



# **SDC3**

Subaru Diff Controller

## **User Manual**

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While every effort is taken to ensure correctness, no responsibility will be taken for the consequences of any inaccuracies or omissions in this manual.

24 August, 2009

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# **Introduction**

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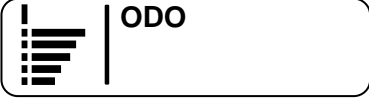


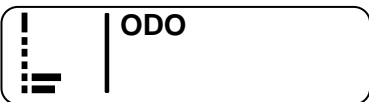

The Subaru Diff Controller 3 (SDC3) is a direct replacement for the Driver Controlled Centre Diff (DCCD) controller in the 2008 WRX STi and similar vehicles.

This manual covers the installation, configuration and functionality of the SDC3.

## SDC3 Functionality

### Mode selection

There are six user selectable control modes, four of which are user configurable. The control modes are selected using the **C.DIFF +/-** toggle switches in the centre console, and indicated on the dash board as follows:

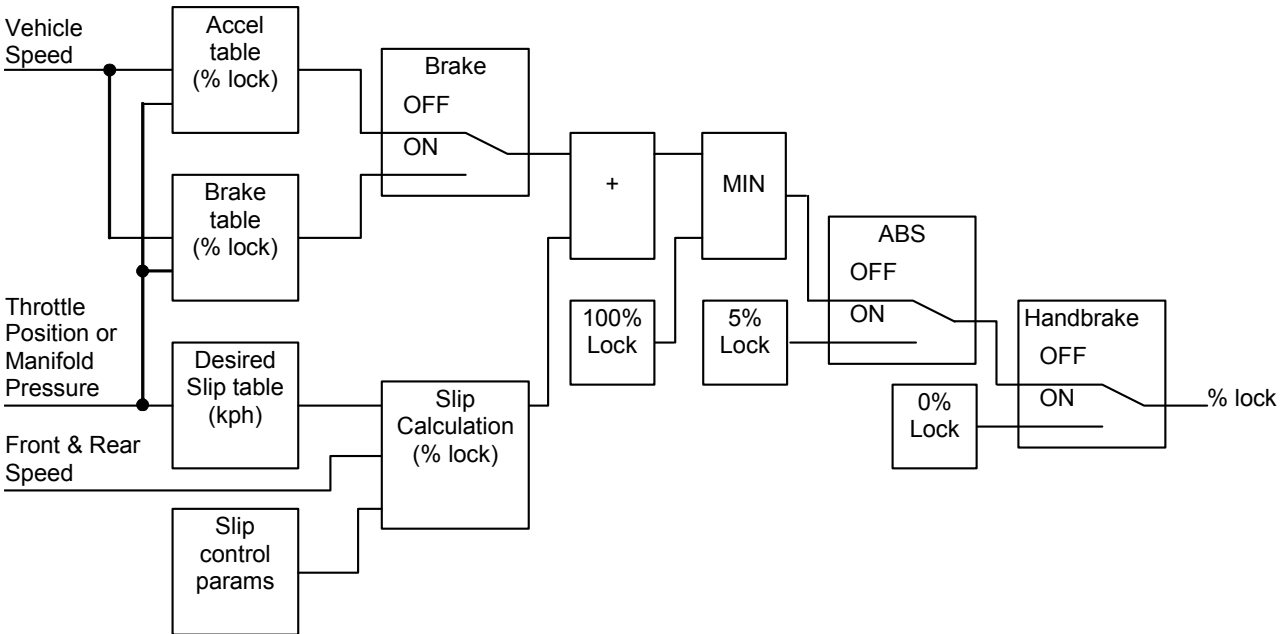
Switch Direction	Dash Display	SDC3 Mode
+		100% lock
		User Mode 4
		User Mode 3
		User Mode 2
		User Mode 1
-		0% lock

# Lock Calculation

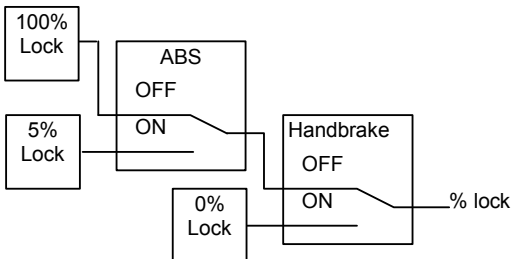
Lock percentage applied to the centre diff is determined primarily by the vehicle speed, throttle position or manifold pressure, and front to rear wheel slip.

Each the four user modes are configured with an acceleration table, a braking table, a desired slip table and slip control parameters. Slip control and ABS override may be disabled if not required.

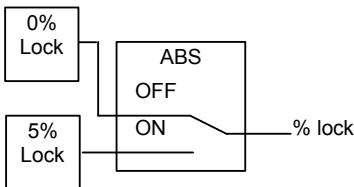
The lock percentage for a user mode is determined according to the following strategy:



The lock percentage for the full lock mode is determined according to the following strategy:



The lock percentage for the zero lock mode is determined according to the following strategy:



For information on configuring the user modes see the SDC Manager section.

