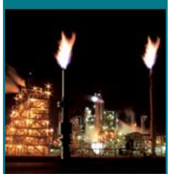


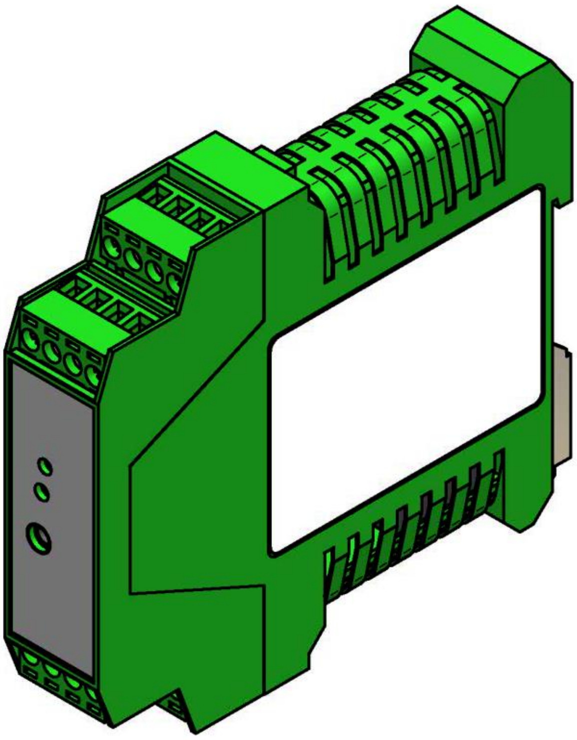
IN CHARGE OF SPEED

JAQUET TECHNOLOGY GROUP

Frequency Measurement and Switching Instruments
T401 / T402

Operating Instructions

This is a translation of the master document 119045 Rev 004



Single Channel Tachometer with 0/4-20mA Output
- **T401.00:** Part No.: 383Z-05307 (+14V Sensor supply)
- **T401.03:** Part No.: 383Z-05671 (+5V Sensor supply)

Single Channel Tachometer with 0/2-10V Output
- **T402.00:** Part No.: 383Z-05308 (+14V Sensor supply)
- **T402.03:** Part No.: 383Z-05672 (+5V Sensor supply)

JAQUET AG , Thannerstrasse 15, CH-4009 Basel
Tel. +41 61 306 88 22   Fax +41 61 306 88 18   E-Mail: info@jaquet.com

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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 (T401 - current, T402 - 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).

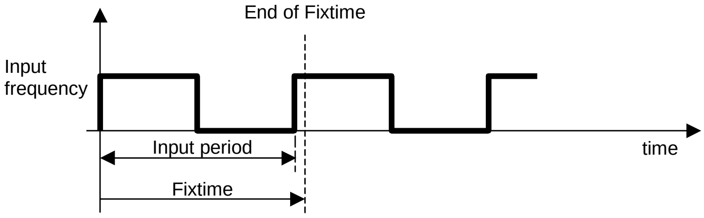
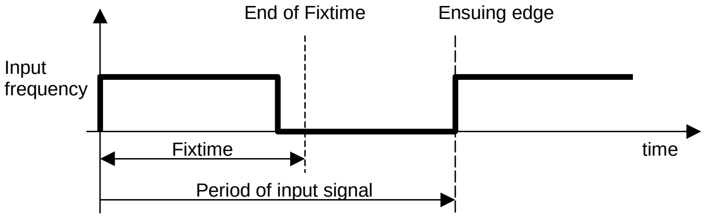
4 models are available:

T401.00	Single Channel Tachometer with +14V Sensor supply, Relay and 0/4-20mA Output	383Z-05307
T402.00	Single Channel Tachometer with +14V Sensor supply, Relay and 0/2-10V Output	383Z-05308
T401.03	Single Channel Tachometer with +5V Sensor supply, Relay and 0/4-20mA Output	383Z-05671
T402.03	Single Channel Tachometer with +5V Sensor supply, Relay and 0/2-10V Output	383Z-05672

