Operating instructions

Frequency Measurement and Switching Instruments Series FT 1400

Part-No. 376A-63515
Status of 30/07/03
starting from serial No. 09312000

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CONTENTS

1 SAFETY INSTRUCTIONS

Certain components within the tachometers FT 1400 are connected to dangerous voltages.

The instruments comply with Class of Protection I . Hence it is mandatory to connect a protective earth on the PE-terminal. The instruments are designed and manufactured according to IEC-Publication 348 and they left the works in a perfect condition.

These operating instructions contain informations referring to risks, which must be considered scrupulously for reasons of safety of the instrument and it´s operation.

Instruments in a doubtful condition after electrical, climatic or mechanical overload have immediatly to be put out of operation and returned to the manufacturer for repair.

2 Functional purpose of the apparatus

The tachometers serve for measuring and monitoring a frequency within the range of 0 to 50 000 Hz respectively to a measured value proportional to a frequency, i.e. rotational speed.

The family consists of the three types

- FTW 1413 Frequency/Current-Converter with output 0/4...20mA
- FTFW 1422 Combination of a Frequency/Current-Converter and a Frequency Relay with 2 switching limits
- FTFW 1424 Combination of a Frequency/Current-Converter and a Frequency Relay with 4 switching limits

There are variants for all three types with different supply voltages and options with different possibilities for parametrization.

3 The composition of the complete apparatus

The instruments are mounted within a plastic housing for installation on rails according to DIN 46 277/3 resp. EN 50 022 or on mounting plates according to DIN 43 660 and 46 121.

The parametrization of the measuring range, the monitoring- and the and relay-functions takes place via a built-in micro terminal with six keys and a liquid cristal display on the front side.

The housing has to be opened only for changing the pull-up resistor to a pull-down resistor or for repair purposes (see paragraph 1 Safety Instructions and 6 Installation.

4 Specifications

Reference-conditions: ambient temperature + 20 degrees C

power supply voltage within specifications

	FTW 1413:	**FTFW 142x**
Lowest Measuring Range	0 . . . 0,9990 Hz	0 . . . 0,9990 Hz
Highest Measuring Range	0 . . . 50,00 kHz	0 . . . 50,00 kHz

Measuring range and limits are entered directly in

physical units (e.g. rpm) after the determination of the

Machine Factor M = frequerncy (Hz)/measured value (rpm)

Signal Output Range	
Standard output	0 . . . 20 mA resp. 4 . . . 20 mA selectable for rising or falling transfer function Maximum Load 500 Ohm corresponding to a maximum of 10 V
Special Execution S3	0 . . . 5 mA resp. 1 . . . 5 mA selectable for rising or falling transfer function Maximum Load 2 000 Ohm corresponding to a maximum of 10 V
Option U: Voltage Output	0 . . . 10 V resp. 2 . . . 10 V selectable for rising or falling transfer function Minimum Load 7 kOhm corresponding to a maximum of 1,4 mA
Maximum open-circuit Voltage :	20 V
Resolution	12 bit corresponding to 1 : 4096
Maximum Linearity Error	0,1 %
Accuracy Class	0,2 % referred to the analog output end of range value
Temperature Drift	typ ± 150 ppm/degree K, max. ± 300 ppm/degree K
Response Time (step response)	The minimum measuring time is programmable as a Fix Time of 5/10/20/50/100/200/500 ms /1/2/5 s - For input-frequencies with a period shorter than the Fix Time, the response time is in maximum: 2* Fix Time + max. period of the input frequency + 7,5 ms typical: Fix-Time 1 period of the input frequency + 7,5 ms - For input-frequencies with a period longer than the Fix Time, the response time is in maximum: max. period of the input frequency + 7,5 ms

Limits (only with instruments FTFW 142x):	
Hysteresis of Setpoints	for each limit an upper and a lower setpoint may be set independently
Relay Functions	monostable relay, individually selectable as normal or inverse
Relay Output	change-over contacts max. 250 V, 1 A, 50 W
Accuracy Class	0,02% referred to the setpoint
Temperature tolerance	max. ± 50 ppm

Time Delay	The minimum measuring time is programmable as a Fix-Time of 5/10/20/50/100/200/500 ms 1/2/5 s - For input-frequencies with a period shorter than the Fix Time, the delay time is in maximum: 2* Fix Time + max. period of the input frequency + 10,5 ms typical: Fix-Time + 1 period of the input frequency + 10,5 ms - For input-frequencies with a period longer than the Fix Time, the delay time is in maximum: max. period of the input frequency + 10,5 ms

Sensor Input	floating, Input resistance 100 kOhm Input voltage : 50 mVeff . . . 80 Veff Frequency range (-3dB): 0,02 Hz / 50 kHz for connection of passive or active sensors (electromagnetic, Ferrostat- or HF-transmitters, proximity detectors and sensors with built-in amplifiers programmable trigger level : 0.00 ... +3.50V programmable sensor power supply : +5.00 . . +12.00 V , max. 70 mA built-in Pull-up und Pull-down resistor 820 Ohm for two-wire transmitters Sensor Monitoring: 2- and 3-wire-sensors with a current consumption < I min resp. > I max will be signalled defective. The two values for I may be programmed within the range of 0.5 .. 80.0 mA.

Binary input	FTW 1413: none FTFW 142x: Binary input B1 for selectable controlling functions like reset of the relays in holding position or external switching between two sets (A/B) of programmable limits TTL - level (+5V): active low, potential not separated from the frequency input FTFW 142x: Binary input B2 for controlling the same functions as with Binary input 1, by means of an external power supply: U low = 0 ...+5 V U high = +15 ...+33 V, max. 4 mA
Datacommunication:	Serial interface according to EIA RS 232, 9 pole sub D plug

Power Supply:	UC2: 93...264 VAC, 47...440 Hz oder 90...375 VDC Supply interruptions of max. 50 ms with minimum supply voltage are bridged without equipment malfunction UC3: 18...58 VAC, 47... 440 Hz oder 18...60 VDC Supply interruptions of max. 5 ms with minimum supply voltage are bridged without equipment malfunction Power consumption max. 4 W resp. 6 VA The inrush current is limited to max. 40 A
Climatic Conditions	KVE according to DIN40040 Operating temperature 0...+ 55 degrees C Storage temperature - 25...+ 65 degrees C relative humidity 75% average over year, up to 90% for 30 days max.

