The World Leader in Vibrating Wire Technology

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Installation Instructions

Model 8020-42

Single Coil Autoresonant Adapter

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1. INTRODUCTION

The Geokon 8020-42 Single Coil Autoresonant Adapter (SCA) is a device that allows single coil vibrating wire gages to be driven in the “Autoresonant” mode, instead of the standard “Pluck and Read” mode. The benefits of Autoresonant vs. Pluck and Read topologies are many, including greater reading stability and wider dynamic bandwidth. In addition, since there is no asynchronous swept frequency or pulse pluck excitation to interfere with the vibrating wire signal, there is the ability to read the gage frequency with a general-purpose frequency counter or low cost datalogger, instead of a complex dedicated readout device or datalogger.

Historically, autoresonant vibrating wire gages have employed two coils. The first is the Transmit (excitation) coil that provides a phase synchronous pulse (pluck) to maintain oscillation, while the second is the Receive (reading) coil that recovers the vibrating wire signal. The two-coil approach, while dependable, adds considerably to the cost and imposes a considerable mechanical limitation to the design and construction of the gage. Since the SCA is designed to operate as a “transceiver” using only one coil, these limitations are eliminated while providing the benefits of the autoresonant mode.

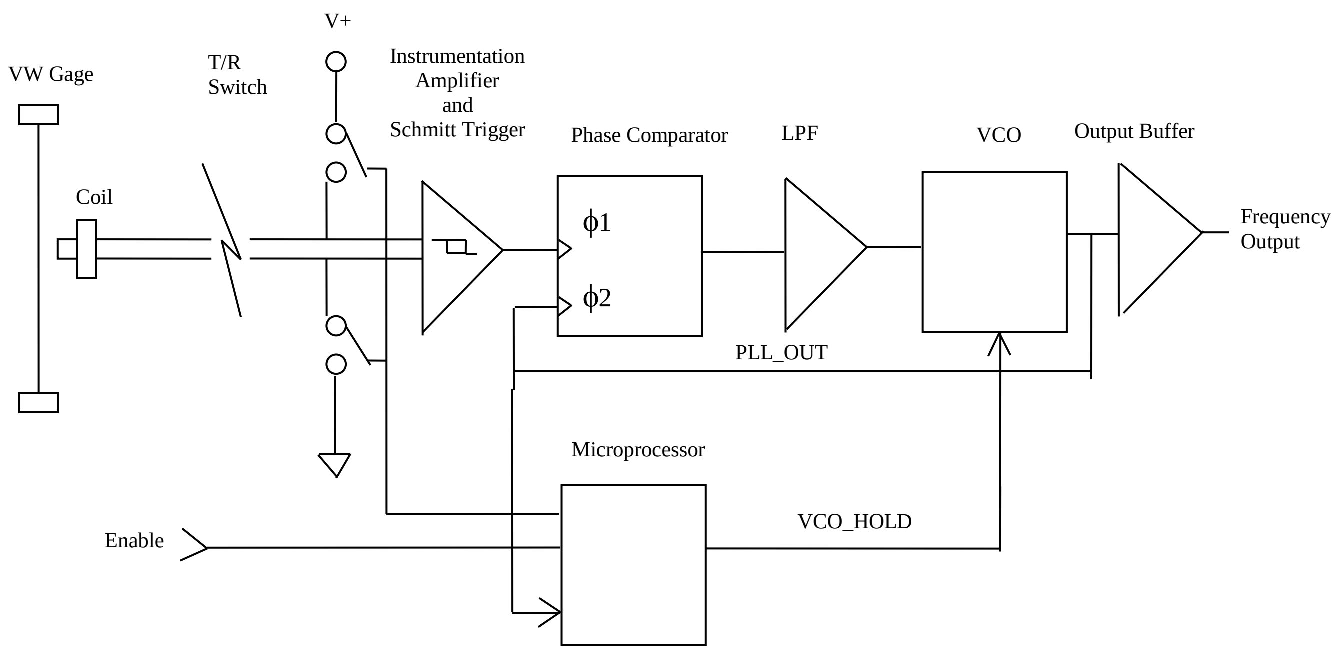

Figure 1 - Block Diagram

2. CONNECTIONS

Connector Position	Signal Name	Signal Description	Type	Level (typ.)
1	T	Temperature Proportional Voltage	Output	0 – 5 VDC
2	F1	Vibrating Wire Gage Frequency	Output	200mv(pp)
3	EX	Swept Frequency Thermistor Excitation	Input	5V CMOS 0-5VDC (max)
4	+12V	+12V Power Supply	Power Input	5.5 – 15.0 VDC (+12V nominal)
5	GND	Ground	Power Input	0V
6	T+	3kΩ @ 25° C Thermistor + input	Input	0 – 5 VDC (max)
7	T-	3kΩ @ 25° C Thermistor – input	Input	0 – 5 VDC (max)
8	C+	Vibrating wire Gage Coil +	Input / Output	1mv(pp) / 4v(pk)
