

Features

- **Embedded 12/24VDC Solenoid Output¹ Module**
 - 22 x Dual Transistor Outputs
 - Discrete or proportional control
 - Switched Coil Supply & Return (Redundancy)
 - Multi-Stage Diagnostic Monitoring
 - 200MIP DSP Controller
 - Programmable PWM Frequency
- **CAN Network**
 - Opto-Coupler Isolation
 - CAN 2.0B Compatible
- **Operates -10°C to +85°C**
 - All industrial components
- **Heavy Duty Enclosure**
 - Electro Nickel Plated
 - Rugged Construction

Description

The LOPE Industrial Solenoid Module is of the Obelix genus designed to directly support Rexroth 12VDC/24VDC 150Hz Solenoids, both proportional and discrete via programmable PWM duty cycle. Additionally, this module supports programmable PWM frequency permitting connection of other solenoid types such as Apitech 12VDC 33Hz.



Obelix

Industrial Solenoid Module

Type LOPE



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¹ Single Fault Tolerant



Typical Applications

- Continuous Bolter/Miners
- Continuous Haulage
- Long Wall Shearers
- Mobile Bolters
- Mobile Roof Supports
- Remote Control Scoops
- Remote Control Loaders
- Any industrial switching application

Ordering Information

Part Number	Description
LOPE0101	Generic Industrial Solenoid Module (Rexroth 24VDC/Apitech 12VDC)
LOPE0201	Generic Industrial Solenoid Module (Rexroth 24VDC/Apitech 12VDC)
H0PE0101	Connector Assembly A30
H0PE0201	Connector Assembly B30
H0PE0301	Connector Assembly C30
H0PE0401	Connector Assembly D30

Interface Description

The Type LOPE Solenoid Module utilizes industrial connectors that are unique when configured for use with the Obelix Control System via type, gender or keying physically preventing improper installation.



Wiring Assignments

Connector A30 V35 Female 34 Way		
PIN	Description	Signal
A30-A	Solenoid 11 Positive	24VDC Switched
A30-B	Solenoid 10 Positive	24VDC Switched
A30-C	Solenoid 11 Negative	24VDC Return
A30-D	Solenoid 10 Negative	24VDC Return
A30-E	CAN Address Modifier 2	24VDC Digital Input
A30-F	Solenoid 9 Positive	24VDC Switched
A30-H	CAN Address Modifier 1	24VDC Digital Input
A30-J	Solenoid 9 Negative	24VDC Return
A30-K	CAN Address Modifier 0	24VDC Digital Input
A30-L	Solenoid 8 Positive	24VDC Switched
A30-M	RS-232 Transmit	Communications
A30-N	Solenoid 8 Negative	24VDC Return
A30-P	RS-232 Receive	Communications
A30-R	Solenoid 7 Negative	24VDC Return
A30-S	RS-232 0VDC Reference	Communications
A30-T	Solenoid 7 Positive	24VDC Switched
A30-U	Solenoid 1 Positive	24VDC Switched
A30-V	Solenoid 6 Negative	24VDC Return
A30-W	Solenoid 1 Negative	24VDC Return
A30-X	Solenoid 6 Positive	24VDC Switched
A30-Y	Solenoid 2 Positive	24VDC Switched
A30-Z	Solenoid 5 Negative	24VDC Return
A30-AA	Solenoid 2 Negative	24VDC Return
A30-BB	Solenoid 5 Positive	24VDC Switched
A30-CC	Solenoid 3 Positive	24VDC Switched
A30-DD	Solenoid 4 Negative	24VDC Return
A30-EE	Solenoid 3 Negative	24VDC Return
A30-FF	Solenoid 4 Positive	24VDC Switched
A30-HH	Solenoid Supply 24VDC	24VDC Supply Input
A30-JJ	Solenoid Supply 0VDC	0VDC Supply Input
A30-KK	Solenoid Supply 24VDC	24VDC Supply Input
A30-LL	Solenoid Supply 0VDC	0VDC Supply Input
A30-MM	Solenoid Supply 24VDC	24VDC Supply Input
A30-NN	Solenoid Supply 0VDC	0VDC Supply Input



Wiring Assignments Continued

Connector A2 Burdndy Female 8 Way		
PIN	Description	Signal
A2-A	Supply Input	24VDC Supply Input
A2-B	Supply Input	0VDC Supply Input
A2-C	CAN A (Positive)	Communications
A2-D	CAN A (Positive)	Communications
A2-E	CAN A (Negative)	Communications
A2-F	CAN A (Negative)	Communications
A2-G	Termination Link 1 - 1	Termination Link Input
A2-H	Termination Link 1 - 2	Termination Link Input

