USER'S MANUAL DC-SERVO-DRIVER TFMxx1

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0 PRECAUTIONS ON SAFETY (DEFINITIONS)

DANGER ***immediately and imminent DANGER for life and limb***
(possibly including the PRECAUTIONS ON SAFETY WARNING and NOTICE)

WARNING ***possibility of a dangerous situation for life and limb***
(possibly including the PRECAUTION ON SAFETY NOTICE)

NOTICE ***possibility of a dangerous situation for the TFMxx1 or an object in its area***

DANGER: *Possibility of an electric shock. The nonobservance of the instructions and the precautions on safety written down in this manual shall produce immediately and imminent danger for life and limb or for the TFMxx1 or an object in its area. The handling including mounting, installation and operating has to be carried out by well trained and instructed personal..*

1 INTRODUCTION

WARNING: *To ward off accidents given by electric shock or destruction of TFMxx1 or an object in its area the instructions and the precautions on safety written down in this manual have to be red and fulfilled before mounting, installation and operating the TFMxx1.*

1.1 Performances of TFMxx1

The **DC-Servo-Driver TFMxx1** is constructed as transistorised 4-Quadrant switching amplifier. The outstanding characteristics are **the high power range in relation to the size, the high efficiency** and **the simple maintainability**. The general specifications are:

-power range	50 to 3000 W
-power supply	24 to 180 Volt
-mechanical construction	single board 100x160mm
-connection	DIN41612 BAUFORM D (plug in)
-output	short current protected (also to the earth)
-EMC	there are no influences between two or more TFMxx1 which are mounted in the same case (e.g. a rack or the like)

The whole construction is well done for a wide range of applications and also for layouts with small sizes.

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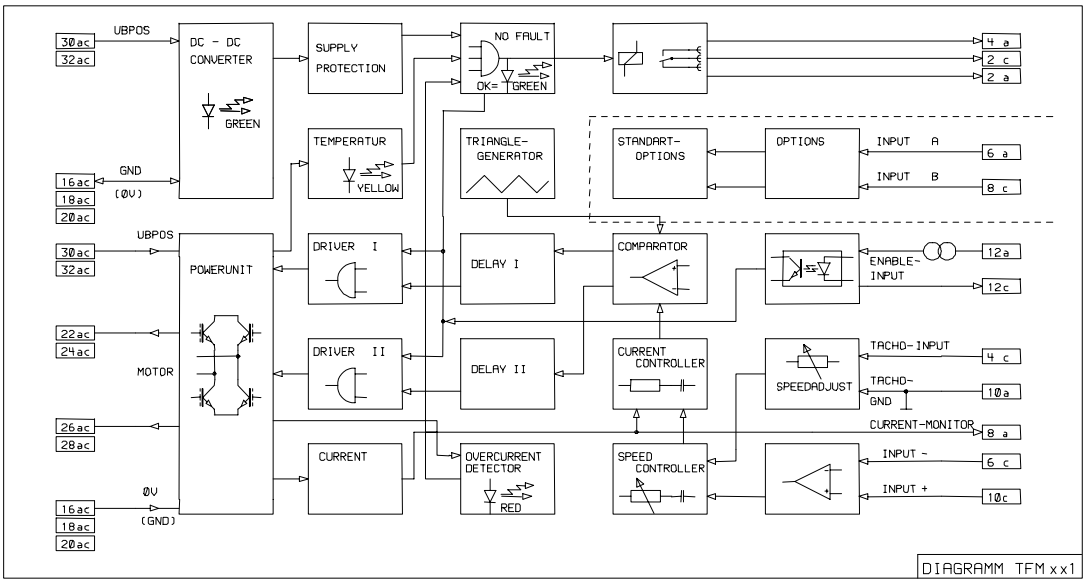
1.2 Circuitry

Basically the servomodul consists of:

A) Built-in Power Supply
B) Controller
C) Power Unit



A) The TFMxx1 has a **Built-in Power Supply** which converts the intermediate circuit voltage to an **internal power supply voltage**. Therefore the controller **never needs an external power supply**. The function of the internal power supply **includes also checking an monitoring** (LED) the whole functions of each TFMxx1. **Faults are monitored** by a **Failure Output** (relay) and several **LED's on the front panel**.