Test voltages against protective earth and between each other, with protective earth connected:	
Power supply:	2 kVAC, 50 Hz, 1 Min
Frequency input:	500 VAC, 50 Hz, 1 Min
Binary input 2:	500 VAC, 50 Hz, 1 Min
Analog output:	500 VAC, 50 Hz, 1 Min
Relay contacts:	2 kVAC, 50 Hz, 1 Min

Electromagnetic Compatibility :	Radiation and immunity in accordance to international standards	
Radio Frequency Interference voltage on mains connection:	Quasi Peak value	Mean value
0.15 - 0.50 MHz	79 dB(uV)	66 dB(uV)
0.50 - 30.0 MHz	73 dB(uV)	60 dB(uV)
Radiated Emission:	Quasi Peak value	
30 - 230	30 dB(uV/m)	
230 MHz - 1000 MHz	37 dB(uV/m)	
Immunity :	power supply circuit	input- and output circuits -
ANSI/IEEE C 37.90) (superposed AC voltage)	10% Vss	- -
IEC 255-4 common mode	2.5 kVs	2.8 kVs
series mode	1.0 kVs	- -
IEC 801-2 (indirect static discharge):		8.0 kVs
IEC 801-3	...	...
IEC 801-4 common mode	2.0 kVs	1.0 kVs 2.0 kVs for Relay output

Material:	frame with terminals made out of polycarbonate, grey protective cover made out of ABS, gray
Mounting:	on rails according to DIN 46277/3 resp. EN 50 022 or on mounting plate according to DIN 43660 and 46121
Terminals:	with self-lifting connection plates - for wires 2 x 2,5 mm2 - or 2 x 1,5 mm2 flex
Protection acc. to DIN 40050:	housing IP 40 - terminals IP 10 - terminals with protection IP 20
Dimensions :	Drawing-Number 4-110.953
Connections :	Drawing-Number 4-111.025

5 Principle of operation

The electronic tachometers type FT 1400 are controlled by a microprocessor. They work according to the period measurement principle with subsequent computing of the reciprocal value (computer principle).

The frequency is measured continuously. The number of cycles considered for one measurement depends on the minimum measuring time (=Fix Time) and the level of the input frequency respectively on the limits to be monitored.

After the input of a Machine Factor M = f/n

- with f (Hz) = signal frequency of the speed transmitter at a determined machine speed
- and n (rpm) = machine speed

the limits for the frequency relay and the measuring range for the frequency/current-converter can be entered directly in rpm.

The relation between the signal frequency (f) of a speed sensor and the ratational speed (n) of a polehwheel is the following:

f = n * p / 60 with f = Frequency of the speed transmitter in Hz

n = Rotational speed of the polewheel in rpm

p = Number of poles on the polewheel

Consequently for rotational speed measurement the machine factor M = p/60.
Instead of the rotational speed any frequency proportional physical quantity to be measured may be used in the above formula.

For the limits, the **switch-on point** (= Limit high) and the **switch-off point** (= Limit low) can be put in separately, thus allowing for the realisation of practically any hysteresis.

The input or changing of all measuring parameters takes place via programming keys and a liquid-crystal-display with two lines of 16 characters each. A matrix diagram (refer to paragraph 7.1 Layout of controls) allows a fast input of most of the parameters.
These are stored independent of the power supply by an EEPROM .

6 Installation

The instruments comply with Class of Protection I. Hence it is mandatory to connect a protective earth on the PE-terminal No. 3 before connecting phase and neutral. The thickness of the wire for protective earth must be in minimum equal to the maximum thickness of phase and neutral.

Warning: Any interruption of the protective earth conductor inside or outside the apparatus or disconnection of the PE-terminal is likely to make the apparatus dangerous. Intentional interruption is prohibited!

The instrument shall be used only when mounted firmly, and the supply line shall contain a switch or another adequate means for disconnection from mains.

Before switching on the apparatus, make sure that it is set to the voltage of the power supply.

The shield of the sensor cable should be connected to terminal No. 12 for reasons of electromagnetic compatibility. Terminal No. 12 is internally connected to protective earth via a certified Y-capacitor of 470 pF/250 VAC.

Connection diagram: drawing No. 4-111.025

When using a speed sensor with a pnp-output connected to V+, before connecting the power supply, an internal jumper has to be set in position "pull-down" according to connection diagram 4-111.025. For this purpose the instrument is to disassemble.

Warning: Disassembly must only take place with power supply disconnected! Capacitors inside the apparatus may still be charged, even if the apparatus has been disconnected from all voltage sources.

The four srews in the corners of the grey housing should be removed, then the two catches on the side of the housing should be pushed out with a screw driver or similar, whilst simultaneously pulling the instrument cover forward. The complete electronic module can then be removed from the housing.

For reassembly proceed in the opposite sequence. When mounting the cover mind the printed circuits to slide in the outermost slots.

7 Parametrization and operating

7.1 Layout of controls

The built-in Microterminal consists of a liquid crystal display with two lines of 16 characters

and 6 push-buttons:

Cursor ∧ (up, forward, increment)

Cursor ∨ (down, backward, decrement)

Cursor > (shift right)

Cursor < (shift left)

ENT (enter, activate)

ESC (escape, return)

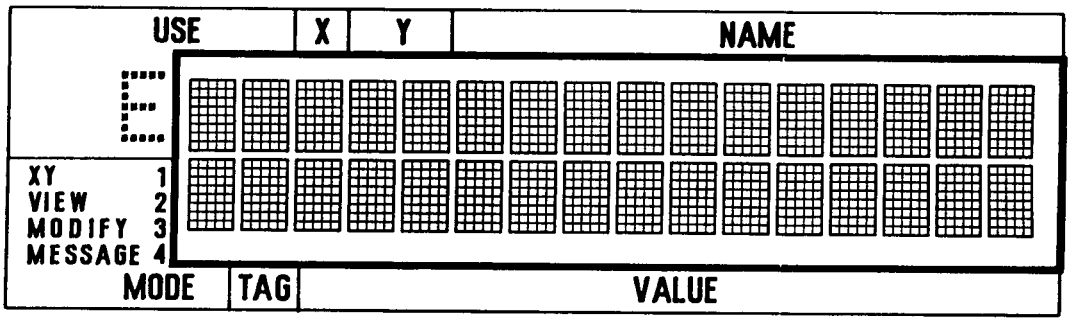
See also Dimensions, drawing No. 3-110.953

Parameters are entered following a matrix-concept, whereby some matrix-cells allow the selection of different functions or parameters out of prepared menues.

