

MicroSAM / Sitrans CV

PA Process Analytics

Process Analytics

Product Competence

Solution Competence

Industry Competence

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- for standard process applications and natural gas CV/BTU analysis
- field mountable
- technology leader (MEMS)







MicroSAM / Sitrans CV & MEMS Technology

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Solution Competence

Industry Competence

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MicroSAM Analytical Module

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The MicroSAM Advantage

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Solution Competence

Industry Competence

- Analyzer installation near sampling point Faster analysis
 No need of air-conditioned shelter
- Analyzer installation in the shelter Installation of several MicroSAMs on the spot of one traditional GC (densification)
- Exchange of standard parts instead repair Save money on stock-keeping and service
- Remote maintenance (check-up of settings)
 No need for checking analyzer settings on site
- Extreme low consumption of utilities Save on power and instrument air





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Siemens Services

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Modern Networking & DCS Coupling Industrial Ethernet & Analytics



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Siemens Analyser System Manager

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Solution Competence

Industry Competence

References

Easy monitoring and storing of important analyser data

Easy configuring of analysers

Easy expandability







Market Specific Expertice Natural Gas Processing

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Process Analytics Product Competence Inno Solution Competence Industry Competence References

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PA

Market Needs vs. Analyser Portfolio

Process Analytics		
Process Analytics Product Competence	Natural Gas (Certified CV/BTU)	dedicated analyzers one specific application
Solution Competence	STIRANS CV	custody transfer with special approvals only
References	Natural Gas (non certified CV/BTU) SITRANS CV	dedicated analyzers one specific application specific environment custody transfer + quality measurement
	Natural Gas Maxum MicroSAM	extended flexibility quality measurement limited number of applications, e.g. - major gas composition - hydrogen sulfide/COS traces - odorants (traces of other sulfur components) - hydrocarbon dew point (higher hydrocarbons
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Key Regions Major Trade Movements

Pipeline & LNG





LNG Plants Key LNG Exports

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Industry Competence

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LNG Transportation Chain Process Analyser Tasks



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Natural Gas CV / BTU Analysis Is Micro Machining an Option?

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References

User Expectations







SITRANS CV Product Concept



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References



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 Standardization of the analytical solution to fulfill cost requirements

- Lean production processes
- CV analyser from stock
- CV analyser fullfills analytical requirements
- Software & hardware features oriented on special custody transfer requirements and market needs
 - Secure fiscal metering software
 - Internal mean values calculation
 - Internal long term data storage
 - Internal trend evaluation
 - Logbook
- Flexible MODBUS protocol
- Built-in display
- Multiple stream (3+1) capabilities





Product Concept Analytical Configuration

PA **Process Analytics**

Solution

Competence

References

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Valveless Injection ("Live") **Narrow-bore Capillary Columns** Valveless Column Switching ("Live") Multi- and In-line Detection (TCDs) **Electronic Pressure Control (EPC)**



Repeatability < 0,01% for all Calculated Values at 20°C amb. temp.

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Process Analytics	Measuring Compo Caloric Values	nents and	Cnzentration (Mean value)		Standard Deviation (absolute) Mol%	Standard Deviation (relative) %	
Product Competence	Superior CV	Но	39,8284	MJ/m3	0,002753	0,006913	
	Inferior CV	Hu	35,9134	MJ/m3	0,002507	0,006981	0.040/
Solution	Density		0,7433	kg/m3	0,000072	0,009645	< 0,01%
Competence	Relative Density		0,5749		0,000056	0,009661	_
Compotence	Wobbe Index		52,5300		0,004761	0,009064	
Industry Compatance	Nitrogen	N2	1,3464	Mol%	0,006531	0,485036	
industry Competence	Carbon Dioxide	CO2	0,3480	Mol%	0,001111	0,319118	
	Methane	C1	97,3048	Mol%	0,008428	0,008662	
References	Ethane	C2	0,3982	Mol%	0,001433	0,359759	
	Propane	C3	0,1996	Mol%	0,000715	0,358462	
	Iso-Butane	i-C4	0,0995	Mol%	0,000553	0,556262	
	n-Butane	n-C4	0,1031	Mol%	0,000615	0,596241	
	neo-Pentane	neo-C5	0,0509	Mol%	0,000437	0,857970	
	iso-Pentane	i-C5	0,0494	Mol%	0,000536	1,084269	
	n-Pentane	n-C5	0,0500	Mol%	0,000479	0,956977	
	Sum C6+	C6+	0,0502	Mol%	0,000422	0,841165	





