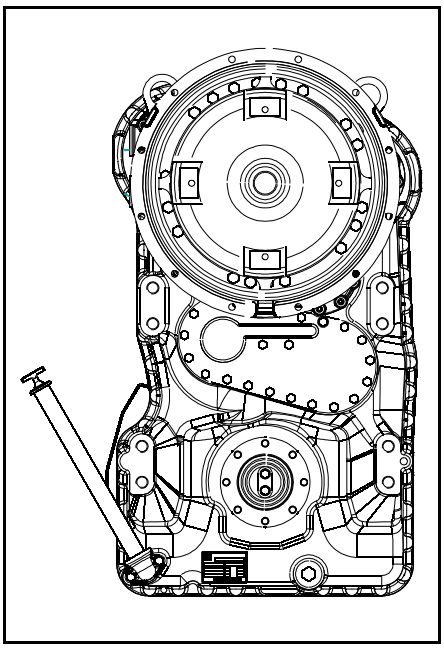


Order-No.: 5872 367 002

ZF REVERSING TRANSMISSION

4 WG-158

TECHNICAL DATA
DESCRIPTION
OPERATION
MAINTENANCE
DIAGNOSTIC SYSTEMS

ZF Passau GmbH
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Subject to changes w/o notice !

1. Edition 2005/05

Preface

The present Documentation has been developed for skilled personnel which has been trained by the ZF for the Maintenance and Repair operations on ZF-units.
However, because of technical development of the product, the Maintenance and Repair of the unit in your hands may require differing steps as well as also different setting and test data.

This Manual is based on the technical state at the printing.
At the preparation, every possible care has been taken to avoid errors.
However, we are not liable for possible mistakes concerning the representation and the description.

We are reserving ourselves the right of modifications without previous information.

The responsibility lies with the owner and the user, to pay attention to the safety indications, and to carry out the Maintenance operations according to the prescribed Specifications.

The ZF is not liable for faulty installation, incorrect treatment, insufficient Maintenance, impro-perly and unskilled performed works, and for the subsequential damages resulting from it.

It is ***imperative*** to pay attention to the corresponding Specifications and Manuals of the Vehicle Manufacturer.

Important Informations concerning the technical reliability and reliability in service are accentuated by the following Symbols:

☞ **Valid for Instructions which must be observed at the Maintenance, the Performance or the Operation of the vehicle !**

⚠ **Is inserted at working and operating procedures which have to be exactly respected to avoid a damage or destruction of the unit or to exclude a danger to persons !**

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APPENDIX, composed of:

Tables 4 WG-158:

1 **Layout**

2A **Installation view - Front view Direct mounting**

2B **Installation view - Side view**

3 **Schedule of measuring points and Connections**

4 **Oil circuit diagram with 2-stage pressure control valve**

5 **Electrohydraulic shift control**

6 **Semi-automatic control EST-17T - Sample**
Circuit diagram - 6029 701 544 –

7 **Semi automatic control EST-17T - Sample**
Connection diagram - 6029 701 545 –

8 **Controller DW-3**

9 **Controller ERGO II**

TECHNICAL DATA

Engine power:	max. KW	----------	100*
Turbine moment:	max. Nm	----------	2 200*
Engine speed:	max. min^{-1}	----------	540*
Starting torque multiplication:		----------	3,0
Engine-dependent Power take-offs:			
Torque:	Nm	----------	1 200
Speed:	n	----------	1 x n_{Engine}
Mass (without oil):	kg about	----------	750**

* = dependent on Vehicle type and application
** = dependent on the Transmission version

Description:
The ZF-Transmissions 4 WG-158 are composed of a hydrodynamic torque converter and a rear-mounted multi-speed powershift transmission with integrated transfer case (see Table-1). The torque converter is a wear-free starting device which is infinitely variable adapting itself to the required situations (necessary input torque).

Input by direct mounting via diaphragm on the engine, or separate installation (input via universal shaft) with DIN-, Mechanic- or Spicer-input flange.

The signals for the gear changes are issued according to the Version of the vehicle by the following ZF-Control units:

- Semi-Automatic EST-17 T (24V) EST-19 T (12V)
- Fully-Automatic EST-25 (24V) EST-26 (12V)

Torque converter:
Unit size W 300 with torque multiplication.

Powershift transmission:
4 Forward speeds and 3 Reverse speeds.

Output:
The powershift transmission has between input and output shaft a center distance of 500 mm, and can be equipped with the following components:
- with output flanges to the front and rear axle for different universal shafts
- on the rear output (rear-side) with a disk brake as parking brake
- on the converter side with axle disconnection.

Power take-off:
For the drive of an external oil pressure pump, an engine-dependent, coaxial power take-off is planned.
It allows the attachment of pumps with „SAE-B and C“ Connection.

Transmission accessories:
Upon request, the transmissions can be additionally equipped with the following components:
- Emergency steering pump with a feed rate of 16 cm ^{3}/rev. or 32 cm ^{3}/rev.
- Electronic speedometer signal, here the Electronic unit EST-17 T offers a speedometer signal.

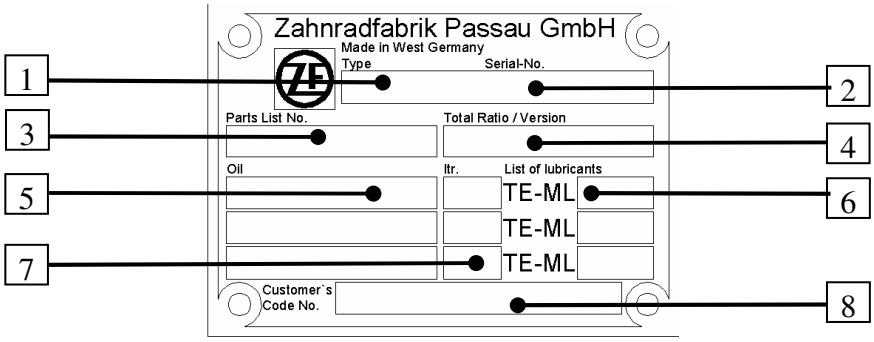
Transmission ratio (mechanical)*

SPEED	DRIVING DIRECTION	Ratio
1	Forward	4,012
2	Forward	2,174
3	Forward	1,088
4	Forward	0,619
1	Reverse	3,804
2	Reverse	2,061
3	Reverse	1,031

* = According to the Transmission version, other ratios are also possible.

INSCRIPTIONS ON A ZF-MODEL INDENTIFICATION PLATE FOR ZF-HYDROMEDIA-REVERSING -TRANSMISSION

1 = Gearbox type
2 = Gearbox Serial-No.
3 = ZF-Parts List-No.
4 = Total ratio of the Gearbox
5 = Oil (Oil specification)
6 = List of lubricants
7 = Oil capacity
8 = Customer no.



NOTES REGARDING THE SPARE PARTS ORDERS:

When ordering genuine ZF-Spare Parts, please indicate:

1. = Gearbox type
2. = Serial-No.
3. = ZF-Parts List-No.

See Model identification Plate!

4. = Mark and type of vehicle
5. = Denomination of the spare part
6. = Spare parts-No.
7. = Way of transport

When all of the above required indications are considered, errors in the delivery of spare parts Orders can be avoided!

IMPORTANT INSTRUCTIONS

Oil level check (see 4.2):
In the cold starting phase, the engine must run for about 2 – 3 minutes at idle speed and the marking on the oil dipstick must then be above the cold starting marking.
The oil level check in the gearbox must be performed at idle engine speed with the gearbox at operating temperature (80° to 90° C).

With the engine standing still, the oil level in the gearbox considerably rises depending on the installation situation!

Upon every oil change, the ZF-micro filter must be replaced.

When starting the engine, always bring the speed range selector into the neutral position.
With running engine and gearbox in neutral position, the parking brake or the foot brake must be activated to avoid rolling off of the vehicle.

Prior to every starting the vehicle, release parking brake.

Reversing must be done upon a standstill or at very low driving speed, only reverse in the 1st gear.

During driving, do not overleap gears, if possible.

With shut down engine, despite a gear pre-selected at the speed range selector, there is no power flux between gearbox and engine, i.e. the gearbox is in idle position.
Therefore, the parking brake must be fully activated!
When leaving the vehicle, additionally secure with the aid of wedges!

The towing speed must by no means exceed 10 km/h, the towing distance must not be longer than 10 km (without secondary pump).
This instruction must absolutely be observed as, otherwise, the gearbox will be damaged due to insufficient oil supply!
For longer distances, the defective vehicle should be transported with a low loader.

Operating temperature behind the converter at least 65° and 100° C upon continuous operation, short-term rising up to 120° C admissible.

In case of irregularities at the gearbox, shut down vehicle, request the support of skilled staff.

Protective measures for the ZF electronic system upon works at the vehicle:

For the following works, the ignition must be disconnected and the plug of the control unit disconnected from the ZF electronic system:

- **Upon any electrical works at the vehicle.**
- **Upon welding works at the vehicle.**
- **Upon insulation checks at the electrical system.**

I. DESCRIPTION

1.1 Function of the Converter:

Function of a hydrodynamic Torque converter
(Schematic view)

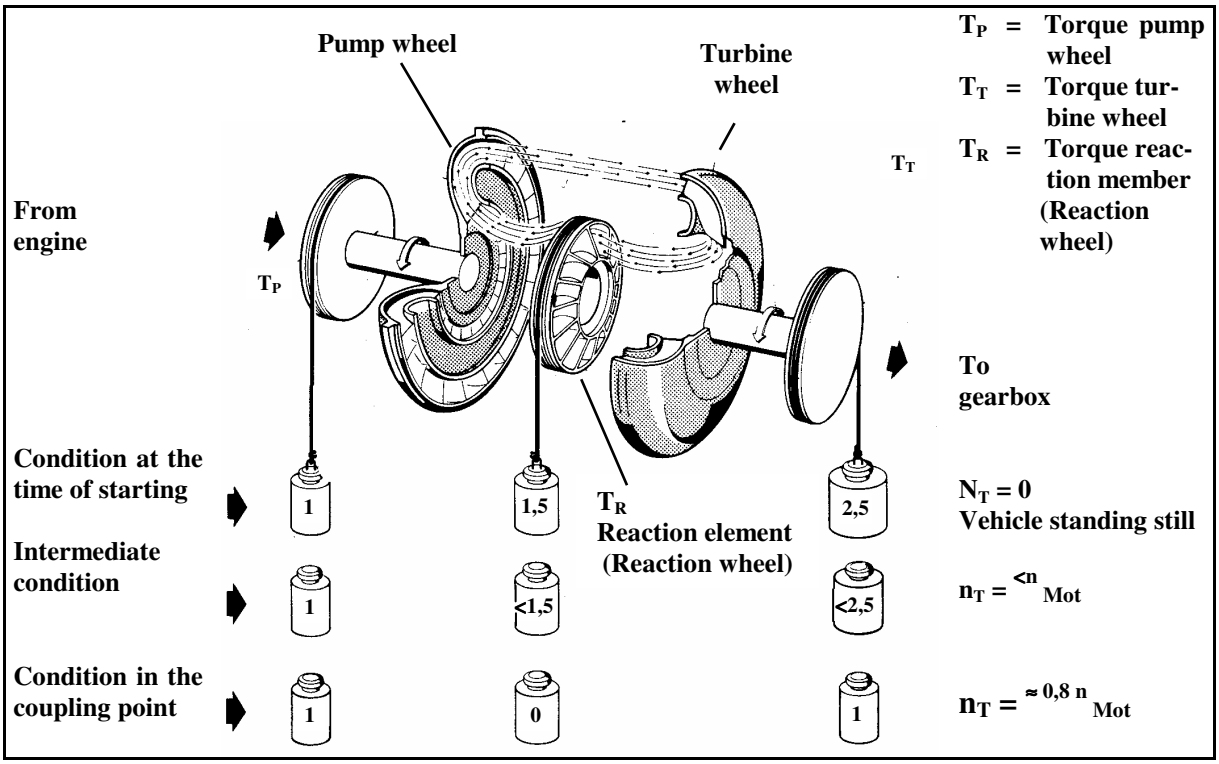


Figure-No. 1.1

The converter is working according to the Trilok-System, i.e. it assumes at high turbine speed the characteristics, and with it the favourable efficiency of a fluid clutch.
The converter is designed according to the engine power so that the most favourable operating conditions are obtained for each installation case.

The Torque converter is composed of 3 main components

Impeller – Turbine wheel – Stator (Reaction member)

These 3 impellers are arranged in such a ring-shaped system that the fluid is streaming through the circuit components in the indicated order.
Pressure oil from the transmission pump is constantly streaming through the converter. In this way, the converter can fulfill its task to multiply the torque of the engine and at the same time, the heat created in the converter is dissipated via the escaping oil.
The oil which is streaming out of the impeller, enters the turbine wheel and is there reversed in the direction of flow.
According to the rate of reversion, the turbine wheel and with it also the output shaft is receiving a more or less high reaction torque.

The stator (reaction member), following the turbine, has the task to reverse the oil streaming out of the turbine once more and to deliver it under the suitable discharge direction to the impeller.
Due to the reversion, the stator is receiving a reaction torque.
The relation turbine torque/pump torque is called torque multiplication. This is the higher, the greater the speed difference of impeller and turbine wheel will be.

Therefore, the maximum torque multiplication is created at stationary turbine wheel.
With increasing output speed, the torque multiplication is decreasing. The adaption of the output speed to a certain required output torque will be infinitely variable and automatically achieved by the torque converter.

When the turbine speed is reaching about 80% of the pump speed, the torque multiplication becomes 1,0 i.e. the turbine torque becomes equal to that of the pump torque.
From this point on, the converter is working similar to a fluid clutch.

A stator freewheel serves to improve the efficiency in the upper driving range, in the torque multiplication range it is backing-up the torque upon the housing, and is released in the clutch range.
In this way, the stator can rotate freely.

1.2 Powershift transmission:

The multi-speed reversing transmission in countershaft design is power shiftable by hydraulically actuated multi-disk clutches.

All gears are constantly meshing and carried on antifriction bearings.

The gear wheels, bearings and clutches are cooled and lubricated with oil.
The 4-speed reversing transmission is equipped with 6 multi-disk clutches.
At the shifting, the actual plate pack is compressed by a piston, movable in axial direction, which is pressurized by pressure oil.
A compression spring takes over the pushing back of the piston, thus the release of the plate pack. As to the layout of the transmission as well as the specifications of the closed clutches in the single speeds, see Table-1, 3 and 4.

1.3 Transmission control:

Transmission control see Oil circulation diagram, Schedule of measuring points and Aluminum Die-casting shift control, Table 3, 4 and 5.
The converter charge and control pressure pump which is necessary for the oil supply of the converter and the transmission control is fitted in the transmission on the engine-dependent drive shaft.

The feed rate of the pump is Q = 85 l/min, at n_{engine} = 2000 min^{-1}.
This pump is sucking the oil through the coarse filter out of the sump and delivers it through the ZF-Fine filter - the filter can be fitted also externally from the transmission - to the control pressure valve.

Coarse filter:
Mesh width: 800 µm

ZF-Fine filter:

Filtration ratio according to ISO 4572:	$ß_{30}$ $^{\geq 75}$ $ß_{15}$ $^{=25}$ $ß_{10}$ $^{=5}$
Filter surface at least:	6 700 cm^2
Dust capacity according to ISO 4572 at least:	17 g

The oil which is pressurized by the control pressure valve is directed through the 2-stage pressure control valve with bleeder valve by the shift valves 1, 2, 3, 4 and 5 to the multi-disk clutches.
The pressure control valve regulates during the shifting procedure the pressure build-up in the clutches. At the change over, the pressure is short-time dropping and is increasing after the completed shifting procedure to 16 $^{+2}$ bar again.

