CYPRESS
ENVIROSYSTEMS

WGR
Installation Manual & Step by Step Guide

For Internal Use Only

Author	Date	Revision	Changes
Derkalousdian, Moses	06-02-08	02.00.02	Replaced hand drawn with digital images. Added in new WMR functionality from 01.12.0 firmware release
Derkalousdian, Moses	10-16-08	02.01.00	Merged in WTR. Finalized WMR instructions. Updated all screen shots to the latest version of the HH Application
Davis, Jim Derkalousdian, Moses	12-17-08	02.01.01	Minor corrections. Added full Units table indicating WGR string units displayed on LCD screen.
Kim, Steve	1-13-09	02.01.02	Minor corrections. Added disclaimer
Derkalousdian, Moses	2-03-09	02.01.03	Updated Units Table for LCD screen.

This manual is designed to be a step by step guide as well as a reference used to configure Cypress Envirosystems products with the Handheld Configuration tool. Formal training is required for all installers.

Table of Contents

Introduction

The Wireless Gauge Reader (WGR) is capable of non-invasively reading a gauge and transmitting the data to a central server. To perform this task you must calibrate each WGR to work with the specific gauge it is mounted on.

The WGR uses a camera to capture an image of the gauge, convert the image into a gauge reading and transmit the results wirelessly. This process requires the proper settings of several parameters that configure the camera, communication settings, and image processing routines.

The Handheld Configuration Tool (HH) must be used to setup these parameters. All WGR configuration parameters are entered on the HH and sent wirelessly to the WGR.

This manual will describe how to configure and use the WGR, and HH. A section covering the Wireless Magnehelic Reader (WMR) and Wireless Transducer Reader (WTR) has been included at the end. The WMR and WTR instructions assume the user is familiar with WGR configuration.

This manual can be used as a reference or step by step guide. The first two sections: *Handheld Configuration* T*ool* and *Wireless Gauge Reader*, has an introduction for each and describes the use of every menu, button, key, etc. The following section: *Configuration*, describes the theory behind configuring a WGR. The *Step – by – Step* section will guide a user through the entire process of configuration from start to finish.

You can either start by reviewing the first three sections than walking through the *Step – by – Step guide*, or jump directly to the *Step – by – Step* guide and refer back to the first three sections as needed.

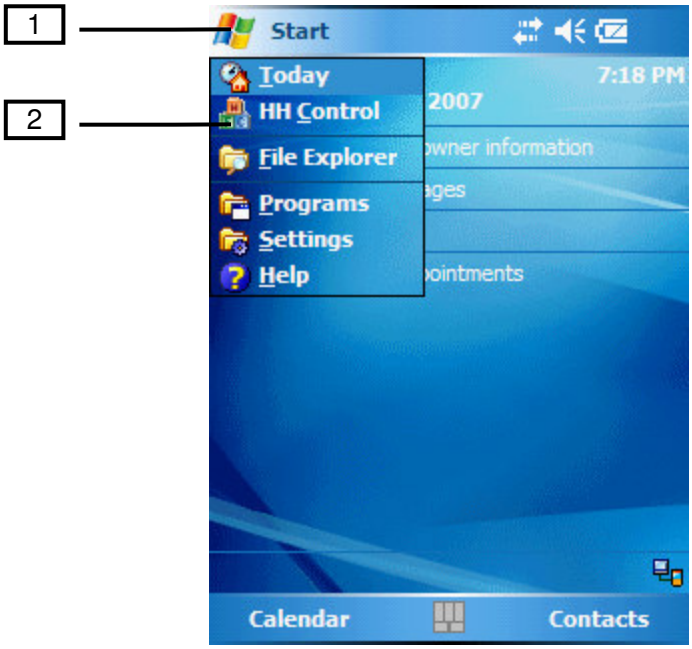
Handheld Configuration Tool (HH)

This section will introduce the HH tool as well as the HH application that performs the configuration functions.

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

The image below highlights the features of the HH which will be used.

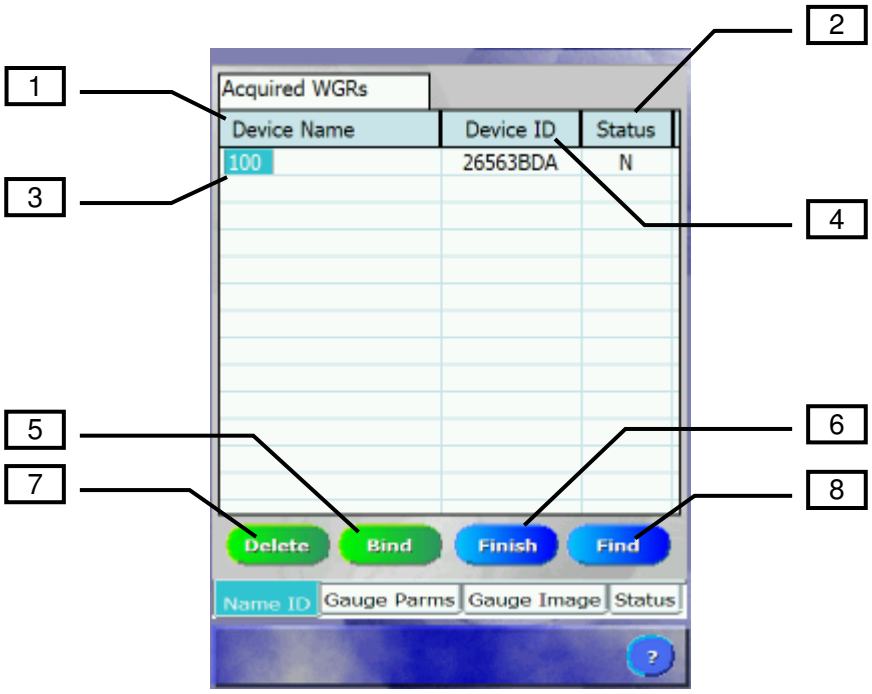
- **Touch Screen:** This is the Touch Screen LCD monitor of the HH device. You can use a stylus to navigate on screen.
- **Navigation Arrows:** These are up, down, left, and right navigation keys. You can use this to navigate to different text entry fields in the application. The Left Arrow is used to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



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

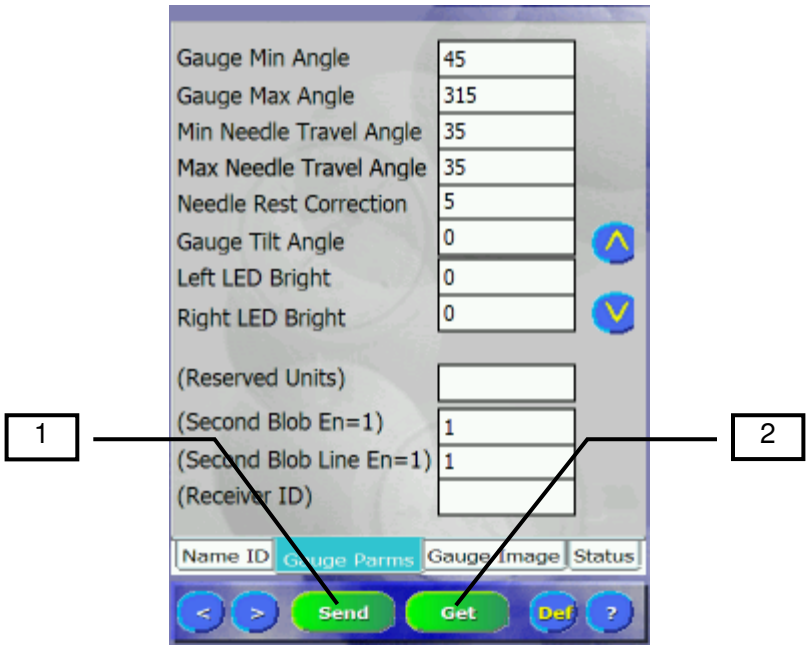
The following will introduce the HH application used to configure a WGR. The application is broken up into four tabs. Each tab will be highlighted below. To select a tab in the application, tap on the name using the stylus.

Name ID Tab



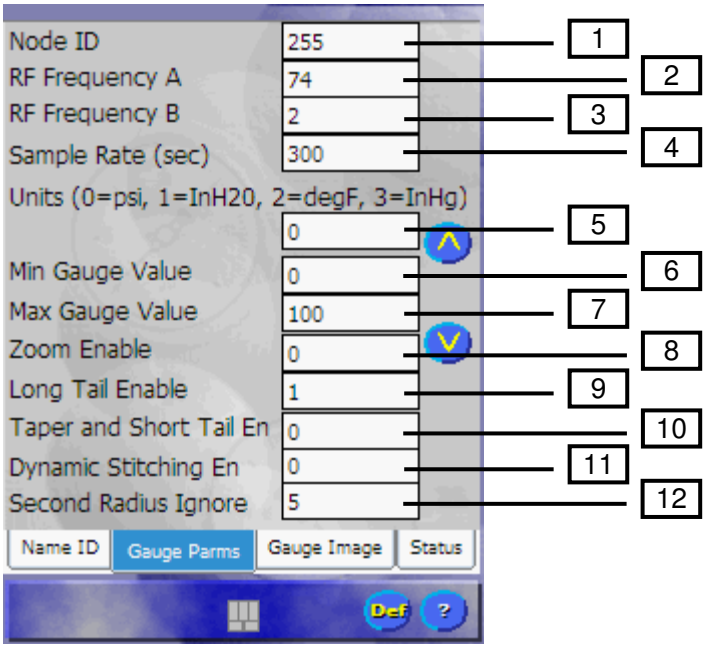
1. **Device Name Column:** This column contains the name of the WGR that the handheld is or has bound to. This is used to identify the WGR by name. Highlighting a WGR from the list will recall its parameters from the saved text file.
2. **Bind Column:** This column shows the connection status between the WGR and the HH.
    - Blank → HH cannot detect WGR
    - "N" → HH detected the WGR but they are not connected
    - "Y" → HH and WGR are connected
3. **Name Entry**: You can select, enter or edit the name of a WGR here. To select a WGR tap on the name with the stylus. To enter or edit the name, first select the WGR, than 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 WGR. This is used to identify the WGR you wish to connect to when the HH has detected more than one. The WGR displays its radio ID on its LCD.
5. **Bind Button**: Used to connect the HH to the highlighted WGR in the Device Name column.
6. **Finish Button**: Terminates connection between the HH and WGR. Use this button when you have completed configuration and want the WGR to save all the settings. The WGR will not save its configuration settings if the connection were terminated any other way.
7. **Delete Button**: Will deleted the highlighted WGR in the Device Name column.
8. **Find Button**: The HH will search for any WGRs within wireless range that is in Discovery Mode. Detected WGRs will be labeled "<UNASSIGNED>" in the Device Name column with an accompanying "N" in the Bnd column.

Gauge Parameters Tab



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

Gauge Parameters Tab – Page 1

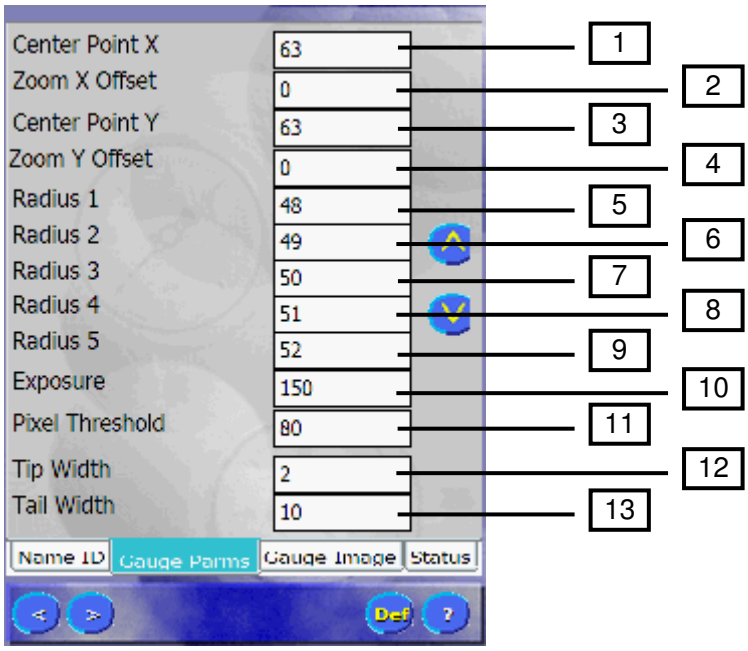


1. **Node ID:** The unique ID of the WGR within its wireless network.
2. **RF Frequency A:** The A channel used for wireless communication.
3. **RF Frequency B:** The B channel used for wireless communication.
4. **Sample Rate (sec):** The time in seconds between samples when the WGR is in Normal Sample Mode.
5. **Units:** The units of data the gauge represents. For example: 0=”PSI”, 1=”InH20”, 2=”deg F”, 3=”inHg”. See table below for full list.
6. **Min Gauge Value:** Minimum value on the gauge scale
7. **Max Gauge Value:** 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, 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 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**

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

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

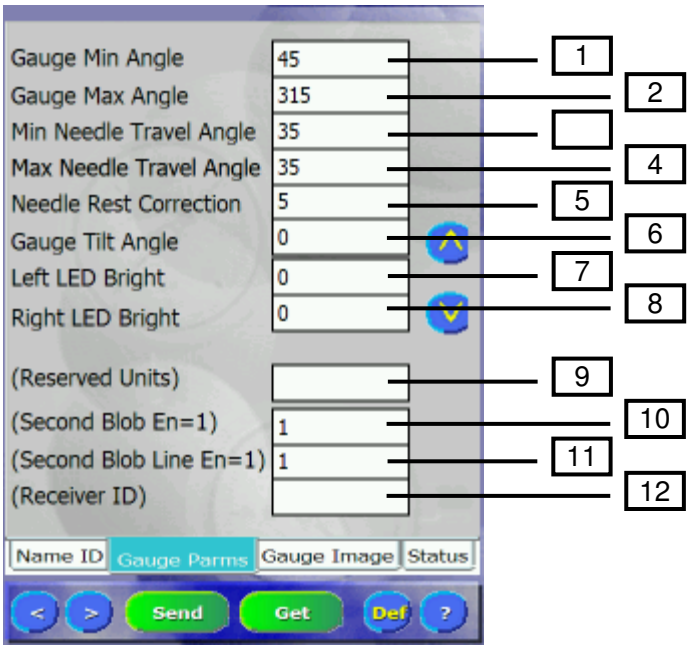
3. **Center Point Y:** Defines the Y dimension center of the needle.
4. **Zoom Y Offset:** This will offset the image in the Y direction. It is used to center the needle in the image. It is recommended that this variable is used to center the needle before attempting to center the concentric circles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