3 Specifications

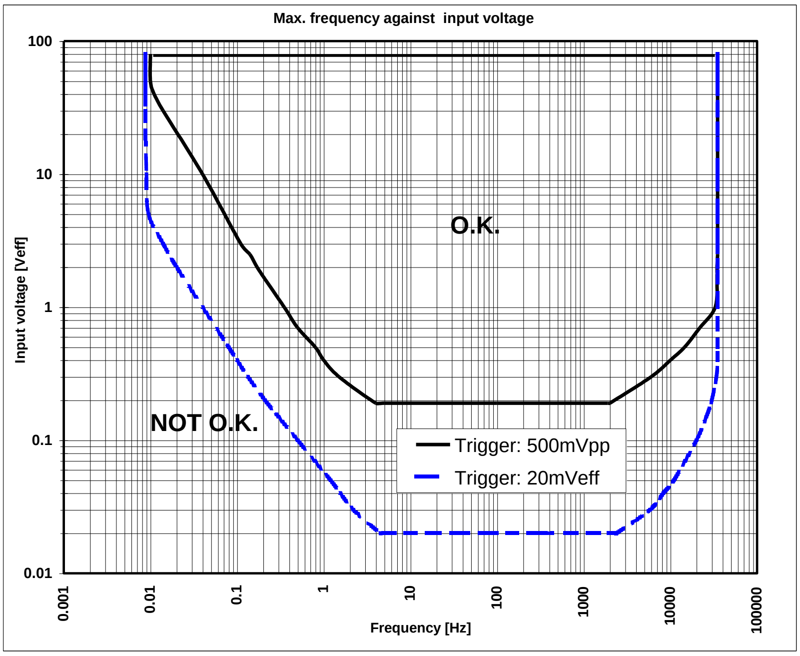
Ambient temperature + 20 °C

3.1 General

T401 - T402	
Lowest measuring range	0.01 . . . 1.000 Hz
Highest measuring range	0.01 . . . 35.00 kHz
Minimum Measuring time (Fixtime)	Selectable values: 2 / 5 / 10 / 20 / 50 / 100 / 200 / 500 ms 1 / 2 / 5 Seconds.
Effective Measuring time	Is based on the minimum measuring time (Fixtime) and the measured frequency. • Input frequency period < Fixtime  typically: $t_{effective}$ = Fixtime max: t_{max} = 2 x Fixtime • Input frequency period > Fixtime  max: t_{max} = 2 x input frequency period • In the event of sensor signal failure: $t_{effective}$ = Fixtime + (2 x last input frequency period)
Resolution	0.05 %
Power supply range	10...36 VDC
Power consumption	10 V : 2.3 W 24 V : 2.6 W 36 V : 3 W
PSU failure bridging	16 V : 4 ms 24 V : 25 ms 36 V : 75 ms
Isolation	Galvanic isolation between: • Power supply, • Sensor input incl. sensor supply, Binary input, Serial interface • Analog output • Relay output • 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	30kOhm
Input voltage	• Max. 80V_{rms} • 

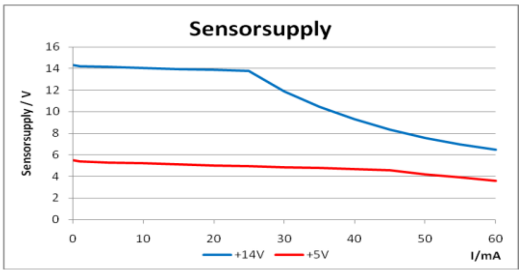
Minimum positive pulse width - digital signals Input voltage

Signal voltage [V_{pp}]	0.5	1	2.5	5	10	20
Min. Pulse width [µs]	2000	667	333	200	166	125

Sensor supply

T40x.00	T40x.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.



Integrated pull-up	820 Ohm to Sensor supply (configurable for 2 wire sensors with Jumper J1)
Trigger level	adaptive Trigger level. Configurable with Jumper J2: • 250mV … 6.5V (>500mVpp) [Factory configuration] • 28mV … 6.5V (>20mV_{rms})
Screen	A terminal is provided for the sensor cable screen. This terminal is connected to the sensor supply 0V. (0VS)

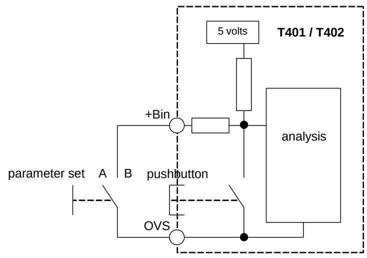
Sensor monitoring	1 of 3 settings may be configured via software: • <u>No Sensor Monitoring</u> • <u>Monitoring of powered sensors</u> [Also for 2 wire sensors supplied via the Pull-up resistor (Jumper J1)]. → The sensor is considered to be defective if the sensor current consumption falls outside of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

3.2.2 Digital Sensor connection (IQ)

<table>
<tr><td>Frequency range (-3dB)</td><td colspan="2">0.01 Hz / 35 kHz</td></tr>
<tr><td>Input impedance</td><td colspan="2">46 kOhm</td></tr>
<tr><td>Input voltage</td><td colspan="2">Max. ± 36V peek</td></tr>
<tr><td>Minimum pulse width</td><td colspan="2">Min. pulse width 1.5 µs</td></tr>
<tr><td rowspan="3">Sensor supply</td><td>T40x.00</td><td>T40x.03</td></tr>
<tr><td>+14V, max. 35mA short circuit proof</td><td>+5V, max. 35mA short circuit proof</td></tr>
<tr><td colspan="2">In case the current limit is activated, the sensor supply must be disconnected to reset the protection.</td></tr>
<tr><td>Trigger level</td><td colspan="2">• min.U_{low} = 1.6 V
• max.U_{high}= 4.5 V</td></tr>
<tr><td>Screen</td><td colspan="2">A terminal is provided for the sensor cable screen. This terminal is connected to the sensor supply 0V. (0VS)</td></tr>
<tr><td>Sensor monitoring</td><td colspan="2">1 of 2 settings may be configured via software:
• <u>No Sensor Monitoring</u>
• <u>Monitoring of powered sensors</u>
[Also for 2 wire sensors supplied via the Pull-up resistor (Jumper J1)].
→ The sensor is considered to be defective if the sensor current consumption falls outside of I_{min} and I_{max}.
$I_{min.}$ = 0.5…25mA
$I_{max.}$ = 0.5…25mA</td></tr>
</table>

