General Specifications

Gas Flow Calculation Portfolio (FCN-RTU)

STARDOM ™
APPF

GS 34P02P31-02E

■ GENERAL

This general specification document describes the Gas Flow Calculation Portfolio on FCN-RTU low power autonomous controllers. Using this portfolio, gas flow rate is calculated on robust and hazardous certified STARDOM controllers FCN-RTU while control logics are running.

Notation in this document:
• The term "FCN" refers to the module consisting type autonomous controllers.
• The term "FCN-RTU" refers to the low power autonomous controllers with NFCP050 CPU module.

For FCN-500, see Gas Flow Calculation Portfolio (FCN-500), GS 34P02P32-01E.

■ FEATURES

● High Speed and Volume Calculation

32bit high speed processor achieves a number of flow meter runs for many gas wells and responds to quick change of gas composition.

● Control with Flow Calculation

Control logics, programmed with IEC 61131-3, run with gas flow calculation. Regulatory control function blocks "NPAS" based on Yokogawa DCS expertise are adaptable for gas flow control such as valve control.

● Parameter Setting Window

Parameter Setting Window is prepared for easier parameters setting. Via OPC server, parameters can be set to SCADA as well.

YOKOGAWA ◆

■ PORTFOLIO COMPONENTS

Gas flow calculation portfolio consists of several components.

● Gas Flow Calculation POU

Gas flow calculation POU calculates the gas flow rate and provides the functions meeting to the API21.1 requirement.

- Gas flow calculation
- Averaging Data
- Hourly and Daily Quantity Record Creation
- Configuration Log
- Alarm Generation

● Parameter Setting Window (*1)

Parameters can be set to POU and the calculated gas flows are monitored on Web-based parameter setting windows.
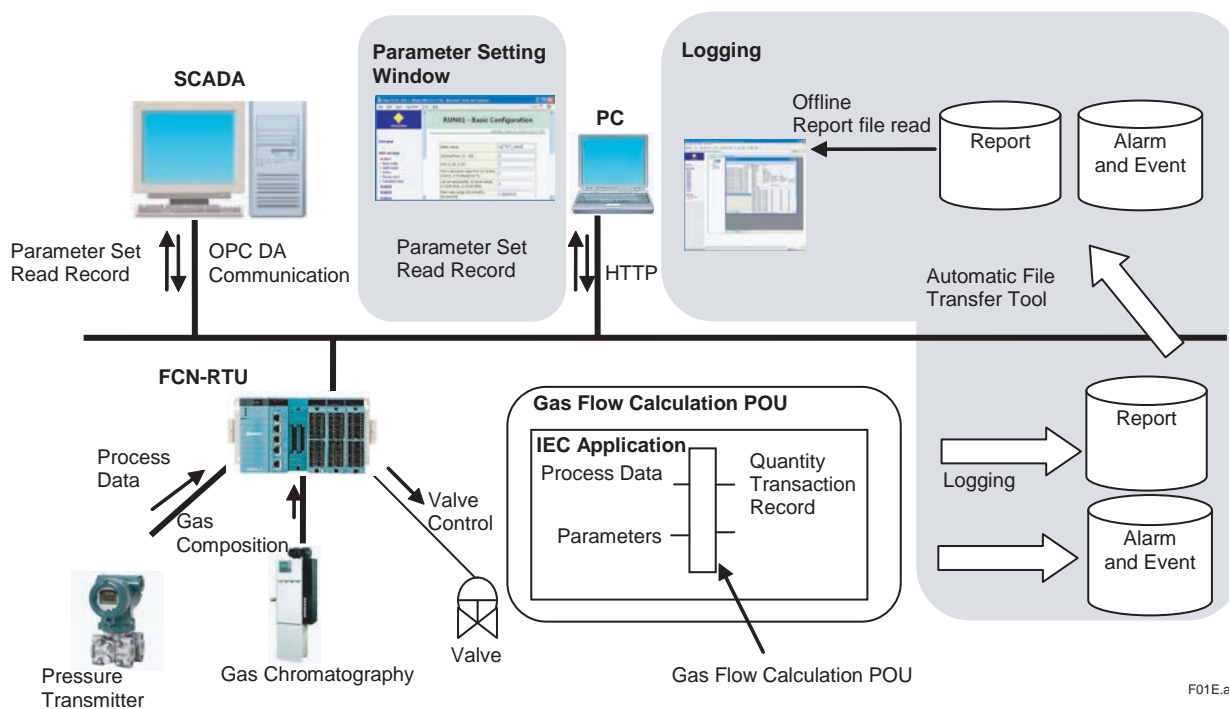
● Parameter Setting on SCADA

