Centurion CGR Series
Safety Manual

Document No. SIL0008

Version 1.7

17/04/2018

1. Revision History:

Revision	Author	Reviewed	Approved	Update Details	Date
0.1	Klaus Lorentschitsch	Dr Issam Mukhtar	Not yet approved	Original Document, Safety Manual	16/01/17
0.2	Klaus Lorentschitsch	Dr Issam Mukhtar	Not yet approved	Menu Structure Proof Test	24/02/17
1.0	Klaus Lorentschitsch	Dr Issam Mukhtar	Not yet approved	1st Submission Version	07/03/17
1.1	Klaus Lorentschitsch	Dr Issam Mukhtar	Not yet approved	Proof Test revised Failure Data added	15/05/17
1.2	Klaus Lorentschitsch	Dr Issam Mukhtar	Not yet approved	Final Version	01/09/17
1.3	Klaus Lorentschitsch	Dr Issam Mukhtar	Approved	Digitize Function and final SW version added	08/11/17
1.4	Klaus Lorentschitsch	Dr Issam Mukhtar	Approved	Product part number added, failure data updated	21/01/18
1.5	Klaus Lorentschitsch	Dr Issam Mukhtar	Approved	HW failure code added, remove “Park Current” option in menu structure	14/02/18
1.6	Klaus Lorentschitsch	Dr Issam Mukhtar	Approved	HW failure code added, unlock code changed	28/02/18
1.7	Klaus Lorentschitsch	Dipl. Ing. Andreas Hesse	TUV Approved	Product Release Version, SIL3 for HFT=1 and certificate added	17/04/18

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

[16] *"Safety Instructions – CGR – Zone 20/21, Centurion Guided Radar Series"*, Document No. SI0051, Rev 1.1, HAWK Measurement Systems, Melbourne, 2016

[17] *"Centurion Guided Radar – CGR Series – User Manual"*, Document No. DOC-CGR-MAN, Rev 1.28, HAWK Measurement Systems, Melbourne, 2018

Contents

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
T_1	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-3[1] 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]
  - During the setup procedure, a check of the safety function by means of an initial filling / emptying is recommended

- **Operation:**
  - Device parameters must not be modified or adjusted during operation.
    - For protection against unwanted or unauthorized adjustment, parameters must be protected against unauthorized access.
    - To avoid possible errors during parameter adjustment for unsafe operating environments, a verification procedure is used that allows safety relevant parameters to be checked.
      - Unlock
      - Change parameters
      - Verify & lock (“commissioned” / “SIL Enabled”)
    - 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 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.
  - If due to a detected failure the electronics or the complete product is exchanged, the manufacturer must be informed including a fault description. **In case of a complete exchange, the faulty unit must be shipped to the manufacturer for further investigations.**

- **Decommissioning:**
  - 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.
  - **After decommissioning at the end of the product lifetime, the level and interface transmitter must be shipped to the manufacturer for proper disposal.**

5.4. Restrictions:

- The system should be used appropriately taking temperature, pressure, density, dielectric value and chemical properties of the medium into account.

- Instructions to critical process and vessel situations are described in the operating instruction manual.

- The user specific limits must be complied with. The specifications of the operating instructions manual must not be exceeded.

- Since the plant conditions influence the functional safety of the product, the parameters must be set according to the application.

- 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.

- DCS or safety logic solver should be configured to handle both High alarm and Low alarm. It is also required that the transmitter is configured for High or Low alarm.

- All parts of the measuring chain must correspond to the planned safety integrity level (SIL).

- HART protocol can only be used for setup, calibration and diagnostic purpose, not for safety critical operation.

- “HART multi drop” mode is not permitted for SIL approved devices.

- External power failure rates are not included.

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**cdeeefgggghijkkllllm
- 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

The HAWK Centurion CGR series is certified under IECEx standards for installation in hazardous gas & dust locations according to IECEx Certificate of Conformity IECEx TSA 14.0037A.

When HAWK CGR equipment is installed and mounted in hazardous areas, user manual, safety and operating instructions, the general Ex installation regulations and the general installation regulations for electrical equipment must all be observed. Installation of Ex instruments should only be made by suitably trained personnel.