9	C-	Vibrating wire Gage Coil -	Input / Output	1mv(pp) / 4v(pk)
10	ENABLE	Enable (Micro-10 configuration)	Input	5V CMOS
11	CLOCK	Clock (Micro-10 configuration) Enable (Generic Datalogger configuration)	Input	5V CMOS
12	F2	Vibrating Wire Gage Frequency	Output	5V(pp) @ 50Ω

Table 1 - Connector/Signal Description

NOTE: Because the 8020-42 requires each vibrating wire gage to have its own pair of twisted leads, the 8020-42 is not compatible with Geokon models 4900 (VW Load Cell) and 4350-3 (Biaxial Stressmeter).

3. CONFIGURATIONS

3.1 Micro-10 Datalogger Configuration

The 8020-42 can be incorporated as the vibrating wire interface in a Micro-10 Datalogger system, taking the place of the Campbell Scientific Inc. AVW-1. In order to configure the 8020-42 for the Micro-10 Datalogger, internal jumpers JP1, JP2 and JP3 must be set across pins one and two. Remove the cover of the 8020-42 and set the jumpers:

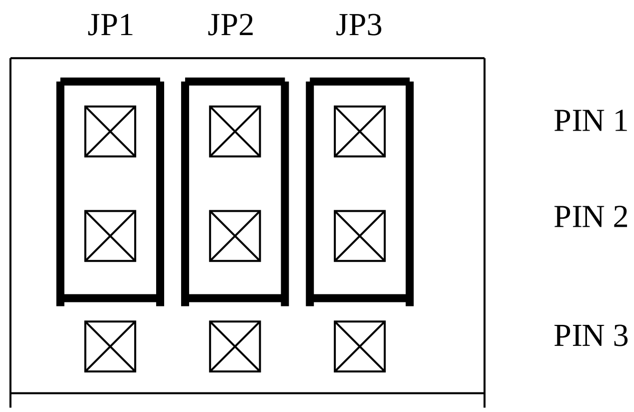

Figure 2 - Internal Jumper Settings for Micro-10 Configuration

Between readings, the 8020-42 will be "asleep", drawing approximately 20μA from the 12V system battery.

When it is time to take a reading, the datalogger will set C1..C7 (ENABLE) high in order to enable the respective multiplexer, and the individual channels are clocked by pulsing C8 (CLOCK) high.

When "ENABLE" and "CLOCK" are both high, the 8020-42 will wake up and wait for the swept frequency excitation signal to appear at EX. The 8020-42 will track and apply this swept frequency to the VW gage. Once the swept frequency is complete, the 8020-42 will lock onto the returned VW signal and maintain excitation by applying one excitation pulse for every 16 cycles of VW frequency. The VW frequency is provided as both a 200mv(pp) signal at F1, and as a 5v(pp) 50Ω output at F2

It is helpful to add a small amount of delay (≈ 0.5 Sec.) from the time that the swept frequency excitation ends and the time that the reading is taken. MultiLogger software, ver. 1.4.0 and above provides this delay when selecting a gage type that has the letters sca included within it, e.g., 4500sca, 4700sca etc.

