

Centurion CGR Series Safety Manual

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Table 1: Revision History

2. Reference Documents:

- [1] IEC61508, "Functional Safety of electrical / electronic / programmable electronic safety related systems", 2nd Edition, International Electrotechnical Commission, Geneva, 2010
- [2] IEC61511, "Functional Safety - Safety instrumented systems for the process industry sector", 1st Edition, International Electrotechnical Commission, Geneva, 2004
- [3] EN61326-1, "Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements", CENELEC, Brussels, 2012
- [4] IEC61326-3-1, "Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) - General industrial applications", 2nd Edition, International Electrotechnical Commission, Geneva, 2017
- [5] "Centurion CGR Series – Safety Requirement Specifications", Document No. SIL0003, Rev 1.3, HAWK Measurement Systems, Melbourne, 2017
- [6] "HART Communication Protocol, Command Summary Specification", HCF_Spec-99, Rev 9.0, HART Communication Foundation, Austin, 2007
- [7] IEC60079-0, "Explosive Atmospheres – Part 0: General requirements", 6th Edition, International Electrotechnical Commission, Geneva, 2011
- [8] IEC60079-1, "Explosive Atmospheres – Part 1: Equipment Protection by flameproof enclosures "d"", 7th Edition, International Electrotechnical Commission, Geneva, 2014
- [9] IEC60079-11, "Explosive Atmospheres – Part 11: Equipment Protection by intrinsic safety "i"", 6th Edition, International Electrotechnical Commission, Geneva, 2011
- [10] IEC60079-26, "Explosive Atmospheres – Part 26: Equipment with Equipment Protection Level (EPL) "Ga"", 3rd Edition, International Electrotechnical Commission, Geneva, 2014
- [11] IEC60079-31, "Explosive Atmospheres – Part 31: Equipment dust ignition protection by enclosure "t"", 1st Edition, International Electrotechnical Commission, Geneva, 2013
- [12] Standard 3600, "Approval Standard for Electrical Equipment for Use in Hazardous Locations – General Requirements", FM Approvals LLC, 2011
- [13] Standard 3610, "Approval Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II and III, Division 1, Hazardous Locations", FM Approvals LLC, 2015

- [14] *Standard 3611, "Approval Standard for Nonincendive Electrical Equipment for Use in Class I,II, Division 2, and Class III, Divisions 1 and 2, Hazardous Locations"*, FM Approvals LLC, 2016
- [15] *"Safety Instructions – CGR – Zone 0/1, Centurion Guided Radar Series"*, Document No. SI0050, Rev 1.9, HAWK Measurement Systems, Melbourne, 2016 www.hawkmeasure.com
- [16] *"Safety Instructions – CGR – Zone 20/21, Centurion Guided Radar Series"*, Document No. SI0051, Rev 1.1, HAWK Measurement Systems, Melbourne, 2016 www.hawkmeasure.com
- [17] *"Centurion Guided Radar – CGR Series – User Manual"*, Document No. DOC-CGR-MAN, Rev 1.32, HAWK Measurement Systems, Melbourne, 2018 www.hawkmeasure.com
- [19] *"Safety Instructions – CGR – ATEX Category 3GD, Centurion Guided Radar Series"*, Document No. SI0052, Rev 1.0, HAWK Measurement Systems, Melbourne, 2018 www.hawkmeasure.com

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3. Abbreviations:

1oo1	Single Channel Architecture (1 out of 1)
1oo2	Dual Channel Architecture (1 out of 2)
CGR	Centurion Guided Radar
DC	Diagnostic Coverage
DCS	Distributed Control System
DU	Dangerous Undetected
E/E/EP	Electrical / Electronic / Programmable Electronic
EUC	Equipment Under Control
FIT	Failure In Time [in 10^9 hours]
FMEA	Failure Mode and Error Analysis
FMEDA	Failure Mode, Error and Diagnostics Analysis
HFT	Hardware Fault Tolerance
MTBF	Mean Time Between Failure
MTTF	Mean Time To Failure
MTTF_d	Mean Time To Dangerous Failure
PFD	Probability Of Failure on Demand
PFD_{avg}	Average Probability Of Failure on Demand
PFH	Probability Of Failure per Hour
PID	Proportional Integral Derivative
PLC	Programmable Logic Controller
PTC	Proof Test Coverage
SC	Systematic Capability
SFF	Safe Failure Fraction
SIF	Safety Instrumented Function
SIL	Safety Integrity Level
SIS	Safety Instrumented System
T₁	Proof Test Interval
λ_{DD}	Rate for Dangerous Detected Failure
λ_{DU}	Rate for Dangerous Undetected Failure
λ_{SD}	Rate for Safe Detected Failure
λ_{SU}	Rate for Safe Undetected Failure

Table 2: Abbreviations

4. Document Purpose:

This document provides the Safety Manual for the HAWK Centurion CGR series level and interface transmitter. This Safety Manual is a complement to the regular user manual [17] and the Safety Requirement Specifications [5]. In addition to the safety rules in this documentation, national and regional safety rules and industrial safety regulations must also be observed.

