Guide Features and Benefits

MACHINE MONITORING	Monitor machine inputs with up to four tower light modules (on up to 24 tower lights) and eight states (flashing or solid for each light module)
UP TIME	Track cumulative ON time for each light module for both flashing or solid independently
EVENT COUNTERS	Count the number of times each light module transitions from OFF to ON for both flashing or solid independently
PART COUNTING	Count parts produced or rejected using internal 32-bit register in TL70
REMOTE MASTER LIGHT	Use a master light to show combined status of all light modules
TIME STAMPED LOGGING	Time stamped logging of light statuses, timers, counts, and part counts to a local SD memory card.
SMS TEXT/EMAIL ALERTS	Generate SMS text and/or email alerts based on specific events
EFFICIENCY METRICS	Produce efficiency metrics with provided data (Avg. Availability, Production Speed, Production Quality, etc.)
CLOUD MONITORING	Push data to Cloud Webserver or PLC (via LAN or Cellular connection) for remote viewing, alerting, and logging.

Using a TL70 Modular Tower Light with a wireless radio base improves machine monitoring and overall equipment effectiveness (OEE) by expanding available data beyond the local indication a standard tower light provides. Beyond local indication, each TL70 can provide remote status of each light module, track the cumulative time ON for each light module, count the number of events each module has transitioned from the OFF to ON state, and count parts. This system provides the information necessary to react quickly to system changes and drive efficiency improvements based on data that was previously unavailable.

Equipment

| Model	Description
TL70DXN9XXXQ or TL70DXN2XXXQ (XXX is any combination of light colors)	EZ-LIGHT TL70 Wireless Modular Tower Light; select either 900 MHz or 2.4 GHz ISM radio to match the DXM100
DXM100-B1C1R1 or DXM100-B1C1R3	DXM100 Wireless Controller with Cell; select either 900 MHz or 2.4 GHz ISM radio to match the TL70

A PDF of this Solutions Guide is available at https://goo.gl/Vuw4wg

The following guide demonstrates how to bind the wireless tower lights to the DXM and load a preconfigured XML file and script to collect data from up to 24 wireless tower lights. The XML file only requires some minor modifications to be customized for any site.

Step 1: Bind the System and Assign Addresses

Binding the TL70s to the DXM100 establishes a secure connection between them and assigns a specific network address to each TL70 in the wireless network.

1. Apply power the TL70s.

   TL70s require a constant power source to maintain wireless communications with the DXM, unlike typical tower lights that use only machine power when lighting.
2. Apply power to the DXM.
3. On the DXM: Use the arrow button to select the **->ISM Radio** menu on the DXM's LCD. Press **Enter**.
4. Select **->Binding** and press **Enter**.
5. Select **Bind to > 1** (the first Node) and press **Enter**.
6. On TL70 Node 1: Remove the base section by grasping the lighting modules and twisting the base clockwise.
7. Triple-click the binding button.

   The LED flashes four times after it binds to the DXM. This Node is now bound as Node ID 1. Label the TL70 for future reference.
8. Reconnect the TL70's base to its light modules.
9. On the DXM: Press **Back** to return to the main menu.
10. To bind additional TL70s, select **Bind to > 2** and press **Enter**.
11. On TL70 Node 2: Repeat steps 6 through 9.
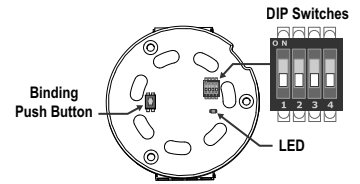
If more TL70s are being used in the system, continue binding in the same fashion until all TL70s are bound to the DXM with each having their own Node ID.

When you are finished binding, press **Back** on the DXM until the DXM returns to the main menu.

Step 2: Run a Site Survey

Verify the wireless connection between your TL70s and the DXM by running a site survey on the DXM100.

1. On the DXM: Use the arrow buttons to select the **->ISM Radio** menu. Push **Enter**.
2. Select the **->Site Survey** submenu, and press **Enter**.
3. Select each Node ID within the system to verify the wireless connection between the Node and the DXM.
4. When you are finished running the site survey, press **Back** twice to return to the main menu.

