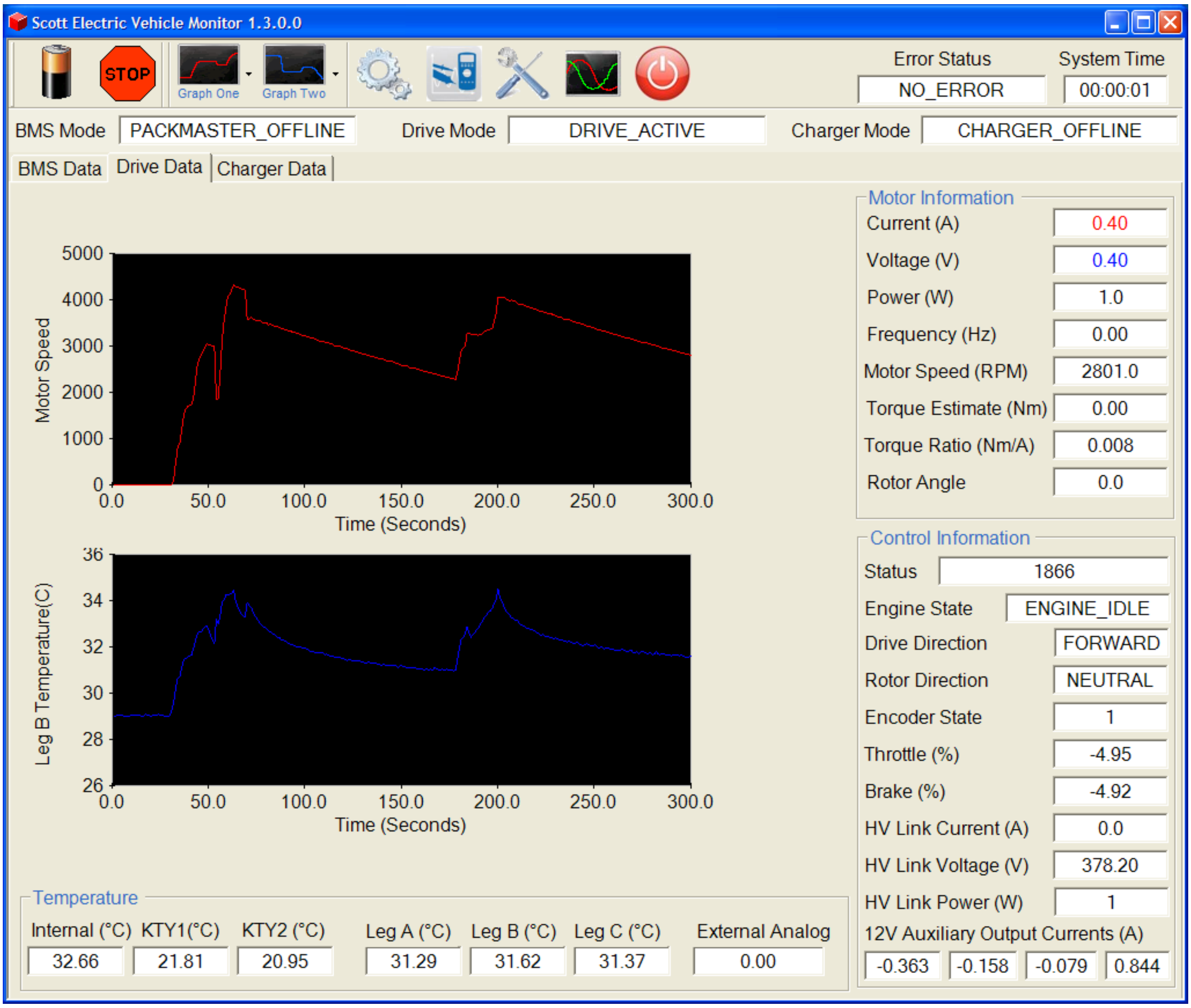

Figure 7.1 Drive Data tab page

7.1 SEV Viewer Toolbar

The SEV Viewer Toolbar is shown in Figure 7.2

Figure 7.2 Main Toolbar used to select various functions and windows.

The Toolbar at the top of the window contains two popup menus and five buttons used to select and access all features within the software. These are as follows:

- Graph One parameter selection
- Graph Two parameter selection
- Settings Button
- Calibration Button
- Diagnostics Button
- Scope Button
- Shutdown Button

The features are discussed in detail in the following sections.

7.2 Drive Data Tab Page

The main features of the Drive Data tab page (Figure 7.1) include two Scrolling graphs and three sets of controller operating parameters separated into Group boxes. Each Scrolling graph can display a range of user selectable drive parameters with a 5 minute history buffer. The selection of data to display is made using the **Group One** and **Graph Two** popup menu buttons in the toolbar in Figure 7.2. All selectable parameters are buffered internally by the software so the user can quickly switch from one to another. All parameters are also visible (as text) in one of the three group boxes. The Group boxes are Motor Information, Control Information and Temperature Information.