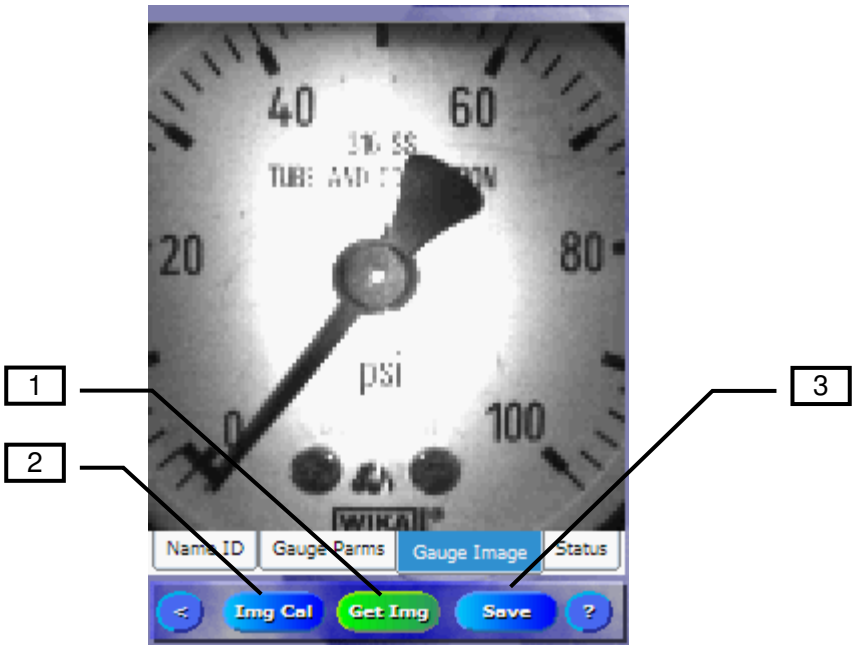
11. **Pixel Threshold:** Defines the sensitivity of dark pixels stored. Decreasing the Luminosity Threshold will increase the number of pixels picked up. Increasing the Luminosity Threshold will decrease the number of pixels picked up.
12. **Tip Width:** The needle tip width in pixels.
13. **Tail Width:** The needle tail width in pixels.

Gauge Parameters Tab – Page 3



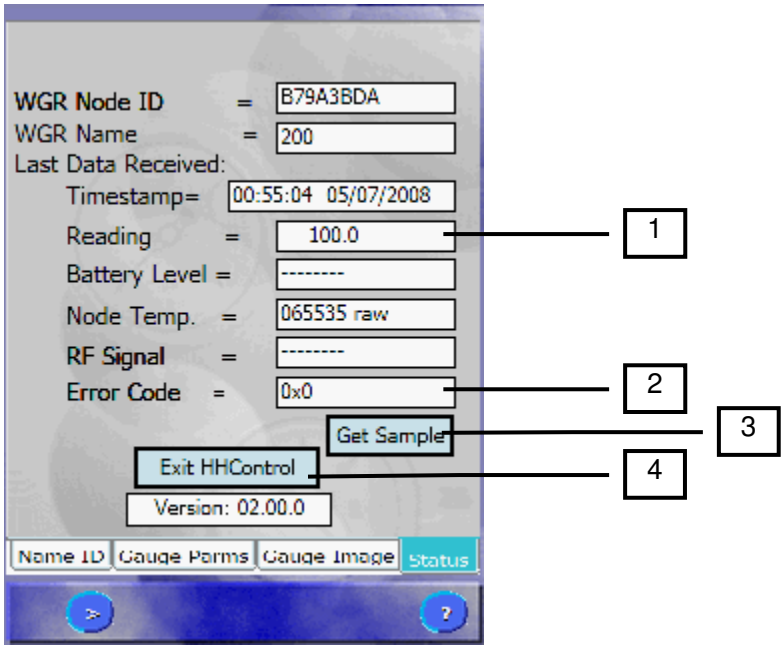
1. **Gauge Min Angle:** Angle, with respect to Gauge Bottom, at which the Min Gauge Value resides.
2. **Gauge Max Angle:** Angle, with respect to Gauge Bottom, at which the Max Gauge Value resides.
3. **Min Needle Travel Angle:** For the WGR this is the angle, with respect to Gauge Bottom, at which the gauge value will switch from Maximum to Minimum or vise versa. Must be between Gauge Min and Max Angle. This value has a different meaning for the WMR, see the WMR section at the end of this manual
4. **Max Needle Travel Angle:** For the WGR set this to the same angle as the Min Needle Travel Angle. This value has a different meaning for the WMR, see the WMR section at the end of this manual
5. **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.
6. **Gauge Tilt Angle:** The angle between the WGR and Gauge Bottom. Example: -30 = Gauge is -30 degrees counterclockwise. +30 Gauge is +30 clockwise.
7. **Left LED Bright: Primarily, a WMR parameter.** This value adjusts the brightness of the left half of the image. Range is 0 → 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.
8. **Right LED Bright: Primarily, a WMR parameter.** This value adjusts the brightness of the right half of the image. Range is 0 → 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.
9. **(Reserved Units):** Unused.
10. **(Second Blob En=1):** Should always be set to 1.
11. **(Second Blob Line En=1):** Should always be set to 1.
12. **(Receiver ID):** Unused.

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.

Status Tab

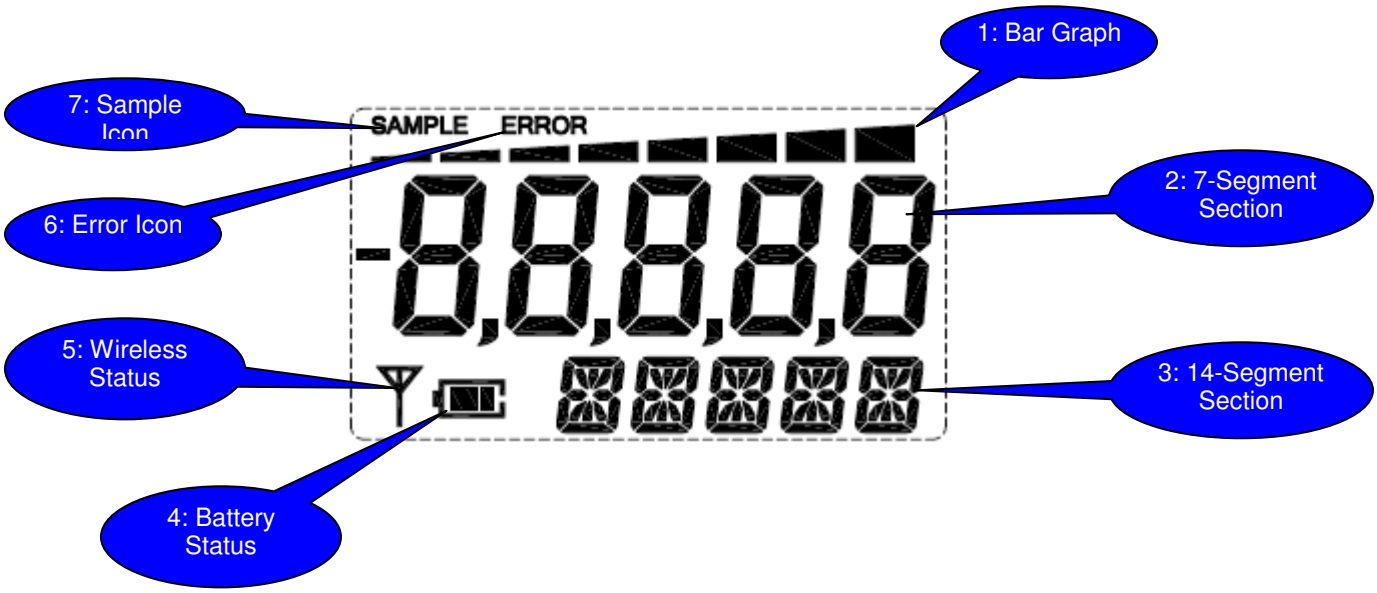


1. **Reading:** Contains reading results from a Get Sample Request. This is used to verify the calibration of the WGR was accurate.
2. **Error Code:** Contains the error code result from the last Get Sample performed. See the error code table at the end of this manual.
3. **Get Sample:** This will initiate 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 HH will return to the Windows interface. Note: Always exit the HHControl application before turning off or suspending the HH configuration tool.

Wireless Gauge Reader (WGR)

The WGR is a battery powered device developed by Cypress Envirosystems which is mounted onto a gauge. A good way to begin learning about the WGR is to get familiar with the buttons and LCD display. You can find details in the images below.

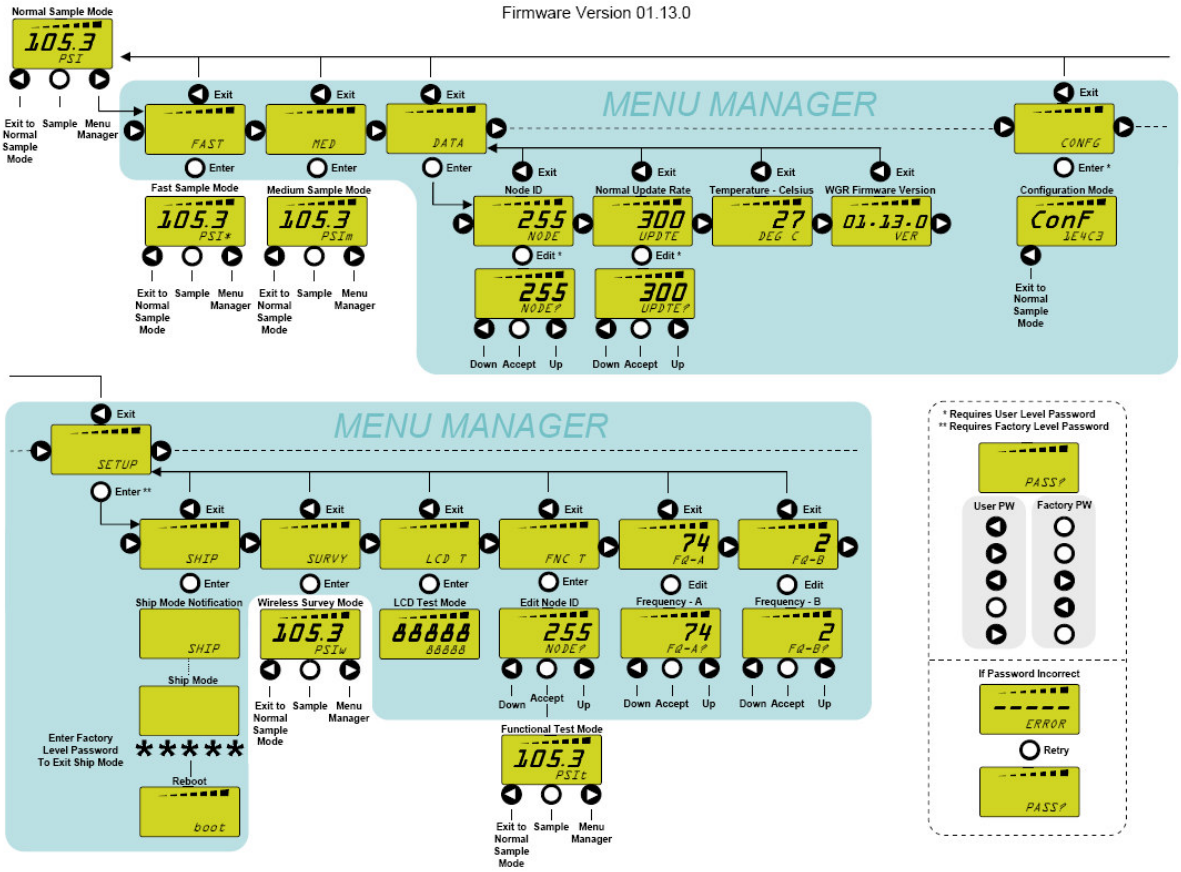
WGR LCD



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:** TBD
6. **Error Icon:** This icon will turn on and stay on when the WGR did not properly process its 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.

WGR Menu Structure

This is the menu structure of the WGR. The three buttons on the WGR are used to navigate the structure. Each mode and button sequences are labeled in the diagram below.



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-segement section on the LCD to the most recent value. The time between samples is setup using the HH.
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 usually less. This is used when a higher resolution of reading is required.
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 usually less but more than Fast Sample Mode. This is used when a higher resolution of reading is required.
4. **Node ID:** The Node ID of the WGR can be viewed and edited.
5. **Normal Update Rate:** The update rate for Normal Sample Mode can be viewed and edited.
6. **Temperature – Celsius:** Displays the current temperature reading at the WGR.
7. **WGR Firmware Version:** Displays the WGR firmware version number.
8. **Configuration Mode:** This mode is used to configure the WGR with a HH device.
9. **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.
10. **Wireless Survey Mode:** This mode is used when performing a wireless survey at a customer site. The WGR will send dummy samples without taking an image to save battery power.
11. **LCD Tests Mode:** This mode is used during manufacturing to test the LCD.
12. **Functional Test Mode:** This mode is used during manufacturing to perform a burn in test.
13. **Frequency – A:** Frequency A can be viewed and edited.
14. **Frequency – B:** Frequency B can be viewed and edited.

Configuration

Certain configuration settings require a deeper understanding of how the WGR works. This section contains descriptions of several WGR concepts and how to set related parameters.

