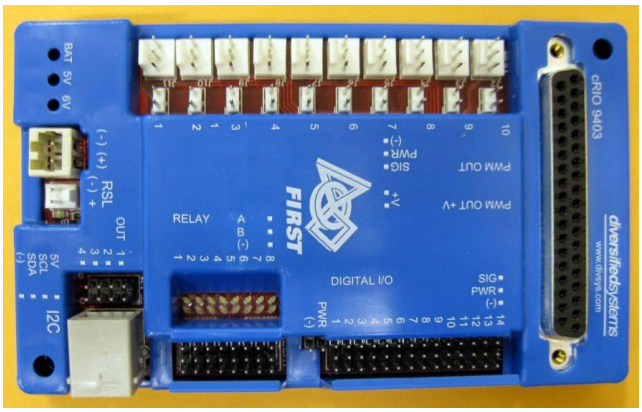
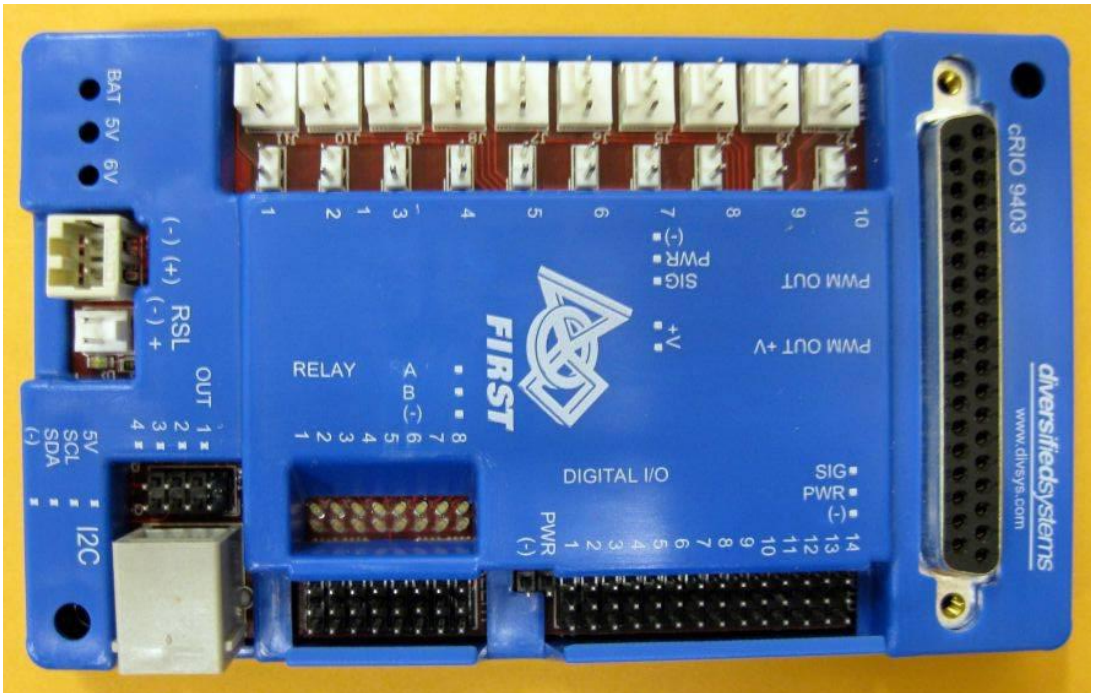
FIRST® Robotics Competition

Digital Sidecar Data Sheet
2012 *FIRST* Robotics Competition



Digital Sidecar



Functional Description

The Digital Sidecar is a breakout module that is designed to adapt a single cRIO 9403 32-channel digital I/O module into a set of I/O that is familiar to robotics hobbyists.

