

OPERATING AND SERVICE MANUAL

DCR E-SCAN

Display Controlled Refractometer

Designed and Manufactured by

THE ELECTRON MACHINE CORPORATION

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The Electron Machine Corporation
DCR E-SCAN

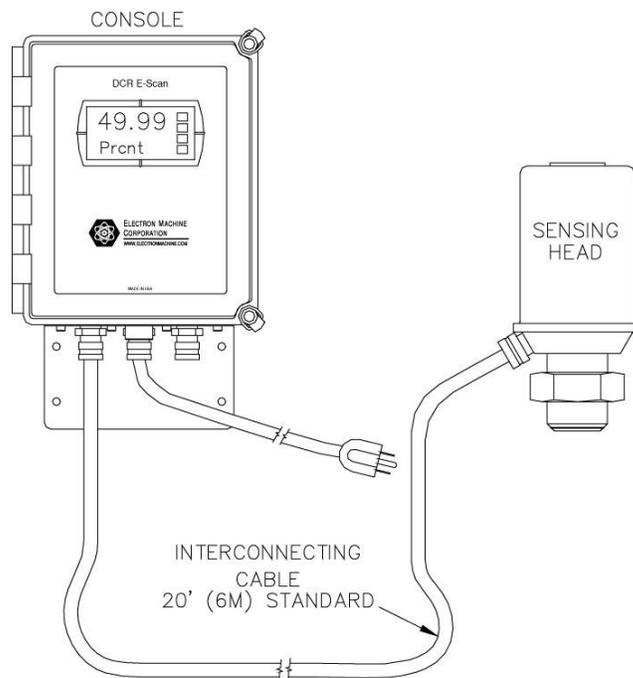
The DCR E-Scan is a critical angle refractometer used to measure the refractive index of process fluids which directly correlate with customer request for dissolved solids, Brix or other meaningful measurement. The DCR E-Scan may be used as an error indicator or an integral part of a complete process control system.

The DCR E-Scan is calibrated before leaving the factory for specific process parameters and is not intended to be re-calibrated in the field. A “Zero” adjustment potentiometer dial is provided to “shift” the measurement to match an off-line reading. Should a change in calibration be needed, it is recommended that the DCR E-Scan be returned to a factory authorized service facility.

Extensive literature is available for various industries listing the correlation between refractive index, degrees Brix, or % concentration and specific process parameters.

The DCR E-Scan consists of:

- Sensing head
- Console
- Interconnecting cable



DCR E-Scan Overview

Important Manual Information

The Chapter title is at the top of each page for quick reference through the manual.

Important points, reminders, and warning messages are printed in bordered boxes as:

NOTE: Box indicates important messages.

This is a general use manual. In the back of the manual are addendums and configuration information specific to the individual unit.

CAUTION

When removing the sensing head from an operating line, *do not assume that the line is empty or that the isolation or bypass means is working properly*. If an EMC isolation valve is used, be sure its travel is not limited by any external attachments or other interference and the valve is closed tightly. No pressure should be felt on the head as the mounting nut is being removed.

ANY PRESSURE FELT WHEN THE NUT IS LOOSENEED MUST BE INVESTIGATED BEFORE PROCEEDING. Steam should be turned off before attempting to remove the head.

Use appropriate Personal Protective Equipment (P.P.E) as dictated by your company's safety procedures to include face shields and protective clothing. Stand to the side when removing the sensing head.

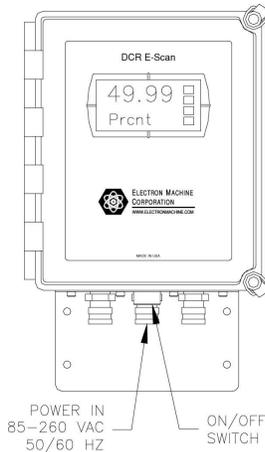
Clean all residue from spud-piece on adapter prior to re-insertion of sensing head. The o-ring seal should be replaced before re-installation.

1. Installation

1.1 Site Selection

The DCR E-Scan console can be mounted in any area where ambient conditions allow personnel to remain for extended periods. The cabinet is Nema 4X rated and should be kept closed.

