Sarasota FD910, FD950, & FD960

Liquid Density Meters
User Guide
P/N HB-9135

Revision H

Part of Thermo Fisher Scientific

Thermo SCIENTIFIC

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Revision History

Revision Level	Date	Comments
0.0	08-1996	Initial release
A	02-2006	Company name and contact information changes. Updated specifications. Applied standardized format.
B	01-2007	Revised per ECO 5425.
C	09-2007	Revised per ECO 5979.
D	04-2008	Revised per ECO 6284.
E	03-2009	Revised per ECO 6804.
F	06-2011	Revised per ECO 7733.
G	10-2011	Revised per ECO 7803.
H	09-2016	Revised ATEX marking per ECO 8915

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Contents

Important Safety Information

Control of Substances Hazardous to Health

- Make sure you know the safety precautions and first aid instructions before you use a hazardous substance.
- Read the label on the container in which the substance is applied.
- Read the data sheet applicable to the substance.
- Obey the local orders and instructions.

Electrical Safety

Warning Remove all power from the unit before making any connections. Electrocution can result if power is present. ▲

Warning Ensure the power supply is isolated. Take suitable precautions to prevent reinstatement of power while working on the system. ▲

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Chapter 1
Product Overview

Introduction

The Thermo Scientific Sarasota FD910, FD950, and FD960 liquid density meters (collectively called “density meters” in this guide) share a common design that provides a high accuracy density measurement of single phase liquids and slurries. The different instrument designations relate to the material of construction. The Sarasota FD910 is constructed of stainless steel and designed as a general purpose sensor for use with most process fluids. The wetted parts of the Sarasota FD950 are Hastelloy® C276. If Hastelloy C276 and the process fluid are compatible, the improved corrosion resistance makes the Sarasota FD950 ideal for aggressive applications in the petrochemical, chemical, and pharmaceutical industries. Ni-Span C® wetted parts gives the Sarasota FD960 a low temperature coefficient, making it the ideal instrument for fiscal or custody transfer applications.

Typical applications are listed below:

- Process control
- Quality control
- Product interface detection
- Product identification
- Process monitoring

Description

The density meters are supplied with 1” fittings. Normally, they are fitted onto a sample bypass line, but if the pipe is small enough, they may be fitted directly into a process plant pipeline. They are suitable for continuous online operation in an industrial environment, and with an environmental rating of IP65 (NEMA 4X), they are dust proof and moisture proof.

Two versions are available. The F option provides frequency output and 4-wire PT100 connections that may be used by a remote density converter or third-party flow computer. With the H option, an onboard HART® compliant density converter provides a linearized 4–20 mA output.

The density meters consist of a stainless steel case capable of full secondary containment to class 300, an electronics housing that contains the maintaining amplifier, and the headmounted electronics (H option).The case contains the sensor element, and process connections are flanged to customer requirements.

Electrical connections to the liquid density meters are via screw terminals that are mounted in the electronics housing, and there are two 3/4" NPT cable entries to the electronics housing.

Operation

The density meters continuously measure the density of liquids or slurries flowing through it. They use the appropriate software in conjunction with the optional headmounted electronics, a density converter, or flow computer to measure line density (the density of the fluid inside the density meter). The line density can then be used to calculate other variables such as density at reference conditions specific gravity, process gravity, concentration, Brix, etc.

These guidelines will help ensure problem-free operation:

- Keep system temperature and pressures within the specified limits.
- Ensure system pipelines do not impose undue loads on the density meter.
- Ensure the density meter is calibrated at regular intervals.
- Install the density meter as detailed in this manual.
- To prevent any upstream throttling effects, use a downstream valve to control the flow in the system.
- If the process fluid solidifies at ambient temperature, the system should be heated or the meter removed and cleaned with a suitable solvent during shutdown periods. If this is not possible, the pipe arrangement must be designed to allow for online flushing with a cleaning solution.

Sensing Element

The sensing element consists of a pair of parallel sensor tubes (stainless steel for FD910, Hastelloy C276 for FD950, Ni-Span C for FD960). The sensor is maintained in oscillation at its resonant frequency by a maintaining amplifier and assembly of electromagnetic drive, pick-up coils, and armatures.

The drive coils are excited with an electric current that causes the sensor tubes to oscillate. The electronic amplifier amplifies the pick-up coil voltage signal and adjusts the phase and gain to produce a current through the drive coils. This current maintains the sensor tubes at their natural resonance. The time period of the resonance is proportional to the total mass of the tubes (a constant) plus the process fluid inside. Changes in the density of the process fluid will change the mass of tubes plus fluid and, therefore, the resonant frequency.

Calibration Temperature & Pressure Compensation Density Calculation

The period output from the density meter (Period = 1/Frequency) is used to calculate the density of product within the meter using the transducer calibration data and the standard Thermo Scientific Sarasota density equation.

From the calibration sheet, the following constants are generated during calibration and are unique for each density meter:

- T0 (period at zero density) in µsec.
- D0 (theoretical density at zero period) in kg/m^3 or lb./ft.^{3}
- K (Constant)
- Pressure and temperature coefficients

Each instrument is fitted with a precision PRT temperature element, allowing accurate correction of both instrument and, if required, fluid temperature effects.

Pressure compensation may be carried via a preset pressure value or a live pressure input into the density converter or flow computer.

$$\rho_m = D0 \times \frac{(t - t0')}{t0'} \times \left[2 + K \times \frac{(t - t0')}{t0'}\right],$$

where

ρ_m = measured line density in kg/m^3 [lb./ft.^{3}]

T0 = calibration constant of spool in µsec.

t0' = corrected calibration constant of spool in µsec. and

$$t0' = T0 + TEMPCO \times (T - T_{cal}) + PRESCO \times (P - P_{cal})$$

(continued)

D0 = calibration constant of spool in kg/m^3 [$lb./ft.^3$]

K = calibration constant of spool in $kg/m^3/°C$ [$lb./ft.^3/°F$]

TEMPCO = temperature coefficient of spool in µsec./°C [µsec./°F]

PRESCO = pressure coefficient of the transducer in µsec./bar [µsec./psi]

t = measured period in µsec.

T = measured/fixed line temperature in °C [°F]

P = measured/fixed absolute pressure in bar A [psi A]

T_{cal} = calibration temperature of densitometer 15°C [60°F]

P_{cal} = calibration pressure of densitometer 1.01325 bar A [14.696 psi A].

Chapter 2
Installation

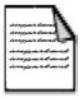
Note Installation must be carried out in accordance with local site requirements and regulations. ▲

Copies of referenced drawings are located in the drawing appendix.

Mechanical Considerations

The recommended orientation of the density meter is vertical with upward flow. Mounting the density meter vertically allows for usage at zero flow, avoiding problems caused by vapor that can become trapped in the density meter at low flows.

Mounting the density meter horizontally is acceptable if the flow is greater than 5 L/min. This is to avoid trapping gas bubbles that cause unsteady density measurements.



Note For clarity, the horizontal installation drawing shows bypass systems above the pipeline, but in practice, the bypass system is best installed to one side of the main pipeline. ▲

In addition to mounting orientation, the following must be considered prior to installation.

- Dimensions: Refer to the dimensional drawing in the drawing appendix.
- Pressure: Place flow restrictors, flow control valves, or pressure control valves downstream of the density meter in order to maintain full line pressure in the sensor. This will prevent gas bubbles from forming in the liquid due to a pressure drop occurring upstream of the instrument.
- Support: The weight of the density meter is carried by the adjoining pipework, which should be supported and correctly aligned to minimize mechanical loads, such as twisting.
- Heat tracing: Where the density meter is to be installed in a system that requires heat tracing, insulation of the density meter may be required. Consult Thermo Fisher.

- Pycnometer connections: Refer to the vertical installation drawing.
- The density meter should be bolted to the adjoining pipework with a suitable gasket between the coupling flanges. The configuration should be in the most convenient direction for connection of electrical cables.

Electrical Considerations

There are also electrical issues to consider prior to installation.

- Terminal box: Six core screened cable should be run to the instrument and inserted into the terminal box through a weatherproof cable gland screwed into the 3/4" NPT threaded hole in the side of the box. The bared ends of each wire should have the cable ends crimped or soldered onto them and then be attached to the terminals in the terminal box.
- Cable: As the output from the density transducer is in the form of a modulated current loop of approximately 8 mA peak-to-peak, the resistance and reactance of the cable is relatively unimportant provided a signal no less than 1.3 V peak-to-peak is available at the density converter or flow computer.
- Zener barriers: For intrinsically safe installations, zener barriers or galvanic isolators must be used. In these cases, cable capacitance, resistance, and inductance must be within the statutory limits or be as specified by the certifying authority. Zener barriers or galvanic isolators must always be mounted in an area allowed by the barrier or isolator certification.
- Screening: Screening is always suggested, but in some cases, it may not be necessary. When used, it must be earthed to the I.S. bus bar or grounded only at the control room end of the cable.

Hazardous Area Installations

The Sarasota FD910, FD950, and FD960 density meters have been designed to satisfy the requirements of Clause 1.2.7 of the essential Health and Safety Requirements such that they will not give rise to physical injury when handled properly. The instruments do not produce excessive surface temperature, nor do they emit infra red, electromagnetic, or ionizing radiation.

Before starting installation work, ensure all power connections are isolated, and take precautions to prevent power from being restored while work is taking place. Hazardous area installations forbid the use of tools or equipment that could produce an explosion hazard by causing a spark or imposing excessive mechanical stress.

The instruments must be installed in a manner to avoid exposure to thermal or mechanically induced stresses, and, in addition, they must not be exposed to chemically aggressive substances beyond the expected levels. The instruments are not intended to be exposed to significant conditions of dust buildup.

In cases of location in Zone 0 (ATEX Category 1), where impact/abrasion or other mechanical forces may be expected, appropriate methods of protection must be used.

Marking

ATEX

The Sarasota FD910, FD950, and FD960 density meters are marked for use in hazardous areas in accordance with the ATEX Directive. They are marked as follows.

F option

[BAS000ATEX1175X] II 1 G Ex ia IIC T6 Ga

Installed in the hazardous area

[BAS000ATEX1175X] is marked on the label as shown below:

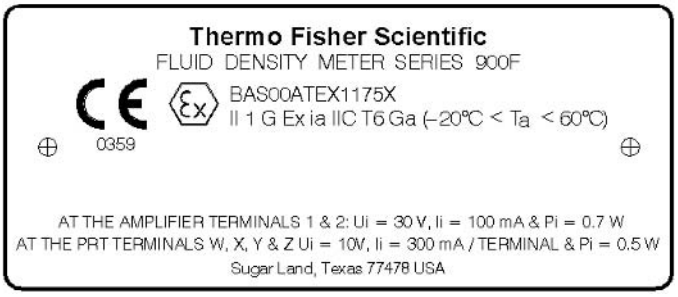


Figure 2–1.