6.2. Product Identification:

An image of the IECEx marking nameplate is shown below.

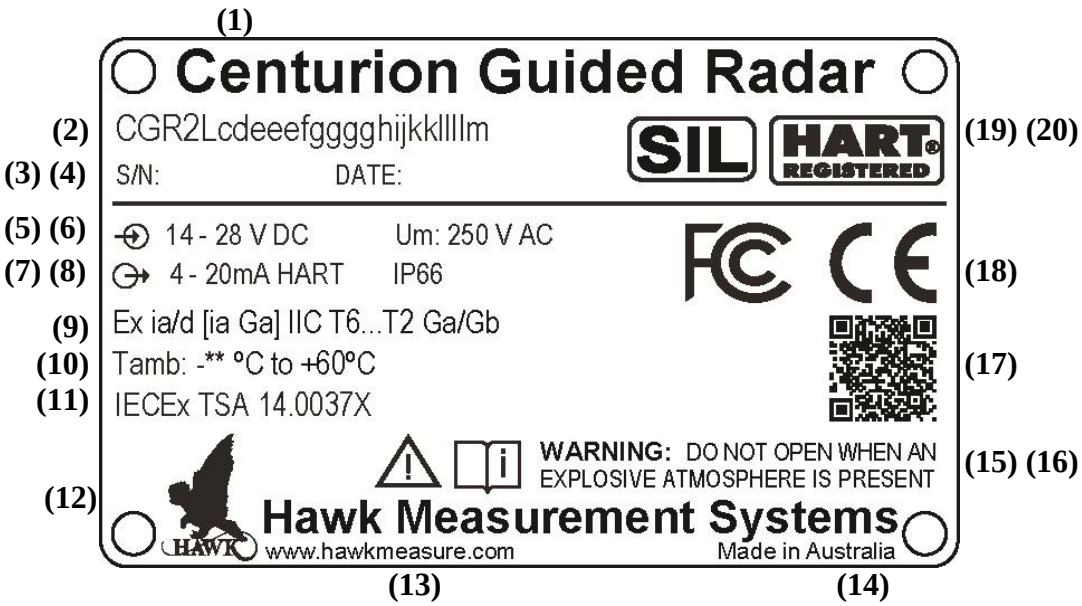


Figure 1: IECEx Marking Nameplate

(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
(10) Approval Codes for Hazardous Location
(11) IECEx Certificate of Conformity number
(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, as configured by the user.

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 ±1% (±0.16mA) 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 ≥ set point	current ≤ set point
20 to 4mA range	current ≤ set point	current ≥ set point
Failure current "fail low"	≤ 3.5mA	≤ 3.5mA
Failure current "fail high"	≥ 21.5mA	≥ 21.5mA

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 stats 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	CGR2Lcdeeefgggghijkkllllm
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)	4.1×10^{-8} [1/h]
PFH (1oo2)	8.2×10^{-10} [1/h]
λ_{DD}	4.17×10^{-7}
λ_{DU}	4.01×10^{-8}
λ_{D}	4.57×10^{-7}
DC_{avg}	91.23%
MTTR	8 [h]
PFD_{avg} (1oo1)	1.8×10^{-4} @ T_1 = 1 year (8760 h)
PFD_{avg} (1oo2)	3.6×10^{-6} @ T_1 = 1 year (8760 h)
PFD_{avg} (1oo1)	3.24×10^{-4} @ T_1 = 2 years (17520 h)
PFD_{avg} (1oo1)	8.05×10^{-4} @ T_1 = 5 years (43800 h)

Table 6: Characteristics acc. IEC61508

[2] Homogenous redundancy possible as device software meets SC3

7. Setup:

Take note of the mounting and installation instructions in the operating manual [17]. The setup must be carried out under process conditions. Check the wiring is correct and all connections are secure.

For detailed installation requirements for hazardous locations please refer to appropriate safety instruction [15, 16] documents:

- The CGR sensing probe can be installed into hazardous zones 0, 1 or 2, in gas groups IIC, IIB or IIA, whereas the transmitter enclosure can only be installed into zones 1 or 2.
- The CGR sensing probe can be installed into hazardous zones 20, 21 or 22, in dust groups IIIC, IIIB or IIIA, whereas the transmitter enclosure can only be installed into zones 21 or 22.

