A Higher Level of Performance

Manual

G1

Microwave Switch Series

Beam Blockage Detection

Circular Polarisation



For more information, please visit >

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PROPRIETARY NOTICE

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WARNING

This instrument contains electronic components that are susceptible to damage by static electricity. Proper handling procedures must be observed during the removal, installation, or handling of internal circuit boards or devices:

Handling Procedure:

1. Power to unit must be removed prior to commencement of any work.
2. Personnel must be grounded, via wrist strap or other safe, suitable means, before any printed circuit board or other internal devices are installed, removed or adjusted.
3. Printed circuit boards must be transported in a conductive bag or other conductive container. Boards must not be removed from protective container until the immediate time of installation. Removed boards must be placed immediately in a protective container for transport, storage, or return to factory.

Principle of Operation

A high power circular polarized Microwave pulse is emitted from the Sending unit to the Receiving unit in a transmission chain of approximately 100 pulses per second.

If the path between the Sender and Receiver is blocked by any object or material which absorbs or reflects microwave energy the Receiving unit will no longer detect the complete transmission chain and indicate via Relay for automatic indication and process control requirements.

Typical Uses

- Blocked chute detection
- Nucleonic switch replacement
- High level alarm / Low level alarm
- Truck / machine detection.

Function

The Gladiator Microwave Switch can be used for blockage detection, barrier detection, machine detection, collision detection or protection and point level measurement, and detection of objects or material between two points.

Primary Areas of Application

- Asphalt
- Brewing
- Cement
- Chemical
- Dairy
- Edible oil
- Fertilizer
- Food & Beverage
- Glass
- Mining & Metals
- Oil & Gas
- Packaging
- Paint
- Paper
- Pharmaceutical
- Plastics
- Power Generation
- Refining
- Semiconductor
- Sugar
- Textile
- Water & Wastewater.

Features

- State of the art circular polarisation
- Simple sensitivity adjustment and calibration
- Hazardous Dust Approved - IECEx & cETLus
- Theoretical ranges up to 300m (984ft)
- Simple ‘1-minute’ setup application pre-sets
- Relay outputs: Integral (1 + failsafe)
- Remote test function
- Adjustable ON and OFF delays (0-20 sec)
- Remote 4G Hawklink connection option
- Bright visual status indication on sensors
- Independent housing alignment after mounting sensor.

G1 Integral System

The G1 Integral System consists of 2 units. One Sender (G1S) and one Receiver (G1R)

G1S



G1R



G1 Remote System

The G1 Remote System consists of 3 units. One Remote Amplifier (GSA), One Sender (G1S) and one Remote Receiver (G1T).

GSA



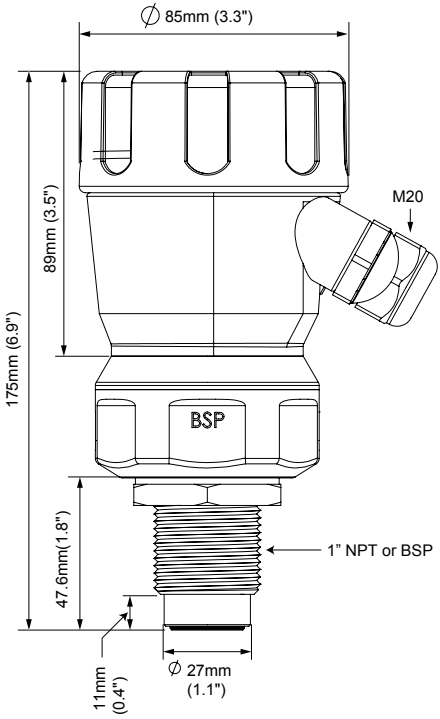
G1S



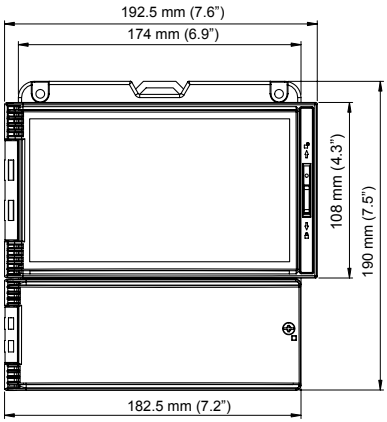
G1T

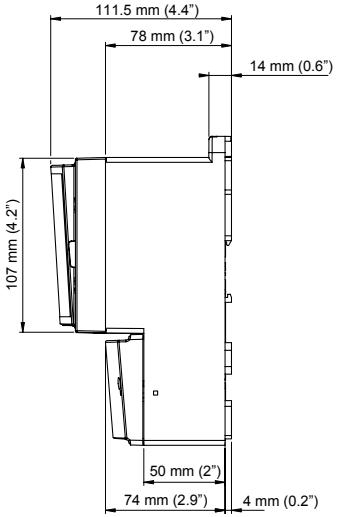


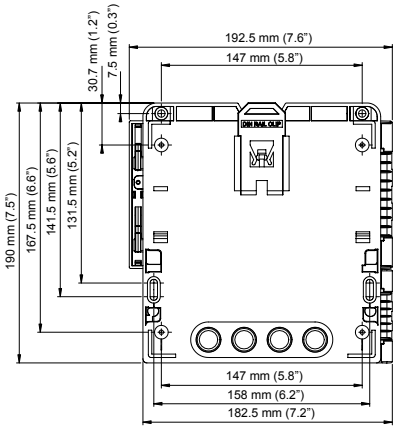
G1S / G1R / G1T

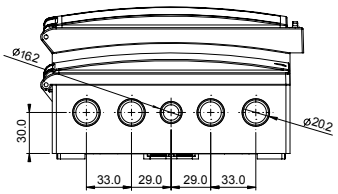

∅ 85mm (3.3")
89mm (3.5")
175mm (6.9")
M20
BSP
47.6mm(1.8")
1" NPT or BSP
11mm
(0.4")
∅ 27mm
(1.1")

Remote Amplifier



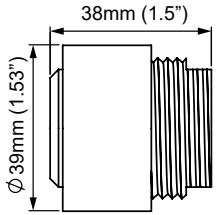




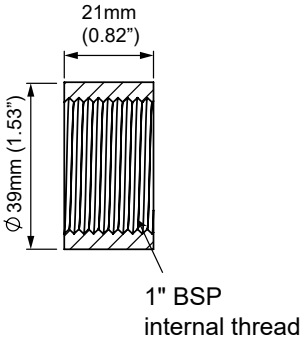


Mounting Accessories

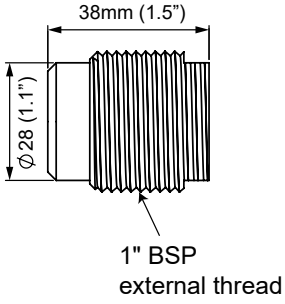
MA1
(Consists of MA1-WC and MA1-UW)



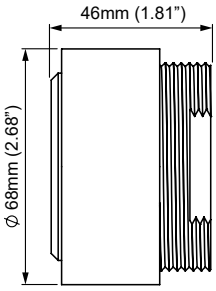
MA1-WC
Weldment / Coupling



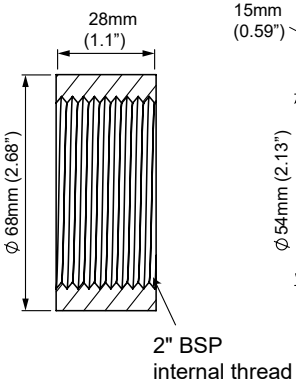
MA1-UW
UHMW Window



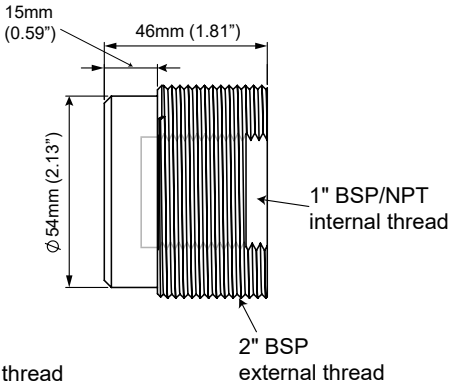
MA2
(Consists of MA1-WC and MA1-UW)



MA2-WC
Weldment / Coupling



MA2-UW
UHMW Window



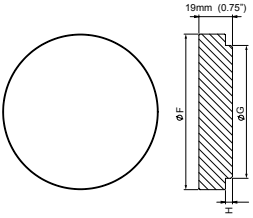
MD Series Weldments and Windows

Weldment with UHMW or PTFE Windows

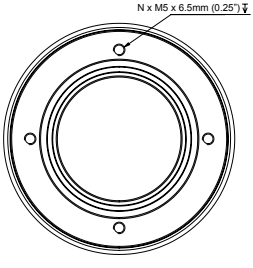
The Weldment is welded to the vessel. The Window locks into the weldment using a locking ring.

For Approval Option 2D & 3C Installations. Consult Safety Instructions for critical details.

UHMW / PTFE Window



Weldment



Assembled Piece



Part No[1].	Window Material	A		B		C		D		E		P.C.D		No. Holes
		mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	
MD1-X	UHMW	75	3.0	48	1.9	29	1.1	68	2.7	43	1.7	52	2.0	4
MD2-X	UHMW	100	3.9	73	2.9	54	2.1	93	3.7	68	2.7	77	3.0	4
MD3-X	UHMW	122	4.8	93	3.7	77	3.0	115	4.5	90	3.5	99	3.9	4
MD6-X	PTFE	122	4.8	93	3.7	77	3.0	115	4.5	90	3.5	99	3.9	4

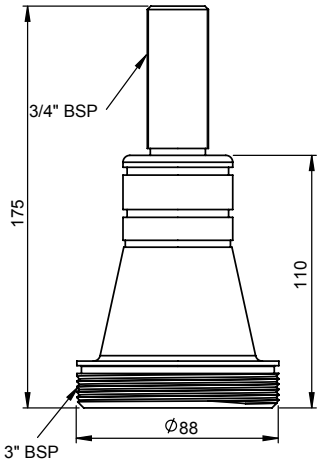
[1]X = Weldment Material Selection

Part No[1].	Window Material	F		G		H		P.C.D		No. Holes
		mm	in	mm	in	mm	in	mm	in	
MD1-X	UHMW	43	1.7	28	1.1	4	1.6	52	2.0	4
MD2-X	UHMW	68	2.7	53	2.1	4	1.6	77	3.0	4
MD3-X	UHMW	89	3.5	76	3.0	4	1.6	99	3.9	4
MD6-X	PTFE	89	3.5	76	3.0	4	1.6	99	3.9	4

