CrossFire™ FX1

User Manual and Reference Handbook for the CrossFire™ Model FX1

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CrossFire™ FX1

Introduction

The CrossFire™ FX1 is a compact, ruggedised and versatile I/O-module designed for mobile applications. The module has a generous I/O setup, making the price per I/O channel extremely competitive.

The CrossFire™ FX1 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.

The CrossFire™ FX1 supports the CANopen protocol: one of the leading protocols used for CAN bus networks.

The CrossFire™ FX1 is highly configurable and has many different types of input and output drivers. All outputs, whether digital or analog can be configured as Digital Outputs, and almost all inputs can be configured as Digital Inputs. This provides a great deal of flexibility.

Functions and Features

- The CrossFire™ FX1 is a CiA DS 401 I/O module, designed for automotive products equipped with hydraulic components. It has 77 I/O ports which can be individually configured to provide various types of I/O. The CrossFire™ FX1 can therefore be configured to have:
  - Up to 35 Digital Inputs, of which 6 are debounced in hardware
  - Up to 42 Digital Outputs
    - 28 High-Side Drivers (PNP) with overload/short-circuit protection
    - 14 Low-Side Drivers (NPN)
  - Up to 20 PWM (Pulse-Width Modulation) Outputs
    - 14 of which are Regulated
  - Up to 9 Pulse Counter Inputs, of which 2 accept sine wave inputs
  - Up to 34 Analog Inputs
    - 14 of which are normally used for Regulated PWM Feedback
- In addition to the 77 I/O ports mentioned above, there are internally
  - 8 Analog “Power Monitor” Inputs
- Configurable using SDOs (Service Data Objects)
- 8 dynamically-mapped PDOs (Process Data Objects) compliant to DS 401
- Supports use of synch object (synch object consumer only)
- Support for both heartbeat and node guarding
- The CrossFire™ FX1 is an EMCY (Emergency) object producer. The COB ID of the EMCY object can be configured.
- Status bits for 14 of the High-Side Drivers sent by default with TPDO1.
- Storage for up to 127 Error codes
- Reset function restores settings back to their factory default values.

Technical data

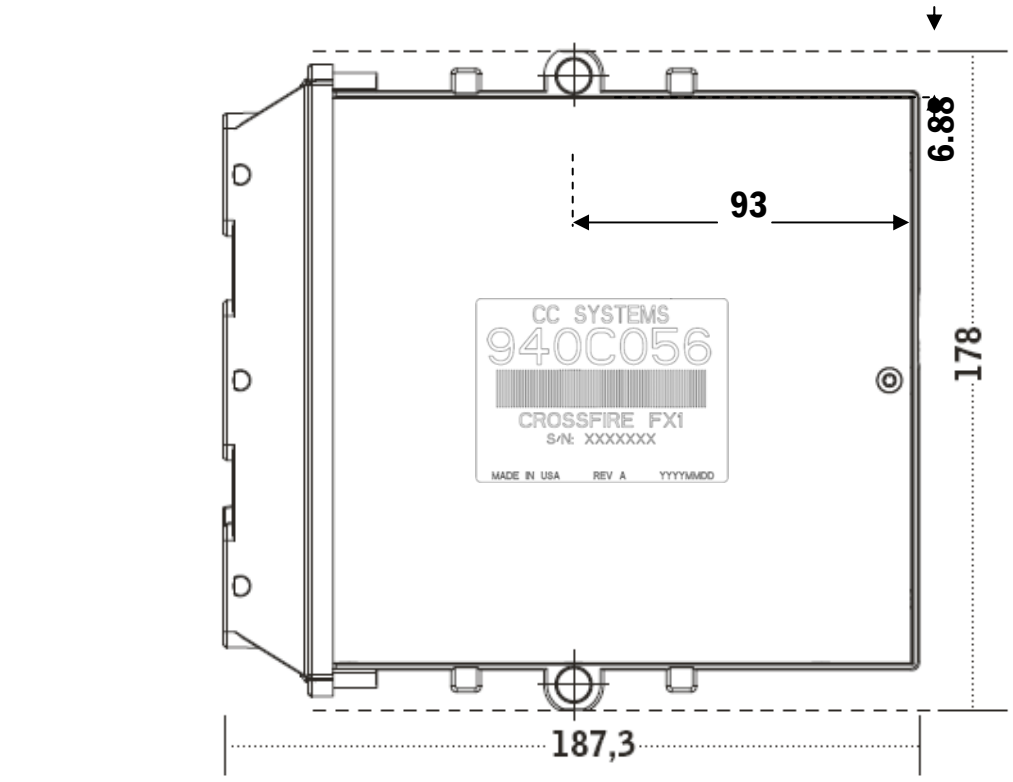
Processor Frequency	Infineon C167 (SAFC167CRLMHA) 24 MHz
Physical Housing Dimensions Mass	 Die-cast metal housing 187.3 x 178 x 37 mm (L x W x H) (L = 254.3 with clearance) 0.88 kg
Environment Temperature Range Protection rating EMC Conformity	 Operating: -40 ˚C to +85 ˚C Storage: -50 ˚C to +105 ˚C IP67 ISO 14982 for Emissions, ISO 11452-2 for Immunity
Power Supply Operating voltage Current consumption	 9 V to 36 VDC < 45 mA at 24 V in Standby, 57.5 Amps max
Indicators	None
CAN interface Communication profile Device Profile Drivers Baud Rate Node ID	ISO 11898-2 (High Speed CAN) CANopen I/O module to CiA DS401 Phillips 82C251 or 82C252 10, 20, 50, 100, 125, 250, 500, 800, 1000 kbit/s 1 to 127 set with SDOs
Serial Interface	RS-232
Connectors	MOLEX 32-pole and 48-pole
Digital Inputs Input Voltage	 0 – 5 V, 0 – 24 V
Pulse Counter Inputs Frequency	 DC to 500 kHz
Analog Inputs Input Voltage Resolution Error	 0 – 5 V, 0 – 40 V 10 bits ±2 LSBs – See specifications for details
Digital Outputs – High Side Max Voltage Max Current Protection Digital Outputs – Low Side Max Current	Infineon BTS621L1 34 V 1.8 A each – see specifications for details Ground Fault, Overload, Open Load, with Status Feedback On Semiconductor NTD3055L104 2.5 A each – see specifications for details
Analog (PWM) Outputs Max Voltage Max Current Resolution Protection	Infineon BTS621L1 34 V 1.8 A typical, 4.4 abs. max. 1 % Ground Fault, Overload, Open Load, etc.
Approvals / Certifications	CiA CE ISO IEC

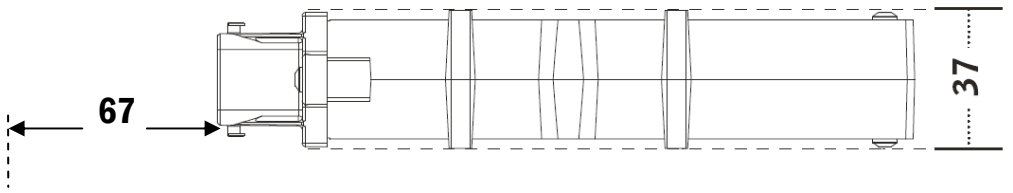
References

CAN in Automation - CANopen standard	http://www.can-cia.org
CE Marking	http://ec.europa.eu/
International Standards Organisation	http://www.iso.org/
International Electrotechnical Commission	http://www.iec.ch/
Infineon – Manufacturer of C167CR Micro and BTS621L1	http://www.infineon.com
On Semiconductors	http://www.onsemi.com

Dimensions

The CrossFire™ FX1 dimensions are illustrated below. The placement of the bolt holes is symmetrical. The mounting lugs have clearance for 8 mm bolts. The minimum clearance required to connect the mating harness is 67 mm. The weight of the module is 0.88 kg.





Identification

There is a label on the front of the CrossFire™ FX1. 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.

Environmental Tolerance

The CrossFire™ FX1 has been designed to cope with tough environmental demands. Strict tests have been conducted on the unit in order to ensure that it fulfills 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 the CrossFire™ FX1 has been tested and approved.

Despite thorough design requirements and testing specifications, it is always best to install and handle the CrossFire™ FX1 with care. For more information, read further.

Installation

Your CrossFire™ FX1 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.

Cooling

Although the CrossFire™ FX1 can operate in relatively high temperatures, cooling should still be considered when installing the CrossFire™ FX1. If the unit becomes too warm, it may not perform to its full capacity and, with high temperature, cease to function.

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

Vibration

We recommend installing the CrossFire™ FX1 in such a way that it is not unnecessarily exposed to vibration or other stress.

Rain / Moisture

The CrossFire™ FX1 shall preferably be covered or enclosed in order to prevent direct exposure to water.

CrossFire™ FX1

Electrical Interface

Connectors

Every I/O pin on the CrossFire™ FX1 is assigned a unique port. The ports are numbered from 1 to 94. Some ports are internal. Most ports may be configured individually in software to one of 5 different I/O types. Not all I/O types are available on all ports.

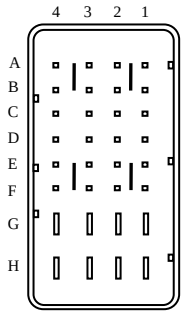
The port assignments of the CrossFire™ FX1 are sequential and unique but the pin assignments are somewhat arbitrary. For I/O interface by order of port number, see Appendix 2.

Connector J1

Conn.Pin	Port	Default Signal Type	Other Configurations
J1.A1	19	Pulse Counter Input	Digital Input
J1.A2		no connection	
J1.A3	93	Reg. PWM Return 13	Analog Input, Digital Output
J1.A4	94	Reg. PWM Return 14	Analog Input,
J1.B1	18	Pulse Counter Input	Digital Input
J1.B2	17	Pulse Counter Input	Digital Input
J1.B3	73	Reg. PWM Output 13	Digital Output
J1.B4	85	Reg. PWM Return 5	Analog Input, Digital Output
J1.C1	2	Digital Input	
J1.C2	8	Analog Input	Digital Input
J1.C3	74	Reg. PWM Output 14	Digital Output
J1.C4	65	Reg. PWM Output 5	Digital Output
J1.D1	25	Pulse Counter Input	Digital Input
J1.D2	15	Analog Input	Digital Input
J1.D3		no connection	
J1.D4	66	Reg. PWM Output 6	Digital Output
J1.E1		no connection	
J1.E2	7	Analog Input	Digital Input
J1.E3	72	Reg. PWM Output 12	Digital Output
J1.E4	86	Reg. PWM Return 6	Analog Input, NPN Digital Output
J1.F1	9	Analog Input	Digital Input
J1.F2	38	Analog Input	Digital Input
J1.F3	71	Reg. PWM Output 11	Digital Output
J1.F4	91	Reg. PWM Return 11	Analog Input, NPN Digital Output
J1.G1	13	Analog Input	Digital Input
J1.G2	47	Digital Output	
J1.G3	48	Digital Output	
J1.G4	92	Reg. PWM Return 12	Analog Input, NPN Digital Output
J1.H1	14	Analog Input	Digital Input
J1.H2		no connection	
J1.H3		no connection	
J1.H4	59	Valve Power (VP3)	

MOLEX
male, 32-pole,
brown

mates with:
MOLEX female
CMC connector
98993-3219
or 98993-1219



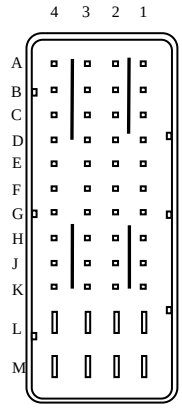
Note NPN = Low-side Driver

Connector J2

Conn.Pin	Port	Default Signal Type	Other Configurations
J2.A1		CANH	
J2.A2		no connection	
J2.A3		RS 232 XMT	
J2.A4	61	Reg. PWM Output 1	Digital Output
J2.B1		CANL	
J2.B2		no connection	
J2.B3		RS232 RCV	
J2.B4	81	Reg. PWM Return 1	Analog Input, NPN Digital Output
J2.C1	12	Analog Input	Digital Input
J2.C2	30	Analog Input	Digital Input
J2.C3	82	Reg. PWM Return 2	Analog Input, NPN Digital Output
J2.C4	53	Non-regulated PWM Out	Digital Output
J2.D1	5	Digital Input	
J2.D2	6	Digital Input	
J2.D3	62	Reg. PWM Output 2	Digital Output
J2.D4	54	Non-regulated PWM Out	Digital Output
J2.E1		no connection	
J2.E2	4	Digital Input	
J2.E3	24	Pulse Counter Input	Digital Input
J2.E4	49	Non-regulated PWM Out	Digital Output
J2.F1		bootstrap load	
J2.F2		no connection	
J2.F3	11	Analog Input	Digital Input
J2.F4	50	Non-regulated PWM Out.	Digital Output
J2.G1	21	Pulse Counter Input	Digital Input
J2.G2	20	Pulse Counter Input	Digital Input
J2.G3	31	Analog Input	Digital Input
J2.G4	46	Digital Output	
J2.H1	23	Pulse Counter Input	Digital Input
J2.H2	22	Pulse Counter Input	Digital Input
J2.H3		CAN2L – unused	
J2.H4	45	Digital Output	
J2.J1	76	Sensor +5 Vref 2	
J2.J2		Sensor Vref 2 return	
J2.J3		CAN2H – unused	
J2.J4	44	Digital Output	
J2.K1	75	Sensor +5 Vref 1	
J2.K2		Sensor Vref 1 Return	
J2.K3	41	Digital Output	
J2.K4	43	Digital Output	
J2.L1	56	Power V+ Battery	
J2.L2		GND	
J2.L3	42	Digital Output	
J2.L4	58	Valve Power (VP2)	
J2.M1	55	Power V+ ELX	
J2.M2		GND	
J2.M3		GND	
J2.M4	60	Valve Power (VP4)	

