CrossFire GX1

Manual and reference handbook

cr•ssc•ntr•l

www.crosscontrol.com

Contents

1. Introduction

CrossFire GX1 is a general, flexible I/O module and controller for rough environments. It fits in distributed and decentralised systems where you want to be able to put electronics close to the I/O that will be managed. The module is highly configurable, and has its I/O distributed over a number of M12 connectors.

CrossFire GX1 is a CAN bus node, and by configuring the node properties, the module can be set up to automatically send and receive I/O to and from the CAN bus network.

CrossFire GX1 supports the CANopen protocol: one of the leading protocols used for CAN bus networks.

This document describes how CrossFire GX1 should be used.

2. Functions and Features

CrossFire GX1 is an I/O (Input/Output) module, designed for automotive products equipped with hydraulic components. It has 46 ports accessible through 22 I/O connectors which can be individually configured to provide various types of I/O. CrossFire GX1 can therefore be configured to have:

- Up to 30 Digital ON/OFF Outputs all with diagnostics and Built-In Test

    o   26 High-side outputs,

    o   4 Low-side outputs

- Up to 40 Digital Inputs

    o   8 pull up

    o   16 pull down

    o   6 floating

    o   10 software-configurable pull up/down

- Up to 12 Analogue Inputs

    o   6 current, 0 – 20 mA

    o   6 voltage, 0 – 5 V, inputs

- Up to 16 PWM (Pulse Width Modulated) Outputs

    o   8 dual PWM connectors

    o   Software controlled ripple frequency and amplitude

CrossFire GX1 also has:

- Up to 2 pairs of Encoder Inputs (for quadrature signal decoding)
- Up to 2 Pulse Counter Inputs
- Support use of sync
- Support for both heartbeat and node guarding
- Support for EMCY (Emergency) object.

3. Technical Data Overview

Kernel **Memory**	Infineon C167 20 MHz Application flash: 8 Mbit Boot flash: 8 Mbit SRAM: 4 Mbit EEPROM: 1k*8-bit
Physical **Housing** **Dimensions** **Weight**	 Metal enclosure filled with silicon compound, metal base plate L x W x H: 226 x 226 x 41.4 mm 1.5 kg
Environment **Temperature Range** **Protection Rating** **Protection Class** **Vibrations** **Shock/Impact** **EMC Conformity**	 Operating: -40 ˚C to +75 ˚C Storage : -40 ˚C to +85 ˚C IP67 (IEC 60529) III Sinus: IEC-60068-2-6 – 4 g Random: IEC-60068-2-34 – 3.7 g 30 g / 6 ms IEC-60068-2-27 ISO 14982 for Emissions, ISO 11452-2 for Immunity
Power Supply **Operating Voltage** **Current Consumption** **Reverse Polarity Protection**	 10 to 36 VDC (24 VDC Nominal) < 200 mA at 24 V without external load Requires external fuse max rated to 20 A
Indicators	Status, +5V, +24V and 30 red/green diodes for I/O monitoring.
CAN Interface **No. of CAN** **Driver** **Baud Rate** **Node ID**	ISO 11898-2 (High Speed CAN) 1 interface with CANin and CANout connectors NXP TJA1050T 10, 20, 50, 100, 125, 250 kbit/s 1 to 16 hardware set
Connectors	I/O: DIN M12 CAN: DIN M12 Power: 7/8''
Digital Inputs **Input Voltage**	 0 – 24 V (supply voltage)
Encoder Inputs	Full Quadrature Decoding
Pulse Inputs	Frequency up to 10 kHz
Analog Inputs **Input** **Input Impedance** **Resolution** **Total Unadjusted Error**	 6 pcs. 0 – 5 V and 6 pcs. 0 – 20 mA 1 MΩ (0 – 5 V) 10 pcs. 10 bits and 2 pcs. 12 bits ±2 LSBs
Digital Outputs **Max Voltage** **Max Current** **Total Current**	 Supply voltage High Side 1.95 A (2.4 A) Low Side 1.6 A 18 A (external fuse not included)
PWM (Analog) Outputs **Max Voltage** **Max Current** **Resolution**	 Supply voltage 2.4 A 0.4 %
Protection **Outputs** **Inputs**	 S/C, Overload, Over-current, Thermal S/D, Load dump, ESD S/C (Short circuit)
Diagnostics (Outputs)	Open Load, Over-temperature / Short circuit supply/ground
Certifications / Compliance	CE ISO IEC CiA

3.1. References

CE Marking: http://ec.europa.eu/

International Standards Organisation: http://www.iso.org/

International Electrotechnical Commission   http://www.iec.ch/

3.2. Dimensions

The CrossFire GX1 dimensions and placement of the four mounting holes is illustrated below. The four mounting lugs have clearance for 8 mm bolts. The module weighs 1.5 kg.
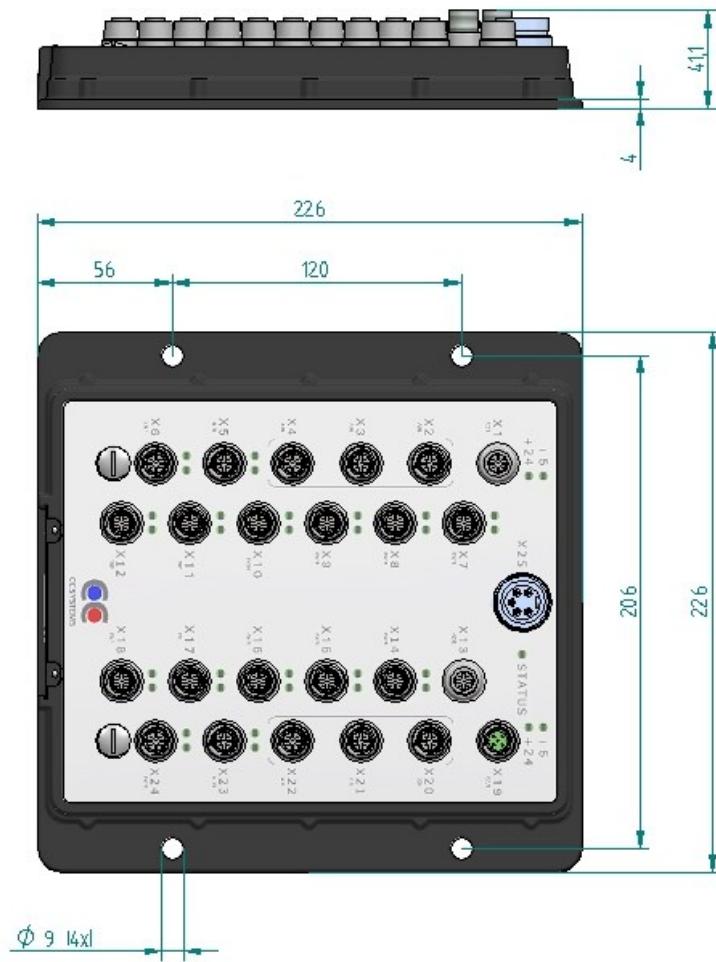
3.3. Identification

There is a label on the bottom of CrossFire GX1. On the label there are numbers which identify your unique module. Take note of them. During service and other contact with the supplier it is important to be able to provide these numbers.

