Frequency Measurement and Switching Instrument
DualTach T501

Instruction Manual
Version 2.00E

T501 : 2 Channel Tachometer with 4 Relays and 2 Analog Outputs 0/4-20mA
T501.50: Part No.: 384Z-05600 (AC Version)
T501.10: Part No.: 384Z-05601 (DC Version)

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Contents

1 Safety notice

T501 Series tachometers may only be connected by competent personnel.

T501 tachometers do not generate dangerous potentials but as soon as circuits exhibiting dangerous potentials are connected, then these may be present in the tachometer circuits.

The Tachometers may only be opened for repair by trained personnel.

These Instruments correspond to protection class I. The PE terminal must therefore be earthed.

The instructions in this manual must be strictly adhered to.

Not following these instructions could result in damage to equipment or plant and injury to personnel, as well as negating warranty claims!

Units that have suffered electrical over load, mechanical stress or been operated outside of specification must be immediately switched off and returned to the manufacturer for repair.

2 Product features

Series T501 tachometers measure and monitor frequency signals (speed proportional values) in the range 0.025Hz to 50,000Hz.

Available are:

- 2 Frequency Inputs (Speed sensors)
- 2 Analog outputs
- 2 Binary input
- 4 Relays
- 2 Open Collector Outputs
- 4 Parameter sets each having 6 System limits with 4 Limit values
- Sensor monitoring
- System monitoring

The Tachometers are configured via Computer (PC) using resident operating software.

2 models are available:

T501: 2 channel Tachometer with 4 Relays and 2 Analog outputs 0/4-20mA
T501.50: Part No.: 384Z-05600 (AC Version)
T501.10: Part No.: 384Z-05601 (DC Version)

3 Specifications

Reference temp: + 20 ℃

3.1 General

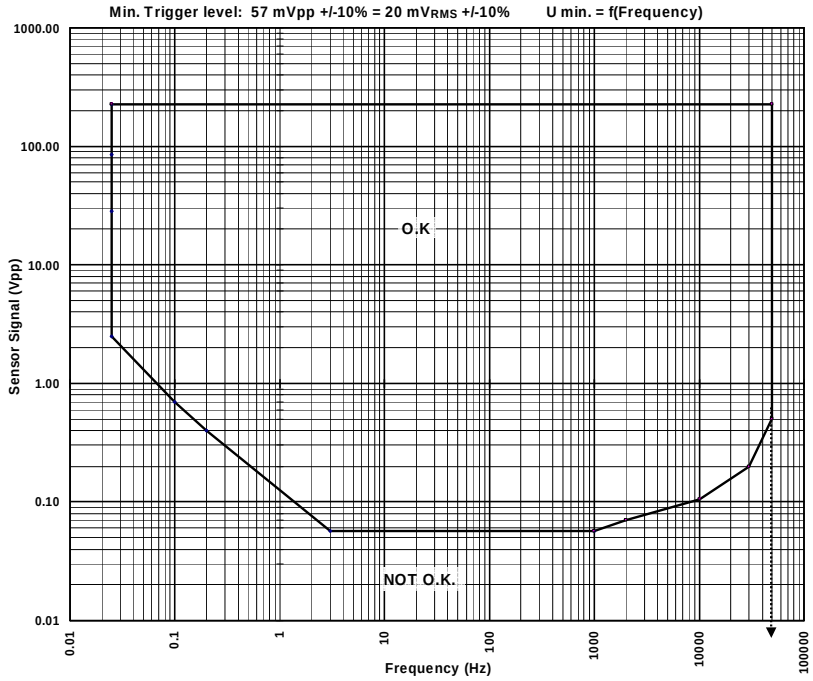
<table>
<tr><td>Measurement time</td><td colspan="4">2ms / 5ms / 10ms / 20ms / 50ms / 100ms / 200ms / 500ms / 1s / 2s / 5s
(Frequency measurements might take longer than the predefined measurement time)</td></tr>
<tr><td rowspan="2">Supply voltage</td><td colspan="2">AC Version</td><td colspan="2">90…264 VAC (47...63 Hz) / 120VDC … 370VDC</td></tr>
<tr><td colspan="2">DC Version</td><td colspan="2">18…36 VDC</td></tr>
<tr><td rowspan="2">Isolation voltage</td><td colspan="2">AC Version</td><td colspan="2">3000 VAC (from AC/DC power supply)</td></tr>
<tr><td colspan="2">AC Version</td><td colspan="2">1500 VDC (from DC/DC converter)</td></tr>
<tr><td>Isolation</td><td colspan="4">Galvanic isolation between:
• Supply
• Sensor input incl. sensor supply
• Binary input 1
• Binary input 2
• Analog output 1
• Analog output 2
• Relay outputs
• Open Collector output 1
• Open Collector output 2
• Ethernet interface</td></tr>
<tr><td rowspan="6">Power consumption</td><td colspan="2"></td><td>P Min. (W)</td><td>P Max. (W)</td></tr>
<tr><td rowspan="3">DC Version</td><td>18 VDC</td><td>3.3</td><td>6.6</td></tr>
<tr><td>24 VDC</td><td>3.4</td><td>6.7</td></tr>
<tr><td>36 VDC</td><td>3.5</td><td>6.8</td></tr>
<tr><td rowspan="2">AC Version</td><td>110 VAC</td><td>5.0</td><td>11.0</td></tr>
<tr><td>230 VAC</td><td>8.0</td><td>14.0</td></tr>
<tr><td rowspan="5">Power supply bridging</td><td rowspan="3">DC Version</td><td>18 VDC</td><td colspan="2" rowspan="3">> 20ms</td></tr>
<tr><td>24 VDC</td></tr>
<tr><td>36 VDC</td></tr>
<tr><td rowspan="2">AC Version</td><td>110 VAC</td><td colspan="2" rowspan="2">> 20ms</td></tr>
<tr><td>230 VAC</td></tr>
<tr><td rowspan="2">Operating temperature</td><td colspan="2">AC Version</td><td colspan="2">-25℃…+50℃</td></tr>
<tr><td colspan="2">DC Version</td><td colspan="2">-40℃…+70℃</td></tr>
<tr><td rowspan="2">Storage temperature</td><td colspan="2">AC Version</td><td colspan="2" rowspan="2">-40℃…+85℃</td></tr>
<tr><td colspan="2">DC Version</td></tr>
<tr><td rowspan="2">Weight</td><td colspan="2">AC Version</td><td colspan="2">430g</td></tr>
<tr><td colspan="2">DC Version</td><td colspan="2">390g</td></tr>
<tr><td>Sealing to DIN EN 60529</td><td colspan="4">IP 20</td></tr>
</table>

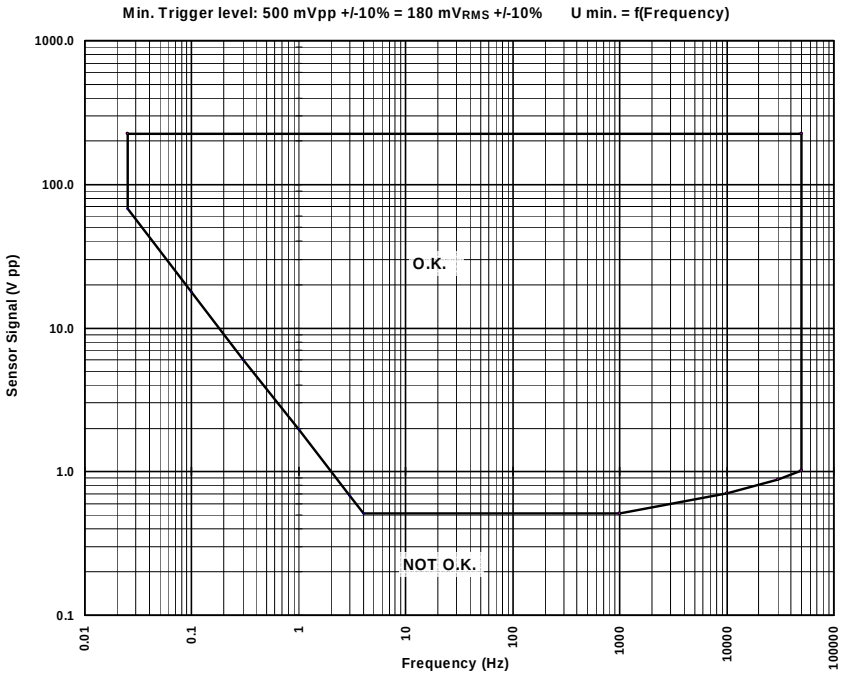
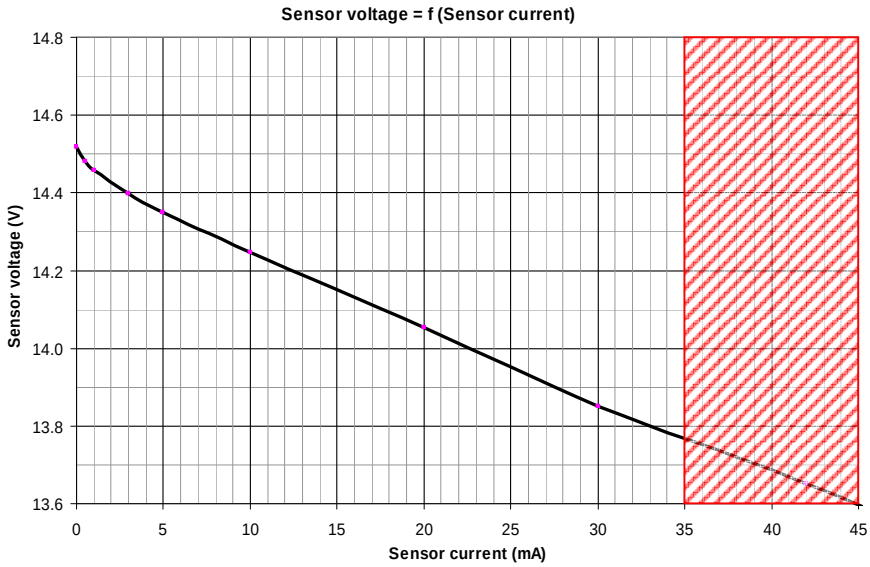
3.2 Inputs

3.2.1 Sensor Inputs

An overview how different sensor can be connected is in chapter 6.1.2 Terminal A

Number	2
Frequency range (-3dB)	0.025 Hz … 50 KHz
Measurement range	Programmable within the frequency range
Measurement accuracy	0.002 %
Resolution (Frequency)	10 ns

Input impedance	> 11.5 kΩ *(0.1 Hz→80 kΩ, 1 KHz→18.5 kΩ, 10 KHz→16 kΩ, 50 KHz→11.6 kΩ)*
Input signal for fixed 3V trigger (+/-15%)	• Max. Voltage: $80V_{RMS}$ ($226V_{pp}$) • Best suited to digital signals • Schmitt Trigger Input (Hysteresis > 1V) • „0“ = Low Level to 1.25V • „1“ = High level from 3V (+/- 15%) • Min. Pulse width: 5µs • NO DC- decoupling
Input signal for adaptive trigger min. 57mVpp (+/-10%) $20mV_{RMS}$	• Max. Voltage: $80V_{RMS}$ ($226V_{pp}$) • DC- decoupling • The Trigger level automatically adapts itself to the input signal in the range +28.5mV to +2V. The Adaptive Trigger improves the signal to noise immunity e.g. where electromagnetic sensors are used. 

Input signal for adaptive trigger min. 500mVpp (+/-10%) 180mV$_{RMS}$	• Max. Voltage: 80V$_{RMS}$ (226V$_{pp}$) • DC- decoupling • The Trigger level automatically adapts itself to the input signal in the range +250mV to +2V. The Adaptive Trigger improves the signal to noise immunity e.g. where electromagnetic sensors are used. 
Sensor supply	• +14V +/- 0.5V, max. 35mA / Short circuit proof • If the current limit has been activated, then the circuit needs to be disconnected to reset the protection. Typical voltage curve as a function of sensor current 
Integral pull up resistor	1000Ω to +14V (Only for 2 wire active e.g. NAMUR sensors)
Screen	Terminals are provided for each sensor cable screen (Sh1 and Sh2). These terminals are internally connected to the sensor input / supply 0V.