## Slip Control

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The slip control strategy detects slip (i.e.: rear speed  $\neq$  front speed) and increases diff lock to maintain slip close to the value specified in the Desired Slip table. The Desired Slip table specifies the value above which additional diff lock will be applied, according to the slip control setup parameters.

The calculation of lock percentage for slip control is determined by the *Slip Control Range* and *Max Slip Control Lock* parameters which apply to all user modes.

The following algorithm determines the %lock for slip control. The desired slip is the output from the Desired Slip table.

IF *Rear Speed* > *Front Speed*

THEN *Measured Slip* = *Rear Speed* – *Front Speed*

ELSE *Measured Slip* = *Front Speed* – *Rear Speed*

*Slip Control Factor* = (*Measured Slip* – *Desired Slip*) / *Slip Control Range*

Constrain *Slip Control Factor* to the range 0 to 1

*Slip Diff Lock* = *Slip Control Factor* \* *Max Slip Control Lock*

NOTE: Slip is specified as speed difference between front and rear wheels, not as a ratio of the speeds.

The addition of the calculated slip diff lock percentage is shown in the lock percentage strategy above.

### Slip control example

Max slip control = 10% lock

Slip control range = 20 km/h

Desired slip (from Desired Slip table) = 10km/h

For a measured slip of 15km/h, slip diff lock =  $((15 - 10) / 20) * 10 = 2.5\%$

For a measured slip of 30km/h or above, slip diff lock = 10%

For information on configuring the slip control parameters, see *Setup | User Modes* in the SDC Manager section.

## Diff Control Methods

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The SDC3 implements two methods of driving the centre differential, selectable in the configuration.

### Current Control

Current output control regulates the solenoid current waveform by setting a minimum current and ripple factor for a particular lock percentage. The parameters for this control mode are pre-configured for the factory centre diff solenoid and should not be changed. **This is the recommended mode of operation.**

### Duty Cycle Control

Duty cycle output control provides a PWM solenoid drive from 0 to 100% duty cycle for 0 to 100% calculated lock. The frequency of the drive pulses changes linearly between specified frequencies for 0% 100% lock. **This mode is not recommended as the effective diff lock will change with diff temperature.**

An absolute limit for solenoid current can be configured for either control method, and is pre-configured for the factory centre diff solenoid.

For information on configuring the diff control method, see *Setup | Output* in the SDC Manager section.

## Speed Measurement

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The SDC3 can be configured to use one of two different methods to measure wheel speeds:

### *ABS CAN (Default method)*

Four wheel speeds are detected by the ABS unit and transmitted over the CAN bus to the SDC3. This is the method used by the factory DCCD controller and requires no modification of the wiring. Individual wheel speeds can be enabled or disabled and the speed calibration can be adjusted for different wheel sizes and sensor teeth.

### *Wheel Speed Sensors*

Up to four wheel speed sensors may be wired directly to the SDC3 connector by modifying the vehicle wiring. The wheel speed inputs can be configured as hall effect or magnetic sensors with adjustable thresholds, and individual sensors can be enabled or disabled. The speed calibration can be adjusted for different wheel sizes and sensor teeth. Magnetic sensor input thresholds are individually configurable for front and rear sensor pairs according to the current front and rear speeds.

Front, rear and vehicle speeds are calculated from the wheel speeds, and all speeds are transmitted in CAN messages for logging by the ADL (Advanced Dash Logger).

Front speed, rear speed and vehicle speed are also transmitted over CAN in a format that can be received by the MoTeC M800 ECU. The MoTeC WRX V910 OEM ECU (if fitted) can be configured to log these wheel speeds or use them in engine control strategies.

For information on configuring speed inputs, see *Setup | Input Setup* in the SDC Manager section.

## Speed Calculations

The method of calculating front, rear and vehicle speeds is dependent on the status of the brake input.

When the foot brake is applied, speeds are calculated as follows:

- Front Speed is the faster of the two front wheel speeds.
- Rear speed is the faster of the two rear wheel speeds.
- Vehicle speed is the faster of the calculated front speed and rear speed.

When the foot brake is not applied, speeds are calculated as follows:

- The front speed is the average of the two front wheel speeds, weighted 80% towards the slowest front wheel speed. If one front wheel speed is less than half of the other front wheel speed, then front speed is simply the faster of the two front wheel speeds.
- The rear speed is the average of the two rear wheel speeds, weighted 80% towards the slowest rear wheel speed. If one rear wheel speed is less than half of the other rear wheel speed, then rear speed is simply the faster of the two rear wheel speeds.
- The vehicle speed is the average of the front and rear speeds, weighted 80% towards the slowest speed. If either the front or rear speed is less than half of the other speed, then vehicle speed is simply the faster out of the front speed and rear speed.

If any wheel speed exceeds 300km/h, the sensor reading is ignored until its speed returns to below 300km/h for 2 seconds. This is to prevent erratic behaviour from noisy wiring or faulty sensors.

