ROTAX®
AIRCRAFT ENGINES

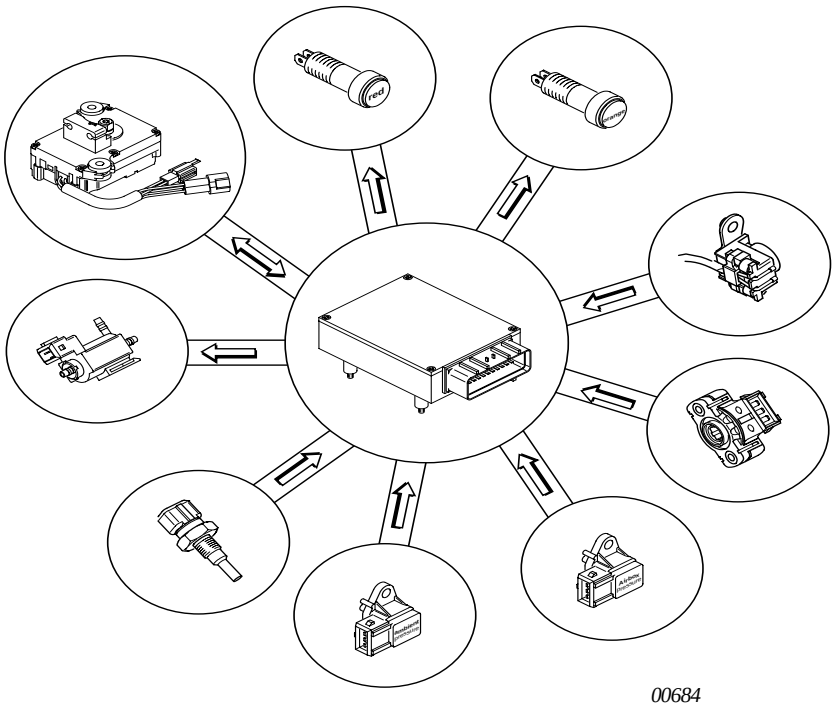
User´s Guide

(for distributors and OEM or special trained personal only)

Communication-program

for TCU Version TLR 4.3
TLR 4.5
TLR 4.6

(ROTAX® Engine Type 914 Serie)



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⚠ WARNING

Before starting with any calibration work on the engine read the User´s Manual for TCU versions in its entirety as it contains important safety relevant information.

Edition: 0 of 1999 09 01

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2) Index

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3) Introduction

Before starting with the calibration program on the engine, read the User´s Manual carefully. It provides you basic information on safe operation of the engine.

If any passages of the Manual are not understood or in case of any questions, please, contact an authorized Distribution- or Service Partner for ROTAX® aircraft engines.

3.1) Remarks

This User´s Manual is to acquaint maintenance service staff approved by the local aviation authorities with some basic maintenance and safety information for service works.

For competent maintenance and servicing, please, refer to the documentation provided in the Maintenance Manual, Operator´s Manual, Installation Manual and Illustrated Parts Catalog.

For additional engine-, maintenance- and parts information you may also contact the nearest ROTAX® aircraft engine distribution partner.

3.2) Engine serial number

On all enquiries or spare parts orders, always indicate the engine serial number, as the manufacturer makes midifications to the engine for further development. The engine serial number is on the top of the crankcase, magneto side.

3.3) Serial number of Dongle (decoding unit), of TCU (turbo control unit) and Program version

On inquiries regarding TCU , Dongle and Communication program always state serial number of the TCU, of Dongle and of calibration program version, as the manufacturer makes modifications for further development. The serial number is directly on the TCU and Dongle. The version of the calibration program is stated on the information line of the communication program.

4) Safety

Although the mere reading of such an instruction does not eliminate a hazard, the understanding and application of the information will promote correct use.

The information and components-/system descriptions contained in this User´s Manual are correct at the time of publication. ROTAX® however, maintains a policy of continuous improvement of its products without imposing upon itself any obligation to install them on its products previously manufactured.

ROTAX® reserves the right at any time to discontinue or change specifications, designs, features, models or equipment without incurring obligation.

The illustration in this Maintenance Manual show the typical construction. They may not represent in full detail or the exact shape of the parts which have the same or similar function.

Specifications are given in the SI metric system with the USA equivalent in parenthesis. Where precise accuracy is not required, some conversions are rounded off for easier use.

4.1) Repeating symbols

This Manual uses the following symbols to emphasize particular information. These indications are important and must be respected.

▲ **WARNING: Identifies an istruction which, if not followed, may cause serious injury including the possibility of death.**

■ **ATTENTION: Denotes an instruction which, if not followed, may severely damage the engine or other components.**

◆ **NOTE: Indicates supplementary information which may be needed to fully complete or understand an instruction.**

4.2) Technical documentation

The information given in the

- ☞ Installation Manual (IM)
- ☞ Operator´s Manual (OM)
- ☞ Maintenance Manual (MM)
- ☞ Repair Manual (RM)
- ☞ Illustrated Parts Catalog (IPC)
- ☞ Service Bulletin (SB)
- ☞ Service Instruction (SI)
- ☞ Service Letter (SL)

is based on data and experience that are considered applicable for professionals under normal conditions.

■ ATTENTION: Due to the fast technical progress and fulfillment of particular specifications of the customers it may occur that existing laws, safety prescriptions, constructional and operational regulations cannot be transferred completely to the object bought, in particular for special constructions, or may not be sufficient.

◆ NOTE: The illustrations in this User´s Manual are stored in a graphic data file and are provided with a consecutive irrelevant number.

This number (e.g. 00277) is of no significance for the content.

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5) Scope of the communication program (distributor-version)

➪ Verification of function of all sensors and pick-ups

➪ Check of throttle potentiometer (throttle position)

➪ On-line data recording of the turbo control

➪ quick analysis of errors

With this program a prompt analysis of defects and irregulations can be conducted.

Further tasks showing the difference to communication programs TLR 4.Xa (customer version):

➪ Input of engine serial number and hours of operation

➪ Calibration of the throttle potentiometer

➪ Display of TCU control data

6) Supply volume of the calibration set

See fig. 1.

➪ Decoding unit (Dongle) with data cable to link with computer

➪ Communication program TLR 4.3, 4.5 or 4.6: Software between TCU and computer

BOMBARDIER-ROTAX
CALIBRATION SET
part no. 966 675

Only available for autorized distributors and OEM at request from our after sales service dept.

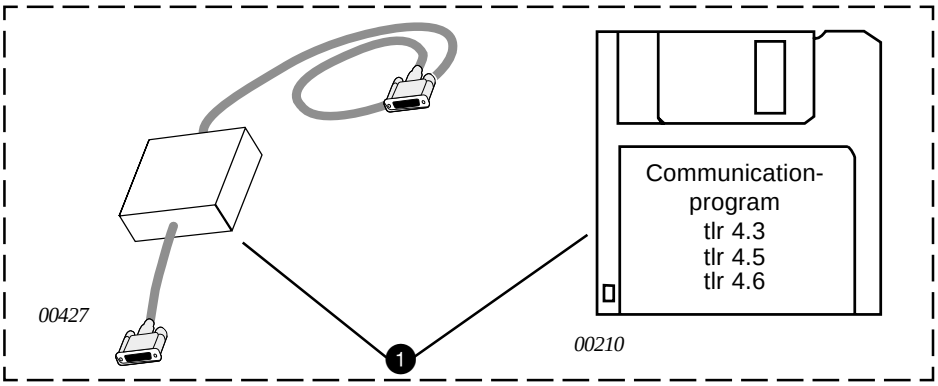
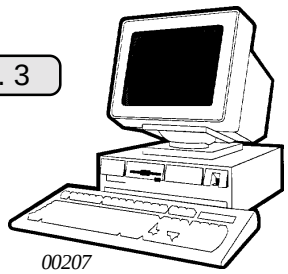


fig. 1

◆ NOTE: For the Monitoring Program tlr. 4.6a no decoding unit (Dongle) is required. Just connect the TCU and the PC via the plug connector RS 232 with the COM (1) interface.

7) Required hardware-items (PC)

fig. 3



See fig. 2 and fig. 3.

➪ PC with processor 80 286 or higher level, with
➪ random access memory min. 640 KB RAM
➪ graphic adapter EGA, CGA or VGA
➪ serial interface COM 1 oder COM 2
➪ floppy disk drive 3,5 inch

◆ NOTE: We recommend a Laptop- or Notebook-computer since these units can be utilized also directly on engine or aircraft.

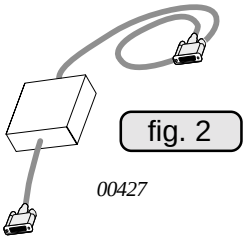


fig. 2

➪ decoding unit (Dongle) ❶ with data cable to link with computer

8) Establishing of the required hardware connection (TCU - PC)

See fig 4 and 5.

➪ Connect decoding unit (Dongle) with 9-pin port of cable harness ❷.

➪ Connect data cable of decoding unit (Dongle) with the **COM1** or **COM2** interface of computer ❸.

◆ NOTE: The computer is normally provided with two serial interfaces ❹ and ❺ (9- or 25-pin).

Normally a serial interface (usually a 9 pin port) is used for connection of a mouse.

Since there is no need for a mouse to control the communication program the Dongle can be connected with the interface for the mouse, best known as COM 1.

❹

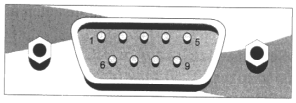


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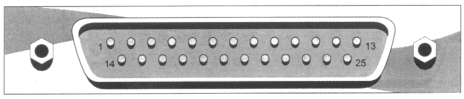
fig. 4

❺



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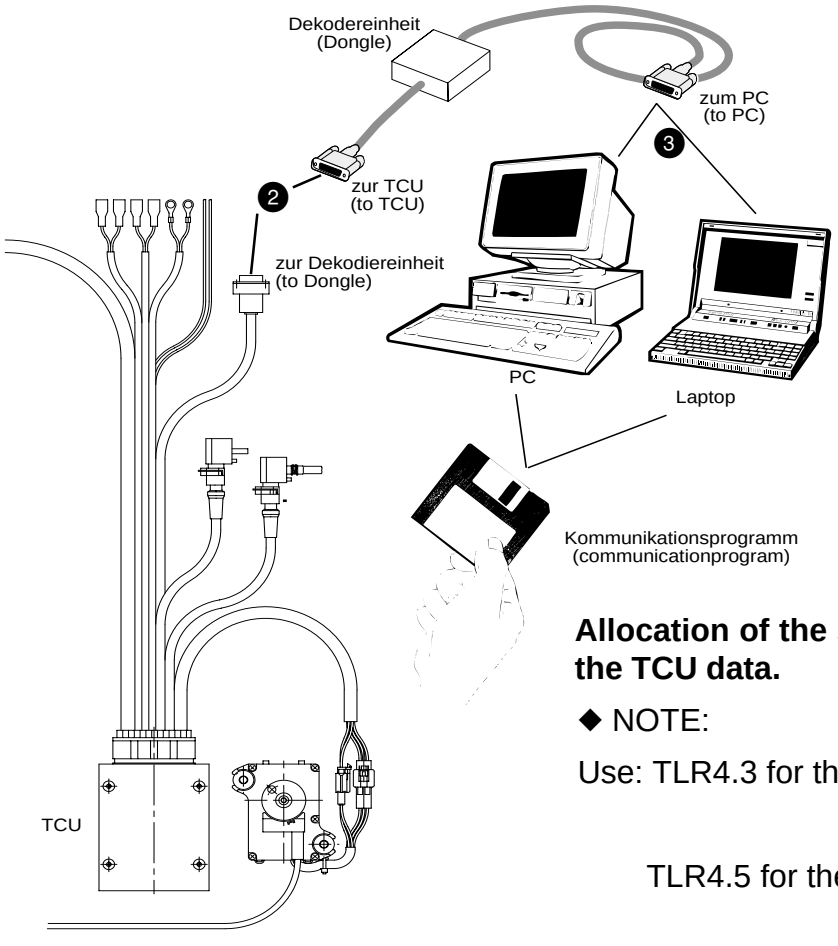

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fig. 5

Allocation of the software for establishing of the TCU data.

◆ NOTE:

Use: TLR4.3 for the TCU	part no. 966.470
TLR4.5 for the TCU	part no. 966.471 part no. 966.472 part no. 966.473
TLR4.6 for the TCU	part no. 966.741

9) Software-requirements (PC)

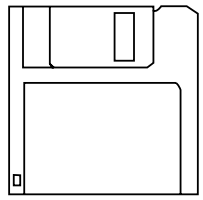

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Bild 6

See fig. 6.

➪ operating system MS-DOS 5.0 or higher level

➪ communication program: software linking TCU with computer

◆ NOTE: The comunication program TLR 4.3, TLR 4.5 and TLR 4.6 is part of the calibration set.

10) Software TLR 4.3, TLR 4.5 and TLR 4.6

➪ The Software is property of ROTAX®. Duplication is only permitted for transmission on a fixed disk or for back up and filing.

➪ The communication program is defined for use of MS-DOS and should be loaded only with MS-DOS.

◆ NOTE: Only that warrants a stable ON-line operation.

11) Installation of the communication program on the PC

◆ NOTE: This procedure has to be performed only once for installation of the communication software from the diskette onto the fixed disk integrated in the computer.

11.1) Entry in MS-DOS

See fig. 7.

➪ Make sure which TCU part no. matches with which program version.

➪ Switch on the PC and wait for the message **C:\>**

◆ NOTE: If this message should not appear (e.g. immediate start of a Windows-version (WINDOWS 95) change over to MS-DOS-level.

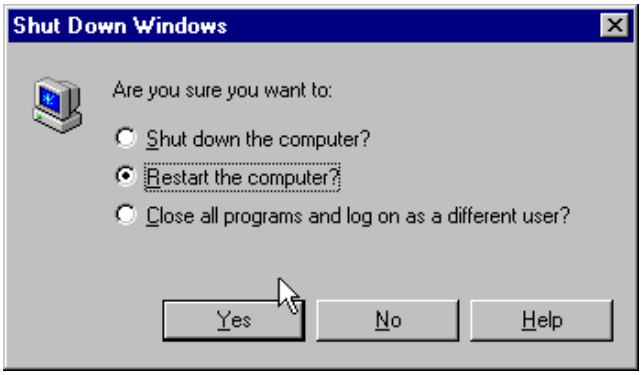

fig. 7

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11.2) Transfer of the software from the floppy-disk to fixed disk of PC

➪ Insert program floppy disk into the drive "A" and enter the command

C:\>**XCOPY_A:*.*_C:_/s [Enter]**

(enter only bold face printed command).

◆ NOTE: With this command the directory "914/progXX" with all its sub directories will be established.

➪ Remove floppy-disk from drive and store safely.

■ ATTENTION: Perform installation of the program every time with the original floppy-disk.

12) Application of the communication program

12.1) Entry of the program

➪ **establish connections PC➜Dongle➜TCU**

➪ **switch on TCU**

▲ WARNING: Ensure engine ignition is "OFF" and secured against unintentional "ON".

➪ **switch on PC (if not active already)**

➪ start of the program direct from MS-DOS by call.

12.2) Start of the program

➪ To start the program enter with command line

C:\914\prog43\>**tlr43 [Enter]**	for TLR 4.3
C:\914\prog45\>**tlr45 [Enter]**	for TLR 4.5
C:\914\prog46\>**tlr46 [Enter]**	for TLR 4.6

◆ NOTE: If only the message **C:\>** appears start the program with the same command line but in bold face print

C:\>**914\progXX\tlrXX [Enter]**	\prog43\tlr43 \prog45\tlr45 \prog46\tlr46

12.3) Choice of the graphic adapter

See fig. 8.

◆ NOTE: Selecting of the monitor display only at the very first entry in the communication program. Select the appropriate configuration for the computer.

➪ The first program window will appear for the correct choice of your graphic adaptor. Make sure which graphic adaptor you use and of what configuration (see fig. 8.)

press the key:

- **C** for a **CGA** (=Color Graphics Adaptor, nowadays a seldom used graphics standard
- **E** for a **EGA** (=Enhanced Graphics Adaptor, a graphics standard)
- **V** for a **VGA** (=Video Graphics Adaptor, the most common used graphics standard today

fig. 8

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➪ With this information, together with the COM-interface choice (as per next point) a configuration file will be opened with the title **tlr.cfg** in the dictionary C:\914\progXX\>.

If wrong choice should have been made delete this sub file with the MS-DOS command

C:\914\progXX\>**del tlr.cfg [Enter]**

and start the communication program anew.

12.4) Choice of interface

See fig. 9.

◆ NOTE: Choice of the interface is not possible when using the software TLR 4.3.

◆ NOTE: Selection of monitor display only at the very first entry in the communication program. Select the appropriate configuration for the computer.

➪ further select the correct COM-port (see fig. 9.) Enter the used COM interface by pressing the key:

1 for **COM**-port **1**

2 for **COM**-port **2**

fig. 9

00189

➪ With this information, together with the chosen graphic adapter a configuration file with the title **tlr.cfg** will be opened in the directory C:\914\progXX\>. If a wrong choice should have been made delete this sub file with the MS-DOS command

C:\914\progXX\>**del tlr.cfg [Enter]**

and start the communication program anew.