Connector Position	Signal Name	Signal Description	CR-10 Connection
1	T	Temperature Proportional Voltage	1L
2	F1	Vibrating Wire Gage Frequency	1H*
3	EX	Swept Frequency and Thermistor Excitation	E1
4	+12V	+12V Power Supply	12V
5	GND	Ground	AG
6	T+	3kΩ @ 25° C Thermistor + input	From MUX COM_ HI_2
7	T-	3kΩ @ 25° C Thermistor – input	From MUX COM_ LO_2
8	C+	Vibrating wire Gage Coil +	From MUX COM_HI_1
9	C-	Vibrating wire Gage Coil -	From MUX COM_LO_1
10	ENABLE	Enable (Micro-10 configuration)	C1..C7
11	CLOCK	Clock (Micro-10 configuration) Enable (Generic Datalogger configuration)	C8
12	F2	Vibrating Wire Gage Frequency	1H*

Table 2 - Micro-10 Configuration/Connections

*Either F1 or F2 can be used to connect to the CR-10 1H input.

3.2 Generic Datalogger Configuration

The 8020-42 can be incorporated as the vibrating wire interface for any datalogger that is capable of reading a frequency input and has the ability to output a single 5V CMOS level control signal. In order to configure the 8020-42 for a generic Datalogger, internal jumpers JP1and JP3 must be set across pins two and three, while JP2 is set across pins one and two. Remove the cover of the 8020-42 and set the jumpers:

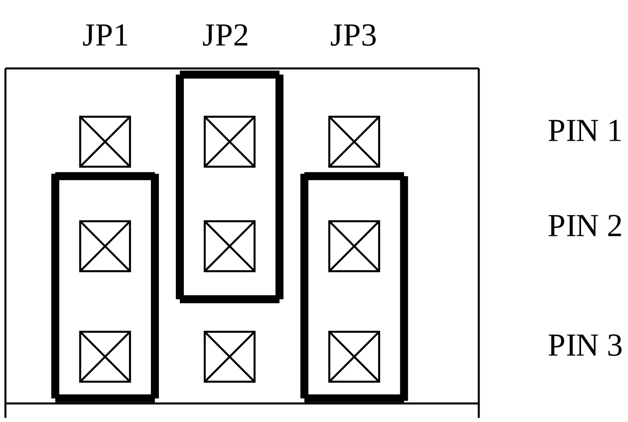

Figure 3 - Internal Jumper Settings for Generic Datalogger Configuration

Between readings, the 8020-42 will be “asleep”, drawing approximately 20µA from the 12V system battery.

When it is time to take a reading, the datalogger will set its control signal, which should be connected to CLOCK, high. When CLOCK goes high, the 8020-42 will generate a 400-4500 Hz swept frequency pluck in order to excite the VW gage. As with the Micro-10 configuration, once the swept frequency is complete, the 8020-42 will lock onto the returned VW signal and maintain excitation by applying one excitation pulse for every 16 cycles of VW frequency. The VW frequency is provided as both a 200mv(pp) signal at F1, and as a 5v(pp) 50Ω output at F2.

The 8020-42 will provide continuous VW frequency output until the CLOCK control line is brought low. At this time, the 8020-42 will go back to sleep

Connector Position	Signal Name	Signal Description	Generic Datalogger Connection
1	T	Temperature Proportional Voltage	See Appendix B
2	F1	Vibrating Wire Gage Frequency (200mv/pp)	Frequency input to Datalogger
3	EX	Thermistor Excitation	See Appendix B
4	+12V	+12V Power Supply	12V
5	GND	Ground	Ground
6	T+	3kΩ @ 25° C Thermistor + input	From Thermistor
7	T-	3kΩ @ 25° C Thermistor – input	From Thermistor
8	C+	Vibrating wire Gage Coil +	From VW gage
9	C-	Vibrating wire Gage Coil -	From VW gage
10	ENABLE	Enable (Micro-10 configuration)	N/A
11	CLOCK	Clock (Micro-10 configuration) Enable (Generic Datalogger configuration)	5V CMOS control from datalogger
12	F2	Vibrating Wire Gage Frequency (5v(pp) @ 50Ω)	Frequency input to Datalogger

