9704 Gen 4 R3D® Modules

Remote-Read Level Sensors for use with Rochester R3D Dials

Maximize your fluid level detection capabilities with Rochester Sensors remote-read R3D modules. Incorporating a remote-read system allows you to monitor your fluid or fuel levels remotely, providing a reliable, safe, and convenient solution to track usage. The ratiometric voltage output from Rochester 9704 remote-read modules allows you to accurately measure tank levels and integrates easily into any automated monitoring system.

Application

The Rochester 9704 module snap-fits into the recess of your existing Rochester Sensors R3D remote-ready dial lens to provide a low power, cost-effective solution to transmit fluid levels. The sensors detect the position of the fluid level indicator in the dial it is attached to. Using the module's onboard microprocessor, this positional data is converted to a ratiometric voltage output (0V to VCC) dependent on the supply voltage. This output voltage can be utilized by the end user's wired, or wireless monitoring device to transmit the fluid level inside a tank. Corresponding voltage-out to percentage-full tables are available for all Rochester R3D dials. 9704 Modules require a 3-5VDC input and have a very low current draw that is excellent for battery powered applications.

General Information and Features

- Cable lengths up to 25 ft. max. (6 ft. standard length) with flying leads
- 22 AWG – 3 conductor cable for power (VCC), ground, Signal (Vout)
- Accuracy: Module output +/- 2% of visual dial indication. (Float gauge errors not included)
- Repeatability: +/- 1%
- Operational Voltage Range: 2.6 to 5.5 VDC
- Output Voltage: Ratiometric, percent of supply voltage
- Resolution: 0.018V
- Operating Current: 4mA TYP @ 5 VDC with 1M load on output
- Recommended Load Impedance: > 10k, 0.5nF for optimal performance
- Turn-on time: 5ms Typical

Operating Temperature Range:

- Dynamic -25°C to +80°C; Static -30°C to + 80°C
- Storage Temperature: -40°C to +105°C
- Ingress Protection: IP69K rated
- Intrinsically safe in explosive atmospheres

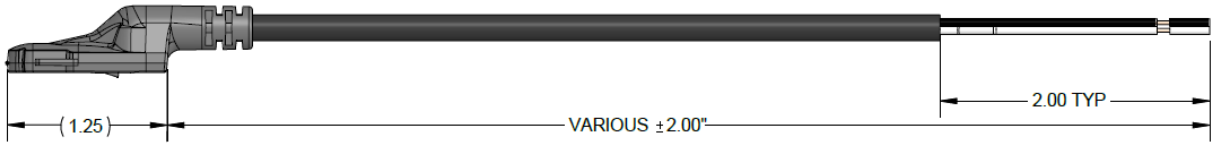
RoHS COMPLIANT

Part Number Options: 9704-ABCXXXM

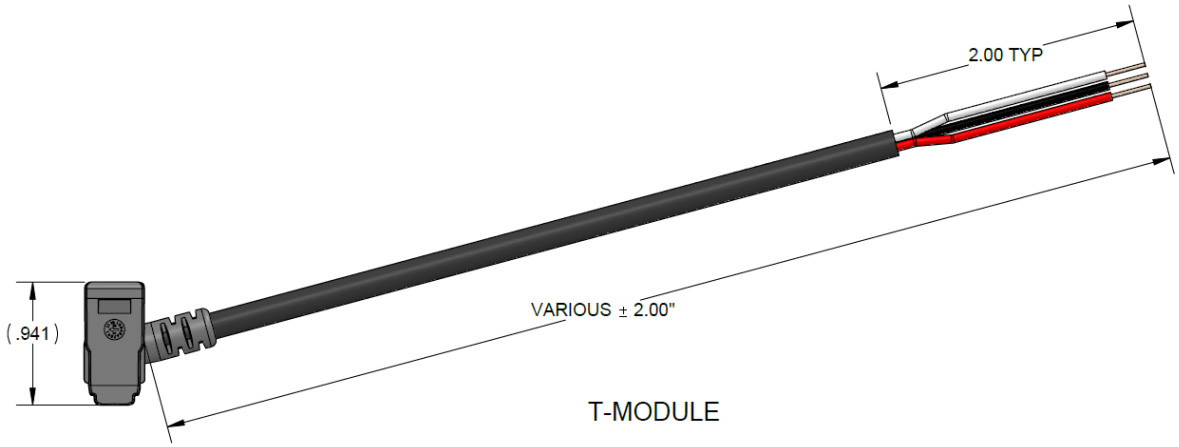
Part Number	Description
9704-ABCXXXM **(Example: 9704-FD106M)**	9704 = Product Family A – Specify orientation of module: (F = 45°, S = Straight, T = Side Exit) B – Specify Rochester Sensors dial type (D = Domestic Jr. & Sr. Dials, M = Magnetel Dials) C – Cable type (C=1 for standard Rochester cable) XX – Specify cable length 00ft. – 25ft. (Standard length is 6ft. = 06) M = Molded construction

