CYPRESS
ENVIROSYSTEMS

Handheld Configuration Tool

User Manual

Doc # 152-10206-01
Revision 1.0
November 2009

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1.0 Introduction

The Handheld Configuration Tool (HHC) is used to set up the various parameters on Cypress Envirosystems field devices. All field device configuration parameters are entered on the HH and sent wirelessly to the WGR.

This manual will describe how to configure and use various field devices, and the HHC. It can be used as a reference or step by step guide. The first section will discuss the HHC and the software associated with programming the various field devices. The subsequent sections will describe how to configure specific field devices such as Wireless Gauge Readers (WGRs), Wireless Transducer Readers (WTRs), Wireless Steam Trap Monitors (WSTMs) and Wireless Freezer Monitors (WFMs).

2.0 Safety Precautions

- Do not immerse the HHC in water.
- Always wear personal protective equipment appropriate to the system the Cypress Envirosystems wireless monitoring system is being installed on.
- Do not try to repair yourself as it contains no user-serviceable parts. Contact a qualified service technician for repairs. See Section 14.0, Support, for details.

3.0 Description of the HHC

The Handheld Configuration tool (HHC) is a battery powered portable Windows Mobile device. Cypress Envirosystems has developed an application that executes on the HHC which is used to configure the WGR and other products. This section will introduce the HHC and the HHC application.

Figure 1 and Figure 2 highlight the features of the HHC that will be used.

Figure 1. Handheld Configuration Tool

- **Touch Screen**: This is the Touch Screen LCD monitor of the HHC device. A stylus is provided to navigate on screen.
- **Navigation Arrows**: These are up, down, left, and right navigation keys. Use these to navigate to different text entry fields in the application. The Left Arrow is used to type a negative symbol "-" into a text entry field.
- **[Enter/On] Key**: Used to power on the HHC and accept changes.
- **[FN] Key**: Used to perform a full reboot of the HHC.
- **[BKSP] Key**: This is the backspace key.
- **Docking Station**: The docking station is used to charge the HHC and an extra battery pack. A USB cable is included to connect the HHC to a PC while on the docking station.
- **Green LED**: Shows power and charge status.

Figure 2. HHC Configuration Application Start Screen

1. **Windows Start**: Tap the Start Icon with the stylus to access the Cypress Envirosystems HHC configuration application.
2. **HHC Configuration Application**: This is the shortcut to the Cypress Envirosystems HHC configuration application. Tap on HH_Control with the stylus to launch the application.

The application is broken up into four tabs:

1. Name ID Tab
2. Gauge Parameters Tab
3. Gauge Image Tab
4. Status Tab

To select a tab in the application, tap on the name using the stylus.

3.1 Name ID Tab

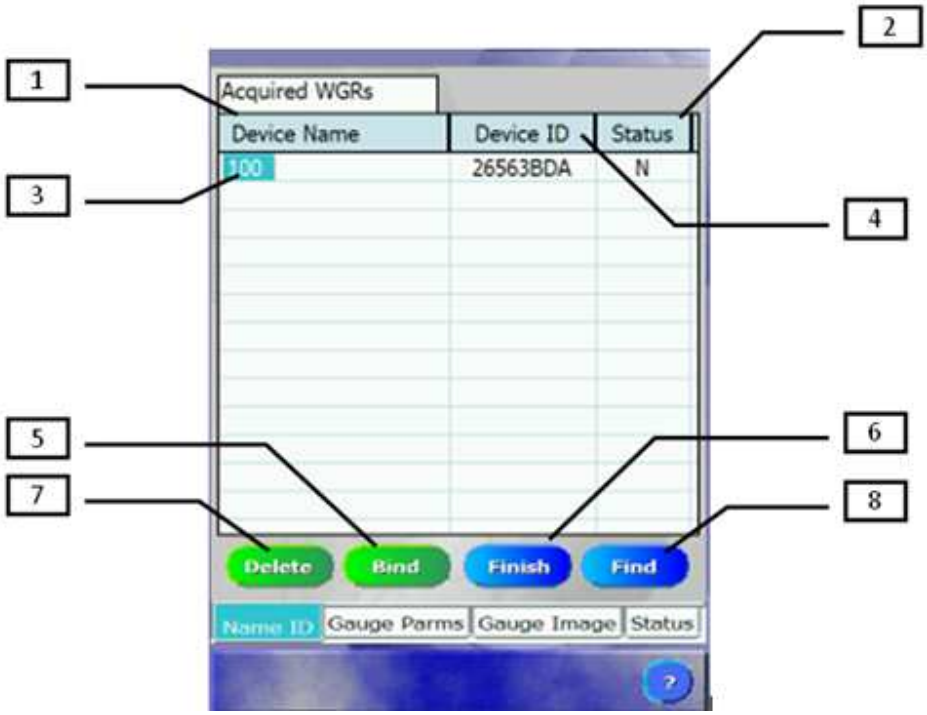


Figure 3. HHC Application Name ID Tab

1. **Device Name Column**: This column contains the name of the field devices that have bound to the handheld. This is used to identify the field device by name. Highlighting a field device from the list will recall its parameters from the saved text file.
2. **Status (Bind Column)**: This column shows the connection status between the field device and the HHC.
   - Blank HHC cannot detect field device
   - "N" HHC detected the field device but they are not connected
   - "Y" HHC and field device are connected
3. **Name Entry**: Select, enter or edit the name of a field device here. To select a field device tap on the name with the stylus. To enter or edit the name, first select the field device, then click on the name once more with the stylus. The entry field will transition to edit mode. Make any changes than press [Enter/On] key or tap anywhere else on the screen with the stylus to exit edit mode.
4. **Device ID**: This column contains the unique radio ID of the field device. This is used to identify the field device to be connected to when the HHC has detected more than one. On the WGR, the radio ID can be found by accessing the configuration menu on the LCD.
5. **Bind Button**: This button is used to connect the HHC to the highlighted field device in the Device Name column.
6. **Finish Button**: This button terminates the connection between the HHC and field device. Use this button when configuration has been completed to save all settings to the field device. The field device will not save its configuration settings if the connection is terminated any other way.

7. **Delete Button**: Selecting this button will delete the highlighted field device in the Device Name column.
8. **Find Button**: The HHC will search for any field devices within wireless range that is in Discovery Mode. Detected field devices will be labeled "<UNASSIGNED>" in the Device Name column with an accompanying "N" in the Status column.

3.2 Gauge Parameters Tab

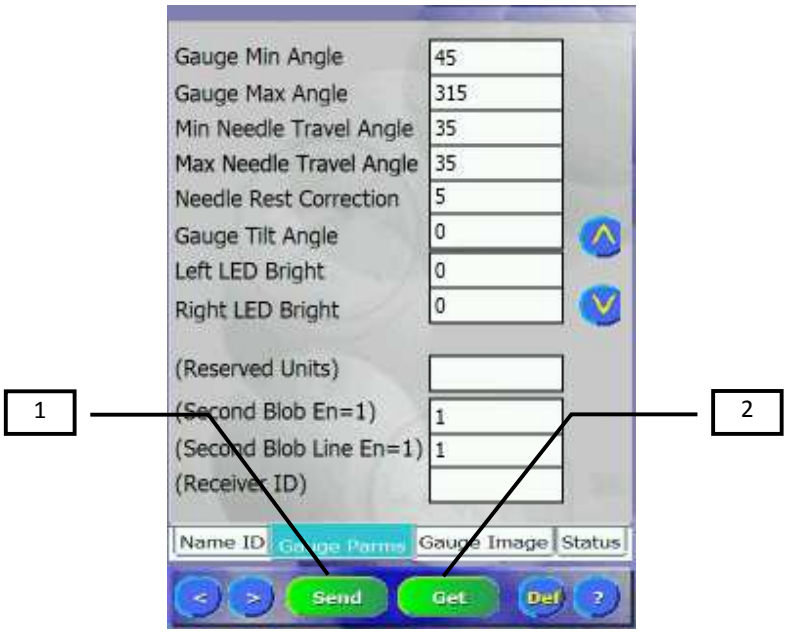


Figure 4. HHC Application Gauge Parameters Tab

1. **Send**: This will send all current parameters from the HHC to the field device.
2. **Get**: This will request all parameters from the field device and fill them in the HHC. If the HHC is connected to an older field device, some parameters may not be filled in.

3.2.1 Gauge Parameters Tab – Page 1

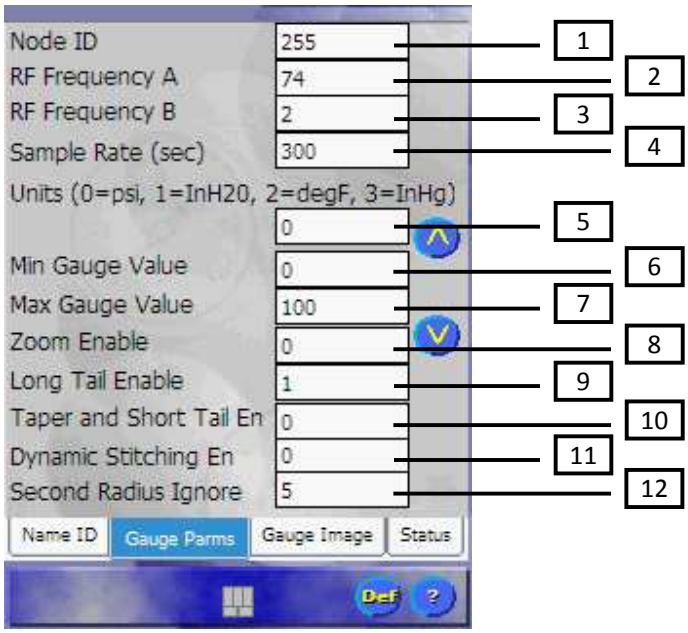


Figure 5. HHC Application Gauge Parameters Tab Page 1

1. **Node ID**: The unique ID of the field device within its wireless network.
2. **RF Frequency A**: The A channel used for wireless communication. See Table 1 below for common channel sets.
3. **RF Frequency B**: The B channel used for wireless communication. See Table 1 below for common channel sets.

Channel Set	Frequency A	Frequency B
A	2	74
B	6	78
C	24	50
D	30	54
E	48	56
F	54	62
G	50	60

Table 1 Common Channel Set Frequencies

4. **Sample Rate (sec)**: The time in seconds between samples when the field device is in Normal Sample Mode.

5. **Units**: The units of data the gauge represents. For example: 0=”PSI”, 1=”InH20”, 2=”deg F”, 3=”inHg”. See Table 2 for a full list.

Units	HH Index	Units	HH Index
PSI	0	mmHg	13
InH2O	1	kg/cm	14
DEG F	2	C	15
inHg	3	F	16
VOLTS	4	MPa	17
mVOLT	5	ftSW	18
uVOLT	6	mbar	19
AMPS	7	cmH2O	20
mAMPS	8	mmH2O	21
uAMPS	9	ftH2O	22
DEG C	10	mBar	23
bar	11	H2O	24
kPa	12	(BLANK)	25

Table 2. Units

6. **Min Gauge Value**: The minimum value on the gauge scale.
7. **Max Gauge Value**: The maximum value on the gauge scale.
8. **Zoom Enable**: The camera will capture the image with a 2x zoom.
9. **Long Tail Enable**: Specifies the type of needle. 1 means Long Tail Mode, 0 means Short Tail Mode.
10. **Taper and Short Tail En**: If enabled, the WGR will also process the taper of a short tail needle to find the tip. Only valid for Short Tail Mode.
11. **Dynamic Stitching En**: Special mode used to find the tip of a long tail needle with a slight taper. Note this mode can decrease battery life. Only valid for Long Tail Mode.
12. **Second Radius Ignore**: Specifies which Circles/Radius to ignore for angle calculation. All circles greater than this value will be ignored. See Table 3 below. For Long Tail Mode this should be set to 5. For Short Tail mode, set this based on the circles that only overlap the tip – usually 3.

Second Radius Ignore	Circles/Radius Ignored
0	ALL
1	2, 3, 4, 5
2	3, 4, 5
3	4, 5
4	5
5	NONE

Table 3. Radius Ignore

3.2.2 Gauge Parameters Tab – Page 2

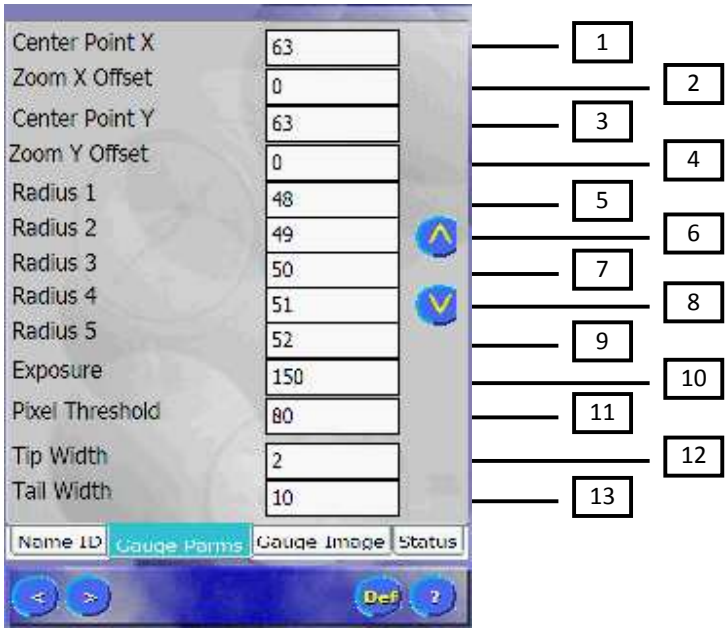


Figure 6. HHC Application Gauge Parameters Tab Page 2

1. **Center Point X**: Defines the center of the needle in the X direction. The concentric circles are centered at this X location.

Center Point X Range	Min	Max
When Dynamic Stitching En = 0	0	126
When Dynamic Stitching En = 1	43	83

2. **Zoom X Offset**: This will offset the image in the X direction. It is used to center the needle in the image. It is recommended that this variable is used to center the needle before attempting to center the concentric circles using the Center Point X variable. This variable is valid when Zoom is enabled or disabled.

Zoom X Offset Range	Min	Max
When Zoom Enable = 0	-24	24
When Zoom Enable = 1	-63	63

3. **Center Point Y**: Defines the Y dimension center of the needle.
4. **Zoom Y Offset**: This will offset the image in the Y direction. It is used to center the needle in the image. It is recommended that this variable is used to center the needle before attempting to center the concentric circles using the Center Point Y variable. This variable is only valid when Zoom is enabled.

Zoom Y Offset Range	Min	Max
When Zoom Enable = 0	NA	NA
When Zoom Enable = 1	-30	30

5. **Radius 1**: Innermost circle radius.
6. **Radius 2**: Circle 2 radius.
7. **Radius 3**: Circle 3 radius.
8. **Radius 4**: Circle 4 radius.
9. **Radius 5**: Outermost circle radius.
10. **Exposure**: This will adjust the brightness of the image. The larger the number the brighter the image.
11. **Pixel Threshold**: Defines the sensitivity of dark pixels stored. Decreasing the Luminosity Threshold will increase the number of pixels picked up. Increasing the Luminosity Threshold will decrease the number of pixels picked up.
12. **Tip Width**: The needle tip width in pixels.
13. **Tail Width**: The needle tail width in pixels.

3.2.3 Gauge Parameters Tab – Page 3

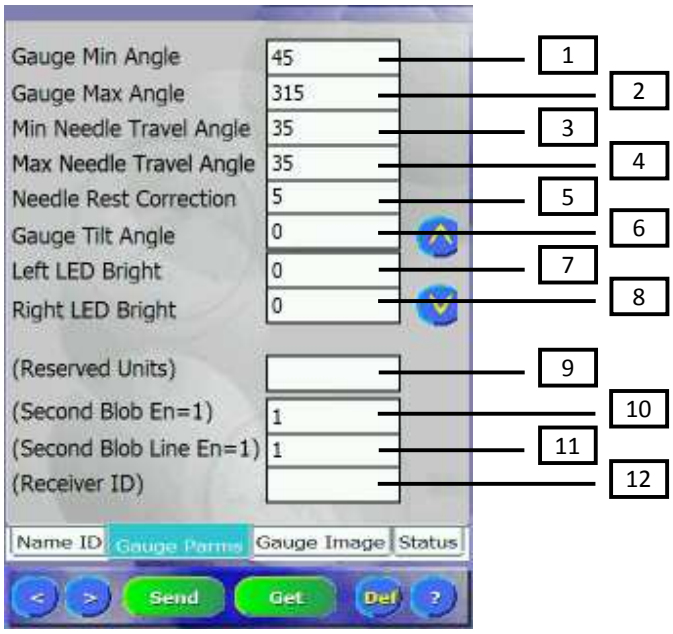


Figure 7. HHC Application Gauge Parameters Tab Page 3

Gauge Min Angle: Angle, with respect to Gauge Bottom, at which the Min Gauge Value resides.

Gauge Max Angle: Angle, with respect to Gauge Bottom, at which the Max Gauge Value resides.

Min Needle Travel Angle: For regular circular gauges this is the angle, with respect to Gauge Bottom, at which the gauge value will switch from Maximum to Minimum or vise versa. Value must be between Gauge Min and Max Angle. This value has a different meaning for the Magnehelic and Photohelic gauges, see Section 5.0.

Max Needle Travel Angle: For regular circular gauges set this to the same angle as the Min Needle Travel Angle. This value has a different meaning for the Magnehelic and Photohelic gauges, see Section 5.0.

Needle Rest Correction: Offset angle from Gauge Min Angle where the value will always read Min Gauge Value. If the needle is between the Gauge Min Angle and Gauge Min Angle + Needle Rest Corr, value will read Minimum.

Gauge Tilt Angle: The angle between the WGR and Gauge Bottom. Example: -30 = Gauge is -30 degrees counterclockwise. +30 Gauge is +30 clockwise.

Left LED Bright: Primarily a parameter used on Magnehelic and Photohelic gauges. This value adjusts the brightness of the left half of the image. Range is 0 to 21. 0 is the darkest and 21 is the brightest. Also, most WGRs do not support this feature and changing this value will have no effect.

Right LED Bright: Primarily a parameter used on Magnehelic and Photohelic gauges. . This value adjusts the brightness of the right half of the image. Range is 0 to 21. 0 is the darkest and 21 is the brightest. Also, most WGRs do not support this feature and changing this value will have no effect.

(Reserved Units): Unused.

(Second Blob En=1): Should always be set to 1.

(Second Blob Line En=1): Should always be set to 1.

(Receiver ID): Unused.

3.3 Gauge Image Tab

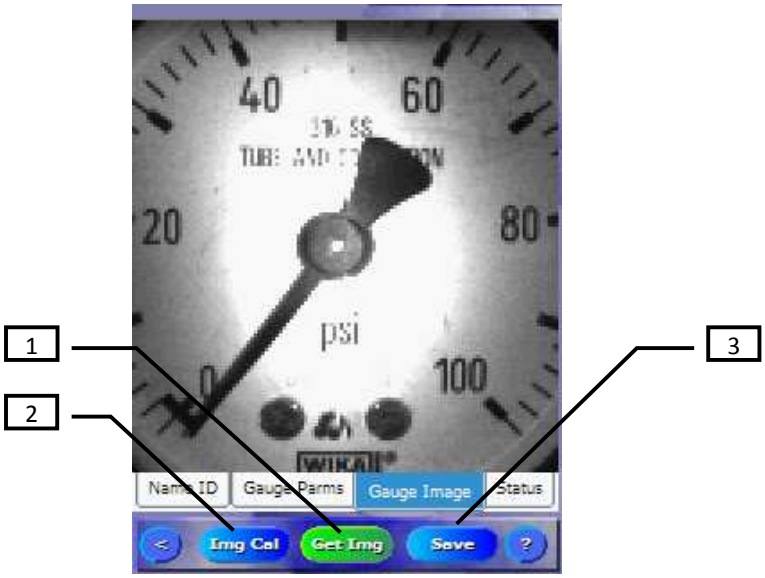


Figure 8. HHC Application Gauge Image Tab

1. **Get Image**: Will request an image from the WGR and display it on the LCD.
2. **Image Calibration**: Will initiate the step by step graphical circle calibration.
3. **Save**: This will save all gauge parameters to a text file with the Device Name.

3.4 Status Tab

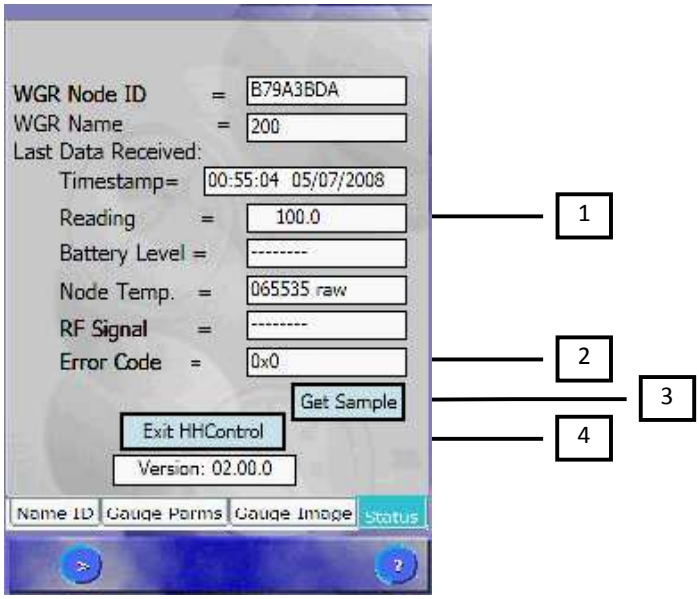


Figure 9. HHC Application Status Tab

1. **Reading**: Contains reading results from a Get Sample Request. This is used to verify the calibration of the WGR was accurate.
2. **Error Code**: Contains the error code result from the last Get Sample performed. See the error code table in Section 11.0.
3. **Get Sample**: This will initiate a sample reading using the current calibration parameters. This is used to request a reading and processing information such as the Green and Red pixels superimposed on the Gauge Image.
4. **Exit HHControl**: Close the Cypress Envirosystems HH configuration application. The HHC will return to the Windows interface. Note: Always exit the HHControl application before turning off or suspending the HHC.

