DEVAR Inc.

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INSTRUCTION MANUAL

18-265A

ISOLATED, 2 WIRE

pH TRANSMITTER

IN EXPLOSION PROOF HOUSING

Manual #990618

TABLE OF CONTENTS	PAGE NUMBER AND REFERENCE DOCUMENTS

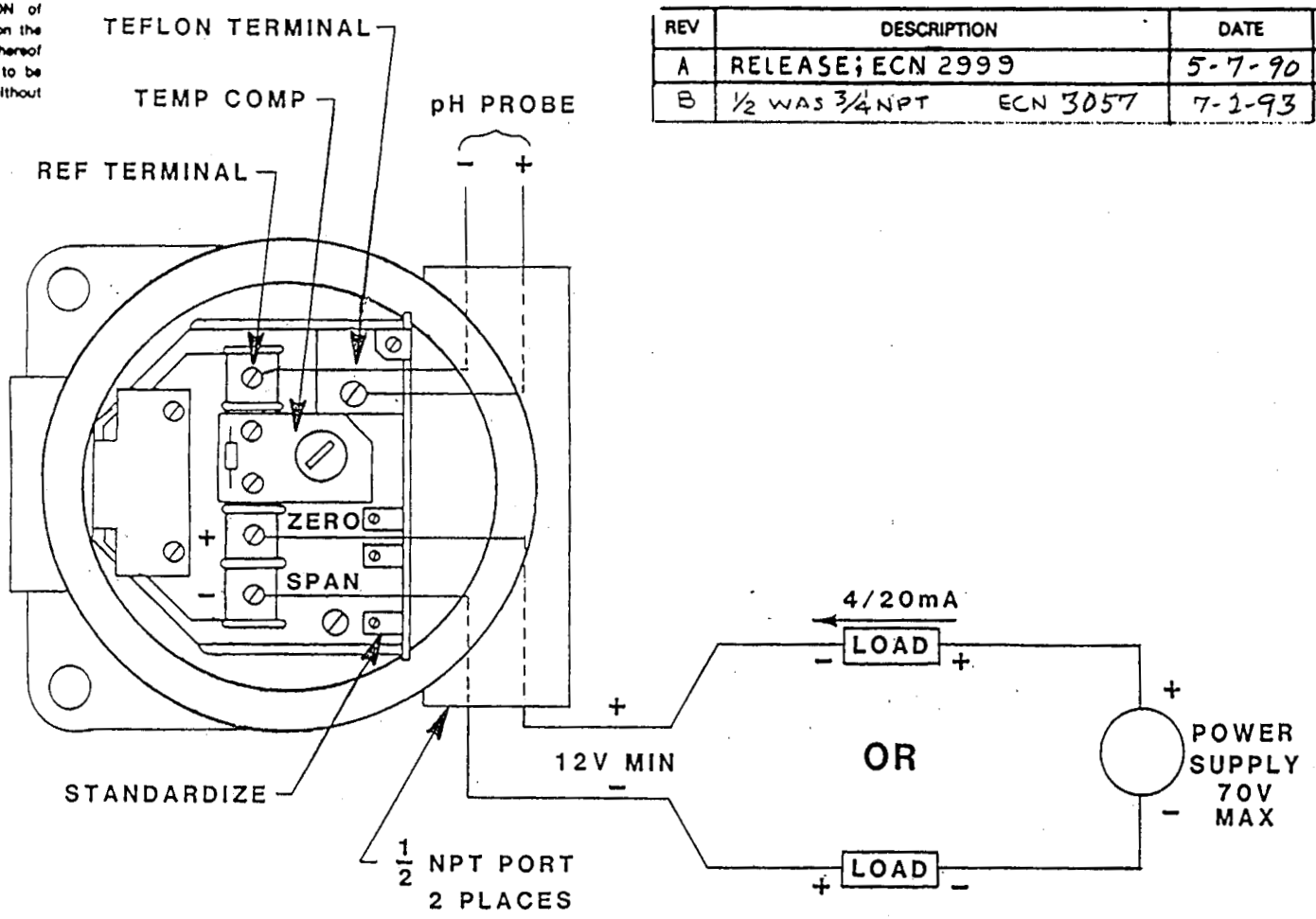
GENERAL DESCRIPTION

THE 18-265A ISOLATED, 2 WIRE TRANSMITTER ACCEPTS AN INPUT FROM A HIGH IMPEDANCE pH OR ORP PROBE AND PROVIDES A 4 TO 20 mA OUTPUT PROPORTIONAL TO THE INPUT. THE 18-265A CONSISTS OF TYPE 18-265 CIRCUIT ASSEMBLY HOUSED IN A RUGGED, NEMA4, HOUSING, WHICH IS ALSO SUITABLE FOR USE IN HAZARDOUS LOCATIONS, CLASS 1, GROUPS B, C, AND D, CLASS 2, GROUPS E, F, AND G, AND CLASS 3.