3.2.3 Binary input and push button

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

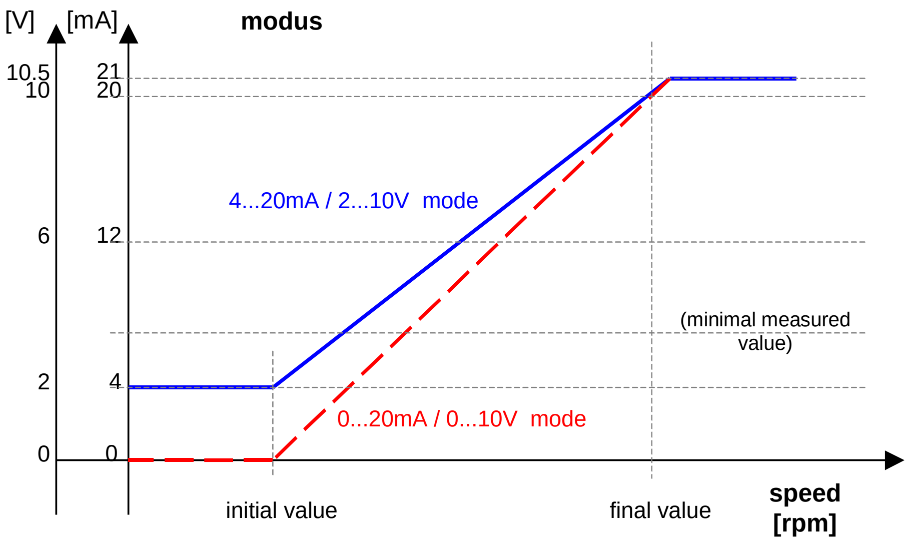


3.3 Outputs

3.3.1 Analog output

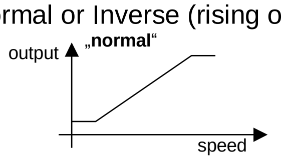
	T401	T402
Type	Current 0…20 / 4…20mA	Voltage 0…10 / 2…10V
Load	Max. 500Ohm	Min. 7kOhm, Max. 1.4mA
Open circuit voltage	Max. 13V	-

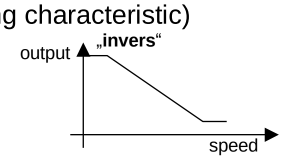
Operating Mode



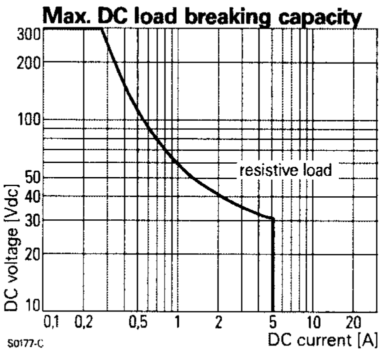
Transfer functions

Normal or Inverse (rising or falling characteristic)





Resolution	12 Bit (4096 Steps)
Max Linear error	0.1 %
Accuracy	0.5 % of the full range value.
Signal to Noise Ratio	38.64dB (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 • Reaction to Alarm, Sensor fault, Limit, always on or off. • „Normal“ or „Inverse“ (normally powered off or on) • With or without ‘Hold function’ (Reset via Binary input)
Accuracy	0.05% of the value set
Temperature tolerance	Max. ± 10ppm of the value set
Reaction time	Effective measurement time + 10.5ms
Contact rating	AC: max. 250 VAC, 1250VA. 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) After batch 1608: R = 91 x V (Ic nominal = 11 mA)
Load voltage	V = 5 – 30V
Max load current	25mA
Isolation	1500VAC

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	- 40 ... + 80 °C
Storage temperature	- 40 ... + 90 °C
Relative humidity	75% averaged over the year; up to 90% for max 30 days. Condensation to be avoided.
CSA conditions	• Pollution degree 2 • Installation category II • Altitude up to 1200m • 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, 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, 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 • UL Std. No. 61010-1 (2nd Edition): Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements
Pattern Approval	CH.C.28.001.A - Nr. 45175

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.