The signals for the gear changes are issued according to the design of the vechicle by the following ZF-Control units:

- Semi-Automatic EST-17T (24V) EST-19T (12V) - see Table 6 and 7.
- Fully-Automatic EST-25 (24V) EST-26 (12V)

The pressure control can be „soft or fast“, to be more precise as follows:

„Soft shifting“

At the shifting in the 1st and 2nd Speed Forward and Reverse, the reduced system pressure (10 bar) is fed forward by the solenoid valve M4 to the shift valve and to the reversing valve.
In this way, the control pressure to the 2-stage pressure control valve is interrupted, and the pressure build-up is realized without the 2-stage pressure control valve.
This is resulting in a „soft shifting“.
In this position, the gear change is realized at low control pressure.

„Fast shifting“

At all other gear changes, the reversing valve will be reset by the elastic force. In this way, the system pressure becomes quickly effective behind the 2-stage pressure control valve, and the gear change is realized at a higher pressure level.
This is resulting in a „fast shifting“.

The bleeder valve has the task to ventilate the pressure chamber behind the pressure control valve for a longer time.

The reset valve resets the pressure control valve into its starting position as soon as the speed has been changed so that the piston is ready for the next gear change.
These shifting operations will be exactly adapted to the different models and types of vehicle.

The pilot pressure for the control of the shift valves is reduced by the reducing valve to 10 bar, and is directed to them through the solenoid valves M1, M2, M3, M4 and M5.

The control pressure valve is limiting the maximum control pressure and releases the main flow to the converter and lubricating circuit.

A safety valve is installed in the inlet to the converter which protects the converter against high internal pressures (opening pressure 11+2 bar).
Within the converter, the oil serves as transfer of the power according to the well-known hydrodynamic principle (see Chapter Torque converter).
To avoid cavitation, the converter must be always completely filled with oil.
This is achieved by a converter pressure holding valve, following the converter, with an opening pressure of about 4,3+3 bar.
The oil which is escaping from the converter is directed to a heat exchanger (oil-water resp. oil-air).

At water-cooled engines, the heat exchanger has to be arranged in the cooling-water stream which is delivered to the engine.
An oil-air cooler can be also used. At air-cooled engines, the heat exchanger must be arranged in the cold-air stream of the cooling fan.
The heat exchanger has to be connected according to the counterflow principle.

These units are not supplied by the **ZF Passau GmbH**.

For the safety of the oil cooler, a bypass valve has to be planned which is reacting at cold oil or clogged oil cooler.

From the oil cooler, the oil is delivered to the transmission and there to the lubricating-oil circuit so that all lubricating points are supplied with cooled lubricating oil.

Five solenoid valves are installed in the control unit - see Table-5.
The allocation of the solenoid valves - shifting positions - to the single speeds can be taken from the Tables 3 and 4.
The selection of the solenoids will be differently combined according to the speed.
These combinations are called coding.
The electric shift control offers the advantage of an easy and exact operation.
It is an essential advantage that due to the electric cable connection, no installation problems are created.

1.4 Controller

1.4.1 General:

☞ Due to the great number of the available Controllers, the precise Technical Data must be taken from the respective installation drawing.

1.4.2 Controller DW-3

- see Table-8

The Controller is designed for the mounting on the steering column left side. By a rotative motion, the positions (speeds) 1 to 4 are selected by tilting the lever, the driving direction (Forward (F) – Neutral (N) – Reverse (R).

The DW-3 Controller is also available with integrated Kickdown pushbutton.
For the protection from unintended start off, a Neutral interlock is installed:
Position „N“ – Controller lever blocked in this position
Position „D“ - Driving

Controller DW-3

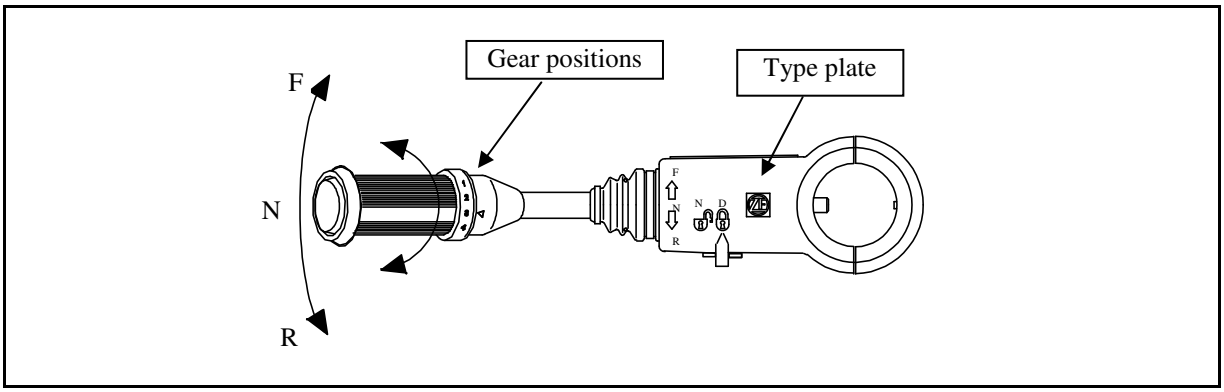


Figure-No.: 1.4.2

1.4.3 Controller ERGO II

- see Table-11

This lever will be installed in the Wheel loader instead of the operating lever for the hydraulic system for implement operation.
By pushing the arrow button „Forward“ and „Reverse“, the driving direction will be selected, the Buttons „+“ and „-„ are preselecting the driving range.
The indication for gear and driving direction is shown on the Display (see 1.5).
By means of the „N“-Button, the transmission is shifting to Neutral.
Gear limitation, if second cabin is activated an the all-wheel drive is engaged.

Controller ERGO II

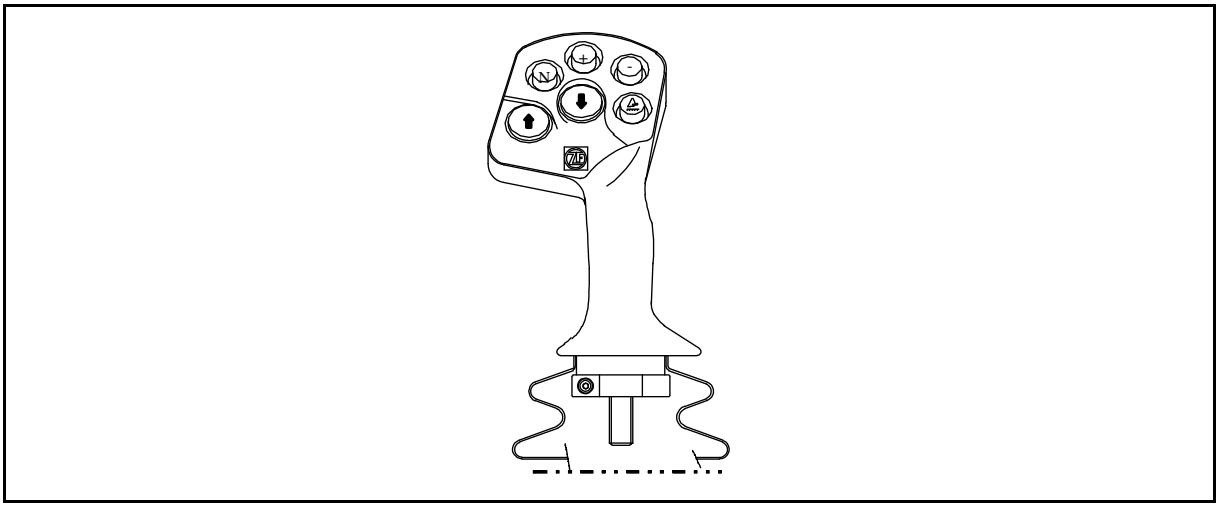


Figure-No.:1.4.3

Another Button on the operating field allows the connection of an electric shovel-horizontal Regulation (Shovel-Neutral). Another function button is installed on the back. It serves, according to the programming, as Kickdown button, Down-shift button or Release button for the start off.

1.5 Display

1.5.1 General:

The Display can be used with all Controller types, e.g. with the DW-3 or ERGO II for Wheel loaders, Lift trucks, RoRo trucks as well as with the VTS-3, SG-6 or D7 for Cranes, Dumpers, Graders and Rail vehicles.
It indicates the gear and the driving direction as well as the activated Kickdown (at vehicles with converter lockup clutch (WK) optionally the Status „WK closed“).
If the Automtic control EST 25 is used, a bar indicator gives additionally also informations about the selected driving range; the automatic range is symbolized by Arrows above and below the bar indication. In case of possible errors in the system, a wrench appears on the display, combined with the indication of the error number.
Errors, which appear sporadically can be also displayed.

1.5.2 Possible Indications on the Display

Display

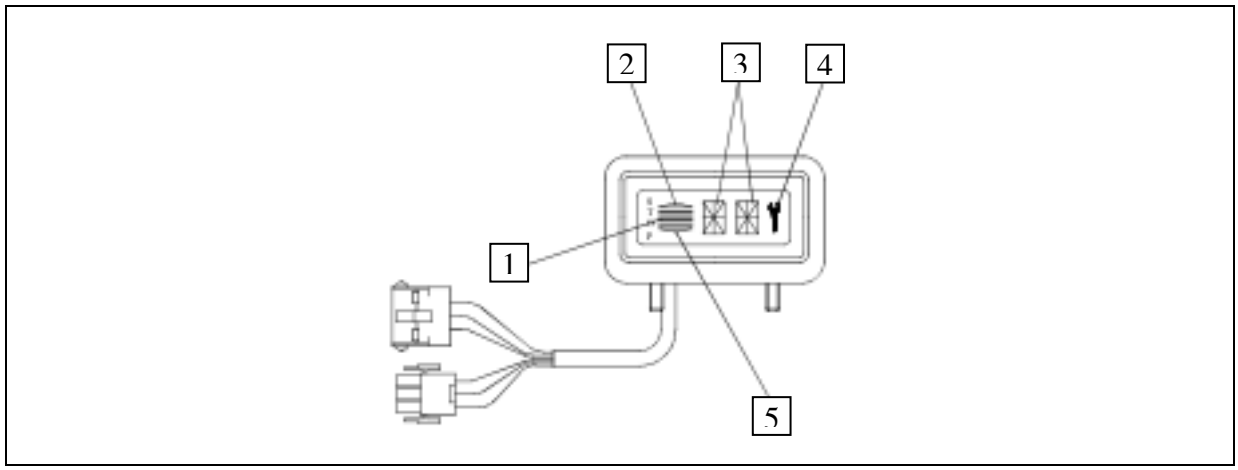


Figure-No.: 1.5.2

LEGEND:

1 = Selected speed
2 = Driving direction Forward
3 = Display error number
4 = Symbol for error in the system
5 = Driving direction Reverse

1.5.3 Error Chart:

In case of unrecoverable errors, the System shuts down completely (RESET; New start only through Ignition OFF/ON).
To it belong especially **Output line interruption** and **Outside supply** at lines to the speed solenoid valves.
These errors **CANNOT** be displayed.

Another error category is leading to an immediate RESET, whereas however, the electronics is still indicating the errors as error numbers as long as a) these are still present and/or b) the Controller is not yet in position „Neutral“ (Status „Waiting for Neutral“).
After the error is cancelled, and in position „Neutral“, the electronics is starting the transmission-control program and clears the error display.

To this belong the following Error classes/Error numbers:

- Invalid Controller input-line combination: 22
- Short circuit of an output against ground: 23
- Defective voltage supply: 24
- Error in the data field: 31
- Error in the program operation: 32
- Error in the processor-RAM: 33

Finally, there are still errors, which are not directly critical. In this case, no RESET will be initiated, i.e. the transmission-control program is running on with limitations; the errors will be only displayed after the shifting to Controller-Neutral, and are only cancelled again with the shifting from Neutral:

- Failure of the turbine speed sensor: 02 (42*)
- Failure of the output speed sensor: 10 (50*)
- Interruption/Foreign power supply of only less critical outputs: 21 (61*)

As a standard, errors are issued through a LED with dropping resistor which must be connected on the diagnostic connector (Flashing signal long: Decimal value, short: Units value, e.g. corresponding to „long/long/short/short“ of the error number „22“).
The LED is flashing shortly after the ignition is switched on (lamp test).
In the Status „Waiting for Controller-Neutral“, it is lighting permanently (possibly with flashing-code output), at trouble-free driving, it is completely off.

(*): If the optional display is used, the errors can be issued on this one as error number. In this case, these error numbers 02, 10 and 21 are also displayed if they had occurred only temporarily and disappeared again in the mean time.
The value of the error number for such sporadic errors is then increased for + 40, therefore to 42, 50 resp. 61.

Still another NOTE concerning the Display:

At a very short-time OFF/ON switching of the power supply (ignition), wrong error messages can be issued on the display, because after the switching off of the ignition, the microprocessor is still „hunting".
If requested, the error indication on the display can therefore be completely suppressed.

1.6 Electronic control units for ZF-Powershift transmissions:

1.6.1 General:

Because of the different designs of the electronic transmission controls at the different vehicles, the corresponding details must be taken from the Operating Instructions of the Vehicle Manufacturer or from the Technical fly leafs of the corresponding Parts-List Versions.
In these are also indicated the relative wiring and connection diagrams, see Sample -Tables-6, and 7.
These Informations can be also requested from the ZF Passau.
Furthermore, a separate description of these Control units is existing.

According to the type of vehicle, the wiring will be realized according to the wiring diagrams.
Variations as double-control platform operation (e.g. RT-Crane Vehicles) are available.
The corresponding switching diagrams are available upon request.
Upon request, the wiring can be also supplied by the ZF.
If the wiring is realized by the Vehicle Manufacturer, it should correspond to our conditions.

1.6.2 Semi- and fully automatic control

1.6.2.1 Description of the Basic function:

The Powershift-Reversing transmissions of the WG-Series are mostly equipped with the Electro-hydraulic transmission control developped for them.
With this Control unit it is possible to automate the transmission control in a simple manner from the Semi-Automatic EST-17T up to the Fully-Automatic EST-25.
For Wheel loaders, ZF has developped a special Controller concept by means of the Controllers DW-2 and ERGO II with integrated kickdown knob.
The System is processing the request of the driver concerning driving direction and speed as well as the actual vehicle speed, and offers essential advantages:

- Optimal adaptation to engine, vehicle and application criteria by specific programming
- Adaption of the shifting points in relation to the load level of the engine
- Optimal reversing behavior
- Comfortable kickdown function
- Wide range of Controllers (for each case of application, the optimal Controller type is available)
- Electric system resistant to short circuit and overvoltage
- Far-reaching protection against operating errors (Software)
  Semi- and Fully-Automatic units available.