MOLEX
male, 48-pole,
brown

mates with:
MOLEX female
CMC connector
98993-3319
or 98993-1319



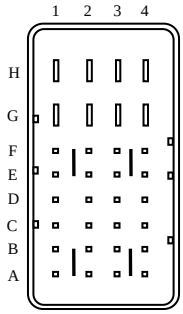
Note NPN = Low-side Driver

Connector J3

Conn.Pin	Port	Default Signal Type	Other Configurations
J3.A1	83	Reg. PWM Return 3	Analog Input, NPN Digital Output
J3.A2	84	Reg. PWM Return 4	Analog Input, NPN Digital Output
J3.A3		no connection	
J3.A4		no connection	
J3.B1	88	Reg. PWM Return 8	Analog Input, NPN Digital Output
J3.B2	64	Reg. PWM Output 4	Digital Output
J3.B3		no connection	
J3.B4		no connection	
J3.C1	68	Reg. PWM Output 8	Digital Output
J3.C2	63	Reg. PWM Output 3	Digital Output
J3.C3	1	Digital Input	
J3.C4	3	Digital Input	
J3.D1	52	Non-regulated PWM Out	Digital Output
J3.D2		no connection	
J3.D3	10	Analog Input	Digital Input
J3.D4	39	Analog Input	Digital Input
J3.E1	51	Non-regulated PWM Out	Digital Output
J3.E2		no connection	
J3.E3	32	Analog Input	Digital Input
J3.E4	33	Analog Input	Digital Input
J3.F1	67	Reg. PWM Output 7	Digital Output
J3.F2	87	Reg. PWM Return 7	Analog Input, NPN Digital Output
J3.F3	40	Analog Input	Digital Input
J3.F4	34	Analog Input	Digital Input
J3.G1	90	Reg. PWM Return 10	Analog Input, NPN Digital Output
J3.G2	70	Reg. PWM Output 10	Digital Output
J3.G3	37	Analog Input	Digital Input
J3.G4	35	Analog Input	Digital Input
J3.H1	57	Valve Power (VP1)	
J3.H2	69	Reg. PWM Output 9	Digital Output
J3.H3	89	Reg. PWM Return 9	Analog Input, NPN Digital Output
J3.H4	36	Analog Input	Digital Input

MOLEX
male, 32-pole, blue

mates with:
MOLEX female
CMC connector
98993-3216 or
98993-1216



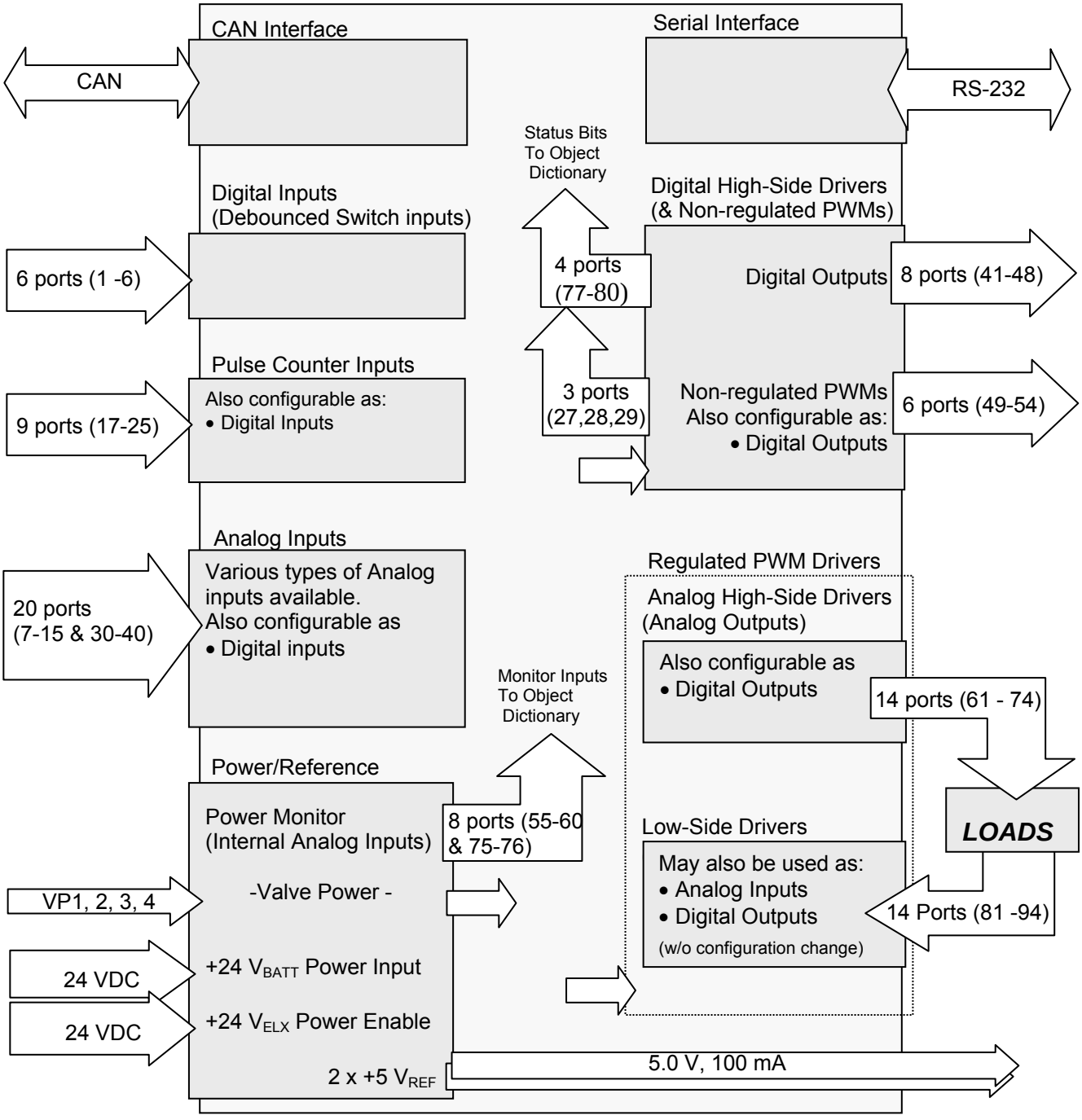
Note NPN = Low-side Driver

⚠ Notice that the connector illustrations provided above represent those on the unit. Not to be confused with the ones that the attached cables shall have in order to mate with them.

Electrical Interface Overview

The following illustration consists of several boxes which represent the main functional groups on the CrossFire™ FX1. The arrows leading to and from the functional groups represent I/O, power or communication busses. The illustration shows the FX1 in its default configuration. The configuration can be changed by writing to the object dictionary at address 0x2000.

CrossFire™ FX1



Ports 16, 26 are undefined. Ports 27–29 and 77–80 are internal inputs

Electrical Interface Characteristics

Digital Inputs

There are 5 types of Digital Inputs available on the CrossFire™ FX1 for a total of 35 ports. Only 6 of them, on ports 1 to 6, are available by default. If more Digital Inputs are needed, the desired ports must be configured by writing an SDO to index 0x2000 of the Object Dictionary. Port assignments and characteristics are presented below. The characteristics of the Digital Inputs which are borrowed from the Pulse Counters and Analog Inputs are, however, not included here. These characteristics can be determined by referring to the appropriate chapters.

Digital Input Interface

Port	Signal Name	Comment
1	Digital Input Type IS1	Debounced Digital Switch Input 2.5 kΩ pull-down to GND
2		
3		
4	Digital Input Type IS4	Debounced Digital Switch Input 10 kΩ pull-up to +5V
5		
6		
7	Analog Input Type IAx configured as Digital Input	Functional Group: Analog Inputs
8		
9		
10		
11		
12		
13		
14		
15		
17	Digital Input Type IF3	Functional Group: Pulse Counter Inputs 15 kΩ pull-up to V_{ELX}
18		
19		
20		
21		
22		
23		
24	Digital Input Type IF1	Functional Group: Pulse Counter Inputs 10 kΩ pull-up to +5V
25		
30	Analog Input Type IAx configured as Digital Input	Functional Group: Analog Inputs These Inputs are Multiplexed and poled and are therefore much slower than the other types of Digital Inputs.
31		
32		
33		
34		
35		
36		
37		
38	Analog Input Type IAx configured as Digital Input	Functional Group: Analog Inputs
39		
40		

Electrical Characteristics for Digital Input Interface

Signal Name	Parameter	Value			Unit	Comment
		Min	Typ	Max		
Digital Input Type IS1	Input Voltage	0	24	36	V	
	Current Sinking	6			mA	continuous at 24 V
	Debounce time	0.4			Ms	Will not respond to a change in state less than 0.4 ms duration
Digital Input Type IS4	Input Voltage	0	-	5	V	
	Debounce time	0.8			Ms	Will not respond to a change in state less than 0.8 ms duration
Digital Input Type IF3	See Pulse Counter Input Type IF3 for Characteristics					
Digital Input Type IF1	See Pulse Counter Input Type IF1 for Characteristics					
Analog Input Types IA1, IA4, IA5 and IA6	See Analog Input Section for port assignments and Characteristics as well as port bias (pull-up / pull-down)					

Pulse Counter Inputs

There are 2 types of Pulse Counter Inputs available on the CrossFire™ FX1 for a total of 9 ports. The ports are configured as Pulse Counter Inputs by default.

The port assignments and corresponding electrical characteristics for the Pulse Counter Inputs are presented in the tables below.

Pulse Counter Input Interface

Port	Signal Name	Comment
17	Pulse Counter Input Type IF3	Square Wave bipolar inputs 15 kΩ pull-up to V_{ELX}
18		
19		
20		
21		
22		
23		
24	Pulse Counter Input Type IF1	Sine Wave bipolar inputs 10 kΩ pull-up to +5V
25		

Electrical Characteristics for Pulse Counter Input Interface

Signal Name	Parameter	Value			Unit	Comment
		Min	Typ	Max		
Pulse Counter Input Type IF3	Input Voltage	0	24	V_{ELX}	V	See Power Interface for description of V_{ELX}
	Input Frequency 20% to 80% duty cycle from open collector	DC	-	2.8	kHz	square wave
	Input Frequency 50% duty cycle from V+ p-p	DC	-	40	kHz	square wave
Pulse Counter Input Type IF1	Input Voltage	0	-	5	V	
	Input Frequency 20% to 80% duty cycle from open collector	DC	-	11.2	kHz	sine wave
	Input Frequency 50% duty cycle from 5 Vp-p	0.2 Hz		500	kHz	sine wave

Analog Inputs

Ports 7 to 15 and ports 30 to 40 make up the 20 Analog Inputs which are available by default.

Ports 81 to 94 form the Low-Side of the Regulated PWM Drivers. Whether acting as part of the Regulated PWM Driver circuit, or as standalone Digital Outputs, these ports are always readable as Analog Inputs without any configuration changes. If a particular Regulated PWM Driver is not being used, this frees up the corresponding Low-Side Driver to be used as an “extra” Digital Output/Analog Input.

When Ports 61 to 74 are being used as Regulated PWM Outputs, it is recommended to reserve the use of corresponding Regulated PWM Returns (Ports 81 to 94) as feedback paths.

The port allocations and electrical characteristics of all Analog Inputs are given in the tables below.

