LAKEWOOD SYSTEMS LTD.
Remote Data Recording Products

SPM-15
SONIC PROBE

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1 Introduction

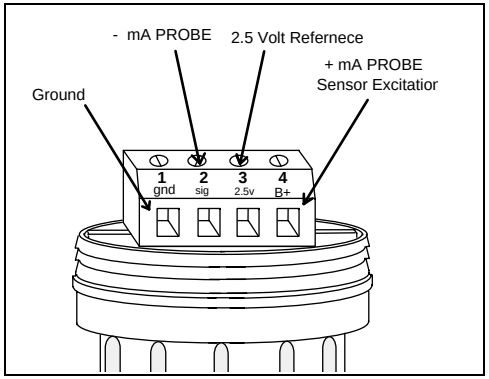
The SPM-15 ultrasonic level sensor is a very accurate device used to measure level by emitting a series of ultrasonic pulses. The SPM-15 determines level by measuring the time it takes the ultrasonic pulses from traveling to the target and back. The SPM-15 has a range for 5 meters and can easily be interfaced to Lakewood Systems dataloggers. It is ideal for battery powered installations due to its very low power consumption.

With the use of advanced electronics the SPM-15 can be interfaced to Lakewood Systems' dataloggers using the IP-420F input plug or the IP-SPM-15 Voltage Booster plug. This connector system allows for easy connection to many Lakewood Systems products such as the R-X Data Storage Unit, Auto Chart, Chart Pac, and DR-X Depth Recorder. The screw terminals are protected from the environment by use of a Rubber Boot Cover.

1.1 Datalogger Connections with IP-CK420 CABLE KIT

The SPM-15 is connected to Lakewood systems dataloggers using the IP-CK420 Cable Kit. The IP-CK420 consists of one IP-X plug which connects to the SPM-15, one IP-420F or IP-SPM-15 which connects to the datalogger and a pre-determined length of IP-CX transducer cable. The four screw terminals of the IP-X, IP-SPM-15 and IP-420F are used to connect the IP-CX cable. The first screw terminal **(1)** is common ground. The second screw terminal **(2) SIG** or analog input (- 4-20 mA SPM-15 input) . Terminal **(3)** is the 2.5 volt reference. The fourth screw terminal **(4)** is the datalogger battery switched excitation. With the IP-SPM-15 the battery voltage is boosted to provide 15 volts to the SPM-15. The SPM-15 must be powered by 12 volts or greater with a warm-up time of at least 8 seconds. When the IP-SPM-15 is not used a 24 volt battery supply is used with a relay switching module. Fig. 1 shows the position of the screw terminals.

Fig. 1 IP-SPM-15 AND IP-420F Terminal assignment.



Make sure the screw terminal is fully open before inserting the wire. A small tug on the wire after tightening can assure the wire is secure.

SPM-15 - IP-CK420 Wiring

#	***IP-X*** *(connect to SPM-15)*	***COLOR***
1	GND	N/C
2	SIG	Green
3	2.5V	N/C
4	15V & B+	Red

#	***IP-SPM-15 or IP-420F****(Connect to datalogger****)***	***COLOR***
1	GND	N/C
2	SIG	Green
3	2.5V	N/C
4	15V or B+	Red

1.2 Using The Rubber Boot Cover

The rubber boot cover can be used to keep the screw terminals protected from the environment. To use the cover, turn it inside out as shown in Fig. 2 and make a small hole to let the wire through. By using a tywrap you can then clamp the wire at the position you desire.