7.3 Settings Window

Click on the Settings Button in the toolbar to bring up Settings Window and select the Drive Settings Tap Page (Figure 7.3). Scott Drive Controller operation is configured by the four groups of settings: **Motor Parameters, Motor Sensor Parameters, Auxiliary Motor Control,** and **Controller Settings.** The settings in each group are described in the following sections. Before making any changes to the settings you should ensure the Scott Drive controller is in the Drive Standby mode (KSI Input open). After making the desired changes you must click on the **Apply Settings** button for the changes to be **saved**.

NOTE: Not all settings are applicable to each motor type.

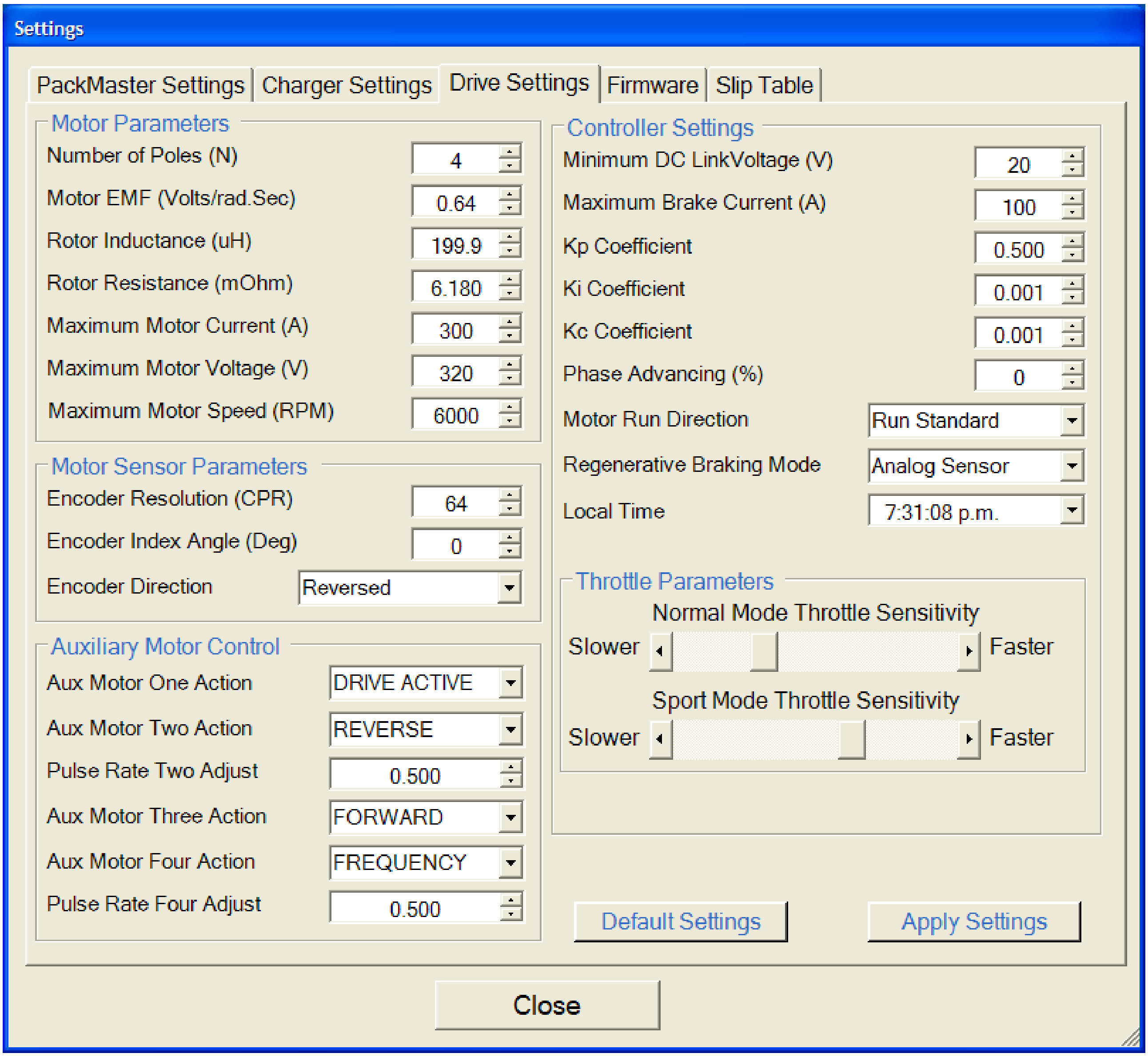

Figure 7.3 Drive Settings Tab Page.