3.4. Environmental Tolerance

CrossFire GX1 has been designed to cope with tough environmental demands. Strict tests have been conducted on the unit in order to ensure that it fulfils the expectations of a rugged unit. Much work has been performed to choose and design integral components so that they, in the best possible way and under all circumstances, provide you with a dependable working instrument. In Appendix 1, a list of standards can be found according to which CrossFire GX1 has been tested and approved.

Despite thorough design requirements and testing specifications, it is always best to install and handle CrossFire GX1 with care. For more information, read further.

4. Installation

CrossFire GX1 should be installed in such a way that the module is not exposed to any unnecessary stress, heat, vibration or moisture. In this section, some recommendations are made regarding methods for how the unit should be installed.

If the unit is opened by non-authorised personnel, the warranty becomes void.

4.1. Mounting

Ensure that CrossFire GX1 is mounted to a smooth, flat surface.

Fastening the unit to an uneven surface may stress the enclosure, damage the outer flange or possibly even flex the circuit board inside, leading to a premature failure.

Ensure the mounting bolts are of grade 8.8 or higher, are clean and dry, and apply torque of about 23 N-m (17 ft-lbs). Use lock washers.

Ensure there is adequate clearance to insert/remove all of the connectors.

4.2. Cooling

Although CrossFire GX1 can operate in relatively high temperatures, cooling should still be considered when installing CrossFire GX1. If the unit becomes too warm, it may not perform to its full capacity and, with high temperature, cease to function. Common sense should be used to select an appropriate location where adequate cooling is achievable. It is not recommended to install the module near a vehicle's exhaust system, for example.

If the mounting surface is normally cooler than the ambient air, then mount CrossFire GX1 directly to that surface to improve heat dissipation. If the surface can become much warmer than the ambient air, then it is recommended to leave a gap between the unit and the surface, using washers, or standoffs. An insulating material can also be considered to shield the unit from the heat from the mounting surface.

Inadequate cooling may lead to overheating, causing permanent damage to the unit.

4.3. Vibration

Loose mounting bolts are the most common reason for excessive vibration. Mounting bolts may become loose due to improper techniques such as missing lock washers, over tightening or under tightening. Proper tightening requires clean dry bolts, and a torque wrench.

We recommend installing CrossFire GX1 in such a way that it is not unnecessarily exposed to vibration or other stress.

4.4. Rain/Moisture

CrossFire GX1 shall preferably be placed under a roof in order to prevent direct exposure to water.

5. Connectors

Power and communications are found on connectors X1 through X3. These connectors are not considered to be I/O (Input/Output) connectors.

On the remaining connectors, X4 to X25, I/O pins which share similar functionality are grouped together. Each connector is therefore designated with a certain interface type. This gives a quick way to easily identify the types of I/O Interfaces found on a certain connector. The pins found on connector X6 for example, taken from the table below, are designated as AIN. This is because there are two Analog Input pins on the connector. Note, however that the characteristic signal type is not always the one configured by default, and that other configurations are often possible.

5.1. Connector Overview

Connector(s)	Interface Type	Characteristic Signal Type	Other Configurations
X1	Power	+24 V Power Supply	
X2, X3	CAN	CAN Bus connector	
X5	ID	Identification Interface	5-V Digital Inputs
X6, X10, X14, X7, X11, X15	AIN	Analog Inputs	Digital Inputs
X20, X21, X22, X24, X25	DIO	Digital Inputs/Outputs	(Pulse Counter Input)
X4, X8, X12, X16	DIOP	PWM Outputs	Digital Outputs, Digital Inputs
X9, X13, X17, X23	EDIO	Encoder Inputs	Low-Side Digital Outputs, Digital Inputs, (Pulse Counter Input)

5.2. Connector Layout
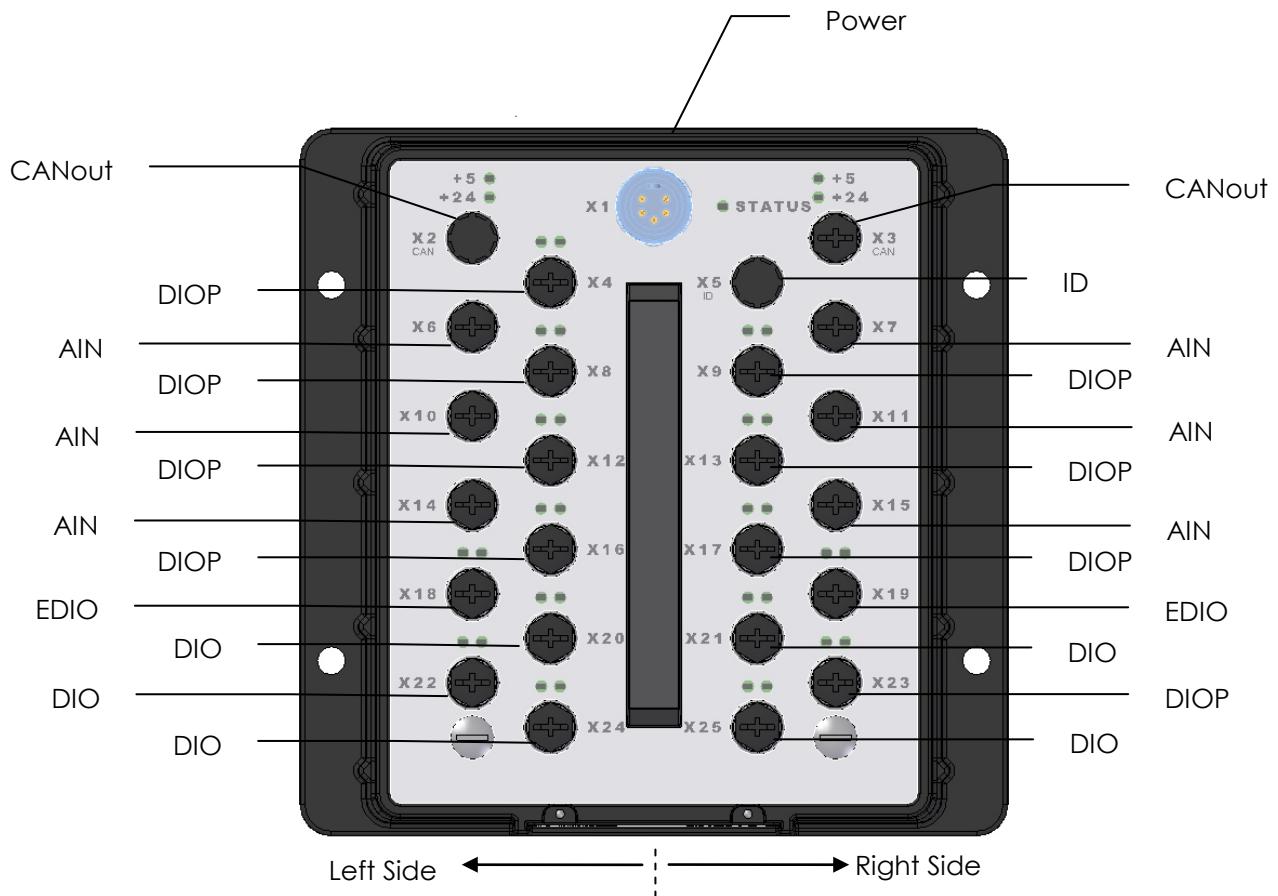
In order to facilitate the discussion of CrossFire GX1, each I/O pin is assigned with a unique port number. The ports are accessible through connectors numbered X4 to X25. The port numbering:

- acts as an interface between hardware and software

- allows easy mapping to the object dictionary's index/subindex system

- distinguishes the electrical independence (i.e. despite identical signal names)

- identifies internal I/O so that it can be reflected in the object dictionary

X1 Power Supply Connector

Pin	Port	Default Signal	Comments
X1.1	-	+24 V Power	Supply for I/O (V$_{batt}$)
X1.2	-	+24 V Power	
X1.3	-	GND	Battery ground
X1.4	-	GND	
X1.5	-	+24 V Logic	Supply for logic (V$_{batt}$)

DIN 7/8
male, 5-pole
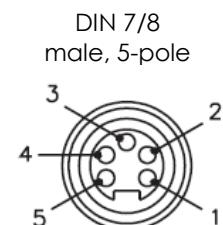
X2 CANin Connector

Pin	Port	Default Signal	Comments
X2.1	-	+24 V Power	Supply for I/O (V_{batt})
X2.2	-	+24 V Power	
X2.3	-	GND	Battery ground
X2.4	-	GND	
X2.5	-	+24 V Logic	Supply for logic (V_{batt})

DIN M12
male, 5-pole
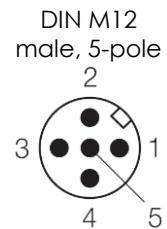
X3 CANout Connector

Pin	Port	Default Signal	Comments
X3.1	-	Shield	To chassis via 1 nF
X3.2	-	CAN Power	From CAN In (X2)
X3.3	-	CANGND	Internally connected to GND
X3.4	-	CANH	
X3.5	-	CANL	

DIN M12
female, 5-pole
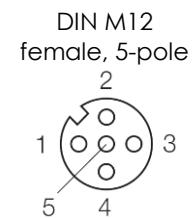
X4 DIOP Connector

Pin	Port	Default Signal Type	Other Configurations
X4.1	-	+24 V Sensor Supply 1	
X4.2	11	Digital Input	Digital Output, PWM Output
X4.3	-	PWM GND	
X4.4	12	Digital Input	Digital Output, PWM Output
X4.5	-	GND	

DIN M12
female, 5-pole
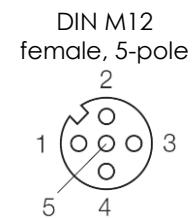
X5 ID Connector

Pin	Port	Default Signal	Other Configurations
X5.1	54	ID2	Digital Input
X5.2	53	ID1	Digital Input
X5.3	-	GND	
X5.4	52	ID0	Digital Input
X5.5	55	ID3	Digital Input

DIN M12 x 1
male, 5-pole
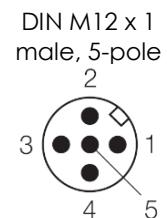
X6 AIN Connector

Pin	Port	Default Signal Type	Other Configurations
X6.1	-	+24 V Sensor Supply 1	
X6.2	1	Analog Input B (0-5 V)	Digital Input
X6.3	-	GND	
X6.4	2	Analog Input A (0-20 mA)	
X6.5	-	+5 V Sensor Supply 1	

DIN M12
female, 5-pole
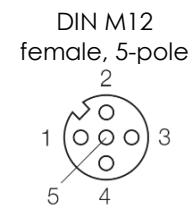
X7 AIN Connector

Pin	Port	Default Signal Type	Other Configurations
X7.1	-	+24 V Sensor Supply 1	
X7.2	37	Analog Input B (0-5 V)	Digital Input
X7.3	-	GND	
X7.4	38	Analog Input A (0-20 mA)	
X7.5	-	+5 V Sensor Supply 2	

DIN M12
female, 5-pole
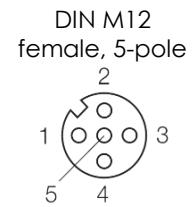
Connector X8 DIOP

Pin	Port	Default Signal Type	Other Configurations
X8.1	-	+24 V Sensor Supply 1	
X8.2	13	Digital Input	Digital Output, PWM Output
X8.3	-	PWM GND	
X8.4	14	Digital Input	Digital Output, PWM Output
X8.5	-	GND	

DIN M12
female, 5-pole
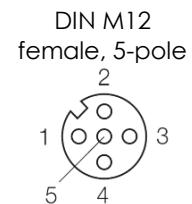
Connector X9 DIOP

Pin	Port	Default Signal Type	Other Configurations
X9.1	-	+24 V Sensor Supply 2	
X9.2	27	Digital Output	Digital Output, PWM Output
X9.3	-	PWM GND	
X9.4	28	Digital Output	Digital Output, PWM Output
X9.5	-	GND	

DIN M12
female, 5-pole
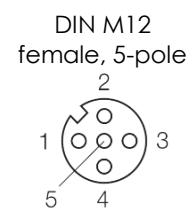
Connector X10 AIN

