Fireye® NEXUS FX20 and FX20-1
Servo Motor Installation

FX20-1
Shown

FM APPROVED

c UL us LISTED

c ETL us Intertek

DESCRIPTION

This Manual describes the installation and operating instructions for the FX20 and FX20-1, 15lb.-ft./ 20Nm . servo motors.

SAFETY INFORMATION

⚠ **WARNING: When this equipment is mounted onto an appliance, all external timers/control-lers must be listed or recognized components and approved by national certification agencies for the purpose for which they are used and approved for use by a local authority who has jurisdiction.**

⚠ **WARNING – EXPLOSION HAZARD. DO NOT CONNECT OR DISCONNECT WHEN ENERGIZED.**
AVERTISSEMENT — RISQUE D'EXPLOSION. NE PAS BRANCHER OU DÉBRANCHER LORSQUE LE CIRCUIT EST SOUS TENSION.

The Fireye FX20 and FX20-1 servo motors are precision actuators designed to accurately position valves and dampers. The servomotor interprets Modbus commands from an external control and uses a stepper motor to drive to the commanded position. A feedback potentiometer provides continuous positional information that can be read and cross checked by the external control.

The FX20 series servo motor offer a maximum output torque of 15lb.-ft./20Nm with a minimum travel time of 30 seconds for 90 degrees of rotation. Maximum rotation angle of the drive shaft is 100 degrees.

The servo is designed to be applied for fuel valves and air damper control on industrial burners. It can also be applied to drive any type of flow control valve or damper as long as the output torque is suited to the application.

Before attempting to install, commission or operate this equipment all relevant sections of this document must be read and fully understood, failure to follow them could damage the product or cause a hazardous condition. If in doubt about any requirements consult the supplier.

Check the ratings in the following instructions to ensure the product is suitable for your application.

Installation, commissioning or adjustment of this product MUST be carried out by personnel qualified by local, state, regional or national requirements.

After installation is complete, check the product operation is as described in these instructions.

The manufacturer of this equipment accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation, commissioning or adjustment of operating parameters of the equipment.

Note: The manufacturer of this equipment has a policy of continual product improvement and reserves the right to change the specification of the equipment and the contents of this manual with-out notice.

These mounting and operating instructions are intended to give the knowledge which is necessary to carry out the mounting and adjustment of FX20 servo motor safely and correctly.

TECHNICAL DATA

Actuating time for 90° angle of rotation:	30 s
Nominal torque:	15 lb.-ft./ 20 Nm
Holding torque:	8 lb.-ft. 10 Nm
Max. revolutions on the output drive shaft:	100°
Nominal voltage	24 VDC~± 10%
Nominal power consumption:	15 VA nominal, 35 VA peak
Angle of rotation limited by:	Software
Degree of protection:	NEMA 4 IP 65 (Note 1)
Installation position:	Any orientation
Working temperature range:	32°F - 140°F (0°C to + 60°C)
Duty cycle:	100%
Weight:	5.43 lb / 2.46 kg

Note 1: For FX04, FX20 and FX50, suitable conduit fittings that meet the desired protection are supplied by the application.

ORDERING INFORMATION

Servos		Bulletin
FX04	Servo motor, 24 VDC operation, 4Nm, 3 lb.-ft. torque, **without** connectors, accepts 1/2 inch NPT fitting, minimum travel time of 30 seconds for 90°	NEX-3004
FX04-1	Servo motor, 24 VDC operation, 4Nm, 3 lb.-ft. torque, **with** connectors, minimum travel time of 30 seconds for 90°	
FX20	Servo motor, 24 VDC operation, 20Nm, 15 lb.-ft. torque, **without** connectors, accepts 1/2 inch NPT fitting, minimum travel time of 30 seconds for 90°	NEX-3020
FX20-1	Servo motor, 24 VDC operation, 20Nm, 15 lb.-ft. torque, **with** connectors, minimum travel time of 30 seconds for 90°	
FX50	Servo motor, 24 VDC operation, 50Nm, 37 lb.-ft. torque, **without** connectors, accepts 1/2 inch NPT fitting, minimum travel time of 30 seconds for 90°	NEX-3050
FX-50-1	Servo motor, 24 VDC operation, 50Nm, 37 lb.-ft. torque, **with** connectors, minimum travel time of 30 seconds for 90°	
Servo Cables		
59-565-6	Cordset, 6 feet, 1/2" NPT connectors on both ends, PVC jacket, temperature rating -40°C to 105°C, meets NEMA 1,3,4,6P and IEC67	133-748
59-565-40	Cordset, 40 feet, 1/2" NPT connectors on both ends, PVC jacket, temperature rating -40°C to 105°C, meets NEMA 1,3,4,6P and IEC67	
Connector Kit		
129-192	Connector, field wirable. Used for FX04-1, FX20-1, FX50-1 servos with connectors. Use cable 59-565	133-747
59-565	Cable, twisted pair with drain wire, 2 power wires, suitable for servo hookup	