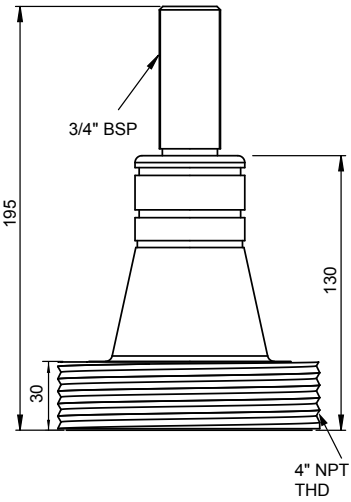
[1]X = Weldment Material Selection

Waveguides and Waveguide Accessories

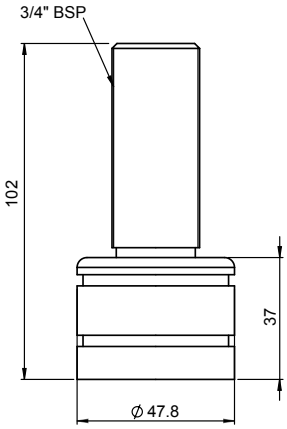
MA-WG-04



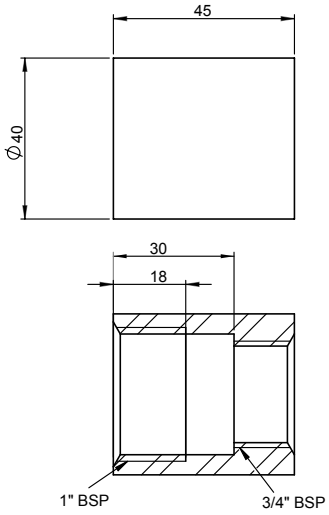
MA-WG-04 with MA-WG14



MA-WG-03

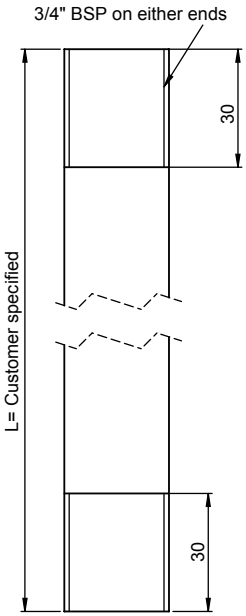


MA-WG-01

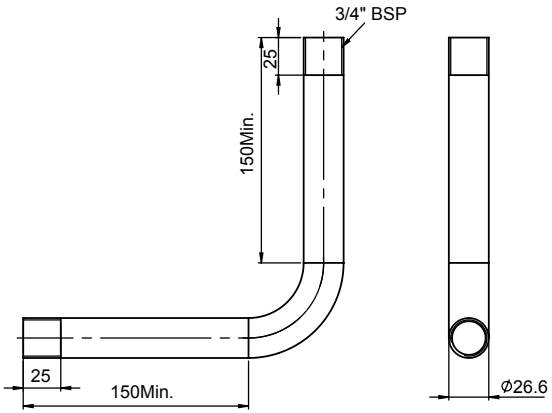


Waveguides and Waveguide Accessories

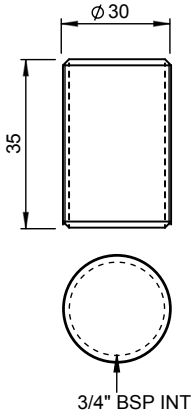
MA-WG12-L=xxx



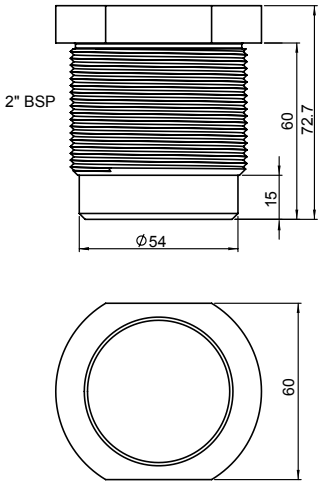
MA-WG-02



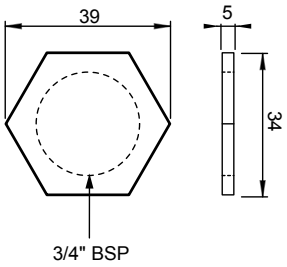
MA-WG-13



MA-WG12



MA-WG11

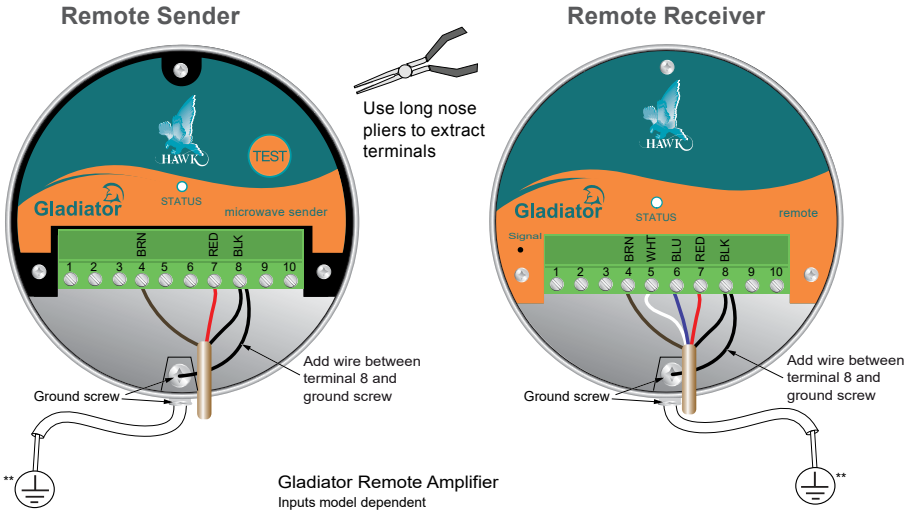


Remote System - HAWK Standard Cable

- The black wire of HAWK supplied cable comes with one end GND and the other GND / SHLD together.
- The GND / SHLD end is a larger cable which has been heat shrunk. The GND only end is the same size as the other cables.
- The GND / SHLD end must be connected to the amplifier.

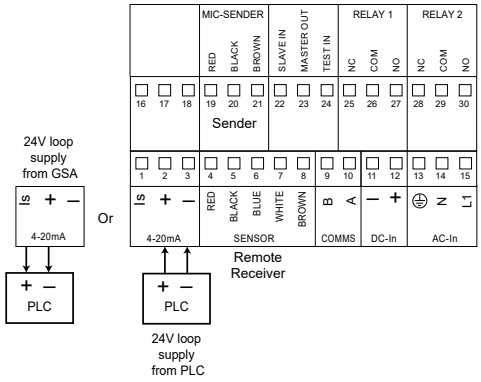
Sender / Receiver (GND only end)

Amplifier (GND / SHLD end)



Gladiator Remote Amplifier

Inputs model dependent



*AC-In is replaced by 36-60VDC with Power Input Option 'C'.

**Ground the housing to vessel if vessel is metallic. Ground the housing to plant ground if vessel is non-metallic.

Remote Sender

Status LED

- Green when powered
- Blinks while working correctly
- Solid while not transmitting

TEST Button

- Press and hold to test level relay action

Remote Receiver

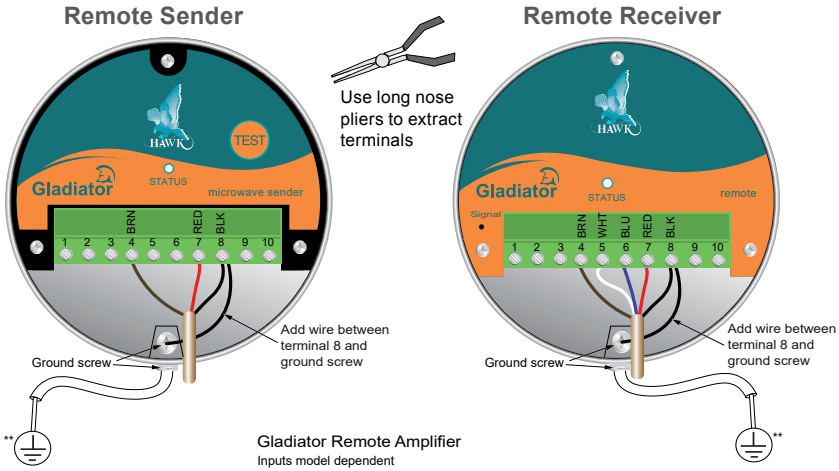
Status LED

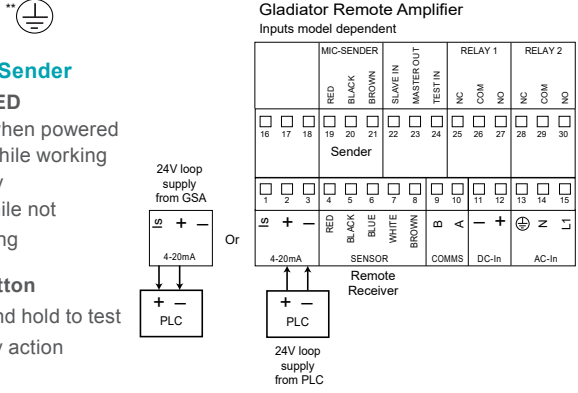
- Green when powered
- High illumination = strong signal
- Low illumination = weak signal

Signal Contact

- Signal can be read with voltmeter across Signal contact point and earth screw (or other ground reference)
- 2.4-2.5V is full signal. 0V is no signal

Remote System - Non-Hawk Cable





Remote Sender

Status LED

- Green when powered
- Blinks while working correctly
- Solid while not transmitting

TEST Button

- Press and hold to test level relay action

Remote Receiver

Status LED

- Green when powered
- High illumination = strong signal
- Low illumination = weak signal

Signal Contact

- Signal can be read with voltmeter across Signal contact point and earth screw (or other ground reference)
- 2.4-2.5V is full signal. 0V is no signal

*AC-In is replaced by 36-60VDC with Power Input Option 'C'.

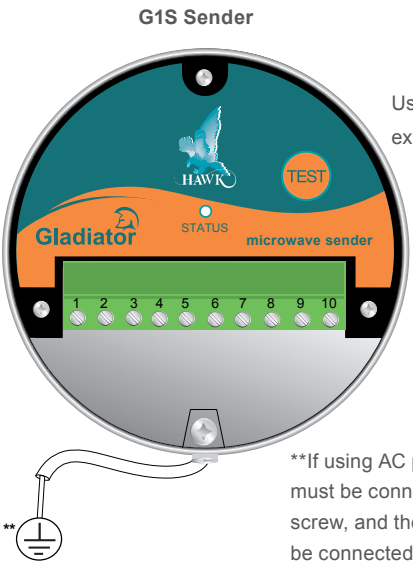
**Ground the housing to vessel if vessel is metallic. Ground the housing to plant ground if vessel is non-metallic.

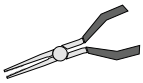
Alternate Cable Type Specification

- 6 or 8 conductor (5 used) shielded twisted pair instrument cable.
- Conductor size dependent on cable length.
- BELDEN 3120A, DEKORON or equivalent.
- Max: BELDEN 3120A = 500m (1640 ft). 3 pairs, 1 conductor not used.