5. General:

5.1. Primary Areas of Applications:

The HAWK range of guided radar products are ideal for the measurement of liquids, sludge, powders and granules to a range of 18.5 meters for level and interface applications. The HAWK Centurion CGR series can be used as a sub-component of a safety instrumented function operating in low demand mode, high demand and continuous demand mode.

The Safety Integrity Level (SIL) of the product is SIL-2 (high demand mode) for single channel architecture (1oo1) and SIL-3¹ for multichannel architecture (1oo2) in the following applications:

- Chemicals
- Petrochemicals
- Cement
- Food & Beverages
- Oil & Gas
- Minerals / Mining
- Pulp & Paper
- Wastewater
- Building Aggregates
- Pharmaceutical
- Energy
- Other applicable industries

The 4 to 20 mA current output can be used to output the measured value (level or interface).

5.2. Supported Standards:

- IEC61508, "Functional Safety of electrical / electronic / programmable electronic safety related systems", International Electrotechnical Commission, Geneva, 2010
- EN61326-1, "Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements", CENELEC, Brussels, 2012
- IEC61000-6-7, Electromagnetic compatibility (EMC) - Part 6-7: Generic standards - Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations", 1st Edition, International Electrotechnical Commission, Geneva, 2014

¹ Homogenous redundancy possible as device software meets SC3

- IEC61326-3-1, “Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) - General industrial applications”, 2nd Edition, International Electrotechnical Commission, Geneva, 2017
- IEC60079-0, “Explosive Atmospheres – Part 0: General requirements”, 6th Edition, International Electrotechnical Commission, Geneva, 2011
- IEC60079-1, “Explosive Atmospheres – Part 1: Equipment Protection by flameproof enclosures “d””, 7th Edition, International Electrotechnical Commission, Geneva, 2014
- IEC60079-10, “Explosive Atmospheres – Part 10: *Classification of hazardous areas*”, 2nd Edition, International Electrotechnical Commission, Geneva, 2015
- IEC60079-11, “Explosive Atmospheres – Part 11: Equipment Protection by intrinsic safety “i””, 6th Edition, International Electrotechnical Commission, Geneva, 2011
- IEC60079-26, “Explosive Atmospheres – Part 26: Equipment with Equipment Protection Level (EPL) “Ga”, 3rd Edition, International Electrotechnical Commission, Geneva, 2014
- IEC60079-31, “Explosive Atmospheres – Part 31: Equipment dust ignition protection by enclosure “t””, 1st Edition, International Electrotechnical Commission, Geneva, 2013
- Standard 3600, “Approval Standard for Electrical Equipment for Use in Hazardous Locations – General Requirements”, FM Approvals LLC, 2011
- Standard 3610, “Approval Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I,II and III, Division 1, Hazardous Locations”, FM Approvals LLC, 2015
- Standard 3611, “Approval Standard for Non-incentive Electrical Equipment for Use in Class I,II, Division 2, and Class III, Divisions 1 and 2, Hazardous Locations”, FM Approvals LLC, 2016

5.3. End User Responsibilities:

- **Authorized Personnel**
 - All operations / procedures described in this safety manual must be carried out only by trained specialist personnel authorized by the plant operator.
- **Mounting & Installation:**
 - Take note of the mounting and installation instructions of the operating instructions [17] and safety instructions [15,16]
- **Setup & Commissioning:**
 - When the device is unlocked (“de-commissioned”), the safety function must be considered as unreliable. This applies until the parameters are verified and the device is locked (“commissioned”) again.
 - The user must input setup parameters appropriate for the application – see section 7.0 Setup
 - The user must commission the unit. See section 7.2 Commissioning
 - During a “proof test” the safety function must be treated as unreliable. Take into account that the function test influences connected devices. If necessary, you must take measures to maintain the safety function.
- **Malfunctions**
 - The instrument is permanently monitored by internal diagnostic systems. If a malfunction is detected, a failure signal will be outputted. The entire system must be shut down and the process held in a safe state by other measures.
- **Decommissioning:**
 - The user must follow Section 7.4 De-commissioning
- **Device Disposal:**
 - At the end of the product lifetime or use, the transmitter must be shipped to the manufacturer for proper disposal.

5.4. Restrictions:

- The system should not be used outside of the technical specifications of the device refer to operating instructions [17]
- Only the 4 to 20mA output can be used in the safety function.
- The signal used in the logic solver must be the analogue 4 to 20mA signal proportional to the level generated.
- All parts of the measuring chain must correspond to the planned safety integrity level (SIL).
- The HART protocol signal is not SIL approved.
- “HART multi drop” mode is not permitted for SIL approved devices.

6. Product Properties:

6.1. Product Version:

This safety manual applies to all HAWK Centurion CGR series level and interface transmitter in a 2-wire, 4 to 20mA / HART with SIL qualification configuration.