SAFETY ADVICE

Device Safety

The servo motor must be used only for purposes corresponding to its construction and within the values specified in the technical data.

The installer should be satisfied that, as a result of the mounting, the commissioning or as a result of the test adjustments on the actuator, no potential hazards will be produced for devices/machines/ plant.

Before mounting the servo motor, check the free movement of the valve/device.

After completing the mounting and adjustment, check the correct functioning of the servo motor.

Safety advice for mounting and adjustments

The Installer must be satisfied that, as a result of the commissioning or the test adjustments on the servo motor, no potential hazards will be produced for personnel or the environment.

After completing adjustments, check the correct functioning of the servo motor.

Check the correct functioning of any safety devices.

Carry out adjustments only in accordance with the instructions described in this documentation.

Adjustments must therefore be carried out only by a licensed electrician or a qualified person having adequate training, who is aware of potential hazards.
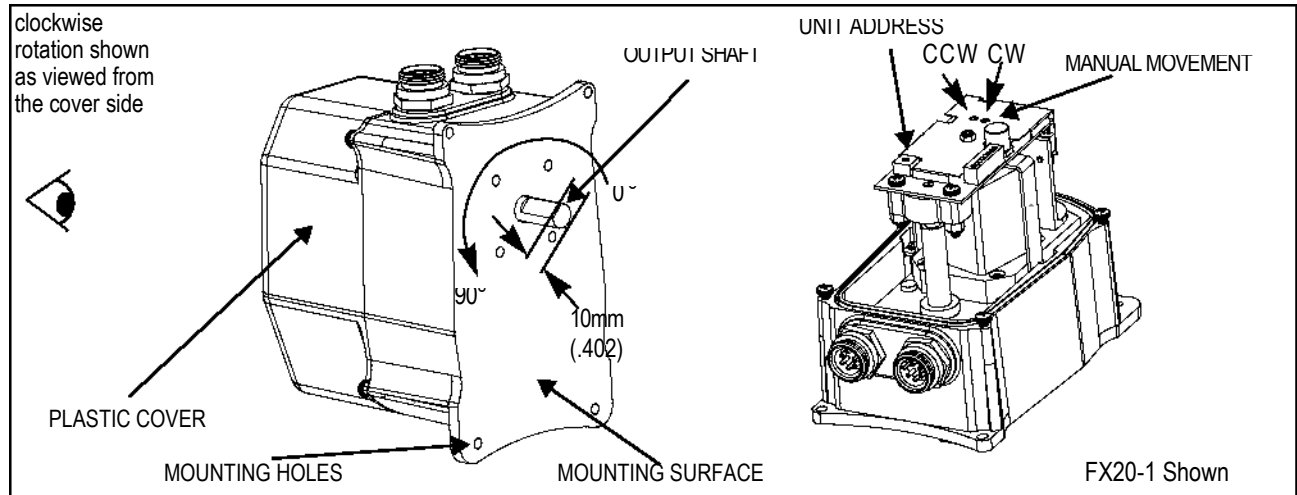
Wiring

Five wires must be connected to power the servo. Cordsets are available for the FX20-1. Field wirable connectors and cable are available for the FX20 (see page 5). Be sure to connect the ground connection first to eliminate the ESD (electro static discharge) potential.

Use in a PPC4000 System

On a previously commissioned system, care must be taken when replacing a servo motor believed to be defective. Although every effort is made to calibrate each servo, there may be slight differences from servo to servo. It is strongly recommended the installer, equipped with a combustion analyzer, use ADJUST RATIO to step through each profile that uses the replacement servo. Each profile set-point should be checked and adjusted for proper combustion.