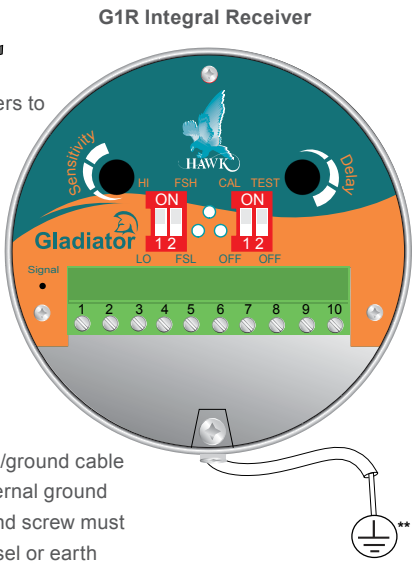
Alternate Cable Colour Equivalents			
Pairs	**HAWK**	**Belden 3120A**	**Dekoron**
Pair 1	Red Black	Red Black	White 1 Black 1
Pair 2	White Blue	Yellow Green	White 2 Black 2
Pair 3	Brown ---	Brown White (not used)	White 3 Black 3 (not used)
Pair 4	Not used	Not used	Not used

Integral System





Use long nose pliers to extract terminals



**If using AC power the earth/ground cable must be connected to the internal ground screw, and the external ground screw must be connected to metallic vessel or earth

SENDER TERMINAL LAYOUT

						DC-IN		AC-IN	
1.	2.	3.	4.	5.	6.	7. +	8. -	9. N	10. L1
						12-30VDC		80-260VAC	

Terminals 1, 2, 3, 4, 5, 6 not used

RECEIVER TERMINAL LAYOUT

RELAY				COMMS		DC-IN		AC-IN	
1. NC	2. COM	3. NO	4. Test	5. A	6. B	7. +	8. -	9. N	10. L1
				RS 485 Modbus D0 D1		12-30VDC		80-260VAC	

Sender

Status LED

Green when powered
Blinks while working correctly
Solid while not transmitting

TEST button

Press and hold to test level relay action

Receiver

Status LED

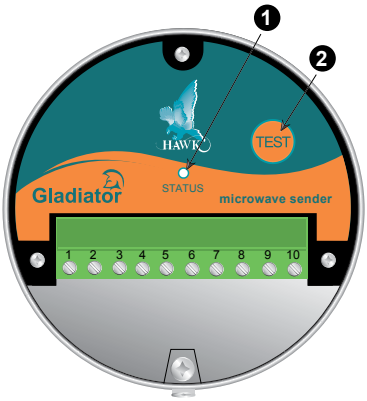
Green when powered
High illumination = strong signal
Low illumination = weak signal

Signal Contact

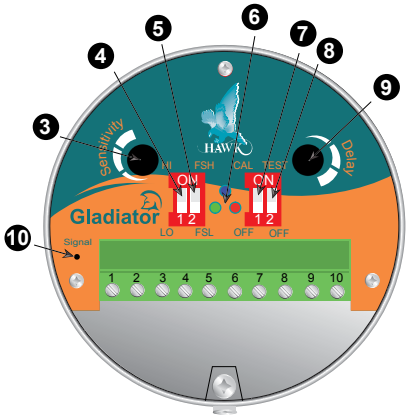
Signal can be read with voltmeter across Signal contact point and earth screw (or other ground reference)
2.4-2.5V is full signal. 0V is no signal

Functionality Layout

G1S Sender



G1R Integral Receiver



(1) Sender status LED

- Blinks while working correctly.
- Solid while not transmitting.

(2) TEST button

- Press and hold to test level relay action.

(3) Sensitivity dial

- Turn clockwise for switching in clean environments and object detection.
- Turn counter-clockwise for difficult applications, dusty/ wet environments.

(4) Hi / Lo switch

- Hi mode for clean environments and object detection.
- Lo mode for difficult applications, dusty/wet environments.

(5) FSH / FSL switch

- FSH relay normally closed.
- FSL relay normally open.

(6) Receiver status LEDs

- Green - High illumination for good signal, Low illumination for weak signal.
- Red - Relay indication. Illuminated when closed.
- Blue - Cal mount indication - flashes during Cal mount, will stay illuminated if Cal mount fails.

(7) Cal Mount switch

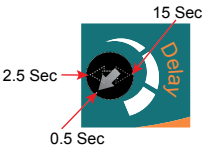
- Cal mount conducts the automatic setup routine for the system. Perform Cal mount for all new installations, and after adjusting either Sensitivity pot or Hi/Lo switch.
- Switch up to initiate Cal mount, wait several seconds, then switch back down. Unit will automatically complete Cal mount routine.

(8) Test switch

- Can be used for a failsafe / test relay.

(9) Delay pot

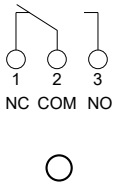
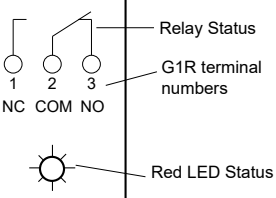
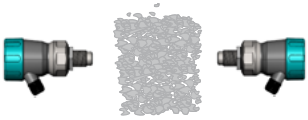
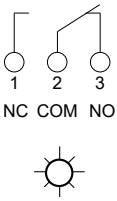
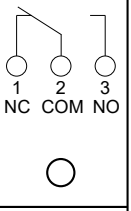
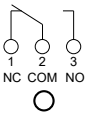
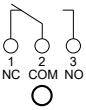
- Rotate clockwise to increase Relay on/off delay time.



(10) Signal contact

- Signal can be read with voltmeter across Signal contact point and earth screw (or other ground reference). 2.4-2.5V is full signal. 0V is no signal.

Relay Functions

	Relay Action	
	FailSafe Low FSL	FailSafe High FSH
State 1 Clear path 		
State 2 Blocked path 		
Power Failure		

G1R Receiver Test Switch Functions

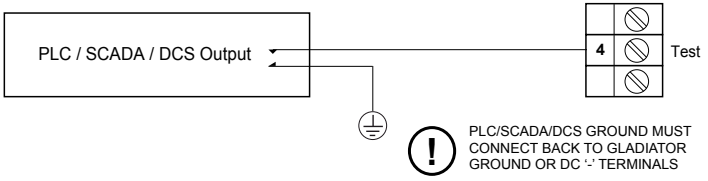
The test terminal has two potential modes of operation.

Test Input Mode

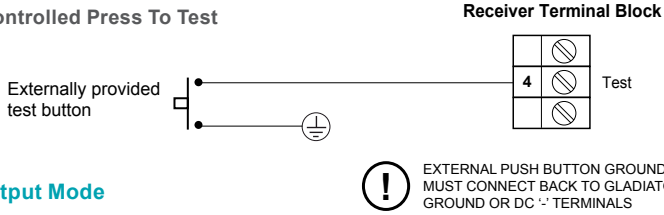
Test Switch: ON

Test terminal acts as an input for remote testing of the instrument's switching function. Used to check for malfunction of unit from a remote position, PLC, SCADA etc.

Test Input from PLC/SCADA/DCS Digital Output



Operator Controlled Press To Test

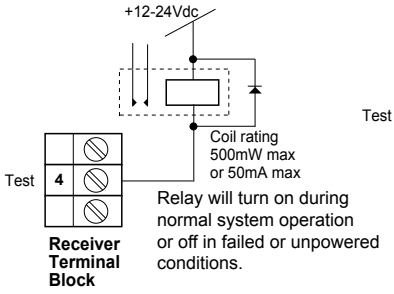


Failsafe Output Mode

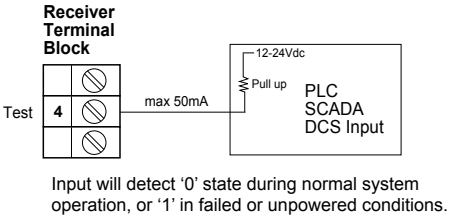
Test Switch: OFF

Test terminal will provide an output which is able to switch an external failsafe relay or PLC/SCADA/DCS input. During normal system operation this terminal will internally switch a solid state (transistor) output to ground (or DC '-'). If power fails or an internal system failure occurs, the terminal will act as an open circuit.

To switch an external relay



To a PLC input



Integral Systems

The GMSEQ Microwave sequencer will operate as the pulse control (Master) for up to 4 Integral systems. Each connected Microwave system will operate as a Slave. The Sequencer will pulse control from CH1 to CH2 to CH3 to CH4 then return to CH1.

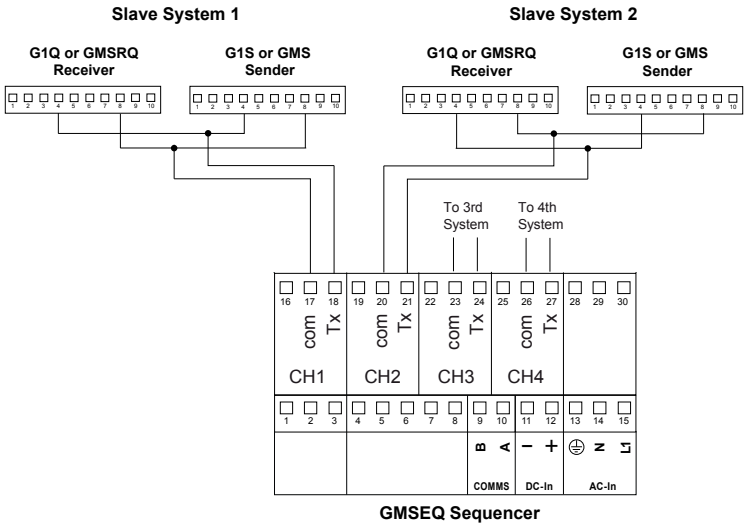
More than one system can be connected to each channel, note that each system connected to the same channel will be part of the same slave 'sequence' in the pulsing.

First, the Sequencer On and Off time (in Quickset menu of Sequencer) must be set to the following values.

- On time – 2000µs
- Off time – 2000µs

Wiring

Please note units still require external power source.



System Calibration

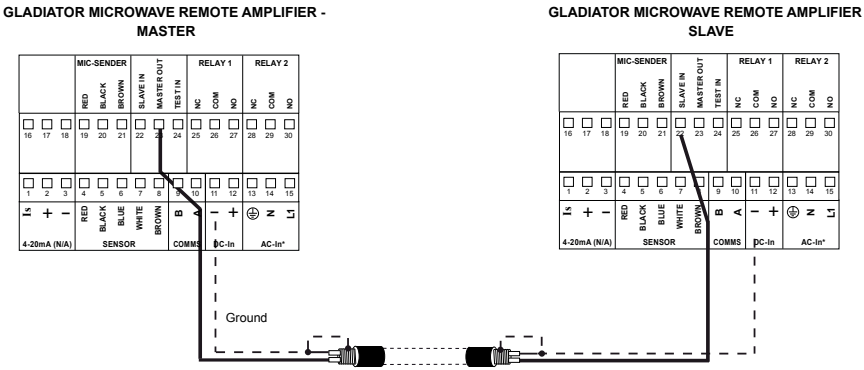
To set up the Microwave systems, perform as per below.

