SHADIN AVIONICS

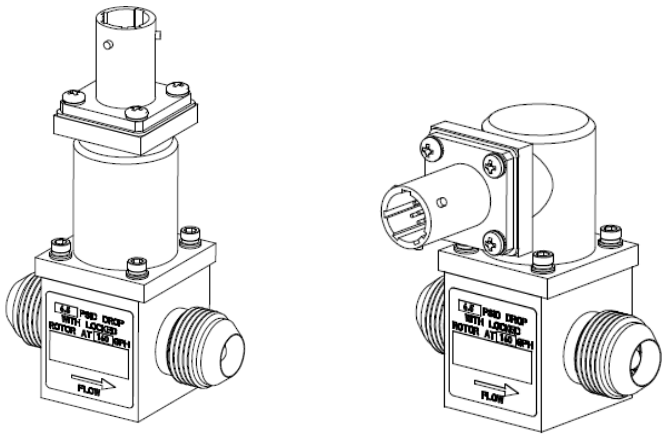
INNOVATION THROUGH SIMPLICITY

FUEL FLOW TRANSDUCER ASSEMBLY,

P/N 660534HX

P/N: 660534HS

P/N: 660534HR



INSTALLATION MANUAL
MANUAL P/N: M660534HX
REV K

SHADIN AVIONICS
7555 Market Place Drive,
Eden Prairie, MN 55344-3637

Sales: (952) 927-6500

REVISION LOG

Rev	Date	ERN	DESCRIPTION
–	05 MAR 2014	1403/001	Initial Issue
A	18 MAR 2014	1403/006	Added wiring recommendation, updated installation drawing
B	03 APR 2014	1404/002	Created M660534HX and updated from M660534HSRevA. Added 660534HR.
C	28 April 2014	1404/009	Changed Sections 2.3.2 and 3.1
D	31 July 2015	1505/005	Updated Installation Drawings. Changed Figures 3, 4, edited Table 2, Sections 3.2, 3.3 & 6
E	05 October 2015	1510/002	Update Temperature Sensor Information. Corrected typos.
F	10 April, 2018	1711/004	Updated Performance to show –(00). Updated Installation Drawing Revision Level.
G	28 June, 2018	1806/011	Added HS-01 and HR-01 Variants, Performance and Install drawings.
H	9 July, 2019	1905/008	Revised HX-01 performance and installation drawings.
J	12 Feb 2021	2102/002	Added HS-02 and HR-02 Variants, Performance and Install drawings. Updated company address and logo.
K	10 Oct 2024	2410/002	Added HS-03 and HR-03 Variants, Performance and Install drawings.

SHADIN AVIONICS

Digitally signed by ShadinCM-met
Date: 2024.10.14 13:17:18 -05'00'

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1 OVERVIEW

The information in this manual is subject to change without notification.

1.1 SCOPE

This manual is intended to guide the proper installation of the Fuel Flow Transducer. Installation instructions should be read and followed.

1.2 PRODUCT DESCRIPTION

The fuel flow transducer is an instrument mounted in the engine fuel line and produces electric signals representing the fuel flow through it. The block diagram below in Figure 1 provides an overview of the functional blocks of the transducer.

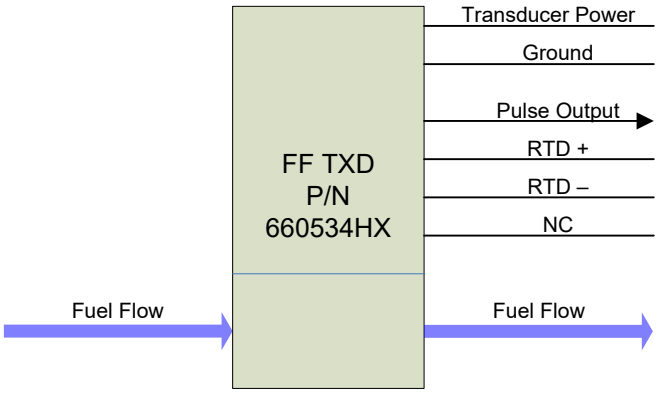


Figure 1: Overview Block Diagram

The Fuel Flow Transducer assembly is comprised of two sub-assemblies, the flow body and the pick-up.

The flow body (Ref Figure 2) is a hydraulic flow fitting with standard flared male ends that is connected into the engine fuel line. The body has a straight tubular bore that contains a small axial turbine wheel mounted on two precision instrument ball bearings supported by two flow straighteners that are located inside the bore with two retainer rings. The turbine is driven by the fuel flow to rotate at a speed proportional to the flow rate.

The pick-up (Ref Figure 3 or Figure 4) is assembled to the flow body and contains a hall-effect sensor that detects the rotation of a small magnet embedded in the turbine and switches the output electric voltage twice in every revolution of the turbine.

The pick-up also carries a RTD that senses the flow body temperature and, when connected to external circuits, can provide a measure of the flow temperature. This is a function not covered by the TSO but can be used to adjust for the changes in Fuel Density due to temperature. The interface is a standard 1000 ohm RTD that varies 3.8 Ohms/°C nominally.

The pickup may have a straight or right angle electric connector (as shown in figures 3 & 4 and installation drawings Appendix A). This is designated by the X digit in FFTXD part number being replaced by the letter S or R respectively.

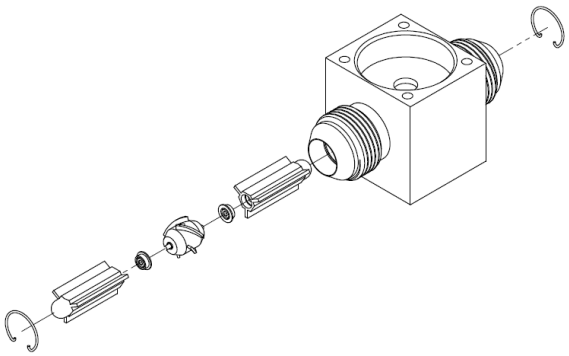


Figure 2: Flow Body

When the fuel flow enters the flow body it is forced by the flow straightener into an axial direction. This ensures no pre-rotation reaches the turbine. The axial flow impacting the turbine blades causes the turbine to rotate. The turbine rotation accelerates until the flow enters the blades point-on. At this speed the flow ceases to accelerate the turbine. The turbine blade angle sets a constant of proportionality between the flow and blade velocities. The small magnet embedded in the turbine and rotates with it causes the hall-effect sensor in the pick-up to switch the signal line on and off, producing electric pulses.

The resulting electric pulse quantity is proportional to the fuel flow volume and the frequency to the flow rate. The proportionality constant is called the K-Factor.

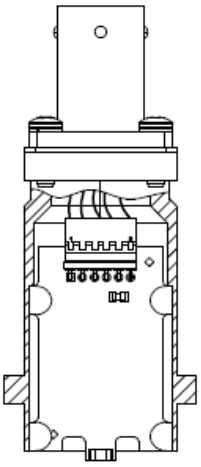


Figure 3: Straight Pick-Up

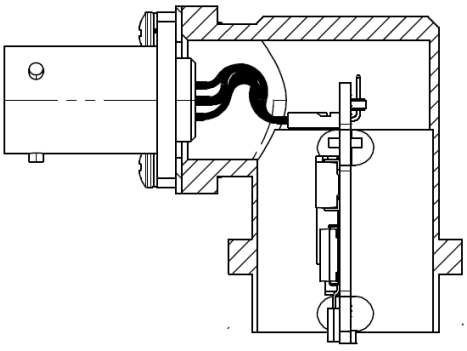


Figure 4: Right Angle Pick-Up

2 SPECIFICATIONS

For a complete listing of product qualifications please review the Environmental Qualification Form (EQF) found in Section 4.

2.1 PHYSICAL

In/Out Fitting:	3/4-16UNF-3A 37° Flare (SAE5309-8 or equivalent)
Maximum Line Pressure:	2000 PSIG
Mounting Screws:	10-32 x 0.50” long (quantity 4)
Mounting Hole Spacing:	0.80” square pattern, 0.187 diameter
Mounting Position:	All
Weight:	11 ounces (oz)

2.2 ELECTRICAL

Transducer Supply Voltage:	+4.0VDC to +29VDC regulated power
Supply Current:	20mA Max
Protection:	Not internally fused
Connector:	MS27505T9B35P on transducer
Connector Mate:	MS27467T9B35S with backshell M85049/49-2S8W or equivalent
Output Type:	Open/GND
Open Circuit Voltage:	24VDC maximum
External Pull-up Resistor:	Sized to limit current to no more than 15mA

2.3 PERFORMANCE

2.3.1 FUEL FLOW 660534HX-(00)

Performance parameters nominal for Jet Fuel at 20° Celsius

Flow Rate:	7 – 160 Gallons per Hour (GPH)
K-Factor:	9,000 – 10,000 Pulses per Gallon (PPG) at 70 GPH The K-Factor is a specific value at 70 GPH. 2% linearity range 35 - 160 GPH.
Output Type:	Pulse
Pressure Drop at 160 GPH:	Rotor Free = 3.0 PSI Rotor Locked = 6.5 PSI

2.3.2 FUEL FLOW 660534HX-(01)

Performance parameters nominal for Jet Fuel at 20° Celsius

Flow Rate:	7 – 90 Gallons per Hour (GPH)
K-Factor:	19,500 – 20,650 Pulses per Gallon (PPG) Average The K-Factor is an average from 15 to 90 GPH. 2% linearity range 15 - 90 GPH.
Output Type:	Pulse
Pressure Drop at 90 GPH:	Rotor Free = 3.0 PSI Rotor Locked = 6.5 PSI

