Honeywell

SLG 700
SmartLine Level Transmitters
Guided Wave Radar
Safety Manual

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About This Document

Release Information

SLG 700 SmartLine Transmitter HART® Communications Options Safety Manual, Document # 34-SL-35-05.

Revision	Date of Change	Details of Change
1.0	July 2015	First release
2.0	June 2016	R101 including SLG726
3.0	December 2016	Updates for R102 release
4.0	December 2017	Updates for R200 release

References

The following list identifies publications that may contain information relevant to the information in this document.

SLG 700 SmartLine Level Guided Wave Radar Transmitter User's Manual, Document #34-SL-25-11

SLG 700 HART Communications Manual, Document #34-SL-25-06

SLG 700 Fieldbus Communications Manual, Document #34-SL-25-07

SLG 700 Quick Start Guide, Document #34-SL-25-04

SLG 700 SmartLine Level Transmitter Guided Wave Radar Specification, Document #34-SL-03-03

Patent Notice

The Honeywell SLG 700 Smartline Level Transmitter family is covered by one or more of the following U. S. Patents 9329072, 9329073, 9476753 and 9518856 and 9329074, 9574929, 9618612, 9711838 and their foreign equivalents and other patents pending.

Support and Contact Information

For Europe, Asia Pacific, North and South America contact details, refer to the back page of this manual or the appropriate Honeywell Solution Support web site:

Honeywell Process Solutions	www.honeywellprocess.com
SmartLine Level Transmitters	https://www.honeywellprocess.com/en-US/explore/products/instrumentation/process-level-sensors/Pages/smartline-level-transmitter.aspx
Training Classes	http://www.honeywellprocess.com/en-US/training

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Terms and Abbreviations

1oo1	One out of one
Basic Safety	The equipment must be designed and manufactured such that it protects against risk of damage to persons by electrical shock and other hazards and against resulting fire and explosion. The protection must be effective under all conditions of the nominal operation and under single fault condition
DU	Dangerous Undetected failures
FMEDA	Failure Modes, Effects and Diagnostic Analysis
Functional Safety	The ability of a system to carry out the actions necessary to achieve or to maintain a defined safe state for the equipment / machinery / plant / apparatus under control of the system
GTS	Global Technical Support Center
HART®	Highway Addressable Remote Transmitter
Handheld Configurator	Honeywell MC Toolkit (MCT404) Handheld Configurator or other handheld device capable of communicating using the HART® protocol.
HFT	Hardware Fault Tolerance
Low demand mode	Mode, where the frequency of demands for operation made on a safety-related system is no greater than one per year and no greater than twice the proof test frequency.
PFD^{AVG}	Average Probability of Failure on Demand
Safety	Freedom from unacceptable risk of harm
Safety Assessment	The investigation to arrive at a judgment - based on evidence - of the safety achieved by safety-related systems. Further definitions of terms used for safety techniques and measures and the description of safety related systems are given in IEC 61508-4.
SFF	Safe Failure Fraction, the fraction of the overall failure rate of a device that results in either a safe fault or a diagnosed unsafe fault.
SIF	Safety Instrumented Function, a set of equipment intended to reduce the risk due to a specific hazard (a safety loop).
SIL	Safety Integrity Level, discrete level (one out of a possible four) for specifying the safety integrity requirements of the safety functions to be allocated to the E/E/PE safety-related systems where Safety Integrity Level 4 has the highest level of safety integrity and Safety Integrity Level 1 has the lowest.
SIS	Safety Instrumented System – Implementation of one or more Safety Instrumented Functions. A SIS is composed of any combination of sensor(s), logic solver(s), and final element(s).

Contents

Tables

1 — Requirements

Requirements for use of the manual

This manual is for users with the models SLG720 and SLG726 Level Transmitter with the HART® with SIL. Any other model of the SLG 700 Level Transmitter or option is not specifically covered by this manual.