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13) Communication program TLR 4.3, 4.5 and 4.6

13.1) Menu control and description of the user´s display:

13.1.1) Menu control

See fig. 10.

The subprograms are always listed on the menu line and will be activated by input of the first letter of the program e.g. **"M"** for MONITOR (monitoring program)

◆ NOTE: The key "ESC" will transfer you to the superordinated menu.

13.1.2) User´s display

Program information line:

This line will inform the user about version and type of the program.

Menu line:

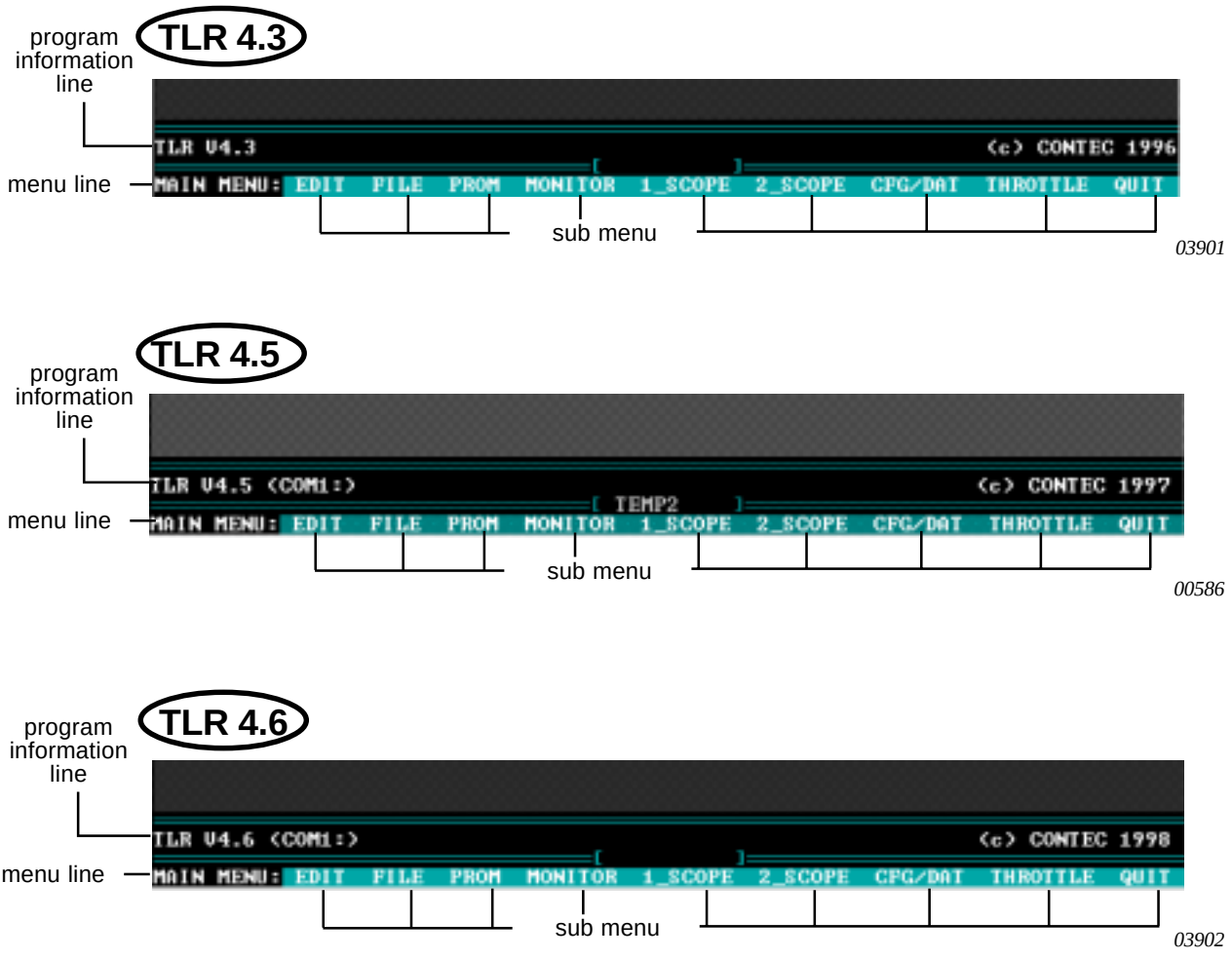
On this line all the retrievable sub programs are listed.

Sub programs:

Are called up as stated above and are branching to the individual options of the sub menu.

◆ NOTE: The illustration shows the communication programs TLR 4.3, TLR 4.5 and TLR 4.6

fig. 10



13.2) On-line-menu

See fig. 11.

➪ These menus serve for the on-line display of engine data at the very moment, such as engine speed, throttle position, airbox pressure etc. which are imperative for maintenance and error detection.

On-line display:

➪ These sub menu are only available in conjunction with an active TCU and Dongle. (not for version TLR 4.6a)

◆ NOTE: If at start of the on-line subprograms (MONITOR, 1_SCOPE, 2_SCOPE aso.) the error message

"/ERROR: Serial I/O Continue with any key..."

should appear in the last line ❶ a connection between TCU and computer is interrupted. Checking of all plug connections between TCU and computer is necessary. In addition verify voltage supply to TCU.

Correct any detected interruption between TCU and computer and switch "OFF" and "ON" TCU power supply.

00191

fig. 11

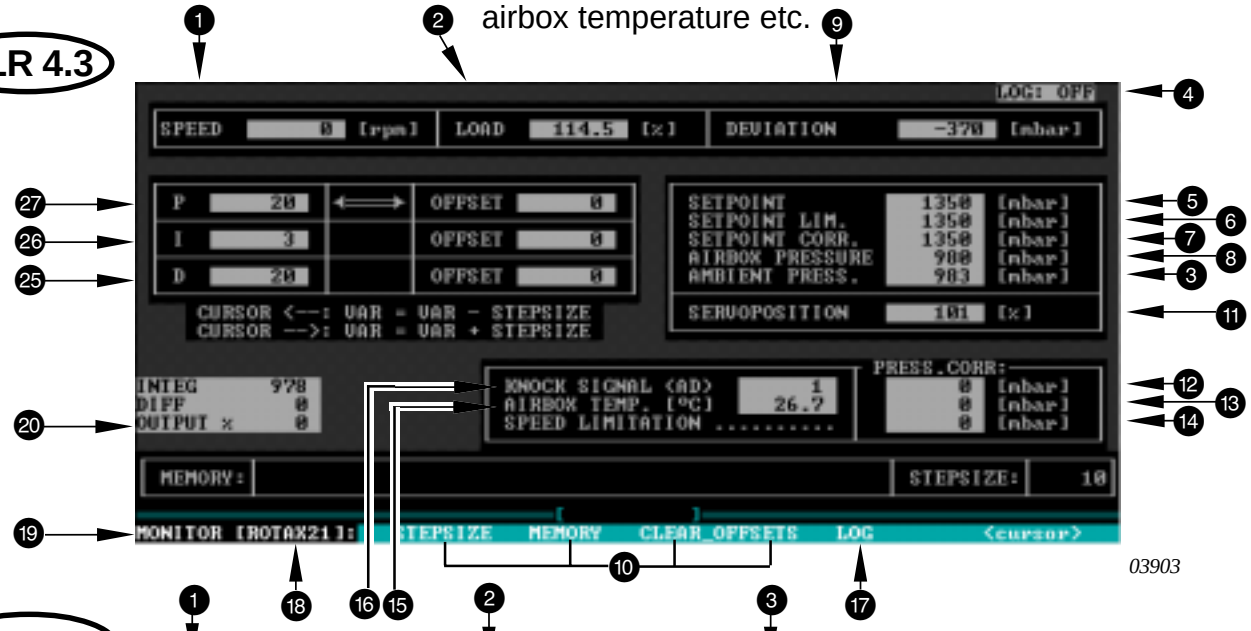
13.2.1) Monitor-menu (data display)

See fig. 12.

fig. 12

MONITOR: Serves for the on-line display of operational engine data such as airbox pressure, ambient pressure, servo position airbox temperature etc.

TLR 4.3



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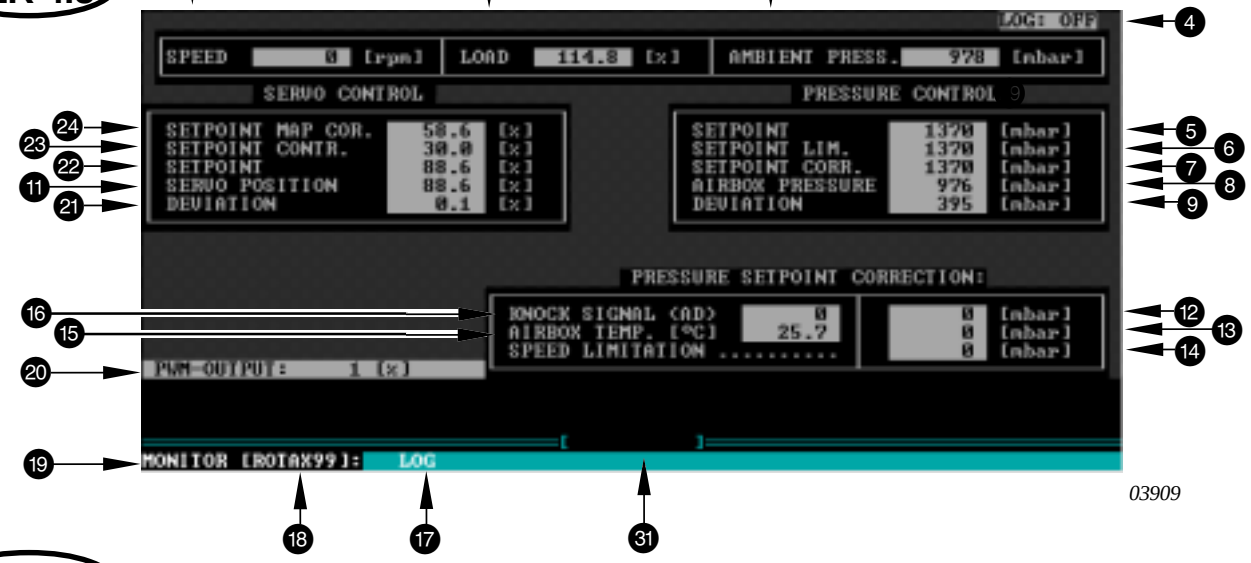
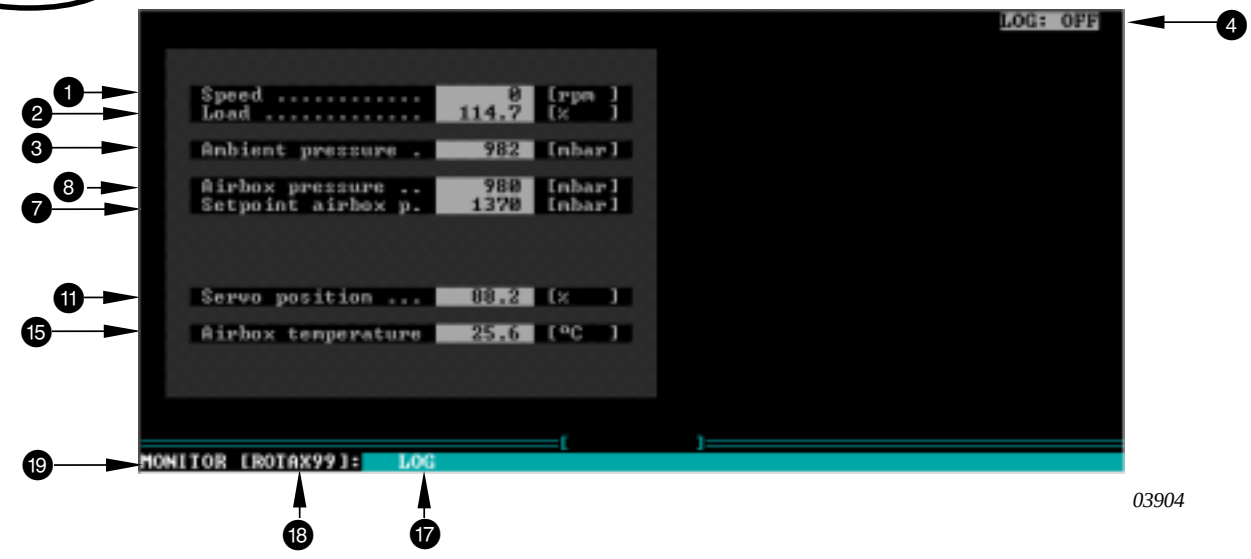
TLR 4.5



03909

TLR 4.6



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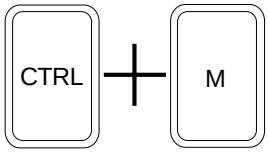
13.2.1.1) Monitor-menu (TLR 4.6 complete version)

See fig. 12 a.

Program TLR 4.6 with facility of display of all engine operating data by fast change-over to "ON-LINE".

03902



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By pressing the keys **CTRL + M** the following monitor display will appear.(in the main menu only)

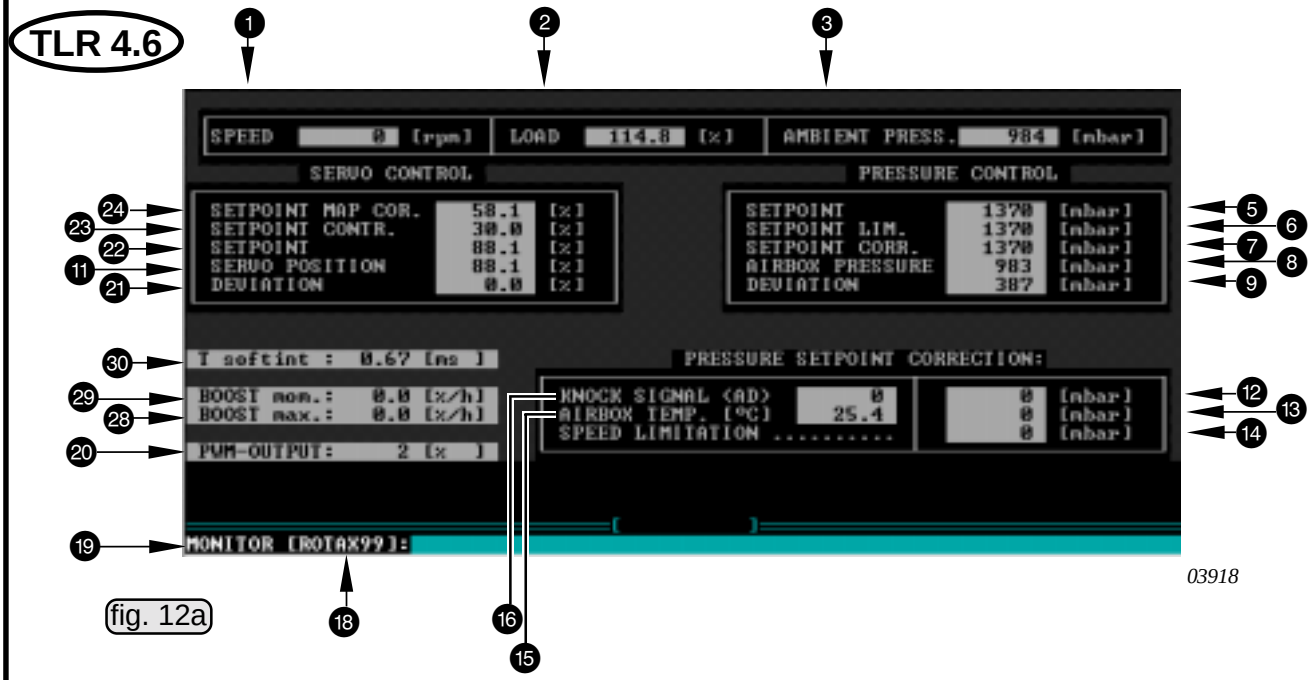

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fig. 12a

This monitor display represents the most important program unit for maintenance. Especially for error analysis, the monitor menu offers some options. It enables verification of indicated values and comparison with the engine instruments in the aircraft. For single error detection, the "Error Detection Chart" in section 16 may be utilized.

Legend to monitor display

❶ **engine speed**

❷ **throttle position**

❸ **ambient pressure**

❹ LOG-state ON/OFF

❺ target pressure input on basis of throttle position

❻ target pressure input on basis of pressure between ❸ and ❽

❼ effective target pressure input (possibly reduced for instance by over-speed, airbox temperature or too high pressure ratio)

❽ **airbox pressure**

❾ pressure difference to ❼ and ❽

❿ no meaning (controller data)

⓫ actual wastegate position

⓬ not active

⓭ target pressure reduction by exceeding of the max. airbox temperature

⓮ target pressure reduction by excessive engine speed

⓯ **airbox temperature**

⓰ knocking signal: not active

⓱ logging ON/OFF

⓲ software status

⓳ subprogram designation

⓴ range of modulation for servo motor

㉑ deviation of ⓫ and ㉒

㉒ target position of wastegate

㉓ correction factor for wastegate position by PID-controller

㉔ target input of wastegate position in correlation to ❼ and ❽

㉕ factor "D"

㉖ factor "I"

㉗ factor "P"

㉘ boost period in the past hours (indication in percentage per hour)

㉙ boost period since switching ON the TCU (indicated in percentage per hour)

㉚ required only for internal evaluation

㉛ Shows the loaded software status (see chapt. 13.3)

◆ NOTE: Because if the multitude of indications, parameters important for the user are printed in bold type and underlined.

