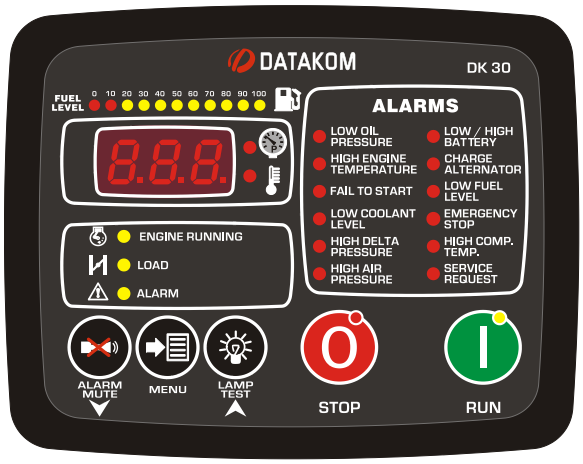
DATAKOM



DK-30

DIESEL COMPRESSOR CONTROLLER

DESCRIPTION

The DK-30 is a high-tech product providing control and protection of diesel engine driven, screw or piston type air compressors.

The controller incorporates all functions needed in a compressor control panel. Thus no additional modules are necessary resulting in lower panel cost.

The controller features full engine protection and instrumentation through analog and digital inputs and outputs. It acts also as an overspeed protection relay protecting the engine from overspeeding.

In order to prevent battery drain, in STOP mode, the controller turns completely off, consuming zero current.

The engine rpm is read through the magnetic pickup sender installed on the engine flywheel.

The “early start” function analyzes the air consumption trend and runs the compressor so that the pressure never falls below the low limit.

In order to have a constant output pressure, the controller is capable of governing the engine speed with its analog output driven by a PID loop.

The controller supports multi-compressor application up to 8 compressors.

The logic level Modbus RTU communication port of the controller allows computer connection providing monitoring and program parameter adjusting.

The controller configuration may be done through the front panel or using the free PC software. The PC software is available for free download at manufacturer’s website.

It is possible to monitor and record the controller using the free RAINBOW+ software.

FEATURES

- ***Automatic operation via output pressure***
- ***Load solenoid control***
- ***Analog speed control output***
- ***Multiple compressor support***
- ***Comprehensive engine instrumentation***
- ***Detailed engine protection***
- ***Engine overspeed protection***
- ***Zero power consumption at rest***
- ***Flexible engine hours calculation algorithm***
- ***Early start function preventing pressure drop***
- ***History records***
- ***5 independent service counters***
- ***Magnetic pickup input***
- ***6 programmable digital outputs***
- ***6 programmable digital inputs***
- ***3 programmable engine analog sender inputs***
- ***2 air pressure sensor inputs***
- ***2 air temperature sensor inputs***
- ***Adjustable sensor characteristics***
- ***Logic level serial port***
- ***MODBUS-RTU communications***
- ***Password protected front panel programming***
- ***Low panel depth, easy installation***
- ***Wide operating temperature range***
- ***Sealed front panel (IP65 with gasket)***

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Any unauthorized use or copying of the contents or any part of this document is prohibited.
This applies in particular to trademarks, model denominations, part numbers and drawings.

ABOUT THIS DOCUMENT

This document describes minimum requirements and necessary steps for the successful installation of the DK-30 family controllers.

Follow carefully advices given in the document. These are often good practices for the installation of compressor controllers which reduce future issues.

For all technical queries please contact Datakom at below e-mail address:

technical.support@datakom.com.tr

QUERRIES

If additional information to this manual is required, please contact the manufacturer directly at below e-mail address:

technical.support@datakom.com.tr

Please provide following information in order to get answers to any question:

- Device model name (see the back panel of the controller),
- Complete serial number (see the back panel of the controller),
- Firmware version (read from the display screen),
- Measuring-circuit voltage and power supply voltage,
- Precise description of the query.

REVISION HISTORY

REVISION	DATE	AUTHOR	DESCRIPTION
01	31.01.2012	MH	First edition, firmware version 1.0

TERMINOLOGY

CAUTION: Potential risk of injury or death.

WARNING: Potential risk of malfunction or material damage.

ATTENTION: Useful hints for the understanding of device operation.

SAFETY NOTICE

Failure to follow below instructions will result in death or serious injury

- **Electrical equipment should be installed only by qualified specialist. No responsibility is assured by the manufacturer or any of its subsidiaries for any consequences resulting from the non-compliance to these instructions.**
- **Check the controller for cracks and damages due to transportation. Do not install damaged equipment.**

- **Do not open the controller. There are no serviceable parts inside.**
- **Fuse must be connected to the battery power supply input, in close proximity of the controller.**

- **Fuses must be of fast type (FF) with a maximum rating of 6A.**

- **Disconnect all power before working on equipment.**

- **Any electrical parameter applied to the device must be in the range specified in the user manual. Although the controller is designed with a wide safety margin, over-range parameters may reduce lifetime, alter operational precision or even damage the controller.**

- **Do not try to clean the device with solvent or the like. Only clean with a dump cloth.**
- **Verify correct terminal connections before applying power.**
- **Only for front panel mounting.**

TABLE OF CONTENTS

1. INSTALLATION INSTRUCTIONS

Before installation:

- Read the user manual carefully, determine the correct connection diagram.
- Remove all connectors and mounting brackets from the controller, then pass the controller through the mounting opening.
- Put mounting brackets and tighten. Do not tighten too much, this can brake the enclosure.
- Make electrical connections with plugs removed from sockets, then place plugs to their sockets.
- Be sure that adequate cooling is provided.
- Be sure that the temperature of the environment will not exceed the maximum operating temperature in any case.

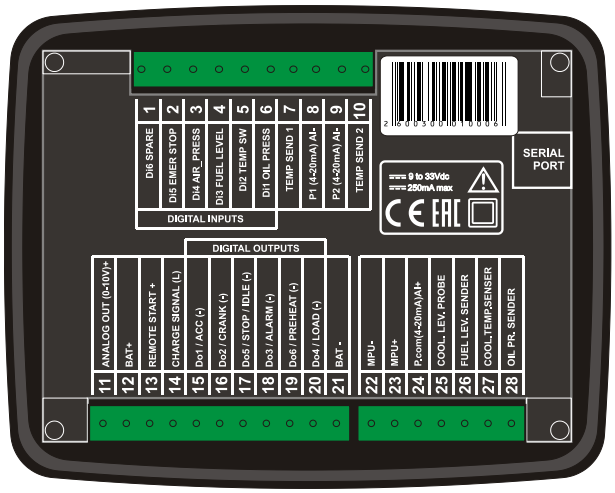
Below conditions may damage the device:

- Incorrect connections.
- Incorrect power supply voltage.
- Voltage at measuring terminals beyond specified range.
- Overload or short circuit at relay outputs
- Connecting or removing data terminals when the controller is powered-up.
- High voltage applied to communication ports.
- Ground potential differences at non-isolated communication ports.
- Excessive vibration, direct installation on vibrating parts.

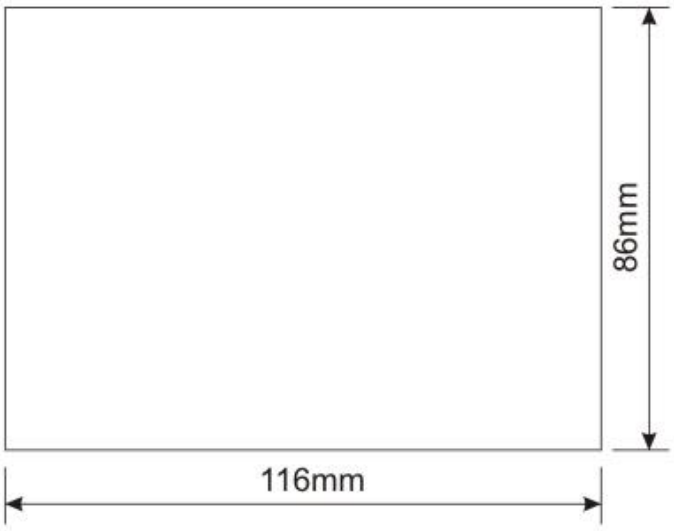
Below conditions may cause abnormal operation:

- Power supply voltage below minimum acceptable level.