Connector B30 V35 Female 34 Way		
PIN	Description	Signal
B30-A	Solenoid 22 Positive	24VDC Switched
B30-B	Solenoid 21 Positive	24VDC Switched
B30-C	Solenoid 22 Negative	24VDC Return
B30-D	Solenoid 21 Negative	24VDC Return
B30-E	CAN Address Modifier 2	24VDC Digital Input
B30-F	Solenoid 20 Positive	24VDC Switched
B30-H	CAN Address Modifier 1	24VDC Digital Input
B30-J	Solenoid 20 Negative	24VDC Return
B30-K	CAN Address Modifier 1	24VDC Digital Input
B30-L	Solenoid 19 Positive	24VDC Switched
B30-M	RS-232 Transmit	Communications
B30-N	Solenoid 19 Negative	24VDC Return
B30-P	RS-232 Receive	Communications
B30-R	Solenoid 18 Negative	24VDC Return
B30-S	RS-232 0VDC Reference	Communications
B30-T	Solenoid 18 Positive	24VDC Switched
B30-U	Solenoid 12 Positive	24VDC Switched
B30-V	Solenoid 17 Negative	24VDC Return
B30-W	Solenoid 12 Negative	24VDC Return
B30-X	Solenoid 17 Positive	24VDC Switched
B30-Y	Solenoid 13 Positive	24VDC Switched
B30-Z	Solenoid 16 Negative	24VDC Return
B30-AA	Solenoid 13 Negative	24VDC Return
B30-BB	Solenoid 16 Positive	24VDC Switched
B30-CC	Solenoid 14 Positive	24VDC Switched
B30-DD	Solenoid 15 Negative	24VDC Return
B30-EE	Solenoid 14 Negative	24VDC Return
B30-FF	Solenoid 15 Positive	24VDC Switched
B30-HH	Solenoid Supply 24VDC	24VDC Supply Input
B30-JJ	Solenoid Supply 0VDC	0VDC Supply Input
B30-KK	Solenoid Supply 24VDC	24VDC Supply Input
B30-LL	Solenoid Supply 0VDC	0VDC Supply Input
B30-MM	Solenoid Supply 24VDC	24VDC Supply Input
B30-NN	Solenoid Supply 0VDC	0VDC Supply Input



CAN Definitions

RX				
Message	Byte	Type	Mask	Description
0x07C8	1	UINT8	N/A	Solenoid 1 Control Word (LSB)
	2	UINT8	N/A	Solenoid 1 Control Word (MSB)
	3	UINT8	N/A	Solenoid 2 Control Word (LSB)
	4	UINT8	N/A	Solenoid 2 Control Word (MSB)
	5	UINT8	N/A	Solenoid 3 Control Word (LSB)
	6	UINT8	N/A	Solenoid 3 Control Word (MSB)
	7	UINT8	N/A	Solenoid 4 Control Word (LSB)
	8	UINT8	N/A	Solenoid 4 Control Word (MSB)

RX				
Message	Byte	Type	Mask	Description
0x07D0	1	UINT8	N/A	Solenoid 5 Control Word (LSB)
	2	UINT8	N/A	Solenoid 5 Control Word (MSB)
	3	UINT8	N/A	Solenoid 6 Control Word (LSB)
	4	UINT8	N/A	Solenoid 6 Control Word (MSB)
	5	UINT8	N/A	Solenoid 7 Control Word (LSB)
	6	UINT8	N/A	Solenoid 7 Control Word (MSB)
	7	UINT8	N/A	Solenoid 8 Control Word (LSB)
	8	UINT8	N/A	Solenoid 8 Control Word (MSB)

RX				
Message	Byte	Type	Mask	Description
0x07D8	1	UINT8	N/A	Solenoid 9 Control Word (LSB)
	2	UINT8	N/A	Solenoid 9 Control Word (MSB)
	3	UINT8	N/A	Solenoid 10 Control Word (LSB)
	4	UINT8	N/A	Solenoid 10 Control Word (MSB)
	5	UINT8	N/A	Solenoid 11 Control Word (LSB)
	6	UINT8	N/A	Solenoid 11 Control Word (MSB)
	7	UINT8	N/A	-
	8	UINT8	N/A	Solenoid Supply Enable Default is 150Hz

