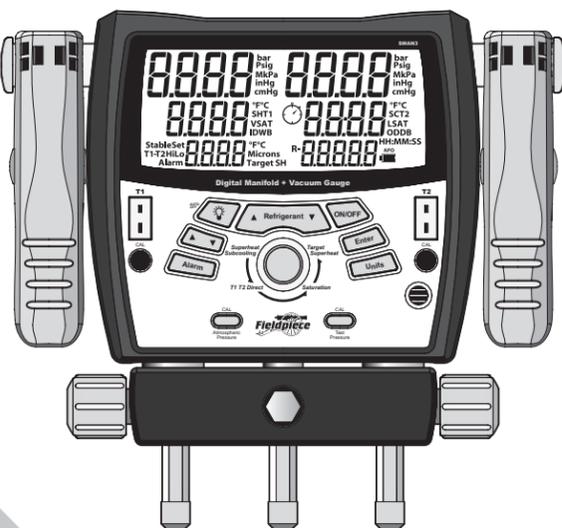


# Fieldpiece

## Digital Manifold & Vacuum Gauge

### OPERATOR'S MANUAL

Models SMAN2 SMAN3



## Quick Start

- 1 Power on your SMAN by holding the ON/OFF button for 1 second.
- 2 Select desired units (English or Metric) by pressing the UNITS button (SMAN3) or holding the ENTER button for 1 second (SMAN2).
- 3 Connect hoses and pipe clamps to the system.
- 4 Press the circular button to select between Actual Superheat and Subcooling, Target Superheat, Direct Temperature Display (T1 T2 Direct) or Saturation Temperature Display.

## Certifications



C-Tick (N22675)



CE

RoHS Compliant

## Description

Your SMAN is the portable digital refrigerant manifold and vacuum gauge (SMAN3) for A/C and refrigeration professionals. Your SMAN combines high pressure manifold gauges, a superheat/subcooling calculator, micron gauge for vacuum (SMAN3), and dual temperature measurements into one easy-to-use instrument. Your SMAN calculates and displays target superheat and actual superheat to ensure proper charging of a unit. Your SMAN can also display the liquid and vapor saturation temperatures in Saturation mode to help you trouble shoot your system.

Your SMAN is designed to meet the demands of the HVAC/R professional with a ruggedized rubber boot for durability, a strong metal hanger for easy storage and a high quality, water resistant nylon pouch. A bright blue backlight and very large, easily viewable display lets you see your measurements in any work environment. SMAN has a very intuitive user interface and extremely long battery life.

Your SMAN comes pre-programmed with the most accurate P-T charts for 44 of the most common refrigerants in the field so you are always prepared for any job.



bar	Pressure (bar)
Psig	Pressure (pounds/in <sup>2</sup> )
MkPa	Pressure (kilopascals or Megapascals)
inHg	Negative Pressure (inches of mercury)
cmHg	Negative Pressure (cm of mercury)



SH	Superheat	T1	T1 Direct
VSAT	Vapor Saturation Temperature		
IDWB	Indoor Wet Bulb		



Stable:	Micron Reading Has Stabilized		
Set	Set Mode	Alarm	Alarm Mode
Hi	High Alarm	Lo	Low Alarm
Microns	Vacuum (Microns of Mercury)		
T1-T2	T1 thermocouple - T2 thermocouple		
Target SH	Target Superheat		



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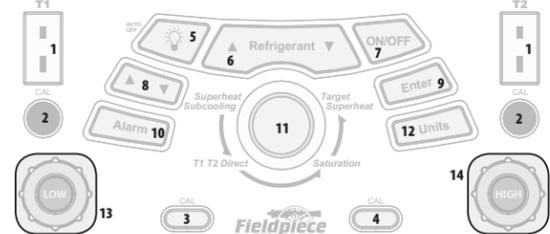


