



Message Queuing Telemetry Transport (MQTT)

API DESCRIPTION



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Perfect Welding / Technical Product Management

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1 Introduction

MQTT (Message Queuing Telemetry Transport) is a publish-subscribe-based messaging protocol based on ISO/IEC PRF 20922 standard. It works on top of the TCP/IP protocol. It is a lightweight protocol designed for connections with remote locations and limited network bandwidth. The publish/subscribe messaging pattern requires a message broker. It does not represent any real-time communication.

This document describes the implementation of the MQTT publisher with FRONIUS TPS/I, iWave and WeldCube Connector.

1.1 What is MQTT and what is it used for

MQTT is one of the most used protocols in the IoT world. It stands for Message Queuing Telemetry Transport. It is designed as a lightweight messaging protocol that uses publish/subscribe operations to exchange data between clients and the server. Small size, low power usage, minimized data packets and ease of implementation make the protocol ideal for machine-to-machine communications.

Compared to other protocols MQTT has unique features:

- ➔ Lightweight protocol
- ➔ It is easy to implement in software
- ➔ Fast in data transmission
- ➔ Based on messaging techniques
- ➔ Low network usage by minimized data packets

Like any other internet protocol, MQTT is based on clients and a server. The server is responsible for handling the client's requests of receiving or sending data between each other.

Terminology and description:

- ➔ **Publish:** a client (e.g. welding machine) sends data to the broker
- ➔ **Subscribe:** a client (e.g. MES connector) receives data from a broker
- ➔ **Topic:** the target a device wants to publish or subscribe messages to or from
- ➔ **Message:** data that a device sends (publish) or receives (subscribe) to or from a topic
- ➔ **Retain:** a broker stores the last retained message and the corresponding QoS for that topic
- ➔ **Last will:** a message that is published by the broker if clients disconnect ungracefully

1.2 MQTT Server (Broker)

The MQTT Server is called a **broker** and the clients are the connected devices. It handles the publish/subscribe actions to the target topics between the clients. There are several broker available

Message Queuing Telemetry Transport (MQTT)

on the market. A description and download about the open source message broker “mosquitto” can be found here: <https://mosquitto.org/>

The number of connected devices to the broker depends on the broker service provider. By design it is nearly limitless but depends on the amount of data, usage and server capacities.

1.3 MQTT Client ID

The MQTT client identifier is an up to 23 byte long string that identifies a MQTT client. Each identifier connected to a broker must be unique. The identifier on FRONIUS welding machines is based on the word “FRONIUS” and the serial number (e.g. “FRONIUS30112419”). This identifier is unique and can’t be changed.

1.4 Quality of Service (QoS)

Each connection between a client and the broker can specify a "quality of service" (QoS) measure.

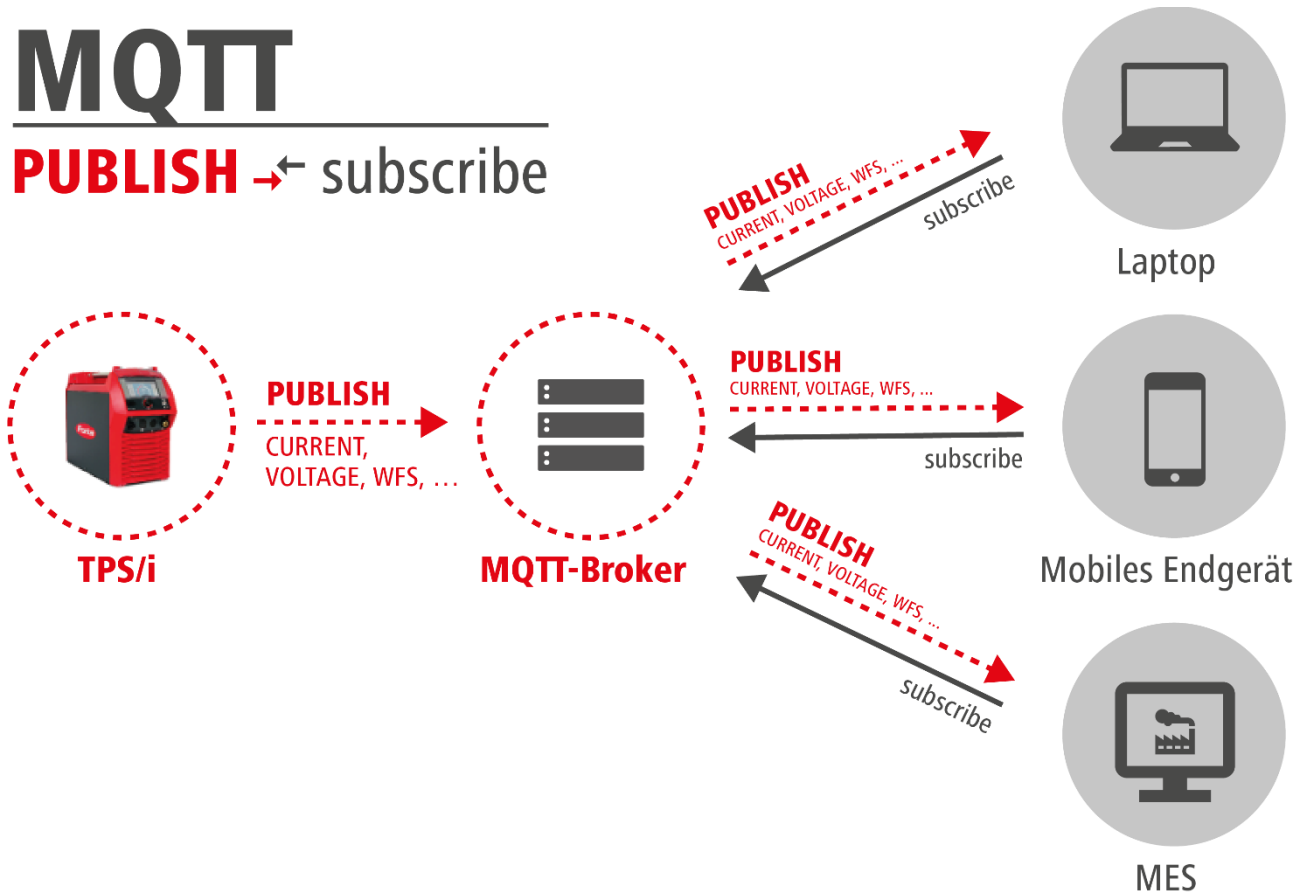
These are classified in increasing order of overhead:

- **At most once:** a message is sent only once and the client and broker without acknowledge.
- **At least once:** a message is re-tried by the sender multiple times until acknowledgement is received.
- **Exactly once:** a two-level handshake between sender and receiver to ensure only one copy of a message is received.

Note: QoS within MQTT is only used by sender and receiver and doesn’t affect handling of the underlying TCP data transmission.

1.5 Schematic overview

The following schematic overview shows how MQTT works.



1.6 Disclaimer

Although MQTT is known as reliable and depending on the implementation as fast, the use of MQTT with FRONIUS welding machines is only for documentation, visualization and informative purposes.

It is not allowed to use any status information provided by this communication for safety implementations.

2 Description of topics

MQTT is organized in hierarchically structured topics. All topics are case sensitive. To make your subscriptions run properly, ensure the proper character typing of the designated topics. All main topics on FRONIUS welding machines are defined in upper case.

Example: `FRONIUS/MYDEVICE_001/SYSTEM/ONLINE`

The MQTT topics hierarchy structure on FRONIUS welding machines is organized in corresponding groups. The following headline topics are available (details see below):

```
FRONIUS/MYDEVICE_001/ACTUAL
FRONIUS/MYDEVICE_001/PROCESS
FRONIUS/MYDEVICE_001/JOB
FRONIUS/MYDEVICE_001/SETTINGS
FRONIUS/MYDEVICE_001/TRACE
FRONIUS/MYDEVICE_001/SYSTEM
```

Note: MYDEVICE_001 represents the device topic as configured in the MQTT settings on the welding machine.

The following objects and nodes are available from firmware version or higher:

TPS/i	3.2.10
iWave 190i/230i	2.2.0
WeldCube Connector	1.3.0

2.1 Values and Format

To ensure an easy implementation and debugging and due to the reason that some topics have multiple types, the values of all topics are published as **strings**. To ensure proper type interpretation the following convention needs to be considered:

Decimal Point	ASCII Code 46 („.“)
Boolean	„TRUE“ and „FALSE“
Enumeration	See topic details below
JSON	See topic details below

2.2 Subscriptions

Once the FRONIUS welding machine (TPS/i, iWave190i/230i) or the WeldCube Connector is configured and MQTT is activated the device sends a control message with the data to the connected broker. The broker then distributes the information to any clients that have subscribed to one or more topics published by the welding machine.

The publisher does not need to have any data on the number or locations of subscribers, and subscribers in turn do not have to be configured with any data about the publishers (welding machines).

To identify the messages from a specific welding machine you can use the device topic as described in chapter 3.3 can be used.

If a broker receives a topic for which there are no current subscribers, it will discard the topic unless the publisher indicates that the topic is to be retained. This allows new subscribers to a topic to receive the most current value rather than waiting for the next update from a publisher.

2.3 Root and device topic

The root topic of each FRONIUS welding machine starts with the fixed word “FRONIUS” followed by the device topic:

Example: `FRONIUS/MYDEVICE_001/`

The device topic can be configured in the MQTT settings located in the SmartManager (website) of the welding machine.

Note: Ensure that you have unique device topics within your network infrastructure to avoid wrong message identification.

2.4 Single and multilevel wildcards

MQTT accepts special characters as wildcards in subscriptions to a broker.

The **single-level wildcard** character “+” ASCII Code 43 matches **only one topic level**. The single-level wildcard can be used at any level in the topic tree, and in conjunction with the multi-level wildcard. The single-level wildcard must be specified next to the topic level separator, except when it is specified on its own.

Example (single-level wildcard on device topic):

`FRONIUS/+ /SYSTEM/ONLINE`

Receiving Messages:

```
FRONIUS/MYDEVICE/SYSTEM/ONLINE TRUE
FRONIUS/YOURDEVICE/SYSTEM/ONLINE FALSE
FRONIUS/SOMEOTHERDEVICE/SYSTEM/ONLINE TRUE
...
```

The **multi-level wildcard** character “#” ASCII Code 35 is used to match **any number of levels** within a topic. This wildcard can represent zero or more levels. The multilevel wildcard is only effective when specified on its own or next to the topic level separator character.