DWG NO

REVISIONS

REV	DESCRIPTION	DATE	APPROVED
A	RELEASE; ECN 2999	5-7-90	a.r.
B	½ WAS ¾ NPT ECN 3057	7-1-93	a.r.



HOUSING SUITABLE FOR HAZARDOUS LOCATIONS
DIVISIONS 1 AND 2
CLASS I, GROUPS B,C,D
CLASS II, GROUPS E,F,G
CLASS III, NEMA 4

TOLERANCES UNLESS SPECIFIED
DECIMAL DIM. ± .005
FRACT. DIM. ± 1/64
ANGLES ± 1/2°

MATERIAL —H

FINISH —H

NEXT ASS'Y NO. B/M 515191

CONTRACT NO.

PREPARED	MF	5/4/90
CHECKED	LFG	5/9/90
MECH		
ELEC		
DESIGN		
APPROVED	a.r. 5/7/90	
APPROVED		

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CONTROL PRODUCTS DIVISION

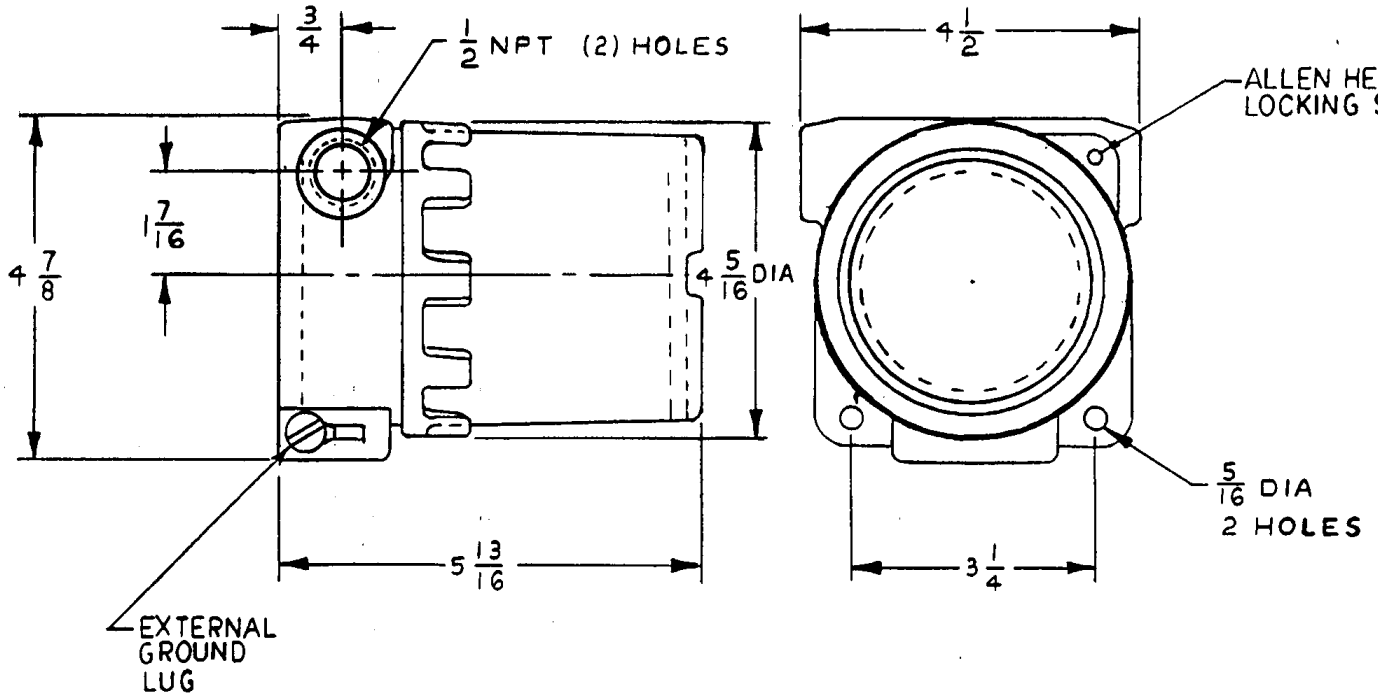
FIELD WIRING, 18-265A ISOLATED pH TRANSMITTER

SIZE A | DRAWING NO. 515209 | REV B

SCALE —H | WT —H | SHEET 1 OF 1

ILVIE PRESS

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	RELEASE; N-69720	3-21-89	a.sz
B	ADD GND LUG, SET SCREW & DIM. CHANGE ECN 3067	3.14.94	a.sz.