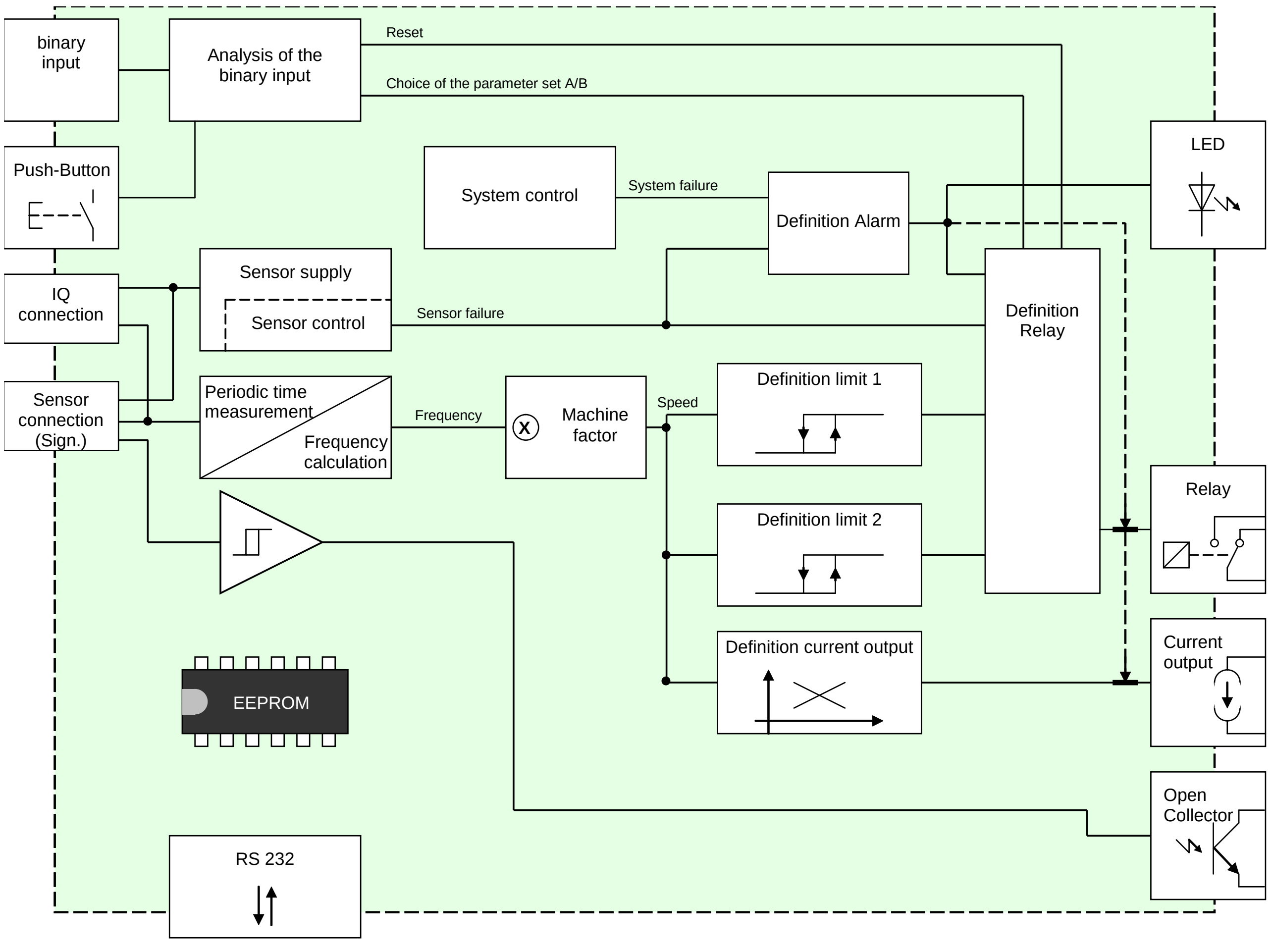
The analogue output (current or voltage) and relay control are determined from the speed.
The relay function is defined via 2 selectable parameter sets. Each parameter set can access the 2 limit values, the alarm definition, sensor monitoring and other process values.
Both limits have an upper and lower 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 voltage 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.

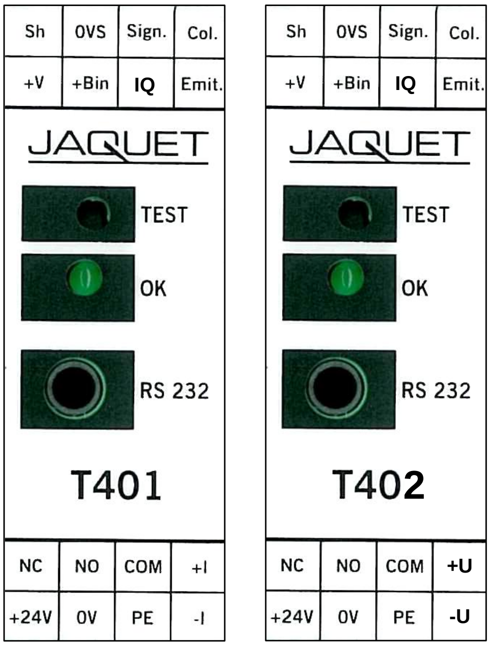
Before switching the equipment on, it is mandatory to verify that the power supply voltage is in the permissible range.