13.2.1.2) LOG-submenu

See fig. 13, 14 and 15.

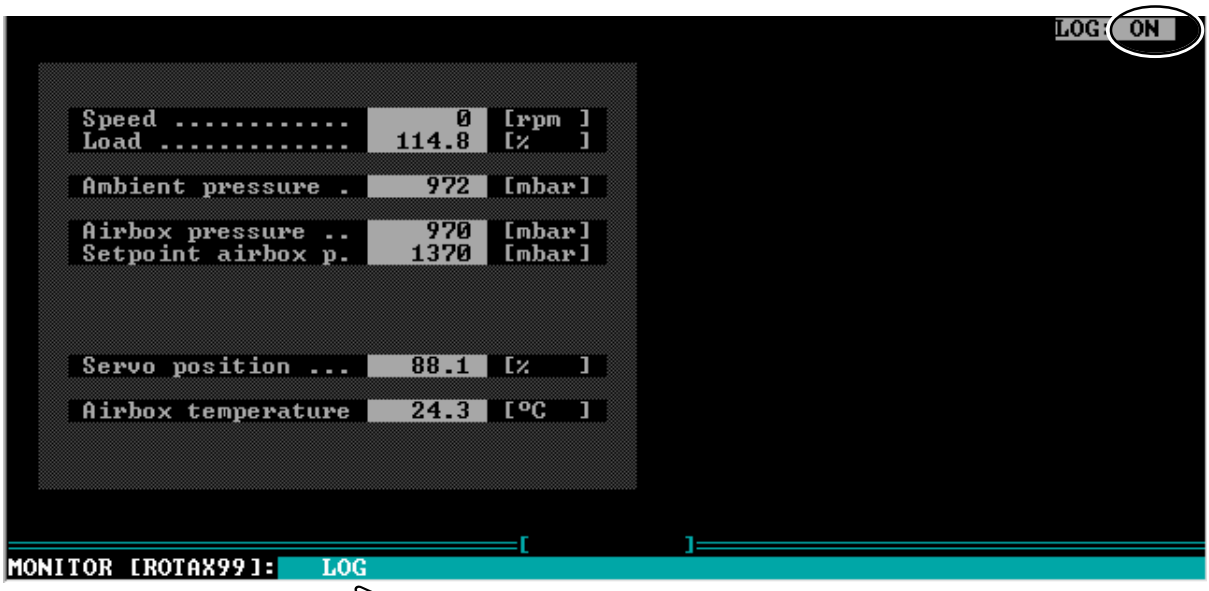
LOG: Is a submenu of the monitoring menu and facilitates recording of the relevant operational data on the hard disk of the connected PC.

The logging will be actuated and stopped by pressing the key **L**. The logging state will be indicated by "ON" for on-line recording and "OFF" respectively for nonrecording (see fig. 13, item ❶).

◆ NOTE: The illustration shows the program version TLR 4.6

fig. 13

❶



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A so-called Log-file will be loaded on a **hard disk** starting date and starting time of the recording.

Example:

11061014.LOG

- Minute (minute)
- Stunde (hour)
- Tag (day)
- Monat (month)

◆ NOTE: Verify this date and starting time at start of the PC. Use at MS-DOS level the commands

C:\> **DATE [Enter]** and

C:\> **TIME [Enter]**

and up-date as per input command date and time.

If more than 4000 data lines are recorded the current LOG file will be closed automatically and a new one opened.

Subsequent to recording the data can be stored on a diskette or printed for evaluation.

➪ data transfer to diskette:

with the command

C:\914\progXX> **DIR*.log [Enter]**

read list of log-files on MS-DOS Monitor.

After finding the requested LOG file, data can be transferred to diskette by command line

C:\914\progXX\>**COPY_C:\FILE-Name_A:**

e.g. 11061014.log

The thus established LOG-files are text files which can be used for further data editing in text-and table calculation programs.

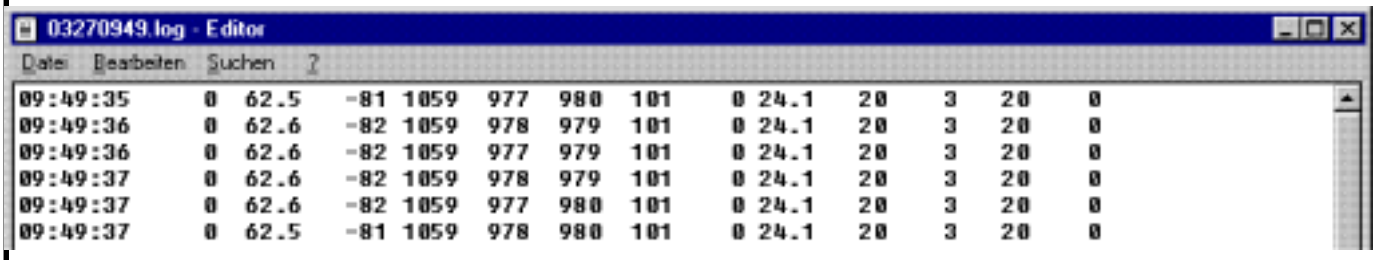
The fig. 14 illustrates data in program version TLR 4.3 on our EXCEL table.

◆ NOTE: The illustration shows program version TLR 4.3

time PC (hh:mm:ss)	speed (1/min)	load throttle (0-115%)	pressure difference (mbar)	nominal pressure (mbar)	actual pressure (mbar)	ambient pressure (mbar)	servo position (0 - 100 zu)	knocking	airbox (°C)	P-factor	I-factor	D-factor	output servo (+/-100)
16:53:01	2388	3,3	-123	1100	977	978	100	500	27,6	20	3	80	0
16:53:01	2384	3,3	-123	1100	977	978	100	495	27,6	20	3	80	0
16:53:02	2386	3,3	-123	1100	977	978	100	495	27,6	20	3	80	0
16:53:02	2369	3,3	-122	1100	978	978	100	528	27,6	20	3	80	0
16:53:02	2387	3,3	-122	1100	978	978	100	526	27,6	20	3	80	0
16:53:02	2388	3,3	-122	1100	977	978	100	526	27,6	20	3	100	0
00475	❶	❷	❾	❺	❽	❸	⓫	⓰	⓯	㉗	㉖	㉕	⓴

for above mentioned numbers see also monitor display TLR 4.3

fig. 14



00764

fig.15

The fig. 14a illustrates data of the program version TLR 4.5 in an EXCEL-table.

◆ NOTE: The illustration shows program version TLR 4.5

time PC (hh:mm:ss)	**speed** (1/min)	**load** throttle (0-115%)	pressure difference (hPa)	**nominal** pressure (hPa)	**actual** pressure (hPa)	**ambient** pressure (hPa)	knock (not used)	**airbox** temp. (°C)	**MAP** servo position	servo offset (+/-20)	**servo** posit **nom.**	**servo** posit **act.**	difference servo nom - act.	output servo PWM (+/-100)
12:44:06	5750	114,6	110	1350	1236	1019	1	47,8	75	10	85	84,2	0,8	11
12:44:06	5753	114,6	102	1350	1240	1020	1	47,9	75	10	85	84,3	0,7	12
12:44:07	5747	114,6	99	1350	1252	1020	1	47,9	75	10	85	84,3	0,6	13
12:44:07	5756	114,6	93	1350	1258	1019	1	48	75	10	85	84,4	0,5	10
12:44:07	5741	114,6	82	1350	1260	1019	1	48,1	75	10	85	84,4	0,4	10
12:44:10	5749	114,7	49	1350	1301	1019	1	48,7	75	10	85	84,8	0,2	10
12:44:10	5755	114,6	42	1350	1303	1019	1	48,8	75	10	85	84,8	0,3	10
12:44:11	5753	114,6	42	1350	1312	1019	1	48,9	75	10	85	84,7	0,2	10
00167	❶	❷	❾	❺	❽	❸	⓰	⓯	㉔		㉒	⓫	㉑	⓴

fig. 14 a

for the mentioned numbers see also monitor display TLR 4.5

02251340.log - Editor

Datei Bearbeiten Suchen ?

```
13:40:04    0   0.0   538 1500  963  966    0 25.6  92.8   20.0 100.0 100.0   0.0   -2
13:40:05    0   0.0   537 1500  963  966    0 25.5  92.7   20.0 100.0  99.8  -0.1    1
13:40:05    0   0.0   537 1500  963  966    0 25.5  92.7   20.0 100.0 100.1   0.0    1
13:40:06    0   8.1    46 1230  963  965    0 25.5  36.8    2.8  39.6 100.1 -47.8 -100
```

00642

fig. 15 a

The fig. 14b illustrates data of the program version TLR 4.6 in an EXCEL-table.

◆ NOTE: The illustration shows program version TLR 4.6

time PC (hh:mm:ss)	**speed** (1/min)	**load** throttle (0-115%)	**ambient** pressure (hPa)	**actual** pressure (hPa)	**nominal** pressure (hPa)	**servo** posit act.	**airbox** temp. (°C)
15:16:13	5750	114.9	972	970	1370	88.4	24.4
15:16:13	5753	114.8	972	970	1370	88.3	24.4
15:16:14	5747	114.8	972	970	1370	88.4	24.4
15:16:14	5756	114.8	972	970	1370	88.4	24.4
03916	❶	❷	❸	❽	㉘	⓫	⓯

for the mentioned numbers see also monitor display TLR 4.6

fig. 14 b

06211605.log - Editor

Datei Bearbeiten Suchen ?

```
16:05:50    0 114.8   972   969  1370   88.3 24.3
16:05:50    0 114.8   972   969  1370   88.2 24.3
16:05:50    0 114.8   972   970  1370   88.4 24.3
16:05:50    0 114.8   972   970  1370   88.3 24.3
16:05:50    0 114.8   972   970  1370   88.3 24.3
16:05:50    0 114.9   972   970  1370   88.3 24.3
16:05:50    0 114.8   972   970  1370   88.4 24.3
```

03917

fig. 15 b

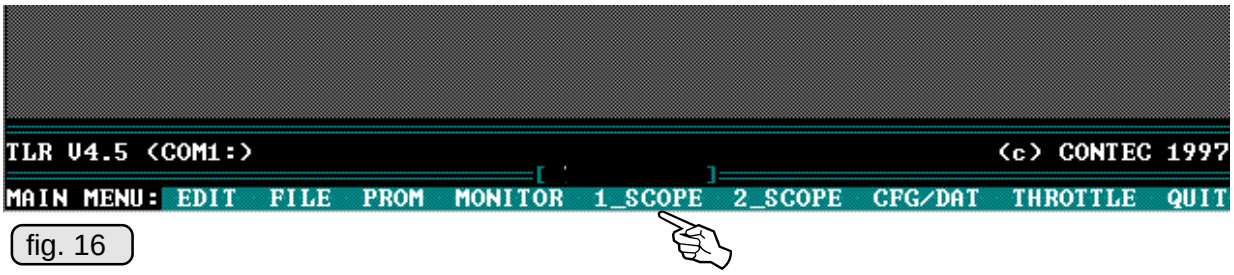
13.2.2) 1_SCOPE-menu

See fig. 16 and 17.

1_SCOPE: For on-line display of the control action with regard to pressure deviation (airbox pressure to target pressure) in the range of ±100 hPa (mbar).

The menu is for graphic evaluaton of the parameters ❼ and ❽ in the monitor menu.

◆ NOTE: The illustration shows program version TLR 4.5



00586

fig. 16

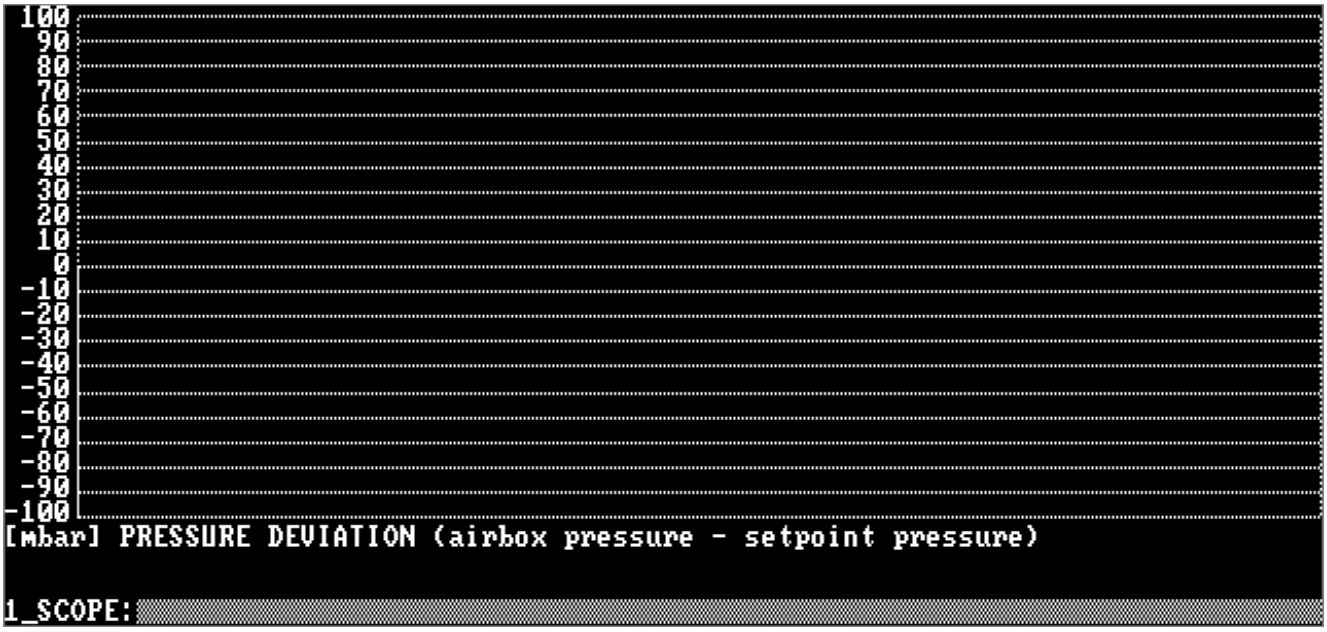


fig. 17

00194

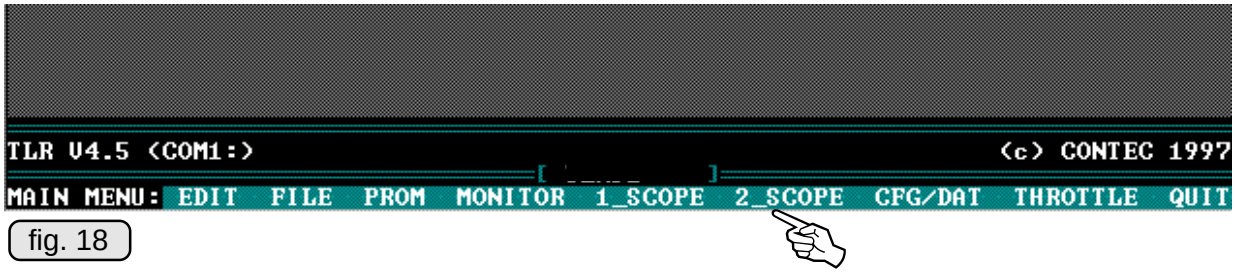
13.2.3) 2_SCOPE-menu

See fig. 18 and 19.

2_SCOPE: For on-line display of the control action between target pressure and effective airbox pressure in the range of 1000 to 1400 hPa (mbar).