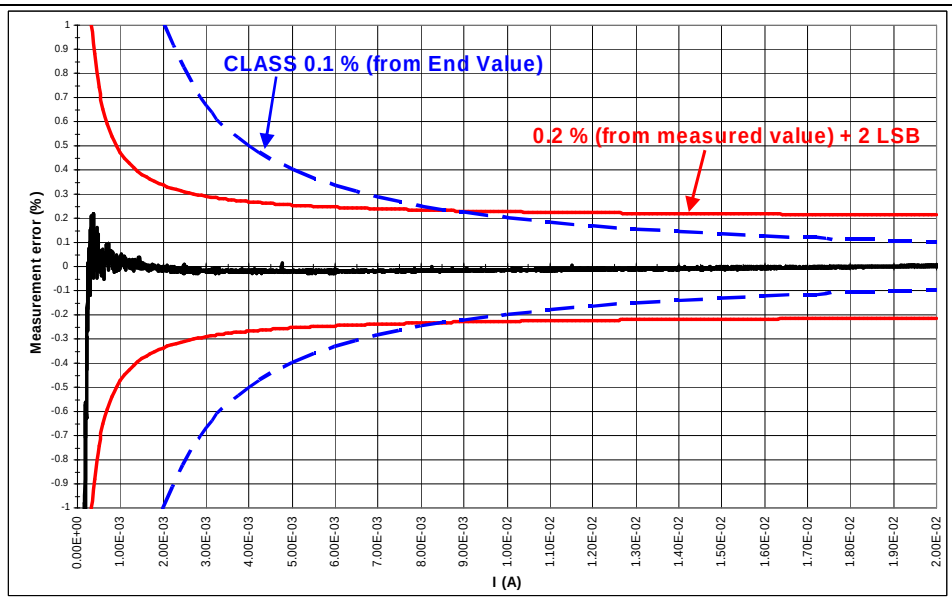
Sensor monitoring	3 sensor monitoring settings are available in the configuration software: • No Sensor Monitoring • Monitoring of supplied sensors (active Sensor Types) [Also for 2 wire sensors that are supplied via the internal Pull-up resistor (1kΩ) → Sensors drawing current outside of I_{min} or I_{max} are considered to be faulty. I_{min} = 0.5…35mA I_{max} = 0.5…35mA • Monitoring of non powered sensors (passive Sensor Types) [For 2 wire sensors such as electromagnetic sensors.] → The sensor is considered to be faulty if the line is broken. Here the sensor impedance is dynamically measured. Z < 60 kΩ = OK Z > 125 kΩ = NOT OK

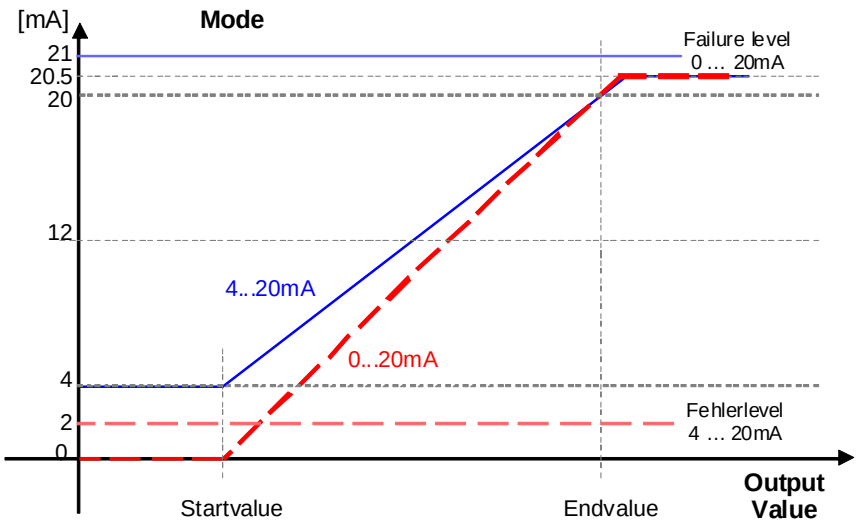
3.3 Binary Inputs

Number	2 Active Binary Inputs and 1 push button (EXEC – logic OR with Binary input B1)
Level	Logic 0 = 0V….+5V Logic 1 = +15V….+36V
Isolation voltage	1500 V_{RMS}
Input resistance	R_{min} = 8.2 kΩ

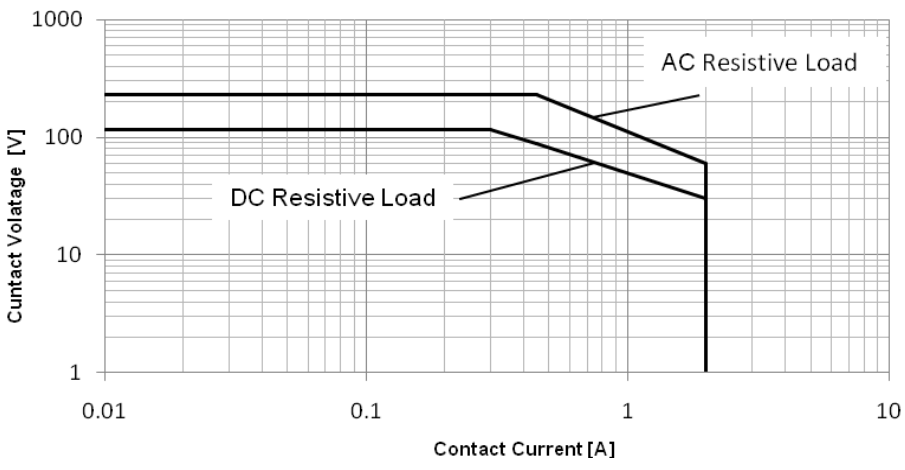
3.4 Outputs

3.4.1 Analog Outputs

Number	2 Analog outputs
Isolation voltage	1000 VDC
Output type	Current (selectable 0…20 / 4…20mA)
Load	Max. 500Ω
Open circuit voltage	Max. 15V
Typical error curve	

Mode	
Transfer Functions	Start value < or > End value 
Resolution	14 Bit (16384 increments)
Max. Linearity error	2 LSB (Least Significant Bit) ca. 2.7uA
Measuring error	Max. 0.15 % f.m.v. + 2 LSB (-25℃ → +50℃) Max. 0.20 % f.m.v. + 2 LSB (-40℃ → +70℃)
Accuracy class	0.1 % of the end value
Damping	Hardware time constant T = 4.1 ms 10% →90% = 8.6 ms (Hardware) Actual time = Hardware time constant + Software setting (configuration)
Temperature Drift	Typ.: 50 ppm/K, max. 120 ppm/K

3.4.2 Relays Outputs

Number	4
Type	Mono-stable single change-over
Functions	• May be assigned to System Limit 1..6, Sensor Alarm, Static error Sensor 1 or 2, dynamic error, always on or off. • With or without Hold function (Reset via Binary input) • Fail Safe or Not Fail Safe
Relay - max. switching current	

Reaction time	Effective Measurement interval + max 6 ms
Contact resistance	50 mΩ Max. (Initial contact)
Contact isolation	1500 VAC (coil to contact) 1000 VAC (between open contacts)

3.4.3 Open Collector Outputs

Number	2 Open Collector outputs
Type	Opto-coupler (passive)
External resistance	IC nominal = 15mA ($R_{Pull-up}$ = V / I) *Example: V = 24 V → R = 1.6 kΩ* IC max. = 30mA
Reaction time	• As Frequency output: <30 us • Effective Measurement interval + max 30 us
Load voltage	V = 5VDC…36VDC
Isolation voltage	1500 VAC
Functions	• May be assigned to System Limit 1..6, Sensor Alarm, Static error Sensor 1 or 2, dynamic error, always on or off. • With or without Hold function (Reset via Binary input) • Frequency Sensor 1 or 2, Frequency x2, Frequency x4 (subject to phase shift) • Fail Safe or Not Fail Safe
Inverting	Open collector output frequencies are in phase with the input signal.

3.5 Data communication

3.5.1 Ethernet

Number	1
Physical Layer	Ethernet 10Base-T, IEEE 802.3i
Max cable length	100 m
Transmission rate	10 MBit/s
Connection	Front panel, 8P8C (RJ45)
Usage	Configuration and measurement status
Protocol	Peer to Peer
Connecting cable	Use a crossover cable

3.6 Environment

3.6.1 Climatic Conditions

Standard	DIN 40 040
Operating temperature	See 3.1 General
Storage temperature	See 3.1 General
Relative Humidity	• 75% average over 1 year; to 90% for max. 30 days. • Condensation to be avoided.

3.6.2 Electromagnetic immunity

Electrostatic discharge	EN 61000-4-2	Contact 6 kV, air 8 kV
Electromagnetic fields	EN 61000-4-3	30 V/m, not modulated and AM 80 % with 1000Hz Sinus wave
Fast transients	EN 61000-4-4	2 kV, repeated 5 kHz duration 15 ms period 300 ms
Slow transients	EN 61000-4-5	Line / line +/- 1kV, earth line +/- 2kV, 1 per minute
Conducted HF	EN 61000-4-6	3 V eff (180 dBuV) 10 kHz – 80 MHz
Mains frequency Magnetic field	EN 61000-4-8	50 Hz, 100 A/m 2 minutes
Voltage dips	EN 61000-4-11	Voltage dips, short interruptions and voltage variations immunity tests

3.6.3 Other Standards

CE	Communauté Européenne

4 Principle of Operation

4.1 General

The T501 Series of tachometers are microprocessor controlled and operate in accordance with the period measurement principle whereby the duration of the input period is measured during the measurement interval. The reciprocal value based on the average input period corresponds to frequency and hence speed.
The relationship between frequency and speed is determined by the Machine Factor.

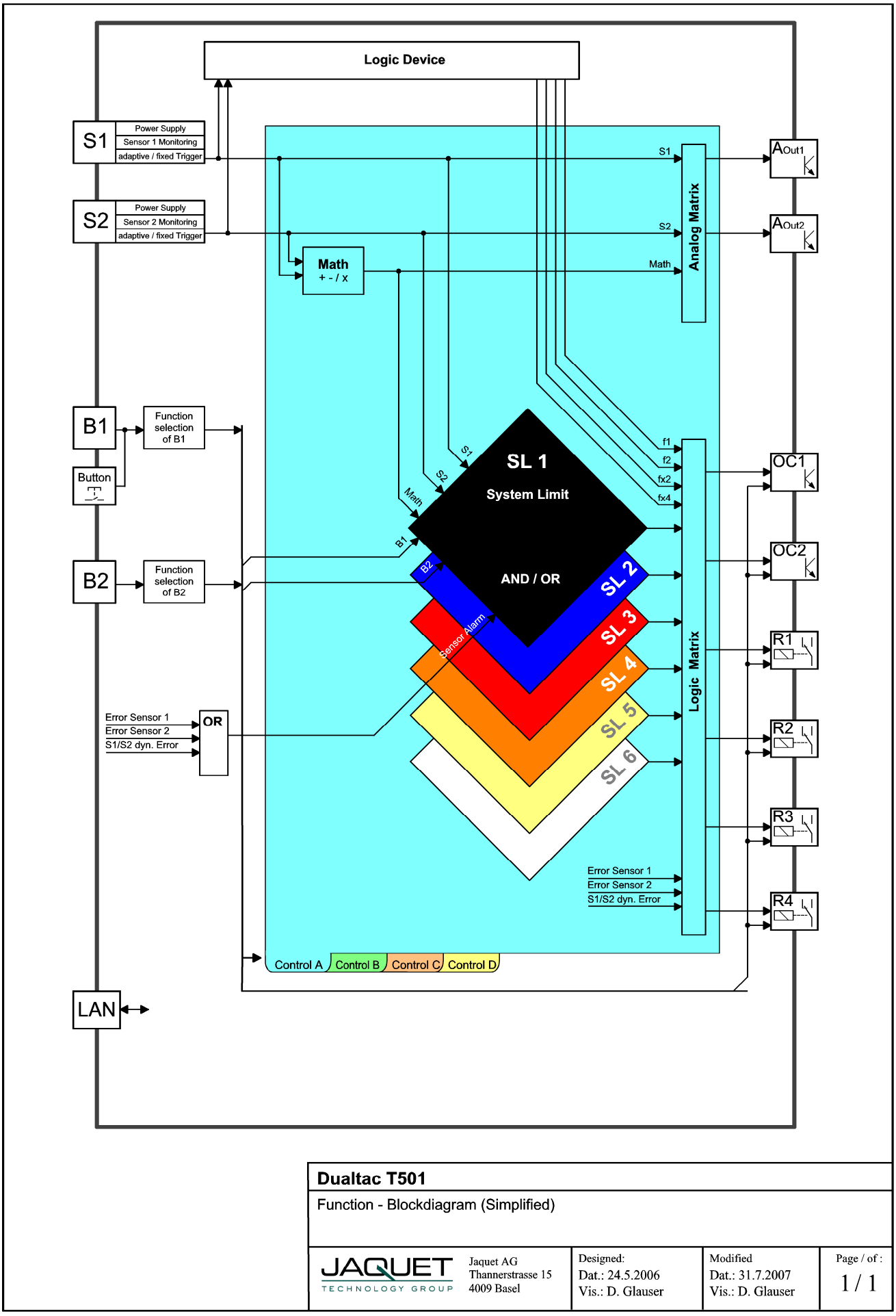
The status of System Limits is based on various inputs that can be logically combined AND or OR. System Limit inputs may be: both speed inputs, a Math function based on the speed inputs and, the 2 binary inputs. A hysteresis may be set for the speed inputs and Math function individually. The 6 System Limits in each of 4 parameter sets may be individually defined. Parameter sets may be selected via binary inputs. The 4 relays and 2 open collector outputs may be assigned to any System Limit and will react accordingly. The 2 open collectors may alternatively be assigned to frequency x1, x2 or x4. Relay and open collector status may be latched and then reset via binary input.

The system permanently monitors itself. Sensors may in addition be monitored. Sensor error may be used in the configuration to influence System Limits. System error would influence the relays, open collectors and Analog outputs and the front panel LED would go out.

Frequency Outputs (Open Collector Outputs) are not influenced by the Machine factor but where so defined correspond to the input signal. For frequency x2 or x4 the 2 input signals should ideally be phase shifted by 90 degrees.

Parameter input is via resident PC software and the Ethernet Interface. This may also be used to interrogate the unit, display measurement and unit status.

The Parameters are safely stored in EEPROM.



Dualtac T501

Function - Blockdiagram (Simplified)

JAQUET TECHNOLOGY GROUP Jaquet AG Thannerstrasse 15 4009 Basel	Designed: Dat.: 24.5.2006 Vis.: D. Glauser	Modified Dat.: 31.7.2007 Vis.: D. Glauser	Page / of : 1 / 1

4.2 Machine factor

The Machine factor determines the relationship between the measured sensor frequency and the corresponding speed.

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

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

There are two means of determining this value:

4.2.1 Measured

Where the Frequency (f) at the Sensor input and the corresponding speed (n) is known:

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

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

4.2.2 Calculated

The relationship between Sensor Signal Frequency (f) and speed (n) at a Pole wheel is:

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

f = Signal frequency in Hz
n = Pole wheel speed in U/min (rpm)
p = Number of teeth

Machine factor is then:

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

M = Machine factor
p = Number of teeth

Should a gearbox be present between the pole wheel and drive shaft the formula becomes:

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

M = Machine factor
p = Number of teeth
i = Gearbox ratio

The gearbox ratio is determined as follows:

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

i = Gearbox ratio
n_1 = Primary pole wheel speed (Sensor position)
n_2 = Secondary pole wheel speed (Speed to be indicated)
p_1 = Nr. Of teeth – primary pole wheel
p_2 = Nr. Of teeth – secondary pole wheel

4.2.3 Other physical parameters

In principle any parameter may be processed as long as it can be translated into a frequency proportional value. The formulae above may still be applied whereby the required parameter is used in place of speed.

5 Installation

Series T501 tachometers may only be installed by competent personnel. Only undamaged and correctly configured units may be used. Please note the safety instructions in Paragraph 1. They should be connected to the power supply by means of an isolating switch and correspond to protection class I. The PE terminal must therefore be earthed.

Before switching on check that the supply is within the permissible range.