7.3.1 Motor Parameters

- **Number of Poles (N):** This is the total number of North and South Poles in the rotor. Some motor manufacturers specify **Pole Pairs** in which case the number of poles is twice the number of Pole Pairs.
- **Motor EMF (Volts/rad.Sec):** This value should be supplied with your motor. Please note that some motor manufacturers supply this value in Volts/Hertz. If this is the case then you must convert the Volts/Hertz value to Volts/Radian.Seconds.
- **Rotor Inductance:** Can be used to tune the controller for some motors.
- **Rotor Resistance:** Can be used to tune the controller for some motors.
- **Maximum Motor Current:** This value should be the lesser of the Controller Current rating and the Motor Current rating.
- **Maximum Motor Voltage:** Only used if overvoltage is a possibility.
- **Maximum Motor Speed:** Maximum allowable motor speed. This feature is not enabled unless requested.

7.3.2 Motor Sensor Parameters

- **Encoder Resolution (CPR):** This setting is only relevant for motors with 2 or 3 channel digital encoders.
- **Encoder Index Angle (Deg):** This setting is only relevant for BLDC or PMSM motors with 3 channel encoders. The value corresponds to the FOC angle when the Index channel pulse is received. For ACI motors the value can be set to zero.
- **Encoder Direction:** This setting can be used to invert the A and B encoder index channels which essentially reverses the count direction relative to the rotor direction. This has the same effect has reversing the U and W motor phase cables on ACI motors.

7.3.3 Auxiliary Motor Control

The Scott Drive 100 provides four low voltage (12V) Auxiliary Outputs capable of providing 10 Amps of continuous current (15A Peak). Each output can be configured to activate on **one** of several conditions using the SEV Monitor software. The default state of all outputs

is OFF under all conditions. All four Auxiliary Outputs can be configured to activate under multiple conditions such as ‘Drive Active; Forward Switch Active, Reverse Switch Active. In addition Auxiliary Output’s 2 and 4 can also be configured to provide a pulsed output proportional to the Drive Frequency which is directly related to the Motor RPM for DC Brushless/AC synchronous motors. It is not recommended to use the pulse outputs with AC Induction motors.

The pulse outputs can be used to drive the Tachometers and Speedos in the instrumentation panel of your vehicle. As these outputs are controlled via low side MOSFET switches special care must be taken when connecting to the instrumentation panels in your vehicle.

To simulate the pulse train to a tachometer for a four cylinder engine a value of 0.5 should be entered “Pulse Rate Adjust” box.

7.3.4 Controller Settings

- **Minimum DC Link Voltage:** Can be used to protect battery from excessive discharge. The controller will stop operating once the HV Battery voltage falls below this level. Not intended to replace a full BMS system.
- **Maximum Braking Current:** This value sets the maximum regenerative braking current. Generally this value is between 50% and 75 % of the maximum motor current. If the value is set too high it can cause loss of traction under braking in wet or slippery road conditions.
- **Kp, Kc, Ki Coefficients:** These coefficients are used in the PI current control loop. Generally these values are set appropriately for each motor type before the controller leaves the factory. Modify with caution!!!
- **Phase Advancing:** This value should normally be set to 0.0. The value only has a noticeable effect for very high pole count PMSM motors running at high speed. For motors with > 16 poles and running > 4000 RPM there can be a small increase in torque at these speeds.
- **Motor Run Direction:** This setting can be used to change the default rotor direction corresponding to the forward and reverse drive switch inputs.
- **Regenerative Braking Mode:** To enable regenerative braking select **one of the**

three regenerative braking modes and make sure the regenerative disable braking input (pin [9]) is not active. The Regenerative Disable Switch Input is intended to enable the driver to easily disable regenerative braking in dangerous road conditions such as ice or heavy rain.

- **Switch Sensor Mode:** In this mode regenerative braking is activated when a micro switch or limit switch is active. As the input is digital the braking level is fixed so it is recommended to use a low braking current value.
- **Analog Sensor Mode:** In this mode a dedicated analog pot is used to provide a variable regenerative braking level. The pot may be connected directly to the brake pedal or mounted elsewhere. Please check the relevant regulations in your country when modifying the braking system in your vehicle.
- **Throttle Sensor Mode:** In this mode the Throttle Sensor pot is also used as the analog input for the braking level. Typically the first 20% of the throttle travel should be used to provide a variable braking level. To correctly setup the throttle pot for regenerative braking the Gain and Offset of the analog input channel must be correctly adjusted in the Calibration Window.

7.3.5 Throttle Parameters

Depending on your particular motor/controller combination, gearbox ratio(s) and vehicle weight the raw throttle pot sensitivity can be adjusted to suit your driving style. In addition the Sport Mode Input allows you quickly change from ‘Normal’ mode throttle sensitivity to a second ‘Sport’ mode setting with an external button or switch.