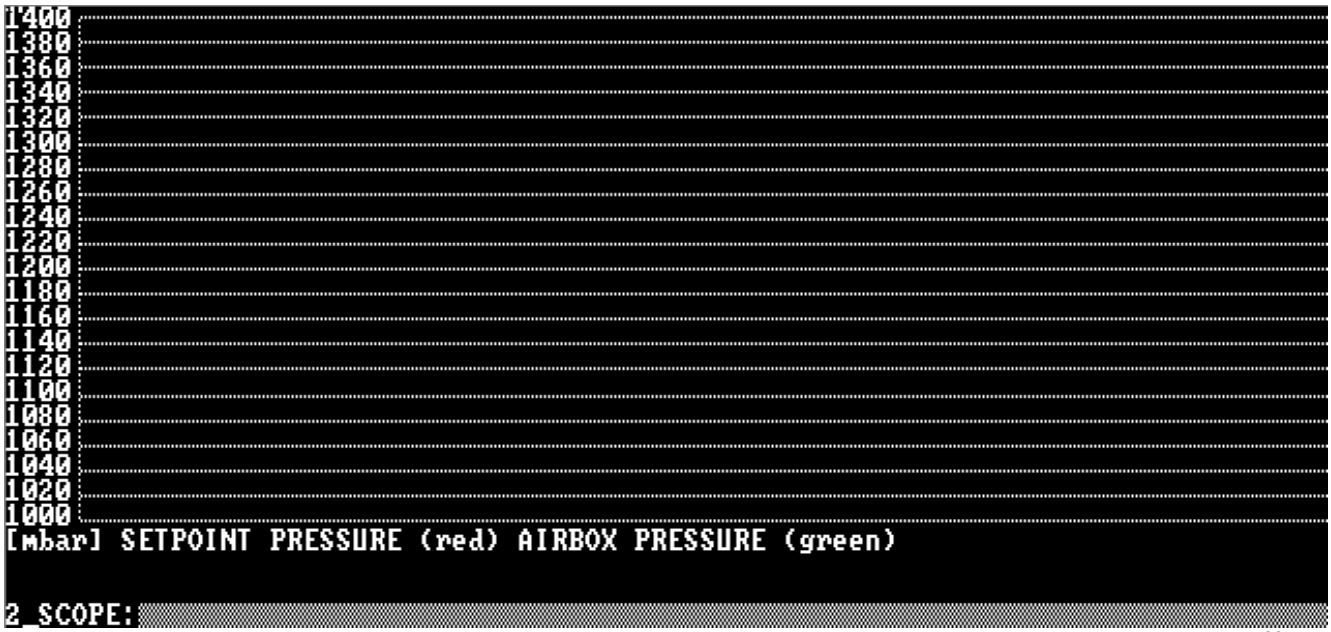
The menu is for graphic evaluation of the parameters ❼ and ❽ in the monitor menu.

◆ NOTE: The illustration shows program version TLR 4.5



00586

fig. 18



00195

fig. 19

13.2.4) CFG/DAT-menu

See fig. 20.

CFG/DAT: This menu branch serves the user for representation of calibration data and for input of TCU data such as serial number, hours of operation and especially of throttle position. This display is imperative for maintenance and calibration.

◆ NOTE: In program version TLR 4.6 the input of the throttle valve data is made automatically (see section. 13.2.5.2)

◆ NOTE: The illustration shows program version TLR 4.5

fig. 20

13.2.4.1) SETUP-subprogram

See fig. 21.

SETUP: facilitates the setting of the engine number for the respective TCU (input of the last four digits of the engine number) and of the actual period of operation.

fig. 21

TRANSMIT_SETUP

See fig. 22, 23, 24 and 25.

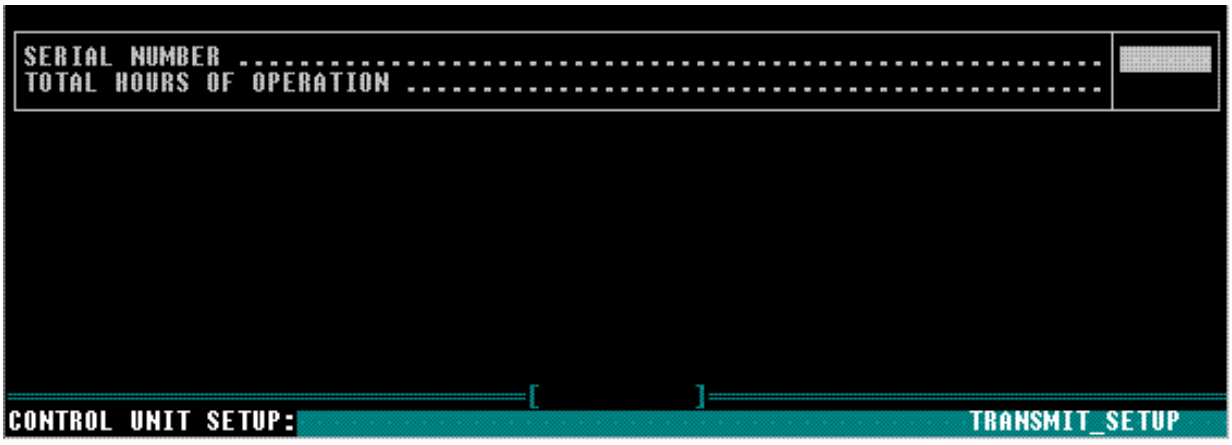
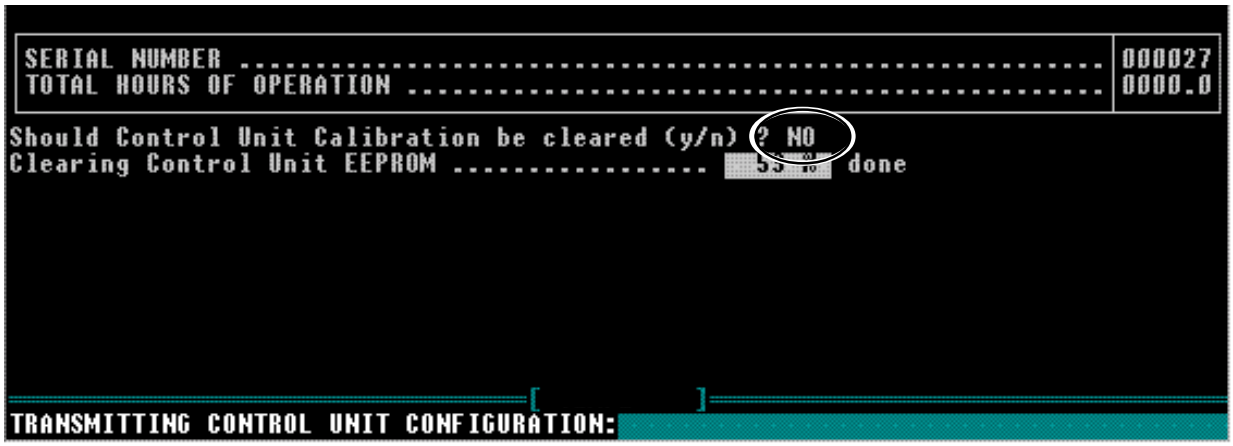


fig. 22

TRANSMIT_SETUP: After input of engine number and hours of operation store the information by Transmit-Setup in the TCU.

◆ NOTE: In program version TLR 4.6 the engine serial number can be put-in in 7 digits.

◆ NOTE: In order not to erase the calibration of the TCU press the key "**N**" for NO before an inquiry. Otherwise the TCU will be reset to default values of the manufacturer and new calibration will be necessary.



00608

fig. 23

➪ At a transfer procedure the process of the data transfer will be indicated in %, in which at 100% the writing is completed and the TCU will be set to input data.

00606

fig. 24

00607

fig. 25

13.2.4.2) CALIBRATE-submenu

See fig. 26.

CALIBRATE: Is besides the THROTTLE-submenu the most important point of the menu for verification and setting of the calibration data.

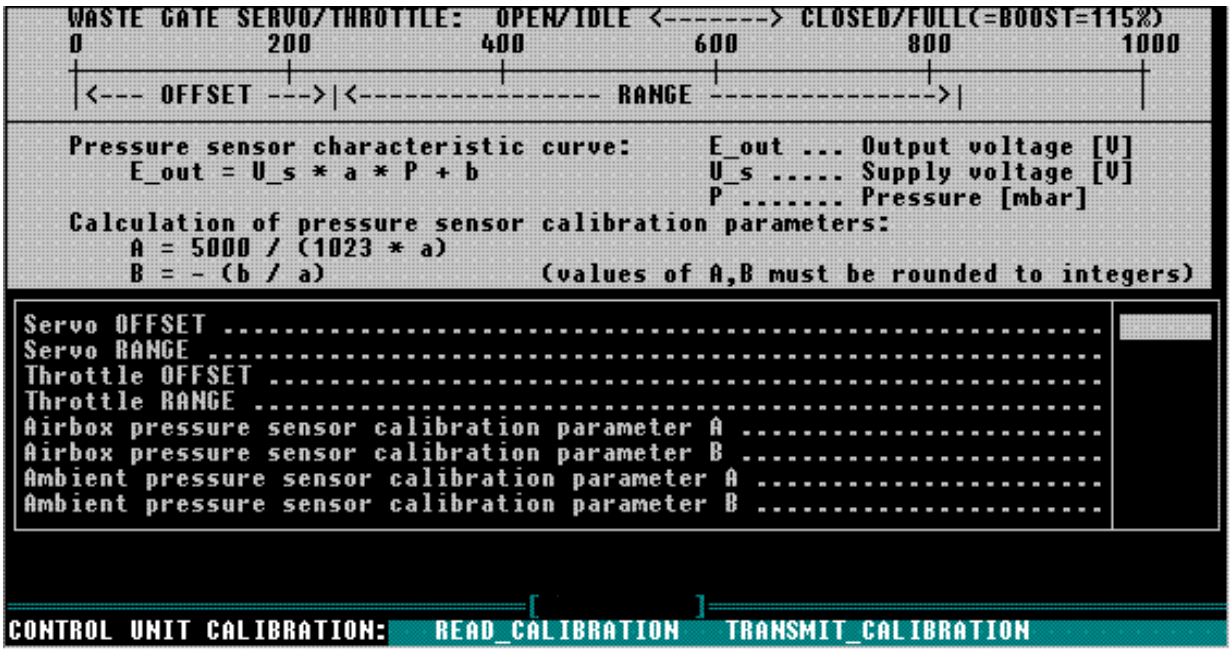
00603

fig. 26

READ_CALIBRATION

See fig. 27 and 28.

READ_ CALIBRATION: Reads the topic calibration data from the TCU.

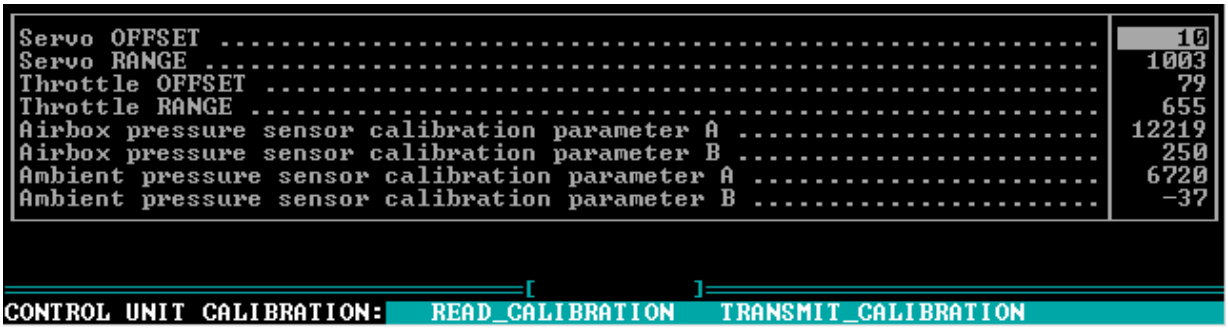


00609

fig. 27

◆ NOTE: The illustration 28 shows program version TLR 4.3

TLR 4.3



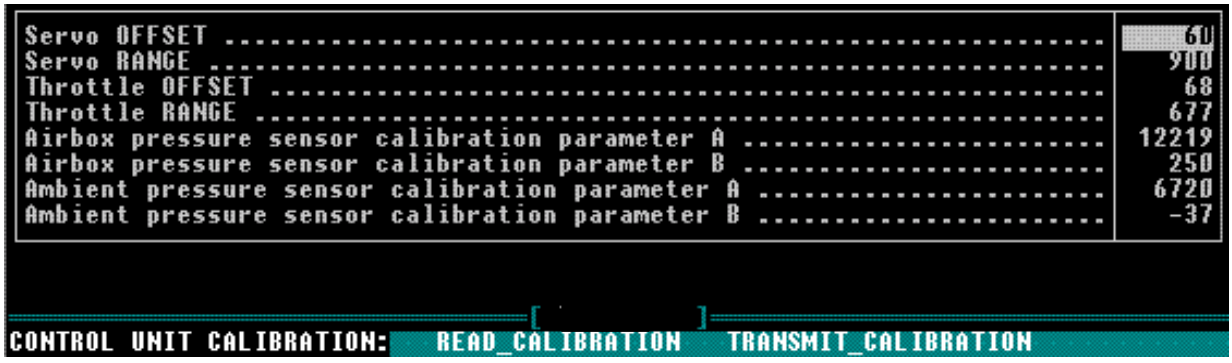
03921

fig. 28

TLR 4.5

TLR 4.6

◆ NOTE: The illustration 28a shows program version TLR 4.5 and TLR 4.6



00610

fig. 28 a

TRANSMIT_CALIBRATION

See fig. 29 and 30.

TRANSMIT_CALIBRATION: Serves for transfer of verified and determined calibration data.

00609

fig. 29

■ ATTENTION: Except for the input of THROTTLE offset and THROTTLE range, compare the transfer values, for the relevant program version, as shown in illustration 28 and 28a and correct as required.

TLR 4.5 u. 4.6 **TLR 4.3**

03922

00611

fig. 30

◆ NOTE: For procedure to receive each relevant THROTTLE offset and THROTTLE range value refer to chapter 13.2.5.

13.2.4.3) READ_DATA-submenu

See fig. 31 and 32.

READ_DATA: Reads data such as serial number, time of operation and the latest transmitted engine data from the storage in the TCU.

00603

fig. 31

After reaching 100% the reading is complete and the data can be displayed on the screen on the sub menu VIEW_DATA.

00612

fig. 32

◆ NOTE: If this command should be carried out during establishing of a LOG file the error message **"SERIAL ACCESS DENIED"** will appear..

In this case repeat the reading procedure.

13.2.4.4) VIEW_DATA-submenu

See fig. 33 and 34.

VIEW_DATA: Shows the file data read from READ_DATA on the screen. The keys "page up" ↑ and "page down" ↓ enable paging on the screen.

PROGRAM-VERSION TLR 4.3 and TLR 4.5

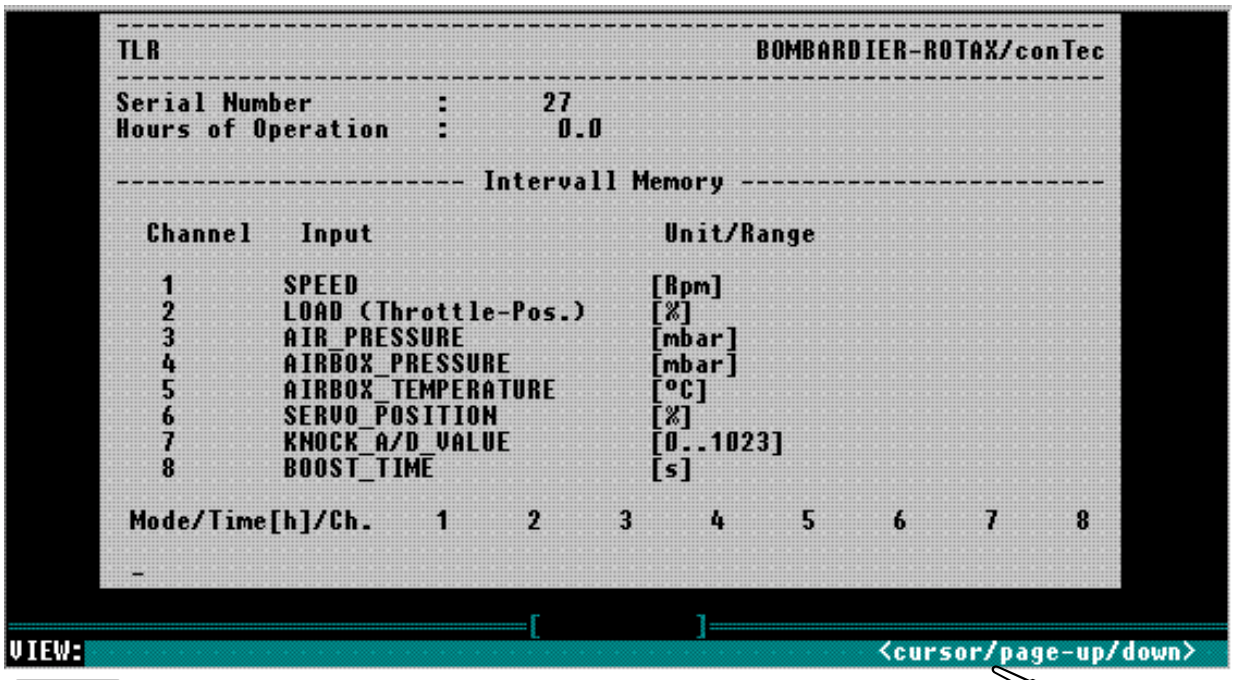
8 control measurements of the last two hours of operation are displayed. The display as well as the recording take place in 6 minute intervals in which the **moment-value** will be stored.

TLR 4.3

TLR 4.5

00603

fig. 33



00614

fig. 34

PROGRAM-VERSION TLR 4.6

See fig. 33a, 34a, 34b, 34c and 34d.