Valid Versions:

- Product Part Number **CGR2L**cdeeeefgggghijkklllm
- From Hardware Version Rev01L (HWID 7) or higher
- From Software Version 20.0 or higher
- Only original probes / sensing elements from HAWK Measurement Systems Pty. Ltd. must be used

6.2. Product Identification:

An image of the IECEx marking nameplate is shown below.

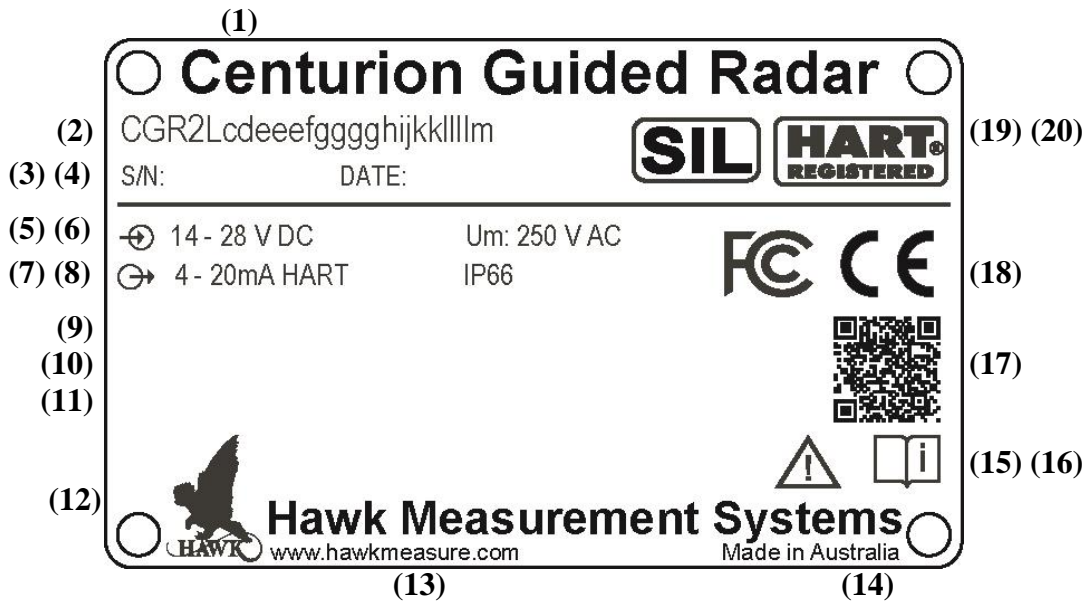


Figure 1: Marking Nameplate

- (1) Product Name
- (2) Part Number – refer to CGR part structure
- (3) Serial Number
- (4) Manufacture Date
- (5) Input supply voltage range
- (6) Maximum value of U_m applied to non intrinsically safe circuits for Hazardous Location
- (7) Output current and communications protocol
- (8) Ingress Protection rating
- (9) Approval Codes for Hazardous Location (if applicable)
- (10) Approval Codes for Hazardous Location (if applicable)
- (11) IECEx Certificate of Conformity number (if applicable)
- (12) Manufacturer Logo and Name
- (13) Manufacturer Web Address
- (14) Manufacturer country
- (15) Warning symbol and Symbol for Reference to written instructions
- (16) Warning message
- (17) Quick Reference code
- (18) FCC and CE marking symbols
- (19) Marking of the Safety Function for a Safety Instrumented System
- (20) HART Registered

6.3. Safety Function:

The element safety function of the HAWK Centurion CGR series level and interface transmitter is the quality and reliability of the transmitter signal output, i.e. measurement performance, error detection and error indication in the signal-processing path of the transmitter.

Under normal operating conditions, the level and interface transmitter generates on the current output a current between 4mA and 20mA corresponding to the measured level or measured interface. Under detected fail conditions, the measuring system generates on the current output a fail-safe state signal.

This analogue signal – equivalent to a level or interface – is transmitted to a programmable logic controller (PLC) to monitor the following conditions depending on the process application:

- **Exceeding a preset level (“Over Flow Protection”)**
- **Falling below a preset level (“Dry Run Protection”)**
- **Range Monitoring**

The current tolerance of $\pm 1\%$ ($\pm 0.16\text{mA}$) refers to the full measuring range of 16mA between 4 and 20mA. Increased measurement deviations can occur at the boundaries of the measuring range.

A connected control and processing unit must have the following properties:

- The output circuit of the level and interface transmitter is judged according to the idle current principle
- If the level and interface transmitter delivers output currents of “fail low” or “fail high”, it can be assumed that there is a malfunction. The PLC must therefore interpret such currents as a malfunction and output a suitable fault signal.

If this is not the case, the respective percentages of failure rates must be assigned to dangerous failures and values stated in chapter 6.5 predetermined.