If the Sport Mode input is left open the Scott Drive controller will default to the Normal mode throttle sensitivity. To activate the Sport Mode function the Sport Mode input (Pin 8) should be connected to the +5V supply (Pin 1) of the EPIC connector.

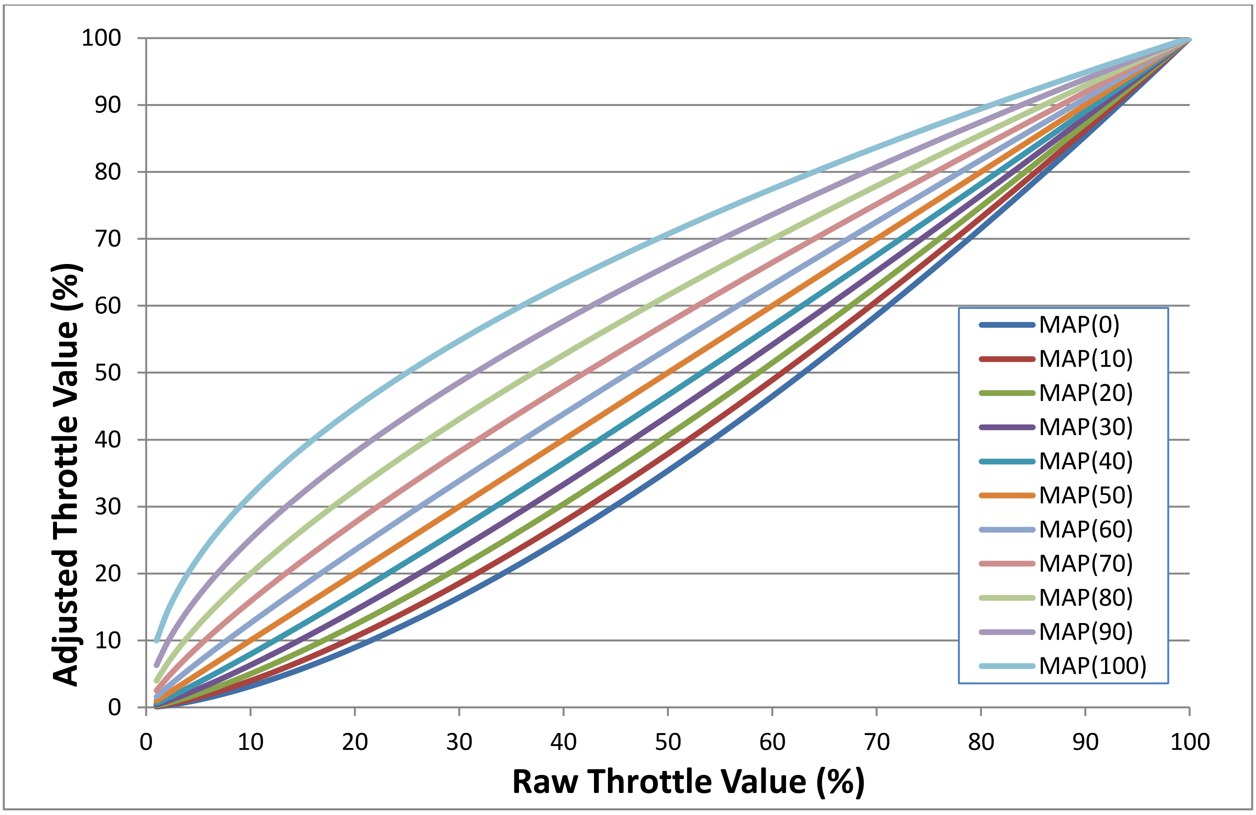

Figure 7.4 Mapping of Raw Throttle Value.

The Normal and Sport mode throttle sensitivity settings are increased by moving the corresponding Scroll bar from left to right. With the Scroll Bar far left corresponding to the MAP(0) curve the motor torque increases very gradually initially. When the scroll bar is centred the throttle sensitivity is linear throughout in entire throttle range corresponding to the MAP(50) line in Figure 7.4. As the Scroll Bar is moved to the far right MAP(100) the motor torque increases quite rapidly as the throttle is depressed.

7.4 Calibration Window

The Calibration Window is shown in Figure 7.5. All Scott Drive Controllers are calibrated and tested before they leave the factory. The only measured signals (ADC channels) that may need to be re-calibrated once the controller is installed are the externally sourced Throttle and Brake channels. The Offset and Gain values should be adjusted so that the resting (inactive) throttle and brake (%) values are between -2.0% and -5.0% and the full scale values are between 100.0% and 101.0%. The controllers are calibrated at the factory with HRS100 Hall Effect potentiometers so that the resting value is typically -4.9% with a full scale reading of 101.0%.

