

# GAPS & HAPS SERIES

000843

Issue 2

## Aerospace Proximity Sensors

### DESCRIPTION

Honeywell has over 30 years' experience designing and delivering accurate and reliable proximity sensors that are currently used in a variety of military and commercial aircraft.

Honeywell has two new platforms of proximity sensors: **General Aerospace Proximity Sensors (GAPS)** and **Harsh Aerospace Proximity Sensors (HAPS)**, formerly known as the IHM Series. Both platforms incorporate Honeywell's patented Integrated Health Monitoring functionality, however the products have some technical differences that allow them to be used in various aerospace applications. GAPS can be used in less harsh areas of application with some differences of electrical and environmental characteristics when compared to HAPS. Whilst, HAPS Aerospace Proximity Sensors are configurable, non-contact, hermetically sealed devices designed to sense the presence or absence of a target in harsh-duty aircraft applications.

The GAPS and HAPS platforms provide on/off outputs and can be configured with an optional health monitoring output to the host system. The sensing mechanism is based on the familiar Eddy Current Killed Oscillator (ECKO) principles; however, Honeywell has designed and implemented the patented FAVCO (Fixed Amplitude Variable Current Oscillator) technology which enables the Honeywell sensors to have the health monitoring (IHM) features. See Figure 5 to compare the ECKO and FAVCO technologies. The GAPS and HAPS Series helps to reduce downtime and maintenance costs due to a unique circuit that can detect any internal failures and display a fault output instead of a false positive or false negative. For the customer, this delivers the best performance with a lower overall cost over the life of the aircraft.

### FEATURES

- Industry-leading indirect lightning and dielectric ruggedness: Meets the increased requirements of today's composite aircraft and most challenging applications including landing gear, thrust reversers, and flight controls
- Enhanced vibration ruggedness: Capable of withstanding extremely high vibration applications
- Environmentally rugged: Fully hermetic packages provide long-term reliability in very harsh environments by eliminating the potential for contamination of the sensor from the application environment. In addition, Honeywell has developed an innovative method to environmentally seal wire-lead (pigtail) configurations
- Integral Health Monitoring Capability: Optional third output state to indicate the health of the sensor (whether it is healthy or failed). Reduces maintenance time, reduces delayed flights, and lowers overall maintenance cost across the life of the aircraft
- Non-contact design: Utilizes non-contact technology to sense the presence or absence of a target regardless of the dirty, harsh environment in which it is placed, eliminating mechanical failure mechanisms, reducing wear, minimizing downtime, increasing durability, and increasing reliability



### VALUE TO CUSTOMERS

- Enhanced vibration and EMI specifications help to increase revenue (flight hours) and reduce cost to serve (system maintenance)
- Hermetic sealing helps increase revenue (flight hours), reduce cost to serve (maintenance), & reduce cost of goods (spares)
- Platform approach helps to increase revenue and reduce cost to serve
- Health monitoring helps to increase revenue, reduce cost to serve, and reduce cost of goods
- Supplier stability helps to reduce cost to serve (troubleshoot with original supplier)
- Current install base helps to reduce cost to serve (proven performance and MTBF)

### PORTFOLIO



Honeywell's GAPS and HAPS Series is part of a comprehensive line of aerospace sensors, switches, and value-added solutions. To view Honeywell's complete product offering, click here.

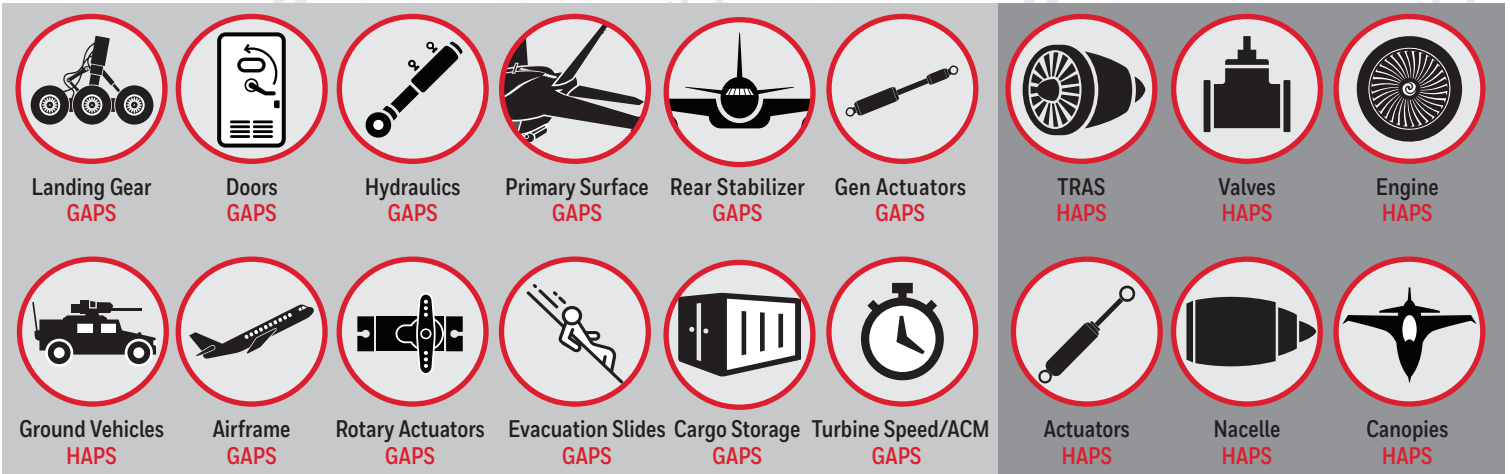
**Honeywell**

# AEROSPACE PROXIMITY SENSORS, GAPS & HAPS SERIES



**GAPS** | GENERAL Aerospace Proximity Sensor

**HAPS** | HARSH Application Proximity Sensor



**GAPS**

**DIFFERENTIATORS**

**HAPS**

500,000	<b>MTBF &gt; FLIGHT HOURS</b>	500,000
	<b>MECHANICAL CHARACTERISTICS</b>	
115°C	<b>OPERATING TEMPERATURE</b>	115°C
20 G	<b>VIBRATION</b>	20 G*
40 G	<b>OPERATING SHOCK</b>	20 G
	<b>ELECTRICAL CHARACTERISTICS</b>	
150 mA Level W	<b>RADIO FREQUENCY CONDUCTED SUSCEPTIBILITY</b>	300 mA Level Y
100 V/m CAT F	<b>RADIO FREQUENCY RADIATED SUSCEPTIBILITY</b>	200 V/m CAT G
Level 3	<b>LIGHTNING INDUCED TRANSIENT SUSCEPTIBILITY</b>	Level 3
ON/OFF 20 mA	<b>OUTPUT TYPE</b>	IHM ON/OFF 250 mA
1000 Vdc/750 Vac	<b>DIELECTRIC/IR</b>	500 Vdc/500 Vac

# AEROSPACE PROXIMITY SENSORS, GAPS & HAPS SERIES

**TABLE 1. GAPS SERIES AND HAPS SERIES PERFORMANCE SPECIFICATIONS**

CHARACTERISTIC	PARAMETER	
Mechanical Characteristics	GAPS	HAPS
<b>Weight</b>	Less than 60 grams (inline variants); 85 grams (right-angle variants)	60 g to 150 g
<b>Sealing</b>	Hermetically sealed	Hermetically sealed, pigtail versions environmentally sealed
<b>Connector/leads</b>	D38999/25YA98PN D38999/25YA98PA EN2997Y10803MN	<ul style="list-style-type: none"> <li>• D38999/25YA98PN</li> <li>• EN2997Y10803MN</li> <li>• M83723/90Y10056</li> <li>• M83723/90Y10058</li> <li>• D38999/25YA98PA</li> <li>• M83723/90Y1005N</li> <li>• M83723/90Y10057</li> <li>• Pigtail</li> </ul>
<b>Form factor</b>	<ul style="list-style-type: none"> <li>• Inline, cylindrical, threaded</li> <li>• Right angle, cylindrical, threaded</li> <li>• Inline, cylindrical, flanged</li> <li>• Right angle, cylindrical, flanged</li> </ul>	<ul style="list-style-type: none"> <li>• Inline, cylindrical, threaded</li> <li>• Right angle, cylindrical, threaded</li> <li>• Inline, cylindrical, flanged</li> <li>• Right angle, cylindrical, flanged</li> </ul>
<b>Sensing distance</b>	3,5 mm max.	4 mm max.
<b>Sensing face</b>	Inconel®	Inconel®
<b>Outer body material</b>	Stainless steel	Stainless steel
<b>Sensor head diameter</b>	13,5 mm [0.53 in]	13,5 mm [0.53 in]
<b>Sensor length</b>	55 mm [2.17 in] max.	various; 60 mm [2.36 in] max.
<b>Target (typical)</b>	SS 17-4PH rectangular target with dimensions 25 mm x 18 mm x 3 mm [0.98 in x 0.71 in x 0.12 in]	SS 17-4PH rectangular target with dimensions 25 mm x 18 mm x 3 mm [0.98 in x 0.71 in x 0.12 in]
<b>MTBF</b>	500,000 flight hours	500,000 flight hours
Electrical Characteristics	GAPS	HAPS
<b>Supply voltage</b>	12 Vdc to 32 Vdc (input)	12 Vdc to 28 Vdc
<b>Supply current</b>	<10 mA	<10 mA
<b>Operating temperature range</b>	-55 °C to 115 °C [131 °F to 239 °F]	-55 °C to 115 °C [-67 °F to 239 °F]
<b>Storage temperature range</b>	-65 °C to 115 °C [-85 °F to 239 °F]	-65 °C to 115 °C [-85 °F to 239 °F]
<b>Target response time</b>	5 ms	5 ms
<b>Power on delay time</b>	<1 second	<1 second
<b>Bonding resistance</b>	< 2.5 mΩ	<2.5 mΩ
<b>Dielectric strength</b>	1000 Vdc/750 Vac for 1 minute	500 Vdc/500 Vac for 1 minute
<b>Insulation resistance</b>	200 MΩ min. at 50 Vdc	200 MΩ min. at 50 Vdc
Sensing Characteristics	GAPS	HAPS
<b>Ga/Gd</b>	see Figure 3	see Figure 3
<b>Target material</b>	17-4 PH stainless steel heat treated to condition H1025	17-4 PH stainless steel heat treated to condition H1025
<b>Target dimension</b>	Rectangular target of 25 mm x 18 mm x 3 mm	Rectangular target of 25 mm x 18 mm x 3 mm