Analog Input Interface

Port	Signal Type	Comment
7	Analog Input Type IA4	Temperature sensor with 499 Ω pull-up to +5 Vref.
8	Analog Input Type IA1	General purpose 301 kΩ pull-down to GND
9	Analog Input Type IA4	Temperature sensor with 499 Ω pull-up to +5 Vref.
10	Analog Input Type IA1 - FAST	General purpose 301 kΩ pull-down to GND
11	Analog Input Type IA1	General purpose 301 kΩ pull-down to GND
12		
13		
14		
15	Analog Input Type IA5	Diagnostic Switch Input 2.8 kΩ pull-down to GND
30	Analog Input Type IA1	General purpose 10 kΩ pull-down to GND
31	Analog Input Type IA5	Diagnostic Switch Input 781 k pull-down to GND
32		
33		
34	Analog Input Type IA1	General purpose 301 kΩ pull-down to GND
35		
36		
37 38	Analog Input Type IA1	General purpose 301 kΩ pull-down to GND
39	Analog Input Type IA5	Diagnostic Switch Input 2.8 kΩ pull-down to GND
40	Analog Input Type IA1	General purpose 301 kΩ pull-down to GND
14 ports (81 – 94)	Analog Input Type IA6	Functional Group: Regulated PWM Drivers Reg. PWM Output Differential Current Sense. R_{SENSE}= 0.1 Ω

Electrical Characteristics for Analog Inputs

Signal Name	Parameter	Value			Unit	Comment
		Min	Typ	Max		
Analog Inputs All Types	Resolution			10	bits	
Analog Input Type IA1 (13 Ports) and Type IA4 (2 Ports)	Input Voltage	0	-	5	V	Max = V_{ref} ±0.1 V
	Input Impedance Type IA1		301		kΩ	pull-down to GND
	Input Impedance Type IA4		499		Ω	pull-up to +5 Vref
	Response time with 10 bits accuracy		10		Hz	IA1 – FAST (Port 10)
			1		Hz	all other IA1 and IA4 Ports
	Error		±1		LSB	with SIN wave sampling at 1 Hz
Analog Input Type IA5 (5 Ports)	Input Voltage	0	-	40	V	uses an internal gain of 0.125
	Current Sink	6			mA	continuous rating when connected to 24 V
	Input Impedance		2.8		kΩ	pull-down to GND
	Response time		1		Hz	with 10 bits accuracy
	Error		±2		LSB	approximate
Analog Input Type IA6 (14 Ports)	Input Current	0	-	5	A	
	Response time		2		Hz	with 10 bits accuracy
	Relative Error		±2.8		%	
	Absolute Error		±0.15		mA	with a sense resistor of 0.1 Ω

Digital Outputs

There are 3 types of Digital Outputs on the CrossFire™ FX1 for a total of 42 Ports. Ports 49 to 54 and 61 to 74 are configured as PWM Outputs by default, and require reconfiguring if they are to be used as Digital Outputs. To reconfigure the ports, see 0x2000 in the Object Dictionary.

Ports 81 to 94 are the Low-Side Drivers.

When Ports 61 to 74 are being used as Digital Outputs, it is permissible to tie the low side of the loads to ground. However, when being used as Regulated PWM Outputs, it is recommended to reserve the use of corresponding Regulated PWM Returns (Ports 81 to 94) as feedback paths.

The port allocations and electrical characteristics of all Digital Outputs are given in the tables below.

Ports 41 to 54 are equipped with Status Bits. There is one Status Bit for each pair of ports. If a Status Bit is set, it indicates a failure with one (or both) of the Ports it represents.

Digital Output Interface

<table>
<tr><th>Port</th><th>Signal Name</th><th>Valve Power</th><th>Status Bit (port)</th><th>Comment</th></tr>
<tr><td>41</td><td rowspan="14">Digital Output Type OD2</td><td rowspan="2">VP1</td><td rowspan="2">77</td><td rowspan="8">Functional Group:
Digital High-Side Drivers
Chip: BTS621L1</td></tr>
<tr><td>42</td></tr>
<tr><td>43</td><td rowspan="2">VP2</td><td rowspan="2">78</td></tr>
<tr><td>44</td></tr>
<tr><td>45</td><td rowspan="2">VP3</td><td rowspan="2">79</td></tr>
<tr><td>46</td></tr>
<tr><td>47</td><td rowspan="2">VP4</td><td rowspan="2">80</td></tr>
<tr><td>48</td></tr>
<tr><td>49</td><td rowspan="4">V_{ELX}</td><td>27</td><td rowspan="6">Functional Group:
Digital High-Side Drivers
(Non-regulated PWM Outputs)
Chip: BTS621L1</td></tr>
<tr><td>50</td></tr>
<tr><td>51</td><td rowspan="2">28</td></tr>
<tr><td>52</td></tr>
<tr><td>53</td><td rowspan="2">VP4</td><td rowspan="2">29</td></tr>
<tr><td>54</td></tr>
<tr><td>61</td><td rowspan="14">Digital Output Type OD3</td><td rowspan="3">VP2</td><td rowspan="14" colspan="2">Functional Group: Analog High-Side Drivers
Chip: BTS621L1</td></tr>
<tr><td>62</td></tr>
<tr><td>63</td></tr>
<tr><td>64</td></tr>
<tr><td>65</td><td rowspan="2">VP3</td></tr>
<tr><td>66</td></tr>
<tr><td>67</td><td rowspan="4">VP1</td></tr>
<tr><td>68</td></tr>
<tr><td>69</td></tr>
<tr><td>70</td></tr>
<tr><td>71</td><td rowspan="2">VP3</td></tr>
<tr><td>72</td></tr>
<tr><td>73</td><td rowspan="2">VP4</td></tr>
<tr><td>74</td></tr>
<tr><td>81 to 94
(14 Ports)</td><td>Digital Output Type OD4</td><td colspan="3">Functional Group: Low Side Drivers
Chip: NTD3055L104</td></tr>
</table>

Electrical Characteristics for Digital Output Interface

Signal Name	Parameter	Value			Unit	Comment
		Min	Typ	Max		
Digital Output Type OD2	Output Voltage		24	VPx / V_{ELX}	V	Outputs follow supply voltages VP1, VP2, VP3, VP4 and V_{ELX} respectively
	Output Current		1.8	4.4	A	Total of 12 Amps max. continuous current per VPx
Digital Output Type OD3	Output Voltage			VPx	V	Outputs follow supply voltages VP1, VP2, VP3 and VP4 respectively
	Output Current		1.8	4.4	A	Total of 12 Amps max. continuous current per VPx
Digital Output Type OD4	Output Voltage		0		V	(Low-Side Driver)
	Output Current		2.5	6	A	Current Sinking Maximum total of 36 Amps through GND prongs of all 14 Low-Side drivers together.

Regulated and Non-regulated PWM Outputs

Regulated PWM Outputs consist of two driver circuits operating in tandem. Namely, one Analog High-Side Driver and one corresponding Low-Side Driver. The High-Side Drivers provide Regulated PWM Output capability, with the help of current feedback signals (called Regulated PWM Return) from the Low-Side Drivers. The regulation is performed in hardware.

When Ports 61 to 74 are being used as Digital Outputs, it is permissible to tie the low side of the loads to ground. However, when being used as Regulated PWM Outputs, it is recommended to use the corresponding Regulated PWM Returns (Ports 81 to 94) as feedback paths.

Note: to use the Low-Side Drivers (Ports 81 to 94) as Regulated PWM Returns, no configuration change is required. Simply connect the low side of the Regulated PWM load to the corresponding Regulated PWM Return Port.

Low-Side Driver Digital Output Ports, must be set to a “logic 1” (thereby closing the circuit) in order for the port’s Regulated PWM Return signal to be valid. This is done through receive PDO1 bytes 5 and 6.

Furthermore, the current in each Regulated PWM Return continues to be read as an Analog Input without any configuration changes. Non-Regulated PWMs do not have PWM Return signals, and are therefore controlled “open loop”.

The PWM Outputs are intended to drive servo valves. Because of this, all PWM outputs are equipped with Ripple Frequency and Ripple Amplitude settings. This is intended to overcome valve static friction with a subtle vibration, keeping the valve

spool in motion. This feature is enabled by default, and can be modified at indices 0x2004 and 0x2005 of the Object Dictionary. The PWM Frequency can also be adjusted using index 0x2006.

Note that the Valve Power listed below is also used by the Digital Outputs.

PWM Output Interface

Port	Signal Name	Valve Power	Comment
49	Non-Reg. PWM Output	V_{ELX}	Functional Group: Digital High-Side Drivers
50	Non-Reg. PWM Output		
51	Non-Reg. PWM Output		
52	Non-Reg. PWM Output		
53	Non-Reg. PWM Output	VP4	
54	Non-Reg. PWM Output		
61 81	Regulated PWM Output 1 Regulated PWM Return 1	VP2	Functional Group: Regulated PWM Drivers
62 82	Regulated PWM Output 2 Regulated PWM Return 2		
63 83	Regulated PWM Output 3 Regulated PWM Return 3		
64 84	Regulated PWM Output 4 Regulated PWM Return 4		
65 85	Regulated PWM Output 5 Regulated PWM Return 5	VP3	
66 86	Regulated PWM Output 6 Regulated PWM Return 6		
67 87	Regulated PWM Output 7 Regulated PWM Return 7	VP1	
68 88	Regulated PWM Output 8 Regulated PWM Return 8		
69 89	Regulated PWM Output 9 Regulated PWM Return 9		
70 90	Regulated PWM Output 10 Regulated PWM Return 10		
71 91	Regulated PWM Output 11 Regulated PWM Return 11	VP3	
72 92	Regulated PWM Output 12 Regulated PWM Return 12		
73 93	Regulated PWM Output 13 Regulated PWM Return 13	VP4	
74 94	Regulated PWM Output 14 Regulated PWM Return 14		

PWM Output Interface Electrical Characteristics

Parameter	Value			Unit	Comment
	Min	Typ	Max		
Output Voltage	0	24	VPx / V_{ELX}	V	Outputs follow supply voltages VP1, VP2, VP3, VP4 and V+ respectively (see table above)
Output Current	0	1.8	4.4	A	Total of 12 Amps max. continuous current per VPx
Output Current Limit			8	A	
On-State Resistance		80		mΩ	
Turn On Time	80	200	400	µs	

Power Interface

Power is supplied to the unit through 6 different Power Input lines. Each line must be protected with an external 20-Amp ATC fuse.

All 6 of the Power Inputs and the two +5 V Reference Outputs are able to be monitored as Analog Inputs.

The 4 Valve Power Inputs directly supply the Digital and PWM Outputs of the CrossFire™ FX1. They are independent of other's circuitry and as such may have different voltage levels.

Power Interface

Port	Signal Type	Comment
55	Power V_{ELX} (Also called V+)	Power Input Enable
56	Power +Vbatt	Main Power Input
57	Valve Power VP1	Power Inputs See Digital Outputs / PWM Outputs to determine which Valve Power Supply feeds which ports.
58	Valve Power VP2	
59	Valve Power VP3	
60	Valve Power VP4	
75	+5 V_{Ref} 1	Voltage Reference Output
76	+5 V_{Ref} 2	Voltage Reference Output
n/a	GND	

Power Interface Electrical Characteristics

Parameter	Value			Unit	Comment
	Min	Typ	Max		
Supply Voltage V_{ELX}, $V_{BATT,}$	9	24	36	V	Fully-operational @ 12 V Outputs disabled @30 V Load-dump protected @40 V
Supply Current V_{ELX}			8.5	A	All drivers on.
Supply Current V_{BATT}		0.9		A	
Total Quiescent Current V_{ELX} + V_{BATT}	40			mA	@ 24 V
GND Current			36	A	Max. continuous ground current
Valve Power Voltage VP1, VP2, VP3, VP4	0	24	32	V	Independent supplies
Valve Power Current VP1, VP2, VP3, VP4	0		12.0	A	each.
+5 V_{Ref} Voltage		5		V	
+5 V_{Ref} Current		100		mA	

Serial Interface

The serial interface is intended to be used for downloading of software onto the module at the time of manufacture. Other uses are not supported.

Serial Interface Electrical Characteristics

Parameter	Value			Unit	Comment
	Min	Typ	Max		
Input Voltage		±10	±12	V	
Baud Rate		120		kbits/s	

CAN Interface

The CAN interface Baud rate can be set using SDOs. For more information, see the Object Dictionary index 0x2011.

CAN Interface Characteristics

Parameter	Value			Unit	Comment
	Min	Typ	Max		
Baud Rate	10	125	1000	kbit/s	125 baud is the default

LED Indicators

There are no LED indicators on the CrossFire™ FX1

CrossFire™ FX1

CANopen Interface

Parameter Overview

The CrossFire™ FX1 supports the CANopen protocol.
The default CANopen Node ID is 1 and the default Baud Rate is 125 kbit/s.
The CrossFire™ FX1 supports both heartbeat and node guarding.
The CrossFire™ FX1 is an NMT slave device. It is a heartbeat producer.
The CrossFire™ FX1 is a SYNC message consumer.

EMCY Object Overview

The following error codes are supported according to DS-401 and DS-301. Up to 127 errors codes are stored at index 0x1003 of the Object Dictionary.

