

# SICK AG WHITE PAPER

BEST SOLUTIONS TO ENHANCE GAS FLOW MEASUREMENT FOR  
MIDSTREAM MARKETS

RETROFIT EXISTING FLOWSIC600 WITH SICK'S GATEWAY TECHNOLOGY

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## SUMMARY

Currently, more than 3,000 of SICK's FLOWSIC600 ultrasonic gas flow meters (now referred to as the "Classic") are in operation in North America. With the development of the FLOWSIC600-XT in 2016 as a successor, the Classic will be gradually phased out. Recognizing Pipeline operators' sizeable investment in FLOWSIC600 Classic, SICK has developed a solution that enables the Classic meters to be converted to the XT environment without need for a full meter replacement and recalibration. This solution is called the FLOWSIC600-XT Gateway Electronics whose compatibility with existing body and transducer hardware enables operators to upgrade to XT environment electronics that have additional features and technology.

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## 1. Introduction

In 2018, the United States consumed 29.97 trillion cubic feet of natural gas. This gas was used for residential/consumer, lease/plant fuel, or pipeline/distribution end uses. As gas production and use steadily rise, it's become more important than ever for natural gas service companies, local distribution companies, and gas production sites to have accurate and reliable measurement of the flow of the natural gas.

For over 25 years, SICK, Inc. has produced gas ultrasonic meters used in midstream natural gas service. Additional products have been introduced tailoring ultrasonic flowmeters for other business field on the gas grid, including downstream (i.e., local distribution companies) and upstream (i.e., gas production sites). Market acceptance in these other business field has been made possible by the success of SICK's FLOWSIC600 Classic in the midstream market, with more than 3,000 units currently in operation in North America.

In 2017, SICK introduced FLOWSIC600-XT, based on entirely new hardware, to refresh the FLOWSIC600 Classic with upgraded technology. The FLOWSIC600 Classic will subsequently be phased out, but this phase out begs the question – will backward compatibility of the 3,000 or so meters currently in service be taken into account?



Fig. 1: FLOWSIC600 Classic



Fig. 2: FLOWSIC600 Classic upgraded with FLOWSIC600-XT Gateway electronic

## 2. Converting to the XT Environment via Gateway Electronics

The FLOWSIC600-XT is an upgrade to the existing FLOWSIC600 Classic system. It provides greater measurement capabilities and flexibility for the midstream market. The installed base of FLOWSIC600 Classic meters in thousands of pipeline applications in the US represents a sizeable investment in existing hardware. With SICK upgrading to new metering technology, SICK determined an upgrade to the diagnostic friendly XT environment without needing to completely upgrade the system.

SICK has developed FLOWSIC600-XT Gateway technology as a backward compatible solution to provide all customers continuous gas flow measurement with their existing FLOWSIC600 Classic hardware, while avoiding the process of pulling a meter from service and sending to a lab for recalibration at a cost of thousands of dollars. SICK's Gateway product was developed and tested to eliminate this step.

Upgrading to the FLOWSIC600-XT Gateway means users do not have to completely replace the FLOWSIC600 Classic to get the i-diagnostics™ capability and enhanced I/O, but can instead convert to the XT environment without the need for a full replacement and meter recalibration. In the upgrade, users retain all existing hardware, including transducers and meter body, as installed, with no recalibration needed. SICK has conducted testing that proves users can make this upgrade without any changes being made to the output of the existing meter (Appendix A & B).

SICK's Gateway electronics can be installed on the existing FLOWSIC600 Classic platform, bringing it into the XT environment at a fraction of the cost of meter replacement. The existing FLOWSIC600 Classic meter body and transducers remain installed in the upgraded unit and is retrofitted with Gateway by taking a short data outage, with no interruption to gas flow.

In addition, users now have access to a local infrared port, eliminating the need to open the back of the electronics panel to connect a laptop. It also has Ethernet connection with TCB over MODBUS data over unit.

**2.1 FLOWGate™ Software and i-diagnostics™**

Existing databases for FLOWSIC600 Classic are converted to the XT environment using FLOWgate™, a user software platform for flow devices from SICK. Its predecessor is the MepaFlow Condition Based Monitoring (CBM) software, which will no longer be compatible with the new Gateway Electronics.

However, FLOWgate™ is user-friendly and easier to use than the CBM environment. It was based on a modular concept, with on dashboard that can access multiple different devices at the same time. This enables users to work with greater efficiency and not have to toggle between separate device dashboards.