# AEROSPACE PROXIMITY SENSORS, GAPS & HAPS SERIES

TABLE 2. GAPS SERIES AND HAPS SERIES PERFORMANCE SPECIFICATIONS		
CHARACTERISTIC	PARAMETER	
Environmental Characteristics	GAPS	HAPS
Temperature and altitude	RTCA/DO-160G – Section 4, Category D3	RTCA/DO-160G – Section 4, Category D3
Temperature variation	RTCA/DO-160G – Section 5, Category S2	RTCA/DO-160G – Section 5, Category S2
Humidity	RTCA/DO-160G – Section 6, Category C	RTCA/DO-160G – Section 6, Category C
Operational shock and crash safety	RTCA/DO-160G – Section 7, Category B	RTCA/DO-160G – Section 7, Category B
Vibration	RTCA/DO-160G – Section 8, Category R (Curve E, E1, and W)	RTCA/DO-160G – Section 8, Category R (Curve E, E1, and W)
Explosion safety	RTCA/DO-160G – Section 9, Category E&H	RTCA/DO-160G – Section 9, Category E&H ENV III
Water proofness	RTCA/DO-160G – Section 10, Category R	RTCA/DO-160G – Section 10, Category R
Fluid susceptibility	RTCA/DO-160G – Section 11, Category F	RTCA/DO-160G – Section 11, Category F
Sand and dust	RTCA/DO-160G – Section 12, Category D	RTCA/DO-160G – Section 12, Category D
Fungus resistance	RTCA/DO-160G – Section 13, Category F	RTCA/DO-160G – Section 13, Category F
Salt spray	RTCA/DO-160G – Section 14, Category T	RTCA/DO-160G – Section 14, Category T
Magnetic effects	RTCA/DO-160G – Section 15, Category A	RTCA/DO-160G – Section 15, Category A
Power input	RTCA/DO-160G – Section 16, Category A	RTCA/DO-160G – Section 16, Category A
Voltage spike	RTCA/DO-160G – Section 17, Category A	RTCA/DO-160G – Section 17, Category A
Audio frequency conducted susceptibility	RTCA/DO-160G – Section 18, Category Z	RTCA/DO-160G – Section 18, Category Z
Induced signal susceptibility	RTCA/DO-160G – Section 19, Category CWE	RTCA/DO-160G – Section 19, Category CWE
Radio frequency radiated susceptibility	RTCA/DO-160G – Section 20, Category F	RTCA/DO-160G – Section 20, Category G
Radio frequency conducted susceptibility	RTCA/DO-160G – Section 20, Category W	RTCA/DO-160G – Section 20, Category Y
Radio frequency emission	RTCA/DO-160G – Section 21, Category M	RTCA/DO-160G – Section 21, Category M
Lightning induced transient susceptibility	RTCA/DO-160G – Section 22, Category B3K3L3	RTCA/DO-160G – Section 22, Category B3K3L3
Icing	RTCA/DO-160G – Section 24, Category A	RTCA/DO-160G – Section 24, Category A
Electrostatic discharge	RTCA/DO-160G – Section 25, Category A	RTCA/DO-160G – Section 25, Category A

# AEROSPACE PROXIMITY SENSORS, GAPS & HAPS SERIES

**FIGURE 1. GAPS PRODUCT NOMENCLATURE**

<b>LG</b>	<b>CT</b>	<b>A</b>	<b>3A</b>	<b>A</b>	<b>O</b>
Series	Form Factor	Range Ga/Gd mm [in]	Electrical Output Type	Termination	Reserved
<b>LG Series</b> General Aerospace Proximity Sensor	<b>CT</b> Inline, cylindrical threaded	<b>A</b> 1,75/2,75 [0.069/0.108]	<b>3B</b> 3-wire, open collector output normally closed	<b>A</b> D38999/25YA98PN	
	<b>RT</b> Right angle cylindrical threaded	<b>B</b> 2,00/3,00 [0.078/0.118]	<b>3C</b> 3-wire, open collector output normally open	<b>B</b> D38999/25YA98PA	
	<b>CF</b> Inline, cylindrical flanged*	<b>C</b> 2,25/3,25 [0.088/0.128]	<b>3A</b> 3-wire, current sink output*	<b>C</b> EN2997Y10803MN*	
	<b>RF</b> Right angle cylindrical flanged*	<b>D</b> 2,50/3,50 [0.098/0.138]			

\*Note: Please contact Honeywell for further details.

**FIGURE 2. HAPS SERIES PRODUCT NOMENCLATURE**

<b>1P</b>	<b>CT</b>	<b>A</b>	<b>3A</b>	<b>A</b>	<b>N</b>	<b>N</b>	<b>-000</b>
Series	Form Factor	Range Ga/Gd mm [in]	Electrical Output Type	Termination	Pigtail Length	Hardware	Reserved
<b>HAPS Series</b> One-Piece (Active) Proximity Sensor	<b>CT</b> Inline, cylindrical threaded	<b>A</b> 1,75/2,75 [0.069/0.108]	<b>3A</b> 3-wire, current sink output Near/Fault/Far	<b>A</b> D38999/25YA98PN	<b>N</b> Not applicable	<b>N</b> No hardware	
	<b>RT</b> Right angle cylindrical threaded	<b>B</b> 2,00/3,00 [0.078/0.118]	<b>3B</b> 3-wire, open collector output normally closed	<b>B</b> D38999/25YA98PA	<b>A</b> 30,84 cm [12.0 in]	<b>1</b> Washer MS25081C6 (1 nos.) Hex nut MS21340-05 (2 nos.)	
	<b>CF</b> Inline, cylindrical flanged	<b>C</b> 2,25/3,25 [0.088/0.128]	<b>3C</b> 3-wire, open collector output normally open	<b>C</b> EN2997Y10803MN	<b>B</b> 60,96 cm [24.0 in]		
	<b>RF</b> Right angle cylindrical flanged	<b>D</b> 2,50/3,50 [0.098/0.138]		<b>H</b> Pigtail (flying lead)	<b>C</b> 91,44 cm [36.0 in]		
		<b>E</b> 2,75/3,75 [0.108/0.147]		<b>D</b> M83723/90Y1005N	<b>D</b> 121,92 cm [48.0 in]		
		<b>F</b> 3,00/4,00 [0.118/0.157]		<b>E</b> M83723/90Y10056	<b>E</b> 152,40 cm [60.0 in]		
				<b>F</b> M83723/90Y10057	<b>F</b> 182,88 cm [72.0 in]		
			<b>G</b> M83723/90Y10058	<b>G</b> 213,36 cm [84.0 in]			

\*Note: These grayed-out options are non-qualified listings (not released as production listings in the ordering system). These listings will be qualified based on customer request. Contact Honeywell for further information on the grayed-out customization options.

