ABLE FT ULTRASONIC FLARE GAS METER TECHNICAL DATA

With DataFlow Data Analysis System, FlareMaster and N2GEN Enhancement Tools

Flare Metering with Reduced Uncertainty

MEASURE | CONTROL | MANAGE

System Components

The ABLE FlareMaster FT comprises two Model TF200 standard transducers (a sender and a receiver unit) and an MFT200 control unit/transmitter. The MFT200 provides signal inputs/outputs, derives reference values (standardisation) and also calculates flow velocity, sound velocity, standard and actual volume flow, mass flow, totalised standard volume flow, totalised mass flow, molecular weight, density, pressure and temperature. The DataFlow software provides access to all parameters, contains graphical display of measured values, trend curves and has an incident ledger for all measurement events and parameter changes.

Operation Summary & Features – Flaremaster

Flow measurement verification

FlareMaster, which is embedded in the ABLE FT, independently verifies the volume and mass flow rate in real time using a different computation principle than the meter's Time-of-Flight ultrasonic measurement, giving a verification within a 5% tolerance. This ensures confidence in the accuracy of the ultrasonic measurement. This feature also indicates when the meter operation is compromised such as flagging when maintenance of the probes is required.

Flow measurement data repair in real time

FlareMaster uses independent flow measurement to automatically identify and repair measurement errors from the ultrasonic flow meter, such as those due to sooty and oily-deposits on the transducer probes, or periods of liquid carry over. This repair is performed in real time without any loss of flow measurements into the control room.

Extended flow range

The standard ultrasonic flare meter typically has an upper flow velocity measurement limit of between 70 and 90 m/sec, depending on pipe size and gas composition. During emergency blowdown conditions the flare flow velocity can easily exceed the upper limit of the ultrasonic flow meter, and operators are forced to find other means to estimate the flare velocity in order to report the mass totals. FlareMaster measures the flow independently of the Time-of-Flight measurement and does not have an upper flow velocity limit. This secondary measurement is cross calibrated to the ultrasonic meter and extends the flow range to ensure even the most extreme blowdown velocities are measured, even up to several hundred metres per second.

Redundancy of flare measurements

FlareMaster provides redundancy of measurement, so that even in the event of total transducer failure, the flare measurement is not lost, as FlareMaster continues to provide the cross calibrated flow measurement from its secondary method until the ultrasonic measurement is restored.

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Overall System Technical Data

Measured Values	Mass flow rate, volumetric flow (actual conditions), volumetric flow (standard conditions), density, molecular weight, gas velocity, sound velocity, Reynolds number Optional N2GEN – N2% and C1% composition analysis
Number of measuring paths	Single path, (Optional dual and multipath system variants)
Measurement principle	Ultrasonic Time-Of-Flight difference measurement, (with optional FlareMaster redundancy extended flow range)
Measuring medium	Flare and vent gas
Measuring ranges	0,03 m/s ... 120 m/s with standard usm measurement principle Optional FlareMaster redundancy 0.5 to 500 m/s
Measuring span	Up to 4000:1 Usm > 10'000 with FlareMaster redundancy
Repeatability	1% usm, 2% for FlareMaster redundancy
Resolution	+/- 0.001 m/s
Uncertainty with N2GEN	
Without 3rd party calibration Single and dual path (See notes A and B).	Raw Time-Of-Flight flow velocity measurement uncertainty 1% to 2% (see note on effects of unknown profile errors) Compensated flow velocity 2% to 3.5% based on Reynolds from gas composition to traceable standards (AGA10/API) Actual volume flow 2% to 3.5% based on Reynolds from gas composition to traceable standards (AGA10/API) Standard volume and mass flow rate 2.5% to 4% based on density and compressibility from gas composition (AGA10)
Spool with 3rd party calibration (Dual path)	Raw Time-Of-Flight flow velocity measurement uncertainty 1% (see note on effects of unknown profile errors) Compensated flow velocity 1% to 2% based on Reynolds from gas composition to traceable standards (AGA10/API) Actual volume flow 1% to 2% based on Reynolds from gas composition to traceable standards (AGA10/API) Standard volume and mass flow rate <3% based on density and compressibility from gas composition (AGA10)
Straight runs required	Recommended (best practice) straight runs are 20 Upstream diameters (20D), and 5 downstream diameters (5D) However, CFD modelling is recommended to reduce effect of profile distortions. (See note). (CFD modelling can be used in applications when there are less than the recommended straight runs)

