MANUFACTURER DOCUMENT PACKAGE

Manufacturer's Manual

Reference package for procurement and maintenance review

PARKER COMPUMOTOR

TBF60/5R

RESOLVER-FEEDBACK SERVO AMPLIFIER

Used with the applicable TBF-R configuration.

REFERENCE PACKAGE

OFFICIAL DOCUMENT

Selected official manufacturer pages follow this cover.

Source: Parker Compumotor TBF60-5R

Pulse Width Modulated
4-Quadrant Servo Controller

Series TBF-R Installation Manual

For electronic commutated servo motors

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1 Safety Instructions

1.1 General Notes

This start-up manual describes functions and gives all necessary information for the designated use of the subassemblies produced by Custom Servo Motors. The manufacturer is responsible for the preparation of an instruction manual in the national language of the end user. The preparation of machine-specific risk analyses is also the manufacturer's duty.

Observance and understanding of the safety instructions and warnings stated in this document is the condition for the riskless transport, installation and set-up of the components by qualified personnel.

1.2 Qualified Personnel

Must be able to correctly interpret and realize the safety instructions and warnings. Furthermore, the personnel entrusted must be familiar with the safety concepts of the automatization technique and must be trained accordingly. Unqualified actions at the subassemblies or the non-observance of the warnings stated in this document or attached to the subassemblies, constitute a risk to life and limb of the user, or cause damage to the machine or other material property.

1.3 Designated Use

is given when:

- any work on equipment of the machine/plant is carried out by a skilled electrician or by instructed persons under the supervision and guidance of a skilled electrician.
- the machine/plant is used only when in a safe and reliable state.
- the machine is used in accordance with instructions set out in the operating manual.

1.4 Description of symbols and signal words



DANGER!
Warning against risk of serious injuries. Observance is absolutely necessary.



ATTENTION!
Information, the non-observance of which may lead to substantial damage to material property. Observance of these safety instructions is absolutely necessary.



IMPORTANT!
This symbol refers to an information, important with regard to the use of the machine. Non-observance may lead to troubles.

1.5 Safety Notes



As the subassemblies are intended for installation in machines, freely accessible parts may carry dangerous voltage. The manufacturer must ensure adequate protection against contact.

Only qualified personnel, who knows the contents of these start-up instructions, must execute any work on these subassemblies.
The instructions contained in this manual have to be observed strictly, as a wrong handling causes additional risks.



A correct transport, storage, set-up and assembly of the machine as well as careful operation and maintenance is an important condition for the correct and safe operation of these products.

1.6 Set-up



The relevant safety and accident prevention regulations for the individual case are to be considered.

Devices, intended for installation in cabinets and housings must be operated only in built-in state.

Prior to setting up the devices, which are operated with line voltage, please check that the adjusted nominal voltage range is identical to the local line voltage.

For supply with 24V ensure that the low voltage is mechanically separated from the mains.

Deviations in the line voltage, exceeding the tolerances stated in the technical data for these devices, are not allowed, as this may lead to dangerous conditions.

Voltage dip or voltage failure requires precautions for restoring an interrupted program. Arising of dangerous operational states must be avoided.

EMERGENCY-STOP equipment must not effect an uncontrolled or undefined restart after unlocking. They must remain effective in all modes of operation.

1.7 Maintenance / Service

For measuring or test work on any live device, please observe the relevant accident prevention regulations. The work must be done only with suitable measuring instruments and tools.



Service work on subassemblies is done exclusively by Custom Servo Motors staff.

Incorrect repair work by unqualified persons may lead to damage to material property, and bears a risk of injuries or mortal injuries. Open the main switches or unplug the main plug before opening the device or pulling it out of the sub-rack. When replacing defective fuses, please observe the stated electrical values. Incorrect modifications and work on the subassemblies lead to a loss of warranty claims and involves unpredictable risks.

2 Technical description

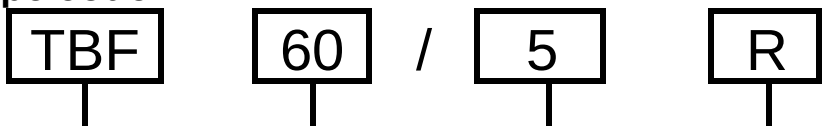
2.1 General Information

The series R amplifiers (= resolver) are servo amplifiers for speed control of brushless servo motors. They extract the information for the sine commutation of the motor and for the speed feedback from the signals of the resolver, attached to the motor. In addition to that, incremental encoder signals are simulated by these signals. This allows the realization of favorable solutions for a large range of applications with low and medium power levels.