B) The **Controller** consists as well of the input circuits and the circuits for the pulse with modulation (PWM) as of:

-the Speed Controller
-the Current Controller

The **Speed Controller relates the actual value (tacho) to the rated value**. **The current controller relates the output of the Speed Controller to the current signal**. **The output of the Current Controller** controls the circuits for **the Pulse With Modulation (PWM)**. This control of **the motor torque** ensures that an **exact regulation of the motor speed without influences caused by the** load is given.

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The adjustment for different applications is given by several marked and well available potentiometers and parts for compensation. The characteristics of different inputs are:

-Control Input	(related value) difference input (to never have earth loops)
-Tacho Input	(actual value) tachometer ***NOTICE:*** *The tachometer GND connector has to be connected to the scheduled TFMxx1 connector Tacho GND (to never have earth loops).*
-Enable	electrically uncoupled input (optoelectronic coupler) to switch on the motor

C) The **Power Unit** is constructed as an transistorised 4-Quadrant switching amplifier and **supplies the motor.** The output is short current protected (also to the earth). **Special circuits protect** the power amplifier in the **case of faulty operation**.

1.3 Mechanical Construction

The TFMxx1 is assembled on a printed wiring board (100x160mm). The wide of each unit is **12TE**. For the **connection in applications** different standard **back planes** are available. The back planes are compatible with the **DIN41612 BAUFORM D**. The internal **potentiometers** are adjustable at the **front plane**. ***WARNING:*** *Possibility of an electric shock. To protect the operator the potentiometers has to be adjusted with a isolated screw driver (blade and shank).*

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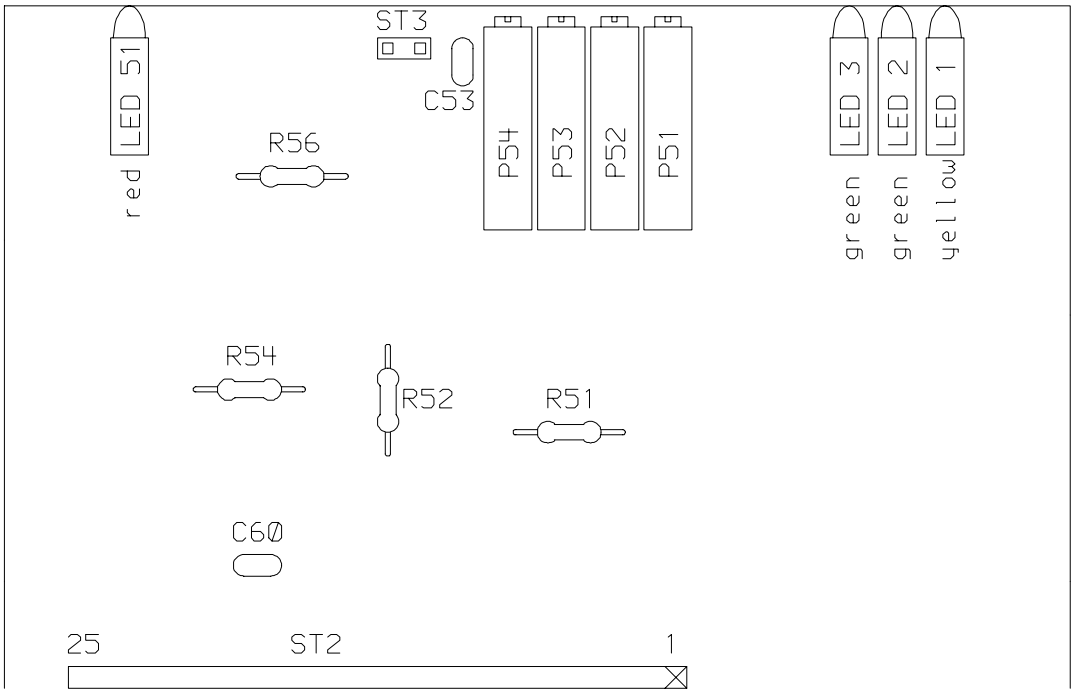
2 POSSIBILITIES OF ADJUSTMENT

WARNING: *To ward off accidents given by electric shock or destruction of TFMxx1 or an object in its area the instructions and the precautions on safety written down in this manual have to be red and fulfilled before mounting, installation and operating the TFMxx1.*