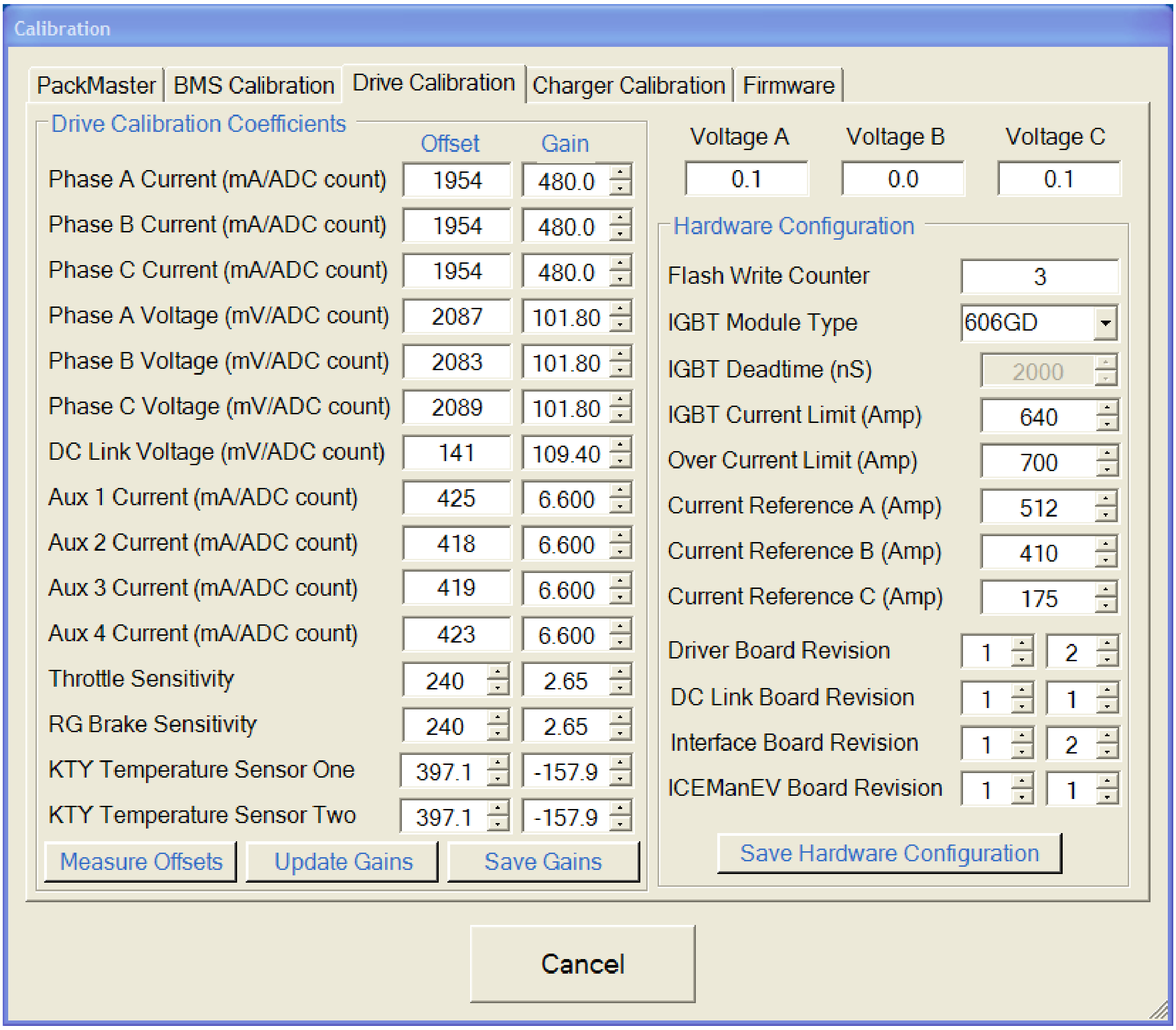

Figure 7.5 Drive Calibration Dialog

If your potentiometers produce resting or full scale readings that are outside of the recommended range then the following procedure should be used to adjust the readings.

Re-calibrating the Throttle and Brake Channels

NOTE: **DO NOT** at any stage click on the Measure Offsets button.

1) With the controller in **Standby Mode** and the Throttle/Brake pot in the resting position, adjust the Offset and use the **Update Gains** button to send the new **Offset** value to the controller. The effect of the new **Offset** value is visible in the **Throttle (%)** or **Brake (%)** text boxes in main Drive Data tab page.
2) Continue adjusting the **Offset** value until the resting Throttle (%) or Brake (%) is between -2.0% and -5.0%.
3) **NOTE: The controller must be in Standby Mode before you attempt this.** With the resting value(s) in the correct range fully depress the Throttle (or Brake) pedal and adjust the **Gain** parameter value so the full scale reading is between 100.0% and 101.0%. Use the **Update Gain** button to apply the new Gain setting.
4) Changing the **Gain** value also affects the resting value to a small degree so you may need to adjust the **Offset** value slightly.
5) Once you have verified the resting and full scale values (inactive and fully depressed pedal positions) are correct in the **Drive Data** window use the **Save Gains** button to store the new **Offset** and **Gain** values into your controller.