4.0 Configuring the Wireless Gauge Reader

The WGR is a battery powered device developed by Cypress Envirosystems that is mounted onto an existing gauge, shown in Figure 10.

Figure 10. Wireless Gauge Reader (WGR)

4.1 WGR LCD

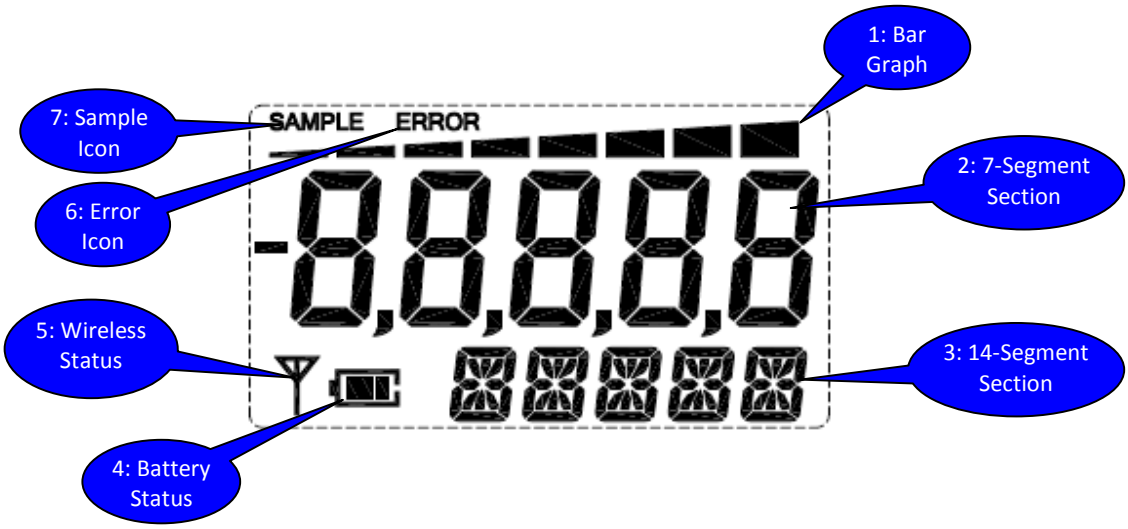


Figure 11. WGR LCD Display

1. **Bar Graph**: This graph is a visual representation of the latest gauge reading. The graph grows from zero to eight bars as the needle moves from its minimum to maximum position.
2. **7-Segment Section**: This section normally displays the gauge reading numerically. It is also used to display status information when WGR is in special operating modes.
3. **14-Segment Section**: This section normally displays the gauge units. It is also used to display status information when WGR is in special operating modes.
4. **Battery Status**: This icon will show the power left in the WGR batteries.
5. **Wireless Status**: The Antenna Icon will be illuminated when a wireless connection is successful.
6. **Error Icon**: This icon will turn on and stay on when the WGR did not properly process the last sample.
7. **Sample Icon**: This icon will turn on and stay on while the WGR is actively processing a sample. When this icon is turned off the WGR is in low power mode.

4.2 WGR Menu Structure

Figure 12 shows the menu structure of the WGR. The three buttons on the WGR are used to navigate the structure. Modes and button sequences are labeled in the diagram below.

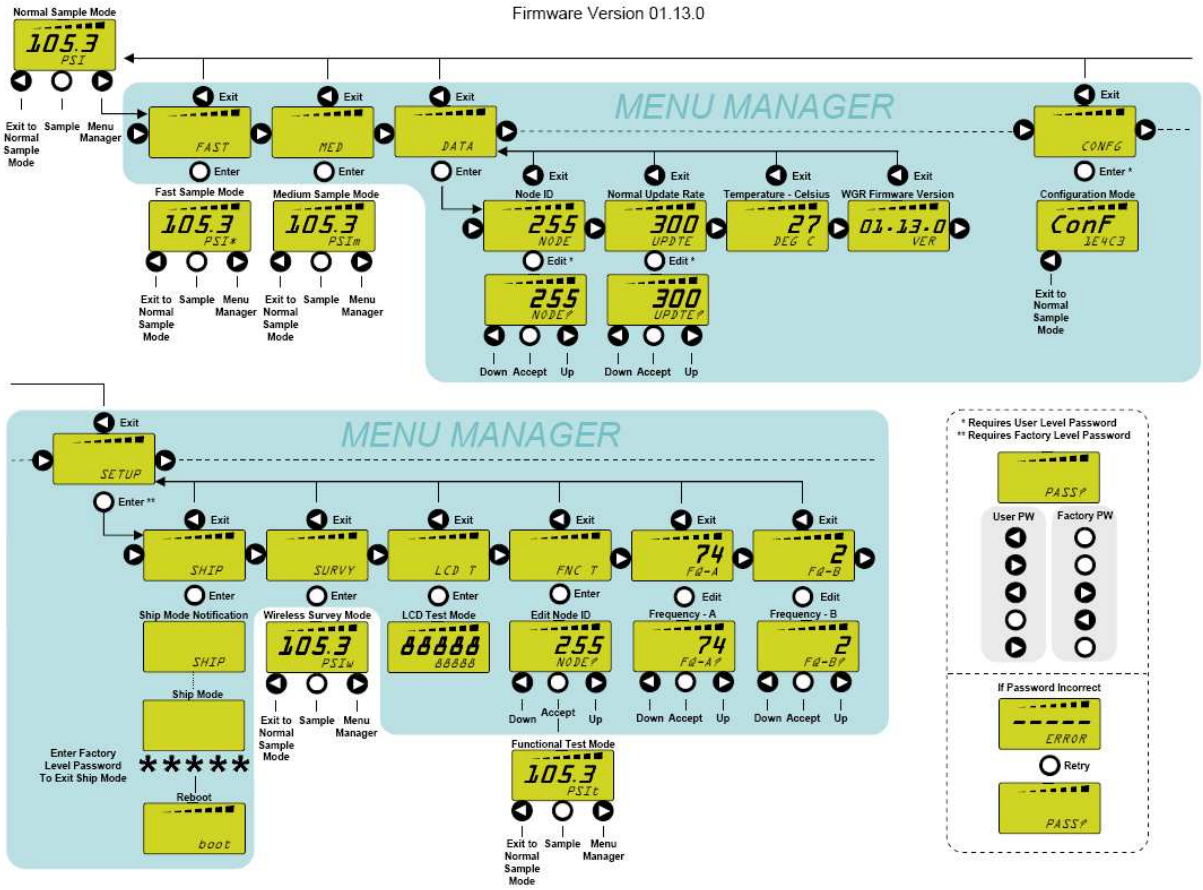


Figure 12. WGR Menu Structure

1. **Normal Sample Mode**: When the WGR is not in any special operating mode it is in the Normal Sample Mode. In this mode the WGR will periodically wake up, sample the gauge, transmit the reading, and update the 7-segment section on the LCD to the latest reading value. The time between samples (update rate) is set up using the HHC.
2. **Fast Sample Mode**: In this mode the WGR will process samples just as in the Normal Sample Mode except that the time between samples is only 5 seconds. This mode will remain active for 5 minutes, before automatically returning back to Normal Sample Mode. This mode is used to monitor a short-term activity that is likely to cause faster gauge movements, or for diagnostics.
3. **Medium Sample Mode**: In this mode the WGR will process samples just as in the Normal Sample Mode except that the time between samples is 30 seconds. This mode will remain active for 8 hours, before automatically returning to the Normal Sample Mode. This mode is used to monitor a medium-term activity that is likely to cause faster gauge movements, or for diagnostics.
4. Data Mode
    a. **RSSI**: (Receive Signal Strength Indication) The RSSI value is displayed in this mode. This is the strength of the wireless signal received by the WGR from the Access Point.
    b. **MAC Address**: (Media Access Control Address) The MAC address for the WGR can be viewed in this mode.
    c. IP Address: (Internet Protocol Address) The assigned IP address for the WGR can be viewed in this mode.
    d. Normal Update Rate: The update rate for Normal Sample Mode can be viewed and edited in this mode.
    e. Temperature – Celsius: Displays the current temperature reading from an internal WGR sensor.
    f. WGR Firmware Version: Displays the WGR firmware version number.
    g. Serial Number: Displays the serial number of the WGR.
    h. Hardware Version: Displays the hardware version of the WGR.
    i. Node ID: The Node ID of the WGR can be viewed and edited.
    j. Normal Update Rate: The update rate for Normal Sample Mode can be viewed and edited.
    k. Temperature – Celsius: Displays the current temperature reading at the WGR.
    l. WGR Firmware Version: Displays the WGR firmware version number.
5. **Configuration**
    a. Configuration Mode: This mode is used to configure the WGR with a HHC.
6. **Setup**
    a. Ship Mode: This mode will effectively power down the WGR. The WGR is in an ultra low power consumption state. This mode is used when storing or transporting WGRs while not in service.
    b. Wireless Survey: This mode is used when performing a wireless survey at a customer site.
    c. LCD Test: This mode is used during manufacturing to test the LCD.
    d. Functional Test: This mode is used during manufacturing to perform a burn in test.
    e. Frequency – A: Frequency A can be viewed and edited.
    f. **Frequency – B:** Frequency B can be viewed and edited.

4.3 Defining the Gauge Face

Related Parameters:

- Gauge Min Angle
- Gauge Max Angle
- Min/Max Needle Travel Angle
- Needle Rest Correction
- Gauge Tilt Angle

The WGR is designed to read many different types of gauges. Gauge features such as minimum value, start angle, units, etc. vary from one another. The WGR must be configured to work with a specific gauge.

The following gauge characteristics do not depend on how the WGR is mounted on a gauge. These parameters could be set prior to mounting a WGR. However, for each WGR, the gauge it will be mounted on and the specific characteristics of the gauge must be known.

All angles are defined with respect to the gauge face. A vertical line cutting down the center of a gauge when the gauge is right side up for a human to read defines the 0° and 180° markers. See the red line in Figure 13. All angles start from 0° and turn clockwise to 359°.

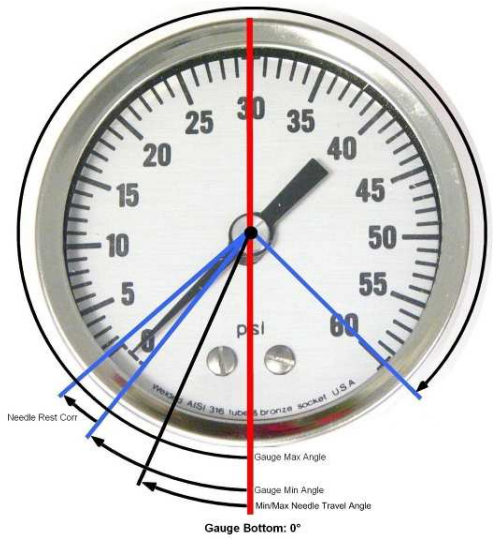


Figure 13. Gauge Angles

Often a gauge is installed at an angle. It makes sense to mount the WGR right side up for readability. It is also possible that a WGR must be mounted at angle if obstacles exist. In either case the WGR must be setup with the correct tilt angle between itself and the gauge.

The following gauge characteristics can only be set AFTER the WGR is mounted on a gauge.

The Gauge Tilt Angle is defined with respect to the WGR. A vertical line cutting down the center of the WGR when the WGR is right side up for a human to read defines the 0° and 180° markers. See the blue lines in Figure 14. Positive angles start from 0° and turn clockwise to 180°, negative angles start from 0° and turn counterclockwise to 180°.

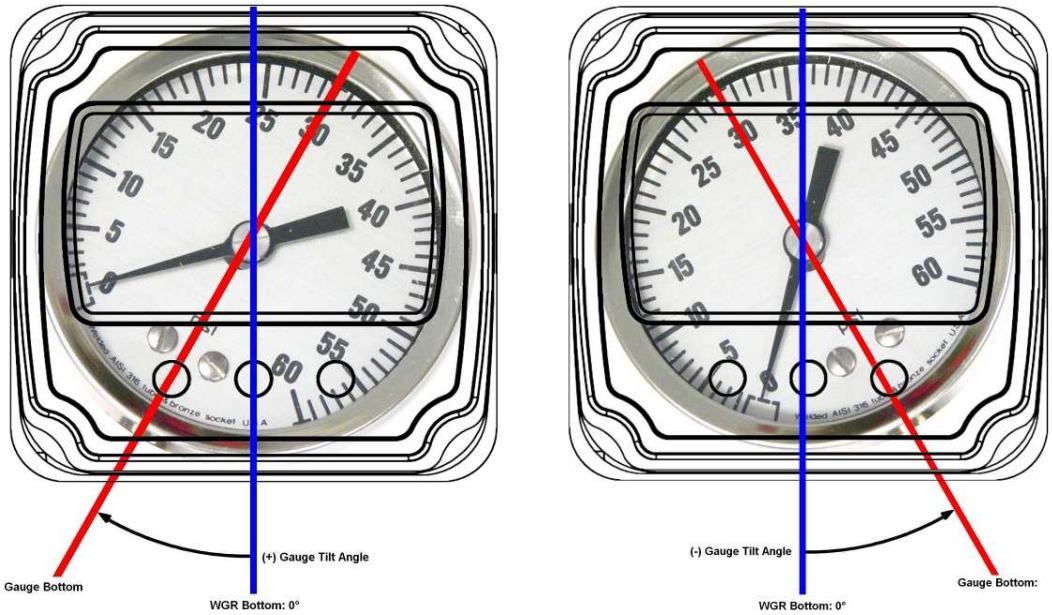


Figure 14. Gauge Tilt Angles

4.4 Circle Calibration

Calibrating the imaging algorithm requires setting these parameters that will be described in the following sections:

- Center Point X
- Center Point Y
- Radius 1
- Radius 2
- Radius 3
- Radius 4
- Radius 5
- Zoom Enable
- Zoom X Offset
- Zoom Y Offset
- Tip Width
- Tail Width

4.4.1 Circles

To find the needle, the WGR image processing algorithm looks for the darkest pixels in the image. Any writing, markings, graphics etc. dark enough will be picked up by the software as part of the needle. To avoid a majority of these background objects, the algorithm will only process the pixels contained in a set of user defined **Concentric Circles**. These circles must be setup to avoid as much background as possible, while still overlapping the needle. **Center Point X and Y** and **Radius 1→5** define the size and location of the circles.

Figure 15 shows an example of concentric circles improperly setup (Green pixels). Notice the five circles overlap the PSI symbol, the numbers, the graphic in the center, and even the rivets at the bottom.

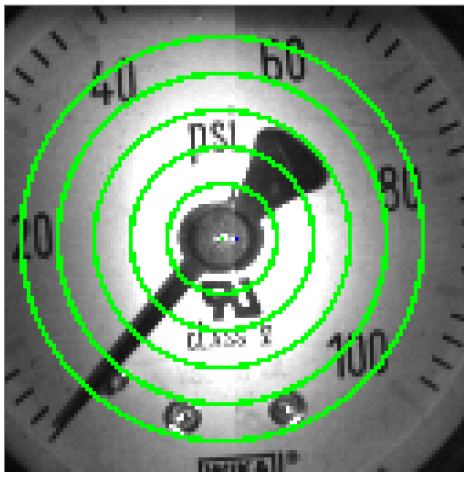


Figure 15. Improperly Calibrated Circles

Figure 16 is the same as Figure 15 except the green pixels represent what the image processing algorithm considers the needle. Notice all green pixels outside of the needle. These could confuse the image processing algorithm and distort the reading.

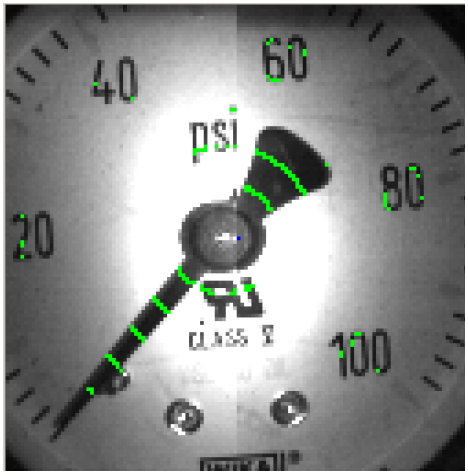


Figure 16. Results of Improperly Calibrated Circles

Figure 17 shows an example of concentric circles properly setup. It may be impossible to avoid all background markings, but an attempt must be made to minimize them. The image processing algorithm will ignore the numbers, rivets and the large graphic in this example. However, portions of the PSI symbol and the top of the "100" marker are still overlapped. The algorithm includes processing steps to filter out as much noise as it can, so a certain amount is tolerable.

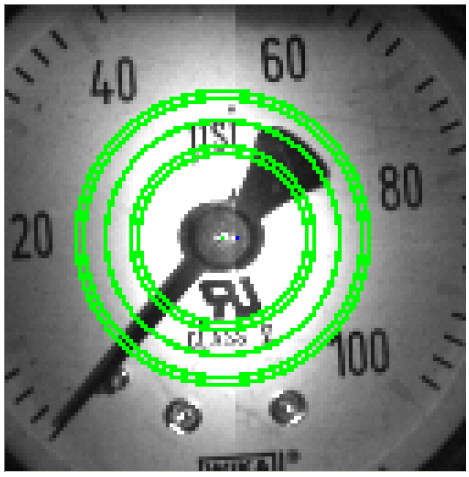


Figure 17. Properly Calibrated Circles

Figure 18 is the same as Figure 17 except the green pixels represent what the image processing algorithm considers the needle. This result is much better than the previous example, Figure 16. The majority of the green pixels are concentrated only on the needle.

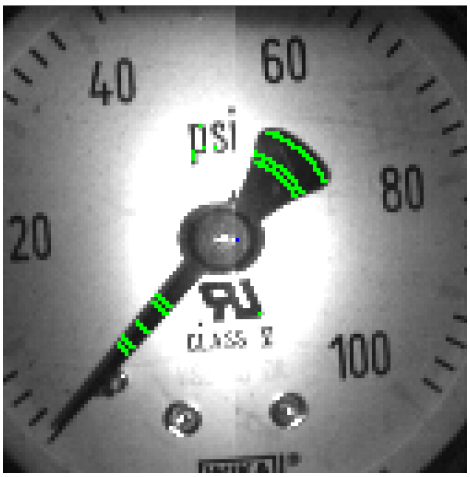


Figure 18. Results of Properly Calibrated Circles

4.4.2 Zoom

In most cases it is beneficial to zoom in on the image. Always try to setup the circles when zoomed in; this will effectively increase the pixel resolution of the needle. To enable zoom, set **Zoom Enable** to 1 and then calibrate the circles.

4.4.3 Zoom X Offset

There is room in the camera's field of view to capture an offset image. Instead of moving the circles to the center of the needle by adjusting the Center Point X variable, move the needle to the center of the image and center the circles. This is the preferred method of centering the circles. This will work when both zoomed in or out.

To set the Zoom X Offset:

1. Center the circles on the Needle.
2. Take the difference: [Center Point X – 63] and enter the result in the Zoom X Offset field.
3. Set Center Point X to 63.
4. The next time a Get Image is performed, the needle will have moved so that it is centered under the circles.

Zoom X Offset Range	**Min**	**Max**
When Zoom Enable = 0	-24	24
When Zoom Enable = 1	-63	63

4.4.4 Zoom Y Offset

Zoom Y Offset can be set the same way as the X Offset except that it can only be used when Zoom mode is enabled.

Zoom Y Offset Range	**Min**	**Max**
When Zoom Enable = 0	NA	NA
When Zoom Enable = 1	-30	30

4.4.5 Get Sample

Once the circles and zoom settings have been set, perform a Get Sample to verify the settings. See Figure 19. Get Sample will superimpose Green and Red pixels on the gauge image in the Gauge Image tab. The Green represents pixels the WGR will treat as potential needle locations. The Red pixels represent the final needle location for each circle. The red pixels should be centered along the width of the needle. From these red pixels the software will calculate an angle.

Note: The red pixels for those circles ignored by the “Second Radius Ignore” variable will not be shown.

Note: If the needle has moved since the time a Get Image was performed, the green and red pixels will not match the image. Either continue as is or get a new image. Keep in mind that every time a new image is obtained, battery power is consumed.

Figure 19. Get Sample Image

4.4.6 Tip/Tail Width

Related Parameters:

- Tip Width
- Tail Width

It is possible that the WGR will confuse a group of green pixels overlapping background objects as the needle. This can cause the WGR to report incorrect readings. To check for and avoid this issue, perform the following:

- Perform a Get Sample. Check the location and group size of all green pixels in the image. If any exist that are close to the group size of the green pixels overlapping the needle, the following adjustments may need to be made:
  - If possible, adjust the circle locations to avoid the background.
  - Adjust the Pixel Threshold. This will only work if the background is not as dark as the needle.
  - Adjust the **Tip Width**. If the erroneous group of green pixels is slightly smaller than the width of the green pixels over the tip of the needle, increase the Tip Width. This will tell the WGR to ignore groups of green pixels smaller than this value.
- Perform a Get Sample. Check the location of all red pixels; make sure they are all centered along the needle. If the red pixels are off the needle the same adjustments listed above can be made. If the red pixels are on the needle but not centered along the needle width, make the following adjustments:
  - If the off centered red pixels are within a wide tail, consider increasing the Tail Width. This will tell the WGR that the group of green pixels that should be considered the needle is wider. The WGR will treat all of the green pixels along the tail as a single group and properly center the red pixel.