Example (single-level wildcard on device topic):

```
FRONIUS/MYDEVICE_001/SYSTEM/#
```

Receiving Messages:

```
FRONIUS/MYDEVICE_001/SYSTEM/COOLER_MODE AUTO
FRONIUS/MYDEVICE_001/SYSTEM/TOTAL_CURRENTFLOW 0.0
FRONIUS/MYDEVICE_001/SYSTEM/TOTAL_POWERON 673.3
FRONIUS/MYDEVICE_001/SYSTEM/COOLER_TEMP invalid
FRONIUS/MYDEVICE_001/SYSTEM/COOLER_FLOW invalid
FRONIUS/MYDEVICE_001/SYSTEM/TOTAL_WIRELENGTH 1650
FRONIUS/MYDEVICE_001/SYSTEM/TOTAL_SHIELDING_GAS 570
FRONIUS/MYDEVICE_001/SYSTEM/SERIALNUMBER 30112419
FRONIUS/MYDEVICE_001/SYSTEM/APIVERSION 1.0
FRONIUS/MYDEVICE_001/SYSTEM/ONLINE TRUE
```

The syntax for the topic-based wildcard scheme has no escape characters. Whether '#' and '+' are treated as wildcards or not depends on their context.

2.5 Topics for TPS/i

2.5.1 Topic: ACTUAL

The following topics are published during the welding process with the defined sampling rate (0.1...100 seconds). The values can be used to record the weld process data.

Topic	Type	Unit	Description
ACTUAL_CURRENT	Float [-5000.0...5000.0]	[A]	Current
ACTUAL_VOLTAGE	Float [-500.0...500.0]	[V]	Voltage
ACTUAL_WFS	Float [-99.9...99.9]	[m/min]	Wire feed speed
ACTUAL_POWER	Float [-0.000...1000000.000]	[W]	Power
ACTUAL_WELDINGTIME	Float [0.0...1000000.0]	[s]	Welding time
ACTUAL_GASFLOW	Float [0.0...100.0]	[l/min]	Gasflow
WIREBUFFER_VALUE	Float [-100...100]	[%]	Status of Wirebuffer (100% Full / -100% Empty)

The following topics can be used for external displays and other visualization. The values for current, voltage, wire feed speed, power and energy are automatically set to the state of the welding process.

Topic	Type	Unit	Description
DISPLAY_STATUS	Enum [HOLD] [REAL] [COMMAND]	N/A	Status of weld
DISPLAY_CURRENT	Float [-5000.0...5000.0]	[A]	Current
DISPLAY_VOLTAGE	Float [-500.0...500.0]	[V]	Voltage
DISPLAY_WFS	Float [-99.9...99.9]	[m/min]	Wire feed speed
DISPLAY_POWER	Float [0.000...1000000.000]	[kW]	Power
DISPLAY_ENERGY	Float [0.000...0.999]	[kJ]	Energy

2.5.2 Topic: PROCESS

The PROCESS topics represent the status of the actual process.

Topic	Type	Unit	Description
PROCESS_ACTIVE	bool [TRUE/FALSE]	N/A	Process active
PROCESS_MAINPHASE	bool [TRUE/FALSE]	N/A	Process main phase
CURRENTFLOW	bool [TRUE/FALSE]	N/A	Current flow
ARCSTABLE	bool [TRUE/FALSE]	N/A	Arc stable
ERROR	uint16 [0...65535]	N/A	Welding Error (0=OK, No error)
SAFETYSTATUS	Enum [INVALID] [ACTIVE] [SELFTEST] [HALT] [STOP]	N/A	Safety status
PENETRATION_STABILIZER_STATUS	ENUM [INVALID] [OFF] [ON]	N/A	Status of penetration stabilizer
ARC_LENGTH_STABILIZER_STATUS	ENUM [INVALID] [OFF] [ON]	N/A	Status of arc length stabilizer
WIREEND_VALUE	ENUM [INVALID] [OFF] [ON]	N/A	Wire end status
WIRE_END_VALUE_DRUM	ENUM [INVALID] [OFF] [ON]	N/A	Wire end status of drum sensor
WIRE_END_VALUE_RINGSENSOR	ENUM [INVALID] [OFF] [ON]	N/A	Wire end status of ring sensor

2.5.3 Topic: JOB

The JOB topics are related to jobs and represent the actual state and number. For details on the specific settings of the selected job refer to 2.5.4 Topic SETTING.

Topic	Type	Unit	Description
JOBNUMBER	Uint16 [1...1000]	N/A	Job number
JOBMODE	bool [TRUE/FALSE]	N/A	Job Mode
JOBREVISION	Uint16 [0...65535]	N/A	Job Revision
JOBSLOPE	Float [0.0...10.0]	[s]	Job Slope
JOBNAME	String [30]	N/A	Job Name

Note: If "JOBMODE" is "FALSE" the "JOBNUMBER" is not representative.

2.5.4 Topic: SETTINGS

The SETTINGS topics represent the actual welding parameter settings including welding mode and trigger mode.