TLR 4.6

7 Measurements of the last 20 minutes of operation are displayed.

```
CONFIGURATION/DATA ACCESS:  SETUP  CALIBRATE  READ_DATA  VIEW_DATA  PRINT_DATA
```

00603

fig. 33a

```
TURBO CONTROL UNIT PROTOCOL                    BOMBARDIER-ROTAX/conTec

TCU Serial Number .....:          123
Hours of Operation [h:mm].:       125:33

 Channel   Input                  [Unit]

   1       SPEED                  [rpm ]
   2       LOAD (Throttle-Pos.)   [%   ]
   3       AIR_PRESSURE           [mbar]
   4       AIRBOX_PRESSURE        [mbar]
   5       AIRBOX_TEMPERATURE     [°C  ]
   6       SERVO_POSITION         [%   ]
   7       (reserved)             [    ]
   8       BOOST_TIME             [s   ]

VIEW:                                        <cursor/page-up/down>
```

03213

fig. 34a

INTERVALL MEMORY: The display as well as the recording take place in 1 minute intervals in which the **highest value each time** will be stored.

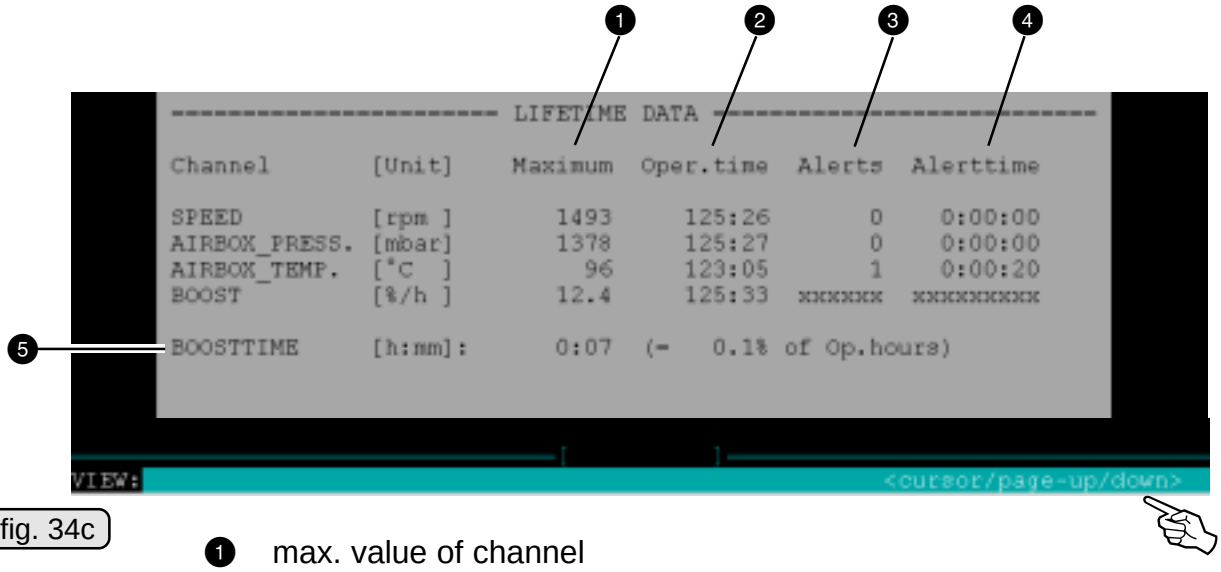
◆ NOTE: Since for each channel the max. values within a period (1 min.) are stored, time differences between the max. values may exist.

```
============== INTERVALL MEMORY (1 Minute Maxima) ==============

 Mode/Time    Ch.    1     2     3     4     5     6     7     8

 I   125:16       1356    84   965   964    26    75     -     0
 I   125:17       1356    84   965   964    26    75     -     0
 I   125:18       1356    84   965   964    26    75     -     0
 I   125:19       1356    84   965   964    26    75     -     0
 I   125:20       1356    84   965   964    26    75     -     0
 I   125:21       1356    84   965   964    26    75     -     0
 I   125:22       1356    84   965   964    26    75     -     0
 I   125:23       1355    84   965   963    26    75     -     0
 I   125:24       1355    84   965   963    26    75     -     0
 I   125:25       1355    84   965   963    26    75     -     0
 I   125:26       1355    84   965   963    26    75     -     0
 O   125:26       1493     0   964   962    23   100     -     0
 I   125:27       1425     0   964  1378    24   100     -    60
 I   125:28       1414     0   964  1377    24   100     -    60
 I   125:29       1404     0   964  1376    25   100     -    60
 I   125:30       1397     0   964  1376    25   100     -    60
 I   125:31       1391     0   964  1377    25   100     -    60
 I   125:32       1386     0   964  1377    25   100     -    60

VIEW:                                        <cursor/page-up/down>
```

03214

fig. 34b

LIFETIME DATA: Displays and stores exceedings of maximum values during the complete period of operation.

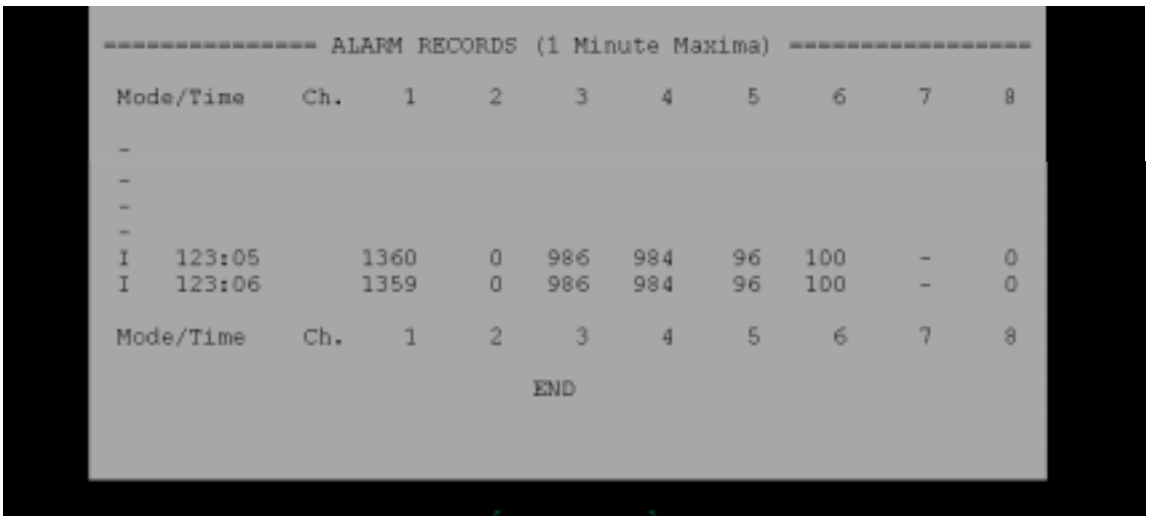


03215

fig. 34c

1. max. value of channel
2. time of max. value recording
3. number of error messages
4. total period of exceeding limits of operation
5. total period of boost operation

ALARM RECORDS: Stores and displays the last 100 exceedings of maximum values in 1 minute intervals.



03216

fig. 34d

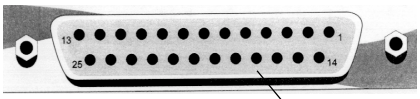
13.2.4.5) PRINT_DATA-submenu

See fig. 35 ,36 ,37 and 38.

fig. 35

PRINT_DATA: Offers the option to print data deduced from READ_DATA.

00603



00196

fig. 36

◆ NOTE: The printer has to be connected with the PC via a parallel interface ❶.

00614

fig. 37

◆ NOTE: If problems should arise regarding connection between computer and printer (e.g. a disconnected printer cable or printer without power) an error message will appear on the menu line.

"/ERROR: Device I/O (Printer) Continue with any key...".

Checking of the connection computer with printer is necessary.

◆ NOTE: The illustration shows program version TLR 4.5

Example of a print-out:

```
TLR                                                BOMBARDIER-ROTAX/conTec
-------------------------------------------------------------------------
Serial Number          :     500
Hours of Operation     :     564.1

----------------------- Intervall Memory ------------------------

  Channel    Input                        Unit/Range

    1        SPEED                        [Rpm]
    2        LOAD (Throttle-Pos.)         [%]
    3        AIR_PRESSURE                 [mbar]
    4        AIRBOX_PRESSURE              [mbar]
    5        AIRBOX_TEMPERATURE           [°C]
    6        SERVO_POSITION               [%]
    7        KNOCK_A/D_VALUE              [0..1023]
    8        BOOST_TIME                   [s]

 Mode/Time[h]/Ch.    1     2     3     4     5     6     7     8

 0    564.0          0     0   985  1249    28    -1     0     0
```

00205

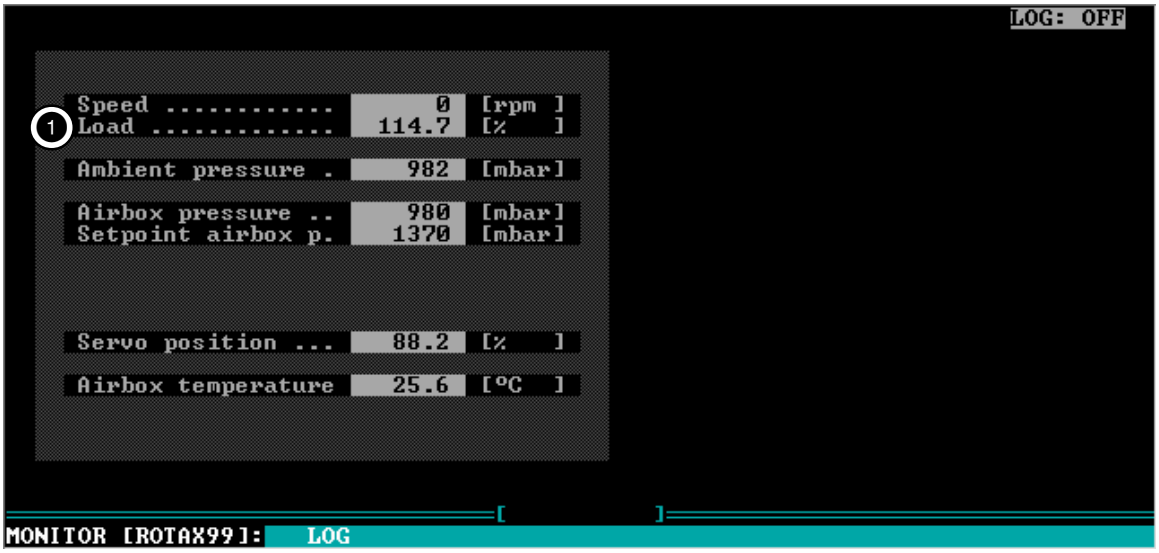
fig. 38

13.2.5) Check and calibration of the throttle potentiometer

13.2.5.1) Checking of the throttle position

See fig. 39 and 40.

◆ NOTE: The illustration shows program version TLR 4.6



03904

fig. 39

➪ Start-up of the submenu MONITOR (see chap. 13.2.1 or 13.2.1.1)

Throttle position is displayed under LOAD ❶ (for carb. 2/4)

00214

0 % ➪ **Throttle completely closed**

115 % ➪ **Throttle fully open**

00215

fig. 40

➪ visually check whether the throttle on both carburetors can be fully opened and closed. If necessary correct the installation setting.

➪ check of the display with throttle completely closed:

nominal: 0° tolerance +3%

➪ check of the display with throttle fully open:

nominal: 115 % tolerance -2%

■ ATTENTION: Check whether indication is **linear over the complete range** from 0 to 115 % i.e. the 115 % position is not indicated before throttle is fully open.

➪ Check the display at max. continuous power.

■ ATTENTION:Throttle lever must be in positive stop position.

nominal: 100 % tolerance +3%.

▲ WARNING: This check of position is only meaningful and allowed, if idle- and full throttle-position are within the allowance.

If the throttle position for idle and full throttle are not within the allowance or if not proceeding linear, then a new calibration of the throttle position is absolutely necessary.

13.2.5.2) THROTTLE-menu (Calibration)

See fig. 41, 41a, 42, 42a, 43, 43a, 44, 44a, 45, 45a, 45b.

THROTTLE: provides the necessary data for calibration of the throttle potentiometer. To receive the relevant data proceed in the following steps:

TLR 4.3

TLR 4.5

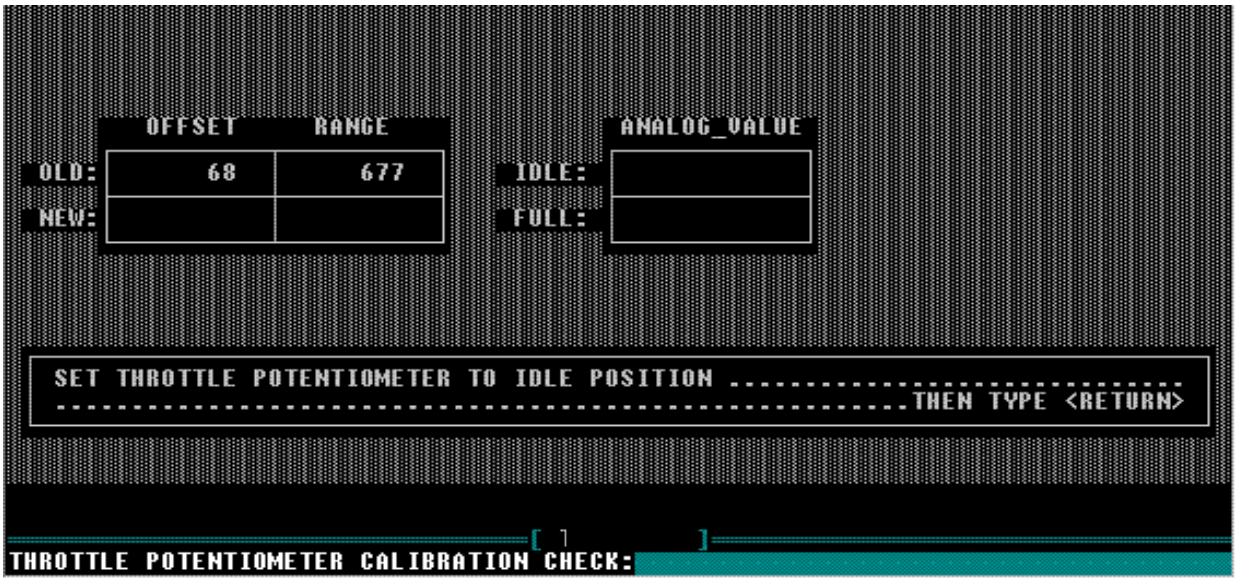
Directions for the program version TLR 4.3 a. TLR 4.5

◆ NOTE: The illustration shows program version TLR 4.5

00586

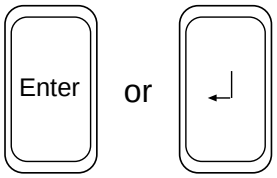
fig. 41

➪ The assignment field indicates to set throttle to idle position. Close the throttle completely.



00615

fig. 42



or

➪ acknowledge this step by pressing the key RETURN.

➪ follow the command in the assignment field to set throttle to fully open position.

