VISHAY INTERTECHNOLOGY, INC.

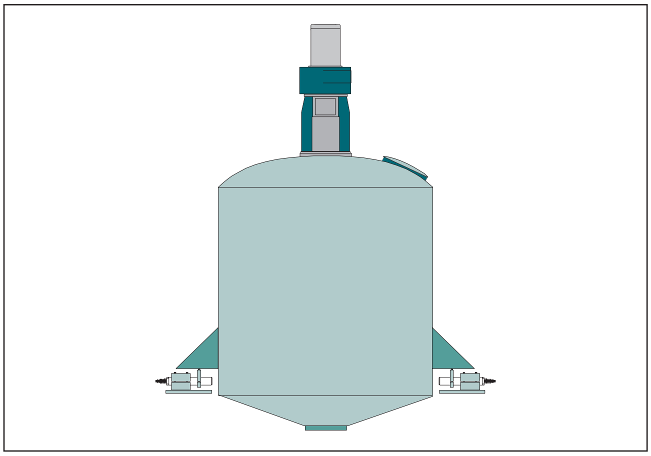
Vishay Systems

Handbook TC0008

Servicing and Troubleshooting Process and Inventory Weighing Systems

Section I – Introduction

This handbook provides guidelines for servicing process and inventory type electronic weigh systems using Vishay equipment. Those systems include tanks, hoppers, reactors, mixers, silos and other vessels supported on multiple load cells. While portions of the procedures may be applicable to other system types, there is no intentional effort to provide procedures for custody transfer scales etc. Also, the procedures assume the use of Vishay BLH weighing system equipment and Vishay BLH calibration and service tools.The procedures and guidelines presented are the most common and reliable known at the time of publication. There is no guarantee that all potential procedures are included or that system technologies and therefore servicing methods will not change over time.Subjects covered in this publication include: system start-up, calibration, mechanical troubleshooting, electrical troubleshooting, and maintenance procedures.



Section II – Mechanical Inspection

In order to measure properly, a load cell or weigh module must be free to deflect in the range of .008 to .10 inches without binding (Figure 1). Therefore, the most basic mechanical inspection should include careful evaluation of through-floor mountings, connected piping, conduits, and vertical vent lines. Also, weigh modules are designed to accommodate vessel thermal expansion and contraction without applying axial or side loads to the measurement element. Therefore, all yokes or slide plates should be in a non-binding orientation at operating temperatures.

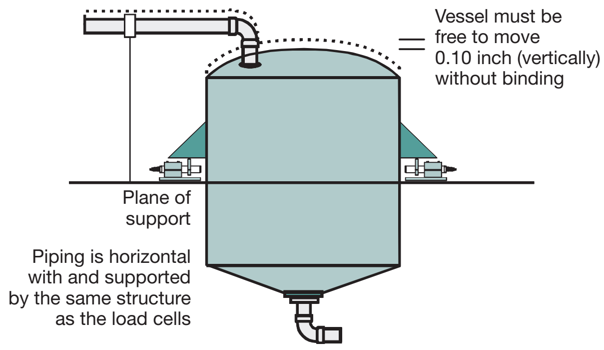


Figure 1. Vertical deflection allowance.

1) Examine orientation of weigh modules and make sure they are arranged under the vessel according to the installation manual. If the modules are oriented 90 degrees out of phase, they will have to be rotated in order to accommodate thermal expansion and contraction properly (Figure 2).
2) Inspect the location of the expansion yoke or slide plate on the weigh module and verify that it will not bind against the built-in motion stops when the vessel is at operating temperature. As a rule-of-thumb, a steel vessel will expand 6.5 × 10 E-6 in/in/F.
3) On weigh modules with cylindrical beam transducers,

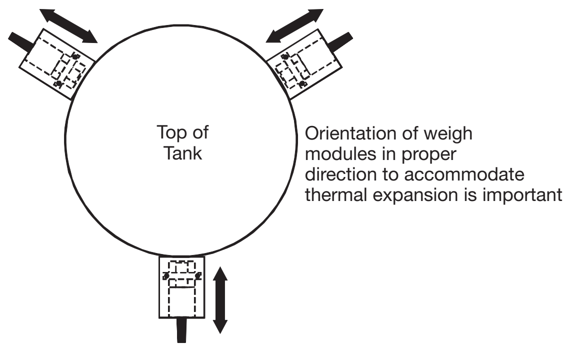


Figure 2. Weigh module orientation.