Defining the Gauge Face

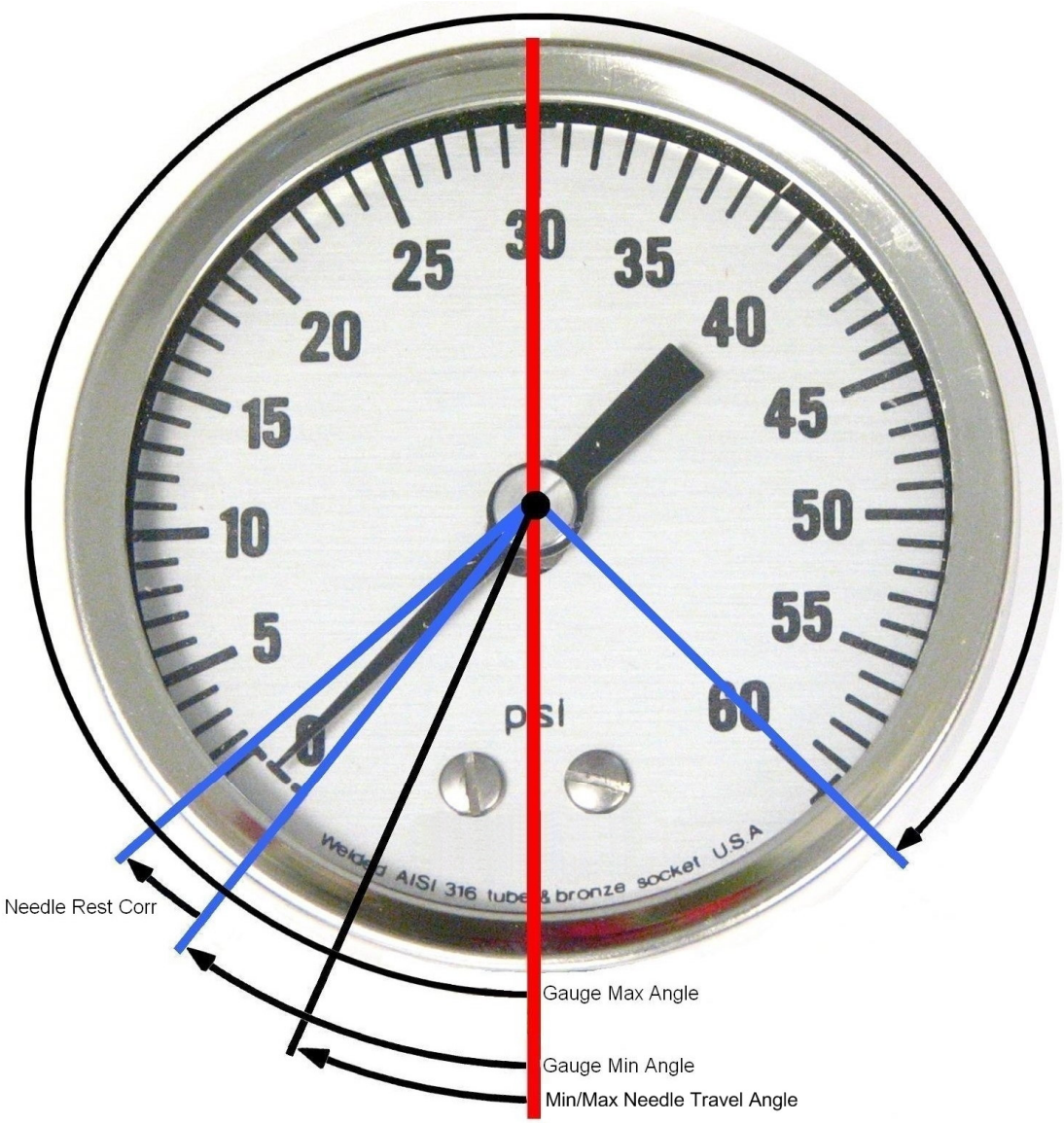
Related Variables:

- **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. You must configure the WGR 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 you must know which gauge it will be mounted on and the specific characteristics of the gauge.

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 below. All angles start from 0° and turn clockwise to 359°.

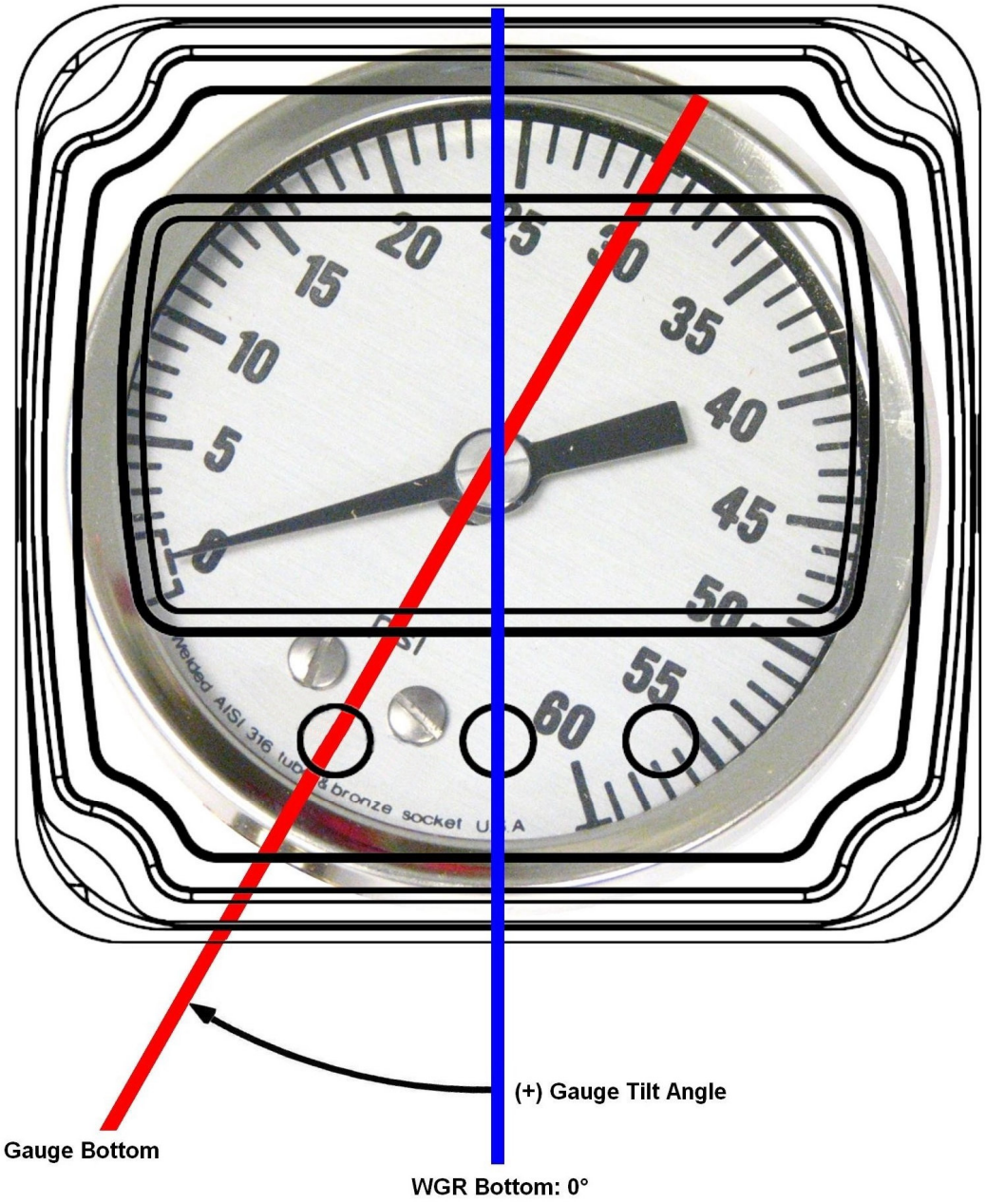


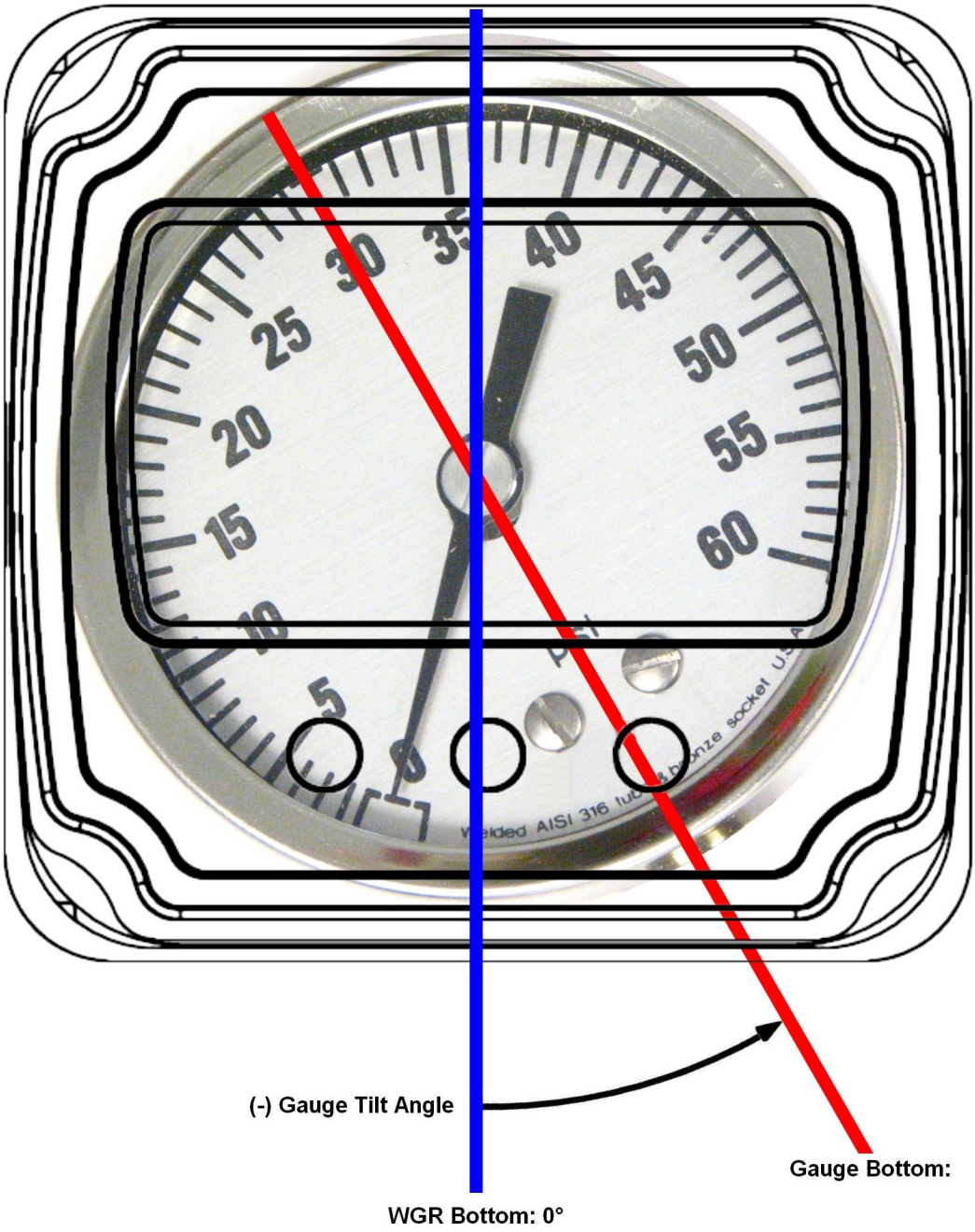
Gauge Bottom: 0°

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 below. Positive angles start from 0° and turn clockwise to 180°, negative angles start from 0° and turn counterclockwise to 180°.


0
5
10
15
20
25
30
35
40
45
50
55
60
PSI
(+) Gauge Tilt Angle
Gauge Bottom
WGR Bottom: 0°


(-) Gauge Tilt Angle
Gauge Bottom:
WGR Bottom: 0°

Circle Calibration

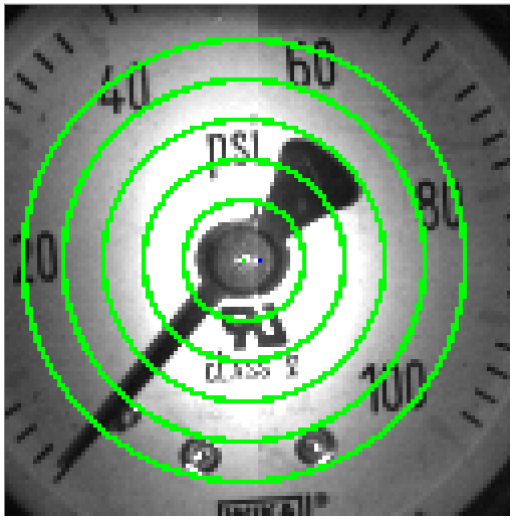
Related Variables:

- **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**

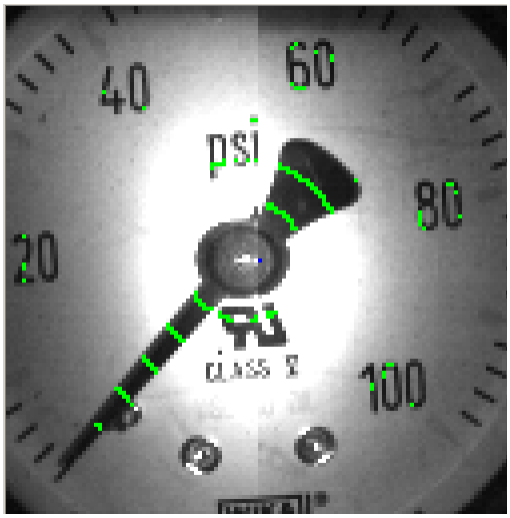
Circles

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**. You must setup these circles 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.

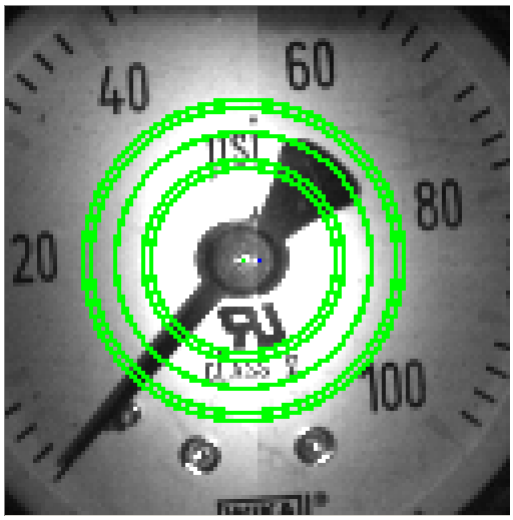
Here is an example of concentric circles improperly setup (Green pixels). Notice the five circles overlap the PSI symbol, the numbers, the graphic in the center, and even the rivets at the bottom.



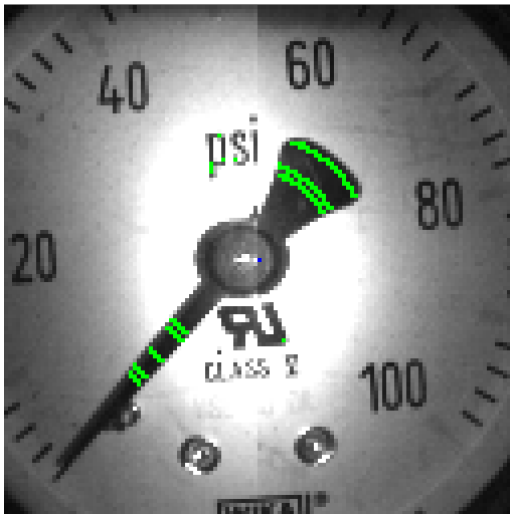
The image below is the same as the one above except the green pixels represent what the image processing algorithm considers the needle. Notice all green pixels outside of the needle. These could confuse the image processing algorithm and distort the reading.