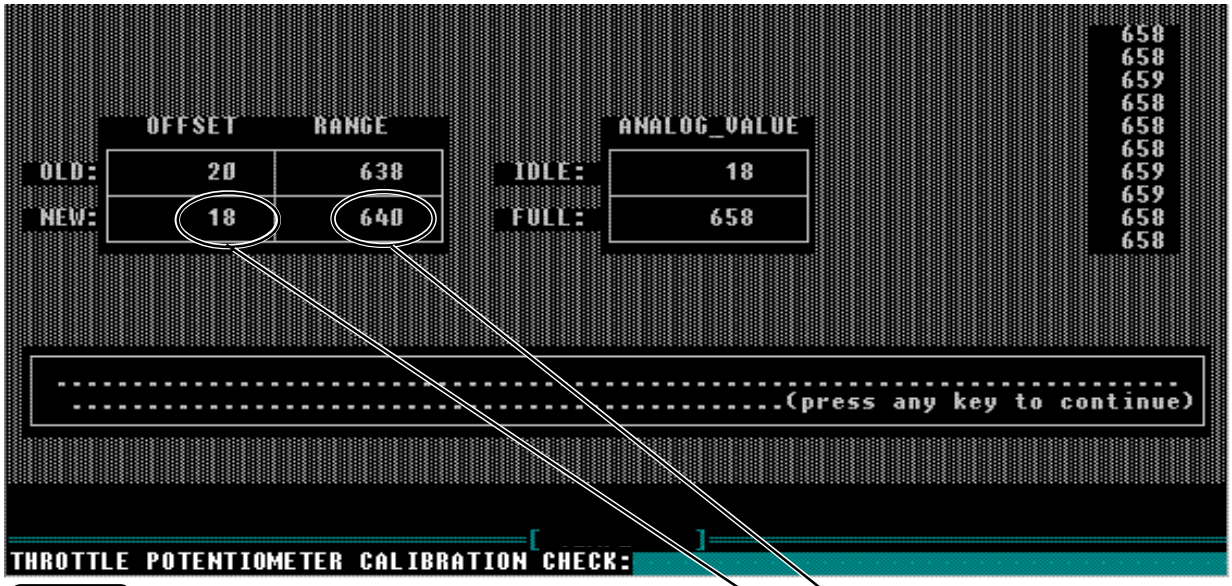
Acknowledge again with the RETURN key.

fig. 43

00616

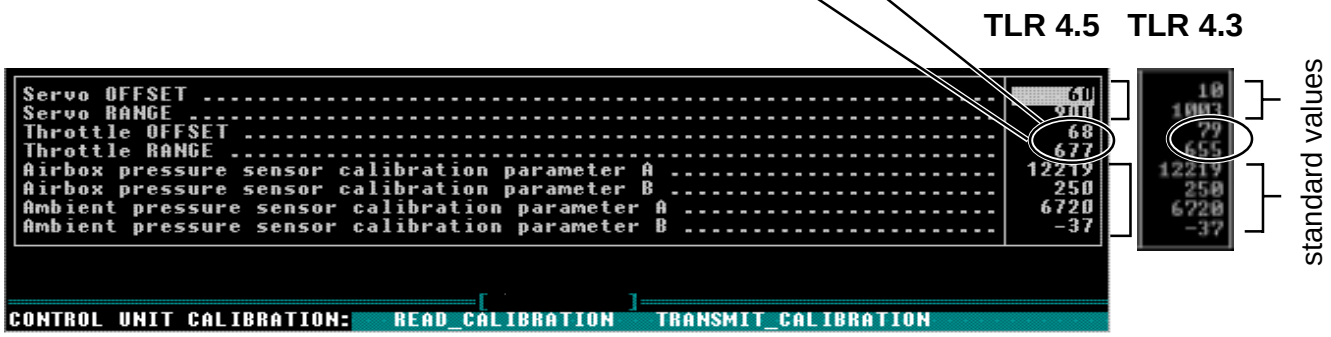
fig. 44

➪ In the field OFFSET-NEW and RANGE-NEW the relevant throttle parameters appear which have to be put in submenu for THROTTLE offset and THROTTLE range.



00617

fig. 45



00610 03922

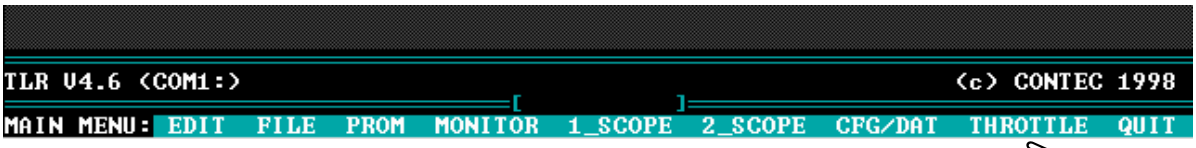
fig. 45b

➪ Check throttle position after calibration and transfer of data (see chapter. 13.2.4.2)

▲ WARNING: Only check and change the THROTTLE OFFSET and THROTTLE RANGE. The other values have to be compared only with the values on the above display and must not be changed.

TLR 4.6

◆ NOTE: The illustration shows program version TLR 4.6



03902

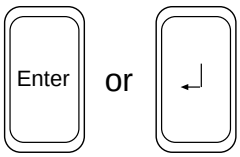
fig. 41a

➪ The assignment field indicates to set throttle to idle position. Close the throttle completely.

03931

fig. 42a

➪ acknowledge this step by pressing the key RETURN.



➪ follow the command in the assignment field to set throttle to fully open position.

Acknowledge again with the RETURN key.

fig. 43a

03932

fig. 44a

➪ The effective values for THROTTLE Offset and THROTTLE Range are automatically stored and can be seen on the CALIBRATE subprogram (chap. 13.2.4.2)

03933

fig. 45a

◆ NOTE: After calibration and transfer of the data check the throttle valve position (see chap. 13.2.4.2)

13.3) TCU-Control data

➪ These program components serve the user display of TCU specific control data and reveal the control response of the TCU.

13.3.1) FILE_menu

See fig. 46 ,47 ,48 and 49.

FILE: For choice of data set, valid for the respective TCU-version and to store date for viewing with the following stated sub menu.

03902

fig. 46

By pressing key L for LOAD, data record valid for this version will be activated.

00584

fig. 47

Allocation of the data-set:

TCU part no.	program-vers.	data-set
966 470	TLR 4.3	ROTAX21
966 471	TLR 4.5	ROTAX881
966 472		ROTAX89
966 473		ROTAX99
966 741	TLR 4.6	ROTAX99

04055

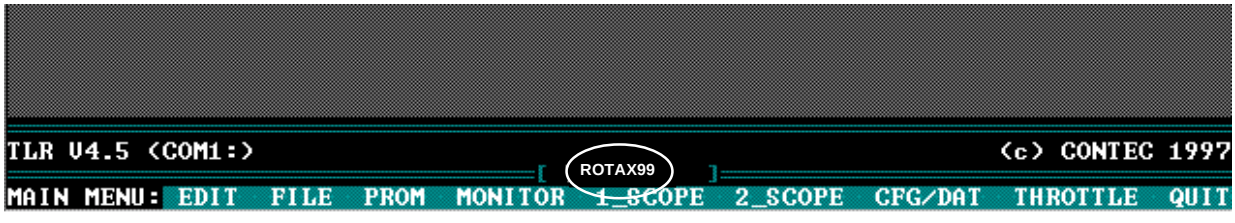
Mark the corresponding data set by the CURSOR-key and put in the activated data set with the RETURN-key.

00585

fig. 48

To continue further with the EDIT submenu the data set (e.g.**ROTAX99**) should appear on the program information line.

fig. 49



00586

13.3.2) EDIT-menu

See fig. 50.

EDIT: is the submenu which informs about the TCU control data.

◆ NOTE: The illustration shows program version TLR 4.6 with data set ROTAX99

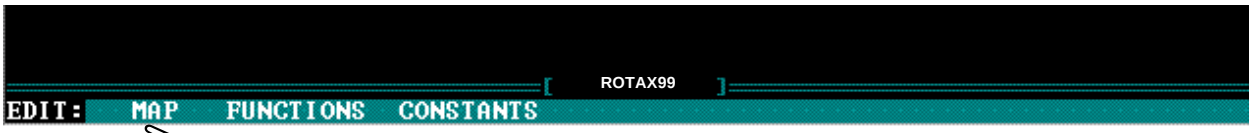
03902

fig. 50

13.3.2.1) MAP-submenu

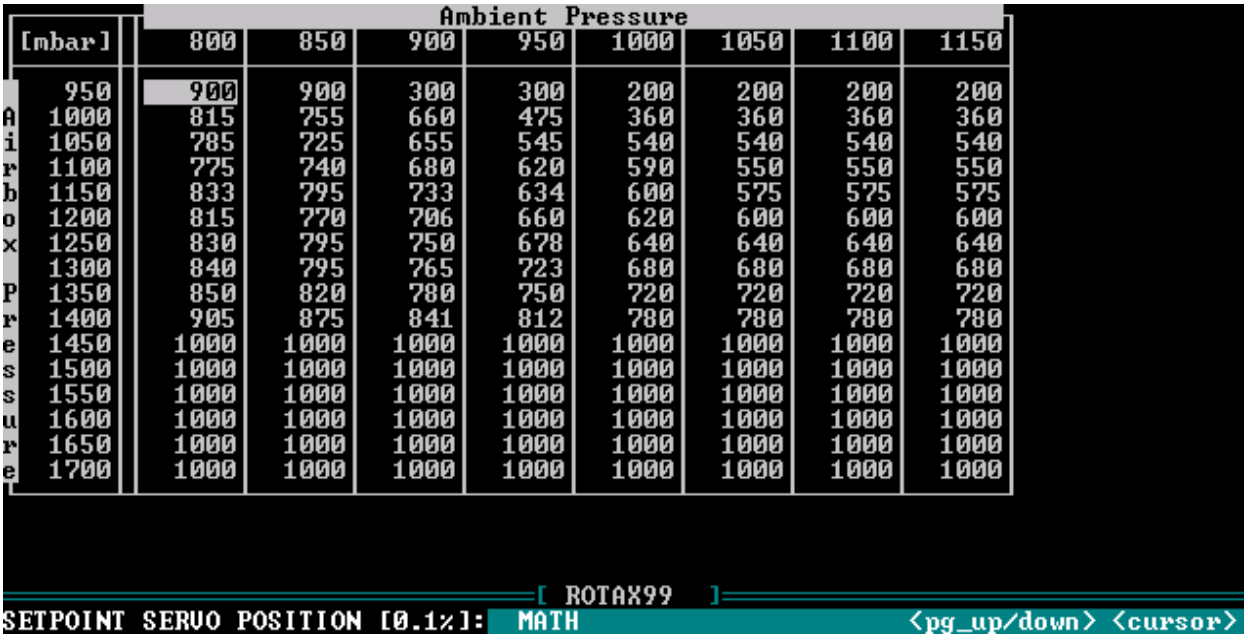
See fig. 51 and 52.

MAP: Visualizes the action of the servo motor in response to target input on MAP in correlation to ambient pressure and airbox pressure.



00587

fig. 51



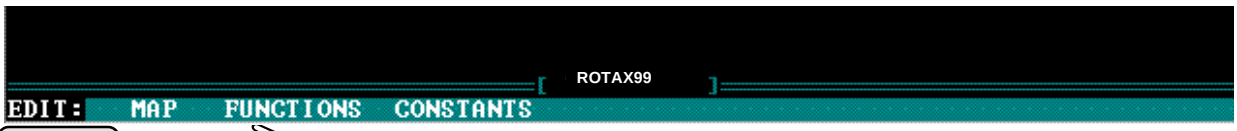
01351

fig. 52

13.3.2.2) FUNCTIONS-submenu

See fig. 53.

FUNCTIONS: provides the submenu for correction of air pressure-and servo motor control.



00587

fig. 53

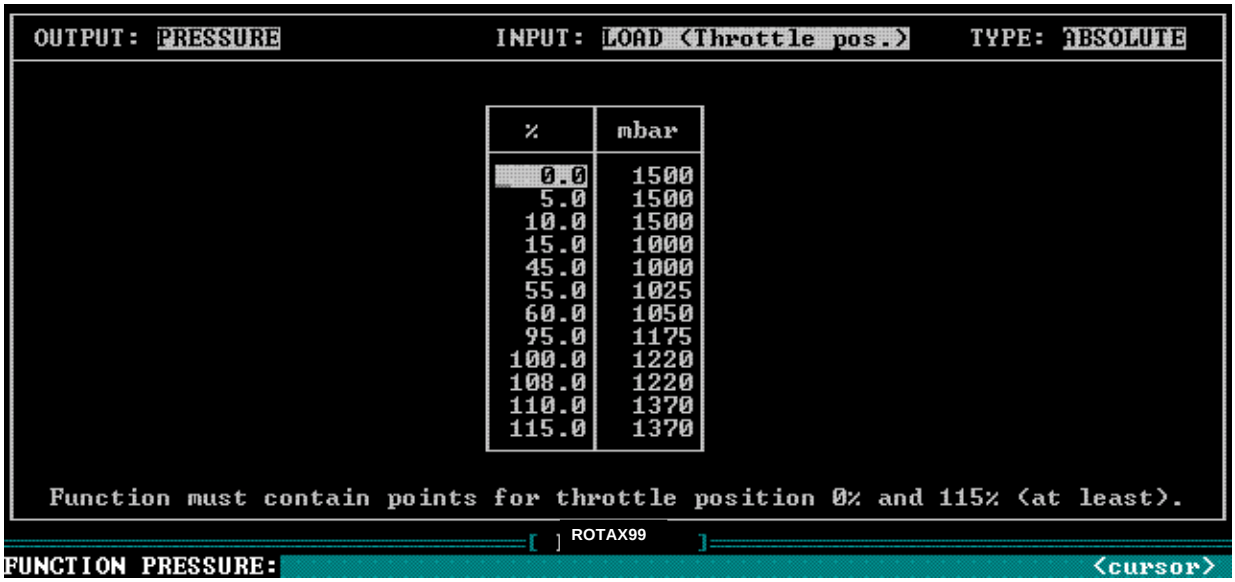
PRESSURE(Load)-submenu

See fig. 54 ,55 ,56 and 57.

PRESSURE(Load): Indicates target pressure corresponding to throttle position.

00590

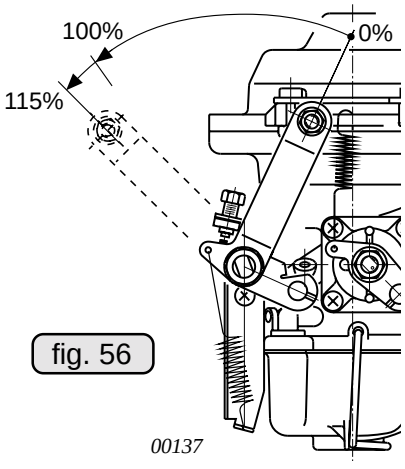
fig. 54



01020

fig. 55

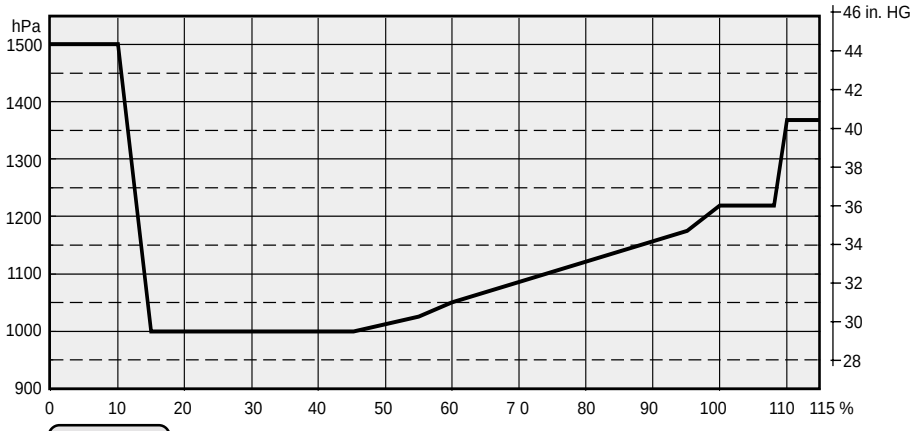
◆ NOTE: The illustration shows data set ROTAX99



00137

fig. 56

0% W.G. open 100% W.G. close



00170

fig. 57

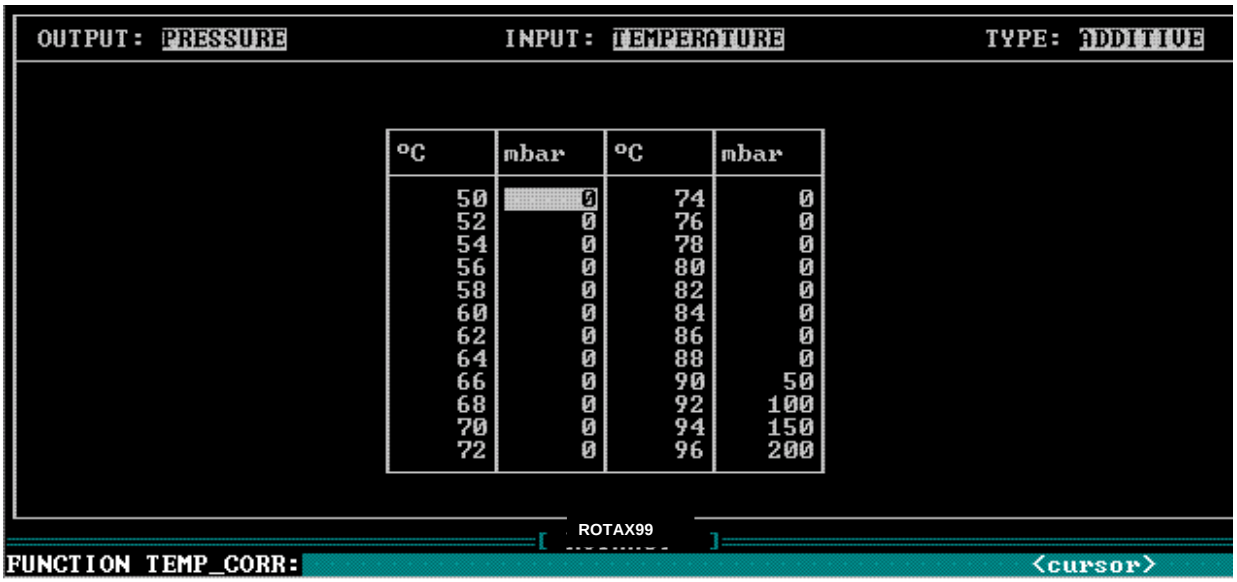
TEMP_CORR-submenu

See fig. 58, 59 and 60.

TEMP_CORR: provides the control parameters for correction of the target pressure in response to increased airbox tempertature resulting in effective target pressure(see Monitor menu chapt. 13.2.1 ❼).

