New Avionics CORPORATION

Ice*Meister™ Model 9732-OEM

ICE DETECTING TRANSDUCER PROBE

Technical Data Sheet

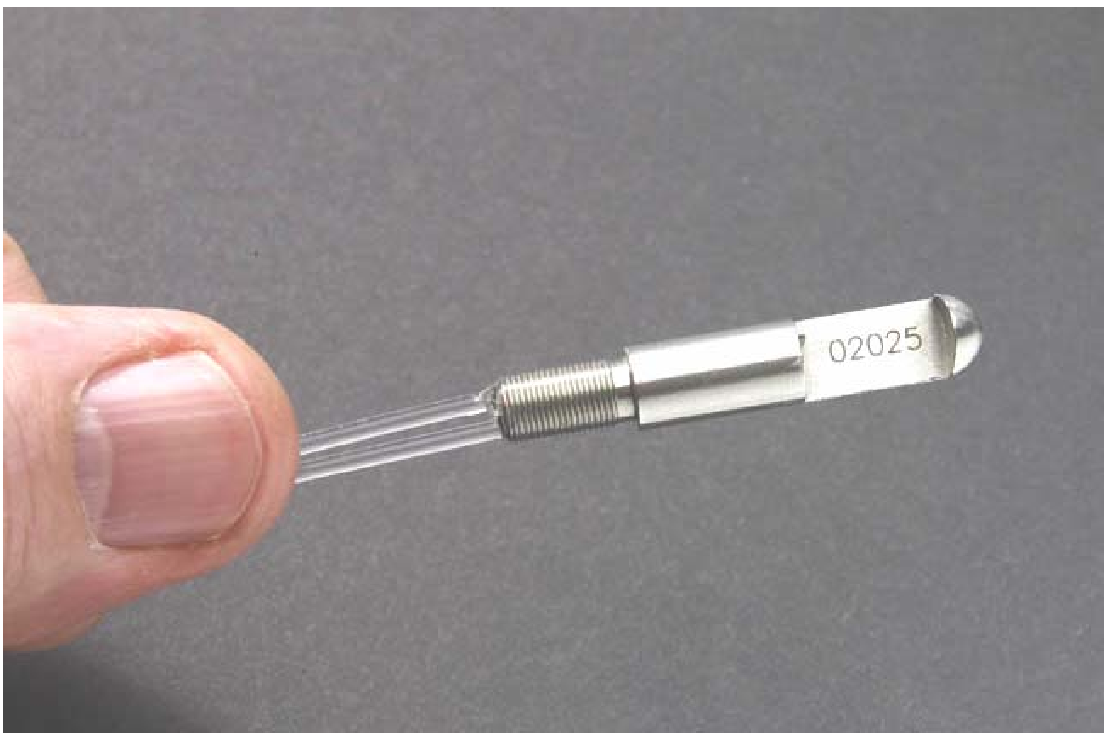


fig 1-- © New Avionics Corporation

GENERAL DESCRIPTION

Light weight, low cost optical ice-detecting transducer probe detects the first 0.001" of airframe icing aloft. Thin profile eliminates ram air heating. Attracts and detects airframe icing instantly upon entering any icing domain, where liquid water changes phase to solid ice. Positive, unambiguous indication of airframe icing conditions before ice becomes a problem on tailplane, wings or struts. Automates pilots' task of "looking for ice" day or night, while on autopilot, or under heavy workload. Eliminates guesswork; leaves nothing to interpretation

Provides useful standard for "known" icing conditions. Advises pilot to disengage autopilot; activate anti-icing system; activate engine anti-ice; climb, descend, or turn around. Improves ice detection sensitivity over earlier technologies. Reduces weight, slashes cost, provides added value to host avionics products.