TOLERANCES UNLESS SPECIFIED DECIMAL DIM. ± .005 FRACT. DIM. ± 1/64 ANGLES ± 1/2°	CONTRACT NO.		
MATERIAL SAND CAST ALUMINUM	PREPARED	MF	8/18/88
	CHECKED	L.S.K	8/22/88
	MECH		
FINISH BLUE EPOXY FINISH	ELEC		
	DESIGN		
	APPROVED		
NEXT ASS'Y NO.	APPROVED		

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CONTROL PRODUCTS DIVISION

EXPLOSION PROOF HOUSING
OUTLINE DIMENSIONS

SIZE		DRAWING NO.	REV
A		515002	B
SCALE N.T.S.	WT		SHEET 1 OF 3

OGILVIE PRESS

2 WIRE ISOLATED
ELECTRODE-TO-ELECTRIC TRANSMITTER
TYPE 18-265
PRODUCT DESCRIPTION

1.0 GENERAL DESCRIPTION

1.1 The Type 18-265 Electrode-to-Electric Transmitter has been designed to accept and amplify a millivolt DC signal from a high-impedance source, such as pH, REDOX, or ION-SELECTIVE electrodes, and to provide a current signal suitable for computation and control. It features compact size and consists of a two-section cast-aluminum housing. The output signal may be either 4/20mA or 10/50mA and is completely isolated from the signal source. It is also designed to operate with only two copper-wire leads between the control room and the field-mounted transmitter. These two leads carry the voltage necessary to operate the transmitter, as well as the transmitter's output current. The current output is inversely proportional (directly proportional for type 18-265R) to the electrode input mV signal and can be used for computation, control or monitoring.

1.2 The input pH or mV span is established by selection of fixed resistors and is set to a specified value by an infinite resolution span adjustor. The standarize adjustor allows offset setting of greater than ±10% of span. Various start of range offset values are accomplished by a fixed resistor and resetting of the standarize adjustor.

2.0 SPECIFICATIONS

2.1 General

a. Linearity	±0.25% typical, ±0.5% max. 10/50 MA Io
b. Supply Voltage Effect on Io Output	±0.1% typical, ± 0.25% max. 4/20 MA Io
c. Load Resistance Effect on Io Output	0.01% per volt (maximum)
d. Environmental Temperature Influence	0.05% per 300 ohm change (maximum)
1. Recommended Temperature Limits	-25°C to 50°C
2. Amplifier Thermal Error	60uV/°C or 0.001 pH/°C with low Input R 72uV/°C @ 25°C, 100 Megohm Input R 84uV/°C @ 35°C, 100 Megohm Input R 100uV/°C @ 45°C, 100 Megohm Input R

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DRAWN:	APPR	ORDER NO.	DRAWING NO.	REV.
5/6/77			513275	C

e. Amplifier Drift — Less than 100uV, or 0.0017pH per month, nonaccumulative

f. Electrical Classifications — Circuit designed to meet requirements of intrinsic-safety and ISA RP 12.2

g. Stray Rejections — Transverse: 20Db at 60Hz
Common-Mode At 120VAC,60Hz, less than 0.25% of Span Output Shift

2.2 POWER SUPPLY REQUIREMENTS

$E_{Min.}$	$E_{Max.}$	Output
12.V + (R_{Load} x 20mA)	70V	4/20mA
14.V + (R_{Load} x 50mA)	70V	10/50mA

2.3 INPUTS

a. Input Impedance — 10^{12} Ohms

b. Source Current — Less than 1.pA @ 25 C

c. Input from pH Electrodes

1. pH Span set with fixed resistors and trimmer adjustor. — Between 1.5 and 14 pH

2. Mid-range of 7pH, set with standarize trimmer adjustor. — Greater than ±10% of span

3. Elevate or suppress pH with fixed resistor and trimmer adjustor. — 0 to 12.5pH

4. pH Solution Temperature Compensation — Provided with manual temperature compensator (M) or for use with automatic thermo-compensator, such as Uni-Loc #2000150 (B) or Van London #160014 (B)

d. Input from Redox, Ion-Selective electrodes or other mV Input Source. — Output is directly proportional to input signal (18-265R)

1. Input Span, set with fixed resistors and trimmer adjustor. — Between 100 to 1000mV

2. Input signal can be suppressed with fixed resistor and trimmer adjustor. (Ex. Range 500 to 700mV.) — Suppression up to 1000mV
Elevation to (-)400mV.
Combined span & offset up to 1200mV.