H option

[BAS01ATEX1002X] II 1 G Ex ia IIC T4 Ga

Installed in the hazardous area

[BAS01ATEX1002X] is marked on the label as shown below:

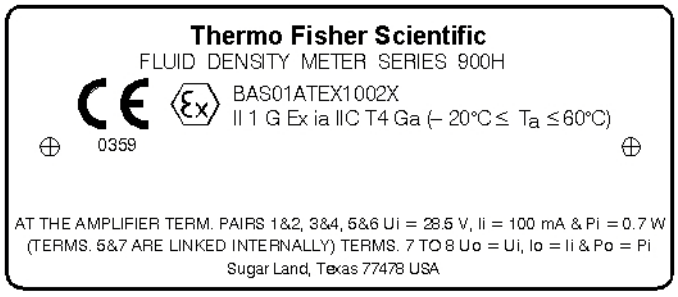


Figure 2–2.

Flameproof option

[Baseefa 02 ATEX 0031X] II 2 G Ex d IIB+H2 T4/T3

Installed in the safe area

[Baseefa 02 ATEX 0031X] is marked on the label as shown below:

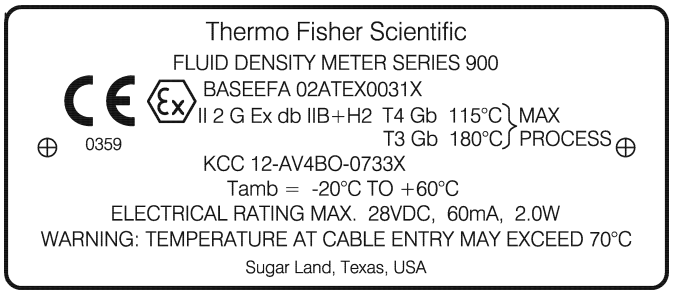


Figure 2–3.

CSA

The Sarasota FD910, FD950, and FD960 density meters are marked for use in hazardous areas in accordance with CSA. The flameproof option is marked as shown in the label below.

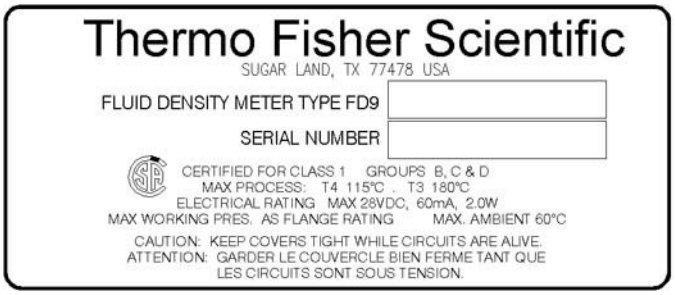


Figure 2–4.

Electrical Data

ATEX

F option

At the amplifier terminals 1 & 2: Ui = 30 V, li = 100 mA, Pi = 0.7 W

At the PRT terminals W, X, Y, & Z: Ui = 10 V, li = 300 mA per terminal, Pi = 0.5 W

H option

At the amplifier terminal pairs 1 & 2, 3 & 4, 5 & 6: Ui = 28.5 V, li = 100 mA, Pi = 0.7 W

(Terminals 5 & 7 are linked internally)

Terminals 7 & 8: Uo = Ui, lo = li, Po = Pi

Flameproof option

Vi max = 28 Vdc, li max = 60 mA, Pmax = 2.0 W

CSA Flameproof option

Vi max = 28 Vdc, li max = 60 mA, Pmax = 2.0 W

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Chapter 3
Commissioning

Caution Ensure all safety rules that apply to this equipment are followed and any permits necessary for the work have been issued. Also ensure obligations under the Health and Safety At Work Act are met. ▲

General

Check all installation details and wiring against the recommended methods in this manual.

If zener barriers or isolators are fitted, ensure they are correctly installed and grounded/earthed where appropriate.

Functional Checks

1. Connect the density meter to its signal converter or use a suitable bench power supply set to 13–24 Vdc.

2. Switch on the power supply and check for 13–24 Vdc across terminals 1 (+ve) and 2 (common).

   With the correct dc voltage applied to the empty instrument, a barely audible sound can be heard from the instrument.

3. The frequency of the oscillating tube should be between 1250 and 1350 Hz (800 and 740 μs) when the instrument is full of air at atmospheric pressure.

   Stand the density meter on end and fill it with water. The frequency should decrease approximately 400 Hz.

Resistance Thermometer

If required, you can check the PRT separately by disconnecting terminals W, X, Y, and Z and measuring the resistance across terminals X and Y. For best results, make an allowance for the internal leads by using a 4-wire method for reading resistance or by measuring and allowing for the internal lead resistances.

To manually allow for the internal lead resistances, take the measurements below, and then perform the calculation that follows.

- Resistance across W and Y (Meas1)
- Resistance across Z and X (Meas2)
- Resistance across X and Y (Meas3)

$$\text{Meas3} - \left[\frac{(\text{Meas1} + \text{Meas2})}{2}\right].$$

Refer to Table 3–1 for resistance and corresponding temperatures. By simultaneously measuring the line temperature using a separate PRT as reference, you can determine the accuracy of the instrument PRT. While performing this check, it is essential to allow the instrument to stabilize to the line temperature and avoid rapid temperature fluctuations.

Table 3–1.

Temperature (°C)	Resistance (ohms Ω)	Tolerance	
		± Ω	±°C
-20	92.16	0.05	0.13
0	100.00	0.04	0.10
20	107.79	0.05	0.13
40	115.54	0.06	0.17
60	123.24	0.08	0.20
80	130.89	0.09	0.23
100	138.50	0.10	0.27
120	146.06	0.11	0.30

Chapter 4
Calibration

A certificate of transducer calibration is supplied with each density meter. Accurate density calibration requires special equipment. Thus, it is recommended that you return it to the manufacturer for accurate calibration. Consult Thermo Fisher.

If you return a density meter, you must complete the Health and Safety Clearance Form (provided in Appendix D). Failure to return this form may result in the meter being returned.

If you do not return the instrument to the factory, you may perform validation checks using one of the methods discussed below.

Method 1: Online Sampling

For measurement at atmospheric pressure of stable, nonvolatile process fluid, a single tapping in the line near the density meter may be all that is required. However, if the sample is at elevated pressure, possibly with entrained gas or volatile components, high pressure pycnometry will be required. This is a specialized technique beyond the scope of this manual.

The sample must be taken from the line carefully, at a rate that will not significantly change line conditions of temperature and density. Simultaneously record the density meter reading.

The density of the sample should be measured in a temperature controlled environment using a hydrometer, pycnometer bottle, or a reference meter. Compare the measured density to the recorded density meter reading.

Note that if the density meter is reading line density, either the sample density must be measured at the same conditions or the density measured at standard conditions (in the laboratory) and then corrected to line conditions. Alternatively, the line density reading (from the density meter) can be corrected to the laboratory reference conditions, but this will add an uncertainty to the measurement. If the density meter is to be corrected based on the laboratory results, a number of samples should be taken and averaged before a correction is made.

Method 2: Off-Line Static Water Test

Remove the unit from the line and clean it as described in Chapter 5. For best results, perform the following test in a temperature controlled or temperature stable room after the meter and water sample have been allowed to stabilize to room conditions for 12 hours.

1. Close the density meter with a plug blanking the lower flange. Tip the unit at a 45-degree angle and slowly pour distilled water, if available, down the side of the tubes. This is to minimize the amount of air and bubbles that may be trapped in the water during filling. Run a cleaning brush that has never been used with anything but water through each tube. This ensures that all bubbles are wiped from the tubes.

2. Allow the temperature to stabilize. Then record the density reading and temperature obtained. Compare the density value with the water data in Table 4–1.

   If the reading is within ±1.0 kg/m^3 of the reading in the table, the density meter is working correctly. If the reading is outside the limit, do the test again carefully. Larger than expected uncertainties, mostly due to air bubbles and thermal gradients, often occur while performing static water tests. Do not expect static water tests to obtain as high a degree of accuracy as the manufacturer's calibration. If accuracy better than ±1.0 kg/m^3 is required, return the density meter to the factory for calibration. Unless the application is particularly severe, a one-year calibration interval should be adequate.

Table 4–1.

Temperature (°C)	Density (kg/m^3)
10.0	999.7
15.0	999.1
20.0	998.2
25.0	997.0

Chapter 5
Maintenance & Service

Note The frequency version (F option) of the density meter has no user serviceable parts and cannot be dismantled. It should be returned to the factory for service. Consult Thermo Fisher. The headmounted electronics version (H option) has exchangeable PCBs. Reference to service exchange of these parts is found in the HME900 manual. ▲

Note Where solid deposit buildup occurs in the pipeline and density meter, the accuracy of the density measurements will be degraded. ▲

The density meters have been designed so that, in general, no maintenance is required. Maintenance is limited to periodically checking the accuracy of the meter via sample fluids, checking the PRT output, and cleaning the meter.

If cleaning is required, remove the meter from the line and flush through with a suitable cleaning fluid. Cleaning fluids should be compatible with the wetted materials. The maximum temperature of the instrument (180°C/356°F) should not be exceeded during cleaning. The sensor tubes may be carefully cleaned using the manufacturer's cleaning brush.

Caution If using the manufacturer's cleaning brush, pass the brush through the sensor tubes carefully and as straight through as possible to avoid damaging (scratching) the sensor tubes. ▲

"Clean in place" procedures may be employed if required.

Contact Information

The local representative is your first contact for support and is well equipped to answer questions and provide application assistance. You can also contact Thermo Fisher Scientific directly.

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Appendix A
Ordering Information

Sarasota FD910

Table A–1. Sarasota FD910 industrial liquid density meter

Code	Model
FD910	Liquid density meter: Suitable for any single phase liquid process, including liquefied gases Class 150 and 300 flange ratings: All wetted parts are 316L SS Class 600 flange rating: Sensing tubes are Hastelloy C276, all other wetted parts are 316L SS
Code	**Signal Output**
F	Frequency output: No local display; requires density converter (consult Thermo Fisher)
H	Smart headmounted electronics: Provides HART® compatible (4–20 mA) output and for use of optional local display; accepts 4 –20 mA input from pressure transducer for pressure compensation
Code	**Transducer Accuracy**
2	±0.00025 g/cm^3
1	±0.0001 g/ cm^3
Code	**Process Temperature Range**
G	-20°C to +120°C (-4°F to +248°F)
H	-50°C to +180°C (-58°C to +356°F)
Code	**Process Connections**
B0	1" ANSI B16.5 316L SS Class 150 lb. RF flanges
B1	1" ANSI B16.5 Class 150 DUPLEX flanges[1]
F0	1" ANSI B16.5 316L SS Class 300 lb. RF flanges
F1	1" ANSI B16.5 Class 300 DUPLEX flanges[1]
A0	1" ANSI B16.5 316L SS Class 600 lb. RF flanges
A1	1" ANSI B16.5 Class 600 DUPLEX flanges[1]
D	BS4504 PN40 DN25 213L SS RF flanges (Form D)

Code	Certification
S	Non-hazardous/Safe Area application
I	ATEX EX II 1 G Ex ia IIC T6 Ga (-20°C≤Ta≤+60°C) with frequency output option only ATEX EX II 1 G Ex ia IIC T4 Ga (-20°C≤Ta≤+60°C) with headmounted electronics option only
C	CSA Class 1, Div. 1, Groups B, C, & D
D	Flameproof EX II 2 G Ex db IIB+H2 T4/T3
Code	**Options**
L	Local display: Only available with smart headmounted electronics option
M	Wetted parts traceability to EN 10204. Type 3.1.
N	NACE Conformance: All wetted parts suitable for sour gas service; NACE specification MR-01-75
T	Traceable Calibration Certificate: Provides a record of all the instruments used during calibration and their certificates
D	Non-destructive testing: NDT of pressure containing welds by dye penetrant; (50% all external welds; 100% all internal and external welds)

Typical model number: FD910-F-A0-S-M

[1]Meets design pressure for carbon steel systems.