Here is an example of concentric circles properly setup. It may be impossible to avoid all background markings but you must attempt 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.



The image below is the same as the one above except the green pixels represent what the image processing algorithm considers the needle. This result is much better than the previous example. The majority of the green pixels are concentrated only on the needle.



Zoom

In most cases it is beneficial to zoom in on the image. Anytime the circles can be setup when zoomed in, you should zoom in. This will effectively increase the pixel resolution of the needle. To enable zoom, set **Zoom Enable** to 1 and than calibrate the circles.

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, we can 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

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

Get Sample

Once the circles and zoom settings have been set, perform a Get Sample to verify the settings. 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 you performed a Get Image, the green and red pixels will not match the image. You can either continue as is or get a new image. Keep in mind every time you get an image you consume battery power.

Tip/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 you can perform the following:

- Perform a Get Sample. Check the location and group size of all green pixels in the image. If any exists that are close to the group size of the green pixels overlapping the needle, you may need to make the following adjustments:
    - 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 you notice red pixels off the needle you can make the same adjustments listed above. If you notice 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, you may 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 HH will not display Red pixels along circles that are ignored by the Second Radius Ignore variable, see Long Tail – Short Tail Selection section.

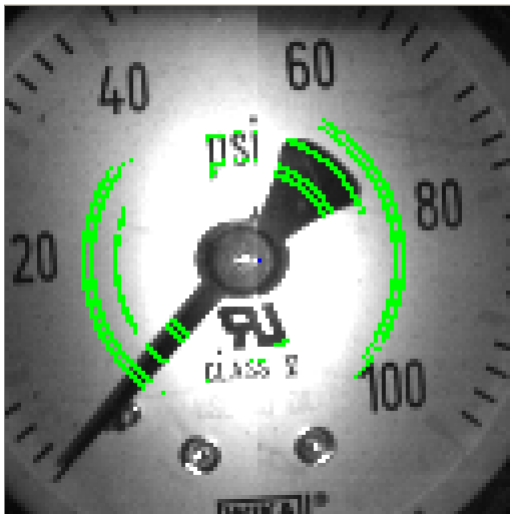
Pixel Threshold

Related Variables:

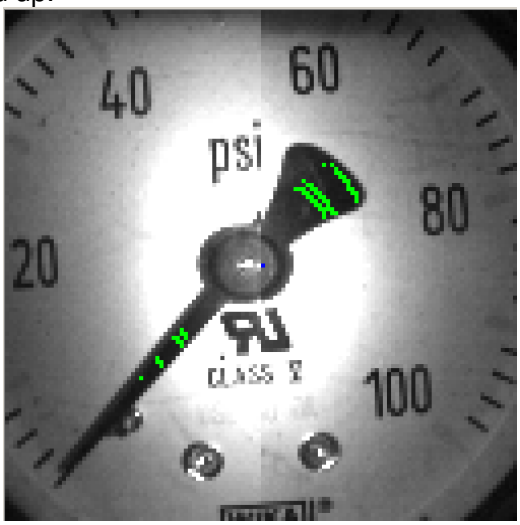
- **Pixel Threshold**

To further isolate the background from the needle you can 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.

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



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



To ensure a robust setup we must 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, your original setting is robust. If step 2 failed you must increase your Pixel Threshold value. If step 4 failed you must decrease your Pixel Threshold value.

Long Tail – Short Tail Selection

Related Variables:

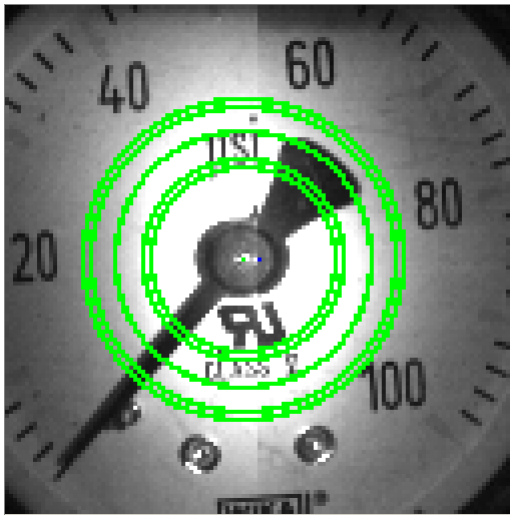
- **Long Tail Enable**
- **Taper and Short Tail En**
- **Second Radius Ignore**

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

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. 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, set **Long Tail Enable** to 0.



Radius Ignore

For Short Tail, some of the outer circles will not overlap both sides of the needle. In this case you want the software to ignore the second set of red pixels that do not exist. In the image above, the two outermost circles only overlap the tip of the needle not the tail. The second set of red pixels could potentially introduce errors into the angle calculation. In this case the **Second Radius Ignore** variable should be set to 3, meaning ignore circle number 4 and 5.

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

Combined Short Tail and Taper

If the circles overlap a lot of background, it is possible 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 a taper detection. 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 the WGR will return more errors in this case, but there is extra reassurance it will not report tip-tail failures. To enable, set **Taper and Short Tail En** to 1. This value is valid only in Short Tail mode.

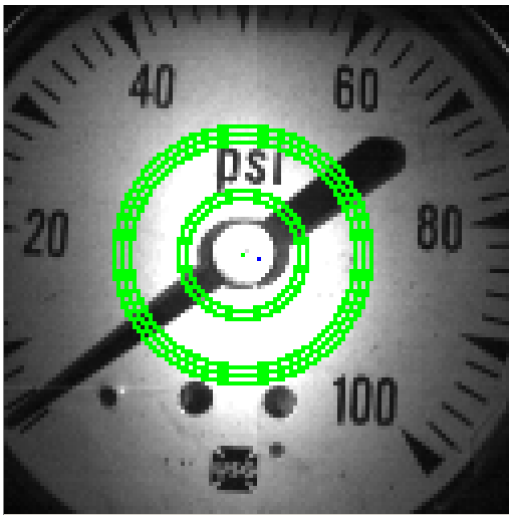
Long Tail

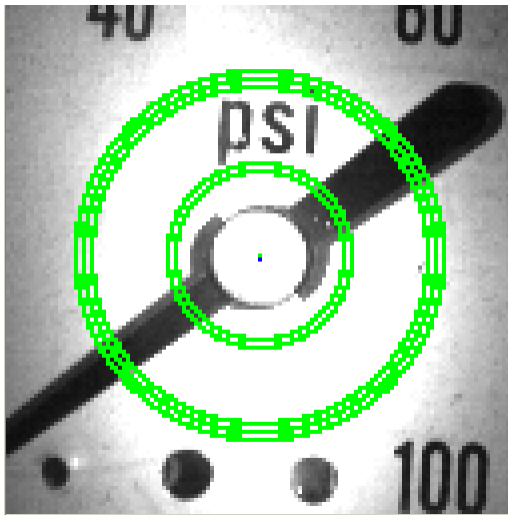
These needles are those with no room to place the circles beyond the end of the tail. To find the tail the software will measure the width of the needle at every point the circles overlap it. The side with the bigger overall width is the tail.

To enable this feature set **Long Tail Enable** to 1.

This approach relies on the fact that most needles are tapered. However, the taper on some needles are finer than others. To maximize the accurately 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 give you more resolution to measure the taper.
- Enable the **Dynamic Stitching** variable. See the Dynamic Stitching section.

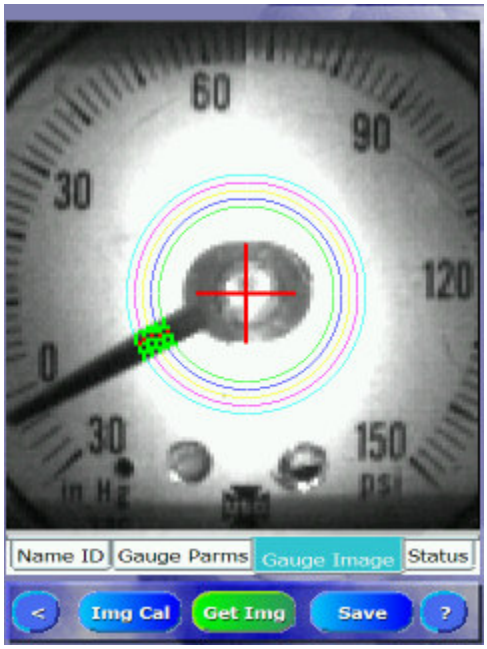




No Tail / No Tip Needles

You may run into gauges that either do not have a tail or the tip is too thin to process. In this case you can define a No Tip or No Tail Needle.

For a No Tail Needle such as the one in the image below, follow the same steps as the Short tail method. You must set the **Second Radius Ignore** variable to the correct value down to 0 if no circles overlap the tail. The Second Radius Ignore variable is 0 for the example below. If one circle did overlap the tail, set Second Radius Ignore variable to 1.



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

Dynamic Stitching

Related Variables:

- **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, we use two LEDs and take two half–image captures. For each half we use the opposite LED and stitch the results together to form one image, see Figure 1. Stitching solves problems related to glare but introduces new issues.

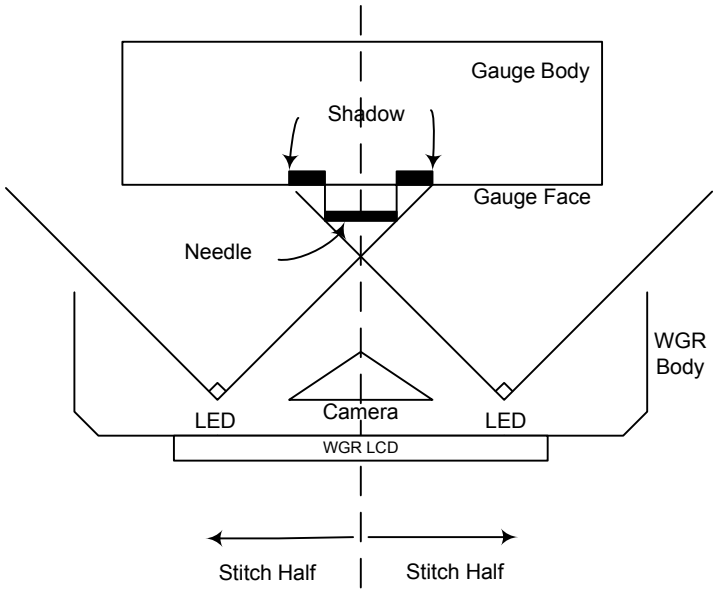


Figure 1: Illustration of Stitching two halves of an image using two LEDs.

For Long Tail Gauges, the needle taper is used to find the tip. The width of the needle's tip and tail are compared at the point they overlap the circles. The side with the bigger total width is the tail. If the taper of the needle is slight or reversed, the tail may only be a couple pixels wider than the tip. There is not enough resolution to always guarantee a successful reading. When stitching, we use two LEDs which will naturally result in two shadows from the needle. If the needle is aligned vertically with the stitch, the image will contain two shadows on either side of the needle. This will further reduce the taper of the needle leading to possible tip tail failures. See figure 2.

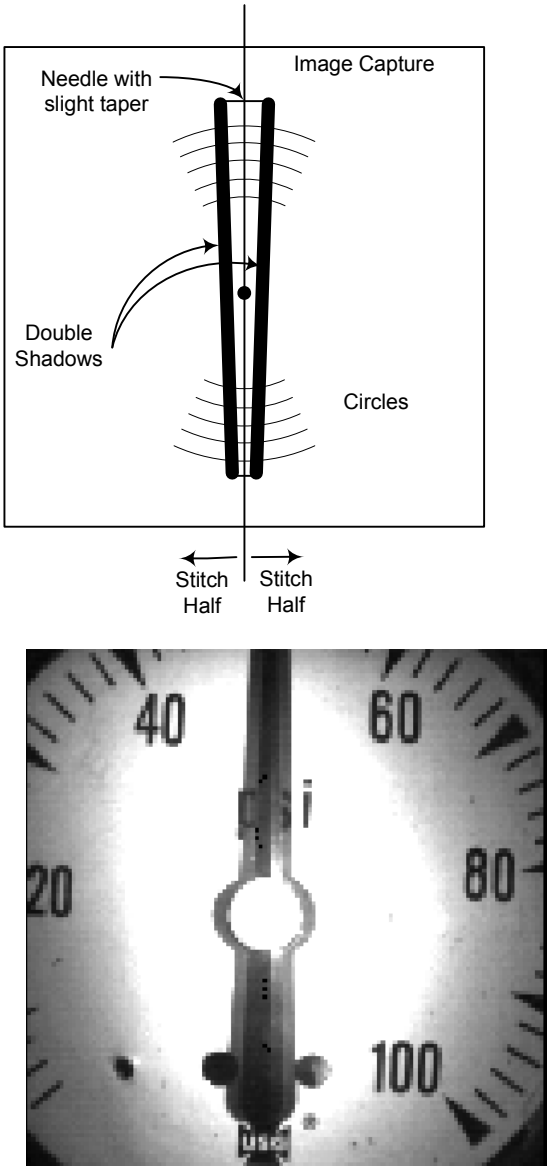


Figure 2: A Stitched image showing a needle with two shadows.

To overcome this problem we developed a dynamic stitching technique. This technique eliminates double shadows but requires extra processing time and power. Instead of stitching down the middle of the image, we stitch using one of two new patterns. The stitch will start offset to one side, then cut diagonally to the other side, and all the way down. See Figure 3. The opposing stitch offsets in the top and bottom half of the image eliminates double shadows.

