Miratron 8 Series Wireless Data Radios
Sensor Selection and Battery Life Optimization

Miratron T8-DLX and T8-LTE radios provide fully wireless transmission of data from a wide range of environmental and energy sensors with industry standard voltage or milliamp outputs. The T8 series are battery powered, and equipped with an internal 12vdc power supply to provide excitation voltage for externally connected sensors. When selecting sensors to be used with the T8 series transmitters, certain considerations must be made to optimize performance and battery life.

Some sensors can draw significant current from the T8 battery. Consequently, not all sensors are well suited to battery powered applications. In general, battery life is a function of three factors:

1. The current required to operate the sensor.
2. The length of time the sensor must be powered on to "warm up" before a stable reading can be made.
3. How frequently the sensor needs to be read to provide meaningful data for the application.

The T8-DLX and T8-LTE feature programmable on-time and measurement interval times for powering sensors. These settings need to be set appropriately to ensure accurate readings and best battery life.

An ideal sensor for battery powered applications requires little or no power and provides a stable reading very shortly after being powered on.

Thermistor type temperature sensors are well suited to battery powered applications. Thermistors require very little current and stabilize quickly. Self-powered and low-power sensors that induce power from the monitored source or harvest energy from the environment are also ideal.

All other sensors must be evaluated for suitability in battery powered systems. Sensor operating current and minimum warm-up time must be determined as well as the measurement interval needed for the application in order to calculate battery life.

Once the sensor current, warm-up time, and measurement interval are determined, battery life estimates can be made using the following calculations:

Step 1: Calculate duty cycle.

Duty Cycle = On Time / Measurement Interval.

Note: "On Time" or warm-up time is the amount of time it takes the sensor to stabilize after being powered on. This should not be confused with response time, which refers to the stimulus the sensor is measuring (e.g. Pressure, Humidity, Power, etc.)

Example: A sensor that is to be read once every minute and requires a warm-up time of one second to stabilize before an accurate reading can be made will have a duty cycle of (1 second / 60 seconds) = 0.017 (1.7%)

Some sensors may require more or less time to provide a stable, accurate reading. If the minimum warm up time for the sensor is not specified, it may have to be determined experimentally, or inquired of the sensor manufacturer.

Step 2: Calculate average current.

Average Current = Current (mA) x Duty Cycle.

Example: A 4-20mA loop-powered (2-wire) sensor will require up to 20mA when the reading is at the maximum range. The average current in this case using a duty cycle of 1.7% as calculated in the previous step is (20mA x 0.017) = 0.34mA.

Other sensor types should have the current requirement specified by the manufacturer.

Step 3: Calculate battery life.

Battery Life = Battery Ampacity (mAh) / Average Current (mA)

Example: For estimating purposes, the T8-DLX and T8-LTE batteries have a useful ampacity of approximately 2000mAh. At the average current calculated in the previous step, the battery life in this example would be (2000mAh / 0.34mA) = 5,882 hours, or about 8 months.

The following table shows example battery life calculations for a range of sensor currents, warm-up times, and measurement intervals:

Battery Life Estimates				
Sensor Current	**Warm-up time**	**Interval**	**Avg Current**	**Battery Life**
1mA	0.1 second	1 second	0.1mA	2.3 years
		1 minute	0.0017mA	5 years*
	1 second	1 second	1mA	83 days
		1 minute	0.017mA	5 years*
10mA	0.1 second	1 second	1mA	83 days
		1 minute	0.017mA	5 years*
	1 second	1 second	10mA	8 days
		1 minute	0.17mA	1.3 years
100mA	0.1 second	1 second	10mA	8 days
		1 minute	0.17mA	1.3 years
	1 second	1 second	100mA	20 hours
		1 minute	1.7mA	49 days

** Calculated battery life exceeds practical limits.*

The table above illustrates the importance of allowing only the minimum warm-up time that will assure an accurate reading and sampling as infrequently as the application will permit. Sensor choice and measurement interval selection can mean the difference between days and years of battery life.

Important: Estimates are for relative comparison only. Calculations are based on battery ampacity of 2000mAh and consider only sensor current consumption. Battery life is also a function of transmitter range and user selectable radio broadcast rate. Longer range (higher power) radio options and faster broadcast (ping) rates will also reduce battery life.

In cases where sensor current or performance requirements do not permit acceptable battery life, alternative power sources should be considered. This may include secondary batteries, or solar charging.

The T8-DLX and T8-LTE are both available with solar charging options. The integral solar panels are designed to extend battery life in outdoor locations where adequate sunlight is available. The following table shows typical solar charging characteristics for various sunlight conditions.

Daily Solar Contribution			
	Current	5 hrs./day	Avg/24 hrs.
Full Sun	25mA	125mAh	26mA
Indirect Sun	2.5mA	12.5mAh	2.6mA
Overcast	0	0	0

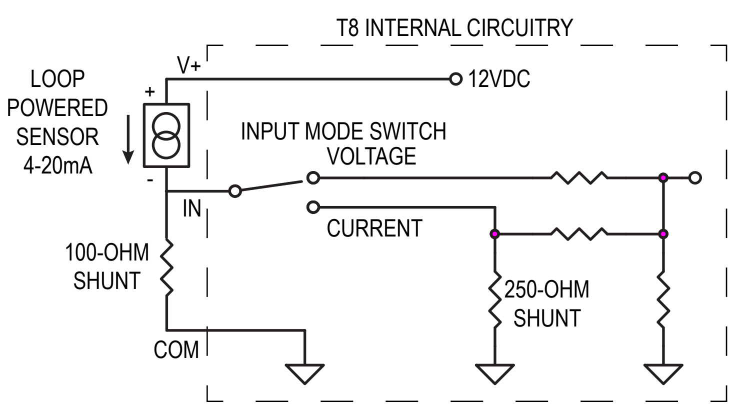
The table above illustrates that with 5 hours per day of sun, the solar panel can provide between 2.6mA and 26mA average charging current for a 24 hour period. This would be adequate to provide the power needed in many of the examples shown in the Battery Life Estimates table.

Other important considerations for sensor selection:

The T8 series provides 12 volts DC at a maximum current of 100mA. If more than one sensor is to be powered, the total current requirement must not exceed this 100mA limit.

When using loop-powered (2-wire) 4-20mA devices, the T8 series utilizes a 250-ohm shunt to convert the 4-20mA signal to a 1-5vdc signal. This means that full-scale readings of 20mA will produce a voltage drop of 5 volts across the shunt, leaving 7 volts (12 volt power supply - 5 volt drop) to power the sensor. This may not be adequate for some loop-powered sensors. One solution is to use a lower resistance external shunt and set the T8 input for voltage mode. A 100-ohm shunt will have only a 2 volt drop, leaving 10 volts to operate the sensor. The trade off is a smaller signal range resulting in diminished measurement resolution.

Alternate wiring for 4-20mA loop-powered (2-wire) sensors:



Connect external 100-ohm shunt between input and common (gnd) terminal.
Set input switch to voltage mode.
Scaling: 4-20mA = 0.4-2vdc

Consult factory for additional questions and details regarding T8 series transmitters and sensor selection.