Data-entry is prepared and documented on printed forms according to drawing No. 4-111.099. The form facilitates the complete input of all the parameters without errors.

7.1.1 Layout of the liquid crystal display

According to the following exhibit, the liquid crystal display is divided on the front cover into different fields:



USE	The printed character "E" is supplemented with a maximum of two LCD-characters. Together the three characters display the name of the key(s) for the next action(s) possible to take place: "**E**NT" Only entering key available. "**E**SC" Only escape key available. "**E** " No key at all available. "**E** cursor cursor" Keys enter, escape and displayed cursor available.
X Y	Indicates the position of the actually selected matrix-cell: X = column (0,1,2,3) / Y = line (0,1, ...)
NAME	Indicates the name of the parameter, the displayed value or the message (max. 11 characters)

MODE	The number indicates one of the four working modes displayed on the left side:	
	1: XY	The XY-Mode allows the selection of any matrix-cell via the four cursor-keys After power-on the instrument is always in the XY-Mode, and the actual displayed matrix-cell is designed with ist X/Y-position. By means of the cursor keys, the X/Y-values may be changed, thereby displaying any matrix-cell. The XY-Mode represents the topmost hierachical layer of parame-trization. The layer below is selected by pressing the the ENT-key. Depending upon the actual matrix-cell and the eventually activated writing-protection, one of the three other modi gets activated. .
	2: VIEW	This mode allows the display of lists, without modifying anything. In certain cases by pressing the cursors, the lists may be skimmed through The VIEW-Mode is left by hitting the ESC-key.

Y	X=0	X=1	X=2	X=3
12	TAG	PASS NUM	PROTECTION	NOT USED
11	DISPLAY	ACTUAL MIN	ALARMDEF	SW VERISON
10	SELECTION	DELAY	NOT USED	SERIAL Nr
9	REL 1 Ctrl B	REL2 Ctrl B	REL3 Ctrl B	REL4 Ctrl B
8	REL 1 Ctrl A	REL2 Ctrl A	REL3 Ctrl A	REL4 Ctrl A
7	ACTUAL VAL	ANALOG VAL	RELAY VAL	STATUS
6	TRIGGER	SENSOR SUP	I min	I max
5	LIMIT4 low	LIMIT4 high	LIMIT4 mode	LIMIT4 stat
4	LIMIT3 low	LIMIT3 high	LIMIT3 mode	LIMIT3 stat
3	LIMIT2 low	LIMIT2 high	LIMIT2 mode	LIMIT2 stat
2	LIMIT1 low	LIMIT1 high	LIMIT1 mode	LIMIT1 stat
1	AN.zero	AN.full	AN.out	NOT USED
0	TYPE	FIX TIME	M.FACTOR	STORE ?
Y	X=0	X=1	X=2	X=3

	3: MODIFY	This mode allows modifying the displayed parameter "VALUE" Depending upon the typus of parameter, the value may be changed with the cursors up/down. The MODIFY-Mode is left without changing the old VALUE by hitting the ESC-key. Should the old parameter be left active, the ESC-key is pressed and the microterminal automatically returns to the XY-Mode. The eventually entered new parameter value thereby is lost and the old value is restored. The MODIFY-Mode is left with changed VALUE by hitting the ENT-key. Consistency of the new value is automatically checked: if inconsistent, an error message is displayed. Otherwise the old parameter value is exchanged by the new one, but not yet activated, and the microterminal is reset in the original XY-resp. VIEW-Mode. In order to activate and store in the EEPROM the newly modified parameters, matrix-cell 3/0 ("STORE ?") must be selected and then left by hitting the ENT-key.
	4: MESSAGE	2x14 LCD characters are used in order to display an ALARM, an ERROR or a WAIT-Message. The MESSAGE-Mode is normally left by hitting the ESC-key. The MESSAGE-Mode is automatically left after a time-out of 5 Minutes with the exeption of an ALARM-Message, which can be left only hitting the ESC-key.
TAG	A double cross indicates that the displayed VALUE, parameter or text may not be changed by keys, or that it is protected by a pass-number against unauthorized modifications.	
VALUE	A maximum of 14 characters display actual value(s) or a choice of parameters. An asterisk (*) right to the parameter signs that he is selected respectively activated after storage via matrix-cell STORE? (3/0). "STORE?" (3/0)aktiviert ist.	

7.1.2 List of parameters and text displays (status Dec. 1993)

The following parameters and text displays are implemented for the microterminal.

Originally activated parameters respectively their values are indicated in bold letters:

Function	**Matrix Position x/y**	**Display (and menue to select)**
Instrument type:	0/0	**FTW 1413/ FTFW 1422 / FTFW 1424**
Fix Time	1/0	FIX TIME (**5**/10/20/50/100/200/500 ms 1/2/5 sec
Machine Factor:	2/0	M.FACTOR ("VALUE" entered in any format e.g. "1.000 E+2" or "**1.0000**")
Storage:	3/0	STORE ?
Measuring range:	0/1	AN. zero ("VALUE = entered, e.g "**0.0000**" or "200". This value corresponds to the lower end of the analog output : 0/4 mA resp. 0/2 V)