SERVO MOTOR DESCRIPTION

FIGURE 1.

clockwise rotation shown as viewed from the cover side

OUTPUT SHAFT UNIT ADDRESS CCW CW MANUAL MOVEMENT

0°

90°

10mm (.402)

PLASTIC COVER

MOUNTING HOLES MOUNTING SURFACE FX20-1 Shown

WARNING - DO NOT USE THE MANUAL MOVEMENT SWITCHES ON THE SERVO MOTORS DURING AUTOMATIC OPERATION OR THE FIRING CYCLE OF THE BURNER. USE OF THE MANUAL MOVEMENT SWITCHES OPERATES THE SERVOMOTORS INDEPENDENT OF THE PPC4000 CONTROL AND COULD RESULT IN AN OFF-RATIO CONDITION IF OPERATED DURING AUTOMATIC OPERATION OR THE FIRING CYCLE

INSTALLATION

> ⚠ **WARNING – All installation, service and troubleshooting of Fireye products must be performed by a qualified technician!**

Fasten the FX20 servo motor using four bolts through a suitable mounting into the 6mm holes so that the mounting surface rests flat.
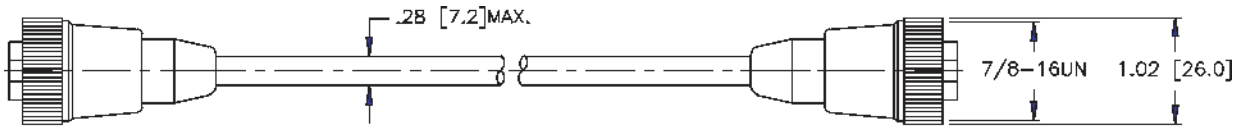
The output drive shaft should be connected using a suitable arm, link, flexible coupling or Fireye "D" hole couplings in order to assure a secure connection.

The mounting position of the FX20 servo motor is arbitrary.

FIGURE 2.   **DIMENSIONS FX20-1 SERVO MOTOR**

103.5
4.08

[169.2]
6.66

7/8-16UN THREADS

139.7
5.50

25.7
1.01

[12mm]
0.47

4 x 16 mm Woodruff Key

[155.6]
6.13

BOLT CIRCLE
[50.0]
1.969

HOLES FOR # 10 SCREWS

46.8
1.84

[7.7]
.70

45.0°

39.7
1.56

93.7
3.69

[79.4]
3.13

[35.4]
1.39

45.0°

Shaft Dim. [12mm] .472 +0 -.001
Shaft Dim. to Flat [10mm] .402

47.6
1.88

4 PLACES
M6 X [11] .44 DEEP

Note: Class I Division 2 Hazardous Location requirements for FX50 (without connectors):
     1. Suitable wiring methods shall be used, which meet Class I Division 2 Hazardous Location requirements

Cables, FX20-1

Cord sets having female connectors on both ends are available in 6 and 40 foot lengths.

.28 [7.2]MAX.

7/8-16UN 1.02 [26.0]

59-565-6 or 59-565-40

FEMALE END VIEW

3
2   4
1   5

1 = BROWN
2 = BLACK
3 = DRAIN
4 = ORANGE
5 = RED

Note: Class I Division 2 Hazardous Location requirements for FX20-1 with electrical connectors. The connector coupling nut setscrew must be tightened after mating the cable to the servo motor.
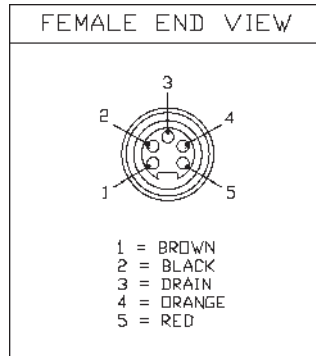
Field wirable cables and connectors, FX20

Loosen the four cross-head housing cover screws and pull the cover hard to remove it. For the electrical installation of the FX20 servo motor, use the prescribed cable type (corresponding to the environmental conditions).

Feed cables through screwed cable entry via suitable conduit and glands and place the stripped ends of the leads into screw connection terminals and terminate. Cable type 59-565 contains a drain wire, and care should be taken when routing this to terminal 3. Tubing over the drain wire is recommended. Wire ends should be properly stripped such that no bare wires protrude from the terminals and thus produce the risk of a current surge or a short circuit.