Step 3: Wire the TL70

Light Modules

Each TL70 requires its own dedicated 12–30 V dc power supply. The light modules also need to be triggered by the machine being monitored and wired as shown. The 5-pin base allows a maximum of three modules and the 8-pin base allows for four modules and part counting. A flashing condition is automatically detected as a separate state as long as it is between 0.8 Hz and 6 Hz.
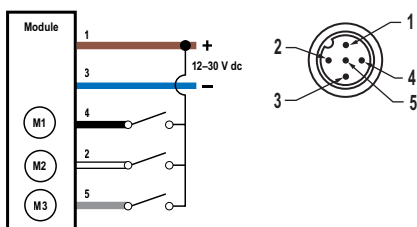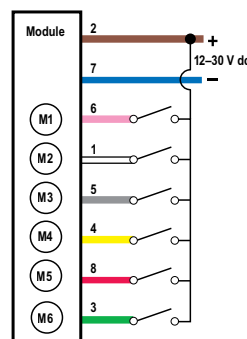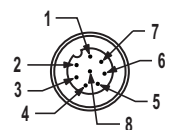
Part Counting

To use the TL70 for part counting, follow these steps:

1. Wire a sensing device with a PNP (sourcing) output (12–30 V dc), such as the QS18, QS30, Q4X, etc, into pin 8.
2. Change DIP switch 3 in the TL70 light base to the ON position.

When using the part counter, the measured signal must be greater than or equal to 25 ms.

The total counts are stored in the TL70 and reported to the master radio. A lost radio link or interruption in the radio signal to the DXM does not interrupt the part counting. As soon as the radio link re-establishes, the correct count is reported from the TL70 to the DXM.
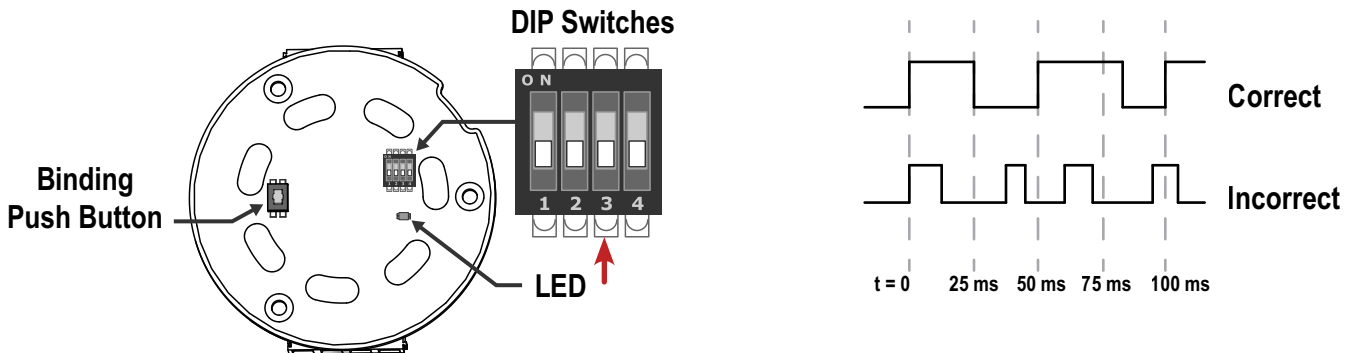
Step 4: Configure the System

To customize the system to an actual application, some basic modification to the template files is necessary. There are two files uploaded to the DXM: the XML file sets the DXM's initial configuration and the ScriptBasic file reads the status of light modules, controls the counting of each light, establishes a reset function for each TL70s timers and counts, and organizes the information in logical and easy to find registers in the DXM.

Loading these files and making adjustments requires the use of Banner's DXM Configuration Tool software and the machine monitoring files available via in the links below.