FLOWgate™ also provides a more visually appealing interface with status color notifications showing immediately if a device is operating correctly, in warning mode, or having a failure. Simple and easy-to-use icons were also added to provide easy access to maintenance reports, metrology logs, one-click diagnostics, and configuration/operation mode.

To enable Gateways full features, users can take advantage of i-diagnostics™, the intelligent connection of firmware and software. It is based on a fuzzy logic principle that handles the concept of “partial truth.” Diagnostic parameters are evaluated and interpreted in a complex matrix (ex., turbulence = high & profile factor = high, resulting in blocked flow conditioner).

It provides enhanced alarming and intelligent diagnostics to alert users of any failures and what type the meter may be experiencing while it’s in service (i.e., electronics fault, flow disturbance, blockage, etc.). In addition, users are able to obtain complete images of device states at different times and know of any possible changes in conditions. Previously, users had to collect a log file and make those interpretations themselves. With FLOWgate™ and i-diagnostics™, the software does all this legwork for the user with trend charts that provide insight to historical measurement periods.

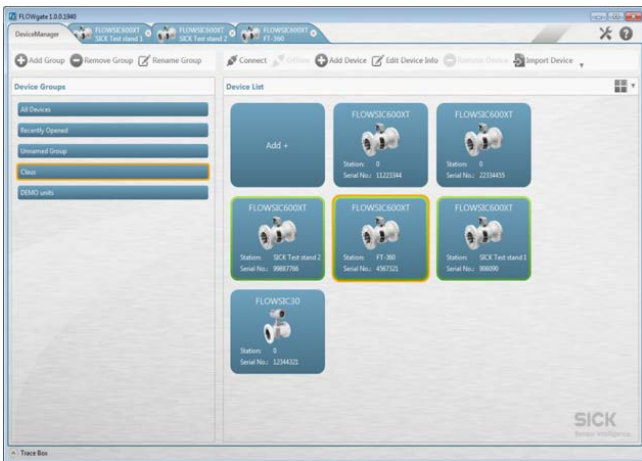


Fig. 3: Gateway Multi-Device Interrogation, GUI

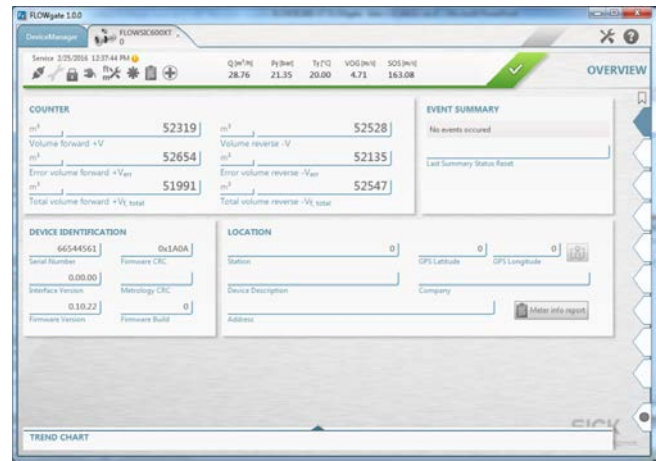


Fig. 4: FLOWgate™ Device Status Overview Page

**2.2 Proven Metrology with Gateway**

SICK has proven the metrology of the replacement of Classic with Gateway electronics so that the upgrade can be completed without need to recalibrate the meter. That is, the retrofit can be made in the field without need to recertify the meter by removing and returning it to a calibration lab for re-test.

The full procedure to making the retrofit, including needed materials and software, are described below, and certified metrological data are presented in Appendix B showing that the upgrade has no impact on metrology.

| Classifier     | State description   | Proposed action  |
|----------------|---|--|
| Pollution      | The meter diagnostic data indicates a possible contamination of the meter. Contamination can build up in case of accompanying components like liquids or dirt that accumulate over time.  | Perform a visual inspection of the transducers and meter body. In case of an existing contamination a cleaning is required by trained service personnel.   |
| External Noise | The meter diagnostic data indicates external noise that interferes with the ultrasonic measurement signals. External noise can be present in case of pressure regulators or control valves that are installed in upstream or downstream direction close to the meter. | Identify the source of noise in the installation. Check if the noise level can be reduced by changing application or installation conditions respectively.<br><br>The gas meter offers several diagnostic limits and setting to compensate for external noise in case the level of noise cannot be reduced itself. These settings may be modified by authorized and trained service personnel only. Refer to the instructions in the operating and service manual. |
| Blocked        | The meter diagnostic data indicates a blockage of the flow conditioner.   | Check the flow conditioner and the inlet pipe for possible foreign objects or for deposits, that may block the flow conditioner openings partially.<br>Perform a cleaning of the flow conditioner if necessary.  |