EMCY Object

Error code	Error register	Manufacturer-Specific Error Field	Meaning
0x8110	0x1	Not used	Buffer overrun. A CAN buffer overrun has occurred in the CrossFire™ FX1. Index 0x1029 specifies the action to take when this error occurs.
0x6100	0x1	SW error code	An internal software error has occurred. This error can be a result of a bug in the software. Please note the manufacturer specific error field of the message, and report the error to CrossControl. Index 0x1029 specifies the action to take when this error occurs.
0x8130	0x1	Not used	Guarding of node failed. This will occur if the CrossFire™ FX1 is guarded with Node Guarding and the master has failed to send a guarding remote frame within the time specified in object 0x100C. Error will also occur if the CrossFire™ FX1 is configured as a heartbeat consumer with object 0x1016 and another node has failed to send its heartbeat message. Index 0x1029 specifies the action to take when this error occurs.
0x8210	0x11	Not used	PDO not processed because of length error. A PDO with the wrong length has been received and thereby ignored. Index 0x1029 specifies the action to take when this error occurs
0x8140	0x1	Not used	The CrossFire™ FX1 has recovered from Bus off.
0x8120	0x1	Not used	The CrossFire™ FX1 has recovered from CAN error state.
0x1000	0x1	0x1	The CrossFire™ FX1 runs in EEPROM Error mode. This means that the EEPROM has malfunctioned. The CrossFire™ FX1 reverts to the default values for EEPROM, instead of the real values in EEPROM. The CrossFire™ FX1 can still work as desired if all the desired settings are sent by SDOs at startup.

Receive PDOs: Digital Outputs and PWM (Analog) Outputs

The CrossFire™ FX has 14 Digital High-Side Drivers. The first 8 (ports 41 to 48) are configured as Digital Outputs by default. The last 6 (ports 49 to 54) are configured as Non-regulated PWM Outputs.

The CrossFire™ FX also has 14 Regulated PWM Drivers, which consist of an Analog High-Side Driver and a Low-Side Driver each. Any pair of ports from the Regulated PWM Drivers can be reconfigured to act as two Digital Outputs.

To reconfigure the required ports, see Object Dictionary, index 0x2000 with the sub-index corresponding to the appropriate High-Side Driver port(s). The Low-Side Drivers require no reconfiguration.

Receive PDO 1:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0..7 Digital High-Side Output Ports 41 to 48	0..5 Digital High-Side Output Ports 49 to 54 6,7 - X	0..7 Analog High-Side Output Ports 61 to 68	0..5 Analog High-Side Output Ports 69 to 74 6,7 - X	0..7 Digital Low-Side Output Ports 81 to 88	0..5 Digital Low-Side Output Ports 89 to 94 6,7 - X	0..7 X	0..7 X

Only bits that correspond to Ports configured as Digital Outputs will be used

Ports 49 to 54 are the Non-regulated PWM Outputs and Ports 61 to 74 are the Regulated PWM Outputs. These PDOs are configured by default, except PDO 5 and 6. The communication parameters are set up beginning at index 0x1401 and the mapping parameters begin at index 0x1601.

Receive PDO 2:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Regulated PWM Output Port 61		Regulated PWM Output Port 62		Regulated PWM Output Port 63		Regulated PWM Output Port 64	

Receive PDO 3:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Regulated PWM Output Port 65		Regulated PWM Output Port 66		Regulated PWM Output Port 67		Regulated PWM Output Port 68	

Receive PDO 4:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Regulated PWM Output Port 69		Regulated PWM Output Port 70		Regulated PWM Output Port 71		Regulated PWM Output Port 72	

Additional Receive PDO 5:
not enabled by default. See Object Dictionary, Index 1404, s-idx 1.

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Regulated PWM Output Port 73		Regulated PWM Output Port 74		Non-Regulated PWM Output Port 49		Non-Regulated PWM Output Port 50	

Additional Receive PDO 6:
not enabled by default. See Object Dictionary, Index 1405, s-idx 1.

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Non-Regulated PWM Output Port 51		Non-Regulated PWM Output Port 52		Non-Regulated PWM Output Port 53		Non-Regulated PWM Output Port 54	

Transmit PDOs: Digital Inputs and Analog Inputs

This section describes the Transmit PDO information from the CrossFire™ FX1. The information transmitted over the CAN bus represents the state of the CrossFire™ FX1 inputs.

The CrossFire™ FX1 is highly configurable, and although there are only 6 default Digital Inputs, many of the other inputs can be configured to act as Digital Inputs as well. The ports are reconfigured by sending an SDO to the Object Dictionary at index 0x2000. The sub-index corresponds to the port number. For further information, see description in the Object Dictionary

Transmit PDO 1:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0..5 Digital Input Ports 1 - 6 6 - X 7 - Ana. In as Digital In Port 7	0..7 Ana. In as Digital Input Ports 8 - 15	0..6 Pulse Counter Input as Digital Input Ports 17-23 7 - X	0..1 Pulse Counter Input as Digital Input Ports 24,25 2..7 - X	0..7 Analog Input as Digital Input Ports 30-37	0..2 Analog Input as Digital Input Ports 38-40 3..7 - X	0 - Port 77, 1 - Port 78, 2 - Port 79, 3 - Port 80, 4 - Port 27, 5 - Port 28, 6 - Port 29 7 - X -status bits	0..7 X

- Only bits that correspond to ports configured as Digital Inputs are valid
- “X” denotes unused bits.

The following Analog Input ports can be configured as either Digital Inputs or Analog Inputs. By default, they are all configured as Analog Input ports. The configuration is set up by writing the appropriate SDO to the manufacturer-specific entries in the Object Dictionary at index 0x2000.

The mapping between Analog Inputs and the Object Dictionary follows the DS401 standard. The information is stored at index 0x6401, the Communication parameters at 0x1801 and the mapping parameters begin at 0x1A01. By default, the PDOs of the node are mapped to the I/O as follows:

Transmit PDO 2:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Analog Input Port 7		Analog Input Port 8		Analog Input Port 9		Analog Input Port 10	

Transmit PDO 3:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Analog Input Port 11		Analog Input Port 12		Analog Input Port 13		Analog Input Port 14	

Transmit PDO 4:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Analog Input 15		Analog Input 30		Analog Input 31		Analog Input Port 32	

- Additional Transmit PDOs: PDO 5 to PDO 17

The CrossFire™ FX1 has more Analog Inputs available that those shown in Transmit PDO 2, 3 and 4. However, since the 401 standard allows for a total of only 4 TPDOs by default, the remaining analog inputs will not be transmitted unless the user explicitly requests them during the pre-operational stage by sending the appropriate SDOs to configure the CrossFire™ FX1 to send the additional information.

The following additional PDOs are already mapped but need to be enabled in order to be transmitted. Several unused CANopen Node IDs must be set aside in order to enable all of the Additional PDOs listed below. See description of the Object Dictionary for further details.

- Analog Inputs, Additional Transmit PDO 5 and PDO 6

Additional Transmit PDO 5:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Analog Input Port 33		Analog Input Port 34		Analog Input Port 35		Analog Input Port 36	

Additional Transmit PDO 6:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Analog Input Port 37		Analog Input Port 38		Analog Input Port 39		Analog Input Port 40	

- Reg PWM Return Inputs as Analog Inputs. Additional Transmit PDO 7, 8, 9 and 10

Whether the Analog High-Side Drivers are used as Regulated PWM Outputs or not, these Regulated PWM Return Inputs can be read as Analog Inputs.

Transmit PDO 7:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Analog Input Port 81		Analog Input Port 82		Analog Input Port 83		Analog Input Port 84	

Transmit PDO 8:

Byte 1	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**	**Byte 8**
Analog Input Port 85		Analog Input Port 86		Analog Input Port 87		Analog Input Port 88	

Transmit PDO 9:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Analog Input Port 89		Analog Input Port 90		Analog Input Port 91		Analog Input Port 92	

Transmit PDO 10:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Analog Input Port 93		Analog Input Port 94		X		X	

» Internal Monitor (Analog) Inputs, Additional Transmit PDO 11 and PDO 12

The CrossFire™ FX has the ability to measure the voltage of its Power Inputs. These measurements are made with an A/D converter similar to the 20 Analog Input channels normally supplied.

Transmit PDO 11:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
$+5V_{Ref}1$ Port 75		$+5V_{Ref}2$ Port 76		$+24\ V_{ELX}$ Port 55		$+24\ V_{BATT}$ Port 56	

Transmit PDO 12:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
VP1 Port 57		VP2 Port 58		VP3 Port 59		VP4 Port 60	

» Pulse Counter Inputs, Additional Transmit PDO 13, 14, 15, 16 and 17

The CrossFire™ FX has a total of 9 Pulse Counter Inputs. Of these, 7 are square wave (numbered 17 to 23), and 2 are sinusoidal inputs (numbered 24 and 25).

Transmit PDO 13:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Pulse Counter Port 17				Pulse Counter Port 18			

Transmit PDO 14:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Pulse Counter Port 19				Pulse Counter Port 20			

Transmit PDO 15:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Pulse Counter Port 21				Pulse Counter Port 22			

Transmit PDO 16:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Pulse Counter Port 23				Pulse Counter Port 24			

Transmit PDO 17:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Pulse Counter Port 25				X			

Object Dictionary

Communication Profile Area; Index 0x1000 to 0x1FFF

Index	S-Idx	Type	Default	Saved	Description
0x1000	0	u32, ro	0xf0191	-	Device type: DS401, analog in/out, digital in/out
0x1001	0	u8, ro	0	-	Error Register: Bit coded as specified in DS301.
0x1003	0	u32, ro	0	-	Pre-Defined Error Field: Number of entries. Value is increased each time a new error is encountered.
	1..127	u32, ro	0	-	Error Code History. New sub-indices are created every time new error is encountered.
0x1005	0	u32, rw	0x80	No	COB ID Synch Object: SYNC configuration as specified in DS301. This module cannot generate sync messages.
0x1008	0	str, ro	CrossFire FX1	-	Device name.
0x1009	0	str, ro	1.0	-	Hardware version.
0x100A	0	str, ro	1.0	-	Software version.
0x100C	0	u16, rw	0	No	Guard time: as specified in DS301.
0x100D	0	u8, rw	0	No	Life time factor: as specified in DS301.
0x1014	0	u32, rw	0x80 + nnn	No	EMCY COB ID: as specified in DS301.
0x1016	0	u8, rw	0	No	Heartbeat: Number of entries. (Number of heartbeat guarded nodes)
	1 - 127	u32, rw	0	No	Heartbeat Consumer time. Monitoring time for node xx as specified in DS301.
0x1017	0	u16, rw	0	Yes	Producer heartbeat time as specified in DS301.
0x1018	0	u8, ro	4	-	Identity Object: Number of entries.
	1	u32, ro	0xF2	-	Vendor ID.
	2	u32, ro	TBD	-	Product code.
	3	u32, ro	0	-	Revision number.
	4	u32, ro	0	-	Serial number.
	0	u8, rw	9	No	Error Behaviour: Number of entries. 0 = Preoperational (if already operational) 1 = no state change 2 = Stopped
	1	u8, rw	0	No	Communication (mandatory) Not used.
	2	u8, rw	0	No	Bus off.

Index	S-Idx	Type	Default	Saved	Description
0x1029	3	u8, rw	0	No	CAN error state.
	4	u8, rw	0	No	CAN buffer overrun.
	5	u8, rw	0	No	SW error.
	6	u8, rw	0	No	Guarding of other node failed.
	7	u8, rw	0	No	Heartbeat from other node failed.
	8	u8, rw	1	No	PDO with wrong length received.
	9	u8, rw	1	No	EEPROM runs in error mode (revert to default values because EEPROM failed).
					Communication Parameters for Receive PDOs
0x1400	0	u8, ro	5	-	Receive PDO 1: Number of entries.
	1	u32, rw	0x0200 + Ynnn	No	COB ID for receive PDO 1.
	2	u8, rw	255	No	Transmission type for receive PDO 1.
	3	u16, rw	0	No	Inhibit time. Not used for receive PDOs.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer. Not used for receive PDOs.
0x1401	0	u8, ro	5	-	Receive PDO 2: Number of entries.
	1	u32, rw	0x0300 + Ynnn	No	COB ID for receive PDO 2.
	2	u8, rw	255	No	Transmission type for receive PDO 2.
	3	u16, rw	0	No	Inhibit time. Not used for receive PDOs.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer. Not used for receive PDOs.
0x1402	0	u8, ro	5	-	Receive PDO 3: Number of entries.
	1	u32, rw	0x0400 + Ynnn	No	COB ID for receive PDO 3.
	2	u8, rw	255	No	Transmission type for receive PDO 3.
	3	u16, rw	0	No	Inhibit time. Not used for receive PDOs.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer. Not used for receive PDOs.
0x1403	0	u8, ro	5	-	Receive PDO 4: Number of entries.
	1	u32, rw	0x0500 + Ynnn	No	COB ID for receive PDO 4.
	2	u8, rw	255	No	Transmission type for receive PDO 4.
	3	u16, rw	0	No	Inhibit time. Not used for receive PDOs.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer. Not used for receive PDOs.
	0	u8, ro	5	-	Receive PDO 5: Number of entries.