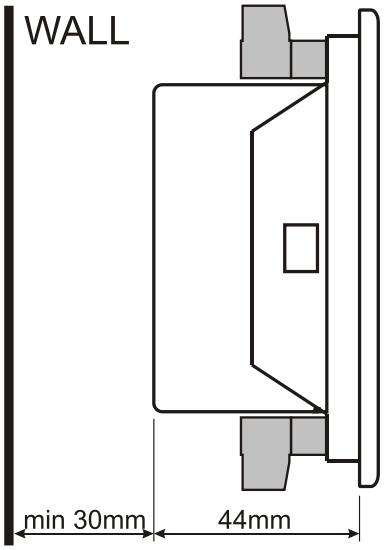
1.1. FRONT AND REAR PANELS



1.2. MECHANICAL INSTALLATION



Panel Cutout Dimensions



Required Panel Depth

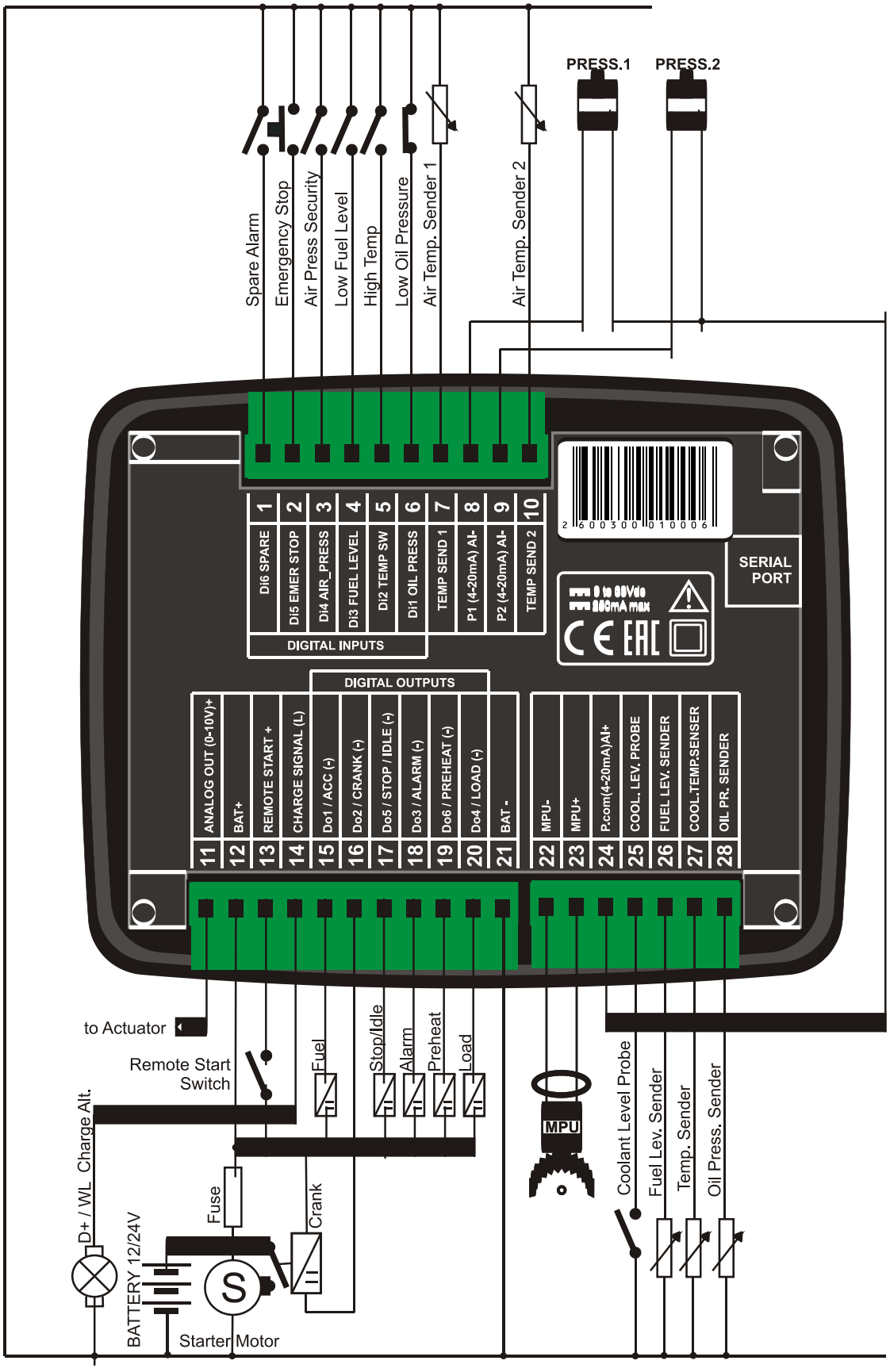
1.3. ELECTRICAL INSTALLATION

Do not install the controller close to high electromagnetic noise emitting devices like contactors, high current busbars, switchmode power supplies and the like.

Although the controller is protected against electromagnetic disturbance, excessive disturbance can affect the operation, measurement precision and data communication quality.

- **ALWAYS remove plug connectors when inserting wires with a screwdriver.**
- **Fuse must be connected to the battery power supply input, in close proximity of the controller.**
- **Fuses must be of fast type (FF) with a maximum rating of 6A.**
- **Use cables of appropriate temperature range.**
- **Use adequate cable section, at least 0.75mm^2 (AWG18).**
- **Follow national rules for electrical installation.**
- **Connect only the provided serial port adapter to the serial communication port.**

1.4. CONNECTION DIAGRAM



2. PUSHBUTTON FUNCTIONS

Three pushbuttons on the front panel allow access to programming and measuring screens.

BUTTON	DESCRIPTION	FUNCTION
	**MENU**	**Displays the next parameter.** **PROGRAMMING: Save the adjusted parameter.**
	**RUN**	**Run the compressor.**
	**STOP**	**Reset alarms and stop the compressor.** **PROGRAMMING: Decrease parameter value.**
	**ALARM MUTE**	**Reset alarms.** **PROGRAMMING: Increase parameter value.**
	**LAMP TEST**	**Turn on all displays for testing.** **PROGRAMMING: Decrease parameter value.**

3. SCREEN SCROLLING

Normally the display will show the pressure from the first sensor (or pressure switch-1 position) and the pressure led is on. If MENU button is pressed the display will show the first temperature value and the temperature led is on.

Other screens may be scrolled by pressing the MENU button. In order to make the reading easier to understand, the parameter name is displayed when the button is pressed and the parameter value when the button is realeased. If the displayed value is larger than the screen, than the value is divided in parts. When the first part is displayed the rightmost decimal point turns on.

Display of some values are selected with program parameters. Display screens may differ following compressor manufacturers.

When an alarm occurs, the display will show the alarm code. The LED related to the alarm and the ALARM led will turn on. If a warning condition occurs the display will show the fault code . The related LED will flash. If no other alarm exists, the ALARM led will also flash.

Below is a list of possible display messages shown in programming, alarm and measurement display.

MESSAGE	DESCRIPTION	MODE
Str	Start pressure	Operation
SEt	Pressure set value (if PID enabled)	Operation
StP	Stop pressure	Operation
bAt	Battery voltage	Operation
rPM	Engine RPM	Operation
C-t	Coolant temperature	Operation
oil	Oil pressure	Operation

MESSAGE	DESCRIPTION	MODE
SHA	Engine hours to service-A	Operation / Program / Alarm
SHb	Engine hours to service-B	Operation / Program / Alarm
SHC	Engine hours to service-C	Operation / Program / Alarm
SHd	Engine hours to service-D	Operation / Program / Alarm
SHE	Engine hours to service-E	Operation / Program / Alarm
r-H	Total engine run hours (LOAD+UNLOAD)	Operation
L-H	Total load hours (LOAD output active)	Operation
ord	Load_hours / Total_hours percentage	Operation
E-t	Engine PTC value or switch position	Operation
t-2	Temperature-2 value or switch position	Operation
P-2	Pressure-2 value or switch position	Operation
d-P	Differential pressure	Operation
n--	Number of starts in the last 1 hour	Operation
rEL	Controller firmware version	Operation
n-C	Switch in closed position	Operation
n-O	Switch in open position	Operation
mSt	Master controller address (multi compressor)	Operation
d-C	Total number of controllers (multi compressor)	Operation
StP	Remote stop status (input function)	Operation
rUn	Remote start status (input function)	Operation

MESSAGE	DESCRIPTION	MODE
AH 1	Alarm number 1 in the alarm history	Operation
not	Alarm not recorded	Operation
AL 1	Alarm code 01	Operation
A99	Alarm code 99	Operation
P99	Program parameter 99	Program
USr	Enter password	Program
SFt	Waiting for safety timer	Operation
PrE	Waiting preheat timer	Operation
rSt	Wait between cranks	Operation
crn	Cranking	Operation
idL	Idle speed timer	Operation
HAt	Engine heating timer	Operation
coL	Cooldown timer	Operation
StP	Stop timer	Operation
ctP	Waiting coolant temperature	Operation
tiP	Waiting temperature condition	Operation

4. MODES OF OPERATION

Selecting the mode of operation:

In order to protect the battery from discharging, in STOP condition, if no button is pressed during 1 minute, the controller will cut-off its power automatically. In multi compressor mode, if the controller Modbus address is between 1 and 8, for a 12V battery it will continue operation until the battery falls to 9 volts. (18volts for a 24V battery)

The compressor is run either by depressing the RUN  pushbutton or with the REMOTE START signal (rUn displayed during 10 seconds).

If the **Safety Timer** (P64) is not expired, then the RUN led will flash until the expiration of the timer. Then the compressor will run if the output pressure is below **P05 Start Pressure**.

If an alarm occurs the compressor will stop immediately and the screen will display the alarm code.
Please see chapter_5 for the complete list of alarm codes.

The compressor is usually stopped with REMOTE STOP signal (StP is displayed during 10 seconds) or by depressing the STOP  pushbutton.

Stop procedure:

STOP led starts flashing.

If the compressor is under load, the load relay will release and the engine continues to run during **P64-Safety Delay Timer** or **P50-Cooldown Timer** (whichever is longer). During cooldown timer, alternatively coL and the cooldown timer value is displayed. At the end of cooldown, if a **Safety Timer** cycle is necessary, SFt and the remaining time is alternatively displayed. RUN mode may be resumed by depressing the RUN  pushbutton.

The STOP led will continue to flash until the complete stop.

If the compressor is running off-load and the STOP pushbutton is depressed, it will continue to run until the expiration of the P50 Cooldown Timer.

Start-up procedure:

The RUN mode is selected by depressing the RUN pushbutton or by setting the REMOTE START signal (if enabled).

When RUN mode is selected rUn is displayed during 10 seconds.

At this stage the compressor engine will run only when the output pressure falls below the **P05-Start Pressure** (or if the pressure switch closes).

Before cranking the engine, the controller activates the FUEL output. If a **P46-Preheat Timer** is not zero, it activates also the PREHEAT relay output and waits for **P46-Preheat Timer**. During preheat the display will alternatively show PrE and remaining preheat time.

If an oil pressure sensor is defined by **P86-Oil Pressure Sender Enable** parameter and if the oil pressure read from the sender is above the **P59-Low Oil Pressure Shutdown** limit then the controller will wait for the oil pressure to drop. During this wait cycle the display will show oIL.

In order to prevent cranking under load, if the air pressure-2 sensor is defined (**P77=2**) and the **P62-Crank Protection** parameter is grater than zero (**P62>0**) and the measured air pressure-2 is higher than **P62-Crank Protection** limit, then the controller will wait air pressure-2 to drop. During this period the display will show P-2.

Then the controller will activate the crank output during **P47-Crank Timer**. The display will alternatively show crn and remaining crank time. During cranking, if defined, the choke output is also activated during **P53-Choke Timer**.

If the engine fires (see below: **Conditions for Engine Start**), cranking will immediately disengaged. If the engine does not fire until end of the cranking cycle, the controller will wait for **P48-Wait Between Cranks** timer. The preheat output will be active during this period. If the **P16-Preheat Between Cranks** timer is longer than **P48**, then the controller will wait **P16** timer to expire before a new crank cycle. The display will alternatively show rSt and remaining wait time.

Crank and wait between crank steps are repeated until the engine runs for a maximum of **P52-Number of Cranks** parameter. If the engine does not start, a **FAIL TO START** alarm is generated.

If P54-Idle Speed Timer is greater than zero, the controller will activate the IDLE relay for P54. The display will alternatively show idL and remaining idle speed time.

The engine will run off_load during P49-Engine Heating Timer. The display will alternatively show HAt and remaining heating time. At the expiration of the timer, other conditions of **P40-Engine Heating Method** parameter are waited to be fulfilled.

If **P40=0**, then only the timer is waited.

If **P40=1** then additionally the controller will wait until the coolant temperature is greater than **P41**. The display will show ctP.

If **P40=2** then additionally the controller will wait until the air temperature-1 is greater than **P12**. The display will show tmP.

Then if the pressure-1 is lower than **P05-Start Pressure**, then the LOAD output is activated and the compressor starts producing compressed air. Otherwise the engine will continue to run off_load until the expiration of **P15-Unload Timer**.