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 Connections

Front view T401/T402



Sensor connections
SH : Screen - Sensor cable
0VS : Sensor reference voltage
+V : Sensor Supply
Sign : Sensor signal analog
IQ : Sensor signal digital

Open Collector Output
Col : Collector Output
Emit : Signal reference for the Open Collector

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

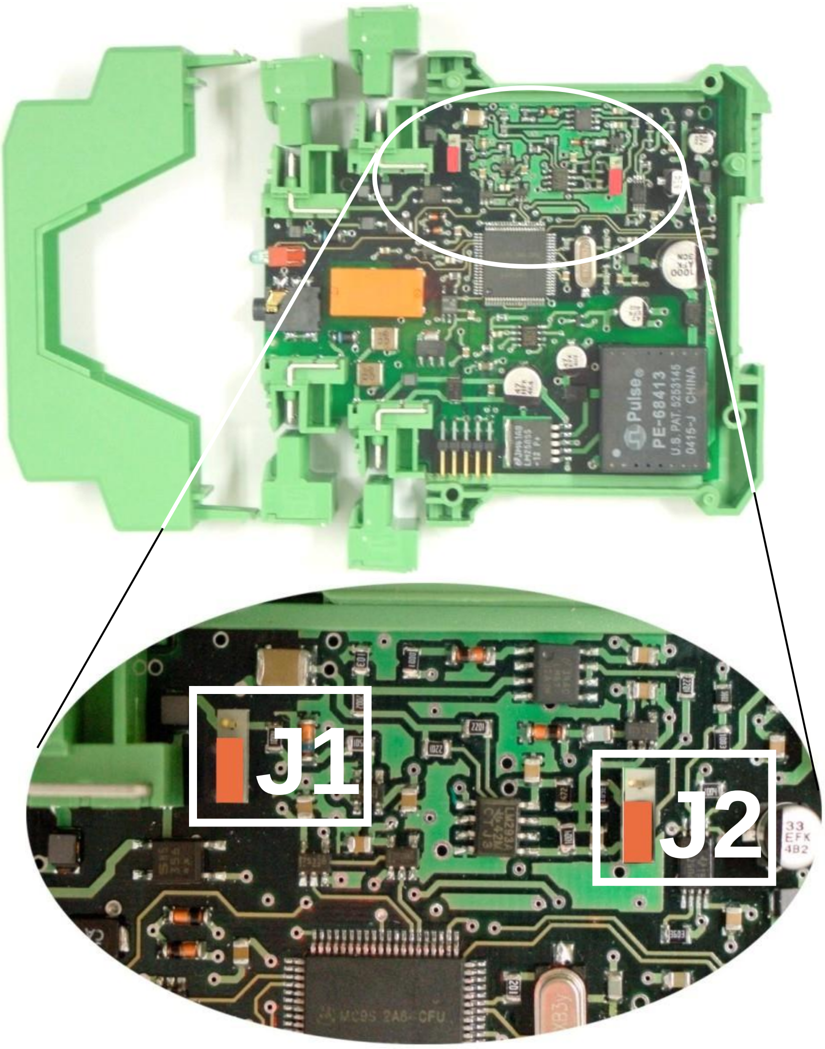
Relay output:
NC : Normally closed
NO : Normally open
Com : Common

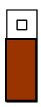
Analog Output:
+I / +U : current / voltage positive
-I / -U : current / voltage negative

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 (with 820Ohm Pull Up resistance)	28mV to 6.5V	($>20mV_{rms}$)
	3 wire and electromagnetic sensors (factory setting)	250mV to 6.5V [factory setting]	(>500mVpp)

7.2 Digital Sensor input (IQ)

No hardware configuration possible or necessary.

8 Configuration with PC Software

8.1 Software Concept

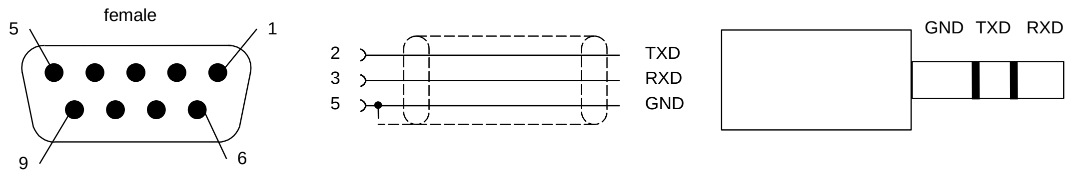
All settings are written via PC to the T400 using the RS232 interface and the user friendly menu driven T400 software.

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.
T401 / T402'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.

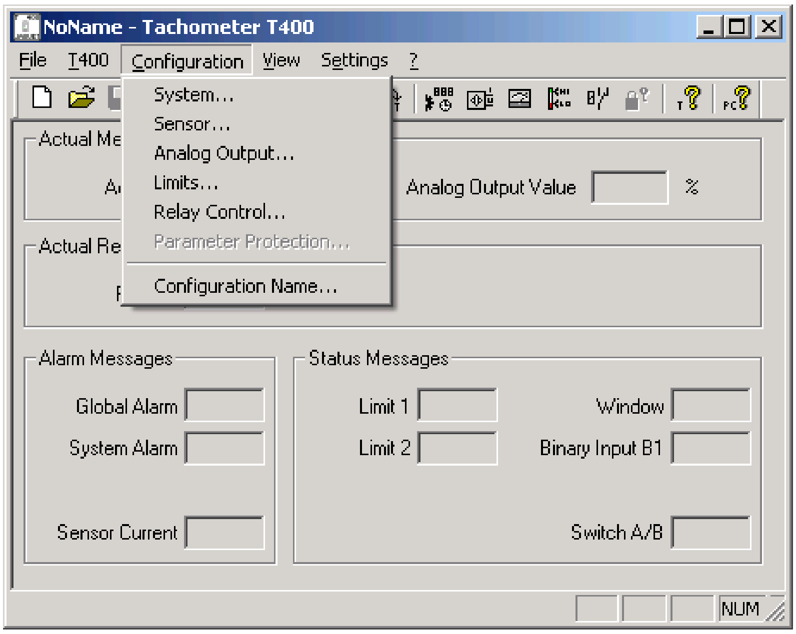
Parameter list and ranges. Factory settings are shown in bold.