## Brake Status

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The SDC3 can be configured to use one of two different methods to measure brake pedal and hand brake status:

### *CAN Status (Default method)*

The brake pedal switch is wired directly to the ABS unit and the hand brake switch is wired directly to the body integrated unit (body computer). This is the method used by the factory DCCD controller and requires no modification of the wiring.

### *Direct Wired Switches*

The brake pedal and hand brake switches may be wired directly to the SDC3 connector by modifying the vehicle wiring.

## **Throttle Calibration**

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The throttle position sensor input can be calibrated using a table to convert voltage to throttle position. This allows non-linear calibration of throttle position to more closely model the change in torque vs. throttle butterfly angle.

The SDC Manager configuration program allows throttle input voltages to be read directly from the SDC3 in order to perform 0% and 100% calibrations.

For information on calibrating the throttle input, see *Setup | Input* in the SDC Manager section.

## **Communications**

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The SDC3 communicates on the factory CAN bus at 500kBit/sec.

### **PC CAN Connection**

A CAN interface to the SDC3 is provided using a MoTeC OEM Communications cable that plugs into the SDC3 board. This cable also provides the power required if the MoTeC CAN cable is used to interface with a PC.

The MoTeC UTC (USB To CAN) adaptor or the MoTeC CAN cable can be used to connect the PC to the CAN bus.

### **Vehicle Communications**

The SDC3 communicates with the ABS module, Body Integrated unit, ECU, Yaw/G sensor and Steering Angle Sensor over the CAN bus using the factory wiring loom.

The SDC3 receives wheel speeds, brake status, yaw, lateral G, longitudinal G, steering angle, ABS status, throttle position and manifold pressure on the CAN bus.

### **MoTeC ADL/M800 Communications**

The SDC3 transmits CAN messages at 50Hz containing information about all input and output functions, such as speed readings, diff currents, duty cycles etc.

The SDC3 transmits CAN messages at 25Hz containing diagnostic information such as fault flags, firmware versions etc.

The ADL can be configured to receive all these channels and an M800 ECU can be configured to receive a subset of the channels.

To configure an ADL to receive SDC3 messages, use the 'SDC3' and 'SDC3 Diagnostics' communications templates included with Dash Manager.

See Appendix E – ECU Communications for information on configuring an M800 ECU to receive SDC3 messages.

The transmission of CAN messages can be disabled. This feature may be used to prevent reverse engineering of user control modes.

## **Miscellaneous functions**

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### **Diff Temperature Override**

The diff temperature override functionality allows a specified control mode to be used if the rear diff overheats.

If this functionality is enabled, the current user control mode (1-4) is overridden with the configured override mode (0%, 100% or one of the 4 user modes) while the rear diff temperature input is active. The diff temperature override does not occur if the thumbwheel is in the full lock or open lock positions.

To prevent rapid transitions between control modes when the diff heats or cools, the diff temperature input must be stable in a new state (high or low) for 2 seconds before the input is considered to have changed.



For information on configuring the diff temperature override, see *Setup | User Modes* in the SDC Manager section.

### ***Fault indication***

Faults are indicated by the flashing of the AUTO[-] and AUTO[+] lights above the LCD display on the dash. The lights will continue to flash until there have been no faults present for 2 seconds.

Fault codes and diagnostic codes are included in the CAN diagnostic messages, as described in Appendix A – Fault Codes.

### ***ABS Active Detection***

The ABS unit transmits status information to the SDC3. ABS Active Detection may be disabled to ignore the status of the ABS in the diff lock calculation.

See *Setup | Input* in the SDC Manager section.

## SDC Manager

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The SDC Manager software is necessary to configure an SDC3 unit from a PC. A new SDC3 unit must be configured before its initial use.

### Computer requirements

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The SDC Manager software runs under Windows 95, 98, ME, NT4, 2000 or XP operating systems. The minimum recommended PC specification is a Pentium 90 with 16MB RAM and a parallel port or USB port.

### Connecting to a SDC3

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The SDC3 connects to the PC using either the MoTeC UTC (USB To CAN) adaptor or the MoTeC CAN cable connected to the PC parallel port. The SDC3 unit must be powered to communicate with the PC.

### Installing SDC Manager

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The SDC software can be installed either from the MoTeC Resource CD supplied with the SDC, or from the MoTeC website (software.motec.com.au).

To start the program after installation, click on Start → Programs → MoTeC → SDC Manager → SDC Manager 1.2

### Managing Configurations

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An SDC configuration file determines exactly how the SDC3 unit will operate. The SDC Manager software allows configurations to be created, edited and sent to the SDC3. To prevent unauthorized copying of configuration data, configurations cannot be read out of the SDC3.

To create a new configuration, select *File | New* from the main menu, or use the default configuration created on startup. The default configuration has similar behaviour to the manual modes in the factory controller.

When SDC Manager is started or when new configuration is created, then the user must select the configuration type (SDC3) when prompted.

To open an existing configuration file, select *File | Open* from the main menu and select the desired file.