Pin	Port	Default Signal Type	Other Configurations
X10.1	-	+24 V Sensor Supply 1	
X10.2	3	Analog Input B (0-5 V)	Digital Input
X10.3	-	GND	
X10.4	4	Analog Input A (0-20 mA)	
X10.5	-	+5 V Sensor Supply 1	

DIN M12
female, 5-pole
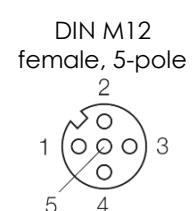
Connector X11 AIN

Pin	Port	Default Signal Type	Other Configurations
X11.1	-	+24 V Sensor Supply 2	
X11.2	39	Analog Input B (0-5 V)	Digital Input
X11.3	-	GND	
X11.4	40	Analog Input A (0-20 mA)	
X11.5	-	+5 V Sensor Supply 2	

DIN M12
female, 5-pole
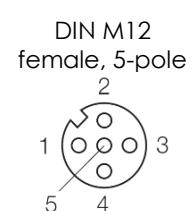
Connector X12 DIOP

Pin	Port	Default Signal Type	Other Configurations
X12.1	-	+24 V Sensor Supply 1	
X12.2	15	Digital Input	Digital Output, PWM Output
X12.3	-	PWM GND	
X12.4	16	Digital Input	Digital Output, PWM Output
X12.5	-	GND	

DIN M12
female, 5-pole
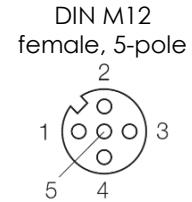
Connector X13 DIOP

Pin	Port	Default Signal Type	Other Configurations
X13.1	-	+24 V Sensor Supply 2	
X13.2	29	Digital Input	Digital Output, PWM Output
X13.3	-	PWM GND	
X13.4	30	Digital Input	Digital Output, PWM Output
X13.5	-	GND	

DIN M12
female, 5-pole
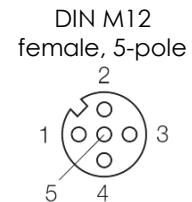
Connector X14 AIN

Pin	Port	Default Signal Type	Other Configurations
X14.1	-	+24 V Sensor Supply 1	
X14.2	5	Analog Input B (0-5 V)	Digital Input
X14.3	-	GND	
X14.4	6	Analog Input A (0-20 mA)	
X14.5	-	+5 V Sensor Supply 1	

DIN M12
female, 5-pole
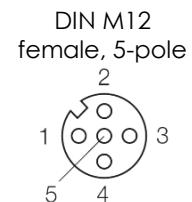
Connector X15 AIN

Pin	Port	Default Signal Type	Other Configurations
X15.1	-	+24 V Sensor Supply 2	
X15.2	41	Analog Input B (0-5 V)	Digital Input
X15.3	-	GND	
X15.4	42	Analog Input A (0-20 mA)	
X15.5	-	+5 V Sensor Supply 2	

DIN M12
female, 5-pole
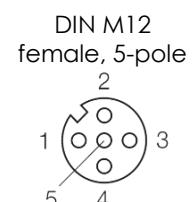
Connector X16 DIOP

Pin	Port	Default Signal Type	Other Configurations
X16.1	-	+24 V Sensor Supply 1	
X16.2	17	Digital Output	Digital Input, PWM Output
X16.3	-	PWM GND	
X16.4	18	Digital Output	Digital Input, PWM Output
X16.5	-	GND	

DIN M12
female, 5-pole
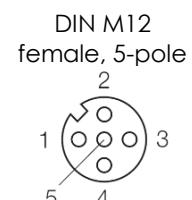
Connector X17 DIOP

Pin	Port	Default Signal Type	Other Configurations
X17.1	-	+24 V Sensor Supply 2	
X17.2	31	Digital Output	Digital Input, PWM Output
X17.3	-	PWM GND	
X17.4	32	Digital Output	Digital Input, PWM Output
X17.5	-	GND	

DIN M12
female, 5-pole
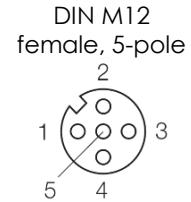
Connector X18 EDIO

Pin	Port	Default Signal Type	Other Configurations
X18.1	-	+24 V Sensor Supply 1	
X18.2	7	Digital Output Low-Side	Digital Input, Encoder Input
X18.3	-	GND	
X18.4	8	Digital Output Low-Side	Digital Input, Encoder Input
X18.5	-	GND	Pulse Counter Input

DIN M12
female, 5-pole
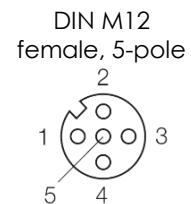
Connector X19 EDIO

Pin	Port	Default Signal Type	Other Configurations
X19.1	-	+24 V Sensor Supply 2	
X19.2	43	Digital Output Low-Side	Digital Input, Encoder Input
X19.3	-	GND	
X19.4	44	Digital Output Low-Side	Digital Input, Encoder Input
X19.5	-	GND	Pulse Counter Input

DIN M12
female, 5-pole
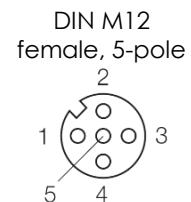
Connector X20 DIO

Pin	Port	Default Signal Type	Other Configurations
X20.1	-	+24 V Sensor Supply 1	
X20.2	19	Digital Output	Digital Input, Encoder Input
X20.3	-	GND	
X20.4	20	Digital Output	Digital Input, Encoder Input
X20.5	-	GND	

DIN M12
female, 5-pole
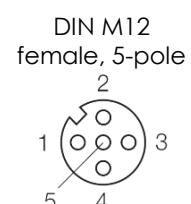
Connector X21 DIO

Pin	Port	Default Signal Type	Other Configurations
X21.1	-	+24 V Sensor Supply 2	
X21.2	33	Digital Output	Digital Input, Encoder Input
X21.3	-	GND	
X21.4	34	Digital Output	Digital Input, Encoder Input
X21.5	-	GND	

DIN M12
female, 5-pole
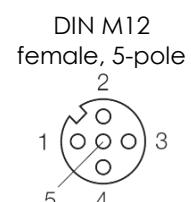
Connector X22 DIO

Pin	Port	Default Signal Type	Other Configurations
X22.1	-	+24 V Sensor Supply 1	
X22.2	9	Digital Output	Digital Input
X22.3	-	GND	
X22.4	10	Digital Output	Digital Input, Pulse Counter Input
X22.5	-	GND	