NOTE A: Even a fully calibrated flare measurement spool that has been certified at a third-party facility and installed in accord with the manufacturers recommended straight runs, can have a very different uncertainty in the real world flare application. This is because CFD studies have shown there are significant flow errors introduced by flow profile distortions from upstream and downstream disturbances outside of the recommended straight runs. We therefore recommend that these profile errors are assessed for the application using CFD studies, and the uncertainties stated assume that CFD modelling has been applied to reduce the effect of these distortions. In addition, there are uncertainty errors introduced from gas composition changes in real world flare applications, that affect Reynolds and density and mass flow calculations, along with molecular weight. These errors can be significant, especially if the application sees variations in nitrogen and methane. ABLE FT with N2GEN analyses the flare gas composition to resolve the percentages of nitrogen and methane in order to correct for changes in the gas composition, and this significantly reduces the uncertainty by using the resolved gas composition to calculate Reynolds and density using traceable standards such as AGA10 and API.

NOTE B: The flow velocity and actual volume uncertainty of ultrasonic flare meters is affected by Reynolds number errors, where historically the prevailing gas composition is unknown, and is especially affected by changes in percentage nitrogen and methane in the flare gas mixture. This can affect the compensated flow velocity by +/- 1.5%. The ABLE FT flare meter addresses this issue by analysis of the gas composition using AGA10 processing, and therefore reduces the overall uncertainty of the flow velocity and volume for unknown gas mixtures by over 1%. In addition, the ABLE FT has the built-in capability of applying dynamic temperature and pressure coefficients for the pipe material, as more typically applied to fiscal and custody transfer meters. These pipe material coefficients directly affect the pipe diameter and therefore the volume of the flow, which can change by over 1% for the full temperature range of the transducers. Therefore, applying these material coefficient corrections further reduces the flare meter volume uncertainty in the order of 0.5% for typical operating conditions. The combination of these two improvements reduces the overall uncertainty for flow velocity volume flow by around 1.5% in comparison to a standard usm flare meter that does not compensate for real time gas composition changes, or pipe material coefficients.

Nominal pipe size	8" to 72"
Ambient humidity	≤ 95 % Relative humidity
Conformities	Zone 0: ATEX: 2014/34/EU EN IEC 60079-0:2018 IEC 61010-1:2018 EN 55016-2-3:2017

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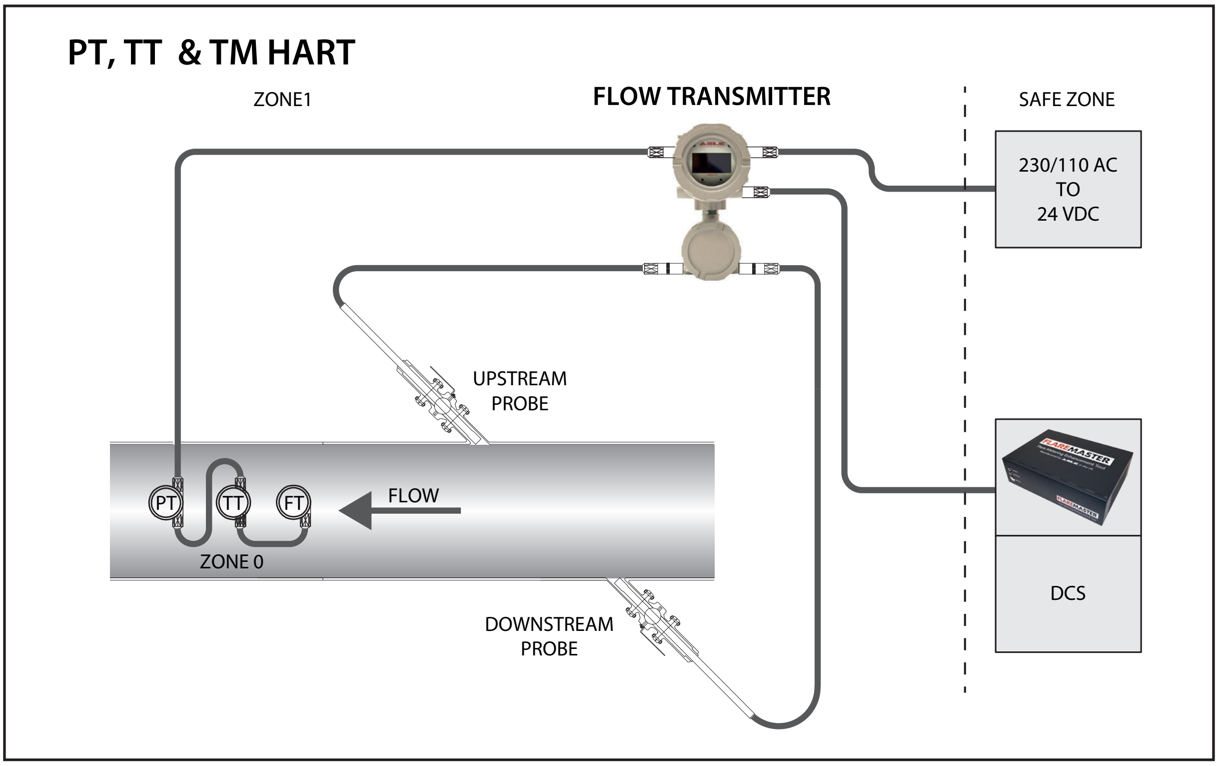
Transducers