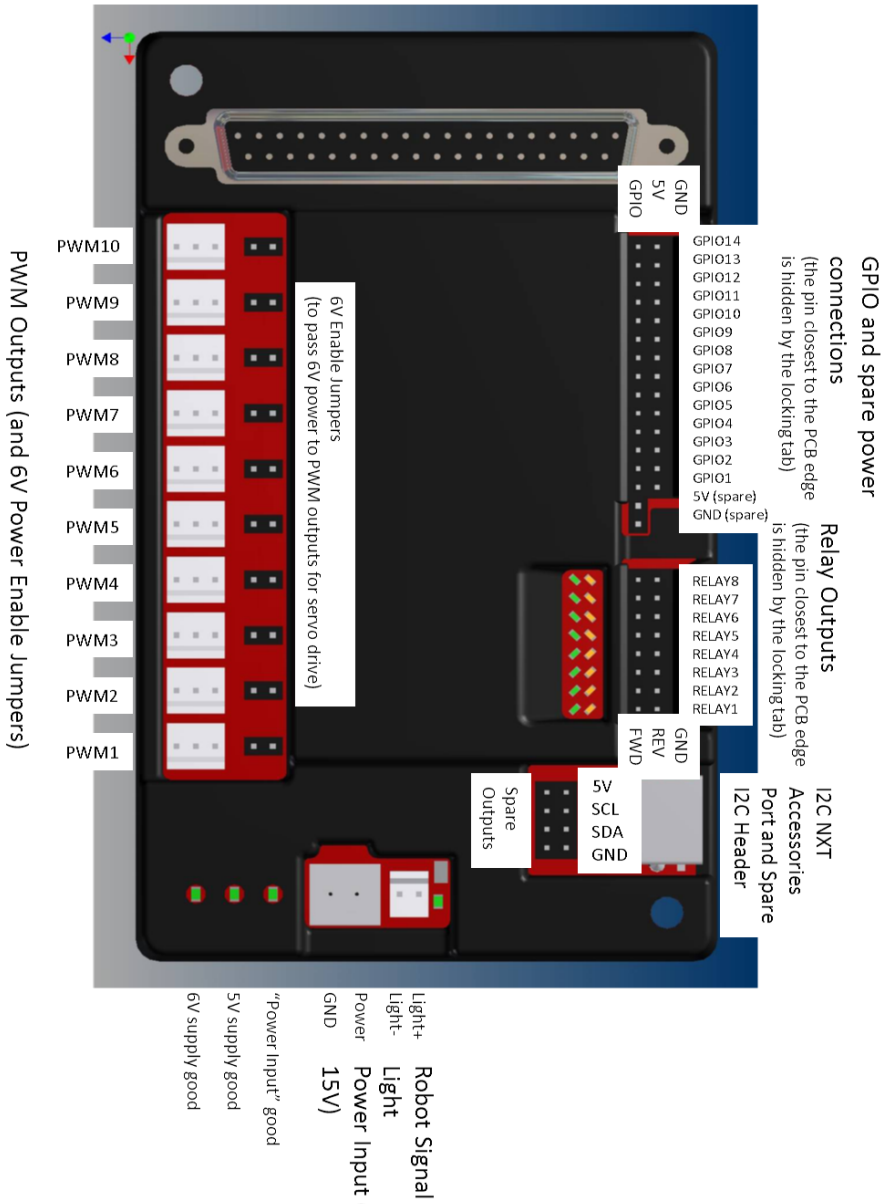
Features

The Digital Sidecar includes the following features:

- 10 PWM outputs for driving speed controllers such as IFI Victors and Luminary Jaguars and servos such as the Hitec HS322HD
- 14 general purpose I/O (aka GPIO) lines with available 5V power for each
- 16 relay outputs (8 FORWARD and 8 REVERSE outputs) for driving relay controllers such as an IFI Spike
- I2C headers – one 2x4 pin header and one connector that is compatible with I2C-based Lego NXT accessories
- Robot Signal Light header for a robot status indicator
- 6V/3A buck power supply to power servos attached to the PWM outputs (with individual jumpers for each PWM output to select application of power)
- 5V/3A buck power supply for DSC circuitry with excess power available at the GPIO and I2C headers
- Extra 5V and ground connections adjacent to GPIO1 for using a single row-header to create a SPI interface (typically using GPIO1-4 for MOSI, MISO, SCLK and CS in addition to the supporting 5V and ground connections)
- Reverse-battery protection to prevent damage due to accidental reversal of applied power

- Power is derived from a nominal 12V supply
- DB37 connector for attachment to a cRIO 9403 32-channel digital I/O module

Pinout



PCB Reference Designator	Name	Description
J1	cRIO Connector	A 37-line DB37 female connector for attaching the module to a cRIO 9403 32-channel digital I/O module (typically via ribbon or shielded cable)
J2-J11	PWM10…PWM1	PWM outputs for controlling speed controllers and servos. The header is a Molex P/N 22-23-2031 (or similar) with a friction locking feature which accepts any standard PWM cable in addition to many 0.1” spacing headers. The center pin is selectable for providing 6V power via adjacent jumper. The pin closest to the PCB’s edge is ground. The pin furthest from the PCB’s edge is the PWM output signal.
J12-J21	PWMx 6V Enable	Install an 0.1” jumper on these headers to provide 6V power on the adjacent PWM output. ONLY INSTALL A JUMPER WHEN ATTEMPTING TO POWER SERVOS SUCH AS A HITEC HS322HD. SPEED CONTROLLERS ATTACHED TO THE PWM OUTPUTS MAY BE DAMAGED IF THE DSC ATTEMPTS TO PROVIDE 6V POWER ON THE CENTER PIN.
J22	Power Input	Nominal 12V power input via WAGO 734-132. WAGO 734-102 is the typical mating connector with wire size between 14 and 20 AWG.
J23	Robot Signal Light	A 2-pin Molex P/N 22-23-2021 header for providing power to an indicator light.
J24	I2C and spare I/O	A 2x4 set of 0.1” pins with I2C, 5V, ground and 4 spare outputs.
J25	NXT I2C Header	A Lego NXT-compatible I2C header for use with NXT-compatible I2C accessories.
J26	GPIO	A 3x14 0.1” pin field for general purpose digital I/O with 5V available on the center pin, ground on the pin closest to the PCB’s edge and I/O signal on the pin furthest from the PCB’s edge.
J27	Extra 5V Header	An extra pair of 0.1” pins for providing power and ground adjacent to GPIO1 (typically for creating a SPI-compatible interface using GPIO1-4 for MOSI, MISO, SCLK and CS)
J28	Relay Outputs	A 3x8 0.1” pin field for driving relay modules. The pin closest to the PCB edge is ground, the center pin is REVERSE and the furthest pin is FORWARD.