2.3.3 FUEL FLOW 660534HX-(02)

Performance parameters nominal for Jet Fuel at 20° Celsius

Flow Rate:	7 – 200 Gallons per Hour (GPH)
K-Factor:	9,000 – 10,000 Pulses per Gallon (PPG) Average The K-Factor is an average from 40 to 200 GPH. 2% linearity range 40 - 200 GPH.
Output Type:	Pulse
Pressure Drop at 200 GPH:	Rotor Free = 3.0 PSI Rotor Locked = 9.0 PSI

2.3.4 FUEL FLOW 660534HX-(03)

Performance parameters nominal for Jet Fuel at 20° Celsius

Flow Rate:	15 – 280 Gallons per Hour (GPH)
K-Factor:	6,000 – 7,000 Pulses per Gallon (PPG) Average The K-Factor is an average from 10 to 280 GPH. 2% linearity range 45 - 280 GPH
Output Type:	Pulse
Pressure Drop at 280 GPH:	Rotor Free = 3.9 PSI Rotor Locked = 8.6 PSI

2.3.5 TEMPERATURE (NON-TSO FUNCTION) ALL MODELS

Sensor Type:	Platinum Resistance Temperature Detector (RTD)
Range:	-55°C - +150°C

Sensor Output: 1k ohms typical at 0° Celsius
Scaling 3.8 Ohms/°C – nominal
Accuracy to Fuel Temp: +/- 5°C (at steady state, ref SETUP AND USE)

2.4 RELIABILITY

MIL-HDBK-217F MTBF: 40,000 hours

3 INSTALLATION PROCEDURE

3.1 LIMITATIONS

The fuel flow transducer is TSO approved to provide data representing fuel flow rate only. Other derived data are not covered by this approval. Functionality and accuracy of the data provided depend on operation within its design parameters and connection to a read-out instrument properly configured to provide the following.

1. Correct transducer power, regulated voltage
2. Correct signal pull-up voltage and current limiting resistance
3. Correct programmed flow K-Factor
4. Correct RTD interface (Non-TSO function)

The conditions and tests required for TSO approval of this article are minimum performance standards. Those installing this article on or in a specific type or class of aircraft, must determine that the aircraft installation conditions are within the TSO minimum performance standards (see 3.2 below for specific ELOS related to pressure drop). TSO articles must have separate approval for installation on an aircraft. The article may be installed only according to 14 CFR part 43 or the applicable airworthiness requirements.

3.2 EQUIVALENT LEVEL OF SAFETY DEVIATION (ELOS)

This transducer design does not meet the minimum performance requirements of TSO C44C with regard to pressure drop as the typical operating range is not covered. A deviation has been granted in the TSO approval. In order to ensure an Equivalent Level Of Safety (ELOS), each unit has a placard attached giving the pressure drop of the locked rotor transducer at the max flow rate. The integrator and installer should ensure the transducer worst case pressure drop would not affect the fuel delivery for normal and failed conditions the system operates under.

3.3 MOUNTING

The Fuel Flow Transducer may be mounted in a controlled or un-controlled temperature, pressurized or un-pressurized locations.

The transducer mounting interfaces are shown in Installation Drawings, P/N D660534HS & D660534HR.

Flared tube fittings should be torqued, not to exceed 350 inch-pounds.

3.4 ELECTRICAL CONNECTION

Table 1 lists the connector and pin number (i.e. J1:3), signal name, and signal description of the electrical connections for the unit.

Table 1: Electrical Connection

Connector & Pin Number	Signal Name	Signal Description
J1:1	SIGNAL_OUT	Output Pulse
J1:2	POWER_HIGH	Transducer Power Positive
J1:3	POWER_RETURN	Transducer Power Negative
J1:4	TEMP +	Resistive Temperature Detector +
J1:5	TEMP -	Resistive Temperature Detector –
J1:6	NC	No Connection

3.4.1 TYPICAL INSTALLATION WIRING

Figure 5 is typical installations wiring diagram.

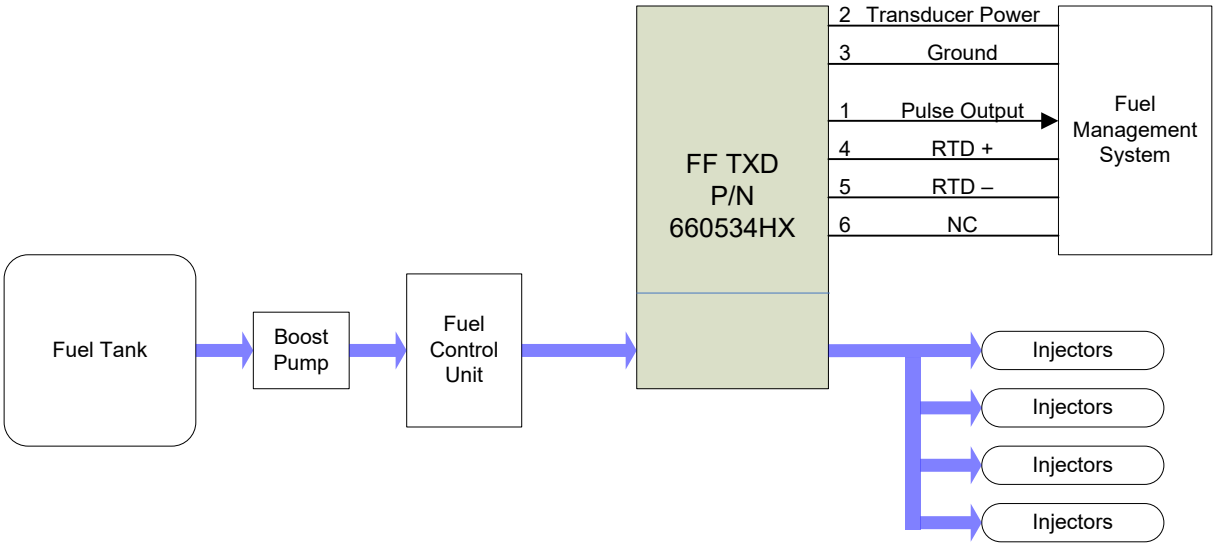


Figure 5: Wiring Diagram

NOTES:

Use 22AWG wiring (recommended)

Twisted pair M27500-22TG2T14 or equivalent

Twisted triple M27500-22TG3T14 or equivalent

4 ENVIRONMENTAL QUALIFICATION FORM (EQF)

The base 660534HS hardware was environmentally tested as required by TSO-C44c/SAE AS407C and RTCA/DO-160E as follows. Test results are documented in Shadin System Verification Report SD-130092 and Shadin TSO Compliance document SD-130133.

NOMENCATURE: Fuel Flow Transducer
TYPE/MODEL/PART NO: 660534HS **CERTIFICATION: TSO-C44c**
MANUFACTURER'S SPECIFICATION AND/OR OTHER APPLICABLE SPECIFICATION:
SD-130092 & SD-130133
MANUFATURER: Shadin Avionics **ADDRESS:** 6831 Oxford Street, St. Louis Park, Minnesota 55426-4412

Items listed with an "X" for test conducted will be identified as not being tested. Any other description indicates either a test category or a modification to a test.

Table 2: Environmental Test Conducted and Specification Used, Limits/Category verified

Test	DO-160 Rev E Section &(Category Tested)	SAE AS407C Section & (Limits Tested)
Temperature	X	7.1 (-55 to +149C)
Extreme Temp	X	7.2 (-65 to 149C)
Operating Altitude	X	3.3.4 (-1000 to 51,000 ft)
Decompression	X	X
Overpressure	X	X
Temperature Variation	X	X
Humidity	X	7.4 (70C, 95%R.H. x6 hrs to 38C, 100%R.H. x 18 hrs) x 5 cycles
Operational Shock	X	X
Crash Safety - Impulse	X	X
Crash Safety – Sustained	X	X
Vibration	X	7.5 (3 hrs resonance scan , 15 min cycles, 5 to 150 Hz, 0.100" p-p, 20g for 1 hour each of X, Y, Z axes)
Explosion Proofness	9 (CAT H)	X
Waterproofness	X	X
Liquid Tolerance	X	X
Sand and Dust	X	X
Fungus	None	None

Test	DO-160 Rev E Section &(Category Tested)	SAE AS407C Section & (Limits Tested)
Resistance		
Salt Fog	X	X
Magnetic Effect	X	7.3 (compass deflection less than 1 deg @ 5” distance)
Power Input	X	X
Voltage Spikes	X	X
AF Conducted Susceptibility	X	X
Induced Signal Susceptibility	19 (CAT ZC)	X
RF Susceptibility	20 (CAT TT)	X
Emission of RF Energy	21 (CAT M)	X
Lightning Induced Transient	X	X
Direct Lightning	X	X
Icing	X	X
ESD	X	X
Flammability	X	X

5 SETUP AND USE

a) Flow Factor:
Each unit manufactured is subjected to a flow test where the flow K-Factor is determined at several fixed flow rates from minimum to maximum design flow and plotted on a calibration document. An average flow K-Factor is determined for the linear flow range, where the change of K-Factor does not exceed ± 2%. This value is stamped on flow body for each unit serial number. Alternatively, a customer may request the K-Factor corresponding to a specific flow rate to be stamped on the unit.