IEC 61508 Ed. 2.0 compliant hardware/software revisions for the SLG720 and SLG726 can be found in the Exida and TÜV Certification Reports. In addition, the most recent release information can be found in the following document:
SmartLineHARTSLGFirmwareRevisions.zip

2 — Safety Function

Primary Safety Functions

The SLG720 and SLG726 measure the liquid level of a process and report the measurement within a safety accuracy of 2%.

Secondary Safety Functions

The SLG720 and SLG726 performs automatic diagnostics to detect internal failures and reports these failures via out of band signals on the 4 – 20mA output. The transmitter must be power cycled or issued a soft reset command (HART command 42) to recover from this condition.

Systematic Integrity: SIL 3 Capable

SIL 3 Capability

The product has met manufacturer design process requirements of Safety Integrity Level (SIL) 3. These are intended to provide sufficient integrity against systematic errors of design by the manufacturer. A Safety Instrumented Function (SIF) designed with this product must not be used at a SIL level higher than the statement without “prior use” justification by end user or diverse technology redundancy in the design. This is a Type B device.

3 — Designing with the SLG720 and SLG726

Diagnostic Response Time

The SLG720 and SLG726 will report an internal failure within 90 minutes of fault occurrence (worst case).

The transmitter will be put to failsafe current if

1. The PV is not updated within five seconds.
2. Current is not as expected for a 1 minute period;
3. Electronics fault is found;
4. A valid level is not detected for a user-configurable time of 3 to 900 seconds.

The transmitter must be power cycled or soft reset (HART Command 42) to recovery from this failsafe condition.

Note: Item 1 indicates that the sensor electronics is not updating the PV as quickly as it should which may indicate an electronics fault. This is different from item 4 which can be caused by transient process conditions such as turbulence and certain foams and emulsions. If the transmitter is being used for safety functions, ensure that the transmitter can read the worst-case process conditions.

Logic Solver Inputs

The logic solver must be configured so that the engineering range in the transmitter matches the expected range of the logic solver.

To take advantage of the internal diagnostics in the SLG720 and SLG726, the logic solver must be configured to annunciate an out of band current reading (greater than 20.8 mA. or less than 3.8 mA.) in standard configuration or (greater than 20.5 mA. or less than 3.8 mA) with Namur configuration as a diagnostic fault. The logic solver configuration must consider the slew time of the current signal and ensure that filtering is used to prevent a false diagnostic failure annunciation.

Reliability data and lifetime limit

A detailed Failure Mode, Effects, and Diagnostics Analysis (FMEDA) report is available from HONEYWELL. This report details all failure rates and failure modes, common cause factors for applications with redundant devices and the expected lifetime of the SLG720 and SLG726.

The SLG720 and SLG726 are intended for low demand mode applications up to SIL 2 for use in a simplex (1oo1) configuration, depending on the PFD^{AVG} calculation of the entire Safety Instrumented Function. SLG720 and SLG726 are classified as type B devices according to IEC61508, having a hardware fault tolerance of 0.

The development process of the SLG720 and SLG726 are certified up to SIL3, allowing redundant use of the transmitter up to this Safety Integrity Level, depending the PFD^{AVG} calculation of the entire Safety Instrumented Function.

When using the SLG720 and SLG726 in a redundant configuration, a common cause factor should be included in reliability calculations. For reliability calculation details, useful lifetime and SFF, see the FMEDA report.

The reliability data listed in the FMEDA report is only valid for the useful lifetime of the SLG720 and SLG726. The failure rates of the SLG720 and SLG72 may increase sometime after this period. Reliability calculations based on the data listed in the FMEDA report for mission times beyond the lifetime may yield results that are too optimistic, i.e. the calculated Safety Integrity Level will not be achieved.

Environmental limits

The environmental limits of the SLG720 and SLG726 are specified in the customer spec sheets as given in the table below.