Solenoid Supply Enable

0x00 = Solenoid Supply Disable

0x01 = Solenoid Supply Enable

0x02 = Solenoid Supply Reset

Any other N value will alter the PWM frequency where N acts as a reference divider and is given by the following formula:

$$N = \frac{30MHz}{4100 \times fpwm}$$



CAN Definitions Continued

RX				
Message	Byte	Type	Mask	Description
0x07C9	1	UINT8	N/A	Solenoid 12 Control Word (LSB)
	2	UINT8	N/A	Solenoid 12 Control Word (MSB)
	3	UINT8	N/A	Solenoid 13 Control Word (LSB)
	4	UINT8	N/A	Solenoid 13 Control Word (MSB)
	5	UINT8	N/A	Solenoid 14 Control Word (LSB)
	6	UINT8	N/A	Solenoid 14 Control Word (MSB)
	7	UINT8	N/A	Solenoid 15 Control Word (LSB)
	8	UINT8	N/A	Solenoid 15 Control Word (MSB)

RX				
Message	Byte	Type	Mask	Description
0x07D1	1	UINT8	N/A	Solenoid 16 Control Word (LSB)
	2	UINT8	N/A	Solenoid 16 Control Word (MSB)
	3	UINT8	N/A	Solenoid 17 Control Word (LSB)
	4	UINT8	N/A	Solenoid 17 Control Word (MSB)
	5	UINT8	N/A	Solenoid 18 Control Word (LSB)
	6	UINT8	N/A	Solenoid 18 Control Word (MSB)
	7	UINT8	N/A	Solenoid 19 Control Word (LSB)
	8	UINT8	N/A	Solenoid 19 Control Word (MSB)

RX				
Message	Byte	Type	Mask	Description
0x07D9	1	UINT8	N/A	Solenoid 20 Control Word (LSB)
	2	UINT8	N/A	Solenoid 20 Control Word (MSB)
	3	UINT8	N/A	Solenoid 21 Control Word (LSB)
	4	UINT8	N/A	Solenoid 21 Control Word (MSB)
	5	UINT8	N/A	Solenoid 22 Control Word (LSB)
	6	UINT8	N/A	Solenoid 22 Control Word (MSB)
	7	UINT8	N/A	-
	8	UINT8	N/A	Solenoid Supply Enable



Solenoid Control Word Definition

Mask	Description
0x0001	Solenoid Coil Request Current (Bit 0)
0x0002	Solenoid Coil Request Current (Bit 1)
0x0004	Solenoid Coil Request Current (Bit 2)
0x0008	Solenoid Coil Request Current (Bit 3)
0x0010	Solenoid Coil Request Current (Bit 4)
0x0020	Solenoid Coil Request Current (Bit 5)
0x0040	Solenoid Coil Request Current (Bit 6)
0x0080	Solenoid Coil Request Current (Bit 7)
0x0100	Solenoid Coil Request Current (Bit 8)
0x0200	Solenoid Coil Request Current (Bit 9)
0x0400	-
0x0800	-
0x1000	-
0x2000	-
0x4000	Control Bits (LSB)
0x8000	Control Bits (MSB)

