Tank Level Monitoring Application Guide

Guide Features and Benefits

Wireless Tank Level Monitoring	Wirelessly monitor up to 16 tank levels from a central location
Low Level Alerts	Generate two user-specified low level alerts (low and/or low low) for a tank in an emptying application
High Level Alerts	Generate two user-specified high level alerts (high and/or high high) for a tank in a filling application
Local Indication Lights	Local alert indication via LEDs on the DXM Controller and the ability to enable lights on the Q45s for local indication of alert status
SMS Text/Email Alerts	Generate SMS text and/or email alerts
Cloud Monitoring	Push data to Cloud Webserver or PLC (via LAN or Cellular)

Using K50Us and Q45Us paired to a DXM100, we can develop a wireless monitoring system for multiple tank level measurements that is easy to set up, interpret the results, and monitor locally and through a cloud-based system. The temperature-compensated system can report and send alarms on user-specified levels locally via outputs to lights and relays, or via emails and text messages using a single K50U sensor per tank. Information can be sent to the cloud using either the internal cellular module or by connecting to the local area network (LAN) with an Ethernet cable directly to the DXM.

Equipment





Model	Description
DX80N9Q45U (900 MHz) or DX80N2Q45U (2.4 GHz)	Sure Cross® Wireless Q45 Sensor Node - Universal 1-Wire Serial
K50UX1ARA or K50UX1CRA	U-GAGE K50U Ultrasonic Sensor
DXM100-B1C1R1 or DXM100-B1C1R3	DXM100 Wireless Controller with Cell; select either 900 MHz or 2.4 GHz ISM radio to match the Q45U
BWA-BK-006	Bracket

A PDF of this Application Guide is available at https://goo.gl/aZrZHx

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The following guide demonstrates how to set up a system to monitor tank levels using by loading a preconfigured XML file and script. The system can monitor tank level of up to 16 tanks with warning and alarm notifications through the DXM LEDs and via text and/or email. The XML file only requires some minor modifications to be customized for any site.

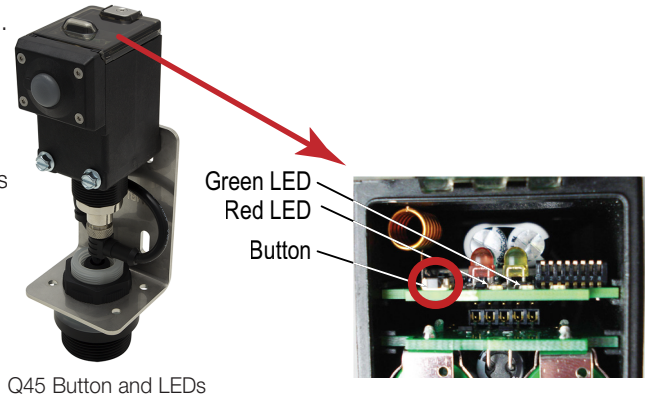
Step 1: Bind the System and Assign Node IDs

Bind each of the Q45Us to the DXM100 to establish a secure connection between them and assign a specific network address to each Q45U in the system.

1. For each K50U and Q45U pair, connect the K50U to the Q45U's integral 5-pin connector.
2. Apply power to the DXM.
3. On the DXM: Use the arrow buttons to select the **->ISM Radio** menu. Push **Enter**.
4. Select the **->Binding** submenu. Push **Enter**.
5. On the Q45U: Starting with the Q45U for Tank #1, triple-click the button to begin the binding procedure.

   The green and red LEDs flash four times after the Node is bound. This Node is now bound to the Gateway in the DXM as Node ID 1. The amber light may turn on after binding, indicating the Q45 has entered into a faster sampling mode, and stops after 15 minutes.
6. Label the device for future reference using the included label.
7. On the DXM: If you are done binding the devices, press **Back** to return to the main menu. If not, continue to the next step.
8. If you are binding another Q45U to the Gateway, change the DXM menu to **Bind to > 2** and press **Enter**. Triple-click the Q45U button to begin binding.