Store the cables such that they are not pinched when the housing cover is fitted or interfere with the end travel switchcam mechanism or potentiometer coupling shaft

Wiring information using 59-565

Terminal	Color	Description
1	Brown	RS485 B(-)
2	Black	24 VDC Return
3	Drain	Earth Ground
4	Orange	RS485 A(+)
5	Red	24 VDC Power

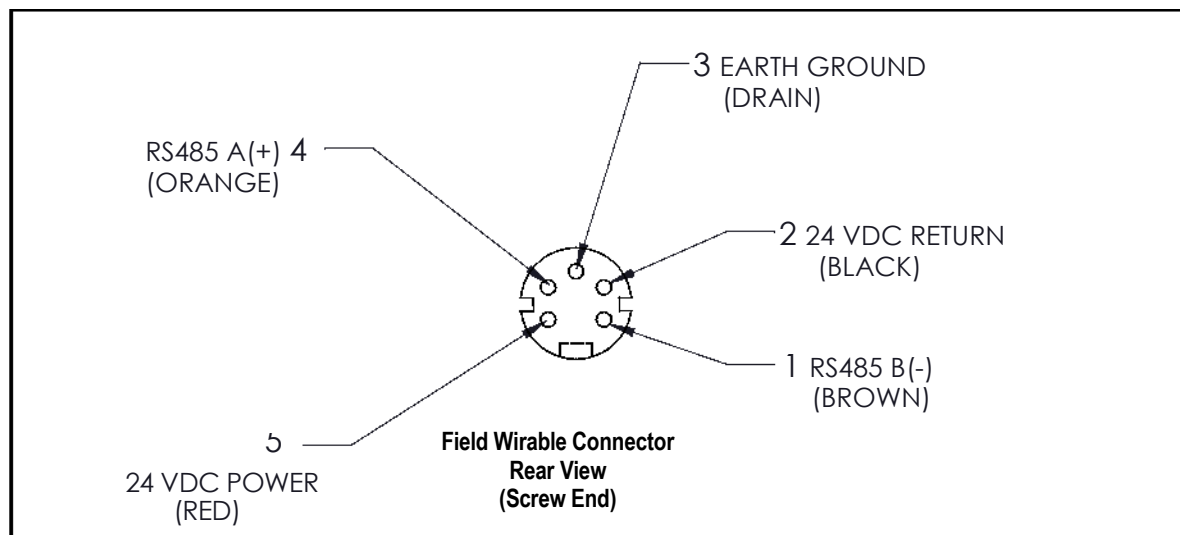Note: Brown and Orange are a twisted pair.
Red and Black are 18 AWG
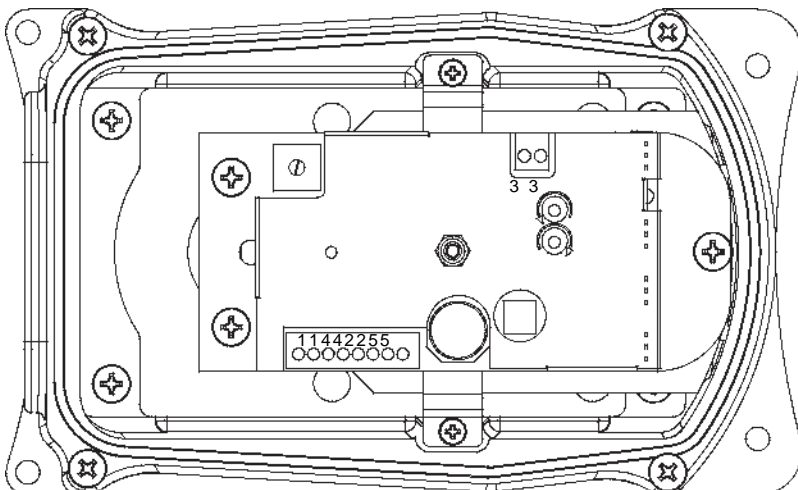
Cables and connectors

