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JES t/FL-USX Ultrasonic Cross Section Air Flow Monitoring System

Features

• Precise ultrasonic air flow measuring system based on different transition times of ultrasonic pulses
• Measurement of average air-flow over the whole tunnel cross section
• Sensor setup via service interface
• Suitable for tunnel cross sections up to 18 m (Measuring path up to 25 m)
• Connection to tunnel control system either via analogue output and relays or via RS 485 MODBUS RTU
• Visible LEDs to indicate sensor status
• Optional, remote smart/HUB touch operation unit to display measured values and to modify parameters
• Certified according IEC/CSA/UL 61010-1 (cCSAus Kennzeichnung)

System setup

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• Terminal box for master to connect the power supply and the connections to the tunnel control system and the slave
• Terminal box for Slave
• Optional remote smart/HUB touch operating unit

Operation

The air flow monitoring system measures the air flow based on different transmission times of ultrasonic pulses sent in one or the other direction. This cross section measurement delivers the average air speed more reliable and meaningful than methods that measure only one or two points on the tunnel wall. Two sensors are mounted below the tunnel ceiling, cross section with an angle of 30° to 60° (usually 45°) such that a vector component of the air flow overlaps the direction of the ultrasonic sound pulses exchanged by the two sensors. Air flow in the tunnel influences the transition time of the pulses between sender and receiver. Based on the difference in transition times of ultrasonic pulses sent in one or the other direction the measured values are calculated.
Measured values are air speed, air flow rate, direction of air flow and acoustic virtual temperature.

Advantanges

• Specifically developed for application in tunnels
• No control unit required
• Easy configuration
• Corrosion resistant against aggressive tunnel atmosphere
• Sensors can be replaced quickly with no special tools, easy re-alignment
• Minimised spare requirements
• Extremely low maintenance requirements

Application

Tunnels are important infrastructure elements in road networks and facilitate the connection of regions. Environmental conditions in tunnels are influenced by fog, particles and emissions and need to be monitored to protect people on their passage through the tunnel from danger and impacts on their health. Accidents in tunnels, and particularly fires, can have dramatic consequences and can prove extremely costly in terms of human life, increased congestion, pollution and repair costs. At every time people in the tunnel need to be supplied with breathable air and sufficient visibility.
Since 1990 JES Elektrotechnik GmbH develops, installs and maintains systems to monitor air characteristics and lighting conditions in tunnels. Our systems are robust, durable and resistant against the corrosive atmosphere in a tunnel. They operate reliably and have a high accuracy in measurement.
All systems fulfil the requirements of the EC guideline 2004/54/EC (Minimum safety requirements for tunnels in the trans-European road network) and the more detailed national guidelines and provisions:
• Austria: RVS 09.02 Tunnelausrüstung
• Germany: RABT Richtlinien für die Ausstattung und den Betrieb von Straßentunneln
• Switzerland: ASTRA Richtlinien und Fachhandbuch Betriebs- und Sicherheitsausrüstungen (BSA)
Our range of products for tunnel covers systems for monitoring of
• Visibility (extractive or in-situ)
• Toxic gases like CO, NO, NO2 (extractive or in-situ)
• Air velocity, direction and temperature
• Luminance (access, threshold and interior zone)
• Illuminance

Technical Specifications

Air flow measurement	
Type	JES t/FL-USX
Measuring method	Determination of direction dependant differential transition times of ultrasonic pulses
Measured values	Air speed Air flow rate Direction of air flow Acoustic virtual air temperature
Measuring range	-20 .. 20 m/s
Resolution	0.1 m/s, accuracy depending on measuring distance, flow profile, installation, typically <±0.2 m/s at 3 m/s
Response time	> 1s ... 180 s, configurable
Measurement path length	1.2 - 25 m
Alignment	30 - 60° to tunnel longitudinal axis, typically 45°

Outputs	
Analogue output	1 x 4-20 mA, 400 Ω, isolated can be assigned any measured value and output range
Output range	configurable, typically: -20 to 20 m/s
Relay contacts	1 x fault indication (NC) 1 x direction of air flow (NC) (max. 48 V / 0.5 A)
Digital interfaces	1x RS 485 MODBUS RTU to control system, bidirectional 1x Intercom RS 485 master-slave

Ultrasonic transceiver (sensor)

