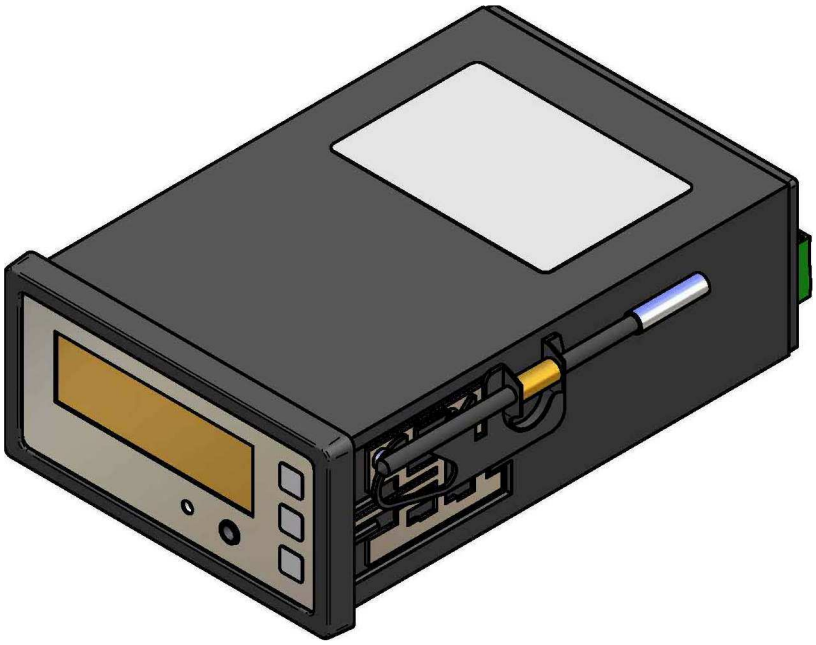
IN CHARGE OF SPEED

JAQUET TECHNOLOGY GROUP

# Frequency Measurement and Switching Instruments
# T411 / T412

## Operating Instructions

This is a translation of the master document 119047 Rev 003



Single Channel Tachometer with Display and 0/4-20mA Output

- **T411.00:** Part No.: 383Z-05318 (+14V Sensor supply )
- **T411.03:** Part No.: 383Z-05595 (+5V Sensor supply )

Single Channel Tachometer with Display and 0/2-10V Output

- **T412.00:** Part No.: 383Z-05319 (+14V Sensor supply)
- **T412.03:** Part No.: 383Z-05596 (+5V Sensor supply)

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## Contents:

# 1 Safety Instructions

T400 series tachometers may only be connected by trained & competent personnel.

As soon as an electrical circuit is connected that can have dangerous voltages, other tachometer components may exhibit a dangerous potential.
(Series T400 tachometers do not themselves generate dangerous potentials)

Before opening the tachometer (Hardware configuration) the unit must be disconnected from circuits that may exhibit dangerous potentials.

These instruments correspond to protection class I and it is therefore mandatory to earth the PE terminal.

The instructions in this operating guide must be strictly adhered to. Not doing so may cause harm to personnel, equipment or plant.

Instruments in a doubtful condition after electrical, climatic or mechanical overload must be immediately disconnected and returned to the manufacturer for repair.

The instruments have been developed and produced in accordance with IC-348 and left the factory in perfect condition.

# 2 Product features

Series T400 tachometers measure and monitor frequencies (speed proportional values) in the range 0 to 35,000 Hz.

The following features are available:

- 1 Current or voltage output (T411 - current, T412 - voltage)
- 1 Sensor frequency output
- 1 Relay
- 2 Limits
- 2 Parameter sets – selectable via binary input
- Sensor monitoring
- System monitoring

The tachometers are configured via T400 PC configuration software.
All settings are in revolutions per minute (rpm).

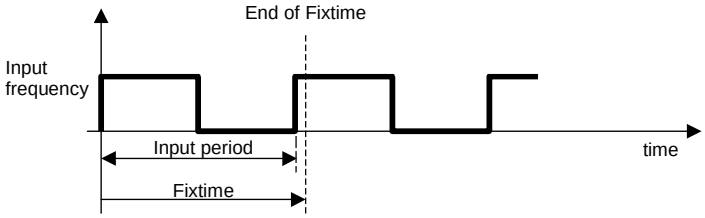
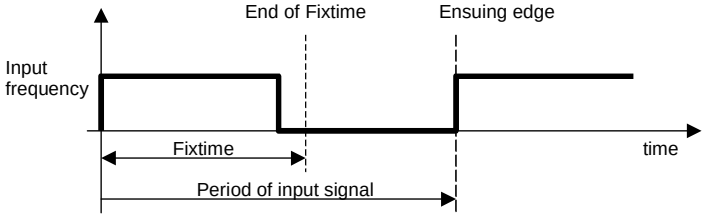
4 models are available:

| | | |
|---|---|---|
| **T411.00** | Single Channel Tachometer with Display, +14V Sensor supply, Relay and 0/4-20mA Output | 383Z-05318 |
| **T412.00** | Single Channel Tachometer with Display, +14V Sensor supply, Relay and 0/2-10V Output | 383Z-05319 |
| **T411.03** | Single Channel Tachometer with Display, +5V Sensor supply, Relay and 0/4-20mA Output | 383Z-05595 |
| **T412.03** | Single Channel Tachometer with Display, +5V Sensor supply, Relay and 0/2-10V Output | 383Z-05596 |

# 3 Specifications

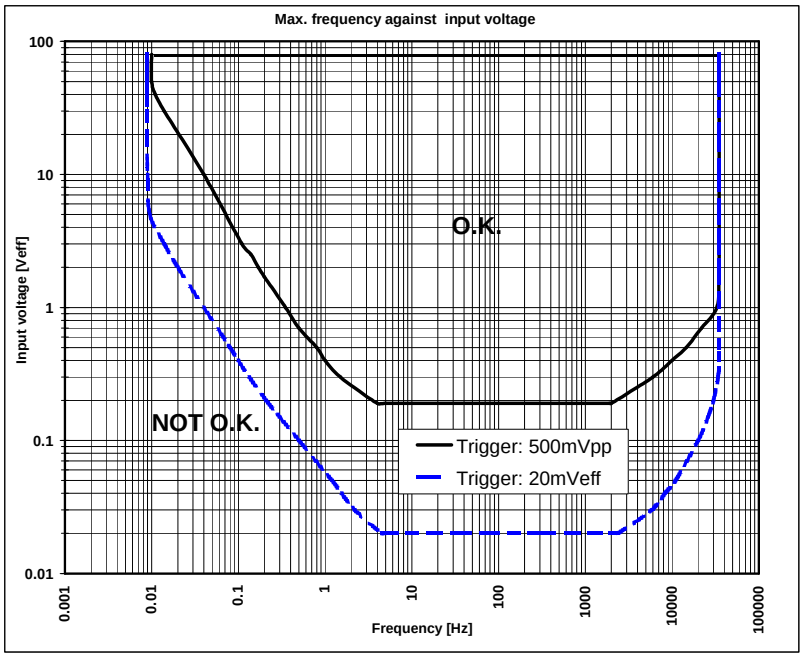
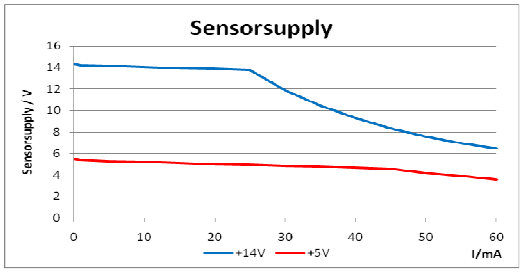
Ambient temperature + 20 °C