Field wireable connectors are available in kit form, 129-192. Fireye recommends cable part number 59-565 to be used for servo wiring.
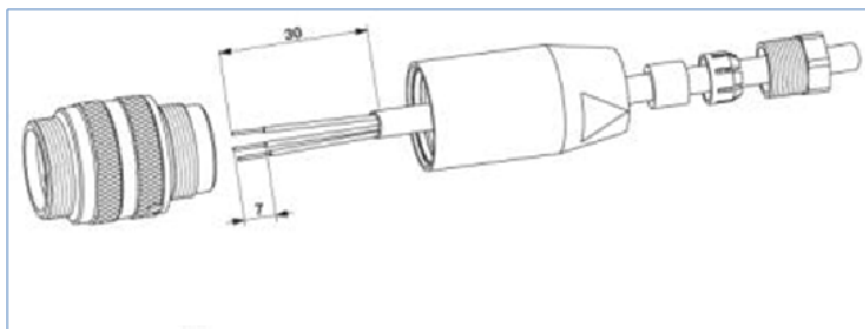
As shown above the cable strip length is specified at 30 mm (1.2 in) and each wire strip length is 7 mm (0.275 in).

To use cable 59-565, strip one end as specified. Strip each wire and wire to connector as shown.

RS485 A(+) 4
(ORANGE)

3 EARTH GROUND
(DRAIN)

2 24 VDC RETURN
(BLACK)

1 RS485 B(-)
(BROWN)

5
24 VDC POWER
(RED)

**Field Wirable Connector
Rear View
(Screw End)**

ADJUSTMENTS/COMMISIONING

Adjustments

Before the servo motor is opened or commissioned, the Safety Information and Safety Advice sections must be read.

Note: The cover must be removed to make the following adjustments.

Unit Address

The servos use a Modbus compatible communications protocol via RS-485. The baud rate is 57.6kb and the data format is 8,N,1. Therefore, each servo connected must have its own unique unit address. Before applying power, use switch (Figure 1 on page 3) to select the unit address. The address is selectable from 1 through 10.

Note: switch position "0" corresponds to address 10. When power is applied, the servo will read the switch position and retain that unit address until power is recycled.

Manual Movement

The servo can be moved manually by using the two red buttons (Figure 1 on page 3) whenever power is applied to the servo. One button moves the servo clockwise, the other is used to move the servo in the opposite direction. The servo will automatically stop when it reaches the end of its travel.

Replace the servo's cover after selecting the unit address and when finished making manual movements.

Writing (0x06 command)

The servo is commanded to move by writing to a Modbus register using the 0x06 command (write a single register). The register written determines the speed at which the servo will move. Writing register 1 will move the servo at its slowest speed. Writing to register 2 will move the servo slightly faster. The higher the register number, the faster the servo will move up until register 61 where the servo will move at the fastest speed, 90 degrees in 30 seconds. See the speed table below for the various speeds the servo can accommodate. Writing to a register higher than 61 will cause a Modbus exception to be returned to the Modbus controller. The number written to the register can range from 0 to 1100 representing the full range of the servo, 110 degrees, in tenths of a degree. For example, writing a 450 to register 61 will cause the servo to go to the 45.0 degree position at the maximum speed.

A new position or speed can be sent at any time. The user does not have to wait for the servo to reach the previous commanded position before issuing a new position.

NOTE: Modbus allows angular rotation beyond the standard 100° movement

Table 1:   **Speed Table**

Register	90 degree travel time in seconds	Register	90 degree travel time in seconds	Register	90 degree travel time in seconds	Register	90 degree travel time in seconds
1	368.4	17	91.9	33	52.5	49	36.8
2	310.1	18	87.8	34	51.2	50	36.1
3	267.7	19	84.1	35	49.8	51	35.4
4	235.6	20	80.6	36	48.6	52	34.8
5	210.3	21	77.4	37	47.4	53	34.2
6	189.9	22	74.5	38	46.3	54	33.6
7	173.2	23	71.8	39	45.2	55	33.0
8	159.1	24	69.2	40	44.2	56	32.5
9	147.2	25	66.8	41	43.3	57	32.0
10	136.9	26	64.6	42	42.3	58	31.5
11	127.9	27	62.6	43	41.4	59	31.0
12	120.1	28	60.6	44	40.6	60	30.5
13	113.2	29	58.8	45	39.7	61	30.0
14	107.0	30	57.1	46	38.9		
15	101.5	31	55.5	47	38.2		
16	96.5	32	54.0	48	37.5		

Reading (0x03 command)

The servo does not use a Modbus map. Instead, reading any single address within the 1 to 61 register space will always return the last commanded position. This is for controllers that need to do a write-read verify. From 1 to 6 registers can be read with a read command and like a single read, the register number is ignored as long as the start register is from 1 to 61. Only the number of bytes is important. Reading more than one register returns the information shown in the Read table.