Table A–2. Sarasota FD910 spares

P/N	Description
21/107	Cleaning brush
ZR20-0117/B	Box seal ring

Table A–3. Sarasota FD910 installation accessories

P/N	Description
ZB/MTL/D1	For use with smart headmounted electronics option with pressure transducer input (set of 3 barriers): 2x MTL728/28V-300 ohm for density meter power supply and pressure transducer loop power 1x MTL787S/28V-300 ohm + diode return to power HART signal loop 4–20 mA
ZB/MTL/D2 (CM515)	For use with frequency output option with connection to Sarasota CM515 (set of 3 barriers): 1x MTL787S/28V-300 ohm + diode return to power density meter 2x MTL755 dual channel 3V-10 ohm ac barriers
ZB/MTL/D3	For use with smart headmounted electronics option without pressure transducer input (set of 2 barriers): 1x MTL728/28V-300 ohm for density meter power supply 1x MTL787S/28V-300 ohm + diode return to power HART signal loop 4–20 mA
ISO/P+F/GH	Isolation barriers for use with smart headmounted electronics option without pressure transducer input (set of 2 barriers): 1x KFD2-STC3-Ex1 for HART signal loop 4–20 mA 1x KFD2-SD-Ex1.48 for density meter power; should be used when no earth ground is available or in some countries or locations when the device is used in Zone 0 hazardous area

Sarasota FD950

Table A–4. Sarasota FD950 chemical liquid density meter

Code	Model
FD950	Liquid density meter: Suitable for corrosive processes or processes with the potential of becoming corrosive; all wetted parts are Hastelloy C276
Code	**Signal Output**
F	Frequency output: No local display; requires density converter (consult Thermo Fisher)
H	Smart headmounted electronics: Provides HART® compatible (4–20 mA) output and for use of optional local display; accepts 4 –20 mA input from pressure transducer for pressure compensation
Code	**Transducer Accuracy**
2	±0.00025 g/cm^3
1	±0.0001 g/cm^3
Code	**Process Temperature Range**
G	-20°C to +120°C (-4°F to +248°F)
H	-50°C to +180°C (-58°C to +356°F)
Code	**Process Connections**
B2	1" ANSI B16.5 Hastelloy C276 Class 150 lb. RF flanges
F2	1" ANSI B16.5 Hastelloy C276 Class 300 lb. RF flanges
A2	1" ANSI B16.5 Hastelloy C276 Class 600 lb. RF flanges
D	BS4504 PN40 Hastelloy C276 DN25 RF flanges (Form D)
Code	**Certification**
S	Non-hazardous/Safe Area application
I	ATEX EX II 1 G Ex ia IIC T6 Ga (-20°C≤Ta≤+60°C) with frequency output option only ATEX EX II 1 G Ex ia IIC T4 Ga (-20°C≤Ta≤+60°C) with headmounted electronics option only
C	CSA Class 1, Div. 1, Groups B, C, & D
D	Flameproof EX II 2 G Ex db IIB+H2 T4/T3
Code	**Options**
L	Local display
M	Wetted parts traceability to EN 10204. Type 3.1.
N	NACE Conformance: All wetted parts suitable for sour gas service; NACE specification MR-01-75
T	Traceable Calibration Certificate: Provides a record of all the instruments used during calibration and their certificates
D	Non-destructive testing: NDT of pressure containing welds by dye penetrant; (50% all external welds; 100% all internal and external welds)

Typical model number: FD950-F-1-G-A2-S-M

Table A–5. Sarasota FD950 spares

P/N	Description
21/107	Cleaning brush
ZR20-0117/B	Box seal ring

Table A–6. Sarasota FD950 installation accessories

P/N	Description
ZB/MTL/D1	For use with smart headmounted electronics option with pressure transducer input (set of 3 barriers): 2x MTL728/28V-300 ohm for density meter power supply and pressure transducer loop power 1x MTL787S/28V-300 ohm + diode return to power HART signal loop 4–20 mA
ZB/MTL/D2 (CM515)	For use with frequency output option with connection to Sarasota CM515 (set of 3 barriers): 1x MTL787S/28V-300 ohm + diode return to power density meter 2x MTL755 dual channel 3V-10 ohm ac barriers
ZB/MTL/D3	For use with smart headmounted electronics option without pressure transducer input (set of 2 barriers): 1x MTL728/28V-300 ohm for density meter power supply 1x MTL787S/28V-300 ohm + diode return to power HART signal loop 4–20 mA
ISO/P+F/GH	Isolation barriers for use with smart headmounted electronics option without pressure transducer input (set of 2 barriers): 1x KFD2-STC3-Ex1 for HART signal loop 4–20 mA 1x KFD2-SD-Ex1.48 for density meter power; should be used when no earth ground is available or in some countries or locations when the device is used in Zone 0 hazardous area

Sarasota FD960

Table A–7. Sarasota FD960 fiscal liquid density meter

Code	Model
FD960	Liquid density meter: Suitable for non-corrosive processes; Ni-Span C sensing tubes
Code	**Signal Output**
F	Frequency output: no local display; requires density converter (consult Thermo Fisher)
H	Smart headmounted electronics: Provides HART® compatible (4–20 mA) output provides for use of optional local display; accepts 4 –20 mA input from pressure transducer for pressure compensation
Code	**Transducer Accuracy**
1	±0.0001 g/cm^3
Code	**Temperature Range**
G	-20°C to +120°C (-4°F to +248°F)
H	-50°C to +180°C (-58°C to +356°F)
Code	**Process Connections**
B0	1″ ANSI B16.5 316L SS Class 150 lb. RF flanges
B1	1″ ANSI B16.5 Class 150 DUPLEX flanges[1]
F0	1″ ANSI B16.5 316L SS Class 300 lb. RF flanges
F1	1″ ANSI B16.5 Class 300 DUPLEX flanges[1]
A0	1″ ANSI B16.5 316L SS Class 600 lb. RF flanges
A1	1″ ANSI B16.5 Class 600 DUPLEX flanges[1]
D	BS4504 PN40 DN25 213L SS RF flanges (Form D)
Code	**Certification**
S	Non-hazardous/Safe Area application
I	ATEX EX II 1 G Ex ia IIC T6 Ga (-20°C≤Ta≤+60°C) with frequency output option only ATEX EX II 1 G Ex ia IIC T4 Ga (-20°C≤Ta≤+60°C) with headmounted electronics option only
C	CSA Class 1, Div. 1, Groups B, C, & D
D	Flameproof EX II 2 G Ex db IIB+H2 T4/T3
Code	**Options**
L	Local display: only available with smart headmounted electronics
M	Wetted parts traceability to EN 10204. Type 3.1.
T	Traceable Calibration Certificate: provides a record of all the instruments used during calibration and their certificates
D	Non-destructive testing: NDT of pressure containing welds by dye penetrant; (50% all external welds; 100% all internal and external welds)

Typical model number: FD960-F-1-G-A0-S-M
[1]Meets design pressure for carbon steel systems.

Table A–8. Sarasota FD960 instrument spares

P/N	Description
21/107	Cleaning brush
ZR20-0117/B	Box seal ring

Table A–9. Sarasota FD960 installation accessories

P/N	Description
ZB/MTL/D1	For use with smart headmounted electronics option with pressure transducer input (set of 3 barriers): 2x MTL728/28V-300 ohm for density meter power supply and pressure transducer loop power 1x MTL787S/28V-300 ohm + diode return to power HART signal loop 4–20 mA
ZB/MTL/D2 (CM515)	For use with frequency output option with connection to Sarasota CM515 (set of 3 barriers): 1x MTL787S/28V-300 ohm + diode return to power density meter 2x MTL755 dual channel 3V-10 ohm ac barriers
ZB/MTL/D3	For use with smart headmounted electronics option without pressure transducer input (set of 2 barriers): 1x MTL728/28V-300 ohm for density meter power supply 1x MTL787S/28V-300 ohm + diode return to power HART signal loop 4–20 mA
ISO/P+F/GH	Isolation barriers for use with smart headmounted electronics option without pressure transducer input (set of 2 barriers): 1x KFD2-STC3-Ex1 for HART signal loop 4–20 mA 1x KFD2-SD-Ex1.48 for density meter power; should be used when no earth ground is available or in some countries or locations when the device is used in Zone 0 hazardous area
ISO/MTL	Isolation barriers for use with smart headmounted electronics option without pressure transducer input (set of 2 barriers): 1x MTL5541 for HART signal loop 4–20 mA 1 x MTL5525 for density meter power; should be used when no earth ground is available or in some countries or locations when the device is used in Zone 0 hazardous area

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Appendix B
Specifications

Results may vary under different operating conditions.

Unless otherwise noted, specifications apply to the Sarasota FD910, FD950, and FD960.

Table B–1. Functional specifications

Transducer calibration accuracy	Available to ±0.1 kg/m^3 (±0.0062 lb./ft.^{3})
Repeatability	0.02 kg/m^3 (0.0012 lb./ft.^{3})
Flow range	Vertical installations: 0–300 L/min. (0–79 gal./min.) Horizontal installations: 5–300 L/min. (1.3–79 gal./min.)
Operating density range	0–2100 kg/m^3 (0–131.1 lb./ft.^{3})
Installation	No instrument or pipework supports required Standard: Vertical installation Optional: Horizontal installation
Pressure effect (corrected)	0.003 kg/m^3/bar (0.000013 lb./ft.^{3}/psi). Note: Correction coefficients applied
Temperature effect (corrected)	0.005 kg/m^3/°C (0.0002 lb./ft.^{3}/°F). Note: Correction coefficients applied
Dimensions	See dimensional drawing (Figure C–3 in Appendix C)
Shipping dimensions	590 x 390 x 290 mm (approx. 24 x 16 x 12 in.)
Net weight	11 kg (24 lb.)
Shipping weight	15 kg (33 lb.)
Environmental rating	IP65 (NEMA 4X)
Electrical connections	Screw terminals; cable entry (2x 3/4" NPT)
Temperature measurement	High accuracy 1/3 DIN integral 4-wire PT100

Table B–1, cont.