# AEROSPACE PROXIMITY SENSORS, GAPS & HAPS SERIES

**TABLE 3. GAPS SERIES INTERFACE DETAILS**

SUPPLY VOLTAGE	SUPPLY CURRENT	OUTPUT TYPE	OUTPUT CONDITION	CONNECTOR	CATALOG LISTING	PIN CONFIGURATION
12 Vdc to 32 Vdc	20 mA max.	Current sink	<b>Target near:</b> $4\text{ mA} \leq I_o \leq 6\text{ mA}$ <b>Target far:</b> $12\text{ mA} \leq I_o \leq 16\text{ mA}$ <b>Internal fault:</b> $9\text{ mA} \leq I_o \leq 11\text{ mA}$ or $I_o < 1\text{ mA}$	D38999/25YA98PN	LGXXD3AAX-000	Pin A: Supply excitation Pin B: Supply return Pin C: Output
				D38999/25YA98PA	LGXXD3ABX-000	Pin A: Supply excitation Pin B: Supply return Pin C: Output
				EN2997Y10803MN	LGXXD3ACX-000	Pin 1: Supply excitation Pin 2: Supply return Pin 3: Output
12 Vdc to 32 Vdc	20 mA max.	Open collector (normally closed)	<b>Target near:</b> Switch open, $I_o < 50\text{ }\mu\text{A}$ <b>Target far:</b> Switch close, $V_o < 1\text{ V}$ @ 20 mA of $I_o$	D38999/25YA98PN	LGXXD3BAX-000	Pin A: Supply excitation Pin B: Supply return Pin C: Output
				D38999/25YA98PA	LGXXD3BBX-000	Pin A: Supply excitation Pin B: Supply return Pin C: Output
				EN2997Y10803MN	LGXXD3BCX-000	Pin 1: Supply excitation Pin 2: Supply return Pin 3: Output
12 Vdc to 32 Vdc	20 mA max.	Open collector (normally open)	<b>Target near:</b> Switch close, $V_o < 1\text{ V}$ @ 20 mA of $I_o$ <b>Target far:</b> Switch open, $I_o < 50\text{ }\mu\text{A}$	D38999/25YA98PN	LGXXD3CAX-000	Pin A: Supply excitation Pin B: Supply return Pin C: Output
				D38999/25YA98PA	LGXXD3CBX-000	Pin A: Supply excitation Pin B: Supply return Pin C: Output
				EN2997Y10803MN	LGXXD3CCX-000	Pin 1: Supply excitation Pin 2: Supply return Pin 3: Output

# AEROSPACE PROXIMITY SENSORS, GAPS & HAPS SERIES

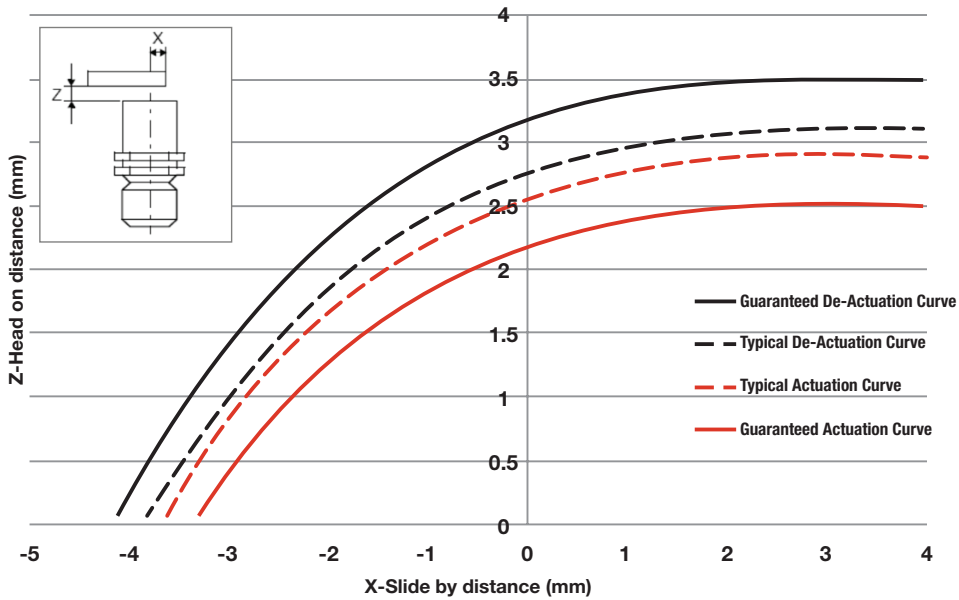
**TABLE 4. HAPS SERIES INTERFACE DETAILS**

SUPPLY VOLT-AGE	SUPPLY CURRENT	OUTPUT TYPE	OUTPUT CONDITION	CONNECTOR	CATALOG LISTING	PIN/WIRE CONFIGURATION
12 Vdc to 28 Vdc	10 mA max.	Current sink	<b>Target near:</b> $4\text{ mA} \leq I_o \leq 6\text{ mA}$ <b>Target far:</b> $12\text{ mA} \leq I_o \leq 16\text{ mA}$ <b>Internal fault:</b> $9\text{ mA} \leq I_o \leq 11\text{ mA}$ or $I_o < 1\text{ mA}$	D38999/25YA98PN	1PXXX3AANX-000	Pin A: Supply excitation Pin B: Supply return Pin C: Output
				D38999/25YA98PA	1PXXX3ABNX-000	
				EN2997Y10803MN	1PXXX3ACNX-000	Pin 1: Supply excitation Pin 2: Output Pin 3: Supply return
				M83723/90Y1005N	1PXXX3ADNX-000	Pin 1: Supply excitation
				M83723/90Y10056	1PXXX3AENX-000	Pin 2: Output
				M83723/90Y10057	1PXXX3AFNX-000	Pin 3: Supply return
				M83723/90Y10058	1PXXX3AGNX-000	Pin 4: No connection Pin 5: No connection
Pigtail (Flying Lead)	1PXXX3AHXX-000	White wire (orange stripes): Supply excitation White wire (blue stripes): Output White wire (no stripes): Supply return				
12 Vdc to 28 Vdc	10 mA max.	Open collector (normally closed)	<b>Target near:</b> Switch open, $I_o < 50\text{ }\mu\text{A}$ <b>Target far:</b> Switch close, $V_o < 1\text{ V}$ @ 20 mA of $I_o$	D38999/25YA98PN	1PXXX3AANX-000	Pin A: Supply excitation Pin B: Output Pin C: Supply return
				D38999/25YA98PA	1PXXX3ABNX-000	
				EN2997Y10803MN	1PXXX3ACNX-000	Pin 1: Supply excitation Pin 2: Output Pin 3: Supply return
				M83723/90Y1005N	1PXXX3ADNX-000	Pin 1: Supply excitation
				M83723/90Y10056	1PXXX3AENX-000	Pin 2: Output
				M83723/90Y10057	1PXXX3AFNX-000	Pin 3: Supply return
				M83723/90Y10058	1PXXX3AGNX-000	Pin 4: No connection Pin 5: No connection
Pigtail (Flying Lead)	1PXXX3AHXX-000	White wire (orange stripes): Supply excitation White wire (blue stripes): Output White wire (no stripes): Supply return				
12 Vdc to 28 Vdc	10 mA max.	Open collector (normally open)	<b>Target near:</b> Switch close, $V_o < 1\text{ V}$ @ 20 mA of $I_o$ <b>Target far:</b> Switch open, $I_o < 50\text{ }\mu\text{A}$	D38999/25YA98PN	1PXXX3AANX-000	Pin A: Supply excitation Pin B: Output Pin C: Supply return
				D38999/25YA98PA	1PXXX3ABNX-000	
				EN2997Y10803MN	1PXXX3ACNX-000	Pin 1: Supply excitation Pin 2: Output Pin 3: Supply Return
				M83723/90Y1005N	1PXXX3ADNX-000	Pin 1: Supply excitation
				M83723/90Y10056	1PXXX3AENX-000	Pin 2: Output
				M83723/90Y10057	1PXXX3AFNX-000	Pin 3: Supply return
				M83723/90Y10058	1PXXX3AGNX-000	Pin 4: No connection Pin 5: No connection
Pigtail (Flying Lead)	1PXXX3AHXX-000	White wire (orange stripes): Supply excitation White wire (blue stripes): Output White wire (no stripes): Supply return				