A flow computer connected to the flow transducer and configured to the Average K-Factor would display a flow rate where the error is within 2% anywhere in the linear flow range. A user who knows the flow rate/range that would prevail the majority of the time (e.g. cruise flow rate) may obtain better system accuracy by configuring the flow computer to the K-Factor corresponding to that flow rate/range. Refer to the installation drawing for the K-Factor setting notes.

b) Temperature Measurement:
The temperature sensor incorporated in the pick-up is verified during the manufacturing flow test at steady state close to room temperature. Because the sensor contacts the flow body internally, its reading is affected by the flow body temperature. Engine room ambient air temperature affects the flow body temperature and, if very different from flow temperature, will cause the sensor to read slightly different from true fuel temperature.

If better coupling of sensor reading to fuel temperature is desired, thermal insulation (e.g. fire sleeve or lagging) may be applied outside the fuel flow transducer, pick-up and fuel tubing to eliminate the effect of engine room ambient air temperature and allow better coupling of sensor reading to fuel flow temperature.

5.1 INITIAL SETUP

There is no field set-up required for the flow transducer other than setting the K-Factor in the flow read-out computer to the value stamped on the flow body.

5.2 CONFIGURATION

The transducer is not field configurable with exception to the HR-XX variants which allow for the re-orientation of the pick-up connector.

6 APPENDIX A: INSTALLATION DRAWING

Installation drawing D660534HS Rev F

Installation drawing D660534HR Rev B

Installation drawing D660534HS-01 Rev A

Installation drawing D660534HR-01 Rev A

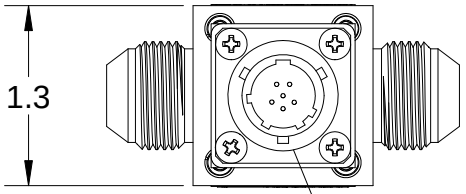
Installation drawing D660534HS-02 Rev –

Installation drawing D660534HR-02 Rev –

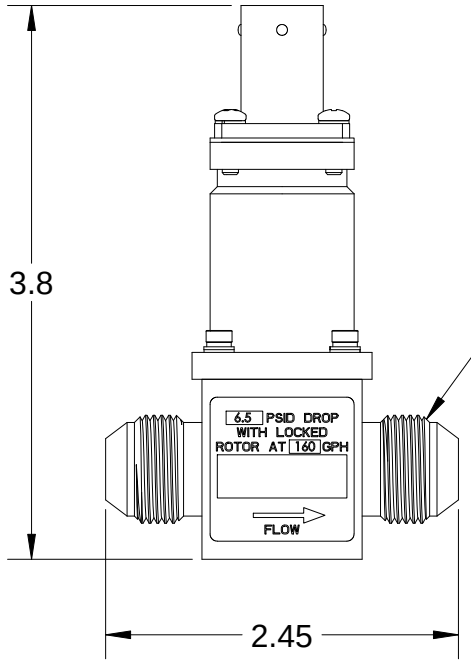
Installation drawing D660534HS-03 Rev A

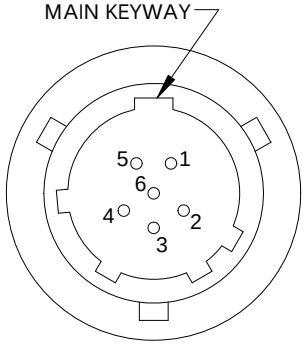
Installation drawing D660534HR-03 Rev –

REVISIONS					
ERN #	REV.	DATE	BY	APP'D	DESCRIPTION
1305/012	-	5/30/2013	CAL	AR	BASELINE RELEASE
1310/002	A	10/16/2013	CSB	AR	UPDATED TSO SPECIFICATION, TEMPERATURE RANGE, AND NOTE 1 WITH TABLE
1402/004	B	2/5/2014	EG	AR	UPDATED CERTIFICATION AND ALTITUDE
1403/006	C	3/18/2014	EG	AR	ADDED IN-OUT FITTING TORQUE
1404/001	D	4/2/2014	EG	AR	UPDATED TITLE
1505/005	E	7/30/2015	EG	AR	REDRAWN
1711/004	F	3/30/2018	EG	AR	CHANGED K-FACTOR NOTE, UPDATED FORMAT

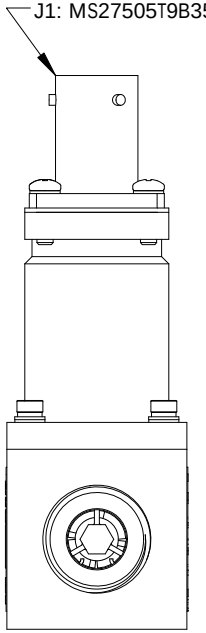


SEE DETAIL A

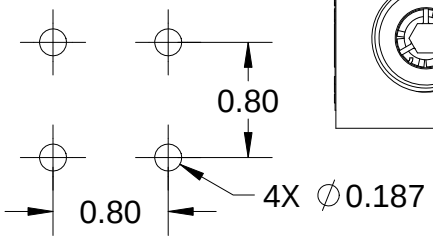




DETAIL A
ENLARGED



2X 3/4-16 UNF-3A 37° FLARE
MATING CONNECTOR:
SAE J514 OR EQUIVALENT



MOUNTING TEMPLATE

SPECIFICATIONS

PART NO.	660534HS-00	
MATING ELECTRICAL CONNECTOR	PLUG: MS27467T9B35S BACKSHELL: M85049/49-2S8W	
	USE ONLY ENVIRONMENTAL TYPE MATING CONNECTOR	
PERFORMANCE	FLOW RATE	7 - 160 GPH
	K-FACTOR (K_{AV})	9,000 - 10,000 PULSES/GAL. (AVG)
		FOR FLOW RATES 35 - 160 GPH, SET THE DISPLAY INSTRUMENT TO THE K-FACTOR STAMPED ON THE UNIT. FOR OTHER FLOW RATES CONTACT SHADIN FOR THE APPROPRIATE K-FACTOR SETTING.
PRESSURE DROP @160 GPH, JET A-1	ROTOR FREE	3.0 PSI
	ROTOR LOCKED	6.5 PSI
CERTIFICATION	TSO-C44c	
ENVIRONMENT	TEMP RANGE	-55°C TO +149°C
	MAXIMUM ALTITUDE	51,000 FT
MECHANICAL	IN/OUT FITTING	3/4-16UNF-3A 37° FLARE
	FITTING TORQUE	350 IN - LBS MAX
	MAXIMUM LINE PRESSURE	2000 PSIG
	MOUNTING POSITION	ANY
	WEIGHT	11 OZ.
MOUNTING	HARDWARE	4X 10-32 SCREWS
	BODY TAP DEPTH	0.5"

[1] [2] J1 CONNECTOR PINOUT

PIN	SIGNAL NAME	DESCRIPTION	TYPE	PAIR
1	SIGNAL_OUT	OUTPUT PULSE (SEE NOTE 1)	STT	2,3
2	POWER_HIGH	TRANSDUCER POWER POSITIVE	STT	1,3
3	POWER_RETURN	TRANSDUCER POWER NEGATIVE	STT	1,2
4	TEMP +	RESISTIVE TEMPERATURE DETECTOR POSITIVE	STP	5
5	TEMP -	RESISTIVE TEMPERATURE DETECTOR NEGATIVE	STP	4
6	NC	NO CONNECTION	N/A	N/A

NOTES:

[1] IF EXTERNAL INTERFACE EQUIPMENT DOES NOT CONTAIN A PULL-UP RESISTOR FOR THE FUEL FLOW PULSE, A PULL-UP RESISTOR MUST BE CONNECTED TO THE SIGNAL OUT TO LIMIT THE CURRENT TO 15 mA DC. THE MAXIMUM VOLTAGE APPLIED TO THE PULL-UP RESISTOR IS +24VDC. EXAMPLE: IF +12 VDC IS APPLIED TO THE PULL-UP RESISTOR, THE ABSOLUTE MINIMUM RESISTOR VALUE WOULD BE 12 VDC/0.015 AMPS = 800 OHMS.

[2] RECOMMENDED WIRING IS 22 AWG IN SHIELDED TWISTED PAIR (STP) M27500-22TG2T14 OR EQUIVALENT AND SHIELDED TWISTED TRIPLE (STT) M27500-22TG3T14 OR EQUIVALENT.