1. Complete wiring of all units to be used in the Sequenced network and apply power.
2. Run setup / calibration as per normal installation instructions.

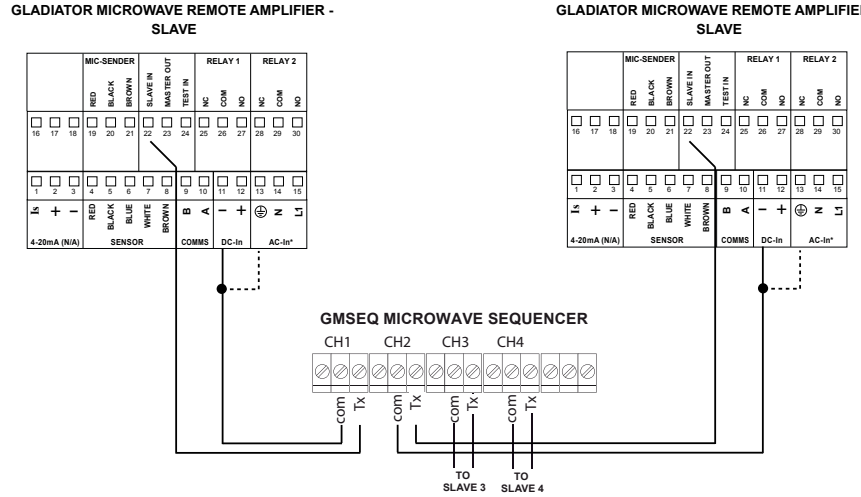
Remote Systems

- Up to four remote Microwave systems can be set up for anti-crosstalk.
- For two systems, one can be set to operating mode ‘Master’ and the other to operating mode ‘Slave’.
- For up to four systems, a dedicated Sequencing control unit must be used with the four systems set to operating mode ‘Slave’.
- If using the Sequencer, the On & Off parameter times should be a high value eg 1500 - 2000µs

Master / Slave Wiring



Sequencer / Slave Wiring



Weldment / Couplings and Windows

The weldment / couplings are designed to be welded into an appropriately sized hole in the vessel or application wall. A matching UHMW high wear window is then threaded into the weldment / coupling to act as a seal for the application. For Approval Option 2D Installations the Window is secured using a Locking Ring. See MD Series Windows and Weldments for further information.

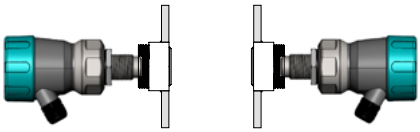
This typical installation isolates the Microwave hardware from coming into contact with any damaging materials and allows simple maintenance or replacement of units without having to unseal the process / application.

The Microwave transmission will pass directly through plastics to measure the material in the process.

MA2 - 2” Weldment / coupling with UHMW windows

Isolated from process with Weldment / Coupling and window

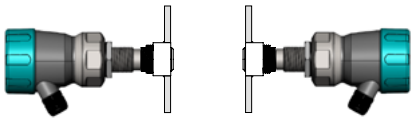
Mount as flush to Window as possible



MA1 - 1” Weldment / coupling with UHMW window

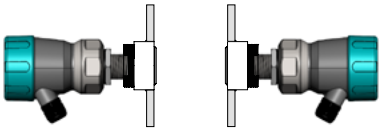
Isolated from process with Weldment / Coupling and window

Mount as flush to Window as possible



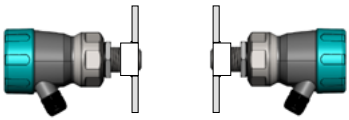
Isolated from process with Weldment / Coupling and window

Mounted to MA2-UW threaded window



Sensing element within process

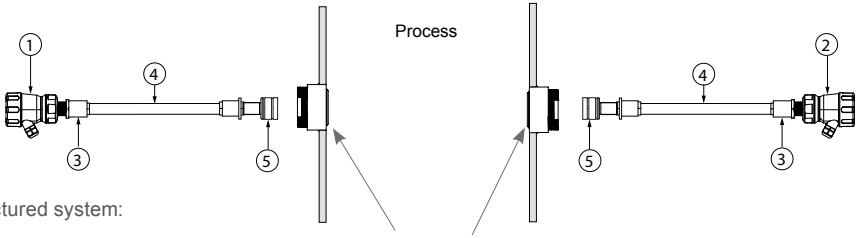
Mounted to MA1-WC threaded weldment / coupling



Waveguides with windowed weldment / coupling process seals

System with Waveguide extensions for remote mounting / signal transmission.

Waveguides can be used for difficult to access areas or to isolate the electronics from high temperature or non-compatible processes

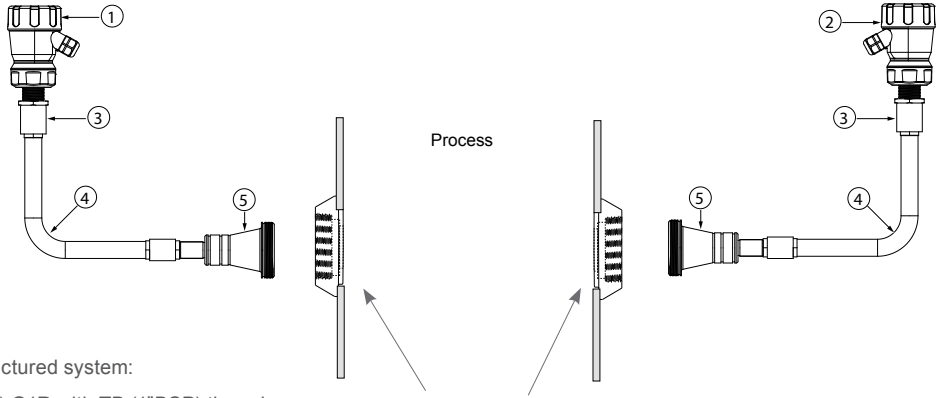


Pictured system:

(1) G1R with TB (1”BSP) thread
(2) G1S with TB (1”BSP) thread
(3) Qty2 of MA-WG01
(4) Qty2 of MA-WG10-L=xx
(5) Qty2 of MA-WG03

MA2-WC-SS
Weldment / coupling
with UHMW window

Ceramic windows for high temperature applications



Pictured system:

(1) G1R with TB (1”BSP) thread
(2) G1S with TB (1”BSP) thread
(3) Qty2 of MA-WG01
(4) Qty2 of MA-WG02
(5) Qty2 of MA-WG04

MA16
3” Weldment with
ceramic window

General Requirements

1. When looking for a mounting location it is important to locate and mount the interior of the window/sensor face for each unit flush with the vessel wall and where minimal build-up will occur.

For chute type applications mount the units as flush as possible to the window. Use Waveguides if electronics cannot be mounted to this requirement.

A cavity or tubed mount in the vessel where the sensor is mounted may fill with process material and will result in a 'plug' forming in front of the beam path resulting in unwanted false trips or unit performance issues.

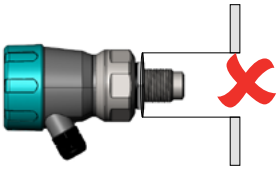
2. Microwave energy cannot penetrate through steel linings or other conductive linings. You must cut a viewing hole and use an appropriate windowed weldment.

3. For high vibration applications, it is necessary to isolate the electronics to keep them from long term damage. This is most often accomplished using 2" UHMW or Teflon windowed weldments in the vessel walls, and mounting the Microwave Sender and Receiver to a separate stable structure (I-beam, handrail) to isolate them from vibration.

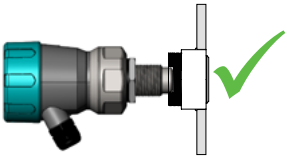
4. For high temperature applications which exceed specified maximum temperature it is necessary to ensure that the sensors always remain below 65°C/150°F. Use waveguide assemblies to the high temperature area with the electronics in an appropriately rated area.

When mounting to monitor the level of a flowing product such as coal, ore or wood chips, position the microwave path out of the direct product flow stream. If at all possible, go behind the flow stream or well in front of it. This will minimise any possibility of unwanted trips due to abnormal product flow blocking the beam.

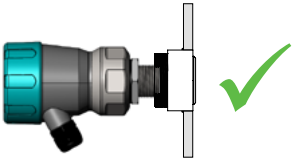
When using the system as a proximity switch such as truck detection the mounting arrangement is application dependent and must ensure proper operation even under worst case conditions.



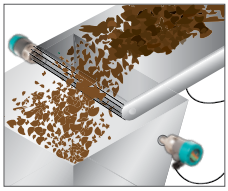
Do not mount with cavity

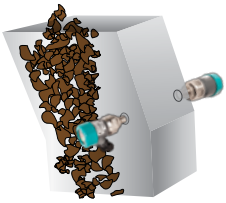


Mount behind flush Weldment / Coupling with Window



Mount behind flush Weldment / Coupling with Window





Mount away from main product flow

Remote System Procedure

1. Mount the units according to Mounting Guidelines

To protect from surges, ensure that an external ground wire is connected between the outside ground screw on the Gladiator housing and the vessel or other ground source.

2. Make sure that the material or target is not blocking the path between sender and receiver.

3. Choose Application Type (App Type)

Selecting the App Type sets the unit to pre-sets specific for blocked/plugged chute detection, boom protection (long range machinery collision detection) and several others.

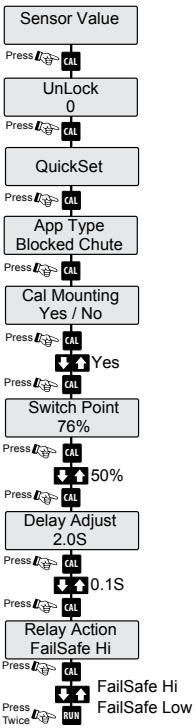
A) Alignment - For aligning the unit at long range. Unit is set to 1.2V signal (~48% switch value on display), move the unit face to get the volt reading high (2.4V will be the maximum reading or 0% switch value). Calibrate & re-select this mode and repeat till you cannot improve the alignment.

B) **Blocked Chute** - Configures the unit for blocked chute applications.

C) Boom Protection - Configures the unit for anti collision applications

D) Switch - Allows selection of Sensitivity% for typical level switch application. The higher the programmed %, the more responsive the unit will be. Use a lower % if build up or dusty conditions are expected.

E) Analog (Density) - Special measurement mode. See App Types for further information.



4. Perform Cal Mount

Some App Types require a Cal Mount. This calibrates the system to ignore any interference caused by mounting etc. There should be clear path between the sender and receiver.

Select 'Yes' to start the mounting calibration. 'Wait' will be displayed during the calibration for up to 30 seconds. Unit is now able to cancel the influence of the mounting. The % reading on the back lit display will be zeroed with the existing process conditions and the measurement history log has been cleared.

Always calibrate the unit after adjusting the App Type.