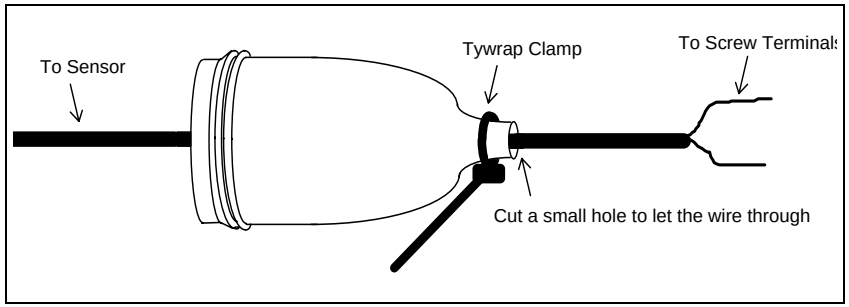


Fig. 2 Preparing the Rubber Boot Cover.

Once you have screwed the wires down and returned the rubber boot cover from the inside out position you can slip it over the screw terminals as shown in Fig. 3 below.

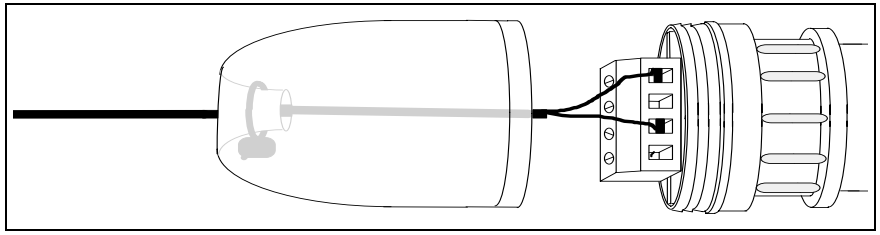
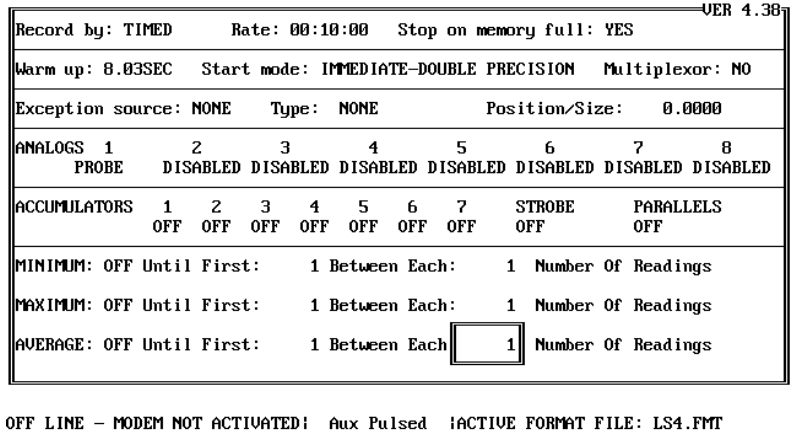


Fig. 3 Final Mounting of the Rubber Boot Cover.

1.3 Software Requirements

When using the SPM-15 with the IP-SPM-15 and IP-420F the analog input of the datalogger must be enabled and set to the 2.5 volt range in the 'PROGRAM', 'MODIFY' screen. The sample rate can be set to record The SPM-15s output at a specified interval from once per every 15 seconds to once per day. Because the SPM-15 is on switched power it requires a warm-up time of 8.03 seconds or longer. The SPM-15 should be operated with LS-4 Software and with any Lakewood Systems datalogger with ROM version 4.9S/**4.9SDEL**. Since the SPM-15 requires a 8.03 second warm-up time or greater the datalogger ROM must be set in the delay position. This is done by moving the ROM jumper into the 4.9SDEL position (consult the factory). With older version ROMS the ROM must be exchanged. To access the delay mode in the software the software must be started by entering LS4/D. This will ensure that the extended warm-up times will be properly displayed in the Status and Program Modify screens in the LS-4 software. When entering the Monitor and Status screens and retrieving data, communications will be interrupted during the SPM-15s 8 second sampling interval. To ensure that communications succeeds the Communication Time Out in the setting menu should always exceed the SPM-15 warm-up time. The SPM-15 should have a communication time out of least 10 seconds.