Note: The HHC will not display red pixels along circles that are ignored by the Second Radius Ignore variable; see Section 4.4.10

4.4.7 Pixel Threshold

Related Parameters:

- Pixel Threshold

To further isolate the background from the needle, adjust what the image processing algorithm considers a dark pixel. Most of the time, the needle is slightly darker than its background. The **Pixel Threshold** variable can be used to adjust the sensitivity to keep just the needle and reject the background. Decreasing the Pixel Threshold will increase the number of pixels picked up. Increasing the Pixel Threshold will decrease the number of pixels picked up.

Figure 20 shows an example of when the Pixel Threshold needs to be increased. Notice that the software is picking up the white background as dark pixels.

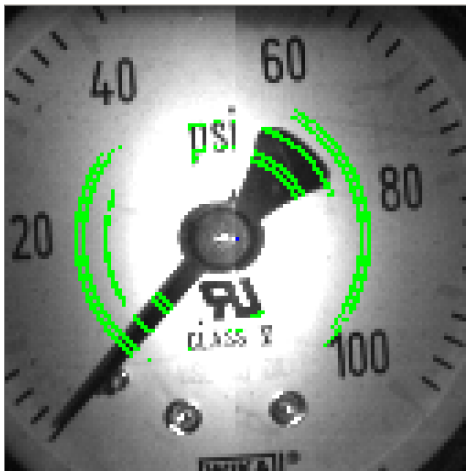


Figure 20. Pixel Threshold Adjustment Required - Increase

Figure 21 shows an example of when the Pixel Threshold needs to be decreased. Notice the entire needle is not being picked up.

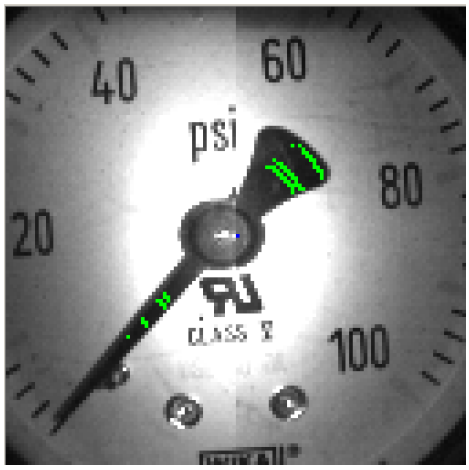


Figure 21. Pixel Threshold Adjustment Required - Decrease

To ensure a robust setup set the Pixel Threshold so it is not at the edge of picking or dropping extra pixels. The camera exposure and lighting can vary depending on temperature, remaining battery power, and other variables. If the Pixel Threshold is at the edge, a slight change in exposure or lighting can cause problems.

The following steps describe this process.

1. Set the Pixel Threshold. Perform a Get Sample and make sure only the needle is picked.
2. Lower the Pixel Threshold by 40 and perform a Get Sample. Make sure too many extra pixels were not picked.
3. Restore the Pixel Threshold to the original value.
4. Increase the Pixel Threshold by 40 and perform a Get Sample. Make sure too many extra pixels were not dropped.
5. If steps 2 and 4 passed, the original setting is robust. If step 2 failed, increase the Pixel Threshold value. If step 4 failed, decrease the Pixel Threshold value.

4.4.8 Long Tail – Short Tail Selection

Related Parameters:

- Long Tail Enable
- Taper and Short Tail En
- Second Radius Ignore

In general there are two types of needles; those that are considered Short Tail and those that are considered Long Tail.

4.4.9 Short Tail

These are needles where at least one of the concentric circles can be position beyond the end of the tail without overlapping background objects, as shown in Figure 22. In other words, the circles can be position to only overlap the tip but not the tail of the needle. To know which direction the needle is pointing the software uses the position of the red pixel(s) along the circles that only overlap the tip.

For this case, select **Short Tail Enable**.

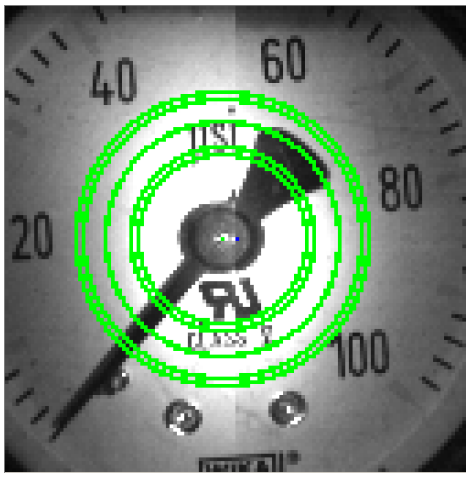


Figure 22. Short Tail Enable

4.4.10 Radius Ignore

For Short-Tail, some of the outer circles will not overlap both sides of the needle. In this case the software should ignore the second set of red pixels that do not exist. In Figure 22, the two outermost circles only overlap the tip of the needle and not the tail. The second set of red pixels could potentially introduce errors into the angle calculation. In this case, set the *Num Non-Tail Circles* to 2, meaning that the outer two circles do not intersect the tail.

Note: The red pixels corresponding to those ignored will not be shown when a Get Sample is performed.

4.4.11 Combined Short Tail and Taper Detection

If the circles overlap a lot of background, it is possible that the outer circle will pick up the background instead of the needle and report the wrong tip. In this case it may be useful to combine the Short-Tail method with an additional Taper Detection method. The algorithm will use information from both methods to try to more reliably determine the needle orientation. This will only work if the needle taper is significant. The WGR will compare the results from the two methods and report the value or error if they do not match. It is possible that this method may cause the WGR to issue more conversion error codes (since multiple algorithms have to be satisfied), but there is extra reassurance it will not report tip-tail failures. To enable, set the Short-Tail Enable and Taper Detection check-boxes.

4.4.12 Long Tail

These needles are those with no room to place the circles beyond the end of the tail, shown in Figure 23. To find the tail the software will measure the taper of the needle at every point where the circles overlap it. The side with the bigger overall width (widest part of the taper) is the tail.

To enable this feature set the Long-Tail Enable checkbox.

This approach relies on the fact that most needles are tapered. However, the taper on some needles are finer than others. To maximize the accuracy of this approach:

- Make sure the concentric circles always overlap the needle. Attempt to position the circles such that they take advantage of large difference in the tip and tail width.
- Ensure the Second Radius Ignore variable is set to 5 so none of the red pixels are ignored in the angle calculation.
- Enable the Zoom to zoom in on the needle. This will provide more resolution to measure the taper.
- Enable the Dynamic Stitching variable. See the Dynamic Stitching section 4.4.14.

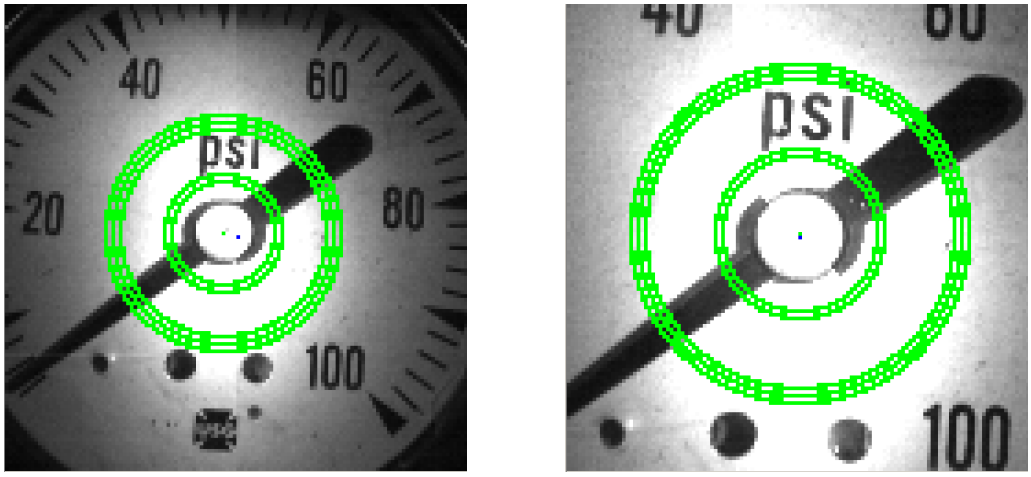


Figure 23. Long Tail Enable

4.4.13 No Tail / No Tip Needles

There may be gauges that either do not have a tail or the tip is too thin to process, shown in Figure 24. In this case a No Tip or No Tail Needle can be defined.

For a No-Tail Needle such as the one in Figure 24, follow the same steps as the Short-Tail method. Set the Num Non-Tail Circles parameter to the correct value to 5 if no circles overlap the tail. If one circle did overlap the tail, set Num Non-Tail Circles parameter to 4.

Figure 24. No-Tail Needle

For a No Tip Needle, do the same as a No Tail. To reverse the readings rotate the Gauge Min, Gauge Max, and Min/Max Needle Travel Angle by 180 degrees in the setup.

4.4.14 Subtle Needle Taper / Dynamic Stitching

Related Parameters:

- Dynamic Stitching

LEDs reflecting off the WGR plastic cover and the gauge lens produces glare. Glare restricts the image processing algorithm from processing segments of the image. To remove the glare, the WGR uses a patent pending image capturing and processing technique. The WGR uses two LEDs and takes two half–image captures. For each half image, the opposite LED is illuminated to avoid glare in the area of interest. The resulting half images are stitched together to form one glare-free image; see Figure 25. Stitching solves problems related to glare but introduces new issues.

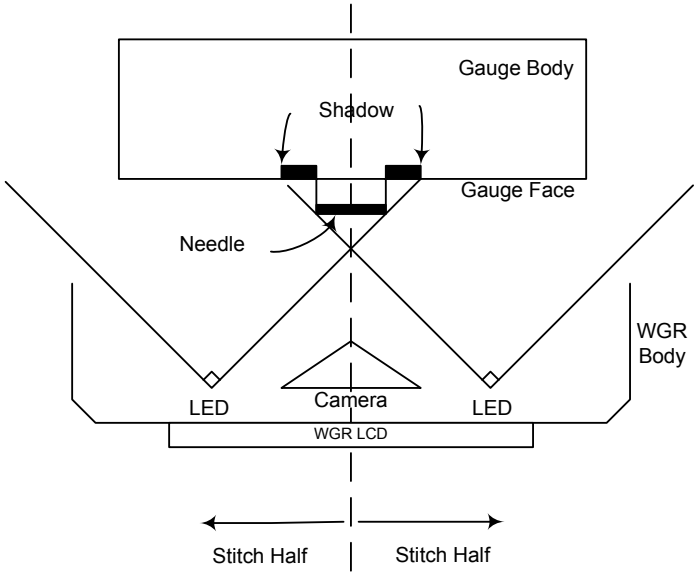


Figure 25. Stitching Two Halves of an Image using Two LEDs

For Long-Tail Gauges, the needle taper is used to determine the orientation of the needle (tip versus tail). Therefore, an accurate reading of the needle's width is required for this algorithm. Using two separate LEDs for light sources causes a shadow effect on the needle. If the needle is aligned vertically with the image seam, the image will contain two shadows on either side of the needle, which may compromise the accuracy of the taper detection algorithm. In order to minimize the shadow effect, the WGR can employ a special patent pending image stitching mode called Dynamic Stitching. See Figure 26.

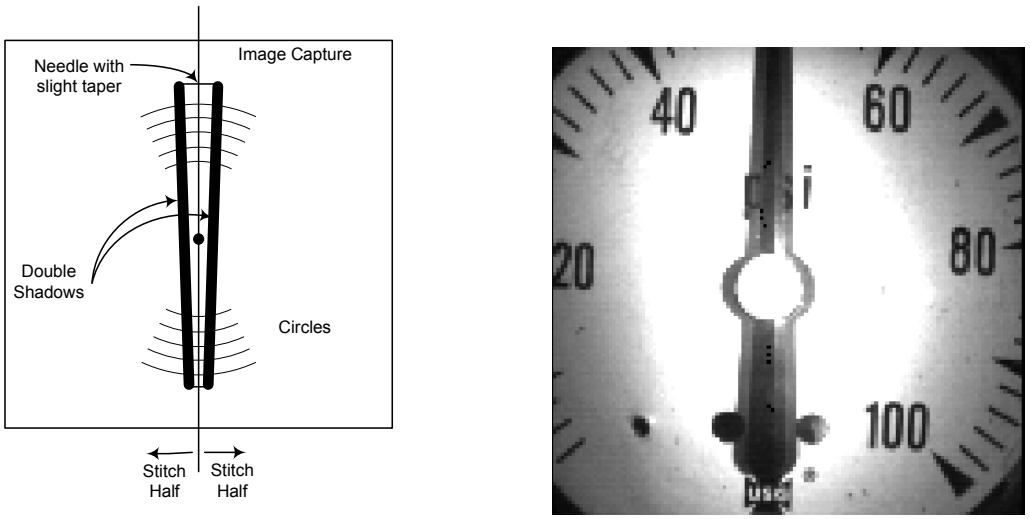


Figure 26. Stitched Image Showing Needle with Two Shadows

The Dynamic Stitching technique eliminates double shadows but requires some extra processing time and power consumption. Instead of stitching down the middle of the image, the WGR stitches using one of two special patterns. The stitch will start offset to one side, then cut diagonally to the other side, and all the way down. See Figure 27 and Figure 28. The opposing stitch offsets in the top and bottom half of the image eliminates double shadows.

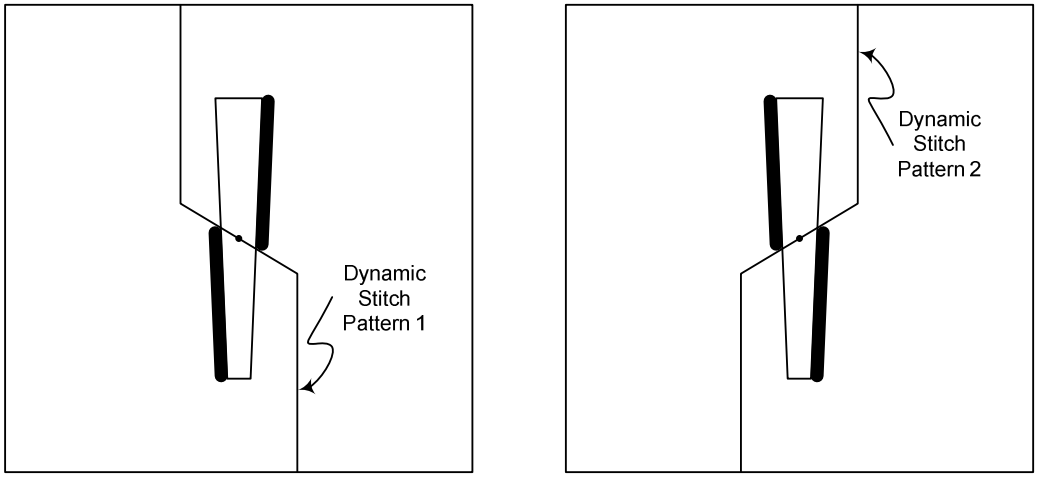


Figure 27. Dynamic Stitching Technique

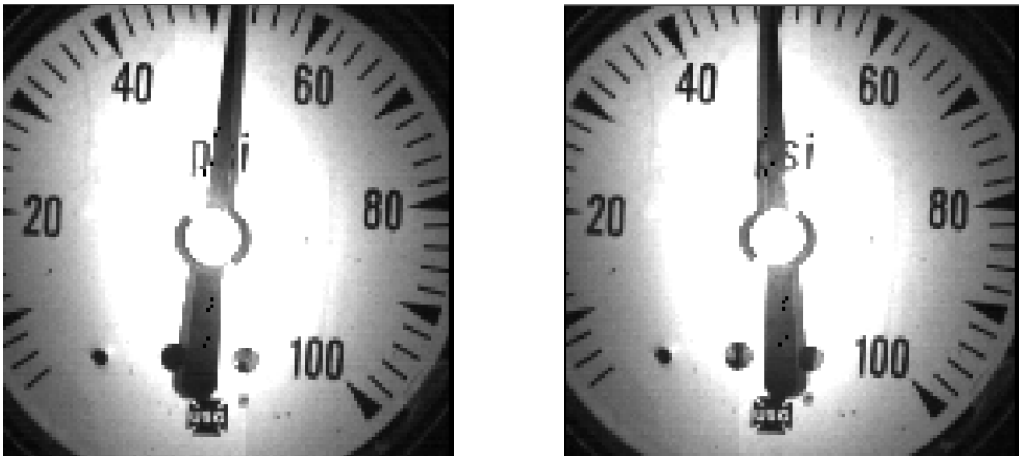


Figure 28. Two Dynamic Stitching Patterns with One Shadow

Two different stitching patterns are required to properly cover all possible needle positions. The pattern must be reversed depending on the current angle of the needle. Figure 29 shows the range of needle angles for each pattern.

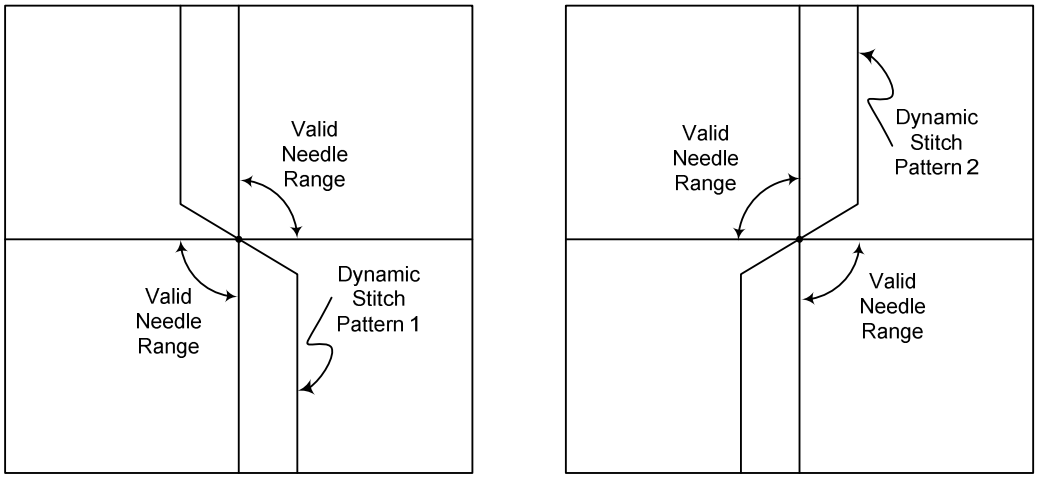


Figure 29. Possible Needle Angles for Each Pattern

To dynamically determine which pattern to use, the WGR defaults to the last pattern used, processes the image, and determines if the needle is out of range. If so, the WGR stitches the image with the new pattern and reprocesses it. When the needle moves enough to require the stitch pattern to change, then the processing time and power consumption is doubled. Typically, most needles will not move between the two different dynamic stitching zones very frequently, so the overall power impact will be low.

The following is a list of consideration when deciding whether or not to use Subtle Needle Taper:

1. Is the Long-Tail Method being used?
    a. Dynamic Stitching matters only when looking at the needle taper in Long-Tail mode. When using Short-Tail method, disable Subtle Needle Taper.
2. Is the needle taper slight, or reversed?

a. If the needle has a significant taper, double shadows are not an issue, so Subtle Needle Taper can be disabled to save battery life.

b. If the needle has a slight or even somewhat reversed taper, then enable Subtle Needle Taper, to help ensure reliable readings. See Figure 30 for an example of a reverse tapered needle.

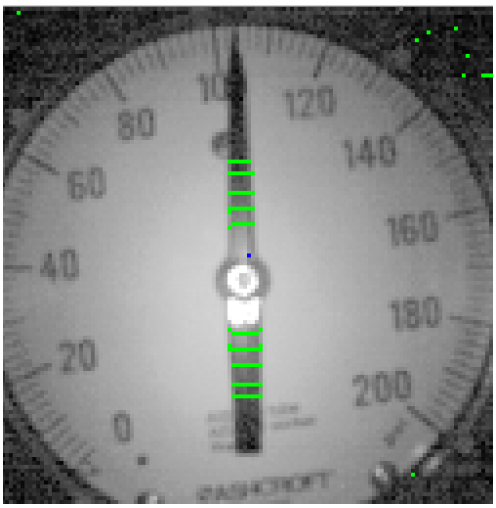


Figure 30. Needle with Reverse Taper

3. Is there glare near the center of the needle?

   a. Since Dynamic Stitching uses a special offset stitching pattern, it is prone to some additional glare near the center of the needle. See Figure 31 for an example.

   b. This is only a concern if the rings are defined near the glare/washed-out area.

   c. If it is affecting the pixel selection in the area, then try turning down the Camera Exposure to see if the glare is reduced or eliminated.

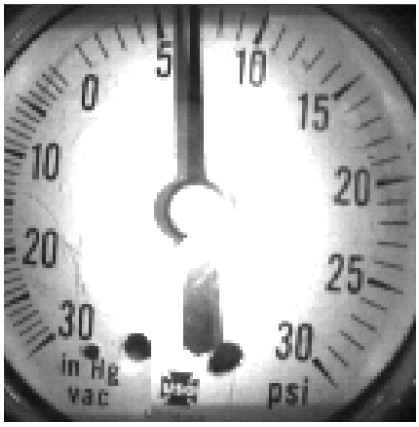


Figure 31. Glare from left LED on Bottom of Needle

When Subtle Needle Taper has been enabled, the HHC can be used to see the resulting image from both stitch patterns.

Image Request: Every time an image is requested from the WGR using the HHC, the WGR will toggle between the two stitch patterns. This allows the installer to examine both patterns for potential glare issues, regardless of the needle location.