After a configuration has been created or modified it should be saved with a meaningful name by selecting *File | Save* or *File | Save As* from the main menu.

To convert an existing SDC configuration to an SDC3 configuration, first load the SDC configuration then select *File | Convert SDC Config* to create the SDC3 configuration.

To send the currently opened configuration to the SDC3, select *File | Send Config* from the main menu, or press F5. The configuration is automatically saved to disk when sent to the SDC3. A new configuration must be saved with a new name before it can be sent.

### Changing Configurations

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#### User Mode Tables

The four user mode each has a set of three tables that determine the diff lock characteristics for the mode.

The speed and throttle position or manifold pressure axis values used for all user mode tables are configurable under the *File | Setup* option in the main menu, and can have between 2 and 11 values. Linear interpolation is used between table points.

The Acceleration table is used to generate the %lock when the foot brake is not applied.

The Braking table is used to generate the %lock when the foot brake is applied, and is an override table for the Acceleration table values.

If a cell in the braking table is left blank, the corresponding cell value from the Acceleration table is used. Cell values should only be entered into the Braking table where a different value is required from the Acceleration table.

The Desired Slip table specifies the value above which additional diff lock will be applied, according to the slip control setup parameters.

The Acceleration and Braking tables specify %lock in 0.5% units.

The Desired Slip table specifies desired slip in 0.1 km/h units.

For more information on the diff control strategy, see the SDC3 Functionality section.

### **Editing Tables**

Cell values in the tables may be incremented/decremented using the Page Up/Page Down keys, or entered directly.

Table regions may be selected, cut, copied and pasted within the application, or to an Excel spreadsheet.

An entire table region can be filled with a value by selecting the region, entering the value, then pressing Enter.

Basic maths operations can be performed on a single cell or an entire table region. To perform an operation on all cells within a region, select the region then enter the number followed by the operator (+, -, /, \*).

Examples:

To add 15 to all values in a region, select the region then type 15+

To multiply all values in a region by 0.8, select the region then type 0.8\*

### **Mode Notes**

Comments about each user mode may be entered in the Notes field, and are stored with the configuration.

### **User Mode Table Font**

The font type and size for the User Mode Tables may be changed using the *File | Select Font* option.

## **File | Setup | Input Setup**

### **Speed**

The speed detection method to be used must be chosen from the list of four methods (*Wheel Speed, Tacho, ABS CAN, and ECU Ground Speed*). The appropriate parameters are shown when a speed detection method is selected.

### **Speed Calibration**

The speed calibration applies to all four wheel speed inputs.

*Pulses/revolution:*

Number of sensor pulses per wheel revolution

*Circumference units:*

Units (mm or inches) used to specify the rolling circumference

*Rolling circumference:*

Tyre rolling circumference, specified in mm or inches

### **Sensor Enable**

For *Wheel Speed* and *ABS CAN* speed measurement methods.

The four speed sensors (Front Left, Front Right, Rear Left and Rear Right) can be individually enabled or disabled. A disabled sensor has a speed of 0km/h. Factory default is all sensors enabled.

## Speed Sensor

For *Wheel Speed* speed measurement method.

### Hall/Magnetic:

If the speed sensor type is hall effect (or equivalent), a hall switching threshold must be specified. If the speed sensor type is magnetic, the Magnetic Levels table (File | Setup | Input Tables) must be configured. Factory default is Hall.

### Hall threshold:

The switching threshold for hall effect speed sensor inputs. Factory default is 2.2V.

## Enable ABS Active Detection

If the ABS Active Detection is enabled then the ABS active status from the ABS computer is used as described in the diff control strategy in the SDC3 Functionality section.

## File | Setup | Input Tables

### Magnetic Levels

For *Wheel Speed* speed measurement method.

If magnetic wheel speed sensors are used, the sensor thresholds must be specified in the magnetic levels table. Thresholds are configured separately for front and rear sensors.

Up to 11 ascending speeds can be specified in the table and linear interpolation is used between points.

### Throttle Position

The Throttle Position table allows the throttle position sensor to be calibrated in up to 11 steps, with linear interpolation between points. The table specifies the throttle position characteristic between the TP Low voltage (0%in) and the TP High voltage (100%in).

The Read buttons for the throttle sensor high and low voltages can be used to calibrate the sensor if the SDC3 is powered and connected to the PC. To calibrate, press the TP High Read button with the throttle pedal fully depressed, then press the TP Low Read button with the throttle pedal fully released.

## File | Setup | Output

### Output Control

The output control method can be configured as Duty cycle or Current control, as discussed under *Diff Control Methods* in the SDC3 Functionality section. The default output control parameters should only be changed by advanced users.

**Duty Cycle control is not recommended as the effective diff lock will change with diff temperature.**

### Full Lock Frequency:

### Open Lock Frequency:

If duty cycle diff control is used, the diff drive frequency varies between the *Open Lock Frequency* at 0% diff lock and *Full Lock Frequency* at 100% diff lock.