Parameters can be set to POU on SCADA.

The variables lists are shown on "PARAMETERS SETTING AND MONITORING WINDOW."

● Logging (*2)

Logging Portfolio logs the quantity transaction record created by Gas Flow Calculation POU and alarms and messages.

F01E.ai

*1:   Parameter Setting Windows are provuded as sample files on Application Portfolio Software Media.
*2:   Logging Settings are provided as sample files.

■ GAS FLOW CALCULATION POU

Gas flow calculation POU calculates the gas flow and creates the quantity transaction record.

● Gas Flow Calculation

Gas flow calculation POU calculates gas flow following AGA publication.

Table Supported Gas Calculation

Report Number	Title	Remark
AGA Report No. 3	Orifice Metering of Natural Gas Part 3: Natural Gas Applications (1992/2013)	
AGA Report No. 7	Measurement of Natural Gas by Turbine Meters (1996)	
AGA Report No. 8	Compressibility Factor of Natural Gas and Related Hydrocarbon Gases (1992)	
AGA Report No. 9	Measurement of Gas by Multipath Ultrasonic Meters (2007)	Pulse input only
AGA Report No. 10	Speed of Sound in Natural Gas and Other Related Hydrocarbon Gases (2003)	
AGA Report No. 11	Measurement of Natural Gas by Coriolis Meter	
GPA 2172	Calculation of Gross Heating Value, Relative Density and Compressibility Factor for Natural Gas Mixtures from Compositional Analysis (1996)	Dry only
V-Cone	V-Cone (2006)	
ISO 5167-3	Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full -- Part 3: Nozzles and Venturi nozzles (2003)	Venturi nozzles only
ISO 5167-4	Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full -- Part 4: Venturi tubes (2003)	

● Averaging Data

The following two averaging method are supported.
- Flow-dependent time-weighted linear average (*1)
- Flow weighted linear average

   *1:   Average is calculated using production time.

● Hourly and Daily Quantity Transaction Record Creation

Gas flow calculation POUs calculate the following value

Table Calculated quantity record

Time	Category	Calculated Value
Today, yesterday, current hour, previous hour	Average	Static pressure, differential pressure, temperature, flow rate, mass flow rate, energy
	Total	Total flow, total mass, total uncorrected flow, total energy, total flow time, total shut-in time, total pulse
Current month	Total	Total flow

● Configuration Log

When the configuration parameters are changed, Gas Flow Calculation POUs notify the configuration change by setting the configuration flag ON.

● Alarm Generation

Process Alarm
   HH/LL/HI/LO messages are generated when process input (Static Pressure, Differential Pressure and Temperature) exceeds the specified limitations.

● Scan Period of Task and Maximum POU number

Table Scan Period of Task and Maximum POU number

Item	Specification
Scan Period of Task	Limited to 1 second when using Gas Flow Calculation POU
Maximum POU number	8 POUs for FCN-RTU when using logging portfolio (*1)

   *1:   The metering numbers are depending on the total CPU performance.

■ PARAMETERS SETTING AND MONITORING WINDOW

The following parameters can be set on Web-based windows (available in sample HTML) or SCADA.