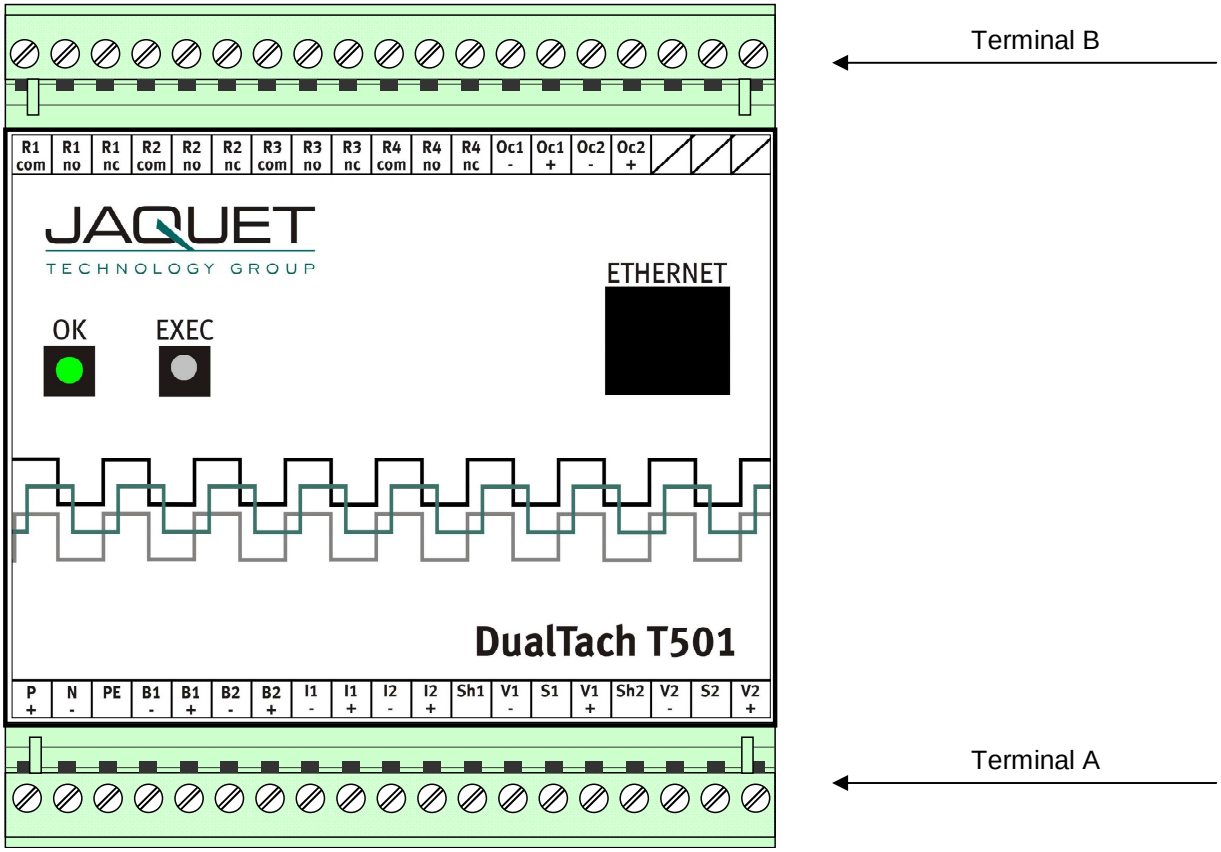
The Sensor cable screens must be connected terminals „Sh1“ and „Sh2“ respectively so as to minimize the effects of signal noise. These terminals are internally connected with 0V (not PE).

Attention: If the password has been changed, there is no way of returning to a factory setup. If the password is forgotten, you have to send in the tachometer and the Jaquet- Service- Team will set it back.

6 Connections

6.1 Front view

6.1.1 Front view T501



The Ethernet Interface, status LED along with the EXEC push buttong are located at the front. For communications please see Paragraph 7 Configuration via PC Software

6.1.2 Terminal A

Supply

N (-) : Neutral (Return)
P (+) : Live
PE : Earth

Sensor connections S1 / S2

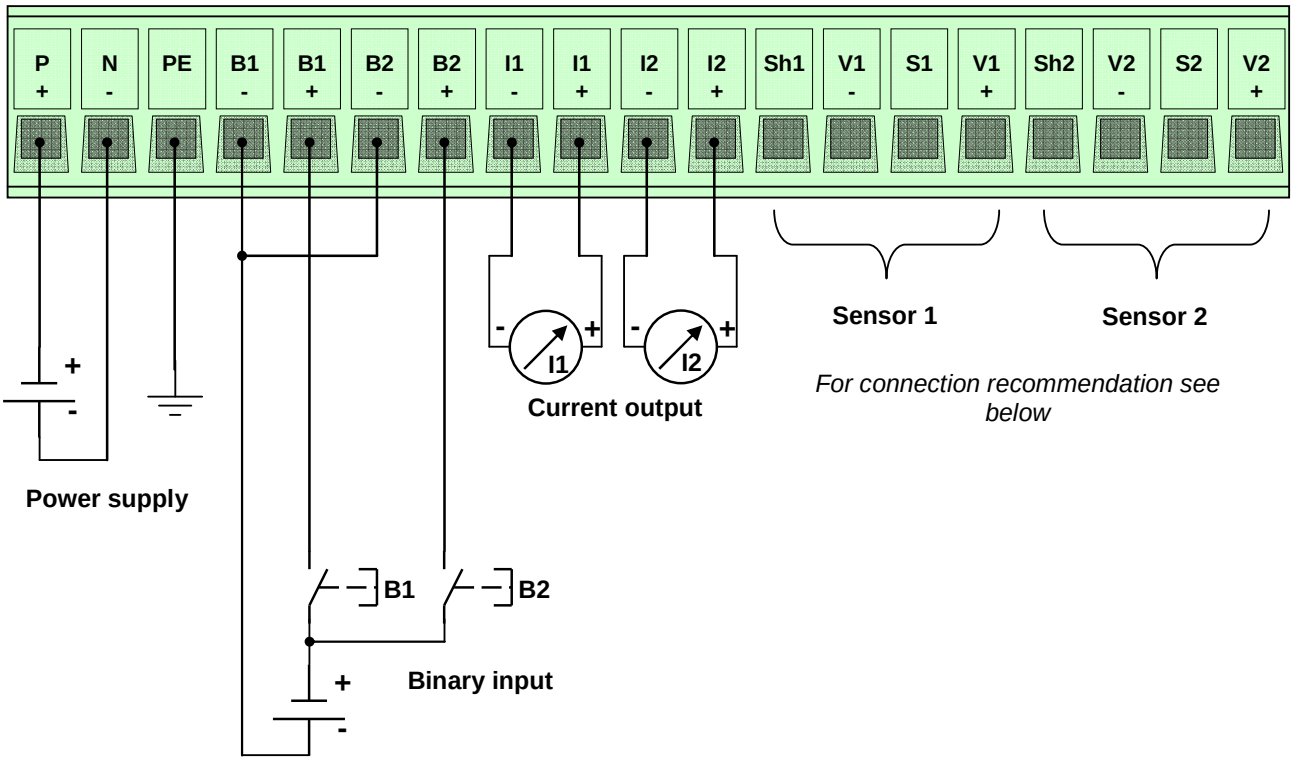
S1 : Sensor input S1
Sh1 : Screen S1
V1+ : Sensor Supply S1
V1- : 0V S1
S2 : Sensor input S2
Sh2 : Screen S2
V2+ : Sensor Supply S2
V2- : 0V S2

Binary Inputs

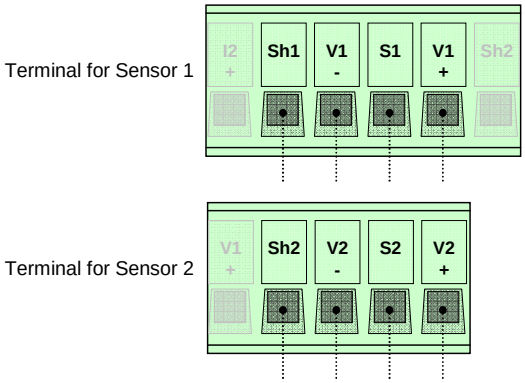
B1+ : positive B1
B1- : negative B1
B2+ : positive B2
B2- : negative B2

Analog outputs

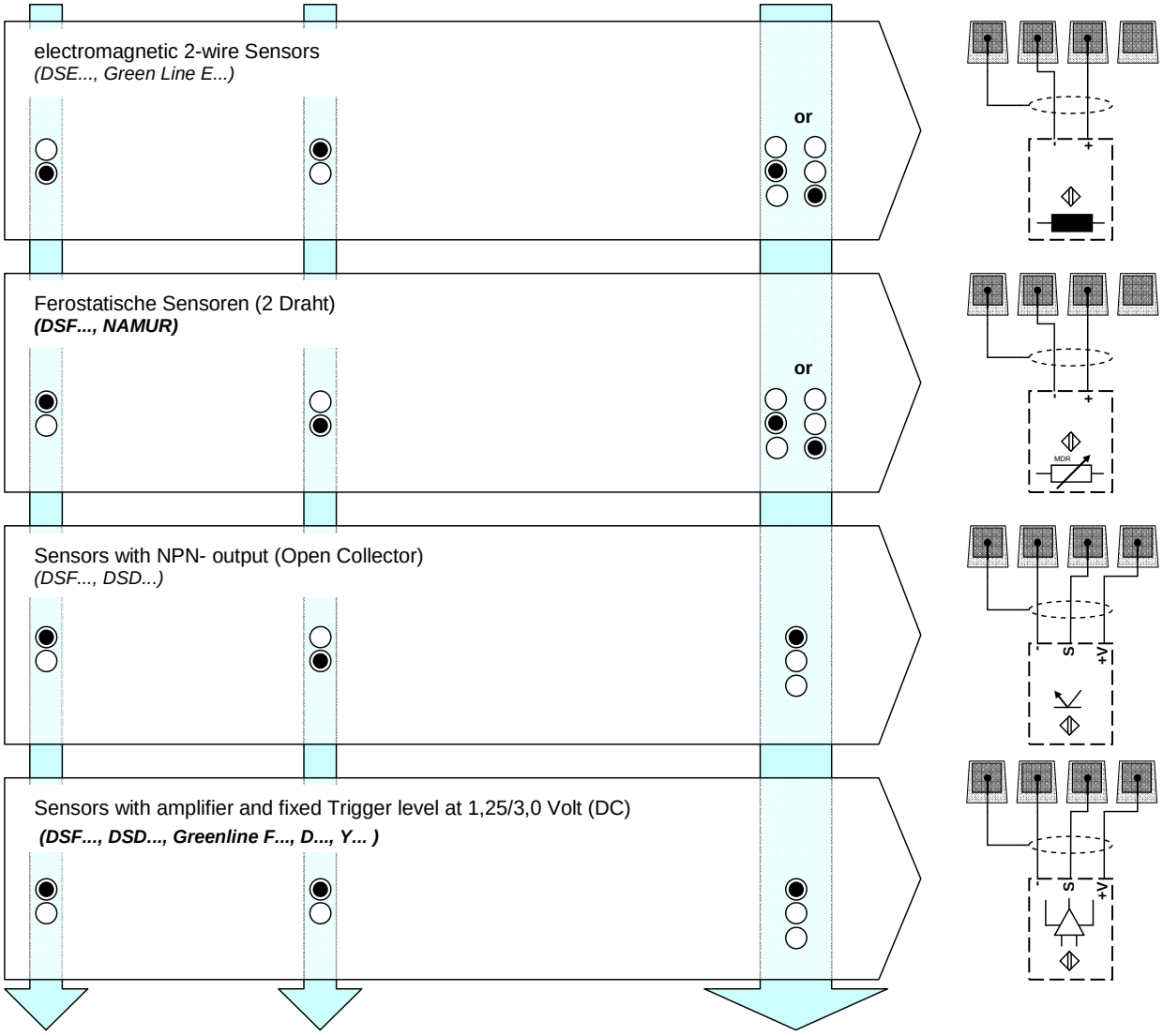
I1+ : positive I1
I1- : negative I1
I2+ : positive I2
I2- : negative I2



Connection recommendation



Sensor types



configuration recommendation of the Software parameters

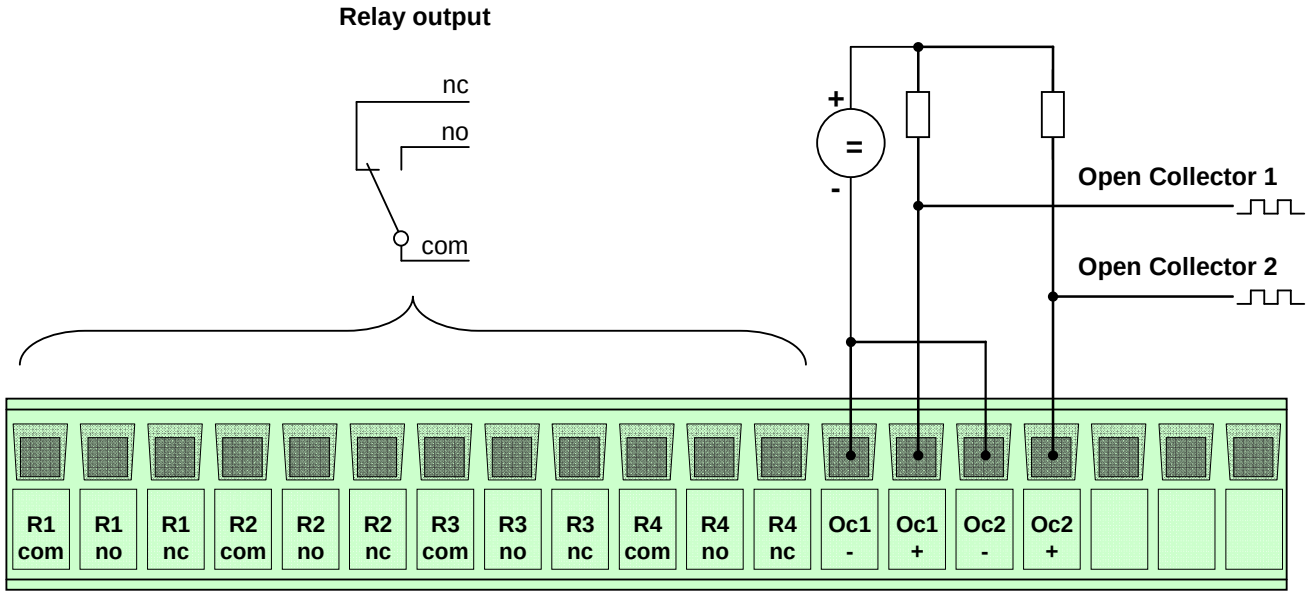
6.1.3 Terminal B

Open Collector Outputs Oc1 / Oc2

Oc1+ : positive Open Collector 1 (Emitter)
Oc1- : negative Open Collector 1 (Collector)
Oc2+ : positive Open Collector 2 (Emitter)
Oc2- : negative Open Collector 2 (Collector)

Relay Outputs R1-R4

NC : Normally closed
NO : Normally open
Com : Common



7 Configuration via PC Software

7.1 Software Concept

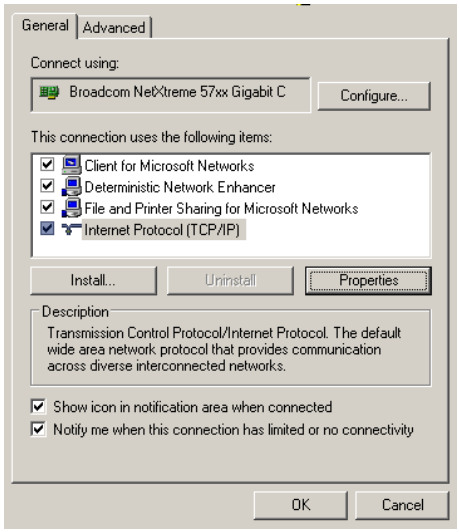
The T501 Ethernet connection is used to configure or interrogate the unit. (see Paragraph 10 Accessories)
The resident menu driven configuration software is used for unit set up.
Normal PC file handling procedures apply and the configuration file can be communicated between computer and T501.