Local display (H option)	4.5-digit, 7.6 mm (0.3 in.), 7-segment LCD display; resolution 0.1% or 0.01%, depending on display variable
Secondary containment	As flange rating to Class 300 then 2.5 times maximum safety flange rating to Class 600
Factory calibration range	650–1600 kg/m^3 (40.58–99.98 lb./ft.^{3})
Ambient temperature range	-20°C to +60°C (-4°F to +140°F)
Process temperature range	-50°C to +180°C (-58°F to +356°F)
Output	F option (frequency output): Frequency related to density on 2-wire current modulated loop 6–18 mA, 4-wire PT100 H option (headmounted electronics): Analog 4–20 mA related to density or density derived variable, HART protocol
Power supply	F option (frequency output): 13–28 Vdc, 10 mA average (peak 18 mA) H option (headmounted electronics): 2x 13–28 Vdc, 25 mA; 4–20 mA current pressure input available
Maximum operating pressure	As flange rating

Table B–2. Material specifications

Sensor	Sarasota FD910 (Class 150, 300): Stainless steel (316L/1.4404) Sarasota FD910 (Class 600): Hastelloy C276 Sarasota FD950: Hastelloy C276 Sarasota FD960: Ni-Span C
Other wetted parts	Sarasota FD910: Stainless steel (316L/1.4404) Sarasota FD950: Hastelloy C276 Sarasota FD960: Stainless steel (316L/1.4404)
Case	Stainless steel (316L/1.4404)
Electronics housing	Copper-free aluminum gray epoxy finish; plate glass window for local display option

Table B–3. Process connections

1-inch ASME B16.5 RF (raised face)	Sarasota FD910 (Class 150, 300, or 600): Stainless steel (316L/1.4404) Sarasota FD910 (Class 150, 300, or 600): Duplex (A 182 Gr.F51) Sarasota FD950 (Class 150, 300, or 600): Hastelloy C276 Sarasota FD960 (Class 150, 300, or 600): Stainless steel (316L/1.4404) Sarasota FD960 (Class 150, 300, or 600): Duplex (A 182 Gr.F51)
25-mm BSEN1092 RF (raised face – type B)	Up to maximum PN100
Other flange types	Consult Thermo Fisher

Table B–4. Compliance/Certification

Quality assurance	ISO 9001:2000
CE mark	Compliant
Electromagnetic compatibility	Compliant (EN 61326:1997)
Pressure Equipment Direct (97/23/EC)	Category III
Low Voltage Directive	Compliant
Safe area use	As standard
BS EN ISO 15156 / NACE MR0175 Conformance	Sarasota FD910 and FD950 only
ATEX Conformance, Intrinsically Safe (97/9/EC)	F option: EX II 1 G Ex ia IIC T6 Ga (-20°C≤Ta≤+60°C) H option: EX II 1 G Ex ia IIC T4 Ga (-20°C≤Ta≤+60°C)
ATEX Conformance, Flameproof (94/9/EC)	EX II 2 G Ex db IIB+H2 T4/T3 Temperature classification of T4 or T3 (for use with maximum process fluid temperature of +115°C or +180°C respectively).
Canadian Standards Association (CSA)	Explosion proof Class 1, Groups B, C, & D
Calibration certification	Calibration traceable to national standards; calibration certificates supplied as standard. Optional traceable calibration equipment listing available.
Material traceability	Wetted parts traceability to EN 10204. Type 3.1.

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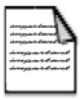
Appendix C
Drawings

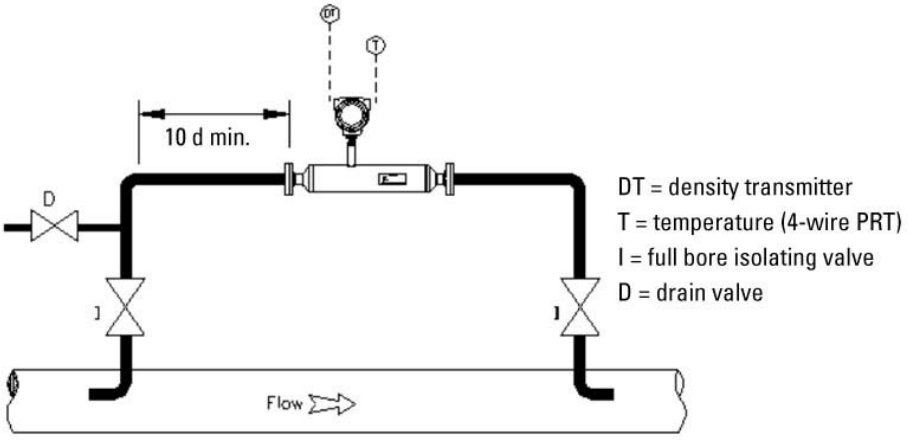
Note Information presented in this chapter has been regenerated from original drawings. Every effort is made to maintain document accuracy. However, in order to enhance legibility, the documents may have been restructured, and some information may have been intentionally excluded. Therefore, the drawings within this guide may not be exact duplicates of the original drawings. ▲



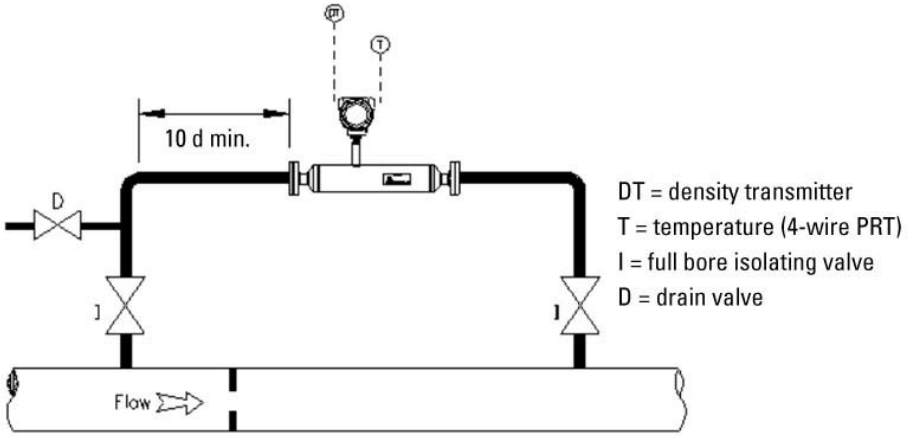
Note Drawings in this manual are included for reference only and may not be the current version. Contact the factory if you need a copy of the latest revision. ▲

Table C–1.

Drawing #	Rev.	Description	Page
-	-	Installation drawing, horizontal methods (1 sheet)	C–2
-	-	Installation drawing, vertical methods (1 sheet)	C–3
AD_5037	A	Dimensional drawing (1 sheet)	C–4
AD_6502	D	Wiring diagrams, barrier & non-hazardous/safe area options for Sarasota density meters (9 sheets)	C–5

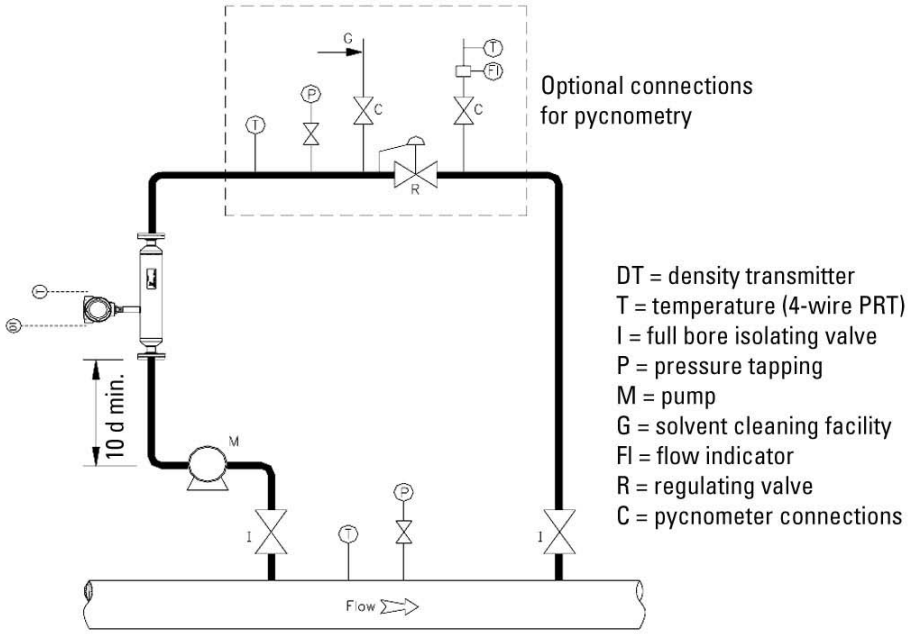


Bypass installation using pitot scoop tubes



Bypass installation using restriction device

Figure C–1. Installation drawing, horizontal methods (sheet 1 of 1)



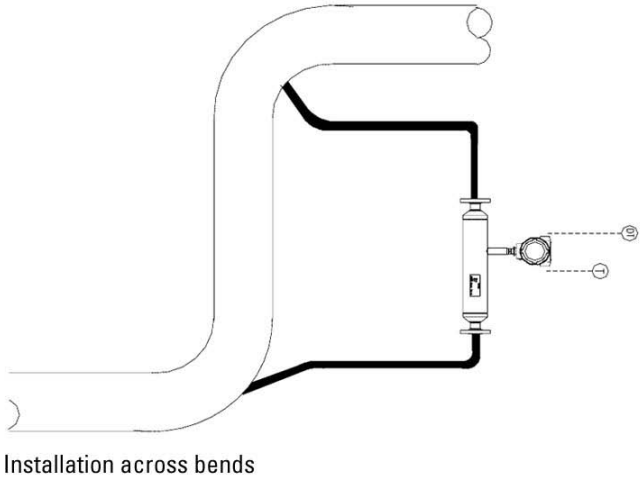


Figure C–2. Installation drawing, vertical methods (sheet 1 of 1)