Solenoid Request Current

Bits 0..9 = 0..1024 = 60..2000mA

Control Bits Definition

0x00 = Disable this Solenoid Output

0x01 = Enable this Solenoid Output

0x02 = Reset this Solenoid Output

0x03 = Reserved



CAN Definitions Continued

TX				
Message	Byte	Type	Mask	Description
0x80	1	UINT8	N/A	Software Version (A30)
	2	UINT8	N/A	Solenoid Supply Status (0=Disabled, 1=Enabled, 2=Fault)
	3	INT8	N/A	Temperature -55°C (-67°F)..+125°C(+257°F)
	4	UINT8	0x01	Over Current Status (1=Fault)
			0x02	Over Voltage Status (1=Fault)
			0x04	Under Voltage Status (1=Fault)
			0x08	Over Temperature (1=Fault)
			0x10	CAN BUS Time Out (1=Fault)
			0x20	-
			0x40	-
			0x80	-
	5	UINT8	0x01	Solenoid 1 Fault Status (0 = OK, 1=Fault)
			0x02	Solenoid 2 Fault Status (0 = OK, 1=Fault)
			0x04	Solenoid 3 Fault Status (0 = OK, 1=Fault)
			0x08	Solenoid 4 Fault Status (0 = OK, 1=Fault)
			0x10	Solenoid 5 Fault Status (0 = OK, 1=Fault)
			0x20	Solenoid 6 Fault Status (0 = OK, 1=Fault)
			0x40	Solenoid 7 Fault Status (0 = OK, 1=Fault)
			0x80	Solenoid 8 Fault Status (0 = OK, 1=Fault)
	6	UINT8	0x01	Solenoid 9 Fault Status (0 = OK, 1=Fault)
			0x02	Solenoid 10 Fault Status (0 = OK, 1=Fault)
			0x04	Solenoid 11 Fault Status (0 = OK, 1=Fault)
			0x08	-
			0x10	-
			0x20	-
			0x40	-
			0x80	-
	7	UINT8	0x01	Solenoid 1 Status (0 = OFF, 1=ON)
			0x02	Solenoid 2 Status (0 = OFF, 1=ON)
			0x04	Solenoid 3 Status (0 = OFF, 1=ON)
			0x08	Solenoid 4 Status (0 = OFF, 1=ON)
			0x10	Solenoid 5 Status (0 = OFF, 1=ON)
			0x20	Solenoid 6 Status (0 = OFF, 1=ON)
			0x40	Solenoid 7 Status (0 = OFF, 1=ON)
			0x80	Solenoid 8 Status (0 = OFF, 1=ON)
	8	UINT8	0x01	Solenoid 9 Status (0 = OFF, 1=ON)
			0x02	Solenoid 10 Status (0 = OFF, 1=ON)
			0x04	Solenoid 11 Status (0 = OFF, 1=ON)
			0x08	-
			0x10	-
			0x20	-
			0x40	-
			0x80	-



CAN Definitions Continued

TX				
Message	Byte	Type	Mask	Description
0x81	1	UINT8	N/A	Software Version (B30)
	2	UINT8	N/A	Solenoid Supply Status (0=Disabled, 1=Enabled, 2=Fault)
	3	INT8	N/A	Temperature -55°C (-67°F)..+125°C(+257°F)
	4	UINT8	0x01	Over Current Status (1=Fault)
			0x02	Over Voltage Status (1=Fault)
			0x04	Under Voltage Status (1=Fault)
			0x08	Over Temperature (1=Fault)
			0x10	CAN BUS Time Out (1=Fault)
			0x20	-
			0x40	-
			0x80	-
	5	UINT8	0x01	Solenoid 12 Fault Status (0 = OK, 1=Fault)
			0x02	Solenoid 13 Fault Status (0 = OK, 1=Fault)
			0x04	Solenoid 14 Fault Status (0 = OK, 1=Fault)
			0x08	Solenoid 15 Fault Status (0 = OK, 1=Fault)
			0x10	Solenoid 16 Fault Status (0 = OK, 1=Fault)
			0x20	Solenoid 17 Fault Status (0 = OK, 1=Fault)
			0x40	Solenoid 18 Fault Status (0 = OK, 1=Fault)
			0x80	Solenoid 19 Fault Status (0 = OK, 1=Fault)
	6	UINT8	0x01	Solenoid 20 Fault Status (0 = OK, 1=Fault)
			0x02	Solenoid 21 Fault Status (0 = OK, 1=Fault)
			0x04	Solenoid 22 Fault Status (0 = OK, 1=Fault)
			0x08	-
			0x10	-
			0x20	-
			0x40	-
			0x80	-
	7	UINT8	0x01	Solenoid 12 Status (0 = OFF, 1=ON)
			0x02	Solenoid 13 Status (0 = OFF, 1=ON)
			0x04	Solenoid 14 Status (0 = OFF, 1=ON)
			0x08	Solenoid 15 Status (0 = OFF, 1=ON)
			0x10	Solenoid 16 Status (0 = OFF, 1=ON)
			0x20	Solenoid 17 Status (0 = OFF, 1=ON)
			0x40	Solenoid 18 Status (0 = OFF, 1=ON)
			0x80	Solenoid 19 Status (0 = OFF, 1=ON)
	8	UINT8	0x01	Solenoid 20 Status (0 = OFF, 1=ON)
			0x02	Solenoid 21 Status (0 = OFF, 1=ON)
			0x04	Solenoid 22 Status (0 = OFF, 1=ON)
			0x08	-
			0x10	-
			0x20	-
			0x40	-
			0x80	-



CAN Definitions Continued

TX				
Message	Byte	Type	Mask	Description
0x88	1	UINT8	N/A	Solenoid 1 Status Word (LSB)
	2	UINT8	N/A	Solenoid 1 Status Word (MSB)
	3	UINT8	N/A	Solenoid 2 Status Word (LSB)
	4	UINT8	N/A	Solenoid 2 Status Word (MSB)
	5	UINT8	N/A	Solenoid 3 Status Word (LSB)
	6	UINT8	N/A	Solenoid 3 Status Word (MSB)
	7	UINT8	N/A	Solenoid 4 Status Word (LSB)
	8	UINT8	N/A	Solenoid 4 Status Word (MSB)