Unloading and reloading of the compressor:

When the output pressure reaches **P04-Stop Pressure** limit (or the pressure switch opens) the LOAD relay will release and the engine will run off-load during **P15-Unload Timer**. If the pressure falls below the **P05-Start Pressure** before expiration of the timer, then the LOAD relay will be activated again.

Stopping and restarting following output pressure:

If the output pressure stays over the **P05-Start Pressure** (or the pressure switch stays open) during **P15-Unload Timer**, then the controller decides to stop the engine.

Thus RUN led will start flashing.

The P37-Max Starts per Hour parameter give a maximum limit for stop-restart sequences per hour. If this limit is reached, the engine is not allowed to stop until the 1 hour period is expired and continues to run off_load.

Conditions for Engine Start:

If **at least one** of below conditions is met, the controller will decide that the engine is running:

1) **ENGINE RPM:** If the engine speed read from the magnetic pickup is over **P101-Crank Cut RPM** limit.
2) **CHARGE VOLTAGE:** If **P38-Crank Cut From Charge=1** and the battery voltage is over 9V for a 12V engine (or 18V for a 24V engine).
3) **OIL PRESSURE SWITCH:** If **P39-Crank Cut Oil Pressure=1** and the oil pressure switch is defined and indicates oil pressure existency.
4) **OIL PRESSURE SENDER:** If **P39-Crank Cut Oil Pressure=1** and the oil pressure measured from the sender is above **P59-Low Oil Pressure Shutdown** limit.

5. ALARMS AND WARNINGS

Abnormal conditions of a compressor are divided into 3 categories, being WARNINGS, ALARMS and SERVICE REQUESTS.

Warnings are the lowest priority fault conditions and result only in visual warnings.

Alarms are highest level fault conditions and cause the compressor to stop immediately, the alarm relay to operate (if enabled) and the controller give visual warning.

When a fault condition occurs, the related fault code will appear on the screen, the related fault led and the ALARM led will turn on. If the fault is a warning or service request then the ALARM led will be flashing.

Alarms and warnings may be cancelled by depressing the ALARM MUTE pushbutton. Emergency Stop alarm cannot be cancelled with pushbuttons. The alarm signal must also be removed.

Service request warnings may prevent the engine from running, depending on the excess amount of service timers.

5.1. SERVICE ALARM OPTIONS

Following the selection of the program parameter **P88-Engine Stop on Service Request**, the expiration of a service timer may simply cause a visual warning and the activation of the alarm relay, or it may also cause below behaviour:

TIME TO SERVICE	ACTION TAKEN
> 100 hours	No warning occurs
100 hours	Service request warning is given and the service led turns on. The compressor continues normal operation.
0 hours	The compressor stops. Service request warning is given and the service led turns on. The compressor may be run again wth the **RUN** pushbutton.
-100 hours	The compressor stops. Service request warning is given and the service led turns on. The compressor may be run again with the **RUN** pushbutton.
Between -120 and -200 hours, every 20 hours	The compressor stops. Service request warning is given and the service led turns on. The compressor may be run again with the **RUN** pushbutton.
Between -210 and -300 hours and every 10 hours	The compressor stops. Service request warning is given and the service led turns on. The compressor may be run again with the **RUN** pushbutton.
-300 hours	The compressor stops. Service request warning is given and the service led turns on. The compressor will run only after service is performed.

5.2. LIST OF FAULT CODES

SYMBOL	CODE	DESCRIPTION	FAULT LEVEL
AL1	01	Reserved	ALARM
AL2	02	High air pressure alarm	ALARM
AL3	03	Air pressure sensor failure	ALARM
AL4	04	High air temperature alarm	ALARM
AL5	05	High air temperature warning	WARNING
AL6	06	Air temperature sensor failure	ALARM
AL7	07	Low air temperature alarm	ALARM
AL8	08	Engine failed to start	ALARM
AL9	09	PTC high temperature	ALARM
A10	10	Engine failed to stop	WARNING
A11	11	Engine charge alternator failure	ALARM
A12	12	Engine coolant liquid sensor not installed	ALARM
A13	13	Engine oil pressure sensor not installed	ALARM
A14	14	Engine fuel level sensor not installed	ALARM
A15	15	Engine low oil pressure (analog sender)	ALARM
A16	16	Reserved	WARNING
A17	17	Max starts per hour exceeded	WARNING
A18	18	Emergency stop	ALARM
A19	19	Reserved	WARNING
A20	20	High differential air pressure / air filter clogged	ALARM
A21	21	Sensor-2 high air pressure	ALARM
A22	22	Air pressure sensor-2 failure	ALARM
A23	23	Sensor-2 high air temperature / Delta_T (tS2-tS1) Alarm	ALARM
A24	24	Air temperature sensor-2 failure	ALARM

SYMBOL	CODE	DESCRIPTION	FAULT LEVEL
A25	25	Sensor-2 low temperature alarm	ALARM
A26	26	Battery voltage out of limits	WARNING
A27	27	Delta air temperature sensor-2	WARNING
A28	28	Engine thermic protection switch open (Engine Overload)	ALARM
A29	29	Sensor-2 low air pressure	ALARM
A30	30	Engine high coolant temperature (analog sender)	ALARM
A31	31	Engine low fuel level (analog sender)	ALARM
A32	32	Engine low coolant level (level switch)	ALARM
A33	33	Engine low oil pressure (oil pressure switch)	ALARM
A34	34	Engine high coolant temperature (high temp switch)	ALARM
A35	35	Engine low fuel level (fuel switch)	ALARM
A36	36	High air pressure (digital input)	ALARM
A37	37	Spare-1 alarm (digital input)	ALARM
A38	38	Engine low oil pressure (analog sender)	WARNING
A39	39	Engine high coolant temperature (analog sender)	WARNING
A40	40	Engine low fuel level (analog sender)	WARNING
A50	50	Data line failure (multiple control)	WARNING
SHA	100	Service period A exceeded	SERVICE
SHb	101	Service period B exceeded	SERVICE
SHC	102	Service period C exceeded	SERVICE
SHd	103	Service period D exceeded	SERVICE
SHE	104	Service period E exceeded	SERVICE
StP	200	Remote stop signal	-

6. OTHER FEATURES

6.1. RESETTING SERVICE COUNTERS

Service counters can be reset only when the compressor is in STOP state.

In order to reset service counters:

- Hold pressed MENU and LAMP TEST pushbuttons during 3 seconds. If the HIGH LEVEL password is not entered in the last 90 minutes, then the controller will ask for password.
- Enter password.
- SHA (hours remaining to service A) will be displayed.
- Press again the MENU pushbutton. The remaining hours to service A will be flashing.
- In order to reset service A, hold the MENU button pressed during 3 seconds.
- SHb (hours remaining to service B) will be displayed.
- Press again the MENU pushbutton. The remaining hours to service B will be flashing.
- In order to reset service B, hold the MENU button pressed during 3 seconds.
- With successive MENU button keypresses other (C,D,E) service counters may be displayed and reset.

SHC: hours remaining to service C

SHd: hours remaining to service D

SHE: hours remaining to service E

After the last counter, the display will revert to the pressure screen.

6.2. MODIFYING ENGINE RUN HOURS

Below are engine run hour counters of the device.

MESSAGE	DESCRIPTION
r-H	Total engine run hours (on_LOAD + off_LOAD) This counter increments while the engine is running.
L-H	Total on_LOAD run hours (LOAD output active) This counter increments while the engine is on load (LOAD led on).

Hour run counters can be modified only when the compressor is in STOP state.

In order to set hour run counters to a given value:

- Hold pressed during 3 seconds MENU, LAMP TEST and ALARM MUTE pushbuttons. If the HIGH LEVEL password is not entered in the last 90 minutes, then the controller will ask for password.

- Enter password.

- r-H will be displayed.

- Adjust the counter to the desired value using LAMP TEST and ALARM MUTE pushbuttons.

- If the MENU pushbutton is held pressed for 3 seconds, r-H will be displayed announcing that the counter is set to its new value.

If MENU pushbutton is shortly depressed, then the counter value will not change and the next counter's value will be displayed. The counter value may be modified and saved as explained above.

After modification, the display will revert to the pressure screen.

6.3. SELECTION OF ENGINE HOURS COUNTING METHOD

The controller offers the possibility of counting engine hours with a variable coefficient depending on output air temperature.

The usage of variable coefficient is selected with **P89- Engine Hours Calculation Method** parameter. If this parameter is not activated, then all service and engine hour counters are calculated with a coefficient of 1.00, independent of the output air temperature.

When the variable coefficient calculation is activated:

On-LOAD operation,

Below 90 °C coefficient is 1.00

Between 90-95 °C coefficient is 1.50

Between 95-100 °C coefficient is 2.00

Above 100 °C coefficient is 3.00

Off_LOAD operation

Below 90 °C coefficient is 0.50

Between 90-95 °C coefficient is 0.75

Between 95-100 °C coefficient is 1.00

Above 100 °C coefficient is 1.50

These coefficients are valid for all service and engine run hour counters.

6.4. PREVENTING PRESSURE LOSS

If the output pressure stays above **P05-Start Pressure** during **P15-Unload Timer**, then the controller will stop the engine. When the engine is at rest, if the pressure falls below **P05-Start Pressure** then the engine will run again.

A delay equal to **P46+P493+P54+P47** will pass until the compressor enters under load again. The engine is supposed to run at the first crank attempt.

During this period, depending on air consumption, the pressure may fall well below **P05-Start Pressure.** But in most systems the pressure is not desired to fall below **P05-Start Pressure**.

In order to prevent this unwanted situation, the controller offers 3 different solutions and the related procedure is selected through **P45-Prevent Pressure Loss** parameter. Using these procedures, the controller redetermines dynamically the startup pressure (**Pi: Restart Pressure**).

P45 = 0 → No special care is taken for pressure loss. Restart pressure is always **P05** parameter.

P45 = 1 → At the moment where the compressor takes the load, if the pressure is below **P05-Start Pressure**, the controller will increase the **Restart Pressure** by 0.1 bar. If the prssure is above the **P05-Start Pressure**, the controller will decrease the **Restart Pressure** by 0.1 bar. Thus it will try to put the compressor under under load exactly when the pressure equals to the **P05-Start Pressure**.

P45 = 2 → When the compressor unloads after reaching the **P04-Stop Pressure**, the controller monitors the pressure decrease in the first 8 seconds and recalculates the **Restart Pressure** dynamically for each restart period.

At the end of P15-Unload Timer, if the pressure is above P05-Start Pressure but below Restart Pressure, then the compressor continues off_load operation.

6.5. ALARM HISTORY

The controller keeps record of last 9 alarms in its alarm history list.

The alarm history may be visualized on the screen or read through Modbus communication.