Get Sample: When requesting a sample reading, the WGR will process the image using the appropriate stitch pattern for the current needle position. The red and green pixels from the sample are always a result of the actual pattern the WGR would use when normally processing. Note that depending on the last time that a new image capture was requested, the green and red pixel pattern seen in the Image tab may not match the image accurately, since the opposite stitch pattern may have been used to process the image. If this is the case, then simply request a new image capture to clarify the results.

**Depending on the last time an image was requested, the pattern seen in the handheld image may not match the actual pattern used by the WGR from a sample request. If the red or green pixels are not perfectly aligned with the needle, request another image to capture the opposite pattern and align the red and green pixels.

4.5 Step-by-Step Configuration

This section presents a step by step guide to calibrate the WGR for a specific gauge. It takes the installer through all the steps necessary to ensure the WGR will process accurate readings.

Any time a WGR is mounted onto a gauge it must be calibrated before it will accurately process gauge readings. Calibration of a WGR is relatively sensitive; small errors can result in inaccurate readings. Physical changes in the way a WGR is mounted may require it to be recalibrated. For example, a WGR is removed from a gauge, remounted on the same or different gauge, or accidently knocked out of its initial mounting position.

4.5.1 Before Mounting

Prior to physically mounting the WGR onto a gauge the following steps are recommended.

1. Monitor gauge needle.

   The goal is to get an idea of the actual gauge reading so it can be used as a reality check against the WGR reading after it has be calibrated. Once the WGR is mounted perform a Get Image to see what the gauge is actually reporting. Note: It is good to have a frame of reference by viewing the actual gauge beforehand.

2. Record the current gauge reading.

   Determine the needle dynamics. Does it seem stable? Is it moving slowly? Does it flutter? Take note of this. This information can later be used as a sanity check that the WGR is reporting correctly.

3. Record gauge information: Units, Min/Max Value

   Once a WGR is mounted onto a gauge it may be difficult or impossible to see the entire gauge surface due to the camera's field of view. Record the information from the gauge face prior to mounting the WGR.

4. Cover up the background.

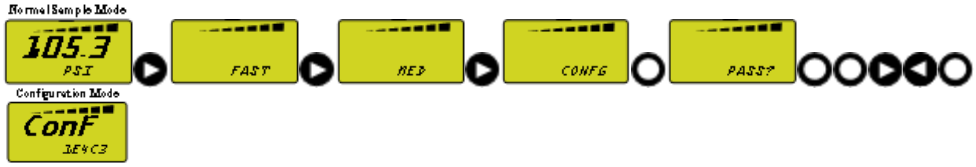
   Sometimes writing or graphics on the gauge face may corrupt the image processing routine attempting to identify the needle position. For gauges with removable lens covers, it may be worth the effort to remove the gauge cover and use non-gloss white tape to cover up some of the background writing to ensure reliable WGR image processing and performance.

4.5.2 Connect the HHC to the WGR

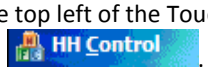
Once the WGR is mounted, then it is ready to be configured. The first step is to establish a communication link between the HHC and the WGR.

Steps:

1. Make sure the WGR is out of Ship Mode.
   a. If the WGR LCD screen is blank, then it is likely in Ship Mode.
   b. Follow these steps to exit Ship Mode: 

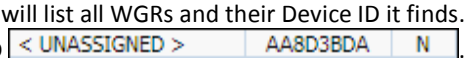
2. Transition the WGR into Configuration Mode:
   a. 

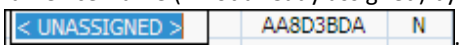
3. Prepare the HHC for use:
   a. Remove the HHC Device from its Docking Station.
   b. Power on the HHC. Press and hold the **[Enter/On]** key for one second. When the **Green LED** flashes, release the **[Enter/On]** key.
   c. Launch the HHC application: Select the Windows Start Icon on the top left of the Touch Screen 

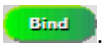
, select the HHC Control application from the Start Menu 

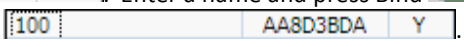
.
4. Bind to WGR: Select the Name ID Tab 

, press the Find Button 

. Wait for the HHC to search for all WGRs in the vicinity who are in Configuration mode.
5. The HHC will list all WGRs and their Device ID it finds. Select the WGR to be configured based on the Device ID 

.
6. Assign a Device Name (if not already assigned) by tapping on the name twice until it is in text entry mode 

. Enter a name and press Bind 

. The Status column should convert to “Y” from “N” 

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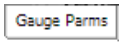
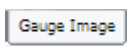
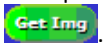
4.5.3 Initial Configuration

After establishing communication between the HHC and the WGR, the configuration steps can begin.

1. There is an option to default all parameters in the HHC by reading them in from the WGR. If a similar gauge was previously configured with the same HHC, the parameters can be kept as is and reused instead of reading in the defaults. To read in the defaults, select the Gauge Parameters tab 

and press the Get button 

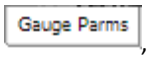
.
2. Next perform a Get Image. Select the Gauge Image tab 

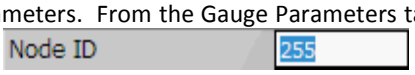
and press the Get Img button 

.
3. From the gauge image record the following information:
   - Gauge Units
   - Min and Max Gauge Value

- Gauge Min and Max Angle
- Min/Max Needle Travel Angle
- Needle Rest Correction
- Gauge Tilt Angle
- Current Reading

4. Look at the gauge and determine if the Long Tail or Short Tail method will be used. Refer to Section 4.4.8 and Section 4.4.14 as necessary.

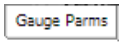
5. Set all known parameters. From the Gauge Parameters tab 

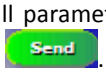
, highlight the field with the stylus and fill in 

with the correct value from the keypad 

. The following variables should be set at this time:

   - Node ID
   - RF Frequency A
   - RF Frequency B
   - Sample Rate
   - Units
   - Min Gauge Value
   - Max Gauge Value
   - Zoom Enable
   - Long Tail Enable
   - Taper and Short Tail En
   - Dynamic Stitching
   - Second Radius Ignore
   - Exposure
   - Gauge Min Angle
   - Gauge Max Angle
   - Min/Max Needle Travel Angle
   - Needle Rest Correction
   - Gauge Tilt Angle

6. Send all parameters to the WGR. From the Gauge parameters tab 

and press the Send button 

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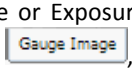
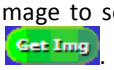
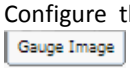
4.5.4 Circles and Camera Configuration

With the initial set of configuration complete, calibration of the more advanced features of the WGR can be performed. In this section, the circles and the camera will be configured.

1. If changes were made to the Zoom Enable or Exposure variable, perform a Get Image to see the updated result. Select the Gauge Image tab 

, press the Get Image button 

.

2. Configure the Circles and the Needle Center; refer to Section 4.4. Select the Gauge Image tab 

and press the Image Calibration button 

. This will begin the Graphical Center/Circle calibration process:

   a. The first step is to set the Center X and Y location 

. Using the stylus, tap on the center on the needle in the gauge image:

Figure 32. Gauge Center Calibration

b. Once the center is set, the application will ask for the first or smallest circle Radius 1 

. Tap on the image where Radius 1 should be positioned. To accurately set the circle Radius 1 may be temporarily defined so that is surrounds the middle of the needle as a reference. Since the circles follow the Center X/Y location, this circle will better gauge the center location. Otherwise, set the circles properly.

c. After Radius 1 is set the HHC will repeat the process for each circle up to Radius 5. Each time, tap on the gauge image with the stylus to set the location.

d. When complete the HHC will display all the circles.

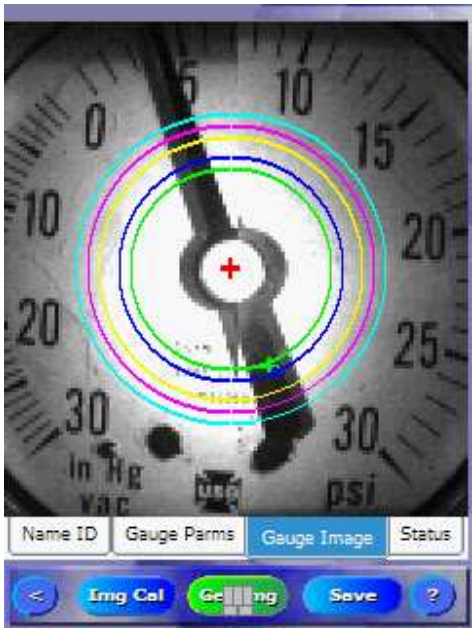


Figure 33. Radii and Center Point Calibration

e. The graphical approach does not provide a high level of accuracy. Switch back to the Gauge Parameters tab [Gauge Parms] to accurately adjust the Center and Radius values so they line up. Every time the values are adjusted, switch back to the Gauge Image tab [Gauge Image] and the graphical representation of the circles and the center will be updated to the new location.

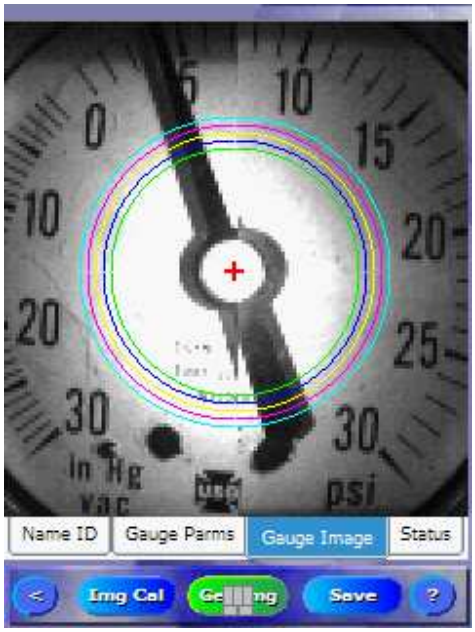
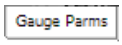
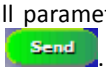


Figure 34. Radii and Center Point Calibration

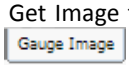
3. If Zoom is enabled, set the Zoom X and Y Offset to [63 – Center Point X/Y], and set Center Point X and Y to 63. See Section 4.4.
4. If there is a glare on the needle, or the contrast difference between the needle and the background is not big enough, adjust the Exposure.
5. Send all parameters to the WGR. From the Gauge parameters tab 

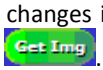
and press the Send button 

.

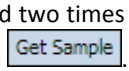
4.5.5 Final Adjustments

At this point all parameters should be set with initial values, some of which may require additional adjustments in order to ensure a robust installation.

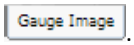
1. Perform a Get Image to see the updated image from changes in the last section. Select the Gauge Image tab 

and press the Get Image button 

.
2. Perform a Get Sample TWICE to view the results. Any time the circle or camera settings have been updated, Get Sample must be performed two times for it to return accurate results. From the Status tab 

, press the Get Sample Button 

. Wait for the results to return.
3. When the status window 

disappears, switch to the Gauge Image tab 

. Green and red pixels will be superimposed on the image.

   Note: If the needle has moved since the time a Get Image was performed, the green and red pixels will not match the image. Either continue as is or get a new image. Keep in mind every time a new image is obtained, battery power is consumed.

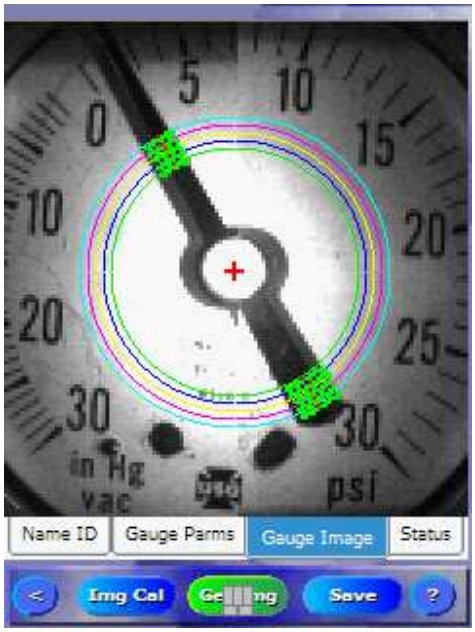


Figure 35. Green and Red Pixels Superimposed on the Gauge Image

4. Adjust the Pixel Threshold as described in Section 4.4.7.

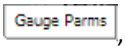
5. Adjust the Tip and Tail Width as described in Section 4.4.6

6. Finally check the WGR Reading 

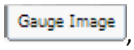
from the Status tab 

after performing a Get Sample. Adjust the Gauge Tile Angle to calibrate the reading to the actual gauge reading seen in the image.

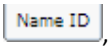
4.5.6 Final Steps

1. Review all variables in the Gauge Image tab. Make sure all settings are correct and they make sense.
2. Send all variables. From the Gauge parameters tab 

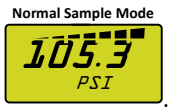
, press the Send button 

.
3. Save the variables. From the Gauge Image tab 

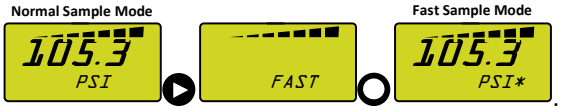
, press the Save Button 

.
4. End the configuration mode on the WGR. This step will save the variables on the WGR. If the WGR is forced out of configuration mode either because of a timeout or the user presses the left button, the variables are not saved. From the Name ID tab 

, press the Finish Button 

. Make sure the WGR exits Configuration Mode and enters Normal Sample Mode 

.

5. Transition the WGR into Fast Sample Mode to collect high resolution readings. The data can be examined on the central serve to ensure the installation was successful. From Normal Sample Mode perform the following steps: 

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5.0 Configuring the WGR for Magnehelic and Photohelic Gauges

This section describes the configuration procedure for Magnehelic and Photohelic type gauges. A special WGR must be used for these types of gauges (WGR-100-003, WGR-100-135 and WGR-100-145 only) For convenience, they will be referred to as Magnehelic gauges in this section. Note that a special WGR must be used with a Magnehelic gauge. Standard WGRs are not compatible with Magnehelic type gauges.

Figure 36. Wireless Magnehelic Gauge Reader

Magnehelics differ from standard gauges in ways that effect the configuration of a WGR. The following table contains key differences and their effect on configuration.

Normal Versus Magnehelic Gauges	Configuration Changes
Magnehelics have Bottom Mount Needles.	Semi-Circles or arcs are used instead of full circles to process the gauge. The Min/Max Needle Travel Angle will define the arc.
The Magnehelic needle is very thin compared to standard gauge needles. The contrast difference is sometimes very slight between the needle and the background.	Pixel Threshold is no longer used to find the needle. An edge detection method is used instead.
The Magnehelic gauge has a large surface area.	The Zoom mode should almost always be disabled for Magnehelic gauges.
The Magnehelic Needle does not have a “Tail”.	Long/Short-Tail, Subtle Needle Taper, Tip/Tail Widths are not required for configuring Magnehelic gauges

5.1 Background

Most of the steps required to configure Magnehelic gauges are unchanged from the standard gauge configuration process. The differences are limited to circle setup and variable usage.

The WGR does not require full circles to process Magnehelic Gauges. Instead Semi-Circles or Arcs are used to process only the area within which the needle will travel. For Magnehelic Gauges the circle radii will be much larger, and the Center Y location will be lower (larger value). The images below contrast the circles for a regular and Magnehelic gauge.

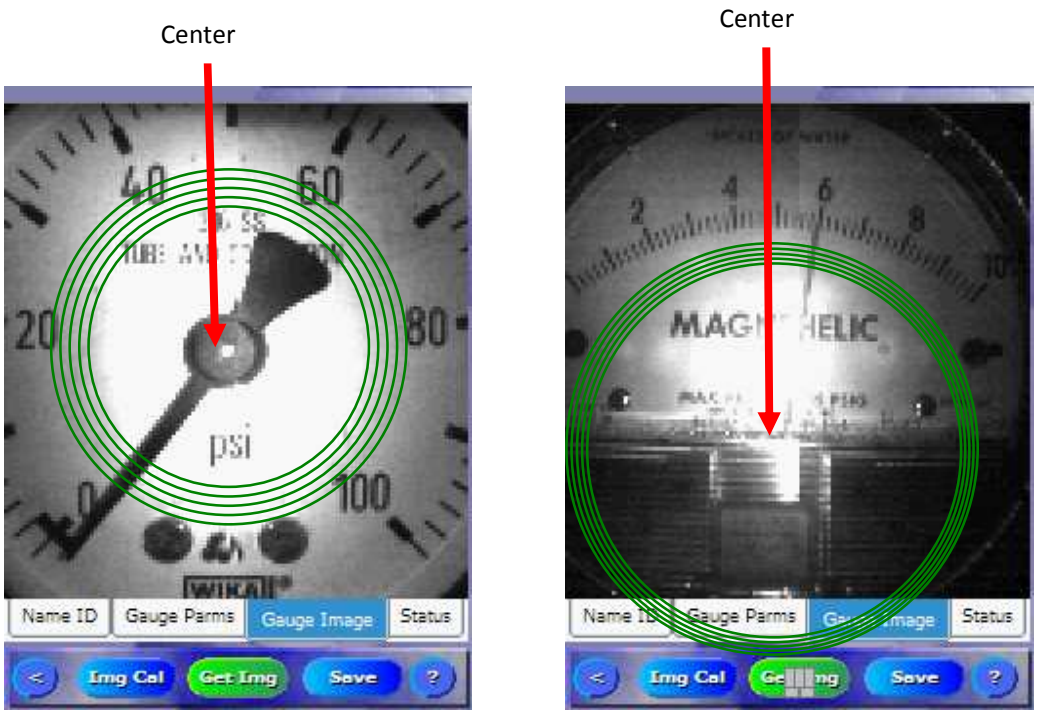


Figure 37. Circles for a Traditional Gauge versus a Magnehelic Gauge

5.2 Creating Arcs

To create Arcs, use the traditional method to define circles, then define the start and stop location of the Arc using the **Minimum Needle Travel Angle** and **Maximum Needle Travel Angle**. These angles specify the range within which the needle can travel.

To view the Arc use **Get Sample**. Unlike regular gauges, Get Sample will highlight, in green (Green Blobs), the areas representing the ends of the Arc. Because thresholds are not used, the Green Blobs do not return the needle location. Instead they are used to ensure the Min and Max Needle Travel Angles have been correctly set. Figure 38 shows an example image after a Get Sample request.

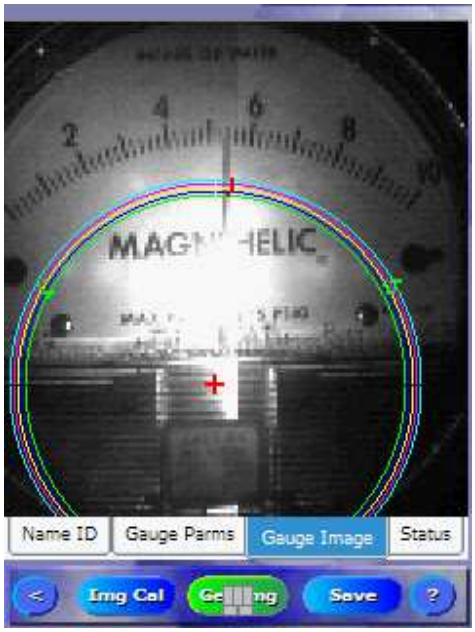


Figure 38. Get Sample on a Magnehelic Gauge

Notice also the red pixels in the image above. They represent the needle location determined by the WGR image processing algorithm. The red pixels behave the same for a Get Sample as they do for regular gauges.

5.3 Circle Setup

The goal is to get the circles lined up underneath the hash marks, making sure they overlap the needle along the entire span.

Unfortunately there is not enough room between the hash marks and the needle stops to properly fit five arcs. Figure 39 shows this situation. If the needle was resting on the stop the WGR not be able to process its location. The green pixels along the circles show the end of the arcs. Because the arcs stop before reaching the needle it would not be processed.

Note: It is very important that the **Needle Travel Angles** encompass the ENTIRE RANGE OF THE NEEDLE. If the needle ever travels outside the arcs, the WGR will consistently report an error.

Figure 39. Improper Circle Setup

To get around this problem configure the circles as shown in Figure 40. In this case, the arcs stop past the needle stops. If a needle were resting on one of the stops, it would be processed.

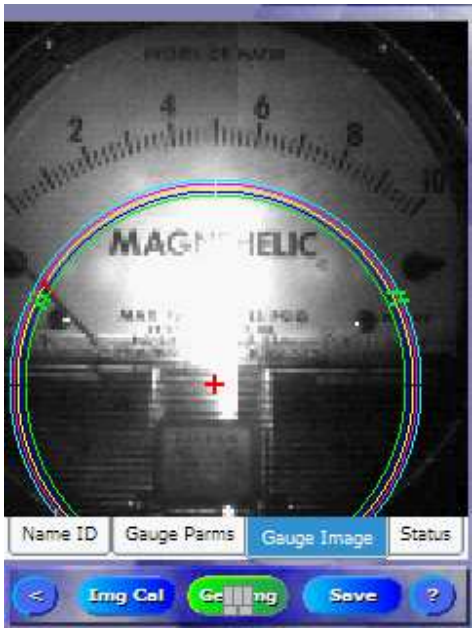


Figure 40. Proper Circle Setup

The **Center Point X** of the circle should match the center of the Gauge Face. The **Center Point Y** of the circle should be adjusted as needed such that the circles are properly spaced between the needle stops and the Magnehelic text.

Note: An attempt should be made to match the circle centers to the needle pivot location on the gauge. This is where the needle is anchored to the gauge. The farther away the circle centers are from the needle pivot location the larger the error would be in the readings.

5.4 Configuration

Steps:

1. Transition the WGR into Configuration Mode and connect to the WGR as described in Section 4.5.2.
2. Setup the following Parameters on the first page of the Gauge Parms Tab. Parameters marked as SAME have the same functionality as the standard WGR. Make sure to setup those parameters normally. Parameters marked NOT USED can be ignored and left as default.