SC	Subcooling	T2	T2 Direct
LSAT	Liquid Saturation Temperature		
ODDB	Outdoor Dry Bulb		
	Vacuum Stopwatch		
HH:MM:SS	Hours:Minutes or Minutes:Seconds		



Battery Life	
AP0	Auto Power Off Enabled
R-	Selected Refrigerant of System

## Controls



- 1 Insert K-type thermocouple plugs here.
- 2 Temperature calibration pots.
- 3 Press to zero atmospheric pressure.
- 4 Press to linear adjust pressure curve. (See Advanced Pressure Calibration section.)
- 5 Press to engage backlight. Hold when powering on to toggle Auto Power Off.
- 6 Press/hold to cycle through refrigerants.
- 7 Hold 1 second to toggle power on/off.
- 8 Press up or down arrow to adjust values.
- 9 Press to confirm selection. For the SMAN2, hold 1 second to adjust units.
- 10 Press to turn on/off the Hi/Lo vacuum alarms and hold to change alarm settings.
- 11 Press to toggle through temperature tests.
- 12 Press to adjust units. (SMAN3)
- 13 Turn clockwise to close Low side port.
- 14 Turn clockwise to close High side port.

## Functions

### Standard Pressure

- 1 Connect your SMAN to the system using EPA approved 1/4in refrigerant hoses.
- 2 Read pressures directly from the upper display.

### Superheat and Subcooling

- 1 Press circular button to cycle through temperature modes until SH and SC are shown. The SMAN can show superheat and subcooling simultaneously.
- 2 Choose the appropriate refrigerant using the REFRIGERANT button.
- 3 Connect the K-type thermocouple and EPA approved refrigerant hoses to your SMAN.
- 4 Connect your SMAN to the system:  
**Superheat:** Hand tighten low side hose to suction line service port. Place the thermocouple on the suction line between the evaporator and compressor, no closer than 6 inches to compressor.  
**Subcooling:** Hand tighten high side hose to liquid line service port. Attach the thermocouple on the liquid line between the condenser and expansion valve (TXV), as close to the service port as possible.
- 5 After turning the system on or making any adjustments to the system wait 15 minutes before charging by superheat or subcooling to ensure that the system is stable and running normally. Add or remove refrigerant using the low and high side valves as needed. Let system stabilize again for 15 minutes.

### Saturation

Shows vapor (VSAT) and liquid (LSAT) saturation temperatures calculated from the pressures measured and the refrigerant selected.

### T1 T2 Direct

- 1 Press circular button until T1 and T2 are shown.
- 2 Plug in any K-type thermocouple into T1 and/or T2.
- 3 Read the temperature directly from the display.
- 4 T1-T2 is displayed in the lower left corner of the display.

### Target Superheat

Target Superheat is only used for charging fixed orifice air conditioning systems. Your SMAN allows you to input indoor wet bulb (IDWB) and outdoor dry bulb (ODDB) temperatures manually, in real-time using K-type thermocouples, or a combination of both to calculate the Target Superheat. Your SMAN will detect if a thermocouple is plugged in or not. Unplugging the thermocouple lead(s), at any time, sends the SMAN into manual input mode and plugging them in, at any time, automatically sends the SMAN to input directly from the thermocouples.

#### Input temperatures with K-type thermocouples

- 1 Press circular button until Target SH is shown in the bottom, center of display.
- 2 Plug ATWB1 Wet bulb K-type thermocouple into T1 and ATA1 Dry bulb K-type thermocouple into T2.
- 3 Press ENTER. The IDWB will display the real-time temperature measured from T1. Use the ARROW button to select the temperature you want to input first, either IDWB or ODDB.
- 4 For IDWB input, wet the sock of the ATWB1. Clip it to the return of the evaporator between the filter and coil. When the wet bulb temperature reaches its lowest point and stabilizes, press ENTER to lock the reading. If the inputted temperature is below the wet bulb range, "-OL" will blink. If the inputted temperature is above the wet bulb range, "OL" will blink. Retake the measurement if "OL" or "-OL" is displayed.