## *3.1 General*

| **T411 - T412** | |
|---|---|
| Lowest measuring range | 0 . . . 1.000 Hz |
| Highest measuring range | 0 . . . 35.00 kHz |
| Minimum Measuring time (Fixtime) | Selectable values: 2 / 5 / 10 / 20 / 50 / 100 / 200 / 500ms<br>1 / 2 / 5 Seconds. |
| Effective Measuring time | Is based on the minimum measuring time (Fixtime) and the measured frequency.<br>• Input frequency period < Fixtime<br>  <br>typically: $t_{effective}$ = Fixtime<br>max: $t_{max}$ = 2 x Fixtime<br>• Input frequency period > Fixtime<br>  <br>max: $t_{max}$ = 2 x input frequency period<br>• In the event of sensor signal failure:<br>$t_{effective}$ = Fixtime + (2 x last input frequency period) |
| Resolution | 0.05 % |
| Power supply range | 10...36 VDC |
| Power consumption | 10 V : 2.3 W<br>24 V : 2.6 W<br>36 V : 3 W |
| PSU failure bridging | 16 V : 4 ms<br>24 V : 25 ms<br>36 V : 75 ms |
| Isolation | Galvanic isolation between:<br>• Power supply,<br>• Sensor input incl. sensor supply, Binary input, Serial interface<br>• Analog output<br>• Relay output<br>• Open collector output |
| Isolation voltage | 700 VDC / 500VAC |

## 3.2 Inputs

### 3.2.1 Analog Sensor connection (Sign)

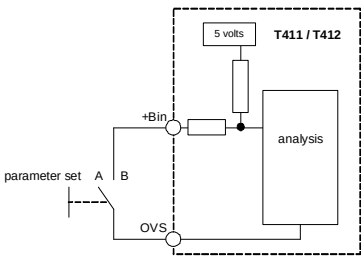
| | |
|---|---|
| Frequency range (-3dB) | 0.01 Hz / 35 kHz |
| Input impedance | 30 kOhm |
| Input voltage | • Max. 80$V_{rms}$   |
| Minimum positive pulse width - digital signals Input voltage | **Signal voltage [$V_{pp}$]** / **0.5** / **1** / **2.5** / **5** / **10** / **20**<br>Min. pulse width [µs] / 2000 / 667 / 333 / 200 / 166 / 125 |
| Sensor supply | **T41x.00**: +14V, max. 35mA short circuit proof<br>**T41x.03**: +5V, max. 35mA short circuit proof<br>In case the current limit is activated, the sensor supply must be disconnected to reset the protection.   |
| Integrated pull-up | 820 Ohm to sensor supply (with Jumper J1) |
| Trigger level | adaptive Trigger level.<br>Configurable with Jumper J2:<br>• 250mV … 6.5V (>500mVpp) [Factory configuration]<br>• 28mV … 6.5V (>20$mV_{rms}$) |
| Screen | A terminal is provided for the sensor cable screen. This terminal is connected to the sensor supply 0V. (0VS) |

| | |
|---|---|
| Sensor monitoring | 1 of 3 settings may be configured via software:<br>• No Sensor Monitoring<br>• Monitoring of powered sensors<br>[Also for 2 wire sensors supplied via the Pull-up resistor (Jumper J1) ].<br>→ The sensor is considered to be defective if the sensor current consumption falls outside of $I_{min}$ and $I_{max}$.<br>$I_{min.}$ = 0.5…25 mA<br>$I_{max.}$ = 0.5…25 mA<br>• Monitoring of non powered sensors<br>[For 2 wire sensors such as electromagnetic sensors.]<br>→ The sensor is considered to be defective if the circuit is disconnected. |

## 3.2.2 Digital Sensor connection (IQ)

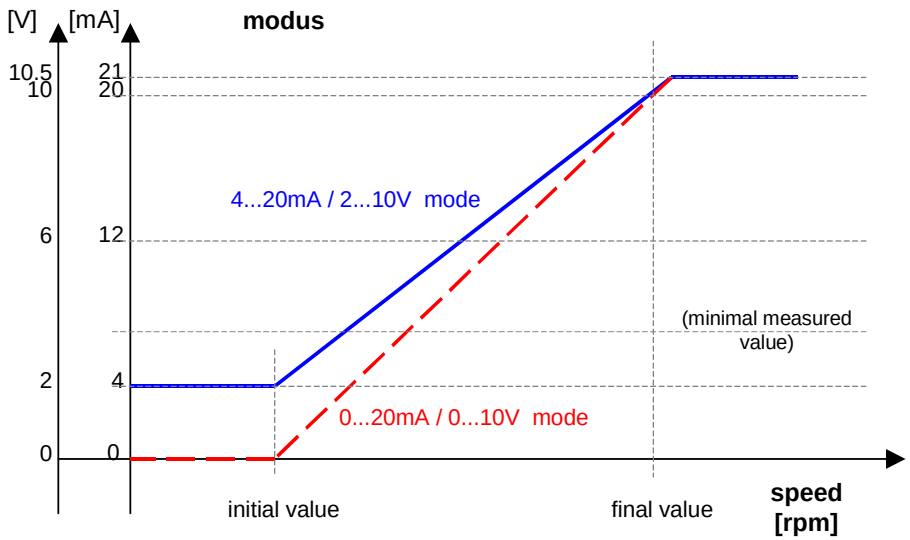
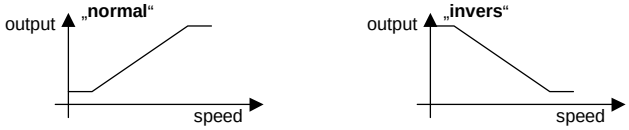
| | | |
|---|---|---|
| Frequency range (-3dB) | 0.01 Hz / 35 kHz | |
| Input impedance | 46 kOhm | |
| Input voltage | Max. ± 36V peek | |
| Minimum pulse width | Min. pulse width 1.5 µs | |
| Sensor supply | **T41x.00** | **T41x.03** |
| | +14V, max. 35mA short circuit proof | +5V, max. 35mA short circuit proof |
| | In case the current limit is activated, the sensor supply must be disconnected to reset the protection. | |
| Trigger level | • $min.U_{low}$ = 1.6 V<br>• $max.U_{high}$= 4.5 V | |
| Screen | A terminal is provided for the sensor cable screen. This terminal is connected to the sensor supply 0V. (0VS) | |
| Sensor monitoring | 1 of 2 settings may be configured via software:<br>• No Sensor Monitoring<br>• Monitoring of powered sensors<br>[Also for 2 wire sensors supplied via the Pull-up resistor (Jumper J1) ].<br>→ The sensor is considered to be defective if the sensor current consumption falls outside of $I_{min}$ and $I_{max}$.<br>$I_{min.}$ = 0.5…25mA<br>$I_{max.}$ = 0.5…25mA | |

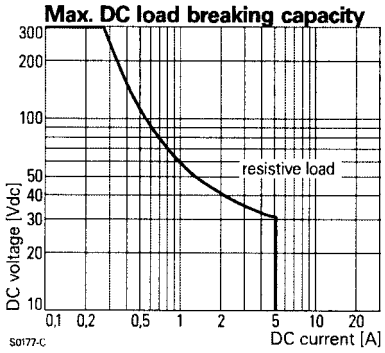
## 3.2.3 Binary input

| | | |
|---|---|---|
| Use | For external selection of Parameter set A or B.<br>• Logic 1 = Parameter set A (Relay control A)<br>• Logic 0 = Parameter set B (Relay control B) | |
| Levels | Logic 1 = V > +3.5V<br>Logic 0 = V < +1.5V |  |
| Reference | Sensor supply 0V | |
| Max voltage | 36V | |
| Input resistance | $R_{min}$ = 10kΩ | |
| Circuit | Internal pull up resistance to 5V<br><br>Shorting the binary input to the sensor 0V creates logic 0. | |

## *3.3 Outputs*

### 3.3.1 Analog output

| | **T411** | **T412** |
|---|---|---|
| Type | Current<br>0…20 / 4…20 mA | Voltage<br>0…10 / 2…10 V |
| Load | Max. 500 Ohm | Min. 7 kOhm, Max. 1.4mA |
| | | |
| Open circuit voltage | Max. 13V | - |
| Operating mode |  | |
| Transfer functions | Normal or Inverse (rising or falling characteristic)<br>  | |
| Resolution | 12 Bit (4096 steps) | |
| Max Linear error | 0.1 % | |
| Accuracy | 0.5 % of the full range value. | |
| Signal to Noise Ratio | 38.13dB (at 20 mA / 500 Ohm) | |
| Damping | Hardware 11 ms + Software setting (Configuration) | |
| Temperature Drift | Typically ± 100 ppm/K, max. ± 300 ppm/K | |
| Reaction time | Effective measuring time + 7.5ms | |

| 3.3.2 Relay | |
|---|---|
| Type | Mono-stable change-over |
| Limit Hysteresis | Programmable – 1 lower and 1 upper set point per limit. |
| Functions | 2 programmable parameter sets selectable via binary input<br>• Reaction to Alarm, Sensor fault, Limit, always on or off.<br>• „Normal“ or „Inverse“ (normally powered off or on)<br>• With or without ‘Hold function’ (Reset via Binary input) |
| Accuracy | 0.05% of the value set |
| Temperature tolerance | Max. ± 10 ppm of the value set |
| Reaction time | Effective measurement time + 10.5ms |
| Contact rating | AC: max. 250VAC, 1250VA.<br><br>DC:  |
| Contact isolation | 1500 VAC |



| 3.3.3 Open Collector Output | |
|---|---|
| Type | Opto-coupler (passive) |
| Activation | Signal from the analogue sensor input (Sign.) |
| External Pull-up | So far: R = 143 x V (Ic nominal = 7 mA)<br>After batch 1608: R = 91 x V (Ic nominal = 11 mA) |
| Load voltage | V = 5 – 30 V |
| Max load current | 25 mA |
| Isolation | 1500 VAC |