The amplifiers work with a pulse-width modulated power amplifier in MOSFET technique. The design is a 3 HE (Euroformat) for 19" slide-in racks. These devices have an integrated power supply unit. The electronics is supplied internally from the intermediate circuit voltage, which also allows a battery-powered operation.
The main characteristics are:

- Sine commutation
- Hybrid technique/ SMD technology
- 19 inch/3HE slide-in technique
- Internal power supply unit
- High dynamics
- High efficiency
- Almost no clock noise by doubling of the current frequency
- Short-circuit proof and ground contact proof
- Protective circuit: Undervoltage, overvoltage, overcurrent, overheating
- I^2t current limiting
- Differential amplifier input
- Enable input
- External current limiting
- Limit switch inputs
- PLC compatible inputs
- Incremental encoder simulation

Type code:



TBF	60 / 5	R
Series	Nominal voltage / Nominal current	Feedback with: R = Resolver (Optional T = Tachometer generator and I = Incremental encoder is separated define.

2.2 Technical Data

Series	**TBF60/5R**	**TBF60/10R**	**TBF120/7R**
Nominal voltage	**60V**	**60V**	**120V**
Nominal current (peak value)	**5A**	**10A**	**7A**
Pulse current (peak value)	**15A**	**25A**	**18A**
Intermediate circuit voltage max.	85VDC	85VDC	170VDC
min.	25VDC	25VDC	70VDC
Recommended transformer voltage	54 AC	54VAC	95VAC
Ballast circuit	–	–	internal
Electronic supply	internal		
Efficiency	93%		
Residual voltage drop (nominal current)	1.5V		
Clock frequency	9.5kHz		
Frequency of the current ripple	19kHz		
Current regulator bandwidth	1kHz		
Minimum load inductance (nominal current)	1.2mH	0.8mH	1.6mH
Auxiliary voltage for external consumers	±15V/10mA +5V/10mA		
Set value input (differential amplifier) Internal resistance	±10V 20kOhm		
Control inputs Enable, Pos.-, Neg.- Stop, Integral-off	"Off"<4V "On"30V< >12V		
Internal resistance	3.9kOhm		
Input Ext. Current limit.. 0-10V for	0-15A	0-25A	0-18A
Internal resistance	20 kOhm		
Incremental encoder outputs A+, A-, B+, B-, I+, I-	RS422		
Electronic commutation	Resolver		
Resolver	2 Pole, Primary : Rotor transformation Ratio 0.5 input voltage 7V rms; 10kHz		
Output conditioned tachometer voltage Scaling	operation amplifier output external load >10kOhm! Only short shielded lines! 10V/6000 rpm		
I^2t message output	≥ 12V with ≤ 20mA		
Operational output	potential free relay contact max. 10W for 100V, 100mA		
Connections	1x plug-type connector DIN 41612-F48 1x D-SUB 9-pole socket		
Dimensions	160x100x40.3 mm	160x100x55.5mm	160x100x80.8 mm
Weight	0.5kg	0.8kg	1.0kg

*= external ventilation with Ieff > 4A additional filtering with Ieff > 4A or IIMP > 12A.
Ieff= 4A and IIMP= 12A is adjustment ex factory

2.3 Principle of the Amplifier

The three-phase servo amplifiers of Series TBF are based on the principle of the speed control with secondary current control loop. In addition to that the current-mode logic controls the commutation of the electronically commutated servo amplifier (brushless). The signal flow of this functional group is shown in the following figure.