00590

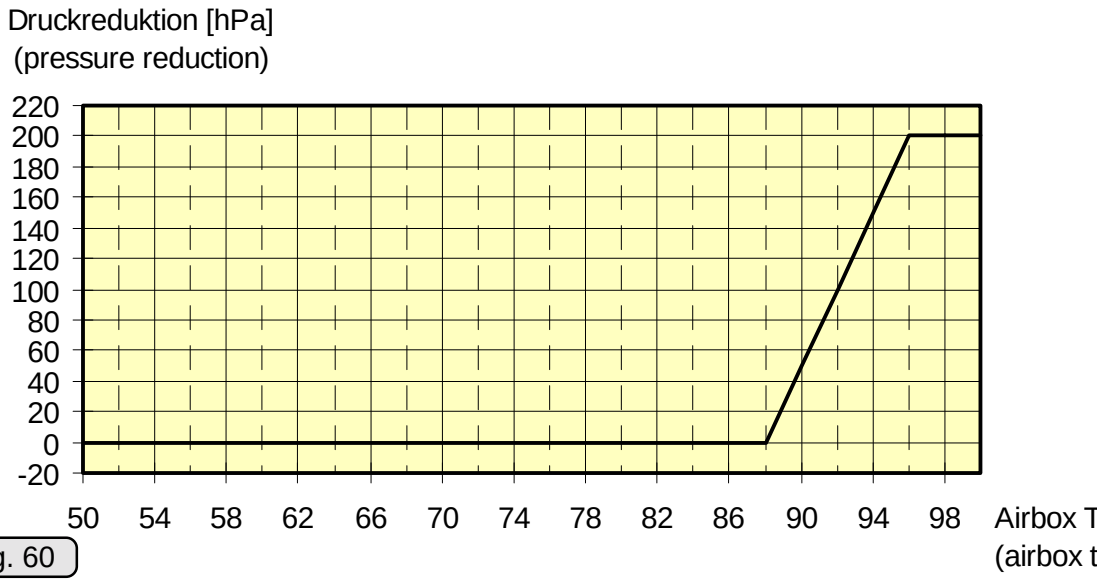
fig. 58



00901

fig. 59

◆ NOTE: The illustration shows data set ROTAX99



00902

fig. 60

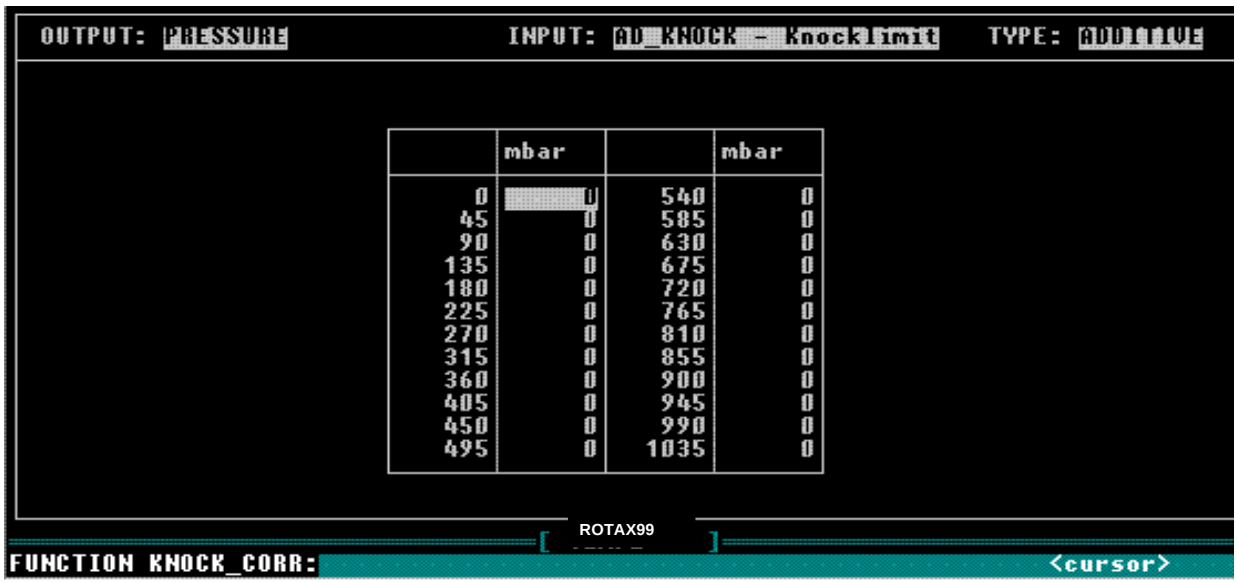
KNOCK_CORR-submenu

See fig. 61 and 62.

KNOCK_CORR: This menu is not active any more and doesn´t contain data sets any longer.

00590

fig. 61



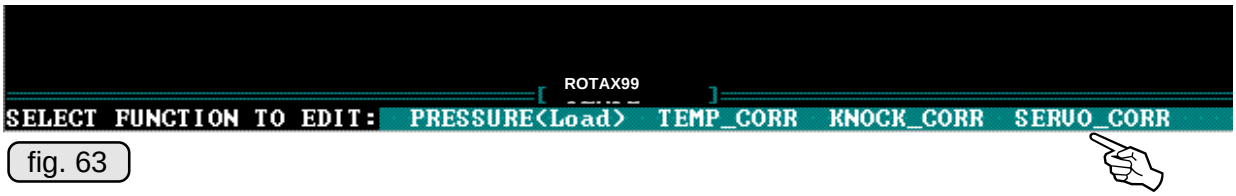
00692

fig. 62

SERVO_CORR-submenu

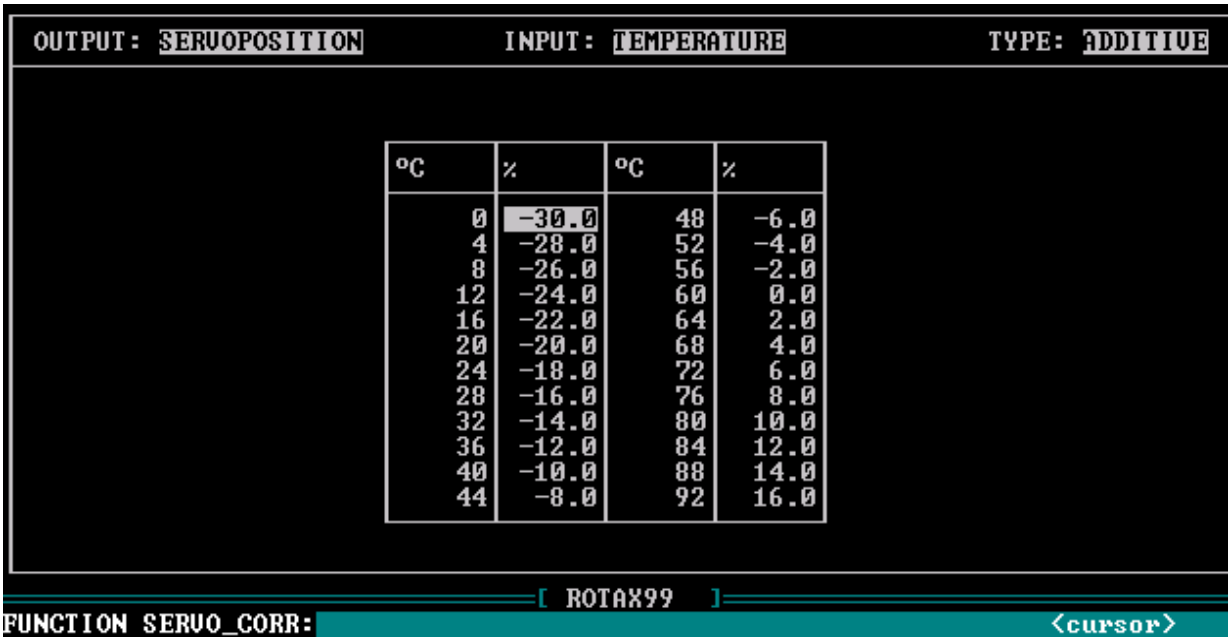
See fig. 63, 64 and 65.

SERVO_CORR: provides the data set for correction of the wastegate input in correlation to respective airbox temperature (see monitor menu 13.2.1 ㉔).



00590

fig. 63

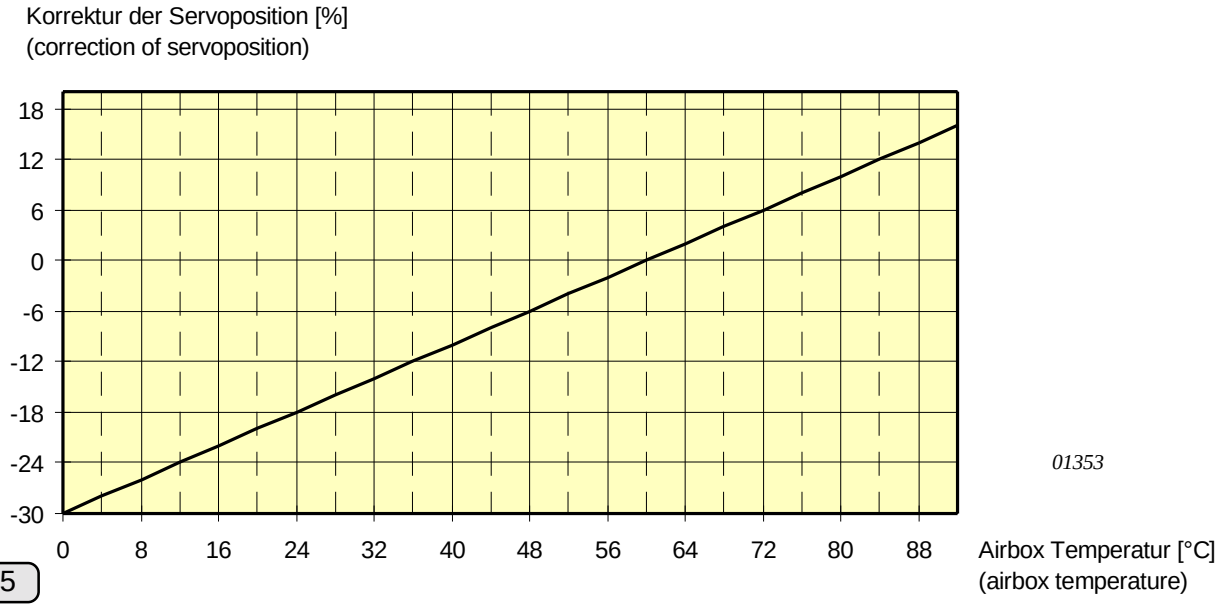


°C	%	°C	%
0	-30.0	48	-6.0
4	-28.0	52	-4.0
8	-26.0	56	-2.0
12	-24.0	60	0.0
16	-22.0	64	2.0
20	-20.0	68	4.0
24	-18.0	72	6.0
28	-16.0	76	8.0
32	-14.0	80	10.0
36	-12.0	84	12.0
40	-10.0	88	14.0
44	-8.0	92	16.0

01352

fig. 64

◆ NOTE: The illustration shows data set ROTAX99



01353

fig. 65

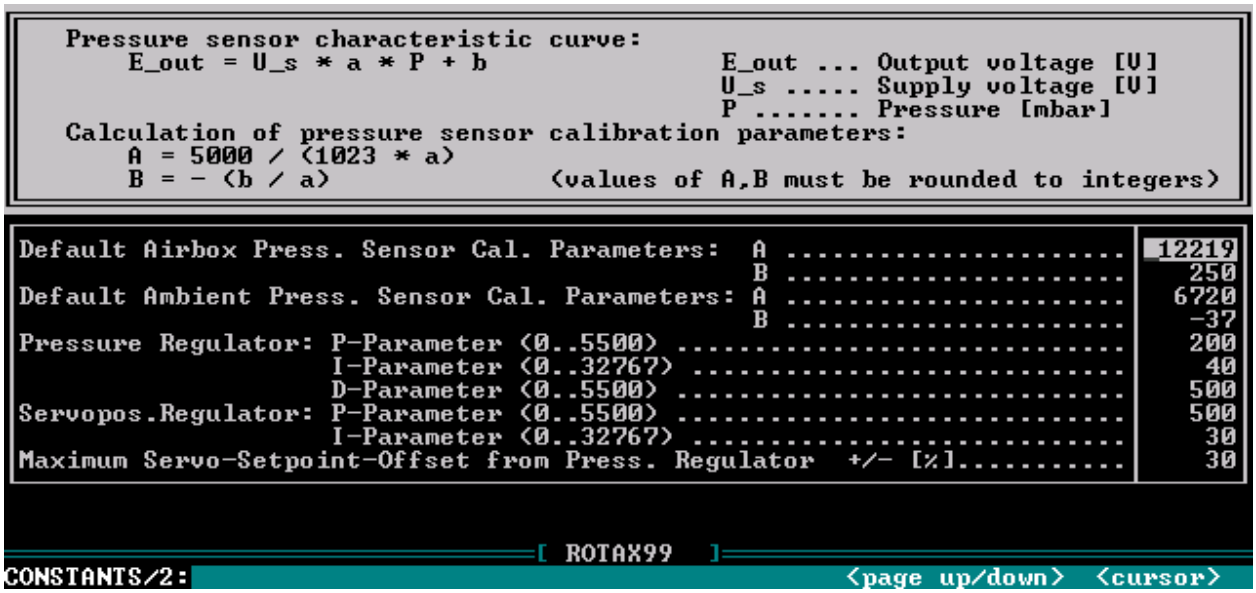
13.3.2.3) CONSTANTS-submenu

See fig. 66, 67 and 68.

CONSTANTS: Provides the various constants.

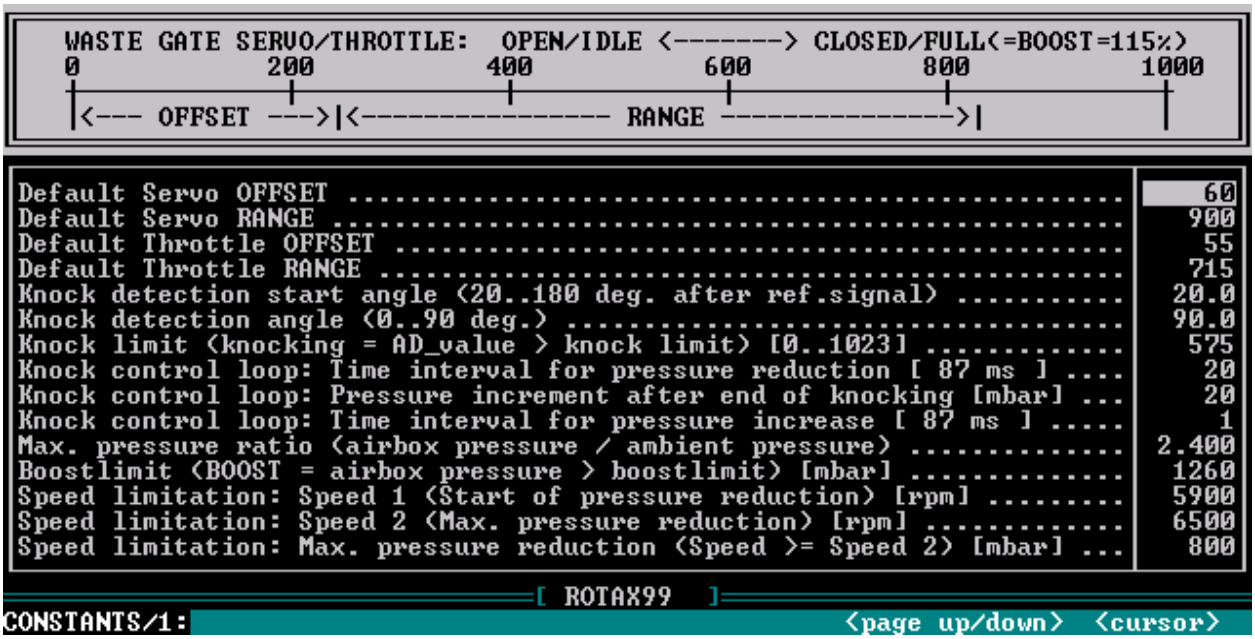
00587

fig. 66



01354

fig. 67



01355

fig. 68

13.3.3) PROM_submenu

See fig. 69.

PROM: Is a furter submenu of no application for the user.

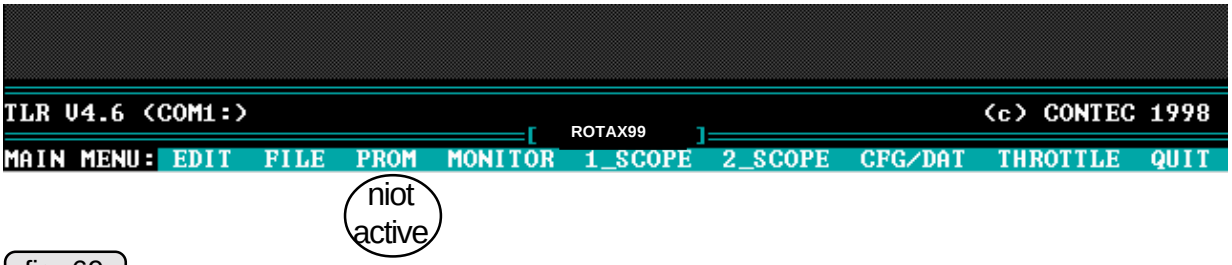


fig. 69

13.4) End of program

See fig. 70.