Gas temperatures	
Design temperature	-150°C to 315°C ASME VIII Div.1:Ed.2017 and ASME B31.3 Standard
Operating temperature	–70 °C to +200 °C
Operating pressure	
Flanges 150 lb	Design pressure 20 barA, ASME VIII-1:Ed.2017 and ASME B31.3 Operating pressure 10 barA
Flanges 300 lb	Design pressure 20 barA, ASME VIII-1:Ed.2017 and ASME B31.3 Operating pressure 20 barA
Transducer materials	
Standard	Titanium/SS316
Operating materials	Titanium/Hastelloy Titanium/Inconel Titanium/Duplex
Straight runs required	Recommended (best practice) straight runs are 20 Upstream diameters (20D), and 5 downstream diameters (5D) However, CFD modelling is recommended to reduce effect of profile distortions. (See note). (CFD modelling can be used in applications when there is less than the recommended straight runs)
Ex-approvals	ATEX II 1G Ex ia IIC T* Ga T2: -110 °C ≤ +200 °C T3: -110 °C ≤ +180 °C T4: -110 °C ≤ +120 °C T5: -110 °C ≤ +85 °C T6: -110 °C ≤ +60 °C
Retraction mechanism	Probes can be retracted during normal operation in compliance with safety rules. Retraction of probes must typically be performed under the control of a hot work permit in compliance with local regulations. Such operation must be conducted only by trained personnel.
Weight	14.5 kg (Transducer pair)