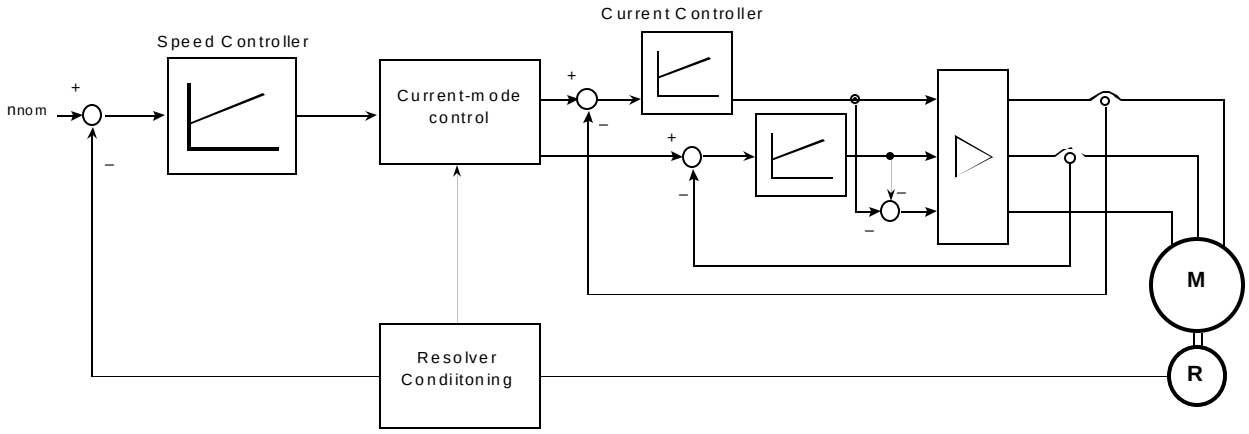


Figure 1: Principle of the Amplifier

The speed control loop consists of speed controller, circuit, motor and speed measurement. The nominal speed value is externally given, e.g. through potentiometer, NC control or something similar. The actual speed value is determined at the motor shaft by a resolver. The difference between nominal value and actual value is formed at the summing point and transmitted to the speed controller. The speed controller then defines the required current set value.

The current control loop consists of the current controllers, the amplifier stage, the current measurement and the motor windings. The current set values available at the output of the current controller, control the six power switches of the inverter through a pulse-width modulator. With a PWM frequency of 9.5kHz this leads, due to the special activation, to a current ripple of 19kHz and consequently to a merely audible clock noise.

This secondary control loop (current) under another one (speed) guarantees a stable control with good dynamics and high rigidity of the drive. This even allows the easy realization of current limitations, necessary to protect the motor and the amplifier, just by limiting the output voltage of the speed controller (current set value).