DCR E-Scan Instrument



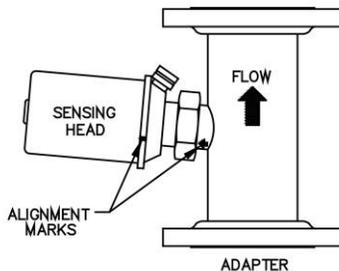
1.2 Power Requirements

The A.C. power should be supplied from a line which is not subjected to power interruptions or heavy inductive loads. A.C. power can be 120/220 VAC at 50 or 60 Hertz.

1.3 Attaching the Sensing Head

The sensing head is attached to the process line by an adapter which can be stainless steel (316) or another material specified by the customer. This adapter must not be placed in an area where vibration is severe or excessive.

Sensing Head to Adapter Positioning.



If the sensing head is to be mounted on a vertical pipe, the fluid flow should be upward. If the sensing head is to be mounted on a horizontal pipe, the adapter should be oriented in a horizontal plane so that the sensing head is installed into the middle of the pipe. This installation practice ensures that the sensing head optics remain in contact with the process. In low-flow conditions, deposits can form at the bottom of the pipe and/or air pockets can form at the top, both of which can adversely affect the measurement.

The arrow on the adapter should point in the direction of fluid flow, if applicable. The cable-entry squeeze fitting of the sensing head should be oriented toward the down-stream flow. (See Head to Adapter Positioning drawing)

The adapter should be oriented to place the head in a horizontal plane to assure that deposit buildup and air pocket creation will be minimal.

The probe end of the sensing head has a groove for an interface o-ring.

This o-ring must be in place prior to installing the head into the adapter to prevent the process leaking out.

The head is attached to the adapter by a 2-inch sanitary nut.

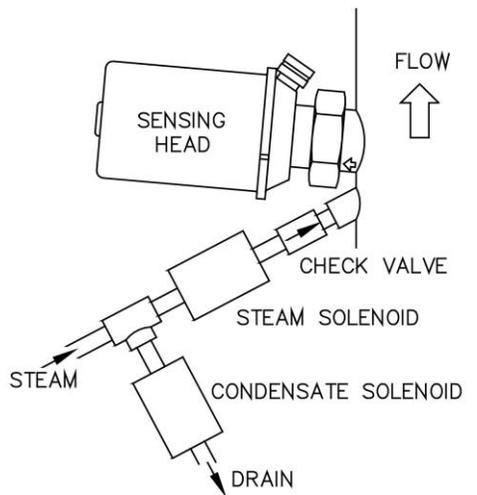
The nut should be tightened with a wrench (supplied by EMC) to a maximum 50 foot pounds of torque (68 Newton-Meter).

Alignment marks are provided for units utilizing a steam purge cleaning cycle to ensure that the thermistor probe will not be in a direct line of the steam blast. (See drawing above.)

The sensing head houses optical components which are susceptible to the effects of moisture. The cover is moisture proof and contains a small amount of desiccant to absorb any moisture remaining in the head after assembly. The sight glass on the head allows inspection of the desiccant. Light orange indicates that it remains effective. Clear indicates it is no longer effective and must be changed. The desiccant can be renewed by heating to approximately 250° F (121° C) until it recovers its orange color.

1.4 Steam Purge Attachment

Steam Purge Attachment- for liquids which exhibit a tendency to "coat"



The DCR E-Scan is not equipped to directly control steam purging or other cleaning functions. However, such functions can be configured using an external control system with the following considerations. The steam purge valve must be mounted to the adapter with a minimum of 6" and a maximum of 18" from the steam port on an adapter preferably with 1/4" tubing.

It is essential that NO LEAKS be present in this line that could allow evaporation of liquids, thereby plugging the purge line.

Steam pressure must be at least 50 psi (3.44 bar) above process pressure but less than 100 psi (6.89 bar) above process pressure with adequate condensate drainage at the steam valve in order to ensure hot steam for cleaning the prism. Trial and error must be employed in determining the minimum steam time necessary for proper steam cleaning of the prism due to variables from application to application.

Steam purge time must be kept at a minimum typically from 1 to 10 seconds duration, to avoid excessive prism deterioration, while at the same time keeping the intervals between these purge times at maximum, which may vary from minutes to many hours.