	1/1	AN. full ("VALUE"= entered, e.g **1000.0**" or "5E3". This value corresponds to the upper end of the analog output : 20 mA resp. 10 V)
Output range:	2/1	AN. out (**0 ... 20 mA** / 4 ... 20 mA resp. 0 ... 10 V/ 2 ... 10 V)
Limit 1	0/2	LIMIT1 low ("VALUE" = lower threshold, e.g.**"200.00",** below which the corres ponding relay is deenergized,when LIMIT mode is set "normal")
	1/2	LIMIT1 high ("VALUE" = upper threshold, e.g.**"300.00",** above which the corres-ponding relay is energized, when LIMIT mode is set "normal")
Mode of operation for Limit 1 resp. the corresponding relay	2/2	LIMIT1 mode (**Normal**: activated,when the measured value exceeds LIMIT1 high Inverse : activated, when the measured value falls short of LIMIT1 low)
Position Status of Limit 1 resp. the corresponding relay	3/2	LIMIT1 stat. (**On**: relay status depends on the corresponding limit Off: limit is inactive resp. the relay is deenergized)
Limits 2 ... 4:	x/3 ... 5	according to Limit 1 (Limits are. set e.g. **400.00/500.00, 600.00/700.00 and 800.00/900.00**)
Trigger level:	0/6	TRIGGER ("VALUE" = entered trigger voltage, e.g. **0,00**")
Sensor supply:	1/6	SENSOR SUP ("VALUE" = entered sensor supply voltage, e.g. **12,00**")
	2/6	I min ("VALUE" = entered minimum accepted sensor supply current in mA, e.g. "**0,05**")
	3/6	I max ("VALUE" = entered maximum accepted sensor supply current in mA, e.g."7**0,00**"
Measured value:	0/7	ACTUAL VAL ("VALUE" displays the actual measured value)
Output value:	1/7	ANALOG VAL ("VALUE" displays the analog output value in % of the range)
Relay output:	2/7	RELAY VAL ("VALUE" displays the actual status of the 2 or 4 relays)

<table>
<tr><th>Function</th><th>Matrix
Position x/y</th><th>Display (and menue to select)</th></tr>
<tr><td>System-Status</td><td>3/7</td><td>STATUS
(The status of each individual system variable according to the following list can be displayed. An asterisk (*) appearing at the right side on the display indicates, that this variable is active.)

Alarm System alarm
CurrentMon. Sensor current beyond Imin/Imax
VoltageMon. Sensorsupply beyond acceptable tolerance
CfgCSError Configuration: checksum-error
CfgCoError Configuration: consistency-error
CfgCrError Configuration: LIMIT X high is lower than LIMIT X low
CalCSError Calibration: checksum-error
CalCoError Calibration: consistency-error
CPU Error Error within central processing unit
RAM Error Error within random access memory
ROM Error Error within read only memory
WDT Error Error detected by watchdog-timer
AN.Voltage Analog output wired for voltage output
LimitX Out normal: Limit X high exceeded AND Status ON
inverse: value falls short of Limit X low AND ON
Window Out Limit 3 Out active AND limit 4 out inactive OR Limit 3 Out inactive AND Limit 4 Out active
Binary 1 Binary input 1 active
Binary 2 Binary input 2 active
Switch A/B Switch in Position B (without asterisk: in Position A)</td></tr>
<tr><td>Control A of Relay 1</td><td>0/8</td><td>REL.1 Ctrl A (The activation of the system variable A according to the following list brings the corresponding relay in the defined status:)
<table><tr><td>Alarm</td><td>System alarm</td><td>deenergized</td></tr><tr><td>SensorMon</td><td>Sensor current beyond Imin/Imax OR
Supply beyond acceptable tolerances</td><td>deenergized</td></tr></table></td></tr>
</table>

Function	**Matrix Position x/y**	**Display (and menue to select)**		
		LimitX (z.B. "**Limit 1**")	- when LIMIT X is set "Normal": (e.g. measured value below Limit X low resp. Limit X high not yet exceeded - when LIMIT X is set "Inverse": Limit X high exceeded resp. measured value not yet below Limit X low	deenergized deenergized
		Window	for identical Limit modes 3 and 4: Measured value exceeds Limits 3 high AND 4 high value of Limits 3 low AND 4 low	deenergized deenergized
		Prog. on	as long as there is NO system Alarm	energized
		Prog. off		deenergized
Control A of Relays 2 ... 4	1...3/8	REL.2 ... 4 CtrlA according to control of relay 1 ("**Limit 2 ... 4**")		
Control B of Relay 1	0/9	REL.1 Ctrl B (The activation of the system variable B according to the following list brings the corresponding relay in the defined status:)		
		Alarm	System alarm	deenergized
		SensorMon	Sensor current beyond Imin/Imax OR Supply beyond acceptable tolerances	deenergized
		LimitX (z.B. "**Limit 1”**)	- when LIMITX is set "Normal": (e.g. measured value below Limit X low resp. Limit X high not yet exceeded when LIMITX is set "Inverse": high exceeded resp. measured value not yet below Limit X low	deenergized deenergized

Function	**Matrix Position x/y**	**Display (and menue to select**		
		Alarm	**System alarm**	**abgefallen**
		Window	for identical Limit modes 3 and 4: Measured	
			value exceeds Limits 3 high AND 4 high	deenergized
			value of Limits 3 low AND 4 low	deenergized
		Prog. on	as long as there is NO system alarm	energized
		Prog. off	Prog. offVariable B activated	deenergized
Control B of Relays 2...4	1...3/8	REL.2 ... 4 CtrlB according to control of relay 1 ("**Limit 2 ... 4**")		
Selection of binary inputs::	0/10	SELECTION (**NONE /** INPUT 1 **/** INPUT 2)		
Delay time:	1/10	DELAY ("VALUE" equals the delay in seconds, e.g. "**0000**", "0020")		
Serial number:	3/10	**SERIAL Nr** ((Year, Month, consecutive number)		
Display:	0/11	DISPLAY (The measuring value to be displayed after power-on and after time-out can be selected out of the following list: **ACTUAL VAL /** ANALOG VAL / RELAY VAL)		
Minimum measured value:	1/11	ACTUAL MIN ("VALUE" equals the minimum value displayed. Lower values than e.g **0,020000**" are displayed as Zero (0))		
Alarm-Definition	2/11	ALARM (**SYSTEMonly**: Alarm triggered by System alarm) SYS+SENSOR: Alarm triggered by System alarm or Sensor-Monitor		
SW-Version	3/11	SW VERSION ("VALUE" corresponds to the actual release number)		
Protected parameters:	0/12	TAG (Parameters protected against unauthorized alteration can be earmarked in the following list by an asterisk (*), whereby they get displayed with a double cross as protected TAG		