Table 1: Solution Assistant Diagnostic Message Examples

### 3. Retrofit Exchange Procedure

In order to complete the retrofit exchange, an examination and documentation of the installed FLOWSIC600 Classic is first required. This is to determine the overall condition of the meter and logs the article and serial number of the installed meter. It also helps determine which Gateway Kit is needed, as the Gateway Kit comprises of the SPU and, if needed, additional spacers and adapter plates. There are four different SPUs that fit depending on the transducer type and the version of the old meter (4path, 2plex, or Quatro). A data backup is then done in FLOWgate™ that saves all past archives, logbooks, meter readings, and diagnostic data. Once these are done, the Gateway system will be installed by SICK service personnel. Beginning with the removal of the existing SPU, users will get the new Gateway “neck” enclosure in one unitized replacement. SICK service personnel will also label the meter according to regulations and guarantee the measuring performance before and after installation. SICK will provide any concluding documentation needed after installation, which includes commissioning protocol, parameter report, status report, and device documentation. The entire process takes about four hours.

### 4. Conclusions

1. Replacement of an FLOWSIC600 Classic electronics with a Gateway electronics causes no significant change in meter output.
2. Removal and reinstallation of the Gateway electronics with the original Classic electronics causes no significant change in meter output.
3. Using the SICK approved procedure, a FLOWSIC600 Classic meter can be upgraded to the XT environment with no impact on metrology.

### 5. Appendix

#### 5.1 Swap testing Procedure

1. Calibrate a new FLOWSIC600 Classic
2. Correct & run verification points
3. Download configuration from Classic using FLOWgate™ c/w conversion utility
4. Replace Classic head with Gateway electronics head
5. Upload configuration to Gateway using FlowGate’s converted file from Classic
6. Test Classic as upgraded with Gateway electronics; measure offset from original proof test
7. Replace Classic head as first tested.8.Run verification points with original electronics to ensure original metrological performance

**5.2 Certified Swap Results (Metrological Tests)**

Two new FLOWSIC600 Classic meters bound for first calibration for testing were selected to use as specimens for testing per the upgrade procedure outlined in Appendix A. The subject meters were both 10", FS-6004p ANSI 600# meters tested with standard AGA 9 style meter runs (10D x FC x1 OD).

Testing was conducted in July of 2018 at CEESI's high-pressure calibration facility in Garner, IA. The Garner facility had a declared uncertainty of +/-0.23% at the time of the testing.

**6. Results**

**Meter 18017371:**

Results are presented graphically and in tabular form as follows. In each test case, the results are within facility uncertainty tolerance, demonstrating no impact on metrology of making, and unmaking, the XT electronics upgrade to the FLOWSIC600 Classic meter.