To run the Software you must have Java Runtime Environment (JRE) 1.5 or higher.

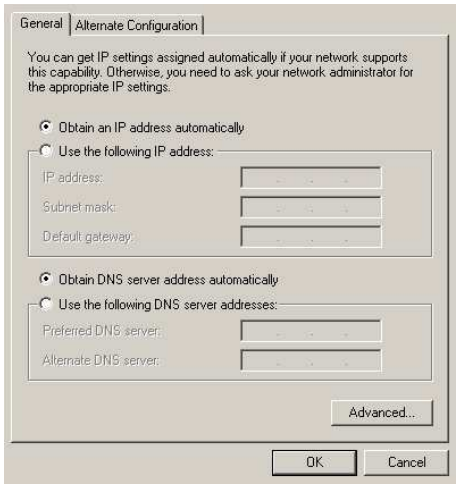
7.2 PC Settings

The PC Ethernet card must first be set correctly. T501's cannot be used on a network.

Go to Desktop, Settings, Network connections and right click on <Properties>. Right click the Network card you want to use for T501 comms and select <Properties>.



Select Internet protocol (TCP/IP) and select the Option <IP-Address automatically recognize>



7.3 Download configuration software

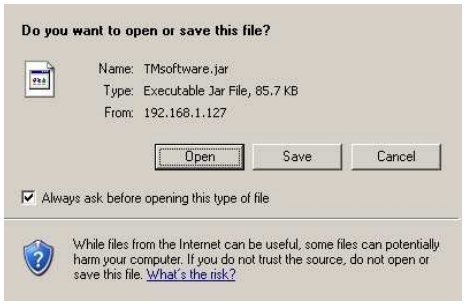
Connect the Tachometer to your PC using a cross over patch cable. Once connected open your browser and enter the IP address 192.168.1.127/software

An HTML page will open with the Link <Download control programm>

Click on the Link. Dependent upon your Internet Explorer configuration you will be asked whether you want to <Open> (Run) or <Save> (Save as) the programme.

7.3.1 Direct execution

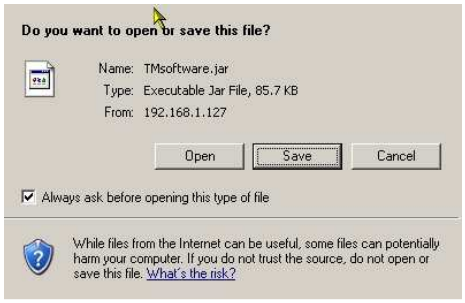
Select <Open> and the configuration will be read from the tachometer (can take a few seconds). Once loaded the configuration software will open automatically.



7.3.2 Save as

Select <Save> to save the file in a path of your choice (can take a few seconds).

Open the file from your PC. The configuration software establishes a connection to the T501 and reads the actual parameters.



7.4 Configuration software

7.4.1 Configuration user and Process user

T501 parameters are divided into 2 groups, Configuration and Process parameters.
When the programme is started the window shows 3 levels one can log into, Config user, Process user or Guest. Process and Configuration users require passwords.

As a Guest one only has the right to view measured data or print out actual parameters.

A Process user can perform Guest functions and view and change Process parameters.

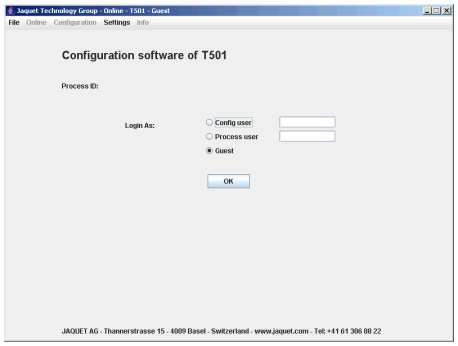
The Configuration user has full access and control over all Parameters, Process as well as Configuration.

The factory settings are shown below **Bold**.

7.4.2 Log in

Here you can Log in on three different levels. The standart passwords for Config- and Process- User are:

Config user password	**1981**
Process user password	**1977**

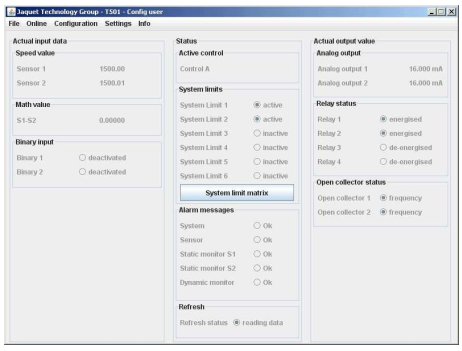


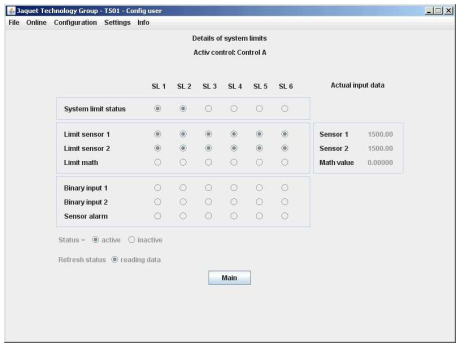
7.4.3 Main window and System Limit Matrix

After successfully logging in you will see the main window used for displaying system and measurement status.

On the left the various System Limit inputs are listed. In the middle the System Limit and alarm status are shown and on the right all outputs and current levels can be seen.

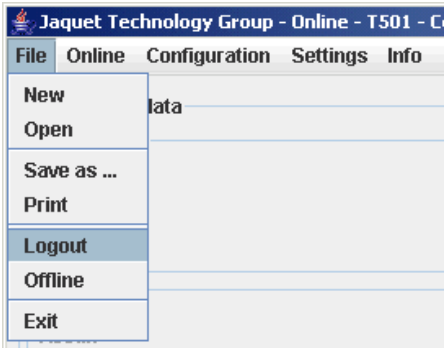
In the middle is a bar called System limit Matrix. Click on this and an overview of the logical status of System Limits, binary inputs and sensor error is shown.





7.4.4 Logging in and out

To change user level log out via <File> and click on <Log out>, then log in again using the appropriate password.

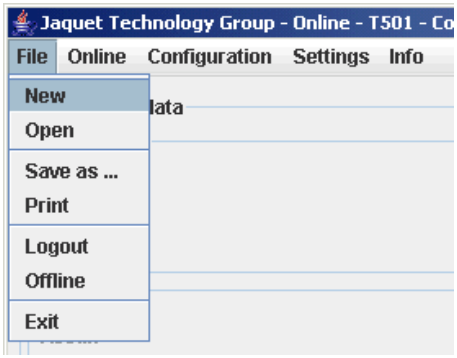


7.5 Configuration file…

7.5.1 … creating new

To create a new configuration file go to <File>, <New> and click on OK. All parameters are then reset.

NB: if you have not saved the live parameters then they would be lost.



7.5.2 … resetting to factory default

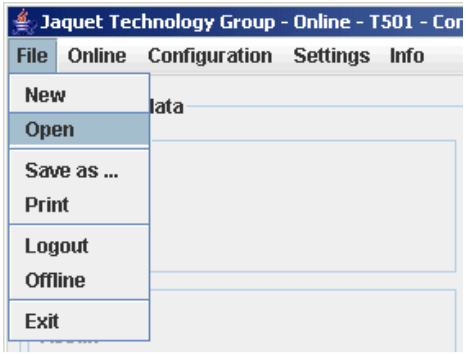
To reset parameters to factory settings go to <Settings> <Back to factory setup> then click on OK.

NB: if you have not saved the live parameters then they would be lost.

7.5.3 … loading

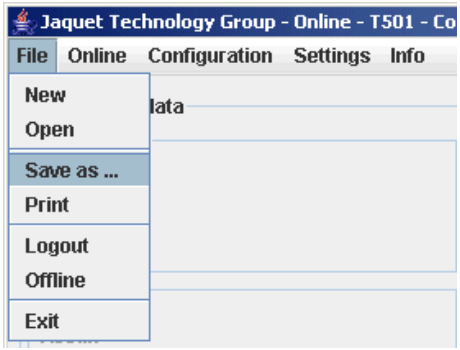
To load an existing file go to <File>, <Open> and select the required configuration file.

NB: if you have not saved the live parameters then they would be lost.



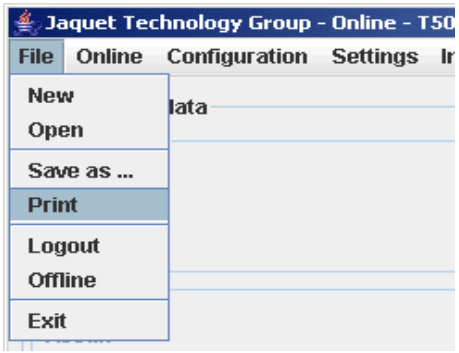
7.5.4 … saving

To save actual parameters go to <File>, <Save as> and choose the path and file name you want to use. Please note that the file name ends in the format *.T501.



7.5.5 … printout

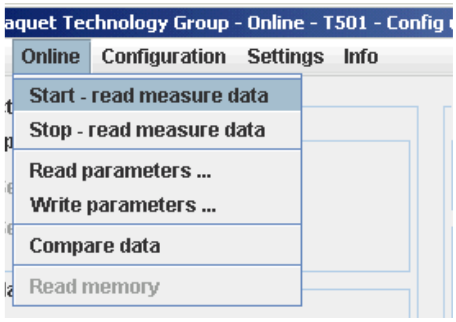
To print actual parameters go to <File>, <Print> and choose your printer. 9 pages will be printed.



7.6 Communication with the Tachometer

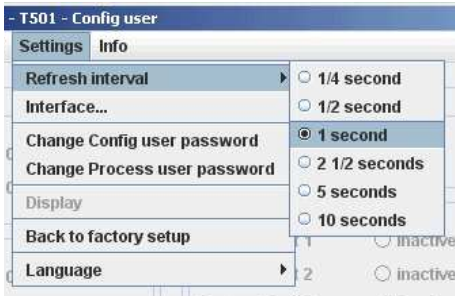
7.6.1 Read measured data

To read actual measured data and unit status go to <Online>, <Start – read measure data>.

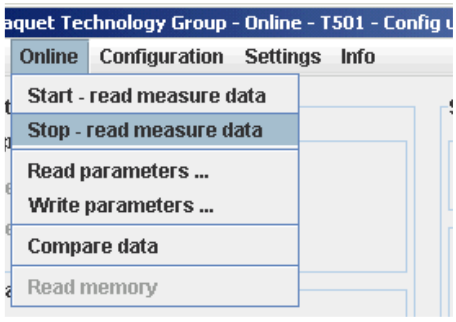


Measured data is updated in the Main window with interval defined under <Settings>, <Refresh Interval>.

¼ Second
½ Second
1 Second
2 ½ Seconds
5 Seconds
10 Seconds



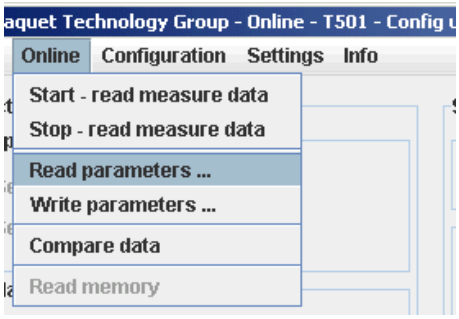
To end the measured data display go to <Online>, <Stop – read measure data>.



7.6.2 Reading configuration from the T501

When the configuration software is started the configuration file is automatically transferred to the PC. To up load the file again go to <Online>, <Read parameters> and confirm with Enter.

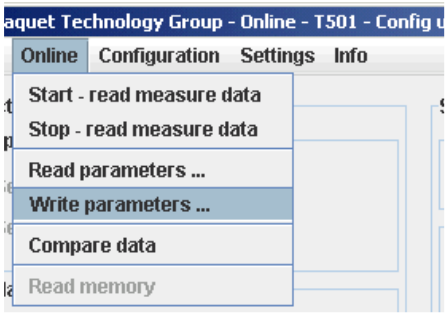
NB: The live parameter data will be overwritten.