Product Construction

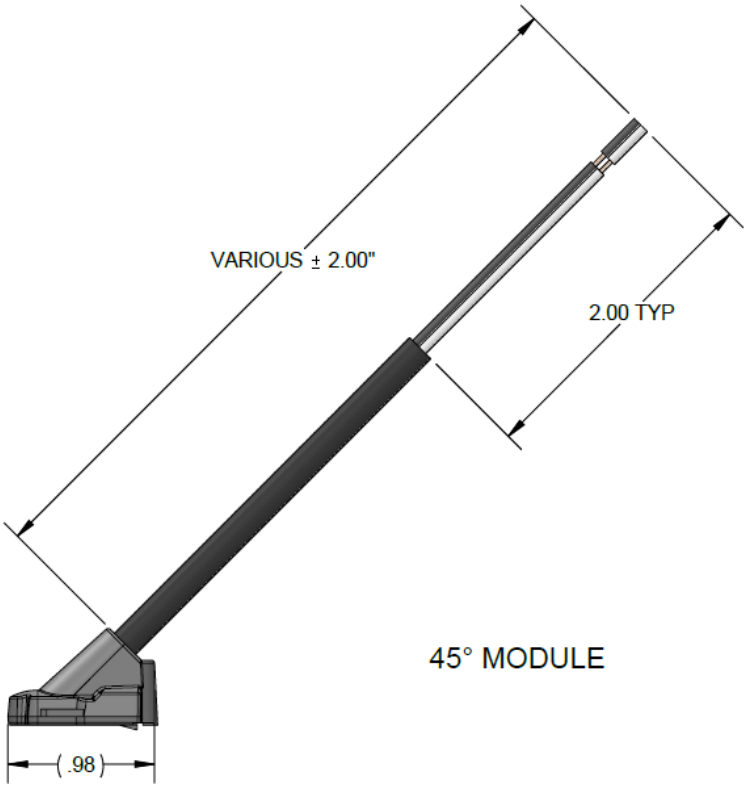
The 9704 product is centered around a position-sensing integrated circuit that works with existing R3D level dials. The sensor is available in both a 45-degree, side exit, and straight orientation. The custom printed circuit board, components, and all electrical connections are fully enclosed in a durable molded polyamide casing which provides excellent insulation and environmental protection. Alignment and snap-fit geometry are integrated into the shape of the sensor to perfectly mate with the remote-read slots on all Rochester Sensors R3D dial faces. Interaction with the 9704 module is accomplished via a multi conductor jacketed cable. The black 600V, 105°C cable is UL Recognized (21768) with a TPU jacket that is oil, water, UV, and cold resistant. The three internal 22 AWG stranded wires are colored for easy assembly into the end user's monitoring device.



STRAIGHT MODULE



T-MODULE



Product Performance

The Rochester Sensors 9704 module sensor offers ideal performance for low power remote level-sensing systems. It offers fast communication, low current consumption, and a high level of accuracy in a robust package.