Function	**Matrix Position x/y**	**Display (and menue to select)**
protected parameters (continue)		FIX TIME minimum measuring time M. FACTOR machine factor AN. all all parameters referring to the analog output LIMITX all all parameters referring to LIMIT X **TRIGGER** trigger level **SENSOR SUP** sensor supply voltage **I min** minimum accepted sensorsupply current **I max** maximum accepted sensorsupply current **DISPLAY** measuring value displayed **RELx CtrlA** Relay control, variable A **RELx CtrlB** Relay control, variable B **DELAY** Delay time **SELECTION** Selection of binary input **ACTUAL MIN** minimum measured value **ALARM DEF** Definition of alarm-condition
Suspension of writing protection:	1/12	PASS NUM ("VALUE" = number to be be entered."**4009**" The protection gets automatically restored five minutes after the last stroke on any key)
Display of the writing protection:	2/12	PROTECTION (**On**/Off)
Unused matrix-cells:	2/10 3/1 3/12	NOT USED
Error-Message:		ERROR "OUT OF RANGE" oder "NO MATCH
Forbidden Access:		WARNING PROTECTED
Loading Data into EEPROM:		WAIT DATA STORED

7.2 Parametrization

The mutation of unprotected parameters is possible without restrictions by selecting the required matrix-cell(s) and selecting or changing the proper parameters. The procedures for mutating the most important parameters are described in paragraph 7.2.2 and the following. In the same manner all the parameters and functions described inparagraph 7.1.2 may be changed.

Warning: Every mutation becomes effective only when the parameters finally are stored in the working memory and the EEPROM:

- Selection of matrix-cell ”STORES” 3/0 by cursor keys
- Activation of the storage routine by hitting the ENT-key
- The message "WAIT DATA STORED" indicates, that every parameter is consistent and now gets loaded down
- Finally the micro terminal is again in the XY-mode and displays the measuring value selected under "DISPLAY"

7.2.1 Mutation of protected parameters

The originally protected parameters are indicated in the list 7.1.2 under matrix-cell 0/12 "TAG" in bold letters. The instrument displays them with an asterisk (*) at their right side.

Mutating protected data requires previously the input of a four-digit pass-number in the matrix-cell ”PASS NUM” (1/12):

- Selection of cell ”PASS NUM” (1/12) by cursors
- Activation of the MODIFY-mode by hitting the ENT-key
- Entering the pass-number:

  This number is set to "4009" (the postal code of JAQUET LTD).

  The number is entered by incrementing/decrementing the activated decade by the cursor keys ∧∨.

  The next decade is activated by hitting the cursors <>.

  Entering the pass-number is closed by hitting the ENT-key.
- The microterminal now is in its XY-mode again, and any matrix-cells to be mutated can be selected and any parameter may be changed according to the previous description.
- After loading down the parameters into the memories via cell ”STORE” (3/0), write-protection gets automatically and at once reactivated.
- Five minutes without hitting any key also reactivates the write-protection and brings the microterminal into the XY-mode, displaying the measuring value selected under "DISPLAY" (0/11).

7.2.2 Machine factor

After the input of a Machine Factor M = f/n

- with f (Hz) = signal frequency of the speed transmitter at a determined machine speed
- and n (rpm) = machine speed

the limits for the frequency relay and the measuring range for the frequency/current-converter can be entered directly in rpm.

- Selection of cell ”MFACTOR” (2/0) by cursors
- Activation of the MODIFY-mode by hitting the ENT-key
- Entering the new Machine-Factor:

  This Factor is set originally to "1,0000" and allows for direct reading of the measured value as the input frequency (Hz).

  The new Machine-Factor is entered by incrementing/decrementing the activated decade by the cursor keys ∧∨..

  The next decade is activated by hitting the cursors <>.

  Entering the Machine-Factor is closed by hitting the ENT-key.
- The microterminal now is in its XY-mode again.

Warning: Every mutation becomes effective only when the changed parameters finally are stored in the working memory and the EEPROM:

- Selection of matrix-cell ”STORE?” (3/0)by cursor keys
- Activation of the storage routine by hitting the ENT-key
- The message "WAIT DATA STORED" indicates, that every parameter is consistent and now gets loaded down.
- Finally the microterminal is again in the XY-mode and displays the measuring value selected under "DISPLAY" (0/11).

7.2.3 Measuring range

Starting value:

- Selection of cell ”AN.zero” (0/1) by cursors
- Activation of the MODIFY-mode by hitting the ENT-key
- Entering the new starting value:

  This value is set originally to "0,0000".

  The new starting value is entered by incrementing/decrementing the activated decade by the cursor keys ∧∨.

  The next decade is activated by hitting the cursors <>.

  Entering the starting value is closed by hitting the ENT-key.
- The microterminal now is in its XY-mode again.

Warning: Every mutation becomes effective only when the changed parameters finally are stored in the working memory and the EEPROM:

- Selection of matrix-cell ”STORE?” (3/0) by cursor keys
- Activation of the storage routine by hitting the ENT-key
- The message "WAIT DATA STORED" indicates, that every parameter is consistent and now gets loaded down.
- Finally the microterminal is again in the XY-mode and displays the measuring value selected under "DISPLAY" (0/11).

End value:

- Selection of cell ”AN.full” (1/1) by cursors
- Activation of the MODIFY-mode by hitting the ENT-key
- Entering the new end value:

  This value is set originally to "1000,0".

  The new end value is entered by incrementing/decrementing the activated decade by the cursor keys VA.

  The next decade is activated by hitting the cursors <>.

  Entering the end value is closed by hitting the ENT-key.
- The microterminal now is in its XY-mode again.

Warning: Every mutation becomes effective only when the changed parameters finally are stored in the working memory and the EEPROM:

- Selection of matrix-cell ”STORE?” (3/0) by cursor keys
- Activation of the storage routine by hitting the ENT-key
- The message "WAIT DATA STORED" indicates, that every parameter is consistent and now gets loaded down.
- Finally the microterminal is again in the XY-mode and displays the measuring value selected under "DISPLAY" (0/11).

Output range:

- Selection of cell ”AN.out” (2/1) by cursors
- Activation of the MODIFY-mode by hitting the ENT-key
- Entering the new output range:

  This value is set originally to "0 ... 20 mA" resp. "O ... 10V".