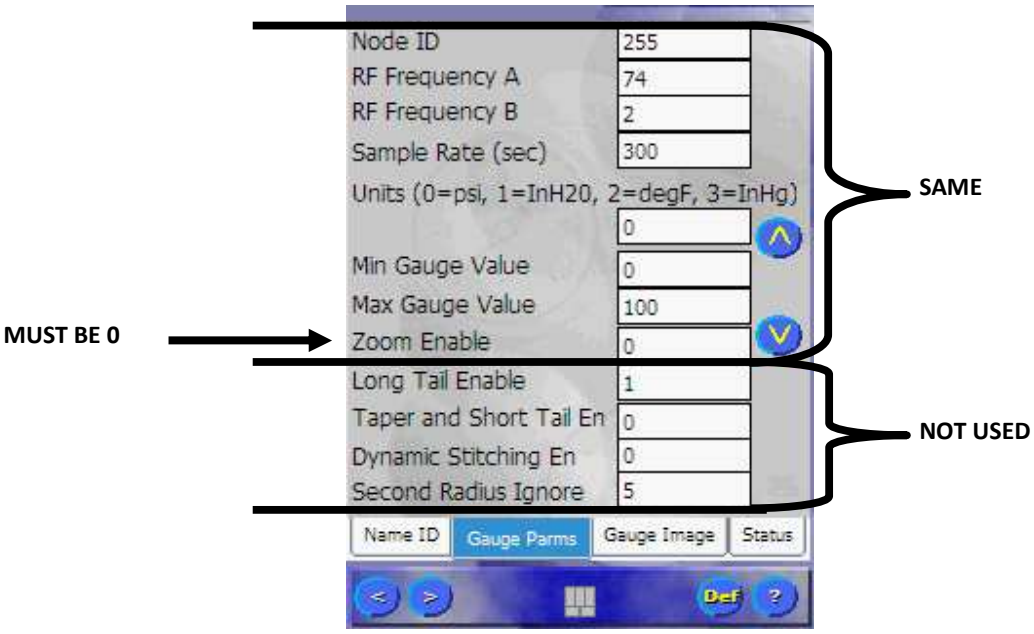


Figure 41. Gauge Parameters Tab - Page 1

3. Setup the following Parameters on the second page of the Gauge Parms Tab. Parameters marked as SAME have the same functionality as the standard WGR. Make sure to setup those parameters normally. Parameters marked NOT USED can be ignored and left as default.

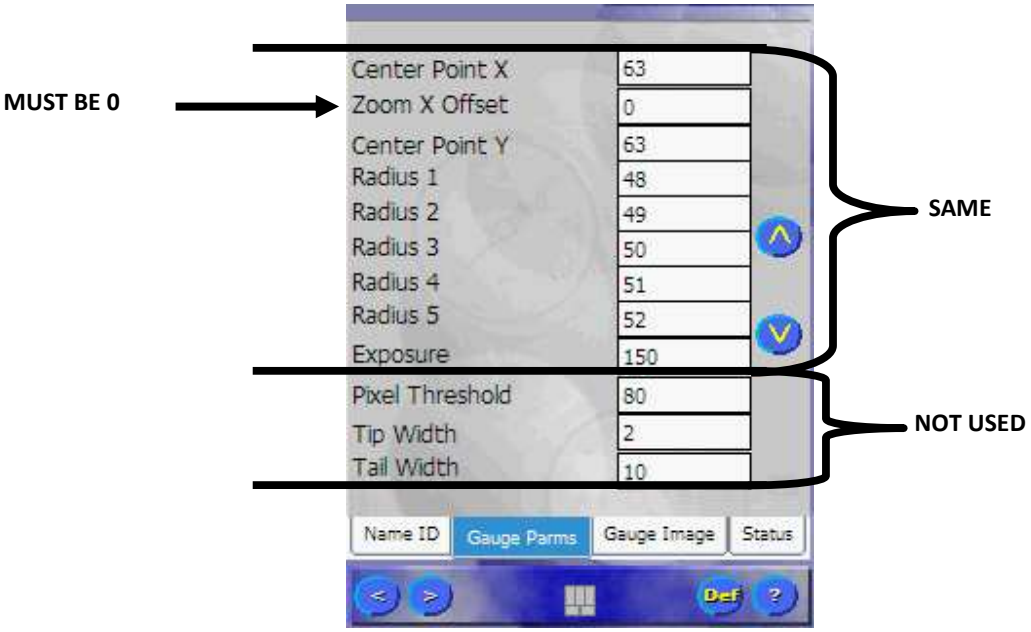


Figure 42. Gauge Parameters Tab - Page 2

4. Setup the following Parameters on the third page of the Gauge Parms Tab. Parameters marked as SAME have the same functionality as the standard WGR. Make sure to setup those parameters normally. Parameters marked NOT USED can be ignored and left as default.

   NOTE: The **Gauge Tilt Angle** must be ZERO. This means the WGR must be installed right side up to the Magnehelic. Firmware version 01.10.0 will not support a WGR installed at an angle with respect to the Magnehelic Gauge.

   NOTE: Four variables below contain a different meaning when configuring WGRs for Magnehelic and Photohelic gauges: Min Needle Travel Angle, Max Needle Travel Angle, Left LED Bright, and Right LED Bright. Setting these parameters are described next.

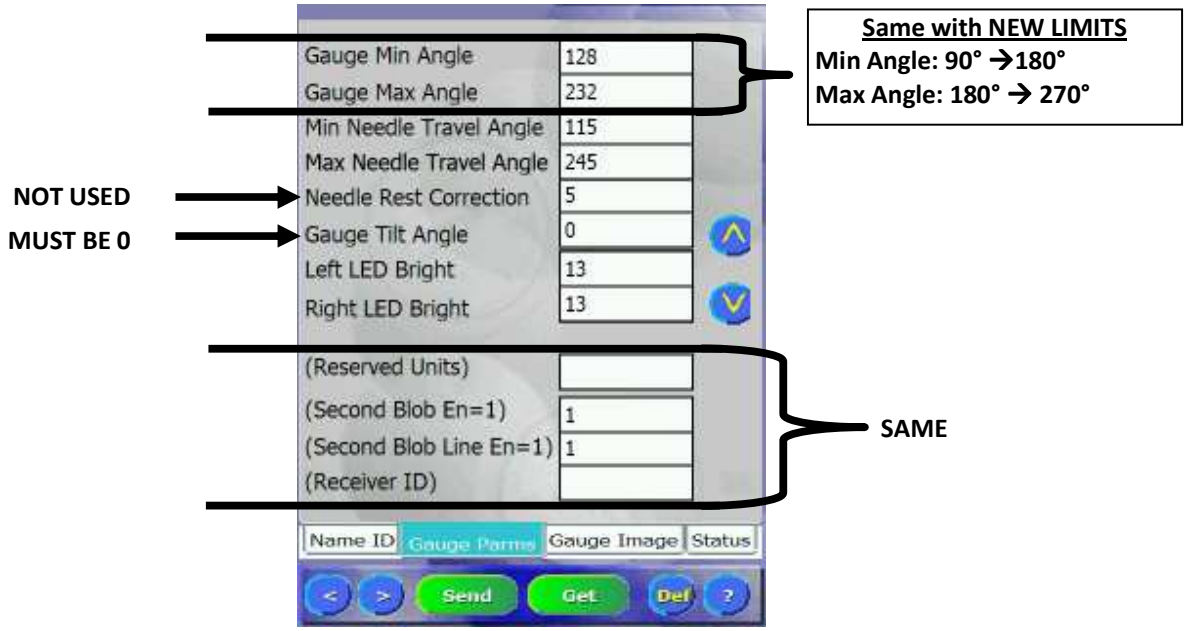


Figure 43. Gauge Parameters Tab - Page 3

To "tweak" the arcs, start by using the "Img Cal" Img Cal method and follow the on-screen instructions to set the center and radius for each circle. Switch back to the Gauge Parms tab as needed to fine adjust the values. Make sure the radii increase with increasing Radius Numbers.

Use a trial and error method to accurately setup the Min and Max Needle Travel Angles. First set the Min and Max values as close as possible. Send the parameters Send to the WGR and do a Get Sample Get Sample from the Status Tab Status.

The Min Needle Travel Angle is limited to: 90° →180°.

The Max Needle Travel Angle is limited to: 180° → 270°.

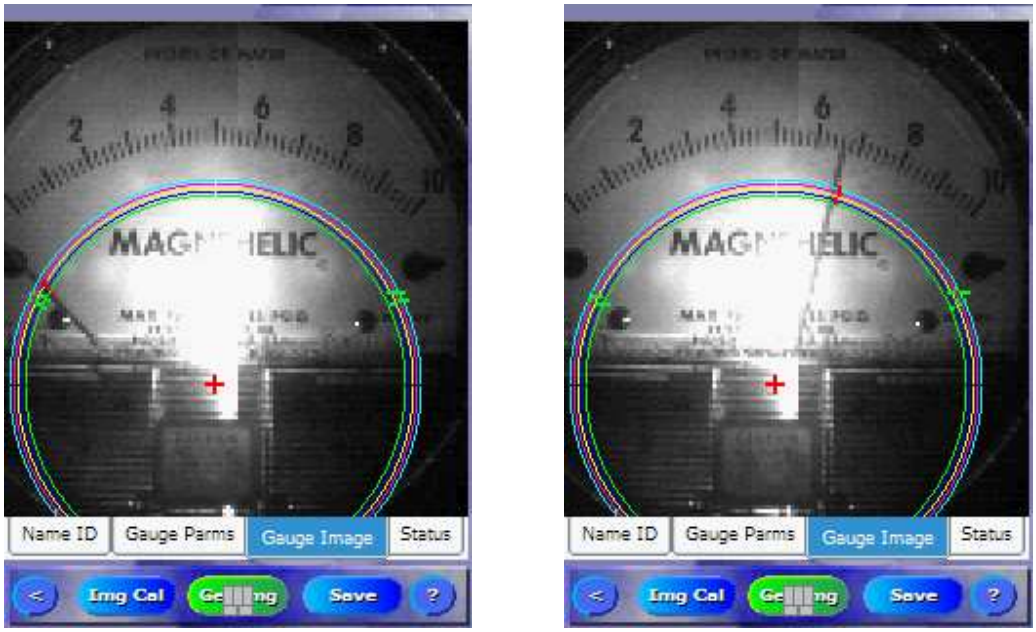


Figure 44. Proper Circle Setup for the WGR on a Magnehelic gauge

Figure 44 shows arcs ending in the proper location. There should not be any overlap at the Needle Stops or the black circles at the ends. The Min and Max Needle Travel Angles for this example are shown below, 115° and 245° respectively.

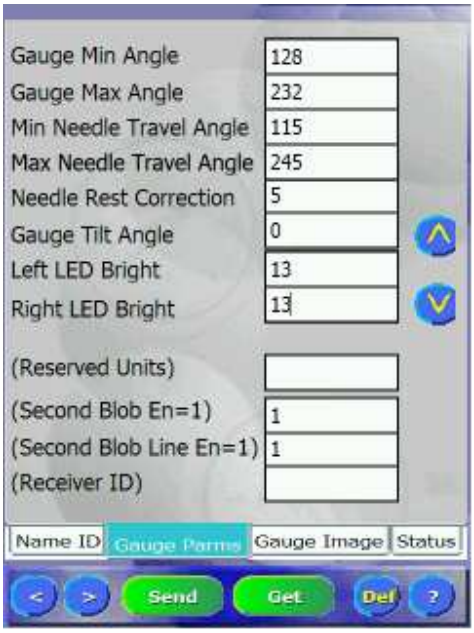


Figure 45. Gauge Parameters for Proper Circle Setup

Figure 46 shows the arcs in the wrong location. Notice the needle can travel past the end of the arcs. When the needle is beyond the end of the arcs, the needle will not be processed and an error will be sent. The Min and Max Needle Travel Angles for this example are 135° and 220° respectively.

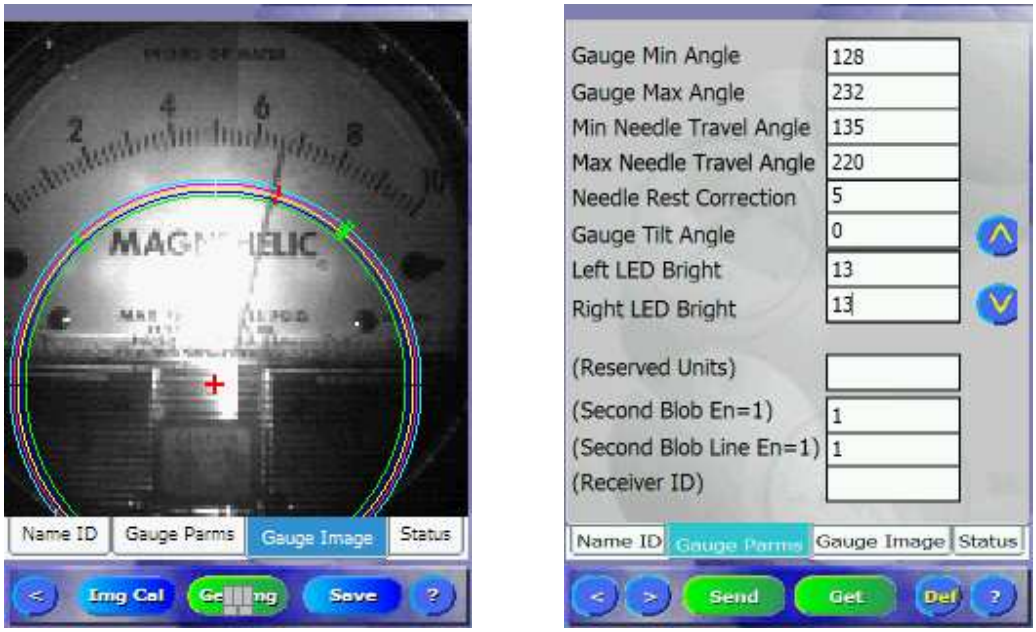


Figure 46. Improper Circle Setup

If there is a contrast difference running down the middle of the image, the left and right half will not match in brightness. To adjust the brightness the Left and Right LED Bright variables need to be adjusted. Decreasing the values will make the image darker; increasing the values will make the image brighter.

If the WGR is mounted on a gauge with a fast moving needle the goal would be to use the LEDs to add brightness to the image rather than increasing the Exposure. The larger the Exposure value, the longer it takes to capture an image. This will blur fast moving needle. In this case take the darker side of the image and increase the LED Bright value until the seam down the middle of the image is gone.

If the WGR is not mounted on a gauge with a fast moving needle the goal would be to save battery life. The brighter the LEDs are the more battery is consumed to capture an image. In this case take the brighter side of the image and decrease the LED Bright value until the seam down the middle of the image is gone.

5. When complete:
   - Review all parameters.
   - Press Save in the Save Gauge Image Tab Gauge Image.
   - Press Finish Finish in the Name ID tab Name ID.

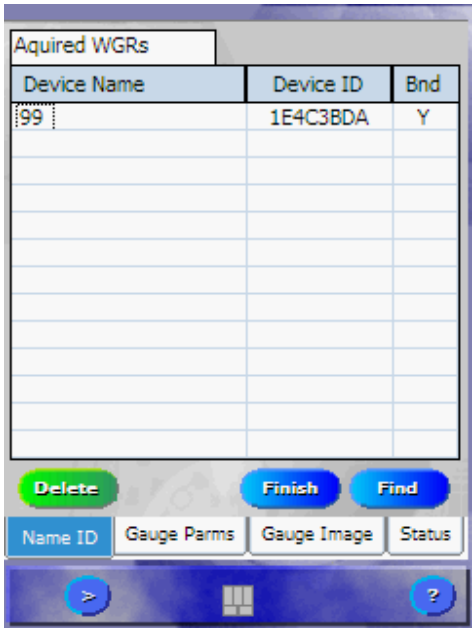


Figure 47. Click Finish when the setup is complete

6. Make sure to exit Configuration back into Normal Sample Mode on the WGR.

Figure 48. Normal Sample Mode on the WGR

5.5 Variables

Variable	Usage	Default	Comments
Node ID	SAME as standard WGR	255	
RF Frequency A	SAME as standard WGR	74	
RF Frequency B	SAME as standard WGR	2	
Sample Rate (sec)	SAME as standard WGR	300	
Units (0=psi, 1=InH20, 2=degF, 3=InHg)	SAME as standard WGR	0	

Min Gauge Value	SAME as standard WGR	0	Make sure to adjust this to match the Gauge Min Angle Location
Max Gauge Value	SAME as standard WGR	10	Make sure to adjust this to match the Gauge Max Angle Location
Zoom Enable	MUST BE 0	0	Do not enable
Long Tail Enable	NOT USED	1	No effect
Taper and Short Tail En	NOT USED	0	No effect
Dynamic Stitching En	NOT USED	0	No effect
Second Radius Ignore	NOT USED	5	No effect
Center Point X	SAME as standard WGR	63	Match the Gauge Face
Zoom X Offset	MUST BE 0	0	Do not set
Center Point Y	SAME as standard WGR	93	Use to adjust circle to fit between Needle Stops and Text on gauge
Zoom Y Offset	MUST BE 0	0	Do not set
Radius 1	SAME as standard WGR	49	
Radius 2	SAME as standard WGR	50	
Radius 3	SAME as standard WGR	51	
Radius 4	SAME as standard WGR	52	
Radius 5	SAME as standard WGR	53	
Exposure	SAME as standard WGR	150	
Pixel Threshold	NOT USED	80	
Tip Width	NOT USED	2	
Tail Width	NOT USED	10	
Gauge Min Angle	SAME as standard WGR	128	90° →180°
Gauge Max Angle	SAME as standard WGR	232	180° → 270°
Min Needle Travel Angle	NEW	115	Defines the minimum angle of the arc
Max Needle Travel Angle	NEW	245	Defines the maximum angle of the arc
Needle Rest Correction	NOT USED	5	
Gauge Tilt Angle	MUST BE 0	0	Do not fine tweak the Magnehelic readings
Left LED Bright	NEW	13	Controls the brightness of the LED for the left half of the image
Right LED Bright	NEW	13	Controls the brightness of the LED for the right half of the image
(Reserved Units)	NOT USED	N/A	
(Second Blob End=1)	NOT USED	N/A	
(Second Blob Len En=1)	NOT USED	N/A	
(Receiver ID)	NOT USED	N/A	

6.0 Configuring the Wireless Transducer Reader

The Wireless Transducer Reader (WTR) is a wall or battery powered wireless device that is used to remotely monitor voltage and current loop outputs from wired sensors and transducers. The high impedance inputs allow seamless integration and wide compatibility with a variety of sensors. The digitized input channel readings and health statistics are transmitted to a central wireless receiver for logging and post processing.

Figure 49. Wireless Transducer Reader

6.1 Start up

When the WTR is powered on its normal boot sequence is as follows:

- All LEDs on for 2.5 sec
- Red LED turns off first
- Orange LED turns off second
- Green LED turns off last

If the sequence above does not take place, the WTR is not functioning properly. The most likely cause for this is a drained battery. Contact Cypress Envirosystems for support; see Section 14.0.

6.2 Operating Modes

All modes will try to send a health packet every 30 minutes, depending on the update rate. It is guaranteed that a health packet will be received every 40 minutes.

Mode	Function	How to enter mode	How to exit mode
Normal	Sends readings at programmed in update rate.	Do nothing	Enter Single Sample, Fast, or Medium modes
Single Sample	Sends a single sample then immediately returns to normal mode. Note: 2 Transmissions are sent, one on each channel.	Push button and release quickly while in Normal mode	Automatically exits to Normal mode

Mode	Function	How to enter mode	How to exit mode
Fast	Sends readings every 5 sec for 5 min (total 60 readings)	Hold down button until both Green and Orange LEDs are lit (3 sec)	Automatically exits after 5min. Or, press button and Orange LED will light indicating returning to Normal mode.
Medium	Sends readings every 30 sec for 8 hours (total 960 readings)	Hold down button until Green, Orange, and Red LEDs are lit (6 sec)	Automatically exits after 8hours. Or, press button and Orange LED will light indicating returning to Normal mode.
Configuration	Allows configuration with the Handheld HHC	Hold down button until Green, Orange, and Red LEDs are all blinking at the same time (8 secs)	Press the button and Orange LED will light indication you are returning to Normal mode. Press Finish in the Handheld HHC once completed. Timeout after 10 minutes

6.3 Configuration Mode

The WTR can be configured using the HHC. Configuration steps:

- Transition the WTR into configuration mode
- Connect the WTR to the HHC
- Configure the WTR using the HHC

6.3.1 Enter Configuration Mode

The WTR can be transitioned into configuration mode using the button on the front panel. Hold down the button until Green, Orange, and Red LEDs are all blinking at the same time (8 seconds).

Note the green LED on the WTR will periodically blink indicating wireless communication activity.

6.3.2 Connect the WTR to the HHC

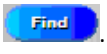
Once the WTR is mounted, it is ready to be configured. The first step is to establish a communication link between the HHC and the WTR.

Steps:

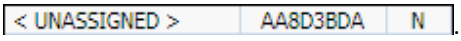
1. Prepare the HHC for use:
   a. Remove the HHC from its Docking Station.
   b. Power on the HHC. Press and hold the **[Enter/On]** key for one second. When the **Green LED** flashes, release the **[Enter/On]** key.
   c. Launch the HHC application: Select the Windows Start Icon on the top left of the Touch Screen 

, Select the HHC Control application from the Start Menu 

.
2. Bind to WTR: Select the Name ID Tab 

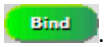
, press the Find Button 

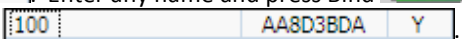
. Wait for the HHC to search for all WTRs in the vicinity that are in Configuration mode.