HANDBOOK

Servicing and Troubleshooting Process and Inventory Weighing Systems

(KIS, KDH-3) verify that the force arrow is pointing downward as close to plumb as possible.

4) Inspect all connected piping making sure that:
   a) All connections are horizontal, wherever possible (avoid vertical piping);
   b) All pipe support points are located as far as possible away from the vessel;
   c) All flexible connections are properly aligned;
   d) All piping supports are attached to the same building structure that the vessel is supported on.
5) Verify that the vessel attachment lug or plate is level within ½ degree (Figure 3).

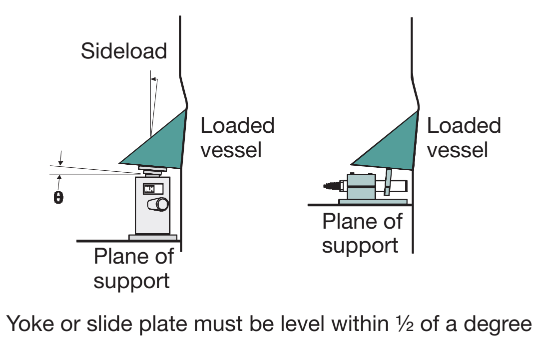


Figure 3. Vessel attachment must be level.

Electrical Inspection

For maximum physical protection and to minimize the potential effect of RFI/EMI, all load cell cables should be routed in metallic conduit away from AC powered equipment and/or motor starters and relays. Despite past warnings, it is OK to cut excess length off load cell cables on systems that will eventually be calibrated in place.

1) Inspect all load cell cable conduits for proper routing away from sources of EMI/RFI. In moist environments, make sure there is a conduit drain located at the lowest point in the run (Figure 4). It is often times recommended that a short run of flexible conduit be used adjacent to the load cell to allow for adjustment or replacement of the load cell.
2) Open and inspect the summing unit for proper wiring terminations. Make sure that remote sense lines are in use on the cable that extends to the remote indicator (if used). For thorough RFI/EMI protection, replace rubber plugs in unused conduit openings with steel conduit fittings.

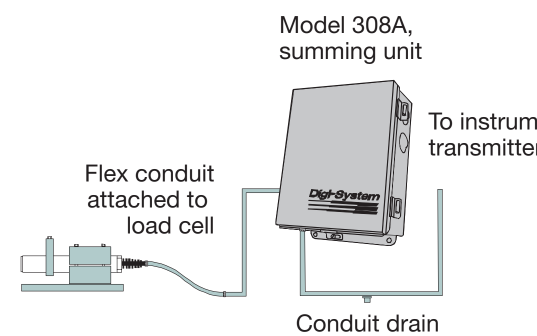


Figure 4. Conduit considerations.

3) On Div. 1 hazardous area systems open the I.S. Barrier box and verify the proper connection of all conductors. The shield wire from the summing junction box must be connected to the I.S. barrier box ground bus bar. The shield wire from the instrument, however, should not be connected to the barrier box ground bar, but to the instrument ground connection.
4) At the back of the instrument/indicator verify that the voltage selection is correct for the power applied. If the instrument is equipped with remote digital inputs that are used for remote control of gross/net, tare, and zero functions, make sure that only non-powered switch contacts are connected to the input. Verify polarity and connection of various options such as analog and serial outputs, and set points. Apply power.

Hook-up of Test Equipment

1) (FSk-40) Disconnect the signal and excitation wires for each load cell in the 306, 308A or built-in summing junction box (DXp units). Using the FSk-40 wiring harness, connect each set of load cell connectors to the harness using the spring loaded connector block (Figure 5). Plug the other end of the cable harnesses into the FSk-40 terminal blocks.
2) (325) Connect the 325 wiring harness to one of the load cell terminal blocks in the 306, 308A, or built-in summing unit. Connect the other end of the harness to the 325 terminal posts.

Basic Electrical Measurements

1) With the FSk-40 powered, and after the reset button has been pressed, put the unit in "shim" mode. Activate the individual measurement mode, mV/V units, and observe the actual mV/V signal from each load cell.