Table 3 - Generic Datalogger Configuration/Connections

3.3 Stand Alone Configuration

When configured in the Stand Alone mode, the 8020-42 will provide continuous excitation and frequency output from a single Vibrating Wire gage. All that is needed is a 12V (nominal) voltage source and a frequency counter to read the VW frequency. In order to configure the 8020-42 for Stand Alone mode, internal jumpers JP1, JP2 and JP3 must be set across pins two and three. Remove the cover of the 8020-42 and set the jumpers:

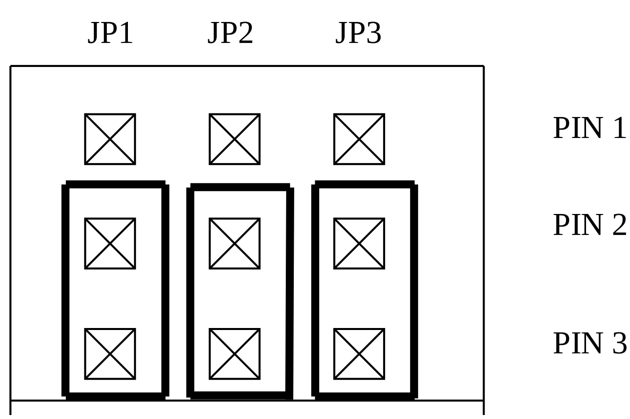

Figure 4 - Internal Jumper Settings for Stand Alone Configuration

Connector Position	Signal Name	Signal Description	Connection
1	T	Temperature Proportional Voltage	See Appendix B
2	F1	Vibrating Wire Gage Frequency (200mv/pp)	To Frequency Counter
3	EX	Thermistor Excitation	See Appendix B
4	+12V	+12V Power Supply	12V
5	GND	Ground	Ground
6	T+	3kΩ @ 25° C Thermistor + input	From Thermistor
7	T-	3kΩ @ 25° C Thermistor – input	From Thermistor
8	C+	Vibrating wire Gage Coil +	From VW gage
9	C-	Vibrating wire Gage Coil -	From VW gage
10	ENABLE	Enable (Micro-10 configuration)	N/A
11	CLOCK	Clock (Micro-10 configuration) Enable (Generic Datalogger configuration)	N/A
12	F2	Vibrating Wire Gage Frequency (5v(pp) @ 50Ω)	To Frequency Counter

Table 4 - Stand Alone Configuration/Connections

APPENDIX A. SPECIFICATIONS

POWER	
Power Requirements:	6-15 VDC (12V nominal)
Current Consumption:	**Sleep:** 30 µA (max.), 20µA (typ.) **Plucking:** 50 mA peak **PLL locked:** 30 mA (max.), 22 mA (typ.)
PLL Capture Range:	1200 – 4000 Hz
PLL Lock Range:	1150 – 4500 Hz
Internally Generated Fsweep:	**Frequency (start):** 400 Hz **Frequency (end):** 4500 Hz **Sweep Duration:** 750 mSec **Sweep Shape:** Linear
Frequency Outputs:	**F1:** 200mV(pp) 1kΩ AC coupled **F2:** 5V(pp) 50Ω AC coupled
Thermistor Output:	**T:** Temperature Proportional Voltage (0-5V)
Control Inputs:	**ENABLE:** 5V CMOS **CLOCK:** 5V CMOS **EX:** 5V CMOS: VW excitation 0-5V (max): Thermistor Excitation
ENVIRONMENTAL	
Temperature range:	0 - 70 °C

Table 5 - Specifications

APPENDIX B. TEMPERATURE MEASUREMENT

The temperature of the gage itself can be determined by measuring the temperature proportional voltage output at **T,** use that voltage to determine the resistance value of the gage thermistor, and then input that value into the Steinhart and Hart log equation. For example, with 2.5 Volts connected to **EX,** and the voltage measured at **T** = 1.4025 V:

1. Determine the current (Ith) flowing through the thermistor (note: Rint1(5k) and Rint2(1k) are internal to the SCA):

I (th)=T/Rint1⇒ I(th)=1.4185V/5,000Ω⇒ I(th) = 283.7 uA

2. Determine the resistance (Rth) of the gage thermistor:

R(th) = (EX-T)/I(th) – Rint2 ⇒ R(th) = ((2.5 – 1.4185)/283.7E-6) - 1000⇒

R(th) = 3812.13Ω - 1000⇒ R(th) = 2812.13Ω

3. Determine the temperature using the Steinhart and Hart linearization equation:

$$T=\frac{1}{A+B(LnR)+C(LnR)^3}-273.2$$

Equation 1 - Resistance to Temperature

Where;
T = Temperature in °C.
LnR = Natural Log of Thermistor Resistance.
$A = 1.4051 \times 10^{-3}$
$B = 2.369 \times 10^{-4}$
$C = 1.019 \times 10^{-7}$
Note: Coefficients calculated over the –50 to +150° C. span.

Thermistor Type: YSI 44005, Dale #1C3001-B3, Alpha #13A3001-B3
Resistance to Temperature Equation

Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp
201.1K	-50	16.60K	-10	2417	+30	525.4	+70	153.2	+110
187.3K	-49	15.72K	-9	2317	31	507.8	71	149.0	111
174.5K	-48	14.90K	-8	2221	32	490.9	72	145.0	112
162.7K	-47	14.12K	-7	2130	33	474.7	73	141.1	113
151.7K	-46	13.39K	-6	2042	34	459.0	74	137.2	114
141.6K	-45	12.70K	-5	1959	35	444.0	75	133.6	115
132.2K	-44	12.05K	-4	1880	36	429.5	76	130.0	116
123.5K	-43	11.44K	-3	1805	37	415.6	77	126.5	117
115.4K	-42	10.86K	-2	1733	38	402.2	78	123.2	118
107.9K	-41	10.31K	-1	1664	39	389.3	79	119.9	119
101.0K	-40	9796	0	1598	40	376.9	80	116.8	120
94.48K	-39	9310	+1	1535	41	364.9	81	113.8	121
88.46K	-38	8851	2	1475	42	353.4	82	110.8	122
82.87K	-37	8417	3	1418	43	342.2	83	107.9	123
77.66K	-36	8006	4	1363	44	331.5	84	105.2	124
72.81K	-35	7618	5	1310	45	321.2	85	102.5	125
68.30K	-34	7252	6	1260	46	311.3	86	99.9	126
64.09K	-33	6905	7	1212	47	301.7	87	97.3	127
60.17K	-32	6576	8	1167	48	292.4	88	94.9	128
56.51K	-31	6265	9	1123	49	283.5	89	92.5	129
53.10K	-30	5971	10	1081	50	274.9	90	90.2	130
49.91K	-29	5692	11	1040	51	266.6	91	87.9	131
46.94K	-28	5427	12	1002	52	258.6	92	85.7	132
44.16K	-27	5177	13	965.0	53	250.9	93	83.6	133
41.56K	-26	4939	14	929.6	54	243.4	94	81.6	134
39.13K	-25	4714	15	895.8	55	236.2	95	79.6	135
36.86K	-24	4500	16	863.3	56	229.3	96	77.6	136
34.73K	-23	4297	17	832.2	57	222.6	97	75.8	137
32.74K	-22	4105	18	802.3	58	216.1	98	73.9	138
30.87K	-21	3922	19	773.7	59	209.8	99	72.2	139
29.13K	-20	3748	20	746.3	60	203.8	100	70.4	140
27.49K	-19	3583	21	719.9	61	197.9	101	68.8	141
25.95K	-18	3426	22	694.7	62	192.2	102	67.1	142
24.51K	-17	3277	23	670.4	63	186.8	103	65.5	143
23.16K	-16	3135	24	647.1	64	181.5	104	64.0	144
21.89K	-15	**3000**	**25**	624.7	65	176.4	105	62.5	145
20.70K	-14	2872	26	603.3	66	171.4	106	61.1	146
19.58K	-13	2750	27	582.6	67	166.7	107	59.6	147
18.52K	-12	2633	28	562.8	68	162.0	108	58.3	148
17.53K	-11	2523	29	543.7	69	157.6	109	56.8	149
								55.6	150

Table 6 - Thermistor Resistance Versus Temperature