### Full Lock Current:

The full lock current is the target diff current for a desired 100% diff lock. The target diff current varies linearly between 0A for 0% lock and *Full Lock Current* for 100% lock. The factory default is 5.0A.

**This parameter should only be changed by advanced users.**

### Min Pulse Width:

### Max Pulse Width:

The width of the diff control pulses varies linearly with the desired diff lock, from *Min Pulse Width* at 0% lock to *Max Pulse Width* at 100% lock. The factory default is 80µS to 800µS.

**These parameters should only be changed by advanced users.**

*Output Current Protection:*

The diff current output is hardware limited to a maximum of *Output Current Protection* Amps, regardless of the control method used. If the Current Control method is used, this current must be at least one Amp higher than the *Full Lock Current*. The factory default is 11.0A.

### **Allow CAN diagnostics**

The CAN data stream can be disabled or enabled. This feature may be used to prevent reverse engineering of user control modes.

## **File | Setup | User Modes**

### **Lock Table Axis**

The Y-axis of the user mode lock tables is configurable as *Throttle Position* or *MAP Sensor*.

The *MAP Sensor* option should only be used when the vehicle is fitted with a correctly configured MoTeC WRX V910 OEM ECU. See Appendix E – ECU Communications for more details.

### **Slip Control**

*Enable Slip Control:*

If slip control is enabled then the Desired Slip table and the slip control parameters are used to determine how much extra diff lock is applied to control wheel slip.

If slip control is disabled then the Desired Slip table has no effect.

*Max slip control:*

This parameter specifies the maximum amount of diff lock (%lock) that can be added to attempt to control slip.

*Slip control range:*

This parameter is the amount of measured slip (km/h) above the desired slip at which the *Max slip control* lock will be applied. If the amount of measured slip is within the range (desired slip + slip control range), then the amount of slip diff lock applied is proportional to how far the measured slip is away from the desired slip.

For more detail on slip control parameters, and slip control examples, see *Slip Control* in the SDC3 Functionality section.

### **Diff Temperature Override**

*Override mode:*

If this functionality is enabled, the current user control mode (1-4) is overridden with the configured override mode (Open, Locked or one of the 4 user modes) while the rear diff temperature input is active. For more detail on the temperature override functionality, see *Diff Temperature Override* in the SDC3 Functionality section.

### **Speed Axis**

Up to 11 values can be specified for the speed axis that is used in all of the user mode Braking and Acceleration tables. The axis values must be ascending and duplicate values are not allowed. Spacing between values is not fixed, allowing non linear axes.

### **Throttle Axis or MAP Axis**

Up to 11 values can be specified for the throttle or MAP axis that is used in all of the user mode tables. The table type (throttle or MAP) is determined by the *Lock Table Axis* option. The axis values must be ascending and duplicate values are not allowed. Spacing between values is not fixed, allowing non linear axes.

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## **Monitoring SDC3 Data**

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Live data from a connected SDC3 may be monitored using the *File | Monitor Channels* option (or the 'M' hotkey) to open the Monitor Channels window.

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## **Sending Firmware**

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The SDC3 firmware is user upgradeable from a PC connected to the MDC with the MoTeC UTC (USB To CAN) or the MoTeC CAN cable.

To upgrade the firmware the SDC3 must be powered and connected to a PC with the SDC Manager software installed. Use *File | Send Firmware* to send the current firmware to the SDC3.

## SDC3 Installation

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The factory centre diff controller box is located on the passenger side behind the glove box.

A standard SDC3 installation involves the replacement of the factory controller circuit board, and the addition of a cable to connect the CAN bus. To remove the controller, locate the box under the dash, unplug the loom connector and remove the single bolt holding the bracket.

To remove the factory circuit board, open the case lid (four screws) and undo the circuit board (4 screws).

If a permanent CAN cable is required, a cable entry hole should be made in the case before the SDC3 board is installed, and the CAN cable should be cable tied to the SDC3 board using the two holes provided next to the connector.

The SDC3 board is fastened using the 4 screws from the factory board.

## Appendices

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### Appendix A – Fault Codes

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The SDC3 fault flags included in the CAN diagnostics are sent as a bit field (16 bit) with the following faults:

Bit 0 (0x0001 = 1)	Bad Configuration (CRC failure)
Bit 1 (0x0002 = 2)	Short circuit diff solenoid
Bit 2 (0x0004 = 4)	Open circuit diff solenoid
Bit 3 (0x0008 = 8)	Output driver failure
Bit 4 (0x0010 = 16)	Diff Relay (in vehicle loom) stuck closed
Bit 5 (0x0020 = 32)	Current protection specified in the configuration is too high for the hardware revision
Bit 6 (0x0040 = 64)	Steering Angle Sensor reported fault
Bit 7 (0x0080 = 128)	Brake status CAN message (ID 0x512) not received
Bit 8 (0x0100 = 256)	Hand brake status CAN message (ID 0x514) not received
Bit 9 (0x0200 = 512)	Wheel speed CAN message (ID 0x513) not received
Bit 10 (0x0400 = 1024)	ECU Throttle Position CAN message (ID 0x410) not received
Bit 11 (0x0800 = 2048)	ABS active status CAN message (ID 0x512) not received
Bit 12 (0x1000 = 4096)	Yaw/G sensor CAN messages (ID 0x070 & 0x080) not received