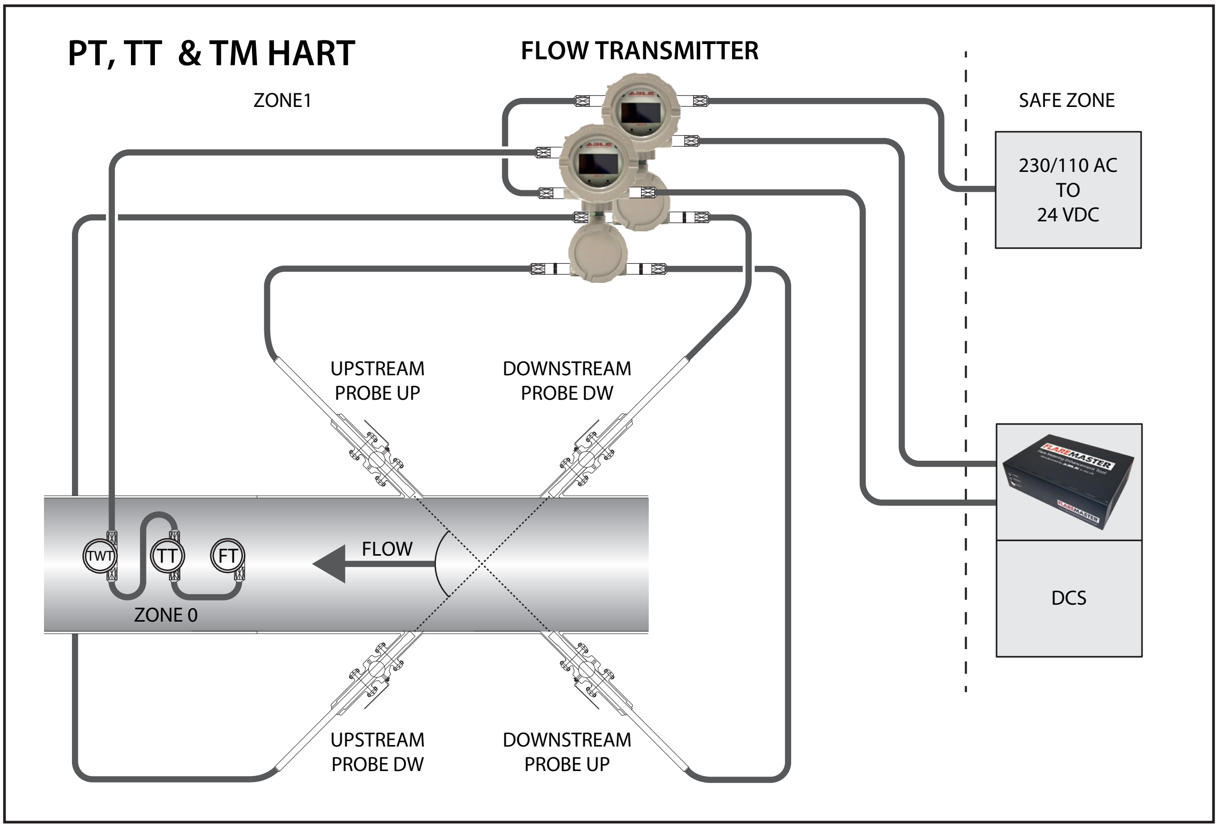
Interface Unit / Flow Computer

Description	Flow computer for controlling the ultrasonic sensors and processing and calculating flow measurement values
Ambient temperature	–40 °C ... +60 °C
Storage temperature	–40 °C ... +70 °C
Ambient humidity	≤ 95 % Relative humidity
Ex-approvals	ATEX Ex 2(1)G Ex db [ia Ga] llC T6 Gb
Enclosure rating	IP66
Analog inputs	2 Hart compatible 4-20 mA current loop In accordance with NAMUR NE43 HART (compatible) master for up to 16 external pressure and temperature transmitters, including absolute atmospheric pressure gauge.
Modbus	2 x RS-485 (Modbus RTU) Optically isolated
Indication	LCD display, main measurement values, system information, maintenance indicators, alarms
Dimensions (W x H x D)	136 x 174 x 286 mm (without brackets)
Weight	7 kg
Power supply	
Voltage	-150°C to 315°C ASME VIII Div.1:Ed.2017 and ASME B31.3 Standard
AC option	–70 °C to +200 °C
Frequency	AC variant: 50 ... 60 Hz
Power consumption	

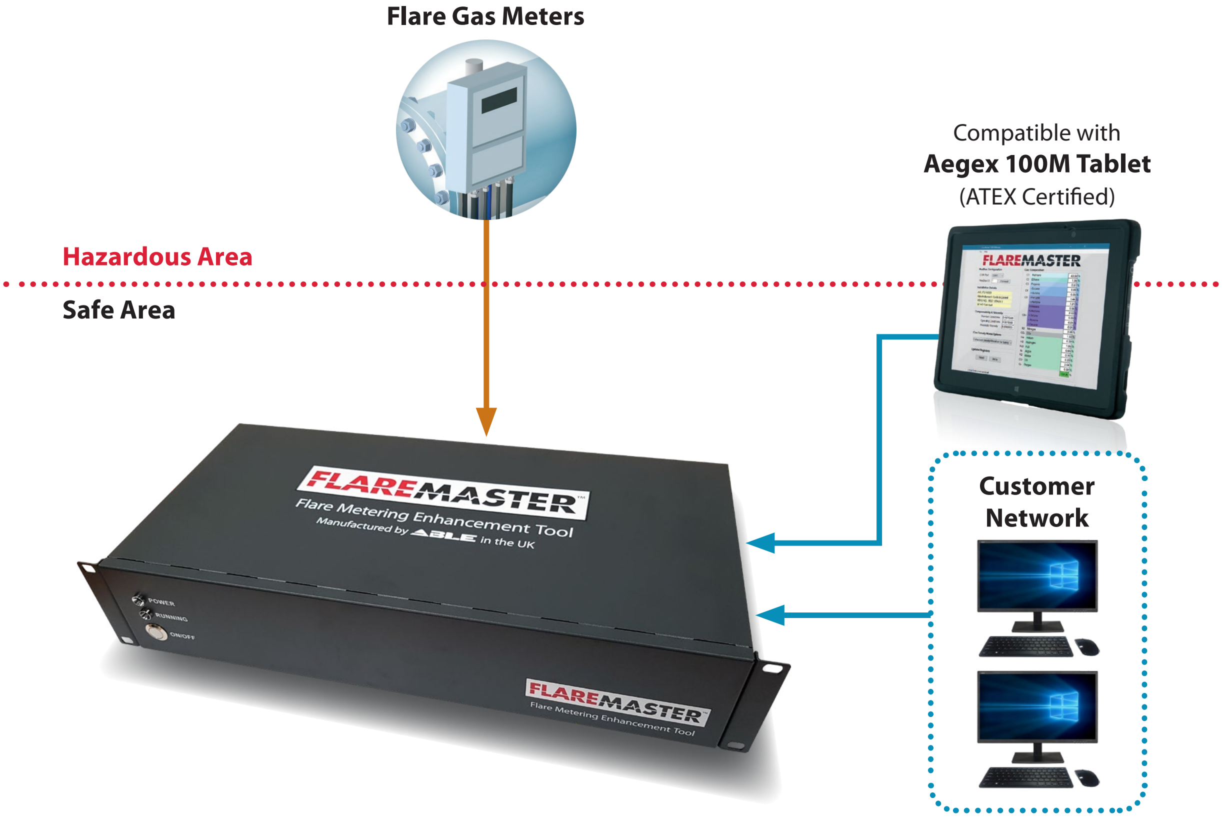
Standard Installation Options – General Arrangement