- 5 For ODDB input, clip the ATA1 thermocouple to the side of the condenser. Once reading is stable, press ENTER. If the inputted temperature is below the dry bulb range, "-OL" will blink. If the inputted temperature is above the dry bulb range, "OL" will blink. Re-take the measurement if "OL" or "-OL" is displayed. For accurate results, keep the ATA1 shaded from direct sunlight.
- 6 Once both IDWB and ODDB are locked in, the Target Superheat will show in the lower left corner of the display. If the Target Superheat calculated from the IDWB and ODDB temperatures is outside the range in which air conditioning is recommended then "OL" is displayed. Usually, raising the indoor temperature will bring the conditions within manufacturer's recommendations. If your target superheat is out of the recommended range, press ENTER to re-take both your measurements.
- 7 To re-take either IDWB or ODDB, press the ARROW button until the label (IDWB or ODDB) you wish to re-take is blinking. Press ENTER. Re-do the measurement and press ENTER to lock it in. The newly calculated target superheat will be displayed.
- 8 To clear both IDWB and ODDB simultaneously, press ENTER.

#### Input temperatures manually

- 1 Press circular button until Target SH is shown at the bottom, center of display. Unplug thermocouples from T1 and/or T2.
- 2 Press ARROW button to select a blinking IDWB or ODDB. Press ENTER to make a selection. Use the ARROW button to change blinking digit and press ENTER to lock in each digit. Once the last digit for ODDB or IDWB is locked in, the calculated target superheat will show in the lower left corner of the display. Note: When pressing ENTER to lock in the last digit for IDWB or ODDB, if the inputted temperature is below the wet bulb or dry bulb range, "-OL" will flash once. If the inputted temperature is above the wet bulb or dry bulb range, "OL" will flash once. In both instances you must re-input the measurement.
- 3 See steps 6-8 above.

### Pulling a Vacuum (model SMAN3)

Follow all manufacturers' evacuation procedures over those in this manual.

Note: larger systems may take much longer to reach a deep vacuum and a different evacuation method or equipment might be preferred.

- 1 Connect your SMAN3 in between your vacuum pump and the system, then power on your SMAN3.
- 2 Draw a vacuum on the system. The SMAN will automatically sense the negative pressure and display the vacuum in microns.
- 3 Press Alarm button to toggle between the High (Hi) alarm, the Low (Lo) alarm and no alarm. No Display of Lo or Hi means alarm is off. Note: The stopwatch will start when an alarm is selected. Pressing Alarm will reset the stopwatch.
- 4 When the rate of change in pressure is less than 1 micron per 10 seconds, Stable will appear in the lower left corner of the display.

#### Additional Tips:

- To achieve a deep vacuum as quickly as possible:
- 1 Use the shortest hoses with the largest diameter available.
  - 2 Remove Schrader cores and core depressors. Core removal tools like the "MegaFlow Valve Core Removal Tool" can be purchased to help with this process.
  - 3 Inspect the rubber seals at both ends of your hoses for damage that may result in leakage.
  - 4 Do not use hoses with low loss fittings when evacuating or pulling a vacuum on a system.

### Set Vacuum Alarms (SMAN3)

- 1 Hold the ALARM button for one second to enter Alarm Set mode.
- 2 Press the ALARM button to toggle between Alarm Hi and Lo.
- 3 Use ARROW button to select the value and press ENTER to lock in each digit. Once last digit in Alarm Lo is locked, your SMAN will automatically revert to normal testing mode.