## *3.4 Data communication*

| 3.4.1 Serial interface (RS 232) | |
|---|---|
| Physical Layer | Similar to EIA RS 232 but with +5V CMOS Level |
| Max cable length | 2 m |
| Transmission rate | 2400 Baud |
| Connection | Front panel, 3.5mm jack plug |

## *3.5 Environment*

### 3.5.1 Climatic conditions

| | |
|---|---|
| Standard | KUE in accordance with DIN 40 040 |
| Operating temperature | - 20 ... + 70 ℃ |
| Storage temperature | - 20 ... + 70 ℃ |
| Relative humidity | 75% averaged over the year; up to 90% for max 30 days.<br>Condensation to be avoided. |
| CSA conditions | • Pollution degree 2<br>• Installation category II<br>• Altitude up to 1200m<br>• The T400 system must be installed in an indoor environment |

### 3.5.2 Electromagnetic immunity

| | | |
|---|---|---|
| Radiation | In accordance with international standards and EN 50081-2 | |
| Conducted Emissions | CISPR 16-1, 16-2; | |
| Radiated Emissions | EN 55011 | |
| Immunity | In accordance with international standards and EN 50082-2 | |
| Electrostatic discharge | IEC 61000-4-2 | Contact 6kV, Air 8kV |
| Electromagnetic Fields | IEC 61000-4-3 | 30V/m,<br>non modulated and AM 80% at 1000Hz Sine wave |
| Conducted fast transients | IEC 61000-4-4 | 2 kV, repetition rate 5kHz duration 15 ms, period 300 ms |
| Conducted slow transients | IEC 61000-4-5 | Line / Line +/- 1 kV, Earth line +/- 2kV, 1 per Minute |
| Conducted high frequency | IEC 61000-4-6 | 3 Vrms (130 dBuV) 10 kHz – 80 MHz,<br>AM 80% 1000 Hz Sine wave, power cable |
| Pulse modulation El. - Field | ENV 50140 | 900MHz (100% pulse mod. /200Hz), > 10 V/m |
| Power freq. magnetic field | IEC 61000-4-8 | 50Hz, 100 A/m, 2 Minutes |

### 3.5.3 Other Standards

| | |
|---|---|
| EN 50155 | Railway applications – Electrical Installations on Railway Vehicles |
| GL | German Lloyd for shipping |
| UL | Underwriters Laboratories (on request) |
| CSA ordinary location | • CAN/CSA-C22.2 No. 61010-1-04: Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements<br>• UL Std. No. 61010-1 (2nd Edition): Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements |

# 4 Principle of operation

## *4.1 General*

T400 tachometers are controlled by a microprocessor. They work according to the period measurement principle whereby the input period is measured with subsequent computing of the reciprocal value corresponding to the frequency or speed. The relationship between frequency and speed is established with the Machine factor.

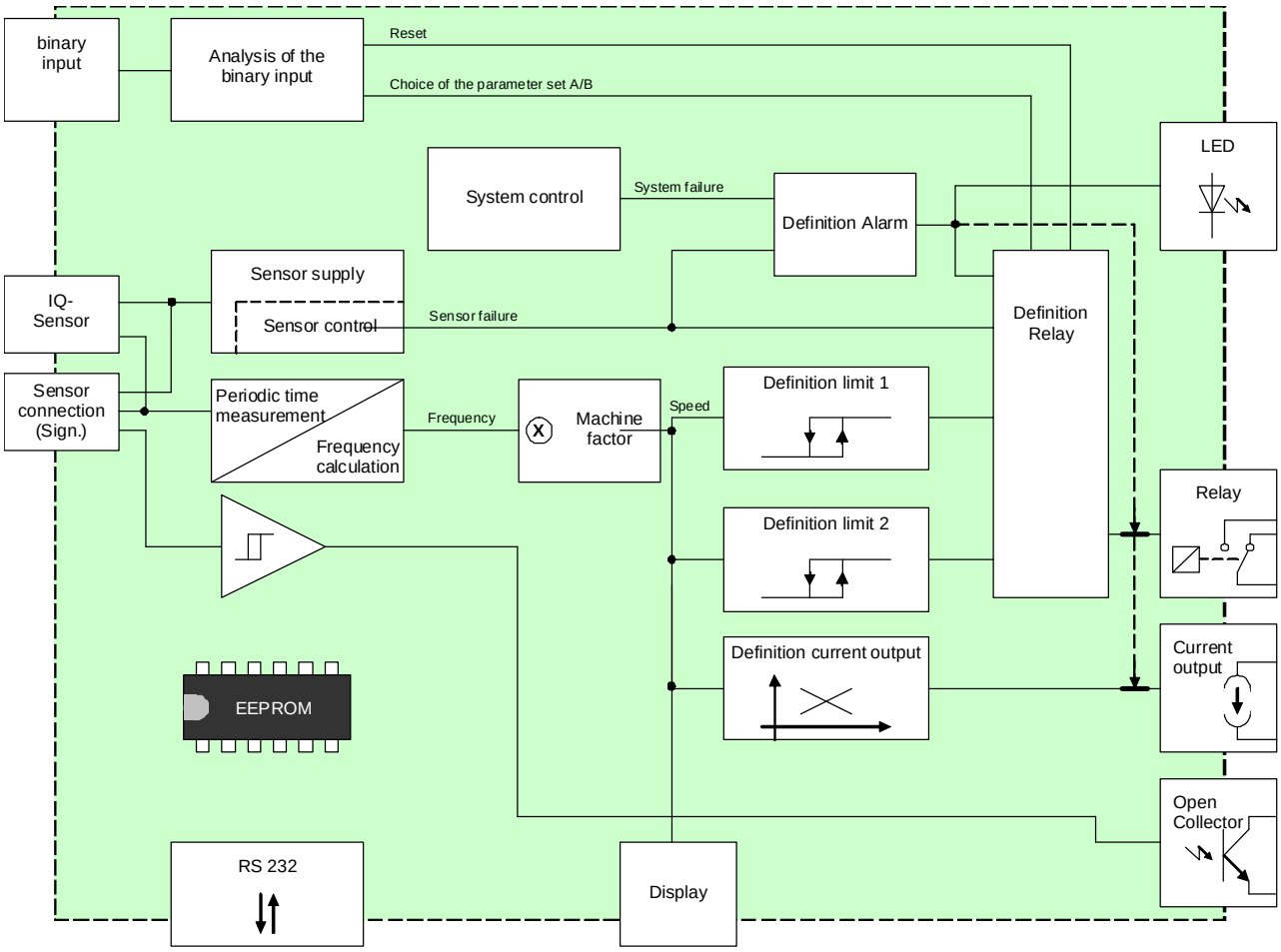
The analogue output (current or voltage) and relay control are determined from the speed.
The relay function is defined via 2 selectable parameter sets. Each parameter set can access the 2 limit values, the alarm definition, sensor monitoring and other process values.
Both limits have an upper and lower set point (hysteresis setting)
The selection of the valid parameter set is done via the binary input.
The relay status may be held until reset via the binary input

The system continuously monitors itself. In addition the sensor may be monitored. Dependent upon the configuration, these conditions can influence the relay and analogue output.
The alarm status is indicated via the front panel LED

The frequency output (open collector output) is not influenced by the machine factor and corresponds to the input signal frequency. The IQ input is not connected to the frequency output.