  The new output range is selected by means of the cursor keys ∧∨..

  Entering the output range is closed by hitting the ENT-key.
- The microterminal now is in its XY-mode again.

Warning: Every mutation becomes effective only when the changed parameters finally are stored in the working memory and the EEPROM:

- Selection of matrix-cell ”STORE?” (3/0) by cursor keys
- Activation of the storage routine by hitting the ENT-key
- The message "WAIT DATA STORED" indicates, that every parameter is consistent and now gets loaded down.
- Finally the microterminal is again in the XY-mode and displays the measuring value selected under "DISPLAY" (0/11).

7.2.4 Setpoints

The instruments FTFW 1422 and FTFW 1424 are equipped with 2 resp. 4 relay outputs, which may be allocated to any one of the four setpoints:

Selection of cell 0/2 ... 5 for LIMIT X low and/or 1/2 ... 5 for LIMIT X high by cursors.

- Activation of the MODIFY-mode by hitting the ENT-key
- Entering the new value for LIMIT X low or LIMIT X high:

  These values are set originally as follows:

  LIMIT 1 low = 200,00 LIMIT 1 high = 300,00 LIMIT 2 low = 400,00 LIMIT 2 high = 500,00

  LIMIT 3 low = 600,00 LIMIT 3 high = 700,00 LIMIT 4 low = 800,00 LIMIT 4 high = 900,00

  The new setpoint value is entered by incrementing/decrementing the activated decade by the cursor keys ∧∨..

  The next decade is activated by hitting the cursors <>.

  Entering the setpoint value is closed by hitting the ENT-key.
- The microterminal now is in its XY-mode again.
- In a similar manner the relay functions "LIMIT X mode" in the cells 2/2 ... 5 and the relay status " LIMIT X status" may be mutated.

  Originally functions are set "normal" and status "on".

Warning: Every mutation becomes effective only when the changed parameters finally are stored in the working memory and the EEPROM:

- Selection of matrix-cell ”STORE?” (3/0) by cursor keys
- Activation of the storage routine by hitting the ENT-key
- The message "WAIT DATA STORED" indicates, that every parameter is consistent and now gets loaded down.
- Finally the micro terminal is again in the XY-mode and displays the measuring value selected under "DISPLAY" (0/11).

7.2.5 Display

- Selection of cell ”DISPLAY” (0/11) by cursors
- Activation of the MODIFY-mode by hitting the ENT-key

- Entering the new measuring value to be displayed:

  This value is set originally to "ACTUAL VAL".

  The new measuring value to be displayed is selected by means of the cursor keys ∧∨..

  Entering the the new value is closed by hitting the ENT-key.

- The microterminal now is in its XY-mode again.

Warning: Every mutation becomes effective only when the changed parameters finally are stored in the working memory and the EEPROM:

- Selection of matrix-cell ”STORE?” (3/0) by cursor keys
- Activation of the storage routine by hitting the ENT-key
- The message "WAIT DATA STORED" indicates, that every parameter is consistent and now gets loaded down.
- Finally the microterminal is again in the XY-mode and displays in matrix-cell (0/11) the newly selected measuring value.

7.3 Operating characteristics

7.3.1 Power-on

Display:

After power-on, the matrix-cell defined under the function "DISPLAY" (0/11) shows up in the liquid crystal display.

Originally this is the actual measured value, i.e. the cell "ACTUAL VAL" (0/7). Thereby the instrument is in the XY-mode, and the actually displayed martix-cell is designed by her X/Y-position.

By means of the cursor-keys the X/Y-coordinates may be changed ant thus every matrix-cell may be selected and displayed.

Analog Output:

After power-on, the output corresponds until the first measurement has been finished to the starting value selected under the matrix-cell ”AN.out” (2/1).

Relay outputs with **binary input not activated**:

After power-on, the relays stay deenergized or they go in the position defined under matrix-cell "REL X ctrlA" (0...3/8).

- The first positive edge of the input signal starts the first measurement interval.
- After accomplishment of the first measurement, those relays which are related to Limits, switch into their corresponding position.
- If there is no input frequency, after a time of **Tmax** the relays switch into the position corresponding to "measured value below Limit X low". Tmax is 2 periods of the Minimum Measured Value, with machine factor of 1. **Tmax** is coerced to 3mn 30s.

Relay outputs with **binary input activated**:

After power-on, the relays stay deenergized or they go in the position defined under matrix-cell "REL X ctrlB" (0 ... 3/9).

- An eventually under matrix-cell "DELAY"(1/10) defined delay time starts only when the binary input choosen under "SELECTION" (0/10) is deactivated.

  During all the delay time the relays are still controlled by the function "REL X ctrlB".

- After the delay has elapsed, the relays get controlled by the function "REL X ctrlA" (0 ... 3/8).
- The first positive edge of the input signal starts the first measurement interval.
- After accomplishment of the first measurement, those relays which are related to Limits, switch into their corresponding position.
- If there is no input frequency, after a time of **Tmax**, the relays switch into the position corresponding to "measured value below Limit X low".

- The delay time is zero, if there is no binary input selected ("NONE") or if the selected binary input is not activated. In these cases the relays get instantly under control of "REL X ctrlA" (0 ... 3/8).

7.3.2 Measuring

- Each measurement starts with a positive edge of the frequency input signal. After elapse of the selected Fix-Time, the next positive edge of the input signal finishes the actual measurement and simultaneously starts the next measurement.
- The total resulting measurement time is computed with a resolution of +- 0,5 us.
- The calculation and control of the outputs immediately takes place at the beginning of the next measurement.
- For input frequencies out of range, the analog output goes to the corresponding extreme value.

7.3.3 Sensor failure

- With a suddenly and fully removed input frequency, the measured value and the analog output are decreased stepwise, as soon as the period for the new measured value becomes longer than 2, 4, 8, times the last period, approximating thereby an exponential function.
- With a suddenly and fully removed input frequency, the measured value is signalled as fallen short of the LIMITx low value.
- With a sensor supply current consumption beyond Imin to Imax and with OR-ed functions "System-Alarm" and "Sensor-Monitor", the relays get deenergized.

