

Understanding Simple Logger® Data Loggers

The Simple Logger® is a battery powered single channel recording device.

The Simple Logger® operates in three modes: LOGGING, STANDBY and OFF. A red LED indicates the mode of operation; it double blinks in the LOGGING mode and single blinks in the STANDBY mode and is off (no blinks) in the OFF mode. A push-button marked <Press> on the label of the logger selects the mode of operation.

In the STANDBY mode the logger retains recorded information for transfer to a computer. In the OFF mode the memory is cleared and the microprocessor is inactive, requiring very little power from the battery. If the logger is turned off by mistake, the data can be recovered.

Analog information on the input is sampled and converted to a digital signal. This digital signal is processed and stored along with scale and time information. A serial port provides for transfer of data from internal memory to the computer for analysis. Figure 1 shows a block diagram of the Simple Logger®.

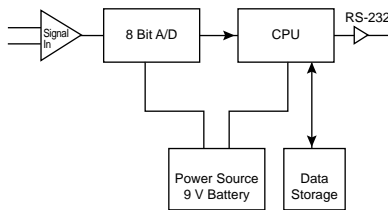


Figure 1. Simple Logger® Block Diagram

Automatic Scaling

Simple Logger® employs a unique method of Auto-Ranging its scale to provide you with the best possible resolution for the recording session. Data logging always starts with the highest resolution and the lowest scale range. The overall scale is divided into four ranges. A maximum of three scale changes is provided for in the data logger to coincide with the four scale ranges. The scale ranges are as follows:

- | | |
|----------------------------------|---------------------------------|
| Range 1: 0 – 12.5% of full scale | Range 3: 0 – 50% of full scale |
| Range 2: 0 – 25% of full scale | Range 4: 0 – 100% of full scale |

Whenever a recorded value crosses over to a higher scale range, the logger increases its scale range by a factor of two and repeats the reading.

Simple Logger® has 250 steps in each scale range. Resolution can be calculated by dividing the scale range in use by 250.

Maximum resolution occurs when all the recorded samples stay within the lowest scale range. Figure 2 shows the relationship between scale range and resolution.

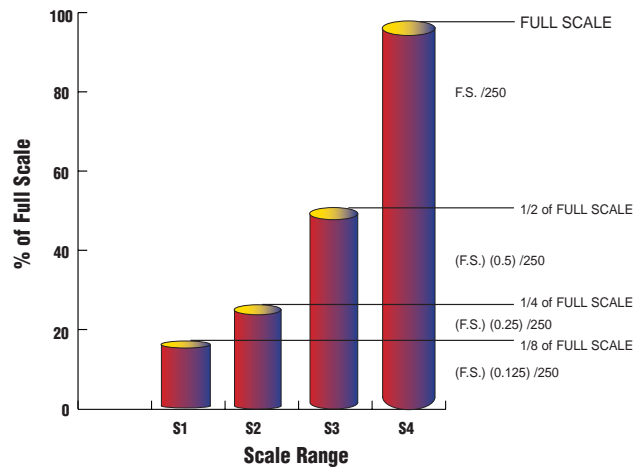


Figure 2. Relationship Between Scale Range and Resolution

Example 1: You have a Model L100 logger which has a full scale value of 1000A. The recording stayed between 60 and 120A for the entire session which indicates that all data is contained in the lowest scale range.

Therefore the resolution is:

$$= \frac{(F.S.) (12.5\%)}{250} = \frac{(1000)(.125)}{250} = \frac{125}{250} = 0.5A$$

Example 2: You have a Model L100 logger which has a full scale value of 1000A. The recording varied between 110 and 225A for the entire session which represents 1 range change.

Therefore the resolution is:

$$= \frac{(F.S.) (25.0\%)}{250} = \frac{(1000)(.250)}{250} = \frac{250}{250} = 1.0A$$

NOTE: Probes that do not have a 1V or 1A output at full scale need to have the reading normalized to 1.

For example, the MD314 current probe has a maximum reading of 500A, and the voltage output at 500A is 0.5V; therefore the following applies:

$$\frac{1}{\text{Voltage Output}} = \frac{1}{0.5} = 2$$

Therefore FS = 500A x 2 = 1000A

See Table 1 for resolutions available on each model with respect to scale changes.

For best resolution, avoid including in the recording session signals that are above the range of interest. For example, when recording the temperature of a freezer, allow the sensor to cool before starting recording. Also, if an input cable is being used, make sure that it is securely plugged in throughout the period of the recording. If the logger is taking a reading as the input cable is being inserted or removed, unwanted rescaling may result. When measuring AC current, be sure to

clamp the probe around the conductor to be measured before starting the recording session.

Auto-scaling for temperature loggers works slightly different. The chart in Figure 3 shows the relationship between scale

range and resolution. To calculate resolution first determine the delta temperature during the recording session to pick the appropriate range curve. Next, find the temperature point on the range curve to determine resolution. You may also use the table to the left of the curve for this purpose.