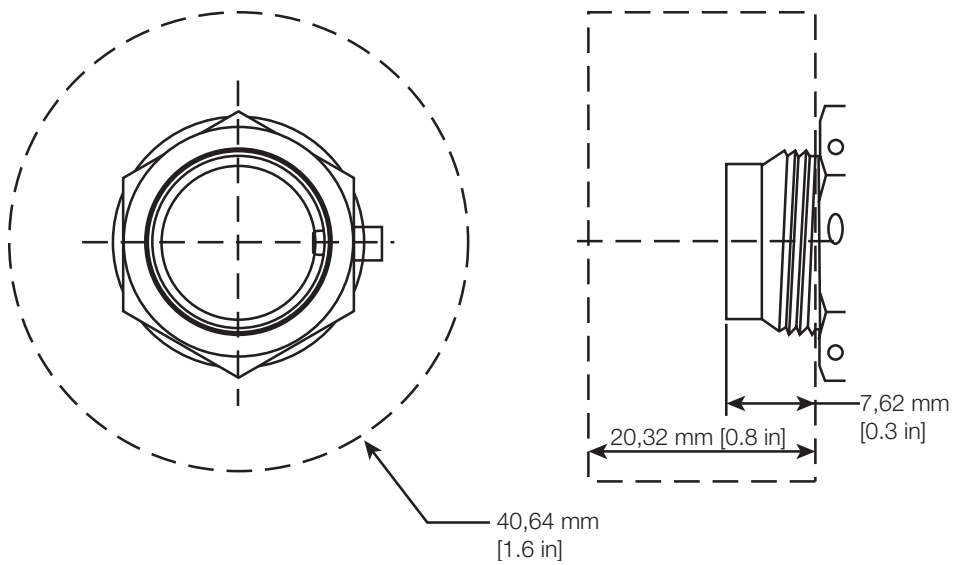
# AEROSPACE PROXIMITY SENSORS, GAPS & HAPS SERIES

**FIGURE 3. SLIDE-BY CURVES**

Proximity Sensor Actuation and De-Actuation Curves



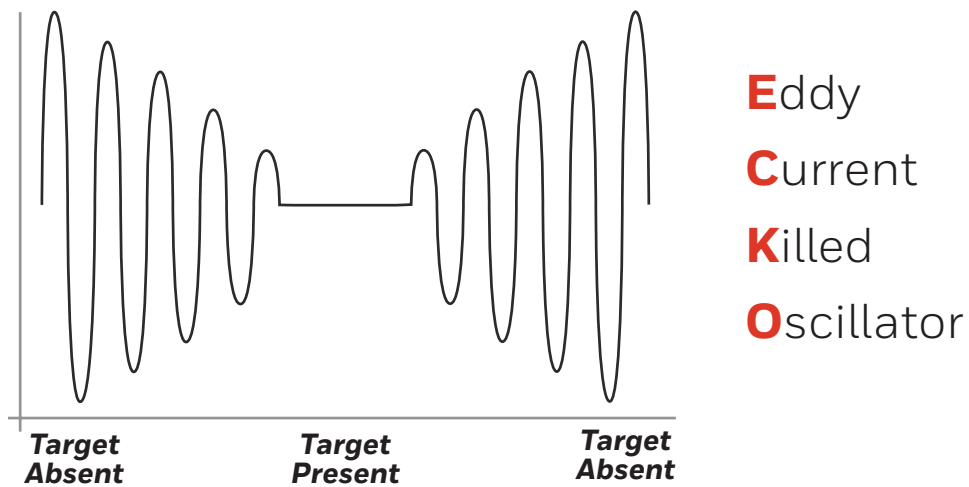
**FIGURE 4. KEEP OUT ZONE MAP**



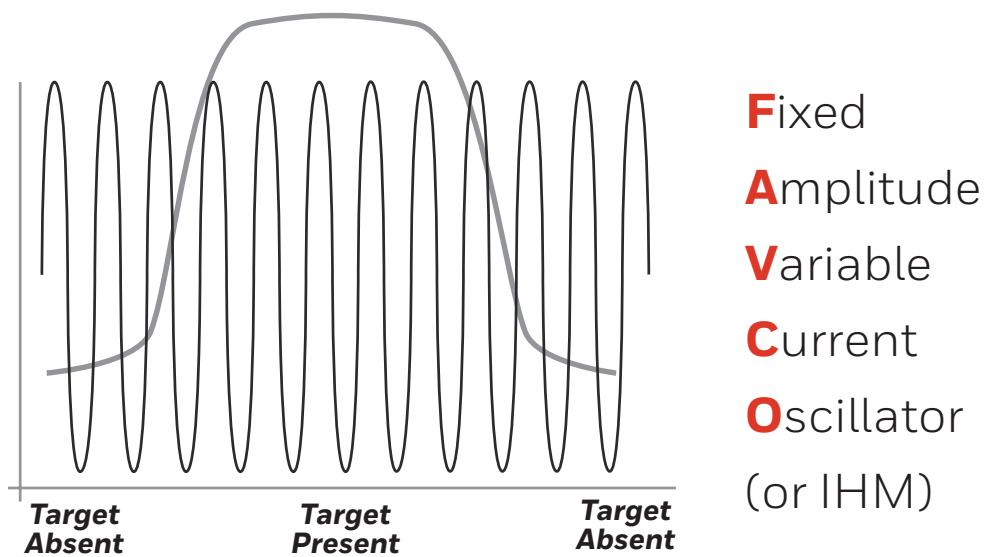


# AEROSPACE PROXIMITY SENSORS, GAPS & HAPS SERIES

FIGURE 5. ECKO VS. FAVCO TECHNOLOGY



Eddy currents within the target cause a load on the sensor decreasing the amplitude of the oscillator, monitored by a trigger switching the output state **on** or **off**.

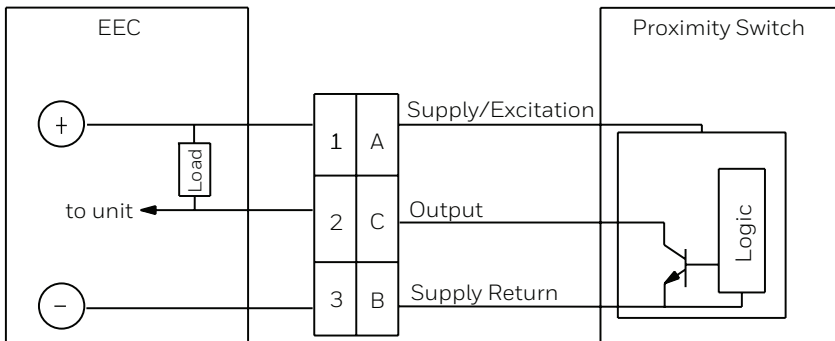


Energy measured to maintain the oscillation when a load on the sensor is applied caused by the eddy currents of the target.