Index	S-Idx	Type	Default	Saved	Description
0x1404	1	u32, rw	0x8000	No	COB ID for receive PDO 5. to enable: set to 0x0200 + xxx
	2	u8, rw	255	No	Transmission type for receive PDO 5.
	3	u16, rw	0	No	Inhibit time. Not used for receive PDO s.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer. Not used for receive PDO s.
0x1405	0	u8, ro	5	-	Receive PDO 6: Number of entries.
	1	u32, rw	0x8000	No	COB ID for receive PDO 6. to enable: set to 0x0300 + xxx.
	2	u8, rw	255	No	Transmission type for receive PDO 6.
	3	u16, rw	0	No	Inhibit time. Not used for receive PDOs.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer. Not used for receive PDOs.
					Mapping Parameters for Receive PDOs
0x1600	0	u8, rw	6	No	Receive PDO 1. Number of entries. Maximum 8.
	1	u32, rw	0x62000108	No	First mapped object for receive PDO 1.
	2	u32, rw	0x62000208	No	Second mapped object for receive PDO 1.
	3	u32, rw	0x62000308	No	Third mapped object for receive PDO 1.
	4	u32, rw	0x62000408	No	Fourth mapped object for receive PDO 1.
	5	u32, rw	0x62000508	No	Fifth mapped object for receive PDO 1.
	6	u32, rw	0x62000608	No	Sixth mapped object for receive PDO 1.
	7	u32, rw	0	No	Seventh mapped object for receive PDO 1. Unused.
	8	u32, rw	0	No	Eighth mapped object for receive PDO 1. Unused.
0x1601	0	u8, rw	4	No	Receive PDO 2: Number of entries. Maximum 8.
	1	u32, rw	0x64110110	No	First mapped object for receive PDO 2.
	2	u32, rw	0x64110210	No	Second mapped object for receive PDO 2.
	3	u32, rw	0x64110310	No	Third mapped object for receive PDO 2.
	4	u32, rw	0x64110410	No	Fourth mapped object for receive PDO 2.
	5 – 8	u32, rw	-	No	Fifth to eighth mapped object for receive PDO2. Unused
0x1602	0	u8, rw	4	No	Receive PDO3: Number of entries. Maximum 8.
	1	u32, rw	0x64110510	No	First mapped object for receive PDO 3.

Index	S-Idx	Type	Default	Saved	Description
	2	u32, rw	0x64110610	No	Second mapped object for receive PDO 3.
	3	u32, rw	0x64110710	No	Third mapped object for receive PDO 3.
	4	u32, rw	0x64110810	No	Fourth mapped object for receive PDO 3.
	5 – 8	u32, rw	-	No	Fifth to eighth mapped object for receive PDO3. Unused
0x1603	0	u8, rw	4	No	Receive PDO4: Number of entries. Maximum 8.
	1	u32, rw	0x64110910	No	First mapped object for receive PDO 4.
	2	u32, rw	0x64110A10	No	Second mapped object for receive PDO 4.
	3	u32, rw	0x64110B10	No	Third mapped object for receive PDO 4.
	4	u32, rw	0x64110C10	No	Fourth mapped object for receive PDO 4.
	5 – 8	u32, rw	-	No	Fifth to eighth mapped object for receive PDO 4. Unused.
0x1604	0	u8, rw	4	No	Receive PDO5: Number of entries. Maximum 8.
	1	u32, rw	0x64110D10	No	First mapped object for receive PDO 5.
	2	u32, rw	0x64110E10	No	Second mapped object for receive PDO 5.
	3	u32, rw	0x64110F10	No	Third mapped object for receive PDO 5.
	4	u32, rw	0x64111010	No	Fourth mapped object for receive PDO 5.
	5 – 8	u32, rw	-	No	Fifth to eighth mapped object for receive PDO 5. Unused.
0x1605	0	u8, rw	4	No	Receive PDO6: Number of entries. Maximum 8.
	1	u32, rw	0x6411110	No	First mapped object for receive PDO 6.
	2	u32, rw	0x64111210	No	Second mapped object for receive PDO 6.
	3	u32, rw	0x64111310	No	Third mapped object for receive PDO 6.
	4	u32, rw	0x64111410	No	Fourth mapped object for receive PDO 6.
	5 – 8	u32, rw	-	No	Fifth to eighth mapped object for receive PDO 6. Unused.
					Communication Parameters for Transmit PDOs
0x1800	0	u8, ro	5	-	Transmit PDO 1. Number of entries.
	1	u32, rw	0x180 + nnn	No	COB ID for transmit PDO 1.
	2	u8, rw	255	No	Transmission type for transmit PDO 1.
	3	u16, rw	500	No	Inhibit time for transmit PDO 1.
	4	-	-	-	Unused.
	5	u16, rw	0	No	Event timer for transmit PDO 1.
0x1801	0	u8, ro	5	-	Transmit PDO 2. Number of entries.
	1	u32, rw	0x280 + nnn	No	COB ID for transmit PDO2.

Index	S-Idx	Type	Default	Saved	Description
	2	u8, rw	255	No	Transmission type for transmit PDO 2.
	3	u16, rw	500	No	Inhibit time for transmit PDO 2.
	4	-	-	-	Unused.
	5	u16, rw	0	No	Event timer for transmit PDO 2.
0x1802	0	u8, ro	5	-	Transmit PDO 3. Number of entries.
	1	u32, rw	0x380 + nnn	No	COB ID for transmit PDO 3.
	2	u8, rw	255	No	Transmission type for transmit PDO3.
	3	u16, rw	500	No	Inhibit time for transmit PDO 3.
	4	-	-	-	Unused.
	5	u16, rw	0	No	Event timer for transmit PDO 3.
0x1803	0	u8, ro	5	-	Transmit PDO 4. Number of entries.
	1	u32, rw	0x480 + nnn	No	COB ID for transmit PDO 4.
	2	u8, rw	255	No	Transmission type for transmit PDO 4.
	3	u16, rw	500	No	Inhibit time for transmit PDO 4.
	4	-	-	-	Unused.
	5	u16, rw	0	No	Event timer for transmit PDO 4.
0x1804	0	u8, ro	5	-	Transmit PDO 5. Number of entries.
	1	u32, rw	0x180 + vvv	No	COB ID for transmit PDO 5.
	2	u8, rw	255	No	Transmission type for transmit PDO 5.
	3	u16, rw	500	No	Inhibit time for transmit PDO 5.
	4	-	-	-	Unused.
	5	u16, rw	0	No	Event timer for transmit PDO 5.
0x1805	0	u8, ro	5	-	Transmit PDO 6. Number of entries.
	1	u32, rw	0x280 + vvv	No	COB ID for transmit PDO 6.
	2	u8, rw	255	No	Transmission type for transmit PDO 6.
	3	u16, rw	500	No	Inhibit time for transmit PDO 6.
	4	-	-	-	Unused.
	5	u16, rw	0	No	Event timer for transmit PDO 6.
0x1806	0	u8, ro	5	-	Transmit PDO 7. Number of entries.
	1	u32, rw	0x380 + vvv	No	COB ID for transmit PDO 7.
	2	u8, rw	255	No	Transmission type for transmit PDO 7.
	3	u16, rw	500	No	Inhibit time for transmit PDO 7.
	4	-	-	-	Unused.
	5	u16, rw	0	No	Event timer for transmit PDO 7.
0x1807	0	u8, ro	5	-	Transmit PDO 8. Number of entries.
	1	u32, rw	0x480 + vvv	No	COB ID for transmit PDO 8.

Index	S-Idx	Type	Default	Saved	Description
	2	u8, rw	255	No	Transmission type for transmit PDO 8.
	3	u16, rw	500	No	Inhibit time for transmit PDO 8.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer for transmit PDO8.
0x1808	0	u8, ro	5	-	Transmit PDO 9. Number of entries.
	1	u32, rw	0x180 + xxx	No	COB ID for transmit PDO 9.
	2	u8, rw	255	No	Transmission type for transmit PDO 9.
	3	u16, rw	500	No	Inhibit time for transmit PDO 9.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer for transmit PDO 9.
0x1809	0	u8, ro	5	-	Transmit PDO10. Number of entries.
	1	u32, rw	0x280 + xxx	No	COB ID for transmit PDO 10.
	2	u8, rw	255	No	Transmission type for transmit PDO 10.
	3	u16, rw	500	No	Inhibit time for transmit PDO 10.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer for transmit PDO 10.
0x1810	0	u8, ro	5	-	Transmit PDO 11. Number of entries.
	1	u32, rw	0x380 + xxx	No	COB ID for transmit PDO 11.
	2	u8, rw	255	No	Transmission type for transmit PDO 11.
	3	u16, rw	500	No	Inhibit time for transmit PDO 11.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer for transmit PDO 11.
0x1811	0	u8, ro	5	-	Transmit PDO 12. Number of entries.
	1	u32, rw	0x480 + xxx	No	COB ID for transmit PDO 12.
	2	u8, rw	255	No	Transmission type for transmit PDO 12.
	3	u16, rw	500	No	Inhibit time for transmit PDO 12.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer for transmit PDO 12.
0x1812	0	u8, ro	5	-	Transmit PDO 13. Number of entries.
	1	u32, rw	0x180 + yyy	No	COB ID for transmit PDO 13.
	2	u8, rw	255	No	Transmission type for transmit PDO 13.
	3	u16, rw	500	No	Inhibit time for transmit PDO 13.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer for transmit PDO 13.
0x1813	0	u8, ro	5	-	Transmit PDO 14. Number of entries.
	1	u32, rw	0x280 + yyy	No	COB ID for transmit PDO 14.
	2	u8, rw	255	No	Transmission type for transmit PDO 14.

Index	S-Idx	Type	Default	Saved	Description
	3	u16, rw	500	No	Inhibit time for transmit PDO 14.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer for transmit PDO 14.
0x1814	0	u8, ro	5	-	Transmit PDO 15. Number of entries.
	1	u32, rw	0x380 + yyy	No	COB ID for transmit PDO 15.
	2	u8, rw	255	No	Transmission type for transmit PDO15.
	3	u16, rw	500	No	Inhibit time for transmit PDO 15.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer for transmit PDO 15.
0x1815	0	u8, ro	5	-	Transmit PDO 16. Number of entries.
	1	u32, rw	0x480 + yyy	No	COB ID for transmit PDO 16.
	2	u8, rw	255	No	Transmission type for transmit PDO 16.
	3	u16, rw	500	No	Inhibit time for transmit PDO 16.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer for transmit PDO 16.
0x1816	0	u8, ro	5	-	Transmit PDO 17. Number of entries.
	1	u32, rw	0x180 + zzz	No	COB ID for transmit PDO 17.
	2	u8, rw	255	No	Transmission type for transmit PDO 17.
	3	u16, rw	500	No	Inhibit time for transmit PDO 17.
	4	-	-	-	Not used.
	5	u16, rw	0	No	Event timer for transmit PDO 17.
					Mapping Parameters for Transmit PDOs
0x1A00	0	u8, rw	7	No	Transmit PDO1. Number of entries.
	1	u32, rw	0x60000108	No	First mapped object for transmit PDO 1.
	2	u32, rw	0x60000208	No	Second mapped object for transmit PDO 1.
	3	u32, rw	0x60000308	No	Third mapped object for transmit PDO 1.
	4	u32, rw	0x60000408	No	Fourth mapped object for transmit PDO 1.
	5	u32, rw	0x60000508	No	Fifth mapped object for transmit PDO 1.
	6	u32, rw	0x60000608	No	Sixth mapped object for transmit PDO 1.
	7	u32, rw	0x60000708	No	Seventh mapped object for transmit PDO 1.
	8	u32, rw	0	No	Unused.
0x1A01	0	u8, rw	4	No	Number of entries.
	1	u32, rw	0x64010110	No	First mapped object for transmit PDO 2.
	2	u32, rw	0x64010210	No	Second mapped object for transmit PDO 2.
	3	u32, rw	0x64010310	No	Third mapped object for transmit PDO 2.