The input of all parameters is done via PC software and the RS232 interface. This may also be used to interrogate the unit's settings, measurement and general status.

Parameters are retained in an EEPROM.



## *4.2 Machine factor*

The machine factor establishes the relationship between sensor frequency and corresponding speed.

$$M = \frac{f}{n}$$

M = Machine factor
f = Signal frequency at machine speed n
n = Machine speed

There are 2 ways of determining the value:

### 4.2.1 Known (Measured)

$$M = \frac{f}{n}$$

M = Machine factor
f = Signal frequency at known machine speed
n = Machine speed at measured signal frequency

### 4.2.2 Calculated

The relationship between a sensor signal frequency (f) and speed (n) of a pole wheel is:

$$f = \frac{n \times p}{60}$$

f = Signal frequency in Hz
n = Pole wheel speed in rpm
p = Nr. of teeth

From which the formula for machine factor is:

$$M = \frac{p}{60}$$

M = Machine factor
p = Nr. of teeth

If there is a gearbox between the pole wheel and the shaft speed to be measured:

$$M = \frac{p \times i}{60}$$

M = Machine factor
p = Nr. of pole wheel teeth
i = Gearbox ratio

Whereby the gearbox ratio is:

$$i = \frac{n_1}{n_2} = \frac{p_2}{p_1}$$

i = Gearbox ratio
$n_1$ = Pole wheel speed (Sensor position) primary side
$n_2$ = Pole wheel speed (Speed to be displayed) secondary side
$p_1$ = Nr. of teeth primary side
$p_2$ = Nr. of teeth secondary side

### 4.2.3 Displaying other physical values

In principle any physical value that can be measured proportional to speed may be displayed.
The formula above should then be modified accordingly.

# 5 Installation

T400's may only be installed by trained and competent personnel. An undamaged T400, valid configuration and suitable installation are required. Please refer to the Safety Instructions in Section 1.

In the case of an emergency, it should be possible to disconnect the T400 from mains using a switch or similar means. These instruments correspond to protection class I and earthing of the PE terminal is therefore mandatory.

Before switching the equipment on, it is mandatory to verify that the power supply voltage is in the permissible range.

The sensor cable screen must be connected to the terminal 'Sh' so as to minimize the influence of noise. This terminal is directly connected internally to 0VS.

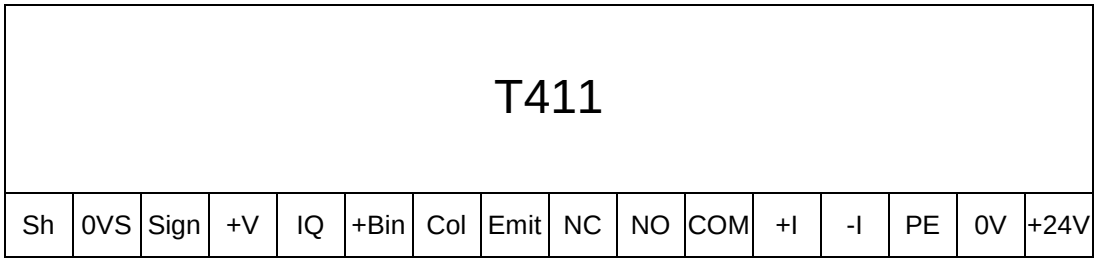
CSA requirement: PERMANENTLY CONNECTED EQUIPMENT requires the special considerations to satisfy the CEC and the Canadian deviations in the standard, including overcurrent and fault protection as required.

# 6 Connnections

## *6.1 Front view*


The T411 / T412 display along with the RS232 interface and the status LED are located at the front. Communications via RS232 are described in section 8.2.

## 6.2 T411 terminals




**Sensor connections**
SH : Screen – Sensor cable
0VS : Sensor Reference voltage
+V : Sensor Supply
Sign : Sensor signal analog
IQ : Sensor signal digital

**Binary Input**
+Bin : Connection of a switch (to 0VS)

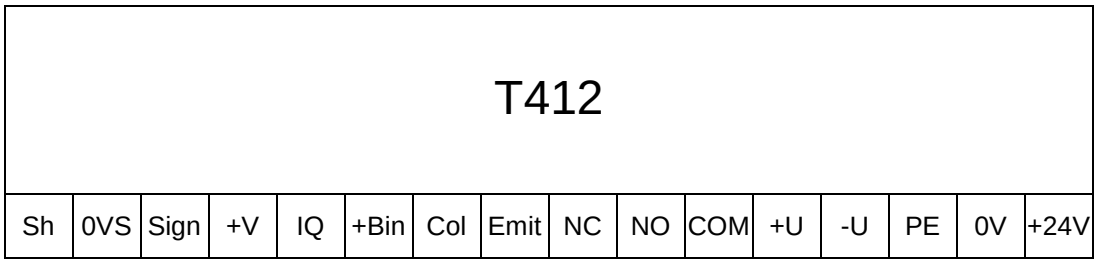
**Open Collector output**
Col : Collector output
Emit : Signal reference for the Open Collector

**Relay output**
NC : Normally closed
NO : Normally open
Com : Common

**Analog output**
+ I : Current positive
- I : Current negative

**Supply**
+24V : Power (10 ... 36 V)
0V : Power reference
PE : Earth

## 6.3 T412 Terminals




**Sensor connections**
SH : Screen - Sensor cable
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Sign : Sensor signal analog
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**Binary Input**
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**Open Collector output**
Col : Collector output
Emit : Signal reference for the Open Collector

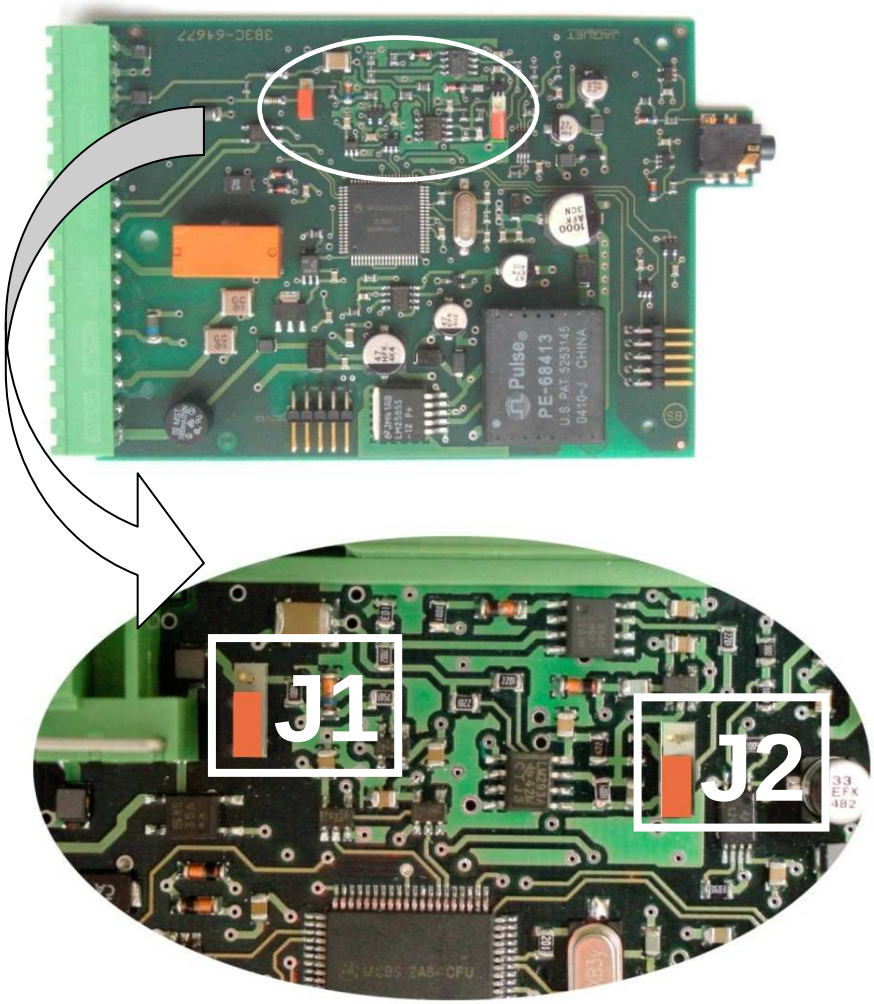
**Relay output**
NC : Normally closed
NO : Normally open
Com : Common

**Analog output**
+ U : Voltage positive
-U : Voltage negative

**Supply**
+24V : Power (10 ... 36 V)
0V : Power reference
PE : Earth

# 7 Hardware configuration

## *7.1 Analog Sensor input (Sign)*




| Jumper position | J1: Sensor type | J2: Adaptive trigger level range |
|---|---|---|
|  | 2 wire sensors<br>(with 820Ohm Pull Up resistance) | 28mV to 6.5V (>20mV$_{rms}$) |
|  | 3 wire and electromagnetic sensors<br>(factory setting) | 250mV to 6.5V (>500mVpp)<br>[factory setting] |

## *7.2 Digital Sensor input (IQ)*

No hardware configuration possible or necessary.