Table Setting Items (1/2)

	Items	Description
Common	Meter name	Meter identifier (Meter Name)
	Contract hour	Report file closing time
	Meter type	Orifice(AGA3 1992), Orifice(AGA3 2013), Turbine, Ultrasonic(Pulse input only), Coriolis, V-Cone, Venturi nozzle, Venturi tube
	Unit	US / SI unit
	Unit Switch	Switch changing unit volume
Flow Conditions	Static pressure	Absolute / Gauge
	Atmospheric pressure	Calculated / Manual Atmospheric pressure is calculated based on "Latitude" and "Altitude" in case of "Calculated".
Base Conditions	Base temperature	Base temperature
	Base pressure	Base pressure
Heating Value	Heating Value calculation method	Manual / GPA 2172 Heating value is calculated on condition that base temperature is equal 60degF in case of "GPA2172."
Compressibility	Compressibility	AGA 8 Detail Characterization Method / Gross Characterization Method 1 / Gross Characterization Method 2
Gas Composition	Gas composition input	Manual / Live Gas composition is set manually in case of "Manual". Gas composition is set to POU inputs in case of "Live".
	Normalize	Yes / No Each gas composition is normalized if total mole fraction is not equal to 1 in case of "Yes".
	Gas composition	Nitrogen, Carbon dioxide, Hydrogen sulfide, Methane, Ethane, Propane, i_Butane, n_Butane, i_Pentane, n_Pentane, n_Hexane, n_Heptane, n_Octane, n_Nonane, n_Decane, Water, Oxygen, Carbon monoxide, Helium, Argon
	Relative density	Calculated / Fixed Relative density calculated based on the gas composition incase of "Calculated". Relative density can be set manually in case of "Fixed".
	Gross heating value	Gross heating value can be set manually.
	Reference temperature for gross heating value	Gross method reference temperature for gross heating value
	Reference temperature for relative density	Gross method reference temperature for relative density
	Reference pressure for relative density	Gross method reference pressure for relative density
	Reference temperature for molar density	Gross method reference temperature for molar density
	Reference pressure for molar density	Gross method reference pressure for molar density
Orifice Parameters	Differential pressure cutoff	Differential pressure cutoff
	Orifice Plate	Bore diameter, material
	Pipe	Internal diameter, material
	Reference temperature	Reference temperature for plate and pipe
	Tap location	Upstream / Downstream
	Isentropic exponent	Isentropic exponent
	Viscosity	Viscosity
	Correction factor	Flow rate correction factor

Table Setting Items (2/2)

Items		Description
V-Cone Parameters	Differential pressure cutoff	Differential pressure cutoff
	V-Cone	V-Cone diameter, material
	Pipe	Pipe internal diameter, material
	Isentropic exponent	Isentropic exponent
	Viscosity	Viscosity
	Correction Factor	Flow rate correction factor
Turbine Parameters	K-Factor	Pulse K-Factor
	Pulse Cutoff	Pulse cutoff
	Meter Factor	Meter Factor
Ultrasonic Parameters	K-Factor	Pulse K-Factor
	Pulse Cutoff	Pulse cutoff
	Meter Factor	Meter Factor
Coriolis Parameters	K-Factor	Pulse K-Factor
	Pulse Cutoff	Pulse cutoff
	Meter Factor	Meter Factor
Calculation condition	Deadband	Gas flow is calculated when process input exceeds the specified deadband. Deadband of static pressure, differential pressure and temperature deadband can be specified.
Alarm	Alarm	HH/HI/LL/LO limits of static pressure, differential pressure and temperature can be specified. Alarms are generated when process inputs exceed limits.
Average	Average method	Flow-dependent time-weighted linear / Flow-weighted linear Average method can be selected for static pressure, differential pressure, temperature and pulse count.
Maintenance	Mode	The specified data is used instead of process data when maintenance mode is set. Maintenance mode of static pressure, differential pressure and temperature can be set.
Venturi nozzle Parameters	DP Cutoff	DP Cutoff (US:inH2O, SI:kPa)
	Venturi nozzle throat diameter	Venturi nozzle throat diameter (US:in, SI:mm)
	Upstream pipe diameter	Upstream pipe diameter (US:in, SI:mm)
	Tap location	Tap location (1:Upstream, 2:Downstream)
	Isentropic K	Isentropic K
	Viscosity	Viscosity (US:lbm/(ft*sec), SI:cP)
	Correction Factor	Factor for adjusting to the real flow rate
Venturi tube Parameters	DP Cutoff	DP Cutoff (US:inH2O, SI:kPa)
	Venturi tube throat diameter	Venturi tube throat diameter (US:in, SI:mm)
	Tube type selection	Tube type selection (1:Cast, 2:Machined, 3:Rough welded)
	Upstream pipe diameter	Upstream pipe diameter (US:in, SI:mm)
	Tap location	Tap location (1:Upstream, 2:Downstream)
	Isentropic K	Isentropic K
	Viscosity	Viscosity (US:lbm/(ft*sec), SI:cP)
	Correction Factor	Factor for adjusting to the real flow rate