Index	S-Idx	Type	Default	Saved	Description
	4	u32, rw	0x64010410	No	Fourth mapped object for transmit PDO 2.
	5 – 8	u32, rw	-	No	Fifth to eighth mapped object for transmit PDO 2.
0x1A02	0	u8, rw	4	No	Number of entries.
	1	u32, rw	0x64010510	No	First mapped object for transmit PDO 3.
	2	u32, rw	0x64010610	No	Second mapped object for transmit PDO 3.
	3	u32, rw	0x64010710	No	Third mapped object for transmit PDO 3.
	4	u32, rw	0x64010810	No	Fourth mapped object for transmit PDO 3.
	5 – 8	u32, rw	-	No	Fifth to eighth mapped object for transmit PDO 3.
0x1A03	0	u8, rw	4	No	Number of entries.
	1	u32, rw	0x64010910	No	First mapped object for transmit PDO 4.
	2	u32, rw	0x64010A10	No	Second mapped object for transmit PDO 4.
	3	u32, rw	0x64010B10	No	Third mapped object for transmit PDO 4.
	4	u32, rw	0x64010C10	No	Fourth mapped object for transmit PDO 4.
	5 – 8	u32, rw	-	No	Fifth to eighths mapped object for transmit PDO 4.
0x1A04	0	u8, rw	4	No	Number of entries.
	1	u32, rw	0x64010D10	No	First mapped object for transmit PDO 5.
	2	u32, rw	0x64010E10	No	Second mapped object for transmit PDO 5
	3	u32, rw	0x64010F10	No	Third mapped object for transmit PDO 5.
	4	u32, rw	0x64011010	No	Fourth mapped object for transmit PDO 5.
	5 – 8	u32, rw	-	No	Fifth to eighths mapped object for transmit PDO 5.
0x1A05	0	u8, rw	4	No	Number of entries.
	1	u32, rw	0x64011110	No	First mapped object for transmit PDO 6.
	2	u32, rw	0x64011210	No	Second mapped object for transmit PDO 6.
	3	u32, rw	0x64011310	No	Third mapped object for transmit PDO 6.
	4	u32, rw	0x64011410	No	Fourth mapped object for transmit PDO 6.
	5 – 8	u32, rw	-	No	Fifth to eighths mapped object for transmit PDO 6.
0x1A06	0	u8, rw	4	No	Number of entries.
	1	u32, rw	0x64011510	No	First mapped object for transmit PDO 7.
	2	u32, rw	0x64011610	No	Second mapped object for transmit PDO 7.
	3	u32, rw	0x64011710	No	Third mapped object for transmit PDO 7.
	4	u32, rw	0x64011810	No	Fourth mapped object for transmit PDO 7.
	5 – 8	u32, rw	-	No	Fifth to eighths mapped object for transmit PDO 7.

Index	S-Idx	Type	Default	Saved	Description
0x1A07	0	u8, rw	4	No	Number of entries.
	1	u32, rw	0x64011910	No	First mapped object for transmit PDO 8.
	2	u32, rw	0x64011A10	No	Second mapped object for transmit PDO 8
	3	u32, rw	0x64011B10	No	Third mapped object for transmit PDO 8.
	4	u32, rw	0x64011C10	No	Fourth mapped object for transmit PDO 8.
	5 – 8	u32, rw	-	No	Fifth to eighths mapped object for transmit PDO 8.
0x1A08	0	u8, rw	4	No	Number of entries.
	1	u32, rw	0x64011D10	No	First mapped object for transmit PDO 9.
	2	u32, rw	0x64011E10	No	Second mapped object for transmit PDO 9.
	3	u32, rw	0x64011F10	No	Third mapped object for transmit PDO 9.
	4	u32, rw	0x64012010	No	Fourth mapped object for transmit PDO 9.
	5 – 8	u32, rw	-	No	Fifth to eighths mapped object for transmit PDO 9.
0x1A09	0	u8, rw	4	No	Number of entries.
	1	u32, rw	0x64012110	No	First mapped object for transmit PDO 10.
	2	u32, rw	0x64012210	No	Second mapped object for transmit PDO 10.
	3	u32, rw	0x0	No	Unused.
	4	u32, rw	0x0	No	Unused.
	5 – 8	u32, rw	-	No	Fifth to eighth mapped object for transmit PDO10
0x1A0A	0	u8, rw	4	No	Number of entries.
	1	u32, rw	0x64012310	No	First mapped object for transmit PDO 11.
	2	u32, rw	0x64012410	No	Second mapped object for transmit PDO 11.
	3	u32, rw	0x64012510	No	Third mapped object for transmit PDO 11.
	4	u32, rw	0x64012610	No	Fourth mapped object for transmit PDO 11
	5 – 8	u32, rw	-	No	Fifth to eighths mapped object for transmit PDO 11.
0x1A0B	0	u8, rw	4	No	Number of entries.
	1	u32, rw	0x64012710	No	First mapped object for transmit PDO 12.
	2	u32, rw	0x64012810	No	Second mapped object for transmit PDO 12.
	3	u32, rw	0x64012910	No	Third mapped object for transmit PDO 12.
	4	u32, rw	0x64012A10	No	Fourth mapped object for transmit PDO 12
	5 – 8	u32, rw	-	No	Fifth to eighth mapped object for transmit PDO 12.
0x1A0C	0	u8, rw	2	No	Number of entries.
	1	u32, rw	0x64020120	No	First mapped object for transmit PDO 13.
	2	u32, rw	0x64020220	No	Second mapped object for transmit PDO 13.

Index	S-Idx	Type	Default	Saved	Description
	3 – 8	u32, rw	-	No	Third to eighth mapped object for transmit PDO 13.
0x1A0D	0	u8, rw	2	No	Number of entries.
	1	u32, rw	0x64020320	No	First mapped object for transmit PDO14.
	2	u32, rw	0x64020420	No	Second mapped object for transmit PDO14
	3 – 8	u32, rw	-	No	Third to eighth mapped object for transmit PDO 14
0x1A0E	0	u8, rw	2	No	Number of entries.
	1	u32, rw	0x64020520	No	First mapped object for transmit PDO 15.
	2	u32, rw	0x64020620	No	Second mapped object for transmit PDO 15.
	3 – 8	u32, rw	-	No	Third to eighth mapped object for transmit PDO 15
0x1A0F	0	u8, rw	2	No	Number of entries.
	1	u32, rw	0x64020720	No	First mapped object for transmit PDO 16.
	2	u32, rw	0x64020820	No	Second mapped object for transmit PDO 16.
	3 – 8	u32, rw	-	No	Third to eighth mapped object for transmit PDO 16
0x1A10	0	u8, rw	1	No	Number of entries.
	1	u32, rw	0x64020920	No	First mapped object for transmit PDO 17.
	2 – 8	u32, rw	-	No	Second to eighth mapped object for transmit PDO 17

» Notes on Communication Profile Area

COB IDs are determined using a bitwise OR operation as follows:
Standard COB ID format: Base (hex) + Ynnn (hex)
COB ID format for additional PDOs: Base (hex) + Yxxx (hex)

Where,
nnn = node ID of this node,
xxx, yyy, etc. = an unused node ID.
Node's ID, 1 = use nnn directly.

Y bit 0..1 reserved
Y bit 2 : 0 = add nnn to this
Y bit 3: 0 = PDO enabled,1 = PDO disabled

Mapping Address

The mapping area controls where the received data in the receive PDOs will be stored. If these values are not changed then the default values will be used, the default value can be read as follows:

E.g.: 0x62000108

0x6200 = address in manufacturer specific area of Object Dictionary.
0x01 = sub index 1 (0x0A = sub-index 10, 0x10 = sub-index 16, etc)
0x08 = 1 byte (0x10 = 2 bytes, 0x20 = 4 bytes, etc.)

Object Dictionary - Continued
Manufacturer-Specific Profile Area; Index 0x2000 to 0x5FFF

Index	S-idx	Type	Default (possible)	Saved to EEPROM	Description
0x2000	0	u8, ro	94	-	Port Configuration: Number of entries. The values used have the following meaning 0= Analog Input 1 = Analog Output (or PWM Output). 2 = Digital Input 3 = Digital Output 4 = Pulse Counter Input
	1	u8, rw	2	Yes	Port configuration for Port 1.
	2	u8, rw	2	Yes	Port configuration for Port 2.
	3	u8, rw	2	Yes	Port configuration for Port 3.
	4	u8, rw	2	Yes	Port configuration for Port 4.
	5	u8, rw	2	Yes	Port configuration for Port 5.
	6	u8, rw	2	Yes	Port configuration for Port 6.
	7	u8, rw	0 (2)	Yes	Port configuration for Port 7.
	8	u8, rw	0 (2)	Yes	Port configuration for Port 8 .
	9	u8, rw	0 (2)	Yes	Port configuration for Port 9.
	10	u8, rw	0 (2)	Yes	Port configuration for Port 10.
	11	u8, rw	0 (2)	Yes	Port configuration for Port 11.
	12	u8, rw	0 (2)	Yes	Port configuration for Port 12.
	13	u8, rw	0 (2)	Yes	Port configuration for Port 13.
	14	u8, rw	0 (2)	Yes	Port configuration for Port 14.
	15	u8, rw	0 (2)	Yes	Port configuration for Port 15.
	16	u8, rw			Unused.
	17	u8, rw	4 (2)	Yes	Port configuration for Port 17.
	18	u8, rw	4 (2)	Yes	Port configuration for Port 18.
	19	u8, rw	4 (2)	Yes	Port configuration for Port 19.
	20	u8, rw	4 (2)	Yes	Port configuration for Port 20.
	21	u8, rw	4 (2)	Yes	Port configuration for Port 21.
	22	u8, rw	4 (2)	Yes	Port configuration for Port 22.
	23	u8, rw	4 (2)	Yes	Port configuration for Port 23.
	24	u8, rw	4 (2)	Yes	Port configuration for Port 24.

Index	S-idx	Type	Default (possible)	Saved to EEPROM	Description
	25	u8, rw	4 (2)	Yes	Port configuration for Port 25.
	26	u8, rw			Unused.
	27	u8, rw	2	Yes	Port configuration for Port 27.
	28	u8, rw	2	Yes	Port configuration for Port 28.
	29	u8, rw	2	Yes	Port configuration for Port 29.
	30	u8, rw	0 (2)	Yes	Port configuration for Port 30.
	31	u8, rw	0 (2)	Yes	Port configuration for Port 31.
	32	u8, rw	0 (2)	Yes	Port configuration for Port 32.
	33	u8, rw	0 (2)	Yes	Port configuration for Port 33.
	34	u8, rw	0 (2)	Yes	Port configuration for Port 34.
	35	u8, rw	0 (2)	Yes	Port configuration for Port 35.
	36	u8, rw	0 (2)	Yes	Port configuration for Port 36.
	37	u8, rw	0 (2)	Yes	Port configuration for Port 37.
	38	u8, rw	0 (2)	Yes	Port configuration for Port 38.
	39	u8, rw	0 (2)	Yes	Port configuration for Port 39.
	40	u8, rw	0 (2)	Yes	Port configuration for Port 40.
	41	u8, rw	3	Yes	Port configuration for Port 41.
	42	u8, rw	3	Yes	Port configuration for Port 42.
	43	u8, rw	3	Yes	Port configuration for Port 43.
	44	u8, rw	3	Yes	Port configuration for Port 44.
	45	u8, rw	3	Yes	Port configuration for Port 45.
	46	u8, rw	3	Yes	Port configuration for Port 46.
	47	u8, rw	3	Yes	Port configuration for Port 47.
	48	u8, rw	3	Yes	Port configuration for Port 48.
	49	u8, rw	3 (1)	Yes	Port configuration for Port 49.
	50	u8, rw	3 (1)	Yes	Port configuration for Port 50.
	51	u8, rw	3 (1)	Yes	Port configuration for Port 51.
	52	u8, rw	3 (1)	Yes	Port configuration for Port 52.
	53	u8, rw	3 (1)	Yes	Port configuration for Port 53.
	54	u8, rw	3 (1)	Yes	Port configuration for Port 54.
	55	u8, rw	0	Yes	Port configuration for Port 55.
	56	u8, rw	0	Yes	Port configuration for Port 56.
	57	u8, rw	0	Yes	Port configuration for Port 57.
	58	u8, rw	0	Yes	Port configuration for Port 58.
	59	u8, rw	0	Yes	Port configuration for Port 59.
	60	u8, rw	0	Yes	Port configuration for Port 60.

Index	S-idx	Type	Default (possible)	Saved to EEPROM	Description
	61	u8, rw	3 (1)	Yes	Port configuration for Port 61.
	62	u8, rw	3 (1)	Yes	Port configuration for Port 62.
	63	u8, rw	3 (1)	Yes	Port configuration for Port 63.
	64	u8, rw	3 (1)	Yes	Port configuration for Port 64.
	65	u8, rw	3 (1)	Yes	Port configuration for Port 65.
	66	u8, rw	3 (1)	Yes	Port configuration for Port 66.
	67	u8, rw	3 (1)	Yes	Port configuration for Port 67.
	68	u8, rw	3 (1)	Yes	Port configuration for Port 68.
	69	u8, rw	3 (1)	Yes	Port configuration for Port 69.
	70	u8, rw	3 (1)	Yes	Port configuration for Port 70.
	71	u8, rw	3 (1)	Yes	Port configuration for Port 71.
	72	u8, rw	3 (1)	Yes	Port configuration for Port 72.
	73	u8, rw	3 (1)	Yes	Port configuration for Port 73.
	74	u8, rw	3 (1)	Yes	Port configuration for Port 74.
	75	u8, rw	0	Yes	Port configuration for Port 75.
	76	u8, rw	0	Yes	Port configuration for Port 76.
	77	u8, rw	2	Yes	Port configuration for Port 77.
	78	u8, rw	2	Yes	Port configuration for Port 78.
	79	u8, rw	2	Yes	Port configuration for Port 79.
	80	u8, rw	2	Yes	Port configuration for Port 80.
	81	u8, rw	3	Yes	Port configuration for Port 81.
	82	u8, rw	3	Yes	Port configuration for Port 82.
	83	u8, rw	3	Yes	Port configuration for Port 83.
	84	u8, rw	3	Yes	Port configuration for Port 84.
	85	u8, rw	3	Yes	Port configuration for Port 85.
	86	u8, rw	3	Yes	Port configuration for Port 86.
	87	u8, rw	3	Yes	Port configuration for Port 87.
	88	u8, rw	3	Yes	Port configuration for Port 88.
	89	u8, rw	3	Yes	Port configuration for Port 89.
	90	u8, rw	3	Yes	Port configuration for Port 90.
	91	u8, rw	3	Yes	Port configuration for Port 91.
	92	u8, rw	3	Yes	Port configuration for Port 92.
	93	u8, rw	3	Yes	Port configuration for Port 93.
	94	u8, rw	3	Yes	Port configuration for Port 94.