UNLESS OTHERWISE SPECIFIED:
DRAWN PER ASME Y14.5M-2009
DIMENSIONS ARE IN INCHES
THIRD ANGLE PROJECTION
TOLERANCES:
X/X ±1/64
X° ±1°
X.X ±0.1
X.XX ±0.01
X.XXX ±0.005
FINISH N/A
MATERIAL N/A

SHADIN AVIONICS
ST. LOUIS PARK, MN 55426

DRAWN	CAL	11/14/2012
CHECKED	AR	11/14/2012
ENG APPR.	AR	11/14/2012

INSTALLATION DRAWING FFTXD 660534HS-( )

SIZE	CAGE CODE: 0Z5P5	DWG. NO.	REV
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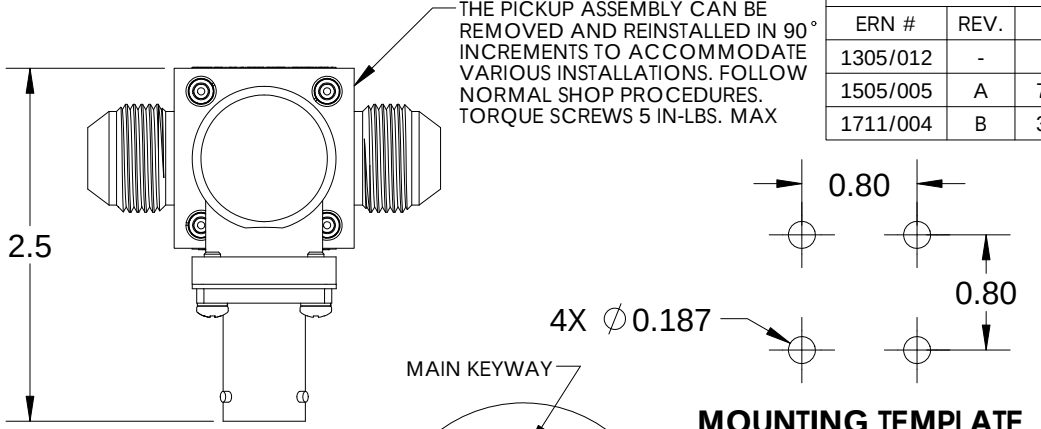
REVISIONS					
ERN #	REV.	DATE	BY	APP'D	DESCRIPTION
1305/012	-	4/3/2014	EG	AR	BASELINE RELEASE
1505/005	A	7/30/2015	EG	AR	REDRAWN
1711/004	B	3/30/2018	EG	AR	CHANGED K-FACTOR NOTE, UPDATED FORMAT



MOUNTING TEMPLATE

DETAIL A
ENLARGED

SPECIFICATIONS

PART NO.	**660534HR-00**	
MATING ELECTRICAL CONNECTOR	PLUG: MS27467T9B35S BACKSHELL: M85049/49-2S8W	
	USE ONLY ENVIRONMENTAL TYPE MATING CONNECTOR	
PERFORMANCE	FLOW RATE	7 - 160 GPH
	K-FACTOR (K_{AV})	9,000 - 10,000 PULSES/GAL. (AVG)
		FOR FLOW RATES 35 - 160 GPH, SET THE DISPLAY INSTRUMENT TO THE K-FACTOR STAMPED ON THE UNIT. FOR OTHER FLOW RATES CONTACT SHADIN FOR THE APPROPRIATE K-FACTOR SETTING.
PRESSURE DROP @160 GPH, JET A-1	ROTOR FREE	3.0 PSI
	ROTOR LOCKED	6.5 PSI
CERTIFICATION	TSO-C44c	
ENVIRONMENTAL	TEMP RANGE	-55°C TO +149°C
	MAXIMUM ALTITUDE	51,000 FT
MECHANICAL	IN/OUT FITTING	3/4-16UNF-3A 37° FLARE
	FITTING TORQUE	350 IN - LBS MAX
	MAXIMUM LINE PRESSURE	2000 PSIG
	MOUNTING POSITION	ANY
	WEIGHT	11 OZ.
MOUNTING	HARDWARE	4X 10-32 SCREWS
	BODY TAP DEPTH	0.5"

[1] [2] J1 CONNECTOR PINOUT

PIN	SIGNAL NAME	DESCRIPTION	TYPE	PAIR
1	SIGNAL_OUT	OUTPUT PULSE (SEE NOTE 1)	STT	2,3
2	POWER_HIGH	TRANSDUCER POWER POSITIVE	STT	1,3
3	POWER_RETURN	TRANSDUCER POWER NEGATIVE	STT	1,2
4	TEMP +	RESISTIVE TEMPERATURE DETECTOR POSITIVE	STP	5
5	TEMP -	RESISTIVE TEMPERATURE DETECTOR NEGATIVE	STP	4
6	NC	NO CONNECTION	N/A	N/A

NOTES:

[1] IF EXTERNAL INTERFACE EQUIPMENT DOES NOT CONTAIN A PULL-UP RESISTOR FOR THE FUEL FLOW PULSE, A PULL-UP RESISTOR MUST BE CONNECTED TO THE SIGNAL OUT TO LIMIT THE CURRENT TO 15 mA DC. THE MAXIMUM VOLTAGE APPLIED TO THE PULL-UP RESISTOR IS +24VDC. EXAMPLE: IF +12 VDC IS APPLIED TO THE PULL-UP RESISTOR, THE ABSOLUTE MINIMUM RESISTOR VALUE WOULD BE 12 VDC/0.015 AMPS = 800 OHMS.

[2] RECOMMENDED WIRING IS 22 AWG IN SHIELDED TWISTED PAIR (STP) M27500-22TG2T14 OR EQUIVALENT AND SHIELDED TWISTED TRIPLE (STT) M27500-22TG3T14 OR EQUIVALENT.

UNLESS OTHERWISE SPECIFIED:
DRAWN PER ASME Y14.5M-2009
DIMENSIONS ARE IN INCHES
THIRD ANGLE PROJECTION
TOLERANCES:
X/X ±1/64
X° ±1°
X.X ±0.1
X.XX ±0.01
X.XXX ±0.005
FINISH N/A
MATERIAL N/A

SHADIN AVIONICS
ST. LOUIS PARK, MN 55426

DRAWN	EG	4/3/2014
CHECKED	AR	4/3/2014
ENG APPR.	AR	4/3/2014

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INSTALLATION DRAWING FFTXD 660534HR-( )

DWG. NO. D660534HR

REV B

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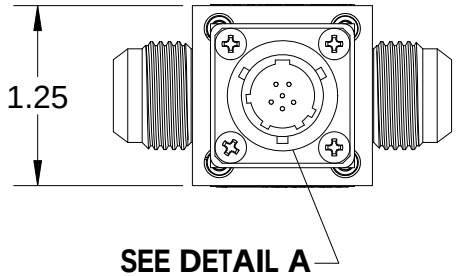
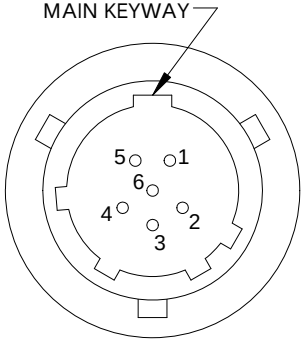
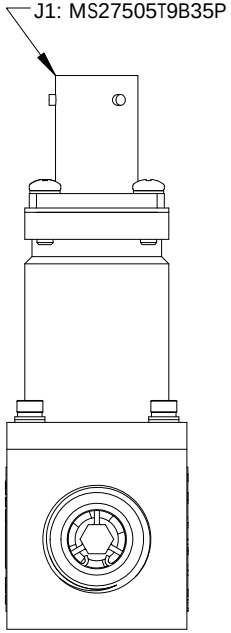
D C B A

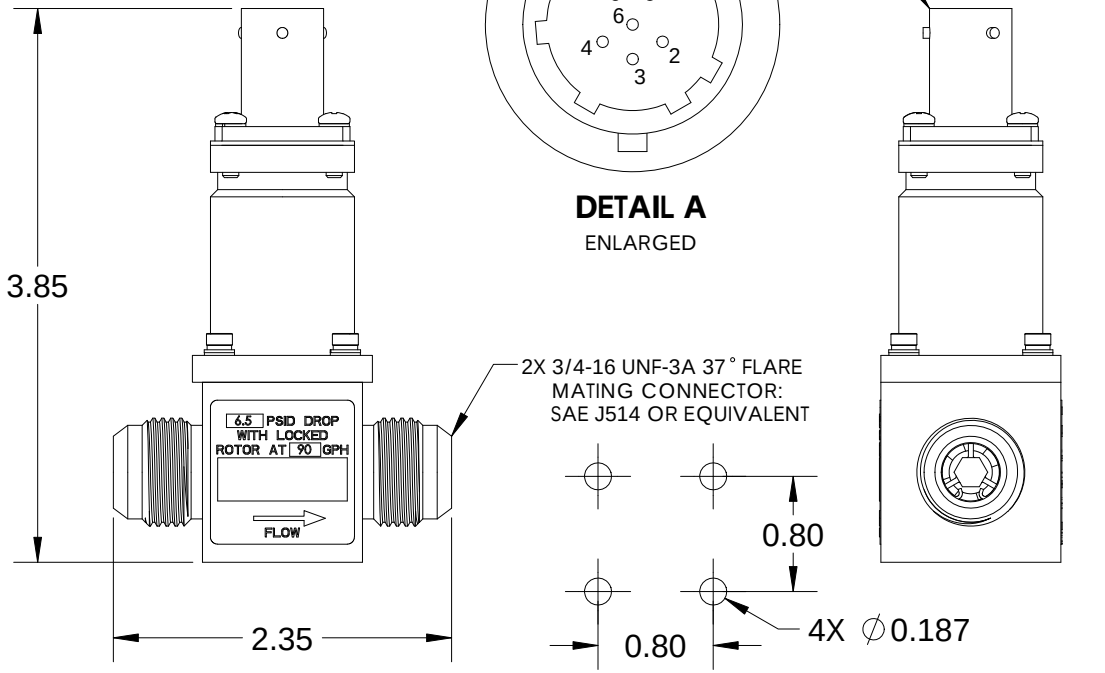
REVISIONS					
ERN #	REV.	DATE	BY	APP'D	DESCRIPTION
1806/011	-	6/28/2018	EG	AR	BASELINE RELEASE
1905/008	A	7/9/2019	EG	AR	UPDATED K-FACTOR