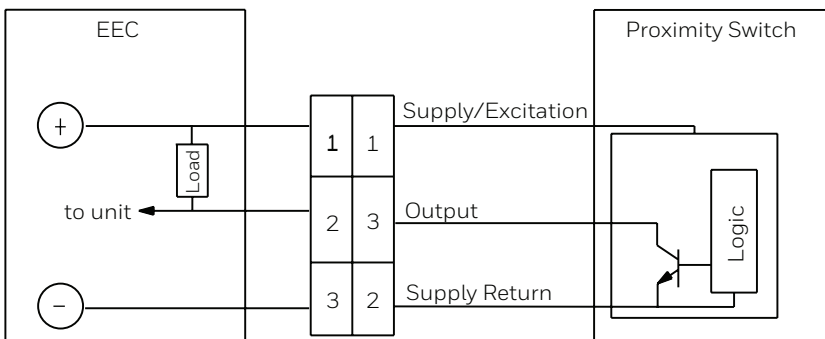
# AEROSPACE PROXIMITY SENSORS, GAPS & HAPS SERIES

## GAPS WIRING DIAGRAMS

**FIGURE 6. GAPS SERIES D38999/25YA98PN CONNECTOR**

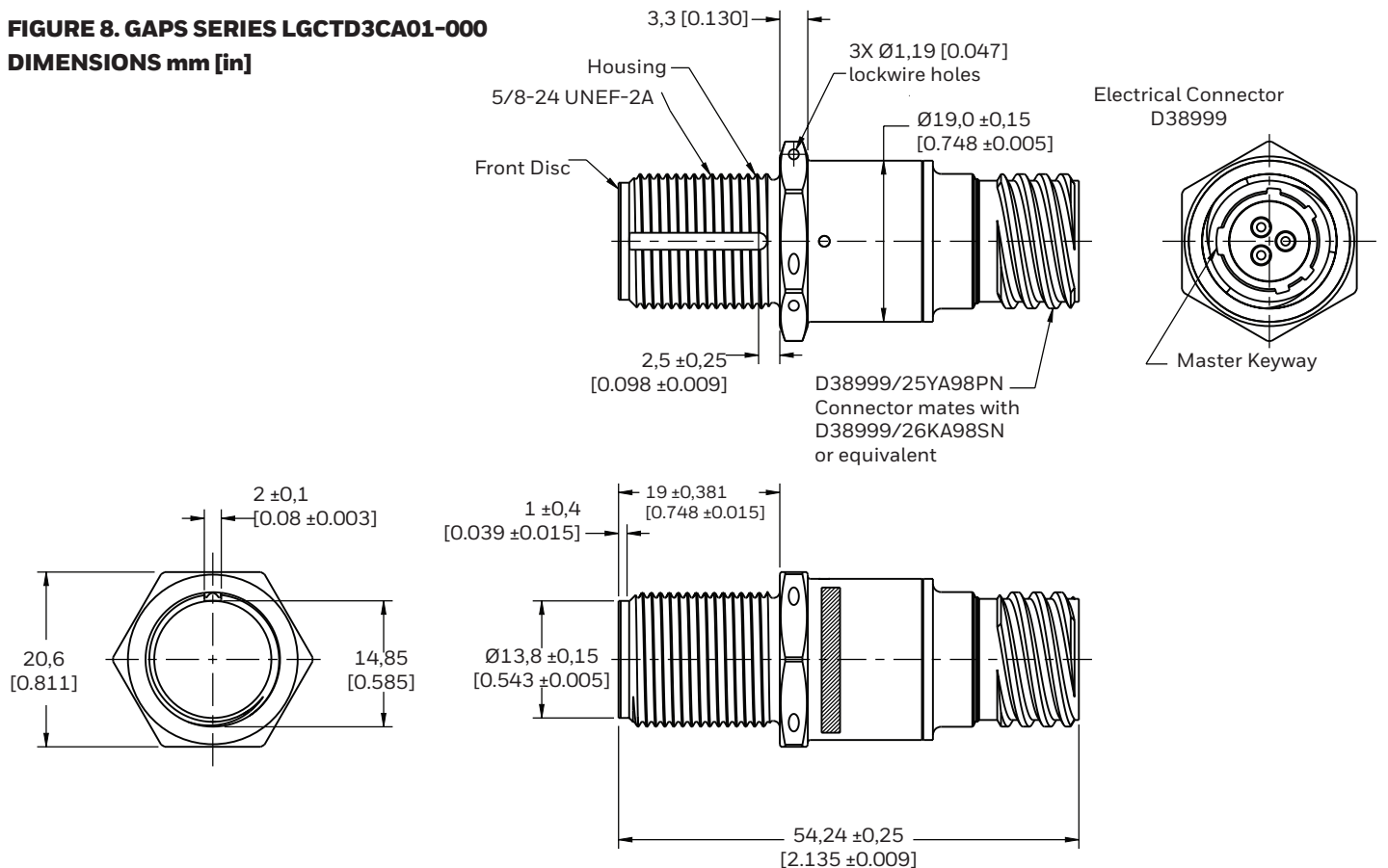


**FIGURE 7. GAPS SERIES EN2997Y10803MN CONNECTOR**



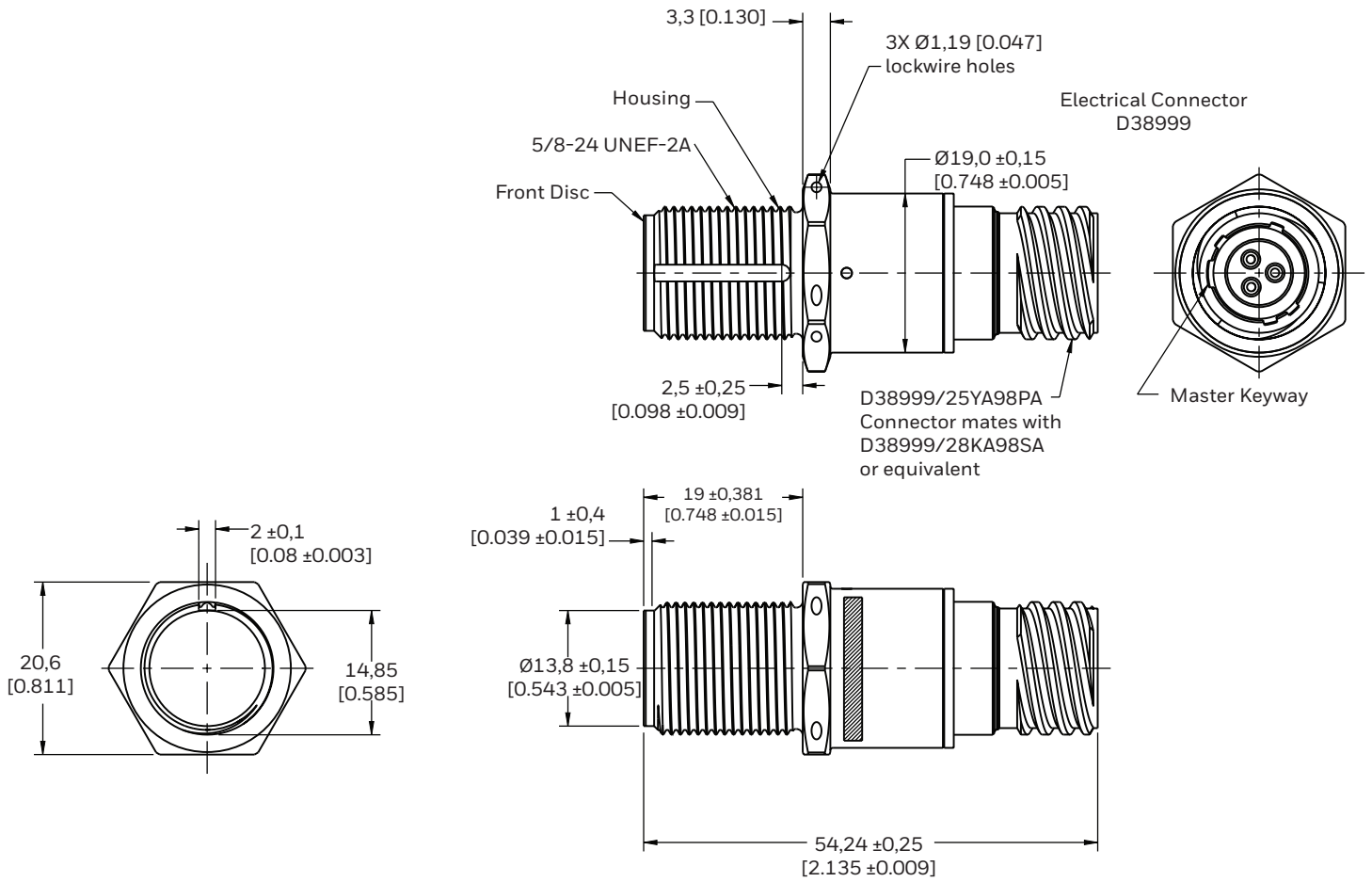
## PRODUCT DIMENSIONS

**FIGURE 8. GAPS SERIES LGCTD3CA01-000 DIMENSIONS mm [in]**



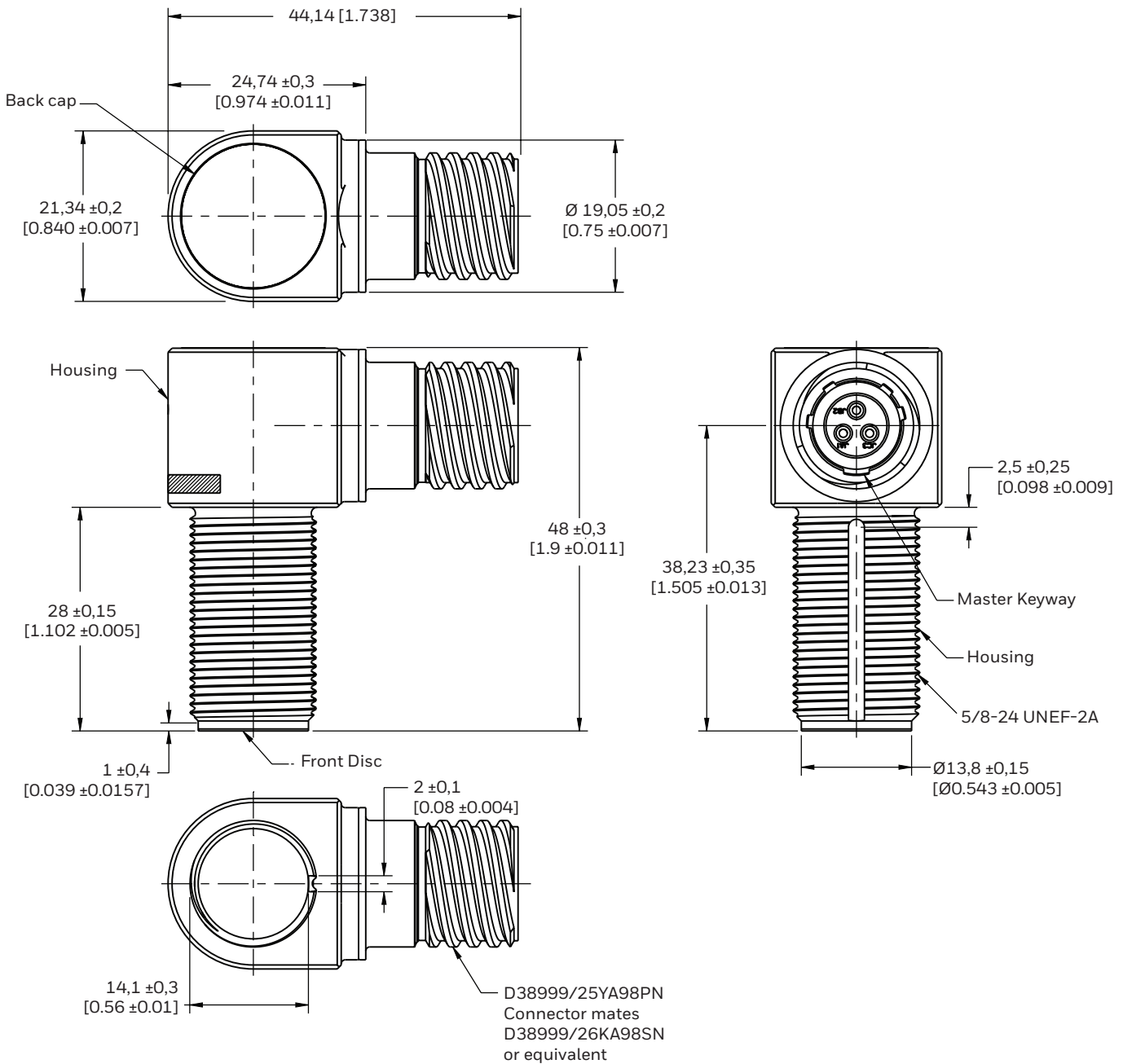
# AEROSPACE PROXIMITY SENSORS, GAPS & HAPS SERIES

**FIGURE 9. GAPS SERIES LGCTD3CB01-000 DIMENSIONS mm [in]**



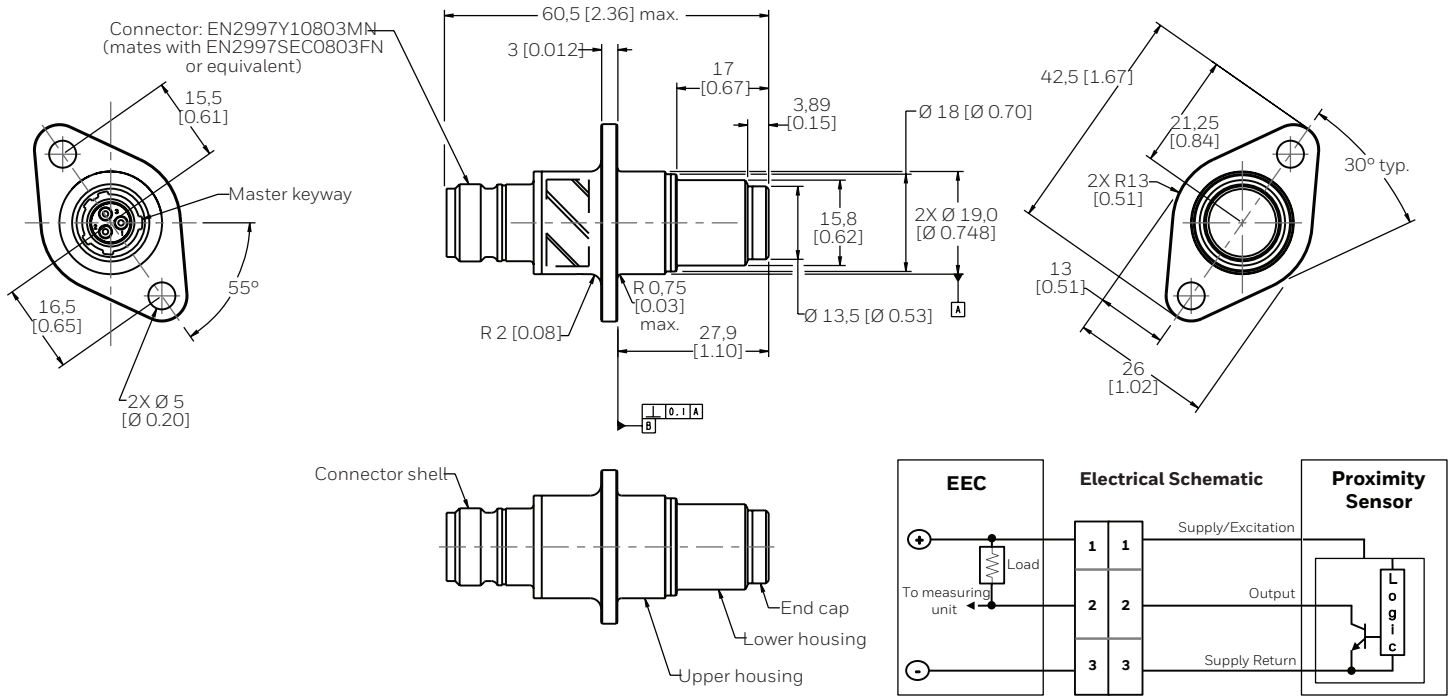