	Overflow Protection	Dry Run Protection
4 to 20mA range	current \geq set point	current \leq set point
20 to 4mA range	current \leq set point	current \geq set point
Failure current “fail low”	$\leq 3.5\text{mA}$	$\leq 3.5\text{mA}$
Failure current “fail high”	$\geq 21.5\text{mA}$	$\geq 21.5\text{mA}$

Table 3: Fail Safe Conditions (factory default)

6.4. SIL Conformity:

The SIL conformity was independently assessed and certified by TUV Rheinland Australia & TUV Rheinland Germany according to IEC61508 [1]. The certificate is valid for the entire service life of all

instruments that were sold before the certificate expired. TUV Rheinland Germany has issued Hawk Measurement Systems Pty. Ltd. a certificate with the number 968/FSP 1375.01/18 and a test report.

The required Systematic Capability would be related to the Safety Integrity Level in most of the cases; a SIL-2 safety integrated function (SIF) would need SC-2 systematic capability in both hardware and software.

IEC61508-2 states the following:

"When the allocation has sufficiently progressed, the safety integrity requirements, for each safety function allocated to the E/E/PE safety-related system(s), shall be specified in terms of the safety integrity level and shall indicate whether the target failure measure is, either:

- The average probability of dangerous failure on demand of the safety function, (PFD_{avg}), for a low demand mode of operation, or
- The average frequency of a dangerous failure of the safety function [h^{-1}], (PFH), for a high or continuous demand mode of operation."

Safety integrity level (SIL)	Average probability of a dangerous failure on demand of the safety function (PFD_{avg})
4	$\geq 10^{-5}$ to $< 10^{-4}$
3	$\geq 10^{-4}$ to $< 10^{-3}$
2	$\geq 10^{-3}$ to $< 10^{-2}$
1	$\geq 10^{-2}$ to $< 10^{-1}$

Table 4: Target Failure Measures for a Safety Function Operating in Low Demand Mode of Operation

Safety integrity level (SIL)	Average frequency of a dangerous failure of the safety function [h^{-1}] (PFH)
4	$\geq 10^{-9}$ to $< 10^{-8}$
3	$\geq 10^{-8}$ to $< 10^{-7}$
2	$\geq 10^{-7}$ to $< 10^{-6}$
1	$\geq 10^{-6}$ to $< 10^{-5}$

Table 5: Target Failure Measures for a Safety Function Operating in High / Continuous Demand Mode of Operation

6.5. Safety Related Characteristics according to IEC61508:

Parameter:	Value:
Part Number	CGR2Lcdeeeffggghijkkllllm
Hardware Version	Rev01L (HWID 7) or higher
Software Version	20.0 or higher
Safety Integrity Level	SIL 2 @ HFT = 0 & SIL3 ² @ HFT = 1
Systematic Capability	SC 3
Instrument Type	Type B, Complex device (using microcontrollers or programmable logic)
Mode	Low / High Demand
SFF	> 90%
PFH (1oo1)	3.74×10^{-8} [1/h]
PFH (1oo2)	7.48×10^{-10} [1/h]
λ_{DD}	4.26×10^{-7}
λ_{DU}	3.74×10^{-8}
λ_D	4.63×10^{-7}
DC _{avg}	91.92%
MTTR	8 [h]
PFD _{avg} (1oo1)	1.54×10^{-4} @ T ₁ = 1 year (8760 h)
PFD _{avg} (1oo2)	3.08×10^{-6} @ T ₁ = 1 year (8760 h)
PFD _{avg} (1oo1)	3.05×10^{-4} @ T ₁ = 2 years (17520 h)
PFD _{avg} (1oo1)	7.57×10^{-4} @ T ₁ = 5 years (43800 h)

Table 6: Characteristics acc. IEC61508

² Homogenous redundancy possible as device software meets SC3

7. Setup & Commissioning:

Take note of the mounting and installation instructions in the operating manual [17]. The setup must be carried out only after unit has been installed.

The minimum parameters that require input for setup are:

- Low Level
- High Level
- Digitize (see Section 7.1)
- Tracking
- Dielectric
- Damping

The 'Damping' value must be adapted to the process safety time. User adjusted damping will affect the ability to respond to process changes. Therefore damping value plus response time should not exceed the loop requirements.

Damping uses the following formula: $\text{Change} = 1 / (1 + \text{Damping}) \times (\text{Old Level} - \text{New Level})$

- Trim 4mA – Value should be as close to 4.000mA as possible
- Trim 20mA - Value should be as close to 20.000mA as possible

For further information about system parameters, see the operating manual [17].

7.1. Digitize:

This function must be performed after physical installation of the Hawk CGR, and re-performed if there is any change to the installation. For best results It should be performed while the vessel is empty.

For applications with a programmed dielectric parameter of less than 5, Digitize must be performed while the vessel is empty.

Running the Digitize process will prompt the user with a measured distance. This distance must be either the material level if material is touching the probe, or the end of probe if the vessel is empty. If the displayed distance is not correct the user can adjust the measurement to the correct value. **Ensure the value is not greater than the distance to the material level.**

The 'Digitize' process requires the product lid closed / screwed on as this is the closest to the application scenario. When running the routine, the unit will prompt the user to close the lid followed by a countdown of 25 seconds. When completed, the unit will prompt the user to remove the lid.