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		1 … **2000.0** … 500000
Output range		**0 ... 20mA** / 4 ... 20mA (T401)
		0 ... 10V / 2 ... 10V. (T402)
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 parameters (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.

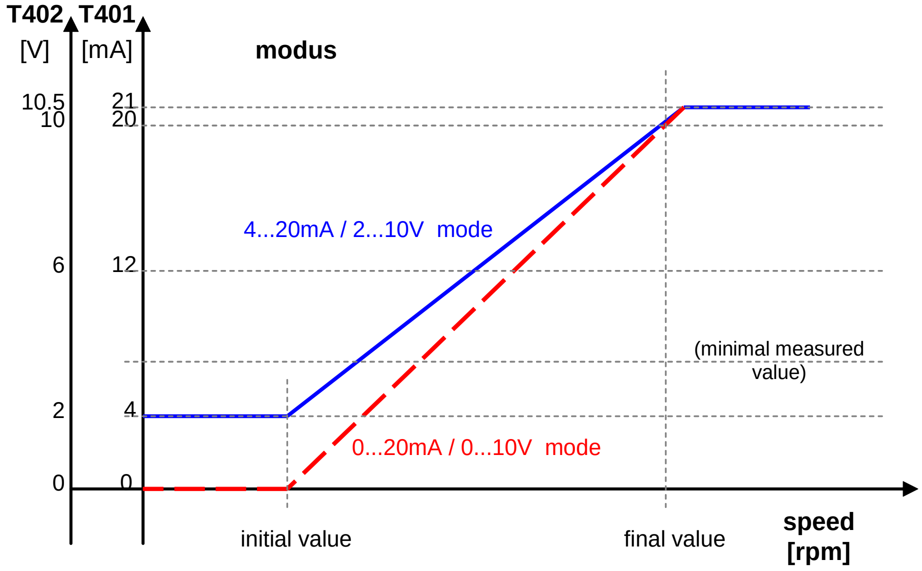
Sensor current minimum

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 T401. 0…10V or 2…10V for the T402.

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 Limits (Configuration → Limits)

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

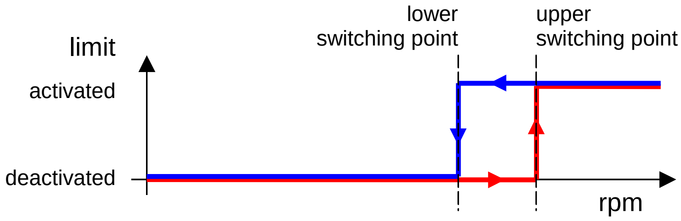
Status

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 can be activated by using the binary input <Binary input B1>.
If parameter set B is deactivated, this setting have to be set to <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 parameters (Configuration → Sensor))
• Limit 1/2	Selection of Limit 1/2	(8.5.4 Limits (Configuration → Limits))
• 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

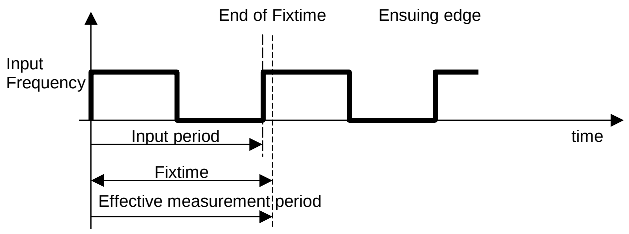
After switching-on the tachometer, the output relates the lower value of the defined output range. After completion of the first measurement the output goes to the corresponding measured value.

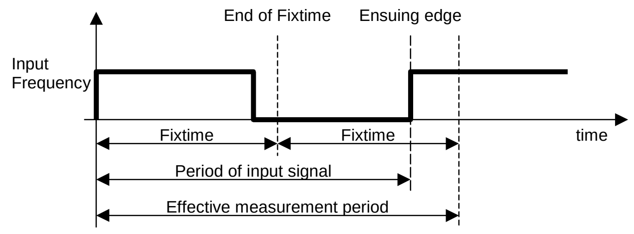
9.1.2 Relay output

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.