Topic	Type	Unit	Description
WELDING_MODE	Enum [MIG_PULS] [MIG_STANDARD] [MIG_STANDARD_MANUAL] [MIG_LSC] [MIG_PMC] [MIG_CMT]	N/A	Welding mode
TRIGGER_MODE	Enum [2_STEP] [4_STEP] [S2_STEP] [S4_STEP] [SPOT]	N/A	Trigger mode
CURRENT_RECOMMVALUE	float [-5000...5000]	[A]	Current recommend value
VOLTAGE_RECOMMVALUE	float [-500.0...500.0]	[V]	Voltage recommend value
WFS_COMMANDVALUE	float [0.0...100.0]	[m/min]	Wire feed speed command value
START_ARCLENGTH_CORRECTION	float [-10.0...10.0]	N/A	Start arc length correction
END_ARCLENGTH_CORRECTION	float [-10.0...10.0]	N/A	End arc length correction
START_CURRENT_TIME	float [0.0...10.0] / [OFF]	[s]	Start current time
END_CURRENT_TIME	float [0.0...10.0] / [OFF]	[s]	End current time
START_CURRENT	uint16 [0..200]	[%]	Start current
END_CURRENT	uint16 [0..200]	[%]	End current
GASPREFLOW	float [0.0...9.9]	[s]	Gas preflow
GASPOSTFLOW	float [0.0...60.0]	[s]	Gas postflow
ARCLENGTH_CORRECTION	float [-10.0...10.0]	N/A	Arc length correction
PULSDYNAMIC_CORRECTION	float [-10.0...10.0]	N/A	Puls dynamic correction
PENETRATION_STABILIZER	float [-10.0...10.0]	[m/min]	Penetration stabilizer
ARC_LENGTH_STABILIZER	float [0.0...5.0]	N/A	Arc length stabilizer
SLOPE_1	float [0.0...9.9]	[s]	Slope 1
SLOPE_2	float [0.0...9.9]	[s]	Slope 2
GASVALUE	float [0.5...30.0] / [AUTO]	[l/min]	Gas command value (or "AUTO")
GASFACOR	float [0.90...20.00]	N/A	Gas factor
SFI	bool [TRUE/FALSE]	N/A	SFI
SFI_HOTSTART	float [0.00...2.00] / [OFF]	[s]	SFI hot start
SYNCHROPULSE_ENABLE	bool [TRUE/FALSE]	N/A	Synchropulse: Enable
SYNCHROPULSE_FREQUENCY	float [0.5...10.0]	[Hz]	Synchropulse: Frequency
SYNCHROPULSE_DELTA_FEEDER	float [0.1...6.0]	[m/min]	Synchropulse: Delta feeder
SYNCHROPULSE_DUTYCYCLE	float [10...90]	[%]	Synchropulse: Duty cycle
SYNCHROPULSE_ARCLENGTH_CORR_HIGH	float [-10.0...10.0]	N/A	Synchropulse: Arc length correction high
SYNCHROPULSE_ARCLENGTH_CORR_LOW	float [-10.0...10.0]	N/A	Synchropulse: Arc length correction low

2.5.5 Topic: TRACE

The TRACE topics represent the traceability parameters for the actual or next weld.

Topic	Type	Unit	Description
PARTITEMNUMBER	string [100]	N/A	Item/Article number of part
PARTSERIALNUMBER	string [100]	N/A	Serial number of part
SEAMNUMBER	uint16 [0...65535]	N/A	Seam number (or processing step)
PARVERSION	string [100]	N/A	Version of part

Note: To set the traceability parameter use the **FRONIUS Data Channel (TCP)** and/or robot interface.

2.5.6 Topic: SYSTEM

The SYSTEM topics represent the actual system state of the welding machine including machine serial number, hour meters and information on the cooler if there is one installed. The values are published on change or update.

Topic	Type	Unit	Description
SERIALNUMBER	string [100]	N/A	Machine serial number
APIVERSION	string [100]	N/A	MQTT API version
ONLINE	bool [TRUE/FALSE]	N/A	Online state (last will)*
FIRMWAREVERSION	string [100]	N/A	Firmware version of welding machine
TOTAL_CURRENTFLOWTIME	float [0.0...1000000.0]	[h]	Hour-meter current flow time
TOTAL_POWERONTIME	float [0.0...1000000.0]	[h]	Hour-meter power on time of machine
TOTAL_WIRELENGTH	float [0.0...1000000.0]	[m]	Total wire length consumption
TOTAL_SHIELDING_GAS	float [0.0...1000000.0]	[l]	Total shielding gas consumption
COOLER_MODE	enum [AUTO] [ECO] [ON] [OFF]	N/A	Cooler mode
COOLER_TEMP	float [-200.0...200.0]	[°C]	Cooler temperature
COOLER_FLOW	float [-100.00...100.00]	[l/min]	Cooling circuit flow rate
MOTOR_FORCE_M1	float [0...999]	[N]	Motor Force (Motor 1)
MOTOR_FORCE_M2	float [0...999]	[N]	Motor Force (Motor 2)
MOTOR_FORCE_M3	float [0...999]	[N]	Motor Force (Motor 3)

*) The online state is defined as “last will”. The broker will send “false” if the machine disconnects ungracefully.