7.2. Commissioning:

SIL Commissioning requires confirming and accepting unit parameters and checking readings prior to completing the commissioning process. The unit will not commission if there are error codes present or all SIL Commissioning settings have not been accepted.

The following parameters or readings must be accepted or performed for the unit to enable SILcommissioned mode. **Do not accept any readings or values which are incorrect.**

- Check Vin
- Check Temp
- Check 4mA
- Check 20mA
- Chk Current
- Chk Hi Level
- Chk Low Level
- Material Level
- Health Check

The 'Digitize' function – see 7.1 – needs to run before commissioning the unit, otherwise the unit will state a 'Mounting not calibrated' message during commissioning process.

Until this commissioning procedure is complete the unit will remain de-commissioned. The unit will state either "SIL Enable" or "SIL Disable" in the top right corner of the default display. This clearly identifies the product as a safety device.

Main Menu
 SILCommission
 Setup
 Advanced

Table 7: Commissioning Steps

Parameter / Reading	Details / Instruction
Error Codes	Displays any stored error codes since last SILcommissioning. Codes will be cleared after successful SILCommissioning. See 'Troubleshooting' 'Error Codes' for complete list
Fault Counter	Displays the number of restarts / power cycles due to self clearing errors like Input Voltage, Temperature or Probe Faults in the past. Counter will be cleared after successful SILCommissioning
Check Vin	User confirms input voltage at unit terminals matches displayed voltage within +/- 0.5V
Check Temp	User confirms housing temperature is within +/-8°C of displayed temperature Note that the displayed temperature measurement is taken on the internal electronic board.
Check 4mA	User confirms 4mA reading with a calibrated current meter on loop. Acceptable tolerance is +/- 10uA If the reading is outside of the acceptable tolerance perform a re-trim (refer to section 7)
Check 20mA	User confirms 20mA reading with a calibrated current meter on loop. Acceptable tolerance is +/- 10uA If the reading is outside of the acceptable tolerance perform a re-trim (refer to section 7)
Chk Current	User confirms current output reading with a calibrated current meter on loop. Output value can be adjusted using arrow keys. Acceptable tolerance is +/- 10uA If the reading is outside acceptable tolerance see 7.5 Troubleshooting

Chk Hi Level	Confirm High Level parameter is set correctly
Chk Lo Level	Confirm Low Level parameter is set correctly
Material LVL	Unit takes measurement of material level. Confirm reading is correct with secondary device such as manual dip. If material level distance is rejected, you will be prompted to close the unit lid and the unit will re-perform the measurement Acceptable tolerance is +/- 3mm
HealthCheck	Runs automated unit health check, Commission Step only possible after passing the health check
Commission	After all required parameters & readings are accepted unit can now be have SILCommission enabled and used for process control