5. Select Switch Point

The output relay will switch when the Switch% exceeds the entered value. The default value of 76% will be suitable for detecting most media. For detection of products which are less absorbent of Microwave energy, select a lower % value and vice versa. For highly absorbent materials, almost any setting will work, but higher % settings will be more immune to build up. When the level or target falls below the sensors the relay will switch back at half of the entered switch point % value (when the beam is no longer broken).

6. Set Delay

Set the time delay to be used for both switch on and switch off action.

7. Choose Relay Action

The Relay can switch 'ON' or 'OFF' as the microwave beam is blocked and switch 'ON' or 'OFF' in response to an instrument failure. Failsafe Hi for normally closed relay, failsafe Low for normally open relay.

Integral System Procedure

1. Mount the units according to Mounting Requirements

1.1 If units are AC powered ensure proper grounding is connected to ground screw.

2. Powering the unit

The green status LED on the G1S Sender will blink while working correctly or be solid if not working correctly or not transmitting.

The green LED on the G1R Receiver will stay on permanently to indicate that power is on. The intensity of illumination of the light indicates signal strength (high intensity indicates good received signal).

3. Select the required relay action

The Relay can switch 'ON' (FSL) or 'OFF' (FSH) as the microwave beam is blocked. Set the relay action selection switch position depending on your requirements. FSH is recommended (ordinarily on/energized, switches off/ DEN during blocked conditions).

4. Select the Sensitivity

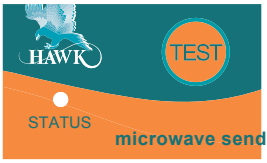
There are two adjustments controlling the sensitivity of the switch point:

4.1 The 'HI/LO' sensitivity switch is used as the primary sensitivity setting. Select LO sensitivity for Blocked Chute detection and if build-up is expected over sensors. Select HI sensitivity for clean environments,object detection and lighter/less absorptive material or targets. LO recommended for most applications.

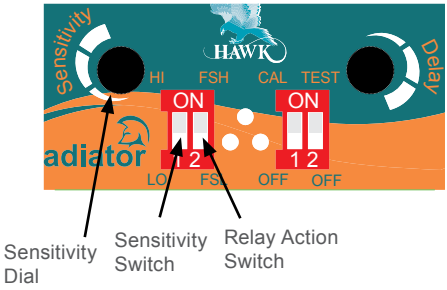
4.2 The Sensitivity Dial

Turning the pot fully counter-clockwise factory recommended for blocked chute applications. If operating in HI mode set the pot to 12 o'clock. In this mode you can turning the pot clockwise to reduce the amount of beam blockage required for switching and vice versa.

G1S Sender



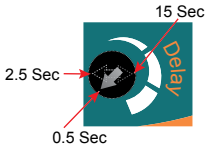
G1R Receiver



Integral System Procedure

5. Select the relay time delay

Full anti clockwise is minimum (0.1 seconds). Full clockwise is maximum (20 seconds). Adjust as required allowing time to avoid possible nuisance trips. The selected delay will be used for both an ON delay and an OFF delay.



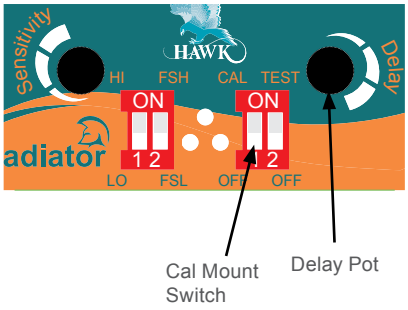
6. Perform a CAL mount

Do not proceed with this step unless there is clear path between the Sender and Receiver.

Switch CAL switch on the Receiver unit to ON position. The Blue LED will blink to indicate that mounting calibration is now in progress. Wait 5 seconds, then switch the mounting calibration switch to 'OFF' position.

The blue LED will switch off after successful calibration. If it stays on this indicates there was a calibration error. If this is the case please check that the path between sender and receiver is clear and alignment is correct. You may need to lower the Sensitivity setting. Try the calibration again. If mounting calibration was successful the blue LED should be off and the Green LED should be ON.

G1R Receiver

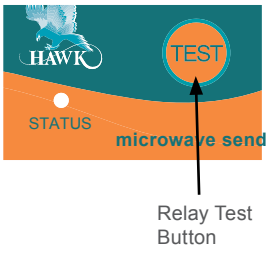


7. Relay test

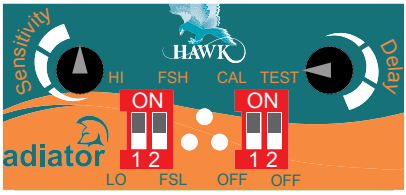
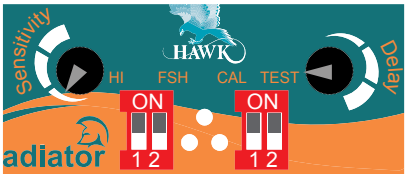
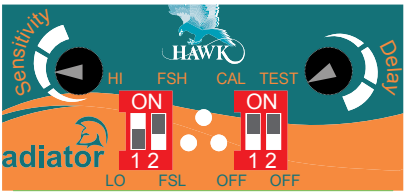
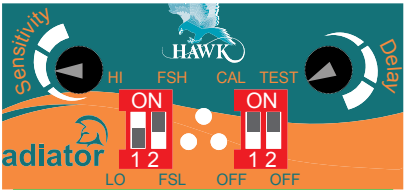
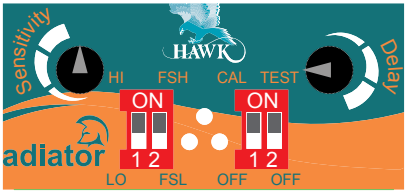
If required block the Sender with a sample of the application material (note the units are capable of penetrating significant amounts build up). The green LED will dim when the Microwave beam begins to be blocked.

You can also press the 'TEST' button on the Sender to simulate the switch condition and trigger the relay action.

G1S Sender



Typical Integral Setups

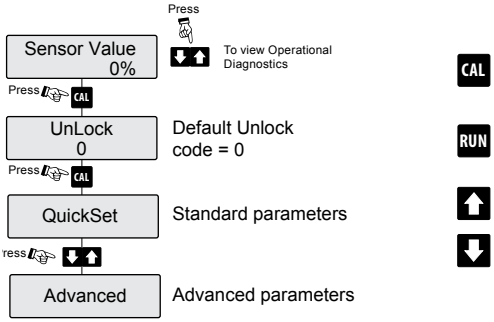
Application	Setup	
Chute Switch		Sensitivity Pot: 12 o'clock Sensitivity Switch: Lo Delay Pot: 9 o'clock
Chute Switch (dirty conditions)		Sensitivity Pot: Fully counter-clockwise Sensitivity Switch: Lo Delay Pot: 9 o'clock
Vehicle / Machine detection		Sensitivity Pot: 9 o'clock Sensitivity Switch: Hi Delay Pot: 8 o'clock
Presence / Absence switch (clean environment)		Sensitivity Pot: 9 o'clock Sensitivity Switch: Hi Delay Pot: 8 o'clock
Presence / Absence switch (dirty environment)		Sensitivity Pot: 12 o'clock Sensitivity Switch: Lo Delay Pot: 9 o'clock

Operational Diagnostics

Diagnostic	Description	Notes
Sensor Value	Sensor value indicates the amount of signal blocked from 0-100%. 0% is full signal, 100% is complete blockage.	
SW On	For the level relay to switch to state '2', the Sensor value must exceed this SW On % for the duration of the on delay time.	
SW Off	For the level relay to switch to state '1', the Sensor value must drop below this SW Off % for the duration of the off delay time.	Switch mode 'Auto' will automatically set the SW Off % to 2/3rds of SW On %
Max	The maximum recorded Sensor value % since last log reset	
Min	The minimum recorded Sensor value % since last log reset	
Delay	Dynamic switch delay time indication	
Temp	Measured temperature inside Receiver unit	
• Normal • Recover • Failed	• Unit in normal operation • Unit applying 'Recover' Gain to retain or enhance signal • Unit is in failsafe condition	Unit will indicate Recover commonly for blocked chute and other switching applications.
Signal	Signal strength measured at the Receiver. This value is proportionate to the Sensor Value %: • 0V = Sensor Value 100%. No Signal • 1V = Sensor Value 50%. Half Signal • 2.0V = Sensor Value 0%. Full Signal • 2.0V to 2.5V = Sensor Value 0%. Full signal	In most modes the unit will be looking to hold a 2.5V signal. 2.0V to 2.5V is used for signal stability purposes.
Recover	Recover Gain % applied. Recover Gain is used retain the incoming signal during difficult conditions.	The programmed App Type will have pre-defined amounts of Recover Gain available.
Gain	Gain % applied. This is the total Gain (Calibrated Gain plus Recover Gain) applied by the system.	
Noise	Noise interference in V - Noise from interfering received frequencies or along the communications wiring.	It is normal to see a small consistent amount of Noise.
• Remote • Master • Slave	• Remote: (default). Standard remote system • Master: Unit mode is set as 'Master' for cross-talk prevention • Slave: Unit mode is set as 'Slave' for cross-talk prevention	

Main Menus & Interface

Note: Parameters may vary depending on older software revisions



Quickset Menu

Parameter	Description	Options
App Type (see next page for additional information about Application Types)	Select application pre-set. This automatically configures the unit to the recommended settings for each specific application. *Note: you must perform a Cal Mount after changing or selecting App Type*	• 4-20mA (Density) • Switch • Boom Protect • Blocked Chute • Alignment
Cal Mounting	Performs a Cal Mount in which the unit automatically configures itself based on the selected App Type and the mounting environment.	• Yes / No
Switch Point	This is the switch on / off sensor value % for relay actions	• Auto - 75% (on) 50% (off) • Manual (set in Advanced)
On Delay Adj	Set on delay time for the first relay. If using the 2nd relay in cleaner / maintenance mode 1/2 of this value will be the duration of the relay timer	• Adjustable in seconds
Relay1Action	Adjust the Relay action to be energised or de-energised during normal operation	• FailSafe Hi • FailSafe Low
Lock Code	Set a lock code to prevent unauthorised access	• Default 0

App Types

App Type	Description	Sub Menu
Analog (see Density Setup Guide below)	Analog is the new App Type which allows customers to measure variation in the amount of Microwave energy blocked and absorbed by on application. The variance is represented by a 4-20mA analog output. *Note: Relay1 as a switch function is disabled while the Analog application is selected.*	**HiSpan%** This is the 20mA reference point. This can be Viewed, Autoset or set to a Custom value. This value will always be a 10-100% with 10% the most sensitive 100% suited to measure the indicate the widest variation.
Switch	Sets the unit to a standard switch mode with adjustable sensitivity	**Sensitivity%** A high value will make the unit more sensitive to switching and responding to lighter materials. A low value will make the unit more resilient and ignore dust / build up.
Boom Protection	Sets the unit to Boom Protection mode. This can also be used for machinery / truck or object detection & collision avoidance.	
Blocked Chute	Sets the unit for blocked chute mode. *Note: This mode may be unsuitable for very low dielectric materials.*	
Alignment	A mode to assist aligning units over long range. Select this mode and perform a Cal Mount. RUN the unit and it will indicate half signal / approximately 48 Switch% on the display. Improving the alignment will reduce the % with the goal to reduce as low possible. Re Cal-Mount if the % reaches 0 and continue to adjust the alignment until it cannot be improved further. After using this mode you must set the unit back to a normal app type as function is purely for alignment.	