1. Download the preconfigured files. (https://goo.gl/fpg0tF)
2. Extract the ZIP files into a folder on your computer. Note the file location.
3. Connect the DXM, via the USB cable supplied with the DXM, to a computer containing the DXM Configuration Tool software or download the software and install it on a computer.
4. Launch the software.
5. Load the Machine Monitoring file (TL70) by going to the **File** > **Load** menu and choosing the configuration files.
6. Connect the software to the DXM by going to the **Device** > **Connection Settings** menu. Select **Serial** and then select the COM port that the USB cable is plugged into. Click Connect. If you are unsure which COM port is being used and multiple ports appear, attempt to connect to each one until you are successful.
7. Upload the Machine Monitoring file (TL70) by going to the **Settings** > **Scripting** screen. Click **Upload Script** and select the file.
8. Select the uploaded file in the window to the right of the **Upload Script** button. Click **Add Selected to Startup**; the DXM will run this script every time it restarts.
9. **Save** the XML file using the **File** > **Save** menu. Save the XML file any time the XML has been changed because the tool does not autosave.

Optional Steps: Customize the XML file

1. Within the DXM Tool, click on the **Local Registers** tab on the left side of the tool then click on **Local Registers in Use** tab along the top.

2. **Rename the Tower Lights** using the text boxes within the **Register Name** column. Because there are 25 registers per tower light to accommodate up to four modules per tower light, a timer for each module (flashing and solid), and a count for each module (flashing and solid), copy and paste names for efficiency.

   To display the tower light status on the website you must change the **Web** column drop-down lists to **Read** for each tower light module information piece (status, Mins ON, and count) that you would like to appear on the website.

3. To display the tower light status on the website, change the cloud permissions.

   a) On the **Modify Multiple Registers** screen, select **Change** in the drop-down list next to **Cloud Permissions and Cloud Reporting**.

   b) In the drop-down list to the right, select **ON** for **Cloud Reporting** and **Read** for **Cloud Permissions**.

   c) Set the **Starting Register** to 1 and the **Ending Register** to the value equal to 25 × Number of tower lights in the system (for example, set the ending register 300 for 12 tower lights).

   d) Click **Change Registers** on the bottom right of the section.

4. **Configure to Receive Email or Text Alerts** when any of the light modules turn on.

   a) Click on the **Action Rules** tab and expand the ANY Module X ON rules using the arrow next to the rule.

   b) Click on the arrow next to **Email/SMS on State Transition**.

   c) Select the recipient of the SMS and/or email upon any of the Tower Light's specific modules transitioning to ON.

   In the example shown, both SMS Recipient 1 and 2 and Email Recipient 1 and 2 will receive a message if any Module #1 is ON in the system.

Set up the Ethernet or Cellular Connection

By default, the XML file configures the DXM100 with an Ethernet Push interface with the ability to send emails and push the data registers to a webserver. The device can also be configured to use a cellular push if the DXM Controller contains a cellular module and data plan. This section is only necessary if the user wants to receive or display information beyond just the DXM Controller's LCD.

1. If the DXM will text, email, or push to the cloud webserver, set up the push interface.

   a) On the DXM Configuration Tool, go to the **Settings > Cloud Services** screen.
   b) Select the appropriate **Push Interface** (Ethernet or Cell) from the drop-down list.

   Selecting Cell requires a cellular module be installed in the DXM Controller and a wireless plan be set up for sending data.

2. The Cloud Push Interval determines how often the DXM pushes the current status data to the webserver. By default, this interval is set to zero and should not be changed. The files associated with this guide are set up to push all data registers when the status of one of the tower light modules changes or once per hour if no changes occurred. Change the hourly push rate by modifying the value in register 842, which is listed in seconds. Note an increase in the push rate increases the data points sent to the website, which could change the number of data points needed in your Web Services Subscription.

3. Set up the email and text messages. SMS works only if the DXM has a cellular module. Expand the **Email Recipients** and **SMS Recipients** to enter up to 10 email addresses and 10 phone numbers, along with a custom message.

   a) Go to the **Settings > Mail and Messaging** screen.

   b) All SMTP fields should remain set to their default values, except the Password field. Enter "sxiemail1" into the password field.

   c) Click **Send SMTP Password**.

   d) Click **Yes** when asked to reboot the device.

# Step 5: Save and Load the XML File

When changes are made to the XML file, save the changes. To apply the changes, load the XML file to the DXM.