7.6.3 Writing a configuration to the T501

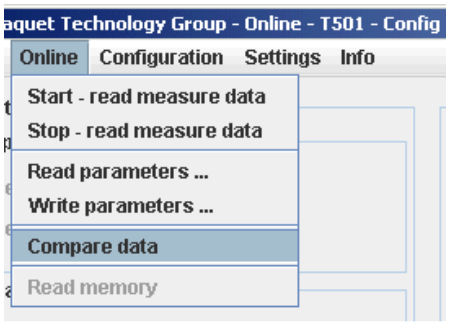
When a new configuration file is ready it can be downloaded into the tachometer. Go to <Online>, <Write Parameters> Enter. The new Parameters are then transferred to the Tachometer (can take 10s.). If no connection can be established this will be aborted after 3 attempts.

NB: The actual file in the tachometer will be overwritten.



7.6.4 Compare data

If you would like to compare a PC configuration file with that in the T501, first open the file and then go to <Online>, <Compare Data>. The actual file is then uploaded from the T501 and compared with the software parameters. A dialogue window will then appear showing whether the files are identical or not.



7.7 Configuring

The factory defaults are written in **bold**.

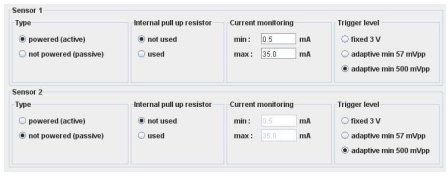
7.7.1 Speed sensors

Go to <Configuration>, <Sensor>.

To connect the sensor see Paragraph 6 Connections.

5 Parameters are used to configure the sensor:

Type:	**powered** / not powered
Resistor:	activated / **deactivated**
Min. current:	**0.5**mA … 35mA
Max. current:	0.5mA … **35**mA
Trigger level:	fixed 3V / min 57mV$_{pp}$ / **min 500mV$_{pp}$**



Sensor Type

Powered: The sensor is supplied from the Tachometer's 14V (+/-0.5V) supply. To use static sensor monitoring the Min/Max current consumption must be defined.

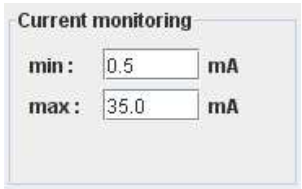
Not powered: The sensor is not powered by the T501 and no static monitoring is possible.

Internal pull up resistor

Deactivated: The internal pull up is not in circuit.

Activated: The internal pull up is in circuit.

Current monitoring



When the sensor is supplied from the tachometer upper and lower current limits must be entered. Current consumption outside of the defined limits results in a static sensor error being signaled.

Trigger level

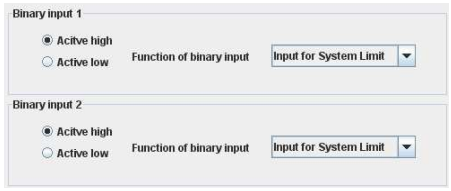
One of 3 modes may be selected. Fixed Trigger (fixed 3V) for digital sensors and two adaptive Triggers (57 mV$_{pp}$ / 500 mV$_{pp}$) for Analog speed sensors (electromagnetic).

7.7.2 Binary input configuration

To configure binary inputs go to <Configuration>, <Binary>.

The following options are available for each binary input:

Logic level: **Active high** / Active low
Function of binary input: **Input for System Limit** / Selection of Control (A/B) (C/D) / Reset latch

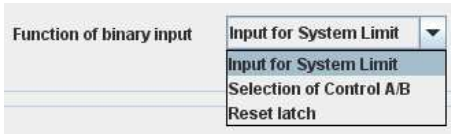


Logic level definition

Active High: Logic 1 = binary input 15V …33V

Active Low: Logic 1 = binary input 0V … 5V

Binary input for



System Limit input:
Binary input is a constituent part of System Limits.

Parameter set selection:
Binary inputs select the parameter set (PS), see Paragraph 8.3.2 Parameter sets A, B, C and D

Reset latch:
Binary input resets the relays and open collectors.

7.7.3 Set Measurement Interval

Go to <Configuration>, <Measurement time>.

This time interval determines the period during which the speed, parameters, status and outputs are recalculated and set accordingly.

Measurement time: **2ms** / 5ms / 10ms / 20ms / 50ms / 100ms / 200ms / 500ms / 1s / 2s / 5s

7.7.4 Sensor alarm

Go to <Configuration>, <Sensor alarm>.

There are 3 sources of errors which may be ORed together. Each error source may be included or excluded.

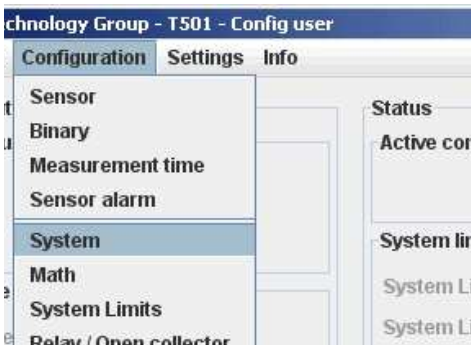
Static error sensor 1:	On / **Off**
Static error sensor 2:	On / **Off**
Dynamic error:	On / **Off**

Box checked = On, unchecked = Off (see also Paragraph 7.7.1 Speed sensors).

Dynamic Error can only be used when 2 sensors are present. (see Paragraph 7.7.6 Dynamic Error).

7.7.5 Machine factor

Go to <Configuration>, <System>.



The Machine factor establishes the relationship between sensor frequency and associated machine speed. (see Paragraph 4.2 Machine factor)

The Machine factor may also be set by means of the number of pulses per rev. The 2 parameters have a fixed relationship of factor 60 (Pulses per rev. = Machine factor x 60)

Machine factor:	0.0001 … **1** … 999,999
Pulses per revolution:	0.006 … **60** … 59,999,940

Once the machine factor has been established all further entries such as speed limits are in machine units e.g. rpm.

7.7.6 Dynamic Error

Go to <Configuration>, <System>.

$$Differenz = \left| f_{S1} - f_{S2} \right|$$

f_{S1}: Sensor 1 frequency
f_{S2}: Sensor 2 frequency

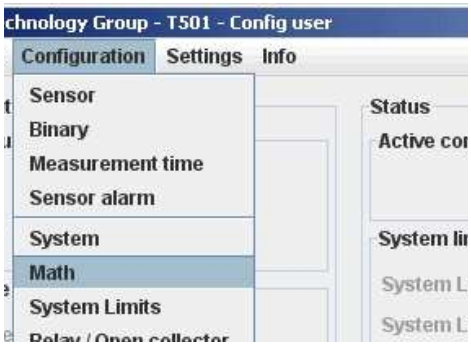
This function is only available used when both sensor inputs are used. This function has influence only on Sensor alaram.

Deviation: 0.0 … **100.0** … 999'999

If the speed difference is greater, then Dynamic error is signalled.

7.7.7 Math function

Go to <Configuration>, <Math>.



Math function is an additional input available for System Limit.
The following Math functions may be constructed.

S1 – S2	Subtraction of speed values
S2 – S1	
S1 / S2	Division of speed values
S2 / S1	
100% x (S1-S2)/S2	Percentage difference
100% x (S2-S1)/S1	
Variance (S1)	Variance
Variance (S2)	
Acceleration (S1)	Speed value acceleration
Acceleration (S2)	
S1	The speed values are fed through e.g. for the Window function.
S2	

Percentage difference

$$\frac{100 \times (n2 - n1)}{n1}$$ n: Speed

Variance

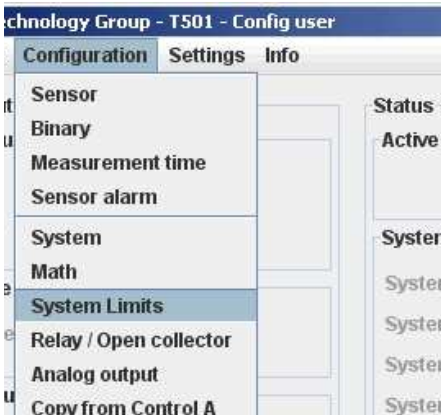
$$S_x^2 = \frac{1}{j-1} \sum_{i=1}^{j} (x_i - \bar{x})^2$$ j = 100

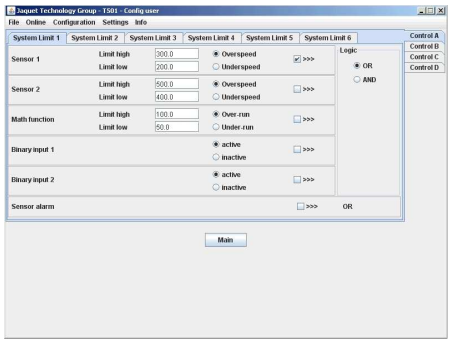
Acceleration

$$a = \frac{\Delta v}{\Delta t} = \frac{n_1 -_{1alt}}{t_{FlankeS1} - t_{FlankeS1alt}}$$ n: Speed

If the variance for S1, S2 or Analog input needs to be calculated, the measurement time must be set to 5ms or higher.

7.7.8 System Limit





Go to <Configuration>, <System Limits>.

Every System Limit has the same 5 logic inputs: Sensor 1, Sensor 2, Math function, Binary input 1, Binary input 2. A hysteresis may be applied to the first 3. Each may be inverted or selected to form part of a logical combination or disabled. The logical combination of inputs may be OR or AND.

Sensor alarm may be additionally combined OR with the System Limit result.

Sensor 1:
- Limit low: 0.01 … **200.0** … 999,999
- Limit high: 0.01 … **300.0** … 999'999

Sensor 2
- Limit low: 0.01 … **400.0** … 999,999
- Limit high: 0.01 … **500.0** … 999,999

Math Function
- Limit low: -999,999 … **50.0** … 999,999
- Limit high: -999,999 … **100.0** … 999,999

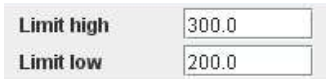
Inversion:
- Sensor 1: **Over speed** / Under speed
- Sensor 2: **Over speed** / Under speed
- Math: **Over-run** / Under-run
- Binary input 1: **active** / inactive
- Binary input 2: **active** / inactive

Inclusion in logical combination:

Sensor 1:	**On** / Off	System Limit 1
Sensor 2:	**On** / Off	System Limit 2
Math:	**On** / Off	System Limit 3
Binary input 1:	**On** / Off	System Limit 4
Binary input 2:	**On** / Off	System Limit 4

Logical combination:
- Combined **OR** / AND

Hysteresis



Hysteresis may be definined for the first 3 inputs via upper and lower limits. If the lower limit is set higher than the upper limit, the hysteresis is inverted.

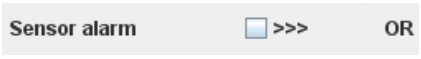
Inversion

Every input may be inverted.

Logical combination

The box must be ticked to include the input in the logical combination.

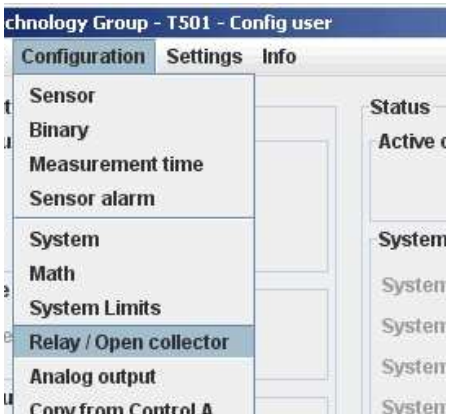
Sensor Alarm



To OR Sensor alarm with the System Limit result the box must be ticked.

7.7.9 Relay outputs

To configure relay outputs go to <Configuration>, <Relay / Open Collector>.



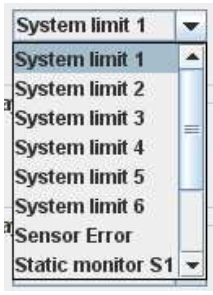
Relay configuration consists of:
Assignment, the Latch Function and the Fail safe/Not fail safe mode.

System limit 1	Sensor Error
System limit 2	Static S1
System limit 3	Static S2
System limit 4	Dynamic error
System limit 5	Always ON
System limit 6	Always OFF

Possible relay assignment:

Latch Function: Latched / **not latched**
Safety function: **Fail safe** / Not fail safe

Assignment selection

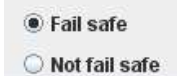


The selection box is used to choose relay assignment.

Latch Function

Defines whether a relay state should be held until reset.

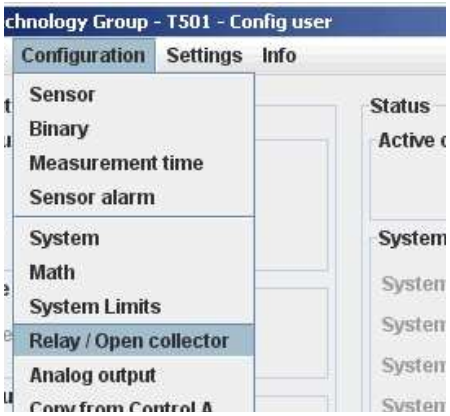
Safety Function



Defines whether the relay is to operate in Fail safe (deactivate at e.g. limit) or not fail safe mode (activate at e.g. limit).

7.7.10 Open Collector Outputs

To configure Open Collector outputs go to <Configuration>, <Relay / Open Collector>.



Open Collector configuration consists of:
Assignment, the Latch Function and the Fail safe/Not fail safe mode.

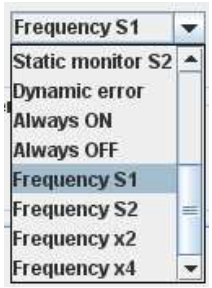
Possible Open Collector assignment:

System Limit 1	Static S2
System Limit 2	Dynamic error
System Limit 3	Always ON
System Limit 4	Always OFF
System Limit 5	**Frequency S1**
System Limit 6	**Frequency S2**
Sensor Error	Frequency x2
Static S1	Frequency x4

Latch Function: Latched / **not latched**
Safety mode: **Fail safe** / Not fail safe

Assignmment selection

The selection box is used to choose Open Collector assignment.