Parameter	Condition	Min	Typical	Max	Unit
Input Voltage		2.6		5.5	**V**
Storage		-40		105	**°C**
Handling Temperature	Moving module or cable assembly	-25		80	**°C**
ESD (Cable conductors)	Human Body Model AEC-Q100-002	-10		+10	**kV**
Output Accuracy	Visual Dial Indication (Float Gauge Errors Not Included)		≤2%		**Level**

Electrical Characteristics

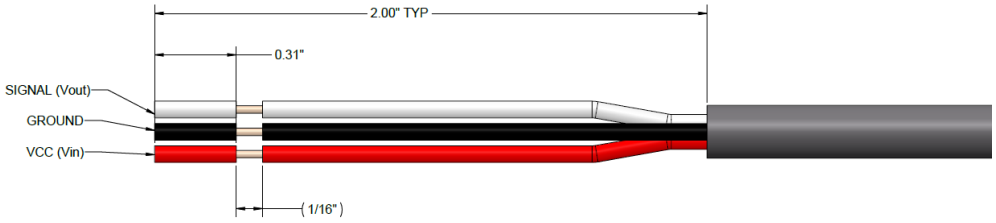
Parameter	Condition	Min	Typical	Max	Unit
Operating Voltage	VDD (VDC)	2.6		5.5	**V**
Current Consumption	Ambient	-	3.9	6.2	**mA**
Current Consumption	@ 85° C	-	3.8	5.2	**mA**
Start up	@ -40°	-	4	7	**mA**
Internal Capacitance	0.0V to VDD	-	5	-	**mS**

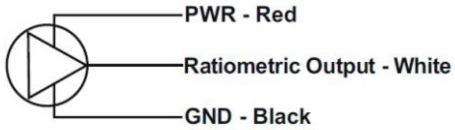
Environmental Ratings

Parameter	Condition	Min	Typical	Max	Unit
Operating Temperature Range	VDD (VDC)	-30	-	85	**°C**
UV withstand	600 hrs, UVA-340 @.76w/m2, 70°C	-	Pass	-	**-**

Product Function Overview

The Rochester Sensors 9704 module can be inserted into to any R3D dial face to detect the fluid level indicated. The sensor accomplishes this by detecting the direction that the level indicator is pointing on the dial. The 9704 module then converts this raw positional data to a percentage of the supply voltage. As fluid levels decrease, the voltage on the signal line will also decrease, proportional to the supply voltage. (Example: At 50% full tank level = the signal voltage will read approximately half of the supply voltage level.) See dial tables for more specific voltage-to-percentage conversions. The 9704 modules use a 3-wire cable to connect to the user's monitoring system: supply voltage (3-5V), ground, and ratiometric Vout signal.





Dial Look Up Tables

Jr/Sr Dials (5-95% Horizontal Tanks)		
Tank Volume	Supply VDC	
	3.7V	5.0V
5%	0.19	0.25
10%	0.37	0.50
20%	0.74	1.00
30%	1.11	1.50
40%	1.48	2.00
50%	1.85	2.50
60%	2.22	3.00
70%	2.59	3.50
80%	2.96	4.00
90%	3.33	4.50
95%	3.52	4.75

Jr/Sr Dials (10-80% Vertical Tanks)		
Tank Volume	Supply VDC	
	3.7V	5.0V
E	0.16	0.25
10%	0.19	0.50
20%	0.58	1.00
30%	1.00	1.50
40%	1.53	2.00
50%	2.05	2.50
60%	2.60	3.00
70%	3.04	3.50
80%	3.43	4.00
F	3.50	4.50

Jr/Sr Dials (Fractional)		
Tank Volume	Supply VDC	
	3.7V	5.0V
Max Empty	0.16	0.21
E	0.20	0.27
1/4	0.84	1.12
1/2	1.84	2.49
3/4	2.88	3.88
F	3.47	4.69
Max Full	3.50	4.73

8" Magnetel Dials (3-97%)		
Tank Volume	Supply VDC	
	3.7V	5.0V
3%	0.11	0.15
5%	0.19	0.25
10%	0.37	0.50
20%	0.74	1.00
30%	1.11	1.50
40%	1.48	2.00
50%	1.85	2.50
60%	2.22	3.00
70%	2.59	3.50
80%	2.96	4.00
90%	3.33	4.50
95%	3.52	4.75
97%	3.59	4.85

4" Magnetel Dials (5-95%)		
Tank Volume	Supply VDC	
	3.7V	5.0V
5%	0.072	0.098
10%	0.260	0.352
20%	0.665	0.898
30%	1.041	1.406
40%	1.445	1.953
50%	1.850	2.500
60%	2.226	3.008
70%	2.630	3.555
80%	2.992	4.043
90%	3.441	4.609
95%	3.555	4.805