Table 1 Model numbers

Model	Specification
SLG 700 Smartline Level Transmitter Model #SLG720 and SLG726	34-SL-03-03

Application limits

The applications of the SLG720 and SLG726 are described in the *SLG 700 SmartLine Transmitter User's Manual*, Document #34-SL-25-11. If the transmitter is used outside of these applications, such as in extreme foam or in close proximity to obstacles, then the FMEDA report's reliability data becomes invalid.

4 — Installation of the SLG720 AND SLG726

There are no additional installation practices required for safety operation beyond those outlined in the *SLG 700 SmartLine Transmitter User's Manual*, 34-SL-25-11. The hardware write protect jumper as well as the software write protect must be used in combination to prevent configuration or calibration changes during safety operation.

Setting the hardware jumper should only be done when conditions are safe to permit physical access to the transmitter electronics. Refer to the SLG 700 SmartLine Transmitter User's Manual for details concerning the write protect jumper.

The software write protect provides a password based feature that helps avoid accidental configuration changes. The software write protect can be enabled and disabled from a HART host. Access from a HART host is permitted only when not in safety operation. Note that the hardware write protect must also be disabled in addition to the software write protect in order to permit write operations.

During safety operation HART enabled devices including a HART host and hand held configuration tools are not permitted to access the transmitter either over the 4-20mA loop or at the terminal interface of the transmitter itself and must be physically disconnected. Physical access security features such as conduits and junction boxes should be considered to reduce the risk of unauthorized connections.

IEC 61508 Ed. 2.0 compliant hardware/software revisions for the SLG720 and SLG726 can be found in the Exida and TÜV Certification Reports. In addition, the most recent release information can be found in the following document:
https://www.honeywellprocess.com/library/support/Public/Documents/SmartLine-HART-SLG-firmware-revisions.zip

Parameter settings

The following parameters must be set in order to maintain the designed safety integrity:

Table 2 Safety Parameters

Failsafe* Current Output (Upscale/Downscale)	The transmitter is shipped with a default failsafe direction of upscale (21.0mA.). This is acceptable for all high trip applications. For low trip applications, the fail-safe direction is downscale (3.6 mA.). A jumper on the transmitter may be changed to accomplish this action, see the User's Manual.
Latching mode	Latching must be selected to maintain designed safety integrity. If the transmitter enters a failsafe condition, the transmitter must be repowered to take it out of an alarm condition.
Engineering Range	All engineering range parameters must be entered to match the trip points in the safety logic solver. These parameters must be verified during the installation and commissioning to ensure that the correct parameters are set in the transmitter. Engineering range parameters can be verified by reading these parameters from the local display or by verifying the calibration of the transmitter.

*Note: Failsafe is sometimes referred to as Burnout in other documentation

5 — Operation and Maintenance of the SLG720 and SLG726

Proof tests

The objective of proof testing is to detect failures within the SLG720 and SLG726 that are not detected by the automatic diagnostics of the transmitter. Of main concern are undetected failures that prevent the safety instrumented function from performing its intended function.

The frequency of proof testing, or the proof test interval, is to be determined in reliability calculations for the safety instrumented functions for which the SLG720 and SLG726 are applied. The Exida exSILentia® tool is recommended for these calculations. The proof tests must be performed more frequently than, or as frequently as specified in the calculation in order to maintain the required safety integrity of the safety instrumented function.

Two proof tests are detailed below. The comprehensive proof test will detect 45% of all failures, and the simple proof test will detect 20% of all failures. The comprehensive test is recommended but the simple test may be necessary as it does not require a change in product level.

The results of the proof test must be documented and this documentation must be part of a plant safety management system. Any failures that are detected and that compromise functional safety should be reported to the Global Technical Support Center (GTS). The person(s) performing the proof test of the SLG720 and SLG726 should be trained in SIS operations, including bypass procedures, transmitter maintenance and company Management of Change procedures.

Refer to the SLG 700 Smartline Transmitter User's Manual for more details regarding the execution of the following proof tests.

Comprehensive Proof Test

CAUTION
Take the device out of the control loop before executing the proof test. Failure to do so may result in unsafe conditions.