# 8 Configuration with PC Software

## *8.1 Software concept*

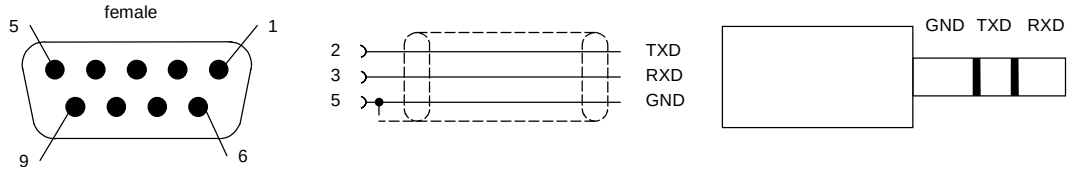
All settings are written via PC to the T400 using the RS232 interface and the user friendly menu driven T400 software.

The parameter file may be stored, opened, printed and exchanged between the T400 and a PC.

## *8.2 PC communications*

Communications with the T400 are initiated by the PC via the RS232 interface.
Before starting the first connection, **Settings → Interface** must be set to an appropriate serial interface.
The following settings also apply:

| | |
|---|---|
| Transmission rate: | 2400 Baud |
| Parity Bit: | none |
| Data Bits: | 8 |
| Stop Bits: | 2 |
| Connector: | 3.5mm jack plug |




The diagram shows the stereo jack plug to D9 connections.
The tachometer RXD must be connected to the PC's TXD and vice versa.
T411 / T412's do not use a standard RS232 signal (-5V…+5V) but operate at 5V CMOS levels, compatible with most PC's as long as the cable is not longer than 2m.
A suitable cable may be ordered from JAQUET AG – see section 11.

## *8.3 PC Software settings*

### 8.3.1 Interface (Settings → Interface)

In this menu the serial interface for communication with the T400 is defined.

### 8.3.2 Display Interval (Settings → Display Interval)

The T400 measurement status may be interrogated and displayed on the PC via **T400 → Start – Reading Measure Data**.

The display update time may be set at intervals of ¼ to 10 seconds.

## *8.4 Parameter list and ranges*

If you already have a configuration file you can open and view it using the T400 Windows Software menu
**File → Open**
You can also connect the T400 to a PC (see section 8.2) and read back the parameters,
**T400 → Read parameters**

Once loaded into the software the parameter set may be printed via **File → Print**

Normal Windows file handling rules apply.

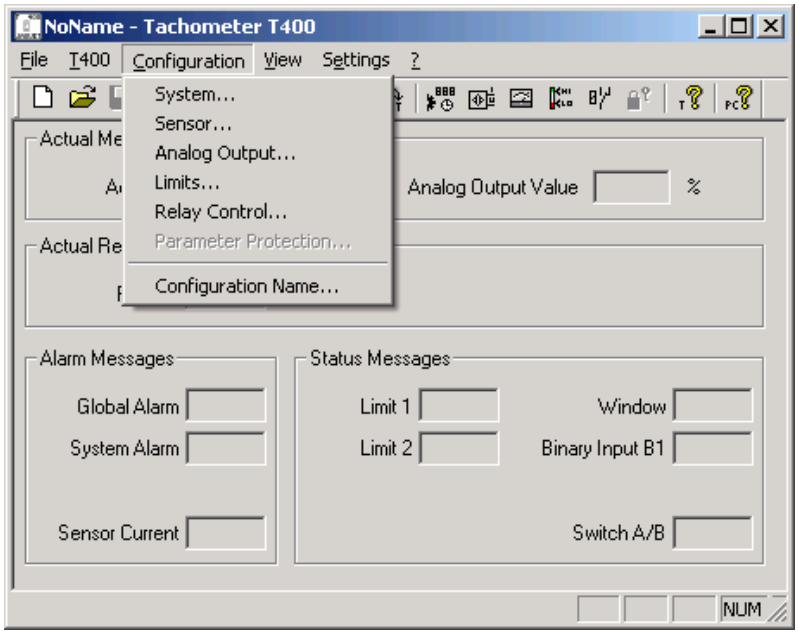
Parameter list and ranges. Factory settings are shown in bold.

Instrument Type
Manufacturer's code
Software version
Calibration date

| | | |
|---|---|---|
| Configuration < System > | | |
| Machine factor | | 1.0000E-07 ... **1.0000** ... 9.9999E+07 |
| Minimum Measuring time | | **2** / 5 / 10 / 20 / 50/ 100 / 200 / 500 **ms** / 1/ 2 / 5 Seconds |
| Min displayed measured value | | 1.0000E-12 ... **1** ... 1.0000E+12 |
| Alarm definition | | Only System error / **System error OR Sensor Monitoring** |
| Configuration < Sensor > | | |
| Sensor Type | | Active / Passive |
| Sensor input | | **Analog (Sign)** / Digital (IQ) |
| Sensor current minimum | | 0.5 ... **1.5** ... 25.0mA |
| Sensor current maximum | | 0.5 ... **25.0**mA |
| Configuration < Analog output > | | |
| Measuring range start value | | **0.0000** ... 90% of the end value |
| Measuring range end value | | 1Hz … **2000.0** … 500000 |
| Output range | | **0 ... 20mA** / 4 ... 20mA (T411) |
| | | 0 ... 10V / 2 ... 10V. (T412) |
| Time constant (Damping) | | **0.0** ... 9.9s |
| Configuration < Limits > | | |
| Status | Limit 1 | **On** / Off |
| Status | Limit 2 | **On** / Off |
| Mode | Limit 1 | **Normal** / Inverse |
| Mode | Limit 2 | **Normal** / Inverse |
| Lower Set point | Limit 1 | 0.1 … **200.00** … 500000 |
| Upper Set point | Limit 1 | 0.1 … **300.00** … 500000 |
| Lower Set point | Limit 2 | 0.1 … **400.00** … 500000 |
| Upper Set point | Limit 2 | 0.1 … **500.00** … 500000 |
| Configuration < Relay control > | | |
| Switching of control A/B | | |
| Selection of actuator | | None (always control A) / **Binary Input B1** |
| Delay time | | **0** ... 2'000 s |
| Relay Assignment | | |
| Control | A | Alarm / Sensor monitor / **Limit** 1 / Limit 2 / Window / On / Off |
| Acknowledge | A | **Without acknowledge (no hold function)** / |
| | | Relay held when control active / |
| | | Relay held when control inactive |
| Acknowledge | B | Alarm / Sensor monitor / Limit 1 / **Limit 2** / Window / On / Off |
| Acknowledge | B | **Without acknowledge (no hold function)** / |
| | | Relay held when control active / |
| | | Relay held when control inactive |

## 8.5 Parameters

Parameters are changed in the sub menus from the drop down menu „Configuration“.




**Warning:**
New configurations only become active after being uploaded into the T400 via:
**T400 → Write Parameters**

### 8.5.1 System parameters (Configuration → System)

#### Machine factor

The machine factor establishes the relationship between sensor frequency and associated speed.

$$M = \frac{f}{n}$$

M = Machine factor
f = Signal frequency at machine speed n
n = Machine speed

See section 4.2 Machine factor.

Once the correct machine factor is entered, all other settings e.g limits are made in rpm.

#### Minimum Measuring Time

The minimum measuring time determines the time during which the input frequency is measured. The calculation is made after termination of this time and after reaching the end of the current signal period. The minimum measuring time may be increased to filter out frequency jitter so as to display a stable reading but at the cost of increased reaction time.

#### Minimum displayed value

The minimum displayed value is a measured value under which „0000“ is displayed.