2.1 Devices for Adjustment



	name	element	no.
1	Speed	potentiometer	P51
2	Speed Controller Gain	potentiometer	P52
3	Current Limit	potentiometer	P53
4	Offset	potentiometer	P54
5	Integration Rate Speed Controller	condensator	C53
6	Control Voltage	resistor	R51
7	Fix Speed	resistor	R55
8	Continuous Current	resistor	R56
9	Current Monitor	ST1/8 or resistor	R57
10	Current Mode	"jumper"	on ST3

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2.1.1 Speed (P51)

To adjust the relation between the actual value (actual speed) and the related value (control voltage). Turning the potentiometer **clock wise** results in a lower damping of the signal (e.g. low speed). To increase the range see 2.1.6 (R51).

2.1.2 Speed Controller Gain (P52)

To adjust the gain of the Speed Controller. Turning the potentiometer **clock wise increases the high frequency gain.** ***NOTICE:*** *To ward off destruction of the motor (warm up) doe carefully adjust the gain.*

2.1.3 Current Limit (P53)

To adjust the peak current. Turning the potentiometer **clock wise** to the end touch results in the **maximum peak current**. Turning the potentiometer **counter clock wise decreases** the **peak current**.

2.1.4 Offset (P54)

To adjust the motor speed to zero (common short circuit of both Control Inputs required). May be that temperature floating makes necessary a correction of first adjustment.

2.1.5 Integration Rate Speed Controller (C53)

To adjust the integration rate of Speed Controller. Increased capacity values results in a slower reaction of the Speed Controller. If the value of C53 is zero (short circuit) the TFMxx1 runs as current controller (see 2.1.10 Current Mode ("jumper" on ST3)).
NOTICE: *To ward off destruction of the motor (warm up) doe carefully change the capacity value.*

2.1.6 Control Voltage (R51)

To adjust the sensitivity of Control Voltage Input (rated value). To increase the sensitivity of the Control Voltage Input (see P51 2.1.1) decrease the value of R51(e.g. in low speed applications).

2.1.7 Fix Speed (R55)

To have a fix adjustment of the tacho signal (actual value). Turning the potentiometer **P52 clock wise** to the end touch required. Increasing of R55 results in decreasing of sensitivity.

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2.1.8 Continuous Current (R56)

To adjust the continuous current. The following requirements are fulfilled in standard TFMxx1:

Type	**maximum continuous current [A]**
TFMxx1-**06**-	6
TFMxx1-**12**-	12
TFMxx1-**18**-	18

Increasing the value of R56 decreases the value of maximum continuous current.
NOTICE: *It is not allowed to increase the continuous current.*

2.1.9 Current Monitor (ST1/8a or R57)

To monitoring the current signal during adjustment connect an oscilloscope to ST1/8a or R57. ***NOTICE:*** *The output of the integrated circuit is laid out for small loads only.*

2.1.10 Current Mode ("jumper" on ST3)

To use the TFMxx1 as current controller connect a jumper to both connectors of ST3 (short circuit). See also C53 2.1.5.

3 MOUNTING AND INSTALLATION

WARNING: *To ward off accidents given by electric shock or destruction of TFMxx1 or an object in its area the instructions and the precautions on safety written down in this manual have to be red and fulfilled before mounting, installation and operating the TFMxx1.*

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3.1 Principles

There are no influences (EMC) between two or more TFMxx1 which are mounted in the same case (e.g. a rack or the like).

To protect the operator and to reduce the emission of electromagnetic radiation (EMC) the case (e.g. a rack or the like) has to fulfil the following requirements:

- each part and each part to the other electrically conducting
- preferably FE-alloy
- connected to earth
- protection against electric shock

Before mounting, installation and operating the case has to be in compliance with the international and the national standards. ***DANGER:*** *To ward off accidents given by electric shock or destruction of TFMxx1 or an object in its area all units have to be protected against electric shock.*

3.2 Mounting

DANGER: *Possibility of an electric shock. Mounting and disassembly have to be carried out without electric power. To discharge the condensators the operator has to wait 2 minutes after switch off the power before disassembly (e.g. a TFMxx1 unit).*

Preferably use a rack system to integrate the TFMxx1 (see also 3.1). For the optimal **connection in applications** different standard **back planes** are available. The back planes are compatible with the **DIN41612 BAUFORM D**.