In addition to a min-to-max current output verification, a two-point measurement verification corresponding to the configured lower and upper range values (LRV and URV) is recommended in order to verify the entire measurement range of the transmitter. As measurements are dependent on transmitter configuration, the level tests must be done on the product normally used.

Tools required are: HART host (HART handheld configurator or PC with HART modem and software), precision electrical meters for measuring current and voltage. Auxiliary measurement devices used for calibration must be precise, and certified for correct operation.

Table 3 Proof Test Procedure

Step	Action
1	*This step checks for primary seal failure.* Examine the transmitter for signs of corrosion or process fluid leakage.
2	*This step checks for probe failure and causes of false reflections.* Examine the waveguide for signs of mechanical damage or unwanted product buildup.
3	Bypass the safety PLC or take other appropriate action to avoid a false alarm, following Management of Change procedures.
4	Connect the HART host and establish communications.
5	*This step checks for possible quiescent current related failures.* Set the Write Protect (WP) jumper to the OFF position. Send a HART command to the transmitter to go to the low alarm current output and verify that the analog current reaches that value (to accuracy 0.01% + inaccuracy due to meters used). Verify that the voltage on the terminals is within the range 14.0 to 42.4 V (maximum is 30 V for IS applications).
6	*This step tests for compliance voltage problems such as a low loop power supply voltage or increased wiring resistance. This also tests for other possible failures.* Send a HART command to the transmitter to go to the high alarm current output and verify that the analog current reaches that value (to accuracy 0.01% + inaccuracy due to meters used). Verify that the voltage on the terminals is within the range 14.0 to 42.4 V (maximum is 30 V for IS applications).
7	Command the transmitter to produce the loop current (based on the level measurement).
8	*Steps 8 – 10 verify that the gauge is measuring accurately and that the PV is properly configured.* Set the process level to be near the lower range value and confirm the level reported is correct. Note that the level should be between the upper and lower range values (URV and LRV) and inaccuracies of alternate measurement devices must be accounted for.
9	Perform a full echo curve capture using a DTM or DD-based tool and examine the curve for false reflections which may cause a false level reading.
10	Set the level near the upper range value and confirm the level reported is correct. Note that the level should be between the upper and lower range values (URV and LRV) and inaccuracies of alternate measurement devices must be accounted for.
11	Use the HART host to view the detailed critical and non-critical device status to ensure no alarms or warnings are present in the transmitter.
12	Verify all safety critical configuration parameters (refer to Table 2).
13	Set the Write-Protect (WP) jumper position to the ON position. Check that it is not possible to write parameters to the transmitter. Note: if this is done using the display, if WP mode is ON, it will not be possible to enter the configuration screens.
14	Restore the loop to full operation.
15	Remove the bypass from the safety PLC or otherwise restore normal operation.

Simple Proof Test:

CAUTION

Take device out of the control loop before executing the proof test. Failure to do so may result in unsafe conditions.

The following proof test is recommended when it is not possible to change the process level for the test. It consists of a simple HART-driven min to max output test. The test comprises a subset of the comprehensive test procedure.

Tools required are: HART handheld configurator or PC with HART modem and software and precision electrical meters.

Table 4 Simple Proof Test

Step	Action
1-7	Steps 1-7 of Comprehensive Proof Test procedure
8	Step 9 of Comprehensive Proof Test procedure (note that obstacles below the surface level may not be visible).
9-13	Steps 11-15 of the Comprehensive Proof Test procedure.

Remote Parameter Configuration Verification

When configuring the SLG720 and SLG726 through a remote host, it is recommended that parameters that affect the 4-20mA analog output be verified using an alternate utility before using the transmitter in a SIS. This helps to ensure that the parameters that are entered remotely by the host are not inadvertently changed from the user intended values. For instance, the values can be read using a PACTWare™ based DTM, and verified on a handheld configurator.

The procedure can consist of listing the parameters and their values entered in the host application. Then, using an alternative application, the same parameters are read back and noted in the same form. The form is then signed, dated, and filed for future reference. See Table 5 - Example Verification Form for an example of this form.