   The Node binds to the Gateway in the DXM as Node ID 2.
9. Continue repeat the previous step for as many K50U/Q45U pairs that you have.
10. On the DXM: Press **Back** to return to the main menu.



Q45 Button and LEDs

Step 2: Conduct a Site Survey

Verify the wireless connection between the DXM and one or more Nodes by running a site survey.

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 one Node ID within the system to verify the wireless connection between the Q45U and the DXM.
4. On the Q45U: Verify the amber LED is on by clicking the Q45U button once on the Q45U being surveyed.
5. On the DXM: When the site survey is finished, press **Back** twice to return to the main menu.

Forgetting to exit out of site survey causes system issues and reduces the battery life of the Q45Us.

Step 3: Configure the System

To customize the system to an actual application, modify the preconfigured template files in the link below. There are two files uploaded to the DXM: the XML file that sets the DXM's initial configuration and the ScriptBasic file that reads raw data, scales the data, and places it in logical and easy-to-find registers in the DXM. There are two versions of each file: one for English units (inches) and one for Metric units (millimeters).

The XML and ScriptBasic files MUST both be the inches version or both the metric version. Loading these files and making adjustments requires using Banner's DXM Configuration Software and the tank monitoring files available in the links below. Edit the files to set the tank height, K50U sensor offset, warning/alarm thresholds, and tank name. Following these basic steps allows for an easy set up with a high level of functionality.

1. Download the preconfigured files. (https://goo.gl/TVZW1k)
2. Extract the ZIP files into a folder on your computer. Note the location of the files.
3. Connect the DXM to the computer containing the DXM Configuration Software.

   a) Plug the DXM into the computer using the USB cable supplied with the DXM.
   b) Launch the DXM Configuration Software.

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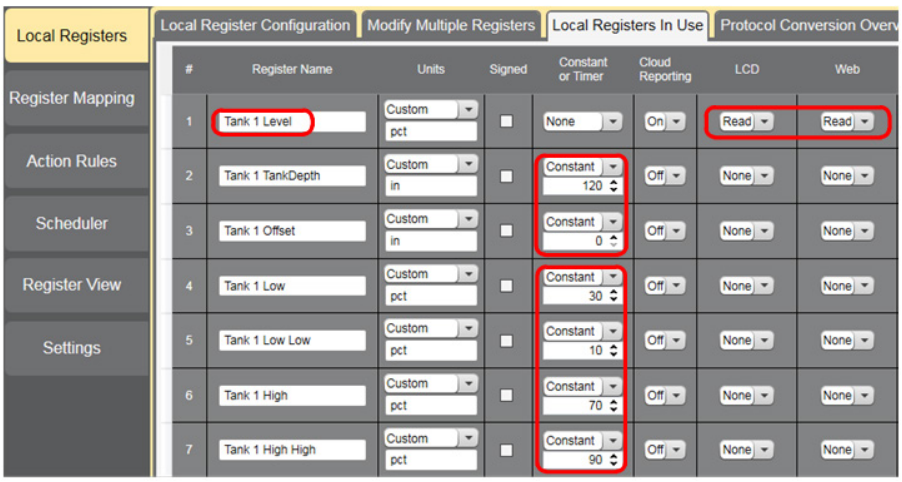
c) Go to **Device > Connection Settings** to connect the software to the DXM.
d) Select **Serial** and then select the COM port the USB cable is plugged into.
e) Click **Connect**. If you are unsure which COM port is being used, and multiple appear, attempt to connect to each one until you connect to the device.