7.3. SILCommission Software Menu Flowchart:

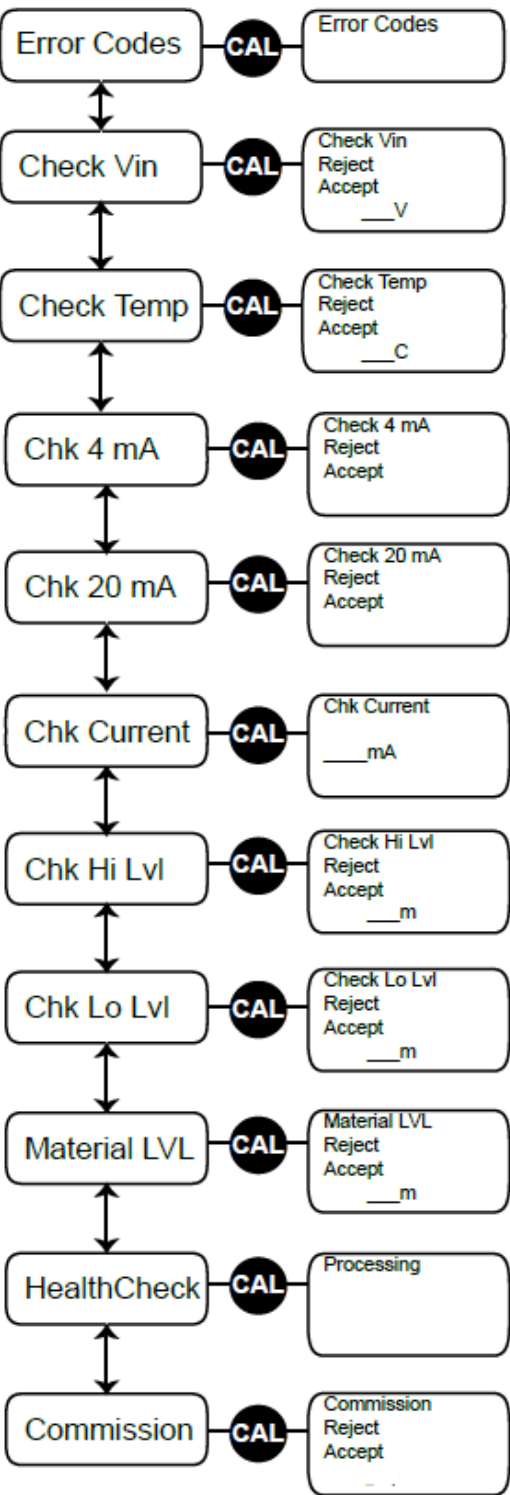


Figure 2: Software Flow Chart

7.4. De-commissioning:

To “de-commission” a SIL enabled (commissioned) unit, press the Cal key for around 5 seconds and use the unlock code 111 to access the menu structure.

When the device is unlocked (“de-commissioned”), the safety function must be considered as unreliable. This applies until the parameters are verified and the device is locked (“commissioned”) again.

7.5. Troubleshooting:

The instrument is permanently monitored by an internal diagnostic system. If a malfunction is detected, a failure signal will be outputted on the safety-relevant output. A fault message coded according to the type of fault is outputted. The fault messages are listed below. If failures are detected, the entire measuring system must be shut down and the process held in a safe state by other measures.

Digitize

- The digitization process will fail if the unit cannot detect a measurable difference between the largest false reflection and the reflection generated by either the end of probe or the material touching the probe. If this happens, ensure no structure is making contact with the probe. Also ensure mounting is correct to specification with good ground reference. Increase sensitivity value and re-run 'Digitize'.
- If Digitize displays a longer distance than the end of the probe length, adjust the 'ProbeLength' parameter in 'Advanced' menu if the Probe length has been modified.

Current

- Confirm integrity of loop. Disconnect any other devices (such as communicators). If unable to rectify there may be a hardware fault and the system should be replaced.

Error Code (Display)	Error Code (Menu)	Category	Action
Hardware Error	H101	Hardware	Info Memory Error Unit will stay in Failsafe until error is cleared. Contact local support.
Hardware Error	H102	Hardware	Digitize Data Error Unit will stay in Failsafe until error is cleared. Contact local support.
Hardware Error	H103	Hardware	Flash Memory Error Unit will stay in Failsafe until error is cleared. Contact local support.
Hardware Error	H201	Hardware	PLL Error Unit will stay in Failsafe until error is cleared. Contact local support.
Hardware Error	H202	Hardware	Loop Current Error Unit will stay in Failsafe until error is cleared. Contact local support.
Hardware Error	H203	Hardware	No Pulse Error Unit will stay in Failsafe until error is cleared. Contact local support.

Hardware Error	H204	Hardware	EMI Noise Error Unit will stay in Failsafe until error is cleared. Contact local support.
Hardware Error	H301	Hardware	ADC Error Unit will stay in Failsafe until error is cleared. Contact local support.
Hardware Error	H302	Hardware	RAM Error Unit will stay in Failsafe until error is cleared. Contact local support.
Hardware Error	H303	Hardware	uC Error Unit will stay in Failsafe until error is cleared. Contact local support.
Hardware Error	H304	Hardware	Comparator Error Unit will stay in Failsafe until error is cleared. Contact local support.
Hardware Error	H305	Hardware	Potentiometer Error Unit will stay in Failsafe until error is cleared. Contact local support.
Hardware Error	W101	Hardware	Watch Dog Error Unit will stay in Failsafe until error is cleared. Contact local support.
Hardware Error	W102	Hardware	uC Error / oscillator fault Unit will stay in Failsafe until error is cleared. Contact local support.
Voltage Error	S101	Supply	Vin Fault Unit will stay in Failsafe until voltage is back within acceptable range. After voltage is in an acceptable range for more than 90 seconds the unit will restart. Check power supply at the device terminals. Ensure voltage is within specified range (14 to 28 VDC). If voltage is correct and error occurs twice, contact local support.
Current Error	S102	Supply	Current Not Available Unit will stay in Failsafe until voltage is back within acceptable range. After voltage is in an acceptable range for more than 90 seconds the unit will restart. Check power supply at the device terminals. Ensure voltage is within specified range (14 to 28 VDC). This error indicates that the voltage is not enough to drive the loop resistance. If voltage is correct and error occurs twice, contact local support.
Hardware Error	S103	Hardware	5V Regulator Fault 5 Volt regulator line regulations out by more than 5%. Therefore level measurement cannot be relied on and unit will stay in Failsafe until error is cleared. Contact local support.
Voltage Error	S104	Supply	3.3V Regulator Fault / uC Brown Out Condition Unit will stay in Failsafe until voltage is back within acceptable range. After voltage is in an acceptable range for more than 90 seconds the unit will restart. Check power supply at the device terminals. Ensure voltage is within specified range (14 to 28 VDC). This error indicates that the uC has gone into a brown out (under voltage) condition. Contact local support.
Probe Error	P101	Probe Fault	Sensing Rod / Cable Fault Unit will stay in Failsafe until error is cleared. Perform inspection of sensing probe (rod or cable). If broken or damaged, replace the probe. If contaminated, clean sensing element. If probe is not damaged and error occurs after re-starting unit, contact local support.
Hardware Error	P102	Hardware	RF Transmit Fault Unit will stay in Failsafe until error is cleared. Contact local support.