Alarm history is kept in a non-volatile memory and is not affected by power failures.

The primary condition for an alarm to be saved to the history, is that the alarm is different from the last one or the engine has run at least 6 minutes from the last alarm.

6.6. PID CONTROL AND ANALOG OUTPUT (PWM)

If **P92-Speed Control Signal** (0-10V) parameter is set to **1** then the PID controlled analog output of the module is activated. The analog control signal is output from the terminal number 11, **ANALOG OUT (0-10V)**.

The analog output will control the engine speed in order to match **P93-PWM Set Pressure**. The control is performed by changing the analog output voltage between 0 and 10VDC.

Before starting the control process, the module will wait for the compressor to heat-up. When the temperature T1 is above **P99-PID Start Temperature** the module will decide to provide analog output. After **P98-PID Control Delay** it will start controlling the engine speed.

PID control coefficients may be adjusted through **P94-PID P Value**, **P95-PID I Value**, **P96-PID D Val**ue and **P97-PID I Inverse Value** parameters.

6.7. PTC INPUT ON TEMPERATURE-2 SENSOR

The secondary temperature sensor or a PTC may be connected to the terminal 10 (TEMP.2/PTC) input of the controller.

If a PTC sensor is connected, then **P17-Temp.2 Sensor** parameter should be **3.**

In this case, when the PTC impedence goes over 2000 ohms, the controller will give **AL9 PTC High Temperature**.

7. MULTI-COMPRESSOR OPERATION

The multi-compressor mode is designed for cases where more than one compressor are needed to supply the necessary compressed air.

In case of low air demand, the multi-compressor mode runs only the necessary number of compressors, providing energy efficiency, cost control and equal aging of compressors.

The controller allows a maximum of 8 compressors to operate in parallel.

In multi-compressor mode, the communication between controllers runs on the serial port. Devices are interconnected using special RS-485 converters provided by the controller manufacturer.

Please contact the manufacturer to order RS-485 converters.

The multi-compressor more is enabled by setting the parameter **P65-Modbus Address** to 1. Other compressors in the group must have **consecutive addresses**. Unused addresses are not allowed.

Controllers with non-consecutive addresses do not take part in the multi-compressor operation. They will run independently.

System operation in multi-compressor mode:

1. If communication between controllers is lost, compressors resume independent operation.
2. The youngest of controllers will become the master and runs continuously for **P04** and **P05** values. Other compressors enter into service depending on their **engine hours**.
3. If any of compressors becomes younger than the master by **P67-Master Change Timer**, then this controller becomes automatically the new master.
4. If an alarm occurs on the master controller, then another controller will become the new master.
5. When the pressure falls below **P05**, the master compressor runs immediately. Other compressors will run in the order of their run-hours (youngest first) with delays of **P66/8**.
6. If the pressure is above **P05**, but below **(P04+P05)/2** at the expiration of **P66**, then controllers will enter into service with delays of **P66/4**.
7. When the pressure approaches **P04**, controllers will quit the system in the order of their age (oldest first).
8. If communication between controllers is lost, “A50” message is displayed.
9. Master controller address and number of compressors can be viewed on the display.

8. DIGITAL INPUTS

The controller provides 6 user programmable digital inputs.

Input characteristics are programmed with parameters **P71** to **P76**.

The input configuration consists on 6 parts and the programmed value is the sum of these 6 parts.

Config. = part_1 + part _2 + part _3 + part _4 + part _5 + part _6

Part_1 = action

This value determines the type of the alarm generated when the fault signal comes from the input.

0: immediate unload and stop

1: immediate unload, stop after cooldown

2: visual warning only

3: no action

Part _2 = sampling

This value determines when the fault input should be taken into consideration.

0: always

4: **P56** seconds after engine starts running

8: when the air pressure is between limits

Part _3 = latching

This value determines if the alarm should be automatically cancelled when the fault signal disappears.

0: non-latching. Fault automatically cancelled when signal turns off.

16: latching. Fault persists even if the signal turns-off.

Part _4= input contact type (NO or NC)

0: NO (normally open) contact

32: NC (normally closed) contact

Part _5 = switching

This value determines if the fault signal is battery positive or battery negative switching.

0: battery negative

64: battery positive

Part _6 = input detection delay

0: 0.1sec delay

128: 4.0sec delay

Example 1:

In order to program the Input_2 (coolant temperature switch input) stop after cooldown, check P56 seconds after engine is running, non-latching (alarm cancelled when signal is off), NC contact, battery positive switching and 0.1 sec delay:

Part_1 = 1 (immediate unload, stop after cooldown)

Part _2 = 4 (P56 seconds after engine starts running)

Part _3 = 0 (non-latching. Fault automatically cancelled when signal turns off.)

Part _4= 32 (NC-normally closed) contact)

Part _5 = 64 (battery positive)

Part _6 = 0 (0.1sec delay)

P72 (Input_2 configuration) = 1+4+0+32+64+0 = **101**

Example_2:

In order to program the Input_4 (high air pressure safety switch) as immediate stop, always checked, latching (alarm persists when signal is off), NO contact, battery negative switching and 4.0sec delay:

Part_1 = 0 (immediate unload and stop)

Part _2 = 0 (always)

Part _3 = 16 (latching. Fault persists even if the signal turns-off.)

Part _4= 0 (NO (normally open) contact)

Part _5 = 0 (battery negative)

Part _6 = 128 (4.0sec delay)

P74 (Input_4 configuration) = 0+0+16+0+0+128 = **144**

9. DIGITAL OUTPUTS

The unit provides 6 digital outputs with fully programmable functions.

Output functions are assigned using program parameters **P23** to **P28**.

OUTPUT FUNCTION LIST:

PARAMETER VALUE	FUNCTION	DESCRIPTION
0	DEFAULT	Relay adjusted to “FACTORY DEFAULT” function. RELAY_1: FUEL RELAY_2: CRANK RELAY_3: ALARM RELAY_4: LOAD RELAY_5: STOP RELAY_6: PREHEAT
1	PREHEAT	Engine preheat glow plugs control output
2	CRANK	Engine starter motor control output.
3	CHOKE	Engine choke control output.
4	IDLE	Engine idle speed control output.
5	CRANK	Gas solenoid control for gas engines.
6	STOP	Stop solenoid control output for “activate to stop” type engines.
7	FUEL	Fuel solenoid control output for “activate to start” type engines.
8	LOAD	Load relay. The compressor starts producing compressed air.
9	reserved	-
10	ALARM	Operates when there is an alarm.
11	PID ACTIVE	Used in engines equipped with an actuator and speed control unit. Allows the compressor provide constant air pressure. Operates when the PID speed control is active.
12	MINIMUM SPEED (PID INACTIVE)	Used in engines equipped with an actuator and speed control unit. Allows the compressor provide constant air pressure. Operates when PID is not active.

10. PROGRAMMING

10.1. ENTERING THE PROGRAMMING MODE

Program menu can be selected only when the compressor is in STOP mode.

The program menu is protected by a 2 level password system. Parameter set and password levels may differ following compressor manufacturers. This document is based on factory set parameter list.

Factory set passwords:

Low level password = 1

High level password = 2

Entering the program menu:

- When the compressor is in STOP MODE, hold pressed ALARM MUTE and LAMP TEST buttons 3 seconds.

- USr (enter password) will appear on display. Enter the password using ALARM MUTE and LAMP TEST buttons and press MENU button. In order to increase/decrease the value faster you can hold ALARM MUTE and LAMP TEST buttons pressed.

Exiting the program menu:

- Hold pressed the MENU button for 3 seconds.

Modifying program parameters:

- When program mode is entered, the program number displayed

- Select the the program number to modify with ALARM MUTE and LAMP TEST buttons. In order to increase/decrease the value faster you can hold ALARM MUTE and LAMP TEST buttons pressed.

- Enter into the parameter value with the MENU button. Adjust the the program parameter value with ALARM MUTE and LAMP TEST buttons. In order to increase/decrease the value faster you can hold ALARM MUTE and LAMP TEST buttons pressed.

- Press MENU button in order to return to the program parameter number display.

If no action is taken during 1 minute, the programming mode will be automatically exited.

10.2. LIST OF PARAMETERS

Some of the parameters in this list may not apeear on the controller.

No	Description	Adjustment range	Factory set
P01	Air pressure sensor type	0: Analog sensor connected 1: Pressure switch connected If this parameter is set to 1 then parameters P02 ... P06 will not be visible.	0
P02	Air pressure upper display limit	4.2 ... 99.9	16.0 bar
P03	High air pressure alarm limit	(P02-0.5) ... (P04+0.5)	9.0 bar
P04	Stop air pressure	(P03-0.2) ... (P05+0.2)	8.5 bar
P05	Start air pressure	3 ... (P04-0.2)	6.5 bar
P06	Air pressure sensor offset adjustment	-2.0 ... +2.0	0.0 °C
P07	Air temperature display upper limit	(P08+2) ... 130	130 °C
P08	High outlet air temperature alarm limit	(P09+2) ... (P07-2)	108 °C
P09	High outlet air temperature warning limit	(P10+2) ... (P08-2)	103 °C
P10	Low air outlet temperature alarm limit	-10 ... (P09-2)	-10 °C
P11	Air temperature sensor offset adjustment	-10 ... +10	0 °C
P12	Load relay enable air temperature (active if P40=2)	0 ... +100	20 °C
P13	Engine coolant temperature sender connected	**0**: No **1**: Yes	0
P14	Air pressure compensation temperature	0 ... (P09) Until air outlet temperature reaches this value, instead of P04-Stop pressure, P05+(P04-P05)/4 is used. Thus the stops before stop pressure.	0 °C
P15	Unload timer	0 ... 900 seconds	3 minutes
P16	Preheat between cranks timer	0 ... 90 seconds	0 seconds

No	Description	Adjustment range	Factory set
P17	Air temperature sensor-2 type	**0**: Not connected **1**: Reads absolute temperature **2**: Reads differential temperature **3**: Motor PTC. Parameters **P78** to **P82** will be visible only if this parameter is set to **2**.	0
P18	Air temperature-2 display upper limit	(P19+2) ... 200	130 °C
P19	High outlet air temperature alarm limit (differential temperature alarm limit)	(P20+2) ... (P18-2) (differential temperature alarm limit)	110 °C
P20	Low air temperature-2 alarm limit (differential temperature warning limit)	-40 ... (P19-2) (differential temp warning limit)	-10 °C
P21	Temperature 2 alarm/warning automatic reset delay	1 ... 600	10 seconds
P22	Temperature sensor 2 offset adjustment	-10 ... +10	0 °C
P23	Digital output_1 function	0 ... 12	0
P24	Digital output_2 function	0 ... 12	0
P25	Digital output_3 function	0 ... 12	0
P26	Digital output_4 function	0 ... 12	0
P27	Digital output_5 function	0 ... 12	0
P28	Digital output_6 function	0 ... 12	0
P29	Service A period	0 ...32767 If this parameter is set to **0** then service A warning will not be given.	250 hours
P30	Service B period	0 ... 32767 If this parameter is set to **0** then service B warning will not be given.	500 hours
P31	Service C period	0 ... 32767 If this parameter is set to **0** then service C warning will not be given.	1000 hours
P32	Service D period	0 ... 32767 If this parameter is set to **0** then service E warning will not be given.	1500 hours
P33	Service E period	0 ... 32767 If this parameter is set to **0** then service E warning will not be given.	2000 hours