Index	S-idx	Type	Default (possible)	Saved to EEPROM	Description
0x2002	0	u8,rw	40	Yes	Logic Threshold: Number of Entries. Only used when respective Analog Input ports are configured as Digital Inputs This index specifies the threshold above which voltages are interpreted as logic hi. Valid values are from 0 to 1023. If port accepts 0 – 5 V range: 512 = 2.5 V
	1 – 6				Unused.
	7	u16, rw	512	Yes	Logic Threshold for Port 7.
	8	u16, rw	512	Yes	Logic Threshold for Port 8.
	9	u16, rw	512	Yes	Logic Threshold for Port 9.
	10	u16, rw	512	Yes	Logic Threshold for Port 10.
	11	u16, rw	512	Yes	Logic Threshold for Port 11.
	12	u16, rw	512	Yes	Logic Threshold for Port 12.
	13	u16, rw	512	Yes	Logic Threshold for Port 13.
	14	u16, rw	512	Yes	Logic Threshold for Port 14.
	15	u16, rw	512	Yes	Logic Threshold for Port 15.
	16 – 29				Unused.
	30	u16, rw	512	Yes	Logic Threshold for Port 30.
	31	u16, rw	512	Yes	Logic Threshold for Port 31.
	32	u16, rw	512	Yes	Logic Threshold for Port 32.
	33	u16, rw	512	Yes	Logic Threshold for Port 33.
	34	u16, rw	512	Yes	Logic Threshold for Port 34.
	35	u16, rw	512	Yes	Logic Threshold for Port 35.
	36	u16, rw	512	Yes	Logic Threshold for Port 36.
	37	u16, rw	512	Yes	Logic Threshold for Port 37.
	38	u16, rw	512	Yes	Logic Threshold for Port 38.
	39	u16, rw	512	Yes	Logic Threshold for Port 39.
	40	u16, rw	512	Yes	Logic Threshold for Port 40.
0x2004			100		PWM Ripple Frequency in Hz. The PWM Ripple frequency is used for adding a ripple to the PWM Outputs. By using a ripple the coil is always in motion, thereby eliminating the “start energy” that is otherwise needed when changing the value of the PWMs. This makes the controlling of the coil more linear. Default value is 100 Hz. Maximum is 500 Hz.
0x2005			100		Ripple Amplitude.

Index	S-idx	Type	Default (possible)	Saved to EEPROM	Description
					This is the amplitude of the ripple for the PWM Outputs. Possible values are 0 – 2000, and these values are on the same scale as the output values of the PWMs. For example, if the user sets the ripple amplitude to 100, and sets the output of a PWM to 1000, the output will ripple between 900 – 1100. If instead the ripple amplitude is set to 200, the ripple would be 800 – 1200. Default value is 100.
0x2006			1000		PWM Frequency in Hz. The PWM frequency is the base frequency of the PWM Outputs. The maximum value is 1500 Hz. This frequency should be greater than the ripple frequency. Default value is 1000 Hz
0x200A	0	u8, ro	25	-	Pulse Counters: Number of Entries.
	1-16	u8,ro	0	-	Unused.
	17	u8, rw	0	No	Pulse Counter 17: To reset, overwrite with nonzero value.
	18	u8, rw	0	No	Pulse Counter 18: To reset, overwrite with nonzero value.
	19	u8, rw	0	No	Pulse Counter 19: To reset, overwrite with nonzero value.
	20	u8, rw	0	No	Pulse Counter 20: To reset, overwrite with nonzero value.
	21	u8, rw	0	No	Pulse Counter 21: To reset, overwrite with nonzero value.
	22	u8, rw	0	No	Pulse Counter 22: To reset, overwrite with nonzero value.
	23	u8, rw	0	No	Pulse Counter 23: To reset, overwrite with nonzero value.
	24	u8, rw	0	No	Pulse Counter 24: To reset, overwrite with nonzero value.
	25	u8, rw	0	No	Pulse Counter 25: To reset, overwrite with nonzero value.
0x2012	0	u8, rw	0	No	Reset EEPROM function. By writing a nonzero value to this index, the EEPROM will reset to its default values the next time the node is restarted or reset.

Object Dictionary - Continued

Device Specific Entries (DS401); Index 0x6000 to 0x9FFF

Index	S-Idx	Type	Default	Saved	Description
					Digital Inputs When configured in software as a Digital Input, the Analog and Pulse Counter Inputs also store their results in this section.
	0	u8, ro	7	-	Number of entries.
	1	u8, ro	0	No	Digital Switch Input Ports 1 – 6. Bit 0 – Digital Input Port 1 Bit 1 – Digital Input Port 2 Bit 2 – Digital Input Port 3 Bit 3 – Digital Input Port 4 Bit 4 – Digital Input Port 5 Bit 5 – Digital Input Port 6 Bit 6 – unused Bit 7 – Analog (as Digital Switch) in Port 7
	2	u8, ro	0	No	Analog Inputs configured as Digital Input Ports 8 to 15 Bit 0 – Analog (as Digital Input) Port 8 Bit 1 – Analog (as Digital Input) Port 9 Bit 2 – Analog (as Digital Input) Port 10 Bit 3 – Analog (as Digital Input) Port 11 Bit 4 – Analog (as Digital Input) Port 12 Bit 5 – Analog (as Digital Input) Port 13 Bit 6 – Analog (as Digital Input) Port 14 Bit 7 – Analog (as Digital Input) Port 15

Index	S-Idx	Type	Default	Saved	Description
0x6000	3	u8, ro	0	No	Pulse Counter Inputs configured as Digital Input Ports 17 to 23 Bit 0 – Port 17 Bit 1 – Port 18 Bit 2 – Port 19 Bit 3 – Port 20 Bit 4 – Port 21 Bit 5 – Port 22 Bit 6 – Port 23 Bit 7 – unused
	4	u8, ro	0	No	Universal Pulse Counter Inputs configured as Digital Input Ports 24 and 25 Bit 0 – Port 24 Bit 1 – Port 25 Bits 2..7 - Unused
	5	u8, ro	0	No	Analog Inputs configured as Digital Input Ports 30 to 37 Bit 0 – Analog (as Digital Input) Port 30 Bit 1 – Analog (as Digital Input) Port 31 Bit 2 – Analog (as Digital Input) Port 32 Bit 3 – Analog (as Digital Input) Port 33 Bit 4 – Analog (as Digital Input) Port 34 Bit 5 – Analog (as Digital Input) Port 35 Bit 6 – Analog (as Digital Input) Port 36 Bit 7 – Analog (as Digital Input) Port 37
	6	u8, ro	0	No	Analog Inputs configured as Digital Input Ports 38 to 40 Bit 0 – Analog (as Digital Input) Port 38 Bit 1 – Analog (as Digital Input) Port 39 Bit 2 – Analog (as Digital Input) Port 40 Bits 3..7 - Unused

Index	S-Idx	Type	Default	Saved	Description
	7	u8, ro	0	No	Digital High-Side Driver / Non-regulating PWM Status Bits Bit 0 – Status Bit Port 77 -> Port 41, 42 Bit 1 – Status Bit Port 78 -> Port 43, 44 Bit 2 – Status Bit Port 79 -> Port 45, 46 Bit 3 – Status Bit Port 80 -> Port 47, 48 Bit 4 – Status Bit Port 27 -> Port 49, 50 Bit 5 – Status Bit Port 28 -> Port 51, 52 Bit 6 – Status Bit Port 29 -> Port 53, 54 Bit 7 – unused
	8	u8, ro	0	No	Unused.
					Digital Outputs When configured in software as a Digital Outputs, the Analog High-Side Drivers and associated Low-Side Drivers also use this section.
0x6200	0	u8, ro	8	-	Number of entries.
	1	u8, rw	0	No	Digital High-Side Driver Ports 41 to 48 Bit 0 – Port 41 Bit 1 – Port 42 Bit 2 – Port 43 Bit 3 – Port 44 Bit 4 – Port 45 Bit 5 – Port 46 Bit 6 – Port 47 Bit 7 – Port 48

Index	S-Idx	Type	Default	Saved	Description
0x6200	2	u8, rw	0	No	Digital High-Side Drivers (Non-regulated PWM Outputs) configured as Digital Output Ports 49 to 54 Bit 0 –Port 49 Bit 1 – Port 50 Bit 2 – Port 51 Bit 3 – Port 52 Bit 4 – Port 53 Bit 5 – Port 54 Bit 6 – Not used Bit 7 – Not used Each bit is only used when the corresponding port is configured as Digital Output.
	3	u8, rw	0	No	Analog High-Side Drivers configured as Digital Output Ports 61 to 68 Bit 0 – Port 61 Bit 1 – Port 62 Bit 2 – Port 63 Bit 3 – Port 64 Bit 4 – Port 65 Bit 5 – Port 66 Bit 6 – Port 67 Bit 7 – Port 68 Each bit is only used when the corresponding port is configured as Digital Output.

Index	S-Idx	Type	Default	Saved	Description
0x6200	4	u8, rw	0	0	Analog High-Side Drivers configured as Digital Output Ports 69 to 74 Bit 0 – Port 69 Bit 1 – Port 70 Bit 2 – Port 71 Bit 3 – Port 72 Bit 4 – Port 73 Bit 5 – Port 74 Bit 6 – unused Bit 7 – unused Each bit is only used when the corresponding port is configured as Digital Output.
	5	u8, rw	0	0	Low Side Driver Ports 81 to 88 Bit 0 – Port 81 Bit 1 – Port 82 Bit 2 – Port 83 Bit 3 – Port 84 Bit 4 – Port 85 Bit 5 – Port 86 Bit 6 – Port 87 Bit 7 – Port 88
	6	u8, rw	0	0	Low Side Driver Ports 89 to 94 Bit 0 – Port 89 Bit 1 – Port 90 Bit 2 – Port 91 Bit 3 – Port 92 Bit 4 – Port 93 Bit 5 – Port 94 Bit 6 – unused Bit 7 – unused
	7	u8, rw	0	0	unused
	8	u8, rw	0	0	unused
					Analog Inputs

Index	S-Idx	Type	Default	Saved	Description
					* Only valid when the respective port is configured as an Analog Input
0x6401	0	u8, ro	42	-	16 Bit Analog Inputs: Number of entries.
	1	u16, ro	0	-	Analog Input Port 7*
	2	u16, ro	0	-	Analog Input Port 8*
	3	u8, ro	0	-	Analog Input Port 9*
	4	u16, ro	0	-	Analog Input Port 10*
	5	u16, ro	0	-	Analog Input Port 11*
	6	u16, ro	0	-	Analog Input Port 12*
	7	u16, ro	0	-	Analog Input Port 13*
	8	u16, ro	0	-	Analog Input Port 14*
	9	u16, ro	0	-	Analog Input Port 15*
	10	u16, ro	0	-	Analog Input Port 30*
	11	u16, ro	0	-	Analog Input Port 31*
	12	u16, ro	0	-	Analog Input Port 32*
	13	u16, ro	0	-	Analog Input Port 33*
	14	u16, ro	0	-	Analog Input Port 34*
	15	u16, ro	0	-	Analog Input Port 35*
	16	u16, ro	0	-	Analog Input Port 36*
	17	u16, ro	0	-	Analog Input Port 37*
	18	u16, ro	0	-	Analog Input Port 38*
	19	u16, ro	0	-	Analog Input Port 39*
	20	u16, ro	0	-	Analog Input Port 40*
	21	u16, ro	0	-	Reg PWM Return port 81
	22	u16, ro	0	-	Reg PWM Return Port 82
	23	u16, ro	0	-	Reg PWM Return Port 83
	24	u16, ro	0	-	Reg PWM Return Port 84
	25	u16, ro	0	-	Reg PWM Return Port 85
	26	u16, ro	0	-	Reg PWM Return Port 86
	27	u16, ro	0	-	Reg PWM Return Port 87
	28	u16, ro	0	-	Reg PWM Return Port 88
	29	u16, ro	0	-	Reg PWM Return Port 89
	30	u16, ro	0	-	Reg PWM Return Port 90
	31	u16, ro	0	-	Reg PWM Return Port 91
	32	u16, ro	0	-	Reg PWM Return Port 92
	33	u16, ro	0	-	Reg PWM Return Port 93
	34	u16, ro	0	-	Reg PWM Return Port 94