# AEROSPACE PROXIMITY SENSORS, GAPS & HAPS SERIES

**FIGURE 10. GAPS SERIES LGRTD3CA01-000 DIMENSIONS mm [in]**

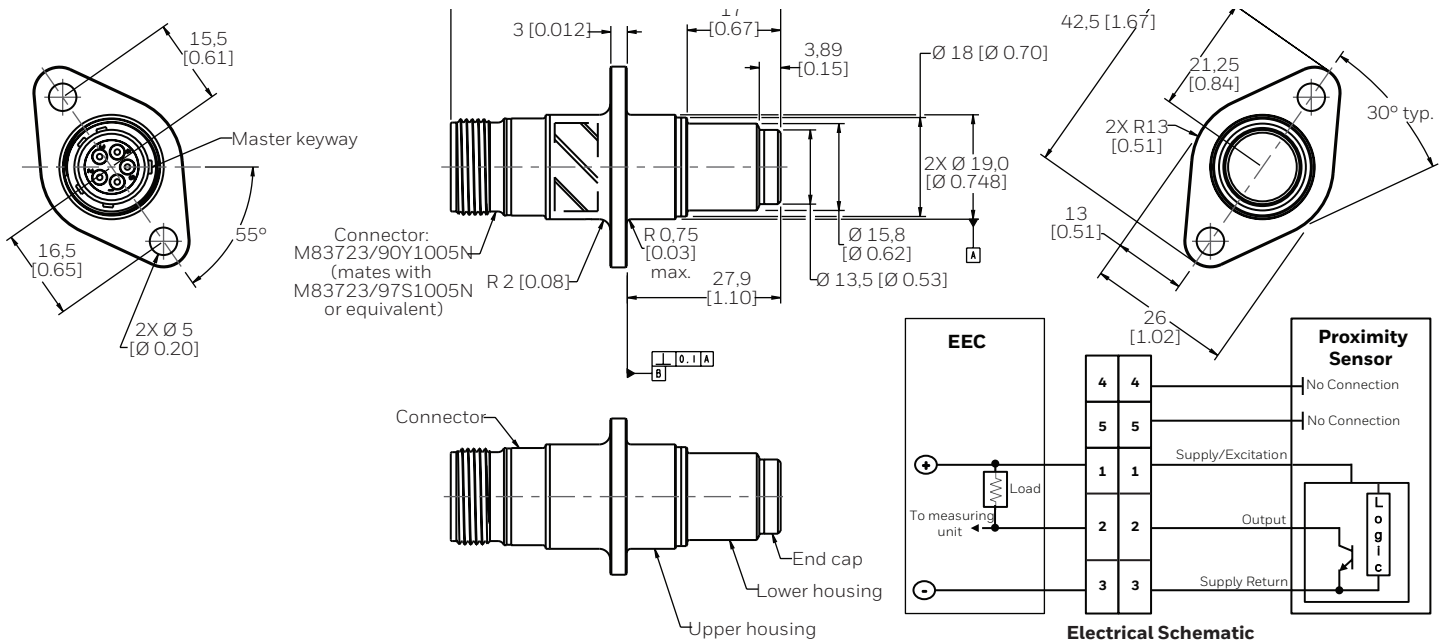


# AEROSPACE PROXIMITY SENSORS, GAPS & HAPS SERIES

**FIGURE 11. HAPS SERIES: CYLINDRICAL, FLANGED HOUSING WITH EN2997Y10803MN CONNECTOR mm [in]**

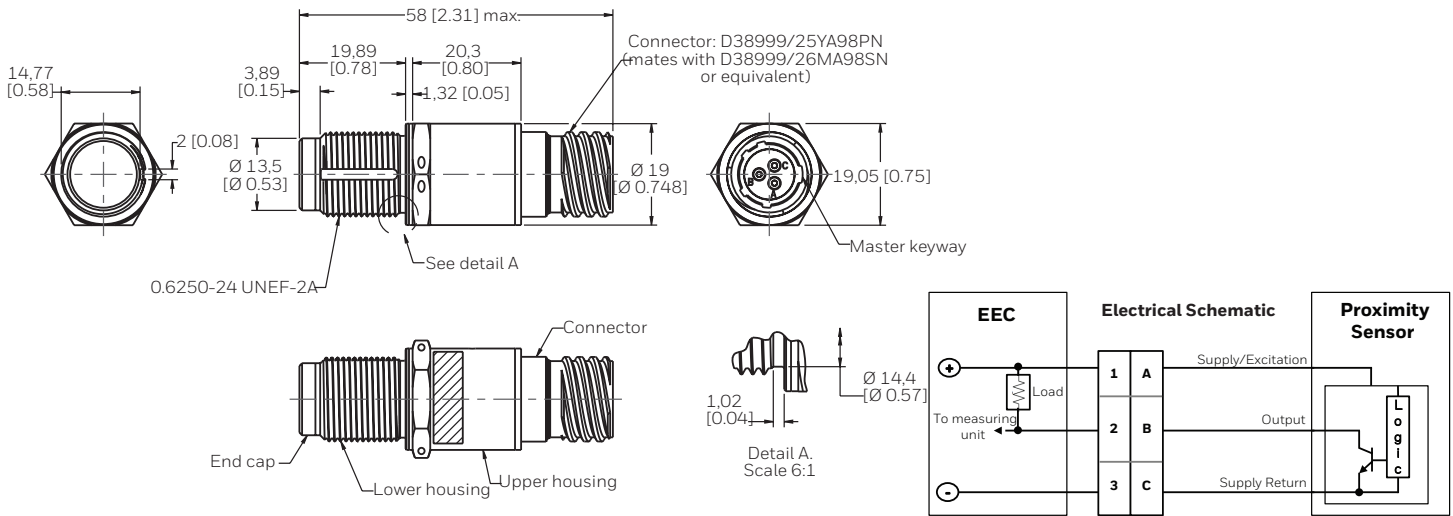


**FIGURE 12. HAPS SERIES: CYLINDRICAL, FLANGED HOUSING WITH M83723/90Y1005N CONNECTOR mm [in]**

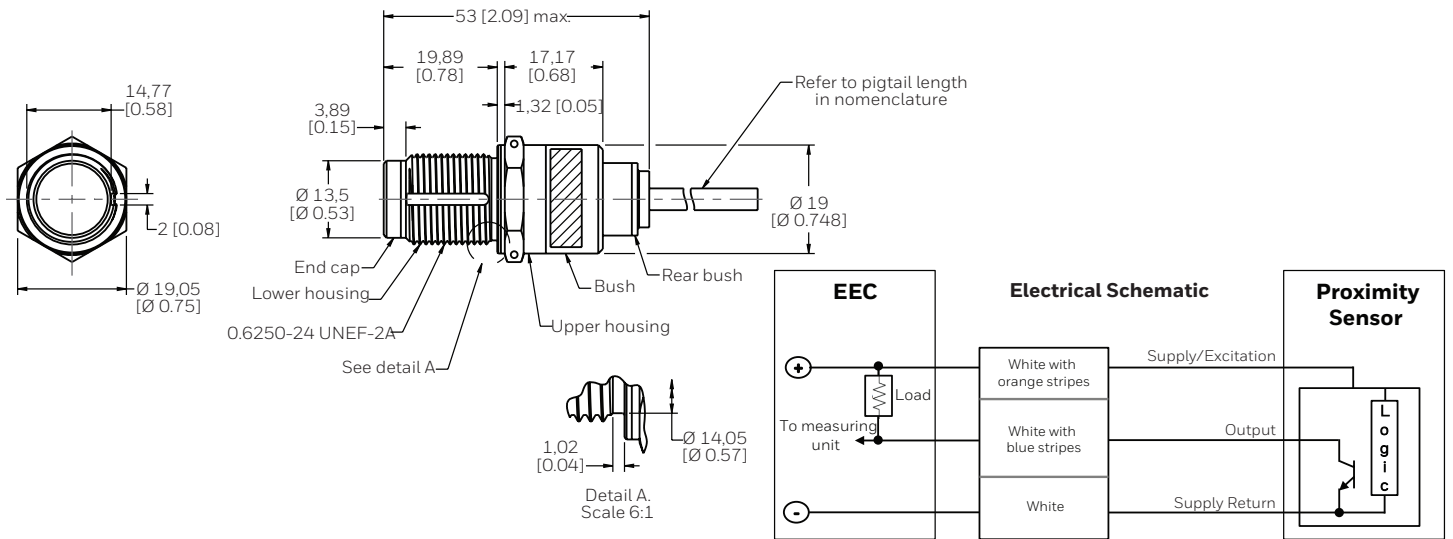


# AEROSPACE PROXIMITY SENSORS, GAPS & HAPS SERIES

**FIGURE 13. HAPS SERIES: CYLINDRICAL HOUSING WITH D38999/25YA98PN CONNECTOR mm [in]**

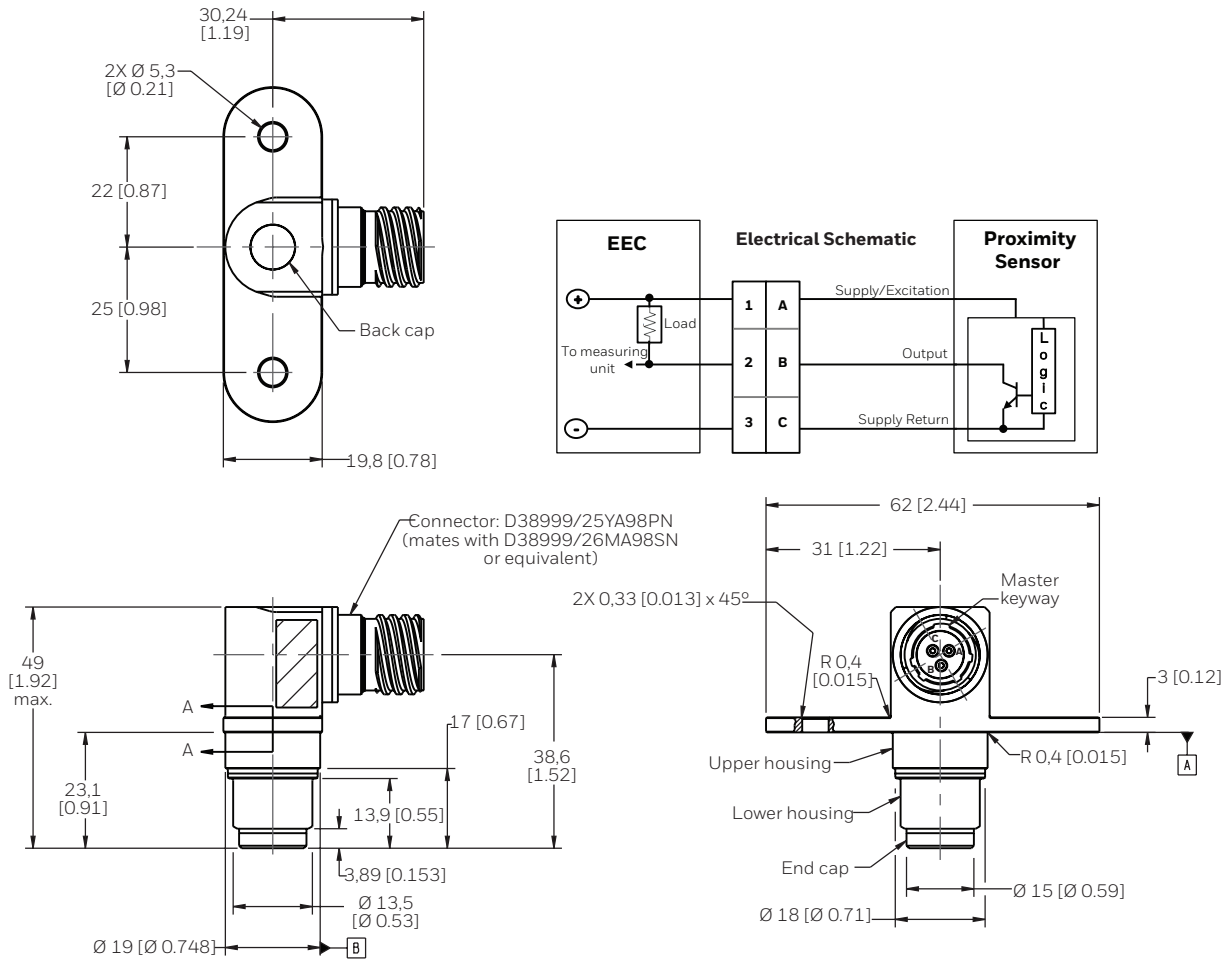