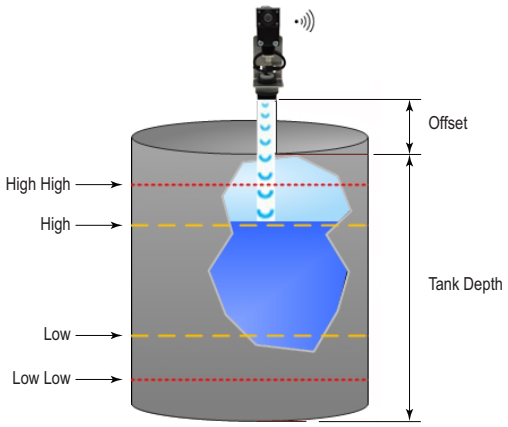
4. Load the XML file.
   a) From within the DXM Configuration Software, go to **File > Load**.
   b) Select the Tank Monitoring.XML file. Select either the inches or metric file based on preference
5. Load the ScriptBasic file.
   a) From the **Settings > Scripting** screen, click **Upload Script**.
   b) Select the Tank Monitoring ScriptBasic (.sb) file. Select either the inches or metric file to match the TankMonitoring.XML file.
6. Set the ScriptBasic file to run every time the DXM Controller boots up.
   a) Click to highlight the uploaded file in the window to the right of the **Upload Script** button.
   b) Click **Add Selected to Startup**.
7. Save the XML file by going to **File > Save**.
8. Load the XML file onto the DXM by going to **Device > Send Configuration to Device**. Select the saved file. (Follow steps 7 and 8 any time the XML has been changed to have the DXM act on those changes.)

Customize the Tank Parameters, Tank Names, and Alarm Thresholds

Follow these steps to customize the tank parameters.

1. From within the DXM Configuration Software, go to the **Local Registers > Local Registers in Use** screen.
2. Set the tank depth.
   TankDepth is the height from the top of the tank to the bottom of the tank in the location of the K50U sensor. Enter the **TankDepth** for each tank, in inches or millimeters depending on the XML and ScriptBasic file chosen, in the **Constant or Timer** column for the Tank # Tank Depth register.





Tank 1 Values: 120 in tank depth and a 0 inch offset. Thresholds are set to Low level at 30%, LowLow Level at 10%, High level at 70%, HighHigh level at 90%. LCD and Web displays are enabled.

Optional Steps

1. Rename the Tank Levels—Rename each tank using the text boxes within the **Register Name** column.

   Only the first register for each tank with default label of **Tank 1 Level**, **Tank 2 Level**, etc. needs to be modified for viewing on the LCD and Web. To display the Tank Level on the DXM display and/or website, change the **LCD** and **Cloud Permissions** column drop-down list to **Read** in the first row for each tank where the Tank Level name was changed.

   The other registers associated with that tank are constants (Depth, Offset, etc) and do not need their LCD or Web values modified. Displaying values other than the tank level value will clutter the display. Note that if names are displayed on the DXM LCD, there is a 10 character limit.

2. Set the sensor offset.

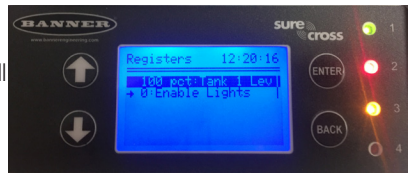
   Offset is used if there is a standoff tube that extends the sensor height above the top of the tank. Enter the offset value, in inches or millimeters depending on the XML file used, in the **Constant or Timer** column for the **Tank # Offset** register. By default, the offset is set to zero.

3. Adjust the Warning and Alarm Thresholds.

   Each tank has four threshold registers: Low, Low Low, High, and High High in the XML file. All default to OFF (0 for Lows and 110 for Highs) and can be left at those defaults if they are not used.

   To enable a threshold, modify the number in the **Constant or Timer** column to be the percent of tank level when the warning/alarm thresholds are triggered.

   These also trigger the DXM lights and the Q45U lights (if enabled).



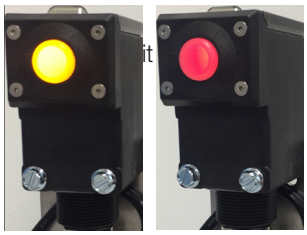
DXM Controller Display. The green LED indicates all level measurements are between the threshold settings. The amber LED indicates a level in the system is within the Low or High thresholds. The red LED indicates a level is in the LowLow or HighHigh threshold.

4. Enable the Q45U lights.

   Users can turn on a flashing indication light on the face of the Q45U to indicate if the tank level for that sensor has crossed any of the defined thresholds. This can be done on the DXM display any time during operation and resets when the DXM is rebooted or power cycled.

   a) On the DXM: Use the arrows to select the **Registers** menu.
   b) Scroll to **Enable Lights** and click **Enter**.
   c) Using the arrows, change the value to 1 to turn the lights on or 0 to turn the lights off.
   d) Press **Enter** three times.