No	Description	Adjustment range	Factory set
P34	Display second air temperature and pressure values	0: No 1: Yes	1
P35	Low level password	0 ... 999	1
P36	High level password	0 ... 999	2
P37	Max Starts per hour	6 ... 60	20
P38	Crank Cut from Charge (9V for a 12V battery and 18V for a 24V battery)	**0**: No **>0**: Detection delay (sec)	1 seconds
P39	Crank cut from engine oil pressure (from digital input or the oil pressure measured from sender input is over low alarm limit (P59).	**0**: No **>0**: Detection delay (sec)	4 seconds
P40	Engine heating method	**0**: use P49 timer only **1**: additionally to P49 timer, wait until coolant temperature reaches P41. **2**: additionally to P49 timer, wait until coolant temperature reaches P41 and air temperature-1 reaches P12.	2
P41	Engine heating temperature	0 .. 150	85 °C
P42	Intermittent alarm relay enable (if enabled, the alarm relay will turn-on/off with the delay defined by P57).	**0**: Disabled **1**: Enabled	0
P43	Engine charge alternator alarm enabled (9...14V for a 12V battery and 18..28V for a 24V battery)	**0**: Disabled **1**: Enabled	1
P44	Display temperature in degrees F.	**0**: display in degrees Celcius **1**: display in degrees Fahrenheit	0
P45	Prevent pressure loss	0:Standart 1:Step 2:Slope (see related chapter)	1
P46	Preheat timer	0 ... 60	6 seconds
P47	Crank timer	1 ... 30	5 seconds
P48	Wait between cranks	0 ... 60	10 seconds
P49	Engine heating timer	10 ... 99	20 seconds
P50	Cooldown timer	0 ... 900	30 seconds
P51	Stop solenoid timer	0 ... 60	2 seconds
P52	Number of cranks	1 ... 6	3
P53	Choke timer	0 ... 30	5 seconds
P54	IDLE speed timer	0 ... 60	0 seconds
P55	Gas solenoid delay timer	0 ... 60	0 seconds
P56	Holdoff timer	3 ... 30	10 seconds

No	Description	Adjustment range	Factory set
P57	Alarm relay timer (If P57=0 then the alarm relay is always on when alarm exists. If P42=0 then the alarm relay will turn-on during this timer for each new alarm. If P42=1 then the alarm relay will turn-on/off during this timer for each new alarm.	0 ... 240	0 seconds
P58	Low oil pressure warning	0.0 ... 25.5 (If P90=1 then displayed in PSI)	2.0 Bar / 29PSI
P59	Low oil pressure shutdown	1.0 ... 25.5 (If P90=1 then displayed in PSI)	1.0 Bar / 14PSI
P60	Coolant temperature high warning limit	0 ... 150 (If P44=1 then displayed in °F)	100 °C / 212 °F
P61	Coolant temperature high alarm limit	0 ... 150 (If P44=1 then displayed in °F)	130 °C / 266 °F
P62	Cranking presssure low limit (P2<P62)	0.0….3.0 Bar Engine cranking enabled if P2 is lower than this limit.	0.5 bar
P63	Battery voltage calibration (Battery voltage displayed. Calibrate the display by comparing with another instrument.)	100 ... 400 **(battery voltage displayed)**	243
P64	Safety timer	1 ... 240 Read chapter 4 for the functionality.	2 seconds
P65	MODBUS address (addresses 1-8 are used for multi-compressor operation)	1: starts multi-compressor 2 ... 254: Modbus addresses	230
P66	Slave start timer (Multi-compressor)	1:999 sn	180 sn
P67	Master change timer (Multi-compressor)	1:999 hours	100 hours
P68	Serial number (lower 16 bits)	0 ... 65535	10
P69	Serial number (higher 16 bits)	0 ... 65535	10
P70	Engine coolant temperature sender enabled	0: Disabled 1: Enabled	0

No	Description	Adjustment range	Factory set
P71	Engine low oil pressure switch digital input (see Digital Inputs)	0 ... 255 (0+4+16+0+0+0)	20
P72	Engine high coolant temperature switch digital input (see Digital Inputs)	0 ... 255 (0+0+16+0+0+0)	16
P73	Engine low fuel level switch digital input (see Digital Inputs)	0 ... 255 (0+0+16+0+0+128)	144
P74	Air pressure safety switch digital input (see Digital Inputs)	0 ... 255 (0+0+16+0+0+0)	16
P75	Emergency stop digital input (see Digital Inputs)	0 ... 255 (0+0+0+32+0+0)	32
P76	SPARE-1 digital input (see Digital Inputs)	0 ... 255 (0+0+16+0+0+0)	16
P77	Air pressure 2 sensor type	**0**: not connected **1**: Pressure switch connected **2**: Analog sensor connected If this parameter is set to 1 then parameters **P78** ... **P82** will not be visible.	2
P78	Air pressure 2 upper display limit	4.2 ... 99.9 Bar	16.0 bar
P79	High air pressure_2 alarm limit	3.7 ... (P78-0.5)	10.0 bar
P80	Differential pressure alarm limit (Press2 – Press1)	-10.0 ... +10.0 If the pressure difference **P1-P2** stays over this limit during **P81** period, then **ALARM 20 High Differential Pressure/filter clogged** is given.	1.2 bar
P81	Differential pressure alarm delay timer	1 ... 600 If the pressure difference **P1-P2** stays over **P80** limit during this period, then **ALARM 20 High Differential Pressure/filter clogged** is given.	13 seconds
P82	Air pressure sensor 2 offset adjustment	-2 ... +2	0.0 bar
P83	Air pressure sensor 2 low alarm limit. (Alarm disabled when set to 0.0 bar)	0.0: alarm disabled 0.1 ... (P79-0.5)	0.0 Bar
P84	Engine low fuel level warning limit	0 ... 100 %	10 %
P85	Engine low fuel level alarm limit	0 ... 100 %	3 %
P86	Engine oil pressure sender enabled	0: Disabled 1: Enabled	0
P87	Engine fuel level sender enabled	0: Disabled 1: Enabled	1

No	Description	Adjustment range	Factory set
P88	Engine stop on service request (please see chapter ALARMS and WARNINGS)	**0**: Warning only **1**: Engine stop enabled as explaineed in chapter ALARMS AND WARNINGS.	0
P89	Engine hours counting method	**0**: Constant coefficient **1**: Variable coefficient Please see chapter 6.3 for details.	0
P90	Air pressure in PSI	**0**: bar (pressure displayed in xx.x format) **1**: PSI(pressure displayed in xxx format)	0
P91	Save/Return to restore values	**0**: no action **1**: Return to restore point values **2**: Save current parameter set as restore point	0
P92	Analog (0-10V) engine speed control signal enable	**0**: Hayır **1**: Evet	0
P93	PID set pressure	(P03-0.2) ... 3	7.0 Bar/101PSI
P94	PID P Gain	0.0 ... 99.9	3.0
P95	PID I DGain	0.0 ... 99.9	0.4
P96	PID D Gain	0.0 ... 99.9	5.0
P97	PID reverse I gain (If the pressure is above the set value this gain is used)	0.0 ... 99.9	0.4
P98	PID control activation delay	1 ... 999	10 seconds
P99	PID control start temperature	(P08-2) ... 30	30 °C / 86 °F
P100	MPU (Magnetic Pickup) teeth count	0 ... 500	30
P101	Crank Cut RPM limit	0 ... 8000	300 RPM

11. MODBUS COMMUNICATIONS

11.1. DESCRIPTION

The unit offers the possibility of MODBUS communication through its serial port.

The serial port has 0/+5V logic levels.Using special adapters it is converted to RS-232 or RS-485 standards.

The MODBUS properties of the unit are:

-Data transfer mode: RTU

-Serial data: 9600 bps, 8 bit, no parity, 1 bit stop
-Supported functions:
  -Function 3 (Read multiple registers, max 120 registers)
  -Function 6 (Write single register)
  -Function 16 (Write multiple registers, max 32 registers)

-Answer to a message is sent within 4.3ms after the reception of the querry.

Each register consists of 2 bytes (16 bits). A larger data structure will contain multiple registers.

Detailed description about the MODBUS protocol is found in the document "**Modicon Modbus Protocol Reference Guide"**. This document may be downloaded at: www.modbus.org/docs/PI_MBUS_300.pdf

Each device in the same RS-485 serial network must be assigned a different slave address. Otherwise the Modbus communications will not be performed.

Data reading

The function 03 (read multiple registers) will be used for data reading. The MODBUS master will send a query. The answer will be one of the below:

-A response containing the requested data
-An exceptional response indicating a read error.

The maximum number of registers read in one message is 120. If more registers are requested, the unit will send only the first 120 registers.

The query message specifies the starting register and quantity of registers to be read. The message structure is below:

Byte	Description	Value
0	Controller address	1-254
1	Function code	3
2	Starting address high	See chapter 11.2 for the description of available registers
3	Starting address low	
4	Number of registers high	always 0
5	Number of registers low	max 78h (120 decimal)
6	CRC low byte	See below for the checksum calculation
7	CRC high byte	

Here is the sequence to read 16 registers starting from address 20h (32 decimal):
01 03 00 20 00 10 45 CC (each byte is expressed as 2 hexadecimal characters)

The checksum value in the above message may be used for the verification of checksum calculation algorithm.

The normal response will be:

Byte	Description	Value
0	Controller address	same as in the query
1	Function code	3
2	Data lenght in **bytes** (L)	number of registers * 2
3	High byte of 1st register	
4	Low byte of 1st register	
5	High byte of 2nd register	
6	Low byte of 2nd register	
....		
L+1	High byte of the last register	
L+2	Low byte of the last register	
L+3	CRC low byte	See below for the checksum calculation
L+4	CRC high byte	

The exceptional response will be:

Byte	Description	Value
0	Controller address	same as in the query
1	Function code	131 (function code + 128)
2	Exception code	2 (illegal address)
3	CRC low byte	See below for the checksum calculation
4	CRC high byte	

Data Writing (single register)

The function 06 (write single register) and the function 16 (write multiple registers) are used for data writing.