3. The HHC will list all field devices and their Device ID it finds. Select the field device to be configured based on the Device ID 

.

4. Assign a Device Name (if not already assigned) by tapping on the name twice until it is in text entry mode 

. Enter any name and press Bind 

. The Status column should convert to “Y” from “N” 

.

5. Click the Gauge Parms Tab 

then click the “Get” 

button to load the default values from the device to the HHC.

6.3.3 Configure WTR using the HHC

The following parameters must be setup using the HHC to configure a WTR.

WTR Parameter	Parameter in HHC	Function
Node ID	Node ID	The Node ID of the WTR
RF Frequency A	RF Frequency A	Wireless communication Frequency A of the WTR
RF Frequency B	RF Frequency B	Wireless communication Frequency B of the WTR
Sample Rate	Sample Rate (sec)	Update rate of the WTR while in Normal Mode (seconds)
Channel 1 Setup	Radius 1	Channel configuration – See channel setup
Channel 2 Setup	Radius 2	Channel configuration – See channel setup
Channel 3 Setup	Radius 3	Channel configuration – See channel setup
Channel 4 Setup	Radius 4	Channel configuration – See channel setup
Thermistor B Constant	Gauge Min Angle	If one of the channels above is setup as a thermistor, this needs to be set to the corresponding B constant from the thermistor datasheet. Otherwise this value is ignored. 10K Thermistor = 3892 5K Thermistor = 3980

Node ID, Frequency A/B and Sample Rate should be setup similarly to a WGR. The rest of the parameters are unique to the WTR. Notice the WTR parameter name is not used in the HHC parameters list. Channel 1-4 setup will be done under Radius 1-4 and Thermistor B-Const is under Gauge Min Angle. The table above shows the mapping between the two.

The following table lists the channel setup values

Channel Setup	Type
0	Channel is off – not used
1	Normal voltage/current sensing (which one depends on hardware)
2	Thermistor – used for special thermistor WTRs only
3	Sample RS232 LR300's ch1 – require additional adapter
4	Sample RS232 LR300's ch2 – require additional adapter
5	Sample RS232 LR300's ch3 – require additional adapter
6	Sample RS232 LR300's ch4 – require additional adapter
7	Sample RS485 LR300's ch1 – require additional adapter
8	Sample RS485 LR300's ch2 – require additional adapter
9	Sample RS485 LR300's ch3 – require additional adapter
10	Sample RS485 LR300's ch4 – require additional adapter
11	Thermocouple – used for special thermocouple WTRs only

The specific WTR hardware determines the channel settings allowed.

- Generic WTR:
  - Channel 1 – Analog or UART. Value = 0 → 11
  - Channel 2 – Analog or UART. Value = 0 → 11
  - Channel 3 – UART ONLY. Value = 3 → 10
  - Channel 4 – UART ONLY. Value = 3 → 10

On the Gauge Params tab ignore all variables seen below and setup only those that apply.

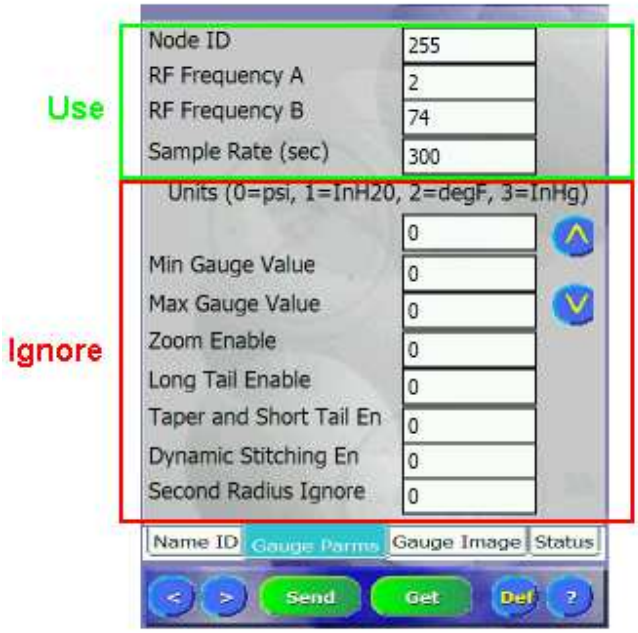


Figure 50. WTR Parameters to Configure – Gauge Parameters Page 1

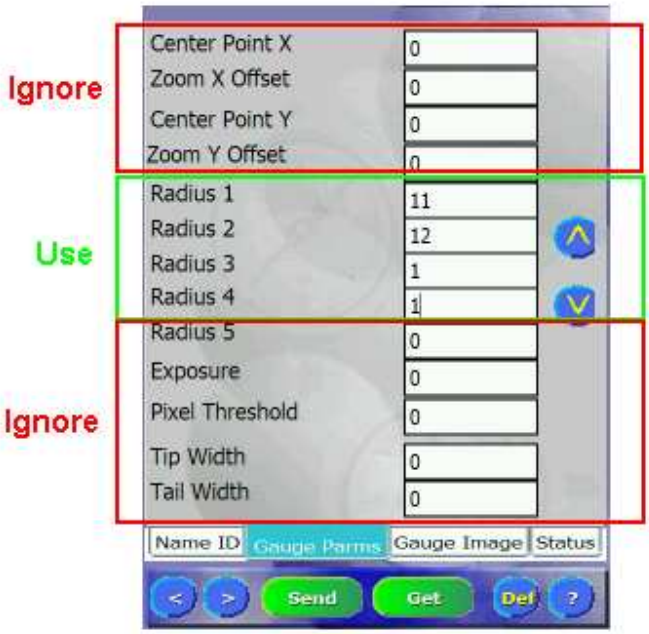


Figure 51. WTR Parameters to Configure – Gauge Parameters Page 2

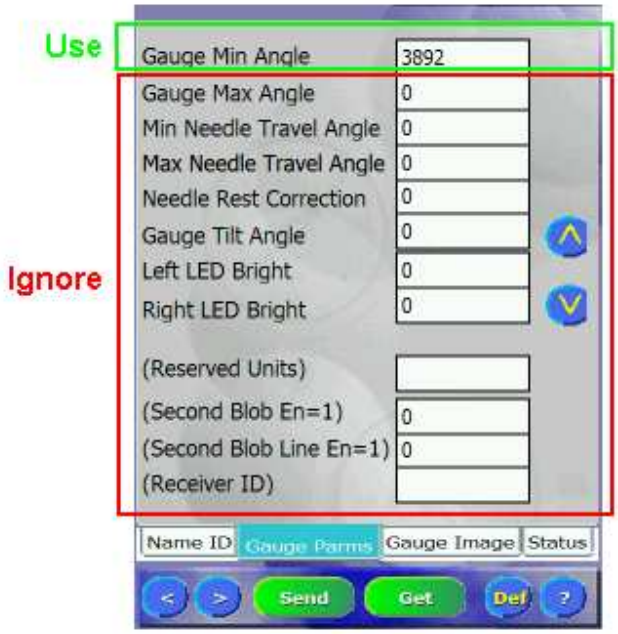


Figure 52. WTR Parameters to Configure – Gauge Parameters Page 3

When complete, click “Send” from the Gauge Params Tab. Then click the Name ID Tab and click “Finish”. The WTR will exit into Normal mode.

6.3.4 Calibration (Thermocouple Channel Only)

Special WTRs that use thermocouples as inputs must be calibrated for the thermocouple to read the correct temperature. All WTRs come pre-calibrated, however, the device must be re-calibrated if firmware is upgraded.

Steps:

1. Short all thermocouple channels that require calibration.
2. Insert the *Calibration Dongle* into Expansion Port (A). (Contact Cypress Support for information on the *Calibration Dongle*. See Section 14.0.)

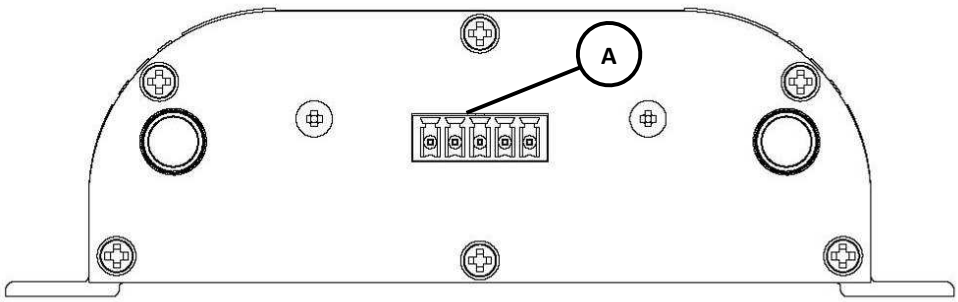


Figure 53. WTR Expansion Port

3. Reset or reboot the WTR by disconnecting then reconnecting the power supply from the Power Input port (B). Alternatively, the Reset Button inside the enclosure can be used.

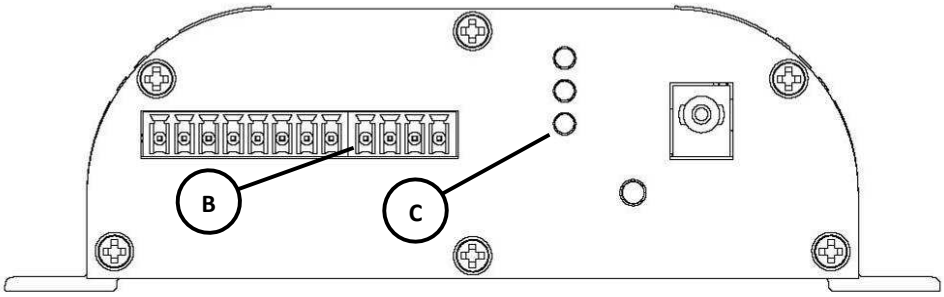


Figure 54. WTR Power Input Port and LEDs

4. After normal start up note the special Calibration Successful sequence on the three LEDs (C). If the calibration was successful,l all three LEDs (Red, Orange, and Green) will blink quickly 3-times in a row.
5. If the calibration was successful remove the dongle and continue. If calibration was unsuccessful, make sure the dongle is connected properly and contact support (see Section 14.0).

7.0 Configuring the Wireless Steam Trap Monitor

The Wireless Transducer Reader (WSTM) is a wall or battery powered wireless device that is used to remotely monitor input and output temperatures of steam traps. The digitized input channel readings and health statistics are transmitted to a central wireless receiver for logging and post processing.

Figure 55. Wireless Steam Trap Monitor

7.1 Start up

When the WSTM is powered on its normal boot sequence is as follows:

- All LEDs on for 2.5sec
- Red LED turns off first
- Orange LED turns off second
- Green LED turns off last

If the sequence above does not take place, the WSTM is not functioning properly. The most likely cause for this is a drained battery. Contact Cypress Envirosystems for support; see Section 14.0.

7.2 Operating Modes

All modes will try to send a health packet every 30 minutes depending on the update rate. It is guaranteed that a health packet will be received every 40 minutes.

Mode	Function	How to enter mode	How to exit mode
Normal	Sends readings at programmed in update rate.	Do nothing	Enter Single Sample, Fast, or Medium modes.
Single Sample	Sends a single sample then immediately returns to normal mode. Note: 2 Transmissions are sent, one on each channel.	Push button and release quickly while in Normal mode	Automatically exits to Normal mode
Fast	Sends readings every 5 sec for 5 min (total 60 readings)	Hold down button until both Green and Orange LEDs are lit (3 sec)	Automatically exits after 5min. Or, press button and Orange LED will light indicating returning to Normal mode.

Mode	Function	How to enter mode	How to exit mode
Medium	Sends readings every 30 sec for 8hours (total 960 readings)	Hold down button until Green, Orange, and Red LEDs are lit (6 sec)	Automatically exits after 8hours. Or, press button and Orange LED will light indicating returning to Normal mode.
Configuration	Allows configuration with the Handheld HHC	Hold down button until Green, Orange, and Red LEDs are all blinking at the same time (8 secs)	Press the button and Orange LED will light indication returning to Normal mode. Press Finish in the Handheld HHC once completed. Timeout after 10 minutes

7.3 Configuration Mode

The device can be configured using the HHC. Configuration steps:

- Transition the device into configuration mode
- Connect the device to the HHC
- Configure the device using the HHC

7.3.1 Enter Configuration Mode

The device can be transitioned into configuration mode using the button on the front panel. Hold down the button until Green, Orange, and Red LEDs are all blinking at the same time (8 seconds).

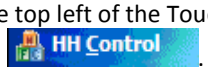
Note the green LED on the device will periodically blink indicating wireless communication activity.

7.3.2 Connect the WSTM to the HHC

Once the WSTM is mounted, it is ready to be configured. The first step is to establish a communication link between the HHC and the WSTM.

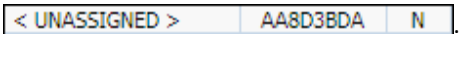
Steps:

1. Prepare the HHC for use:
   d. Remove the HHC Device from its Docking Station.
   e. Power on the HHC. Press and hold the **[Enter/On]** key for one second. When the **Green LED** flashes, release the **[Enter/On]** key.
   f. Launch the HHC application: Select the Windows Start Icon on the top left of the Touch Screen 

, select the HHC Control application from the Start Menu 

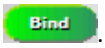
.
2. Bind to WSTM: Select the Name ID Tab 

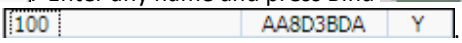
, press the Find Button 

. Wait for the HHC to search for all field devices in the vicinity who are in Configuration mode.
3. The HHC will list all field devices and their Device ID it finds. Select the field device to be configured based on the Device ID 

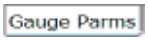
.

4. Assign a Device Name (if not already assigned) by tapping on the name twice until it is in text entry mode 

. Enter any name and press Bind 

. The Status column should convert to "Y" from "N" 

.

5. Click the Gauge Params Tab 

then click the "Get" 

button to load the default values from the device to the HHC.

7.3.3 Configure WSTM using the HHC

The following parameters must be setup using the HHC to configure a WSTM.

WSTM Parameter	Parameter in HHC	Function
Node ID	Node ID	The Node ID of the WSTM
RF Frequency A	RF Frequency A	Wireless communication Frequency A of the WSTM
RF Frequency B	RF Frequency B	Wireless communication Frequency B of the WSTM
Sample Rate	Sample Rate (sec)	Update rate of the WSTM while in Normal Mode (seconds)
Channel 1 Setup	Radius 1	11
Channel 2 Setup	Radius 2	11
Channel 3 Setup	Radius 3	0
Channel 4 Setup	Radius 4	0
Thermistor B Constant	Gauge Min Angle	Ignore

Node ID, Frequency A/B and Sample Rate should be setup similar to a WGR. The rest of the parameters are unique to the WSTM. Notice the WSTM parameter name is not used in the HHC parameters list.

On the Gauge Params tab ignore all variables seen below and setup only those that apply.

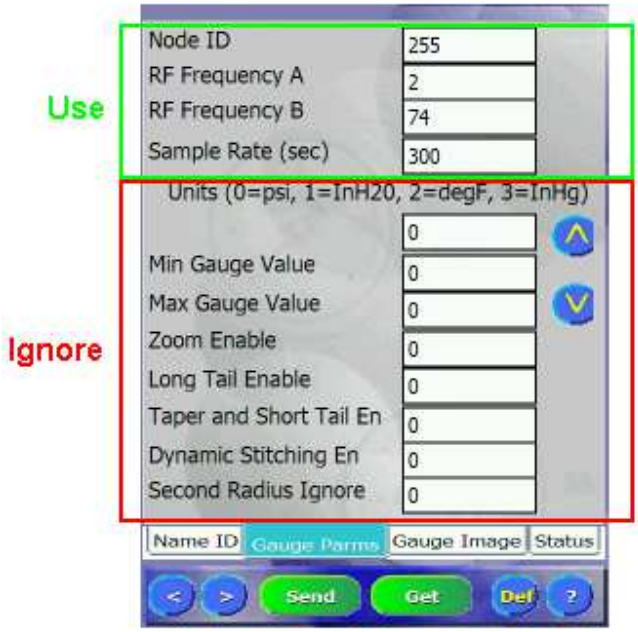


Figure 56. WSTM Parameters to Configure – Gauge Parameters Page 1

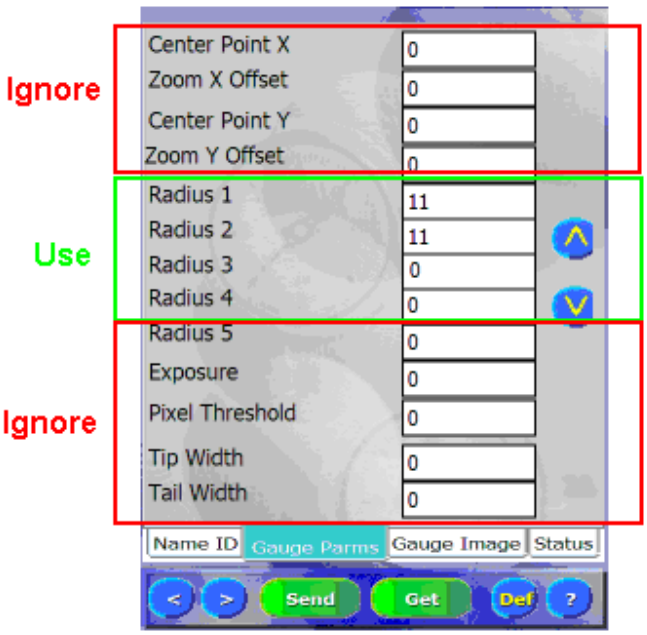


Figure 57. WSTM Parameters to Configure – Gauge Parameters Page 2

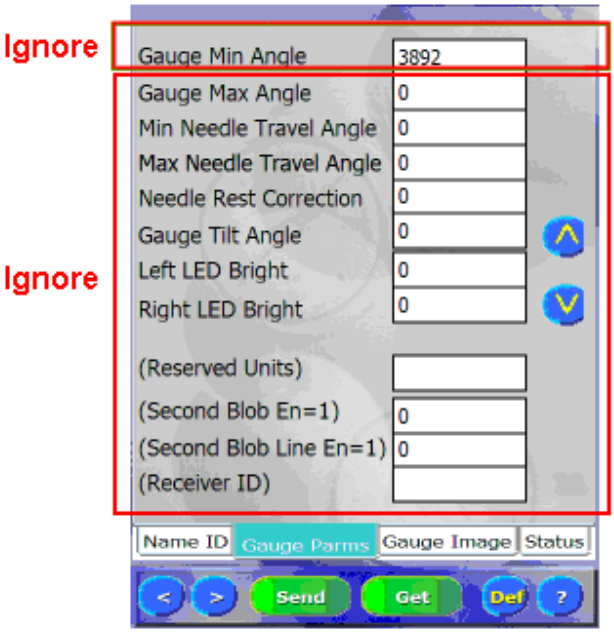


Figure 58. WSTM Parameters to Configure – Gauge Parameters Page 3

When complete, click “Send” from the Gauge Params Tab. Then click the Name ID Tab and click “Finish”. The WSTM will exit into Normal mode.

7.3.4 Calibration

The WSTM must be calibrated for the thermocouples to read the correct temperature. All WSTMs come pre-calibrated, however, the device must be re-calibrated if firmware is upgraded.

Steps:

1. Short all thermocouple channels which require calibration.
2. Insert the *Calibration Dongle* into Expansion Port (A).

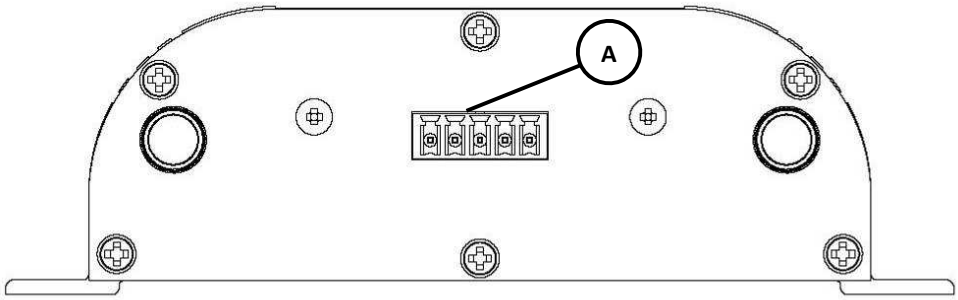


Figure 59. WSTM Expansion Port

3. Reset or reboot the device by disconnecting then reconnecting the power supply from the Power Input port (B). Alternatively, the Reset Button inside the enclosure can be used.

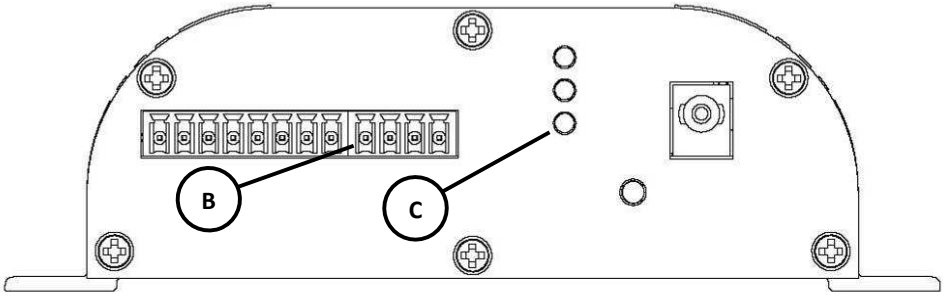


Figure 60. WSTM Power Input Port and LEDs

4. After normal start up note the special Calibration Successful sequence on the three LEDs (C). If the calibration was successful all three LEDs (Red, Orange, and Green) will blink quickly 3-times in a row.
5. If the calibration was successful remove the dongle and continue. If calibration was unsuccessful, make sure the dongle is connected properly and contact support (see Section 14.0).