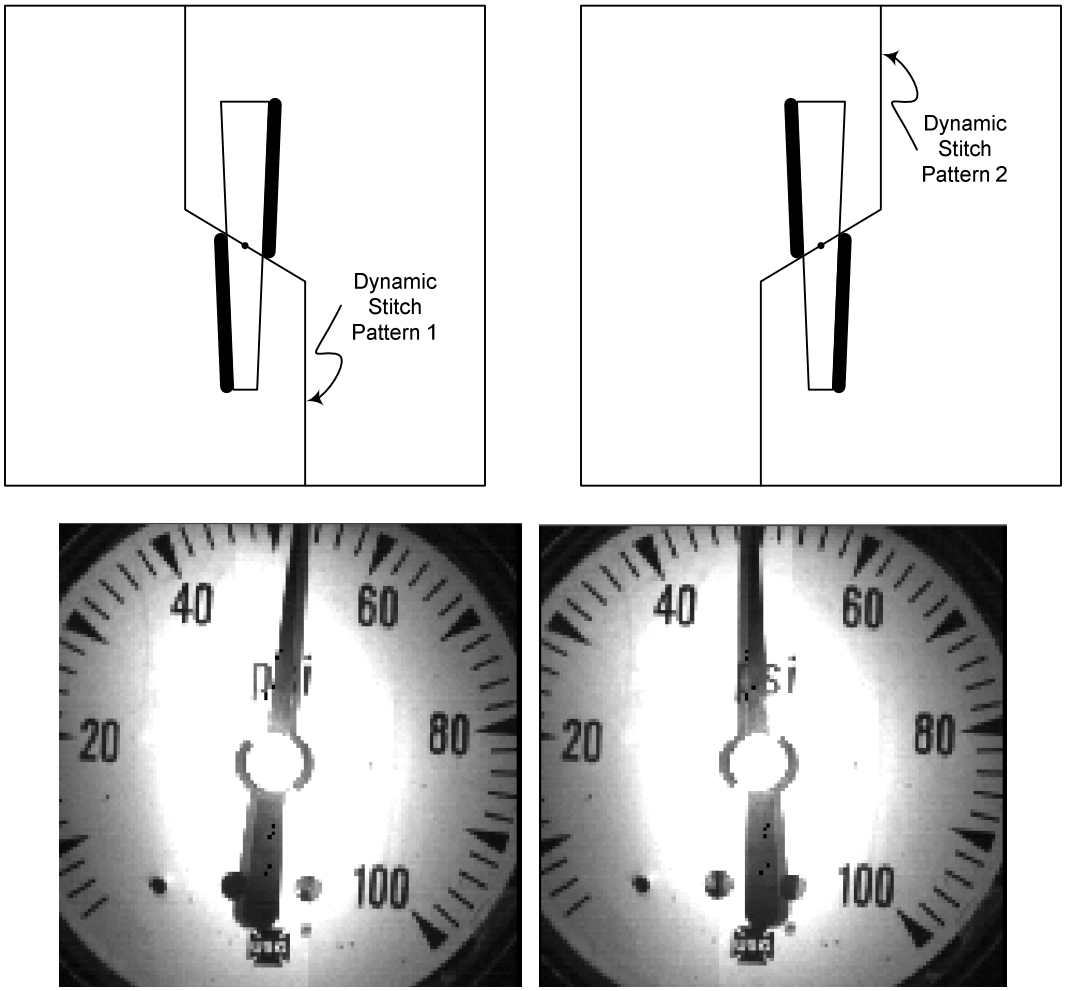


Figure 3: Showing the two Dynamic Stitching patterns with one shadow.

One pattern will not work for all possible needle positions. The pattern must be reversed depending on the current angle of the needle. Figure 4 shows the range of needle angles for each pattern.

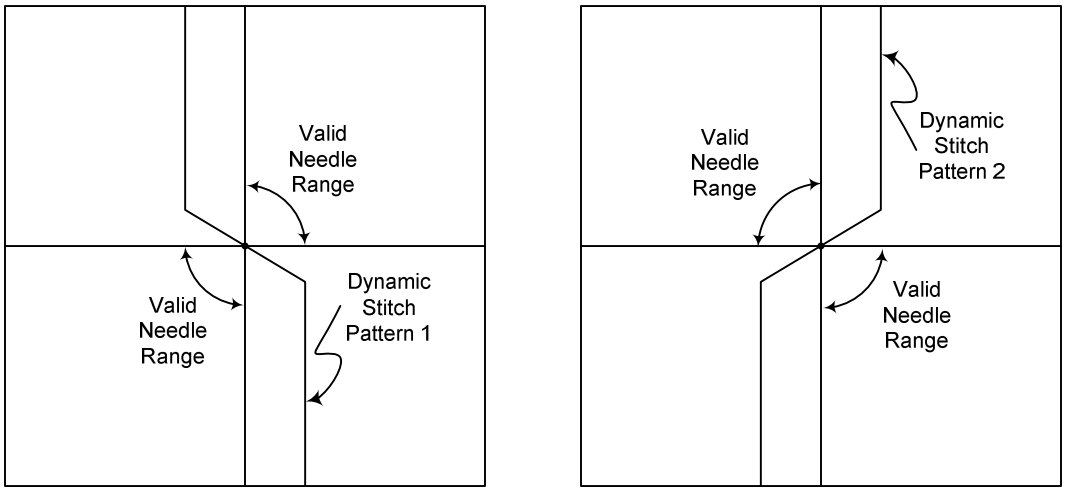


Figure 4: The possible needle angles for each pattern.

To dynamically determine which pattern to use, we start with the last pattern used, process the image, and determine if the needle is out of range. If so, we stitch the image with the new pattern and reprocess. **When this occurs the processing time is doubled**. Worst case scenario is when the needle is toggling at the edge of the range. It is possible that the stitch pattern would change every time we sample the gauge. This can reduce the battery life significantly.

The following is a list of consideration when deciding whether or not to use Dynamic Stitching:

Are you using the Long Tail Method? Dynamic Stitching matters only when we are looking at the needle taper in Long Tail mode. When using Short Tail method disable Dynamic Stitching

Is the needle taper slight, or reversed? If the needle has a significant taper, errors from double shadows will be insignificant, disable Dynamic Stitching to save battery life. If the needle has a slight or reversed taper, enable Dynamic Stitching, see Figure 5.

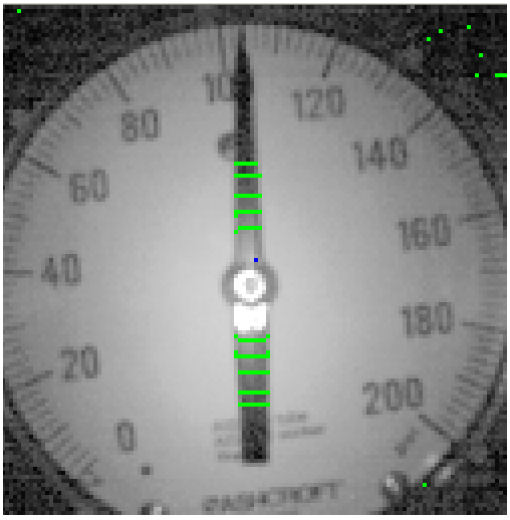


Figure 5: Example needle with reverse taper.

If you have decided to use Dynamic Stitching, do you notice extra glare on the needle? Recall stitching eliminates glare by using two opposite LED for each half of the image. Because the Dynamic Stitching uses an offset pattern, the stitch is now exposing an area of the image with the LED turned on. It is possible that glare will be reintroduced on the needle. If this is the case, try turning down the exposure. If that does not work, you may have a WGR that is mounted off center or tilted. Try remounting the WGR to better center the gauge.

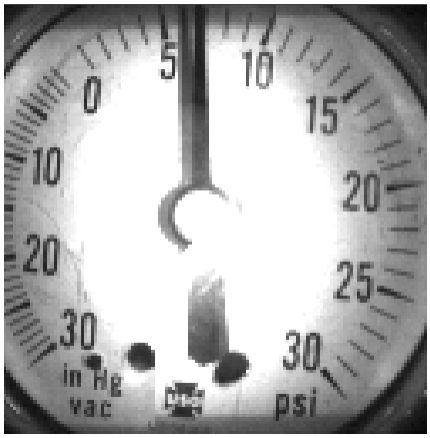


Figure 6: Glare from the left LED on the bottom of needle.

When Dynamic Stitching has been enabled, the Handheld Configuration tool can be used to see the resulting image from both stitch patterns.

Get Image: Every time you request an image, the WGR will toggle between stitch patterns. The pattern you will see in the image will change for every image request. This allows you to examine both patterns for glare, regardless of the needle location.

Get Sample: When you request a sample, 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.

**Depending on the last time you requested an image, 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, you can request another image to capture the opposite pattern and align the red and green pixels.

Step – by – Step

This section presents a step by step guide to calibrate the WGR for a specific gauge. It takes you through all the steps necessary to ensure the WGR will process accurate readings. Please refer to the Configuration section as needed to accomplish required steps.
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 accidentally knocked out of its initial mounting position.

Before Mounting

Description: Prior to physically mounting the WGR onto a gauge it is recommended you perform the following steps.

1. Monitor Gauge Needle.

The goal here 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 you must perform a Get Image to see what the gauge is actually reporting – this consumes extra battery power.

2. Record the current gauge reading.

Get an idea of 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. Record the information from the gauge face prior to mounting the WGR.

4. Record the gauge Units, Min/Max Value.

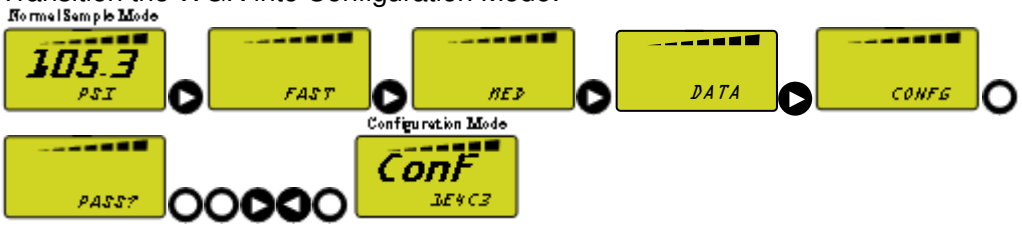
5. Cover up Background.

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 the background.

Connect the HH to WGR

Description: Once the WGR is mounted you are ready to begin configuration. To do this you need to establish a wireless connection between the HH and the WGR.
Steps:

1. Make sure the WGR is out of Ship Mode: 

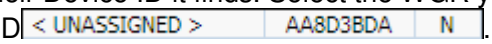
2. Transition the WGR into Configuration Mode:


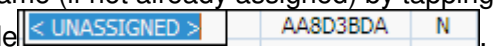
3. Remove the HH Device from its Docking Station
4. Power on the HH. Press and hold the **[Enter/On]** key for one second. When the **Green LED** flashes, release the **[Enter/On]** key.
5. Launch the HH application: Select the Windows Start Icon on the top left of the Touch Screen 

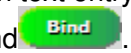
, Select the HH Control application from the Start Menu 

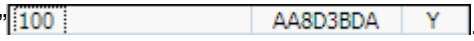
.
6. Bind to WGR: Select the Name ID Tab 

, press the Find Button 

. Wait for the HH to search for all WGRs in the vicinity who are in Configuration mode.
7. The HH will list all WGRs and their Device ID it finds. Select the WGR you want to configure based on the Device ID 

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

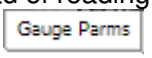
. Enter a name and press Bind 

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

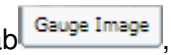
.

Initial Configuration

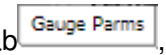
With the HH and WGR connected, we are now ready to configure the specific gauge.

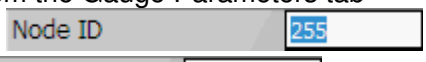
1. You can optionally default all parameters in the HH by reading them in from the WGR. If you had previously configured a similar gauge with the same HH, you can keep the parameters as is and reuse them instead of reading in the defaults. To read in the defaults, select the Gauge Parameters tab 

press the Get button 

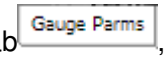
.
2. Next perform a Get Image. Select the Gauge Image tab 

, 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. Looking at the gauge image, determine if you will use the Long Tail or Short Tail method. Refer to the Long Tail – Short Tail Selection and the Dynamic Stitching section as necessary.
5. Set all known parameters. From the Gauge Parameters tab 

, highlight the field with your stylus and fill in 

with the correct value from the keypad 

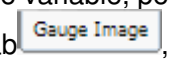
. The following variables should be set at this time:
    - Node ID
    - RF Frequency A
    - RF Frequency B
    - Sample Rate
    - Units
    - Min Gauge Value
    - Max Gauge Value
    - Zoom Enable
    - Long Tail Enable
    - Taper and Short Tail En
    - Dynamic Stitching
    - Second Radius Ignore
    - 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 

, press the Send button 

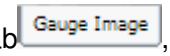
.

Circles and Camera Configuration

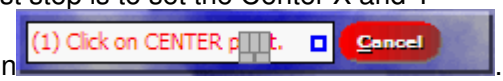
With the initial set of configuration complete, you can begin to calibrate the more advanced features of the WGR. In this section, the circles and the camera will be configured.

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

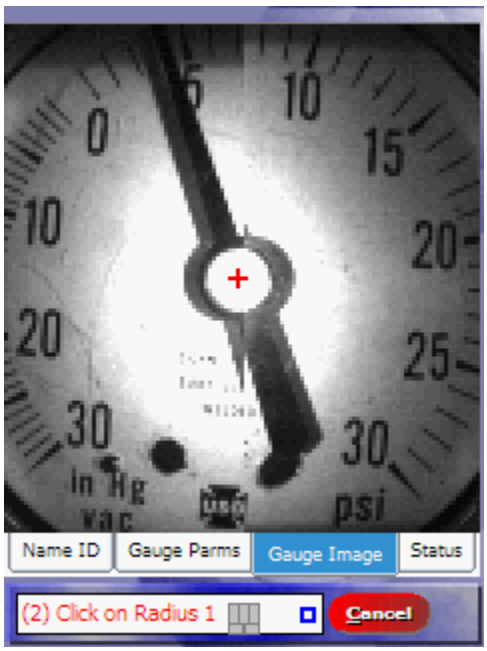
, press the Get Image button 

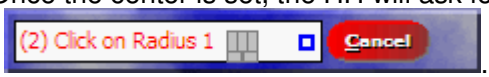
.
2. Configure the Circles and the Needle Center; refer to the Circle Calibration section. Select the Gauge Image tab 

, press the Image Calibration button 

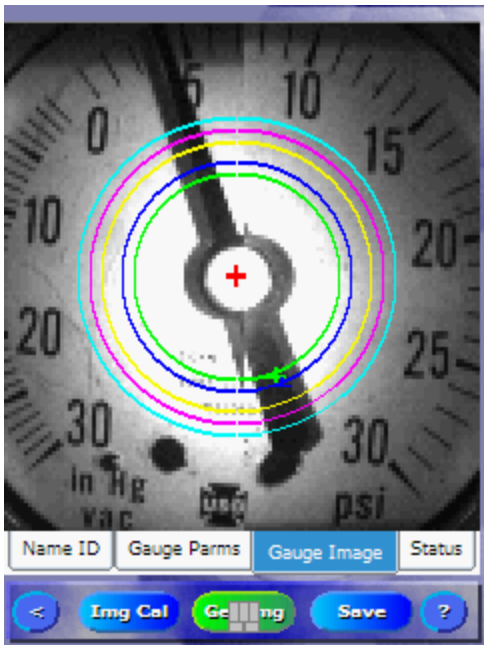
. This will begin the Graphical Center/Circle calibration process:
    a. The first step is to set the Center X and Y location 

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

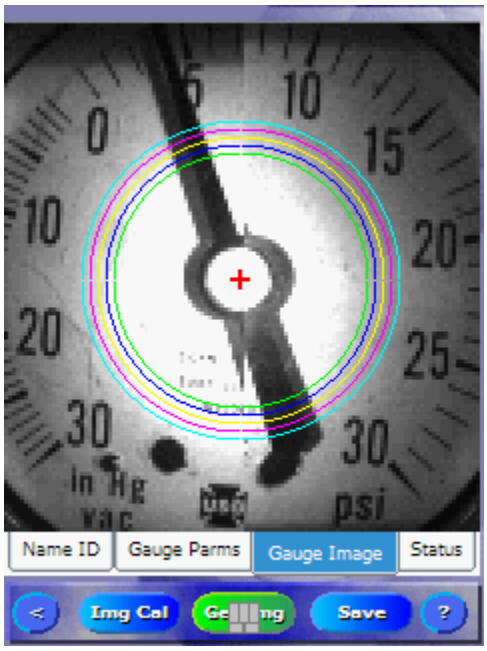


    b. Once the center is set, the HH will ask for the first or smallest circle Radius 1 

. Tap on the image where you want Radius 1 to go. To accurately set the circle you may want to temporarily set Radius 1 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 you set Radius 1 the HH will continue in the same way for each circle up to Radius 5. Each time tap on the gauge image with your stylus to set the location.
    d. When complete the HH will display all the circles.