Servicing and Troubleshooting Process and Inventory Weighing Systems

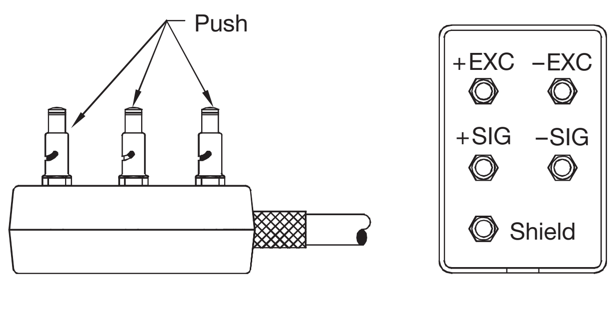


Figure 5. Load cell to FSk-40 connection.

a) Each measurement should be approximately equal to the signal that corresponds to the weight at that point of the vessel and attached equipment. To calculate the approximate value:

value = deadload/(# of load cells × load cell capacity) × mV/V rating of load cell

b) Check to verify that the average of all four readings equates approximately to the known deadweight signal of the vessel and attached equipment. To calculate what the average value should be, add the signal values from each channel (load cell) and divide by the number of channels: value (4 cell system) = (C1+C2+C3+C4)/4.

c) If the measurements seem to be correct, move on to the shimming procedures. If the measurements are in error, refer to load cell troubleshooting in Section IV.

Shimming

It is important that each load cell under a vessel receive an approximately equal distribution of load (Figure 6).

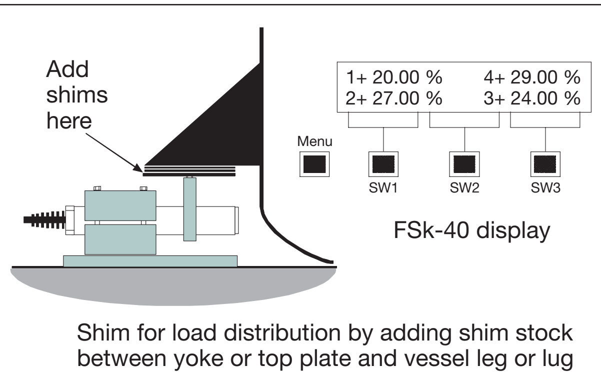


Figure 6. Load cell shimming.

This is necessary to ensure that one or some of the load cells do not become overloaded because they are exposed to an unequal share of load. Also, achieving proper load distribution will also demonstrate a stable structural design that will not create measurement problems when loaded and will partially prove that there will be minimal piping effects. Generally speaking, a three-point support will tend to be naturally balanced because three points define a horizontal plain. Systems using four or more supports will tend to require some degree of mechanical shimming to achieve balance.

1) With the FSk-40 in the shim mode, activate the individual channel readings in percentage of load. If the reading values between the lowest and the highest in a 3-point system are no greater than 30% to 36%, or 4-point system are no more than 22.5% to 27.5%, shimming will not be required. If the difference is greater, then it will be necessary to mechanically apply a greater portion of weight to the lowest point (s).
2) To re-distribute the load, it is usually easiest to install shim materials between the load cell top plate or yoke and the bottom of the vessel support plate. To do this it is necessary to jack-up the vessel a slight amount, loosen the attachment bolts and insert shim material. The amount of material thickness required will be dependent upon how large the vessel is, etc., but as a general rule, it will be on the order of a few thousandths to a few tenths of an inch.
3) After installing the shim material, lower the vessel and observe the new weight distribution. Re-shim as required to achieve the desired balance.
4) If it becomes difficult or impossible to achieve the desired balance, it may be an indication of a severe piping attachment problem. See Section IV on troubleshooting.
5) Hanging vessels obviously do not have mounting plates to apply shim material. To adjust for balance, threaded tension rod-type adjustments must be provided.

Instrument Set-Up

These procedures are not intended as a substitute for set-up per the instruction manual included with the instrument. However, the procedures do provide a general guideline to connect the calibrator and prove-out cabling, etc. If the summing unit is a model 308A, you should see a slight shift in measured output in the range of 2% to 4% depending upon the number of, and input resistance of, the connected load cells. This is caused by the addition of a guard circuit in the 308A that minimizes the adverse effects of contamination on the board surface. The Model

Servicing and Troubleshooting
Process and Inventory Weighing Systems

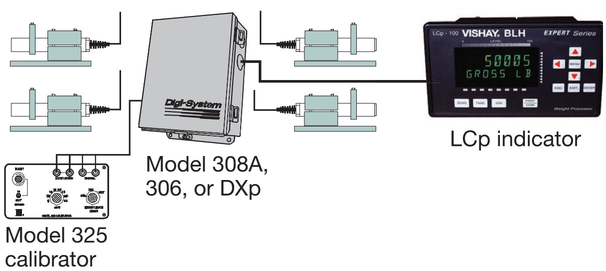


Figure 7. Model 325 calibrator connection.