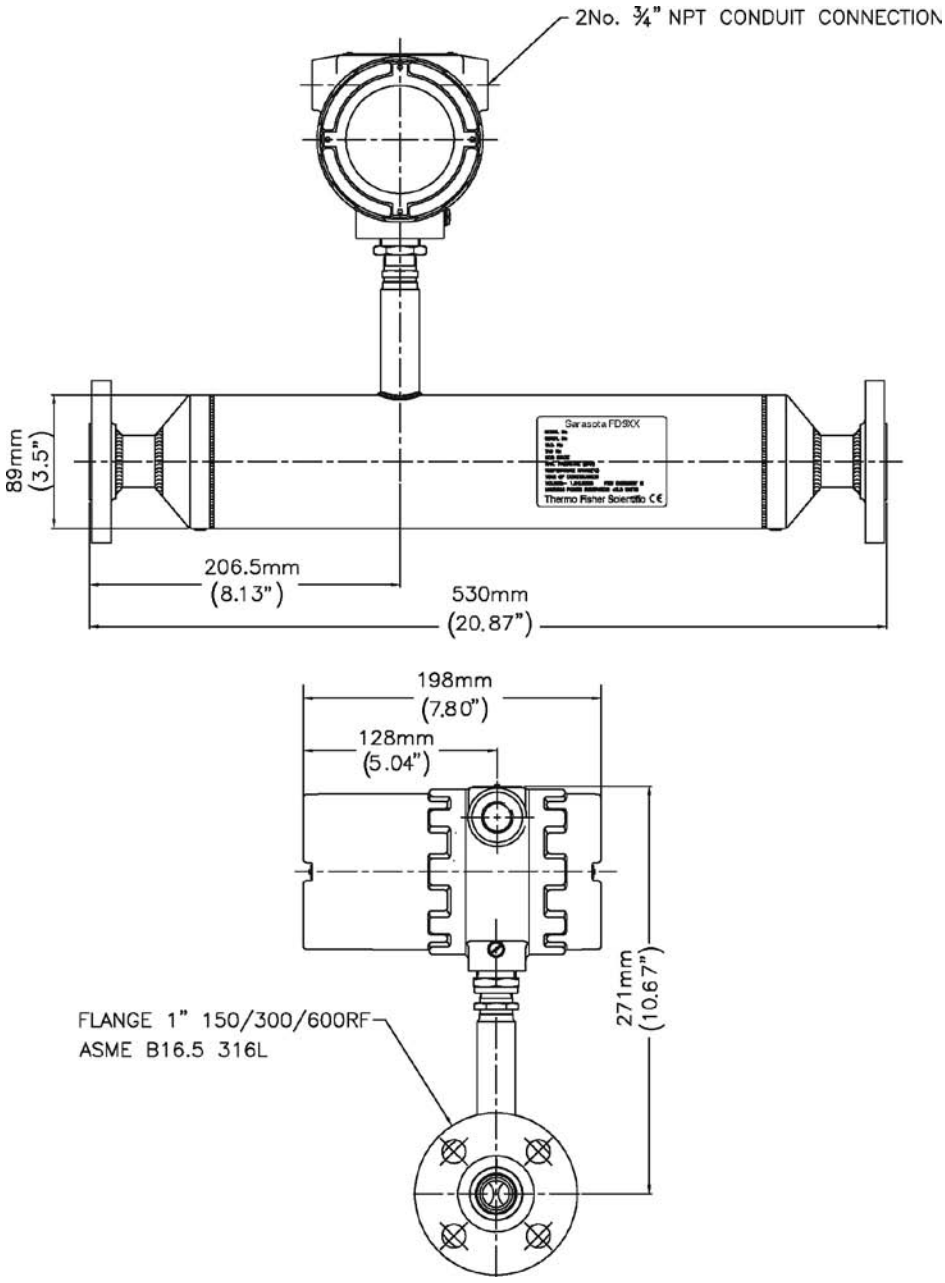


Figure C–3. AD_5037: Dimensional drawing (sheet 1 of 1)

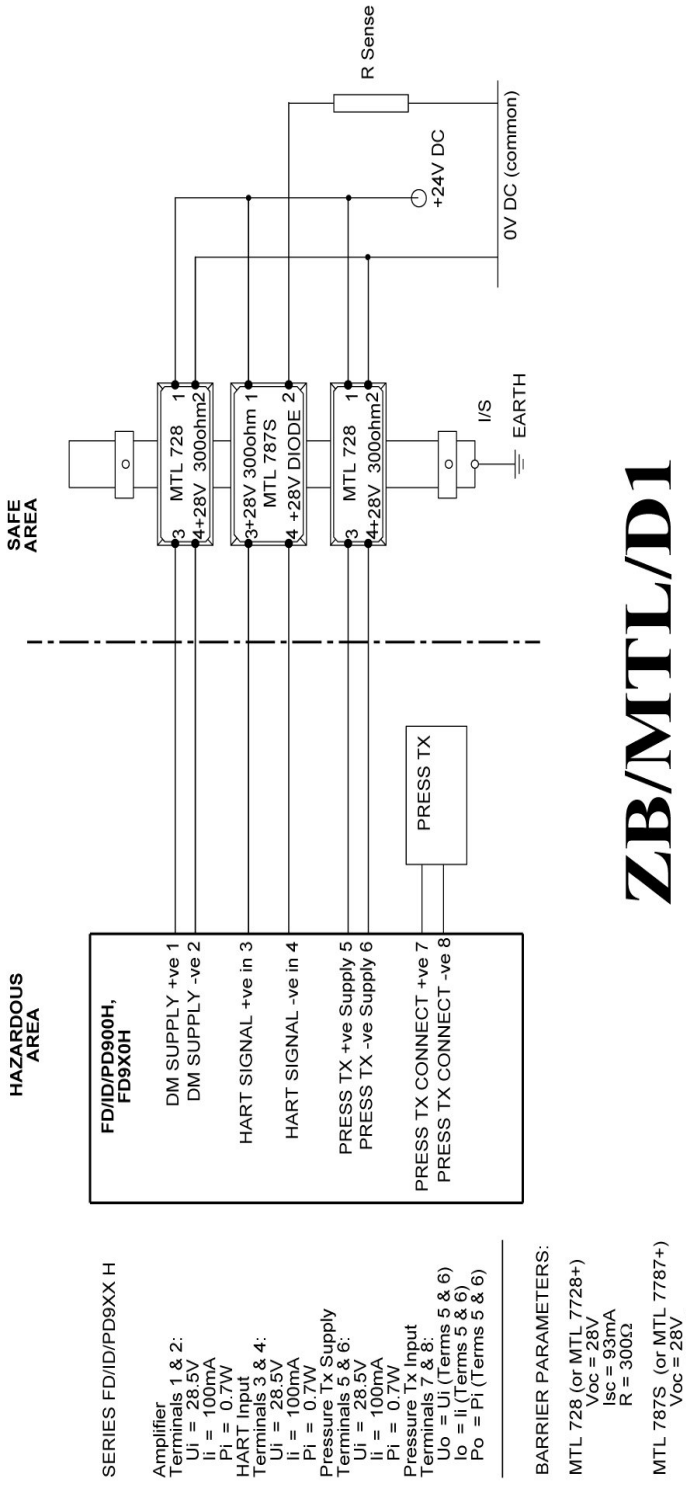


Figure C–4. AD_6502: Wiring diagrams, barrier & non-hazardous/safe area options for Sarasota density meters (sheet 1 of 9)

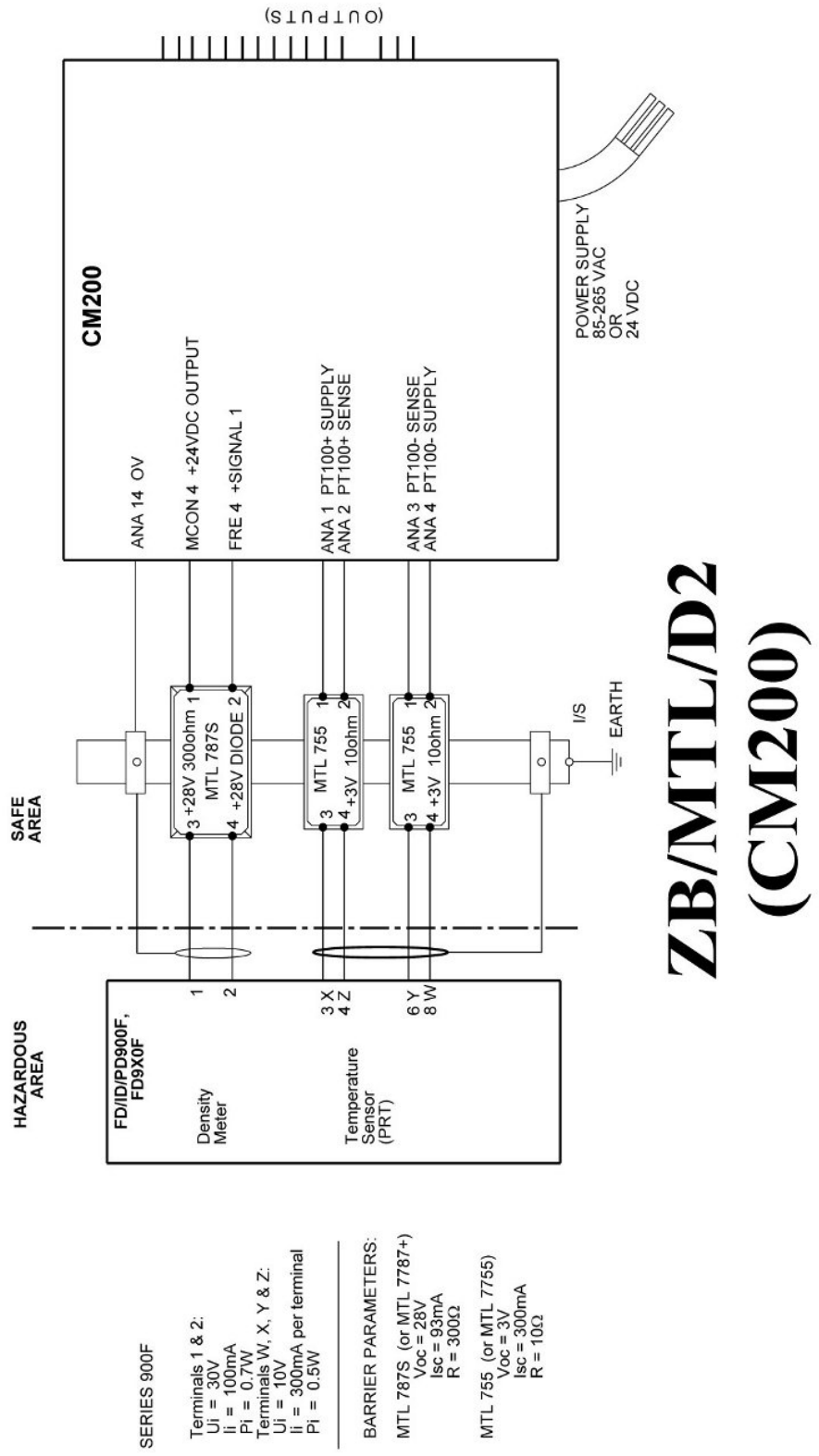


Figure C–5. AD_6502: Wiring diagrams, barrier & non-hazardous/safe area options for Sarasota density meters (sheet 2 of 9)