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5/6/77	A.H.		513275	C

2.4 OUTPUTS

a, Current Outputs with supply voltage not to exceed 70V DC	1. 4/20mA Requires 12V + (R Load x .02) 2. 10/50mA Requires 14.0V + (R Load x .0[illegible]

2.5 HOUSING

a. Rain-Tight Enclosure	1/4-20 Drain Plug 1/4-18 NPT Enclosure Purging Port
b. Outline Dimensions	Drawing No. C-381516

2.6 FIELD WIRING TERMINALS

Screw Size	6-32 Screw Terminals used for all field wiring.

2.7 PRODUCT CODING

Type 18-265- [-][-]	Specify Input Range
[1][-]	4/20mA Output Signal
[2][-]	10/50mA Output Signal
[M]	pH Input Manual Temperature Compensator
[B]	pH Input Automatic Temperature Compensator "B" rated for use of 3,000 Ohms @ 25°C probe with T.C. 0.0045 Ohms/Ohms/°C
[R]	Redox, Ion-Selective, or other mV signal source where output is directly proportional to input.

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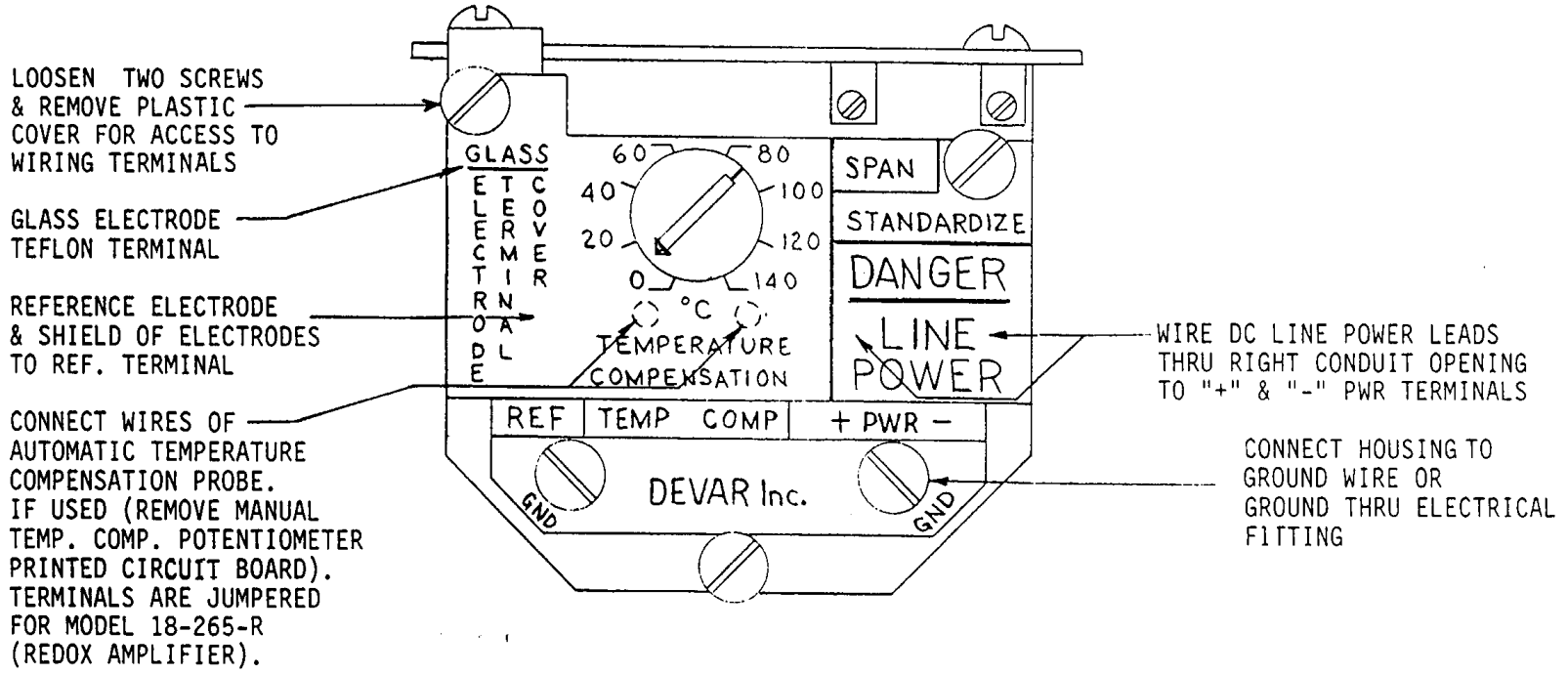
DRAWN:	APPR	ORDER NO.	DRAWING NO.	REV.
5/6/77	a.m		513275	C



