

Machine Monitoring Application Guide

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 the remote status of each light module, track the cumulative time ON for each light module, count the number of times each module transitions 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.

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.

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.
Parts Counting	Count parts produced or rejected using internal 32-bit register in the TL70 Tower Light.
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 and 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.

Equipment



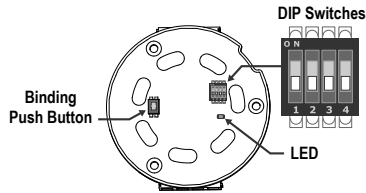
Model	Description
TL70DXN9XXXQ or TL70DXN2XXXQ (XXX is any combination of light colors)	EZ-LIGHT TL70 Wireless Modular Tower Light; Select either the 900 MHz or 2.4 GHz ISM radio to match the DXM's ISM radio
DXM700-B1R1 or DXM700-B1R3	DXM700 Wireless Controller; select either 900 MHz or 2.4 GHz ISM radio to match the TL70's ISM radio. The DXM1200 models will also work in this application. To order the DXM1200, replace the DXM700 in the model with DXM1200 .

Step 1: Bind the TL70 to the DXM and Assign the Device ID

Binding the TL70s to the DXM 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 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 until all TL70s are bound to the DXM with each having their own Node ID.
12. When you are finished binding, press **Back** on the DXM until the DXM returns to the main menu.

Step 2: Conduct a Site Survey from the DXM

Conduct a Site Survey to verify the wireless communication between the radios without your wireless network.

1. On the DXM: Use the arrow buttons to select the **ISM Radio** menu and press **ENTER**.
2. Select the **Site Survey** menu and press **ENTER**.
3. Use the Up or Down arrows to select the radio ID number and press **ENTER** to run the site survey with that Node or slave.
The site survey results display as green, yellow, red, and missed packets. Green indicates the highest signal strength, then yellow, and red. Missed packets were not received.

```
Site Survey 14:49:20
Node > 1
Grn: 92 Ylw: 0
Red: 0 Mis: 8
<Back> Previous Menu
```

4. When you are finished running the Site Survey, press **Back** twice to return to the main menu.
Exit Site Survey mode when you have finished to avoid causing system problems and reducing the battery life of any battery-powered radios.

Step 3: Wire the TL70 Tower Lights

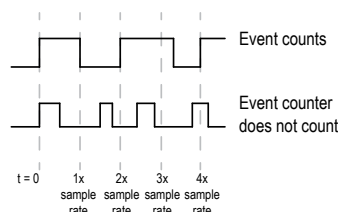
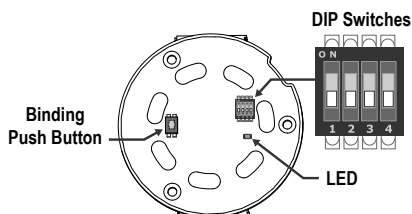
Each TL70 requires its own dedicated 12–30 V DC power supply. The light modules also need to be triggered by the machine being monitored and wired as shown.

A flashing condition is automatically detected as a separate state as long as it is between 0.8 Hz and 6 Hz.

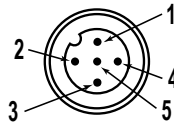
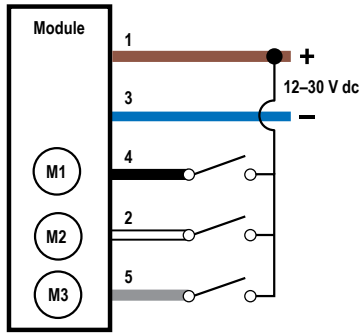
To use the TL70 for part counting:

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.