1.5 Analog Output

The DCR E-Scan has an isolated 4-20mA output for measurement. The output for this reading is found inside the console and is labeled “+” for the positive output and “-” for the negative output.

The cable should not be placed in a tray or conduit with wires attached to heavy inductive loads or SCR drives. A separate conduit is recommended.

1.6 Start-Up

Turn power on. Allow sufficient time for the sensing head to stabilize at the process temperature. It is recommended that no adjustments be made for at least 15 minutes after start-up.

This equipment is designed for continuous operation and may be left on for extended periods of time.

Compare the reading against a sample taken from the process line close to where the unit is installed and at the process operating temperature. If the sample does not equal the displayed reading, adjust the “Zero” potentiometer per Operation/Calibration section.

2. Operation

Important: Prior to shipment the sensing head is matched to the console and factory calibrated. DO NOT ATTEMPT TO RE-CALIBRATE

2.1 The Operator's Panel

The Operator's Panel consists of a simple process meter with two 6 digit displays. The measurement is continuously shown on the top display and an abbreviated description of the process is shown on the smaller bottom display. The capability to correctly abbreviate all process descriptions is limited due to the 7-segment character set. The most common used abbreviation is “Prcnt” for percent solids, degrees Brix, etc. The process meter is “locked” before leaving the factory to prevent in-advertent changes to the calibration. If changes to the calibration are desired, please contact a factory authorized service facility. No other adjustments or features are available.

2.2 Zero Adjustment

A “Zero” adjustment potentiometer is provided to “shift” the measurement to match an off-line reading. The dial for this potentiometer is located inside the console. The locking tab of the dial must be moved before the potentiometer can be turned. Turning the dial counter-clockwise lowers the measurement and clockwise raises the measurement. When satisfied with the adjustment, moved the locking tab back to the locked position.

If desired measurement cannot be attained, a change in the calibration may be needed. Please return the DCR E-Scan to a factory authorized service facility.

NOTE: As the offset is changed, the 4-20mA analog output will also be adjusted to reflect the offset change.

3. Problem Analysis

The following analysis procedures are meant to aid in isolating DCR E-Scan failures down to the device level. Device replacement with a fast turnaround is available from EMC. (See “Repair/Replacement Policy”)

Typical display ranges for voltages are:

+15V voltage	14.8Vdc – 15.3Vdc typical
+5V voltage	4.8Vdc – 5.3Vdc typical
-15V voltage	-14.8Vdc – -15.3Vdc typical
LAMP (LED) voltage	2.5Vdc – 4.8Vdc (varies with temperature and cable length)
TEMP (temperature) voltage	0Vdc – 5Vdc = -25C to 225C
MEAS (measurement) voltage	Varies with process 1Vdc – 9Vdc range nominal

Before any troubleshooting always check that all connections are properly secured and that correct power is supplied.

4. Service

4.1 EMC Warranty

The Electron Machine Corporation warrants that the equipment manufactured by EMC is free of defects in material and workmanship. Should such fault appear within two years of date of shipment from our factory, the Electron-Machine Corporation will repair or replace the defective part upon its prepaid return to Umatilla, Florida USA. (This warranty does not apply to equipment which has been tampered with or abused).

4.2 Return of Defective Parts

No return authorization is necessary. Pack defective parts carefully to avoid damage in transit. The shipper will be liable if, in the opinion of the carrier, insufficient packing was used. Attach a letter stating the nature of the difficulty encountered, the reason for failure (if known), the date of delivery of original equipment, and the approximate number of hours of operation.

<p>Please include model number and serial number in all correspondence.</p>
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All return shipments must be prepaid.

4.3 Service in the Field

Services of factory trained field engineers are available at standard rates upon request.

Requests should be addressed to: **Technical Services Department**
The Electron-Machine Corporation
P O Box 2349
Umatilla, FL 32784-2349

For after hours emergency technical service please call 352-669-3101 to obtain the Technical Service Phone Number.

4.4 Spare Parts

4.4.1 How to Order Parts

Orders for parts should be addressed to: **Sales Dept.**
The Electron-Machine Corporation
P O Box 2349
Umatilla, FL 32784-2349

Purchase orders should include the model number and the serial number of the equipment that the part is to be used with, in addition to the part number or drawing number and the chassis number.