EXTERIOR WIRING 18-265

DEVAR INC

513221 REV.B

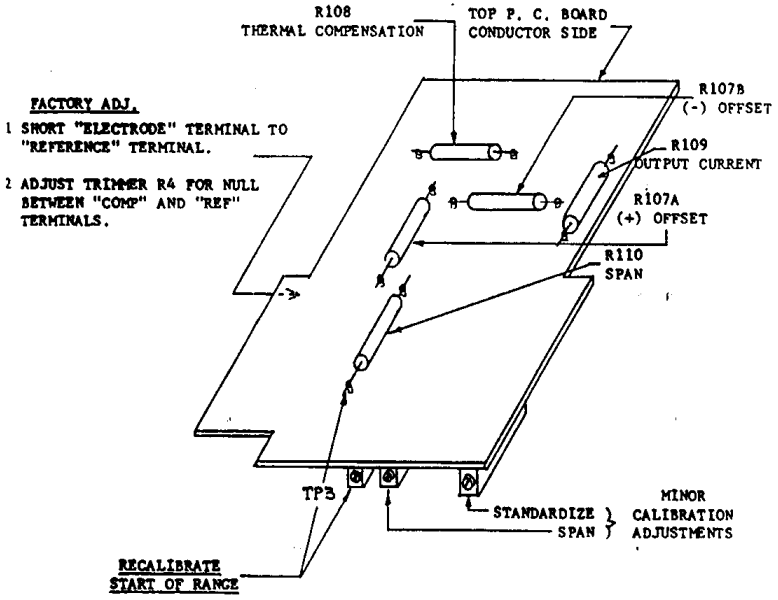
INPUT SPAN		INPUT SPAN RESISTOR	
pH	mV	R110	DEVAR PART NO.
1.5/2.5	88.71/147.85	38.3K	223737-172
2.5/4	147.85/236.56	23.2K	223737-102
4/6	236.56/354.84	15K	223737-27
6/9	354.84/532.26	10K	221734-07
9/14	532.26/827.96	6.81K	223737-47

SELECTION OF R110 INPUT SPAN RESISTOR

START OF INPUT RANGE (INPUT OFFSET)		INPUT OFFSET NULLING RESISTOR		
pH	mV	R107A	R107B	DEVAR PART NO.
0	+413.98	——	28.7K	223737-173
1	+354.84	——	34.8K	223737-174
2	+295.70	——	45.3K	223737-85
3	+236.56	——	61.9K	223737-175
4	+177.42	——	100K	223737-135
5	+118.28	——	255K	223737-81
6	+59.14	2M	——	380019-02
7	0	499K	——	223737-133
8	-59.14	294K	——	223737-242
9	-118.28	205K	——	223737-89
10	-177.42	158K	——	223737-231
11	-236.56	127K	——	223737-107
12	-295.70	110K	——	223737-225

SELECTION OF R107A OR R107B INPUT OFFSET NULL RESISTORS

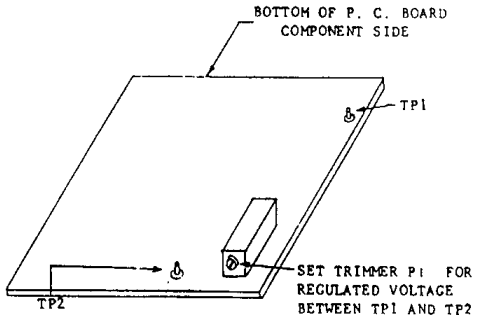
INPUT RANGE CALIBRATING RESISTORS FOR 18-265 ISOLATED 2-WIRE ELECTRODE TRANSMITTER



1 APPLY MINIMUM RANGE SIGNAL BETWEEN "ELECTRODE" AND "REF" TERMINALS.

2 MEASURE VOLTAGE BETWEEN TP3 AND "REF" TERMINAL.

3 ADJUST TRIMMER R6 FOR NULL.



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18-265 LOCATION OF CALIBRATING RESISTORS AND POTENTIOMETERS

B-513422 REV B

TYPE 18-265
ISOLATED 2-WIRE ELECTRODE TRANSMITER
RECALIBRATION, STANDARDIZATION,AND
OPERATION PROCEDURE

1. Recalibration

The Model 18-265 Transmitter has been factory calibrated following the procedures described in Devar drawing #514921. While it may be necessary, from time to time, to make minor adjustments to the 18-265 Transmitter, the extensive procedure of drawing #514921 need only be applied for a complete recalibration of the instrument.

To recalibrate the 18-265 Transmitter, first specify the new input range of the instrument, for example 0 to 14 pH or 4 to 10 pH. Select the value of span resistor "R110" and offset resistor "R107" from Devar drawing #513286. For a calibration range of 0 to 14 pH, the span would be 14 pH or 827.96 mV and the offset would be +413.98 mV. For this range select R110 equal to 6.81K and R107B equal to 28.7K. Reference Devar drawing #513422 for the location of the calibrating resistors and the adjustment pots. Then following the procedure of Devar drawing #514921, calibrate the instrument.