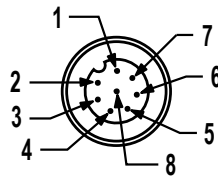
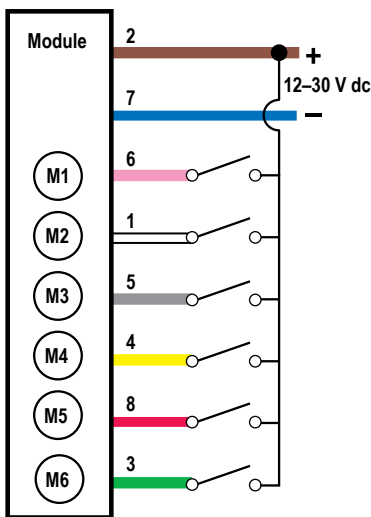


The 5-pin base allows a maximum of three modules



- 1 = brown
- 2 = white
- 3 = blue
- 4 = black
- 5 = gray
- M1 = Module 1
- M2 = Module 2
- M3 = Module 3

The 8-pin base allows for four modules and part counting



- 1 = white
- 2 = brown
- 3 = green
- 4 = yellow
- 5 = gray
- 6 = pink
- 7 = blue
- 8 = red (event counter input, if enabled)
- M1 = Module 1
- M2 = Module 2
- M3 = Module 3
- M4 = Module 4
- M5 = Module 5
- M6 = Module 6

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 TL70's timers and counts, and organizes the information in logical and easy to find registers in the DXM.

Loading these files and making adjustments requires Banner's DXM Configuration Software and the machine monitoring files available via the links below.

1. Download the [preconfigured files](#) from the DXM or Wireless TL70 series pages.
2. Extract the ZIP files into a folder on your computer. Note the file location.
3. Connect the DXM, using the USB cable supplied with the DXM, to a computer containing the DXM Configuration Software or download the software and install it on a computer.
4. Launch the software.
5. Load the Machine Monitoring XML file (TL70) by going to **File > Open** and choosing the XML configuration file.
6. Connect to the DXM.
 - a) Go to **Select Mode** screen.
 - b) Select **Serial** and then select the COM port that the USB cable is plugged into.
 - c) 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. Go to **Settings > Scripting** to upload the Machine Monitoring XML file (TL70). Click **Upload File** and select the .sb file.
8. Save the XML file any time the XML has been changed because the tool does not autosave.

Customize the XML File

1. Within the DXM Configuration Software, go to the **Local Registers > Local Registers in Use** screen.

ID	Register Name	Register Group	Units	Signed	Constant or Counter	Cloud Settings	LCD Permissions	Protocol Conversion	Log Files	Read Rules	Write Rules	Threshold Rules
1	TL 1 Mod1 Status		None	Unsigned		Read	None	None	None			TL 1 Mod1 Time ON TL 1 Mod1 Flash Time ON
2	TL 1 Mod2 Status		None	Unsigned		Read	None	None	None			TL 1 Mod2 Time ON TL 1 Mod2 Flash Time ON
3	TL 1 Mod3 Status		None	Unsigned		Read	None	None	None			TL 1 Mod3 Time ON TL 1 Mod3 Flash Time ON
4	TL 1 Mod4 Status		None	Unsigned		Read	None	None	None			TL 1 Mod4 Time ON TL 1 Mod4 Flash Time ON

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.
3. Configure your application to receive email or text alerts when any of the light modules turn on.
 - a) Go to **Local Registers > Action Rules > Thresholds** and click on the arrow next to the rule's name to display the parameters of ANY Module X ON 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. Note that any potential email or text message recipient must first be defined in the **Settings > Notifications** screen.

Set Up the Ethernet or Cellular Connection

By default, the DXM with an Ethernet Push interface is configured to send email and push the data registers to a webserver. The DXM 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 you want to receive or display information to more than the DXM Controller's LCD.

1. On the **Local Registers in Use** screen, set the **Value Type** of register 844 to **Constant** and a value of 1 to enable the data push.
2. If the DXM will text, email, or push to the cloud webserver, set up the push interface.
 - a) Go to the **Settings > Cloud Services** screen.
 - b) From the **Network Interface** drop-down list, select either **Ethernet** or **Cell**. Selecting **Cell** requires a cellular module be installed in the DXM Controller and a wireless plan be set up for sending data.
3. Set the **Cloud Push Interval** to **None**. The script associated with this file establishes the five-minute push interval internally, so that it occurs immediately after the sample of the sensors.
4. To send emails, go to the **Settings > Notifications** screen and enter in the addresses in the recipient boxes.