Fig. 4 Example Header Settings NOTE: WARM-UP > = to 8.03 SECONDS



1.4 THE SPM-15 LIBRARY CONFIGURATION

A LS-4 Library setting for the SPM-15 can be made which will convert it's 4-20 mA signal into engineering units. This is done by selecting 'FILE', 'LIBRAY', 'REVISE' in the LS-4 Software. Figure 5 is typical field installation for the SPM-15.

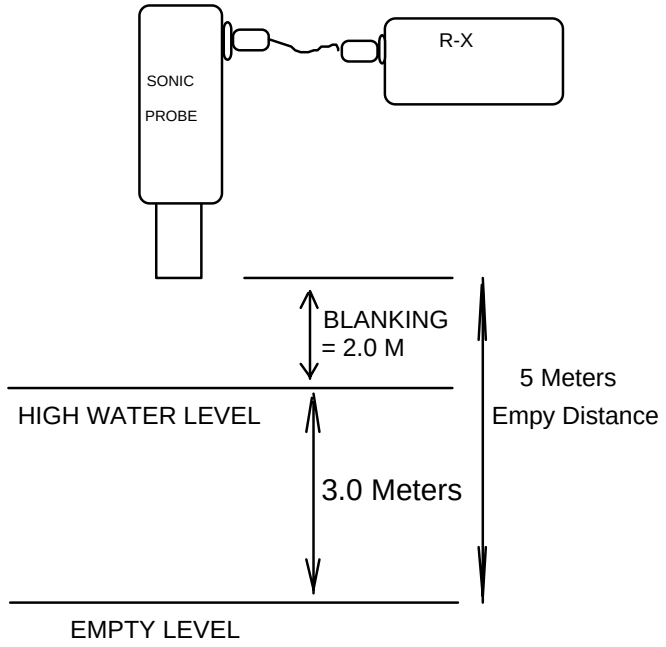


Figure 5 Example Field Installation.

From the previous example the SPM-15 would be programmed as follows: BLANKING = 2 Meters, 4 mA = 0, 20 mA = 5. This can be done using the scrolling method of calibration as that stated in the SPM-15 manual. For calibration, the SPM-15 has to powered on continuously which can be done by selecting MONITOR, AUX ON in the LS-4 software. After entering the 4-20 mA levels and the blanking value ensure that the auxiliary is turned off by selecting AUX OFF.

The IP-420F & IP-SPM-15 converts the 4 to 20 mA output of The SPM-15 to 0.5 to 2.5 Volts. The 4 - 20 mA output of The SPM-15 is proportional to some type of engineering units. For example 0 meters can generate a 4 mA signal and 5 meters a 20 mA signal. The following table in Fig. 7 A represents the voltage unit pairs that are to be entered in the sensor library's *least squares curve fitting* in the LS-4 software. Example 7A will translate the SPM-15 's 4-20mA signal to give the distance in meters from the transducer to the water surface. To get the datalogger readings to give water level in meters enter the voltage unit pairs as in Figure 7 B. Note that the voltage unit pairs are inverted from the previous example.

(A) Voltage unit pair to give distance from the transducer to water from Figure 5 (example field installation)

mA output	Voltage	METERS	Inches H_2O
4.0	0.5	0.0	0.0
20.0	2.5	5.0	118.91

(B) Voltage unit pair to give water level from Figure 5 (example field installation

mA output	Voltage	METERS	Inches H_2O
4.0	0.5	5.0	118.91
20.0	2.5	0	0

Fig. 7 Voltage Unit Pairs entered in to LS-4 Library

From the previous tables we can see that the sensor ranges from 0" to 3 M for a 4 to 20 mA output. This can be entered directly into the Library. By using many values that are actually measured over the sensor's range, it is possible to generate a more accurate curve fit. This can be done by connecting the sensor to the IP-420F Input Plug that is connected to a datalogger. Program the analog channel connected to the IP-420F to read in volts. Monitor the voltage in the Monitor screen while the sensor is at zero engineering units. Slowly increase the sensor's output and record the Monitor screen voltage value along with the sensor's current engineering unit (what the sensor is measuring). These values should be evenly spaced from 0% to 100% of the sensors span. After you have recorded 2 to 60 points they can be entered into the library.