WARNING: All Scott Drive controllers include a Throttle lock-out feature to prevent the un-intentional acceleration when the controller goes from Drive Standby to Drive Active mode. If the resting value of the Throttle (%) is positive (> 0.0) when the Drive Active switch is closed the controller will go into an error lockout mode instead of Drive Active mode. This is to prevent the vehicle accelerating.

7.5 Scope Window

The Scope Window shown in Figure 7.6 is accessed using the **Scope** button in the Main Toolbar. This window contains three separate graphs and each graph typically has two scope traces (lines) which cover a 20ms (millisecond) period of time. The blue coloured traces always show the three Hall sensor channels or the two/three encoder sensor channels regardless of the selected data type to display. The red coloured traces always show the type of data selected using the Combo Box at the top right of the window. Typically these graphs are used to display the motor **Phase Voltage Data** or motor **Phase Current Data**. The other options available (Interrupt Data, Process Data, Drive System Data etc.) are primary used for internal testing and development by Scott Drive. After selecting the type of data to display use the **Scope On** button to start the data transfer process. The graphs will continue to be updated once per second until the Scope Off button is pressed.

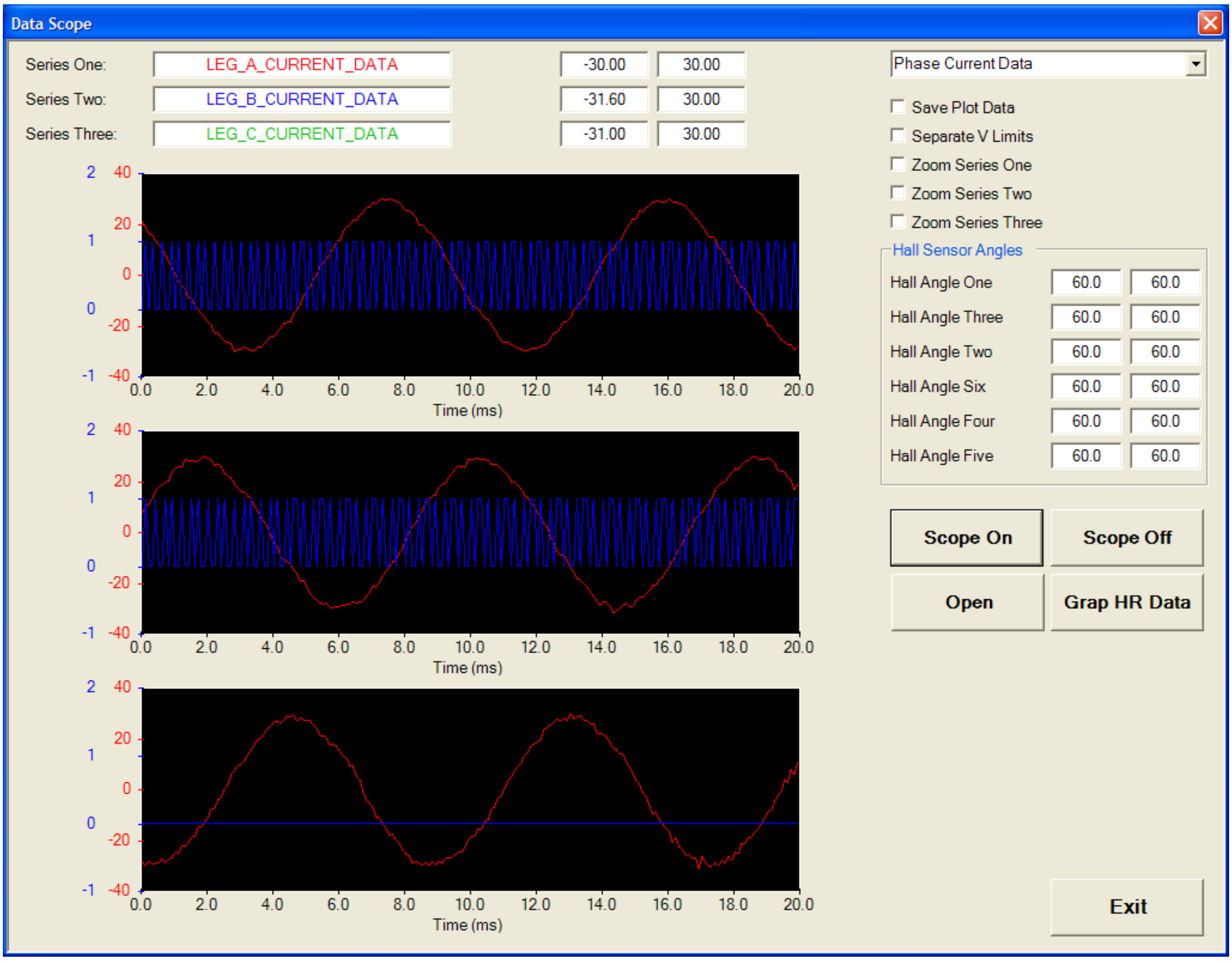

Figure 7.6 Scope Data Window

8 Controller Specifications

Scott Drive Limited is continuously improving and updating the hardware and software features available in the range of controllers listed in Table 8.1 and Table 8.2. The specifications in these tables are subject to change at any time.