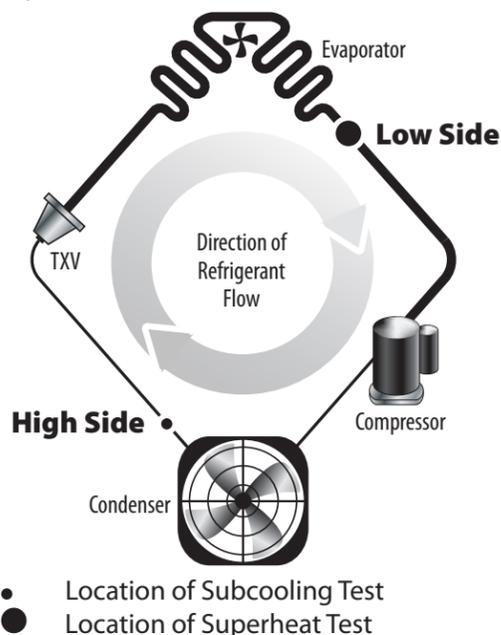
## What is Superheat and Subcooling? Why Do I Need to Measure It?

Superheat is the difference between the actual temperature of the refrigerant (gas) as it leaves the evaporator and the boiling point of the refrigerant. After boiling, the refrigerant continues to heat up. The number of degrees it "heats up" after boiling is called the superheat. Under worst case conditions (low load for fixed orifice systems), the refrigerant in the evaporator boils off near the end of the evaporator coil. To make sure liquid doesn't enter the compressor under the worst case condition (low load), the refrigerator or A/C manufacturers publish charts indicating what the superheat should be at a given indoor wet bulb measurement and outdoor air temperature.

Measuring superheat is your best indication on a fixed orifice system of the proper refrigerant charge and operating conditions. If everything else is working properly and the actual superheat is too high, add refrigerant. If it's too low, evacuate refrigerant.

Subcooling is the difference between the boiling point of the refrigerant in the condenser and the actual temperature of the refrigerant

as it leaves the condenser. The degrees that the refrigerant "cools down" below the boiling point is the subcooling. Under worst case scenario (low load for TXV) the subcooling will continue to rise. If the subcooling rises too high, liquid may be backed into the compressor causing damage and catastrophic failure. See [www.fieldpiece.com](http://www.fieldpiece.com) for more technical articles.



## Specifications

**Display size:** 5 inches (diagonal)  
**Backlight:** Blue (On for 1 minute unless turned off manually)  
**Battery:** 6 x AA (Battery life below based on alkaline type)  
**Battery life (SMAN2):** Approx. 500 hours (without backlight)  
**Battery life (SMAN3):** Approx. 135 hours (without backlight)  
**Low battery indication:** is displayed when the battery voltage drops below the operating level  
**Auto Shut off:** 30 minutes of inactivity when APO is activated  
**Operating environment:** 32°F to 122°F (0°C to 50°C) at <75% relative humidity  
**Storage temperature:** -4°F to 140°F (-20°C to 60°C), 0 to 80% RH (with battery removed)  
**Temperature coefficient:** 0.1 x (specified accuracy) per °C (0°C to 18°C, 28°C to 50°C), per 0.6°F (32°F to 64°F, 82°F to 122°F)  
**Over range:** "OL" or "-OL" is displayed  
**Weight:** 3.05 lbs (1.38 kg)

## Pressure

**Connector Type:** Standard 1/4 NPT male flare fitting  
**Range:** 29" HgV to 580 Psig (English), 74 cmHgV to 0 to 4000KPa (Metric)  
**Resolution:** 0.1 psi/inHg; 1 kPa/cmHg  
**Accuracy:** 29" HgV to 0" HgV: ±0.2" HgV  
 74 cmHgV to 0 cmHgV: ±1 cmHgV  
 0 to 200 Psig: ±1 Psi; 0 to 1378 KPa: ±7 KPa; 0 to 1.378MPa: ±0.007MPa; 0 to 13.78 bar ±0.07 bar  
 200 to 580 Psig: ±0.3%+1 Psi; 1378 to 4000KPa: ±0.3%+7 Kpa; 1.378 to 4.000MPa: ±0.3%+0.007MPa; 13.78 to 40.00bar: ±0.3%+0.07bar  
**Maximum overload pressure:** 800 psig  
**Units:** Psig, kPa, MPa, bar, inHg, and cmHg