Analog Setup Guide

1. Select '**Analog**' (Density) App Type
2. To set the **4mA** condition reference - Perform a **Cal Mount**. HAWK recommends this should be done with Clear Path between Sender and Receiver.
3. Press **RUN** several times to restart the unit.
   This will be the **4mA** reference point for the analogue
   Note: You must RUN the unit before proceeding with the next step

To set the **20mA** reference point you can either:

4. Enter a specific '**HighSpan%**' (10-100%) or;
5. Start the process you wish to measure. When the desired density of product is between the Sender & Receiver you can enter the Quickset menu and run '**Autoset**'. This sets the measured condition between Sender and Receiver to the **20mA / 100%** reference.
   If Autoset returns '**Failed**' you either did not press **RUN** after the **Cal Mount** to set the **4mA** point or the Microwave pulses are not blocked by a high enough density which the unit can detect.

Advanced Menu

Parameter	Description	Sub Menu
Switch Mode	• Auto - Switch On% set in Quickset, Switch Off% automatically configured • Manual - Manually adjust Switch On and Switch Off % • Off - Switch mode disabled in Analog (Density) mode	• Switch On% • Switch Off%
Relay2Action	Set Relay2Action as one of the below: • **Failsafe** - Relay2 triggers on failsafe conditions • **Relay2** - Mirrors Relay1 action to act as a second / backup relay for the system • **Maintnce Chk*** - Triggers Relay2 at a pre-defined Gain value for a maintenance / build up alarm • **GainOpt Cln*** - Triggers Relay2 to activate a cleaner system based on total Gain used • **TimeOpt Cln*** - Triggers Relay to activate a cleaner system based on a programmed time delay	** For further information about the Maintenance and Cleaner Relay2 alarms see 'Relay 2 Actions' on next page*
View Log	View measured max/min values log	
Reset Log	Re-set log	
Comms Type	Adjust & select additional communications, baud rate and device ID. All GSA units by default include Modbus.	• DeviceNet (not functional) • Profibus (not functional) • HART (not functional) • Modbus
Back Light	Turn on / off LCD backlight	
Operating Mode	• Remote: Default setting for standard remote system • Master: Set system to Master mode for 2 system anti-crosstalk • Slave: Set system to Slave mode for 2 system anti-crosstalk	For further information see 'Cross Talk Prevention / Sequencer Wiring' section
Display Span		
Probe Avg	Probe Avg is a output damping parameter. Increase to smooth out unwanted fluctuations or instability.	
LoadDefaults	Reset system to defaults (amplifier and/or sensor)	
InputVolChk	Used for power related failsafe. When active the unit will switch to failsafe mode if input voltage drops below required power. When not active unit will display 'Input Voltage too low' on the display if input voltage drops below required power.	

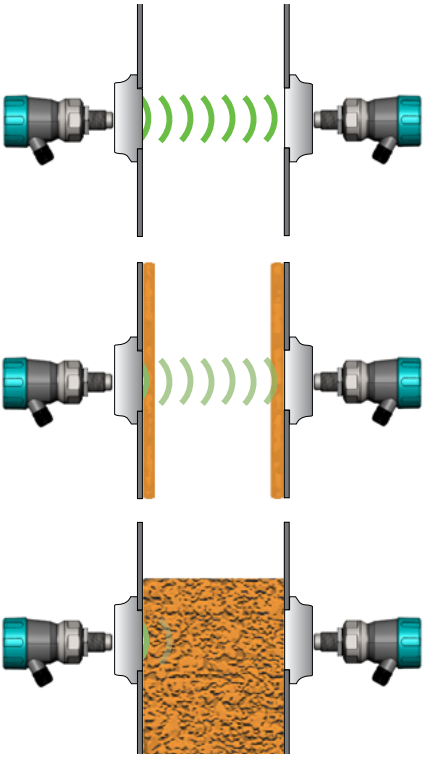
Using Relay 2 & Modbus for Predictive Maintenance

Microwave Switches are traditionally used as Blocked Chute switches. Some switches can give a false alarm and trip because of build up on the chute walls. This causes lot of downtime to the mine site costing them valuable time and money.

The world leading receiving circuitry detects and amplifies the diminished signal. The Gladiator Microwave is able to use a relay or Modbus to notify operators the chute requires maintenance before the an emergency occurs. The system uses a parameter called Gain% to amplify the incoming Microwave signal when build up begins to occur or conditions within the chute change.

Relay 2 can be programmed to switch when the Gain% passes a certain point. The higher then Gain%, the less Microwave signal is being received due to build up.

The Gain% is also available as a live reading via Modbus / Modbus over Ethernet TCP/IP so this can be monitored, tracked or alarmed remotely.



Specifications

Speed	Data bits	Parity	Stop bits	Device Type	Address Range
19200	8	None	1	Slave	1-255

Registers

Register No.	Title	Data	Description
40122	Sensor Value (Switch%)	% = Data / 10	Sensor value indicates the amount of signal blocked from 0-100%. 0% is full signal, 100% is complete blockage.
40127	Signal Voltage	Signal = Data / 1638	Signal strength measured at the Receiver. This value is proportionate to the Sensor Value %: • 0V = Sensor Value 100%. No Signal • 1V = Sensor Value 50%. Half Signal • 2.0V = Sensor Value 0%. Full Signal • 2.0V to 2.5V = Sensor Value 0%. Full signal
40135	Temperature (k) Temperature (c)	Data / 10 (Data - 273.2) / 10	Temperature (measured at Receiver)
40140	Gain%	% = Data / 2.55	Gain % applied (0-100). This is the total Gain (Calibrated Gain plus Recover Gain) applied by the system. A high value indicates there may be requirement for application inspection or cleaning / maintenance
40004	Device ID	Data Range 1-255	Can be written or read. Value = ID
40100	Restart Unit		Write Data 32768 to re-start unit

Relay 2 Actions

Maintenance & Auto cleaner functions

- The Gladiator Amplifier can use **Relay 2** as a trigger mechanism to notify the user or activate a cleaning system based on time or conditions within the application which require cleaning/maintenance.
- There are three software options using two different concepts. The first concept is based on total **Gain** used and the second is based on a **Time interval**.

The selectable software options are as follows:

[Maintnce Chk]

- The unit will switch on the relay when total **Gain** is greater than the **CleanGainHigh** % - the relay will switch off when **Gain** falls below **CleanGainLow** %.

[GainOpt Clng]

- When total **Gain** exceeds the **CleanGainHigh** point the unit activates the relay for 1/2 of the **On Delay** time and then switches off.
- The unit will then count the **Clean Time interval** time before repeat the process until total **Gain** is below **CleanGainLow** point.

[TimeOpt Clng]

- At every **Clean Time interval** the unit will switch on the relay for 1/2 of the **On Delay** time and then switch off.

Other Relay2 Actions

- **Relay 2** - Sets the 2nd relay to mirror the first relay action
- **Failsafe** - Sets the relay to trigger for a failsafe condition such as sender/receiver fail or voltage problem

Setup Example - Time Based

- In '**Quickset**' Set '**On Delay**' to 4.0 seconds - this will provide a 2.0 second water blast.
- In '**Advanced**' set '**Relay2Action'** to '**TimeOptCln**' with a '**Clean Timer'** of 30min.
- Every 30 minutes the sensors will be sprayed for 2 seconds.

Setup Example - Gain Based

See next page for Software flow chart.

- In '**Quickset**' Set '**On Delay**' to 4.0 seconds - this will provide a 2.0 second water blast.
- In '**Advanced**' set '**Relay2Action** to '**GainOptCln**' with a '**CleanGainHi**' of 80%, '**CleanGainLo**' of 70% and '**Clean Timer**' to 5.0min.
- This will trigger the water spray for 2 seconds when **Gain** goes above 80%. The spray will repeat every 5 minutes until **Gain** goes below 70%.
- You can view **Gain** while the unit is running by using the arrow key to locate the diagnostic display.



Troubleshooting

Problem	Check
Unit Relay incorrectly tripping	Ensure no material build up is between the sensors. Ensure mounting is correct to mounting guidelines. For Integral System, adjust unit settings to 'Lo' Sensitivity modes.
Unit Calibration fails (Blue LED stays illuminated)	Ensure no material build up is between the sensors. Ensure mounting is correct to mounting guidelines. For Integral System, rotate Sensitivity pot anti clockwise. For Integral System, adjust unit settings to 'Lo' Sensitivity modes. Bench test system with different Sender and Receiver. Replace faulted unit.
Relay flickers on/ off (relay chatter)	Increase 'Delay' time. For Integral System, reduce Sensitivity / Switch to Lo Sensitivity mode. Check for material build up in between the sensors. Ensure mounting is correct to mounting guidelines. For Remote system, If the system is operating correctly increase 'Probe Avg' to create a smoother Sensor% value.
Switch / Relay testing	The units are designed to penetrate through generous amounts of material build up, small or thin objects may not be appropriate for Switch testing. Use the 'Test' button on the Sender unit to confirm unit Relay function is correct. The green LED on the Receiver (G1R/T) will dim when the signal is partially blocked. In some applications the unit beam spread may bounce around the target. Increase Sensitivity or use Waveguides to control the transmitted beam closer to the target or chute. For a Remote system, if the Sensor% reads 0% this means full signal is present and the system is operating correctly. Use the 'Test' button on the Sender to test the relay action.
Relay does not switch when pressing 'Test' button during Switch testing	For Remote system, confirm wiring is correct Bench test system with different Sender and Receiver. Replace faulted unit if required.
Sender (G1S) green LED is permanently solid	This indicates the Sender is not transmitting. Ensure wiring is correct. Confirm incoming voltage is to correct specification. Replace with new Sender unit.

Troubleshooting

No LEDs illuminated on either unit	Ensure wiring is correct. Confirm power is present at the correct terminals and incoming voltage is to correct specification. Bench test system and replace any failed hardware.
Erratic / non responsive Sensor% value	Press and hold the 'Test' button on the Sender unit. This will force the Sensor % to read 99-100%. If this functions correctly the system is operating correctly. If the system is operating correctly increase 'Probe Avg' to create a smoother displayed value. There may be build up or signal loss if the unit is not able to hold a 0% value this indicates signal loss or not enough Gain is available. Check for build up, obstructions

Remote System Error Codes

Error 01:

- Remote Amplifier can not communicate with Receiver.
- Error No 01 is displayed on power up with a reset loop or after unit has successfully operated and subsequently failed.
- Check wiring terminals for a loose or incorrect connection (including junction box / cable extensions).
- Check the cables for any signs of damage.
- Ensure any customer supplied cable meets HAWK specifications.
- Ensure correct power is applied to the correct terminals. DC only version units will not support AC.
- Use a multimeter to check voltage supply for the Remote Sender & Receiver on the red/black labeled terminals of the Amplifier. You should get approximately as below:

Sender 15-16VDC
Receiver 9-10VDC

- Disconnect Sender and Receiver from amplifier and use a multimeter to check kohm resistance values (approximate) across the following wires.