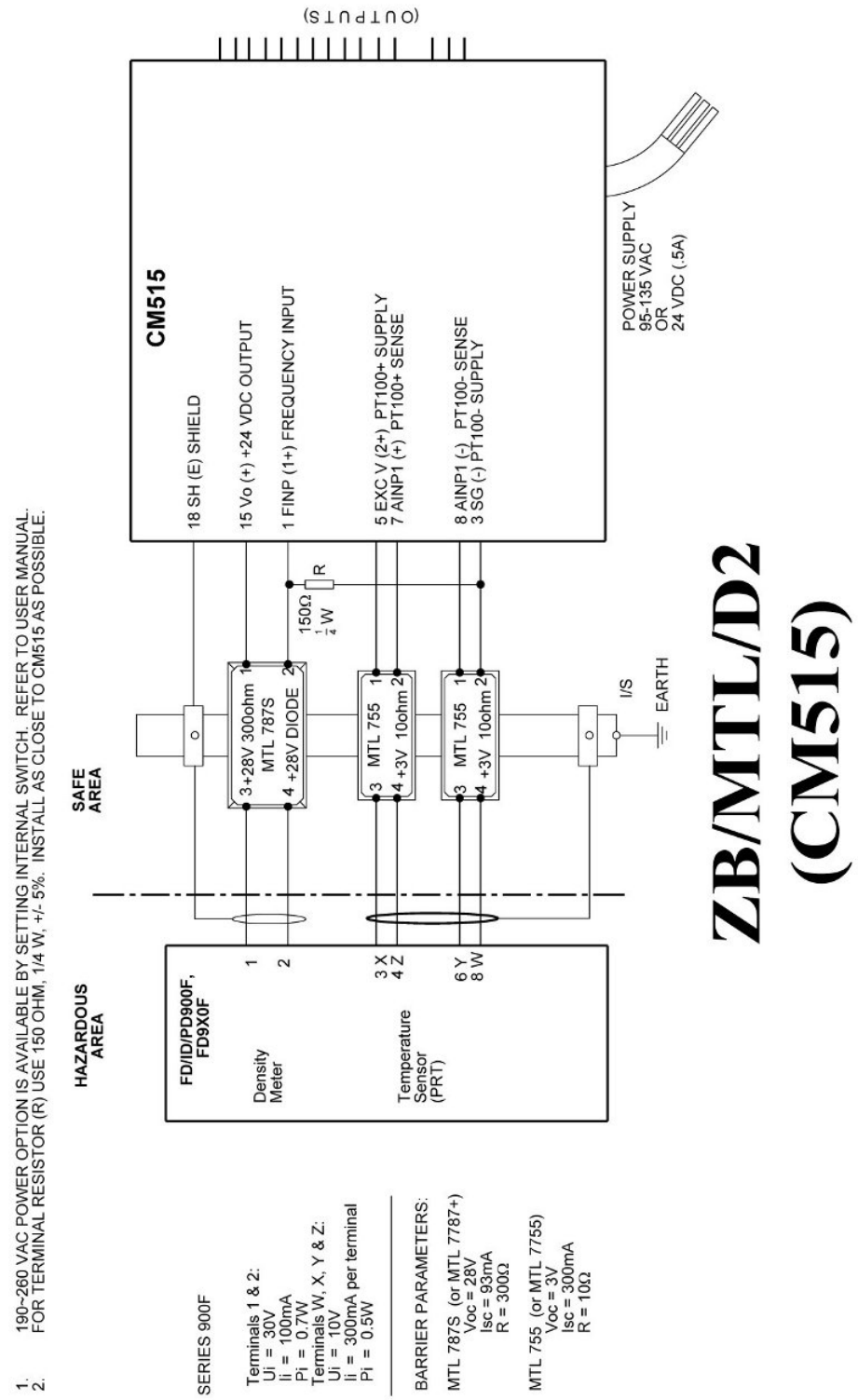


Figure C–6. AD_6502: Wiring diagrams, barrier & non-hazardous/safe area options for Sarasota density meters (sheet 3 of 9)

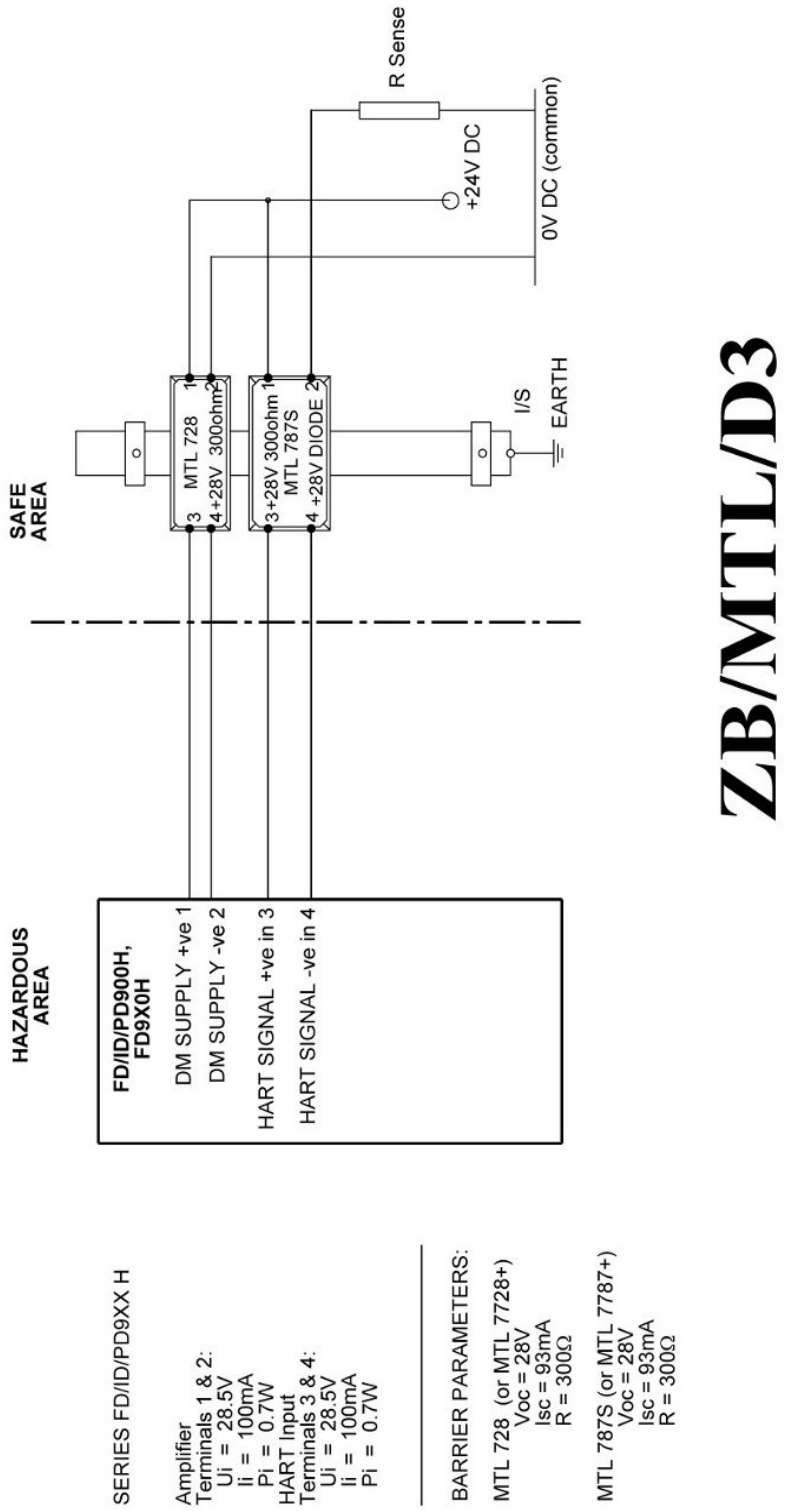


Figure C–7. AD_6502: Wiring diagrams, barrier & non-hazardous/safe area options for Sarasota density meters (sheet 4 of 9)

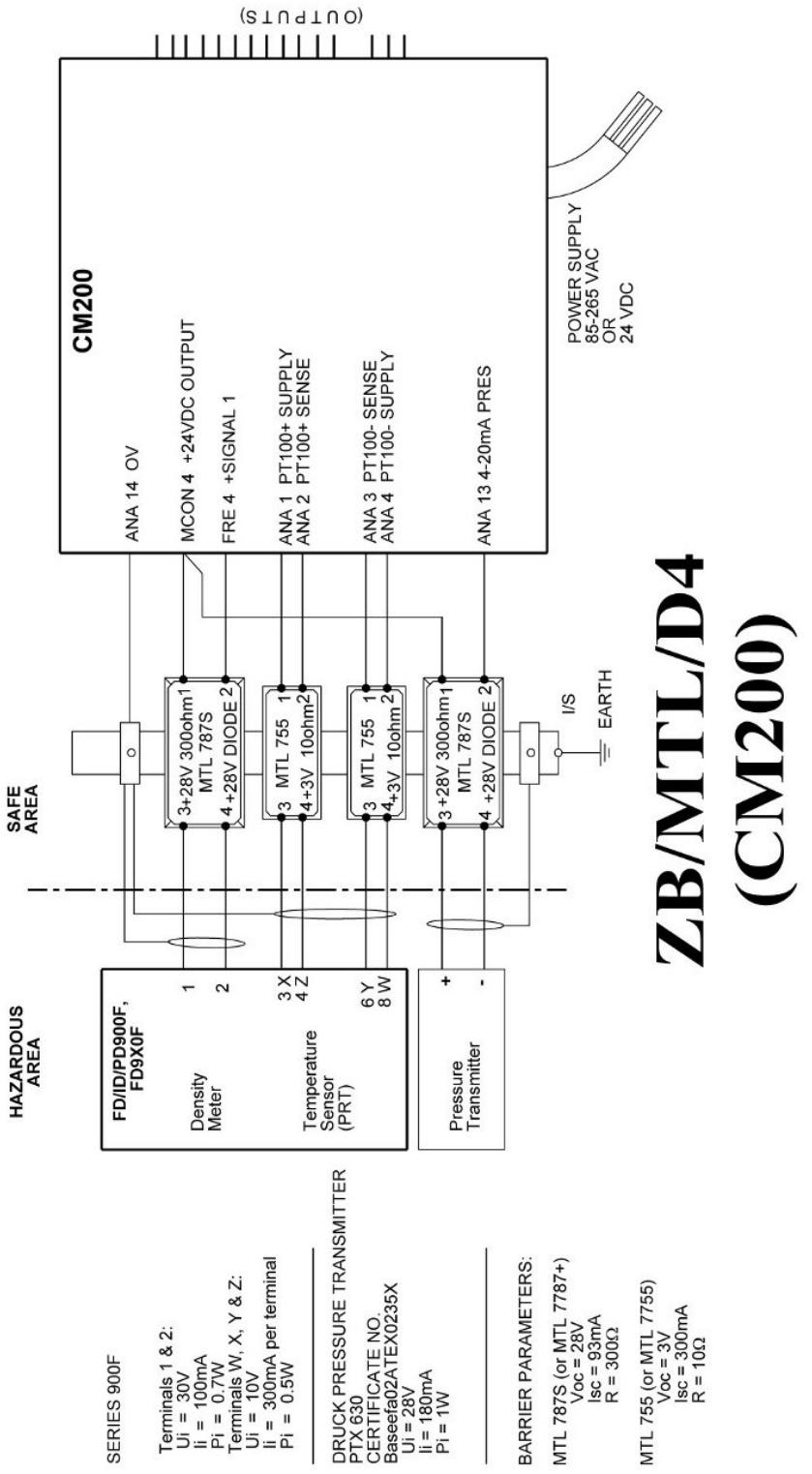


Figure C–8. AD_6502: Wiring diagrams, barrier & non-hazardous/safe area options for Sarasota density meters (sheet 5 of 9)