If the transmitter is pre-configured at the factory according to the ordering specifications, no further basic configuration is required unless application conditions have changed. It is highly recommended that prior to changing any parameters, save your current configuration as a backup file. If for any reason configuration data is lost or accidentally modified making the device inoperable, this backup file can be reloaded into the device. A safety-certified transmitter should always be protected from unintentional configuration changes by a password protected function.

Temperature:

The allowed product ambient temperature is specified between -40ºC and 80ºC. The temperature is measured on the actual PCB. Therefore there will be a slight difference in ambient temperature between the unit housing and the electronic board. The measurement will be slightly lower for positive temperature and slightly higher for negative temperature due to heat transfer between housing and electronic boards. Most of the electronic components are rated up to 125ºC but Hawk decided to keep a critical temperature set at 90ºC. This means that the unit will recover from an over temperature fault between 80ºC and 90ºC with de-energizing and a power cycling the unit once the temperature is below 80ºC. Should the ambient temperature have reached 90ºC or more, please contact your local Hawk support.

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.

Alarm Levels:

DCS or safety logic solver should be configured to handle both High alarm and Low alarm. It is also required that the transmitter is configured for High or Low alarm. It is assumed that the current output signal is fed to a SIL 2-compliant analogue input board of a safety logic solver. **Only the High or Low Alarm Mode can be used for the safety function.**

7.1. Digitize:

The 'Digitize' function is a setup routine to create a digital map of false echoes generated by problems such as non-recommended mounting. **Hawk Measurement Systems highly recommends performing this function after physical installation of the Hawk CGR on an empty tank for the application.**

During the process the unit will prompt a measured distance; this must be either the material level if material is touching the probe, or the end of probe, if the vessel is empty. The distance is adjustable if the displayed distance is not correct. **Ensure the value is not greater than the distance to the material level.**

- 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 closer distance than the material level or end of probe, enter the distance to the correct material level or probe end. The unit will automatically eliminate the detected echo and find the correct level.

- 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.

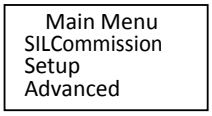
Running the 'Digitize' function is required to run the 'Probe Fault' feature correctly. 'Probe Fault' enables the detection of a “loss of probe” or a “broken probe”. 'Probe Fault' will activate Failsafe in the event of a missing or broken probe.

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 '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.



Parameter	Acceptance	Instruction Required?
Error Codes	Yes	See 'Troubleshooting' 'Error Codes'
Fault Counter	Yes	Displays the number of restarts / power cycles due to self clearing errors like Input Voltage, Temperature or Probe Faults in the past.
Check Vin	Yes	Confirm voltage input at unit terminals is in range (14 to 28 VDC) with multimeter.
Check Temp	Yes	Confirm unit temperature (ambient) is within acceptable range (-40ºC to 80ºC). Note that the temperature measurement happens on the electronic board. Therefore the reading can be a bit lower than the ambient temperature on the housing.
Check 4mA	Yes	Confirm 4mA reading with a calibrated current meter on loop
Check 20mA	Yes	Confirm 20mA reading with a calibrated current meter on loop
Chk Current	Yes	Confirm current output reading with a calibrated current meter on loop. Output value can be adjusted using arrow keys.
Chk Hi Level	Yes	Ensure High Level parameter is set correctly
Chk Lo Level	Yes	Ensure Low Level parameter is set correctly
Material LVL	Yes	Unit takes measurement of material level. Confirm reading is correct with secondary device such as manual dip.
HealthCheck	No	Runs automated unit health check, Commission Step only possible after passing the health check
Commission	Yes	Run to finalize commissioning process and return unit to active measurement