TX				
Message	Byte	Type	Mask	Description
0x90	1	UINT8	N/A	Solenoid 5 Status Word (LSB)
	2	UINT8	N/A	Solenoid 5 Status Word (MSB)
	3	UINT8	N/A	Solenoid 6 Status Word (LSB)
	4	UINT8	N/A	Solenoid 6 Status Word (MSB)
	5	UINT8	N/A	Solenoid 7 Status Word (LSB)
	6	UINT8	N/A	Solenoid 7 Status Word (MSB)
	7	UINT8	N/A	Solenoid 8 Status Word (LSB)
	8	UINT8	N/A	Solenoid 8 Status Word (MSB)

TX				
Message	Byte	Type	Mask	Description
0x98	1	UINT8	N/A	Solenoid 9 Status Word (LSB)
	2	UINT8	N/A	Solenoid 9 Status Word (MSB)
	3	UINT8	N/A	Solenoid 10 Status Word (LSB)
	4	UINT8	N/A	Solenoid 10 Status Word (MSB)
	5	UINT8	N/A	Solenoid 11 Status Word (LSB)
	6	UINT8	N/A	Solenoid 11 Status Word (MSB)
	7	UINT8	N/A	Solenoid Supply Voltage (0..255 = 0..64VDC)
	8	UINT8	N/A	Solenoid Supply Current (0..255 = 0..16A)



CAN Definitions Continued

TX				
Message	Byte	Type	Mask	Description
0x89	1	UINT8	N/A	Solenoid 12 Status Word (LSB)
	2	UINT8	N/A	Solenoid 12 Status Word (MSB)
	3	UINT8	N/A	Solenoid 13 Status Word (LSB)
	4	UINT8	N/A	Solenoid 13 Status Word (MSB)
	5	UINT8	N/A	Solenoid 14 Status Word (LSB)
	6	UINT8	N/A	Solenoid 14 Status Word (MSB)
	7	UINT8	N/A	Solenoid 15 Status Word (LSB)
	8	UINT8	N/A	Solenoid 15 Status Word (MSB)

TX				
Message	Byte	Type	Mask	Description
0x91	1	UINT8	N/A	Solenoid 16 Status Word (LSB)
	2	UINT8	N/A	Solenoid 16 Status Word (MSB)
	3	UINT8	N/A	Solenoid 17 Status Word (LSB)
	4	UINT8	N/A	Solenoid 17 Status Word (MSB)
	5	UINT8	N/A	Solenoid 18 Status Word (LSB)
	6	UINT8	N/A	Solenoid 18 Status Word (MSB)
	7	UINT8	N/A	Solenoid 19 Status Word (LSB)
	8	UINT8	N/A	Solenoid 19 Status Word (MSB)

TX				
Message	Byte	Type	Mask	Description
0x99	1	UINT8	N/A	Solenoid 20 Status Word (LSB)
	2	UINT8	N/A	Solenoid 20 Status Word (MSB)
	3	UINT8	N/A	Solenoid 21 Status Word (LSB)
	4	UINT8	N/A	Solenoid 21 Status Word (MSB)
	5	UINT8	N/A	Solenoid 22 Status Word (LSB)
	6	UINT8	N/A	Solenoid 22 Status Word (MSB)
	7	UINT8	N/A	Solenoid Supply Voltage (0..255 = 0..64VDC)
	8	UINT8	N/A	Solenoid Supply Current (0..255 = 0..16A)



Solenoid Status Word Definition

Mask	Description
0x0001	Solenoid Coil Current Status (Bit 0)
0x0002	Solenoid Coil Current Status (Bit 1)
0x0004	Solenoid Coil Current Status (Bit 2)
0x0008	Solenoid Coil Current Status (Bit 3)
0x0010	Solenoid Coil Current Status (Bit 4)
0x0020	Solenoid Coil Current Status (Bit 5)
0x0040	Solenoid Coil Current Status (Bit 6)
0x0080	Solenoid Coil Current Status (Bit 7)
0x0100	Solenoid Coil Current Status (Bit 8)
0x0200	Solenoid Coil Current Status (Bit 9)
0x0400	-
0x0800	-
0x1000	-
0x2000	-
0x4000	Status Bits (LSB)
0x8000	Status Bits (MSB)

Solenoid Current Status

Bits 0..9 = 0..1024 = 0..2000mA

Solenoid Status Bits

0x00 = Solenoid Output is OFF

0x01 = Solenoid Output is ON

0x02 = Solenoid Output is FAULTY

0x03 = Reserved

CAN Address Modifiers

There are multiple variants of the L0PE module permitting up to four modules per single configuration. This is determined by application of 0VDC & 24VDC to CAN Address Modifier Inputs.