   Yellow indicates a condition within the Low/High thresholds and Red indicates a condition within the Low Low/High High thresholds set previously. Indication lights reduce the battery life of the Q45U; it is recommended that lights only be enabled while attempting to locate the level sensor measuring below one of the thresholds.

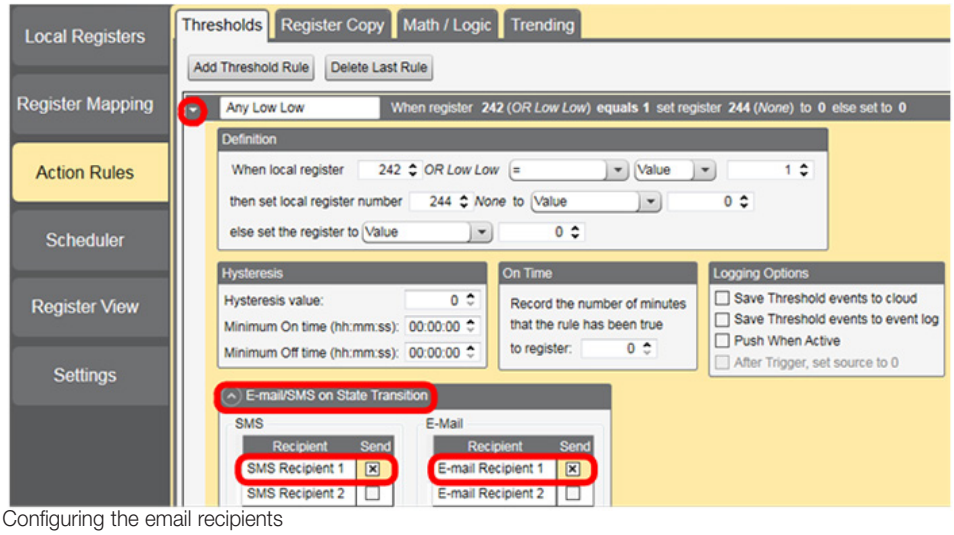


Wireless Q45 Sensor Node lights

5. Receive email or text alerts when a tank falls within the warning or alarm thresholds.

   a) Go to the **Action Rules** screen.
   b) Click on the arrow to expand the **Any Low, Any Low Low, Any High,** or **Any High High** rules.
   c) Click on the **Email/SMS on State Transition**.
   d) Select the recipient of either the SMS or email upon the alarm condition.

   In the example screenshot, both SMS Recipient 1 and Email Recipient 1 will receive a message when any tank in the system drops below the Low Low threshold set previously and when the tank level goes back above the Low Low threshold.