It is important to note that during calibration, the temperature compensator, of the 18-265, should be set to 25 deg. C. For a discussion of temperature compensation see section 3 of this drawing.

2. Periodic Adjustment and Calibration Verification

As with any measurement instrument, it is necessary to check the calibration accuracy, of the 18-265 transmitter, at specified intervals. We recommend that a calibration check be done on an annual basis.

To check the calibration, disconnect the pH electrode from the 18-265 and connect a millivolt source or pH simulator in its place. Input the top and bottom of the input range and measure the output of the transmitter. If adjustment is necessary, apply the minimum input signal to the instrument and adjust the standarize pot for 4 mA at the output. Apply the maximum input signal and adjust the span pot for 20 mA at the output. Repeat this procedure until no further adjustment is required. Before initiating this procedure, see section 3 of this drawing for a discussion of the effect of temperature on pH measurements.

It should be noted that when the minimum input signal is applied from the calibrator, the output, will in general, not be 4 mA. This is not because the calibration has drifted, but is because the zero has been shifted during routine standardization of the instrument.

The electrodes used to measure pH have extremely high output impedances. When recalibrating the 18-265 using a millivolt source a 100 megohm resistor may be connected between the positive input terminal of the 18-265 and the positive output terminal of the millivolt source. This resistor should be connected right at the positive input terminal of the 18-265. The use of the 100 megohm resistor in calibrating the 18-265 is not absolutely necessary. It is only added to assure that the instrument is tested under conditions as close as possible to actual operating conditions. For additional information on the effect of the 100 megohm output impedance see step 11 of calibration procedure #514921.

3. Temperature Compensation

The millivolt output of the pH electrode varies both with the pH of the solution and with the temperature of the probe. An uncompensated probe will exhibit the following error for every 10 deg. C change in probe temperature:

pH	ERROR	pH	ERROR	pH	ERROR
0	.23 pH	5	.07 pH	10	-.10 pH
1	.20	6	.03	11	-.13
2	.17	7	.00	12	-.17
3	.13	8	-.03	13	-.20
4	.10	9	-.07	14	-.23

Note that for a neutral solution of 7 pH, when the millivolt output of the pH probe is zero millivolts, there is no temperature error.

APPROVED A.B. 5-14-91	DEVAR Inc. 706 Bostwick Avenue, Bridgeport, Conn. 06605	
APPROVED LFG 5-14-91	CONTROL PRODUCTS DIVISION	
ECN 3012	CALIBRATION & STANDARDIZATION 18-265	
	SIZE A	DRAWING NO. 515327 REV

The 18-265 Transmitter allows for either manual or automating temperature compensation of the pH electrode. Automatic temperature compensation requires the use of a pH probe in which a temperature sensitive resistor has been incorporated. Leads from the resistor are connected to the temperature compensate terminals of the 18-265 Transmitter. As the resistance of the resistor increases with temperature the gain of the amplifier decreases, compensating for the increased sensitivity of the pH electrode. Automatic compensation should be used in applications where wide or frequent variations in solution temperature occur. However, automatic compensation may not be required if the solution being measured is relatively neutral. For example, with no compensation at all, a 10 deg. C temperature change in a 6 pH solution would cause an error of only .03 pH.

When manual compensation is being used, a single turn potentiometer is connected between the temperature compensate terminals, of the 18-265 Transmitter. The pot has a calibrated dial, which can be set from 0 to 140 deg. C, with an adjustability of about 5 degrees. The dial on the pot must be set to the temperature of the solution being measured. Manual compensation is not recommended for very high or very low pH solutions, or where the temperature of the solution is not accurately known. For example, if the temperature of the solution were 10 deg. C above or below the dial setting on the manual compensator an error of .2 pH would result for solutions with a pH of 1 or 13.

It should be noted that the millivolt output from a pH simulator is equivalent to the output from a pH electrode at 25 deg. C. Therefore, it is important that the temperature compensator of the 18-265 be set to 25 deg. C when calibrating the unit. When using manual temperature compensation, set the dial of the temperature compensation pot to 25 deg. C before calibrating the transmitter. The 25 deg. C position has been marked on the face of the pot. When using automatic temperature compensation, disconnect from the temperature compensation terminals of the 18-265, the two leads coming from the compensating resistor in the pH probe. Connect a fixed resistor between these terminals and then calibrate the transmitter. The value of the fixed resistor should equal the value of the compensation resistor at 25 deg. C +/- 1%. The most commonly used resistor for temperature compensation has a temperature coefficient of 0.0045 ohm/ohm/deg. C and equals 3000 ohms at 25°C. After the calibration is complete, remove the fixed resistor and reconnect the two leads coming from the compensating resistor.