Signal Quality Error	P103	Probe Fault	<p>Signal Quality Error</p> <p>Unit will stay in Failsafe until error is cleared.</p> <p>Measured signal quality is poor. Please adjust the sensitivity setting accordingly.</p> <p>If error occurs after re-start and adjusting the sensitivity, contact local support.</p>
Temperature Error	T101	Temperature	<p>Temperature Out of Range</p> <p>Unit will stay in Failsafe until error is cleared</p> <p>Measure ambient temperature. If temperature is out of range, - below - 40°C or above 80°C, de-energize the device until temperature is back in range. Inspect unit for damage.</p> <p>If error occurs while temperature is in range after re-start, contact local support.</p>
Hardware Error	T102	Hardware	<p>Critical Temperature Reached</p> <p>Unit will stay in Failsafe until error is cleared. This error indicates that temperature has gone out of absolute maximum specs (above 90°C) for electronic components.</p> <p>Contact local support.</p>

Table 8: Error Codes

8. Proof Test:

8.1. Scope:

To identify possible dangerous and undetected failures, the safety function must be checked by a so called “proof test” at adequate intervals (T_1). It is the user’s responsibility to choose this type of testing.

- Please carry out the test in such a way, that the correct safety function in combination with all components is granted. This is granted by the control of the response height during a filling process. If a filling up to the response height is not practicable, the measuring system has to be responded by an appropriate simulation of the level or the physical measuring effect.
- During this proof test, the safety function must be treated as unreliable. If one of the tests proves negative, the entire measuring system must be switched out of service and the process held in a safe state by means of other measures. After the test, the status specified for the safety function must be restored.
- During this proof test, inspect the level and interface transmitter for any visible damage or contamination. It is also recommended to inspect the probe for possible build up. Special tools are not required.

Additional proof tests should be done:

- During commissioning of the device
- Replacement of the device
- Reconfiguration / relocation of the device

8.2. Required Tools:

- Actual Hawk Measurement System GosHawk Version
- Actual Hawk Measurement System DTM Collection
 - The DTM suitable for Hawk Centurion CGR in conjunction with an adjustment software according to the FDT/DTM standard; e.g. PACTware
 - The device description EDD suitable for Hawk Centurion CGR
- Calibrated Reference Current Meter or PLC or process control system

8.3. Minimal Proof Test – current loop only:

The suggested proof test described below will detect **55%** (PTC) of possible dangerous undetected failures in the HAWK CGR Level & Interface Transmitter.

- a) Take appropriate steps to withdraw unit from live operation to avoid false trips.
- b) If removing unit lid in a hazardous location, take appropriate steps to ensure safe environment.
- c) Access Menu structure by pressing CAL and using the Unlock Code “111”
- d) Run Proof Test. Navigate to Main Menu > SILCommission > Chk Current. Press CAL to run function. Set current value to process low alarm and confirm loop reading. Then set value to process high alarm and confirm loop reading again.
- e) Perform a single point level Verification – see Figure 3. Leave the Main Menu by pressing RUN twice. Confirm displayed reading is correct with another device such as manual reading or reference device. Confirm loop current reading is correct with ammeter.
- f) Inspect the unit for any leaks, visible damage, or contamination.
- g) Access Menu structure by pressing CAL and navigate to Main Menu > SILCommission and follow the commissioning process – see 7.2
- h) Re-secure lid
- i) Return unit to live process operation.

8.4. Comprehensive Proof Test:

The suggested proof test described below will detect **95%** (PTC) of possible dangerous undetected failures in the HAWK CGR Level & Interface Transmitter.

Note: Verification Level checks will always be displayed in distance to level

Measured Span Reference

A	Distance - measured from base of thread or bottom of flange to material level
---	---