The MODBUS master will send a query containing data to be written. The answer will be one of the below:

-A normal response confirming successful write,

-An exceptional response indicating a write error.

Only some of the available registers are authorized to be written. An attempt to write a write protected register will result to the exceptional response.

The query message specifies the register address and data. The message structure is below:

Byte	Description	Value
0	Controller address	1 to 254
1	Function code	6
2	Register address high	See below the description of available registers
3	Register address low	
4	Data high byte	
5	Data low byte	
6	CRC low byte	See below for the checksum calculation
7	CRC high byte	

Here is the sequence to write the value 0010h to the register 40h (64 decimal):

01 06 00 40 00 10 89 D2 (each byte is expressed as 2 hexadecimal characters)

The checksum value in the above message may be used for the verification of checksum calculation algorithm

The normal response will be the same as the query:

Byte	Description	Value
0	Controller address	1 to 240
1	Function code	6
2	Register address high	See below the description of available registers
3	Register address low	
4	Data high byte	
5	Data low byte	
6	CRC low byte	See below for the checksum calculation
7	CRC high byte	

The exceptional response will be:

Byte	Description	Value
0	Controller address	same as in the query
1	Function code	134 (function code + 128)
2	Exception code	2 (illegal address) or 10 (write protection)
3	CRC low byte	See below for the checksum calculation
4	CRC high byte	

Data Writing (multiple register)

The function 06 (write single register) and the function 16 (write multiple registers) are used for data writing. A maximum of 32 registers can be written at once.

The MODBUS master will send a query containing data to be written. The answer will be one of the below:

-A normal response confirming successful write,
-An exceptional response indicating a write error.

Only some of the available registers are authorized to be written. An attempt to write a write protected register will result to the exceptional response.

The query message specifies the register address and data. The message structure is below:

Byte	Description	Value
0	Controller address	1 to 254
1	Function code	16
2	Starting address high	See below the description of available registers
3	Starting address low	
4	Number of registers high	always 0
5	Number of registers low	max 32
6	Data lenght in **bytes** (L)	number of registers * 2
7	High byte of 1st register	
8	Low byte of 1st register	
9	High byte of 2nd register	
10	Low byte of 2nd register	
....		
L+5	High byte of the last register	
L+6	Low byte of the last register	
L+7	CRC low byte	See below for the checksum calculation
L+8	CRC high byte	

The normal response is below:

Byte	Description	Value
0	Controller address	1 to 240
1	Function code	16
2	Starting address high	See below the description of available registers
3	Starting address low	
4	Number of registers high	always 0
5	Number of registers low	max ??
6	CRC low byte	See below for the checksum calculation
7	CRC high byte	

The exceptional response will be:

Byte	Description	Value
0	Controller address	same as in the query
1	Function code	144 (function code + 128)
2	Exception code	2 (illegal address) or 10 (write protection)
3	CRC low byte	See below for the checksum calculation
4	CRC high byte	

CRC calculation

Here is a procedure for generating a CRC:

1) Load a 16–bit register with FFFF hex (all 1's). Call this the CRC register.

2) Exclusive OR the first 8–bit byte of the message (the function code byte) with the low–order byte of the 16–bit CRC register, putting the result in the CRC register.

3) Shift the CRC register one bit to the right (toward the LSB), zero–filling the MSB. Extract and examine the LSB. The LSB is the least significant bit of the CRC **before** the shift operation.

4) If the LSB is 1: Exclusive OR the CRC register with the polynomial value A001 hex.

5) Repeat Steps 3 and 4 until 8 shifts have been performed. Thus, a complete 8–bit byte will be processed.

6) Repeat Steps 2 through 5 for the next 8–bit byte of the message. Continue doing this until all bytes have been processed.

7) The final contents of the CRC register is the CRC value.

8) Place the CRC into the message such that the low byte is transmitted first. The algorithm should give the correct CRC for below messages:

01 03 00 20 00 10 45 CC
01 06 00 40 00 10 89 D2

Error codes

Only 3 error codes are used:
01: illegal function code
02: illegal address
10: write protection (attempt to write a read_only register)

Data types

- Each register consists of 16 bits (2 bytes)
- If the data type is a byte, only the low byte will contain valid data. High byte is don't care.
- For data type longer than 16 bits, consecutive registers are used. The least significant register comes first.

Data formats

16bit variables: These variables are stored in a single register. Bit_0 denotes the LSB and bit 15 denotes the MSB.

32 bit variables: These variables are stored in 2 consecutive registers. The high order 16 bits are in the first register and the low order 16 bits are in the second register

Bit arrays: Arrays larger than 16 bits are stored in multiple registers. The LSB of the first register is bit_0. The MSB of the first register is bit_15. The LSB of the second register is bit_16. The MSB of the second register is bit_31, and so on.

11.2. MODBUS REGISTER LIST

CONTROLLER REGISTERS						
ADDR.	**NAME**	**DESCRIPTION**	**LEN.**	**RD/W**	**DATA TYPE**	**COEF**
40001	Engine RPM	Read from the MPU	16 BIT	R-O	unsigned word	1
40002	Air Pressure	Read from press. Sensor-1	16 BIT	R-O	unsigned word	0.1
40003	Air Pressure-2	Read from press. Sensor-2	16 BIT	R-O	unsigned word	0.1
40004	Temperature	Read from temp sensor-1	16 BIT	R-O	signed word	1
40005	Temperature-2	Read from temp sensor-2	16 BIT	R-O	signed word	1
40006	Coolant level	0: low level; 1:level OK	16 BIT	R-O	unsigned word	1
40007	Coolant temperature	Read from engine sender	16 BIT	R-O	signed word	1
40008	Engine oil pressure	Read from engine sender	16 BIT	R-O	unsigned word	0.1
40009	Engine fuel level	Read from engine sender	16 BIT	R-O	unsigned word	1
40010	Low oil pressure switch digital input	1:fault 0:normal	16 BIT	R-O	unsigned word	1
40011	Coolant high temp. switch digital input	1:fault 0:normal	16 BIT	R-O	unsigned word	1
40012	Low fuel level switch digital input	1:fault 0:normal	16 BIT	R-O	unsigned word	1
40013	Air pressure safety switch digital input	1:fault 0:normal	16 BIT	R-O	unsigned word	1
40014	Emergency stop switch digital input	1:fault 0:normal	16 BIT	R-O	unsigned word	1
40015	Spare-1 switch digital input	1:fault 0:normal	16 BIT	R-O	unsigned word	1
40016	Battery voltage		16 BIT	R-O	unsigned word	0.1
40017	Charge voltage		16 BIT	R-O	unsigned word	0.1
40018	Service A counter	Time to service-A	32 BIT	R-O	signed long	0.1
40020	Service B counter	Time to service-B	32 BIT	R-O	signed long	0.1
40022	Service C counter	Time to service-C	32 BIT	R-O	signed long	0.1
40024	Service D counter	Time to service-D	32 BIT	R-O	signed long	0.1
40026	Service E counter	Time to service-E	32 BIT	R-O	signed long	0.1
40028	-					
40029	-					
40030	Total engine hours	On_load+off_LOAD the total time the engine has run	32 BIT	R-O	unsigned long	0.1
40032	Total load hours	the total time the engine has run on_LOAD	32 BIT	R-O	unsigned long	0.1
40034	Alarms	Alarm bits List is given in chapter 11.3	32 BIT	R-O	unsigned long	1
40036	Warnings	Warning bits List is given in chapter 11.3	32 BIT	R-O	unsigned long	1
40038	Service request	Service request bits List is given in chapter 11.3	16 BIT	R-O	unsigned word	1

CONTROLLER REGISTERS						
ADDR.	**NAME**	**DESCRIPTION**	**LENGTH**	**READ/ WRITE**	**DATA TYPE**	**COEFF**
40039	Engine status	Current status of the engine 0: Compressor STOP mode 1: Wait before fuel 2: Preheat 3: Wait oil pressure 4:Wait between cranks 5: Cranking 6: Idle speed running 7: Engine heating 8: Running Off_load 9: Running On_load 10: Wait before cooldown 11: Cooldown 12: Wait before stop 13: Emergency stop 14: Stopping	16 BIT	R-O	unsigned word	1
40040	Last fault code	Currently active alarm, warning or service request code. Fault code list is given in chapter 5.	16 BIT	R-O	unsigned word	1
40041	-	-	16 BIT	R-O	unsigned word	1
40042	-	-	16 BIT	R-O	unsigned word	1
40043	Alarm 1	Alarm #1 in alarm history	16 BIT	R-O	unsigned word	1
40044	Alarm 2	Alarm #2 in alarm history	16 BIT	R-O	unsigned word	1
40045	Alarm 3	Alarm #3 in alarm history	16 BIT	R-O	unsigned word	1
40046	Alarm 4	Alarm #4 in alarm history	16 BIT	R-O	unsigned word	1
40047	Alarm 5	Alarm #5 in alarm history	16 BIT	R-O	unsigned word	1
40048	Alarm 6	Alarm #6 in alarm history	16 BIT	R-O	unsigned word	1
40049	Alarm 7	Alarm #7 in alarm history	16 BIT	R-O	unsigned word	1
40050	Alarm 8	Alarm #8 in alarm history	16 BIT	R-O	unsigned word	1
40051	Alarm 9	Alarm #9 in alarm history	16 BIT	R-O	unsigned word	1
40052	0-10 V output	Output analog value (0-1023)	16 BIT	R-O	unsigned word	1
40053	7-Segment 1	7-SEGMENT Display 1	16 BIT	R-O	unsigned word	1
40054	7-Segment 2	7-SEGMENT Display 2	16 BIT	R-O	unsigned word	1
40055	7-Segment 3	7-SEGMENT Display 3	16 BIT	R-O	unsigned word	1
40056	LEDs 1	LED 1 status (see LED 1)	16 BIT	R-O	unsigned word	1
40057	LEDs 2	LED 2 status (see LED 2)	16 BIT	R-O	unsigned word	1
40058	Outputs	see OUTPUTS	16 BIT	R-O	unsigned word	1
40059	% Load	Load percentage	16 BIT	R-O	unsigned word	1
40060	Inputs	Logic statuses of inputs	16 BIT	R-O	unsigned word	1