FEATURES, BENEFITS

- Analog rime ice
- Analog or digital output
- Detects first 0.001" of ice
- Digital clear ice
- Fail-safe operation
- #12-56 or 5/16-24 threads
- Hermetically sealed
- Laser-etched serial number
- Low energy consumption
- Low coefficient of drag = 1.09
- -50 °C to +50°C
- No moving parts
- NASA tested and documented
- Patent protected
- Pulsed or DC operation
- Quick to market
- Radio silent; no MHz clock
- Reference schematic provided
- Robust to 25G all six axes
- Simple, lightweight, low cost
- 316L marine grade stainless steel
- 3.3V operation <100 mA drain
- Tri-state optical stability

- Adds value to host avionics products
- Standardizes "known" icing conditions

AEROSPACE APPLICATIONS

- **Antennas**
- **Altimeters**
- **Anti-icing systems**
- **Autopilots**
- **Flight data recorders**
- **In-cockpit WX systems**
- **Jet engines**
- **OAT gauges**
- **Pitot tubes**
- **Stall warning indictors**
- **UAVs**

PRINCIPLE OF OPERATION

Ice*Meister Model 9732-OEM ice detecting transducer probe functions as an optical spectrometer. It monitors both the opacity and the optical index-of-refraction of whatever substance is on the probe.

The transducer probe is excited by a microwatt IR LED coupled to the driver plastic optical fiber. A likewise-IR detector is coupled to the receiver fiber which inputs to an op amp and comparators (see fig 4).

The threshold comparators register the IR signal voltage-analog from the op amp.

NO-ICE state is reported back to the op amp as a stable mid-level signal. When the ice detecting transducer probe enters an icing domain, it can attract either rime ice or clear ice.

RIME ICE is opaque and milky white, similar to the ice formed in the freezer compartment of a refrigerator that is not frost-free. Because rime ice is opaque, the transducer probe reports it back to the op amp as a decrease in signal level. The comparators detect three decreasing levels of signal, analogously ice-alert, more-ice, and saturation-ice, as the IR signal diminishes. This gives the pilot a rudimentary idea of how fast the rime ice is accumulating (see fig 2).

CLEAR ICE is clear, similar to the ice served in a cocktail glass. Because of the difference in the optical index of refraction between air (1.0) and clear ice (1.3), the transducer probe reports clear ice back to the op amp as a step-function increase in signal level. Clear ice normally cannot be seen, thus it is deemed more hazardous than rime ice, and so is logically or'd with the saturation-ice signal.

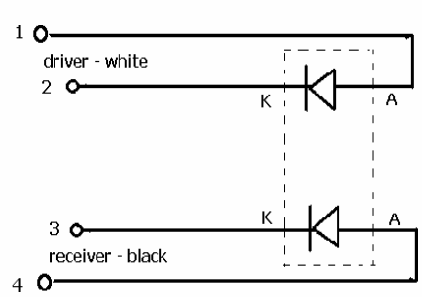
fig 2 -- courtesy NASA

Parameter	Symbol	Value	Units
Absolute maximum ratings			
Input forward current DC	I_{max}	125	mA
Input surge current <10μ sec	I_{surge}	3000	mA
Input reverse voltage	V_{rmax}	4.0	V
Operating temperature	T_{op}	-40 to +70	℃
Storage temperature	T_{st}	-40 to +70	℃
Soldering temperature	T_s	250	℃
Junction temperature	T_J	100	℃
Minimum bend radius	R_b	1.5	inches
Operating characteristics - with NAC reference circuit			
Peak wavelength	λ_{peak}	950	nM
Spectral bandwidth	Δ_λ	55	nM
Forward voltage	V_f	<1.5	V
Input current pulse	I_{in}	200	mA
Input pulse duration	t_{on}	500	μ sec
Sensitivity to ice	♪	0.001	inch of ice
Weight - transducer probe	W_1	0.25	ounce
Weight - probe + short tube	W_2	0.8	ounce
Weight - probe + long tube	W_3	1.0	ounce