1. **Save** the file by going to the **File** > **Save** menu.
2. **Load** the file onto the DXM by going to the **Device** > **Send Configuration to Device** menu.

   Because of the size of the XML file, the file may take up to three minutes to load. Verifying the file is loading by looking at the Application Status indicator in the status bar.

   If the Application Status indicator is red, close and restart the DXM Configuration Tool, unplug and re-plug in the USB cable and reconnect the DXM to the software. If the Application Status indicator is green, the file upload is complete. If the Application Status indicator is yellow, the file transfer is in progress.
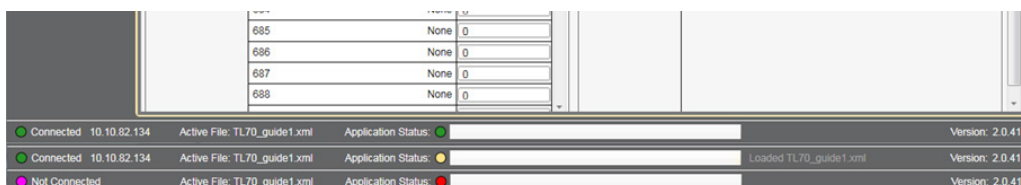
Step 6: Push Information to the Cloud

The DXM100 can connect to the web via Ethernet or an internal cell module to push data from the site to the cloud and displayed on a website. To enable this capability for remote monitoring and alarms settings, modify the XML file.

The website for storing and monitoring the system's data is https://data.sensonix.net/.

1. Connect the DXM to a computer with the DXM Configuration Tool software.
2. Launch the software and connect to the DXM.
3. Load the saved XML file.
4. Go to the **Settings > Cloud Services** screen.
5. Visit the Sensonix Web Services website (https://data.sensonix.net/) and log into an existing account or register a new account.
6. Click **+ New Site** and name your site.
7. Go to the **Settings > Sites** webpage.
8. Highlight and copy the Site ID.
9. On the DXM Configuration Tool: Return to the **Settings > Cloud Services** screen and paste the copied ID into the Site ID field.
10. Save the XML file (**File > Save**).
11. Upload the file to the DXM (**Device > Send Configuration to the Device**).

12. On the Sensonix Web Services website, click **Send XML to Web** and select the XML file that was just saved and uploaded to the DXM.

    This creates continuity between the site created on the website with the DXM used in the field. The DXM pushes data to the website, which can be viewed at any time. Refer to the Sensonix Web Services Instruction Manual to review all the features available for monitoring, comparing data, and establishing warnings/alarms on the website.

Additional Features

Resetting the Timer and Counts

Each TL70 in the system has a reset register that is available on the face of the DXM's LCD and via the website. Setting this register to 1 resets all the counts and timers on that particular TL70.

Resetting from the DXM

1. On the DXM: Use the arrows to select Registers. The registers are labeled **TL X Reset** (where X is the TL70 Node ID you want to reset).
2. Select the appropriate register to reset.
3. Click the **Enter** button.
4. Change the value to 1 then click Enter three times. The reset register automatically returns to zero after the TL70s reset.

Resetting from the Website

1. Go to the **Dashboard** > **Sites** screen.
2. Click **Update Device** for the site where the particular TL70 exists.

   The Update pop-up window appears.
3. From the **Type** drop-down list, select **Register**.
4. From the **Register Name** drop-down list, select the TL70 you want to reset.
5. Enter 1 into the **Value** field and click **Queue**.
6. Repeat steps 4 and 5 for each TL70 that needs to be reset.

When the next data push occurs, the chosen units will reset. The reset registers automatically return to zero after the TL70s reset.

Creating a Master Light

Local Registers 794–797 are used to OR each module independently for all the TL70s (for example, 794 is 1 when ANY tower light in the system has module #1 on or flashing).

A master light can be used as one of the 24 in the system to reflect these OR'd statuses.

1. On the DXM Configuration Tool software: Go to **Register Mapping** > **Write Rules**.
2. Select **Add Write Rule** and map four registers starting at 794 to slave ID #1 at the four output registers for the Master Light.