Typical Application

** Always refer to FIRST rules for using this module in competition robots. The following sequence describes an example application that may not fully comply with FIRST rules.

1) Apply power to the DSC via J22 from a 5A (or larger) breaker on the PD
2) Connect to a cRIO 9403 via 37-channel ribbon cable
3) Attach servos (eg Hitec HS322HD) to the PWM Outputs and place a corresponding jumper on the 6V Enable header for the PWM Outputs
4) Attach speed controllers to the PWM Outputs (NO JUMPER FOR 6V ENABLE!)
5) Attach relay modules to the Relay Outputs
6) Attach a Robot Signal Light to the header
7) Attach I2C-compatible NXT accessories to the NXT port
8) Attach devices to the GPIO headers

Specifications

General

Parameter	Min	Nom	Max	Units	Description
PWM Output – Current			15	mA (source and sink)	There are 330 Ohm series resistors in each output's path. The outputs are buffered using a 74AC244 and a 74LVC2G125 with a 5V supply.
Relay Output – Current			7.5	mA (source and sink)	There are 680 Ohm series resistors in each output's path. The outputs are buffered using a pair of 74LV595s with a 5V supply.
GPIO – Pull-Ups		10		kOhms	These signals are passed directly to the NI 9403 module without any series resistance but include pull-ups to 5V
I2C Pull-Ups		3.16		kOhms	Pull-ups to 5V supply (included on the DSC) for I2C signals
Robot Signal Light – Voltage		Vin			The Robot Signal Light is powered by the same voltage as passed to the DSC via power input connection
Robot Signal Light – Current		1.1	2.2	A	Determined by a PTC for current-limiting, There is a snubber diode in parallel with the output header for protection from any load inductance.

6V Supply

Parameter	Min	Nom	Max	Units	Description
Input Voltage, Operational	6.7	12	15	V	
Input Voltage, Survive	-25		25	V	Limited by reverse battery protection FET
Undervoltage Lockout	6.3		6.5	V	
Output Voltage, Unloaded	5.8	6	6.2	V	
Ripple (pk-pk), 2A Load		22	100	mV	
Per Cycle Current Limit	4	5	6	A	
Continuous Current Limit		3	4	A	

5V Supply

Parameter	Min	Nom	Max	Units	Description
Input Voltage, Operational	6.7	12	15	V	
Input Voltage, Survive	-25		25	V	Limited by reverse battery protection FET
Undervoltage Lockout	5.3		5.5	V	
Output Voltage, Unloaded	4.8	5	5.2	V	
Ripple (pk-pk), 2A Load		21	100	mV	
Per Cycle Current Limit	4	5	6	A	
Continuous Current Limit		3	4	A	

Warnings

Only install the jumpers for applying 6V power to the PWM Output headers for connecting to servos such as a Hitec HS322HD. If the jumper is installed and the PWM Output is used to drive a speed controller, the application of 6V power could damage the speed controller and/or DSC.

Troubleshooting and FAQ

Either or both of the power supply LEDs are out, but the power-in LED is on. Why?

- Both of these supplies are internally protected against short circuits. It is possible to short one without affecting the other, which may explain why one is not working.
- Power off your robot – the offending element may be hot.
- Examine your wiring and your module carefully for the short.

Why isn't my servo motor moving?

- Check to make sure that the PWM channel's 6V selection jumper is inserted.
- Check the 6V supply LED.

The PWM connectors have a locking tab. How do I use them?

- They are Molex 22-23-2031 KK vertical friction locks.
- You may use the same cables you have always used – The locking tab won't get in your way, and does add a small bit of friction to the connection.
- For added security, use a Molex 2695, 6471, 7880, 4455 or 7720 series connector. We recommend the 0022013037.

How do I build a cable for passing 12V power to the Digital Sidecar?

- Take a color coded pair of 22AWG or better wire and cut to length
- Optionally twist the pair now for better cable management.
- Strip 7mm off the ends.
- To insert wire into a WAGO 734-102 connector, push down on the actuation port in back with a screw driver, or use an actuation lever.
- Insert the positive wire in the right port of the WAGO 734-102 connector. Note: the correct orientation can be verified by looking at the silk screen on the Digital Sidecar.
- Insert the negative wire in the left port of the WAGO 734-102 connector.
- Give a smart tug to verify the connection is secure.
- Insert the WAGO 734-102 into the mating connector on the Digital Sidecar.

Mechanicals