2.6 Topics for iWave 190i/230i

2.6.1 Topic: ACTUAL

The following topics are published during the welding process with the defined sampling rate (0.1...100 seconds). The values can be used to record the weld process data.

Topic	Type	Unit	Description
ACTUAL_CURRENT	Float [-5000.0...5000.0]	[A]	Current
ACTUAL_VOLTAGE	Float [-500.0...500.0]	[V]	Voltage
ACTUAL_WFS	Float [-99.9...99.9]	[m/min]	Wire feed speed
ACTUAL_POWER	Float [-0.000...1000000.000]	[W]	Power
ACTUAL_WELDINGTIME	Float [0.0...1000000.0]	[s]	Welding time
ACTUAL_GASFLOW	Float [0.0...100.0]	[l/min]	Gasflow

The following topics can be used for external displays and other visualization. The values for current, voltage, wire feed speed, power and energy are automatically set to the state of the welding process.

Topic	Type	Unit	Description
DISPLAY_STATUS	Enum [HOLD] [REAL] [COMMAND]	N/A	Status of weld
DISPLAY_CURRENT	Float [-5000.0...5000.0]	[A]	Current
DISPLAY_VOLTAGE	Float [-500.0...500.0]	[V]	Voltage
DISPLAY_POWER	Float [0.000...1000000.000]	[kW]	Power
DISPLAY_ENERGY	Float [0.000...0.999]	[kJ]	Energy

The Telemetry Topic includes values which are time synchronous and can be used for data documentation. A new Telemetry Topic will be sent when at least one value changes.

Topic	Type	Unit	Description
TELEMETRY	JSON	N/A	Time synchronous data: { "ActualCurrent": "0.0", "ActualVoltage": "0.0", "ActualWFS": "0.0", "ActualPower": "0", "ActualGasFlow": "", "ActualWeldingTime": "0.0", "ProcessActive": "", "ProcessMainPhase": "", "CurrentFlow": "", "ArcStable": "", "ProcessError": "" }

2.6.2 Topic: PROCESS

The PROCESS topics represent the status of the actual process.

Topic	Type	Unit	Description
PROCESS_ACTIVE	bool [TRUE/FALSE]	N/A	Process active
PROCESS_MAINPHASE	bool [TRUE/FALSE]	N/A	Process main phase
CURRENTFLOW	bool [TRUE/FALSE]	N/A	Current flow
ARCSTABLE	bool [TRUE/FALSE]	N/A	Arc stable
ERROR	uint16 [0...65535]	N/A	Welding Error (0=OK, No error)

2.6.3 Topic: JOB

The JOB topics are related to jobs and represent the actual state and number. For details on the specific settings of the selected job refer to 2.6.4 Topic SETTING.

Topic	Type	Unit	Description
JOBNUMBER	Uint16 [1...1000]	N/A	Job Number
JOBMODE	bool [TRUE/FALSE]	N/A	Job Mode
JOBREVISION	Uint16 [0...65535]	N/A	Job Revision
JOBSLOPE	Float [0.0...10.0]	[s]	Job Slope
JOBNAME	String [30]	N/A	Job Name

Note: If "JOBMODE" is "FALSE" the "JOBNUMBER" is not representative.

2.6.4 Topic: SETTINGS

The SETTINGS topics represent the actual welding parameter settings including welding mode and trigger mode.

Topic	Type	Unit	Description
WELDING_MODE	Enum [TIG ext] [MMA] [CEL]	N/A	Welding mode
TIG_TRIGGER_MODE	enum [2_STEP] [4_STEP] [SPOT]	N/A	Trigger mode
TIG_I1	float [0...5000]	[A]	TIG main current
TIG_START_CURRENT	uint16 [0...200]	[%]	Start current in % of main current
TIG_UP_SLOPE	float [0.01...30.0]	[s]	Up slope time
TIG_DOWN_SLOPE	float [0.01...30.0]	[s]	Down slope time
TIG_END_CURRENT	uint16 [0...100]	[%]	End current in % of main current
TIG_ELECTRODE_DIAMETER	float [1.0...6.4] / [OFF]	[mm]	TIG electrode diameter
TIG_BALANCE	float [15.0...50.0]	[%]	Balance in TIG AC mode
TIG_TAC	float [0.1...9.9] / [OFF] [ON]	[s]	Tac time or ON OFF
TIG_START_CURRENT_TIME	float [0.01...30.0] / [OFF]	[s]	Duration of starting phase
TIG_END_CURRENT_TIME	float [0.01...30.0] / [OFF]	[s]	Duration of end phase
TIG_PULSE_FREQUENCY	float [0.2...10000.0] / [OFF]	[Hz]	Pulse frequency TIG DC
TIG_PULSE_BACKGROUND_CURRENT	uint16 [0...100]	[%]	Base current in % of main current at TIG pulse
TIG_PULSE_DUTY_CYCLE	uint16 [10...90]	[%]	Pulse pause ratio
TIG_AC_FREQUENCY	uint16 [40...250] / [SYN]	[Hz]	TIG AC frequency
TIG_AC_CURRENT_OFFSET	float [-70...70]	[%]	TIG AC current offset
TIG_CALOTTE_MODE	enum [OFF] [ON]	N/A	TIG AC Calotte mode
TIG_AC_WAVEFORM_POSITIVE	enum [SQUARE_HARD] [SQUARE_SOFT] [TRIANGLE] [SINUS]	N/A	TIG AC waveform of positive curve
TIG_AC_WAVEFORM_NEGATIVE	enum [SQUARE_HARD] [SQUARE_SOFT] [TRIANGLE] [SINUS]	N/A	TIG AC waveform of negative curve
TIG_HF_IGNITION	enum [ON] [OFF] [TOUCHHF] [EXT]	N/A	High frequency start
TIG_IGNITION_TIMEOUT	float [0.1...9.9]	[s]	Ignition timeout
TIG_POLARITY	enum [DC-] [AC]	N/A	TIG polarity
TIG_SPOT_TIME	float [0.02...120]	[s]	Main phase time in Spot Trigger Mode
TIG_RPI	enum [OFF] [ON] [AUTO]	N/A	Ignition in different polarity
TIG_GASPREFLOW	float [0.0...9.9]	[s]	Gas preflow time
TIG_GASPOSTFLOW	float [0.0...60.0]	[s]	Gas postflow time