   The register number for the master light outputs is N × 16 + 9, where N is the Node ID of the master light. The example shows the setup for the Master Light on Node ID 10 (10 × 16 + 9 = 169).

Configuring Time Stamped Logging

By default, the files associated with this guide trigger a time-stamped event in the log each time a tower light module changes status or once per hour if no changes have occurred. Change the hourly log rate by modifying the value in register 842, which is listed in seconds. Note this also modifies the cloud push rate if it is used.

To setup time-stamped logging, follow these steps.

1. Go to the **Local Registers > Modify Multiple Registers** screen.
2. Click **Reset Form**.
3. From the SD Card Logging drop-down list, select Change.
4. Select Log 1 in the drop-down list that appears to the right.
5. Set the Starting Register to 1 and the Ending Register to the value equal to 25 × Number of tower lights in the system (ex. Ending Register 300 for 12 tower lights).
6. Click **Change Registers** on the bottom right portion of the section.

Retrieving a Log File

1. Connect the DXM to the computer via USB or Ethernet. Connect the DXM Configuration Tool software to the DXM using the **Device > Connection Settings** menu.
2. Go to the **Settings > Logging** screen.
3. Click **Refresh List**.
4. In the **Log File Management** window, select the file to save.
5. Click **Save Selected** to save the file to a folder on your computer.

Local Registers

	Local Registers	Description
Module Status	$1 + 25 \times (N - 1)$	Module 1 Status (On/Off/Flash)
	$2 + 25 \times (N - 1)$	Module 2 Status (On/Off/Flash)
	$3 + 25 \times (N - 1)$	Module 3 Status (On/Off/Flash)
	$4 + 25 \times (N - 1)$	Module 4 Status (On/Off/Flash)
Module Timers	$5 + 25 \times (N - 1)$	Module 1 Time On (Minutes)
	$6 + 25 \times (N - 1)$	Module 2 Time On (Minutes)
	$7 + 25 \times (N - 1)$	Module 3 Time On (Minutes)
	$8 + 25 \times (N - 1)$	Module 4 Time On (Minutes)
Module Count	$9 + 25 \times (N - 1)$	Module 1 Count
	$10 + 25 \times (N - 1)$	Module 2 Count
	$11 + 25 \times (N - 1)$	Module 3 Count
	$12 + 25 \times (N - 1)$	Module 4 Count
Module Timers	$13 + 25 \times (N - 1)$	Module 1 Flash Time On (Minutes)
	$14 + 25 \times (N - 1)$	Module 2 Flash Time On (Minutes)
	$15 + 25 \times (N - 1)$	Module 3 Flash Time On (Minutes)
	$16 + 25 \times (N - 1)$	Module 4 Flash Time On (Minutes)
Module Count	$17 + 25 \times (N - 1)$	Module 1 Flash Count
	$18 + 25 \times (N - 1)$	Module 2 Flash Count
	$19 + 25 \times (N - 1)$	Module 3 Flash Count
	$20 + 25 \times (N - 1)$	Module 4 Flash Count
Part Count	$21 + 25 \times (N - 1)$	Part Count
TL All Modules OFF	$22 + 25 \times (N - 1)$	All OFF Status
	$23 + 25 \times (N - 1)$	All OFF Timer
TL RF Connection Status	$24 + 25 \times (N - 1)$	Connection Status
	$25 + 25 \times (N - 1)$	Connection Status Timer
All Off NOR'd	601–624	All Off Status NOR'd
Read Rule Module Statuses	625–648	Read Module 1 Statuses
	649–672	Read Module 2 Statuses
	673–696	Read Module 3 Statuses
	697–720	Read Module 4 Statuses
TL70 Resets	770–793	TL70 Timer and Count Reset
OR'd Alerts	794	Any Module 1 Active
	795	Any Module 2 Active
	796	Any Module 3 Active
	797	Any Module 4 Active
Read Rule Connection Status	800–823	Read TL Connection Status
Log Timer Constant	842	Time (seconds) for Log and Cloud Push
Log Timer	843	Log Timer
Log Trigger	844	Trigger to Log/Cloud Push

Where N represents the TL70 Node ID.

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