If the part drawing number is not known, give a detailed description including a sketch, if possible. All orders will receive prompt attention.

Phone: (352)-669-3101 Fax: (352)-669-1373 E-Mail: sales@electronmachine.com

4.4.2 Available Spare Parts

Description	Catalog #
DCR E-Scan Door Assembly w/Display	
Sensing Head DCR E-Scan	
O-Ring 03-030 Viton (other materials available)	96405
Fuses – 5 Amp Slo Blo (Little Fuse)	46501

4.5 Preventive Maintenance

The DCR E-Scan requires very little maintenance, but should be checked periodically for proper working conditions. We suggest that the measurement, temperature, and lamp voltages be checked every month and recorded on the log sheet or copy of the sheet at the end of this section. The condition of the desiccant in the cover of the head should be observed and recorded also. Normal operating conditions will be indicated by a light orange color of the desiccant. If the desiccant becomes clear it should be dried or changed. A continuous changing of the desiccant would indicate a leak in the head. A continuous increase in the lamp voltage would indicate that the optical intensity is deteriorating or the prism is being coated.

4.6 Caution

CAUTION

When removing the sensing head from an operating line, *do not assume that the line is empty or that the isolation or bypass means is working properly*. If an EMC isolation valve is used, be sure its travel is not limited by any external attachments or other interference and the valve is closed tightly. No pressure should be felt on the head as the mounting nut is being removed.

ANY PRESSURE FELT WHEN THE NUT IS LOOSEMED MUST BE INVESTIGATED BEFORE PROCEEDING. Steam should be turned off before attempting to remove head.

Use a face shield and protective clothing. Stand to the side when removing the sensing head.

Clean all process residue from spud-piece on adapter prior to re-insertion of sensing head. The o-ring seal should be replaced before re-installation.

CAUTION

Close off isolation valve or remove the sensing head and replace with maintenance plug prior to steam cleaning process lines to prevent prism breakage.

5. System Information

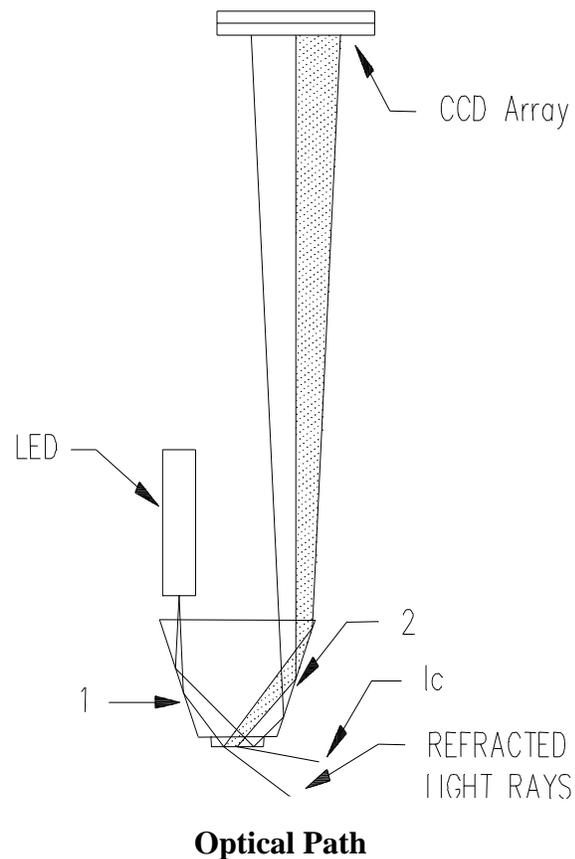
5.1 Technical Description

5.1.1 Sensing Head

The DCR E-Scan uses an LED as a light source and utilizes state of the art CCD (charge coupled device) technology to accomplish scanning the reflected light returned from the prism.

5.1.1.1 Optics

Light radiated from the LED passes through the prism surface to be reflected off mirror 1 to the prism-to-process interface. The light reaching this interface intersects the same interface over a series of angles chosen to include critical angle for the process being measured. Light intersecting the interface at an angle greater than critical angle is refracted into the solution. Light intersecting the interface at less than critical angle is reflected up to mirror 2 and out of the prism up to the CCD linear array to be scanned.