Sender:

- Brown: Black 200-320kohm (may vary)

Receiver:

- White: Blue 27-32kohm
- Brown: Blue or White 70-80kohm increasing
- Black: Blue or White 16-16kohm

Error 02:

- Error Codes can also indicate communication data failures or corruption between Amplifier and Receiver.
- Ensure any junction box / wiring extensions are as per HAWK wiring guide. Make sure wiring is correct especially look to the screen (earth).

Error 03:

- Incorrect comms module selected (eg Profibus, FF). Check part number to confirm communications options (All units are Modbus as default)

Error 04:

- Amplifier is programmed with incorrect software. Contact your local support.

Specifications & Registers

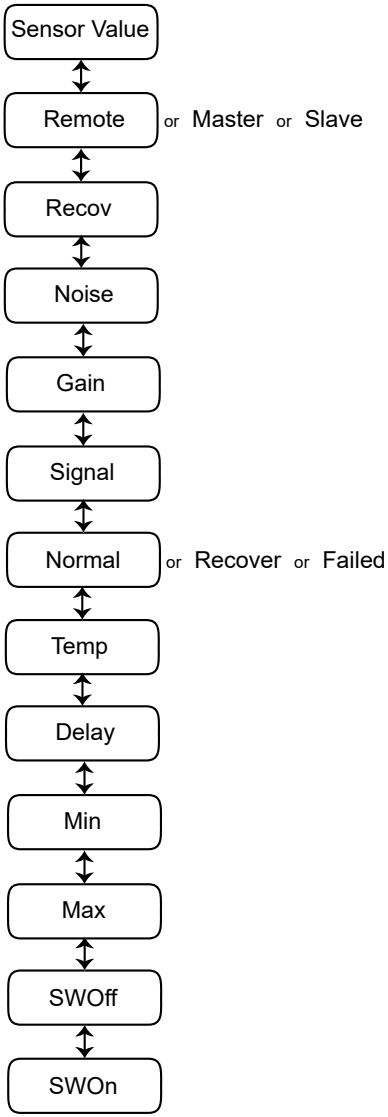
Modbus Specifications

Speed	Data bits	Parity	Stop bits	Device Type	Address Range
19200	8	None	1	Slave	1-255

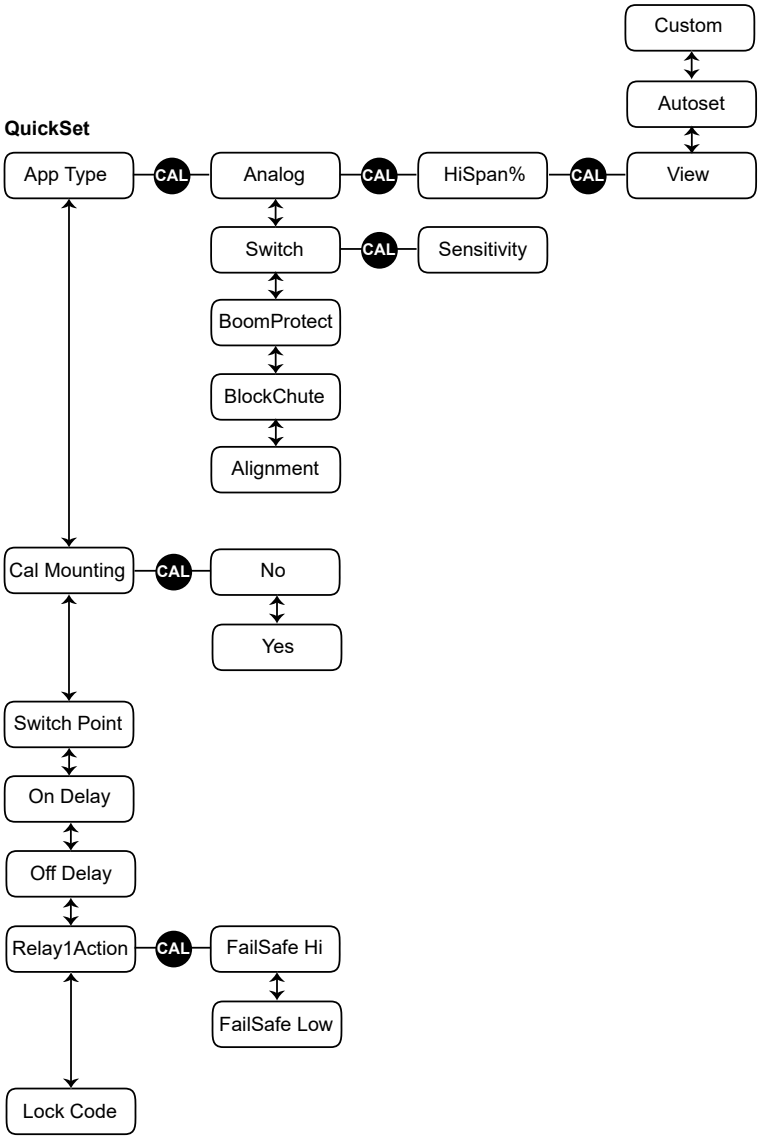
Modbus Register Information

Register No.	Title	Data	Description
40122	Sensor Value (Switch%)	% = Data / 10	Sensor value indicates the amount of signal blocked from 0-100%. 0% is full signal, 100% is complete blockage.
40127	Signal Voltage	Signal = Data / 1638	Signal strength measured at the Receiver. This value is proportionate to the Sensor Value %: • 0V = Sensor Value 100%. No Signal • 1V = Sensor Value 50%. Half Signal • 2.0V = Sensor Value 0%. Full Signal • 2.0V to 2.5V = Sensor Value 0%. Full signal
40135	Temperature (k) Temperature (c)	Data / 10 (Data - 273.2) / 10	Temperature (measured at Receiver)
40140	Gain%	% = Data / 2.55	Gain % applied (0-100). This is the total Gain (Calibrated Gain plus Recover Gain) applied by the system. A high value indicates there may be requirement for application inspection or cleaning / maintenance

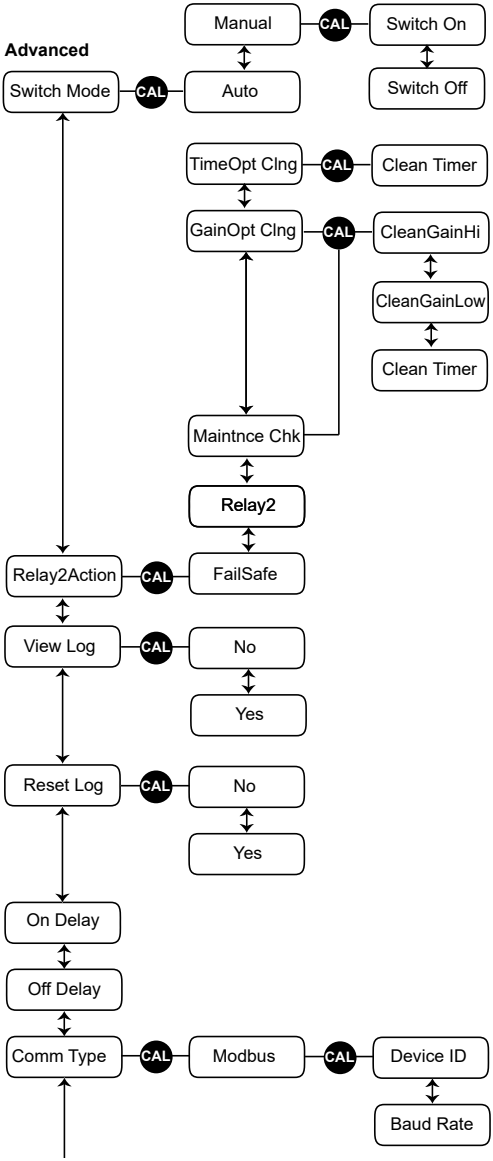
Diagnostics

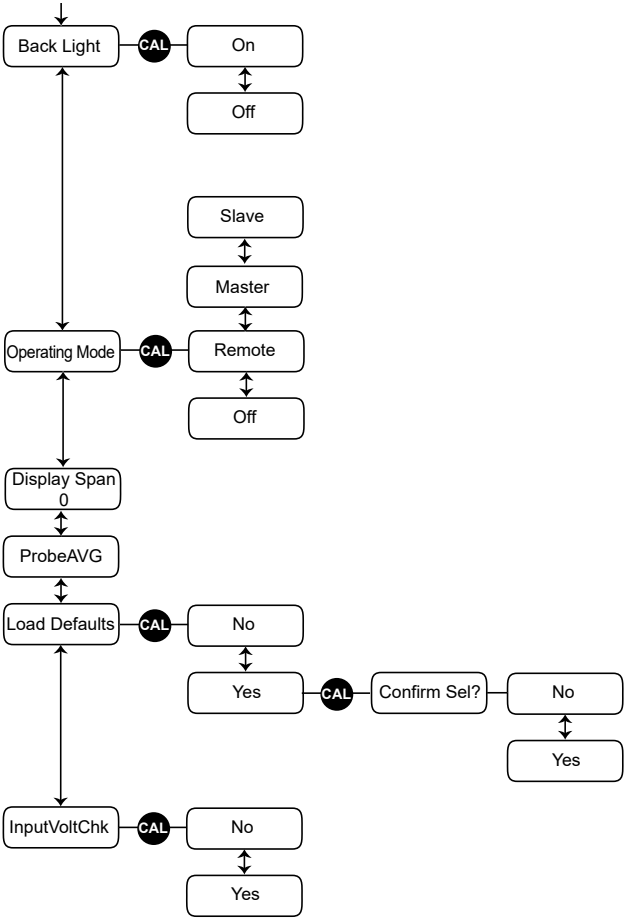


Quickset


QuickSet
App Type
CAL
Analog
CAL
HiSpan%
CAL
View
Custom
Autoset
Switch
CAL
Sensitivity
BoomProtect
BlockChute
Alignment
Cal Mounting
CAL
No
Yes
Switch Point
On Delay
Off Delay
Relay1Action
CAL
FailSafe Hi
FailSafe Low
Lock Code

Advanced


Advanced
Switch Mode
CAL
Manual
Auto
CAL
Switch On
Switch Off
TimeOpt Clng
CAL
Clean Timer
GainOpt Clng
CAL
CleanGainHi
CleanGainLow
Clean Timer
Maintnce Chk
Relay2
Relay2Action
CAL
FailSafe
View Log
CAL
No
Yes
Reset Log
CAL
No
Yes
On Delay
Off Delay
Comm Type
CAL
Modbus
CAL
Device ID
Baud Rate