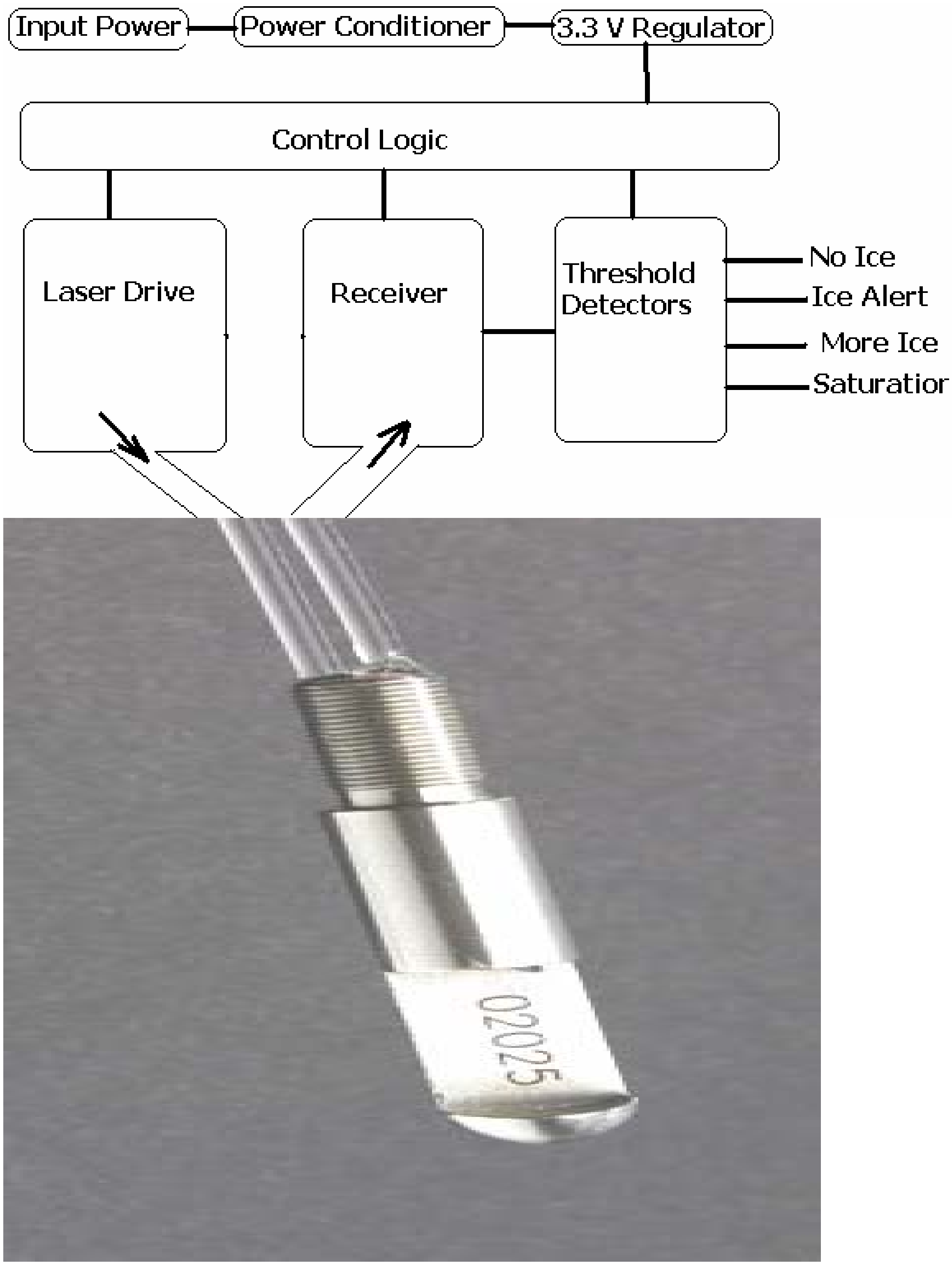
Ordering information

9732-OEM-transducer	1.5 inches total length	#12-56 thread
9732-OEM-tube-short	6.062 inches total length	5/16"-24 thread
9732-OEM-tube-long	8.625 inches total length	5/16"-24 thread

Connection diagram - fig 3



Reference schematic block diagram - fig 4



A brief note about airframe icing aloft...