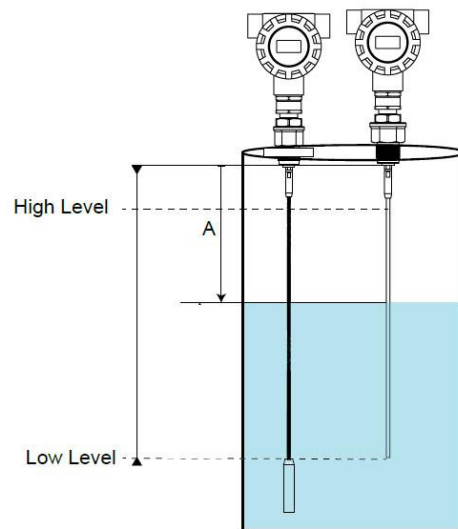


Figure 3: Verification Level Check

- Take appropriate steps to withdraw unit from live operation to avoid false trips.
- If removing unit lid in a hazardous location, take appropriate steps to ensure safe environment.
- Access Menu structure by pressing CAL and using the Unlock Code "111"
- Run Proof Test. Navigate to Main Menu > SILCommission > Chk Current. Press CAL to run function. Set current value to process low alarm and confirm loop reading. Then set value to process high alarm and confirm loop reading again.
- Run High Level Verification. Navigate to Main Menu > SILCommission > Chk Hi Level and press CAL. Confirm High Level value is correct.
- Run Low Level Verification. Navigate to Main Menu > SILCommission > Chk Lo Level and press CAL. Confirm Low Level value is correct.
- Perform a single point level Verification – see Figure 3. Leave the Main Menu by pressing RUN twice. Confirm displayed reading is correct with another device such as manual reading or reference device. Confirm loop current reading is correct with ammeter.
- Perform High Alarm Level Verification. Run process to High Alarm level. Confirm displayed reading is correct for High Alarm with another device such as manual reading or reference device. Confirm loop current reading is correct with ammeter.

- i) Perform Low Alarm Level Verification. Run process to Low Alarm level. Confirm displayed reading is correct for Low Alarm with another device such as manual reading or reference device. Confirm loop current reading is correct with ammeter.
- j) Inspect the unit for any leaks, visible damage, or contamination.
- k) Access Menu structure by pressing CAL and navigate to Main Menu > SILCommission and follow the commissioning process – see 7.2
- l) Re-secure lid
- m) Return unit to live process operation.

9. Appendix:

9.1. Proof Test Report Example:

Product Identification	
Company / Tester:	
Plant / Instrument:	
Measurement Loop / SIF:	
Instrument Type / Order Code:	
Serial Number:	
Setup / Commission Date:	
Date of last function test:	
Test Scope	
<input type="checkbox"/>	Setup / Commissioning without reoccurring proof test
<input type="checkbox"/>	Setup / Commissioning with reoccurring proof test
<input type="checkbox"/>	Reoccurring Proof Test – Minimal
<input type="checkbox"/>	Reoccurring Proof Test - Comprehensive
Mode	
<input type="checkbox"/>	Overflow Protection
<input type="checkbox"/>	Dry Run Protection
<input type="checkbox"/>	Range Monitoring
Adjusted Parameters for SIF documented	
<input type="checkbox"/>	YES
<input type="checkbox"/>	NO

Test Results - Loop Only		
High Alarm Current Set	Current Value Output	Result
		Pass / Fail

Low Alarm Current Set		Current Value Output	Result
			Pass / Fail
Level	Expected Measured Value	Real Value	Result
			Pass / Fail


Comprehensive Proof Test			
High Alarm Current Set		Current Value Output	Result
			Pass / Fail
Low Alarm Current Set		Current Value Output	Result
			Pass / Fail
Level	Expected Measured Value	Real Value	Result
			Pass / Fail
Overflow Protection		Trip Safety Function Yes / No	Result Pass / Fail
Dry Run Protection		Trip Safety Function Yes / No	Result Pass / Fail

Range Monitoring				
Point	Level	Expected Measured Value	Real Value	Result
Level 1				Pass / Fail
Level 2				Pass / Fail
Level 3				Pass / Fail
Level 4				Pass / Fail
Level 5				Pass / Fail

Table 9: Test Report Example

9.2. Certificate:

Certificate



No.: 968/FSP 1375.01/18

Product tested	Level Transmitter	Certificate holder	Hawk Measurement Systems Pty. Ltd. 15-17 Maurice Crt. Nunawading, Victoria 3131 Australia
Type designation	Centurion Guided Radar CGR2L		
Codes and standards	IEC 61508 Parts 1-7:2010	IEC 61326-3-1:2017	
Intended application	The level transmitter complies with the requirements of the relevant standards (Hardware Safety Integrity SIL 2 according to IEC 61508 and Systematic Capability SC 3) and can be used in applications up to SIL 2 (HFT=0) resp. SIL 3 (HFT=1) for the safety functions MIN, MAX or monitoring of a range. The product was also reviewed for the use in the application area of IEC 61511-1 up to SIL 2 (HFT=0) / SIL 3 (HFT=1).		
Specific requirements	The instructions of the associated Operating Manual and Safety Manual shall be considered.		
Valid until 2023-03-28			


The issue of this certificate is based upon an examination, whose results are documented in Report No. 968/FSP 1375.01/18 dated 2018-03-28.
This certificate is valid only for products which are identical with the product tested.

Köln, 2018-03-28

TÜV Rheinland Industrie Service GmbH

Bereich Automation
Funktionale Sicherheit
Am Grauen Stein, 51105 Köln

Certification Body Safety & Security for Automation & Grid



Dr.-Ing. Thorsten Gantevoort

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