**As Found and As Left Results**

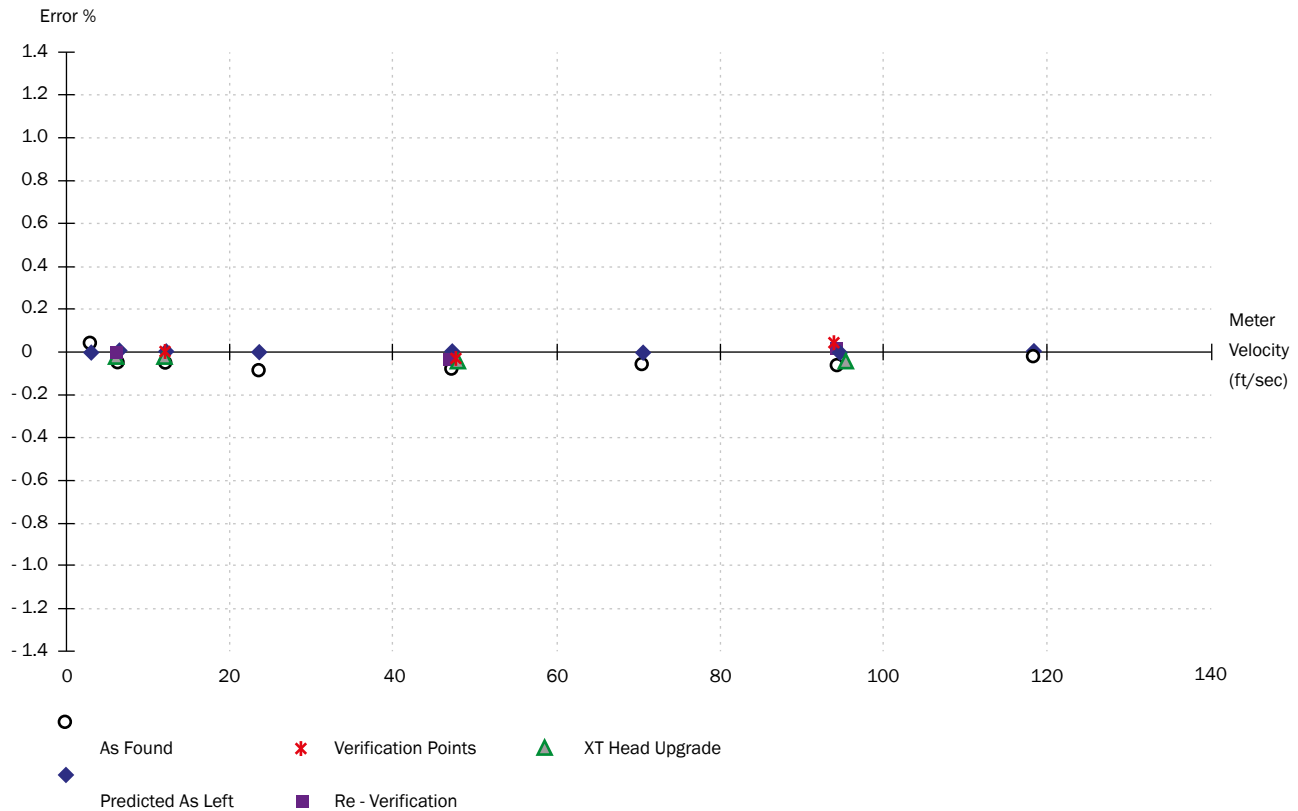


Fig. 5: Graphical results of XT upgrade for SN 18078371

**10" FLOWSIC600 Classic, 4p: S/N 18078371**

| As Found error % | Predicted As Left Error % | Verification Vel ft/sec | Verification Results % | XT Head Upgrade ft/sec | XT Head Upgrade Results % | Re-Verification Vel ft/sec | Re-Verification Results % |
|------------------|---------------------------|-------------------------|------------------------|------------------------|---------------------------|----------------------------|---------------------------|
| -0.03            | 0.000                     |                         |                        |                        |                           |                            |                           |
| -0.07            | 0.000                     | 93.90                   | 0.034                  | 95.29                  | -0.037                    | 94.46                      | 0.020                     |
| -0.06            | 0.000                     |                         |                        |                        |                           |                            |                           |
| -0.08            | 0.000                     | 47.72                   | -0.029                 | 47.76                  | -0.036                    | 47.21                      | -0.037                    |
| -0.09            | 0.000                     |                         |                        |                        |                           |                            |                           |
| -0.06            | 0.000                     | 12.06                   | 0.002                  | 11.98                  | -0.011                    | 6.12                       | -0.013                    |
| -0.06            | 0.000                     |                         |                        | 6.05                   | -0.023                    |                            |                           |
| 0.04             | 0.000                     |                         |                        |                        |                           |                            |                           |

Table 2: Results for FLOWSIC600 Classic to Gateway Upgrade and reinstallation of original Classic SPU

**Meter 18017372:**

Results are presented graphically and in tabular form as follows. In each test case, the results are within facility uncertainty tolerance, demonstrating no impact on metrology of making, and unmaking, the XT electronics upgrade to the FLOWSIC600 Classic meter.