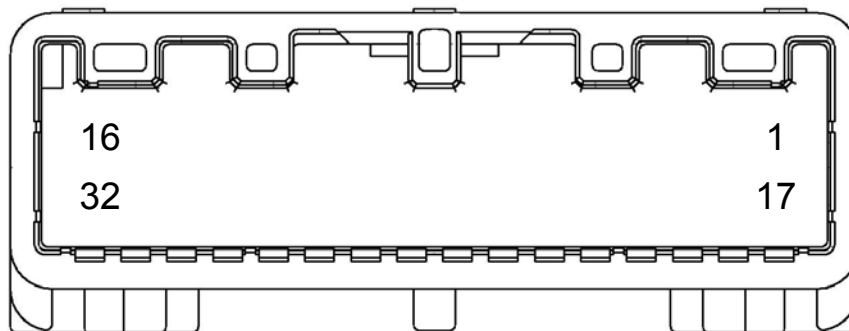
The SDC3 diagnostic flags included in the CAN diagnostics are sent as a bit field (16 bit) with the following faults:

Bit 0 (0x0001 = 1)	Output circuit stopped
Bit 1 (0x0002 = 2)	Output limited to protection current limit
Bit 2 (0x0004 = 4)	Yaw Sensor fault
Bit 3 (0x0008 = 8)	G-sensor fault
Bit 4 (0x0010 = 16)	Steering Angle Sensor not present on vehicle CAN bus



## Appendix B – SDC3 Pinout and Links

### SDC3 Connector Pinout



Pin	Function	Notes
1	Not connected	
2	CAN-HI	
3	Not connected	
4	Down Switch Input	'C.DIFF -' switch (switch to 0V)
5	Rear diff temperature input	0V when temp high
6	AUTO/MANUAL switch input	For future use (switch to 0V)
7	Diff relay control output	Solenoid power relay control (active low)
8	Brake pedal input	OPTIONAL (12V when brakes applied)
9	Front right speed sensor input	OPTIONAL (Magnetic or Hall sensor)
10	Front left speed sensor input	OPTIONAL (Magnetic or Hall sensor)
11	Battery + input	Power for electronics
12	Not connected	
13	Diff power input	Solenoid power from relay
14	Diff power input	Solenoid power from relay
15	Diff Drive+ output	Solenoid positive
16	Handbrake input	OPTIONAL (0V when handbrake ON)
17	Battery- input	
18	CAN-LO	
19	Yaw sensor input	OPTIONAL (18mV/°S scaling, offset = Yaw Ref)
20	Lateral G input	OPTIONAL (1V/G scaling, Offset = Yaw Ref)
21	Yaw Ref	OPTIONAL (2.5V Reference for Yaw and Lateral G)
22	Up Switch Input	'C.DIFF +' switch (switch to 0V)
23	AV2	Reserved for future use
24	AV1	Reserved for future use
25	Throttle Position Sensor input	OPTIONAL (0-5V)
26	Rear right speed sensor input	OPTIONAL (Magnetic or Hall sensor)
27	Rear left speed sensor input	OPTIONAL (Magnetic or Hall sensor)
28	Battery- input	
29	Battery- input	

30	Battery- input	
31	Battery- input	
32	Diff drive- output	Solenoid negative (switched)

***Links***

The only user changeable link is LK05 on the back of the SDC3 circuit board. This link may be soldered closed to place a 100ohm termination across the CAN bus.

## Appendix C – CAN Wiring Practices

**NOTE!** The factory CAN bus in the STi is already terminated. This information is provided as a reference for adding extra devices to the bus.

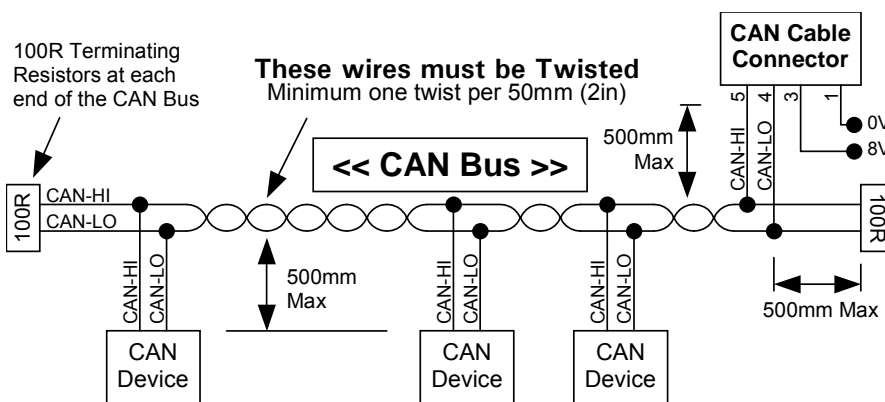
The CAN bus should consist of a twisted pair trunk with 100R (0.25Watt) terminating resistors at each end of the trunk.