1.5 SPM-15 Field Set-Up

The SPM-15 is typically installed in a stilling well with a Lakewood Systems datalogger. Before the IP-SPM-15 and IP-420F interface is connected to the datalogger the following procedures should be followed:

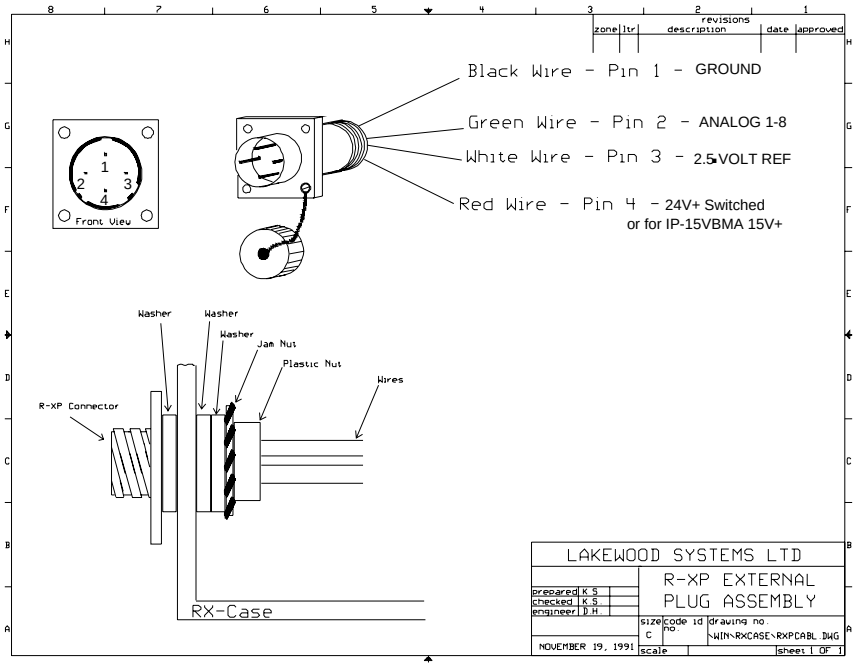
The SPM-15 should now have its 4-20mA levels and blanking values set by using the scrolling method of calibration. Then enter the desired voltage unit pairs into the LS-4 sensor library to create engineering units, and create a datalogger program with a header as in Figure 4. The IP-SPM-15 or the IP-420F can now be connected to the datalogger and the IP-X plug connected to the SPM-15.

With the proper format file active, the system can be tested by manually raising or lowering the SPM-15 and observing the datalogger readings in the 'MONITOR' mode. This can be done by selecting 'MONITOR', 'MONITOR' in the LS-4 Software. To verify the dataloggers operation the dataloggers reading should match the readings on the display of the SPM-15. Due to the damping factor programmed into the SPM-15 from the factory, it may take time for the readings to stabilize once the SPM-15 is moved.

1.6 R-XP External Plug Assembly and IP-SPM-15 AND IP-420F

The IP-SPM-15 AND IP-420F can be wired to an *Ultra-Logger* directly through the UL16-TB Terminal Board by using an R-XP External Plug Assembly. The wiring and mounting information is shown in Fig. 7.

Fig. 7 R-XP Wiring and Mounting Information



1.7 Wiring an IP-SPM-15 and IP-420F to a SPM-15

The IP-SPM-15 and IP-420F can be wired to a large assortment of sensors. The wiring to a SPM-15 is shown in Fig. 8.