Sensor	
Type	DURAG D-FL 220T M
Operating voltage	24 VDC ± 10 %
Current consumption	1 A
Appliance class	Class III
Service interface	USB 1.1
MTBF	> 170.000 h within service life if used within specifications
Material	Sensor housing: Polyamide RAL5017, Flammability rating: B1 (UL 94 V0) Wall bracket: Stainless steel 1.4404 (AISI 316L) or 1.4571 (AISI 316Ti)
IP rating	IP 69
Dimensions	270 x 130 x 95 mm
Weight	Sensor 2.2 kg Wall bracket 1.6 kg
Indoor/Outdoor use	Indoor use (tunnel)
Altitude	up to 2,000 m
Temperature range	-40 .. +70 °C
Humidity range	0 .. 100% relative humidity (non-condensing)
Pollution degree	4 (intended environment)

t/FL-USX-TBX terminal boxes

Terminal box A - JES t/FL-USX-TBX-A	
Type	t/FL-USX-TBX-A
System cable port	1 (for D-FL 220 T M Sensor A)
Power supply	100 to 240 VAC, 50/60 Hz
Supply voltage fluctuations	± 10 %
Overvoltage category	II
Power rating	60 W
Appliance class	Class I
Material	Stainless steel 1.4404 (AISI 316L)
Mounting	incl. mounting clamp made from Stainless steel 1.4404 for wall mounting
IP rating	IP 69
Dimensions	250 x 160 x 110 mm
Weight	approx. 3.2 kg
Indoor/Outdoor use	Indoor use (tunnel)
Altitude	up to 2,000 m
Temperature range	-40 .. +60 °C
Humidity range	0 .. 100% relative humidity (non-condensing)
Pollution degree	4 (intended environment) / 2 (when cover removed)

Terminal box B - t/FL-USX-TBX-B	
Type	t/FL-USX-TBX-B
System cable port	1 (for D-FL 220 T M Sensor B)
Power supply	24 VDC ±10 %
Current rating	1 A
Appliance class	Class III
Material	Stainless steel 1.4404 (AISI 316L)
Mounting	incl. mounting clamp made from Stainless steel 1.4404 for wall mounting
IP rating	IP 69
Dimensions	160 x 160 x 110 mm
Weight	approx. 1.9 kg
Indoor/Outdoor use	Indoor use (tunnel)
Temperature range	-40 .. +60 °C
Humidity range	0 .. 100% relative humidity (non-condensing)
Pollution degree	4 (intended environment) / 2 (when cover removed)

smart/BOX-S-FL-USX gateway (instead of t/FL-USX-TBX-A for Ethernet connection)

smart/Architecture gateway for t/FL-USX - smart/BOX-S-FL-USX	
Type	smart/BOX-S-FL-USX
System cable port	1 (for D-FL 220 T M sensor)
Power supply	100 to 240 VAC, 50/60 Hz
Supply voltage fluctuations	± 10 %
Overvoltage category	II
Power rating	60 W
Appliance class	Class I
Digital interfaces	MODBUS RTU (RS-485) MODBUS/TCP (Ethernet) Webserver for configuration (Ethernet)
Material	Stainless steel 1.4404 (AISI 316L)
Mounting	incl. mounting clamp made from Stainless steel 1.4404 for wall mounting
IP rating	IP 69
Dimensions	250 x 160 x 110 mm
Weight	approx. 3.2 kg
Indoor/Outdoor use	Indoor use (tunnel)
Altitude	up to 2,000 m
Temperature range	-40 .. +60 °C
Humidity range	0 .. 100% relative humidity (non-condensing)
Pollution degree	4 (intended environment) / 2 (when cover removed)

Conformities

Conformities	
Markings	
Electrical standards	2014/35/EU Low Voltage Directive (LVD) 2014/30/EU Electromagnetic compatibility (EMC) EN 61010-1 Safety requirements for electrical equipment for measurement, control and laboratory use EN IEC 61326-1:2021 Electrical equipment for measurement, control and laboratory use - EMC requirements
Tunnel safety standards	Austria: RVS 09.02.22 Germany: RABT 2006 Switzerland: ASTRA RL 13001, Fachhandbuch BSA Norway: Norwegian Public Roads Administration Handbook No. 021 Road Tunnels International: ISO 23431 Measurement of road tunnel air quality