The preferred cable for the trunk is 100R Data Cable but twisted 22# Tefzel is acceptable.

The maximum length of the bus is 16m (50ft) including the **MoTeC** CAN Cable (PC to CAN Bus Communications Cable)

CAN Devices (such as **MoTeC** ADL, M800 etc) may be connected to the trunk with up to 500mm (20in) of twisted wire.

The connector for the CAN Communications Cable may also be connected to the trunk with up to 500mm (20in) of twisted wire and should be within 500mm of one end of the trunk. If desired two CAN Cable connectors may be used so that the **MoTeC** CAN Cable may be connected to either side of the vehicle. Both connectors must be within 500mm of each end of the trunk.



### Short CAN Bus

If the CAN Bus is less than 2m (7ft) long then a single termination resistor may be used. The resistor should be placed at the opposite end of the CAN Bus to the CAN Cable connector.

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## ***Appendix D – Removing ABS systems***

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Details of ABS removal will be provided in a future version of this manual.

## Appendix E – ECU Communications

The SDC3 can communicate with the MoTeC WRX V910 OEM ECU using the factory CAN bus.

### Receiving SDC3 Data

To receive SDC3 data, one of the ECU CAN setup slots must be configured in ECU Manager as ‘M800 ECU Receive’ on CAN ID 500 under *Adjust* → *General Setup* → *Communications* → *CAN Setup*.

Parameter	Value	CAN 2 Data
CAN 0 Data	8	Selects the data that is sent or received on this CAN Channel.
CAN 0 Address	1040	
CAN 0 Transfer Rate	50	
BR2 Lap Beacon ID	0	0: Off
CAN 1 Data	0	1: PLM Receive
CAN 1 Address	0	2: E888/E816 Receive
CAN 1 Transfer Rate	50	3: MDD/Wheel Receive
<b>CAN 2 Data</b>	<b>5</b>	4: ADL Receive
CAN 2 Address	500	5: M800 ECU Receive
CAN 3 Data	0	6: BR2 Receive
CAN 3 Address	0	7: DBW4 Transmit
CAN 4 Data	0	8: DBW4 Receive
CAN 4 Address	0	9: F888/F816 Transmit

If the CAN Setup is configured, data from the SDC3 can be assigned to ECU channels using inputs ECU2 1 to ECU2 12 in the *Adjust* → *Sensor Setup* → *Input Setup* window in ECU Manager.

The following data is sent from the SDC3 to the ECU:

SDC3 Data	ECU Input	Scaling
Vehicle Speed	ECU2 1	0.1 km/h
Front Wheel Speed	ECU2 2	0.1 km/h
Rear Wheel Speed	ECU2 3	0.1 km/h
Yaw Rate	ECU2 4	0.1 deg/sec
Lateral G	ECU2 5	0.001 G
Longitudinal G	ECU2 6	0.001 G
Slip Lock %	ECU2 7	0.1 %
Lock %	ECU2 8	0.1 %
Steering Wheel Angle	ECU2 9	1 deg
Fault Flags	ECU2 10	Bit field
Diag Flags	ECU2 11	Bit field
SDC Mode	ECU2 12	0 to 5

The ECU Manager examples below show the allocation of SDC3 channels to ECU speed and user channels.

Input Pins Setup				
Engine   EGT   DBW/Servo   User   Lambda Cyls   Speed   Other				
Channel Name	Input	Calibration	Default	Dia
Yaw Rate (User 1)	ECU2 4	1-to-1: Unitless 1 decimal place	0.0	-32
SDC3 Slip Lock (User 2)	ECU2 7	1-to-1: % 1 decimal place	0.0	-32
SDC3 Lock (User 3)	ECU2 8	1-to-1: % 1 decimal place	0.0	-32
Steering Angle (User 4)	ECU2 9	1-to-1: Unitless no decimal place	0	-32
SDC3 Fault flags (User 5)	ECU2 10	1-to-1: Unitless no decimal place	0	-32
SDC3 Diag & Status flags (User 6)	ECU2 11	1-to-1: Unitless no decimal place	0	-32
SDC3 Mode (User 7)	ECU2 12	1-to-1: Unitless no decimal place	0	-32
User Channel 8 (User 8)				

Channel Name	Input	Calibration	Defa
Left Drive Speed (LD Spd)	ECU2 3	1-to-1: km/h 1 decimal place	0.0
Right Drive Speed (RD Spd)			
Left Ground Speed (LG Spd)	ECU2 2	1-to-1: km/h 1 decimal place	0.0
Right Ground Speed (RG Spd)			

### Receiving ECU Data

If present, the WRX V910 OEM ECU must be configured to transmit throttle position (and optionally manifold pressure) to the SDC3 on the CAN bus.