DIN M12 female, 5-pole
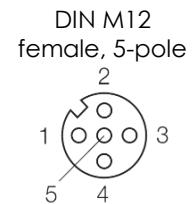
Connector X23 DIOP

Pin	Port	Default Signal Type	Other Configurations
X23.1	-	+24 V Sensor Supply 2	
X23.2	45	Digital Output	Digital Input, PWM Output
X23.3	-	GND	
X23.4	46	Digital Output	Digital Input, PWM Output
X23.5	-	GND	

DIN M12 female, 5-pole
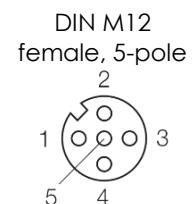
Connector X24 DIO

Pin	Port	Default Signal Type	Other Configurations
X24.1	-	+24 V Sensor Supply 1	
X24.2	21	Digital Output	Digital Input
X24.3	-	GND	
X24.4	22	Digital Output	Digital Input
X24.5	-	GND	

DIN M12 female, 5-pole
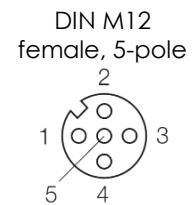
Connector X25 DIO

Pin	Port	Default Signal Type	Other Configurations
X25.1	-	+24 V Sensor Supply 2	
X25.2	35	Digital Output	Digital Input
X25.3	-	GND	
X25.4	36	Digital Output	Digital Input
X25.5	-	GND	

DIN M12 female, 5-pole
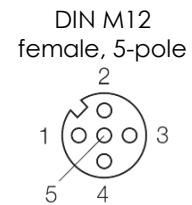
For a complete list of I/O ports, including internal ports 58 to 63, see Appendix 2.

It is not possible to combine a Digital Output with a PWM in the same connector. If any of the ports in a connector is configured as digital out, the other one will also work as digital out even if it is configured as PWM.

Notice that the connector descriptions are those which are located on the unit, not those that the attached cables shall have in order to mate with them.

Use caution when plugging/unplugging connectors. If the pins become bent or damaged they may not function correctly, or in the worst case, CrossFire GX1 or other equipment may be damaged.

6. Electrical Interface Overview

CrossFire GX1 is highly configurable. The following illustration consists of several boxes which represent the main interfaces on CrossFire GX1. Each port is associated with a single Interface. Each interface can have one of many functions. The arrows leading to and from the interfaces represent I/O, power or communication busses. Many of the ports are individually configurable.

CAN Interface
Single CAN BUS Interface with 2 connectors

X2, X3
CANin
CANout

Identification Interface (ID)
Possible Node ID 1 to 16 (CANopen version specific)
Also configurable as
- 4 Digital Inputs

X5
4 Ports
(52, 53, 54, 55)

Encoder Inputs (EDIO)
May be individually configured as:
- 2 Encoder Inputs (default)
- 4 Digital Inputs
- 4 Digital Sinking Outputs

X18, X19
4 Ports
(7, 8, 43, 44)

Digital Inputs/Outputs (DIO)
May be individually configured as:
- 10 Digital Outputs (default)
- 10 Digital Inputs
- 1 Pulse Counter Input

X20, X22, 24, X21, X25
10 Ports
(9, 10, 19–22, 33–36)

Analog Inputs (AIN)
Also configurable as:
6 Digital Inputs (odd numbered ports)

X6, X10, X14, X7, X11, X15
12 Ports
(1 – 6 & 37 to 42)

Digital Inputs/Outputs/ PWM Outputs (DIOP)
Configured by default as:
- 16 Digital Inputs

May also be individually configured for up to
- 16 Digital Outputs
- 16 PWM Outputs (8 Opposing pairs)

X4, X8, X12, X16, X9, X13, X17, X23
16 Ports
(27 – 32, 45, 46)

8 x PWM GND

Internal Analog Inputs
Monitor of
- Case Temperature
- 3 Supply Voltages
- 2 5-V Ref. Voltaes

1 Port Case Temperature (Port 62)

5 Ports - Voltages (Ports 58 to 61, 63)

Power Interface

X1
+24 VDC (V$_{batt}$)

+24 V Sensor Supply 1 & 2 / GND
to AIN, DIO, DIOP and EDIO interfaces

+5 V Sensor Supply 1 & 2 / GND
to AIN interfaces

7. Electrical Interface Characteristics

The following chapters are organized in terms of similar functions, not interfaces. There is no chapter about the DIOP interface, for example. However, each chapter will mention which interfaces are relevant to it. Information about the DIOP interface for example, can be found in the Digital Inputs, Digital Output and PWM Output sections below.

7.1. Analog Inputs

There are two types of Analog Inputs, namely: type B and type A making up a total of 12 Analog Inputs. Type B measures voltage, while Type A measures current. After their respective filters, the values are fed directly to the microprocessor's A/D converter. Ports 1 and 2 have 12 bits resolution, instead of 10.

Analog Inputs

Port	Signal Type	Channel	Comment
1	Analog Input	B*	
2	Analog Input	A*	
3	Analog Input	B	
4	Analog Input	A	
5	Analog Input	B	
6	Analog Input	A	Interface: AIN
37	Analog Input	B	
38	Analog Input	A	
39	Analog Input	B	
40	Analog Input	A	
41	Analog Input	B	
42	Analog Input	A	
58 – 63	Intenal Analog Input	-	Interface: Internal Analog Inputs

Electrical Characteristics for Analog Inputs

Signal Name	Parameter	Value			Unit	Comment
		Min	Typ	Max		
Analog Input Channel B 0 – 5 V	Input Voltage	0		+5 REF	V	
	Voltage Protection	-0.1		5.1	V	150 mA max
	Leakage Current	0		0.005	mA	@5 Volts
	Bias Resistance, Rb		1		MΩ	Pull-down
	Input Resistance, Rτ		15		kΩ	
	Input Capacitance, Cτ		100		nF	
	Time Constant		1.5		ms	$\tau = R\tau \times C\tau$
	Resolution		10	(12)*	bit	Temp. compensated
	Total Unadj. Error			±2	LSB	@polling freq of 200 Hz
Analog Input Channel A 0 – 20 mA	Input Current	0	4 – 20	25	mA	@ 6 Volts
	Bias Resistance, Rb		240		Ω	Pull-down
	Input Resistance, Rτ		15		kΩ	
	Input Capacitance, Cτ		100		nF	
	Time Constant, τ		1.5		ms	$\tau = R\tau \times C\tau$
	Resolution		10	(12)*	bit	Temp. compensated
	Total Unadj. Error			±2	LSB	@polling freq of 200 Hz
Internal Analog Inputs	Input Voltage	0		40	V	Max continuous voltage
	Maximum input voltage			55	V	
	Time Constant		1.5		ms	$\tau = R\tau \times C\tau$
	Resolution		10		bit	Temp. compensated

* Note 12 bits resolution for Ports 1 and 2

7.2. PWM Outputs (Analog Outputs)

There are 16 DIOP ports, all of which are capable of being configured as a PWM Outputs as shown below. All of the PWMs are per default current regulated in hardware. The current regulation is achieved by completing the circuit to PWM GND (pin 3 on all DIOP connectors). Although digital in nature, the ports are considered to be Analog Outputs for the purposes of the CANopen interface, which uses 16-bit values to represent the PWM Outputs, just as would for true Analog Outputs.