DETAIL A
ENLARGED





MOUNTING TEMPLATE

SPECIFICATIONS

PART NO.	**660534HS-01**	
MATING ELECTRICAL CONNECTOR	PLUG: MS27467T9B35S BACKSHELL: M85049/49-2S8W	
	USE ONLY ENVIRONMENTAL TYPE MATING CONNECTOR	
PERFORMANCE	FLOW RATE	7 - 90 GPH
	K-FACTOR AVG.	19.50 - 20.65 X 1,000 PULSES PER GAL.
		THE K-FACTOR IS AN AVERAGE FROM 15 - 90 GPH. FOR SPECIFIC FLOW RATES, CONTACT SHADIN
PRESSURE DROP @90 GPH, JET A-1	ROTOR FREE	3.5 PSI
	ROTOR LOCKED	6.5 PSI
CERTIFICATION	TSO-C44c	
ENVIRONMENT	TEMP RANGE	-55˚C TO +149˚C
	MAXIMUM ALTITUDE	51,000 FT
MECHANICAL	IN/OUT FITTING	3/4-16UNF-3A 37˚ FLARE
	FITTING TORQUE	350 IN - LBS MAX
	MAXIMUM LINE PRESSURE	2000 PSIG
	MOUNTING POSITION	ANY
	WEIGHT	11 OZ.
MOUNTING	HARDWARE	4X 10-32 SCREWS
	BODY TAP DEPTH	0.5"

[1] [2] J1 CONNECTOR PINOUT

PIN	SIGNAL NAME	DESCRIPTION	TYPE	PAIR
1	SIGNAL_OUT	OUTPUT PULSE (SEE NOTE 1)	STT	2,3
2	POWER_HIGH	TRANSDUCER POWER POSITIVE	STT	1,3
3	POWER_RETURN	TRANSDUCER POWER NEGATIVE	STT	1,2
4	TEMP +	RESISTIVE TEMPERATURE DETECTOR POSITIVE	STP	5
5	TEMP -	RESISTIVE TEMPERATURE DETECTOR NEGATIVE	STP	4
6	NC	NO CONNECTION	N/A	N/A

NOTES:

[1] IF EXTERNAL INTERFACE EQUIPMENT DOES NOT CONTAIN A PULL-UP RESISTOR FOR THE FUEL FLOW PULSE, A PULL-UP RESISTOR MUST BE CONNECTED TO THE SIGNAL OUT TO LIMIT THE CURRENT TO 15 mA DC. THE MAXIMUM VOLTAGE APPLIED TO THE PULL-UP RESISTOR IS +24VDC. EXAMPLE: IF +12 VDC IS APPLIED TO THE PULL-UP RESISTOR, THE ABSOLUTE MINIMUM RESISTOR VALUE WOULD BE 12 VDC/0.015 AMPS = 800 OHMS.

[2] RECOMMENDED WIRING IS 22 AWG IN SHIELDED TWISTED PAIR (STP) M27500-22TG2T14 OR EQUIVALENT AND SHIELDED TWISTED TRIPLE (STT) M27500-22TG3T14 OR EQUIVALENT.

UNLESS OTHERWISE SPECIFIED:
DRAWN PER ASME Y14.5M-2009
DIMENSIONS ARE IN INCHES
THIRD ANGLE PROJECTION
TOLERANCES:
X/X ±1/64
X˚ ±1˚
X.X ±0.1
X.XX ±0.01
X.XXX ±0.005

FINISH N/A

MATERIAL N/A

SHADIN AVIONICS
ST. LOUIS PARK, MN 55426

DRAWN	EG	5/8/2018
CHECKED	AR	6/28/2018
ENG APPR.	AR	6/28/2018

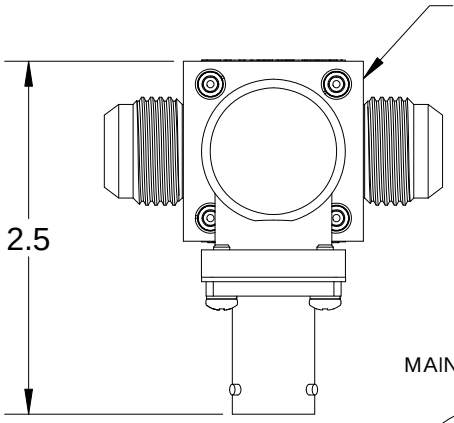
SIZE **A** | CAGE CODE: **0Z5P5** | **F/N** D660534HS-01.SLDDRW | SCALE: N/A | SHEET 1 OF 1

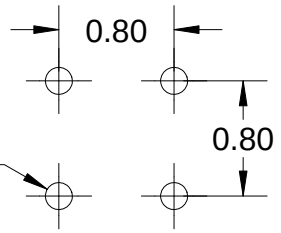
INSTALLATION DRAWING FFTXD 660534HS-01

DWG. NO. D660534HS-01 **REV** A

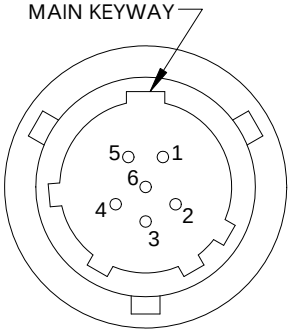
5 4 3 2 1

REVISIONS					
ERN #	REV.	DATE	BY	APP'D	DESCRIPTION
1806/011	-	6/28/2018	EG	AR	BASELINE RELEASE
1905/008	-	7/9/2019	EG	AR	UPDATED K-FACTOR

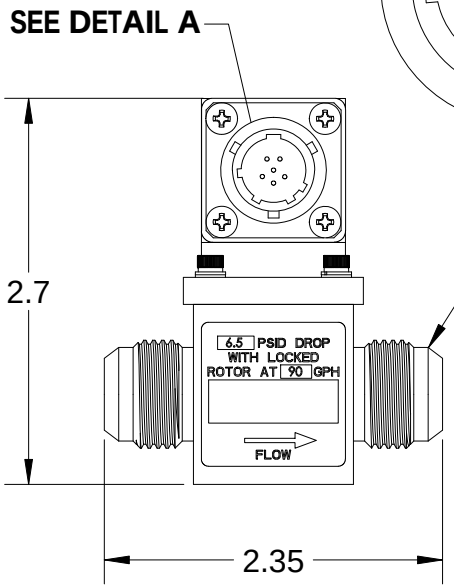


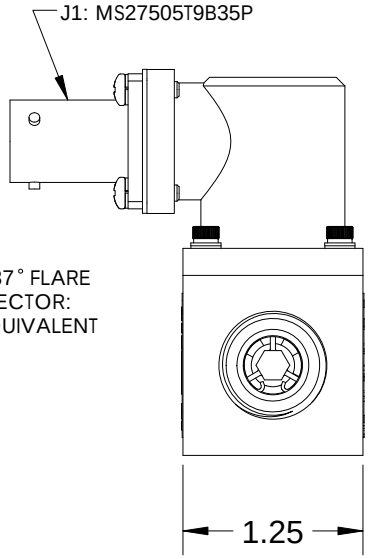


MOUNTING TEMPLATE



DETAIL A
ENLARGED





SPECIFICATIONS

PART NO.	**660534HR-01**	
MATING ELECTRICAL CONNECTOR	PLUG: MS27467T9B35S BACKSHELL: M85049/49-2S8W	
	USE ONLY ENVIRONMENTAL TYPE MATING CONNECTOR	
PERFORMANCE	FLOW RATE	7 - 90 GPH
	K-FACTOR AVG.	19.50 - 20.65 X 1,000 PULSES PER GAL.
		THE K-FACTOR IS AN AVERAGE FROM 15 - 90 GPH. FOR SPECIFIC FLOW RATES, CONTACT SHADIN.
PRESSURE DROP @90 GPH, JET A-1	ROTOR FREE	3.5 PSI
	ROTOR LOCKED	6.5 PSI
CERTIFICATION	TSO-C44c	
ENVIRONMENTAL	TEMP RANGE	-55°C TO +149°C
	MAXIMUM ALTITUDE	51,000 FT
MECHANICAL	IN/OUT FITTING	3/4-16UNF-3A 37° FLARE
	FITTING TORQUE	350 IN - LBS MAX
	MAXIMUM LINE PRESSURE	2000 PSIG
	MOUNTING POSITION	ANY
	WEIGHT	11 OZ.
MOUNTING	HARDWARE	4X 10-32 SCREWS
	BODY TAP DEPTH	0.5"

[1] [2] J1 CONNECTOR PINOUT

PIN	SIGNAL NAME	DESCRIPTION	TYPE	PAIR
1	SIGNAL_OUT	OUTPUT PULSE (SEE NOTE 1)	STT	2,3
2	POWER_HIGH	TRANSDUCER POWER POSITIVE	STT	1,3
3	POWER_RETURN	TRANSDUCER POWER NEGATIVE	STT	1,2
4	TEMP +	RESISTIVE TEMPERATURE DETECTOR POSITIVE	STP	5
5	TEMP -	RESISTIVE TEMPERATURE DETECTOR NEGATIVE	STP	4
6	NC	NO CONNECTION	N/A	N/A

NOTES:

[1] IF EXTERNAL INTERFACE EQUIPMENT DOES NOT CONTAIN A PULL-UP RESISTOR FOR THE FUEL FLOW PULSE, A PULL-UP RESISTOR MUST BE CONNECTED TO THE SIGNAL OUT TO LIMIT THE CURRENT TO 15 mA DC. THE MAXIMUM VOLTAGE APPLIED TO THE PULL-UP RESISTOR IS +24VDC. EXAMPLE: IF +12 VDC IS APPLIED TO THE PULL-UP RESISTOR, THE ABSOLUTE MINIMUM RESISTOR VALUE WOULD BE 12 VDC/0.015 AMPS = 800 OHMS.