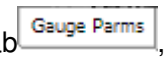


e. The graphical approach does not provide much accuracy. Switch back to the Gauge Parameters tab [Gauge Parms] and accurately adjust the Center and Radius values so they line up where you want them to. Every time you adjust the values, you can switch back to the Gauge Image tab [Gauge Image] and the graphical representation of the circles and the center will be updated to the new location.



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 the Circle Calibration section.

4. If you notice 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 

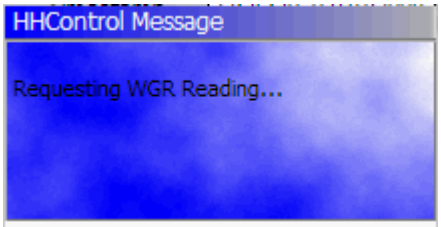
, press the Send button 

.

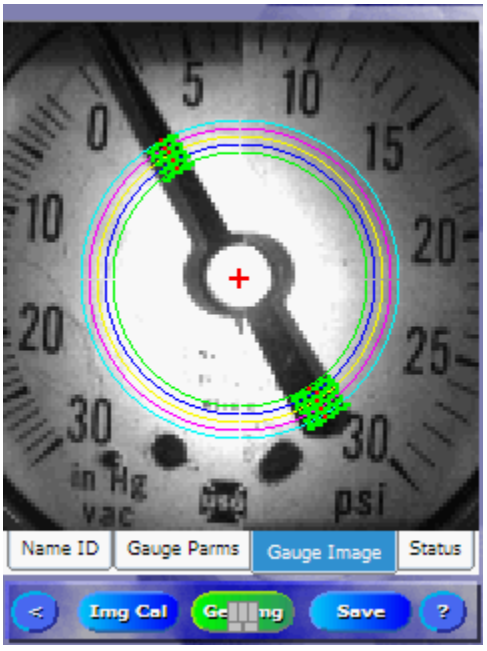
Final Tweaking

At this point all variables should be set. Now you must make final adjustments to some of those variables 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 [Gauge Image], press the Get Image button [Get Img].
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 [Status], press the Get Sample Button [Get Sample]. Wait for the results to return.

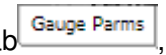


3. When the status window disappears, switch to the Gauge Image tab [Gauge Image]. You will see the Green and Red pixels superimposed on the image. Note: if the needle has moved since the time you performed a Get Image, the green and red pixels will not match the image. You can either continue as is or get a new image. Keep in mind every time you get an image you consume battery power.

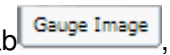


4. Adjust the Pixel Threshold as described in the Pixel Threshold section.
5. Adjust the Tip and Tail Width as described in the Circle Calibration section.
6. Finally check the WGR Reading [Reading = +38 psi] from the Status tab [Status] after you do a Get Sample. You can adjust the Gauge Tilt Angle to calibrate the reading to the actual gauge reading seen in the image. Tip: To increase the gauge reading value, decrease the Gauge Tilt Angle value.

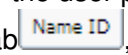
Final Steps

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 

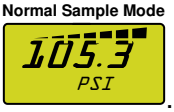
, press the Send button 

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

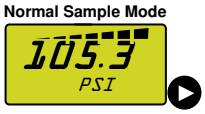
, press the Save Button 

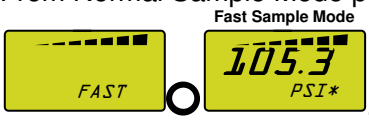
.
4. End the configuration mode on the WGR. Note this step will save the variables on the WGR. If the WGR is forced out of configuration mode either because of a timeout or the user presses the left button, the variables are not saved. From the Name ID tab 

, 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: 

.

Magnehelics

This document contains step by step directions for configuring a Magnehelic gauge using the WGR. **It is assumed that the reader is already familiar with the WGR and Handheld Configuration Tool. The Installation Reference Manual & Step by Step Guide for the WGR and HH is a prerequisite.**

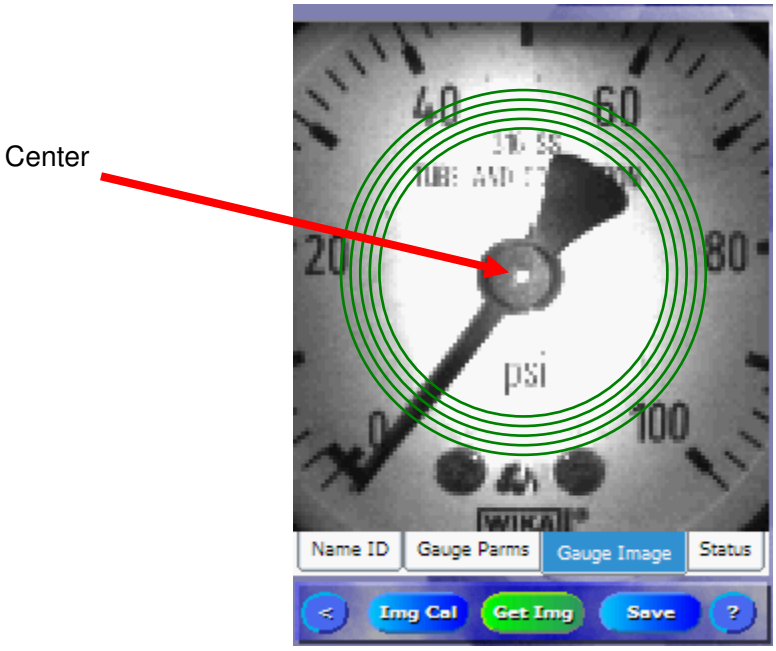
Magnehelics differ from standard gauges in ways that effect the configuration of a WGR. The following table contains key differences and their effect on configuration.

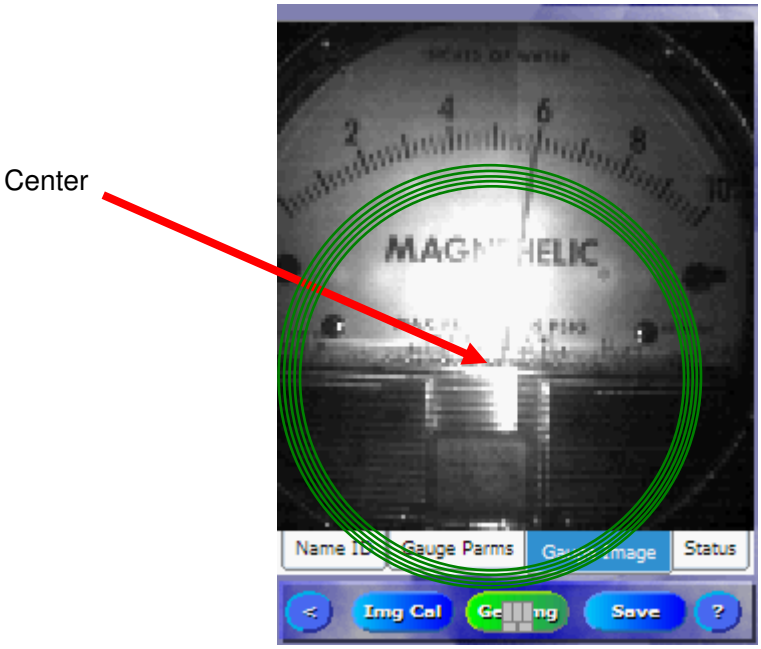
Normal Versus Magnehelic Gauges	Configuration Changes
Magnehelics have Bottom Mount Needles.	We use Semi-Circles or Arcs instead of full circles to process the gauge. The Min/Max Needle Travel Angle will define the arc.
The Magnehelic needle is very thin compared to standard gauge needles. The contrast difference is very slight between the needle and the background	We no longer use a Threshold to find the needle.
The Magnehelic gauge has a large surface area.	We will never Zoom In on the gauge.
The Magnehelic Needle does not have a “Tail”.	Long/Short Tail, Dynamic Stitching, Tip/Tail Widths are not required

Background

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

The WGR does not require full circles to process Magnehelic Gauges. Instead we use Semi-Circles or **Arcs** 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.

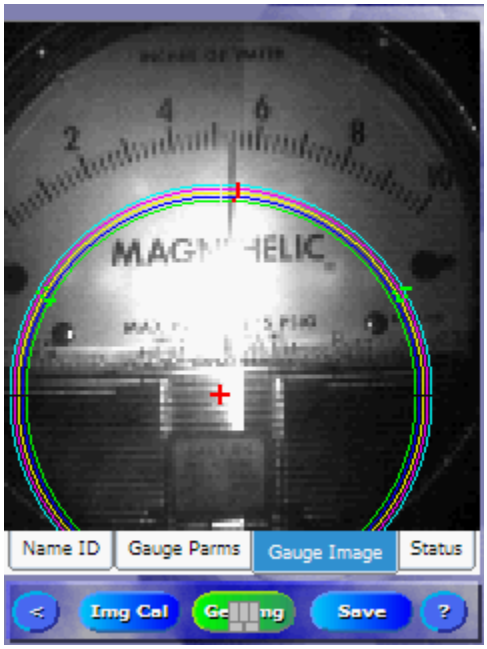




Creating Arcs

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 you must use **Get Sample**. Unlike regular gauges, Get Sample will return Green Blobs 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. The following is an example image after a Get Sample request.



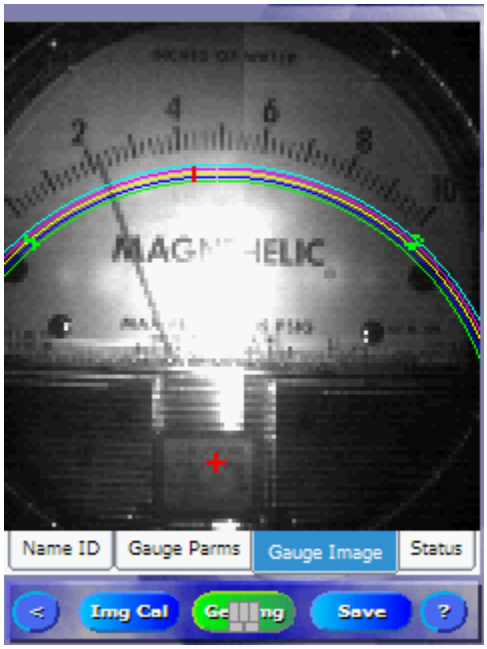
Notice also the Red Pixels in the images above. They represent the needle location determined by the WMR image processing algorithm. The Red Pixels behave the same for a Get Sample as they did for regular gauges.

Circle Setup

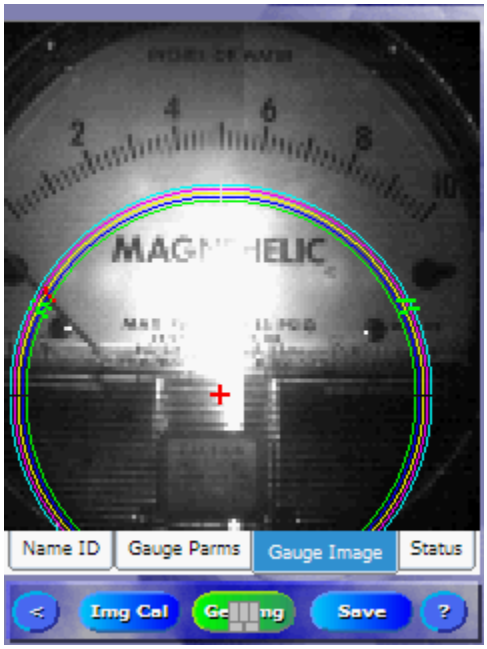
The goal is to get the circles lined up underneath the hash marks making sure they overlap the needle along the entire span.

Unfortunately there is not enough room between the hash marks and the needle stops to properly fit five Arcs. The image below shows this situation. If the needle was resting on the stop we would not be able to process it. The green pixels along the circles show the end of the Arcs. Because the Arcs stop before we get to 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 WMR will consistently report an error.



To get around this problem we recommend configuring the circles as seen in the image below. In this case, the Arcs stop passed the needle stops. If a needle were resting on the stops they would be processed.



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.