7.3.4 System alarm

- If the microprocessor fails or for any error-message according to matrix-cell "STATUS" (3/7), the analog output will go to zero and the relays get deenergized (fail-safe behaviour).

7.3.5 Power failure

- For power supply interruptions longer than 50 ms the analog output will go to zero and the relays get deenergized. When the supply voltege returns to standard level, the instrument will go through its initialization routines according to paragraph 7.3.1.
- A break-down of the internal supply-voltage due to a power supply voltage below the specified minimum level will be detected as a power-failure.

7.4 Calibration of frequency measurement

The instrument was adjusted at the manufacturing site, and the calibration data are stored within the EEPROM.

The two printed circuits ”Power supply” and ”Front-Print” must not be exchanged, since the instrument had to be recalibrated or even readjusted.

The instruments do not have any manually adjustable components; erraneous measurement values can get readjusted only at the manufacturing site.

7.4.1 Calibration instruments

- Source for frequencies:

  Highprecision-Frequency-Generator or LF-Generator with Digitaltachometer with accuracy class 0.05% or better, with respect to the output frequency. For reduced requirements with respect to the accuracy, the calibration can also take place with the speed sensor mounted at the machine and its output frequency supervised by a Digitaltachometer. In any case **The Machine Factor M** is to be considered, i.e. the relation between the frequency f and and the corresponding measuring value (e.g. rotational speed n).

- Measurement of the output current or voltage:

  Highprecision Multimeter with accuracy class 0.05. or better, or the definite instrument used for indicating the measured value. In this way measuring range errors of the definitive instrument are automatically compensated, and the accuracy of the measuring chain depends only on the precision of the frequency source.

7.4.2 Components influencing the measuring precision

- Quartz crystal (SMD SCM 309):

  Temperature tolerance ±50 ppm over the whole temperature range

  Longterm drift ± 5 ppm/year

- Reference voltage (ICL 8069 CCZQ2):

  Temperature drift ± 50 ppm/degree K

  Longterm drift typ. 1 ppm/1´000 Std

  Failure rate < 4,5 fit

- D/A-Converter (PM 7543 FPC):

  Temperature drift ± 5 ppm/degree K corresponding to end value

  Longterm drift negligible

  Failure rate < 120 fit

- Precision resistors (Mini-MELF MMA 0204):

  Temperature drift ± 50 ppm/degree K

  Longterm drift < + 500 ppm/year

  Failure rate < 0,7 fit

7.4.3 Calibration procedure

Before starting the calibration, the instruments are connected to the specified frequency source and the multimeter according to the connection diagram 3-111.025.

Compare the displayed values with the theoretical values and record any differences.

- Calibration of the analog output:

  Set input frequency according to the starting value defined in matrix-cell "**AN.zero**" (0/1):

  ACTUAL VAL (0/7) = starting value

  ANALOG VAL (1/7) = 0,00%

  Input frequency **below** the value defined in matrix-cell **"ACTUAL MIN"** (1/11) will be displayed as ”0”.

  The analog output should correspond to the starting value selected in matrix-cell "AN.out"

  Set input frequency according to the end value defined in matrix-cell "**AN.full**" (1/1):

  ACTUAL VAL (0/7) = end value

  ANALOG VAL (1/7) = 100,00%

  The analog output should correspond to the mean value of "AN.out**”**

  Set input frequency **in the middle between** the values defined in matrix-cells "**AN.full**" and "**AN.zero**" (0/1):

  ACTUAL VAL (0/7) =mean value

  ANALOG VAL (1/7) = 50,00%

  The analog output should correspond to the mean value of "AN.out" .

  Differing displays or output values can only be readjusted at the manufacturing site.

- Calibrationof the setpoints:

  Set matrix-cells LIMIT 1...4 status (3/2...5) "on".

  When slowly changing the input frequency from lower to higher values, relays with "normal" function should get energized when sweeping beyond the value defined unter matrix-cell ”LIMIT X high” (1/2...5), and relays with ”inverse” function should get deenergized.

When slowly changing the input frequency from higher to lower values, relays with ”normal” function should get deenergized when sweeping beyond the value defined under matrix-cell ”LIMIT X low” (0/2...5), and relays with ”inverse” function should get energized.

Actual display fo the end values under matrix-cell ”RELAY VAL” (2/7).

Differing setpoints can only be readjusted at the manufacturing site.

7.5 Calibration of sensor monitoring functions

The instrument was calibrated at the manufacturing site, and the calibration data are stored within the EEPROM.

The two printed circuits ”Power supply” and ”Front-Print” must not be exchanged, since the instrument had to be recalibrated or even readjusted.

The instruments do not have any manually adjustable components; erraneous measurement values can get readjusted only at the manufacturing site.

7.5.1 Calibration instruments

- Measurement of the sensor supply voltage and the limits for the sensor current monitor
  Digital Multimeter with accuracy class better than 0.1%:

  Präzisions-Messgerät mit einer Klassengenauigkeit besser als 0,1%

- Fixed load resistor, 50 Ohm/1 W
- Variable resistor, 1 kOhm/ 250 mA/ 1 W

  The 50 Ohm resistor is wired in series to the 1 kOhm resistor and thus limits the current to max. 240 mA.

- Variabler Lastwiderstand, 50 kOhm/ 15 mA/ 0,5 W

  The 1 kOhm resistor is wired in series to the 50 Ohm resistor and thus limits the current to max. 12 mA.

7.5.2 Components influencing the measuring precision

- A/D-Converter (within mikroprozessor uPD 78324 GJ):

  Temperature tolerance ± 2`000 ppm of measuring range over the whole temperature range

- Precision resistors (Mini-MELF MMA 0204):

Temperature drift	± 50 ppm/degree K
Longterm drift	< + 500 ppm/year
Failure rate	< 0,7 fit

7.5.3 Calibration procedure

- Compare the measured values with the following values defined under matrix-cells "SENSOR SUP" (1/6), "Imin" (2/6) and "Imax"(3/6) and record any differences:

  The sensor supply voltage (+V) is measured unloaded and with a load of 70 mA.

  A differing supply voltage can be readjusted only by the manufacturer.

  With a supply current exceeding 70 mA, the output voltage gets reduced:

  When the voltage falls short of about 0,9 * (+V), under matrix-cell "STATUS" (3/7) the display for "VoltageMon." will be signed by an asterisk (*) as activated.