Table 2: **Read Table**

Registers in Sequential Order	Description	Range
1 (first)	Last commanded position	10 to 1100 0xFFFF if servo is in an error state
2	Current servo position	10 to 1100
3	Current servo speed (bits 8 to 15)	-61 to +61
	Tweak Error (bits 0 to 7)	-100 to +100
4	Servo's torque rating (bits 8 to 15)	20
	Tweak Mode Active (bit 7)	0 or 1
	Button Pressed (bit 6)	0 or 1
	Error condition (bits 0-5)	0 (if no error) to 63 (see table 3)
5	Linearity Error since last command in 0.1 degree increments	-32767 to +32768
6 (last)	ROM CRC of servo software	0x0000 to 0xFFFF

To reduce communication overhead once a position/speed command has been issued, only two registers need to be read to keep track of the servos position and any error condition. If an error occurs, then the 4th register can be read to determine the error code.

Table 3: **Actuator Error Codes**

Error Code #	Description	Possible Remedies
0	No error, actuator is running normally	-
1 - 7	Internal CPU self check error detected. A false positive should be a rare occurrence.	Re-write the commanded position. Log when error occurred to determine frequency of error.
8	Actuator shaft is not moving as expected.	Most likely, the shaft is jammed or the actuator is undersized for the application. Check linkage for binding or lubrication problems. Less likely, the supply voltage is too low or the motor may be extremely hot.
9 - 10	The actuator's voltage regulator self checking detected an error. A false positive should be a rare occurrence.	Re-write the commanded position. Log when error occurred to determine frequency of error.
11	The supply voltage at actuator is less than 21.6V.	Power cable is too long or gauge of wire is too small. Power supply may also not be able to handle the load. Measure power supply and/or monitor power supply voltage at actuator to determine where the problem lies.
12	The supply voltage at actuator is greater than 33V.	Measure the power supply voltage to ensure that voltage is not set too high. Inductive or capacitive coupling may cause spikes on supply line. Separate actuator power supply lines from other high power lines.
13 - 63	Not implemented, these error codes are reserved for future use.	

Note: Sending a commanded position to the actuator will erase/reset the present error code. It should be your normal process to read the actuator before sending a new commanded position so that any detected errors will not be missed. In addition, once an error is detected, the actuator will stop moving and release any braking feature. The actuator will remain in an error state as long as power is not recycled or a commanded position is not sent to the actuator.

Certifications:

UL: MP1537 & MH10808

FM: FM 7610

ETL: ISA 12.12.01:2016 Ed.7, CSA C22.2#213:2016 Ed.2

Intertek
5010076

Conforms to ISA 12.12.01:2016 Ed.7
Cert. to CAN/CSA Std. C22.2 No. 213:2016 Ed. 2

FX04 & FX04-1:

CLASS I, DIVISION 2, GROUPS A, B, C AND D,
HAZARDOUS LOCATIONS, T5 -20°C TO +60°C

FX20 & FX20-1:

CLASS I, DIVISION 2, GROUPS A, B, C AND D,
HAZARDOUS LOCATIONS, T5 0°C TO +60°C

FX50 & FX50-1:

CLASS I, DIVISION 2, GROUPS A, B, C AND D,
HAZARDOUS LOCATIONS, T4A 0°C TO +60°C

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NOTICE

When Fireye products are combined with equipment manufactured by others and/or integrated into systems designed or manufactured by others, the Fireye warranty, as stated in its General Terms and Conditions of Sale, pertains only to the Fireye products and not to any other equipment or to the combined system or its overall performance.

WARRANTIES

FIREYE guarantees for *one year from the date of installation or 18 months from date of manufacture* of its products to replace, or, at its option, to repair any product or part thereof (except lamps and photocells) which is found defective in material or workmanship or which otherwise fails to conform to the description of the product on the face of its sales order. **THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES AND FIREYE MAKES NO WARRANTY OF MERCHANT-ABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED.** Except as specifically stated in these general terms and conditions of sale, remedies with respect to any product or part number manufactured or sold by Fireye shall be limited exclusively to the right to replacement or repair as above provided. In no event shall Fireye be liable for consequential or special damages of any nature that may arise in connection with such product or part.