EST-17 T - Family pack

(Example Transmission WG-158, Maximum System *)

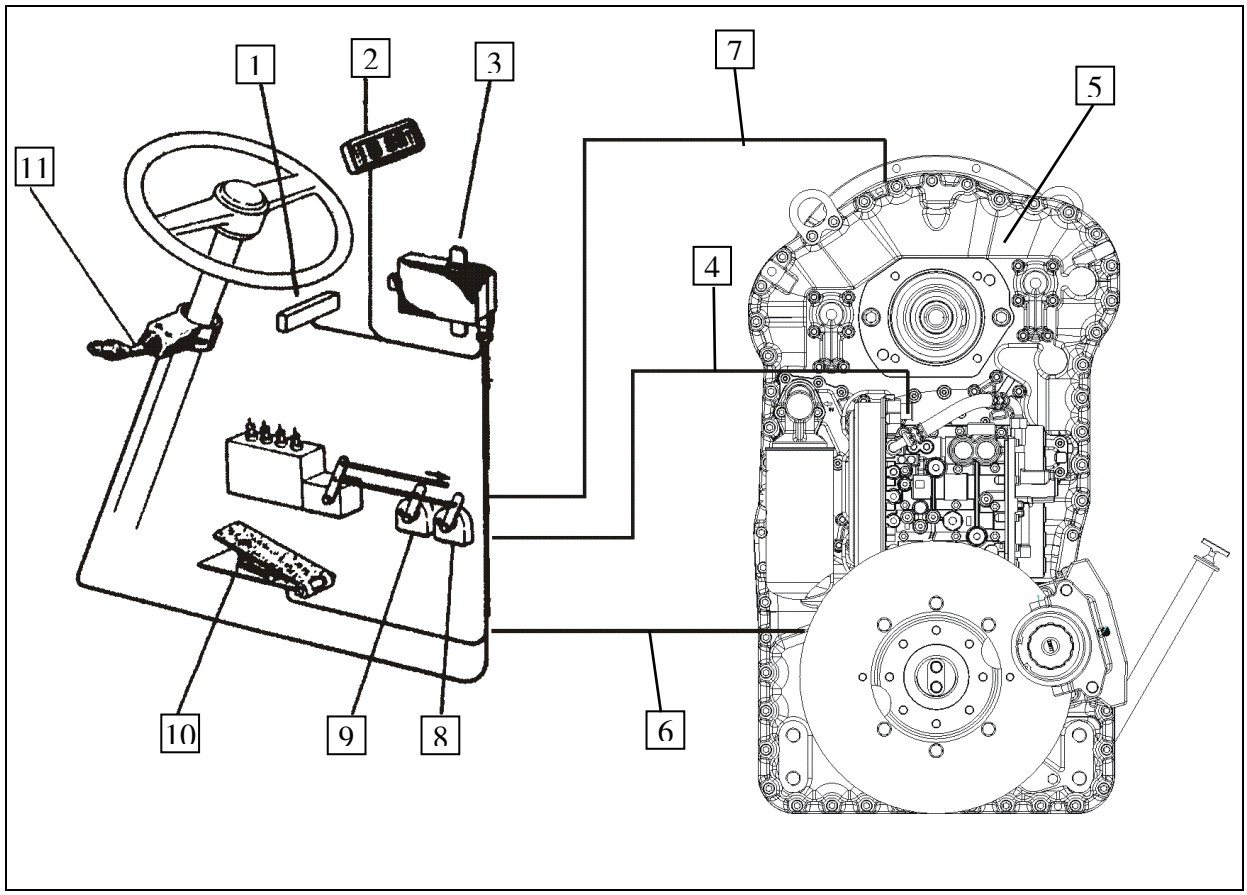


Figure-No.: 1.6.2

LEGEND:

1	=	Supply sytem connection
2	=	Display
3	=	EST-17 T Transmission control
4	=	Cable to the speed valves
5	=	Transmission of the WG-Series 158
6	=	Cable to the Inductive transmitter Output
7	=	Cable to the Inductive transmitter Turbine
8	=	Idle rotary switch
9	=	Load cell Lastgeber
10	=	Kickdown switch
11	=	Controller DW-3

1.6.3 Description of the Microprocessor Control unit EST-..

1.6.3.1 General:

The Microprocessor Control units are distinguished between:

- Semi-Automatic EST-17T (24V Supply system voltage), resp.
  EST-19T (12V) and
- Fully-Automatic EST-25 (24V) resp.
  EST-26 (12V)

The difference between Semi- and Fully-Automatic is essentially consisting in the load and speed-dependent automatic gear changes at the Fully-Automatic unit (see 1.6.3.5).
The installation of the Electronic system, resistant to short circuit and overvoltage, must be realized on a protected point in the driver's cabin, and by means of the enclosed rubber buffers.
The housing must be connected with the chassis-ground. Besides, the Limit values and Specifications, indicated on the Installation drawing resp. in the Technical Costumer documentation have to be observed.
With slipped on plug, the box is splash-proof.
Pay attention to the correct installation of the supply line according to the ZF-Instructions.
.

1.6.3.2 Direct selection of the solenoid valves:

The solenoid valves of the electro-hydraulic control block are directly selected by the electronic unit without interconnection of relays. This means that under normal conditions, only the outputs for starter interlock and back-up lamps have still to be connected through relays (see in this connection the corresponding circuit diagram) Sample - Table-8 and 9.

1.6.3.3 Speed engagement:

After the switching on of the ignition, the electronic unit is remaining in the Waiting State; by the position NEUTRAL of the Controller, resp. by pressing on the Key NEUTRAL, it becomes ready for operation.
Now, a speed can be engaged. For the speed engagement from NEUTRAL, the following is generally applicable:

If the driving speed is too high in relation to the preselected speed (danger of overspeeds), the lowest still permitted speed will be engaged and is then downshifted, possibly in dependence on the driving speed.

1.6.3.4 Passive reversing lock:

The Controllers DW-3 and ERGO II are not equipped with an active reversing lock.
On the contrary, the driver can start reverse shiftings at any time.

Example „Wheel loader“:

Dependent on the actual driving speed, the following is resulting:

- In the speeds 1 and 2, direct reversing is realized at any time (1F ⇔ 1R and 2F ⇔ 2R).
- Reverse shiftings in the speeds 3 and 4, are carried out in dependence on the driving speed according to the following Algorithm:
  - • *Semi-Automatic EST-17T (EST-19T):*
  - Above a programmable speed limit (as a rule, the maximum speed of the 2nd Speed) After a short hold time, the 2nd Speed will be upshifted.

    If the limit speed falls below, during this operation, this procedure will be interrupted and the reversing in the target speed is immediately realized.

  - Below this speed, reversing is realized immediately.
  - • *Fully-Automatic EST-25 (EST-26):*

    At driving speeds below the reversing limit, the Automatic control is generally downshifting at first for one speed, and is then reversing in this speed.
    Apart from that remains valid what has been mentioned before under „Semi-Automatic“.

At vehicles as Dumpers, Cranes and Rail vehicles, reversing can be permitted in all speeds, however it is limited to very low driving speeds.
At a too high driving speed, the electronic unit is shifting the transmission to Neutral and is finally carrying out the reversing only at relatively low output speeds.

1.6.2.5 Gear shiftings:

General:
In relation to the gear shiftings, maximally four load conditions, Partial load (TL), Full load (VL), Kickdown (KD and Retarder/Engine brake (RET) can be distinguished.
For each of these load ranges, separate values for Upshiftings, Downshiftings and WK-Shiftings as well as different speed allocations (available speeds) are programmable.

In the driving program, a difference is made in dependence on the charge lever position (injection pump) between the Load ranges TL and VL. As far as a kickdown switch is planned, an additional Load range KD can be distinguished.
A load-dependent adaptation of the shifting points is therefore ensured.

TL: Since the full engine power is not required, speed-upshiftings can be carried out relatively early i.e. at low driving speeds, and downshiftings correspondingly late.
The engine is run in a range of low fuel consumption and at a low noise level.

VL: In this load range, the shifting points of the speeds are tuned in such a way that the zone of the optimal engine torque will be fully utilized.
Engine and transmission are collaborating ideally.

KD: The engine power is now fully utilized in order to achieve an optimal acceleration . At the same time, it is possible by actuation of the kickdown switch, to achieve an optimal deceleration of the vehicle by earliest possible downshiftings. Then overspeeds of the engine are excluded.

RET: For vehicles with Engine brake and/or Retarder, this shifting-point field allows an optimal vehicle-specific adaptation.
Retarder/Engine-brake operation is practically only permitted in the overrun-, resp. partial-load operation, and requires therefore the Signal (the Status) „TL“.

Upshiftings:

Semi-Automatic EST-17T (EST-19T):

If the preselected target speed is at least 2 gear steps higher than the speed just engaged, upshiftings are realized in a cycle of 2,0 seconds (typical value for Wheel loaders).

Fully-Automatic EST-25 (EST-26):

In the Automatic driving range, upshiftings at normal driving are realized in dependence on driving speed and load. If a so-called LL-Switch (switch for the acknowledgment „accelerator pedal in idle position“, i.e.in the range 0 up to about 20%) is used, the Automatic control is suppressing any upshiftings in the overrun condition, so holding the actual speed.

Downshiftings:

EST-17T (EST-19T):

Downshiftings are only released if after the downshifting, the turbine speed does not exceed 1,0 ... 2,0 times (according to the vehicle type; Wheel loaders: 2,0) the permitted maximum engine speed, and the just engaged speed has been shifted longer than the so-called minimum dwell time (typical value: 2,0 seconds).
Upon request of the customer, also other speed sequences e.g. $4 \Rightarrow 2 \Rightarrow 1$ can be programmed.

Fully-Automatic EST-25 (EST-26):

Here, downshiftings are principally carried out in dependence of driving speed and load.
In addition, a downshifting for one gear step can be forced by pressing a knob (kickdown knob in double function or separate knob). According to the request, this function can be at disposal or generally or only in idle operation (LL-Switch, see above).

1.6.3.6 Special kickdown function for Wheel loaders:

Through the kickdown knob, integrated in the Controller lever, the 1st Speed can be selected at any time in the Speeds 2F and 2R (i.e. Pos. 2 of the Controller, at Automatic control also in the 2nd Speed of the Automatic range) by a short touch..

This kickdown condition can be cut off - according to the programming - by:

1. Another pressing of the kickdown knob
2. Carrying out of a reverse operation
3. Change of the Controller lever position by changing (rotating) of the driving position 1 ... 4, resp. by pressing the Keys „+“ or „-“ .
4. Exceeding of a rotational speed limit

The kickdown will be always completed after shifting to Neutral.

1.6.3.7 Pressure cutoff:

Especially at Wheel loaders and Lift trucks, the pressure cutoff can be activated in the speeds 1 and 2 Forward and Reverse through an external plus signal.
It is interrupting the power flow in the transmission as long as this signal is present.
At other vehicles, this function can be used for the Neutral shifting of the transmission at applied hand brake or as „Emergency Stop“ (in this case, another drive off is only possible through the Controller-Neutral position).

1.6.3.8 Special function:

There are different special functions possible, as for example:

- Control of Converter clutch, Retarder/Engine brake, Antigas, Engine power
- Starter interlock from Neutral at too high engine speed during speed engagement from Neutral
- Limitation of the available speeds in dependence on Control platform (I or II), All-wheel steering, Front-axle engagement (Crane vehicles)
- Control/Limitation of the available speeds at inching operation (Lift truck)

1.6.3.9 Customized control outputs:

The Electronic unit disposes of a total of 8 line outputs (+24 V resp. +12 V, max. 0,5 A each). According to the type of the transmission and the vehicle, possibly not all of them will be needed, and can then be used for customized purposes.

Typical parameters are:

- Vehicle speed
- Controller lever position / Speed range
- Engaged speed
- Preselected driving direction
- Reversing condition

At the same time, logical operations can be also created.

1.6.3.10 Solenoid valve selection in Position Neutral:

Especially at Wheel loaders and Lift trucks, determined, transmission-specific solenoid valve combinations are issued in the Positions 1 and 2 in the Neutral position of the Controller lever for the pre-filling of the speed clutches. These will be cancelled if the vehicle is exceeding a determined maximum speed (Wheel loaders: the maximum speed of the 2nd Speed). (See Table-5 and 6).

1.6.3.11 Inductive transmitter - Failure recognition:

Example „Wheel loader“:

The driving speed is acquired through an output-side inductive transmitter.
Its failure during the drive will be acquired and recognized by the Electronic unit. The maximally permitted speed is then the highest speed, in which a direct reversing, independently from the driving speed is permitted, i.e. the 2nd Speed.

A failure will be also supposed if the vehicle has already at least one time reversed, and is standing in a speed higher than the 2nd for more than 10 seconds.
If the Electronic unit has recognized a sensor failure, upshiftings beyond the limit „2nd Speed“ can no more be realized, and from the speeds 3 and 4 only reverse shiftings are still possible. Besides, reverse shiftings from the speeds 3 and 4 are only still possible into the 2nd Speed of the other driving direction.
At the speed engagement from Neutral, the highest disposable speed will be generally engaged and then downgraded in the preselected (lower) speed.

At vehicles equipped with WK, and generally at all Automatic vehicles, a sensor for the acquisition of the turbine speed is additonally planned. Its signals are constantly checked for plausibility with those of the output sensor.
The maximally disposable speed at output sensor failure on vehicles equipped with WK, is normally the 1st Speed. The above-mentioned is applicable accordingly.

The Status „Sensor failure“ will be cancelled, as soon as the inductive transmitter signal is recognized again. Then however, follows an automatic upshifting in a possibly preselected speed (see also 1.6).

1.6.3.12 System behavior at faults:

The Control unit is constantly monitoring all inputs from the Controller and outputs to the solenoid valves as well as the speed sensors. In case of illegal combinations (e.g. by a cable break, external supply), the Electronic unit is going immediately in the Neutral condition and switches off all outputs. The same happens if the voltage supply is exceeding determined limit values or a short circuit is existing. The cutoff can be cancelled again by shifting the Controller lever beyond the position „NEUTRAL“. The cancelation of the upshifting lock after (terminated) sensor failure, is realized by shifting to Neutral or automatically as soon as preselected and the actual speed are coinciding.
It will be distinguished between unrecoverable failures (emergency properties plus display, see Appendix A). At a repeated fault, it is absolutely necessary to check the supply system electrics; defective components must be immediately replaced.

1.6.4 Diagnosis-System:

An error readout is possible by connection of a diplay unit on the diagnostic connector. This unit can be a LED with dropping resistor (flash code) or the ZF-Display (Wrench symbol plus errror number).

IMPORTANT: According to the programming, only the LED or the Display can be used, i.e. the type of the display unit must be already determined prior to the programming of the EST. Statically and sporadically occurring faults will be acquired and displayed.

1.6.5 Wiring:

In the so-called compact wirings, we have combined the cable connection to Solenoid valves, Inductive transmitter, Controller, Electronic unit, Diagnosis, Supply system etc.
Thereby, the laying and connecting of single cables is eliminated.
This compact wiring is regularly available in different lengths.
For the perfect function of the system, the use of a ZF-Wiring is recommended.

1.6.6 Test of the Electronic transmission control:

The different ZF-Control units can be tested with the Testers PR-68 and PR-78 A + B (see Chapter-V Diagnose) combined with the special equipments of the actually installed Automatic shift control.

The relative Operating Instructions are delivered together with the corresponding Tester.

These Test Instructions can be requested from the ZF-Passau Service Department against a fee of 8.00 EUR.

II. INSTALLATION INSTRUCTIONS

These instruction for the installation of hydro-dynamic powershift gearboxes of the Ergopower series are the basis for the technically correct installation of these gearboxes in the vehicle. The installation instructions are part of the gearbox documentation and must absolutely be observed.

An improper installation of the gearbox in the vehicle can

* affect the operating quality
* cause failures in gearbox functioning
* lead to gearbox defects or failures.

**The vehicle manufacturer is responsible for the correct installation of the gearbox.
ZF does not accept a warranty or warranty claims for failures
which are due to an improper installation.**

To support the customer upon a new or first application, ZF has the gearbox installation checked by authorised staff. Here, all gearbox-specific installation parameters are checked and defects found notified to the manufacturer of the vehicle or of the equipment.
In case of an improper installation, ZF reserves the right not to take over the warranty for the installed ZF products.
The vehicle manufacturer alone will be liable for damage which must be contributed to him and which could not be found by the ZF staff during the installation check.