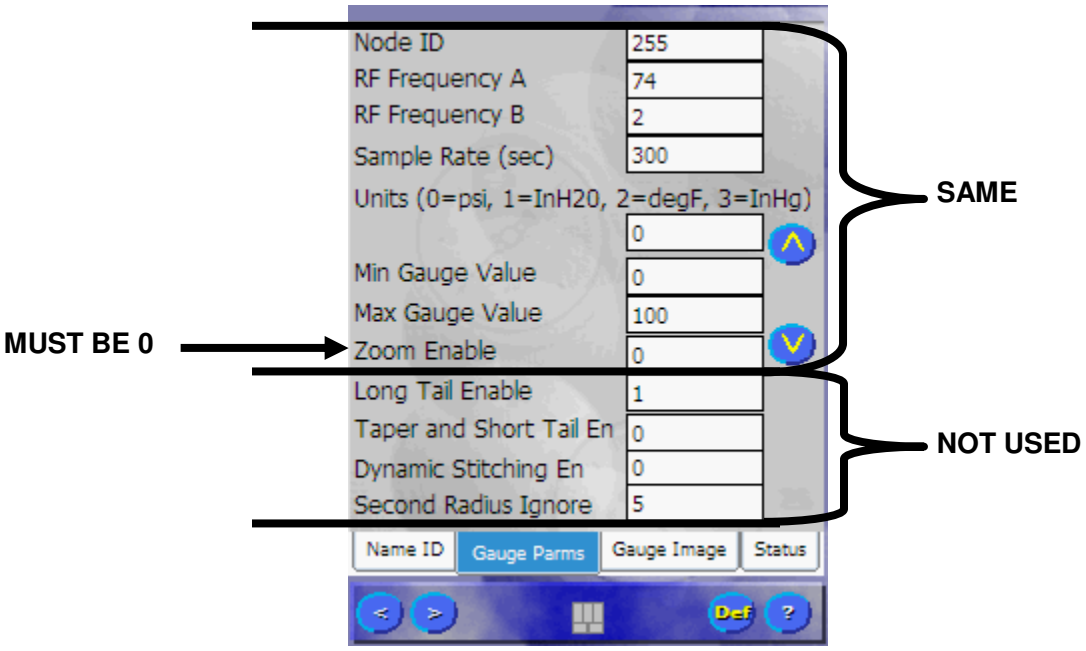
Note: An attempt should be made to match the circle centers to the needle pivot location on the gauge. This is where the needle is anchored to the gauge and rotates about. The farther away the circle centers are from the needle pivot location the larger the error would be in the readings.

Configuration

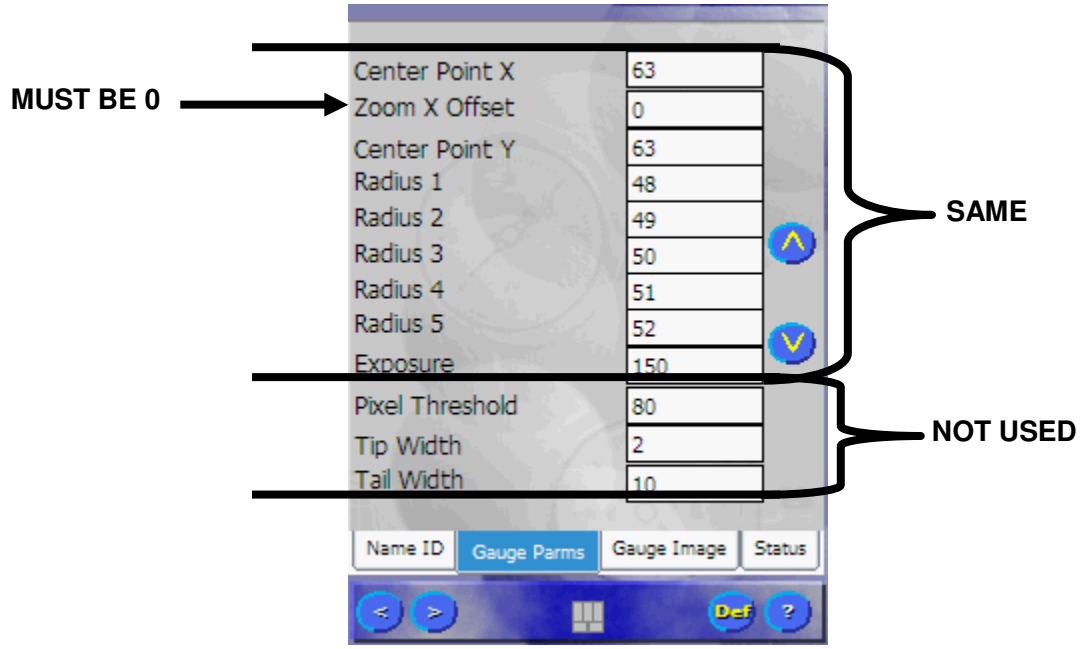
Steps:

1. Transition the WGR into Configuration Mode and Connect to the WMR as described in the *Step – by – Step* section “Connect the HH to WGR” above.

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



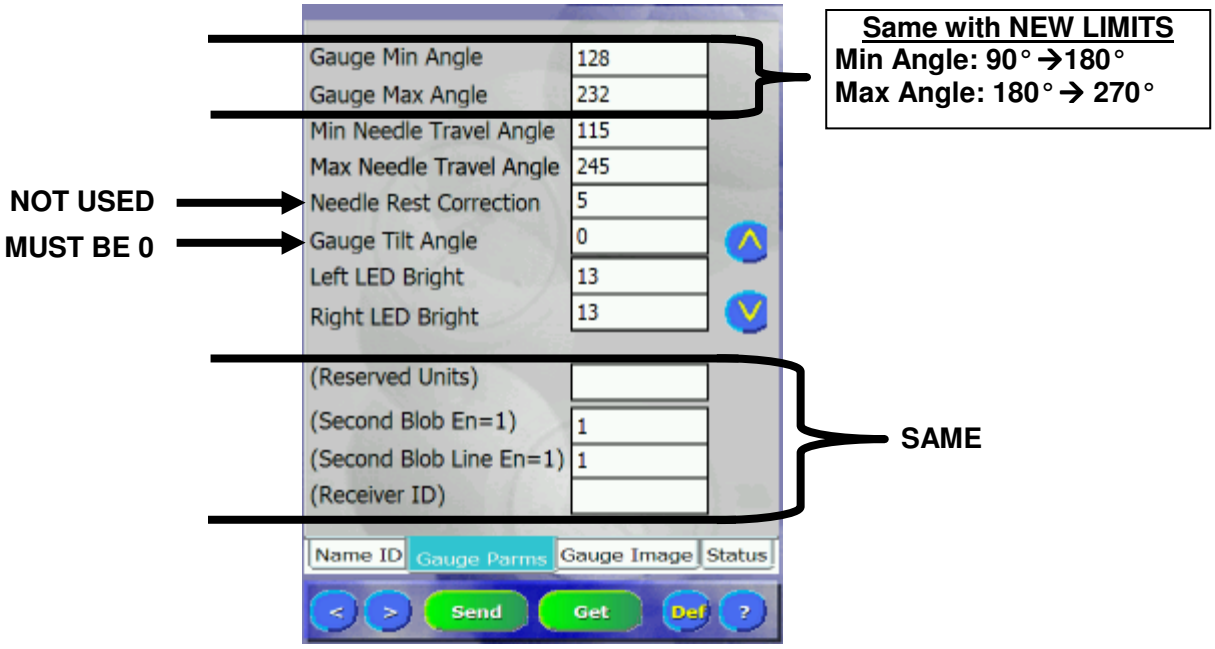
3. Setup the following Parameters on the **Second** page of the Gauge Parms Tab. Parameters marked as **SAME** have the same functionality as before. Make sure to setup those parameters normally. Parameters marked **NOT USED** can be ignored and left as default.



4. Setup the following Parameters on the **Third** page of the Gauge Parms Tab. Parameters marked as **SAME** have the same functionality as before. 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.

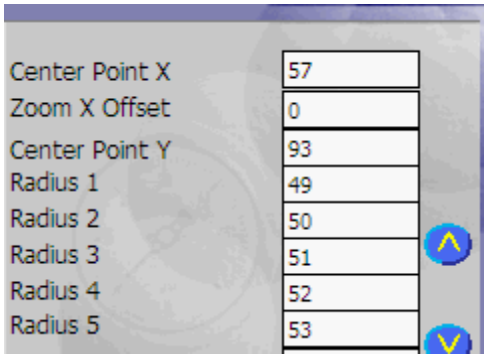
NOTE: Four variables below contain a different meaning when configuring WGRs and WMRs. Setting these are described next. Those are Min Needle Travel Angle, Max Needle Travel Angle, Left LED Bright, and Right LED Bright.

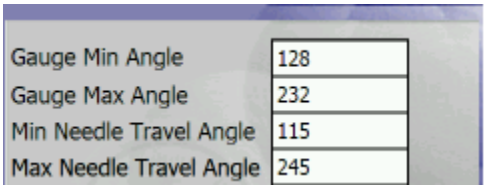


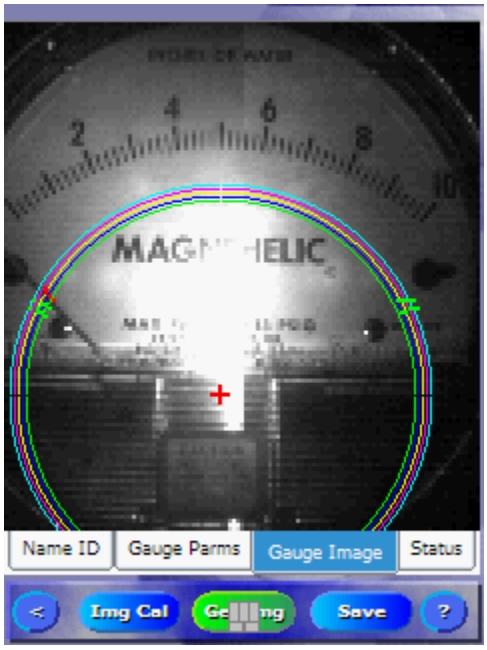
To “Tweak” the Arcs, start by using the “Img Cal” Img Cal method and follow the on screen instructions to set the center and radius for each circle. Switch back to the Gauge Parms tab as needed to fine adjust the values. Make sure the Radii increase with increasing Radius Numbers.

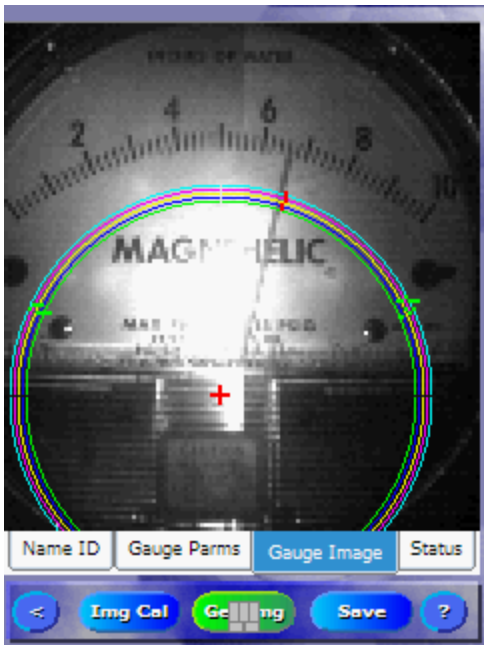
To accurately setup the Min and Max Needle Travel Angles you must use a trial and error method. First set the Min and Max values the best you can. Send the parameters Send to the WGR and do a Get Sample Get Sample from the Status Tab Status.

The Min Needle Travel Angle is limited to: 90° →180°.
The Max Needle Travel Angle is limited to: 180° → 270°.

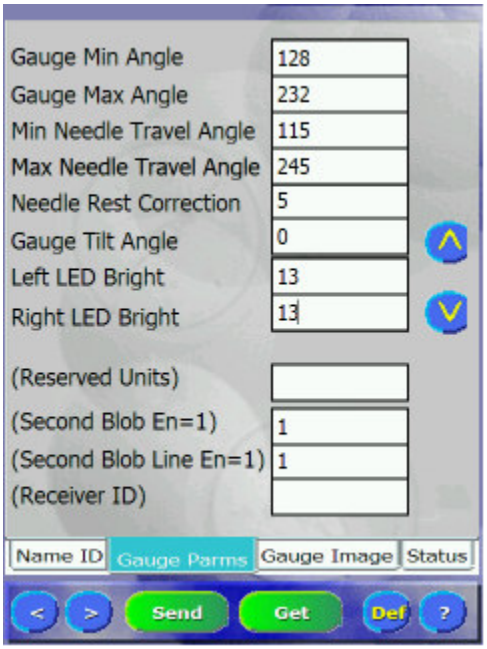


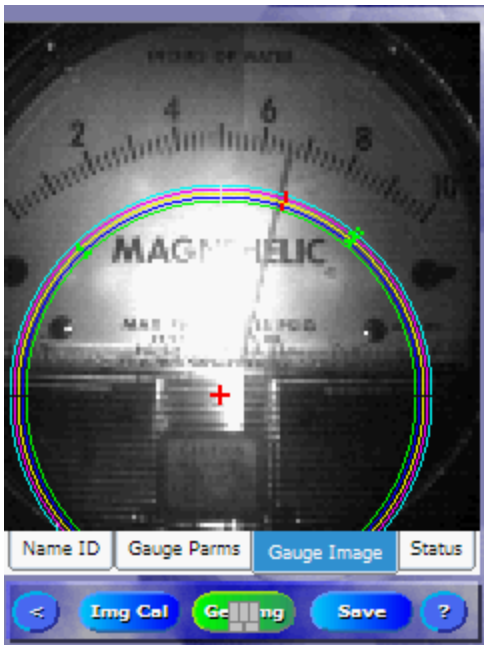




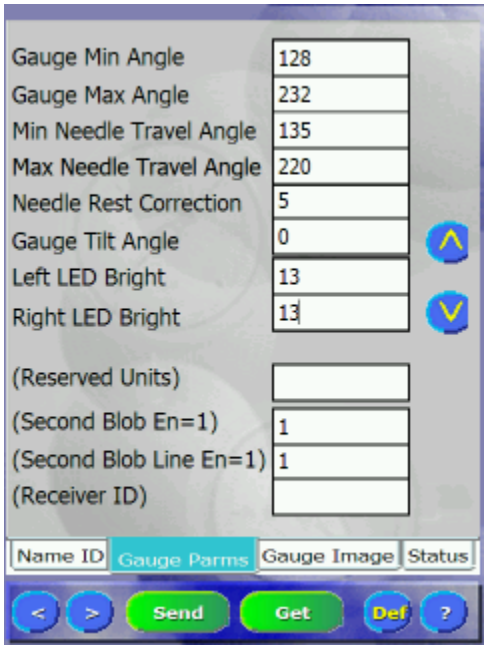


The image above shows the Arcs end in the proper location. You do not want them to overlap the Needle Stops or the black circles at the ends. The Min and Max Needle Travel Angles for this example are shown below, 115° and 245° respectively.





This is an example image that 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, they will not be processed and an error will be sent. The Min and Max Needle Travel Angles for this example are shown below, 135° and 220° respectively.