➪ With "**Q**" for QUIT stop communication program

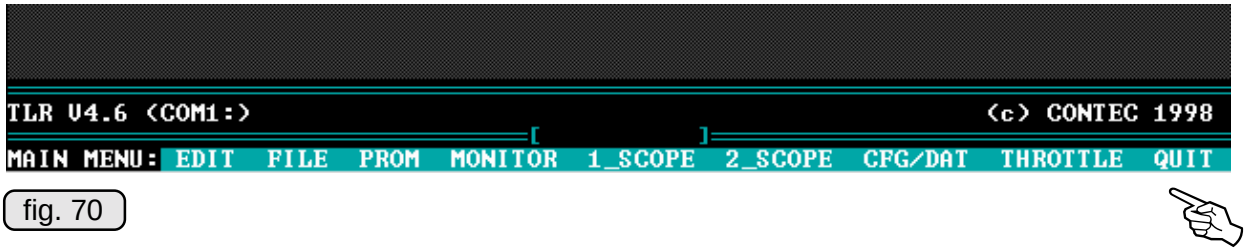


fig. 70

➪ **Turn off the TCU**

➪ **Disconnect wiring (store Dongle proper)**

➪ **Switch off PC**

14) Schematic arrangement of control items of Turbo charger control

See fig. 71.

This general chart should help you to familiarize yourself with items of turbo charger control and TCU specific control sequence.

◆ NOTE: The illustration shows program version TLR 4.6

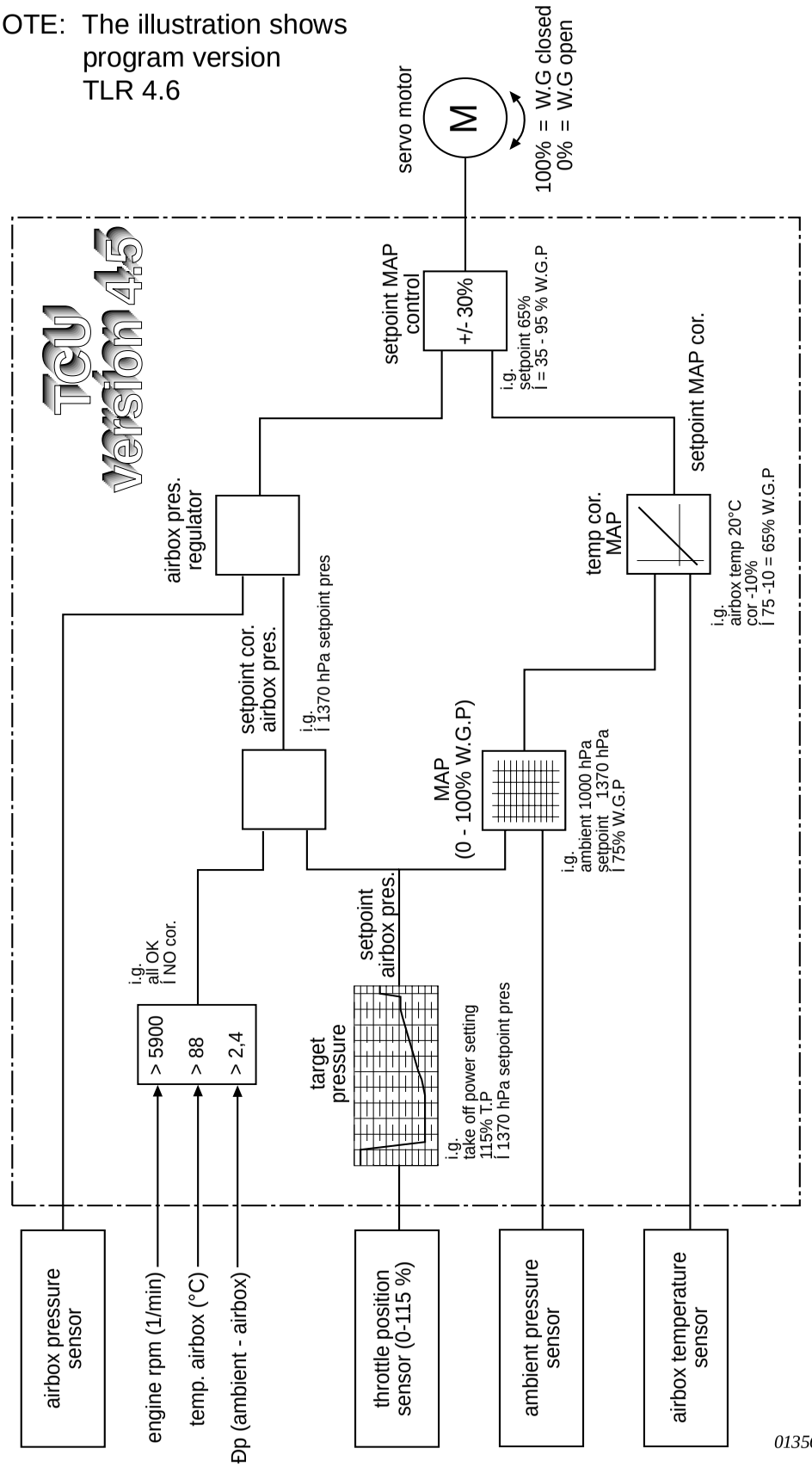


fig. 71

15) Chart of program items

See fig. 72 and 72a.

fig. 72

Program version TLR 4.3

user field	key	point of menu	brief description
	Esc		exit from the respective sub program, back to the main menu
choice of graphic adapter	V	V G A	option to choose VGA-graphic card
	C	C G A	option to choose CGA-graphic card
	E	E G A	option to choose EGA-graphic card
On-line-display[1)2)]	M	MONITOR	display of engine data
	S	STEPSIZE	shows the input of the PID-values
	M	MEMORY	shows the stored values for PID regulator
	C	CLEAR OFFSET	clears limit values
	L	LOG	ON/OFF of engine data recording
	1	1_SCOPE	display deviation (AIRBOX-pressure to SETPOINT-pressure)
	2	2_SCOPE	display (AIRBOX-pressure and SETPOINT-pressure)
Calibration-data[1)]	C	CFG/DAT	submenu, calibration and TCU data analysis
	S	SETUP	submenu for input of serial number and hours of operation
	T	TRANSMIT_SETUP	Setup data transfer to TCU
	C	CALIBRATE	display (SERVO, THROTTLE, pressure sensor)
	R	READ_CALIBRATION	reading of data from TCU
	T	TRANSMIT_CALIBRATION	transfer of calibration data to memory of TCU
	R	READ_DATA	reading of data stored in TCU
	V	VIEW_DATA	display of stored data in TCU
	P	PRINT_DATA	printing of data stored in TCU
Calibration[2)]	T	THROTTLE	data loading for the relevant throttle pos. calib.
Data sets	F	FILE	submenu for selecting and loading of TCU control data
TCU-control data[3)]	E	EDIT	submenu for display and load of control data
	S	SPEED	speed coordinates for PID regulator
	L	LOAD	throttle position coordinates for PID regulator
	P	PID	PID factors
	F	FUNCTIONS	subprogram for viewing of the correction function
	P	PRESSURE_LOAD	target input servo position - airbox pressure
	T	TEMPERATURE_CORR	correction of target pressure governed by airbox temperature
	K	KNOCK_CORR	irrelevant, not active
	S	SERVO_CORR	correction of target input of wastegate pos. governed by airbox temp.
	C	CONSTANTS	display of various constants
	Q	QUIT	exit from the communication program

[1)] contains the most important data for the maintenance

[2)] effective only in conjunction with a TCU

[3)] for information only

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Program version TLR 4.5 and TLR 4.6

fig.72a

user field	key	point of menu	brief description
	Esc		exit from the respective sub program, back to the main menu
choice of graphic adapter	V	V G A	option to choose VGA-graphic card
	C	C G A	option to choose CGA-graphic card
	E	E G A	option to choose EGA-graphic card
choice of interface	1	COM1	manual dialing of COM1 interface
	2	COM2	manual dialing of COM2 interface
On-line-display[1)2)]	M	MONITOR	display of engine data
	L	LOG	ON/OFF of engine data recording
	1	1_SCOPE	display deviation (AIRBOX-pressure to SETPOINT-pressure)
	2	2_SCOPE	display (AIRBOX-pressure and SETPOINT-pressure)
Calibration-data[1)]	C	CFG/DAT	submenu, calibration and TCU data analysis
	S	SETUP	submenu for input of serial number and hours of
	T	TRANSMIT_SETUP	Setup data transfer to TCU
	C	CALIBRATE	display (SERVO, THROTTLE, pressure sensor)
	R	READ_CALIBRATION	reading of data from TCU
	T	TRANSMIT_CALIBRATION	transfer of calibration data to memory
	R	READ_DATA	reading of data stored in TCU
	V	VIEW_DATA	display of stored data in TCU
	P	PRINT_DATA	printing of data stored in TCU
Calibration[2)]	T	THROTTLE	data loading for the relevant throttle pos. calib.
Data sets	F	FILE	submenu for selecting and loading of TCU control data
TCU-control data[3)]	E	EDIT	submenu for display of TCU control data
	M	MAP	data set for indication of characteristics
	F	FUNCTIONS	subprogram for viewing of the correction function
	P	PRESSURE_LOAD	target input servo position - airbox pressure
	T	TEMPERATURE_CORR	correction of target pressure governed by airbox temperature
	K	KNOCK_CORR	irrelevant, not active
	S	SERVO_CORR	correction of target input of wastegate pos. governed by airbox temp.
	C	CONSTANTS	display of various constants
	Q	QUIT	exit from the communication program

[1)] contains the most important data for the maintenance

[2)] effective only in conjunction with a TCU

[3)] for information only

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16) ERROR Detection Chart

display	target	actual (1)	possible reason (5)	orange lamp	red lamp
SPEED	engine speed (~1500 ÷ 5800)	n = Ø	engine shut down	off	off
		n = Ø	faulty rev-pickup, gap of pickup too big	off	off
		n = Ø	circuit break (15)	off	off
		n = Ø	circuit break (27)	off	off
		n = Ø	short circuit (13 to 26)	off	off
		n = Ø	short circuit (15 to GND)	off	off
		n = Ø	short circuit (13 to GND)	off	off
LOAD	0 bis 115%	idling > 3% full load < 113%	defective potentiometer misadjustment of throttle pos./new cal. required	off	off
		0%	severed plug connection on pot.	flashing	off
		0%	circuit break (8)	flashing	off
		0%	circuit break (20)	flashing	off
		115%	circuit break (32)	off	off
		0%	short circuit (8 to GND)	flashing	off
		0%	short circuit (20 to 8)	flashing	off
		I/O error (4)	shor circuit (20 to GND)	off	off
AMBIENT PRESS	ambient pressure (~ 990 mbar)	1000 mbar	severed plug connector on sensor	flashing	off
		ca. 350 mbar	air box pressure sensor connected	off	off
		ambient pressure (6)	airbox pressure hose connected	off	off
		1000 mbar	circuit break (6)	flashing	off
		1000 mbar	circuit break (18)	flashing	off
		ca 1300 mbar	circuit break (30)	off	off
		1000 mbar	short circuit (6 to GND)	flashing	off
		1000 mbar	short circuit (6 to 18)	flashing	off
		I/O error (4)	short circuit (18 to GND)	off	off
AIRBOX PRESS.	airbox pressure (ambient pressure) (7)	1500 mbar	severed plug connection on sensor	flashing	off
		ca. 2100 mbar	ambient pressure sensor connected	off	off
		ambient pressure (6)	airbox pressure hose not connected/kinked	off	off
		1500 mbar	circuit break (9)	flashing	off
		1500 mbar	circuit break (21)	flashing	off
		ca. 2700 mbar	circuit break (33)	off	off
		1500 mbar	short circuit (9 to GND)	flashing	off
		1500 mbar	short circuit (9 to 21)	flashing	off
		I/O error (4)	short circuit (21 to GND)	off	off
AIRBOX TEMP.	air temp. in airbox	50°C	severed plug connection to sensor	flashing	off
		50°C	faulty temperature sensor	flashing	off
		50°C	conn. temp. sensor mistaken for solenoid valve	flashing	off
		50°C	circuit break (3)	flashing	off
		50°C	circuit break (4)	flashing	off
		50°C	short circuit (4 to GND)	flashing	off
SERVO POSITION	0% to 100%	< 0%	severed plug connection Servopoti. 3 pole	off	off
		restrained	severed plug connection Servomotor 2 pole	off	off
		restrained	circuit break (2)	off	off
		ca. -10%	circuit break (7)	off	off
		restrained	circuit break (14)	off	off
		< 0%	circuit break (19)	off	off
		cont. changing	circuit break (31)	off	off
		I/O error (4)	short circuit (7 to 31)	off	off
		> 100%	short circuit (7 und 19)	off	off
		restrained (4)	short circuit (19 to GND)	off	off
		restrained	short circuit (2 to 14)	off	off
		restrained	short circuit (2 to GND)	off	off
		undef./restrained	short circuit (14 to GND)	off	off

(1) possible default values

(2) at automatic re-activation of the TCU, auto test of servo motor and lamps is performed

(3) SETPOINT = target pressure input for airbox

(4) I/O error = circuit break TCU to computer or short circuit in voltage supply to TCU

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possible effect on TCU	possible effect on engine
none	no target pressure correction by excessive engine speed
none	no target pressure correction by excessive engine speed
none	no target pressure correction by excessive engine speed
none	no target pressure correction by excessive engine speed
none	no target pressure correction by excessive engine speed
none	no target pressure correction by excessive engine speed
none	no target pressure correction by excessive engine speed
confined target pressure range sudden target pres. changes, fixed target pres.	performance loss
setpoint 1500 mbar (3)	wastegate closes completely, no control possible
setpoint 1500 mbar (3)	wastegate closes completely, no control possible
setpoint 1500 mbar (3)	wastegate closes completely, no control possible
setpoint 1350 mbar (3)	engines runs with take-off performance, no control possible
setpoint 1500 mbar (3)	wastegate closes completely, no control possible
setpoint 1500 mbar (3)	wastegate closes completely, no control possible
TCU stops (2)	wastegate restrained, no control possible
incorrect setpoint of wastegate pos.	as of approx. 950 mbar wastegate is not closing enough, performance loss
incorrect setpoint of wastegate pos. (8)	wastegate closes too far - possible performance rise
incorrect setpoint of wastegate pos.	wastegate closes too far - pressure rise, no overboost warning
incorrect setpoint of wastegate pos.	wastegate is not closing enough - performance loss
incorrect setpoint of wastegate pos.	wastegate is not closing enough - performance loss
incorrect setpoint of wastegate pos.	wastegate is not closing enough - performance loss
incorrect setpoint of wastegaste pos.	wastegate is not closing enough - performance loss
incorrect setpoint of wastegate pos.	wastegate is not closing enough - performance loss
TCU stops (2)	wastegate restrained, no control possible
target pressure correction not possible	wastegate is not closing enough - performance loss
target pressure correction not possible (8)	wastegate closed too far - possible performance rise
incorrect setpoint of wastegate pos.	wastegate closed too far - pressure rise, no overboost warning
target pressure correction not possible	wastegate is not closing enough - performance loss
target pressure correction not possible	wastegate is not closing enough - performance loss
target pressure correction not possible	wastegate is not closing enough - performance loss
target pressure correction not possible	wastegate is not closing enough - performance loss
target pressure correction not possible	wastegate is not closing enough - performance loss
TCU stops (2)	wastegate restrained, no control possible
temp. correction of MAP impossible (const +5%)	neither temp. limitation nor power adaptibility in regard to ambient conditions
temp. correction of MAP impossible (const +5%)	neither temp. limitation nor power adaptibility in regard to ambient conditions
temp. correction of MAP impossible (const +5%)	neither fuel enrichening nor temperature limitation
temp. correction of MAP impossible (const +5%)	neither temp. limitation nor power adaptibility in regard to ambient conditions
temp. correction of MAP impossible (const +5%)	neither temp. limitation nor power adaptibility in regard to ambient conditions
temp. correction of MAP impossible (const +5%)	neither temp. limitation nor power adaptibility in regard to ambient conditions
none	wastegate closes completely, no control possible
none	no control possible
none	no control possible
none	wastegate opens fully - performance loss
none	no control possible
none	wastegate closes completely, no control possible
none	wastegate opens fully - performance loss
TCU stops (2)	wastegate opens fully - performance loss
TCU stops (2)	wastegate opens fully - performance loss
TCU stops (2)	wastegate restrained, no control possible
none	no control possible
none	no control possible
none	no control possible

(5) relevant defective TCU component
(6) shortcoming perceptible only at engine operation
(7) at engine operation up to approx. 1350 mbar
(8) MAP 100% ± (temp. corr.) - (20% setpoint corr.)

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