ADDR.	NAME	DESCRIPTION	LENGTH	READ/ WRITE	DATA TYPE	COEFF
40061	Input type	See INPUT TYPES	16 BIT	R-O	unsigned word	1
40062	Input Control 1	See INPUT CONTROL 1	16 BIT	R-O	unsigned word	1
40063	Input Control 2	See INPUT CONTROL 2	16 BIT	R-O	unsigned word	1
40064	Input Control 3	See INPUT CONTROL 3	16 BIT	R-O	unsigned word	1
40065	-	-	16 BIT	R-O	unsigned word	1
40066	RUN/STOP	Engine RUN/STOP request (see REQUESTS)	16 BIT	R-O	unsigned word	1
40067	Master address	Modbus address of master	16 BIT	R-O	unsigned word	1
40068	Number of controllers	Number of controllers in multi compressor	16 BIT	R-O	unsigned word	1
40069	Operation timer	Cuurently active timer (see OPERATION TIMERS)	16 BIT	R-O	unsigned word	1
40070	Operation timer value	Value of currently active timer	16 BIT	R-O	unsigned word	1

PROGRAM PARAMETERS

ADDR.	NAME	DESCRIPTION	LENGTH	READ/ WRITE	DATA TYPE	COEFF.
40129	P01	See chapter 10.2	16 BIT	R/W	unsigned word	1
40130	P02	See chapter 10.2	16 BIT	R/W	unsigned word	0,1
40131	P03	See chapter 10.2	16 BIT	R/W	unsigned word	0,1
40132	P04	See chapter 10.2	16 BIT	R/W	unsigned word	0,1
40133	P05	See chapter 10.2	16 BIT	R/W	unsigned word	0,1
40134	P06	See chapter 10.2	16 BIT	R/W	signed word	0,1
40135	P07	See chapter 10.2	16 BIT	R/W	signed word	1
40136	P08	See chapter 10.2	16 BIT	R/W	signed word	1
40137	P09	See chapter 10.2	16 BIT	R/W	signed word	1
40138	P10	See chapter 10.2	16 BIT	R/W	signed word	1
40139	P11	See chapter 10.2	16 BIT	R/W	signed word	1
40140	P12	See chapter 10.2	16 BIT	R/W	signed word	1
40141	P13	See chapter 10.2	16 BIT	R/W	signed word	1
40142	P14	See chapter 10.2	16 BIT	R/W	signed word	1
40143	P15	See chapter 10.2	16 BIT	R/W	unsigned word	1
40144	P16	See chapter 10.2	16 BIT	R/W	unsigned word	1
40145	P17	See chapter 10.2	16 BIT	R/W	signed word	1
40146	P18	See chapter 10.2	16 BIT	R/W	signed word	1
40147	P19	See chapter 10.2	16 BIT	R/W	signed word	1
40148	P20	See chapter 10.2	16 BIT	R/W	signed word	1
40149	P21	See chapter 10.2	16 BIT	R/W	signed word	1
40150	P22	See chapter 10.2	16 BIT	R/W	signed word	1

ADDR.	NAME	DESCRIPTION	LENGTH	READ/ WRITE	DATA TYPE	COEFF.
40151	P23	See chapter 10.2	16 BIT	R/W	unsigned word	1
40152	P24	See chapter 10.2	16 BIT	R/W	unsigned word	1
40153	P25	See chapter 10.2	16 BIT	R/W	unsigned word	1
40154	P26	See chapter 10.2	16 BIT	R/W	unsigned word	1
40155	P27	See chapter 10.2	16 BIT	R/W	unsigned word	1
40156	P28	See chapter 10.2	16 BIT	R/W	unsigned word	1
40157	P29	See chapter 10.2	16 BIT	R/W	unsigned word	1
40158	P30	See chapter 10.2	16 BIT	R/W	unsigned word	1
40159	P31	See chapter 10.2	16 BIT	R/W	unsigned word	1
40160	P32	See chapter 10.2	16 BIT	R/W	unsigned word	1
40161	P33	See chapter 10.2	16 BIT	R/W	unsigned word	1
40162	P34	See chapter 10.2	16 BIT	R/W	unsigned word	1
40163	P35	See chapter 10.2	16 BIT	R/W	unsigned word	1
40164	P36	See chapter 10.2	16 BIT	R/W	unsigned word	1
40165	P37	See chapter 10.2	16 BIT	R/W	unsigned word	1
40166	P38	See chapter 10.2	16 BIT	R/W	unsigned word	1
40167	P39	See chapter 10.2	16 BIT	R/W	unsigned word	1
40168	P40	See chapter 10.2	16 BIT	R/W	unsigned word	1
40169	P41	See chapter 10.2	16 BIT	R/W	signed word	1
40170	P42	See chapter 10.2	16 BIT	R/W	unsigned word	1
40171	P43	See chapter 10.2	16 BIT	R/W	unsigned word	1
40172	P44	See chapter 10.2	16 BIT	R/W	unsigned word	1
40173	P45	See chapter 10.2	16 BIT	R/W	unsigned word	0,1
40174	P46	See chapter 10.2	16 BIT	R/W	unsigned word	1
40175	P47	See chapter 10.2	16 BIT	R/W	unsigned word	1
40176	P48	See chapter 10.2	16 BIT	R/W	unsigned word	1
40177	P49	See chapter 10.2	16 BIT	R/W	unsigned word	1
40178	P50	See chapter 10.2	16 BIT	R/W	unsigned word	1
40179	P51	See chapter 10.2	16 BIT	R/W	unsigned word	1
40180	P52	See chapter 10.2	16 BIT	R/W	unsigned word	1
40181	P53	See chapter 10.2	16 BIT	R/W	unsigned word	1
40182	P54	See chapter 10.2	16 BIT	R/W	unsigned word	1
40183	P55	See chapter 10.2	16 BIT	R/W	unsigned word	1
40184	P56	See chapter 10.2	16 BIT	R/W	unsigned word	1
40185	P57	See chapter 10.2	16 BIT	R/W	unsigned word	1
40186	P58	See chapter 10.2	16 BIT	R/W	unsigned word	0,1
40187	P59	See chapter 10.2	16 BIT	R/W	unsigned word	0,1
40188	P60	See chapter 10.2	16 BIT	R/W	unsigned word	1
40189	P61	See chapter 10.2	16 BIT	R/W	unsigned word	1
40190	P62	See chapter 10.2	16 BIT	R/W	unsigned word	1

ADDR.	NAME	DESCRIPTION	LENGTH	READ/ WRITE	DATA TYPE	COEFF.
40191	P63	See chapter 10.2	16 BIT	R/W	unsigned word	1
40192	P64	See chapter 10.2	16 BIT	R/W	unsigned word	1
40193	P65	See chapter 10.2	16 BIT	R/W	unsigned word	1
40194	P66	See chapter 10.2	16 BIT	R/W	unsigned word	1
40195	P67	See chapter 10.2	16 BIT	R/W	unsigned word	1
40196	P68	See chapter 10.2	16 BIT	R/W	unsigned word	1
40197	P69	See chapter 10.2	16 BIT	R/W	unsigned word	1
40198	P70	See chapter 10.2	16 BIT	R/W	unsigned word	1
40199	P71	See chapter 10.2	16 BIT	R/W	unsigned word	1
40200	P72	See chapter 10.2	16 BIT	R/W	unsigned word	1
40201	P73	See chapter 10.2	16 BIT	R/W	unsigned word	1
40202	P74	See chapter 10.2	16 BIT	R/W	unsigned word	1
40203	P75	See chapter 10.2	16 BIT	R/W	unsigned word	1
40204	P76	See chapter 10.2	16 BIT	R/W	unsigned word	1
40205	P77	See chapter 10.2	16 BIT	R/W	unsigned word	1
40206	P78	See chapter 10.2	16 BIT	R/W	unsigned word	0,1
40207	P79	See chapter 10.2	16 BIT	R/W	unsigned word	0,1
40208	P80	See chapter 10.2	16 BIT	R/W	unsigned word	0,1
40209	P81	See chapter 10.2	16 BIT	R/W	unsigned word	1
40210	P82	See chapter 10.2	16 BIT	R/W	unsigned word	0,1
40211	P83	See chapter 10.2	16 BIT	R/W	unsigned word	0,1
40212	P84	See chapter 10.2	16 BIT	R/W	unsigned word	1
40213	P85	See chapter 10.2	16 BIT	R/W	unsigned word	1
40214	P86	See chapter 10.2	16 BIT	R/W	unsigned word	1
40215	P87	See chapter 10.2	16 BIT	R/W	unsigned word	1
40216	P88	See chapter 10.2	16 BIT	R/W	unsigned word	1
40217	P89	See chapter 10.2	16 BIT	R/W	unsigned word	1
40218	P90	See chapter 10.2	16 BIT	R/W	unsigned word	1
40219	P91	See chapter 10.2	16 BIT	R/W	unsigned word	1
40220	P92	See chapter 10.2	16 BIT	R/W	unsigned word	1
40221	P93	See chapter 10.2	16 BIT	R/W	unsigned word	0,1
40222	P94	See chapter 10.2	16 BIT	R/W	unsigned word	0,1
40223	P95	See chapter 10.2	16 BIT	R/W	unsigned word	0,1
40224	P96	See chapter 10.2	16 BIT	R/W	unsigned word	0,1
40225	P97	See chapter 10.2	16 BIT	R/W	unsigned word	0,1
40226	P98	See chapter 10.2	16 BIT	R/W	unsigned word	1
40227	P99	See chapter 10.2	16 BIT	R/W	unsigned word	1
40228	P100	See chapter 10.2	16 BIT	R/W	unsigned word	1
40229	P101	See chapter 10.2	16 BIT	R/W	unsigned word	1

SENSOR GRAPHICS						
40385 - 40416	Pressure Sensor Graphic [32]	Pressure sensor table (mA - Bar)	32*16 BIT	R-O	unsigned word	1
40417 - 40448	Pressure Sensor-2 Graphic [32]	Pressure sensor-2 table (mA - Bar)	32*16 BIT	R-O	unsigned word	1
40449 - 40480	Temperature Sensor Graphic [32]	Temperature sensor table (Ohm - °C)	32*16 BIT	R-O	signed word	1
40481 - 40512	Temperature Sensor-2 Graphic [32]	Temperature sensor-2 table (Ohm - °C)	32*16 BIT	R-O	signed word	1
40513 - 40544	Pressure Sensor (0-10V) graphic [32]	Pressure sensor table (V - Bar)	32*16 BIT	R-O	unsigned word	1
40545 - 40576	Engine coolant temperature sender graphic [32]	Engine temperature sender table (Ohm - °C)	32*16 BIT	R-O	signed word	1
40577 - 40608	Engine oil pressure sender graphic [32]	Pressure sensor table (Ohm - Bar)	32*16 BIT	R-O	unsigned word	1
40609 - 40640	Engine fuel level sender graphic [32]	Fuel level sensor table (Ohm - %)	32*16 BIT	R-O	unsigned word	1