TIG_WAVEFORM_PULSE	enum [SQUARE_HARD] [SQUARE_SOFT] [TRIANGLE] [SINUS]	N/A	TIG DC waveform of pulse
TIG_WAVEFORM_BACKGROUND	enum [SQUARE_HARD] [SQUARE_SOFT] [TRIANGLE] [SINUS]	N/A	TIG DC waveform of base current
TIG_DROP_CURRENT_SLOPE1	float [0.01...30] / [OFF]	[s]	Slope time from main current to drop current
TIG_DROP_CURRENT_SLOPE2	float [0.01...30] / [OFF]	[s]	Slope time from drop current to main current
TIG_HF_IGNITION_DELAY	float [0.1...5.0]	[s]	Delay of HF Impulse
TIG_EXT_UCUTOFF	float [6.0...90.0]	[V]	TIG extended cut off current
TIG_EXT_CSS	float [0.1...10.0]	[V]	TIG extended comfort stop
CYCLETIG_INTERVAL_TIME	float [0.02...2.00]	[s]	Cycle TIG duration of impulse
CYCLETIG_INTERVAL_PAUSETIME	float [0.02...2.00]	[s]	Cycle TIG pause time
CYCLETIG_INTERVAL_CYCLES	float [1...2000] / [PERMANENT]	N/A	Amount of Cycles
CYCLETIG_ENABLED	enum [ON] [OFF]	N/A	Cycle TIG enabled
TIG_SHIELDING_1_GASVALUE	float [0.5...30.0]	[l/min]	Shielding Gas 1
TIG_SHIELDING_1_GASFACTOR	float [0.9...20.0] / [AUTO]	N/A	Shielding Gas 1 factor
TIG_WORKING_2_GASVALUE	float [0.5...30.0]	[l/min]	Working Gas 2
TIG_WORKING_2_GASFACTOR	float [0.9...20.0] / [AUTO]	N/A	Working Gas 2 factor
ARCBREAKTIME	float [0.00...2.00]	[s]	Arc break watchdog
ARCBREAKREACTION	enum [IGNORE] [ERROR]	N/A	Arc break watchdog reaction

2.6.5 Topic: TRACE

The TRACE topics represent the traceability parameters for the actual or next weld.

Topic	Type	Unit	Description
PARTITEMNUMBER	string [100]	N/A	Item/Article number of part
PARTSERIALNUMBER	string [100]	N/A	Serial number of part
SEAMNUMBER	uint16 [0...65535]	N/A	Seam number (or processing step)
PARVERSION	string [100]	N/A	Version of part

Note: To set the traceability parameter use the **FRONIUS Data Channel (TCP)** and/or robot interface.

2.6.6 Topic: SYSTEM

The SYSTEM topics represent the actual system state of the welding machine including machine serial number, hour meters and information on the cooler if there is one installed. The values are published on change or update.

Topic	Type	Unit	Description
SERIALNUMBER	string [100]	N/A	Machine serial number
APIVERSION	string [100]	N/A	MQTT API version
ONLINE	bool [TRUE/FALSE]	N/A	Online state (last will)*
FIRMWAREVERSION	string [100]	N/A	Firmware version of welding machine
TOTAL_CURRENTFLOWTIME	float [0.0...1000000.0]	[h]	Hour-meter current flow time
TOTAL_POWERONTIME	float [0.0...1000000.0]	[h]	Hour-meter power on time of machine
TOTAL_SHIELDING_GAS	float [0.0...1000000.0]	[l]	Total shielding gas consumption
COOLER_MODE	enum [AUTO] [ECO] [ON] [OFF]	N/A	Cooler mode
COOLER_TEMP	float [-200.0...200.0]	[°C]	Cooler temperature
COOLER_FLOW	float [-100.00...100.00]	[l/min]	Cooling circuit flow rate

*) The online state is defined as “last will”. The broker will send “false” if the machine disconnects ungracefully.

2.7 Topics for WeldCube Connector

2.7.1 Topic: ACTUAL

The following topics are published during the welding process with the defined sampling rate (0.1...100 seconds). The values can be used to record the weld process data. Wire feed speed is only available for WeldCube Connector U/I/WFS.