#### Alarm definition

This function defines the alarm. It may be only system error or a logical OR combination of system error OR sensor monitoring. During an alarm the LED is off. In addition, the relay is deactivated and the analog output goes to 0mA (0V) irrespective of the output range.

### 8.5.2 Sensor parameter (Configuration → Sensor)

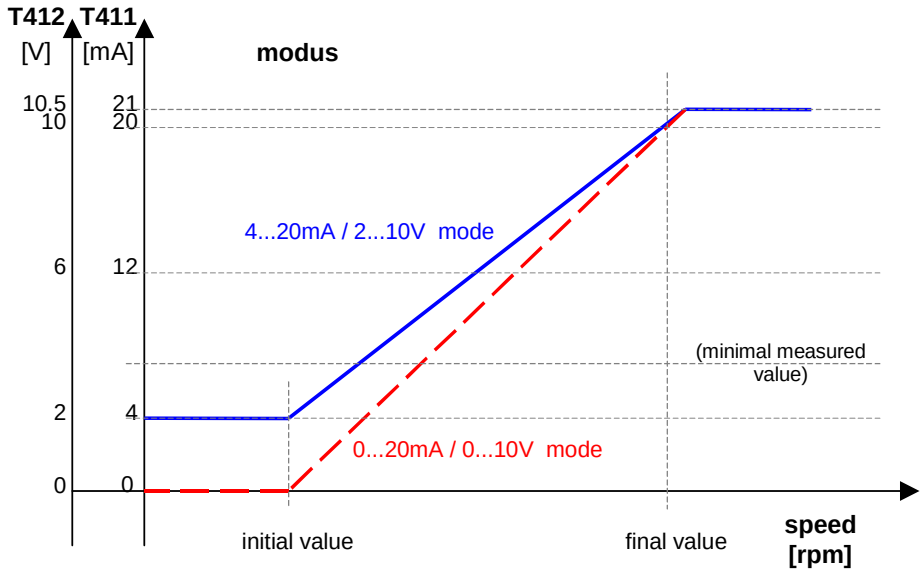
**Sensor Type**
The type of sensor to be used is defined here.
<Sensor active> is for monitoring sensors powered by T400 including 2 wire sensors supplied via the internal pull up resistor. (Jumper J1).
<Sensor passive> is for monitoring non powered sensors e.g. 2 wire VR sensors.
See also section 9.4.1 Sensor fault (Sensor monitoring).

**Sensor input**
The sensor input “analog” (Sign) or “digital” (IQ) is defined here.

**Sensor current minimum**
As long as the sensor current consumption lies above the value <Current Minimum>, the sensor is considered to be functioning correctly.

**Sensor current maximum**
As long as the sensor current consumption lies below the value <Current Maximum>, the sensor is considered to be functioning correctly.

### 8.5.3 Analog Output (Configuration → Analog Output)




**Measuring range – start value**
Analog output start value 0/4mA or 0/2V

**Measuring range – end value**
Analog output end value 20mA or 10V
In the case of a negative transfer function the end value must be set smaller than the start value.

**Output range**
0…20mA or 4…20mA for the T411. 0…10V or 2…10V for the T412.

**Output time constant**
The analog output signal may be smoothed by applying a software time constant. This damping is deactivated when the time constant is 0.0 seconds.

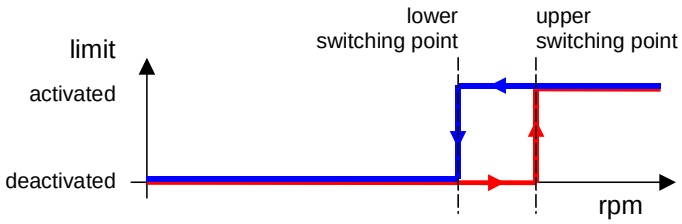
### 8.5.4 Limit (Configuration → Limit)

The T400 series offers 2 independent limits → Limit 1 and 2.

**Status**
Limits are selected here. If the limit is deactivated, the other values such as set points and mode have no further effect.

**Mode**
In Normal Mode the limit is active as soon as the High set point is exceeded. In Inverse Mode the limit is active from the start (zero speed) and deactivates when the set point is reached (Fail Safe operation)

**Upper and Lower Set point**




As the speed increases, the limit switches when the High set point is reached and remains in that condition until the speed reduces past the Low set point.

### 8.5.5 Relay parameter and selection of Parameter set (Configuration → Relay control)

**Parameter set A / B selection**
The parameter set B may be activated via the binary input <Binary input B1>.
If parameter set B is to be deactivated, this setting should be none (always control A)

**Delay time when switching B -> A**
This value corresponds to the time needed for switching from parameter set B to parameter set A after changing the binary input accordingly.

**Relay assignment with control A**
Defines the relay behavior in parameter set A.

**Relay assignment with control B**
Defines the relay behavior in parameter set B.

**Relay**
Defines the source information for relay switching.

| Status register | Relay dependency | |
|---|---|---|
| • Alarm | (Common) Alarm | (8.5.1 System parameters (Configuration → System)) |
| • Sensormonitor | Sensor status | (8.5.2 Sensor parameter (Configuration → Sensor)) |
| • Limit 1/2 | Selection of Limit 1/2 | (8.5.4 Limit (Configuration → Limit)) |
| • Window | ExOR combination of both limits | |
| • On | The relay is on | |
| • Off | The relay is always off | |

**Acknowledge**
Acknowledge establishes if and under what conditions the relay status is held. A relay that is held no longer reacts to the assigned signal and can only be reset via the binary input.

# 9 Operating behavior

## *9.1 Power on*

### 9.1.1 Analogue Output

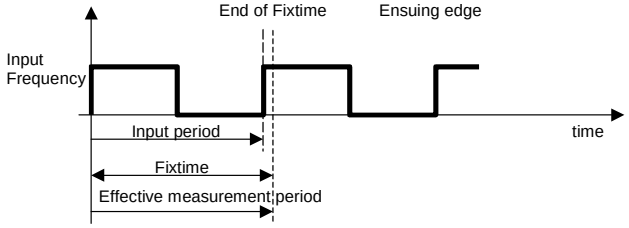
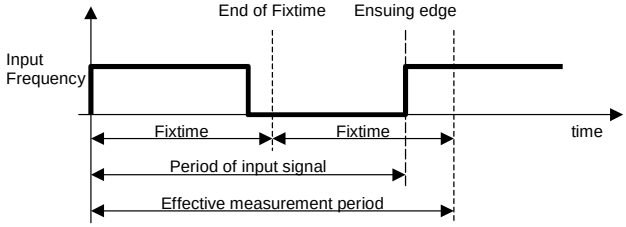
After switching-on the tachometer, the output relates the lower value of the defined output range. After completion of the first measurement the output goes to the corresponding measured value.

### 9.1.2 Relay Output

The parameter set determined by the configuration and binary input is valid from the start.
If the relay is assigned to a limit it remains deactivated until completion of the first measurement. After this it switches to the status, which is defined under <Limit>.
If the relay is assigned to any other item in the status register it immediately switches to the corresponding status.
If no input frequency is present, then after a period of 2 x Fixtime a measured value below the lower set point is assumed.

## *9.2 Measurement*

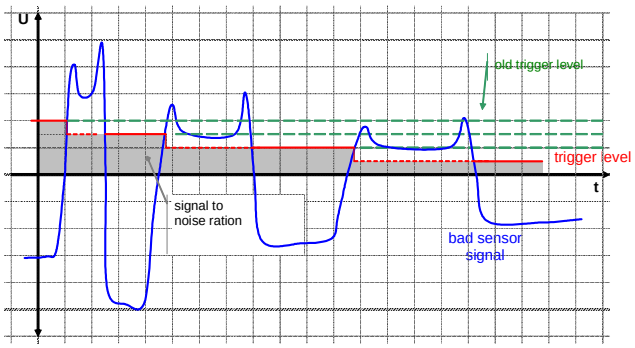
Every measurement begins with the positive edge of the input signal. The next positive edge closes the current measurement and starts the next one after termination of the fixtime.
The resulting effective measurement time is dependent upon whether the input signal period is longer or shorter than the Fixtime.

| Input signal period < Fixtime | Input signal period > Fixtime |
|---|---|
|  |  |
| $t_{Messung\ typisch}$ = Fixtime<br>$t_{Messung\ maximal}$ = 2 x Fixtime | $t_{Messung\ maximal}$ = 2 x Input signal period |

The total measurement time has a resolution of ± 0.4 µs.
The calculation and adaptation of outputs follows immediately after the Fixtime.
With input frequencies outside of the measuring range, the corresponding final values will be assumed.