General Specifications	SD100	SD200	Units
Recommended DC Bus Voltage	200-400	200-400	Volts
Maximum DC Bus Voltage	450	450	Volts
Maximum RMS Current	330	450	Amps
Switching Frequency	10.0-15.0	10.0-15.0	kHz
Minimum Coolant Flow Rate	3.0	3.0	L/min
Recommended Coolant Flow Rate	6-9	6-9	L/min
Drive Supply Voltage	11-16	11-16	Volts
Minimum Drive Supply Current	2	2	Amps
Maximum Drive Supply Current	40	40	Amps
Weight	12.5	12.5	kg
Dimensions	384×304×111	384×304×111	mm

Table 8.1 SD100 and SD200 Controller Specifications

General Specifications	SD250	SD300	Units
Recommended DC Bus Voltage	200-400	500-800	Volts
Maximum DC Bus Voltage	450	900	Volts
Maximum RMS Current	600	500	Amps
Switching Frequency	10.0-15.0	10.0-15.0	kHz
Minimum Coolant Flow Rate	3.0	3.0	L/min
Recommended Coolant Flow Rate	6-9	6-9	L/min
Drive Supply Voltage	11-16	11-16	Volts
Minimum Drive Supply Current	2	2	Amps
Maximum Drive Supply Current	40	40	Amps
Weight	14.0	14.0	kg
Dimensions	384×304×111	384×304×111	mm