☞ These installation instructions

4657 700 078 GERMAN
4657 700 079 ENGLISH

can be obtained under the following address:

ZF Passau GmbH
Abt. ACET5
Donaustr. 25 - 71
94034 Passau

III. OPERATION

3.1 Preparations for driving and maintenance:

Prior to starting up the gearbox, make sure that the correct volume of the specified oil type is filled in. Upon first filling of the gearbox, it must be considered that the oil cooler, the pressure filter and the pipelines must be filled with oil.
In view of these cavities, the oil volume to be filled in is larger than for later oil fillings within the scope of the normal maintenance.

☞ As the converter and also the oil cooler installed in the vehicle as well as the pipelines can empty into the gearbox upon a standstill, the

oil level check must be made with the engine idling and with the gearbox at operating temperature (see chapter oil level check 4.2)

⚠ **For the oil level check, the specified safety regulations as per $ 6 of the accident prevention regulations for drive systems in Germany and in other countries the respective national regulations must be observed.**
The vehicle must be secured against rolling e.g. with wedges, articulated vehicles in addition against unintended steering.

3.2 Driving and shifting:

☞ The pilot lights lighted in the INFOCENTER (dashboard) for function control may differ from vehicle manufacturer to vehicle manufacturer.
Operating elements and indicators can be of ZF-make but also customer-specific product; therefore the precise data must be taken from the operating instructions of the respective vehicle manufacturer.

The engine must always be started in the NEUTRAL POSITION of the speed range selector.
For reasons of safety, it is recommended to always securely brake the vehicle prior to starting using the parking brake.

After starting and having pre-selected the driving direction and the gear, the vehicle can be moved by accelerating.
Upon starting, the converter takes over the task of a main clutch.
On even ground, it is possible also to start in higher gears.
However, the acceleration will be smaller.

If the vehicle is stopped and stands with running engine and activated gearbox, the engine cannot be killed. On an even and horizontal roadway, it may happen that the vehicle starts creeping, as the engine when idling is generating a small drag torque via the converter.
It is reasonable to securely brake the vehicle with the parking brake upon every stopping.

In case of longer stopping times, the speed range selector must be set to the NEUTRAL POSITION.
Upon starting, the parking brake must be released. Experience showed that, in the case of a converter gearbox, forgetting of this natural operating step must not be recognised at once, since the converter, thanks to its high transmission ratio, can overcome the braking torque of the parking brake without any problem.

Temperature increases in the converter oil as well as brakes having run hot are consequences which are noticed only later on.

It is pointed out that, upon downshifting, in particular when overleaping a gear, the engine is pushed up in its speed by the braking effect of the converter and can reach speeds (especially for converters with torque converter lock-up clutch) which can jeopardise the engine. Shifting should be done only, when the maximum velocity of the lower gear has been reached.
If required, the vehicle must be braked down to this velocity with the aid of the brake pedal.
This must also be observed with the speed range selector in the NEUTRAL POSITION to avoid a harmful speed of the gearbox.

Shifting from NEUTRAL to reverse, reverse to forward or vice-versa is only permitted upon a vehicle standstill with the parking brake activated and at idle speed!

3.3 Gearbox control with electronic automatic system:

Precise information on the design of the speed range selector and on the gears shifted in the individual driving range must be taken from the operating instructions for the vehicle.

A manual intervention in the automatic shifting course (shifting through of the driving ranges) is little reasonable.

In extreme driving situations, e.g. starting on slopes, a low driving range can be pre-selected and, upon a standstill or after moving off of the vehicle, directly a higher driving range can be shifted. Such, the lower starting gear is used and shifting into higher gears is not blocked. If required, by this measure, all gears of the gearbox can be automatically passed (details see operating instructions for the vehicle).

At certain slopes, upshifting and downshifting at short intervals can become necessary, i.e. when the traction force is to small for the slope in the rapid gear but too large in the slow gear. This gearshift hunting can be avoided by less accelerating or by selecting the lower driving range.

When driving on descents, undesired upshifting is avoided by selecting a lower driving range.

If, for accelerating or driving on slopes, the next lower gear shall be shifted, this is possible via the Kick-Down position of the accelerator pedal.
This pedal position permits the earliest possible downshifting into the smaller gear.

3.4 Shutting down and parking:

As by the converter no rigid connection from the engine to the axle is given, it is recommended on slopes or descents to secure the vehicle against rolling not only by activating the parking brake but also by a wedge placed underneath the wheel when the driver wants to leave the vehicle.

3.5 Towing:

The towing speed for gearbox versions without secondary pump must be 10 km/h at a maximum and the towing distance must not exceed 10 km.
For gearbox versions with secondary pump, towing is only possible at 30 km/h at a maximum and over a distance of up to 50 km.

This regulation must absolutely be observed, as otherwise the gearbox will be damaged due to insufficient oil supply!

For longer distances, the defective vehicle must be loaded onto a transport vehicle.

3.6 Oil temperature:

The oil temperature of the gearbox must be monitored by a temperature sensor.
A maximal temperature of 120°C at the converter outlet must not be exceeded.

Operating temperature behind the converter at least 65° and 100° C for continuous operation, short-term rising of up to 120° C admissible.
If the temperature rises above 120° C, the vehicle must be stopped, checked for external oil loss and the engine run at a speed of 1200 – 1500 min^{-1} with the gearbox in NEUTRAL POSITION.
The temperature must rapidly (within about 2 – 3 minutes) decrease to normal values.
If this is not the case, there is a failure which must be eliminated prior to continuing working.

Shift pressure:

To monitor the shift pressure, a pressure gauge or pressure governor must be installed.
If, with activated clutch, the shift pressure falls below the specified minimum pressure (during shifting, the pressure will temporarily drop), the cause of the pressure loss must be eliminated.
The consequence of an excessively low shift pressure is a damage to the clutches which are permanently slipping due to the too small pressing force and are damaged by overheating.

The measuring plan and the oiling diagrams contain the measuring points of the individual gears, the converter pressures and the lubricating pressure (see table-5 and 6).

☞ At measuring point **„63“**, the temperature is measured (see measuring plan table-3!)

IV. MAINTENANCE

4.1. Oil grade:

☞ Permitted for the Powershift transmissions 4 WG-158 are oils according to ZF-List of lubricants TE-ML 03.

☞ This List of lubricants will be updated every three months and can be requested, resp. inspected as follows:

- At all ZF-Plants
- At all ZF-Service Stations
- Internet http://www.zf.com **Products for / Tech. Information**

4.2 Oil level check:

⚠ **At the oil level check, the prescribed safety directions according to § 6 of the rules for accident prevention for power plants in Germany, and in all other countries the respective national regulations have to be absolutely respected. For example, the vehicle has to be secured against rolling with blocks, articulated vehicles additionally against unintended turning-in.**

The oil level check must be carried out as follows:
- Oil level check (weekly)
- At horizontally standing vehicle
- Transmission in Neutral position „N“
- In the cold start phase, the engine must be running about 2 – 3 minutes at idling speed, and the marking on the oil dipstick must then be lying above the cold start mark „COLD“ (see Figure-No. 4.2 B2)
- At operating temperature of the transmission (about 80° - 90° C)
- At engine idling speed
- Loosen oil dipstick by counterclock rotation, remove and clean it
- Insert oil dipstick slowly into the oil level tube until contact is obtained, and pull it out again.
- On the oil dipstick, the oil level must be lying in the zone „HOT“ (see Figure-No.: 4.2 B2)
- Insert the oil dipstick again, and tighten it by clockwise rotation

☞ If the oil level has dropped in operating temperature condition below the „HOT“ Zone, it is absolutely necessary to replenish oil according to the ZF-List of lubricants TE-ML-03.
An oil level above the „HOT“ marking, is leading to a too high oil temperature.

☞ The oil dipstick and the oil filler tube can have different lengths and shapes, according to the Transmission version. Besides, the mounting on the transmission can be optionally realized on the converter side or on the output side.(In this Illustration, the mounting of the oil dipstick is illustrated on the converter side).

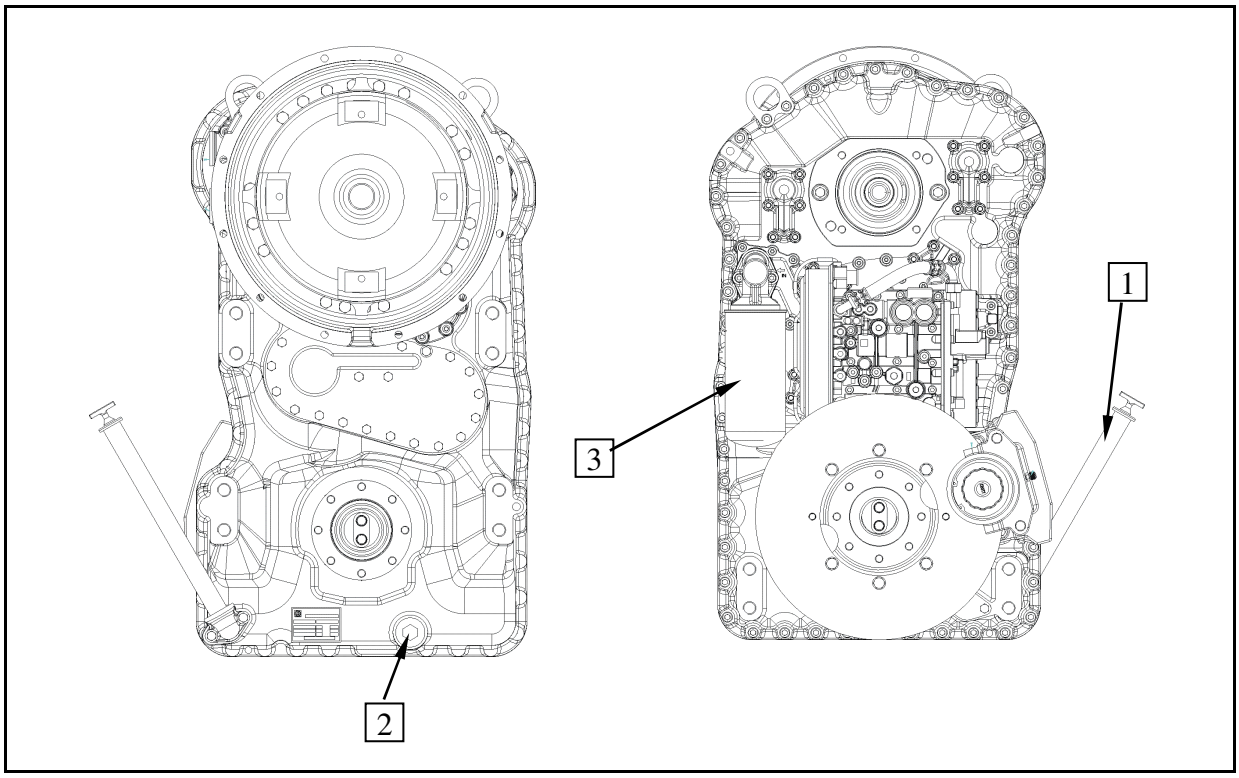


Figure-No.: 4.2 B1

Legend:

1 = Oil filler tube with oil dipstick
2 = Oil drain plug M38x1,5
3 = ZF Fine filter

Oil dipstick

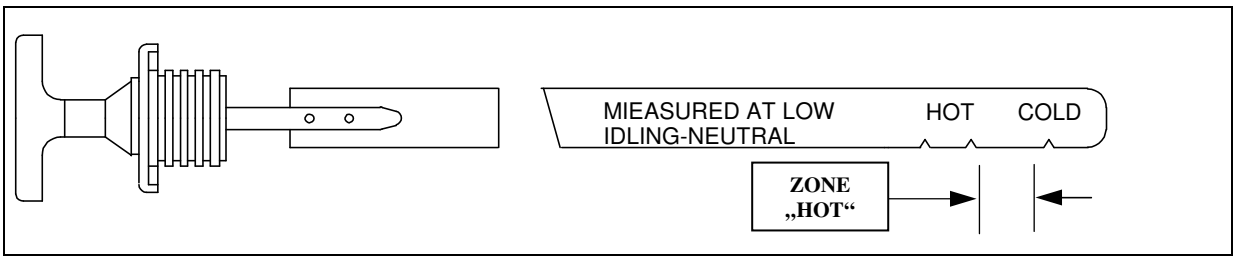


Figure-No.: 4.2 B2

4.3 Oil change and Filter replacement intervals:

☞ **First oil change after 100 operating hours in service.**
Every further oil change after 1000 operating hours in service, however at least once a year !
At every oil change, the ZF-Fine filter (pressure filter) has to be replaced.

4.3.1 Oil change and Oil filling capacity:

The oil change has to be carried out as follows:

- At operating temperature of the transmission, horizontally standing vehicle open the oil drain plug and drain the used oil.
- Clean oil drain plug with magnetic insert and surface on the housing and install again along with O-ring.
- Fill in oil (about 38 liters) according to ZF-List of lubricants TE-ML 03.

(Sump capacity, external oil capacities e.g. in the heat exchanger, in the lines etc. are dependent on the vehicle).
The indicated value is a guide value.

☞ **It is imperative to pay attention to absolute cleanliness of oil and filter !**
Binding is in any case the marking on the oil dipstick !

- Start the engine – idling speed
- Transmission in Neutral position „N“
- Top up oil up to the marking „COLD“
- Brake the vehicle securely in position and warm up the transmission
- Shift all Controller positions through
- Check the oil level once more and top up oil once more if necessary
- On the oil dipstick, the oil level must be lying in the Zone „HOT“ (see Figure-No.: 4.2 B2)
- Insert the oil dipstick again and tighten it by clockwise rotation.

☞ At the initial filling of the transmission has to be considered that the heat exchanger, the pressure filter as well as the pipes must get filled with oil.
According to these cavities, the oil capacity to be filled in is greater than at the later oil fillings in the course of the usual Maintenance service.

4.3.2 Filter replacement:

At the replacement of the ZF-Filter in the main oil stream, pay attention that no dirt or oil sludge can penetrate into the circuit. Besides, the parking brake has to be covered, resp. protected from oil wetting.
At the mounting of the filter, any exertion of force has to be avoided.

☞ Treat the filter carefully at the installation, the transport and the storage !
Damaged filters must no more be installed !

The mounting of the filter must be carried out as follows:

- Cover the gasket with a small amount of oil.
- Screw the filter in until contact with the sealing surface is obtained and tighten it now by hand about 1/3 to 1/2 turn.