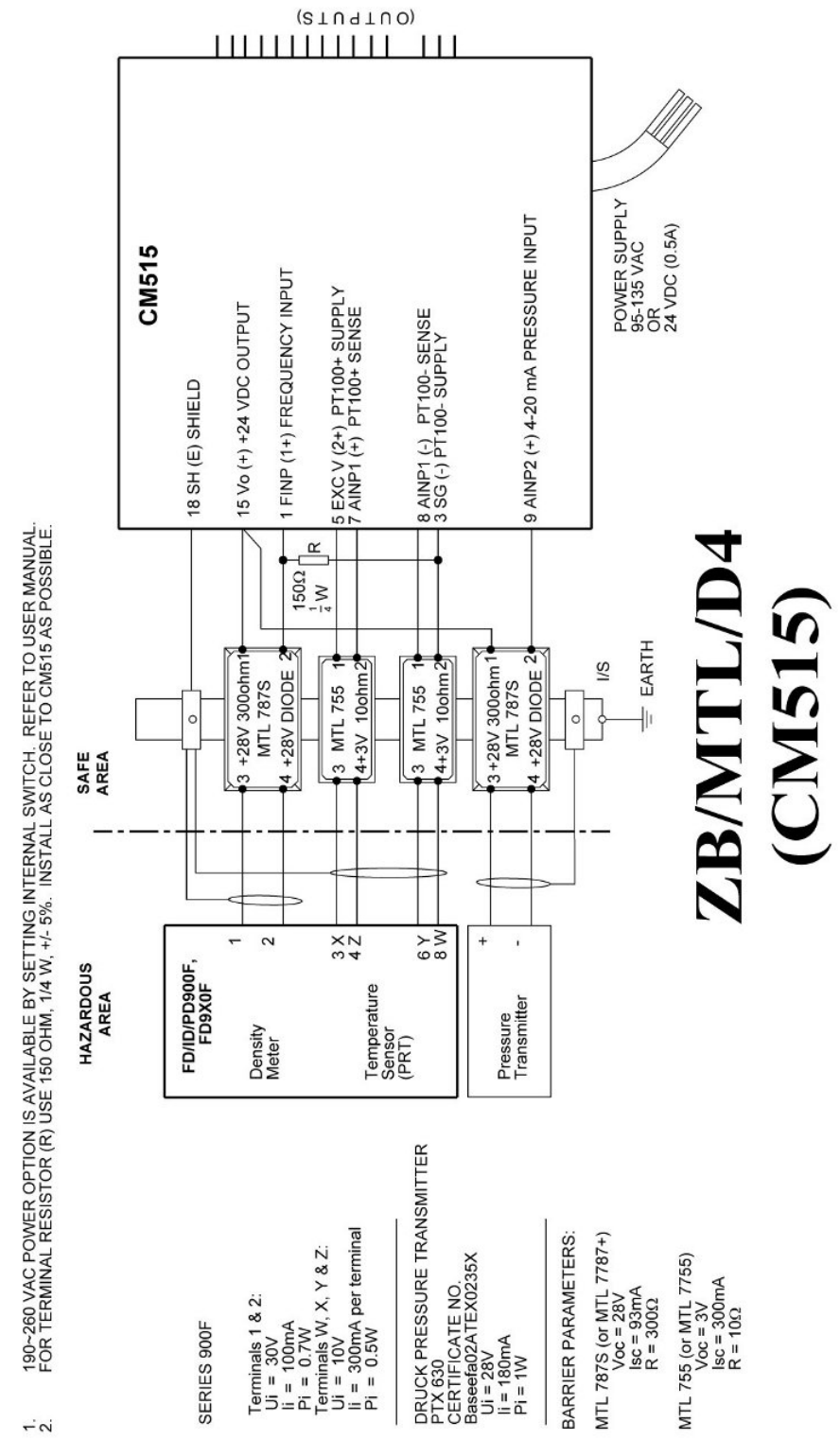


Figure C–9. AD_6502: Wiring diagrams, barrier & non-hazardous/safe area options for Sarasota density meters (sheet 6 of 9)

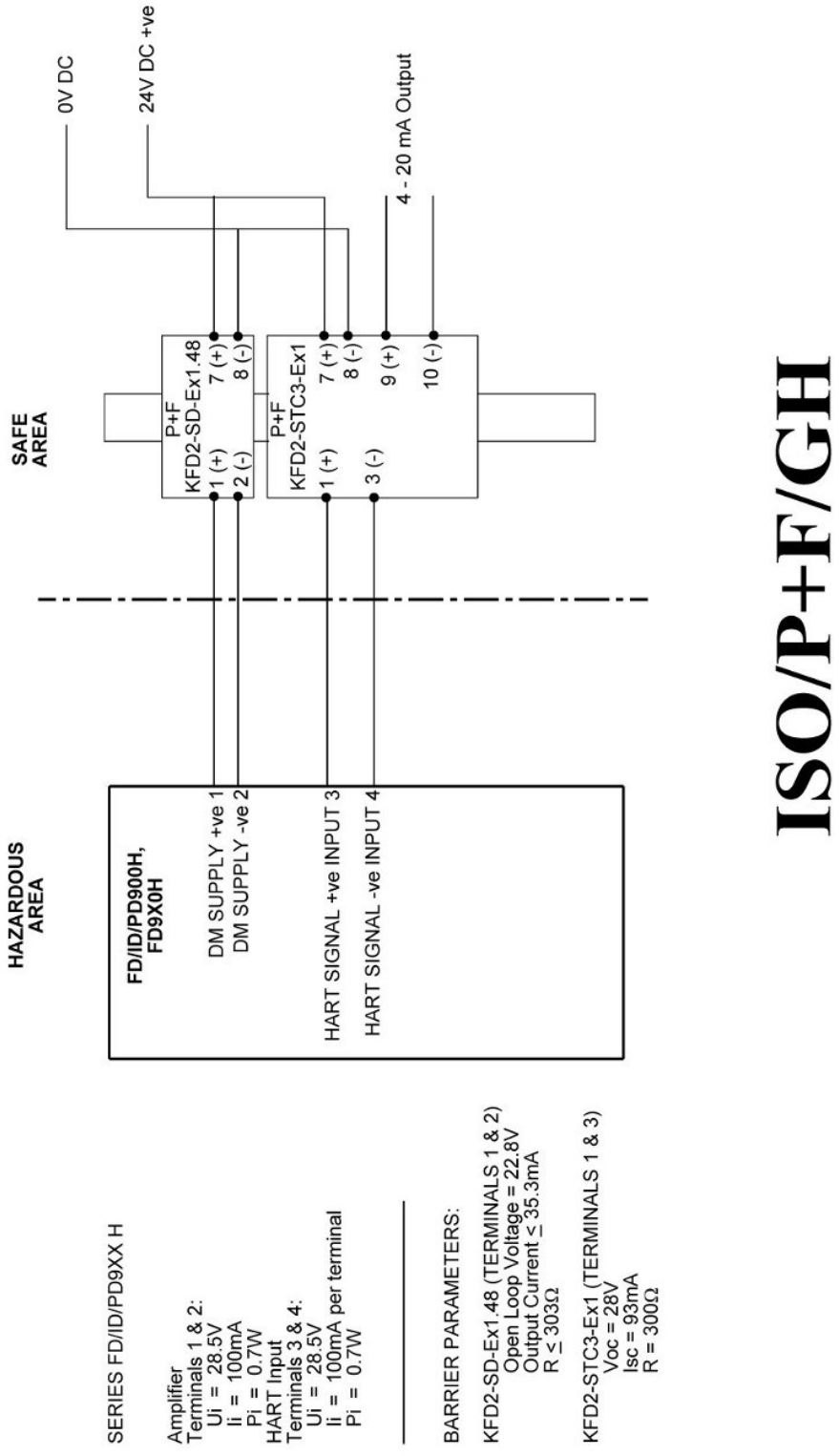


Figure C–10. AD_6502: Wiring diagrams, barrier & non-hazardous/safe area options for Sarasota density meters (sheet 7 of 9)

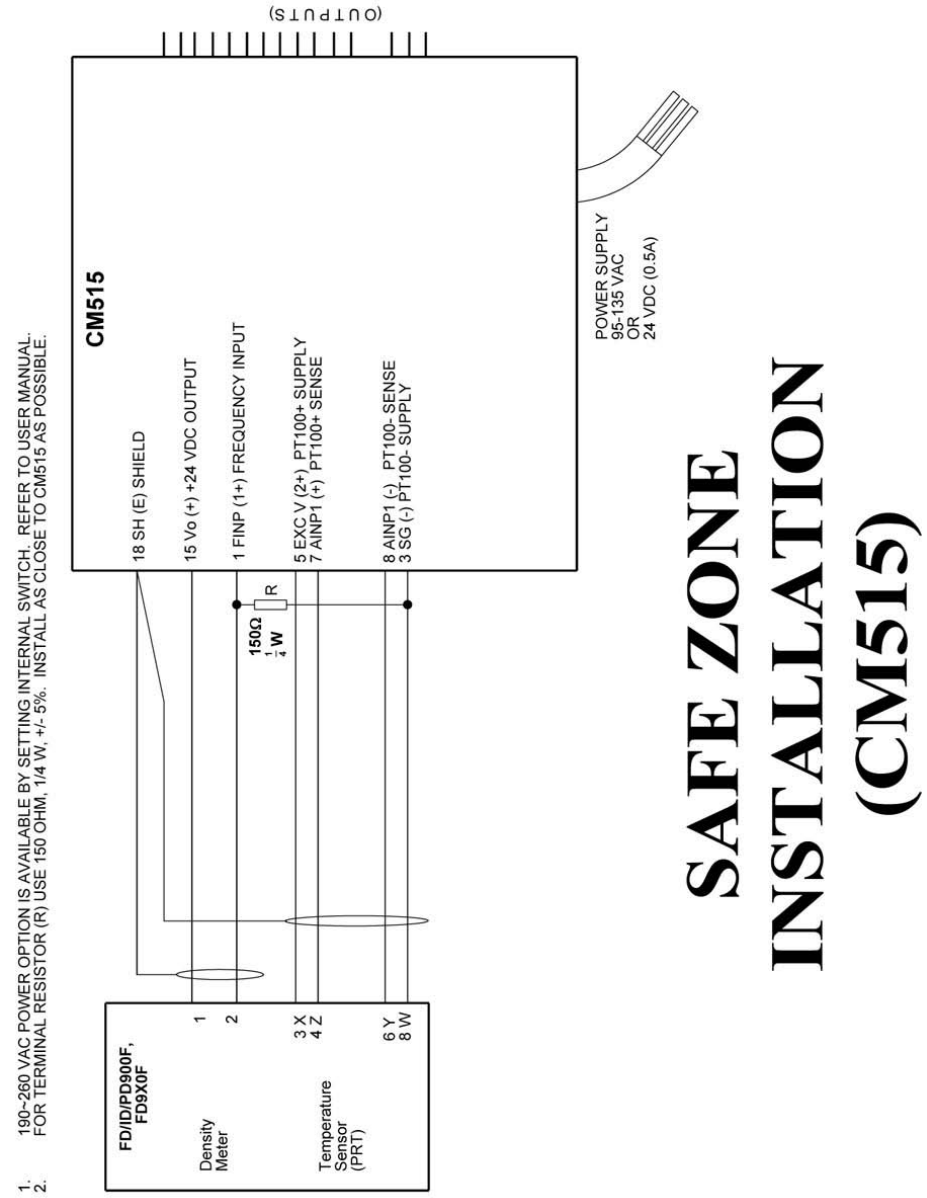


Figure C–11. AD_6502: Wiring diagrams, barrier & non-hazardous/safe area options for Sarasota density meters (sheet 8 of 9)