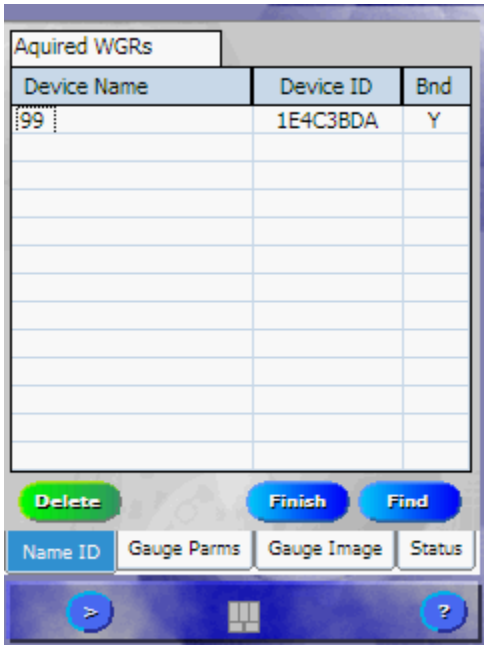


If you notice a contrast difference running down the middle of the image, the left and right half do not match in brightness. To adjust the brightness the **Left and Right LED Bright** variables need to be adjusted. Decreasing the value will make the image darker; increasing the value will make the image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

If the WMR 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 WMR 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.



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


100.0
PSI

Variables

Variable	Usage	Default	Comments
Node ID	SAME	255	
RF Frequency A	SAME	74	
RF Frequency B	SAME	2	
Sample Rate (sec)	SAME	300	
Units (0=psi, 1=InH20, 2=degF, 3=InHg)	SAME	0	
Min Gauge Value	SAME	0	Make sure to adjust this to match the Gauge Min Angle Location
Max Gauge Value	SAME	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	63	Match the Gauge Face
Zoom X Offset	MUST BE 0	0	Do not set
Center Point Y	SAME	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	49	
Radius 2	SAME	50	
Radius 3	SAME	51	
Radius 4	SAME	52	
Radius 5	SAME	53	
Exposure	SAME	150	
Pixel Threshold	NOT USED	80	
Tip Width	NOT USED	2	
Tail Width	NOT USED	10	
Gauge Min Angle	Same	128	90°→180°
Gauge Max Angle	Same	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	

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. The WTR is fully compatible with and complementary to systems containing Wireless Gauge Readers (WGR).

Start up

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

1. All LEDs on for 2.5sec
2. Red LED turns off first
3. Orange LED turns off second
4. 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 support.

Operating Modes

All modes will try to send a health packet every 30min depending on the update rate. It is guaranteed that you will get a health packet every 40min.

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 (3sec)	Automatically exits after 5min. Or, press button and Orange LED will light indicating you are returning to Normal mode.
Medium	Sends readings every 30sec for 8hours (total 960 readings)	Hold down button until Green, Orange, and Red LEDs are lit (6sec)	Automatically exits after 8hours. Or, press button and Orange LED will light indicating you are returning to Normal mode.
Configuration	Allows configuration with the Handheld Configuration tool	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 configuration tool once completed. Timeout after 10mintues

Configuration Mode

The WTR can be configured using the Handheld (HH) Configuration tool. Configuration steps:

- Transition the WTR into configuration mode
- Connect the WTR to the HH Device
- Configure the WTR using the HH

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.

Connect the WTR to the HH Device

Follow the steps in the section "Connect the HH to WGR" above.

Configure WTR using the HH

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

WTR Parameter	Parameter in HH	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 as you would a WGR or WMR. The rest of the parameters are unique to the WTR. Notice the WTR parameter name is not used in the HH 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.

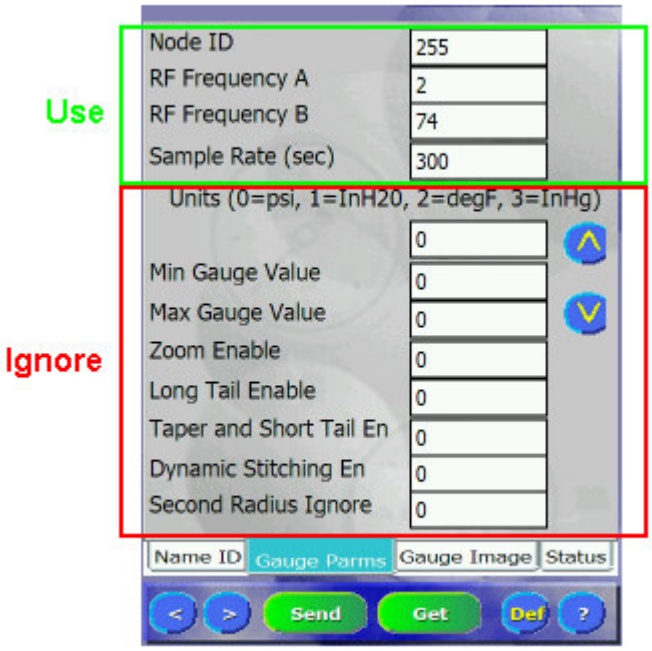
The following table lists the channel setup values

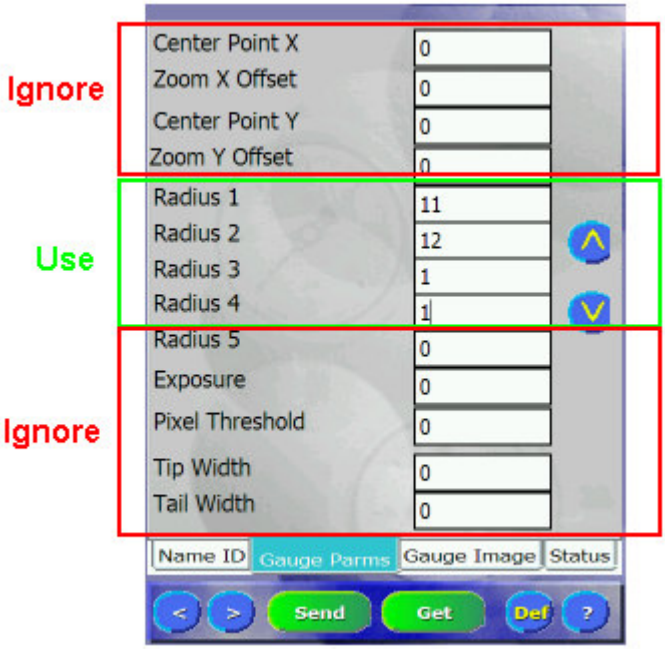
Channel Setup	Type
0	Channel is off – not used
1	Normal voltage/current sensing (which one depends on hardware)
2	Thermistor
3	Sample RS232 LR300's ch1
4	Sample RS232 LR300's ch2
5	Sample RS232 LR300's ch3
6	Sample RS232 LR300's ch4
7	Sample RS485 LR300's ch1
8	Sample RS485 LR300's ch2
9	Sample RS485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

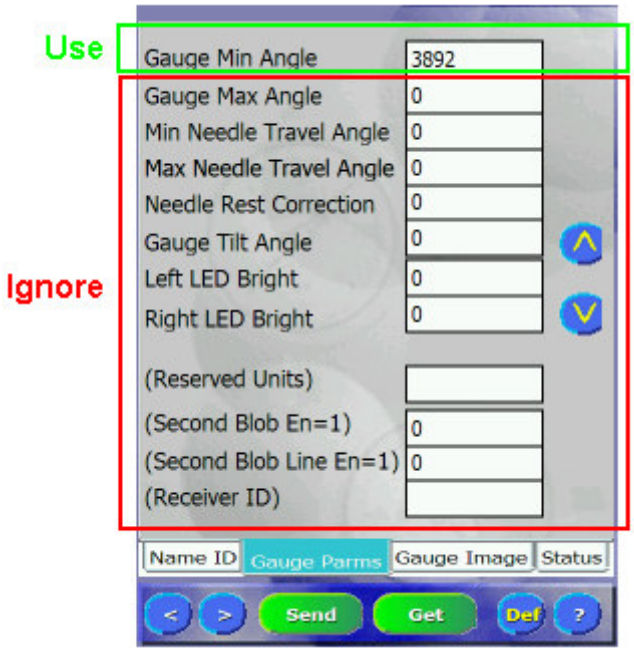
The specific WTR Hardware determines the channel settings allowed

- Freezer Monitor WTR:
  - Channel 1 – Thermocouple ONLY. Value = 11
  - Channel 2 – Switch ONLY. Value = 12
  - Channel 3 – Voltage ONLY. Value = 1
  - Channel 4 – Voltage ONLY. Value = 1
- Steam Trap WTR:
  - Channel 1 – Thermocouple ONLY. Value = 11
  - Channel 2 – Thermocouple ONLY. Value = 11
  - Channel 3 – Off ONLY. Value = 0
  - Channel 4 – Off ONLY. Value = 0
- 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.







When complete, “Send” the results to the WTR and press “Finish”. The WTR will exit into Normal mode.

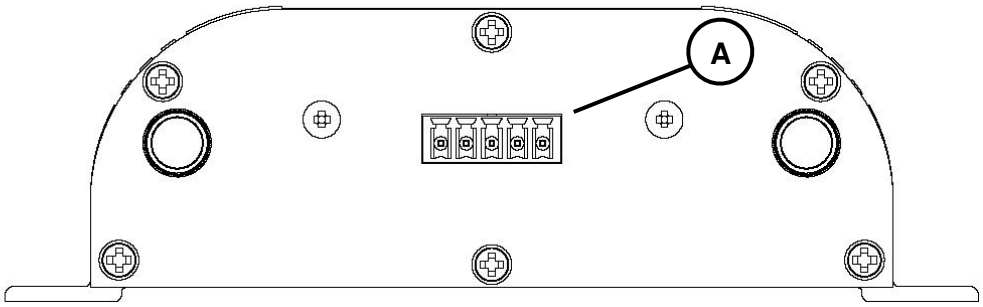
Calibration (Thermocouple Channel Only)

The WTR must be calibrated any time a thermocouple is connected to one or both of the WTR input channels (e.g. Freezer Monitor, Steam Trap).

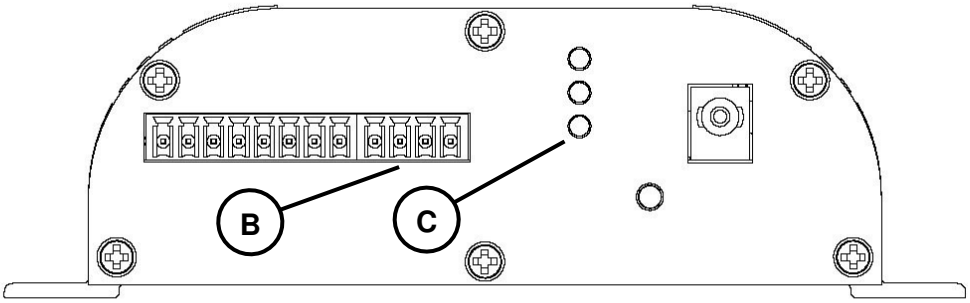
When upgrading firmware, the WTR will loose its calibration. The device must be re-calibrated when firmware is upgraded

Steps:

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



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.



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 engineering.

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	• 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. • Exit Configuration Mode on the WGR by pressing the **Left WGR Button**. Make sure the WGR is in **Normal Operating Mode**. • You are now ready to start over

Firmware Version's Prior to 01.08.1-3				
Handheld Parameter	**Description**	**Min Value**	**Max Value**	**Firmware MACRO**
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
Overlap Middle En	Will stich the two halves of image by keeping the lighter of the two. Removes shadows. (OUTDATED, Use Dynamic Stitching Instead).	0	1	OVERLAP_IMAGE_ENABLE
Zoom En	The camera will capture the image with a 2x zoom. 0→ Disabled, 1→Enabled.	0	1	ENABLE_ZOOM
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
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
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
Weight Tip/Tail En	This will set the mode to Long tail or Short tail. 0→ Short Tail, 1→ Long Tail.	0	1	WEIGTHED_TIP_TAIL
Luminosity 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
Exposure	This will adjust the brightness of the image. The larger the number the brighter the image.	0	250	OSPREY_EXPOSURE
Frequency A	A Channel, Bigger Number (78, 74)	2	80	RF_FREQUENCY_A
Frequency B	B Channel, Smaller Number (6, 2)	2	80	RF_FREQUENCY_B
Second Blob En	Specifies whether the software should find one or two red pixels per circle. 0 → Disabled, 1→ Enabled.	0	1	FIND_SECOND_DARK_BLOB
Second Rad 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.	0	5	SECOND_BLOBS_TO_IGNORE
Second Blob Line En	Not Used. Always set to 0.	0	0	USE_SECOND_DARKEST_IN_LINE_FIT
Nearby Pix Thresh	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
Receiver ID	**Not Used**	**0**	**0**	**Not Used**
Gauge Units (Sum Of Err En)	The units of data the gauge represents. 0="PSI", 1="InH20", 2="deg F", 3="inHg"	0	3	DEFAULT_GAUGE_UNITS_LCD
Min Close Pix Thresh	Minimum number of pixels that are close together to be considered a valid group. 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.	0	255	MIN_CLOSE_PIXELS_THRESHOLD
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 Corr	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
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
Normal Update Rate	The time in seconds between samples when the WGR is in Normal Sample Mode.	0	65535	NORMAL_UPDATE_RATE
Display Unit	**Not Used**	**0**	**0**	**Not Used**
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
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. 0→ Disabled, 1→Enabled.	0	1	ENABLE_REFLECTION_KILL3

Firmware Version's 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. 0→ Disabled, 1→Enabled.	0	1	ENABLE_ZOOM
Long Tail Enable	This will set the mode to Long tail or Short tail. 0→ Short Tail, 1→ 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. 0→ Disabled, 1→Enabled. 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. 0→ Disabled, 1→Enabled. 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. 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.	0	255	MIN_CLOSE_PIXELS_THRESHOLD
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 → Disabled, 1→ Enabled.	0	1	FIND_SECOND_DARK_BLOB

(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 Version's 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. 0→ Disabled, 1→Enabled.	0	1	ENABLE_ZOOM
Long Tail Enable	This will set the mode to Long tail or Short tail. 0→ Short Tail, 1→ 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. 0→ Disabled, 1→Enabled. 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. 0→ Disabled, 1→Enabled. 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. 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.	0	255	MIN_CLOSE_PIXELS_THRESHOLD
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 → Disabled, 1→ Enabled.	0	1	FIND_SECOND_DARK_BLOB
(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 Version's 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. 0→ Disabled, 1→Enabled.	0	1	ENABLE_ZOOM
Long Tail Enable	This will set the mode to Long tail or Short tail. 0→ Short Tail, 1→ 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. 0→ Disabled, 1→Enabled. 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. 0→ Disabled, 1→Enabled. 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. 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.	0	255	MIN_CLOSE_PIXELS_THRESHOLD
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 WMR 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 WMR 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 → Disabled, 1→ Enabled.	0	1	FIND_SECOND_DARK_BLOB
(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**

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.

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 Envirosystems Engineering.
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.