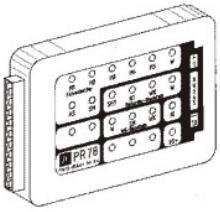
V. ZF-DIAGNOSTIC SYSTEMS

5.1 Tester PR-78 A (6008 001 001 + PR-78 B (6008 001 002)

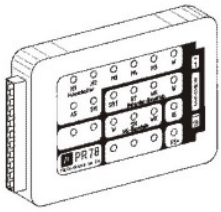
The Test - System PR - 78 A and PR - 78 B allows the testing of electronic gearboxcontrol
EST - 2 / EST - 17 T / EST - 17 TE / EST - 19 T / EST - 25 / EST - 25 E / EST - 26

In combination with different gearselectors like :
SG - 6 / SG - 6 S / SG - 8 S / DW - 2 / ERGO - II / push-button switches D-7 / D - 9

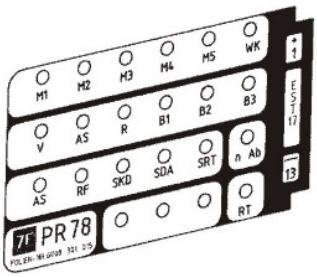
Tester PR - 78 A with LED displays
Order- No. 6008 001 001



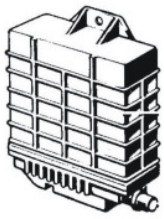
Tester PR - 78 B with socket bushs:
Order- No. 6008 001 002



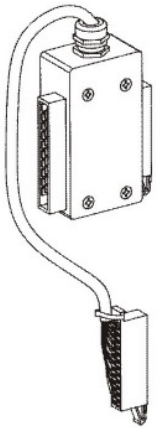
Foil 6008 301 015



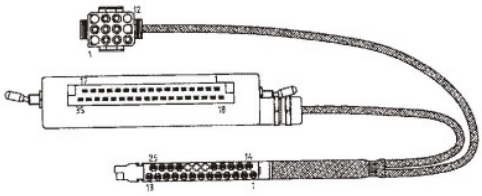
Electronic Control Unit EST - 2
EST - 17 / EST - 17 T / EST - 17 TE
EST - 19 T /EST - 25 / EST - 25 E / EST - 26



T - Adapter cable 6008 201 013 allows the combination of Tester PR - 78 A and PR- 78 B to form a complete test unit.



Adaptercable 5870 221 143



Ancillary Instruments can be directly connected through the Tester PR-78 B, thus enlarging possibilities as for example : CURRENT - VOLTAGE - RESISTANCE - FREQUENCY

Digital - Multimeter 5870 221 129 or 5870 221 103
Kableset 2x 5870 221 014

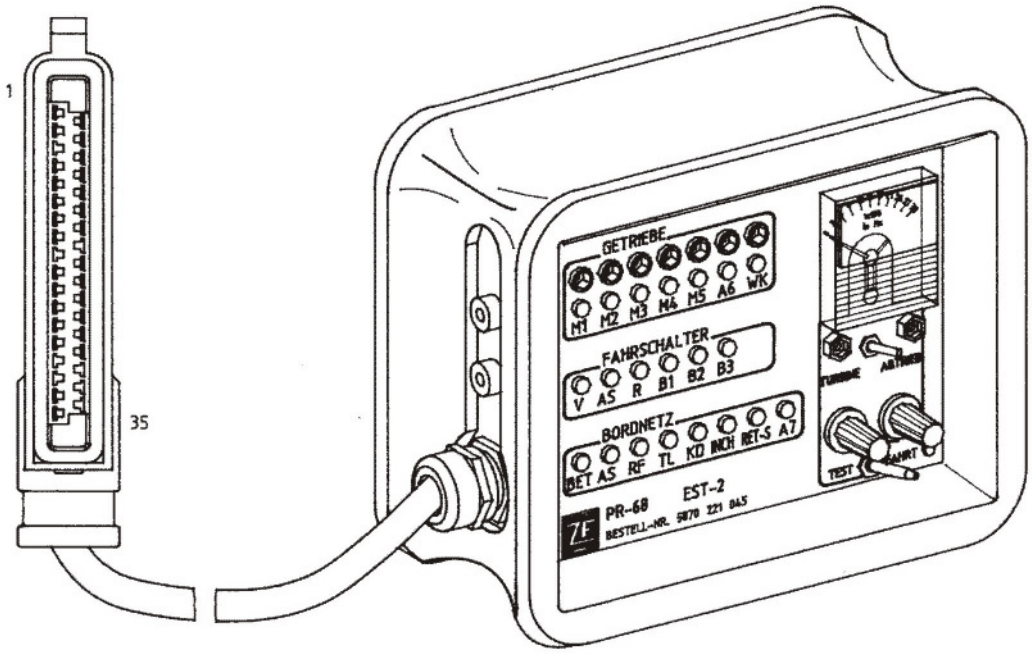
Figure-No.: 5.1

5.2 Tester PR-68 (5870 221 045)

The Tester PR-68 allows the testing of electronic control units, developed by ZF.

EST - 2 / EST - 17 / EST - 17 T / EST - 19 T / EST - 25 / EST - 26
EST - 17 TE / EST - 25 E

Transmissions with 4 - 5 - and 6 Solenoid valves .



Instruction manual for PR - 68 and EST -2 5872 991 602

Instruction manual for PR - 68 and EST -17 T 5872 991 607

Instruction manual for PR - 68 and EST - 25 5872 991 617

Figure-No.: 5.2

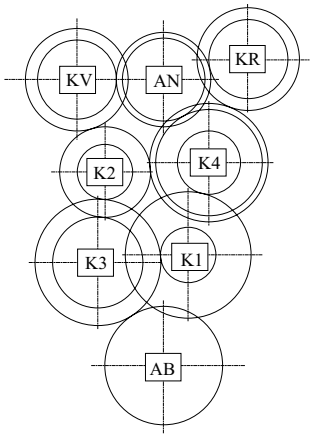
5.3 Measuring box with Multi-System 5050

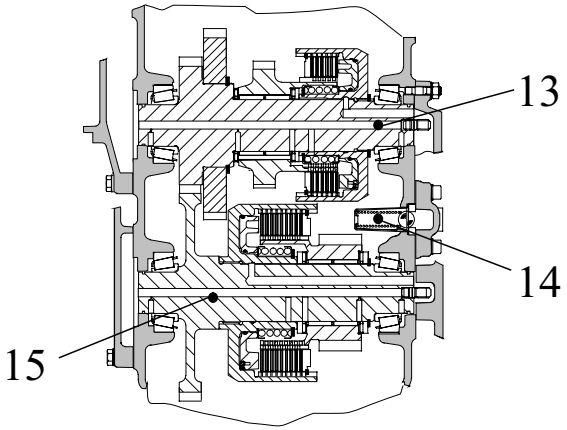
Siehe Tabelle-10

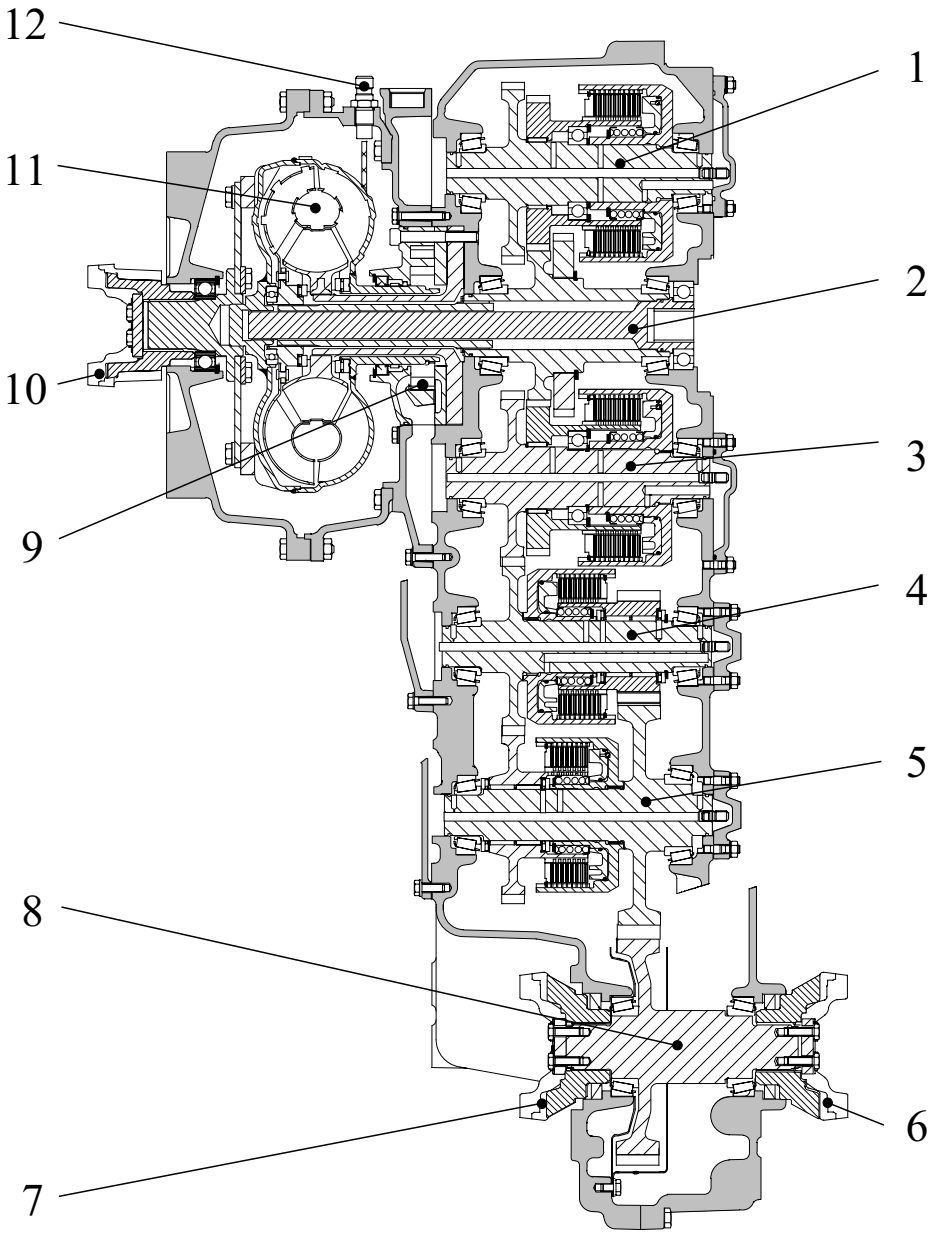
LAYOUT 4 WG-158
TABLE-1

1	=	Clutch shaft	"KR"
2	=	Power take-off; coaxial engine-dependent	
3	=	Clutch shaft	"KV"
4	=	Clutch shaft	"K2"
5	=	Clutch shaft	"K3"
6	=	Output flange (rear side)	“AB”
7	=	Output flange (converter side)	“AB”
8	=	Output shaft	
9	=	Transmission pump	
10	=	Input flange – Input through universal shaft	“AN”
11	=	Converter	
12	=	Inductive trans´mitter for engine speed	
13	=	Clutch shaft	"K4"
14	=	Converter relief valve	
15	=	Clutch shaft	"K4"

Gearbox diagram

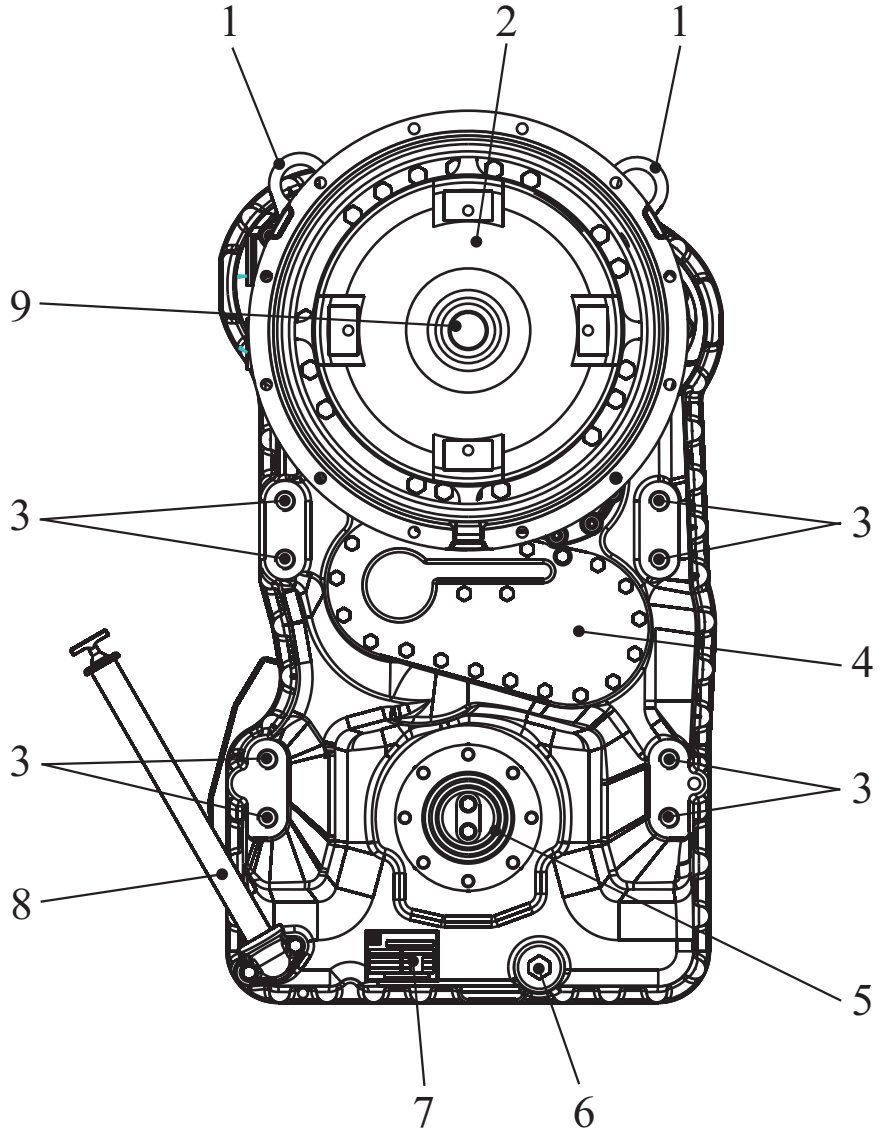






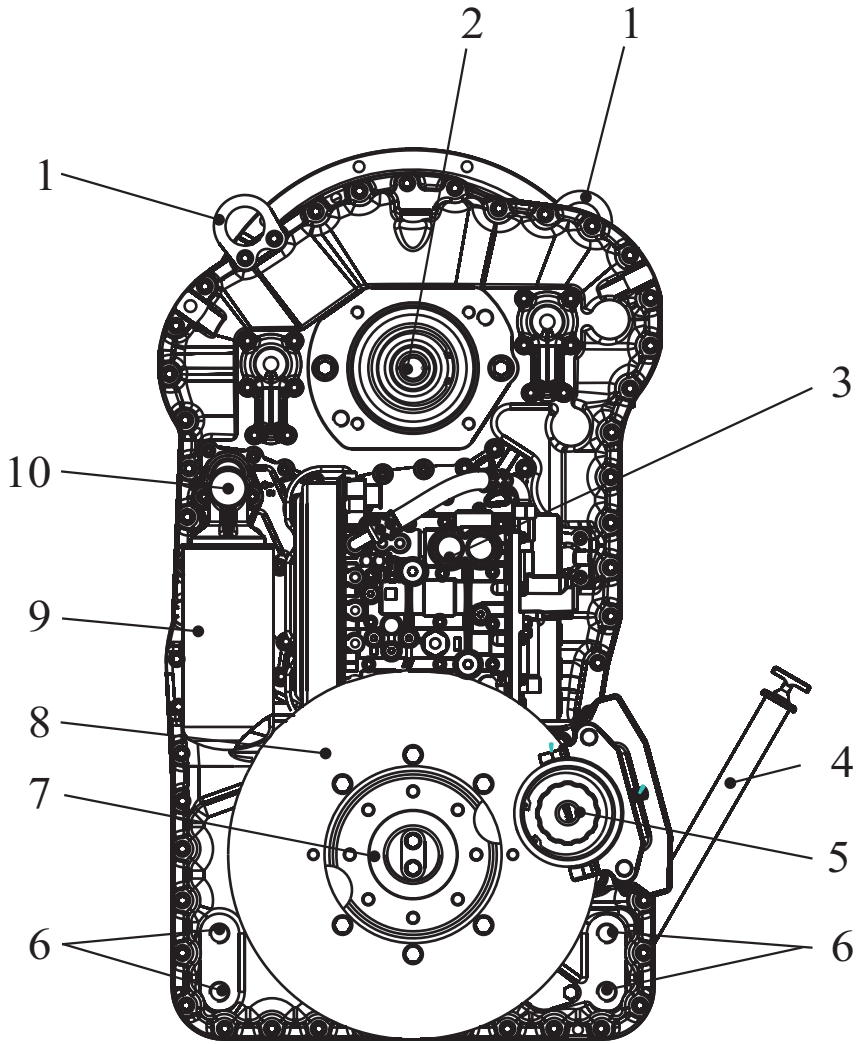
INSTALLATION VIEW 4 WG-158 - DIRECT INSTALLATION
FRONT VIEW
TABLE-2A

1 = Lifting lugs
2 = Diaphragm – direct mounting
3 = Transmission suspension holes M20
4 = Attachment possibility for emergency steering pump
5 = Output flange (converter side)
6 = Oil drain plug with magnet M38x1,5
7 = Model identification plate
8 = Oil filler tube with oil dipstick (converter side)
9 = Converter