Note that there is only one PWM GND for each pair of PWM Outputs. Therefore, the PWM Outputs must be used in opposing pairs if both outputs are to be used. i.e. "forwards/backwards", "left right" or "up/down" etc. In this way, the PWM GND is never used simultaneously by both PWM Outputs in the pair. The pairs are matched on the same connector. Each of the pairs are split into channels A and B.

The ports are protected against ESD, short circuit and current overload.

PWM Outputs

Port	Signal Type	Channel	Comment
11	PWM Output	B	
12	PWM Output	A	
13	PWM Output	B	
14	PWM Output	A	
15	PWM Output	B	
16	PWM Output	A	
17	PWM Output	B	
18	PWM Output	A	
27	PWM Output	B	Interface: DIOP
28	PWM Output	A	
29	PWM Output	B	
30	PWM Output	A	
31	PWM Output	B	
32	PWM Output	A	
45	PWM Output	B	
46	PWM Output	A	

PWM Output Electrical Characteristics

| Signal Name | Parameter | Value | | | Unit | Comment |
		Min	Typ	Max		
PWM Output	Output Voltage	0	24	36	V	Note: Unregulated
	Over/Under Voltage Protection	-39		39	V	Zener diode
	Output Current	0.05		2	A	
	Short-Circuit indication					VIA LED Indication, See ch 2.3.12
	Time Constant		1.5		ms	$\tau = R\square\ \tau\ C\tau$
	Resolution		0.4		%	Approx. 10 bits 0 to 1275 in 5 Hz steps

7.3. Digital Inputs

There are five types of Digital Inputs on the CrossFire GX1. Every port on the unit is capable of being configured as a Digital Input (with the exception of Ports 2, 4, 6, 38, 40, 42) provided that the ports are not already configured as something else.

For best results, the installation of the CrossFire GX1 should be such that the Digital Inputs are matched with the type of signal source.

- For high-side drivers or open emitter, open source: hook up to Digital Inputs with pull-down resistors

- For low-side drivers, open collector, open drain: hook up to Digital Inputs with pull-up resistors

- For bipolar, totem-pole or "push-pull" signals, use either of the above types, or floating inputs

Digital Inputs

Port	Signal Type	Channel	Comment
1	Digital Input Type AIN	B	Interface: AIN (channel B)
3		B	
5		B	
7	Digital Input Type EDIO	B	Interface: EDIO
8		A	
9	Digital Input Type DIO	B	Interface: DIO
10		A	
11	Digital Input Type DIOP	B	Interface: DIOP
12		A	
13		B	
14		A	
15		B	
16		A	
17		B	
18		A	
19	Digital Input Type DIO	B	Interface: DIO
20		A	
21		B	
22		A	
27	Digital Input Type DIOP	B	Interface: DIOP
28		A	
29		B	
30		A	
31		B	
32		A	
33	Digital Input Type DIO	A	Interface: DIO
34		B	
35		A	
36		B	
37	Digital Input Type AIN	B	Interface: AIN
39		B	
41		B	
43	Digital Inputs Type EDIO	B	Interface EDIO
44		A	
45	Digital Inputs Type DIOP	B	Interface: DIOP
46		A	
52	Digital Input Type ID	ID0	Interface: ID
53		ID1	
54		ID2	
55		ID3	

Digital Input Electrical Characteristics

Signal Name	Parameter	Value			Unit	Comment
		Min	Typ	Max		
Digital Input Type DIOP, and Type DIO	Input Voltage	0	0 - 24	36	V	
	Logic High Threshold	9			V	
	Logic Low Threshold			5	V	
	Bias Resistance (configure in S/W)		4.7		kΩ	Pull up
			10		kΩ	Pull down
	Input Capacitance		0		nF	
	Filter Time Constant τ		0.1		Ms	
Digital Input Type AIN (channel B)	Input Voltage	0		5	V	
	Logic High Threshold		3		V	Configurable in software
	Logic Low Threshold		3		V	Configurable in software
	Bias Resistance Rb		10		MΩ	Pull down (considered as floating)
	Input Capacitance		100		nF	
	Filter Resistance Rτ		15		kΩ	
	Filter Capacitance Cτ		100		nF	
	Filter Time Constant τ		1.5		ms	τ = Rτ x Cτ
Digital Input Type ID	Input Voltage	0		5	V	
	Logic High Threshold	TTL			V	
	Logic Low Threshold			TTL	V	
	Bias/Filter Resistance Rb,Rτ		10		kΩ	Pull up
	Input Capacitance Cτ		100		nF	
	Filter Time Constant τ			1.0	ms	τ = Rτ x Cτ
Digital Input Type EDIO	Input Voltage	0		36	V	
	Logic High Threshold	9			V	
	Logic Low Threshold			5	V	
	Bias Resistance Rb		4.7		kΩ	Pull up
	Input Capacitance C		100		nF	
	Filter Resistance Rτ		100		kΩ	
	Filter Capacitance C		1		nF	
	Filter Time Constant		0.1		ms	τ = Rτ x Cτ

7.4. Digital (On/Off) Outputs

There are 30 ports capable of acting as Digital Output, 4 of these are low-side drivers.

The 26 DIOP and DIO Digital Outputs use the BTS5210L chip, which is a dual N-channel MOSFET. The two channels of the chip are designated either A or B. When driving only a single channel, the maximum current limit is increased slightly.

The ports are protected against ESD, short circuit and current overload.

The 4 EDIO ports use the BSP76 chip, also an N-channel FET acting as a low-side driver.