**FIGURE 14. HAPS SERIES: CYLINDRICAL HOUSING WITH PIGTAIL CONNECTION mm [in]**

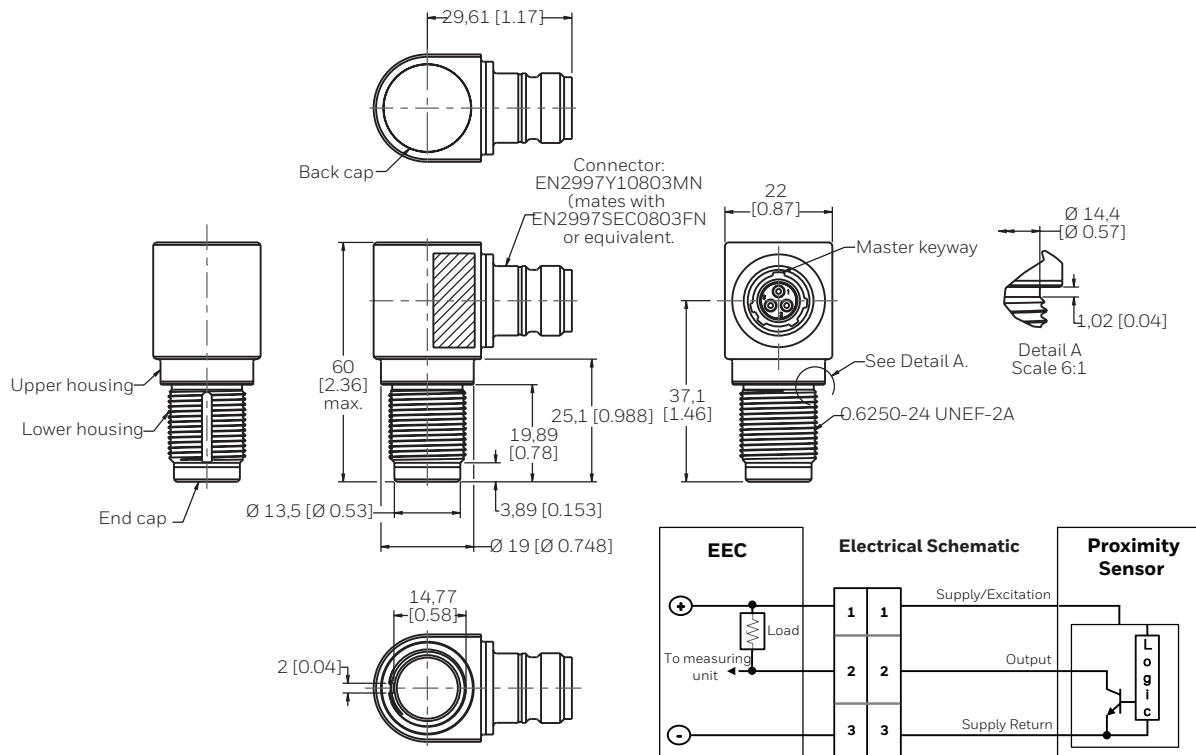


# AEROSPACE PROXIMITY SENSORS, GAPS & HAPS SERIES

**FIGURE 15. HAPS SERIES: RIGHT ANGLE, FLANGED HOUSING WITH D38999/25YA98PN CONNECTOR mm [in]**

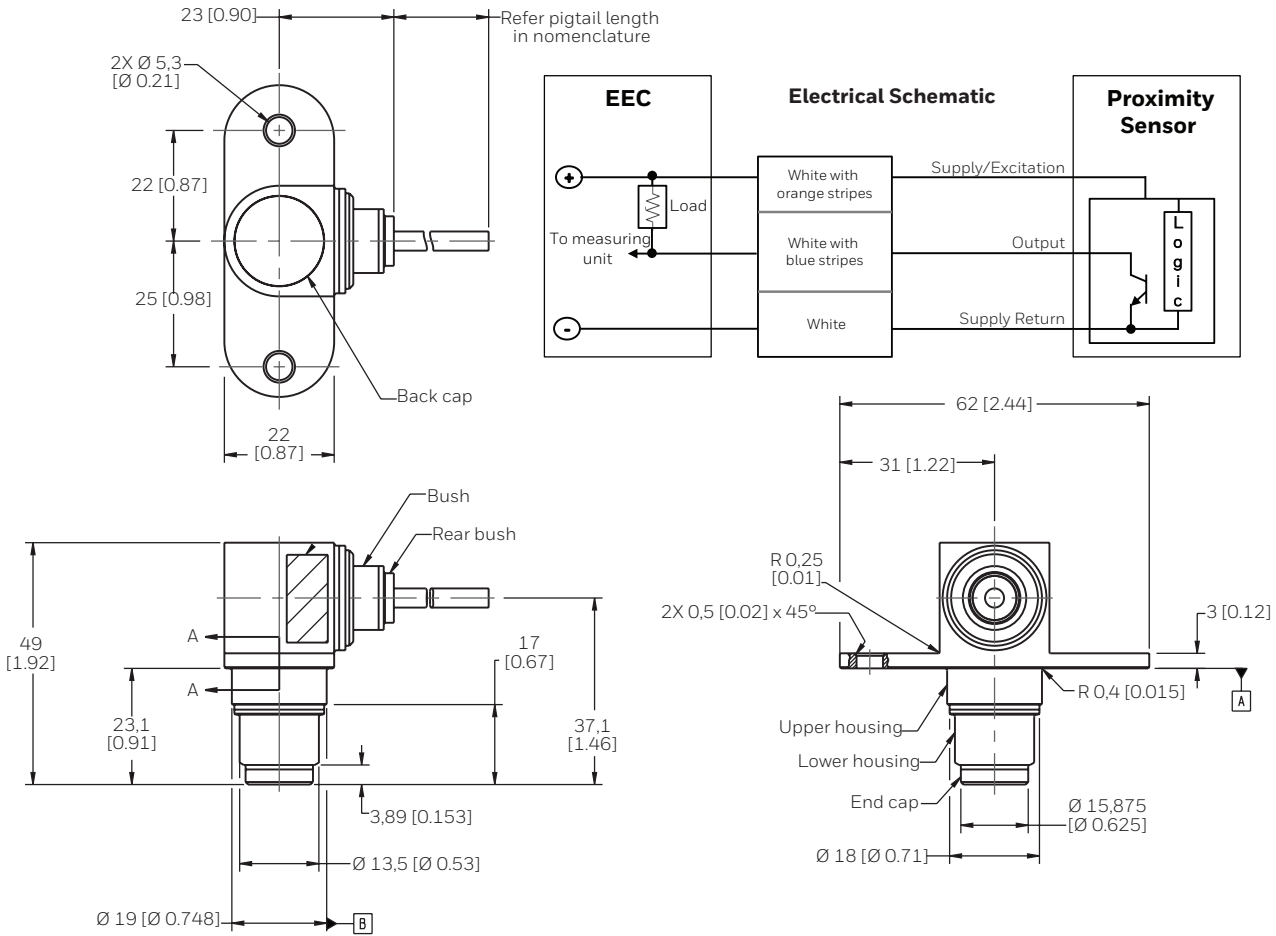


**FIGURE 16. HAPS SERIES: RIGHT ANGLE WITH EN2997Y10803MN CONNECTOR mm [in]**

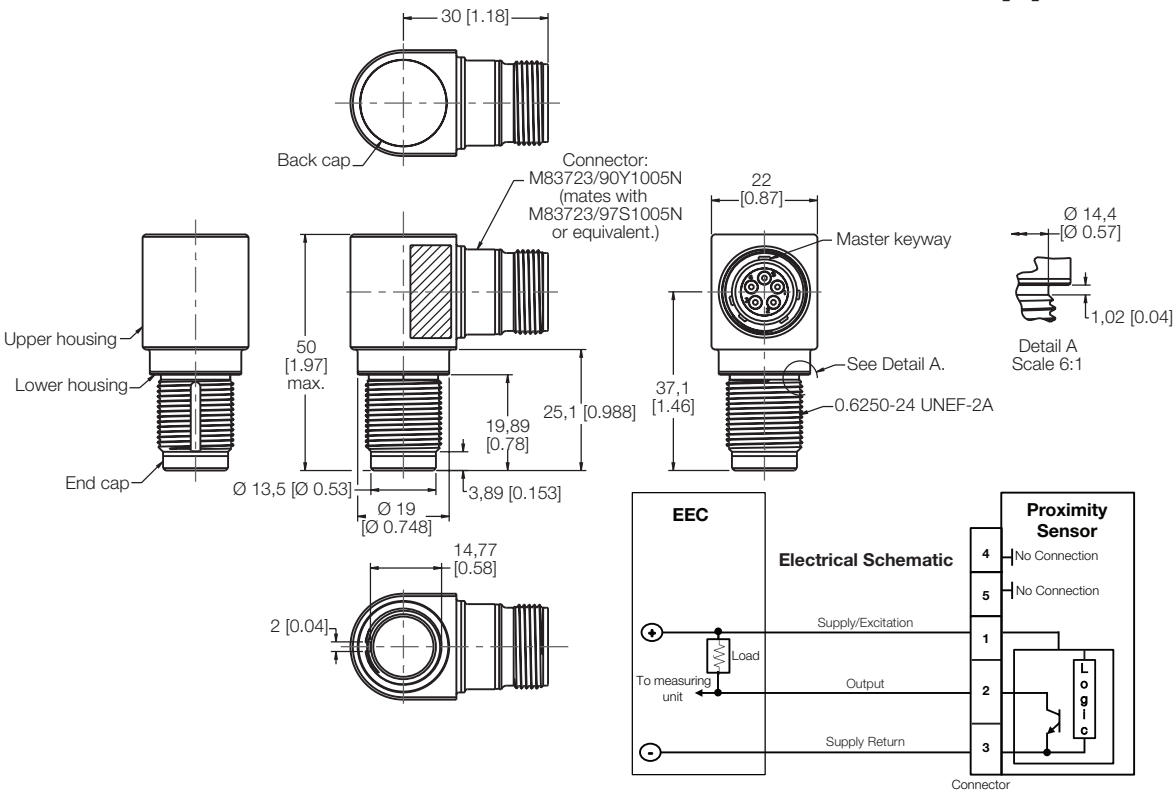


# AEROSPACE PROXIMITY SENSORS, GAPS & HAPS SERIES

**FIGURE 17. HAPS SERIES: RIGHT ANGLE, FLANGED HOUSING WITH PIGTAIL CONNECTION mm [in]**



**FIGURE 18. HAPS SERIES: RIGHT ANGLE WITH M83723/90Y1005N CONNECTOR mm [in]**





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**Failure to comply with these instructions could result in death or serious injury.**

## WARNING MISUSE OF DOCUMENTATION

- The information presented in this product sheet is for reference only. Do not use this document as a product installation guide.
- Complete installation, operation, and maintenance information is provided in the instructions supplied with each product.

**Failure to comply with these instructions could result in death or serious injury.**