[2] RECOMMENDED WIRING IS 22 AWG IN SHIELDED TWISTED PAIR (STP) M27500-22TG2T14 OR EQUIVALENT AND SHIELDED TWISTED TRIPLE (STT) M27500-22TG3T14 OR EQUIVALENT.

UNLESS OTHERWISE SPECIFIED:
DRAWN PER ASME Y14.5M-2009
DIMENSIONS ARE IN INCHES
THIRD ANGLE PROJECTION
TOLERANCES:
X/X ±1/64
X° ±1°
X.X ±0.1
X.XX ±0.01
X.XXX ±0.005
FINISH N/A
MATERIAL N/A

SHADIN AVIONICS
ST. LOUIS PARK, MN 55426

DRAWN	EG	5/9/2018
CHECKED	AR	6/28/2018
ENG APPR.	AR	6/28/2018

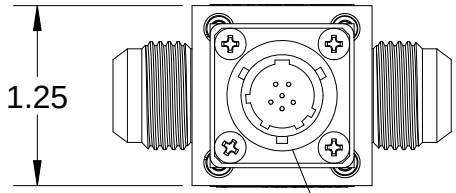
INSTALLATION DRAWING FFTXD 660534HR-01

SIZE A | CAGE CODE: 0Z5P5 | F/N D660534HR-01.SLDDRW | SCALE: N/A | SHEET 1 OF 1

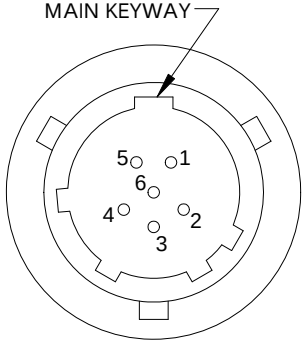
DWG. NO. D660534HR-01

REV A

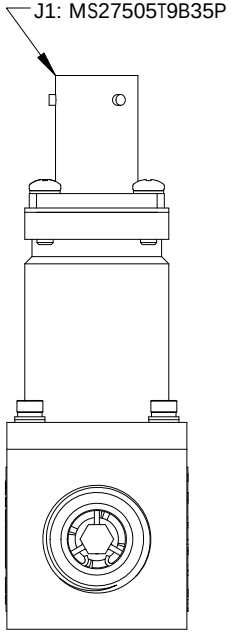
REVISIONS					
ERN #	REV.	DATE	BY	APP'D	DESCRIPTION
2102/001	-	2/12/2021	EG	AR	BASELINE RELEASE

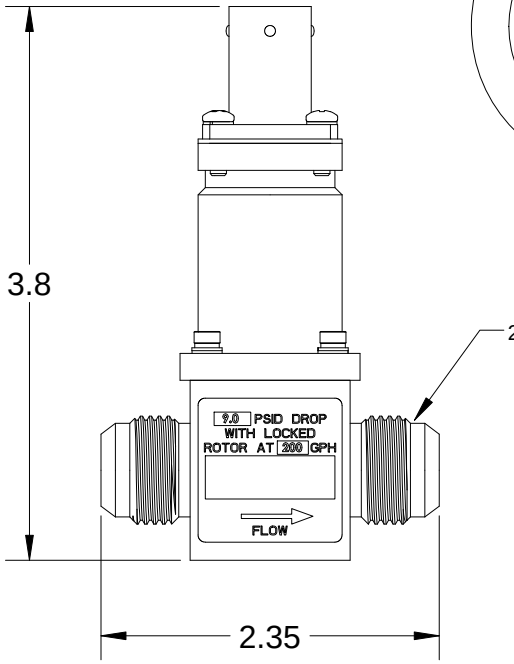


SEE DETAIL A

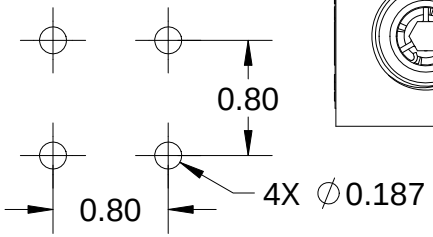


DETAIL A
ENLARGED





2X 3/4-16 UNF-3A 37° FLARE
MATING CONNECTOR:
SAE J514 OR EQUIVALENT



MOUNTING TEMPLATE

SPECIFICATIONS

PART NO.	**660534HS-02**	
MATING ELECTRICAL CONNECTOR	PLUG: MS27467T9B35S BACKSHELL: M85049/49-2S8W	
	USE ONLY ENVIRONMENTAL TYPE MATING CONNECTOR	
PERFORMANCE	FLOW RATE	7 - 200 GPH
	K-FACTOR (K_{AV})	9,000 - 10,000 PULSES/GAL. (AVG)
		FOR FLOW RATES 40 - 200 GPH, SET THE DISPLAY INSTRUMENT TO THE K-FACTOR STAMPED ON THE UNIT. FOR OTHER FLOW RATES CONTACT SHADIN FOR THE APPROPRIATE K-FACTOR SETTING.
PRESSURE DROP @200 GPH, JET A-1	ROTOR FREE	3.0 PSI
	ROTOR LOCKED	9.0 PSI
CERTIFICATION	TSO-C44c	
ENVIRONMENT	TEMP RANGE	-55˚C TO +149˚C
	MAXIMUM ALTITUDE	51,000 FT
MECHANICAL	IN/OUT FITTING	3/4-16UNF-3A 37˚ FLARE
	FITTING TORQUE	350 IN - LBS MAX
	MAXIMUM LINE PRESSURE	2000 PSIG
	MOUNTING POSITION	ANY
	WEIGHT	11 OZ.
MOUNTING	HARDWARE	4X 10-32 SCREWS
	BODY TAP DEPTH	0.5"

[1] [2] J1 CONNECTOR PINOUT

PIN	SIGNAL NAME	DESCRIPTION	TYPE	PAIR
1	SIGNAL_OUT	OUTPUT PULSE (SEE NOTE 1)	STT	2,3
2	POWER_HIGH	TRANSDUCER POWER POSITIVE	STT	1,3
3	POWER_RETURN	TRANSDUCER POWER NEGATIVE	STT	1,2
4	TEMP +	RESISTIVE TEMPERATURE DETECTOR POSITIVE	STP	5
5	TEMP -	RESISTIVE TEMPERATURE DETECTOR NEGATIVE	STP	4
6	NC	NO CONNECTION	N/A	N/A

NOTES:

[1] IF EXTERNAL INTERFACE EQUIPMENT DOES NOT CONTAIN A PULL-UP RESISTOR FOR THE FUEL FLOW PULSE, A PULL-UP RESISTOR MUST BE CONNECTED TO THE SIGNAL OUT TO LIMIT THE CURRENT TO 15 mA DC. THE MAXIMUM VOLTAGE APPLIED TO THE PULL-UP RESISTOR IS +24VDC. EXAMPLE: IF +12 VDC IS APPLIED TO THE PULL-UP RESISTOR, THE ABSOLUTE MINIMUM RESISTOR VALUE WOULD BE 12 VDC/0.015 AMPS = 800 OHMS.

[2] RECOMMENDED WIRING IS 22 AWG IN SHIELDED TWISTED PAIR (STP) M27500-22TG2T14 OR EQUIVALENT AND SHIELDED TWISTED TRIPLE (STT) M27500-22TG3T14 OR EQUIVALENT.

UNLESS OTHERWISE SPECIFIED:
DRAWN PER ASME Y14.5M-2009
DIMENSIONS ARE IN INCHES
THIRD ANGLE PROJECTION
TOLERANCES:
X/X ±1/64
X˚ ±1˚
X.X ±0.1
X.XX ±0.01
X.XXX ±0.005