The onset of airframe icing formation on a large cross sectional airframe member such as a wing is artificially retarded by compressed-air heat. The wing collides at high velocity with water vapor molecules in the air, compresses them, and briefly heats them as the wing passes through the domain.

This heat-pulse may increase the H_2O molecules' temperature above the latent heat of fusion. After the pressure dome of the wing leading edge has passed, the molecules relax; give up their dose of temporary heat, and resume their original lower ambient temperature (*).

At that lower ambient temperature, the H_2O molecules may cool enough to overcome their latent heat of fusion and change state, from liquid water to solid ice. But by that time, the forward velocity of the aircraft has advanced the wing past the original point of impact, and the ice forms somewhere aft of the leading edge (**).

A slender (1/4" diameter) transducer probe does not retard the onset of airframe icing because its small cross sectional area compresses fewer air molecules, and heats the surrounding air far less than the leading edge of a thick wing.

Ice*Meister™ Model 9732 OEM ice detecting transducer probe operaters on this principle to attract airframe icing at its earliest (0.001") thickness, and immediately alert the pilot to ice.

It provides useful standard for "known" icing conditions. Advises pilot to disengage autopilot; activate anti-icing system; activate engine heat; climb, descend, or turn around. Improves ice detection sensitivity over earlier technologies. Reduces weight, slashes cost, provides added value to host avionics products.

(*) For water, the latent heat of fusion is 80 calories per gram, or 144 BTU per pound.

(**) At 100 knots, the leading edge of an aircraft wing advances 3 feet in 17.7 milliseconds.

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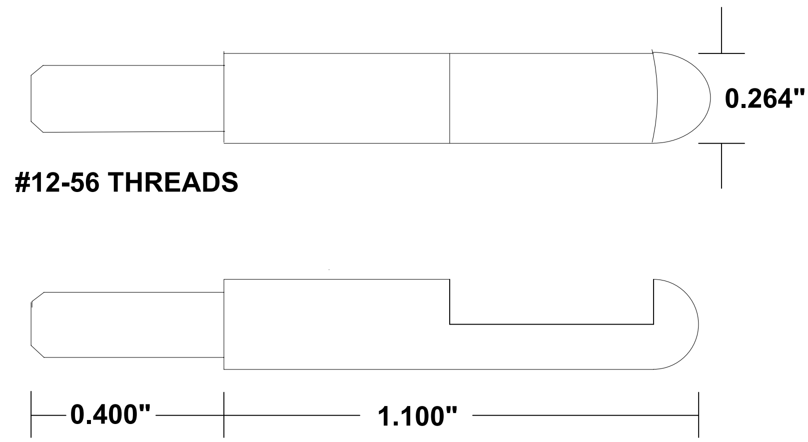
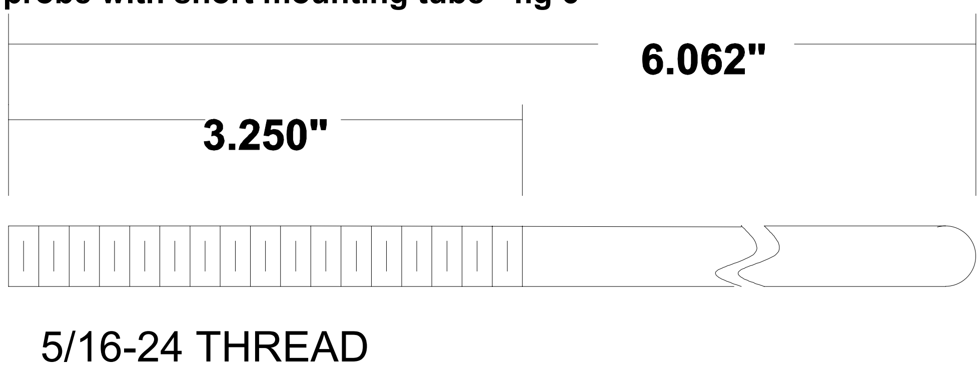
Dimensions