4. Standardization

The standardization adjustment on the 18-265 Transmitter is used to zero out spurious offsets from the pH electrode. This adjustment compensates for differences between probes and should be repeated periodically to correct for zero shifts which occur through aging and contamination of the electrode.

To standardize, remove the electrode from the test solution. If the electrode has become fouled, wipe it carefully with a damp cloth, then rinse with distilled water. If you find that during subsequent standardizations more and more correction is required, cleaning the glass electrode with a 5% solution of HCl may help. This can be applied with a cotton swab, then rinsed with distilled water.

After rinsing with distilled water, insert the electrode into freshly poured pH 7 buffer solution and adjust the standardization pot for the proper milliamp output from the 18-265. It is sometimes desirable to standardize using a buffer solution with a pH close to the pH of the solution being measured. However, when pH 7 buffer is not being used and the probe does not have automatic temperature compensation, it is important that the temperature setting of the manual temperature compensator be set to the same temperature as the buffer solution. See section 3 of this drawing for more information on the effect of temperature on pH measurements. It should also be noted that the pH of the buffer solutions vary with temperature and in general should be used at room temperature.

For better accuracy a two-point calibration may be performed. To do this, two standard buffer solutions are required. The buffers most commonly used are pH 4, 7 and 10. Select two closest to the pH of the solution being measured. If using manual temperature compensation, be sure the manual compensator is set to the temperature of the buffer solution, then proceed as follows:

1. Rinse the electrode with distilled water.

2. Using fresh buffer solution, insert the electrode into the solution with the lower pH and adjust the standardize pot for the correct milliamp output.

3. Rerinse the electrode with distilled water.

4. Insert the electrode into the second buffer solution and adjust the span pot for the correct milliamp output.

5. For best accuracy repeat the process a second time.

APPROVED A.H. 5-14-91	**DEVAR Inc.** 706 Bostwick Avenue, Bridgeport, Conn. 06605
APPROVED LFG 5-14-91	CONTROL PRODUCTS DIVISION
ECN 3012	CALIBRATION & STANDARDIZATION 18-265
	SIZE | DRAWING NO. 515327 | REV

FINAL CALIBRATION PROCEDURE

18-265 ISOLATED 2 WIRE ELECTRODE TRANSMITTER

1. Connect 24 V power supply and decade box (set to 250 ohms) in series, between output terminals (+) 4 and (-) 5.

2. Measure voltage across test points (+) TP1 and (-) TP2 on voltage regulator (bottom) board. Adjust POT R21 for 10.9V between the test points.

3. Short electrode terminal to input reference terminal.

4. Measure voltage between compensation terminal (+) 3 and input reference terminal (-) 1. Adjust null POT R4 (top board) for zero volts between terminals 3 and 1.

5. Apply minimum input signal between (+) electrode terminal and reference terminal (-) 1.

6. Measure voltage between test point (+) TP3 (top board) and reference terminal (-) 1. Adjust zero POT R6 (top board) for zero volts at TP3.

7. Adjust standardize POT R12 (top board) for 4 mA at the output.

8. Apply maximum input signal adjust span POT R9 (top board) for 20 mA out.

9. Repeat steps 7 and 8 until unit is calibrated.

10. Set input to midrange verify output equals 12 mA ±.04 mA.

11. Connect a 100 megohm resistor between the input voltage source and the electrode terminal. Verify that the output does not change by more than $\frac{.027}{\text{INPUT SPAN}}$ mA.

    EXAMPLE: For an input of 2 to 12 pH

    Δ OUTPUT = $\frac{.027}{10}$ = .0027 mA

12. Adjust the input for 20 mA at the output. Increase the resistance of the decade box from 250 to 600 ohms. Verify that output does not change by more than .008 mA.

14. With the output at 20 mA and the load at 600 ohms, momentarily break the output current loop then reconnect it. Verify that the output returns to 20 mA and that the transmitter does not begin to oscillate.

REFERENCE DRAWINGS:
SCHEMATIC C513273
CALIBRATION COMPONENT LOCATION B513422
ASS'Y AMPLYFIER (TOP) BOARD B513259
ASS'Y ISOLATION (CENTER) BOARD B513452
ASS'Y REGULATOR (BOTTOM) BOARD A514232

REVISIONS	B ECN 2874A 7-5-88 a.s. A ECN 2874 3-18-88 a.s.		DEVAR Inc. 706 Bostwick Avenue, Bridgeport, Conn. 06605	
PREPARED: LFG 3-14-88	APPROVED:	DRAWING NO.: 514921	REV: B

SWITCH SELECTION PROCEDURE FOR THE CALIBRATION BOARD FOR THE 18-265 Ph TRANSMITTER

The calibration board for the Model 18-265A pH transmitter provides a means of calibrating the transmitter for various pH ranges without having to solder calibration resistors to the transmitters circuit board. All calibration components are mounted on the calibration board and are selected through the use of DIP switches.