Topic	Type	Unit	Description
ACTUAL_CURRENT	Float [-5000.0...5000.0]	[A]	Current
ACTUAL_VOLTAGE	Float [-500.0...500.0]	[V]	Voltage
ACTUAL_WFS	Float [-99.9...99.9]	[m/min]	Wire feed speed
ACTUAL_POWER	Float [-0.000...1000000.000]	[W]	Power
ACTUAL_WELDINGTIME	Float [0.0...1000000.0]	[s]	Welding time

The Telemetry Topic includes values which are time synchronous and can be used for data documentation. A new Telemetry Topic will be sent when at least one value changes.

Topic	Type	Unit	Description
TELEMETRY	JSON	N/A	Time synchronous data: { "ActualCurrent": "0.0", "ActualVoltage": "0.0", "ActualWFS": "0.0", "ActualPower": "0", "ActualGasFlow": "", "ActualWeldingTime": "0.0", "ProcessActive": "", "ProcessMainPhase": "", "CurrentFlow": "", "ArcStable": "", "ProcessError": "" }

2.7.2 Topic: PROCESS

The PROCESS topics represent the status of the actual process.

Topic	Type	Unit	Description
PROCESS_ACTIVE	bool [TRUE/FALSE]	N/A	Process active
CURRENTFLOW	bool [TRUE/FALSE]	N/A	Current flow
ERROR	uint16 [0...65535]	N/A	Welding Error (0=OK, No error)

2.7.3 Topic: TRACE

The TRACE topics represent the traceability parameters for the actual or next weld.

Topic	Type	Unit	Description
PARTITEMNUMBER	string [100]	N/A	Item/Article number of part
PARTSERIALNUMBER	string [100]	N/A	Serial number of part
SEAMNUMBER	uint16 [0...65535]	N/A	Seam number (or processing step)
PARVERSION	string [100]	N/A	Version of part

Note: To set the traceability parameter use the **FRONIUS Data Channel (TCP)** and/or robot interface.

2.7.4 Topic: SYSTEM

The SYSTEM topics represent the actual system state of the welding machine including machine serial number, hour meters and information on the cooler if there is one installed. The values are published on change or update. TOTAL_WIRELENGTH is only available for WeldCube Connector U/I/WFS.

Topic	Type	Unit	Description
SERIALNUMBER	string [100]	N/A	Machine serial number
APIVERSION	string [100]	N/A	MQTT API version
ONLINE	bool [TRUE/FALSE]	N/A	Online state (last will)*
FIRMWAREVERSION	string [100]	N/A	Firmware version of welding machine
TOTAL_CURRENTFLOWTIME	float [0.0...1000000.0]	[h]	Hour-meter current flow time
TOTAL_POWERONTIME	float [0.0...1000000.0]	[h]	Hour-meter power on time of machine
TOTAL_WIRELENGTH	float [0.0...1000000.0]	[l]	Total wire length consumption

*) The online state is defined as “last will”. The broker will send “false” if the machine disconnects ungracefully.

3 Setup and Installation

The configuration page for MQTT setup is located in the SmartManager (welding system website) under the topic “Power Source Settings”. Note: The settings for MQTT are not affected on backup and restore of FRONIUS welding machines.

The screenshot shows the 'Power source settings' page in the SmartManager web interface. The 'MQTT settings' tab is selected. The 'MQTT' section has a checkbox that is checked. Below it are input fields for 'Broker' (host), 'Port' (1883), and 'Device topic' (31154852). The 'Security' section has three 'Browse...' buttons for 'CA certificate', 'Client certificate', and 'Client private key', all showing 'No file selected.'. The 'Authentication' section has input fields for 'Username' and 'Password'. At the bottom are two buttons: 'Delete adjustments' and 'Save adjustments'.

MQTT ☒

Broker

Port

Device topic

Security

CA certificate No file selected.

Client certificate No file selected.

Client private key No file selected.

Authentication

Username

Password

Delete adjustments

MQTT Settings

- ➔ Enable/Disable: Enable or disable MQTT communication
- ➔ Broker: Host name or IP Address of MQTT broker
- ➔ Port: Port used by MQTT broker
- ➔ Device topic: Device name used in the root topic

Security

- ➔ CA certificate: CA root certificate
- ➔ Client certificate: Client certificate
- ➔ Client private key: Client private key

Authentication

- ➔ Username: Username for authentication
- ➔ Password: Password for authentication

3.1 Enable/Disable MQTT Communications

By using the enable/disable flag of the checkbox the MQTT communication for the welding machine can be enabled or disabled in general. Disabling the communication will also inform the broker to set the online status of the device to "false".

3.2 Broker Settings

To connect to the designated MQTT broker in your network you have to fill in the host name or IP address and the used TCP port. Please check in advance the network settings of the welding machine and the firewall configuration (in- and out) of your network infrastructure to ensure proper function. MQTT uses by default the TCP port 1883. If using SSL/TLS it is recommended to use port 8883 as defined in the standard. Any other port can be used if needed.

3.3 Device Topic (Name)

The device topic is part of the root topic and identifies the message for any subscriber. If this field is blank the serial number of the welding machine will be used by default.