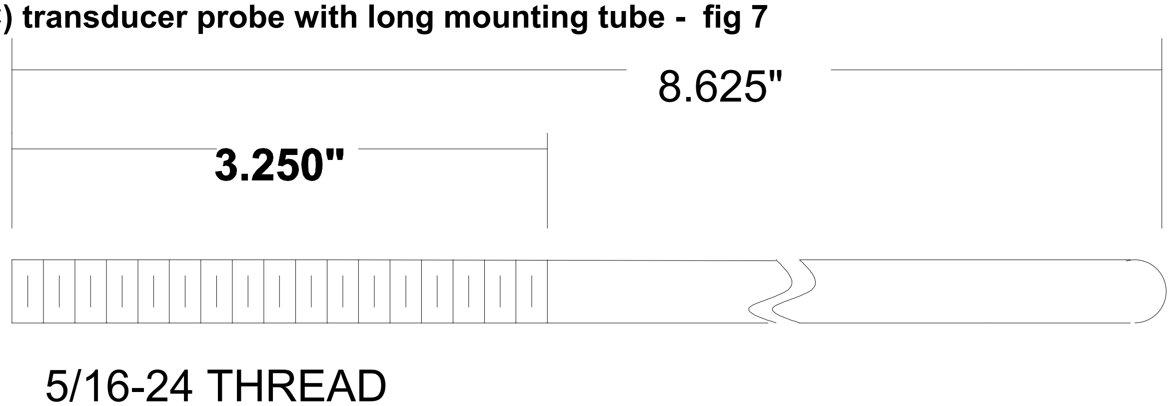
(A) transducer probe - fig 5



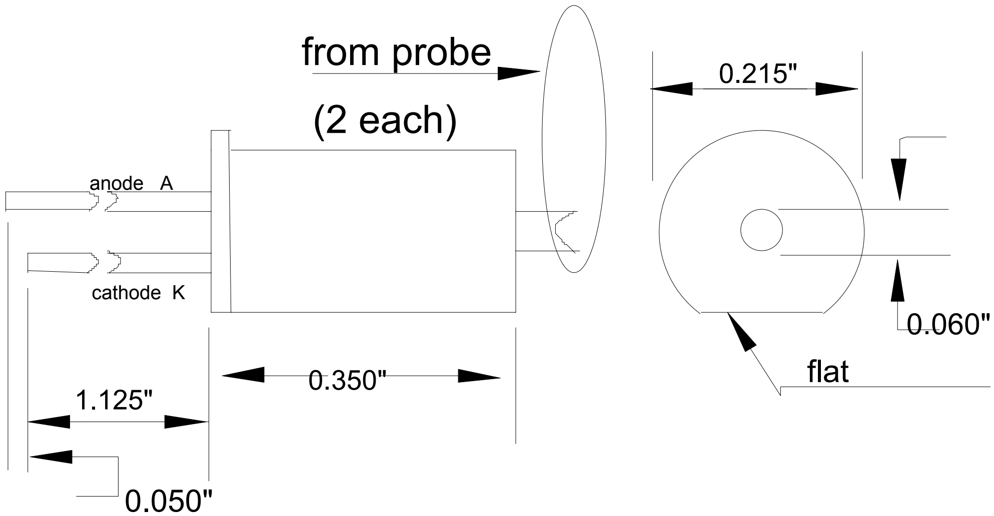
(B) transducer probe with short mounting tube - fig 6



(C) transducer probe with long mounting tube - fig 7



(D) IR LASER AND IR RECEIVER - one of each used - fig 8



note: laser channel is white
receiver channel is black
see connection diagram fig 3

Disclaimers
1. Product specifications and other contents are subject to change without notice.
2.This document is not contractual, and nothing in it constitutes or implies a warranty or guaranty that the goods described herein are fit for any particular purpose of any customer.
3. Plastic optical fiber connections between transducer probe and circuit board must be protected from ambient light.
4. Plastic optical fibers are made of polymethylmethacrylate, also known as PMMA, acrylic, or Plexiglas, and is commonly used in aircraft windshields. All cautions applicable to aircraft windshields also apply to this product.
5. Flying in volcano ash or pumice voids the warranty

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