## Microns for Vacuum (SMAN3 only)

**Connector Type:** Standard 1/4 NPT male flare fitting  
**Range:** 50 to 9999 microns of mercury  
**Resolution:** 1 micron (50 to 2000 microns), 250 microns (2001 to 5000 microns), 500 microns (5001 to 8000 microns), 1000 microns (8001 to 9999 microns)  
**Accuracy:** ±10% or ±10 microns, whichever is greater (50 to 1000 microns)  
**Maximum Overload pressure:** 500 psig  
**Units:** Microns of mercury  
**Temperature**  
**Sensor type:** K-Type thermocouple  
**Range:** -95°F to 999.9°F (-70°C to 537.0°C)  
**Resolution:** 0.1°F/°C  
**Accuracy:** ±(1.0°F) -95°F to 199.9°F; ±(0.5°C) -70°C to 93°C ±(2.0°F) 200°F to 999.9°F; ±(1.0°C) 93°C to 537.0°C  
 Note: All accuracies are after a field calibration.

## Refrigerants

The P-T charts of the following refrigerants come pre-programmed into your SMAN. In your SMAN the refrigerants are listed in order of most commonly used. Here, they are listed in numerical order for easy reference.

R11, R113, R114, R12, R123, R1234YF, R124, R125, R13, R134A, R22, R23, R401A(MP39), R401B, R402A, R402B, R404A, R406A, R407A, R407C, R407F, R408A, R409A, R410A, R414B (Hotshot), R416A, R417A, R417C (HOT SHOT 2), R420A, R421A, R421B, R422A, R422B (NU22B), R422C (Oneshot), R422D, R424A, R427A, R434A (RS-45), R438A (MO99), R500, R502, R503, R507A, R508B (Suva95)

## Maintenance

Clean the exterior with a dry cloth. Do not use liquid.

## Battery Replacement

The battery must be replaced when the battery life indicator is empty. Turn your SMAN off and replace with 6 AA batteries.

## Cleaning the Sensors (SMAN3)

Over time, the vacuum sensor of the SMAN3 may become contaminated with dirt, oil, and other contaminants introduced from pulling vacuums.

- 1 **Never** use an object such as a cotton swab to clean the sensor, you may cause damage to the sensor.
- 2 Open all knobs/valves, and cap all the ports except for the center port.
- 3 Drop enough Isopropyl (rubbing) alcohol into the uncapped port using an eye dropper or funnel so that it can flush out contaminants.
- 4 Cap central port and gently shake your SMAN upside down to clean sensor.
- 5 Turn right side up. Open a port to pour out the rubbing alcohol and open all ports to allow sensors to dry out; usually an hour or so.

## Calibration Temperature

To calibrate your SMAN temperature thermocouples, adjust the pot on the front of the meter labeled T1 Cal or T2 Cal. The best way to calibrate is to match to a known temperature. Ice water is very close to 32°F and is readily available. Accuracies of one degree or better are easily obtained.

- 1 Stabilize a large cup of ice water by stirring. Pure, distilled water will be the most accurate.
- 2 Press the circular button until your SMAN enters Direct Temperature (T1 T2) mode.
- 3 Immerse the temp probe in ice water from T1 and adjust the T1 Cal pot with a flathead screwdriver and let it stabilize, keep stirring.
- 4 Repeat Step 3 for temp probe in T2.

## Pressure Zeroing

To calibrate your SMAN pressure sensors to atmospheric pressure, ensure that your SMAN is disconnected from any pressure source and at equilibrium with the ambient pressure.

- 1 SMAN must be in Superheat/Subcooling, Saturation, or T1 T2 Direct mode.
- 2 Press the CAL Atmospheric Pressure button and your SMAN will set the zero point of pressure to the ambient pressure.