DANGER: *To ward off accidents given by electric shock or destruction of TFMxx1 or an object in its area all units have to be protected against electric shock. Before mounting, installation and operating the case has to be in compliance with the international and the national standards.*

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3.3 Installation

DANGER: *Possibility of an electric shock. Mounting and disassembly have to be carried out without electric power. To discharge the condensators the operator has to wait 2 minutes after switch off the power before disassembly (e.g. a TFMxx1 unit).*

For the optimal **connection in applications preferably use** the **standard back planes**. The back planes are compatible with the **DIN41612 BAUFORM D**.To ensure that the TFMxx1 operates correct and to reduce the emission of electromagnetic radiation (EMC) the **following installation requirements have to be fulfilled:**

connector	**requirement**
Motor	motor windings **without connection to earth.** Always use an electrical shielded cable. The electrical shield has to be connected **at one end** to the **earth.** An inductivity (EMI-filter) has to be connected between the TFMxx1 and the motor windings **inside the case** (e.g. rack or the like).
Tacho Input	tacho (sensor) **without connection to earth.** Connect the actual value sensor GND to the Tacho Input GND. Always use an electrical shielded cable. The electrical shield has to be connected **at one end** to the **earth.**.
intermediate circuit voltage	connect the **transformator without connection to earth.** Always use an electrical shielded cable. The electrical shield has to be connected **at one end** to the **earth. Inside of the case** (e.g. rack or the like) an inductivity (EMI-filter) and if required X and Y condensators have to be connected to the primary side of the transformator.
Control Input, Enable Input and Failure Output	If required use electrical shielded cables. ***WARNING:*** *The connectors are **not** protected against electric shock. If protection against electric shock is required a special module is available.* ***DANGER:*** *To ward off accidents given by electric shock or destruction of TFMxx1 or an object in its area **never** use only the Control Input or the Enable Input in security loops.*

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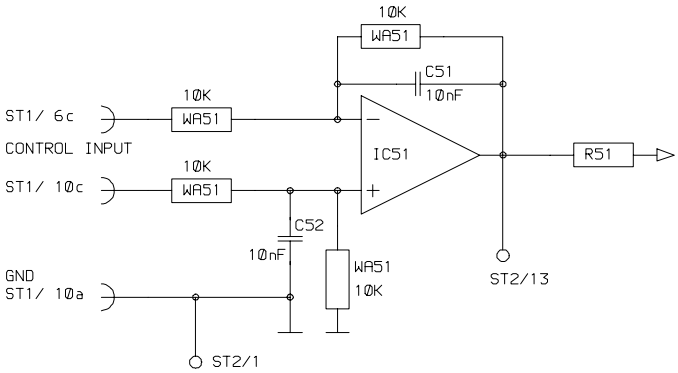