To send emails, all SMTP fields need to be filled out. The values will be custom for the mail server used to deliver the emails. Passwords are not stored in the XML file and must be clicking **Send SMTP Password** after the DXM Configuration Software is connected to the DXM Controller.

The screenshot displays three configuration panels. The 'Mail Server Settings' panel includes fields for SMTP server (smtpmail.visi.com), SMTP server port (587), encryption options (No encryption selected), and SMTP authentication (checked) with fields for user name (device@sensorix.com) and password. The 'E-mail Recipients' panel lists 10 recipients, with the first two having addresses person1@gmail.com and person2@gmail.com. The 'SMS Recipients' panel shows four recipients, with the first two having names Person1 and Person2, and numbers 2125555555 and 2125551234, both with the message 'Vibration Alert'.

Step 5: Save and Upload the Configuration File

After making any changes to the configuration, you must save the configuration files to your computer, then upload it to the device. Changes to the XML file are not automatically saved. Save your configuration file before exiting the tool and before sending the XML file to the device to avoid losing data. If you select **DXM > Send XML Configuration to DXM** before saving the configuration file, the software will prompt you to choose between saving the file or continuing without saving the file.

1. Save the XML configuration file to your hard drive by going to the **File > Save As** menu.
2. Go to the **DXM > Send XML Configuration to DXM** menu.



- If the Application Status indicator is red, close and restart the DXM Configuration Tool, unplug and re-plug in the USB or Ethernet 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.

The device reboots and begins running the new configuration.

Step 6: Push Information to the Cloud

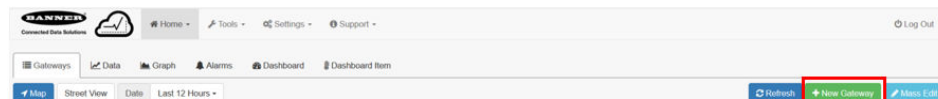
The DXM Wireless Controller can connect to the Web via Ethernet or an internal cell module. The controller pushes data from the DXM to the cloud to be stored and displayed on a website. To enable this capability, modify the DXM's XML configuration file.

The Banner website for storing and monitoring the system's data is <https://bannercds.com>. The Banner Cloud Data Services website automatically generates dashboard icons and graphs for the Solutions Kit that can be placed in the Dashboard tab. Email alerts can be set up on the Alarms tab as well.

Create a New Gateway

After you log into the Banner Cloud Data Services website, follow these steps to create a new monitoring site.

1. Click on **+New Gateway**.
Create a new Gateway/site for each device that will be sending data to the web server.



2. Enter a site name.
3. Under the **Options** column, click **+**.
Detailed information about your new site displays.
4. Copy the **Site ID** number shown on the dashboard.

The Site ID number created by the web server is a required parameter in the configuration setup of the DXM. The Site ID is the address the webserver uses to store the data pushed from the DXM.

5. Click **Save**.

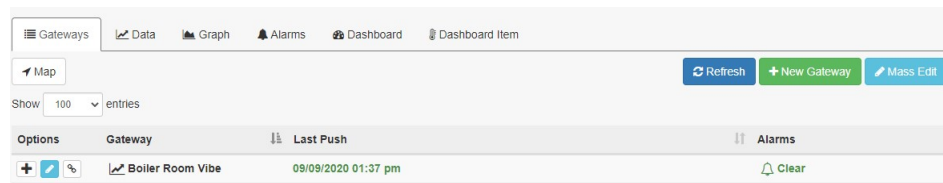
Configure the DXM to Push Information to the Cloud

1. Within the DXM Configuration Software, go to the **Settings > Cloud Services** screen.
2. Set the **Server name/IP** to push.bannercds.com.
3. In the **Web Server** section, keep the **Gateway ID is** drop-down selection as **GUID**.
4. Use the **File > Save** menu to save the XML file to your hard drive.
5. Send the updated XML to the DXM Controller using the **DXM > Send XML COnfiguration to DXM** menu.