Digital Outputs

Port	Signal Type	Channel	Comment
7	Digital Output Low-Side	B	Interface: EDIO
8		A	
9	Digital Output	A	Interface: DIO
10	Digital Output	B	
11	Digital Output	B	
12	Digital Output	A	
13	Digital Output	B	
14	Digital Output	A	Interface: DIOP
15	Digital Output	B	
16	Digital Output	A	
17	Digital Output	B	
18	Digital Output	A	
19	Digital Output	B	
20	Digital Output	A	Interface: DIO
21	Digital Output	B	
22	Digital Output	A	
27	Digital Output	B	
28	Digital Output	A	
29	Digital Output	B	Interface: DIOP
30	Digital Output	A	
31	Digital Output	B	
32	Digital Output	A	
33	Digital Output	B	
34	Digital Output	A	Interface: DIO
35	Digital Output	B	
36	Digital Output	A	
43	Digital Output	B	Interface: EDIO
44	Digital Output	A	
45	Digital Output	B	Interface: DIOP
46	Digital Output	A	

Digital Outputs Electrical Characteristics

Signal Name	Parameter	Value			Unit	Comment
		Min	Typ	Max		
Digital Output DIOP and DIO	Output Voltage	0	24	36	V	
	Over/Under Voltage Protection	4.5		52	V	
	Output Current	0.05	1.8	1.95	A	2.4 Amps possible if driving only a single channel of dual package
	Max Switchable Inductance (Single Pulse)			14	mH	(7.6 mH with two parallel channels)
	Current Limit	5	9	14	A	@-40, +25 and +150 °C and V_{out} = 0
	Repetitive Short Circuit Current Limit		6.5		A	
	Short-Circuit indication					VIA LED Indication, See ch 2.3.12
	Turn on Time		100	250	µs	
	Thermal Overload trip Temperature	150			°C	
	Load Dump Protection			60	V	Loaded with R_L = 13.5Ω
	Open Load Detection Voltage (V_{out})	1.7	2.8	4.0	V	
Digital Output EDIO (Low-Side)	Output Voltage	0		42	V	
	Output Current	1.4	1.6	1.8	A	
	Max Inductive Energy (Single Pulse)	150			mJ	
	Current Limit	5	7.5	10	A	@-40, +25 and +150 °C Vin = 10V
	Turn on Time		45	100	µs	@25 °C
	Thermal Overload trip Temperature	150	175		°C	
	Load Dump Protection		50		V	Loaded with R_L = 9Ω

7.5. Encoder Inputs

There are 4 Encoder Inputs, which act as 2 pairs in order to decode pulse trains from 2 encoders. The pairs are matched on the same connector. Each of the pairs is split into channels A and B.

Encoder Inputs

Port	Signal Type	Channel	Comment
7	Encoder Input	B	Interface: EDIO
8	Encoder Input	A	Interface: EDIO
43	Encoder Input	B	Interface: DIOP
44	Encoder Input	A	Interface: DIOP

Encoder Inputs Electrical Characteristics

Signal Name	Parameter	Value			Unit	Comment
		Min	Typ	Max		
Encoder Input	Input Voltage	0		36	V	
	Logic High Level Threshold	9			V	
	Logic Low Level Threshold			5	V	
	Bias Resistance Rb		4.7		kΩ	Pull up
	Input Capacitance C		100		nF	
	Filter Resistance Rτ		100		kΩ	
	Filter Capacitance C		1		nF	
	Filter Time Constant		0.1		ms	$\tau = R\tau \times C\tau$
	Pulse Frequency		10		kHz	

7.6. Pulse Counter Inputs

There are 2 Pulse Counter Inputs. For more details see description in the Object Dictionary.

Pulse Counter Inputs

Port	Signal Type	Comment
8	Pulse Counter Input	Interface: EDIO
10	Pulse Counter Input	Interface: DIO

Pulse Counter Inputs Electrical Characteristics

Signal Name	Parameter	Value			Unit	Comment
		Min	Typ	Max		
Pulse Counter Input	Input Voltage	0		36	V	
	Input Frequency			10	kHz	

7.7. Power Interface

Power is fed in from a battery to the two main power inputs, +24 V Power, and +24 V Logic.

Power Interface

Signal Type	Comment
+24 V Power	V_{batt}
+24 V Logic	V_{batt}
+24 V Sensor Supply 1	Shared between Left Side* AIN, DIO, DIOP and EDIO interfaces.
+24 V Sensor Supply 2	Shared between Right Side* AIN, DIO, DIOP and EDIO interfaces.
+5 V Sensor Supply 1	Left Side AIN
+5 V Sensor Supply 2	Right Side AIN
GND	

*See section 2.1 Connectors: Connector Layout for description of Left Side / Right Side

Power Electrical Characteristics

Signal Name	Parameter	Value			Unit	Comment
		Min	Typ	Max		
+24 V Power	Supply Voltage	10	24	36	V	Also called V_{batt}
	Supply Current			18	A	
	Total Quiescent current		200		mA	@24 V
	Reverse Polarity Protection			20	A	With external 20 A Fuse
	Load dump Protection					
+24 V Logic	Supply Voltage	10		36	V	Directly connected to V_{batt}
	Load Dump Protection					
+24V Sensor Supply 1 & 2	Output Voltage	10	24	36	V	Note: Unregulated
	Output Current			2	A	2 A is max per group (therefore 4 A in total)
+5 V Sensor Supply 1 & 2	Output Voltage	4.995	5	5.005	V	
	Output Current			60	mA	Max per group (therefore 120 mA total)
GND	Supply Current			18	A	Max 9 Amps per pin x 2 pins

7.8. CAN Interface (CANin, CANout)

CAN in interface to unit. CAN power is only going through from CAN in to CAN out. Other than gender, the only electrical difference between the connectors is that CANH and CANL signals on the CANout connector do not pass through an inductive filter.

Can Interface Characteristics

Parameter	Value			Unit	Comment
	Min	Typ	Max		
CAN Baud Rate	10	24	250	kbit/s	Higher rates available on request

7.9. ID Interface

For convenience the ID connector and truth table is located under heading Connector X5 ID in the Connector layout chapter.