### 9.2.1 The adaptive Trigger level

After triggering, the trigger level is set for the next pulse anew.
This guarantees that the trigger level can follow a 50% reduction in speed from pulse to pulse.
DC offset, resonance and negative pulses have no influence on the triggering



### 9.2.2 Signal failure

In the event of a sudden loss of a good signal, no positive edge arrives to complete the measurement or start a new one. Once the minimum measurement time (Fixtime) has lapsed, the unit waits for twice the last measurement period, following which half the last measured speed is assumed.
If the signal remains missing then the measurement approaches zero following an e-function.

## *9.3 Functions*

### 9.3.1 Limits and Window Function

Since the upper and lower sets points are freely selectable a large hysteresis may be set. If that is not necessary we recommend setting a 10% hysteresis.

The Window function allows an Exclusive OR combination of Limits 1 and 2, whereby the status of both limits is first determined (including any inversion) and a subsequent ExOR comparison executed.

As soon as Relay assignment is <Window> the relay behaves as follows:

- With identical limit modes (both Normal or both Inverse) the relay is activated when the measured value lies between the Limit 1 and 2 settings.
- If different modes are set (one Normal and the other Inverse) the relay is deactivated when the measured value is between Limits 1 and 2.

### 9.3.2 Parameter set A and B

T400's have 2 parameter sets available that define the relay assignment. Parameter set A would normally be used. If another parameter set is needed, e.g. for test purposes, the binary input may be used to change to parameter set B. The transfer from parameter set B to parameter set A may be delayed in the range 0 to 2000 seconds. Transferring from A to B is however immediate and not affected by this setting.
To be able to select parameter sets using the binary input, Relay control - Selection of Actuator must be appropriately set, see 8.5.5.

| **Binary input condition** | **Selected Parameter set** |
|---|---|
| High (5V) „normal“ | A |
| Low (0V) „connected to 0V“ | B |

### 9.3.3 Relay hold function

A latch function may be assigned to the relay. By selecting <Relay is hold if control is active> the relay is activated once the assigned limit is active and remains held even if the input frequency would no longer cause a trip. By selecting <Relay is hold if control is inactive>, the deactivated state of the relay is held. The latched status may be reset by cycling power or via the binary input, whereby the binary input must be activated as per the configuration (0V or 5V) for between 0.1 and 0.3 seconds.

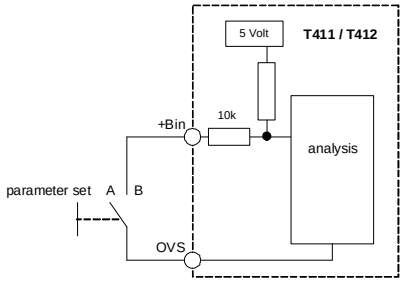
### 9.3.4 Binary Input

2 functions are executable using the binary input:
- Switching between parameter sets A and B. See 9.3.2 Parameter set A and B.
- Resetting a latched relay. See 9.3.3 Relay hold function.

The binary input has an internal pull up resistor to +5V and is therefore normally logic High.

Shorting the binary input to the sensor supply 0V creates a logic 0.

Switching the input for between 0.1 and 0.3 seconds resets a latched relay but does not influence parameter set selection, which requires longer than 0.3 seconds.




## *9.4 Fault behavior*

### 9.4.1 Sensor fault (Sensor monitoring)

The sensor may be monitored in 2 ways. With sensors powered by the T400 the sensor supply current is monitored. If the current falls outside the permitted range then sensor fault is indicated.
If the sensor is not powered by the T400 then it may only be monitored for disconnection. If disconnected, sensor fault is indicated.

The T400 behavior in the event of a sensor fault is depending on the configuration:

| **Alarm Configuration** | **Outputs in the event of a sensor fault** | | | |
|---|---|---|---|---|
| | LED | Analog output | | Relay |
| | | Current (T411) | Voltage (T412) | |
| Only System error | On | Measured value output per configuration | | |
| System error OR Sensor monitoring | Off | 0mA | 0V | deactivated |

### 9.4.2 System alarm

If the microprocessor detects a checksum fault (RAM, ROM or EEPROM) the measured value is set to 0rpm, the analog output goes to 0 mA or 0 V and the relay is deactivated.

| **Alarm Configuration** | **Outputs in the event of a System alarm** | | | |
|---|---|---|---|---|
| | LED | Analog output | | Relay |
| | | Current (T411) | Voltage (T412) | |
| Only System error | Off | 0mA | 0V | deactivated |
| System error OR Sensor monitoring | | | | |

### 9.4.3 Alarm

As long as a combined alarm is present, no measurements are conducted and the outputs behave as described above. Once the fault or alarm condition is removed the last correct measured value is assumed. Eventual limit activation is not taken into account.

## *9.5 Power supply interruption*

If the PSU remains off for longer than the permitted period the outputs deactivate i.e. the analog output goes to 0mA (0V), the relay deactivates and the „open collector“ output becomes high resistance.
Once the supply resumes in range the T400 begins its initialization routine (see chapter 9.1)

## *9.6 Display adjustments*

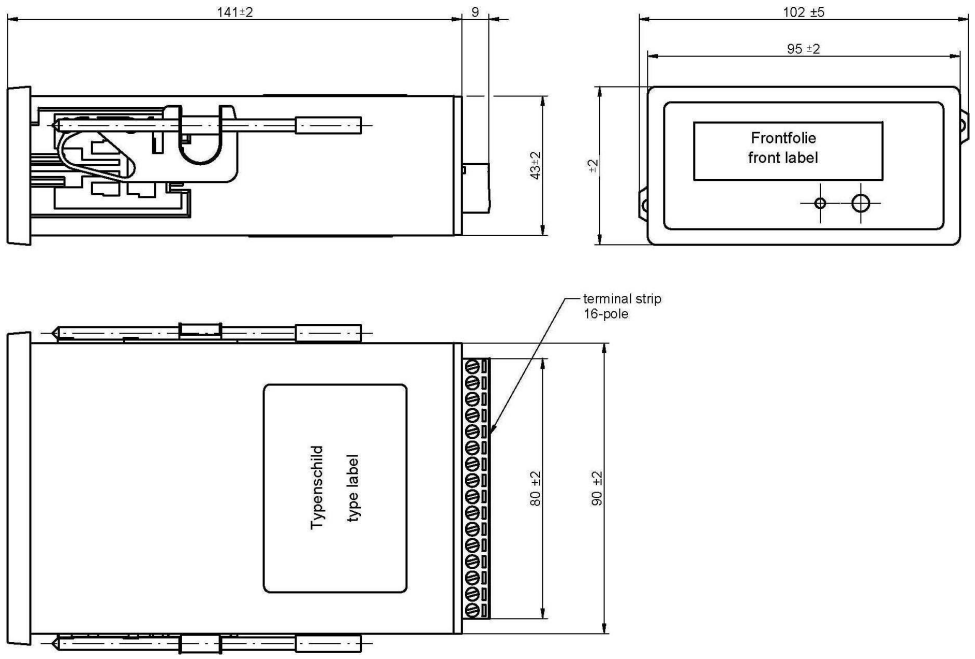
### 9.6.1 Brightness

The brightness of the display can be adjusted by pressing the up and down arrow buttons at the front panel.

### 9.6.2 Contrast

The contrast of the display can be adjusted by pressing the up or down arrow button and the center button at the front panel.

# 10 Mechanical Construction / Housing

| | |
|---|---|
| Housing Material | Noryl SE GFN1, black RAL 9005 |
| Mounting | Using DIN 43835 Form B clamps |
| Terminals | Detachable Terminal block.<br>2.5 mm 2 - Cable or 1.5 mm2 flex<br>AWG 24 – AWG 12<br>UL CSA |
| Sealing to EN 60925<br>resp. IEC 925 | Housing IP 40<br>Terminals IP 20 |
| Dimensions |  |
| Labeling | Isopropanol-resistant type label. |

# 11 Accessories

**Interface cable RS232 PC – T400** **Part Nr. 830A-36889**
Cable for PC to tachometer communications.

**USB adapter for interface cable** **Part Nr. 830A-37598**
USB to RS232 converter.

**Power supply 100-240Vac/24Vdc, 1A** **Part Nr. 383Z-05764**

# 12 Maintenance / Repair

T400 tachometers do not require maintenance since they exhibit minimal drift and do not use batteries or other consumables. If the instrument is to be cleaned please note the protection class. It is preferable to remove all forms of power (including relay contact supply) during cleaning. Surface cleaning may be carried out using spirit, pure alcohol or soap only.