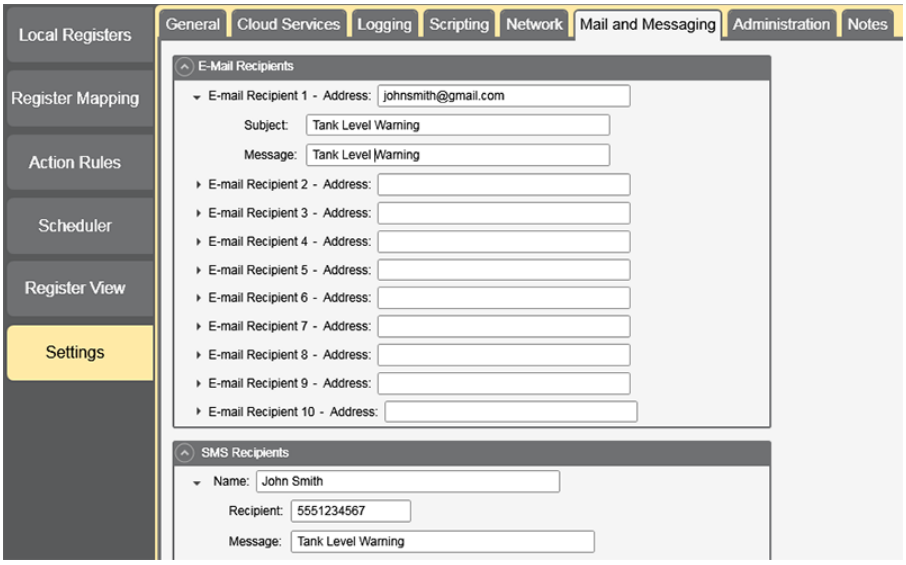
Configuring the email recipients

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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 Software, 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 tank level data to the webserver. By default, this interval is set to zero. If data is being pushed to the cloud, set the **Cloud Push Interval** to 00:15:00 (15 minutes).
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.
4. Save the XML file by going to the **File > Save** menu.
5. Load the XML file by going to the **Device > Send Configuration to Device** menu. Select the saved file.



Setting up the email addresses and text message phone numbers.

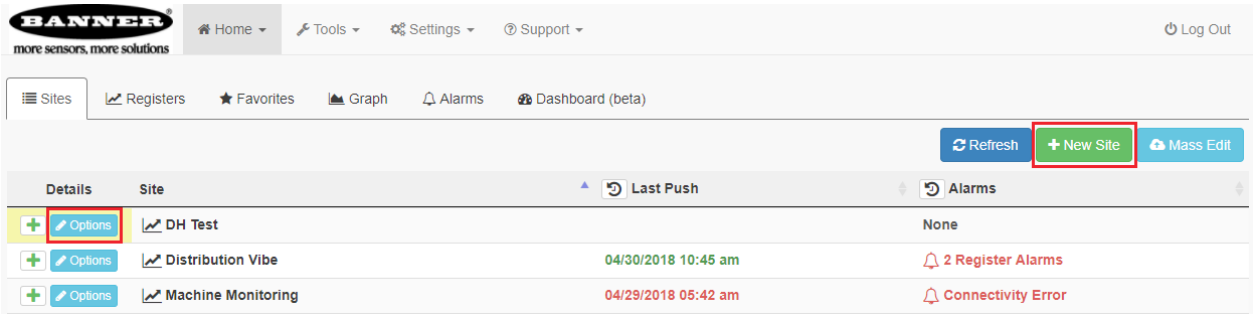
Step 4: Push Information to the Cloud

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 Banner Cloud Data Services (BannerCDS) website for storing and monitoring the system's data is https://bannercds.com.

1. Connect the DXM to a computer with the DXM Configuration 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 BannerCDS website and log into an existing account or register a new account.
6. Click **+ New Site** and name your site.
7. Highlight and copy the Site ID.
8. On the DXM Configuration Software: Return to the **Settings > Cloud Services** screen and paste the copied ID into the Site ID field.
9. Save the XML file (**File > Save**).

10. Upload the file to the DXM (**Device > Send Configuration to the Device**).
11. On the website: Click **Options** on the row of the newly created site. Click the checkbox next to **XML Config** and select the XML file that was just saved/uploaded to the DXM.
12. Click **Save** to complete the connection to the website.



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 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.

Local Registers

	Local Registers	Description
Tank Information & Settings	1 + 20 × (N - 1)	Tank Level Percentage
	2 + 20 × (N - 1)	Tank Depth Setting
	3 + 20 × (N - 1)	Tank Offset Setting
	4 + 20 × (N - 1)	Tank Alert Low Setting
	5 + 20 × (N - 1)	Tank Alert Low Low Setting
	6 + 20 × (N - 1)	Tank Alert High Setting
	7 + 20 × (N - 1)	Tank Alert High High Setting
Tank High Alerts	160–175	High Alert for each Tank
Tank High High Alerts	180–195	High High Alert for each Tank
Tank Low Alerts	201–216	Low Alert for each Tank
Tank Low Low Alerts	221–236	Low Low Alert for each Tank
OR'd Alerts	239	Any High active
	240	Any High High active
	241	Any Low active
	242	Any Low Low active
Enable Lights	245	Enable Q45 Lights
Enable Lights Switch	246	External Lights Switch Reg. via Universal Input 1`

Where N represents the Wireless Q45U Sensor Node ID.

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