Table 8.2 SD250 and SD300 Controller Specifications

9 Dimensions

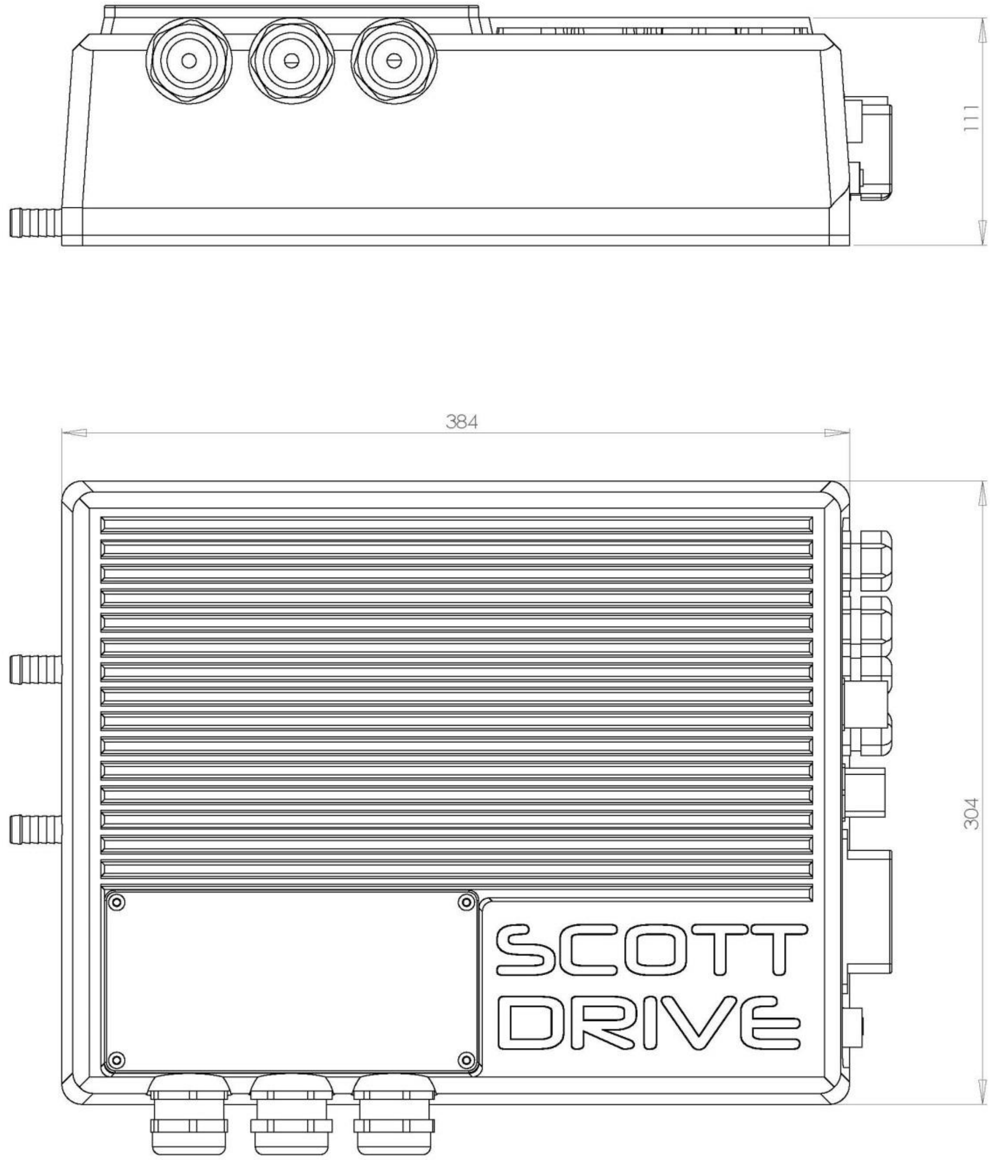

Figure 9.1 SD100 & SD200 Dimensions

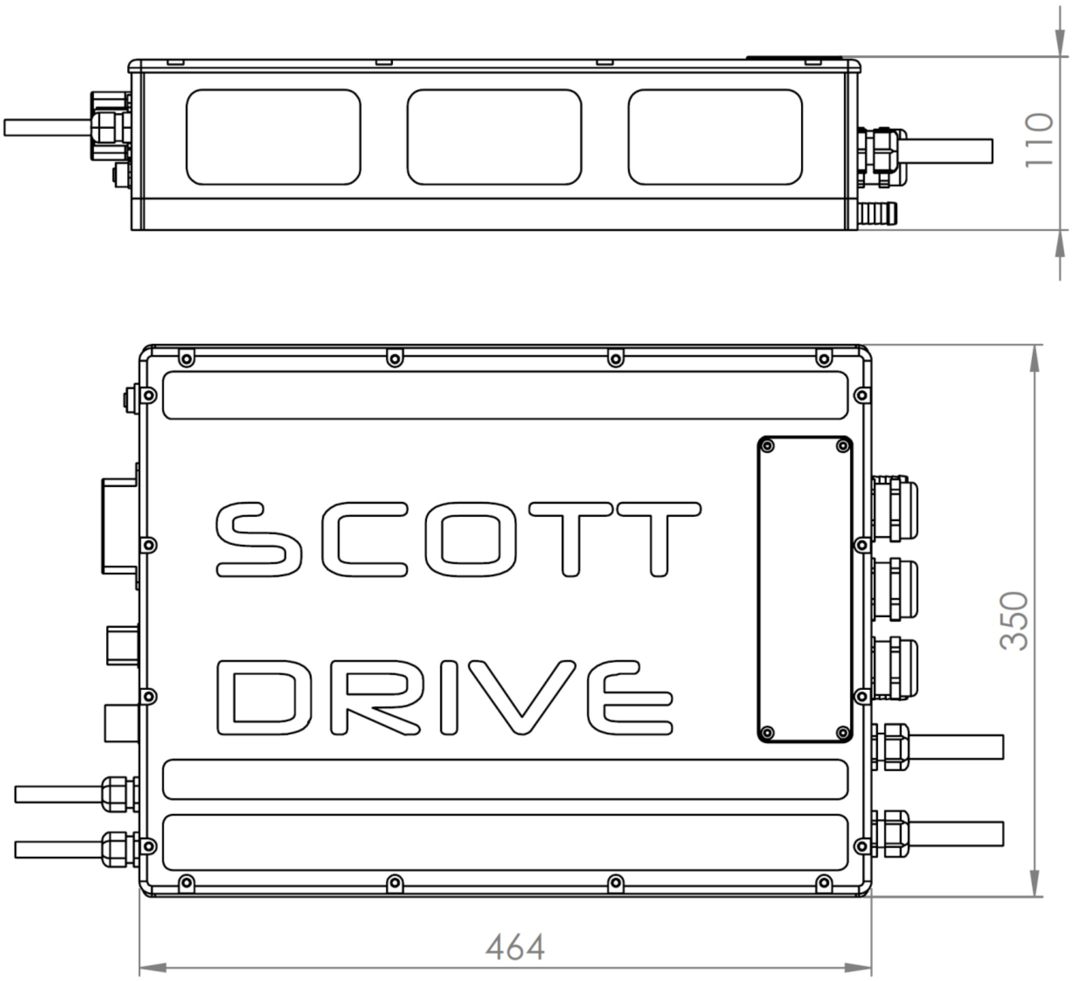

Figure 9.2 SD250 and SD300 Dimensions