The following characters are allowed: "A-Z", "a-z", "0-9", "_". In addition the use of "/" is possible to extend the root topic.

3.4 Security Settings

Without any authentication and SSL/TLS certificated MQTT will work in anonymous mode. By using username and password the access on the published topics can be restricted. To encrypt the communication between broker and client you can use certificates and private keys. **It is not recommended to use authentication by username and password without encryption.**

3.5 Sampling Rate

For actual values for **current**, **voltage**, **wire feeder speed** (wfs) and **power** it is possible to setup the sampling rate for publishing. The sampling rate can be set from 0.1 to 100 seconds.

Note: If you use Job-Mode for welding, the sampling rate defined in the selected job is used for publishing the values. Ensure that the required sampling rate is set correctly in each job upon your needs.

3.6 Network Settings

To ensure proper function of MQTT communication it is necessary to setup the TCP/IP parameters according to your network policy. When using a host name instead of the IP address for the MQTT broker a DNS server is required.

Actual system data

Documentation Logbook

JOB
Job Data

Power source settings

Backup & Restore

User ma

Designation & Location

parameter display

date & time

Network settings

Management

MAC address: 00:03:AC:2D:52:EF
current IP address: 10.5.138.240

DHCP

Manual

IP address

10.5.138.240

Network mask

255.255.255.0

Standard gateway

10.5.138.254

DNS server 1

10.1.1.60

DNS server 2

Delete adjustments

Save adjustments

3.7 Time Server Settings (NTP)

For all documentation purposes within the FRONIUS welding data product family it is recommended to synchronize date and time with a local or global time server.

Actual system data

Documentation Logbook

JOB
Job Data

Power source settings

Designation & Location

parameter display

date & time

date & time

automatically

manually

time zone

Europe/Vienna

date

08 / 14 / 2024

time

03 : 07 PM

Delete adjustments

Save adjustments

4 Examples and Best Practice

This chapter includes and examples and best practice information on using MQTT with FRONIUS welding machines.

4.1 Getting started with Mosquitto

The easiest way to start with MQTT on FRONIUS welding machines is to use the Mosquitto broker and subscriber. The following instruction will guide you through the first steps by using Microsoft Windows® and default settings in anonymous mode.

Step 1: Download the Mosquitto from <https://mosquitto.org/>

Install the software on your computer (e.g. C:\Mosquitto)

Setup your firewall to allow TCP port 1883 for incoming and outgoing traffic.

Step 2: Enable MQTT on your FRONIUS welding machine by using the SmartManager

Setup your computer's host name or IP address as MQTT broker and setup the port 1883

Configure your device topic (e.g. MYDEVICE_001). Leave blank for using the machine serial number instead.

Step 3: Open a command line prompt window (cmd.exe)

Change to the directory where Mosquitto is installed (e.g. C:\mosquitto)

Start the Mosquitto broker. Use the "-v" option to display log information (optional):

```
C:\mosquitto\mosquitto.exe -v
```

The welding device will connect automatically to the broker within seconds and publish initial retained messages.

Step 4: Open another command line prompt window (cmd.exe)

Change to the directory where Mosquitto is installed (e.g. C:\mosquitto)

Start the Mosquitto subscriber. Use the "-v" option to display log information (optional):

```
C:\mosquitto\mosquitto_sub.exe -h localhost -v -t "FRONIUS/+/SYSTEM/#"
```

The above command will subscribe to all SYSTEM topics of all connected FRONIUS welding devices using wildcards

Information published by the broker (example):

```
FRONIUS/MYDEVICE_001/SYSTEM/COOLER_MODE AUTO  
FRONIUS/MYDEVICE_001/SYSTEM/TOTAL_CURRENTFLOW 0.0
```

```
FRONIUS/MYDEVICE_001/SYSTEM/TOTAL_POWERON 673.3
FRONIUS/MYDEVICE_001/SYSTEM/COOLER_TEMP invalid
FRONIUS/MYDEVICE_001/SYSTEM/COOLER_FLOW invalid
FRONIUS/MYDEVICE_001/SYSTEM/TOTAL_WIRELENGTH 1650
FRONIUS/MYDEVICE_001/SYSTEM/TOTAL_SHIELDING_GAS 570
FRONIUS/MYDEVICE_001/SYSTEM/SERIALNUMBER 30112419
FRONIUS/MYDEVICE_001/SYSTEM/APIVERSION 1.0
FRONIUS/MYDEVICE_001/SYSTEM/ONLINE TRUE.
```

4.2 Frequently Asked Questions

How and when exactly does the Fronius welding system publish messages to the broker?

During initialization of the MQTT connection between broker and FRONIUS machine, the machine is publishing all topics to the broker to be retained. This happens e.g. when activating the MQTT function, switching on the welding machine with MQTT active or when restarting the broker.

If the connection is up and running MQTT **topics get published** reliable only **on change** of the topic value. All publications are flagged as retain, and with QoS Level: **At most once (Fire and Forget)**

Can parameters of specific jobs be collected which are stored in the welding system? And can I use this as comparison of Jobs?

If Job mode is active, some parameters of the Topic SETTINGS represent information of the currently selected Job. But nevertheless, it is not usable to compare different Jobs or build a Job change history. For such purposes we recommend using the Fronius Software WeldCube Premium.