<table>
<tr><th>Input signal period < Fixtime</th><th>Input signal period > Fixtime</th></tr>
<tr><td>


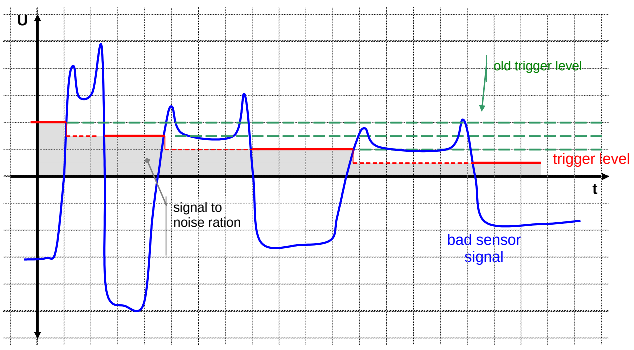
$t_{\text{Measurement typically}}$ = Fixtime
$t_{\text{Measurement max}}$ = 2 x Fixtime
</td><td>


$t_{\text{Measurement max}}$ = 2 x Input signal period
</td></tr>
</table>

The total measurement time has a resolution of $\pm$ 0.4 μs.
The calculation and adaptation of outputs follows immediately after the Fixtime.
With input frequencies outside of the measuring range, the corresponding extreme value 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 sets 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 Push-button

The front panel push button internally connects the binary input to 0VS thus generating a logic 0.

9.3.5 Binary input

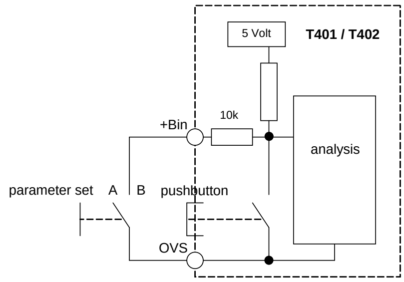
2 functions are executable using the binary input:

- Switching between parameter sets A and B. See 9.3.2 Parameter sets 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 (T401)	Voltage (T402)	
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 (T401)	Voltage (T402)	
Only System error	Off	0mA	0V	deactivated
System error OR Sensor monitoring				

9.4.3 Alarm

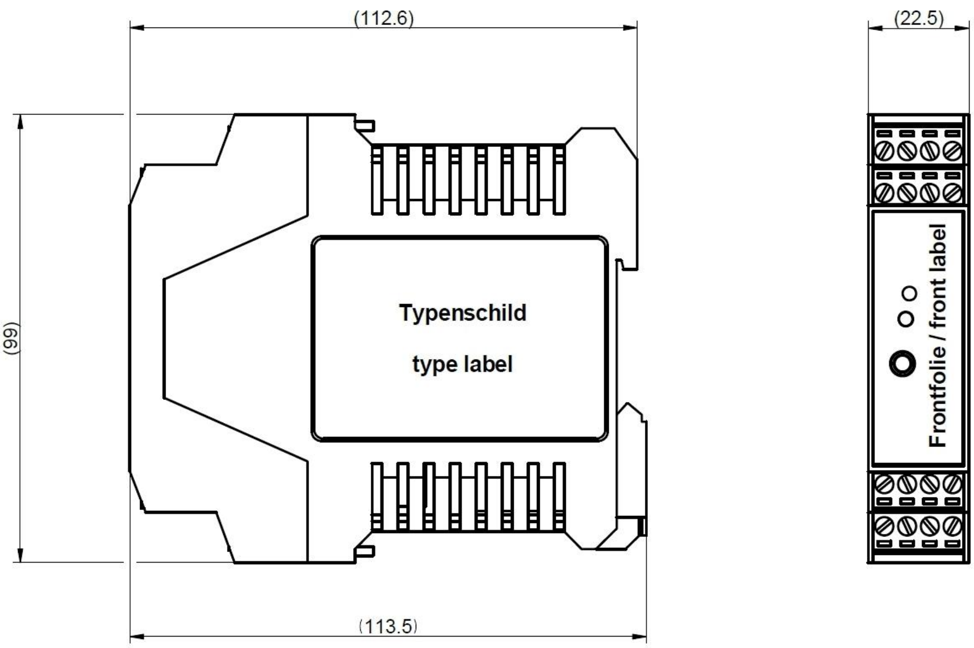
As long as a combined alarm is present no measurements are conducted and the outputs behave as described above. Once the fault or alarm condition is removed the last correct measured value is assumed. Eventual limit activation is not taken into account.

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).

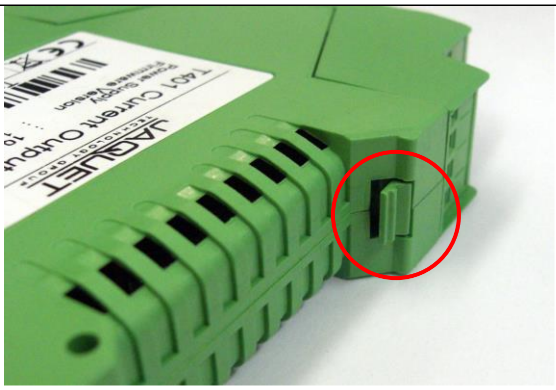
10 Mechanical Construction / Housing

The housing features front plugable terminals that are protected from accidental contact. The rear is designed for mounting onto a DIN rail.