8.0 Configuring the Wireless Freezer Monitor

The Wireless Freezer Monitor (WFM) is a wall or battery powered wireless device that is used to remotely monitor freezers. The digitized input channel readings and health statistics are transmitted to a central wireless receiver for logging and post processing.

Figure 61. Wireless Freezer Monitor

8.1 Start up

When the WFM is powered on its normal boot sequence is as follows:

- All LEDs on for 2.5 sec
- Red LED turns off first
- Orange LED turns off second
- Green LED turns off last

If the sequence above does not take place, the device is not functioning properly. The most likely cause for this is a drained battery. Contact Cypress Envirosystems for support; see Section 14.0.

8.2 Operating Modes

All modes will try to send a health packet every 30 minutes depending on the update rate. It is guaranteed that a health packet will be received every 40 minutes.

Mode	Function	How to enter mode	How to exit mode
Normal	Sends readings at programmed in update rate.	Do nothing	Enter Single Sample, Fast, or Medium modes.
Single Sample	Sends a single sample then immediately returns to normal mode. Note: 2 Transmissions are sent, one on each channel.	Push button and release quickly while in Normal mode	Automatically exits to Normal mode
Fast	Sends readings every 5sec for 5min (total 60 readings)	Hold down button until both Green and Orange LEDs are lit (3 sec)	Automatically exits after 5min. Or, press button and Orange LED will light indicating returning to Normal mode.

Mode	Function	How to enter mode	How to exit mode
Medium	Sends readings every 30 sec for 8 hours (total 960 readings)	Hold down button until Green, Orange, and Red LEDs are lit (6 sec)	Automatically exits after 8hours. Or, press button and Orange LED will light indicating returning to Normal mode.
Configuration	Allows configuration with the Handheld HHC	Hold down button until Green, Orange, and Red LEDs are all blinking at the same time (8 secs)	Press the button and Orange LED will light indication returning to Normal mode. Press Finish in the Handheld HHC once completed. Timeout after 10 minutes

8.3 Configuration Mode

The device can be configured using the HHC. Configuration steps:

- Transition the device into configuration mode
- Connect the device to the HHC
- Configure the device using the HHC

8.3.1 Enter Configuration Mode

The device can be transitioned into configuration mode using the button on the front panel. Hold down the button until Green, Orange, and Red LEDs are all blinking at the same time (8 seconds).

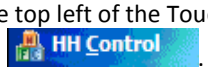
Note the green LED on the device will periodically blink indicating wireless communication activity.

8.3.2 Connect the WFM to the HHC

Once the WFM is mounted, then it is ready to be configured. The first step is to establish a communication link between the HHC and the WFM.

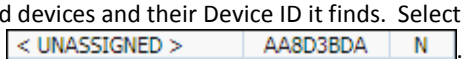
Steps:

6. Prepare the HHC for use:
   g. Remove the HHC Device from its Docking Station.
   h. Power on the HHC. Press and hold the **[Enter/On]** key for one second. When the **Green LED** flashes, release the **[Enter/On]** key.
   i. Launch the HHC application: Select the Windows Start Icon on the top left of the Touch Screen 

, select the HHC Control application from the Start Menu 

.
7. Bind to WFM: Select the Name ID Tab 

, press the Find Button 

. Wait for the HHC to search for all field devices in the vicinity who are in Configuration mode.
8. The HHC will list all field devices and their Device ID it finds. Select the field device to be configured based on the Device ID 

.

9. Assign a Device Name (if not already assigned) by tapping on the name twice until it is in text entry mode < UNASSIGNED > AA8D3BDA N. Enter any name and press Bind. The Status column should convert to "Y" from "N" 100 AA8D3BDA Y.

10. Click the Gauge Params Tab Gauge Parms then click the "Get" Get button to load the default values from the device to the HHC.

8.3.3 Configure WFM using the HHC

The following parameters must be setup using the HHC to configure a WFM.

WFM Parameter	Parameter in HH	Function
Node ID	Node ID	The Node ID of the WFM
RF Frequency A	RF Frequency A	Wireless communication Frequency A of the WFM
RF Frequency B	RF Frequency B	Wireless communication Frequency B of the WFM
Sample Rate	Sample Rate (sec)	Update rate of the WFM while in Normal Mode (seconds)
Channel 1 Setup	Radius 1	11 – for the thermocouple
Channel 2 Setup	Radius 2	12 – for the door switch connection
Channel 3 Setup	Radius 3	1 – for the low stage compressor current
Channel 4 Setup	Radius 4	1 – for the high stage compressor current
Thermistor B Constant	Gauge Min Angle	Ignore

Node ID, Frequency A/B and Sample Rate should be setup similar to a WGR. The rest of the parameters are unique to the WFM. Notice the WFM parameter name is not used in the HHC parameters list. Channel 1-4 setup will be done under Radius 1-4 and Thermistor B-Const is under Gauge Min Angle. The table above shows the mapping between the two.

On the Gauge Params tab ignore all variables seen below and setup only those that apply.

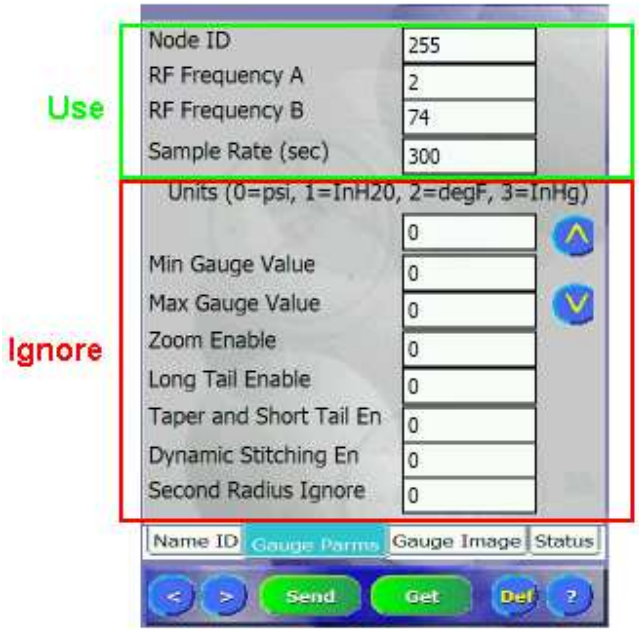


Figure 62. WFM Parameters to Configure – Gauge Parameters Page 1

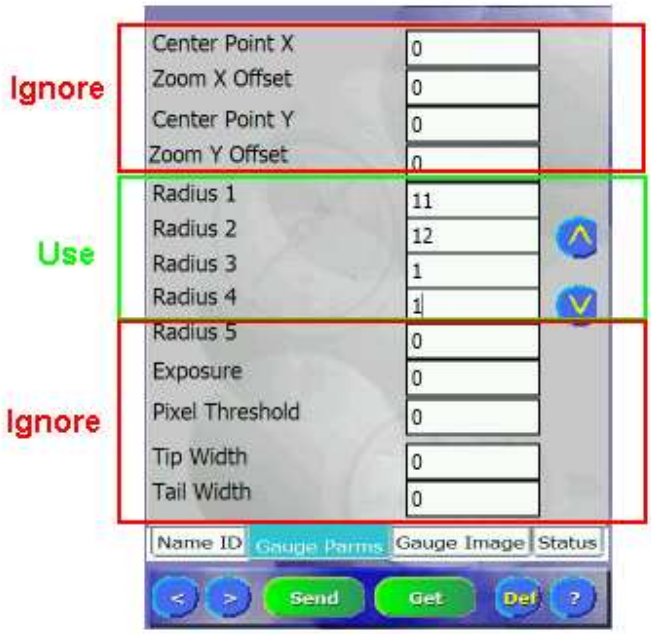


Figure 63. WFM Parameters to Configure – Gauge Parameters Page 2

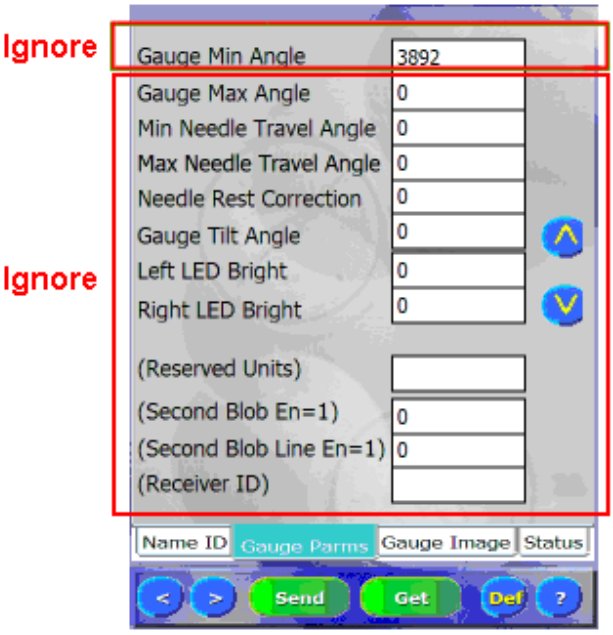


Figure 64. WFM Parameters to Configure – Gauge Parameters Page 3

When complete, click “Send” from the Gauge Params Tab. Then click the Name ID Tab and click “Finish”. The WFM will exit into Normal mode.

8.3.4 Calibration (Thermocouple Channel Only)

The WFM must be calibrated for the thermocouple to read the correct temperature. All WFMs come pre-calibrated, however, the device must be re-calibrated if firmware is upgraded

Steps:

1. Short all thermocouple channels which require calibration.
2. Insert the *Calibration Dongle* into Expansion Port (A). (Contact Cypress Envirosystems for support; see Section 14.0.)

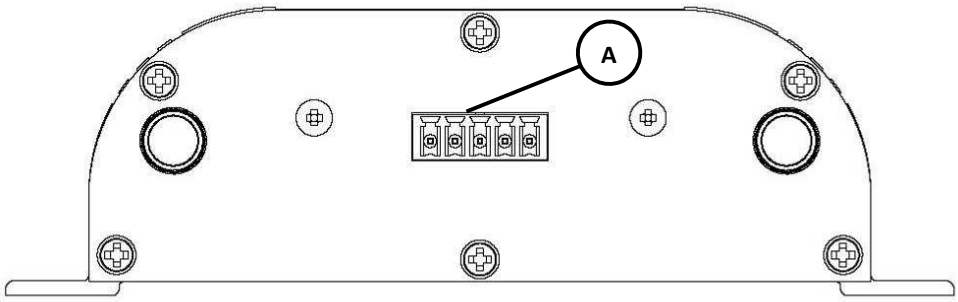


Figure 65. WFM Expansion Port

3. Reset or reboot the device by disconnecting then reconnecting the power supply from the Power Input port (B). Alternatively, the Reset Button inside the enclosure can be used.

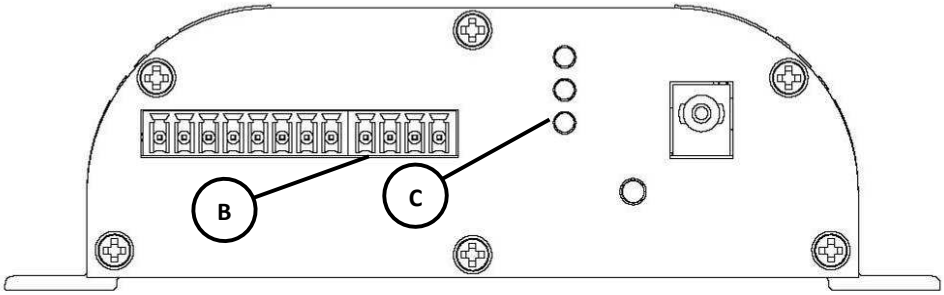


Figure 66. WFM Power Input Port and LEDs

4. After normal start up note the special Calibration Successful sequence on the three LEDs (C). If the calibration was successful all three LEDs (Red, Orange, and Green) will blink quickly 3-times in a row.
5. If the calibration was successful remove the dongle and continue. If calibration was unsuccessful, make sure the dongle is connected properly and contact support (see Section 14.0).

9.0 Configuring the Wireless Range Extender

The Cypress Envirosystems Wireless Range Extender (WRE) is used to extend the range of wireless data from a field device to the Blue Box Server. When the WRE receives a message, it waits its specified delay time, and repeats the signal twice.

Each WRE has two radios that are pre-programmed with a specific radio channel set that must match the channel set of the field devices. WREs are pre-programmed with a specified delay. When a WRE receives a message, it appends its tag (also known as its ID) to the message. If a WRE receives a message that already contains the same ID, it will drop the message and will not repeat it.

Figure 67. Wireless Range Extender

9.1 Start up

When powered up, versions WRE-100-001 Revision 4 and above or WRE-105-001 Revision 1 and above, the green light will blink for 15 seconds. All older versions of the WRE have no indication they are powered on until they receive a wireless signal in which case the green or yellow light will flash.

9.2 Configuration Mode

WRE-100-001 Revision 4 and above or WRE-105-001 Revision 1 and above can be configured using the HHC. All older revisions require a PSoC mini prog and PSoC Programmer for configuration.

9.2.1 Enter Configuration Mode

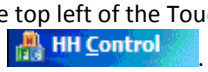
The device can be transitioned into configuration mode when the unit is first powered up. There is a 15 second window when the green light is flashing to bind to the WRE using the HHC. If WRE is not bound to the HHC in 15 seconds it will resume its normal mode and will require a power cycle to put it back into configuration mode.

While bound, the green LED on the device will periodically blink indicating wireless communication activity.

9.2.2 Connect the WRE to the HHC

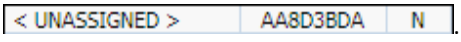
Steps:

1. Prepare the HHC for use:
   a. Remove the HHC from its Docking Station.
   b. Power on the HHC. Press and hold the **[Enter/On]** key for one second. When the **Green LED** flashes, release the **[Enter/On]** key.
   c. Launch the HHC application: Select the Windows Start Icon on the top left of the Touch Screen 

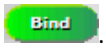
, select the HHC Control application from the Start Menu 

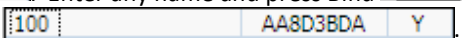
.
2. Bind to WRE: Select the Name ID Tab 

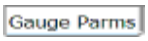
, press the Find Button 

. Wait for the HHC to search for all field devices in the vicinity that are in Configuration mode.
3. The HHC will list all field devices and their Device ID it finds. Select the field device to be configured based on the Device ID 

.
4. Assign a Device Name (if not already assigned) by tapping on the name twice until it is in text entry mode 

. Enter any name and press Bind 

. The Status column should convert to “Y” from “N” 

.
5. Click the Gauge Params Tab 

then click the “Get” 

button to load the default values from the device to the HHC.

9.2.3 Configure WRE using the HHC

The following parameters must be setup using the HHC to configure a WFM.

WRE Parameter	Parameter in HHC	Function
Node ID	Node ID	The delay of the WRE (either 1, 2, 3, or 4)
RF Frequency A	RF Frequency A	Wireless communication Frequency A of the WRE
RF Frequency B	RF Frequency B	Wireless communication Frequency B of the WRE
Sample Rate	Sample Rate (sec)	Ignore

Node ID, Frequency A/B and Sample Rate should be setup similarly to a WGR. The rest of the parameters are unique to the WRE. Notice the WRE parameter name is not used in the HHC parameters list. Channel 1-4 setup will be done under Radius 1-4 and Thermistor B-Const is under Gauge Min Angle. The table above shows the mapping between the two.

On the Gauge Params tab ignore all variables seen below and setup only those that apply.

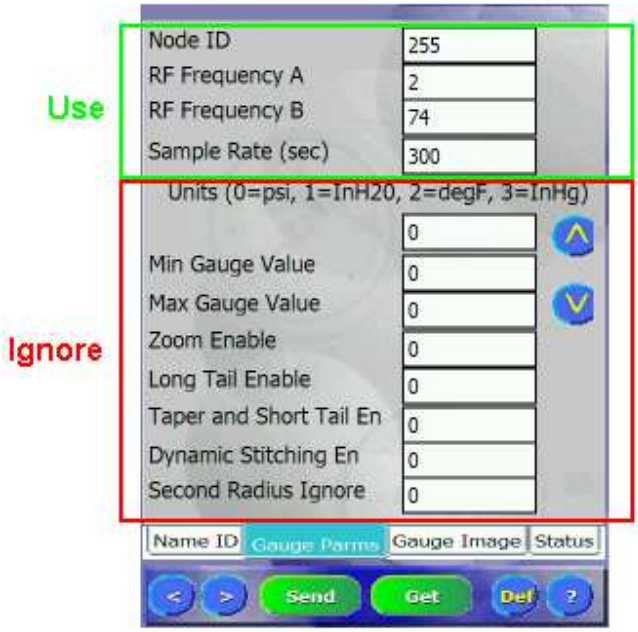


Figure 68. WRE Parameters to Configure – Gauge Parameters Page 1

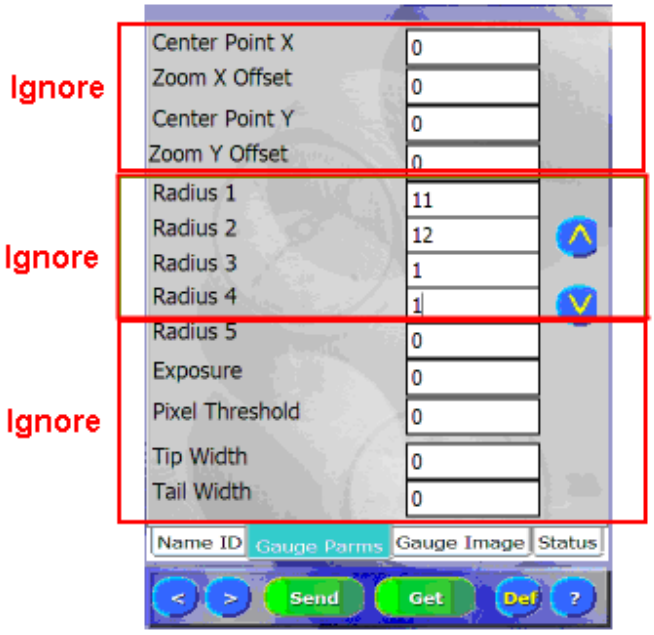


Figure 69. WRE Parameters to Configure – Gauge Parameters Page 2

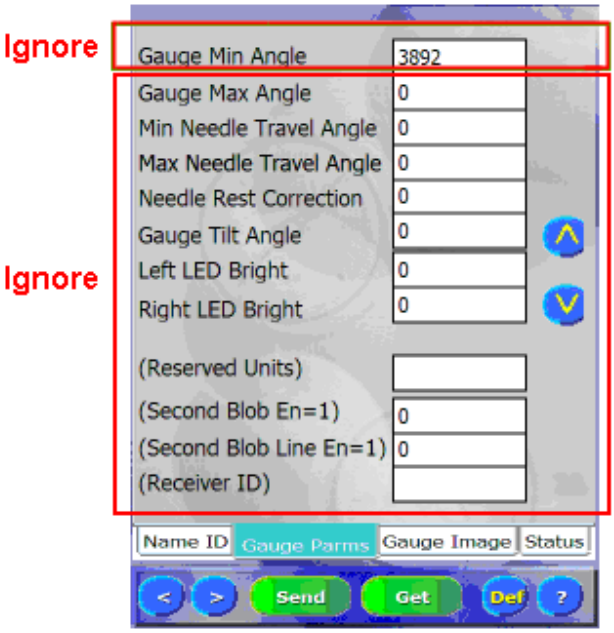


Figure 70. WRE Parameters to Configure – Gauge Parameters Page 3

When complete, click “Send” from the Gauge Params Tab. Then click the Name ID Tab and click “Finish”. The WRE will exit into Normal mode.