Index	S-Idx	Type	Default	Saved	Description
	35	u16, ro	0	-	Power/Ref Status +5Vref1 Port 75
	36	u16, ro	0	-	Power/Ref Status +5Vref2 Port 76
	37	u16, ro	0	-	Power/Ref Status V+ ELX Port 55
	38	u16, ro	0	-	Power/Ref Status V+ batt Port 56
	39	u16, ro	0	-	Power/Ref Status VP1 Port 57
	40	u16, ro	0	-	Power/Ref Status VP2 Port 58
	41	u16, ro	0	-	Power/Ref Status VP3 Port 59
	42	u16, ro	0	-	Power/Ref Status VP4 Port 60
0x6402	0	u8, ro	9	-	32-bit Analog Inputs: Number of entries. Only valid when respective port is configured as a Pulse Counter Input
	1	u32, ro	0	-	Pulse Counter Input Port 17
	2	u32, ro	0	-	Pulse Counter Input Port 18
	3	u32, ro	0	-	Pulse Counter Input Port 19
	4	u32, ro	0	-	Pulse Counter Input Port 20
	5	u32, ro	0	-	Pulse Counter Input Port 21
	6	u32, ro	0	-	Pulse Counter Input Port 22
	7	u32, ro	0	-	Pulse Counter Input Port 23
	8	u32, ro	0	-	Pulse Counter Input Port 24
	9	u32, ro	0	-	Pulse Counter Input Port 25
					PWM (Analog) Outputs Only used when respective port is configured as an Analog Output
0x6411	0	u8, ro	20	-	Number of entries.
	1	u16, rw	0	No	Analog Output Port 61
	2	u16, rw	0	No	Analog Output Port 62
	3	u16, rw	0	No	Analog Output Port 63
	4	u16, rw	0	No	Analog Output Port 64
	5	u16, rw	0	No	Analog Output Port 65
	6	u16, rw	0	No	Analog Output Port 66
	7	u16, rw	0	No	Analog Output Port 67
	8	u16, rw	0	No	Analog Output Port 68
	9	u16, rw	0	No	Analog Output Port 69
	10	u16, rw	0	No	Analog Output Port 70
	11	u16, rw	0	No	Analog Output Port 71
	12	u16, rw	0	No	Analog Output Port 72

Index	S-Idx	Type	Default	Saved	Description
	13	u16, rw	0	No	Analog Output Port 73
	14	u16, rw	0	No	Analog Output Port 74
	15	u16, rw	0	No	Analog Output Port 49
	16	u16, rw	0	No	Analog Output Port 50
	17	u16, rw	0	No	Analog Output Port 51
	18	u16, rw	0	No	Analog Output Port 52
	19	u16, rw	0	No	Analog Output Port 53
	20	u16, rw	0	No	Analog Output Port 54

CrossFire™ FX1

Appendix 1 Environmental Tolerances

Physical Environmental Tolerances

Environmental Test	Level	Standard
Operating Temperature	Functional During test -40 °C to +85 °C in a 24-hour cycle duration of 50 days max. rate of change is ca. 100 °C/hour	JDQ 53.2, section 15.2
Storage temperature	Functional After test -55 °C for 24 hours +105 °C for 24 hours	JDQ 53.2, section 16
Humidity	Functional After test, 95% relative humidity for 168 hours @ 40 °C	JDQ 53.2, section 17.2
Inorganic Dust	Functional After test, no dust infiltration. 24 hours exposure to SAE J726 dust. performed @ 25 °C	JDQ 53.2, section 7
Salt Spray	Functional After test, no corrosion. 5% aqueous solution for 48 hours @ 35 °C	JDQ 53.2, section 9
Cleaning	Functional After test 55 psi spray wash with 0.075 orifice held at 1 meter from unit water temperature of 15 °C	JDQ 53.2, section 12
Splash	Functional After test splash with various chemicals, e.g. fuels, lubricants, ethylene glycol, rain, battery acid, refrigerant, paints, fertilizers	JDQ 53.2, section 13
Immersion	Functional After test immerse for 5 minutes in 18 °C tap water depth of 500 mm freeze in -10 °C air for 1 hour allow to reach room temp and dry.	JDQ 53.2 section 28
Shock	Operating Shock: Functional After test, visual inspection 5 ms pulse, 490 m/s^2 (50 g's) Bench Handling Shock: Functional After test, visual inspection one edge of the unit is raised to a 45° angle and dropped on an oak table. Transit Shock: Functional After test, visual inspection the unit is dropped from 1.2 m in its shipping container	JDQ 53.2 sections 11.2, 14.1.2, 14.2
Vibration	Functional During test, visual inspection. 1.5 mm amplitude 10 to 40 Hz 35 m/s^2 (5 g's) amp. From 40 to 2000 Hz 8 hours in 3 directions	JDQ 53.2 section 10.2

Particle Impact	Functional After test blast with air/gravel at 70 psig for 10 s. gravel diameter 0.96 to 1.6 cm 12 cycles for a total time of 2 min.	JDQ 53.2 section 29

Electrical Environmental Tolerances

Environmental Test	Level	Standard
Maximum Load	Functional During and After Test operation at 32 Volts, with all outputs activated to produce max. current draw. Duration = 168 hours	JDQ 53.2 section 19.2
Vehicle Start up Operation	Functional After test Power supply = 10.6 Volts @ -30 °C duration of 5 minutes	JDQ 53.2 section 19.3
Vehicle Jump Start Operation	Functional After test Power supply = 36 Volts @ +70 °C duration of 5 minutes	JDQ 53.2 section 19.4
Battery-less Operation	Functional During test (Micro-controller should not reset, and no outputs are activated) Power supply = 14.0 + | 22 sin(2πft) | sweep from 150 Hz to 1.5 kHz	JDQ 53.2 section 19.6.1
Electrical Transients	Functional During Test • Negative Inductive Switching • Positive Inductive Switching • Inductive & Capacitive Switching • Start-up Waveform	ISO 7637-2 Pulse 1 ISO 7637-2 Pulse 2 ISO 7637-2 Pulse 3 ISO 7637-2 Pulse 4
	Functional After test • Load Dump • Inductive Load Switching • Alternator Field Decay • Inductive and Capacative Coupled Switching Transients	JDQ 53.2 section 19.7.2
Short Circuit Protection	Functional After test Short all external leads to all other external leads, and the case.	JDQ 53.2 section 20
EMC Susceptibility (Component)	Functional During test Electromagnetic field strength of 100 V/m each of 3 axes continuous wave from 14 kHz to 1 GHz	JDQ 53.2 section 22.2.1
RF electromagnetic field	Functional During test 14kHz – 1GHz 100V/m	ISO 11452-2

Radiated emission	Functional During test max acceptable level @ distance of 1m Frequency Narrowb. Broadb. dBµV/m 30-75 MHz 54-44 64-54 75-400 MHz 44-55 54-65 400-1000 MHz 55 65	ISO 14982
Electrostatic Discharge	Functional After test 8 kV contact or 15 kV air 10 pulses in 10 seconds.	JDQ 53.2 section 26 IEC-801-2

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Appendix 2 - I/O Interface in order of Port Number

I/O Interface

Port	Conn.Pin	Default Signal Type	Other Configurations
1	J3.C3	Digital Input	
2	J1.C1	Digital Input	
3	J3.C4	Digital Input	
4	J2.E2	Digital Input	
5	J2.D1	Digital Input	
6	J2.D2	Digital Input	
7	J1.E2	Analog Input	Digital Input
8	J1.C2	Analog Input	Digital Input
9	J1.F1	Analog Input	Digital Input
10	J3.D3	Analog Input	Digital Input
11	J2.F3	Analog Input	Digital Input
12	J2.C1	Analog Input	Digital Input
13	J1.G1	Analog Input	Digital Input
14	J1.H1	Analog Input	Digital Input
15	J1.D2	Analog Input	Digital Input
16	undefined		
17	J1.B2	Pulse Counter Input	Digital Input
18	J1.B1	Pulse Counter Input	Digital Input
19	J1.A1	Pulse Counter Input	Digital Input
20	J2.G2	Pulse Counter Input	Digital Input
21	J2.G1	Pulse Counter Input	Digital Input
22	J2.H2	Pulse Counter Input	Digital Input
23	J2.H1	Pulse Counter Input	Digital Input
24	J2.E3	Pulse Counter Input	Digital Input
25	J1.D1	Pulse Counter Input	Digital Input
26	undefined		
27	internal	status bit 5 for PWM 49, 50	
28	internal	status bit 6 for PWM 51, 52	
29	internal	status bit 7 for PWM 53, 54	
30	J2.C2	Analog Input	Digital Input
31	J2.G3	Analog Input	Digital Input
32	J3.E3	Analog Input	Digital Input
33	J3.E4	Analog Input	Digital Input
34	J3.F4	Analog Input	Digital Input
35	J3.G4	Analog Input	Digital Input
36	J3.H4	Analog Input	Digital Input
37	J3.G3	Analog Input	Digital Input
38	J1.F2	Analog Input	Digital Input
39	J3.D4	Analog Input	Digital Input
40	J3.F3	Analog Input	Digital Input
41	J2.K3	Digital Output	
42	J2.L3	Digital Output	
43	J2.K4	Digital Output	

44	J2.J4	Digital Output	
45	J2.H4	Digital Output	
46	J2.G4	Digital Output	
47	J1.G2	Digital Output	
48	J1.G3	Digital Output	
49	J2.E4	Non-regulated PWM Output	Digital Output
50	J2.F4	Non-regulated PWM Output	Digital Output
51	J3.E1	Non-regulated PWM Output	Digital Output
52	J3.D1	Non-regulated PWM Output	Digital Output
53	J2.C4	Non-regulated PWM Output	Digital Output
54	J2.D4	Non-regulated PWM Output	Digital Output
55	J2.M1	Power +24 V_{ELX}	
56	J2.L1	Power +24 V_{BATT}	
57	J3.H1	Valve Power (VP1)	
58	J2.L4	Valve Power (VP2)	
59	J1.H4	Valve Power (VP3)	
60	J2.M4	Valve Power (VP4)	
61	J2.A4	Reg. PWM Output 1	Digital Output
62	J2.D3	Reg. PWM Output 2	Digital Output
63	J3.C2	Reg. PWM Output 3	Digital Output
64	J3.B2	Reg. PWM Output 4	Digital Output
65	J1.C4	Reg. PWM Output 5	Digital Output
66	J1.D4	Reg. PWM Output 6	Digital Output
67	J3.F1	Reg. PWM Output 7	Digital Output
68	J3.C1	Reg. PWM Output 8	Digital Output
69	J3.H2	Reg. PWM Output 9	Digital Output
70	J3.G2	Reg. PWM Output 10	Digital Output
71	J1.F3	Reg. PWM Output 11	Digital Output
72	J1.E3	Reg. PWM Output 12	Digital Output
73	J1.B3	Reg. PWM Output 13	Digital Output
74	J1.C3	Reg. PWM Output 14	Digital Output
75	J2.K1	Sensor +5 V_{Ref} 1	
76	J2.J1	Sensor +5 V_{Ref} 2	
77	internal	status bit 1 for ports 41, 42	
78	internal	status bit 2 for ports 43, 44	
79	internal	status bit 3 for ports 45, 46	
80	internal	status bit 4 for ports 47, 48	
81	J2.B4	Regulated PWM Return 1	Analog Input, NPN Digital Output
82	J2.C3	Regulated PWM Return 2	Analog Input, NPN Digital Output
83	J3.A1	Regulated PWM Return 3	Analog Input, NPN Digital Output
84	J3.A2	Regulated PWM Return 4	Analog Input, NPN Digital Output
85	J1.B4	Regulated PWM Return 5	Analog Input, NPN Digital Output
86	J1.E4	Regulated PWM Return 6	Analog Input, NPN Digital Output
87	J3.F2	Regulated PWM Return 7	Analog Input, NPN Digital Output
88	J3.B1	Regulated PWM Return 8	Analog Input, NPN Digital Output
89	J3.H3	Regulated PWM Return 9	Analog Input, NPN Digital Output
90	J3.G1	Regulated PWM Return 10	Analog Input, NPN Digital Output
91	J1.F4	Regulated PWM Return 11	Analog Input, NPN Digital Output
92	J1.G4	Regulated PWM Return 12	Analog Input, NPN Digital Output
93	J1.A3	Regulated PWM Return 13	Analog Input, NPN Digital Output
94	J1.A4	Regulated PWM Return 14	Analog Input, NPN Digital Output

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Technical Support

Contact your reseller or supplier for help with possible problems with your CrossFire™ FX1. In order to get the best help, you should have access to your CrossFire™ FX1 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
- EMCY object Error Codes (if possible)
- Description of external equipment which is connected to the CrossFire™ FX1

CrossFire™ FX1

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