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

Opening of the housing:

To adjust the jumper in the desired position, the housing must be opened. There are 2 types of housing and both of them have a different opening procedure.

Housing type until Date-code T1139…	Housing type from Date-code T1140…
	
To open press both fastening clips together and pull out at the same time the upper side of the housing.	To open press both locking tabs with a screwdriver and then pull out the upper side of the housing.

11 Accessories

Interface cable RS232 PC – T400 Cable for PC to tachometer communications.	**Part Nr.**	**830A-36889**
USB adapter for interface cable USB to RS232 converter.	**Part Nr.**	**830A-37598**
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.

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

i.V.

Andreas Kister
Engineering & Technology Manager

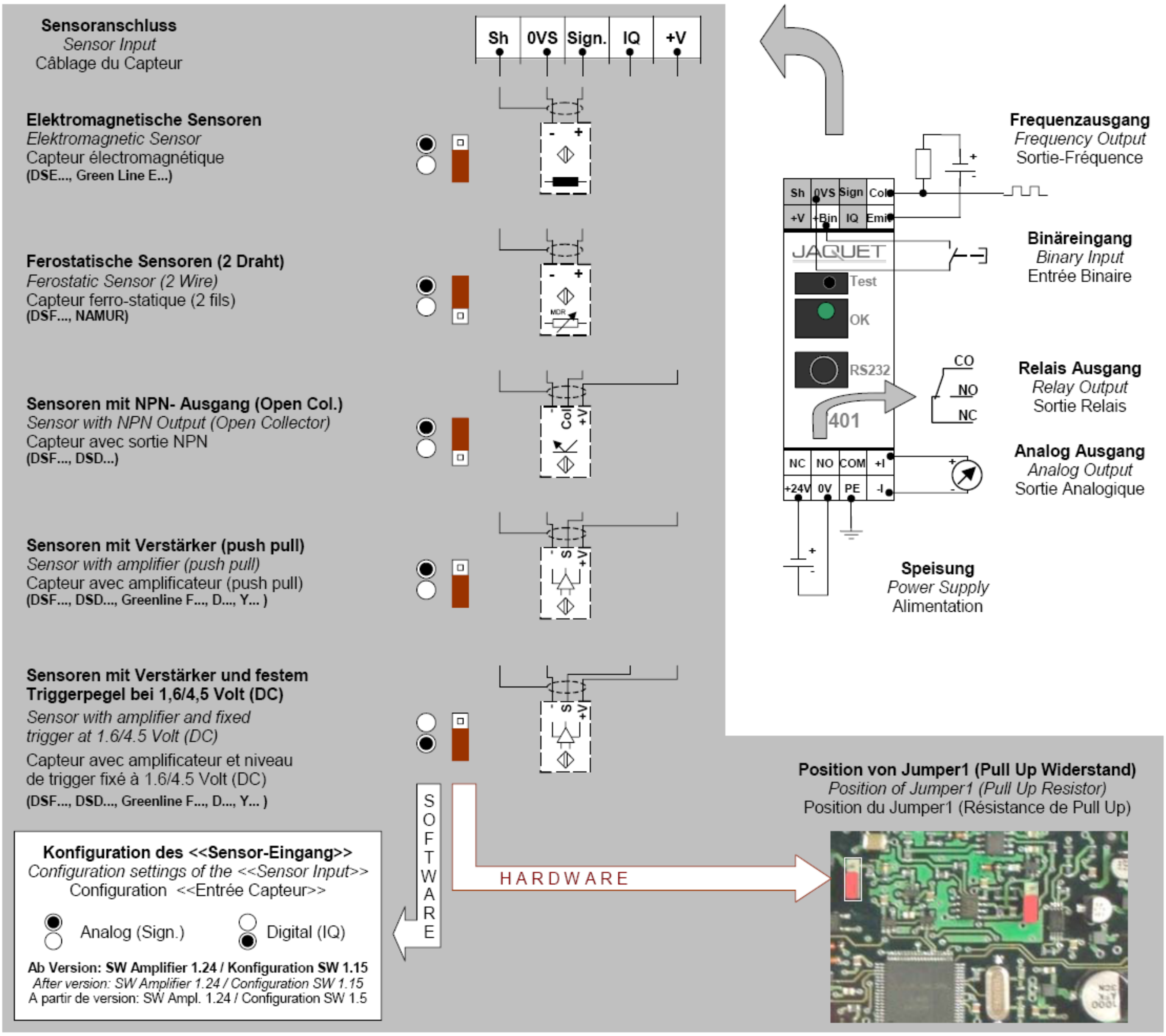
Wolfgang Schnell
Senior Quality Manager

Document: DoC T400.doc Page 1 of 1

JAQUET AG, Thannerstrasse 15, CH-4009 Basel, Switzerland / +41-(0)61 306 8822 / www.jaquet.com / info@jaquet.com

16 Connection diagram T401/402

Anschlussbild T401 / T402
Connection Diagram T401 / T402
Raccordements T401 / T402



	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