10.0 HHC Parameters

Firmware Versions 01.08.1-3 and Up				
Handheld Parameter	Description	Min Value	Max Value	Firmware MACRO
Node ID	The unique ID of the WGR within its wireless network. You cannot have two WGRs with identical Node ID who are on the same channel and within range of their receiver.	0	255	NODE_ID
RF Frequency A	A Channel, Bigger Number (78, 74)	2	80	RF_FREQUENCY_A
RF Frequency B	B Channel, Smaller Number (6, 2)	2	80	RF_FREQUENCY_B
Sample Rate (Sec)	The time in seconds between samples when the WGR is in Normal Sample Mode.	0	16384	NORMAL_UPDATE_RATE
Units (0=PSI, 1=InH20, 2=degF, 3=inHg)	The units of data the gauge represents. 0=”PSI”, 1=”InH20”, 2=”deg F”, 3=”inHg”	0	3	DEFAULT_GAUGE_UNITS_LCD
Min Gauge Value	Minimum value on the gauge scale	-32767	32767	GAUGE_MIN_VALUE
Max Gauge Value	Maximum value on the gauge scale	-32767	32767	GAUGE_MAX_VALUE
Zoom Enable	The camera will capture the image with a 2x zoom. 0à Disabled, 1àEnabled.	0	1	ENABLE_ZOOM
Long Tail Enable	This will set the mode to Long tail or Short tail. 0à Short Tail, 1à Long Tail.	0	1	WEIGTHED_TIP_TAIL
Taper and Short Tail En	If enabled a weighted tip tail algorithm will execute after a short tail algorithm has executed for further verification. 0à Disabled, 1àEnabled. Only valid in Short Tail Mode.	0	1	WEIGHTED_WITH_SHORT_TAIL
Dynamic Stitching	Will dynamically stitch the left and right side with a stair step pattern down the middle. the pattern will mirror image based on needle angle to avoid shadows. This is an advanced feature. Consult Cypress Systems. 0à Disabled, 1àEnabled. Should only be used in Long Tail mode.	0	1	ENABLE_REFLECTION_KILL3
Second Radius Ignore	Angle calculation will ignore all circles with indexes greater than or equal to this value. Index starts at 0 with the innermost circle. e.g. 3 = means the second set of red pixels of circle 3 & 4 will not be used in the angle calculation. 5 = all sets of red pixels will be used. For Long Tail Mode set this to 5. For Short Tail Mode set this based on the number of cirlces that only overlap the tip – Usually 3.	0	5	SECOND_BLOBS_TO_IGNORE
Center Point X	Defines the X direction center of the circles. This should match the center of the pivot point of the needle (may not always be center of image sensor).	0	127	CENTER_POINT_X
Zoom X Offset	This offset will adjust the image frame right or left along the gauge face. Used only when Zoom En = 1. This is used to center the needle in the image. When used the Center Point X variable should always be set to 63.	-60	60	ZOOM_X_OFFSET
Center Point Y	Defines the Y direction center of the circles. This should match the center of the pivot point of the needle (may not always be center of image sensor).	0	127	CENTER_POINT_Y
Radius 1	Innermost Radius in pixels of each circle	0	63	RADIUS_1
Radius 2	Radius in pixels of each circle	0	63	RADIUS_2
Radius 3	Radius in pixels of each circle	0	63	RADIUS_3
Radius 4	Radius in pixels of each circle	0	63	RADIUS_4
Radius 5	Outermost Radius in pixels of each circle	0	63	RADIUS_5
Exposure	This will adjust the brightness of the image. The larger the number the brighter the image.	0	230	OSPREY_EXPOSURE
Pixel Threshold	Defines the sensitivity of dark pixels stored. Decreasing the Luminosity Threshold will increase the number of pixels picked up. Increasing the Luminosity Threshold will decrease the number of pixels picked up.	0	255	LUMINOUS_THRESHOLD_DELTA
Tip Width	Minimum number of pixels that are close together to be considered a valid group.	0	255	MIN_CLOSE_PIXELS_THRESHOLD

Firmware Versions 01.08.1-3 and Up				
Handheld Parameter	Description	Min Value	Max Value	Firmware MACRO
	This allows us to easily filter out individual pixels of noise or numerals or hash marks etc. This is an advanced feature. Consult Cypress Systems.			
Tail Width	Max delta in X or Y direction to consider two points in the same group/blob. This is an advanced feature. Consult Cypress Systems.	0	255	NEARBY_PIXEL_THRESHOLD
Gauge Min Angle	Angle, with respect to Gauge Bottom, at which the Min Gauge Value resides.	0	359	GAUGE_MIN_ANGLE
Gauge Max Angle	Angle, with respect to Gauge Bottom, at which the Max Gauge Value resides.	0	359	GAUGE_MAX_ANGLE
Switching Angle	Angle, with respect to Gauge Bottom, at which the gauge value will switch from Maximum to Minimum or vise versa. Must be between Gauge Min and Max Angle.	0	359	SWITCHING_ANGLE
Needle Rest Correction	Offset angle from Gauge Min Angle where the value will always read Min Gauge Value. If the needle is between the Gauge Min Angle and Gauge Min Angle + Needle Rest Corr, value will read Minimum.	0	255	NEEDLE_RESTING_CORRECTION
Gauge Tilt Angle	The angle between the WGR and Gauge it is mounted on. Example: -30 = Guage is -30 degrees counterclockwise. +30 Guage is +30 clockwise.	-180	180	WGR_ANGLE_TO_GAUGE
(Reserved Units)	Not Used	0	0	Not Used
(Second Blob En=1)	Specifies whether the software should find one or two red pixels per circle.	0	1	FIND_SECOND_DARK_BLOB
	0 à Disabled, 1à Enabled.			
(Second Blob Line En=1)	Not Used. Always set to 1.	1	1	USE_SECOND_DARKEST_IN_LINE_FIT
(Receiver ID)	Not Used	0	0	Not Used

Firmware Versions 01.11.0-1 and Up				
Handheld Parameter	Description	Min Value	Max Value	Firmware MACRO
Node ID	The unique ID of the WGR within its wireless network. You cannot have two WGRs with identical Node ID who are on the same channel and within range of their receiver.	0	255	NODE_ID
RF Frequency A	A Channel, Bigger Number (78, 74)	2	80	RF_FREQUENCY_A
RF Frequency B	B Channel, Smaller Number (6, 2)	2	80	RF_FREQUENCY_B
Sample Rate (Sec)	The time in seconds between samples when the WGR is in Normal Sample Mode.	0	16384	NORMAL_UPDATE_RATE
Units (0=PSI, 1=InH20, 2=degF, 3=inHg)	The units of data the gauge represents. 0=”PSI”, 1=”InH20”, 2=”deg F”, 3=”inHg”	0	3	DEFAULT_GAUGE_UNITS_LCD
Min Gauge Value	Minimum value on the gauge scale	-32767	32767	GAUGE_MIN_VALUE
Max Gauge Value	Maximum value on the gauge scale	-32767	32767	GAUGE_MAX_VALUE
Zoom Enable	The camera will capture the image with a 2x zoom. 0à Disabled, 1àEnabled.	0	1	ENABLE_ZOOM
Long Tail Enable	This will set the mode to Long tail or Short tail. 0à Short Tail, 1à Long Tail.	0	1	WEIGTHED_TIP_TAIL
Taper and Short Tail En	If enabled a weighted tip tail algorithm will execute after a short tail algorithm has executed for further verification. 0à Disabled, 1àEnabled. Only valid in Short Tail Mode.	0	1	WEIGHTED_WITH_SHORT_TAIL
Dynamic Stitching	Will dynamically stitch the left and right side with a stair step pattern down the middle. the pattern will mirror image based on needle angle to avoid shadows. This is an advanced feature. Consult Cypress Systems. 0à Disabled, 1àEnabled. Should only be used in Long Tail mode.	0	1	ENABLE_REFLECTION_KILL3
Second Radius Ignore	Angle calculation will ignore all circles with indexes greater than or equal to this value. Index starts at 0 with the innermost circle. e.g. 3 = means the second set of red pixels of circle 3 & 4 will not be used in the angle calculation. 5 = all sets of red pixels will be used. For Long Tail Mode set this to 5. For Short Tail Mode set this based on the number of cirlces that only overlap the tip – Usually 3.	0	5	SECOND_BLOBS_TO_IGNORE
Center Point X	Defines the X direction center of the circles. This should match the center of the pivot point of the needle (may not always be center of image sensor).	0	127	CENTER_POINT_X
Zoom X Offset	This offset will adjust the image frame right or left along the gauge face. This is used to center the needle in the image. When used the Center Point X variable should always be set to 63.	-60	60	ZOOM_X_OFFSET
Center Point Y	Defines the Y direction center of the circles. This should match the center of the pivot point of the needle (may not always be center of image sensor).	0	127	CENTER_POINT_Y
Zoom Y Offset	This offset will adjust the image frame up or down along the gauge face. Used only when Zoom En = 1. This is used to center the needle in the image. When used the Center Point Y variable should always be set to 63.	-30	30	ZOOM_X_OFFSET
Radius 1	Innermost Radius in pixels of each circle	0	63	RADIUS_1
Radius 2	Radius in pixels of each circle	0	63	RADIUS_2
Radius 3	Radius in pixels of each circle	0	63	RADIUS_3
Radius 4	Radius in pixels of each circle	0	63	RADIUS_4
Radius 5	Outermost Radius in pixels of each circle	0	63	RADIUS_5
Exposure	This will adjust the brightness of the image. The larger the number the brighter the image.	0	230	OSPREY_EXPOSURE
Pixel Threshold	Defines the sensitivity of dark pixels stored. Decreasing the Luminosity Threshold will increase the number of pixels picked up. Increasing the Luminosity Threshold will decrease the number of pixels picked up.	0	255	LUMINOUS_THRESHOLD_DELTA
Tip Width	Minimum number of pixels that are close together to be considered a valid group.	0	255	MIN_CLOSE_PIXELS_THRESHOLD
	This allows us to easily filter out individual pixels of noise or numerals or hash marks etc. This is an advanced feature. Consult Cypress Systems.			

Firmware Versions 01.11.0-1 and Up				
Handheld Parameter	Description	Min Value	Max Value	Firmware MACRO
Tail Width	Max delta in X or Y direction to consider two points in the same group/blob. This is an advanced feature. Consult Cypress Systems.	0	255	NEARBY_PIXEL_THRESHOLD
Gauge Min Angle	Angle, with respect to Gauge Bottom, at which the Min Gauge Value resides.	0	359	GAUGE_MIN_ANGLE
Gauge Max Angle	Angle, with respect to Gauge Bottom, at which the Max Gauge Value resides.	0	359	GAUGE_MAX_ANGLE
Switching Angle	Angle, with respect to Gauge Bottom, at which the gauge value will switch from Maximum to Minimum or vise versa. Must be between Gauge Min and Max Angle.	0	359	SWITCHING_ANGLE
Needle Rest Correction	Offset angle from Gauge Min Angle where the value will always read Min Gauge Value. If the needle is between the Gauge Min Angle and Gauge Min Angle + Needle Rest Corr, value will read Minimum.	0	255	NEEDLE_RESTING_CORRECTION
Gauge Tilt Angle	The angle between the WGR and Gauge it is mounted on. Example: -30 = Guage is -30 degrees counterclockwise. +30 Guage is +30 clockwise.	-180	180	WGR_ANGLE_TO_GAUGE
(Reserved Units)	Not Used	0	0	Not Used
(Second Blob En=1)	Specifies whether the software should find one or two red pixels per circle.	0	1	FIND_SECOND_DARK_BLOB
	0 à Disabled, 1à Enabled.			
(Second Blob Line En=1)	Not Used. Always set to 1.	1	1	USE_SECOND_DARKEST_IN_LINE_FIT
(Receiver ID)	Not Used	0	0	Not Used

Firmware Versions 01.12.0-1 and Up				
Handheld Parameter	Description	Min Value	Max Value	Firmware MACRO
Node ID	The unique ID of the WGR within its wireless network. You cannot have two WGRs with identical Node ID who are on the same channel and within range of their receiver.	0	255	NODE_ID
RF Frequency A	A Channel, Bigger Number (78, 74)	2	80	RF_FREQUENCY_A
RF Frequency B	B Channel, Smaller Number (6, 2)	2	80	RF_FREQUENCY_B
Sample Rate (Sec)	The time in seconds between samples when the WGR is in Normal Sample Mode.	0	16384	NORMAL_UPDATE_RATE
Units (0=PSI, 1=InH20, 2=degF, 3=inHg)	The units of data the gauge represents. 0=”PSI”, 1=”InH20”, 2=”deg F”, 3=”inHg”	0	3	DEFAULT_GAUGE_UNITS_LCD
Min Gauge Value	Minimum value on the gauge scale	-32767	32767	GAUGE_MIN_VALUE
Max Gauge Value	Maximum value on the gauge scale	-32767	32767	GAUGE_MAX_VALUE
Zoom Enable	The camera will capture the image with a 2x zoom. 0à Disabled, 1àEnabled.	0	1	ENABLE_ZOOM
Long Tail Enable	This will set the mode to Long tail or Short tail. 0à Short Tail, 1à Long Tail.	0	1	WEIGTHED_TIP_TAIL
Taper and Short Tail En	If enabled a weighted tip tail algorithm will execute after a short tail algorithm has executed for further verification. 0à Disabled, 1àEnabled. Only valid in Short Tail Mode.	0	1	WEIGHTED_WITH_SHORT_TAIL
Dynamic Stitching	Will dynamically stitch the left and right side with a stair step pattern down the middle. the pattern will mirror image based on needle angle to avoid shadows. This is an advanced feature. Consult Cypress Systems. 0à Disabled, 1àEnabled. Should only be used in Long Tail mode.	0	1	ENABLE_REFLECTION_KILL3
Second Radius Ignore	Angle calculation will ignore all circles with indexes greater than or equal to this value. Index starts at 0 with the innermost circle. e.g. 3 = means the second set of red pixels of circle 3 & 4 will not be used in the angle calculation. 5 = all sets of red pixels will be used. For Long Tail Mode set this to 5. For Short Tail Mode set this based on the number of cirlces that only overlap the tip – Usually 3.	0	5	SECOND_BLOBS_TO_IGNORE
Center Point X	Defines the X direction center of the circles. This should match the center of the pivot point of the needle (may not always be center of image sensor).	0	127	CENTER_POINT_X
Zoom X Offset	This offset will adjust the image frame right or left along the gauge face. This is used to center the needle in the image. When used the Center Point X variable should always be set to 63.	-60	60	ZOOM_X_OFFSET
Center Point Y	Defines the Y direction center of the circles. This should match the center of the pivot point of the needle (may not always be center of image sensor).	0	127	CENTER_POINT_Y
Zoom Y Offset	This offset will adjust the image frame up or down along the gauge face. Used only when Zoom En = 1. This is used to center the needle in the image. When used the Center Point Y variable should always be set to 63.	-30	30	ZOOM_X_OFFSET
Radius 1	Innermost Radius in pixels of each circle	0	63	RADIUS_1
Radius 2	Radius in pixels of each circle	0	63	RADIUS_2
Radius 3	Radius in pixels of each circle	0	63	RADIUS_3
Radius 4	Radius in pixels of each circle	0	63	RADIUS_4
Radius 5	Outermost Radius in pixels of each circle	0	63	RADIUS_5
Exposure	This will adjust the brightness of the image. The larger the number the brighter the image.	0	230	OSPREY_EXPOSURE
Pixel Threshold	Defines the sensitivity of dark pixels stored. Decreasing the Luminosity Threshold will increase the number of pixels picked up. Increasing the Luminosity Threshold will decrease the number of pixels picked up.	0	255	LUMINOUS_THRESHOLD_DELTA
Tip Width	Minimum number of pixels that are close together to be considered a valid group.	0	255	MIN_CLOSE_PIXELS_THRESHOLD
	This allows us to easily filter out individual pixels of noise or numerals or hash marks etc. This is an advanced feature. Consult Cypress Systems.			

Firmware Versions 01.12.0-1 and Up				
Handheld Parameter	Description	Min Value	Max Value	Firmware MACRO
Tail Width	Max delta in X or Y direction to consider two points in the same group/blob. This is an advanced feature. Consult Cypress Systems.	0	255	NEARBY_PIXEL_THRESHOLD
Gauge Min Angle	Angle, with respect to Gauge Bottom, at which the Min Gauge Value resides.	0	359	GAUGE_MIN_ANGLE
Gauge Max Angle	Angle, with respect to Gauge Bottom, at which the Max Gauge Value resides.	0	359	GAUGE_MAX_ANGLE
Min Needle Travel Angle	For the WGR this is the angle, with respect to Gauge Bottom, at which the gauge value will switch from Maximum to Minimum or vise versa. Must be between Gauge Min and Max Angle. For the Magnehelic and Photohelic gauges this defines the Min arc angle	0	359	GAUGE_MIN_NEEDLE_TRAVEL_ANGLE
Max Needle Travel Angle	For the WGR set this equal to the Min Needle Travel Angle. For the Magnhelic and Photohelic gauges this defines the Max arc angle.	0	359	GAUGE_MAX_NEEDLE_TRAVEL_ANGLE
Needle Rest Correction	Offset angle from Gauge Min Angle where the value will always read Min Gauge Value. If the needle is between the Gauge Min Angle and Gauge Min Angle + Needle Rest Corr, value will read Minimum.	0	255	NEEDLE_RESTING_CORRECTION
Gauge Tilt Angle	The angle between the WGR and Gauge it is mounted on. Example: -30 = Guage is -30 degrees counterclockwise. +30 Guage is +30 clockwise.	-180	180	WGR_ANGLE_TO_GAUGE
Left LED Bright	Controls the left LED brightness. For model that do not support this feature it will be ignored	0	21	LEFT_LED_INTENSITY
Right LED Bright	Controls the right LED brightness. For model that do not support this feature it will be ignored	0	21	RIGHT_LED_INTENSITY
(Reserved Units)	Not Used	0	0	Not Used
(Second Blob En=1)	Specifies whether the software should find one or two red pixels per circle.	0	1	FIND_SECOND_DARK_BLOB
	0 à Disabled, 1à Enabled.			
(Second Blob Line En=1)	Not Used. Always set to 1.	1	1	USE_SECOND_DARKEST_IN_LINE_FIT
(Receiver ID)	Not Used	0	0	Not Used

11.0 Troubleshooting

Problem	Solution	Detailed Steps
The LCD Screen on Handheld Device is Dim.	Adjust the Backlight	Press the [Backlight] Key to cycle through from light to dark.
The Cypress Systems Application has exited OR The Cypress Systems Application is stalled, frozen, or malfunctioning OR The Handheld unit is unresponsive	Reboot the Handheld Device AND Exit Configuration Mode	1. Press and hold both the [Enter/On] and [Blue] key for 6 seconds. The unit will perform a full reboot. The Cypress Systems Application will automatically launch. 2. Exit Configuration Mode on the WGR by pressing the Left WGR Button. Make sure the WGR is in Normal Operating Mode. 3. You are now ready to start over

Error Code	Description	Resolution
0x21	Not enough points on the needle. The WGR is picking up dark pixels that are not part of the needle.	The circles are overlapping background noise (text, graphics, etc) causing the WGR to pick them over the needle. Adjust the circles so they do not overlap the background. The WGR has moved and the circles are no longer centered on the needle. Re-center the circles. The WGR threshold is set too low causing the algorithm to pick up more pixels (green blobs) than it should. Adjust the threshold.
0x22	Either the tip or the tail of the needle does not contain any “Red Pixels”. One side of the needle is completely missing.	Make sure the circles overlap both sides of the needle, regardless of the needle angle. If the tip of the needle is very thin, reduce the Tip Width variable. The WGR threshold is set too high causing the algorithm to lose pixels (green blobs). Adjust the threshold.
0x23	Only when using the Short Tail method. Circles 4 and 5 are both overlapping the tip but their “Red Pixels” are on opposite sides of the needle. The WGR cannot find the tip.	Make sure circles 4 and 5 only overlap the tip and avoid all background. The WGR threshold is set too low causing the algorithm to pick up more pixels (green blobs) than it should. Adjust the threshold.
0x24	Only when using the Short Tail method. The WGR cannot find the needle along circles 4 and 5. There are no Red Pixels. The WGR cannot find the tip	Make sure circles 4 and 5 are both overlapping the tip of the needle. If the tip of the needle is very thin, reduce the Tip Width variable. The WGR threshold is set too high causing the algorithm to lose pixels (green blobs). Adjust the threshold.
0x25	Only when using the Short Tail method with “Taper and Short Tail En” is enabled, set to 1. The WGR is attempting to find the tip of the needle using the long tail method in addition to the short tail method. The long tail method is failing because the difference between the tip and tail thickness is too small. The needle has a slight taper.	Check the taper of the needle, if it is slight, enable Dynamic Stitching. Check for any glare on the needle. This can cause missing green blobs on the tail. If glare is discovered, make sure the WGR is mounted parallel to the gauge face and centered to the needle. Turn down the exposure and adjust the threshold. If possible use Short Tail method alone. Disable Taper and Short Tail En.

Error Code	Description	Resolution
0x26	Only when using the Short Tail method with "Taper and Short Tail En" is enabled, set to 1. The WGR is attempting to combine the results of the Short and Long tail method but they do not match. Cannot find the tip.	Check the taper of the needle, if it is slight, enable Dynamic Stitching. Check for any glare on the needle. This can cause missing green blobs on the tail. If glare is discovered, make sure the WGR is mounted parallel to the gauge face and centered to the needle. Turn down the exposure and adjust the threshold. The WGR threshold is set too low causing the algorithm to pick up more pixels (green blobs) than it should. Adjust the threshold. If the tip of the needle is very thin, reduce the Tip Width variable. If possible use Short Tail method alone. Disable Taper and Short Tail En.
0x27	Only when using the Long Tail method. The WGR is attempting to find the tip of the needle by analyzing the taper of the needle. The difference between the tip and tail thickness is too small. The needle has a slight taper.	Check the taper of the needle, if it is slight, enable Dynamic Stitching. Check for any glare on the needle. This can cause missing green blobs on the tail. If glare is discovered, make sure the WGR is mounted parallel to the gauge face and centered to the needle. Turn down the exposure and adjust the threshold. If possible use Short Tail method.
0x28	The WGR cannot find the needle. The WGR does not have enough Red Pixels.	The WGR has been removed from the gauge. Re-mount the WGR. The Threshold is set too high causing missing Green Blobs. Turn down the threshold and adjust the exposure so the WGR has enough Green Blobs along the needle.
0x29	The WTR cannot communicate with the LR300. The WTR heard no response, or LR300 protocol is not compatible.	Replace the Communication Cable. Protocol for this LR300 might be different. Verify LR300 firmware version: RS232 = 2.32 RS485 = 4.01 If different LR300 firmware version, contact Cypress Systems Engineering.

Error Code	Description	Resolution
0x2A	The WTR is communicating with the LR300 but is getting corrupt data.	Replace the Communication Cable. Try moving the LR300 and WTR away from any source of EMI. Protocol for this LR300 might be different. Verify LR300 firmware version: RS232 = 2.32 RS485 = 4.01 If different LR300 firmware version, contact Cypress Systems Engineering.

If you have additional problems, please contact us. See Section 14.0, Support, for contact information.

12.0 Technical Specifications

13.0 Product Disposal

The WGR is recycled by Cypress Envirosystems. Contact a service technician or Cypress Envirosystems headquarters to recycle the WGR. See Section 10.0, Support, for details.

14.0 Support

For additional support, including configuration, maintenance, and troubleshooting, please contact us.

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15.0 Warranty Information

Every product comes with a full one-year parts and labor warranty. Cypress Envirosystems monitoring of battery status, product status, and potential communications packets are included during this period, so that proactive service can be provided to our customers.