Fulfills requirements of ISO 6974 for measuring components:

Measuring Comp.	Repeatability
[Mol %]	(% relative)
< 0,1	± 30
0,1 to 1,0	± 10
1,0 to 10	± 1
10 to 100	± 0,1



Repeatability At various conditions

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References



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- Repeatability of < 0.02 % RSD over full ambient temperature range of-20 °C to 55 °C
- Influence by ambient pressure changes negligible
- Influence by sample pressure changes negligible
- No memory effects for contrast streams ("High Methane" vs. High Nitrogen")









Accuracy Various Calibration Gases (CRM)

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Solution Competence





Technical Data

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Industry Competence

References



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Analytical system

Sample streams Repeatability for CV and density Accuracy for CV and density Detection limit, e.g. for neo pentane Cycle time

Communication

Communication Protocols

Data storage

- Reports
- Hourly average
- Daily average
- Chromatogram (calibration)
- Averages

3x sample, 1x calibration

- < 0.01%
- < 0.1%
- < 10 ppm
- < 180 s

Ethernet, RS485 TCP/IP, MODBUS RTU MODBUS "Danalyzer"

100 days (48.000 reports)
1 year
2 years
Last updated analysis
2 weeks (comp. & calc. Values)



System Solution Installation Requirements

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Sample Streams 3x sample, 1x calibration

Weight

Protection

NFMA 4X

15 kg

IP 65

Accomodation In protection box or in analyzer shelter (AC not required)

Instrument Air not required

Carrier Gas Helium (typically) Consumption: < 35 ml/min

Hazardous Class ATEX 2 G EExd IIC T4 CSA Class 1 Div. 1, Group B,C,D FM Class 1 Div. 1, Group B,C,D FM Class 1 Zone 1, GroupIIB+H₂

Power 24 V DC; 15 VA

> Temperature Range - 20 °C to + 55 °C

Gas connections 1/8" Swagelok



Field Installation

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References





Installation close to gas export metering skid









Benefit SITRANS CV – at a Glance

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References



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Determine natural gas precise

- Independent of variations of sample or ambient pressure using valveless Live injection
- High separation power using narrow-bore capillary columns
- Low detection limits using powerful detectors
- High linearity throughout measuring ranges saves expensive calibration gases

Determine natural gas fast

- Fast analysis through pioneering MEMS technology
- Update of calorific value each 180 s also for C6 to C9 individually

Determine natural gas reliable

- Reliable technology through many years of experiences
- Separation reliability guaranteed through in line detection
- Improved reliability no conventional valve switching with movable parts
- Automatic optimization of methods increases availability
- Perfect integration into network through communication options



Gas-to-Liquid (GTL) Plants Process Steps & Analytics

PA Process Analytics



Industry Competence

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Saturator		Suitable Analyzer	
Condensate stabilizer	Total S H ₂ S	MAXUM II MAXUM II	
Hydrogenation/ Desulphurization Claus off gas	Total S, H ₂ S, CO ₂ Mercaptans O _{2,} SO ₂	MAXUM II MAXUM II OXYMAT, TPA	
Dehydration/ Mercaptan removal	RSH, Total S, COS, H ₂ S	MAXUNM II	
LPG	RSH, Total S, COS, H ₂ S, Mercaptans	MAXUM II	
Propane, Butane product	C2-C4, C3-C5+	MAXUM II / MicroSAM	
Treated NG	Sulphur (ppm/ppb)	MAXUM II	
Various furnaces flue gases and process off gases	O ₂ , SO ₂ , NO _x , H ₂ ,	OXYMAT, ULTRAMAT, CALOMAT	
Raw Syngas	CH ₄ , CO ₂	ULTRAMAT	
Syngas	H ₂ , CO, CO ₂ , N ₂ , CH ₄ , COS, H ₂ S, TS	MAXUM II	
	Hydrogenation/ Desulphurization Claus off gas Dehydration/ Mercaptan removal LPG Propane, Butane product Treated NG Various furnaces flue gases and process off gases Raw Syngas Syngas rd party analyzer	Hydrogenation/ Desulphurization Total S, H2S, CO2 Mercaptans Claus off gas O2, SO2 Dehydration/ Mercaptan removal RSH, Total S, COS, H2S LPG RSH, Total S, COS, H2S, Mercaptans Propane, Butane product C2-C4, C3-C5+ Treated NG Sulphur (ppm/ppb) Various furnaces flue gases and process off gases O2, SO2, NOx, H2, Raw Syngas CH4, CO2 Syngas H2, CO, CO2, N2, CH4, COS, H2S, TS rd party analyzer C	