  If the load subsequently is reduced, the asterisk (*) disappears when the sensor supply voltage exceeds 0,94 * (+V).

- Differing setpoints can only be readjusted at the manufacturing site.

  The sensor supply current is measured for different loads:

  If the load current exceeds Imax or if it falls short of Imin, under matrix-cell "STATUS" (3/7) the display for "CurrentMon." will be signed by an asterisk (*) as activated.

If the load subsequently is readjusted, the asterisk (*) disappears when the sensorsupply current exceeds Imin by 0,4mA repectively falls short Imax of 0,4 mA.

Differing setpoints can only be readjusted at the manufacturing site.

8 Mechanical construction

The housing consists of a frame with terminals and a protective cover with fixing elements. In order to improve the protection against accidental electrical shock, terminal-covers are mounted atop the two terminal rows.

Internally the terminals are directly connected with twin contacts of two one-piece printed circuit board connectors for directly plugging in two boards. Those boards are fixed by guide strips of the protective cover.

The electronic components are mounted on the printed circuits Front-Print, Power supply and Relay-Print:

module is soldered firmly into the terminal frame.

- The Front-Print with the microprocessor and its glue logic, the keys and the liquid crystal
- The Power supply print is plugged into the the lower connector. It holds the primary switched power-supply, the input amplifier, the sensor supply, the D/A-converter and the analog output stage.
- The Relay-Print is plugged only within instruments type FTFW 142.in the upper connector. It holds the relays with their driver transistors and a resistor, whose value identifies the variant of the printed circuit according to FTFW 1422 or FTFW 1424.

9 Description of the electronic circuitry

On the Front-Print (Schematic 4-110.906) the microprocessor handles and generates different signals:

- Input frequency SIGNAL
- Triggerlevel AN T
- Sensorsupply voltage AN S
- Sensorsupply current AN I
- Binary input 1 B1+
- Binary input 2 B2+/-
- Triggerlevel-control PWM T
- Sensorsupply-control PWM S
- D/A converter-control CLK/DATA/LOAD
- Analog output Enable OUT/EN
- Serial interface RS 233 RXD/TXD (RTS/CTS will not be lead to plugs)
- Card identity DETECT
- Relay outputs RELAY 1 ... 4

The microprocessor communicates with the following peripheral functions located on the Front-Print :

- 6 keys
- supervision of +5V power-supply
- Liquid crystal display
- EEPROM

§On the Powersupply print (Schematic 4-110.917/1+2 for supply voltage UC2, Schematic 4-110.955 for supply voltage UC3) the primary switching power supply circuit generates the +5V supply for the microprocessor. The regulation of this supply is performed by a shunt regulator and feedback via on optocoupler to the primary circuit.

Two additional secondary windings on the transformer generate +15VE for the input amplifier and the sensorsupply as well as +18VA for the analog output.

Additional functions are implemented on the Power supply print:

- Input amplifier and Schmitt-trigger
- Pulse width demodulator and voltage follower for the trigger level voltage
- Pulse width demodulator and voltage follower for the sensor supply
- Shunt and short-circuit protection for the sensor supply

The relay print (Schematic 4-110.916) for instruments FTFW 142. holds the relays and their driving transistors as well as a resistor for the identification of the print variant.

10 Maintenance

These instruments don´t need any maintenance since the have very low driftrates and they contain neither batteries nor other components subject to wear.

When cleaning the instruments mind the limited protection against accidental electrical shock! Whenever possible the power supply should be interrupted during cleaning.

For cleaning the surfaces use only spirit, pure alcohol or soap-suds. Other solvents must not be used.

11 Repair

Warning: Disassembly must only take place with power supply disconnected!

Capacitors inside the apparatus may still be charged, even if the apparatus has been disconnected from all voltage sources.

Warning: The printed circuits of the apparatus hold mainly surface mounted devices (SMD) which hardly ca be exchanged without special tools. Therefore it is recommended to exchange the whole printed circuits and not the electronic components. More over troubleshooting SMD-boards with complex integrated circuits is rather difficult.

The four srews in the corners of the grey housing should be removed, then the two catches on the side of the housing should be pushed out with a screw driver or similar, whilst simultaneously pulling the instrument cover forward. The complete electronic module can then be removed from the housing.

For reassembly proceed in the opposite sequence. When mounting the cover mind the printed circuits to slide in the outermost slots.

When connecting the mains, mind the safety instructions according to paragraphs 1 and 6 !

Following the description of the electronic circuitry in paragraph 9, failures can be located on one of the 2 or 3 printed circuits. In most cases the trouble is removed by exchanging the defective board.

The Front-Print is soldered to the terminals together with a shield. Therefore it must not be removed, but the terminal frame should be exchanged as one unit.

Warning: The two printed circuis "Power supply" and " Front-Print" must only be exchanged in pairs, since the calibration data of components on the print powersupply are stored within the EEPROM on the Front-Print; otherwise the instrument may need to be recalibrated or even readjusted.

The instruments don´t have any manually adjustable components; erraneous measurement values can get readjusted only at the manufacturing site.

12 Storage

The storage temperature of -25 ... +65 degrees Centigrade applies for long-term storage.

For short intervals of at maximum one day, the instrument may be exposed to a temperature within the range of -40 ... +90 degrees Centigrade. At excess temperatures any mechanical stress is absolutely prohibited.

When quickly cooling the instrument, dew may considerably reduce the the isolation between the galvanically separated circuits.

13 Warranty

The guarantee for a careful and perfect execution of the delivered products includes the replacement or repair of instruments showing a manufacturing defect, agreed upon by JAQUET, within a period of 12 (twelve) months from date of delivery.

Travelling and labour costs are excluded from the guarantee. The garantee also does not cover any damage due to misuse or to improper handling.

Complaints due to visible defects are only accepted if adressed to JAQUET within 14 days after receipt of the goods.

14 Drawings

Designation	**Drawing No.**	**File Name**
Dimensions	3-110.953	(110953-1.PDF)
Connection diagrams and layout	4-111.025	(111025-1.PDF)
Matrix of parameters	4-111.099	(111099-1.PDF)
Block diagramme	4-111.385	(111385-1.PDF)