## Advanced Pressure Calibration

Your SMAN has the ability to perform a linear adjustment of the pressure sensors based on refrigerant type, temperature, and pressure.

**Calibration setup:** For best results, perform both the Temperature and Pressure Zeroing procedures. See Calibration section for details. This will ensure pressure readings are zeroed and thermocouple is properly calibrated to the T1 port of the SMAN. Calibration to T2 port is not necessary for this calibration. The refrigerant cylinder should be stored in a stable ambient environment for at least 24 hours before calibration.

- 1 Press circular button until your SMAN enters T1 T2 Direct mode.
- 2 Plug in a K-type thermocouple into T1. (A bead type thermocouple, like the ATB1, is recommended.)
- 3 Connect the SMAN to a refrigerant cylinder of a known, single refrigerant using an EPA approved service hose. Be sure to open both HIGH and LOW side valves on your manifold and cap the unused ports. (If caps are not available you can connect both ends of a refrigerant hose to the two unused caps. Note you will lose some refrigerant into the hose using this method.)
- 4 Press the REFRIGERANT button to match the refrigerant of the cylinder you are using.
- 5 Attach bead-type thermocouple to the side of the cylinder using tape. It is recommended to attach in the middle of the cylinder. Important: Let the temperature of the thermocouple stabilize to the refrigerant temperature for 1 to 2 minutes or until stable.
- 6 Open the refrigerant cylinder. The pressure inside cylinder should now be displayed on both HIGH and LOW side pressure sensors.
- 7 Press the CAL Test Pressure button. If successful, "Good" will display for 3 seconds. If failed, "Err" will display for same time.

Your SMAN checks with its built-in P-T charts to compare the temperature of the refrigerant in the tank to the vapor saturation temperature based on the refrigerant you selected. If the measured pressures on your SMAN are within ±3psi of the P-T chart pressure corresponding to the vapor saturation temperature, the SMAN will adjust the pressure sensor linearity to match the P-T chart.

### Possible causes of failed "Err" pressure calibration:

1. Refrigerant tank was not stored in stable ambient conditions for at least 24 hours.
2. Thermocouple attached to refrigerant tank was not properly calibrated to T1 port of SMAN.
3. Thermocouple was plugged into wrong port T2 instead of T1.
4. Incorrect refrigerant was selected on the SMAN.

## WARNINGS

DO NOT APPLY MORE THAN 800 PSI TO ANY PORT ON THE MANIFOLD.

FOLLOW ALL EQUIPMENT MANUFACTURER'S TESTING PROCEDURES ABOVE THOSE IN THIS MANUAL IN REGARDS TO PROPERLY SERVICING THEIR EQUIPMENT.

## Limited Warranty

This meter is warranted against defects in material or workmanship for one year from date of purchase. Fieldpiece will replace or repair the defective unit, at its option, subject to verification of the defect.

This warranty does not apply to defects resulting from abuse, neglect, accident, unauthorized repair, alteration, or unreasonable use of the instrument.

Any implied warranties arising from the sale of a Fieldpiece product, including but not limited to implied warranties of merchantability and fitness for a particular purpose, are limited to the above. Fieldpiece shall not be liable for loss of use of the instrument or other incidental or consequential damages, expenses, or economic loss, or for any claim of such damage, expenses, or economic loss.

State laws vary. The above limitations or exclusions may not apply to you.

## Obtaining Service

Call Fieldpiece Instruments for current costs on our fixed price warranty service. Send check or money order for the amount quoted. Send your digital manifold, freight prepaid, to Fieldpiece Instruments. Send proof of date and location of purchase for in-warranty service. The meter will be repaired or replaced, at the option of Fieldpiece, and returned via least cost transportation.

For international customers, warranty for products purchased outside of the U.S. should be handled through local distributors.

**Fieldpiece**  
 Designed in USA  
MADE IN TAIWAN

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