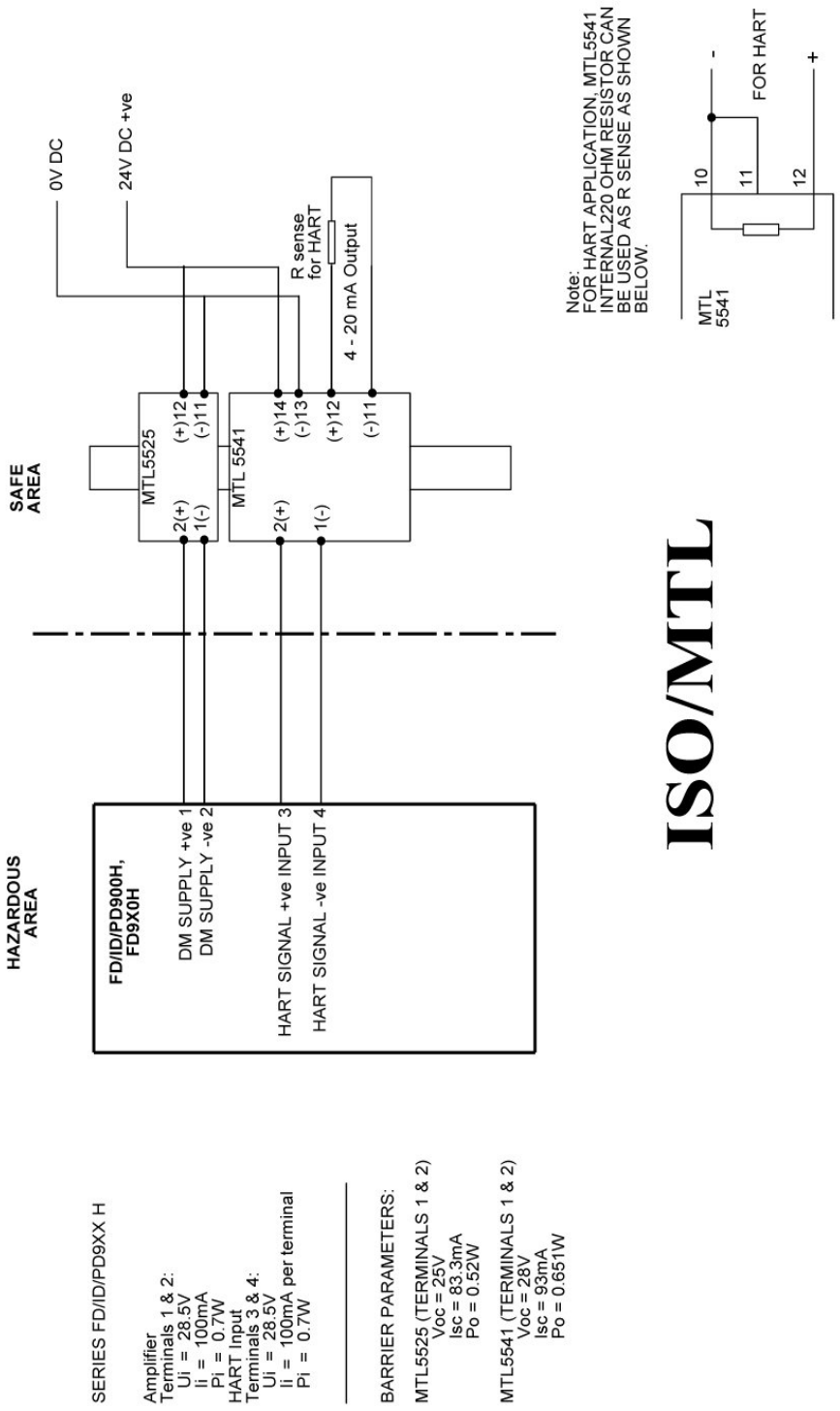


Figure C–12. AD_6502: Wiring diagrams, barrier & non-hazardous/safe area options for Sarasota density meters (sheet 9 of 9)

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Appendix D
Health & Safety Clearance Form

The Health & Safety (COSHH) Clearance form can be found on the following page. Failure to return this form may result in the meter being returned.

ThermoFisher SCIENTIFIC

12320 Cardinal Meadow Dr. Suite 150
Sugar Land, TX 77478 USA
Tel: 800-437-7979

HEALTH AND SAFETY (COSHH) CLEARANCE FORM

Failure to comply with this procedure will result in equipment service delays.

This form must be completed for *all* equipment returned to Thermo Fisher Scientific (Thermo Fisher) – Franklin, MA Depot Repair. Depot repair personnel are unable to handle any equipment that has been in contact with a process fluid or hazardous material if it is not accompanied by this correctly completed Health and Safety Clearance Form.

All sections of this form must be completed, and the form must arrive at Thermo Fisher prior to the arrival of the equipment. A copy of this form must also accompany the equipment.

Prior to returning any equipment for service, authorization must be obtained from customer service. A Return Material Authorization (RMA) number will be issued and must be entered in Section 1 of this form.

Section 1: Reference Details

RMA #: _____

Equipment type: _____

Serial #: _____

Section 2: Process Fluid Information

All substances in contact with the equipment must be declared.

Chemical names (list all): _____

_____

Precautions to be taken when handling these substances (list all): _____

_____

_____

Action to be taken in the event of human contact or spillage: _____

_____

Additional information you consider relevant: _____

_____

_____

Section 3: Shipping Information

Carrier details: _____

Tel:_____ / Fax: _____

Scheduled delivery date to Thermo Fisher: _____

Section 4: Declaration

Must be authorized ONLY if non-toxic or non-hazardous substances apply.

I hereby confirm that the equipment specified above *has not* come into contact with any toxic or hazardous substances.

Signed: _____

Name: _____

Position: _____

For/on behalf of: _____

Date: _____

Must be authorized if toxic or hazardous substances apply.

I hereby confirm that the only toxic or hazardous substances that the equipment specified has been in contact with are named in Section 2, that the information given is correct, and that the following actions have been taken:

1. The equipment has been drained and flushed.
2. The inlet/outlet ports have been sealed, and the equipment has been securely packed and labeled.
3. The carrier has been informed of the hazardous nature of the consignment and has received a copy of this completed form.

Signed: _____

Name: _____

Position: _____

For/on behalf of: _____

Date: _____

A copy of this completed form MUST BE HANDED TO THE CARRIER to accompany the equipment.

Appendix E
Toxic & Hazardous Substances Tables

The English and Chinese versions of the Toxic & Hazardous Substances tables for the density meters can be found on the following pages.

Toxic & Hazardous Substances Table – Sarasota Density FD910

For Chinese Regulation: Administrative Measure on the Control of Pollution Caused by Electronic Information Products

Names and Content of Toxic and Hazardous Substances or Elements

Parts Name	Toxic and Hazardous Substances or Elements (FD910)					
	Pb	Hg	Cd	Cr6+	PBB	PBDE
Junction Box	o	o	o	o	o	o
Amplifier Board	x	o	o	o	o	o
Connection Board	x	o	o	o	o	o
Frequency Board*	x	o	o	o	o	o
Head Mount Boards*	x	o	o	o	o	o
Terminal Board	x	o	o	o	o	o
Pipe Assembly	x	o	o	o	o	o
Cabling	o	o	o	o	o	o
RTR 900**	x	o	o	x	o	o

○: Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in **SJ/T11363-2006**

x: Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in **SJ/T11363-2006**

* Product will contain either "Head Mount Boards" or "Frequency Board"
** Product may contain an optional RTR900 subassembly

有毒有害物质名称及含量的标识格式

部件名称	有毒有害物质或元素 (FD910)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr6+)	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
接线盒	o	o	o	o	o	o
放大器电路板	x	o	o	o	o	o
连接电路板	x	o	o	o	o	o
频率电路板*	x	o	o	o	o	o
头安装电路板*	x	o	o	o	o	o
终端电路板	x	o	o	o	o	o
管组件	x	o	o	o	o	o
缆线连接	o	o	o	o	o	o
RTR 900**	x	o	o	x	o	o

○：表示该有毒有害物质在该部件所有均质材料中的含量均在**SJ/T 11363-2006**标准规定的限量要求以下
x: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出**SJ/T 11363-2006**标准规定的限量要求

* 产品将包括"设备头安装电路板"或"频率电路板"
**产品可能带有 RTR900 子组件选配件

Toxic & Hazardous Substances Table – Sarasota Density FD950

For Chinese Regulation: Administrative Measure on the Control of Pollution Caused by Electronic Information Products

Names and Content of Toxic and Hazardous Substances or Elements

Parts Name	Toxic and Hazardous Substances or Elements (FD950)					
	Pb	Hg	Cd	Cr6+	PBB	PBDE
Junction Box	o	o	o	o	o	o
Amplifier Board	x	o	o	o	o	o
Connection Board	x	o	o	o	o	o
Frequency Board*	x	o	o	o	o	o
Head Mount Boards*	x	o	o	o	o	o
Terminal Board	x	o	o	o	o	o
Pipe Assembly	x	o	o	o	o	o
Cabling	o	o	o	o	o	o
RTR 900**	x	o	o	x	o	o

○: Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in **SJ/T11363-2006**

x: Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in **SJ/T11363-2006**

* Product will contain either "Head Mount Boards" or "Frequency Board"
** Product may contain an optional RTR900 subassembly

有毒有害物质名称及含量的标识格式

部件名称	有毒有害物质或元素 (FD950)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr6+)	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
接线盒	o	o	o	o	o	o
放大器电路板	x	o	o	o	o	o
连接电路板	x	o	o	o	o	o
频率电路板*	x	o	o	o	o	o
头安装电路板*	x	o	o	o	o	o
终端电路板	x	o	o	o	o	o
管组件	x	o	o	o	o	o
缆线连接	o	o	o	o	o	o
RTR 900**	x	o	o	x	o	o

○：表示该有毒有害物质在该部件所有均质材料中的含量均在**SJ/T 11363-2006**标准规定的限量要求以下

x: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出**SJ/T 11363-2006**标准规定的限量要求

* 产品将包括“设备头安装电路板”或“频率电路板”
**产品可能带有 RTR900 子组件选配件

Toxic & Hazardous Substances Table – Sarasota Density FD960

For Chinese Regulation: Administrative Measure on the Control of Pollution Caused by Electronic Information Products

Names and Content of Toxic and Hazardous Substances or Elements

Parts Name	Toxic and Hazardous Substances or Elements (FD960)					
	Pb	Hg	Cd	Cr6+	PBB	PBDE
Junction Box	o	o	o	o	o	o
Amplifier Board	x	o	o	o	o	o
Connection Board	x	o	o	o	o	o
Frequency Board*	x	o	o	o	o	o
Head Mount Boards*	x	o	o	o	o	o
Terminal Board	x	o	o	o	o	o
Pipe Assembly	x	o	o	o	o	o
Cabling	o	o	o	o	o	o
RTR 900**	x	o	o	x	o	o

○: Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in **SJ/T11363-2006**

x: Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in **SJ/T11363-2006**

* Product will contain either "Head Mount Boards" or "Frequency Board"
** Product may contain an optional RTR900 subassembly

有毒有害物质名称及含量的标识格式

部件名称	有毒有害物质或元素 (FD960)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr6+)	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
接线盒	o	o	o	o	o	o
放大器电路板	x	o	o	o	o	o
连接电路板	x	o	o	o	o	o
频率电路板*	x	o	o	o	o	o
头安装电路板*	x	o	o	o	o	o
终端电路板	x	o	o	o	o	o
管组件	x	o	o	o	o	o
缆线连接	o	o	o	o	o	o
RTR 900**	x	o	o	x	o	o

○：表示该有毒有害物质在该部件所有均质材料中的含量均在**SJ/T 11363-2006**标准规定的限量要求以下

x: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出**SJ/T 11363-2006**标准规定的限量要求

* 产品将包括"设备头安装电路板"或"频率电路板"
**产品可能带有 RTR900 子组件选配件

Thermo Fisher Scientific
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P.O. Box 9046
Waltham, Massachusetts 02454-9046
United States

www.thermofisher.com