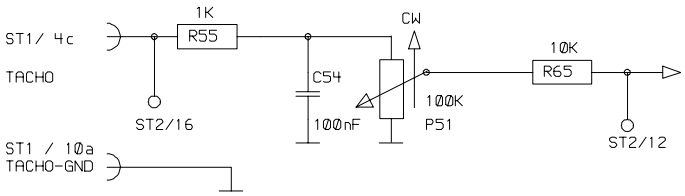

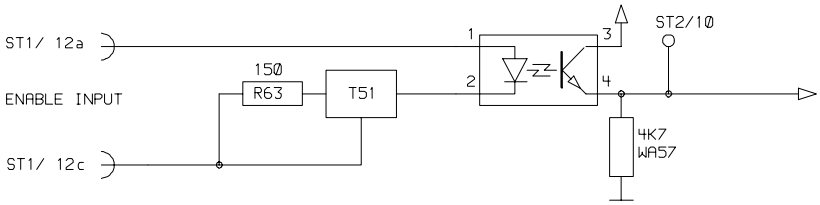

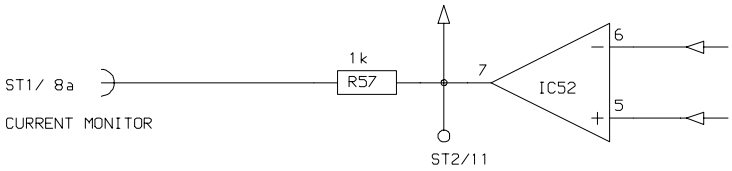

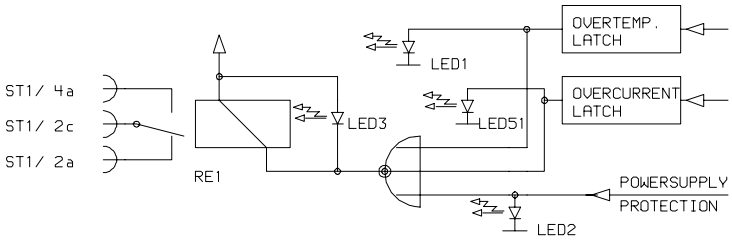

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4 OPERATING OF TFMxx1

DANGER: *Possibility of an electric shock. The nonobservance of the instructions and the precautions on safety written down in this manual shall produce immediately and imminent danger for life and limb or for the TFMxx1 or an object in its area. The handling including mounting, installation and operating has to be carried out by well trained and instructed personal. Measuring instruments has to be connected without electric power. To discharge the condensators the operator has to wait 2 minutes after switch off the power before any manipulation is carried out. To protect the operator the potentiometers has to be adjusted with a isolated screw driver (blade and shank).*

WARNING: *To ward off accidents given by electric shock or destruction of TFMxx1 or an object in its area the instructions and the precautions on safety written down in this manual have to be red and fulfilled before mounting, installation and operating the TFMxx1 (e.g. chapter 2 POSSIBILITIES OF ADJUSTMENT).*
The TFMxx1 are delivered in defined adjustment. It is not allowed to change specific adjustments given by customer requirements. Variations (e.g. to fulfil customer requirements) of TFMxx1 have different identification numbers.

4.1 Before Power On

WARNING: *To ward off accidents given by electric shock or destruction of TFMxx1 or an object in its area the instructions and the precautions on safety written down in this manual have to be red and fulfilled before mounting, installation and operating the TFMxx1.*

Before power on the following requirements have to be fulfilled:

A) Preadjustments

name	**element**	**no.**	**preadjustment**
Speed	potentiometer	P51	clock wise to the end touch
Speed Controller Gain	potentiometer	P52	counter clock wise to the end touch
Current Limit	potentiometer	P53	medium
Offset	potentiometer	P54	medium

B) The Enable Inputs has to be connected together (0V between the two connectors).

C) No signal at the Control Voltage Input (0V between the two connectors).

D) Power and intermediate circuit voltage has to be checked.

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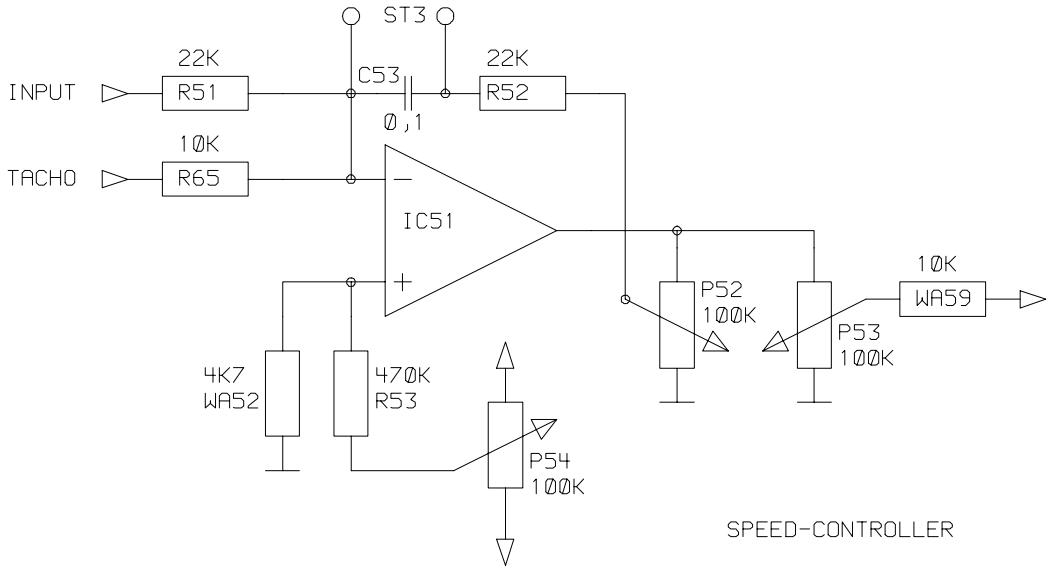
E) Cooling in the case (e.g. ventilator) runs correct.