Back Light
CAL
On
Off
Slave
Master
Operating Mode
CAL
Remote
Off
Display Span
0
ProbeAVG
Load Defaults
CAL
No
Yes
CAL
Confirm Sel?
No
Yes
InputVoltChk
CAL
No
Yes

Remote Version

Remote Amplifier

GSA Gladiator Amplifier (compatible with all Gladiator products), Modbus

Housing
S Polycarbonate

Power Supply
B 12-30VDC
C 36-60VDC
U 12-30VDC and 90-260VAC

Output Options
S 2 x SPDT Relays
X 2 x SPDT Relays & 4-20mA output
E 2 x SPDT Relays & Modbus Over Ethernet
R 2 x SPDT Relays & Modbus Over Wi-Fi
E 2 x SPDT Relays & Modbus Over Bluetooth

Approval
A22 ATEX Grp II Cat 3 GD T85°C IP67 Tamb -40°C to 70°C

GSA	S	U	S

Remote Sender / Receiver

Model
G1S Gladiator 1" Microwave Sender
G1T Gladiator 1" Microwave Remote Receiver

Electronics Housing (Sensor element is 316L with Teflon face)
S Powder Coated Aluminum
C 316L Stainless Steel

Power Supply[1]
B Not Required (power supplied by GSA Amplifier)

Mounting Thread
TB 1" BSP
TN 1" NPT

Approvals
X Not Required
A22 ATEX Grp II Cat 3 GD T85°C IP67 Tamb -40°C to 70°C
2D IECEx ta tb IIIC T* Da Db Tamb = -30 to +80C

G1T	S	B	TB	X

[1]Model G1T may have option 'X' Power Supply which is the same as option 'B'. Model G1S with Power Supply option 'U' can also be used.

Connection Cable

CA-GMR Pre-cut cable for remote sender or receiver

10 10m cable
20 20m cable
30 30m cable
50 50m cable
100 100m cable

CA-GMR	10

Lengths above 100m available via special order

***Consult Safety Instructions, Temperature Code information for temperature and other ratings**

Integral Sender / Receiver

Model

G1S Gladiator 1" Microwave Sender

G1R Gladiator 1" Microwave Integral Receiver, 1 Relay with Failsafe

G1Q Gladiator 1" Microwave Integral Sequenced Receiver, 1 Relay with Failsafe (Requires GMSEQ Sequencer)

Electronics Housing (Sensor element is 316L with Teflon face)

- S Powder Coated Aluminum
- C 316L Stainless Steel

Power Supply

- B 12-30VDC
- U 12-30VDC and 80-260VAC

Mounting Thread

- TB 1" BSP
- TN 1" NPT

Approvals

- X Not Required
- A22 ATEX Grp II Cat 3 GD T85°C IP67 Tamb -40°C to 70°C
- 2D IECEx ta tb IIIC T* Da Db Tamb = -30 to +80C
- 3C cETLus (power supply option 'B only', model option G1S, G1R only)
  Ex ta/tb IIIC T* Da/Db
  Zone 20/21, AEx ta/tb IIIC T* Da/Db
  Sensor Face: Class II, III Div. 1, Groups EFG, T*
  Sensor Body: Class II, III Div. 2, Groups EFG, T*

G1S	C	B	TB	X

Consult Safety Instructions, Temperature Code information for temperature and other ratings

Microwave Sequencer

GMSEQ Gladiator Microwave Sequencer

Power Supply

- B 12-30VDC
- C 30-48VDC and 48-90VAC
- U 12-30VDC and 90-260VAC

GMSEQ	U

MA Series Mounting Accessories

MA

1	1” UHMW Window & mild steel weldment/coupling each
1-SS	1” UHMW Window & 316L stainless steel weldment/coupling each
1-UW	1” UHMW Window each
1-WC	1” mild steel weldment/coupling each
1-WC-SS	1” 316L stainless steel weldment/coupling each
2	2” UHMW Window & mild steel weldment/coupling each
2-SS	2” UHMW Window & 316L stainless steel weldment/coupling each
2-UW	2” UHMW Window each
2-WC	2” mild steel weldment/coupling each
2-WC-SS	2” 316L stainless steel weldment/coupling each

MA 2

Additional mounting accessory variants and materials including high temperature ceramics are available. See Gladiator Gen 3 Microwave datasheet available at www.hawkmeasurement.com

Waveguides & Waveguide Accessories

MA-WG

01	316L Threaded connector for Sender / Receiver
02	316L 90deg bend pipe (150mm + 150mm). Includes qty 2 of MA-WG11
03	316L 1-1/2” Wave guide horn. Includes Qty 1 MA-WG13
04	316L 3” Wave guide horn. Includes Qty 1 MA-WG13
10-L=[1]	316L Straight pipe extension 1L= length in mm. Includes qty 2 of MA-WG11
11	316L Locking nut
12	2” BSP Teflon plug with socket to match MA-WG03 horn
13	316L Pipe to pipe connector coupling
14	4” Teflon window to match MA-WG04 Horn. Fits into MA18 weldment

MA-WG 01

MD Series Mounting Accessories - Kit

For Approval Option 2D & 3C Installations. Consult Safety Instructions for critical details.

MD Mounting Accessories Kit

Window Facing Material

1	1" UHMW Window (-30°C to +75°C)
2	2" UHMW Window (-30°C to +75°C)
3	3" UHMW Window (-30°C to +75°C)
6	3" PTFE Window (-30°C to +200°C)

-

Weldment Material

A	SS304
S	SS316
M	Mild Steel

MD 3 - A

MD Series Mounting Accessories - Parts

For Approval Option 2D and 3C Installations. Consult Safety Instructions for critical details.

BASE Weldment Only

-

Weldment Size

MD1	Matches MD1
MD2	Matches MD2
MD3	Matches MD3 & MD6

-

Material

A	SS304
S	SS316
M	Mild Steel

BASE - MD2 - A

WIN Window only

-

Window Facing Material

MD1	UHMW for MD1 (-30°C to +75°C)
MD2	UHMW for MD2 (-30°C to +75°C)
MD3	UHMW for MD3 (-30°C to +75°C)
MD6	PTFE for MD6 (-30°C to +200°C)

WIN - MD2

LRING Locking Ring Only

-

Ring Size

MD1	Matches MD1
MD2	Matches MD2
MD3	Matches MD3 & MD6

-

Material

A	SS304
S	SS316
M	Mild Steel

LRING - MD2 - A

MD Series Part Combinations

Full Kit[1]	Size	Window	Weldment[1]	Locking Ring[1]
MD1-X	1"	WIN-MD1	BASE-MD1-X	LRING-MD1-X
MD2-X	2"	WIN-MD2	BASE-MD2-X	LRING-MD2-X
MD3-X	3"	WIN-MD3	BASE-MD3-X	LRING-MD3-X
MD6-X	3"	WIN-MD6	BASE-MD3-X	LRING-MD3-X

[1]X = Material Selection

Operating Voltage

- Integral 12-30VDC / Remote 12-30VDC (residual ripple no greater than 100mV)
- Integral 80-260VAC / Remote 90-260VAC 50 / 60Hz.
- Remote 36-60VDC

Power Consumption

- <0.8W @ 24VDC
- <3VA @ 115VAC
- <6W @ 48VDC
- <5VA @ 240VAC

Relay Output

- Form 'C' (SPDT) contacts, rated 5A at 240Vac resistive
- Remote fail-safe test facility for one relay.

Relay Output: (1) Integral (2) Remote

- Form 'C' (SPDT) contacts, rated 5A at 240VAC resistive
- Remote fail-safe test facility for one relay.

Operating Temperature

- Remote electronics -40°C (-40°F) to 80°C (176°F)
- Integral Units -30°C (-20°F) to 65°C (150°F)*
- Remote Sensors -30°C (-20°F) to 65°C (150°F)*.

**For higher temperature applications, remote mounting with refractory windows is necessary.*

Maximum Temperature (Mounting Accessories)

- 316L parts: 800°C
- Mild steel parts: 500°C
- Ceramic parts (alumina ceramic 95%) -50 to 800°C
- Teflon parts: 250°C
- UHMW parts: 80°C
- MD Weldment O-ring seals: NBR (Nitrile) 90°C (194°F). O-ring can be replaced with appropriate material for application.

Power Density

- Rated from emitter to receiver at approximately 20µW/cm²
- Complies with FCC Title Rules Part 15 (Beam Blockage)
- Caution sign posting not required.

Transmitted Signal

- Circular polarisation polarity
- Frequency: 10.525GHz
- Power: +14dBm / 25mW
- Sensitivity -88dBm
- Beam width 50°

Fail-Safe

- Selectable - presence or absence of material
- High level fail-safe: relay is activated when material is present.
- Low level fail-safe: relay is activated when no material is present.

Range

- Theoretical maximum range: 300m (984 ft)
- Recommended range (chutes) 15m
- Recommended range (object detection) 50m
- Minimum range under ideal conditions: 10cm (4 inches).

Note: Minimum ranges are dependent on application conductivity.

Sender / Receiver to Amplifier Separation

- Up to 500m (1640ft) using specified extension cable.

Alternate Cable Type Between Amplifier and Sensors

- 6 or 8 conductor (5 used) shielded twisted pair instrument cable
- Conductor size dependent on cable length
- BELDEN 3120A, DEKORON or equivalent
- Max: BELDEN 3120A = 500m (1640 ft). 3 pairs, 1 conductor not used
- Max: DEKORON IED183AA004 = 350m (1150 ft). 4 pairs, 3 conductors not used.

Specifications model dependent

Maximum Operating Pressure

• 10 BAR (Sender / Receiver).

Enclosure Sealing

• Sender / Receiver: IP66/67
• Remote Electronics: Rated IP65 (NEMA 4x).
• Designed for and tested to pass IP66 hose and IP67 submergence standards

Wetted Materials

• Sensing element housing: 316L stainless steel
• Sensing element face: Teflon.

Cable Entries

• Remote Sensors: 1 x M20 Gland / 3/4" NPTF threaded adaptor
• Remote Amplifier: 4 x 20mm (0.8"), 1 x 16mm (0.6") knock outs
• Integral Units: 2 x M20 Glands / 3/4" NPTF threaded adaptors.

Mounting

• 1" NTP
• 1" BSP.

Remote Test Input

• Press to test (used to check for malfunction of unit from remote position, PLC, SCADA etc).

Weight

• G1R 1kg
• G1S 1kg.
• GSA 1kg

Approval

• IECEx
Certificate No. IECEx TSA 16.0005X
Zone 20/21, Zone 21
Ex ta tb IIIC T* Da Db Tamb = -30 to +80C
• cETLus
Certificate No. ETL24CA105410316X
Ex ta/tb IIIC T* Da/Db
Zone 20/21, AEx ta/tb IIIC T* Da/Db
Sensor Face: Class II, III Div. 1, Groups EFG, T*
Sensor Body: Class II, III Div. 2, Groups EFG, T*

Consult Safety Instructions, Temperature Code information for temperature and other ratings

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