2.4 Block diagram

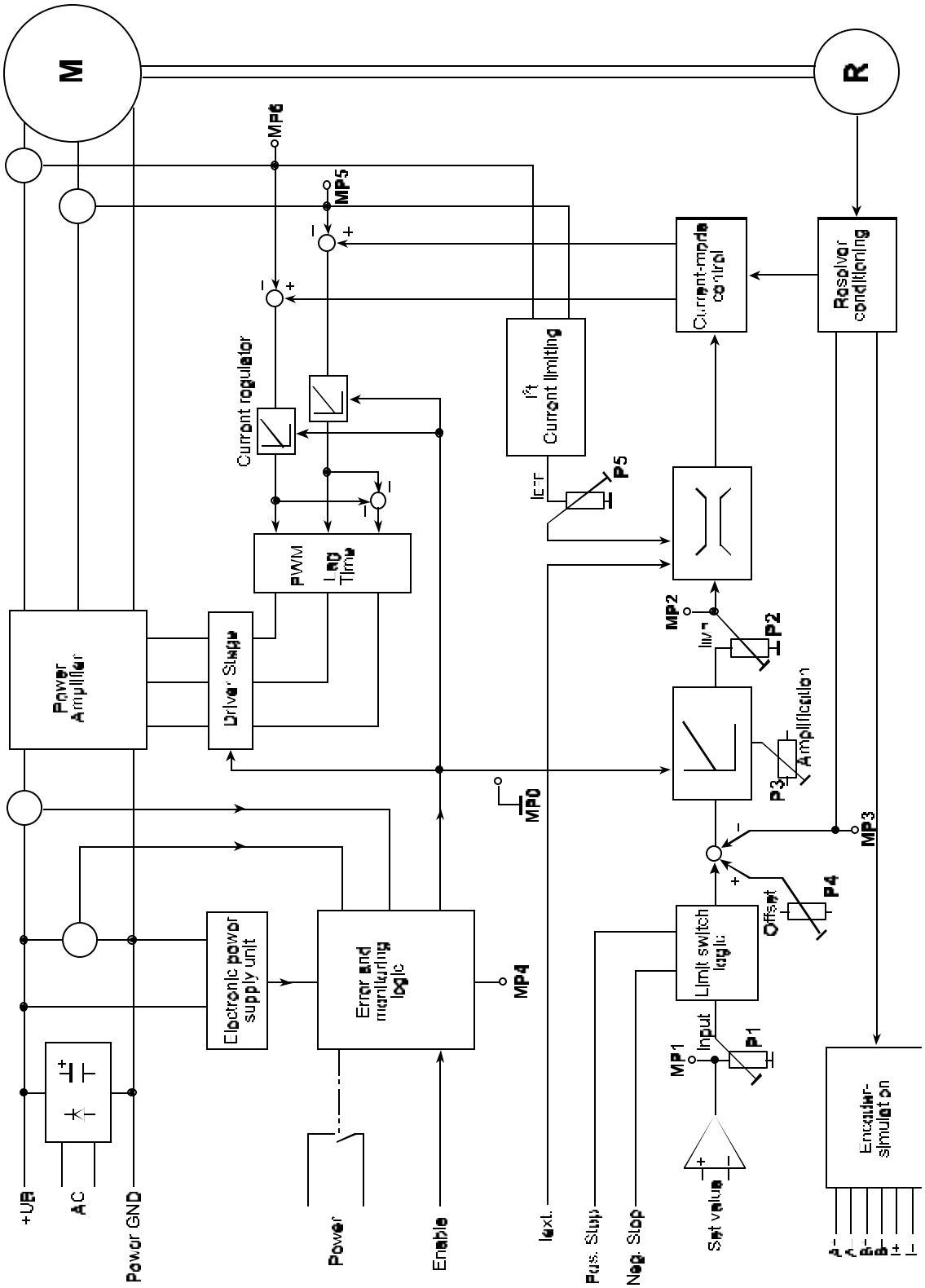


Figure 2: Block Diagram

2.5 Function Description

The function of the amplifier is described by means of the block diagram shown in Figure 2.

2.5.1 Power Supply

- Power amplifier:

  Rectification and filtering form the direct voltage (intermediate circuit voltage UB), necessary to operate the power amplifier, from the AC power supply. This intermediate circuit voltage can also be fed directly as d.c. voltage.

- Electronic supply

  The electronic supply takes place internally through a switched-mode power supply from the intermediate circuit voltage.

2.5.2 Control System

- Speed controller and current limiting

  The nominal speed value can be fed through the input differential amplifier. In the stage connected on load side the positive and negative set values are suppressed separately (limit switch logic). The speed set value, conditioned by this way, is then injected to the speed controller. The inverted tachometer voltage, injected to the speed controller, in this device, is gained from the resolver signals, by means of a corresponding procedure. The current set value is then available at the output of the speed controller.

  There are different possibilities to limit the nominal current:

  The I^2t current limiting reduces the current set value, using the following procedure: The actual current values are rectified, quadrated and run to a low pass. The circuit limits the current to the continuous current value, which corresponds to the position of the potentiometer P5, when the output voltage of the low pass reaches the voltage, adjusted at this potentiometer. Furthermore, the maximum possible nominal current can be adjusted to 0...15A, 0...25A or 0...18A with an externally fed voltage of 0...10V at the input $I_{ext.}$

  The maximum pulse current, deliverable by the device can be adjusted with the potentiometer P2 of the internal current limiting. This current limiting is connected on load side of the previously mentioned current limitations - this guarantees that the current adjusted here, can never by exceeded.

2.7 List of Possible Adjustments and Indicators

2.7.1 The LEDs

LED1 (green)	Indicates readiness of the device; lights also when the amplifier is not enabled.
LED2 (yellow)	I^2t- current limiting is active
LED3 (red)	Fault (overcurrent, overvoltage, overtemperature).
LED4 (yellow)	Ballast circuit operates (only for 120V devices).

2.7.2 The Potentiometers

Potentiometer 1	Signal Potentiometer scales the nominal speed input to match the maximum velocity feedback used for adjusting the maximum motor speed (10 to 100%).
Potentiometer 2	Pulse current limiting; range from 10 to 100% of the rated peak current.
Potentiometer 3	Adjustment of the amplification of the speed controller.
Potentiometer 4	Offset adjustment of the speed controller.
Potentiometer 5	Continuous current limit; range from 0 to 100% of rated peak current.

2.7.3 The Test Points

MP0	Ground reference 0V			
MP1	Nominal voltage	Voltage at the differential - nominal speed input (referred to ground)		
MP2	Output of the speed controller (set value):		10V	≈ 15A (TBF60/5R) ≈ 25A (TBF60/10R) ≈ 18A (TBF120/7R)
MP3	Tachometer voltage:		10V	≈ 6000 rpm
MP4	Fault diagnosis		9V ±0.4V 8V ±0.4V 7V ±0.4V	≈ Overcurrent ≈ Overvoltage ≈ Overtemperature
MP5	Current monitor Phase V:		10V	≈ 15A (TBF60/5R) ≈ 25A (TBF60/10R) ≈ 18A (TBF120/7R)
MP6	Current monitor Phase U:		10V	≈ 15A (TBF60/5R) ≈ 25A (TBF60/10R) ≈ 18A (TBF120/7R)

2.7.4 The Soldering Jumpers

JP1 to JP8 Adjustment only for devices without resolver.

JP9 Closed when operating the device as speed controller, open for current control.