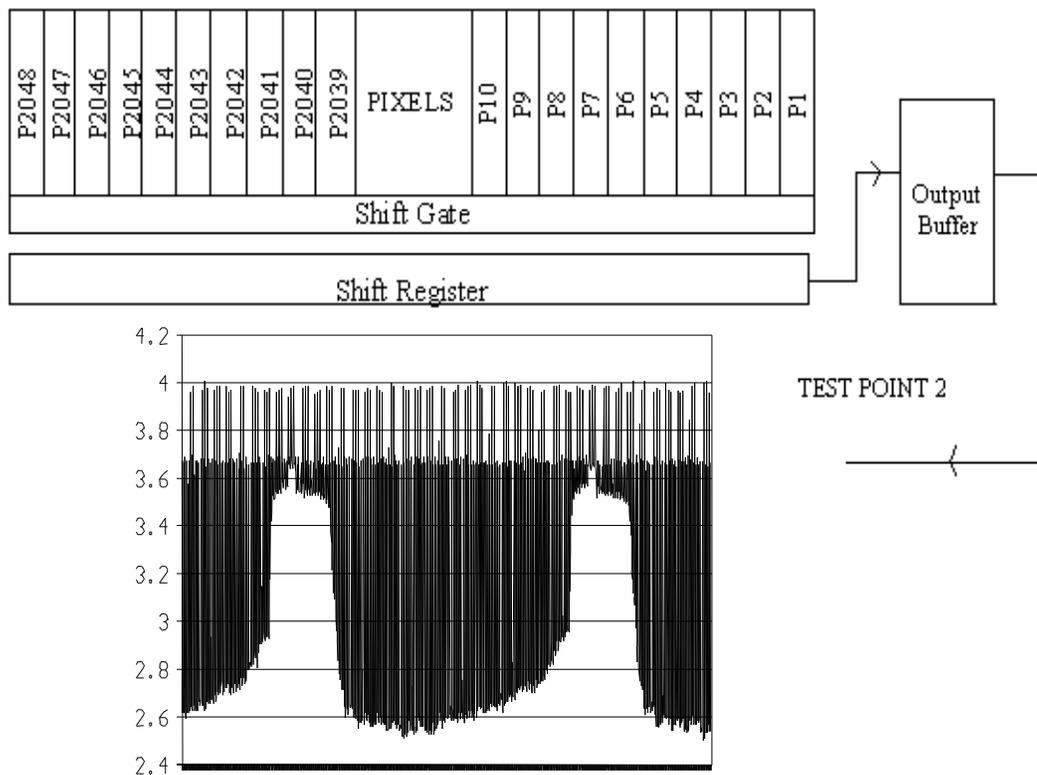


5.1.1.2 CCD Linear Array

The linear array used in the DCR E-Scan includes 2048 individual photo sites. Each of these photo-diodes independently measures the incident radiation between scan intervals and stores an electrical charge which reflects the measured intensity. At the end of this interval the shift gate is activated and the charges are simultaneously transferred into the shift register. The charges are transferred out of the shift register in "bucket brigade" fashion through the signal output buffer.

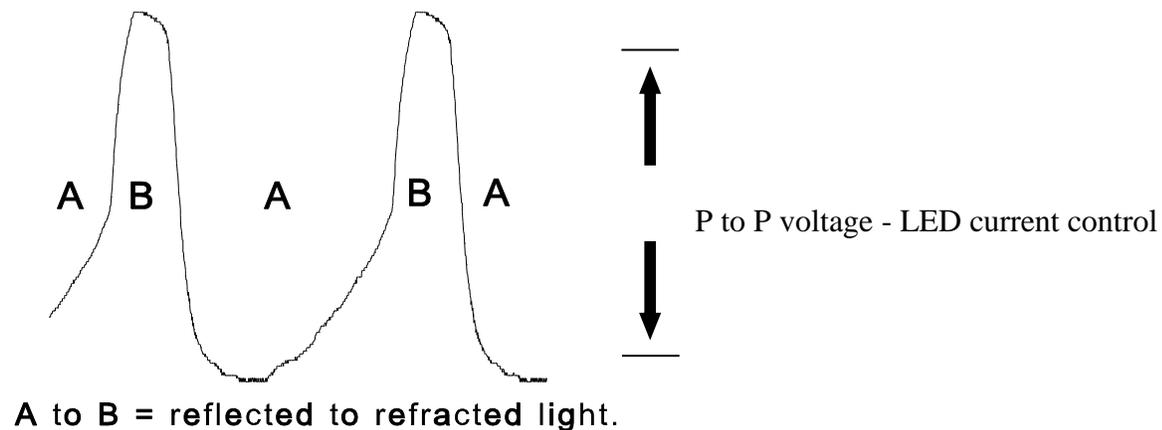
The output is an analog voltage representative of the charge per pixel (photo site) and is reset to ground between each transfer.