The input span is selected by setting switch 1 positions 1 through 5. The span is defined as the bottom of the input range subtracted from the top of the input range. For example, if the input to produce a 4 to 20 mA output is 7 to 10 pH, the input span would be 3 pH units.

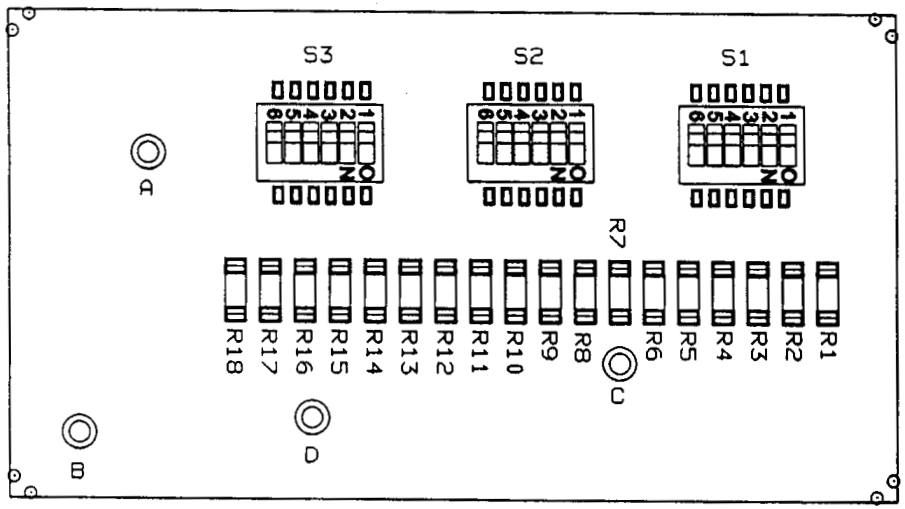
The start of range, or input offset, is selected by setting the remaining 13 DIP switch positions. The start of range is the input value which produces a 4 mA output.

Example: For an input range of 5 to 12 pH the span would be 7 pH and the start of range would be 5 pH. Switch 1 position 4 would be on for a span range of 6 to 9 pH and switch 2 position 5 would be on for a start of range of 5 pH. All other switches would be off.

SWITCH	RES.	RESIST.	INPUT SPAN pH	INPUT SPAN mV	START OF RANGE pH	START OF RANGE mV
SW1-1	R1	38.3K	1.5 / 2.5	88.7 / 147.8		
SW1-2	R2	23.2K	2.5 / 4	147.8 / 236.6		
SW1-3	R3	15K	4 / 6	236.6 / 354.8		
SW1-4	R4	10K	6 / 9	354.8 / 532.3		
SW1-5	R5	6.81K	9 / 14	532.3 / 828		
SW1-6	R6	28.7K			0	+ 413.98
SW2-1	R7	34.8K			1	+ 354.84
SW2-2	R8	45.3K			2	+ 295.70
SW2-3	R9	61.9K			3	+ 236.56
SW2-4	R10	100K			4	+ 177.42
SW2-5	R11	255K			5	+ 118.28
SW2-6	R12	2M			6	+ 59.14
SW3-1	R13	499K			7	.00
SW3-2	R14	294K			8	- 59.14
SW3-3	R15	205K			9	- 118.28
SW3-4	R16	158K			10	- 177.42
SW3-5	R17	127K			11	- 236.56
SW3-6	R18	11.1K			12	-295.70

REV	ECN	PREPARED	APPROVED	DEVAR Inc. 706 BOSTWICK AVE. BRIDGEPORT, CT. 06605			
A	3147	L.F.G	11-11-97	NEXT ASSY B/M 5-0058-01	PAGE 1 OF 1	DRAWING NO. 516063	REV A

REV	DESCRIPTION	DATE	APPROVED
A	RELEASE ECN 3147A	12-8-97	a.s.



TOLERANCE UNLESS SPECIFIED DECIMAL +/- .005 FRACTION +/- .005 ANGLE 1/2 degree	CONTRACT NO.		DEVAR Inc. 700 BOSTWICK AVE, BRIDGEPORT CT 06605
MATERIAL	PREPARED	L RO 12.4.97	CALIBRATION BOARD ASSEMBLY FOR THE 18-265A
	CHECKED		
	MECH		
FINISH	ELEC		
	DESIGN		
	APPROVED	a.s. 12-8-97	SIZE A — DRAWING NO. 516061 — REV A
NEXT ASSY NO. BM 516058-01	APPROVED		SCALE 2 TO 1 — WT — SHEET 1 OF 1