F) Switch the power off.

DANGER: *Possibility of an electric shock. Measuring instruments has to be connected without electric power. To discharge the condensators the operator has to wait 2 minutes after switch off the power before any manipulation is carried out. To protect the operator the potentiometers has to be adjusted with an isolated screw driver (blade and shank).*

4.2 Put into Operation and Adjustment

DANGER: *Possibility of an electric shock. Measuring instruments has to be connected without electric power. To discharge the condensators the operator has to wait 2 minutes after switch off the power before any manipulation is carried out. To protect the operator the potentiometers has to be adjusted with an isolated screw driver (blade and shank).*



A) Step by step carry out the step 4.1.

B) Connect the TFMxx1. After switch on the power the following requirements have to be fulfilled:

I **L2** (intermediate circuit voltage; green) **has on after 3 seconds.**
II **L3** (no fault; green) **activated after step I** (with a small delay).
III **After step II** only L2 and L3 have on. **The other LED's have to be inactive**.

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C) Have special attention during the first put into operation. ***WARNING:*** *To ward off accidents given by electric shock or destruction of TFMxx1 or an object in its area (e.g. machines or electric equipment) the following instructions have to be carried out step by step.*

I **Equipments to detect end touches and other security elements and cooling equipment have to be installed, controlled and tested**.

II **To check the polarities is a requirement for correct operation of the TFMxx1**.

a) No signal at the Control Voltage Input. (0V between the two connectors).
b) Switch on the Enable Input (high signal) to set up the function of TFMxx1.
c) After step II.b) the motor speed has to be very slow (offset) or zero.

If the motor accelerates to a high speed immediately switch off the Enable Input (0V between the two connectors).
Change the polarity of the connectors of the Tacho Input. After this operation go back to the step 4.2.C.

d) To control the direction of the rotor in relation to the Control Input Voltage slowly increase the Control Input Voltage (rated value).

If the direction is wrong two possibilities to change it are given:

-Change the polarity of the connectors of the Control Input.
-Change the polarity of the connectors of the motor **and** the Tacho Input.
-After this operation go back to the step 4.2.C.

D) To ensure a correct operation of TFMxx1 the adjustment has to be carried out with high attention. To monitor the Tacho Input Voltage and the current signal at the Current Monitor an oscilloscope has to be used. ***NOTICE:*** *It is possible that an incorrect adjustment results in destruction of the motor or objects in its area.*

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I The **Offset has to be adjusted** as follows:

a) Short circuit the two connectors of the Control Input and connect it to the signal GND (e.g. tacho GND). ***NOTICE:*** *It is possible that this short circuit destroys the rated value equipment.*

b) After switch on the power and the Enable Input (high signal) adjust the offset (P54). It is helpful to use a voltmeter to measure the Tacho Input Voltage.

c) Undo the actions done in step I.a). To check correct function repeat step 4.2.C.

II **To adjust the maximum rotor speed** a signal at the Control Input is needed. The voltage range depends on the source. The maximum value is +/-10VDC.

a) After switch on the power and the Enable Input (high signal) **slowly increase** the Control Input Voltage watching the rotor speed (Tacho Input Voltage).

b) Adjust the speed potentiometer (P51) step by step. To achieve the correct rotor speed in relation to the rated value repeat the steps II.a) and II.b) as long as necessary. Adjust the rotor speed higher (approximately 10%) **to achieve a increased precision in positioning systems**.

III Adjust the peak current (Current Limit P53) watching the current signal (Current Monitor) during acceleration.

IV **To optimise the dynamic characteristics of the system** carry out the following actions:

a) Connect a signal (2Hz) to the Control Input.

b) Set the amplitude of the signal (IV.a) like the value needed for a medium rotor speed.

c) Adjust the Speed Controller Gain (P52) step by step to achieve the fastest respond. ***NOTICE:*** *It is possible that an excessive current ripple (to high gain) increases the motor temperature.*

d) Vary the amplitude of the signal (IV.b) to have different rotor speeds and watch the respond. If necessary readjust the Speed Controller Gain (P52).