5.1.1.3 Signal



CCD Signal

To further increase resolution, the signal is rectified and averaged as shown in the following figure. This signal is used to control the LED current to eliminate the effects of process color changes, suspended solids, entrained air and other problems associated with non scanning refractometers. The refractive index information is also contained in this signal in the form of the ratio of A to B. The signal is passed through circuitry to develop a DC voltage which is related to the ratio of the time of A to B. This voltage is sent to the console to be processed by the microprocessor and displayed in the customers preferred units of measurement.



Filtered CCD Signal

5.1.2 Console

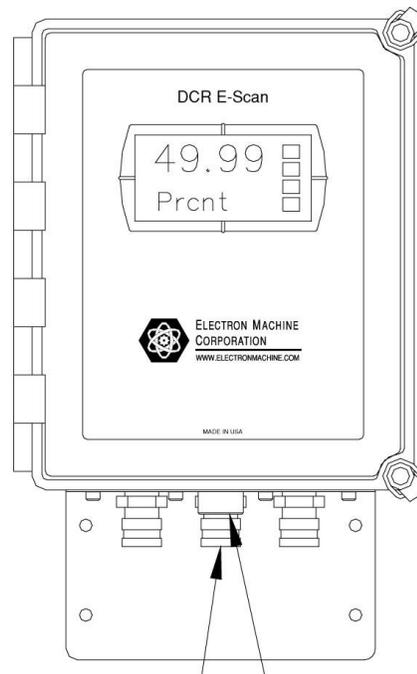
The console is constructed of molded fiberglass polyester to give protection in harsh environments.

5.1.2.1 Display

The simple LED display provides the linearized measurement indication and the 4-20mA output. The display is NEMA 4X and IP65 rated.

5.1.2.2 Buttons

The front panel buttons of the display are only used for factory authorized adjustments. No customer adjustments are available and the software is shipped from the factory “locked” to prevent inadvertent changes. If changes to the calibration are desired, please contact a factory authorized service facility. No other adjustments or features are available.



Console and Display

5.1.2.3 Cable entry and mounting

The DCR E-Scan console is set up to be mounted to a wall or other mounting device by the bracket located on the bottom of the console. This also serves as a cable and power entry plate. It is possible to change out the console without removing any wiring from the connectors. This can be done by removing the cable connectors from the internal interface board along with the screws holding the console to the mounting plate. Another method may be to utilize the connector option offered for the sensing head.

5.1.2.4 Terminal strip for external connection

The terminal strip is located inside the console. All external connections are made to these terminals.

5.1.2.5 Power supply

The power supply is located in the top of the console. The power supply supplies power to both the display and the terminal strip. The voltages supplied are +5 vdc and +/- 15 vdc.

5.2 Refractometer Specifications

Accuracy	+/- 0.05 Brix (0.000075 R.I) or 0.5% of span, whichever is greater
Span	Configured for specific application for max. resolution
Repeatability	Corresponds to accuracy
Sensitivity	Corresponds to accuracy
Stability	Corresponds to accuracy
Response time	0.25 seconds to 3 minutes
Process temperature	Up to 300° F (150°C) without air-purge
Ambient temperature	Up to 125°F (52°C) without air-purge
	Console - 32°F to 120°F (0°C to 50°C)
Calibration	See Engineering Order Sheet
Sensing head	
Wetted materials of Construction	2205 Duplex S/S, sapphire, Teflon, Viton (other materials available)
Outputs	4-20ma isolated

- NOTES -

6. Drawings List

Drawing #	Rev	Description
A-13108		Outline DCR E-Scan System
B-13109		Interconnection Diagram DCR E-Scan System