Model	Full Scale Value	Units	Resolution			
			S1	S2	S3	S4
L100, L110	10	Amps	0.005	0.01	0.02	0.04
	100	Amps	0.05	0.1	0.2	0.4
	500*	Amps	0.5	1	2	4
	1000	Amps	0.5	1	2	4
	3000	Amps	1.5	3	6	12
CL600	600	Amps	0.5	1	2	4
L320	25	mAmps	0.025	0.025	0.05	0.1
L205	25	Volts	0.012	0.025	0.051	0.102
L215	255	Volts	0.125	0.25	0.5	1
L220	255	Volts	0.125	0.25	0.5	1
L230**	300	Volts	0.25	0.5	1	2
L260**	600	Volts	0.5	1	2	4
L430	10	Volts	0.005	0.01	0.02	0.04
L605	Temperature °C		See Figure 4			
L410	100	MILI-VOLTS	0.05mV	0.1mV	0.2mV	0.4mV

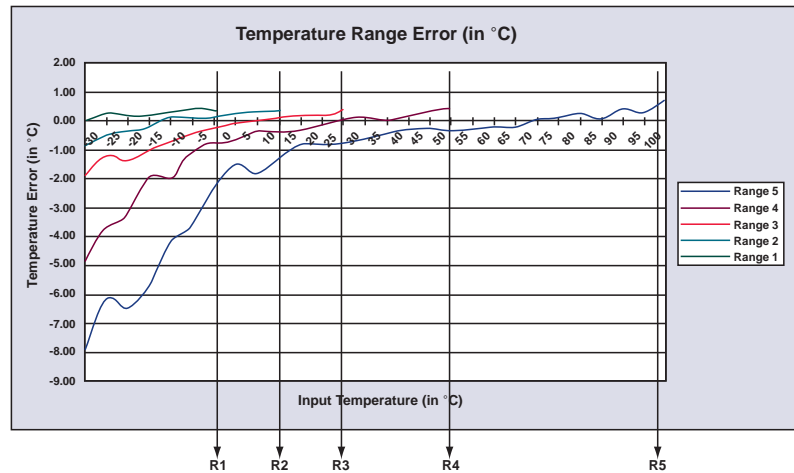
*The 500A Probe MD314 provides 0.5V out at full scale.
 **Resolution is based on 500V full scale for L230 and 1000V Full Scale for L260

Time Extension Recording™ (TXR™)

Time Extension Recording™(TXR™) is an automatic process that updates the sample rate and the number of stored data points based on the length of the recording. The maximum number of stored data points is 8192. When Simple Logger® starts a new recording session, it does so at its fastest sample rate of 4096 points per hour (0.88 seconds per point). Simple Logger® can record at this rate for two hours. If the recording session continues beyond two hours, the time extension recording technique becomes active. Beginning with the sample, after the completion of two hours of recording, Simple Logger® continues recording by selectively overwriting previously stored data. Simple Logger® also halves its sample rate to 2048/hr (1.76 seconds per point) for the new stored values to be compatible with the previously recorded values. Recording continues for the next two hours at this new rate until the remaining 4096 storage points are filled. See Figure 4.

Table 1. Resolution vs. Scale Range

Test Range	Range 5	Range 4	Range 3	Range 2	Range 1
-35	-7.92	-4.83	-1.87	-0.85	0.02
-30	-6.20	-3.62	-1.24	-0.45	0.23
-25	-6.46	-3.20	-1.35	-0.35	0.17
-20	-5.66	-1.92	-0.99	-0.21	0.20
-15	-4.16	-1.95	-0.75	0.12	0.32
-10	-3.58	-1.03	-0.43	0.06	0.43
-5	-2.30	-0.75	-0.26	0.15	0.36
0	-1.52	-0.73	-0.07	0.27	
5	-1.82	-0.33	0.01	0.29	
10	-1.28	-0.37	0.10	0.33	
15	-0.80	-0.31	0.24		
20	-0.84	-0.16	0.19		
25	-0.77	0.07	0.38		
30	-0.63	0.13			
35	-0.43	0.04			
40	-0.32	0.15			
45	-0.25	0.37			
50	-0.33	0.44			
55	-0.28				
60	-0.21				
65	-0.19				
70	0.05				
75	0.10				
80	0.26				
85	0.10				
90	0.40				
95	0.30				
100	0.74				



R1, 2, 3, 4 & 5 = range boundaries

Figure 3. Temperature Resolution Curves

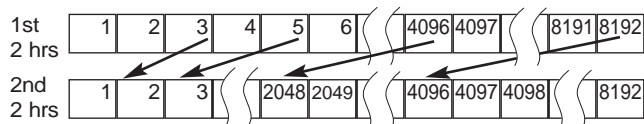


Figure 4. Time Extension Memory Allocation

Sample Rate Per Hr.	Seconds per Sample	Total Recording Time (hrs)	Total Recording Time (days)
4096	0.88	2	0.083
2048	1.76	4	0.167
1024	3.52	8	0.333
512	7.04	16	0.667
256	14.08	32	1.333
128	28.16	64	2.667
64	56.32	128	5.333
32	112.64	256	10.667
16	225.28	512	21.333
8	450.56	1024	42.667
4	901.12	2048	85.333
2	1802.24	4096	170.667
1	3604.48	8192	341.333

Table 2. Sample Rate vs. Recording Time

The Time Extension Recording™ process of selectively overwriting previously stored data and halving the sample rate for new stored data continues every time the memory fills up. Table 2 shows the relationship between recording time and sample rate for Simple Logger® using this technique.

Recording continues in this manner until the battery wears out or recording is stopped. For convenience in data analysis, the recording interval takes on values of fifteen minutes, one-half hour, one hour and so on.

Like automatic scaling, time extension recording is practically invisible to the user. For best results, stop the recording when the measurement is completed, both to avoid including unwanted information in the plot, and to provide maximum resolution for the period of interest.

***Accuracy**

Reference Conditions 23°C ± 3°K, 20-75% RH, DC or 50/60 Hz, no external AC magnetic field, DC magnetic ≤ 40A/m (earth field), supply 9V Alkaline battery.

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