Table 7: Commissioning Steps

7.3. Commissioning Flowchart:

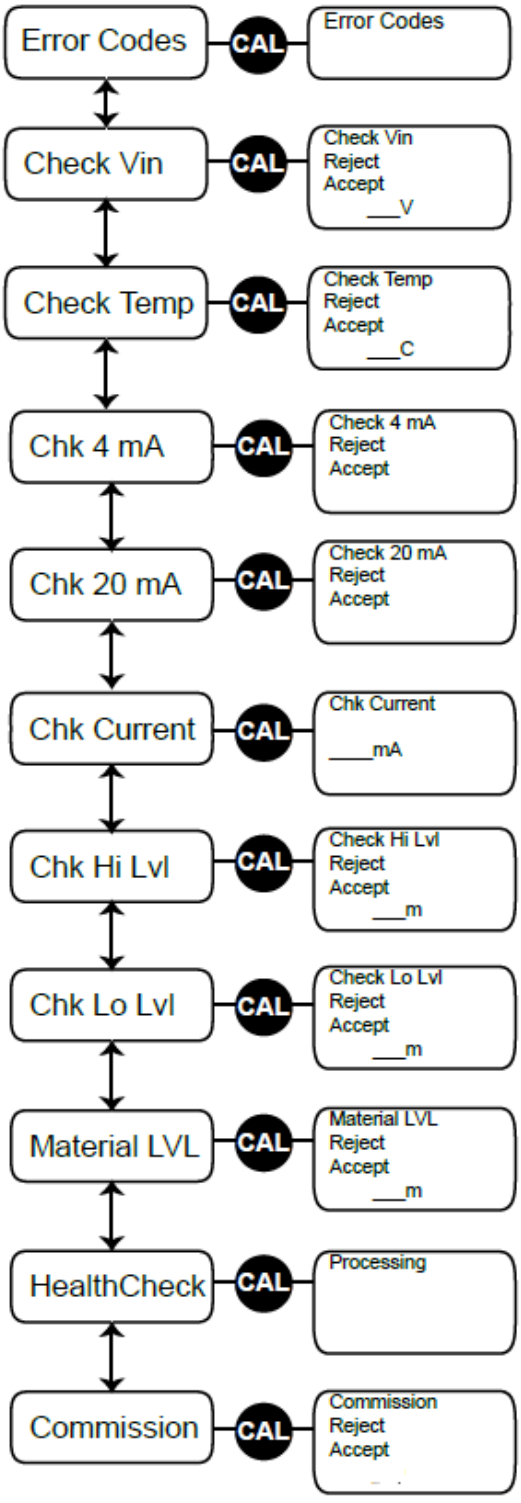


Figure 2: Software Flow Chart

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.

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.

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

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

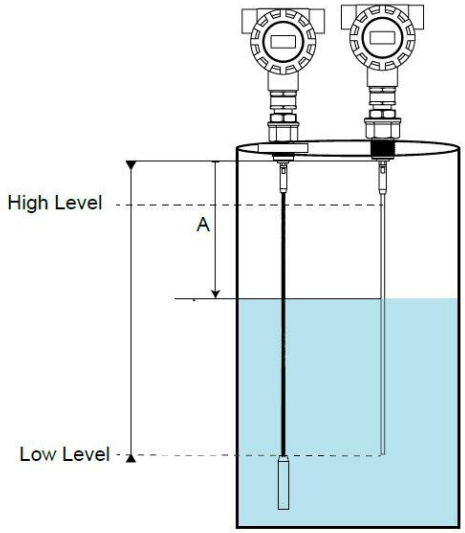


Figure 3: Verification Level Check

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) Run High Level Verification. Navigate to Main Menu > SILCommission > Chk Hi Level and press CAL. Confirm High Level value is correct.
f) Run Low Level Verification. Navigate to Main Menu > SILCommission > Chk Lo Level and press CAL. Confirm Low Level value is correct.
g) 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.

h) 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	
☐	Setup / Commissioning without reoccurring proof test
☐	Setup / Commissioning with reoccurring proof test
☐	Reoccurring Proof Test – Minimal
☐	Reoccurring Proof Test - Comprehensive

Mode	
☐	Overflow Protection
☐	Dry Run Protection
☐	Range Monitoring

Adjusted Parameters for SIF documented	
☐	YES
☐	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

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Funktionale Sicherheit
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DAkkS Deutsche Akkreditierungsstelle D-ZE-11052-02-01

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Precisely Right.

9.3. Table of Contents:

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Printing Date: 17 April 2018