7.10. LED Indicators

+5 V Power Indicators 1 & 2

+5	Meaning
GREEN	+5 V Supply Power ON
RED	+5 V Supply Shorted to GND
OFF	+5 V Supply Failure

+24 V Power Indicators 1 & 2

| +5	Meaning
GREEN	+24 V Supply Power ON
RED	+24 V Supply Shorted to GND
OFF	+24 V Supply Failure

DIO and DIOP Indicators, for Channels B and A respectively

LED Colour	Meaning
YELLOW	Normal Function: Output active and operating
GREEN	24 V at Input/Output
RED	Output active from MCU
OFF	Output in OFF state
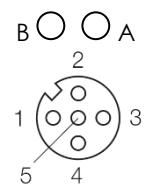
EDIO Indicators, for Channels B and A respectively

LED Colour	Meaning
YELLOW	Normal Function: Output active and operating
GREEN	0 V at Input/Output
RED	Output active from MCU
OFF	Output in OFF state
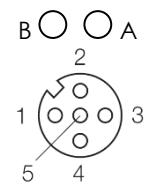
8. Appendix 1 – Environmental Tolerances

Environmental Tolerances

Environmental Test	Level			Standard
High temperature	Functional During test +70 °C, 24 hours			IEC 60068-2-2 Bd
Low temperature	Functional During test -40 °C, 24 hours			IEC 60068-2-1 Ad
Shock	Functional During test 30 g / 6 ms 6 impulses in 6 directions			IEC 60068-2-27
Vibration Sinus: Functional test during test	5-1000 Hz, 1 oct / min 5 -11.5 Hz ± 7.5 mm 11.5-1000 Hz 4 g 3 directions, 10 double sweeps/dir.			IEC 60068-2-6
Random: Functional test during test	5-199 Hz 0.03 g2 / Hz 200-399 Hz 0.02 g2 / Hz 400-599 Hz 0.01 g2 / Hz 600-1000 Hz 0.005 g2 / Hz 3.72g (RMS) 3 directions x 1h			IEC 60068-2-64
Electrical Transients	Conducted transients Pulse 1: -50 V 2: +25 V 3a: -220 V 3b: +220 V 4: -5 V 5: +70 V			ISO 7637-2
EMC Susceptibility (Component)	RF electromagnetic field 200 – 1000 MHz 30 V/m 1 kHz sine			ISO 11452-2
	Bulk Current Injection 20 – 200 MHz 60 mA 1 kHz sine			ISO 11452-4
EMC Emissions (Component)	**Frequency MHz** 30-75 75-400 400-1000	**Narrowb. dBmV/m** 54-44 44-55 55	**Broadb. dBmV/m** 64-54 54-65 65	EN 13 309
Electrostatic Discharge	+/- 4 kV air/contact			ISO/TR 10605
Enclosure	IP67			IEC 60529

9. Appendix 2 – I/O Interface in Order of Port Number

I/O Interface

Port	Pin	Default Signal	Other Configurations	Interface Type
1	X6.2	Analog Input B (0-5 V)	Digital Input	AIN
2	X6.4	Analog Input A (0-20 mA)		AIN
3	X10.2	Analog Input B (0-5 V)	Digital Input	AIN
4	X10.4	Analog Input A (0-20 mA)		AIN
5	X14.2	Analog Input B (0-5 V)	Digital Input	AIN
6	X14.4	Analog Input A (0-20 mA)		AIN
7	X18.2	Digital Output Low-Side	Digital Input, Encoder Input	EDIO
8	X18.4	Digital Output Low-Side	Digital Input, Encoder Input, Pulse Counter Input	EDIO
9	X22.2	Digital Output	Digital Input	DIO
10	X22.4	Digital Output	Digital Input, Pulse Counter Input	DIO
11	X4.2	Digital Input	Digital Output, PWM Output	DIOP
12	X4.4	Digital Input	Digital Output, PWM Output	DIOP
13	X8.2	Digital Input	Digital Output, PWM Output	DIOP
14	X8.4	Digital Input	Digital Output, PWM Output	DIOP
15	X12.2	Digital Input	Digital Output, PWM Output	DIOP
16	X12.4	Digital Input	Digital Output, PWM Output	DIOP
17	X16.2	Digital Output	Digital Input, PWM Output	DIOP
18	X16.4	Digital Output	Digital Input, PWM Output	DIOP
19	X20.2	Digital Output	Digital Input	DIO
20	X20.4	Digital Output	Digital Input	DIO
21	X24.2	Digital Output	Digital Input	DIO
22	X24.4	Digital Output	Digital Input	DIO
27	X9.2	Digital Output	Digital Input, PWM Output	DIOP
28	X9.4	Digital Output	Digital Input, PWM Output	DIOP
29	X13.2	Digital Output	Digital Input, PWM Output	DIOP
30	X13.4	Digital Output	Digital Input, PWM Output	DIOP
31	X17.2	Digital Output	Digital Input, PWM Output	DIOP
32	X17.4	Digital Output	Digital Input, PWM Output	DIOP
33	X21.2	Digital Output	Digital Input	DIO
34	X21.4	Digital Output	Digital Input	DIO
35	X25.2	Digital Output	Digital Input	DIO
36	X25.4	Digital Output	Digital Input	DIO
37	X7.2	Analog Input B (0-5 V)	Digital Input	AIN
38	X7.4	Analog Input A (0-20 mA)		AIN
39	X11.2	Analog Input B (0-5 V)	Digital Input	AIN
40	X11.4	Analog Input A (0-20 mA)		AIN
41	X15.2	Analog Input B (0-5 V)	Digital Input	AIN
42	X15.4	Analog Input A (0-20 mA)		AIN
43	X19.2	Digital Output Low-Side	Digital Input, Encoder Input	EDIO
44	X19.4	Digital Output Low-Side	Digital Input, Encoder Input	EDIO
45	X23.2	Digital Output	Digital Input, PWM Output	DIOP
46	X23.4	Digital Output	Digital Input, PWM Output	DIOP
52	X5.4	ID0	Digital Input	ID
53	X5.2	ID1	Digital Input	ID
54	X5.1	ID2	Digital Input	ID
55	X5.5	ID3	Digital Input	ID

Internal AINs

Port	Pin	Default Signal	Other Configurations	Interface Type
58	internal	Analog Input		Internal AIN
59	internal	Analog Input		Internal AIN
60	internal	Analog Input		Internal AIN
61	internal	Analog Input		Internal AIN
62	internal	Analog Input		Internal AIN
63	internal	Analog Input		Internal AIN

10. Contact Technical Support

Contact your reseller or supplier for help with possible problems with your CrossFire GX1. Contact information is found on the front and back cover pages of this handbook.

Preparation before contacting technical support

In order to get the best help, you should have access to your CrossFire GX1 and be prepared with the following information before you contact support.

- Part number and serial number of the unit, which you find on the brand label

- Date of purchase, which is found on the invoice

- The conditions and circumstances under which the problem arises

- Description of external equipment which is connected to the CrossFire GX1

11. Trade Mark, etc.

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