Table Monitoring Items

Items		Description
Current data	Process input	Static pressure, differential pressure and temperature
	Calculation status	Calculation status
	Calculated data	Flow rate, raw flow rate (uncorrected flow), mass flow rate(Coriolis only) energy, compressibility, compressibility at base condition, super compressibility, ideal relative density, ideal heating value, real heating value, Speed of sound (Ultrasonic only)

Average	Data item	Static pressure, differential pressure, temperature, flow rate, mass flow rate(Coriolis only)
	Time span	Today, yesterday, previous hour
Total	Data item	Flow rate, energy
	Time span	Today, yesterday, previous hour
Time	Data item	Production time, shut-in time
	Time span	Today, yesterday, previous hour

■ LOGGING

● Quantity Transaction Record Logging

Quantity transaction records are logged on the controllers using Logging portfolio (*1)

Table Default Logging Items

Items	Description
File Format	CSV File
File Type	Hourly quantity transaction record file Daily quantity transaction record file
File Closing Timing	Contract hour or configuration change
Default Hourly Quantity Transaction Record	date, time, specified data items

*1:   Please refer to GS 34P02P20-02E "Application Portfolio" for the details of logging portfolio specifications.

● Alarm and Message Logging

The alarms and events are logged in the controllers using Logging portfolio (*1)

Table Default Logging Items

Items		Description
File Format		CSV File
File Type	Alarm logging file	Process alarm, system alarm
	Event logging file	Audit trail (configuration change) User event, event message

*1:   Please refer to GS 34P02P20-02E "Application Portfolio" for the details of logging portfolio specifications.

■ OPERATING ENVIRONMENT

● Low Power Autonomous Controller FCN-RTU

Table Hardware

Hardware	Description
Model (CPU)	NFCP050
Style (CPU)	S1 or later

Table Software

Software	Description
Basic Software	FCN/FCJ Basic Software
Revision	R4.30.01 or later
License	For FCN-RTU, the licenses are bundled with CPU module (Model: NFCP050). Select CPU modules with the portfolio licenses required.

● PC for Configuration

PC for Logging follows the operating environment described in Logging Portfolio GS (GS 34P02P20-02E).

■ STYLE OF SOFTWARE SUPPLY

● Media

Programs and Help for Gas Flow Calculation Portfolio are supplied with FCN/FCJ Application Portfolio Media .

● Gas Flow Calculation Portfolio License

Low Power Autonomous Controller FCN-RTU
For FCN-RTU, the licenses are bundled with CPU module (Model: NFCP050). Select CPU modules with the Gas Flow Calculation Portfolio License required.

■ ORDERING INFORMATIONS

For the type of software media supplied, refer to the separate GS, "Application Portfolios(FCN-500/FCN-RTU)" (GS 34P02P20-02E).

■ RELATED DOCUMENTS

GS 34P02P20-02E   Application Portfolios (FCN-500/FCN-RTU)
TI 34P03A51-01E   Gas Flow Calculation Portfolio

■ TRADEMARK ACKNOWLEDGMENTS

The names of corporations, organizations, products and logos herein are either registered trademarks or trademarks of Yokogawa Electric Corporation and their respective holders.