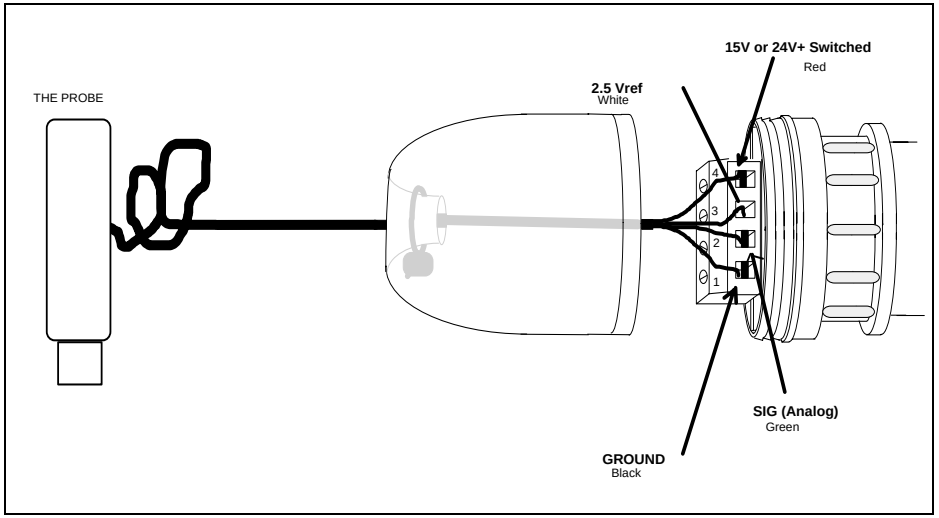


Fig. 8 SPM-15 Wiring Connections to IP-SPM-15 AND IP-420F.

1.8 Battery Life Table for SPM-15 Connected to Lakewood Systems R-X Data Storage Unit

Battery Size = 2.3 Ahr 24 Volts LE8304 & RSM
Sleep Current = 150 uA
Sample Current Max. = 60 mA
Length of Sample = 8.03 Seconds

SAMPLE RATE			BATTERY LIFE			POWER CONSUPTION mAH/Day		
Sec.	Min.	HR.	Days	Months	Years	Sampling	Sleeping	Total
1			0.20	0.01	0.00	11520.000	-25.200	11494.8
2			0.40	0.01	0.00	5760.000	-10.800	5749.2
5			1.00	0.03	0.00	2304.000	-2.160	2301.84
10			2.00	0.07	0.01	1152.000	0.720	1152.72
15			2.99	0.10	0.01	768.000	1.680	769.68
20			3.98	0.13	0.01	576.000	2.160	578.16
30			5.95	0.20	0.02	384.000	2.640	386.64
45			8.88	0.29	0.02	256.000	2.960	258.96
	1		11.79	0.39	0.03	192.000	3.120	195.12
	2		23.15	0.76	0.06	96.000	3.360	99.36
	5		54.89	1.80	0.15	38.400	3.504	41.904
	10		101.09	3.31	0.28	19.200	3.552	22.752
	15		140.52	4.61	0.38	12.800	3.568	16.368
	20		174.56	5.72	0.48	9.600	3.576	13.176
	30		230.37	7.55	0.63	6.400	3.584	9.984
	45		292.77	9.60	0.80	4.267	3.589	7.856
		1	338.63	11.10	0.93	3.200	3.592	6.792
		2	442.65	14.51	1.21	1.600	3.596	5.196
		3	493.14	16.17	1.35	1.067	3.597	4.664
		4	522.96	17.15	1.43	0.800	3.598	4.398
		5	542.66	17.79	1.49	0.640	3.598	4.2384
		6	556.63	18.25	1.53	0.533	3.599	4.132
		8	575.14	18.86	1.58	0.400	3.599	3.999
		12	594.93	19.51	1.63	0.267	3.599	3.866
		24	616.13	20.20	1.69	0.133	3.600	3.733

1.9 Specifications

Parameter	Min.	Typical	Max.	Units
Output	4		20	mA
Measurement Range	0.25		5	M
Power Consumption	4		20	mA
Excitation Voltage	12	15	28	Volts
Operating Temperature	-40	25	60	°C
Accuracy		+/-12.5		mm

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