Note that using the same host application to verify the remotely entered values will not provide as much assurance as using an alternate application.

Table 5 - Example Verification Form

Parameter	Host Value	Verified Value
Distance Units		
Volume Units		
Velocity Units		
Measured Products		
Vapor Dielectric Constant		
Upper Product Dielectric Constant		
Lower Product Dielectric Constant		
Maximum Filling Rate		
Sensor Height		
Level offset		
Maximum Product Level		
PV Selection		
Upper Range Value		
Lower Range Value		
PV Damping		
Echo Lost Timeout		
Latching Mode		
Sensor Connection Type		
Mounting Location		
Mounting Angle		
Nozzle/Stillwell/Bypass Diameter		
Nozzle Height		
Full Tank Detection		
Amplitude Tracking		
Background Type		
Dynamic Background		
Use Field Background		
Probe Type		
Probe End Type		
Probe Length		
Centering Disk Type		
Centering Disk Diameter		
Propagation factor		
Blocking Distance High		
Blocking Distance Low		
Blocking Zone Action		
Linearization Enabled		

Linearization Table	**Measured Level**	**Correct Level**
Volume Calibration Method		
Parameter	**Host Value**	**Verified Value**
Tank Shape		
Tank Diameter		
Tank Height		
Tank Length		
Tank Width		
Volume Offset		
Volume Strapping Table	**Level**	**Volume**

Parameter	Host Value	Verified Value
Upper Product Attenuation		
Lower Product Attenuation		
Vapor Attenuation		
Reference Width		
Reference Attenuation		
Reference Gain		
Reference Objective Function Threshold		
Surface Width		
Surface Attenuation		
Surface Gain		
Surface Objective Function Threshold		
Interface Width		
Interface Attenuation		
Interface Gain		
Interface Objective Function Threshold		
End Of Probe Width		
End Of Probe Attenuation		
End Of Probe Gain		
End Of Probe Objective Function Threshold		
Process Connector Width		
Process Connector Attenuation		
Process Connector Gain		
Process Connector Objective Function Threshold		
Steam Reference Width		
Steam Reference Attenuation		
Steam Reference Gain		
Steam Reference Objective Function Threshold		
Calibration Offset		
NAMUR Enabled		
Write Protection Enabled		
Amplitude Tracking		
Background Type		
Dynamic Background		
Verified By:		
Date:		

Repair and replacement

Any failures that are detected and that compromise functional safety should be reported to the Global Technical Support Center (GTS). When replacing the SLG720 and SLG726 the procedures in the *SLG 700 Transmitter User's Manual*, Document #34-SL-25-11 should be followed.

Firmware update

The user will not be required to perform any firmware updates. If the user has selected the firmware upgrade option, it can be done by Honeywell service representative.

Security Guidelines

1. Ensure the device has Hardware/ Software write protect on/enabled; this will prevent any unauthorized configuration changes in the device.
2. Be aware of any unauthorized access of a secondary master alarm present in Distributed Control System (DCS). If this is because of a secondary handheld device being connected then this can be ignored.
3. Enable the Tamper alarm and monitor the Tamper Counter value for unintended changes.

6 - Security

How to report a security vulnerability

For the purpose of submission, a security vulnerability is defined as a software defect or weakness that can be exploited to reduce the operational or security capabilities of the software or device.

Honeywell investigates all reports of security vulnerabilities affecting Honeywell products and services.

To report potential security vulnerability against any Honeywell product, please follow the instructions at:

https://honeywell.com/pages/vulnerabilityreporting.aspx

Submit the requested information to Honeywell using one of the following methods:

• Send an email to security@honeywell.com.

or

• Contact your local Honeywell Process Solutions Customer Contact Centre (CCC) or Honeywell Technical

Assistance Centre (TAC) listed in the "Support and Contact information" section of this document.

Sales and Service

For application assistance, current specifications, pricing, or name of the nearest Authorized Distributor, contact one of the offices below.

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