INSTALLATION VIEW 4 WG-158 - SEPARATE INSTALLATION
REAR VIEW
TABLE-2B

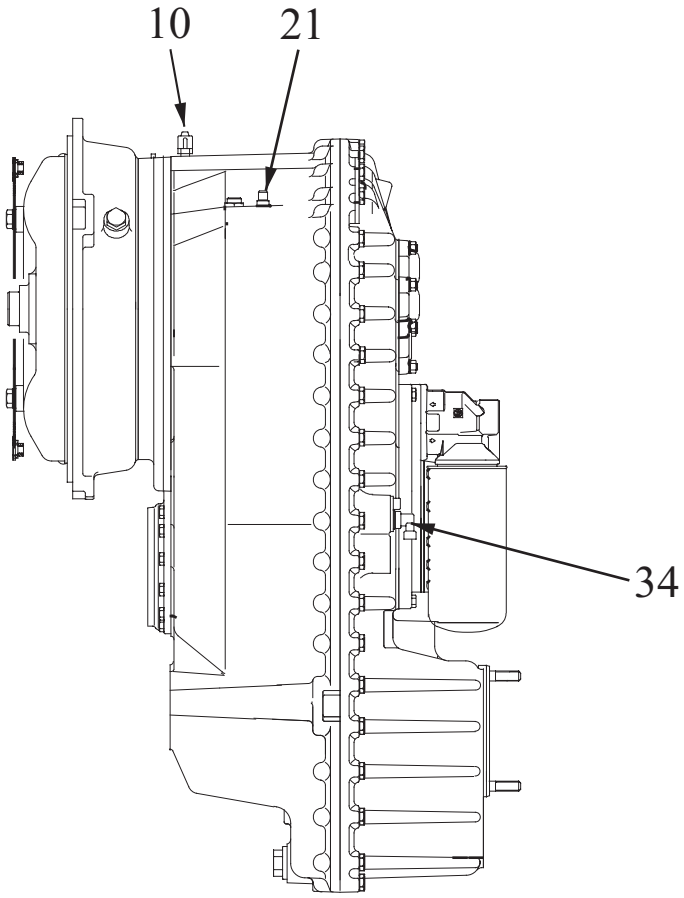
1 = Lifting lugs
2 = Power take-off; coaxial, engine-dependent
3 = Electro-hydraulic control
4 = Oil filler tube with oil dipstick
5 = Parking brake operated hydraulically
6 = Transmission suspension holes M20
7 = Output flange (rear side)
7 = Connection return line from parking brake
8 = Brake disc
9 = Exchange filter (fine filter)
10 = Filter head with



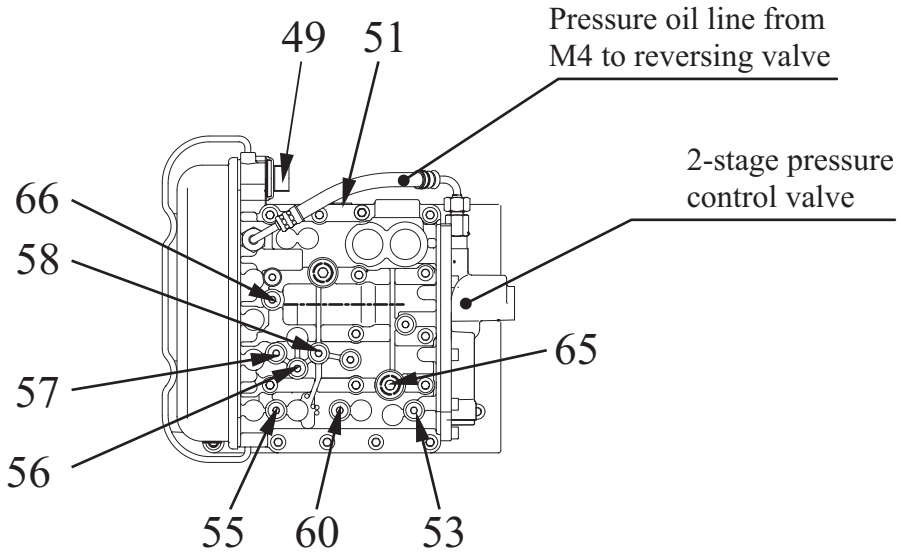
SCHEDULE OF MEASURING POINTS AND CONNECTIONS 4 WG-158 TABLE-3

The marked positions (e.g. 53) correspond with the positions on the table-4!
The measurements have to be carried out at hot transmission (about 80° - 95° C) !

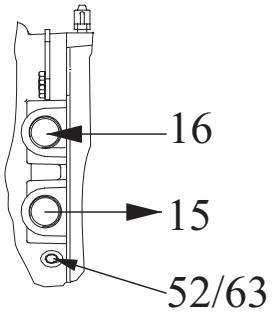
No.		*Denomination of the position*			*Connection*
		Measuring points for hydraulic and temperature:			
51	=	In front of the converter – opening pressure	11+2 bar		M10x1
52	=	Behind the converter – opening pressure	4,3+3 bar		M10x1
53	=	Clutch Forward	16 +2 bar	KV	M10x1
55	=	Clutch Reverse	16 +2 bar	KR	M10x1
56	=	Clutch	16 +2 bar	K1	M10x1
57	=	Clutch	16 +2 bar	K2	M10x1
58	=	Clutch	16 +2 bar	K3	M10x1
60	=	Clutch	16 +2 bar	K4	M10x1
63	=	Behind the converter Temperature 100° C; short-time 120° C			M14x1,5
65	=	System pressure	16 +2 bar		M10x1
66	=	Reducing valve	10 bar		M10x1
		Connection:			
10	=	Breather			M10x1
15	=	To the heat exchanger			$1^5/_{16}$“ - 12 UN-2B
16	=	From the heat exchanger			$1^5/_{16}$“ - 12 UN-2B
49	=	Plug connection on the electro-hydraulic control unit			
		Inductive:			
21	=	Inductive transmitter	n Turbine		M18x1,5
34	=	Inductive transmitter	n Ouput		M18x1,5



VIEW X



VIEW Y



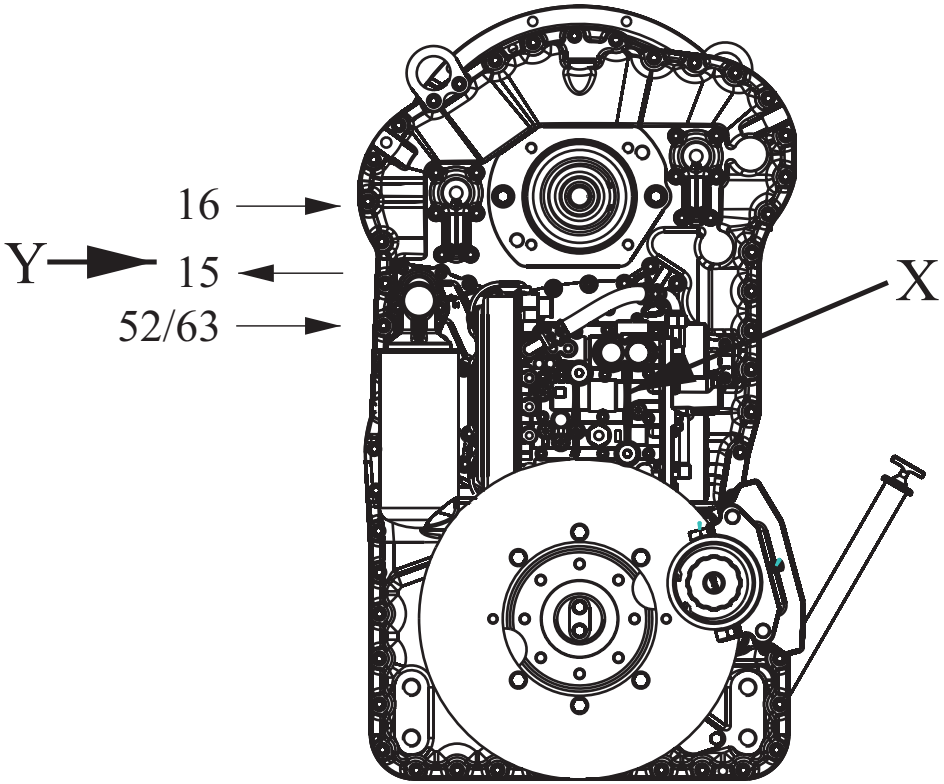


DIAGRAM CODE "G"
4-SPEED VERSION

	● Magnet under Voltage										
	Forward				Reverse			Neutral			
Speed	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**1**	**2**	**3**	**4**
M1					●	●	●				
M2	●				●			●			
M3	●	●	●								
M4	●	●			●	●		●	●		
M5				●							
Clutch	**KV**	**KV**	**KV**	**K4**	**KR**	**KR**	**KR**	**K3**			
Clutch	**K1**	**K2**	**K3**	**K3**	**K1**	**K2**	**K3**				

OIL CIRCULATION DIAGRAM 4 WG-158 WITH 2-STAGE PRESSURE CONTROL VALVE TABLE-4

The marked positions (e.g. 53) correspond with the positions on the table-3!