Product Certification

Rochester Sensors R3D modules are certified as intrinsically safe for Class 1, Division 1, Groups C & D hazardous locations. Products are marked and approved by ETL, ATEX, UKCA, and CE. Certification and testing have been performed to the following standards:

Ordinary Locations Safety Standards	
Conforms to UL STD 61010-1 Ed.3	Electrical Equipment for Measurement, Control, and Laboratory Use; Part1: General Requirements *Note: for USA ordinary locations listing certification
Certified to CSA STD C22.2 #61010-1-12 Ed.3	Electrical Equipment for Measurement, Control, and Laboratory Use; Part1: General Requirements *Note: for Canada ordinary locations listing certification
Hazardous Locations Safety Standards	
IEC 60079-0: 2017	Explosive atmospheres – Part 0: Equipment – General requirements *Note: For IECEx Certification
IEC 60079-11: 2017 + C1: 2012	Explosive atmospheres – Part 11: Equipment protection by intrinsic safety "i" *Note: For IECEx Certification
EN 60079-0: 2018	Explosive atmospheres – Part 0: Equipment – General requirements *Note: For ATEX Certification
EN 60079-11: 2012	Explosive atmospheres – Part 11: Equipment protection by intrinsic safety "i" *Note: For ATEX Certification
UL 60079-0, 7th Ed., Issued 03/26/2019	Explosive atmospheres – Part 0: Equipment – General requirements *Note: For USA listing Certification
UL 60079-11, 6th Ed., Revised 03/28/2014	Explosive atmospheres – Part 11: Equipment protection by intrinsic safety "i" *Note: For USA listing Certification
CSA C22.2 No. 60079-0: 2011	Explosive atmospheres – Part 0: Equipment – General requirements *Note: For Canada listing Certification
CSA C22.2 No. 60079-11: 2019	Explosive atmospheres – Part 11: Equipment protection by intrinsic safety "i" *Note: For Canada listing Certification

Rochester Sensors R3D modules all bear the following ATEX markings:

II  1G Ex ia IIB T4 Ga

-  Explosion Protected under the ATEX directive II – For use in areas with explosive gasses
  1G – Rated for use with explosive gasses in Zone 0
    - Zone 0 is areas with constant exposure to explosive gas
  Ex ia – Protection method is Intrinsic Safety
    - Intrinsic Safety limits the available energy in the system to prevent ignition
  T4 – Maximum temperature the module housing or components may reach 135°C (275°F)
    - Note that module is not intended to be used in environments warmer than 80°C (176°F)
  Ga – Equipment Protection Level: Very High (Gas)

Installation Instructions

Reference INS-9704

Warning: For LP-Gas and other flammable product service applications, connect only to circuits and power sources classified and labeled Intrinsically Safe for Class 1, Division 1, Group C and D hazardous locations. Connection of non-intrinsically safe power could result in fire or explosion of flammable vapor which may be present.

Warning: Sensor not to be used as the primary means of determining high or low fuel condition. It must not be used in the absence of redundant systems in critical applications where there may be significant safety risk or financial exposure in the event of fuel overfill or fuel exhaustion condition. This sensor is not to be used for tank filling.

Warning: Level Gauging devices and sensors sold by Rochester Sensors, are components only.

The purchaser/installer is solely responsible for the application of these components and ensuring all necessary steps have been taken to assure each application and use meets all performance and applicable safety requirements, and/or local, national and/or international safety codes as required by the application. Rochester Sensors cannot certify that our products used solely or in conjunction with other Rochester Sensors or other vendors' products will assure desired performance and safety for any application.

Any person using or applying any products sold by Rochester Sensors is responsible for learning the performance and safety requirements for their individual application and applying them, and therefore assumes, all risks, and accepts full and complete responsibility of the product for their respective application. Rochester Sensors does not provide system design or consulting services and cannot advise whether any specific application or use of our products would ensure compliance with all performance and safety requirements for any application.

Hall Effect modules are intrinsically safe for Class 1, Division 1, Groups C & D Hazardous Locations. See SD-583 for control drawings. Protected by U.S. Patents.

Ordering Information

Contact your local sales representative for samples, availability, and pricing information.