Latch Function

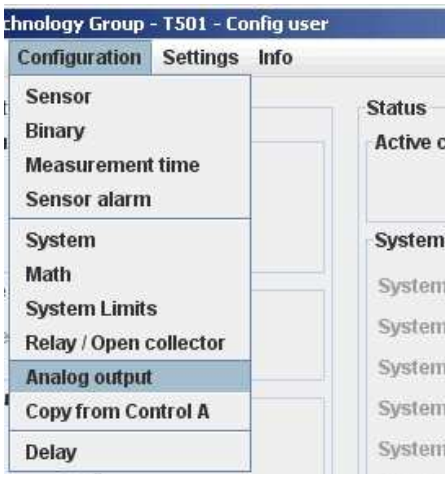
Defines whether an Open Collector state should be held until reset.

Safety Function

Defines whether the Open Collector is to operate in Fail safe (deactivate at e.g. limit) or not fail safe mode (activate at e.g. limit).

7.7.11 Analog output

To configure Analog outputs go to <Configuration>, <Analog out>.



4 parameters are available: Assignment, Current range, Start and End values and the time constant

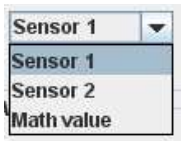
Assignment possibilities:

Sensor 1	Analog output 1
Sensor 2	Analog output 2
Math value	

Current range:	0 ..20mA / **4 .. 20mA**
Start value:	-999,999 … **0.0** … +999,999
End value:	-999,999 … **2'000.0** … +999'999
Time constant	**0** … 9.9 in 0.1 Second increments

Assignment selection

The selection box is used to choose Analog Output assignment.



Current range

0 … 20mA or 4 … 20mA
Error status for 0 … 20mA > 21mA.
Error status for 4 … 20mA > 2mA.

Start and End values

Enter the start and end values e.g.
0 (rpm) = 4mA
2000 (rpm) = 20mA

If the end value is lower than the start value the output current follows a falling characteristic.

Time constant

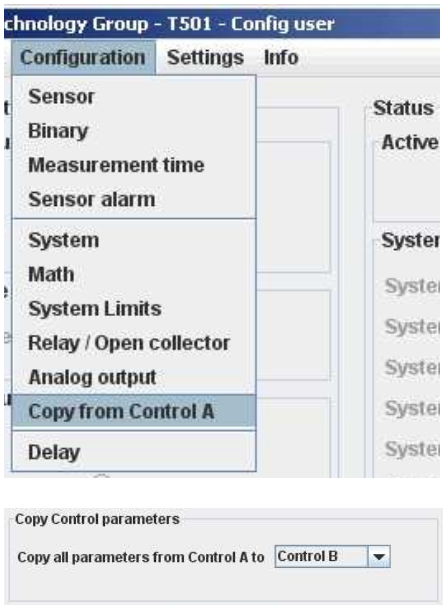
Sets a time constant T. The target value is reached after 5xT.
The output current follows an e- Function.

7.7.12 Copy Parameter Set

Go to <Configuration>, <Copy from Control A>.

A Parameter set may only be copied from Parameter set A! The following Parameters will be copied:

- Machine factor 1 and 2
- Difference
- Math Function selection
- Upper and Lower Limits in System Limits
- System Limit inversion
- Inclusion of input in the logical combination
- Inclusion of Sensor alarm in the logical combination
- Relay / Open Collector assignment
- Relay / Open Collector latch mode
- Relay / Open Collector fail safe mode
- Analog output assignment
- 0..20mA or 4..20mA setting
- Start and End values
- Analog output time constant



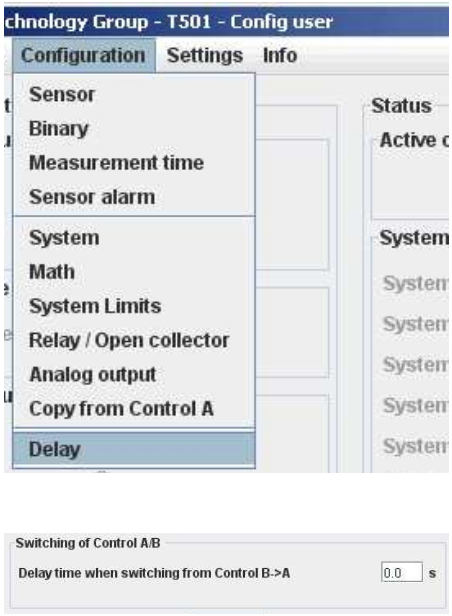
7.7.13 Change-over delay

Go to <Configuration>, <Delay>.

One change-over delay may be set for the delay in switching from Parameter set B to Parameter set A only.

Delay time: **0** … 2000 Seconds

Only integer values can be used for the change-over delay.



7.8 Settings

7.8.1 Ethernet Interface

Go to <Settings>, <Interface …>.

No settings can be made. The PC-T501 connection is Peer to Peer (PC to PC). T501's cannot be connected to a network!

For technical data see Paragraph 3.5.1 Ethernet.

DHCP Server	**ON** / OFF
TCP/IP Adresse	**192.168.1.127**
TCP/IP Maske	**255.255.255.0**

7.8.2 Changing the Password

Go to <Settings>, <Change Config user password> or <Change Process user password>.

Changing the password involves entering the old password and the new password twice. To save the password click on <OK>.
The password is now stored in the configuration software.
To change it in the T501 the data must be downloaded.

A Configuration user may change the Process user password by entering the Configuration user password first. Factory set passwords:

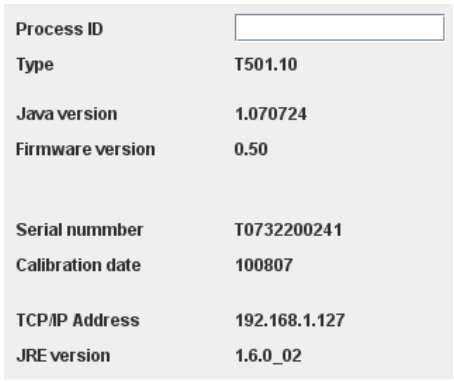
Config User:	**1981**
Process User	**1977**

Attention: If the password has been changed, there is no way of returning to a factory setup. If someone has forgotten the password, you have to send in the tachometer and we will set it back.

7.9 Info

To gain information about the Tachometer or to enter a Proces name <Info>, <Info about>.

An individual Process name may be entered into the text field to the right of <Prozess ID>, max. 16 characters. (Only alphanumeric characters).



Type: Tachometer type number

Java version: Java Version stored in the Tachometer
Firmware: T501 Firmware Version

Serial Nr: T501's serial nr.
Cal. Date: Calibration date

TCP/IP Address: T501's IP Address
JRE Version: PC's JAVA Runtime

8 Operating behaviour

8.1 Power on

The parameter set e.g. as defined by binary inputs is immediately valid.

8.1.1 Analog Output

Immediately after power on the output corresponds to the lower range value set. Following the first measurement interval the output corresponds to the measured value.

8.1.2 Relay Output

Up until the first measurement interval is completed, all relays are de-energised. Thereafter they assume the defined condition.

If no input frequency is present then after measurement interval x 2, 0Hz is assumed.

8.1.3 Open Collector Output

Up until the first measurement interval is completed, all Open Collectors are inactive. Thereafter they assume the defined condition.

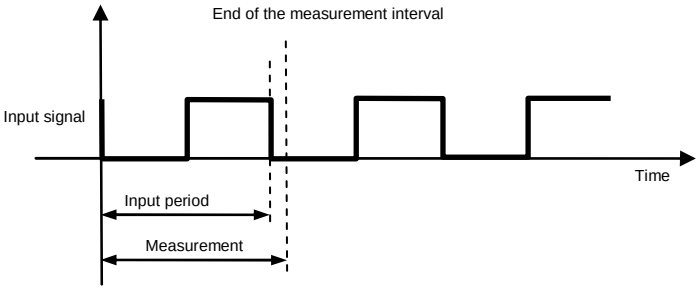
If the Open Collector is assigned to a frequency, then it immediately assumes the corresponding status.

If no input frequency is present then after measurement interval x 2, 0Hz is assumed.

8.2 Frequency Measurement

Every frequency measurement starts with the negative edge of the input signal. The last measured edge prior the end of the measurement interval completes the running measurement and immediately starts the next.

An optimum measurement is achieved when the input period is shorter than the measurement interval.

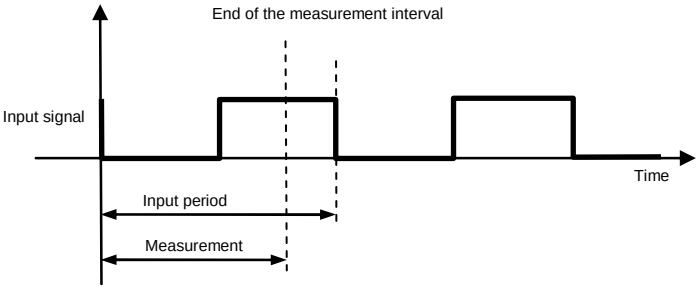


If the input period is greater than the measurement interval, the frequency is calculated as follows:

$$f = \frac{1}{t_{\text{Measurement}} \times n}$$

n: Number of measurement intervals without input signal

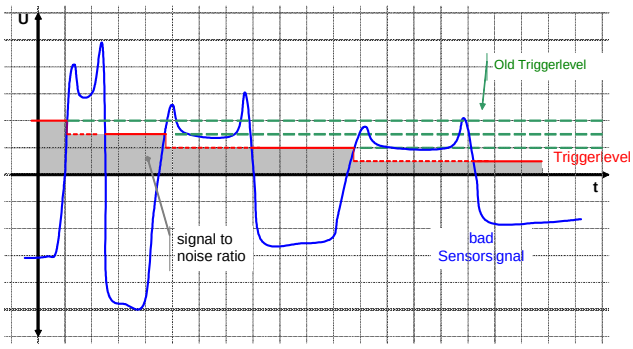
This continues until a second negative edge arrives.



The calculation and adjustment of outputs occurs immediately after the start of the next measurement interval. If the input frequency is lower than the lower limit (0.025Hz), then the output will be zero. The measurement of input frequencies above the upper limit (50kHz) is not guaranteed.

8.2.1 The Adaptive Trigger Level

The trigger level is continuously adjusted for successive pulses. 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 effect on the triggering



8.2.2 Signal failure

Signal failure is defined as the sudden transition from an input frequency to no further recognisable pulses. The frequency is then calculated as follows:

$$f = \frac{1}{t_{\text{Measurement}} \times n}$$ n: the number of measurement intervals without an input signal

The measured speed thereby follows an exponential function to the minimum frequency (0.025Hz) and then falls to zero.

8.3 Functions

8.3.1 "Exec" Push button

The front panel "Exec" button is ORed with binary input B1. Pushing the button executes the B1 function.

8.3.2 Parameter sets A, B, C and D

The binary inputs must be used to change parameter sets. To configure binary inputs see paragraph 0

Binary input configur.

Binary input configuration	Status BIN 1	Status BIN 2	Selected Parameter set
Binary input 1 to <Selection of Control A/B> Binary input 2 **not** to parameter set selection	0	X	A
	1	X	B
Binary input 1 **not** to parameter set selection Binary input 2 to <Selection of Control C/D>	X	0	C
	X	1	D
Binary input 1 to <Parameter set selection A/B> **and** Binary input 2 to <Parameter set selection C/D>	0	0	A
	0	1	B
	1	0	C
	1	1	D

For delay in switching between Parameter sets B and A see Paragraph 7.7.13 Change-over delay.

8.3.3 Limits

User defined upper and lower limits allow wide or narrow hysteresis to be set. Unless otherwise required we recommend a hysteresis of 10%.

8.3.4 Window Function

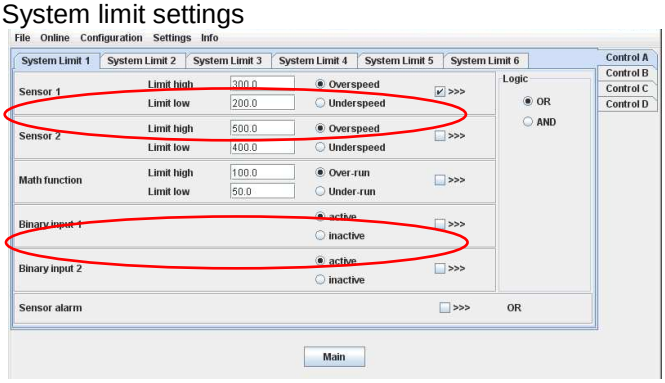
The Window function as implemented in earlier tachometers is realized in the T501 by means of the Math function.

To set a Window function on a speed input please follow the steps below. (Example for Sensor 1):

1. Set the Math function to S1.

2. Set Math function and Sensor 1 hysteresis.
3. The Sensor – hysteresis gets the higher limit.
4. Math function must be set to under run.
5. All logic inputs must be switched off except Sensor 1 and Math function.
6. The two inputs must be combined OR.

System limit settings

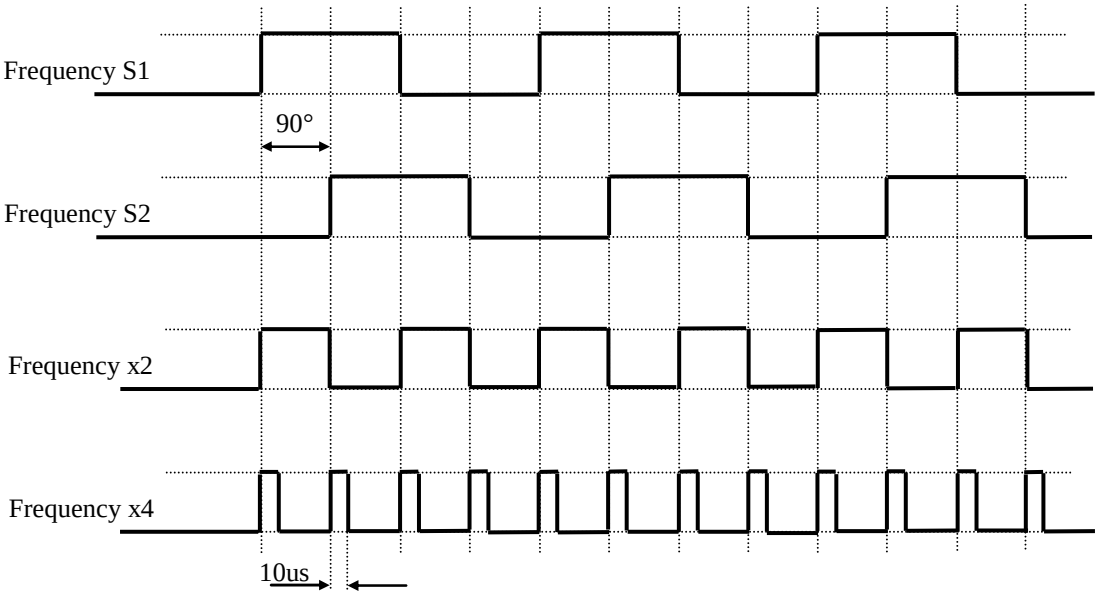


8.3.5 Frequency x2 and x4

Prerequisites for the x2 and x4 function are that the input frequencies are synchronised, they exhibit approximately 90 degrees phase shift and a Mark : Space ratio of approximately 1:1.