A custom data set must be configured in ECU Manager under *Adjust* → *General Setup* → *Communications* → *Setup Custom Data Sets*. This data set must contain Throttle Position and Manifold Pressure as shown below:

Item	Channel
1	Throttle Position (TP)
2	Manifold Pressure (MAP)

To transmit the custom data set, one of the ECU CAN setup slots must be configured in ECU Manager as 'Custom Data Set 1 Sequential' on CAN ID 1040 under *Adjust* → *General Setup* → *Communications* → *CAN Setup*.

Parameter	Value	CAN 0 Data
CAN 0 Data	8	Selects the data that is sent on this CAN Channel.
CAN 0 Address	1040	
CAN 0 Transfer Rate	50	
BR2 Lap Beacon ID	0	0: Off
CAN 1 Data	0	1: ADL Dash Logger
CAN 1 Address	0	2: Telemetry Monitor: not normally used
CAN 1 Transfer Rate	50	
CAN 2 Data	5	3: MoTeC CRC32: normally used for MDD
CAN 2 Address	500	
CAN 3 Data	0	4: Custom Data Set 1 CRC 32
CAN 3 Address	0	5: Custom Data Set 2 CRC 32
CAN 4 Data	0	6: Custom Data Set 1 Compound
CAN 4 Address	0	7: Custom Data Set 2 Compound
CAN 5 Data	0	8: Custom Data Set 1 Sequential
CAN 5 Address	0	9: Custom Data Set 2 Sequential

## Appendix F – CAN Messages

SDC3 operational data messages are each transmitted at 50Hz.

SDC3 diagnostic messages are each transmitted at 25Hz.

### 50Hz Messages

CAN ID 0x1F4		
Byte	Bits	Data
0		Compound Id = 0
1		Diff Current Average (0.1A resolution)
2		Ground Speed (0.1 km/h resolution)
3		
4		Front Wheels Speed (0.1 km/h resolution)
5		
6		Rear Wheels Speed (0.1 km/h resolution)
7		

CAN ID 0x1F4		
Byte	Bits	Data
0		Compound Id = 1
1		Diff Current Minimum (0.1A resolution)
2		Yaw rate (0.1 deg/sec resolution)
3		
4		Lateral G (0.001G resolution)
5		
6		Longitudinal G (0.001G resolution)
7		

CAN ID 0x1F4		
Byte	Bits	Data
0		Compound Id = 2
1		Diff Current Maximum (0.1A resolution)
2		Percentage Slip Diff Lock (0.1% resolution)
3		
4		Percentage Diff Lock (0.1% resolution)
5		
6		Steering Angle (1deg Resolution)
7		0deg = centre, +deg = anticlockwise, -deg = clockwise

CAN ID 0x1F4		
Byte	Bits	Data
0		Compound Id = 3
1		Diff+ Voltage (0.1V resolution)
2		Fault Flags (See Appendix A – Fault Codes)
3		
4		Diagnostic Flags (See Appendix A – Fault Codes)
5	0	Front Left Speed Sensor Fault (0 = OK, 1 = Fault)
	1	Front Right Speed Sensor Fault (0 = OK, 1 = Fault)
	2	Rear Left Speed Sensor Fault (0 = OK, 1 = Fault)
	3	Rear Right Speed Sensor Fault (0 = OK, 1 = Fault)
	4	Foot brake Status (0 = Off, 1 = On)
	5	Hand brake Status (0 = Off, 1 = On)
	6	Diff Temperature Status (0 = OK, 1 = Diff Temperature High)
	7	ABS Active Status (0 = Not Active, 1 = Active)
6		0
7		SDC3 User Selected Mode 0 = Diff open 1 to 4 = SDC3 user modes 5 = Diff locked

CAN ID 0x1F4		
Byte	Bits	Data
0		Compound Id = 4
1		Throttle Position (1% resolution)
2		Diff control duty cycle (0.1% resolution)
3		
4		Front Right Wheel Speed (0.1 km/h resolution)
5		
6		Front Left Wheel Speed (0.1 km/h resolution)
7		

CAN ID 0x1F4		
Byte	Bits	Data
0		Compound Id = 5
1		Diff- Voltage (0.1V resolution)
2		Desired slip (0.1 km/h resolution)
3		
4		Rear Right Wheel Speed (0.1 km/h resolution)
5		
6		Rear Left Wheel Speed (0.1 km/h resolution)
7		

## 25Hz Messages

CAN ID 0x1F5		
Byte	Bits	Data
0	4..7	Compound Id = 0
	0..4	Reserved
1		
2		Aux 5V Output Voltage (0.01V resolution)
3		
4		Battery Voltage (0.01V resolution)
5		
6		SDC3 Internal temperature (1°C resolution with +50°C offset)
7		

CAN ID 0x1F5		
Byte	Bits	Data
0	4..7	Compound Id = 1
	0..4	
1		Speed sensor noise fault flags Front Left = 0x01 Front Right = 0x02 Rear Left = 0x04 Rear Right = 0x08
2		Diagnostic Flags (See Appendix A – Fault Codes)
3		
4		Fault Flags (See Appendix A – Fault Codes)
5		
6		SDC3 Firmware version Eg. 123 = V1.23
7		