Upload the XML Configuration File to the Website

To upload an XML configuration file to the website, follow these instructions.

1. At the webserver, select the **Home** screen.



2. On the row displaying your new site, click the **Edit Gateway** (pencil) icon.
3. Select **Update XML**.
4. Click **Choose File** and select the file that was just updated to the DXM and click **Save**.

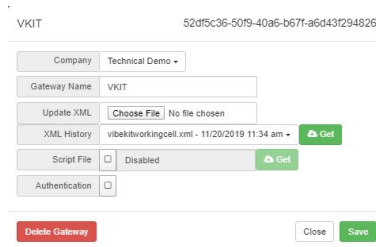


Figure 1. Example file selection screen that may not represent your specific kit

After the XML file is loaded into the webserver, the webserver uses the register names and configurations defined in the configuration file.

5. Click on the **Site Name** link to go to the configured registers to see the values uploaded by the DXM.
The same XML configuration files is now loaded on both the DXM and the Website. After some time, the data should be seen on the website.

Completing these steps 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 [Banner Cloud Data Services Instruction Manual](#) to review all the features available for monitoring, comparing data, and establishing warnings/alarms on the website. To access a demo version of the website please contact your local Banner distributor and follow the instructions in the technical note: [Connecting to the Banner Cloud Data Services Demo Site](#) for modified instructions on how to send data to the demo site.

Additional Information

Reset the Timer and Counts

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

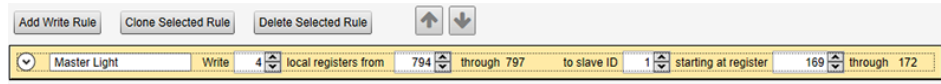
1. On the DXM: Use the arrows to select Registers.
The registers are labeled **TL X Reset** (where X is the TL70 Node ID you want to reset).

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.

Create 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 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 $N \times 16 + 9$, where N is the Node ID of the master light. The example shows the setup for the Master Light on Node ID 10 ($10 \times 16 + 9 = 169$).

Configure 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 $25 \times$ 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.

Save a Log File

1. Connect the DXM to the computer using USB or Ethernet.
2. Connect the DXM Configuration Software to the DXM using the **Select Mode** screen.
3. Go to the **Settings > Logging** screen.
4. Click **Refresh List**.
5. In the **Log File Management** window, select the file to save.
6. Click **Save selected file** to save the file to a folder on your computer.

Local Registers

Where N represents the TL70 Node ID.

	Local Register #	Description
Tower Light 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)
Tower Light 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)
Tower Light 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

	Local Register #	Description
	$12 + 25 \times (N - 1)$	Module 4 Count
Tower Light 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)
Tower Light 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
Tower Light All Modules OFF	$22 + 25 \times (N - 1)$	All OFF Status
	$23 + 25 \times (N - 1)$	All OFF Timer
Tower Light RF Connection Status	$24 + 25 \times (N - 1)$	Connection Status
	$25 + 25 \times (N - 1)$	Connection Status Timer
Bit-Packed Module Status	601–624	Module Status bit-packed for web push
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
Connection Status Bit-Packed	826	Connection Status bit-packed for web push
Log Timer Constant	842	Time in seconds for Log and Cloud Push
Log Timer	843	Log Timer
Log Trigger	844	Trigger to Log/Cloud Push
Cloud Push	851	Enable cloud pushing from the script (0/1)
Part Count Push	852	Enable pushing of part counts (0/1)
First Run	853	Nonvolatile register used for initial setup by script
Delay Mode	854	Enable 4 second script loop delay for troubleshooting