306 summing units do not use guard circuit resistors and should not cause an output shift.

1) With the 325 calibrator connected to the instrument via the 306, 308A, or built in summing unit (Figure 7), adjust the calibrator to zero. With the indicator or transmitter in the mV/V display mode (instrument must have mV/V cal feature), the displayed value should be zero.

Note: DXp-10/15 units are not equipped with a display or mV/V output (although A-B RIO units do have a mV/V output) and cannot be subjected to this initial test.

2) Adjust the 325 calibrator to 1.0 mV/V. The displayed transmitter mV/V value should be 1.0 mV/V. Repeat for 2.0 and 3.0 mV/V settings.
3) Deviations .01% of reading will be an indication of a wiring or equipment problem.

Section III – Calibration

Much energy has been allocated to defining calibration methods and procedures. This chapter simply points to existing publications and documents that already provide extensive calibration technique information. To obtain a copy of any publication noted in this handbook, contact the Vishay BLH Field Service department at (781) 298-2216.

1) Available methods: request document title FSD001 Version 2.0 for a complete discussion of calibration options.
2) Procedures: both the instrumentation device operations manual, and document title FSD 001 Version 2.0 offer an overview of procedures for various calibrations.
3) Summary of available methods (Table 1).

Table 1. Summary of calibration options.

				Applicable Vessels		Equipment Required					
Relative Difficulty*	Type	Accuracy	Model Structure	Silo	Mixer/ Blender	DVM	mV Source	mV/V Calibrator	Dead Weights	Load Cell Cal. Data	Special Equipment
Electronic Methods											
1	Push-button PROM	0.05 to 0.5%	No	Yes	Marginal	No	No	No	No	Yes	No
2	mV simulation	0.25 to 1.0%	No	Yes	Marginal	Yes	Yes	No	No	Yes	No
3	mV/V simulation	0.10 to 1.0%	No	Yes	Marginal	No	No	Yes	No	Yes	No
Physical Methods											
4	Partial dead weight	0.5 to 2.0%	Yes	Yes	Yes	No	No	No	Yes	No	No
5	Flow	0.25 to 1.0%	Yes	Yes	Yes	No	No	No	No	No	Yes
6	Applied force	0.25 to 1.0%	Yes	Yes	Yes	No	No	No	No	No	Yes
7	Full build-up	0.05 to 0.2%	Yes	Yes	Yes	No	No	No	Yes	No	No
8	Full dead weight	0.02 to 0.1%	Yes	Yes	Yes	No	No	No	Yes	No	Yes

Servicing and Troubleshooting
Process and Inventory Weighing Systems

Section IV – Troubleshooting

Load Cell Electrical Problems

1) **A zero shift** (non-loaded electrical output) is an indication of an overloaded load cell. An overloaded load cell with a zero shift of 20% rated capacity is generally not repairable and should be replaced with a new unit after the cause of the overload is determined and corrected.
2) **A drifting output**, either loaded or unloaded, is an indication of electrical leakage either internally, in the cable, or in the summing unit. A common cause of electrical leakage is moisture contamination in a humidor wet location. Moisture contamination can be accelerated when cables are damaged and act as a wick to bring moisture into the load cell. The factory load cell repair facility can usually dry out and recondition load cells with moisture-related problems. To test for electrical leakage, measure resistance between any one of the excitation or signal lead and case ground. The resistance value should be a minimum of 2000 megohms using a megohm meter that applies less that 20 volts. (Note: use clips to attach leads, not your fingers which will cause inaccurate measurements.)
3) **Negative voltage output** can be caused by the transducer being loaded in the opposite direction from intended. Transducers marked with a force arrow should always be oriented towards the direction of applied force. For example, a typical tank weighing application would have the load beam transducer arrows pointed directly downward.
4) **No output** (when proper excitation and some load is applied) is an indication that the circuit inside the load cell has opened. Causes can be welding currents, lightning, or less commonly, fatigue caused by excessive cycling or vibration. In some cases the factory repair department can rebuild the load cell. This type of problem is not repairable in the field. In addition to measuring the mV output to detect the problem, it is also possible to check the input and output circuit resistance. Most load cells have input and output resistance values of 350 or 700 ohms ± a small tolerance. Measure resistance using a conventional ohm meter across both of the excitation leads, and then across the signal leads. In both cases the value should not deviate from the specification by more than approximately 1 ohm.
5) Using the FSk-40 display, **an overload display** in the shim mode will be an indication that the output of the load cell exceeds the input range of the instrument (which is set at 3.5 mV/V). Overload or overrange is an indication that the load cell has been subjected to a force substantially greater than it's rating and the element has experienced plastic deformation. This type of failure is generally not repairable. A secondary test to verify load cell overload is to measure the mV/V output using the FSk-40 or a DVM at zero load. If the output exceeds the zero balance specification, the load cell has probably been overloaded.
6) **Long-term drift** (output or display cycling over a several-hour period) can be detected using the drift function in the FSk-40. This function will identify the magnitude of the drift as well as the load cell (s) channel (s) that is problematic. Causes of long-term drift can be electrical leakage within a load cell (see procedure 2) or changing structural interaction. To identify potential structural problems, review connected piping or conduits adjacent to the load cell (s) that the FSk-40 determines are drifting. All pipe supports should be anchored to the same structure as the load cells as opposed to perhaps a roof system. If there are no obvious deficiencies in that area, it may be necessary to begin disconnecting pipes one at a time until the problem disappears. Refer to the new Weigh Systems Handbook (HDBK 002) for additional guidance related to structural design.
7) **Non-repeatability problems** can be caused by mechanical interference or excessively stiff connected piping. To quickly identify the location of the problem using the multi-channel FSk-40 display, record weight data on each channel throughout a range of applied weight both ascending and descending. Data reduction, (plotting) should show a channel (s) that does not perform well compared to others. The mechanical problem is likely to be adjacent to the measurement point showing poor performance.