JP10 As JP9

JP11 Open when operating the device as speed controller, closed for current control

JP12 Only for adjustment by factory

JP13 Only for adjustment by factory

2.7.5 The Internal Potentiometers

P6 Only for adjustment by factory

P7 Only for adjustment by factory

P8 For special requirements to clock frequency of the power amplifier a potentiometer can be used here (normally no components inserted)

P9 Only for adjustment by factory

P10 Only for adjustment by factory

2.7.6 The DIP switches

S1 Adjustment to pole number of the motor

1	2	Poles	Comment
on	on	8	
off	on	6	Delivery condition
on	off	4	
off	off	2	

S2 Adjustment of the number of pulses per rotation from incremental encoder simulation

1	2	Pulse number	Comment
off	off	128	
off	on	256	
on	off	512	Delivery condition
on	on	1024	

2.8 Front view

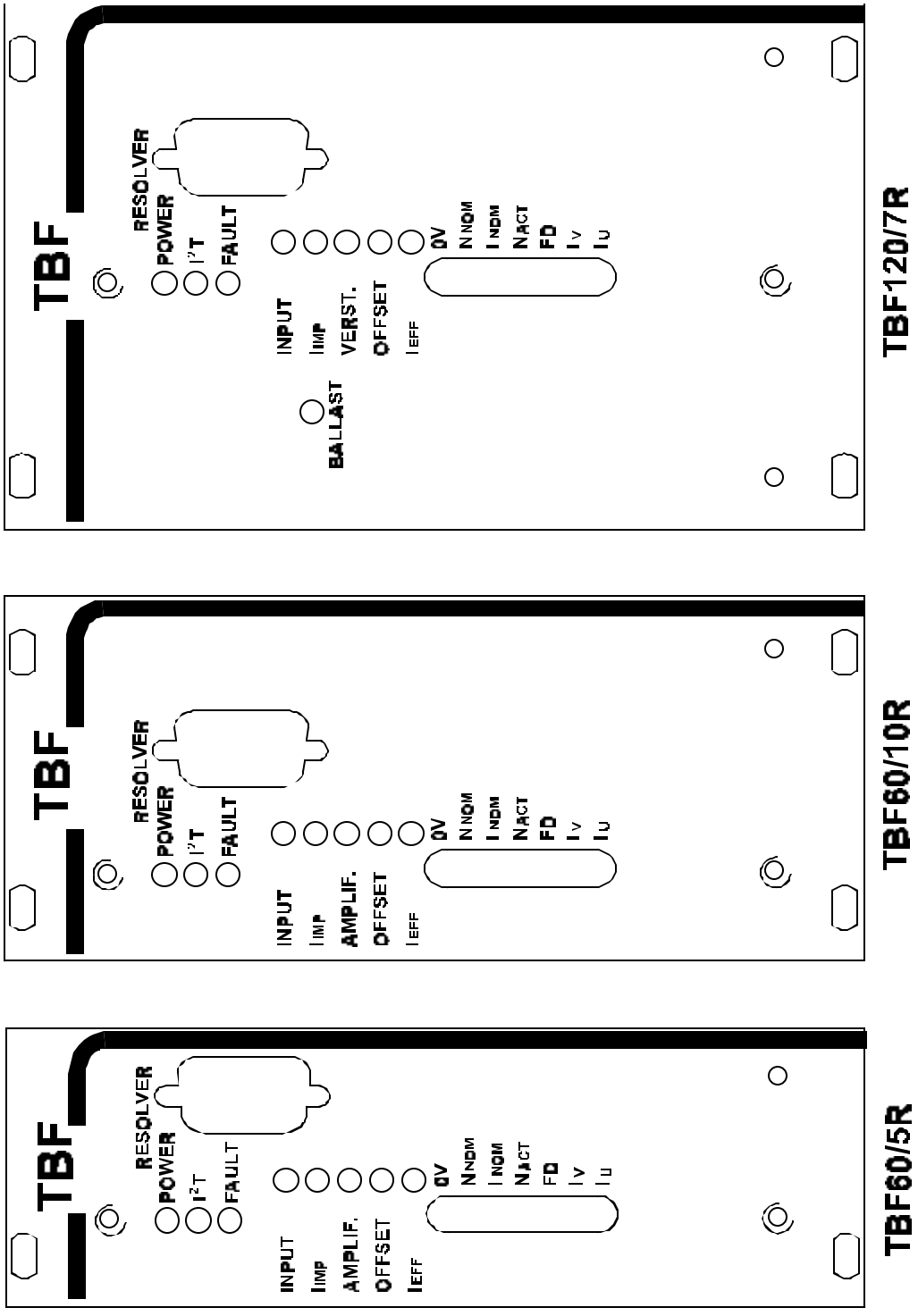


Figure 4: Front Views