NEUTRAL

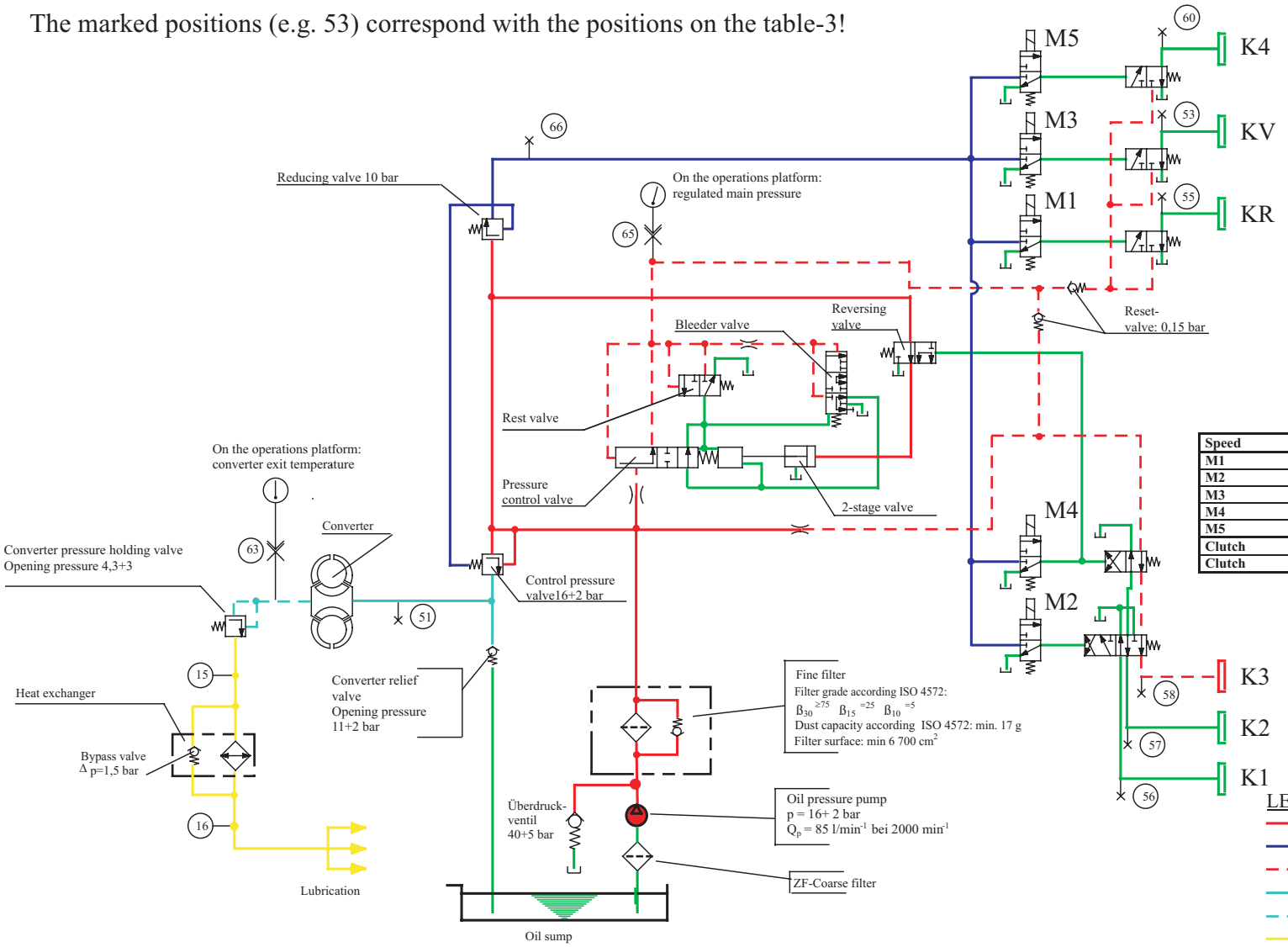


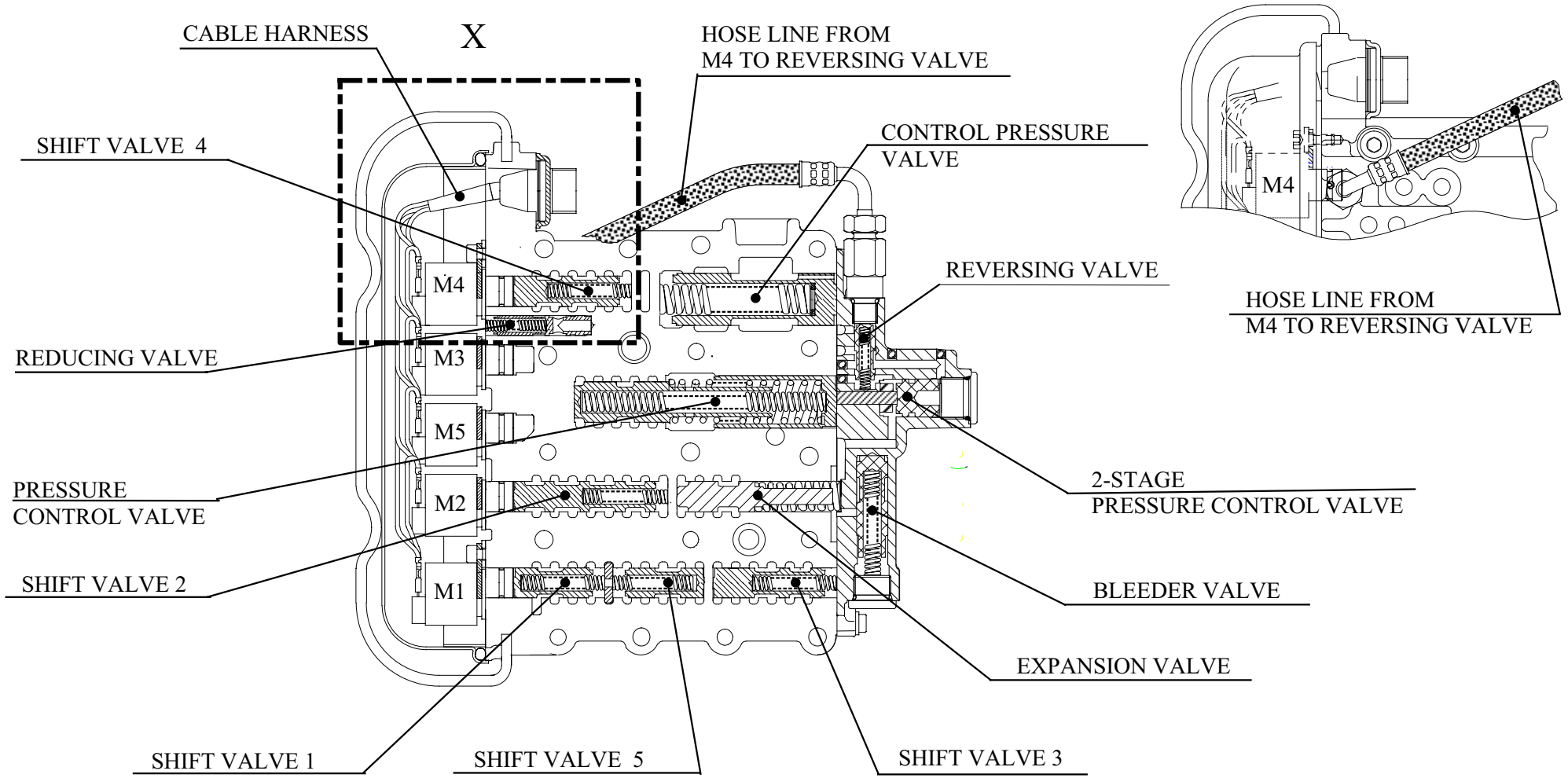
DIAGRAM CODE "G"
4 SPEED - VERSION

	● Magnet under Voltage										
	Forward				Reverse			Neutral			
Speed	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**1**	**2**	**3**	**4**
M1					●	●	●				
M2	●				●			●			
M3	●	●	●								
M4	●	●			●	●		●	●		
M5				●							
Clutch	**KV**	**KV**	**KV**	**K4**	**KR**	**KR**	**KR**	**K3**			
Clutch	**K1**	**K2**	**K3**	**K3**	**K1**	**K2**	**K3**				

LEGEND:

= CONTROL PRESSURE
= CONTROL PRESSURE REDUCED
= CONTROL PRESSURE MODULATED
= CONVERTER INLET PRESSURE
= CONVERTER EXIT PRESSURE
= LUBRICATION
= RETURN FLOW INTO THE SUMP

ALUMINUM DIE-CASTING SHIFT CONTROL WITH 5 SOLENOID VALVES EXPANSION VALVE AND 2-STAGE PRESSURE CONTROL VALVE TABLE-5



4 WG-158 SEMI AUTOMATIC CONTROL
CIRCUIT DIAGRAM - 6029 701 544 - „ CODE G „
TABLE-6

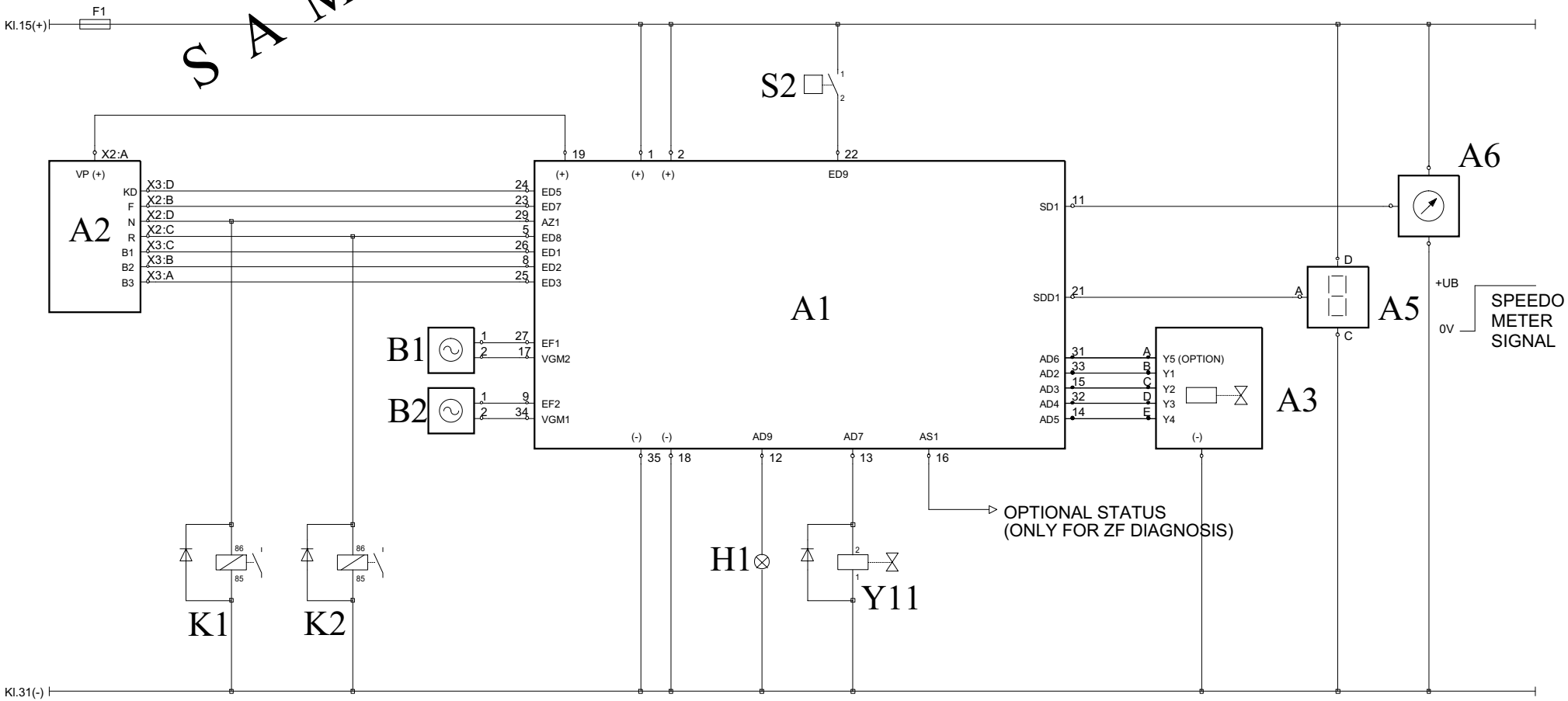
POS	LEGENDE
A1	CONTROL UNIT EST-17T
A2	SPEED RANGE SELECTOR DW-3
A3	ELECTRO. – HYDR. CONTROL UNIT
A5	DISPLAY, DIAGNOSTIC (OPTION)
A6	SPEEEDOMETER (CUSTOMER SCOPE)
B1	OUTPUT SPEED SENSOR
B2	TURBINE SPEED SENSOR
F1	FUSE 8A
K1	RELAY STARTER INTERLOCK
K2	RELAY REVERSING DRIVE
S2	SWITCH CLUTCH CUT OFF
Y11	VALVE SPEED SIGNAL 7KM/H

REFERENCE:

- BINDING IS THE RESPECTIVE PARTS LIST DESIGN

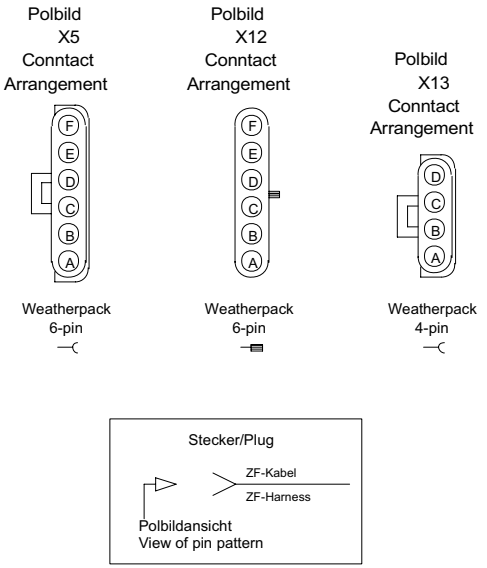
- CONNECTION DIAGRAM 6029 701 545 - SEE TABLE-9

S A M P L E


Kl.15(+)
F1
S2
A2
VP (+)
KD
F
N
R
B1
B2
B3
X2:A
X3:D
X2:B
X2:D
X2:C
X3:C
X3:B
X3:A
A1
(+)
(+)
(+)
ED9
ED5
ED7
AZ1
ED8
ED1
ED2
ED3
B1
B2
EF1
VGM2
EF2
VGM1
(-)
(-)
AD9
AD7
AS1
SD1
SDD1
AD6
AD2
AD3
AD4
AD5
A3
Y5 (OPTION)
Y1
Y2
Y3
Y4
(-)
A6
A5
+UB
0V
SPEEDO
METER
SIGNAL
K1
K2
H1
Y11
OPTIONAL STATUS
(ONLY FOR ZF DIAGNOSIS)
Kl.31(-)

4 WG-158 SEMI AUTOMATIC CONTROL
CONNECTION DIAGRAM - 6029 701 545 - „ CODE G „
TABLE-7

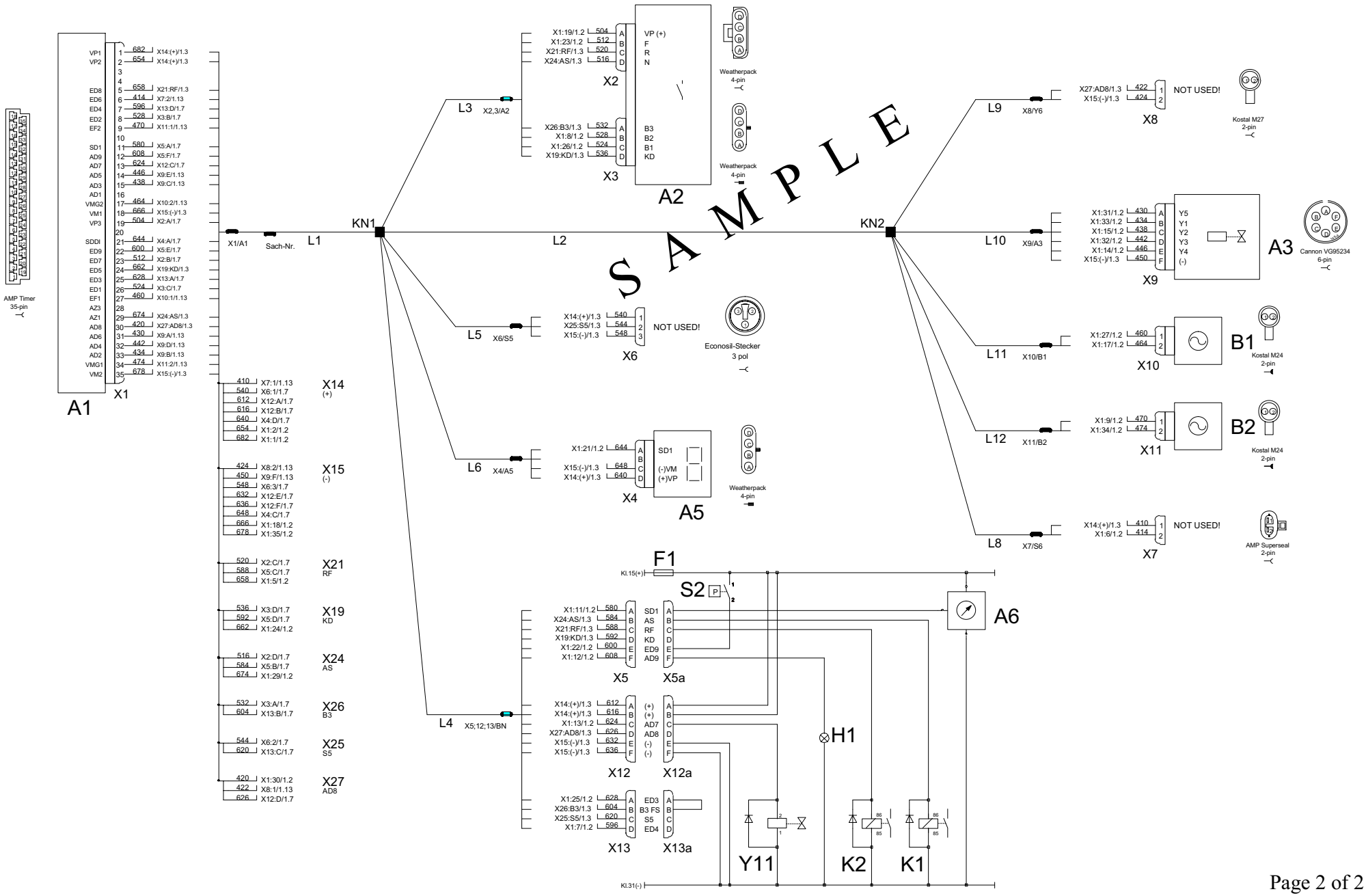
POS	LEGENDE
A1	CONTROL UNIT EST-17T
A2	SPEED RANGE SELECTOR DW-3
A3	ELECTRO. – HYDR. CONTROL UNIT
A5	DISPLAY, DIAGNOSTIC (OPTION)
A6	SPEEEDOMETER (CUSTOMER SCOPE)
B1	OUTPUT SPEED SENSOR
B2	TURBINE SPEED SENSOR
F1	FUSE 8A
K1	RELAY STARTER INTERLOCK
K2	RELAY REVERSING DRIVE
S2	SWITCH CLUTCH CUT OFF
Y11	VALVE SPEED SIGNAL 7KM/H



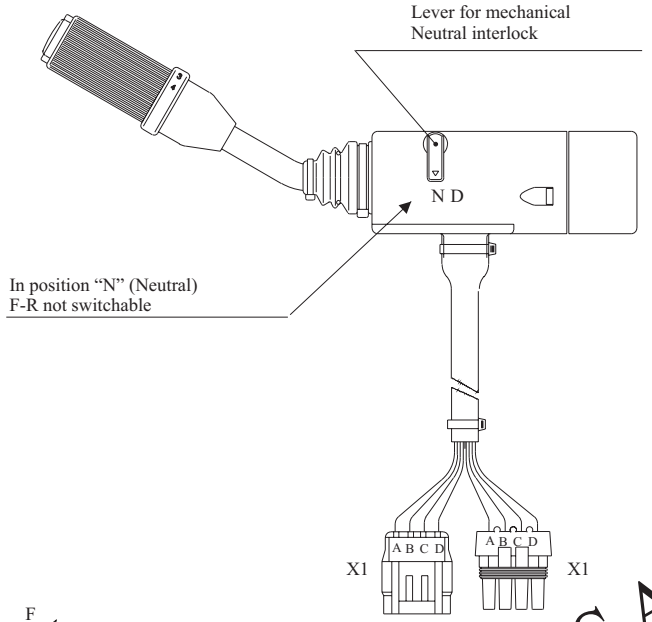
REFERENCE:

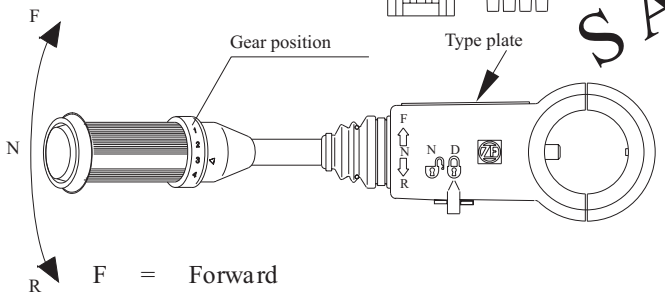
- BINDING IS THE RESPECTIVE PARTS LIST DESIGN

- CIRCUIT DIAGRAM 6029 701 544 - SEE TABLE-8


A1
X1
VP1 1 682 X14:(+)/1.3
VP2 2 654 X14:(+)/1.3
ED8 5 658 X21:RF/1.3
ED6 6 414 X7:2/1.13
ED4 7 596 X13:D/1.7
ED2 8 528 X3:B/1.7
EF2 9 470 X11:1/1.13
SD1 11 580 X5:A/1.7
AD9 12 608 X5:F/1.7
AD7 13 624 X12:C/1.7
AD5 14 446 X9:E/1.13
AD3 15 438 X9:C/1.13
VMG2 17 464 X10:2/1.13
VM1 18 666 X15:(-)/1.3
VP3 19 504 X2:A/1.7
SDDI 21 644 X4:A/1.7
ED9 22 600 X5:E/1.7
ED7 23 512 X2:B/1.7
ED5 24 662 X19:KD/1.3
ED3 25 628 X13:A/1.7
ED1 26 524 X3:C/1.7
EF1 27 460 X10:1/1.13
AZ3 28
AZ1 29 674 X24:AS/1.3
AD8 30 420 X27:AD8/1.3
AD6 31 430 X9:A/1.13
AD4 32 442 X9:D/1.13
AD2 33 434 X9:B/1.13
VMG1 34 474 X11:2/1.13
VM2 35 678 X15:(-)/1.3
AMP Timer 35-pin
X1/A1
Sach-Nr.
L1
KN1
L2
KN2
L3 X2,3/A2
L4 X5;12;13/BN
L5 X6/S5
L6 X4/A5
L8 X7/S6
L9 X8/Y6
L10 X9/A3
L11 X10/B1
L12 X11/B2
X14 (+)
410 X7:1/1.13
540 X6:1/1.7
612 X12:A/1.7
616 X12:B/1.7
640 X4:D/1.7
654 X1:2/1.2
682 X1:1/1.2
X15 (-)
424 X8:2/1.13
450 X9:F/1.13
548 X6:3/1.7
632 X12:E/1.7
636 X12:F/1.7
648 X4:C/1.7
666 X1:18/1.2
678 X1:35/1.2
X21 RF
520 X2:C/1.7
588 X5:C/1.7
658 X1:5/1.2
X19 KD
536 X3:D/1.7
592 X5:D/1.7
662 X1:24/1.2
X24 AS
516 X2:D/1.7
584 X5:B/1.7
674 X1:29/1.2
X26 B3
532 X3:A/1.7
604 X13:B/1.7
X25 S5
544 X6:2/1.7
620 X13:C/1.7
X27 AD8
420 X1:30/1.2
422 X8:1/1.13
626 X12:D/1.7
X2
X1:19/1.2 504 A VP (+)
X1:23/1.2 512 B F
X21:RF/1.3 520 C R
X24:AS/1.3 516 D N
X3
X26:B3/1.3 532 A B3
X1:8/1.2 528 B B2
X1:26/1.2 524 C B1
X19:KD/1.3 536 D KD
A2
Weatherpack 4-pin
Weatherpack 4-pin
X6
X14:(+)/1.3 540 1
X25:S5/1.3 544 2
X15:(-)/1.3 548 3
NOT USED!
Econosil-Stecker 3 pol
X4
X1:21/1.2 644 A SD1
X15:(-)/1.3 648 B (-)VM
X14:(+)/1.3 640 C (+)VP
D
A5
Weatherpack 4-pin
F1
Kl.15(+)
S2
P
X5
X1:11/1.2 580 A SD1 A
X24:AS/1.3 584 B AS B
X21:RF/1.3 588 C RF C
X19:KD/1.3 592 D KD D
X1:22/1.2 600 E ED9 E
X1:12/1.2 608 F AD9 F
X5a
A6
X12
X14:(+)/1.3 612 A (+) A
X14:(+)/1.3 616 B (+) B
X1:13/1.2 624 C AD7 C
X27:AD8/1.3 626 D AD8 D
X15:(-)/1.3 632 E (-) E
X15:(-)/1.3 636 F (-) F
X12a
H1
X13
X1:25/1.2 628 A ED3 A
X26:B3/1.3 604 B B3 FS B
X25:S5/1.3 620 C S5 C
X1:7/1.2 596 D ED4 D
X13a
Y11
K2
K1
Kl.31(-)
X8
X27:AD8/1.3 422 1
X15:(-)/1.3 424 2
NOT USED!
Kostal M27 2-pin
X9
X1:31/1.2 430 A Y5
X1:33/1.2 434 B Y1
X1:15/1.2 438 C Y2
X1:32/1.2 442 D Y3
X1:14/1.2 446 E Y4
X15:(-)/1.3 450 F (-)
A3
Cannon VG95234 6-pin
X10
X1:27/1.2 460 1
X1:17/1.2 464 2
B1
Kostal M24 2-pin
X11
X1:9/1.2 470 1
X1:34/1.2 474 2
B2
Kostal M24 2-pin
X7
X14:(+)/1.3 410 1
X1:6/1.2 414 2
NOT USED!
AMP Superseal 2-pin
SAMPLE

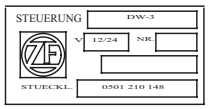
CONTROLLER DW-3
TABLE-8





F = Forward
N = Neutral
R = Reverse
D = Mechanical Neutral interlock
1 = 1st Speed
2 = 2nd Speed
3 = 3rd Speed
4 = 4th Speed

TYPENSCHILD

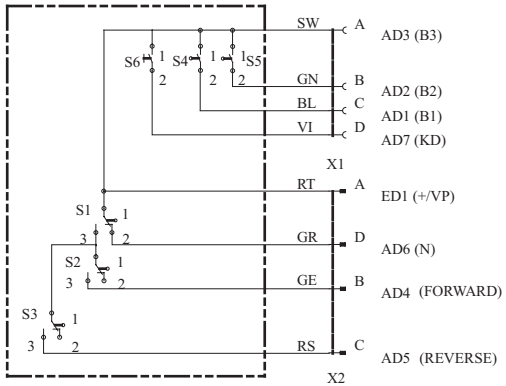


CODING CONTROLLER

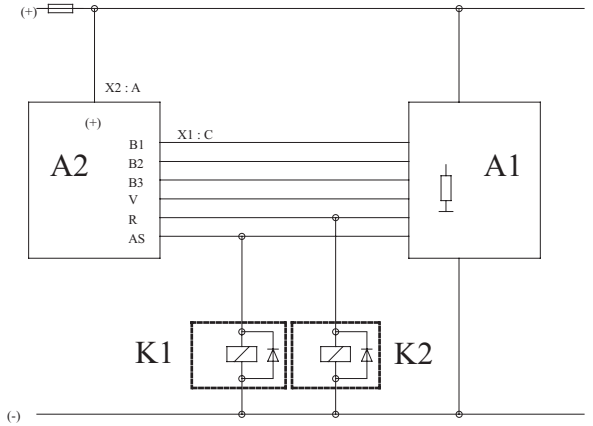
SPEED		OUTPUT FORWARD 1	2	3	4	REVERSE 1	2	3	4	NEUTRAL 1	2	3	4
AD1	B1	●			●	●			●	●			●
AD2	B2			●	●			●	●			●	●
AD3	B3	●	●	●	●	●	●	●	●	●	●	●	●
AD4	V	●	●	●	●								
AD5	R					●	●	●	●				
AD6	AS									●	●	●	●
AD7													

SAMPLE

CIRCUIT DIAGRAM CONTROLLER

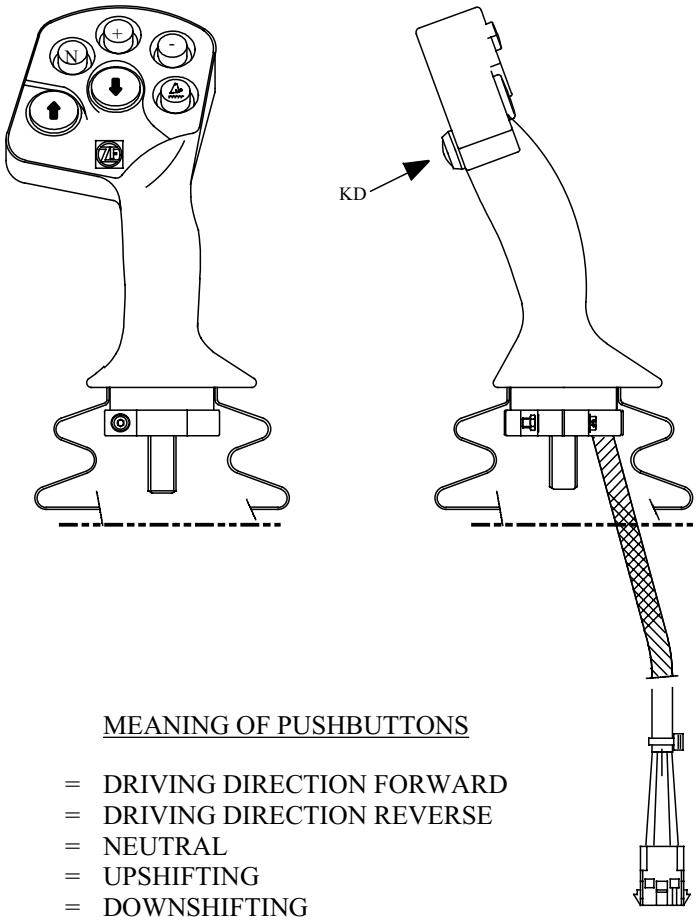


CONNECTION DIAGRAM CONTROLLER



K1 = RELAY STARTER INTERLOCK
K2 = RELAY REVERSING LIGHTS
A1 = ELECTRONIC UNIT EST-37
A2 = CONTROLLER

CONTROLLER ERGO II
TABLE-9



MEANING OF PUSHBUTTONS

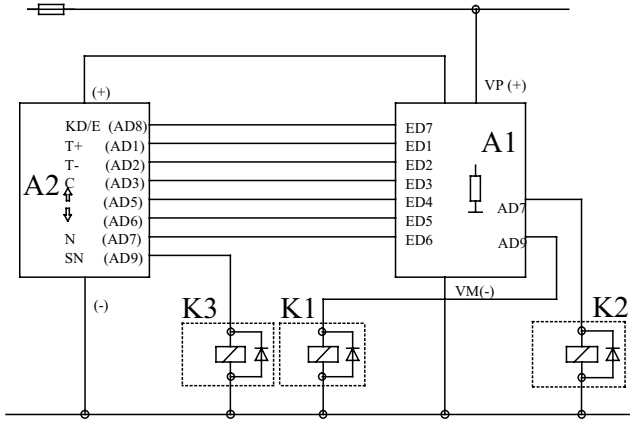
⬆	=	DRIVING DIRECTION FORWARD
⬇	=	DRIVING DIRECTION REVERSE
N	=	NEUTRAL
+	=	UPSHIFTING
-	=	DOWNSHIFTING
(SN)	=	SHOVEL-NEUTRAL (SHOVEL HORIZONTAL)
KD/E	=	KICKDOWN CONTROL AND SAFETY RELEASE

CODING CONTROLER

		OUTPUT						
		V	R	N	T+	T-	KD/E	SN
AD1	B1				●			
AD2	B2					●		
AD3	B3	●	●					
AD5	V	○						
AD6	R		○					
AD7	N			○				
AD8	KD						●	
AD9	SN							●

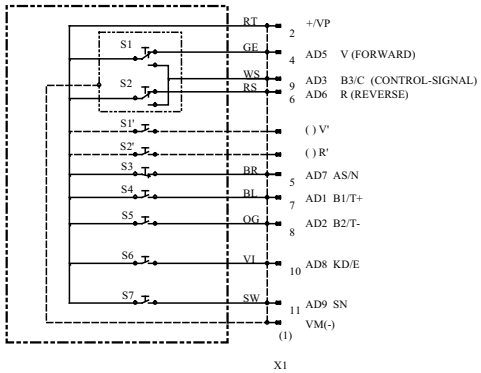
○ : = U OUTPUT = OV (ACTIVE LOW)
● : = U SERVICE - 0,3 V

CONNECTION DIAGRAM CONTROLLER



K1 = RELAY STARTER INTERLOCK
K2 = RELAY REVERSING LIGHTS
K3 = RELAY SHOVEL NEUTRAL (CUSTOMIZED)
A1 = ELECTRONIC UNIT EST-17T/EST-25
A2 = CONTROLLER ERGO II

CIRCUIT DIAGRAM CONTROLLER



POS	LEGEND
S1	PUSHBUTTON DRIVING DIRECTION FORWARD AND C-SIGNAL FORWARD
S2	PUSHBUTTON DRIVING DIRECTION REVERSE AND C-SIGNAL REVERSE
S3	PUSHBUTTON NEUTRAL
S4	PUSHBUTTON UPSHIFTING
S5	PUSHBUTTON DOWNSHIFTING
S6	PUSHBUTTON KICKDOWN/RELEASE
S7	PUSHBUTTON SHOVELNEUTRAL

MEASURING BOX II with color printer

5870 221 301



Pressure transmitter



5870 221 308



Printer cable
5870 221 229



MS - 5050
5870 221 296
12 bit-converter
max. 500 000 measuring values
36 storage locations
Centronics- RS-232 and USB interface

The Multi-System 5050 with ISDS (Intelligente Sensor Detection System)
By connecting ISDS sensors to the measuring instrument the parameters are automatically transmitted .

Parts list 5870 221 301

5870 221 296	Multi – System 5050 + Software on CD-ROM	1
5870 221 234	Electrical supply adaptercablel 12 to 27V DC	1
5870 221 308	Messkabel MKS / ISDS Verbindung zum Sensor	4
5870 221 297	Pressure sensor ISDS -1 / + 6 bar	1
5870 221 298	Pressure sensor ISDS 0 – 60 bar	2
5870 221 310	Temperature sensor ISDS -50 / 200 ?C	1
5870 221 241	Pressure / Temp. coupling P/T M10x1	1
5870 221 206	Rotation sensor DrS 03 with magnetic stand	1
5870 221 293	Colour printer HP 350 with power supply unit 230V	1
0501 207 939	Srew coupling M10x1	2
5870 286 064	Measuring house RN04/M10x1	2
0501 206 836	Measuring house M10x1/M10x1	2
5870 221 306	Cable USB interface	1
5870 221 229	Cable to printer 25-pol.D-Sub/Centr.	1
5870 325 017	triple case	

Triple case
5870 325 917





Rotation sensor
DrS - 03

Temperatur-
sensor with
ISDS





Screw couppling
M10x1



Color printer
HP-350
with 2 ink cartridge





Measuring house
5870 286 064

P / T Couppling
M10x1



USB - Cable
5870 221 306



Electrical supply cable
5870 221 234