Instruments and Communication

Most problems with the indicator/transmitter portion of the system will be related to either improper wiring and/or improper configuration.

1) **Drifting display** or outputs are usually caused by mechanical (load cell) or wiring problems. In order to properly diagnose a noisy or erratic display/output it is important to separate the load cell and summing portion of the system from the indicator or transmitter, and to connect the 325 calibrator directly to the indicator/transmitter (Figure 7). With the 325 calibrator connected and the proper resolution settings in the indicator transmitter, the output and display should be steady. If not, verify proper terminal connections and return the unit to the factory for repair if the problem persists.

Servicing and Troubleshooting
Process and Inventory Weighing Systems

2) **Overload/overrange/underrange** conditions can be caused by overloaded cells, incorrect or open wiring circuits, or improper indicator/transmitter set-up or operation. If the input signal to the indicator or transmitter is open or overrange (35mv), the indicator and or output diagnostics bits will be set for either overrange or underrange. Causes can be inadequate connection of the sense and/or signal leads. Double-check the security of the wiring connections. If the problem persists, return the unit to the factory for repair.
3) **Excitation fault indication** can be caused by improper wiring connections related to the excitation circuit. Double-check the excitation connections and check for proper excitation voltage at the green and black terminals of the 325 calibrator. If the wiring is correct and/or the excitation voltage is incorrect, return the unit to the factory for repair.
4) Serial transmit and receive problems can often times be traced to incorrect wiring or polarity of wiring. To test for simple electrical function of RS-232, RS-485 and RS-422 communication interfaces, install LEDs in parallel across both the transmit and receive circuits (short/flat/negative/cathode lead connected to negative conductor) and observe for flashing (Figure 7). The presence of flashing will be an indication that the sending and receiving devices are producing a digital pulse output. If the send port in the weight transmitter will not cause the LED to flash, with the unit configured for continuous output mode, return the unit to the factory for repair. A secondary and potentially more involved test of ASCII protocol interfaces can be done using the standard MS Windows terminal accessory program.
5) **Analog output fault indication** can be caused by open wiring of the analog current output loop. Verify integrity of the loop by double-checking wiring and/or testing conductivity with an ohm meter. If the wiring is intact and the problem persists, return the unit to the factory for repair.

Section V – Maintenance

One of the many benefits of load cell based measurement systems is very high reliability and stability. Load cell technologies based on the simple strain gage have effectively no moving parts to wear out and the maturity of the technology contributes to long life spans with minimal maintenance.