FINISH N/A

MATERIAL N/A

SHADIN AVIONICS

DRAWN	EG	1/20/2021
CHECKED	AR	2/10/2021
ENG APPR.	AR	2/12/2021

INSTALLATION DRAWING, FFTXD 660534HS-02

SIZE **A** | CAGE CODE: **0Z5P5** | **F/N** D660534HS-02.SLDDRW | SCALE: N/A | SHEET 1 OF 1

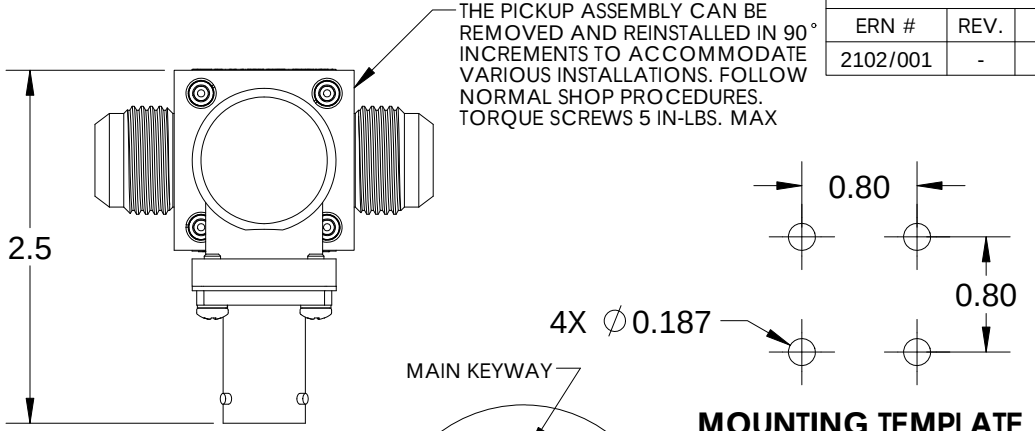
DWG. NO. D660534HS-02

REV -

5 4 3 2 1

D C B A

REVISIONS					
ERN #	REV.	DATE	BY	APP'D	DESCRIPTION
2102/001	-	2/12/2021	EG	AR	BASELINE RELEASE



SPECIFICATIONS

PART NO.	**660534HR-02**	
MATING ELECTRICAL CONNECTOR	PLUG: MS27467T9B35S BACKSHELL: M85049/49-2S8W	
	USE ONLY ENVIRONMENTAL TYPE MATING CONNECTOR	
PERFORMANCE	FLOW RATE	7 - 200 GPH
	K-FACTOR (K_{AV})	9,000 - 10,000 PULSES/GAL. (AVG)
		FOR FLOW RATES 40 - 200 GPH, SET THE DISPLAY INSTRUMENT TO THE K-FACTOR STAMPED ON THE UNIT. FOR OTHER FLOW RATES CONTACT SHADIN FOR THE APPROPRIATE K-FACTOR SETTING.
PRESSURE DROP @200 GPH, JET A-1	ROTOR FREE	3.0 PSI
	ROTOR LOCKED	9.0 PSI
CERTIFICATION	TSO-C44c	
ENVIRONMENTAL	TEMP RANGE	-55°C TO +149°C
	MAXIMUM ALTITUDE	51,000 FT
MECHANICAL	IN/OUT FITTING	3/4-16UNF-3A 37° FLARE
	FITTING TORQUE	350 IN - LBS MAX
	MAXIMUM LINE PRESSURE	2000 PSIG
	MOUNTING POSITION	ANY
	WEIGHT	11 OZ.
MOUNTING	HARDWARE	4X 10-32 SCREWS
	BODY TAP DEPTH	0.5"

[1] [2] J1 CONNECTOR PINOUT

PIN	SIGNAL NAME	DESCRIPTION	TYPE	PAIR
1	SIGNAL_OUT	OUTPUT PULSE (SEE NOTE 1)	STT	2,3
2	POWER_HIGH	TRANSDUCER POWER POSITIVE	STT	1,3
3	POWER_RETURN	TRANSDUCER POWER NEGATIVE	STT	1,2
4	TEMP +	RESISTIVE TEMPERATURE DETECTOR POSITIVE	STP	5
5	TEMP -	RESISTIVE TEMPERATURE DETECTOR NEGATIVE	STP	4
6	NC	NO CONNECTION	N/A	N/A

NOTES:

[1] IF EXTERNAL INTERFACE EQUIPMENT DOES NOT CONTAIN A PULL-UP RESISTOR FOR THE FUEL FLOW PULSE, A PULL-UP RESISTOR MUST BE CONNECTED TO THE SIGNAL OUT TO LIMIT THE CURRENT TO 15 mA DC. THE MAXIMUM VOLTAGE APPLIED TO THE PULL-UP RESISTOR IS +24VDC. EXAMPLE: IF +12 VDC IS APPLIED TO THE PULL-UP RESISTOR, THE ABSOLUTE MINIMUM RESISTOR VALUE WOULD BE 12 VDC/0.015 AMPS = 800 OHMS.

[2] RECOMMENDED WIRING IS 22 AWG IN SHIELDED TWISTED PAIR (STP) M27500-22TG2T14 OR EQUIVALENT AND SHIELDED TWISTED TRIPLE (STT) M27500-22TG3T14 OR EQUIVALENT.

UNLESS OTHERWISE SPECIFIED:
DRAWN PER ASME Y14.5M-2009
DIMENSIONS ARE IN INCHES
THIRD ANGLE PROJECTION
TOLERANCES:
X/X ±1/64
X° ±1°
X.X ±0.1
X.XX ±0.01
X.XXX ±0.005
FINISH N/A
MATERIAL N/A

SHADIN AVIONICS

DRAWN	EG	1/20/2021
CHECKED	AR	2/10/2021
ENG APPR.	AR	2/12/2021

INSTALLATION DRAWING FFTXD 660534HR-02

SIZE A | CAGE CODE: 0Z5P5 | F/N D660534HR-02.SLDDRW | SCALE: N/A | SHEET 1 OF 1

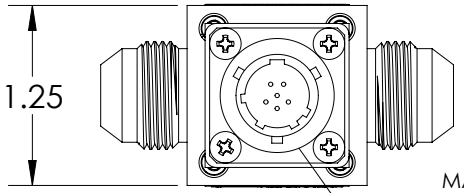
DWG. NO. D660534HR-02

REV -

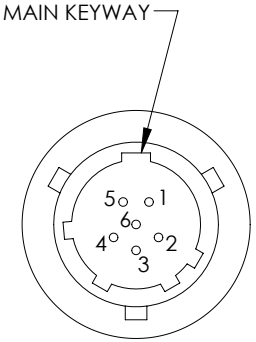
5 4 3 2 1

D C B A

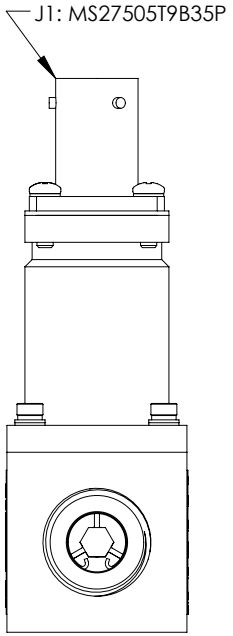
REVISIONS					
ERN #	REV.	DATE	BY	APP'D	DESCRIPTION
2408/023	-	7/25/2024	SRJ	TL	BASELINE RELEASE
2410/002	A	10/9/2024	SRJ	DB	UPDATED ROTOR FREE PSI DROP

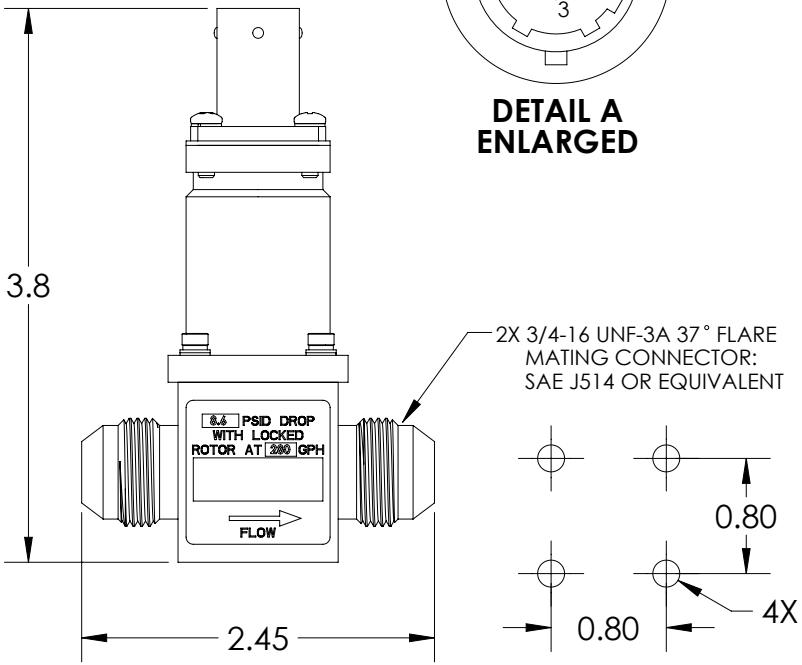


SEE DETAIL A



DETAIL A ENLARGED





MOUNTING TEMPLATE

SPECIFICATIONS

PART NO.	660534HS-03	
MATING ELECTRICAL CONNECTOR	PLUG: MS27467T9B35S BACKSHELL: M85049/49-2S8W	
	USE ONLY ENVIRONMENTAL TYPE MATING CONNECTOR	
PERFORMANCE	FLOW RATE	15 - 280GPH
	K-FACTOR (K_{AV})	6,000 - 7,000 PULSES/GAL. (AVG)
		FOR FLOW RATES 15 - 280 GPH, SET THE DISPLAY INSTRUMENT TO THE K-FACTOR STAMPED ON THE UNIT. FOR OTHER FLOW RATES CONTACT SHADIN FOR THE APPROPRIATE K-FACTOR SETTING.
PRESSURE DROP @280 GPH, JET A-1	ROTOR FREE	3.9 PSI
	ROTOR LOCKED	8.6 PSI
CERTIFICATION	TSO-C44c	
ENVIRONMENT	TEMP RANGE	-55°C TO +149°C
	MAXIMUM ALTITUDE	51,000 FT
MECHANICAL	IN/OUT FITTING	3/4-16UNF-3A 37° FLARE
	FITTING TORQUE	350 IN - LBS MAX
	MAXIMUM LINE PRESSURE	2000 PSIG
	MOUNTING POSITION	ANY
	WEIGHT	11 OZ.
MOUNTING	HARDWARE	4X 10-32 SCREWS
	BODY TAP DEPTH	0.5"

[1] [2] J1 CONNECTOR PINOUT

PIN	SIGNAL NAME	DESCRIPTION	TYPE	PAIR
1	SIGNAL_OUT	OUTPUT PULSE (SEE NOTE 1)	STT	6,3
6	POWER_HIGH	TRANSDUCER POWER POSITIVE	STT	1,3
3	POWER_RETURN	TRANSDUCER POWER NEGATIVE	STT	1,6
4	TEMP +	RESISTIVE TEMPERATURE DETECTOR POSITIVE	STP	5
5	TEMP -	RESISTIVE TEMPERATURE DETECTOR NEGATIVE	STP	4
2	NC	NO CONNECTION	N/A	N/A

NOTES:

[1] IF EXTERNAL INTERFACE EQUIPMENT DOES NOT CONTAIN A PULL-UP RESISTOR FOR THE FUEL FLOW PULSE, A PULL-UP RESISTOR MUST BE CONNECTED TO THE SIGNAL OUT TO LIMIT THE CURRENT TO 15 mA DC. THE MAXIMUM VOLTAGE APPLIED TO THE PULL-UP RESISTOR IS +24VDC. EXAMPLE: IF +12 VDC IS APPLIED TO THE PULL-UP RESISTOR, THE ABSOLUTE MINIMUM RESISTOR VALUE WOULD BE 12 VDC/0.015 AMPS = 800 OHMS.