Module	X30-E	X30-H	X30-K	Address
1 (A30)	0VDC	0VDC	0VDC	0x07C8
1 (B30)	0VDC	0VDC	24VDC	0x07C9
2 (A30)	0VDC	24VDC	0VDC	0x07CA
2 (B30)	0VDC	24VDC	24VDC	0x07CB
3 (A30)	24VDC	0VDC	0VDC	0x07CC
3 (B30)	24VDC	0VDC	24VDC	0x07CD
4 (A30)	24VDC	24VDC	0VDC	0x07CE
4 (B30)	24VDC	24VDC	24VDC	0x07CF



Electrical Characteristics

Supply	
Voltage Module	24VDC Nominal
Wattage MIN	1W
Wattage MAX	6W
Voltage Solenoids	24VDC Nominal
Wattage MIN	0W
Wattage MAX	528W

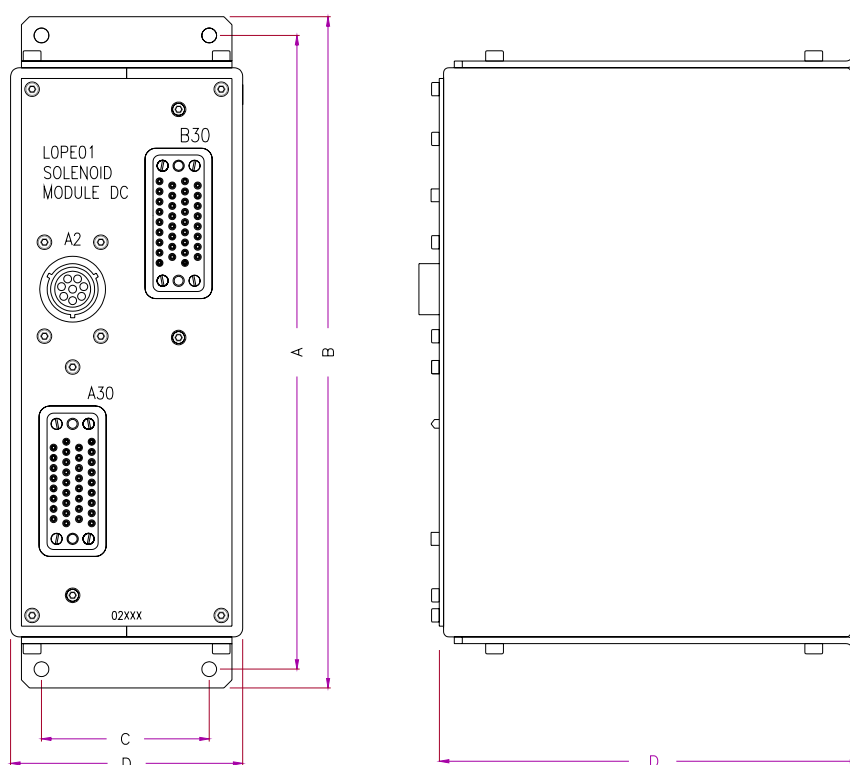
Solenoid Outputs	
Installed	22 Redundant
Voltage	24VDC
Minimum Voltage	24VDC
Maximum Voltage	24VDC

Communications	
Interface	CAN 2.0B
Throughput	500kbs (Supports Autobaud)
Protocol(s)	Message Oriented
Medium	Copper

Environmental	
Operating Temperature	Minus 20°C to +85°C
Humidity	T.B.A.
MTBF	12,000 hours



Mechanical Characteristics



Dimension	Measurement	Description
A	250	Height
B	236	Height Mounting Centre
C	62.5	Width Mounting Centre
D	86.5	Width
E	159.5	Depth

Notes

- All dimensions are in millimetres.

Material

- Enclosure is Electroless nickel plated mild steel.
- Facia is stainless steel.
- Mounting brackets are stainless steel.

Fasteners

- M5 x 10mm x 4
- M4 x 10mm x 8
- M3 x 10mm x 8

Mass

- 3.5kg (7.7lb)