The x2 function is an EXOR combination of input frequencies S1 and S2. The x2 output frequency can reach a max value of 35kHz.

The x4 function is based on doubling of the x2 frequency and generates a 10us output pulse each time a positive or negative x2 edge is detected.
The Mark : Space ratio thereby changes with frequency. The x4 output frequency can reach a max value of 35kHz.



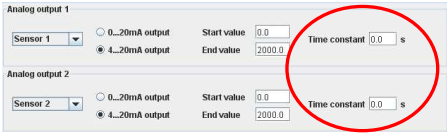
8.3.6 Relay and Open Collector Latch Function

Relays and Open Collectors can be assigned a latch function. If a signal arrives from the assigned function the relay / OC is latched and remains latched until reset via binary input or the <Exec> button.

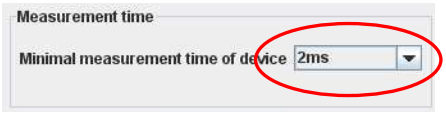
Where fail safe mode is selected the deactivated Relay / Open Collector state is held.

8.3.7 Analog Output

If an analog time constant higher than zero is set, with measurement interval of 2ms, then the max. frequency that can be measured is 35kHz.



To measure frequencies higher than 35kHz with time constant higher than zero, a min. measurement interval of 5ms must be selected.



If Sensor Alarm is active that influences the analog output, which assumes the error condition:

Configuration	Output current
0 .. 20mA	21mA
4 .. 20mA	4mA

8.3.8 Interpretation of system limit inputs

Upper and lower set points may be set for each of the 3 system limit inputs. In this way a hysteresis is defined. If the upper set point is exceeded then this input assumes a status of 1. When the lower set point is then passed, the status returns to 0. If the actual value lies between the 2 set points then the status is as before.

If a parameters set change takes place when the actual value lies between the set points, then the status also remains as before.

8.4 Fault behaviour

8.4.1 Sensor error

The sensors may be monitored in 3 ways.

- Sensor powered by the T501 – Sensor supply current monitoring.
  If the current falls outside of the defined range then static error is signalled.
- Sensor not powered by the T501 – wire break detection.
  Static error is signalled when wire breakage occurs. (Impedance measurement of 2 wire sensor)
- 2 speed sensors connected – Dynamic sensor monitoring, i.e. the 2 signals may be compared. If the values differ by more than the defined tolerance, dynamic error is signalled.

The T501 behaviour in the event of a sensor fault is a function of the software configuration. If sensor monitoring is selected, a fault causes the LED to go off and the analog output (both) go to error status. The Relay and open collector behaviour is a function of the configuration.

8.4.2 System alarm

The microprocessor continuously monitors the following functions for errors: Supply, math functions of the micro controller, RAM, EEPROM.
In the event of a fault the relays are de-activated, the current output goes to 2mA (4-20mA) or 21mA respectively and the Open Collectors become high resistance if assigned to a function other than frequency output. The T501 then initializes and attempts to run again.

8.5 Power failure

If the power fails for longer than the bridging time the outputs are de-activated, i.e. Analog outputs go to 0mA, relays de-activate and the Open Collectors go to high resistance.

As soon as the supply returns to the minimum required the T501 recommences its initialization routine.

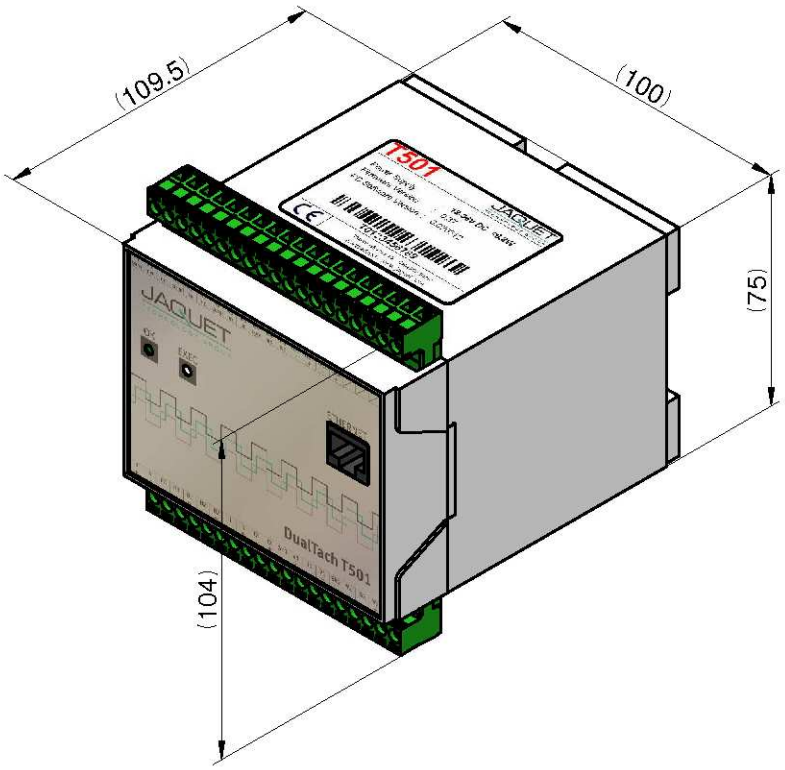
8.6 Behaviour during Configuration

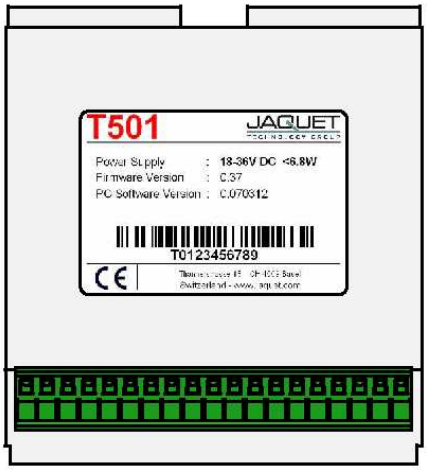
During the transmission of configuration or process parameters to the tachometer, it goes into a safe mode, i.e. the outputs assume a defined state. For individual outputs that means:

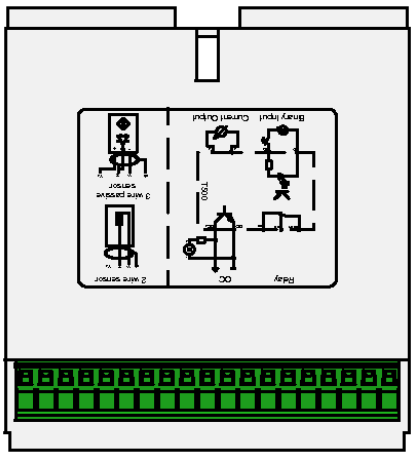
- Relays: are no longer powered
- Open Collectors: become high resistance
- Analog outputs: assume the fault mode according to the configuration

9 Mechanical Construction / Housing

9.1 Tachometer

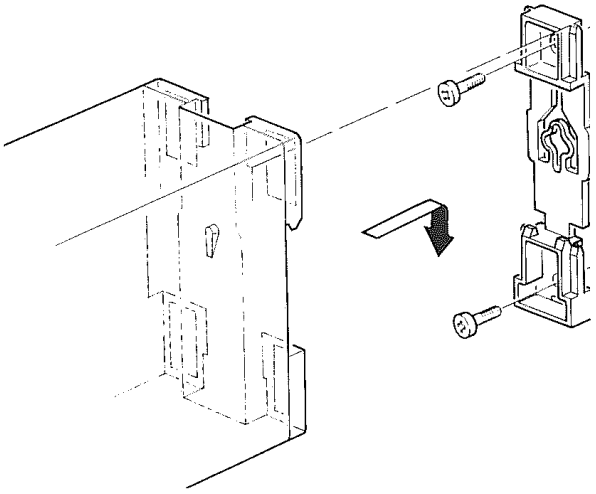




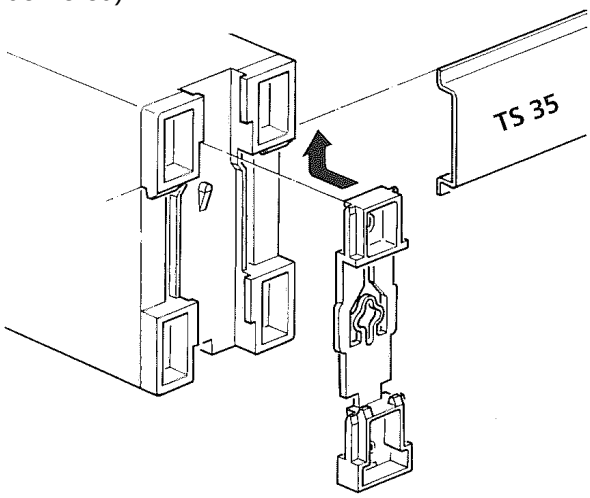


9.2 Mounting

Wall mounting



Top hat rail mounting
(as delivered)



10 Accessories

- Interface cable PC-T501, crossed, 2m: Part No. 830A-37649

- Interface cable PC-T501, crossed, 5m: Part No. 830A-37650

11 Maintenance / Repair

T501 tachometers do not require maintenance since they exhibit minimal drift and do not use batteries or other consummables.

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.

12 Software-Version

History and changes of the configuration software and firmware

12.1 Configurations software

Software version	Changes
1.070906	First edit
1.080428	Parameter structure expanded

12.2 Firmware

Firmware version	Changes
0.50	First edit
0.89	Parameter structure expanded

13 Warranty

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

Appendix

A: Declaration of Conformity

According to the CE guidelines

- 89/336/EEC Electromagnetic Compatibility directive, as amended
- 73/23/EEC Low Voltage Equipment directive, amended by 93/68/EEC

The Products Covered by this Declaration

Tachometer Dualtach T501 and Tachometer Multitasker T601

The Manufacturer of the Products covered by this Declaration is

JAQUET
TECHNOLOGY GROUP

Company: JAQUET AG, Thannerstrasse 15, CH - 4009 Basel Schweiz

The Basis on which Conformity is being Declared

The manufacturer hereby declares under his sole responsibility that the products identified above comply with the protection requirements of the EMC directive and with the principal elements of the safety objectives of the Low Voltage Equipment directive, and that the following standards have been applied:
The following harmonised standards are applicable:

- EN 61000-6-4: Generic standarts – Emission standart for industrial environments
- EN 61000-6-2: Generic standarts – Immunity for industrial environments
- EN 61000-4-2: Electrostatic discharge ommunity test
- EN 61000-4-3: Radiated, radio-frequency, electromagnetic field immunity test
- EN 61000-4-4: Electrical fast transient/burst immunity test
- EN 61000-4-5: Surge immunity test
- EN 61000-4-6: Immunity to conducted disturbances, induced by radio-frequency fields
- EN 61000-4-8: Power frequency magnetic field immunity test
- EN 61000-4-11: Voltage dips, short interruptions and voltage variations immunity test

The following national standards are applicable:

- IEC 60068-2-1/2/30/6
- IEC 61131-2

The technical documentation required to demonstrate that the products meet the requirements of the Low Voltage Equipment directive has been compiled and is available for inspection by the relevant enforcement authorities. The CE mark was first applied in:

Signed: W. Edwall Authority: P. Bleuler

Head Quality Management CTO

Date: Basel, the 07.11.07

B: Possible Problems

Neither green nor yellow LAN connector LED light up

Cause: No physical (electrical) connection present.
Solution: Check that a LAN Crossover cable is being used.

Cause: Tachometer is unpowered.
Solution: Check the supply connections and level.

Cause: Computer network card is switched off or de-activated (energy save mode)
Solution:
- Open the Network Connections window.
  <Start> → <Settings> → <Control Panel> → <Network Connections>
- Click on the appropriate connection
- Open the Menu <File>
- Select <Deactivate>
- Re-open Menu <File>
- Select <Activate>

Yellow LAN connector LED lights but no connection to browser

Cause: Several instruments are connected to the same LAN as the tachometer.
Solution: The tachometer only functions with a <Pier to Pier> connection. Remove the other equipment and insure that no hub, switch or router is connected between tachometer and computer.

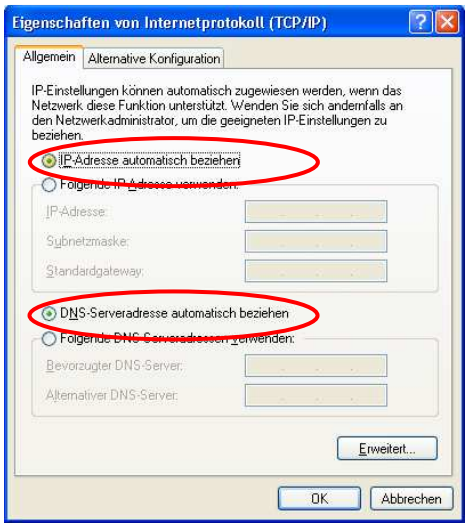
Cause: Computer LAN card not set correctly.
Solution: Configure the card in accordance with chapter 7 Configuration via PC Software. If that does not solve the problem check that the network card is configured as follows:
Go to Desktop, Settings, Network connections and right click on <Properties>. Right click on the network card you want to use and select <Properties>.