San San	npling point npling stream	Measuring Component	Suitable Analyzer
3.1	Syngas feed	H ₂ , CO, CO ₂ , N ₂ , CH ₄ , COS, H ₂ S, TS	MAXUM II
3.2	Syngas FT reactor	H ₂ S, COS, TS	MAXUM II
3.2	Syngas FT reactor	H ₂ , CO, CH ₄ , N ₂ , C2-C6+,H ₂ /CO ratio	MAXUM II / MicroSAM
3.3	Tail gas, PSA unit	CO; CO/CO ₂	ULTRAMAT / MicroSAM
3.4	Recycle gas	$CO, CO_2, CH_4, N_2, H_2, H_2/CO$ ratio	MAXUM II
3.5	Off gas	H_2 , CO, CH ₄ , N ₂ , C2-C5, H ₂ /CO ratio	MAXUM II
3.6	FT liquids	Related components	MAXUM II
3.7	LPG	C4, C5+	MAXUM II / MicroSAM
3.8	Final products	Related components	MAXUM II
	Various off/flue gases	02	OXYMAT 6 / 61
	Various off/flue gases	SO ₂ , NO _x	ULTRAMAT



Conventional Analysis of FT-Products

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Challenging Application Approach using Maxum

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Target:

FT-Product

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Industry Competence

References



Challenges:

GC

<u>Complete</u> online-analysis <u>Without</u> intermediate condensation <u>250-400°C & 5-30 bar</u> at sampling point



Stream Composition:

H2	< 50%
CO, H2O	< 30%
CO2, N2, Ar	< 10%
C1 C20	< 5%
C21C40	< 0,5 %
Olefins	< 0,5 %
Alcohols, Alc	dehydes, Acids < 0,5 %





Challenging Application Approach using Maxum

GC #1: Enhanced Natural Gas Analysis N2 to C12

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Leftside Oven: Combined injection + backflush valves to avoid condensation of the high boiling components

Rightside Oven: Separation columns

Parallel Chromatography:

- Train 1: Separation + detection of water
- Train 2: Separation + detection of H2
- Train 3: Separation + detection of molecular sieve components
- Train 4: Separation + detection of C2 ... C5 hydrocarbons
- Train 5: Separation + detection of C6 ... C12 hydrocarbons



FD= Filament detector TCD=Thermal conductivity detector



Challenging Application Approach using Maxum

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References

GC #2: C12 to C40 similar to Simulated Distillation





FID= Flame ionization detector PTGC= programmed temperature gas chromatograph



Preliminary Results

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Solution Competence

Industry Competence

References

Sample: Liquid Organic Phase of FT-Product

Laboratory GC: RGC 202

- Carrier gas: Hydrogen
- Airbath Oven
- Programmed Temperature
- Liquid Injection Valve (250°C)
- Narrow bore capillary column
- Temperature Ramp 80 to 320°C
- FID (320°C)





Preliminary Results





Preliminary Results







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Composition of Liquid Organic Phase

PA Process Analytics	n-Alkanes *	Retention time	Concentration [%] **
Trocess Analytics	C8	0.83	13.15
Process Analytics	C9	1.29	14.09
Product Competence	C10	1.95	12.50
Solution	C11	2.75	10.03
Competence	C12	3.62	7.46
Industry Competence	C13	4.50	5.42
References	C14	5.35	3.94
	C15	6.19	2.96
	C16	7.00	2.34
	C17	7.77	1.90
	C18	8.50	1.46
	C19	9.19	1.09
	C20	9.86	0.75
	above C26 not identified	> 15	0.75

* iso-Alkanes as a sum for individual Cn

** Normalization: sum of peak areas





Customer Base CV / BTU Market User List

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Siemens Process Analytics Summary

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Process Analytics

Product Competence

Solution Competence

Industry Competence

- Broad product portfolio with state-of-the art and complementary technologies for the overall process analyser market, such as chromatography & continuous gas analytics
- Solution expertise in the oil&gas market,
 e.g. for GTL, LNG, natural gas (processing)
- Services and support over the whole plant life cycle, from FEED consultance to startup





Oil & Gas Processes Best Power together with Siemens

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Analytical Solutions





for the LNG & Gas Industry