1) Routine mechanical inspection should include visually checking for any kind of obstruction that could inhibit free vertical movement of the vessel or weighed structure over a range of approximately 0.10 inch (Figure 1). This should include checking for dirt, ice or other solid materials building up underneath the weigh module transducer. Also, although load cells are well sealed against moisture, it is important that they not be submersed in standing water for long periods of time.
2) Routine electrical inspection should include visually checking for chaffed or otherwise damaged load cell cables. If a cable jacket becomes damaged it is important to repair it immediately to prevent moisture entry. It is also desirable to periodically check the inside of the summing junction box for moisture or condensation problems. If condensation becomes a routine problem in the summing unit, desiccant and or drains should be installed.
3) In-plant quality requirement programs usually dictate calibration schedules. Generally speaking, the stability of a weigh system is very good, but calibration should be verified on at least an annual basis.
4) A large percentage of load cells are constructed of stainless steel that will not corrode in most environments. Painted load cells should be inspected periodically for coating breaks and touched-up as needed.

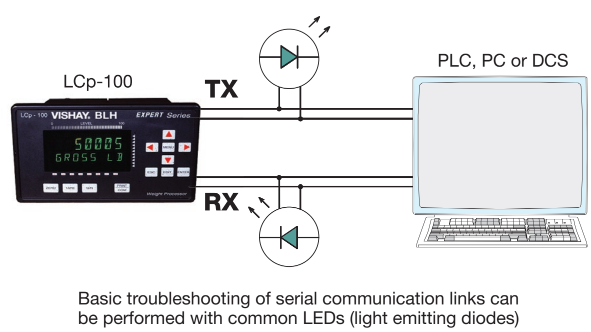


Figure 8. Troubleshooting communication links.

Servicing and Troubleshooting Process and Inventory Weighing Systems

WORLDWIDE SALES AND TECHNICAL SUPPORT

THE AMERICAS

VISHAY SYSTEMS AMERICAS
3 EDGEWATER DRIVE
NORWOOD, MA 02062
USA
PH: +1-781-298-2200
FAX: +1-781-762-3988
E-MAIL: VTS.US@VISHAYMG.COM

VISHAY SYSTEMS CANADA
12 STEINWAY BLVD, UNIT 1
TORONTO, ONTARIO M9W 6M5
CANADA
PH: +1-800-567-6098 (TOLL FREE)
+1-416-251-2554
FAX: +1-416-251-2690
E-MAIL: VT.CAN@VISHAYMG.COM

ASIA

VISHAY SYSTEMS TAIWAN*
15 FL, NO. 86, SEC.1 SHINTAI 5TH RD.
SHIJR CITY, TAIPEI, 221
TAIWAN, R. O. C.
PH: +886-2-2696-0168
FAX: +886-2-2696-4965
E-MAIL: VT.ROC@VISHAYMG.COM
*ASIA EXCEPT CHINA

VISHAY SYSTEMS CHINA
NO. 5 BINGUAN NAN DAO YOUYI RD.
HEXI DISTRICT, TIANJIN CHINA
CODE 300061
PH: +86-22-2835-3503
FAX: +86-22-2835-7261
E-MAIL: VT.PRC@VISHAYMG.COM

EUROPE

VISHAY MEASUREMENTS GROUP UK
STROUDLEY ROAD
BASINGSTOKE
HAMPSHIRE RG24 8FW
UNITED KINGDOM
PH: +44-125-685-7490
FAX: +44-125-634-6844E-MAIL:
VT.UK@VISHAYMG.COM

VISHAY MEASUREMENTS GROUP GERMANY
TATSCHENWEG 1
74078 HEILBRONN
GERMANY
PH: +49-7131-3901-260
FAX: +49-7131-3901-2666
E-MAIL: VT.DE@VISHAYMG.COM

VISHAY MEASUREMENTS GROUP FRANCE
16 RUE FRANCIS VOVELLE
28000 CHARTRES
FRANCE
PH: +33-2-37-33-31-25
FAX: +33-2-37-33-31-29
E-MAIL: VT.FR@VISHAYMG.COM

VISHAY SYSTEMS SWEDEN
P.O. BOX 423
SE-691 27 KARLSKOGA
SWEDEN
PH: +46-586-63000
FAX: +46-586-63099
E-MAIL: VT.SE@VISHAYMG.COM

VISHAY SYSTEMS NORWAY
BROBEKKVEIEN 80
0582 OSLO
NORWAY
PH: +47-22-88-40-90
FAX: +47-22-88-40-99
E-MAIL: VT.SE@VISHAYMG.COM

VISHAY MEASUREMENTS GROUP ISRAEL
8A HAZORAN STREET
P.O. BOX 8381, NEW INDUSTRIAL ZONE
NETANYA 42506
ISRAEL
PH: +972-9-863-8888
FAX: +972-9-863-8800
E-MAIL: VT.IL@VISHAYMG.COM