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4.3 To take into Account

A) If the TFMxx1 is well adjusted before mounting and installation there is no more adjustment necessary after mounting and installation. It may be necessary to repeat the step 4.2.C).

B) Change the value of C53 if it is not possible to adjust the respond (4.2.D)IV) by the Speed Controller Gain (P52).

C) The possibility of arising resonances is given in several applications (e.g. servos). Try to remove the problem by changing the high frequency gain of the Speed Controller as follows: Connect a condensator (500pF to several nF) parallel to the resistor R52. The value of the condensator depends on the adjustment of the potentiometer P52.

D) If the manufacturer changes performances, mounting, installation or operating given by customers request the differences are written down in the product documents (plans, part lists and so on).

E) Contact the manufacturer in the case of unclearness or having troubles.

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5 TROUBLESHOOTING

Monitoring / Symptom	Status	Failure	Cause/Removing
OVERTEMPERATURE L1/yellow heatsink temperature check	activated	yes	-insufficient cooling -short current by having a high inductivity between the TFMxx1 and the motor (is not detected as overcurrent) -reset by power off and power on
	inactive	**no**	
POWER ON L2/green intermediate circuit voltage and built in power supply	inactive	yes	-intermediate circuit voltage to small or missing -incorrect connected TFMxx1 -fuse on TFMxx1 is blown -to high during load -destroyed power unit
	activated	**no**	
NO FAULT L3/green no fault	inactive	yes	- intermediate circuit voltage to high or other faults; see also: **L1; L2; L51/L52**
	activated	**no**	
OVERCURRENT L51/red output monitoring of overcurrent (power unit)	activated	yes	-destroyed power transistor -short circuit (output or to earth or motor windings) -reset by set off and set on the Enable Input
	inactive	**no**	
All LED's	inactive	yes	-see **L2/green (POWER ON)**
Motor the rotor rotates with highest speed	---------	yes	-potentiometer P51 is turned counter clock wise to the touch -tacho signal is missing -tacho signal (+/-) changed

Each failure monitored by one of the LED's activates the failure output (relay).

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6 DECLARATION

DESIGN	:	**Integrated transistor servo amplifier to operate in machines and controls**
TYPE	:	**TFMxx1**
SERIAL-NO.	:	**No. 110000 and higher**
DESCRIPTION	:	**In this manual**
MANUFACTURER	:	**LEAG Antriebstechnik AG, CH-8200 SCHAFFHAUSEN, SWITZERLAND**

The construction of the TFMxx1 and its mounting, installation, adjustment and operating written down in this manual fulfil not only the requirements for a world-wide operation but also the legal compliances in the EC (EWG-Richtlinien):

Niederspannungsrichtlinie
-73/23/EWG vom 19.02.1973 (ABI. EG Nr. L 11/29 vom 26.03.1973)
geändert durch:
-93/68/EWG vom 22.07.1993 (ABI. EG Nr. L 220/1 vom 30.08.1993)

Elektromagnetische Verträglichkeit
-89/336/EWG vom 03.05.1989 (ABI. EG L Nr. 139/19 vom 23.05.1989)
geändert durch:
-91/263/EWG vom 29.04.1991 (ABI. EG Nr. L 128/1 vom 23.05.1991)
-92/31/EWG vom 28.04.1992 (ABI. EG Nr. L 126/11 vom 12.05.1992)
-93/68/EWG vom 22.07.1993 (ABI. EG Nr. L 220/1 vom 30.08.1993)

Use the integrated transistor servo amplifier TFMxx1 only to operate in machines and controls. It is absolutely not allowed to put the TFMxx1into operation before it is noticed that the machine or the control are in compliance with the international and the national standards, requirements and law. The enduser has to be informed of the instructions written down in this manual, this declaration and the specific product documents given by customer specific changes. The manual DC-SERVO-DRIVER TFMxx1 is part of this declaration and the TFMxx1.

CH-8200 Schaffhausen
the 27th of January 1998
the Manager of the Staff

Monika Egloff

CH-8200 Schaffhausen
the 27th of January 1998
the General Manager

Lucas Egloff

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