[2] RECOMMENDED WIRING IS 22 AWG IN SHIELDED TWISTED PAIR (STP) M27500-22TG2T14 OR EQUIVALENT AND SHIELDED TWISTED TRIPLE (STT) M27500-22TG3T14 OR EQUIVALENT.

UNLESS OTHERWISE SPECIFIED:
DRAWN PER ASME Y14.5M-2009
DIMENSIONS ARE IN INCHES

THIRD ANGLE PROJECTION

TOLERANCES:
X/X ±1/64
X° ±1°
X.X ±0.1
X.XX ±0.01
X.XXX ±0.005

FINISH N/A

MATERIAL N/A

SHADIN AVIONICS

DRAWN	SRJ	7/25/2024
CHECKED	TL	7/25/2024
ENG APPR.	TL	7/25/2024

INSTALLATION DRAWING, FFTXD 660534HS-03

SIZE **A** | CAGE CODE: **0Z5P5** | **F/N** D660534HS-03.SLDDRW | SCALE: N/A | SHEET 1 OF 1

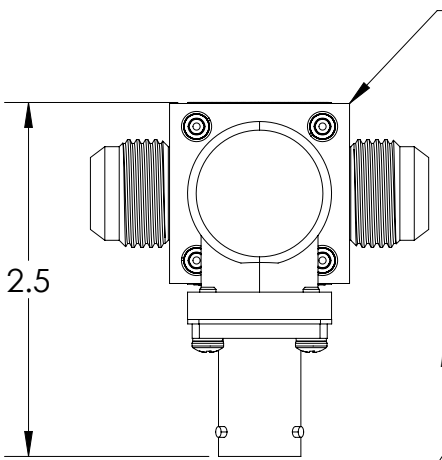
DWG. NO. D660534HS-03

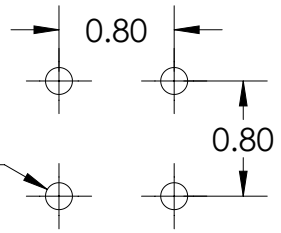
REV A

5 4 3 2 1

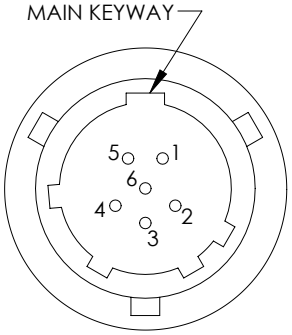
D C B A

REVISIONS					
ERN #	REV.	DATE	BY	APP'D	DESCRIPTION
2410/002	-	10/9/2024	SRJ	DB	BASELINE RELEASE

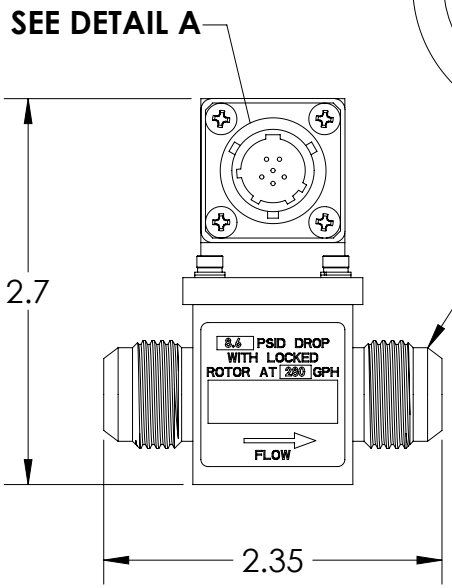


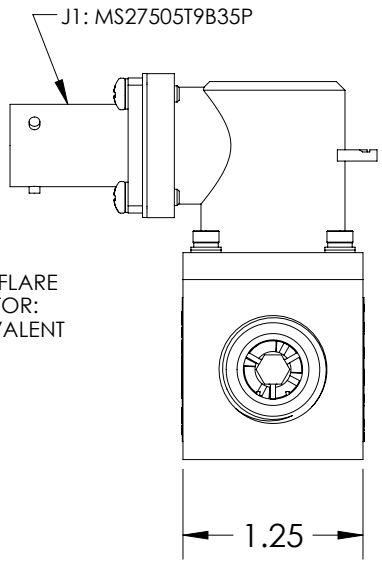


MOUNTING TEMPLATE



DETAIL A
ENLARGED





SPECIFICATIONS

PART NO.	**660534HR-03**	
MATING ELECTRICAL CONNECTOR	PLUG: MS27467T9B35S BACKSHELL: M85049/49-2S8W	
	USE ONLY ENVIRONMENTAL TYPE MATING CONNECTOR	
PERFORMANCE	FLOW RATE	15 - 280 GPH
	K-FACTOR (K_{AV})	6,000 - 7,000 PULSES/GAL. (AVG)
		FOR FLOW RATES 40 - 200 GPH, SET THE DISPLAY INSTRUMENT TO THE K-FACTOR STAMPED ON THE UNIT. FOR OTHER FLOW RATES CONTACT SHADIN FOR THE APPROPRIATE K-FACTOR SETTING.
PRESSURE DROP @280 GPH, JET A-1	ROTOR FREE	3.9 PSI
	ROTOR LOCKED	8.6 PSI
CERTIFICATION	TSO-C44c	
ENVIRONMENTAL	TEMP RANGE	-55°C TO +149°C
	MAXIMUM ALTITUDE	51,000 FT
MECHANICAL	IN/OUT FITTING	3/4-16UNF-3A 37° FLARE
	FITTING TORQUE	350 IN - LBS MAX
	MAXIMUM LINE PRESSURE	2000 PSIG
	MOUNTING POSITION	ANY
	WEIGHT	11 OZ.
MOUNTING	HARDWARE	4X 10-32 SCREWS
	BODY TAP DEPTH	0.5"

[1] [2] J1 CONNECTOR PINOUT

PIN	SIGNAL NAME	DESCRIPTION	TYPE	PAIR
1	SIGNAL_OUT	OUTPUT PULSE (SEE NOTE 1)	STT	6,3
6	POWER_HIGH	TRANSDUCER POWER POSITIVE	STT	1,3
3	POWER_RETURN	TRANSDUCER POWER NEGATIVE	STT	1,6
4	TEMP +	RESISTIVE TEMPERATURE DETECTOR POSITIVE	STP	5
5	TEMP -	RESISTIVE TEMPERATURE DETECTOR NEGATIVE	STP	4
2	NC	NO CONNECTION	N/A	N/A

NOTES:

[1] IF EXTERNAL INTERFACE EQUIPMENT DOES NOT CONTAIN A PULL-UP RESISTOR FOR THE FUEL FLOW PULSE, A PULL-UP RESISTOR MUST BE CONNECTED TO THE SIGNAL OUT TO LIMIT THE CURRENT TO 15 mA DC. THE MAXIMUM VOLTAGE APPLIED TO THE PULL-UP RESISTOR IS +24VDC. EXAMPLE: IF +12 VDC IS APPLIED TO THE PULL-UP RESISTOR, THE ABSOLUTE MINIMUM RESISTOR VALUE WOULD BE 12 VDC/0.015 AMPS = 800 OHMS.

[2] RECOMMENDED WIRING IS 22 AWG IN SHIELDED TWISTED PAIR (STP) M27500-22TG2T14 OR EQUIVALENT AND SHIELDED TWISTED TRIPLE (STT) M27500-22TG3T14 OR EQUIVALENT.

UNLESS OTHERWISE SPECIFIED:
DRAWN PER ASME Y14.5M-2009
DIMENSIONS ARE IN INCHES
THIRD ANGLE PROJECTION
TOLERANCES:
X/X ±1/64
X° ±1°
X.X ±0.1
X.XX ±0.01
X.XXX ±0.005
FINISH N/A
MATERIAL N/A

SHADIN AVIONICS

DRAWN	SRJ	7/25/2024
CHECKED	TL	7/25/2024
ENG APPR.	TL	7/25/2024

SIZE A | CAGE CODE: 0Z5P5 | F/N D660534HR-03.SLDDRW | SCALE: N/A | SHEET 1 OF 1

INSTALLATION DRAWING FFTXD 660534HR-03

DWG. NO. D660534HR-03 | REV -

5 4 3 2 1