Standard Installation Options – Dual Arrangement



FlareMaster & FlareMaster Dataflow:
Technical Specification v2 19" Rackmount Option



Applicability	All makes of Ultrasonic Flare Gas Meter (FGM)
Power Input	100VAC – 240VAC (Internal Battery Backed UPS)
Flare Gas Meter Inputs & DCS Connectivity	• Four RS485 (2 or 4 wire configurable) ports provide connectivity to flare gas meters and a single DCS host system • Flare Gas Meters are Modbus Slaves with FlareMaster™ as a Modbus Master • DCS as Modbus Master with FlareMaster™ as Modbus Slave
Ethernet	10/100/1000Mb for data/HMI access from a local area network (LAN)
Wireless	802.11ac @ 300Mb, for local data/HMI access via ATEX certified Aegex tablet access
Operating System	Windows 10 Professional running proprietary FlareMaster™ Software
Weight & Dimensions	Weight – 4.5Kg Dimensions – Standard 19" rack 2U (19" wide with rack mounts, 17" without x 9" depth x 3.5" high)
Operating Temperature	-20°C to + 70°C
Response/Update time	2500ms

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Operation Summary & Features – **Dataflow**

- Data capture, storage of multiple FGM process data
- Download of process data in Excel XLSX format

Graphing of key flare gas process data including; actual, standard, and mass flow, velocity, pressure, temperature and density.

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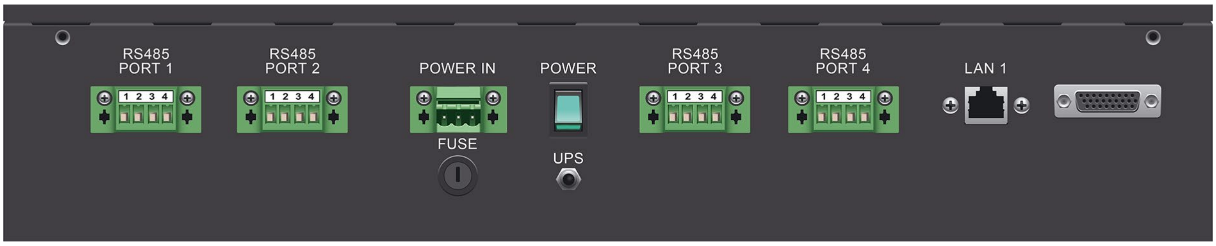
Front View

POWER	Indicates state of power in mains and UPS power supply
RUNNING	Indicates FlareMaster operational state
ON/OFF	Start or shutdown FlareMaster



Rear View

PORT 1	Flare Meter 1	RS485 2 or 4 Wire	Pin 1 – Tx- Pin 2 – Tx+ Pin 3 – Rx+ Pin 4 – Rx-
PORT 2	Flare Meter 2		
PORT 3	DCS		
PORT 4	Future Use		
POWER IN/FUSE	Mains Power, 2A	100C – 240V AC	L – Live N – Neutral E – Earth
POWER	Internal isolation of Power In		
UPS	Internal UPS power isolation		
LAN1	10/100/1000Mb Ethernet CAT5/6		
(unlabelled connector)	ABLE service use only		

3D View

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