**As Found and Left Results**

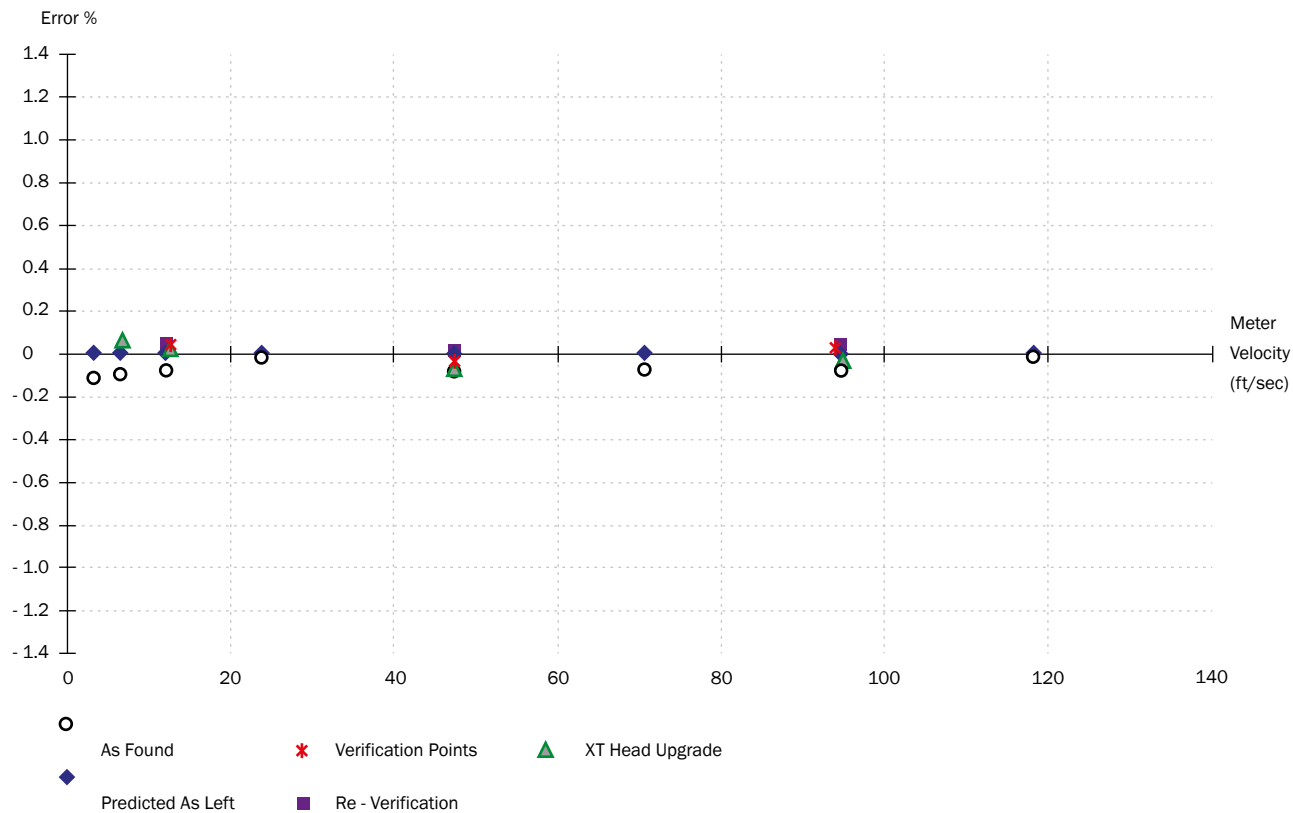


Fig. 6: Graphical results of XT upgrade for SN 18078371

**10\* FLOWSIC600 Classic, 4p: S/N 18078372**

| As Found error % | Predicted As Left Error % | Verification Vel ft/sec | Verification Results % | XT Head Upgrade ft/sec | XT Head Upgrade Results % | Re-Verification Vel ft/sec | Re-Verification Results % |
|------------------|---------------------------|-------------------------|------------------------|------------------------|---------------------------|----------------------------|---------------------------|
| -0.01            | 0.000                     |                         |                        |                        |                           |                            |                           |
| -0.08            | 0.000                     | 93.75                   | 0.032                  | 94.88                  | -0.032                    | 94.29                      | 0.047                     |
| -0.07            | 0.000                     |                         |                        |                        |                           |                            |                           |
| -0.08            | 0.000                     | 47.70                   | -0.020                 | 47.20                  | -0.060                    | 47.01                      | 0.023                     |
| -0.01            | 0.000                     |                         |                        |                        |                           |                            |                           |
| -0.08            | 0.000                     | 12.46                   | 0.046                  | 12.36                  | -0.031                    | 11.91                      | 0.053                     |
| -0.09            | 0.000                     |                         |                        | 6.57                   | -0.067                    |                            |                           |
| -0.11            | 0.000                     |                         |                        |                        |                           |                            |                           |

Table 3: Results for FLOWSIC600 Classic to Gateway Upgrade and reinstallation of original Classic SPU