Select Internet protocol (TCP/IP) and select the options:

→ <IP-Address automatically recognize>

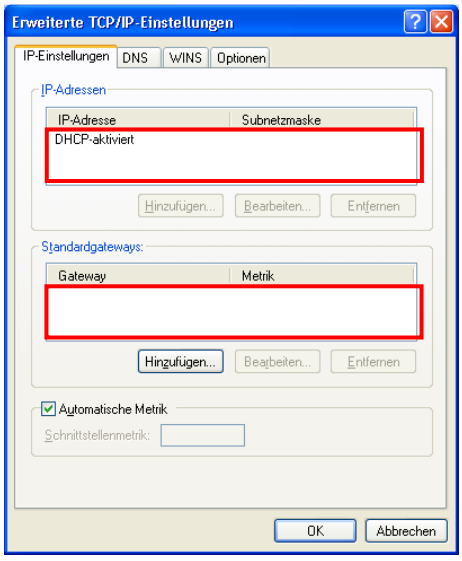
→ <DNS-Server address automatically recognize>

Then select <Advanced>.



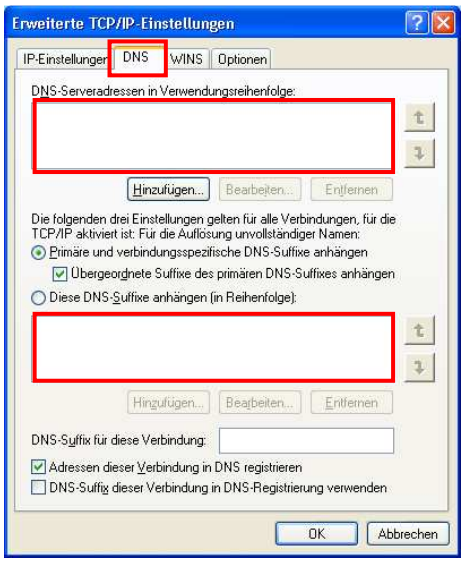
Insure that:

→ apart from the entries shown, no other entries are present.



Select the tag <DNS> and insure that:

→ no entries are present.

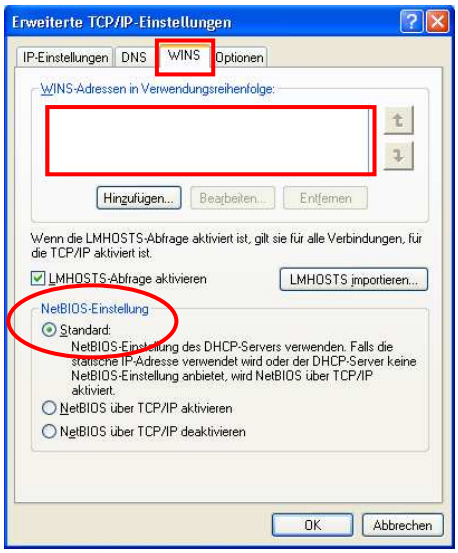


Select the tag <WINS> and insure that:

→ no entries are present.

→ NetBIOS- Setting is Standard.

Confirm with <OK>

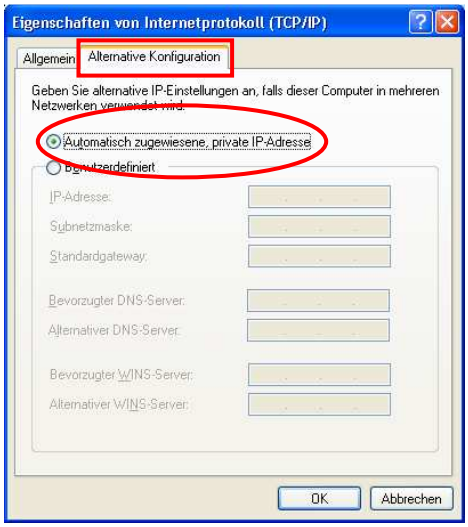


Change to tag <Alternative Configuration>.

Insure that:

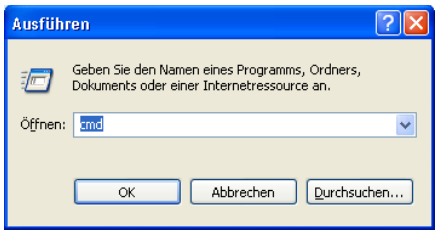
→ <Automatically allocated, private IP-Address> is selected.

Confirm all settings with <OK>



Confirm settings with <OK>

If you had to make changes you must now reset the LAN card:



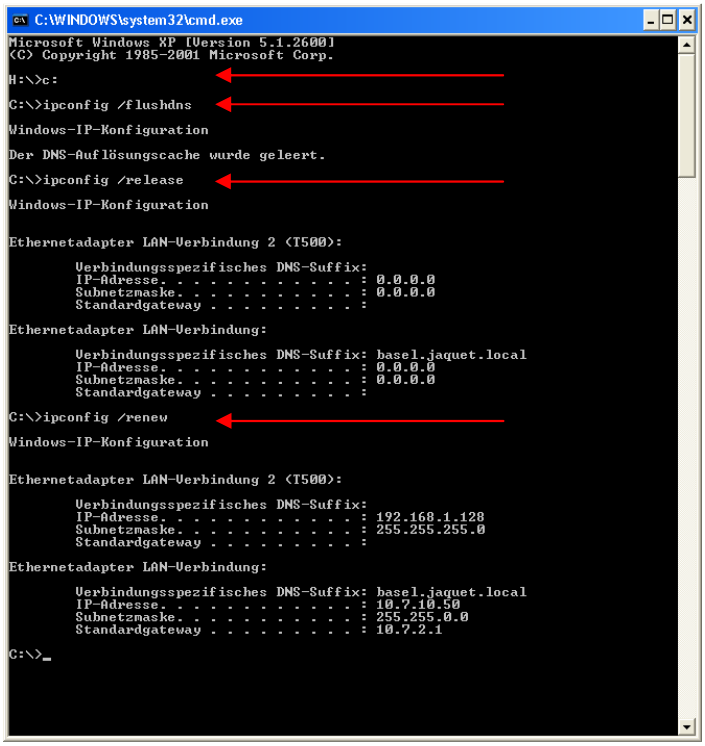
Enter the following commands:

→ c:

→ ipconfig /flushdns

→ ipconfig /release

→ ipconfig /renew



The tachometer responds with incomprehensible hieroglyphics

Cause: Your browser and computer interpret the address incorrectly.

Solution: Extend the address with a forward slash: http://192.168.1.127/software/

Problems when using Microsoft Internet Explorer

Cause: Your browser and computer interpret the address incorrectly.

Solution:

- Close Internet Explorer
- Restart Internet Explorer
- Wait until IE has fully loaded and the computer is inactive.
- Call the tachometer using the address: http://192.168.1.127/software/

Solution: Should the solution above not work, go to the menu <Extras> and select <Internet options>

Click on <Security>

Select <Adjust level>

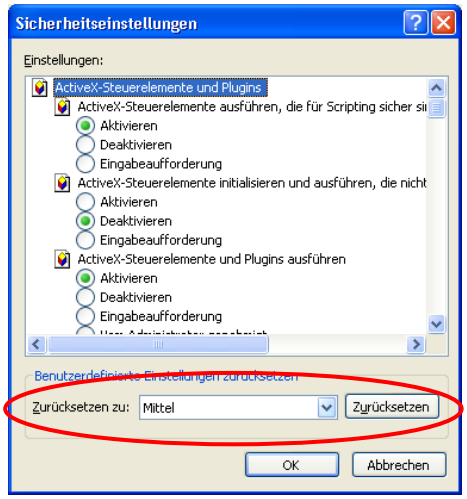
Change setting to „Medium“

→ Click on <Reset>

→ Click on <OK>

→ Click <OK> again

Start IE again and proceed as described in the operating instructions.



The first page is shown correctly but after selecting Download nothing happens

Cause: The IE security level is too restrictive.

Solution: Set the security level to „Medium“.

In the Menu <Extras> select <Internet options>

Change tab to <Security>

Select <Adjust Level>

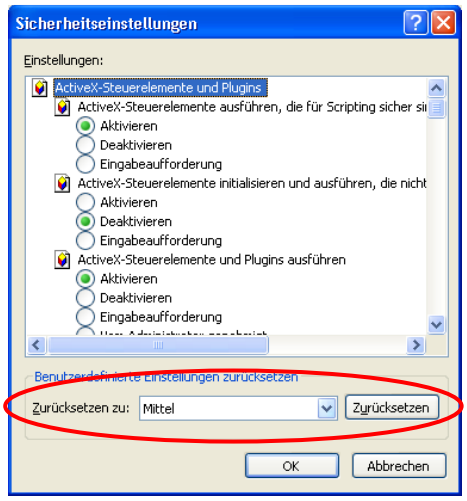
→ Change settings to „Medium“

→ Click on <Reset>

→ Click <OK>

→ Click <OK> again

Start IE again and proceed as described in the operating instructions.



Solution: Should you not be able to change these settings we recommend you try the browser Firefox (freeware).

Problems using Internet Browser Mozilla

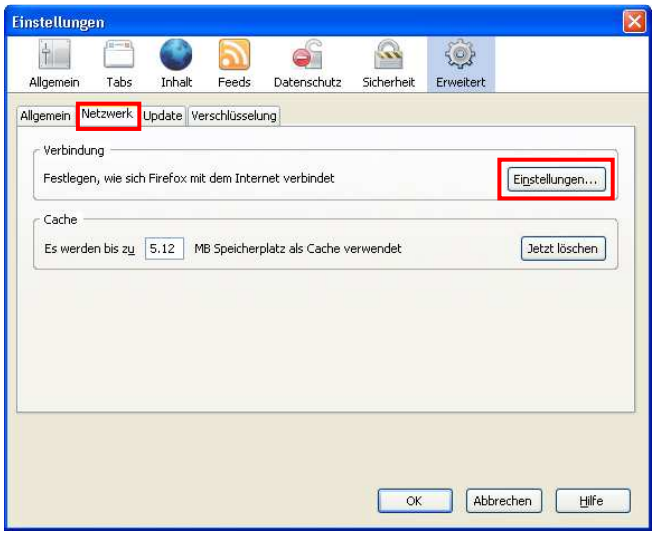
Cause: „Ping“ works but an error message appears - Proxy Server not found. A Proxy Server is defined.

Solution: Avoid the Proxy- Server.

In the Menu <Extras> select <Settings>

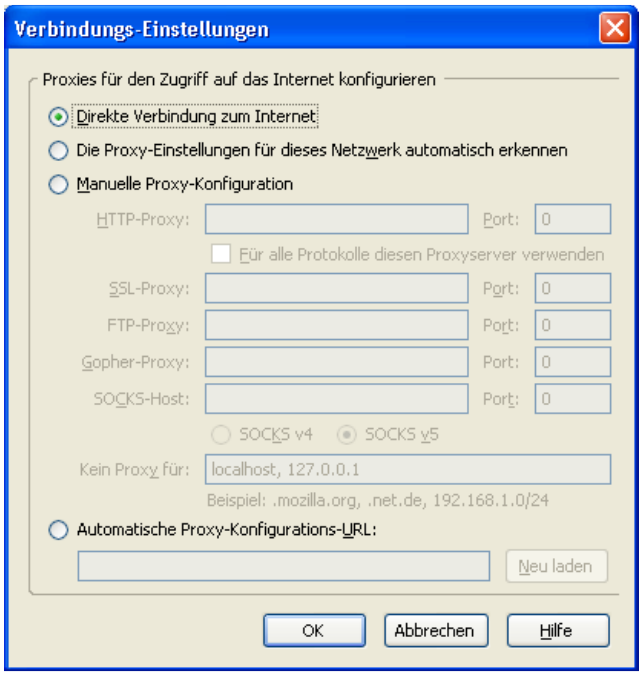
Change the tab to <Network>

Select <Settings>



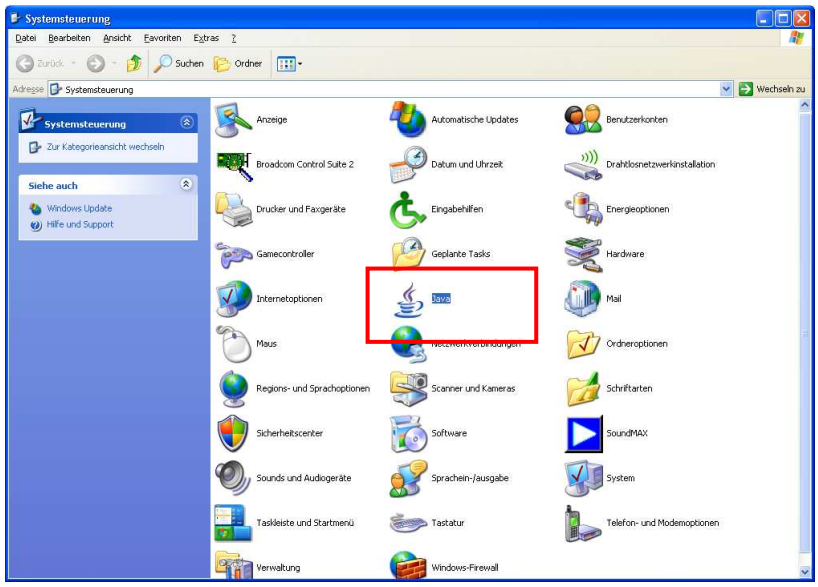
Select <Direct Connection to Internet>

Confirm with <OK>

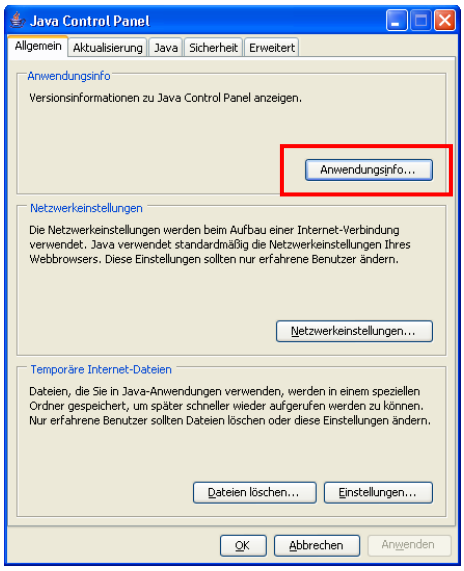


How do I see which Java Version is installed on my PC?

Solution (Win XP) Go to <Control Panel> And select <Java> (the coffee cup)



Select <Application Info…>



Further information on Java-Technologies and Applications can be seen at http://www.java.com