# 13 Software Versions

- Since unit software version 1.24 or higher and configuration software 1.15 or higher the digital sensor (IQ) input is available. Additionally the value range of the measured speed has been increased to 500k.
- For software display version 1.2 are values to 999.9k possible.

# 14 Warranty

The standard warranty in the event of a manufacturing failure confirmed by Jaquet consists of repair or replacement within 12 months of delivery. Ancillary costs are excluded s well as damages caused by use outside of the specification. Complaints concerning visible defects will only be accepted if advised to Jaquet within 14 days of receipt.

# 15 Declaration of conformity

IN CHARGE OF SPEED

JAQUET
TECHNOLOGY GROUP

**Declaration of Conformity**
(in accordance with ISO/IEC 17050-1)

Objects of the declaration:

- Tachometers T401/T402
- Tachometers T411/T412 with display

As delivered, the objects of the declaration described above are in conformity with the requirements of the following Directives:

- 2004/108/EC EMC
- 2002/95/EC RoHS
- 2002/96/EC WEEE

Conformity to the Directives is assured through the application of the following standards:

- GL VI Part 7 (2003) Guidelines for the Performance of Type Approvals
- IEC 61000-4-2 (2000-11) Electrostatic discharge immunity test
- IEC 61000-4-3 (2001-04) Radiated, radio-frequency, electromagnetic field immunity test
- IEC 61000-4-4 (2004-07) Electrical fast transient/burst immunity test
- IEC 61000-4-5 (2001-04) Surge immunity test
- IEC 61000-4-6 (2004-10) Conducted high frequency interference
- CISPR 16-1 (2003-04) Radio disturbance and immunity measuring apparatus
- CISPR 16-2 (2003-07) Methods of measurement of disturbances and immunity

Additional information:

- The objects of this declaration have been type approved by Germanischer Lloyd on 2005-05-02 (certificate no. 23 038 – 05 HH).
- The objects of this declaration have received a Certificate of Design Assessment from American Bureau of Shipping on 2007-07-09 (certificate no. 07-HG256734-PDA).

Basel, 2009-09-11

Andreas Kister
Engineering & Technology Manager

i.V.
Wolfgang Schnell
Senior Quality Manager

Document: DoC T400.doc Page 1 of 1

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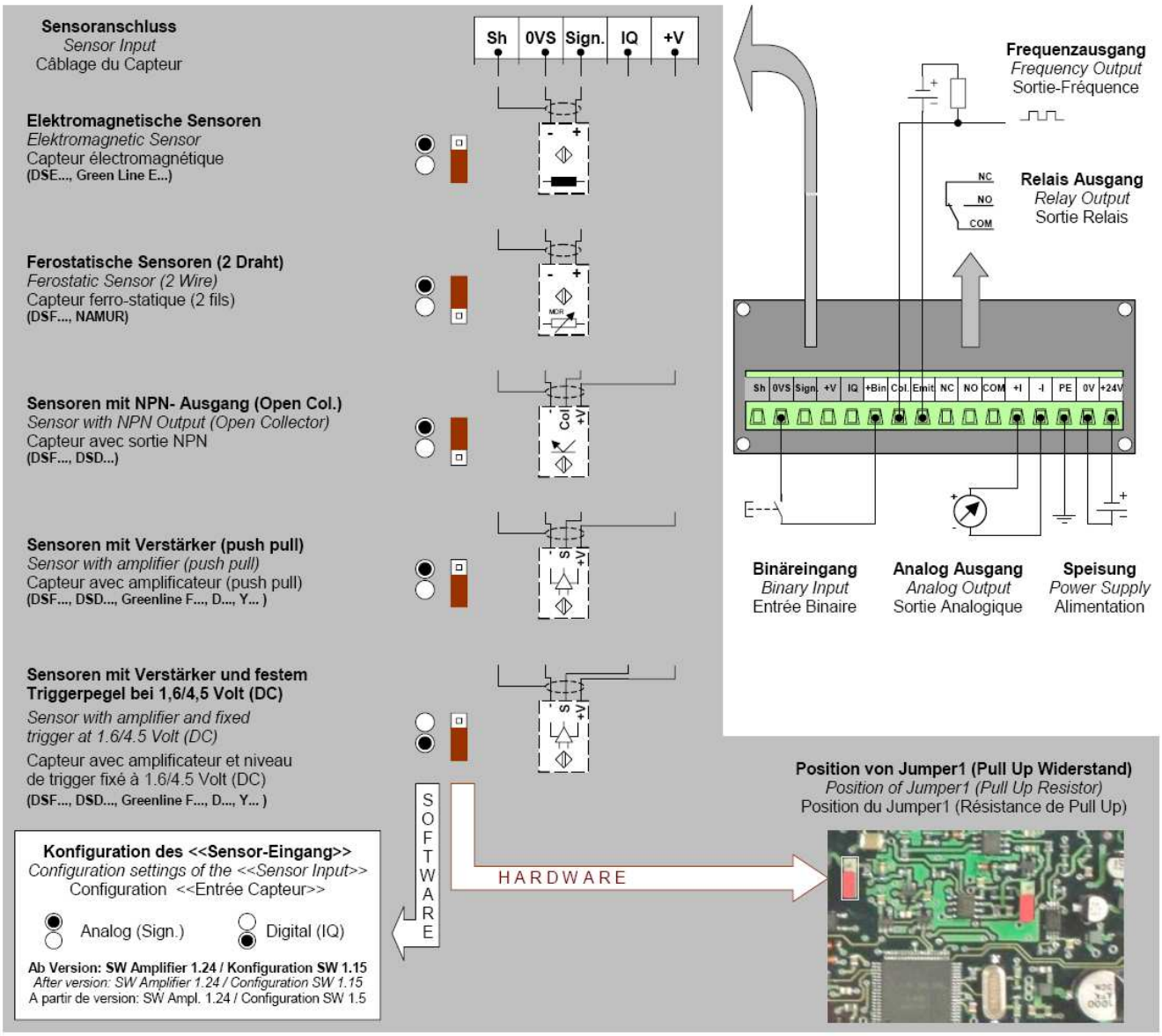
# 16 Connection diagram T411/412

**Anschlussbild T411 / T412**
***Connection Diagram T411 / T412***
Raccordements T411 / T412




| | Bezeich. / Label | Beschreibung | *Description* | Description |
|---|---|---|---|---|
| Input | SH | Schirm Sensorkabel | *Screen for the sensor cable* | Câble blindé du capteur |
| | OVS | Sensor Referenzspannung | *Sensor reference voltage* | Référence d'alimentation du capteur |
| | +V | Sensor Speisung | *Sensor power supply* | Alimentation du capteur |
| | Sign | Sensorsignal | *Sensor signal* | Signal du capteur |
| OC-Output | Col | Collector Ausgang | *Open collector output* | Sortie du collecteur |
| | Emit | Signalreferenz für den Open Collector Ausgang | *Signal reference for the open collector output* | Référence de sortie du collecteur |
| IQ | IQ | Digitaler Sensor- Eingang | *Digital sensor input* | Entrée digitale pour le capteur |
| Relay | NC | Öffner | *Normally Closed contact* | ouverture |
| | NO | Schliesser | *Normally Open contact* | fermeture |
| | Com | gemeinsamer Kontakt | *Common contact* | Contact commun |
| Analog Output | +I/+U | positiver Pol für Analogausgang | *Analog output positive pole* | Sortie analogique positive |
| | -I/-U | negativer Pol für Analogausgang | *Analog output negative pole* | Sortie analogique négative |
| Power Supply | +24V | Speisespannung | *Power line* | Tension d'alimentation |
| | 0V | Referenz für Speisung (GND) | *Power reference* | Référence d'alimentation |
| | PE | Erde | *Earth* | Mise à la terre |