COMMANDS						
40769	C01	Reserved	16 BIT	W-O	unsigned word	1
40770	C02	Return to factory settings (value = 0xAA55h)	16 BIT	W-O	unsigned word	1
40771	C03	Reset counter { value = Counter (1-8) }	16 BIT	W-O	unsigned word	1
40772	C04	Lock key (Value = keycode to be locked)	16 BIT	W-O	unsigned word	1
40773 - 40800	Reserved	-	16 BIT	W-O	unsigned word	1
40801	Set service 1	Time to service-A (lower 2 bytes)	16 BIT	W-O	unsigned word	1
40802	Set service 2	Time to service-A (higher 2 bytes)	16 BIT	W-O	unsigned word	1
40803	Set service 3	Time to service-B (lower 2 bytes)	16 BIT	W-O	unsigned word	1
40804	Set service 4	Time to service-B (higher 2 bytes)	16 BIT	W-O	unsigned word	1
40805	Set service 5	Time to service-C (lower 2 bytes)	16 BIT	W-O	unsigned word	1
40806	Set service 6	Time to service-C (higher 2 bytes)	16 BIT	W-O	unsigned word	1
40807	Set service 7	Time to service-D (lower 2 bytes)	16 BIT	W-O	unsigned word	1
40808	Set service 8	Time to service-D (higher 2 bytes)	16 BIT	W-O	unsigned word	1
40809	Set service 9	Time to service-E (lower 2 bytes)	16 BIT	W-O	unsigned word	1
40810	Set service 10	Time to service-E (higher 2 bytes)	16 BIT	W-O	unsigned word	1
40811	Set service 11	LOAD+UNLOAD+STOP counter (lower 2 bytes)	16 BIT	W-O	unsigned word	1
40812	Set service 12	LOAD+UNLOAD+STOP counter (higher 2 bytes)	16 BIT	W-O	unsigned word	1
40813	Set Service 13	LOAD+UNLOAD counter (lower 2 bytes)	16 BIT	W-O	unsigned word	1
40814	Set Service 14	LOAD+UNLOAD counter (higher 2 bytes)	16 BIT	W-O	unsigned word	1
40815	Set Service 15	LOAD counter (lower 2 bytes)	16 BIT	W-O	unsigned word	1
40816	Set Service 16	LOAD counter (higher 2 bytes)	16 BIT	W-O	unsigned word	1
40817	C05	Reset history records (Value = 0xAA55)	16 BIT	W-O	unsigned word	1

11.3. ALARMS, WARNINGS, SERVICE REQUESTS

The alarm record is 32 bytes long. Every bit shows the existency of a given alarm.

ALARMS:

BIT NO	CODE	DESCRIPTION
0	AL4	High air temperature alarm (T1)
1	AL6	Air temperature sensor failure (T1)
2	AL7	Low air temperature alarm (T1)
3		-
4	AL2	High air pressure alarm (P1)
5	AL3	Air pressure sensor failure (P1)
6		-
7	AL9	Engine PTC High temperature alarm
8	A24	Air temperature sensor-2 failure (T2)
9	A23	High air temperature-2 alarm / Delta (tS2-tS1) alarm
10	A25	Low air temperature-2 alarm (T2)
11	A22	Air pressure sensor-2 failure (P2)
12	A21	High air pressure-2 alarm (P2)
13	A20	High delta air pressure alarm (P1-P2)
14	A28	-
15	A29	Low air pressure-2 alarm (P2)
16	A12	Engine coolant temperature sender failure
17	A13	Engine oil pressure sender failure
18	A14	Engine fuel level sender failure
19	A11	Engine charge alternator voltage alarm
20	A15	Engine low oil pressure alarm
21	A30	Engine high coolant temperature alarm
22	AL8	Engine fail to start alarm
23		-
24	A31	Engine low fuel level alarm
25	A33	Engine low oil pressure switch alarm
26	A34	Engine high temperature switch alarm
27	A35	Engine low fuel level switch alarm
28	A36	Air pressure safety switch alarm
29	A18	Emergency stop alarm
30	A37	Spare-1 input alarm
31	A32	Engine coolant level switch alarm

The warning record is 32 bits long. Every bit shows the existency of a given warning.

WARNINGS:

BIT NO	CODE	DESCRIPTION
0	StP	Remote stop signal
1	Run	Remote start signal
2	AL5	High air temperature warning (T1)
3	A17	Engine not stopped in last 1 hour
4	A26	Battery voltage out of limits
5	A27	Differential temperature warning (T1-T2)
6	A10	Engine fail to stop
7	A38	Engine low oil pressure warning
8	A39	Engine high coolant temperature warning
9	A40	Engine low fuel level warning
10	A33	Engine low oil pressure switch warning
11	A34	Engine high coolant temp switch warning
12	A35	Engine low fuel level switch warning
13	A36	Air pressure safety switch warning
14	A18	Emergency stop warning
15	A37	Spare-1 input warning
16	A50	Modbus communication failure (multi compressor, for addresses 1 to 8)
17-31		reserved

The SERVICE record is 16 bits long. Every bit shows the existency of a given service request

SERVICE:

BIT NO	CODE	DESCRIPTION
0	SHA	Service period A exceeded
1	SHb	Service period B exceeded
2	SHC	Service period C exceeded
3	SHd	Service period D exceeded
4	SHE	Service period E exceeded
5-15		-

The OUTPUT record is 16 bits long. Every bit shows the status of one output function.

OUTPUT:

BIT NO	CODE	DESCRIPTION
0		Fuel
1		Crank
2		Alarm
3		Load
4		Stop
5		Preheat
6-15		-

The LED 1 record is 16 bits long. Every bit shows the status of one led.

LED 1:

BIT NO	CODE	DESCRIPTION
0		0%
1		10%
2		20%
3		30%
4		40%
5		50%
6		60%
7		70%
8		80%
9		90%
10		100%
11		PRESSURE
12		TEMPERATURE
13		ENGINE RUNNING
14		LOAD
15		ALARM

The LED 2 record is 16 bits long. Every bit shows the status of one led.

LED 2:

BIT NO	CODE	DESCRIPTION
0		LOW OIL PRESSURE
1		HI TEMPERATURE
2		FAIL TO START
3		COOLANT LEVEL
4		HI DELTA PRESSURE
5		HI AIR PRESSURE
6		STOP
7		RESERVED
8		BATTERY
9		CHARGE
10		LOW FUEL
11		EMERGENCY STOP
12		COMPRESSOR TEMPERATURE
13		SERVICE
14		RUN
15		-

The INPUT TYPE record is 16 bits long. Every bit shows the status of one digital input.

INPUT TYPE:

BIT NO:	KOD:	AÇIKLAMA
0		Engine low oil pressure switch → 0: Warning 1:Alarm
1		Engine high temperature switch → 0: Warning 1:Alarm
2		Engine low fuel level switch → 0: Warning 1:Alarm
3		Air pressure safety switch → 0: Warning 1:Alarm
4		Emergency stop → 0: Warning 1:Alarm
5		Spare-1 input alarm → 0: Warning 1:Alarm
6		-
7		-
8		Engine low oil pressure switch → 0: Cooldown 1: Shutdown
9		Engine high temperature switch → 0: Cooldown 1: Shutdown
10		Engine high temperature switch → 0: Cooldown 1: Shutdown
11		Air pressure safety switch → 0: Cooldown 1: Shutdown
12		Emergency stop → 0: Cooldown 1: Shutdown
13		Spare-1 input → 0: Cooldown 1: Shutdown
14		-
15		-

The INPUT CONTROL 1 record is 2 bytes long. Every byte shows the programming of one digital input.

INPUT CONTROL 1:

BYTE NO	DESCRIPTION
0	P71 value (Engine low oil pressure digital input)
1	P72 value (Engine high temperature digital input)

The INPUT CONTROL 2 record is 2 bytes long. Every byte shows the programming of one digital input.

INPUT CONTROL 2:

BYTE NO	DESCRIPTION
0	P73 value (Engine low fuel level digital input)
1	P74 value (Air pressure safety switch digital input)

The INPUT CONTROL 3 record is 2 bytes long. Every byte shows the programming of one digital input.

INPUT CONTROL 3:

BYTE NO	DESCRIPTION
0	P75 value (Emergency stop digital input)
1	P76 value (Spare-1 digital input)

The REQUEST record is 16 bits long. Every bit shows the status of one request.

REQUEST:

BIT NO	DESCRIPTION
0	Cooldown request
1	Emergency stop request
2	Shutdown request
3	Run request
4-15	-

The OPERATION TIMERS record is 16 bits long. Every bit shows the status of one timer.

OPERATION TIMERS:

BIT NO	DESCRIPTION
0	'SFt ' counting safety timer (P64)
1	'PrE ' counting preheat timer (P46)
2	'rSt ' counting wait between starts timer (P48)
3	'Crn ' counting crank timer (P47)
4	'IDL ' counting idle speed timer (P54)
5	'HAT ' counting engine heating timer (P49)
6	'CoL ' counting cooldown timer (P50)
7	'StP ' counting stop timer (P51)
8	'CTP ' waiting coolant temperature to rise (P41)
9	'tNP ' waiting air temperature to rise (P12)
10	Displaying active timer on screen
11-15	-

12. DECLARATION OF CONFORMITY

The unit conforms to the EU directives
-2006/95/EC (low voltage)
-2004/108/EC (electro-magnetic compatibility)
Norms of reference:
EN 61010 (safety requirements)
EN 61326 (EMC requirements)

The CE mark indicates that this product complies with the European requirements for safety, health environmental and customer protection.

13. TECHNICAL SPECIFICATIONS

DC Supply Voltage: 9.0 to 33.0 V-DC
Cranking Dropouts: Survives 0V for 100ms.
Typical Current consumption: 130mA-DC
Maximum current consumption: 250mA-DC
DC Outputs: Protected mosfet semiconductor outputs, rated 1Amp@28V-DC
Charge Alternator Excitation: min 2W
Magnetic pickup voltage: 0.5 to 30V-AC
Magnetic pickup frequency: 0 to 10000 Hz.
Digital inputs: input voltage 0 to 30 V-DC. Connected to BAT+ via internal 47K resistor.
Analog sender input range: 0-5000 ohms.
Pressure inputs: 4-20mA pressure sensor
Temperature Inputs: 1000 to 5000 ohms, (KTY/NTC/PTC sensors)
Serial Port:
Signal Type: logic levels
Communication: Modbus RTU
Data Speed: 9600 bauds
Operating Temperature: -30°C to +70 °C
Storage Temperature: -40°C to +80 °C
Max. Relative Humidity: **%**95 non condensing
Protection Degree: IP 65 (front, with gasket)
IP 30 (back)
Enclosure: Flame retardant, ROHS compliant, high temperature ABS/PC (UL94-V0)
Installation: Panel mounted, rear retaining plastic brackets.
Dimensions: 132x105x54mm (WxHxD)
Panel Cutout: 116x86mm minimum
Weight: 250 gr

EU Directives:	**Reference standards:**
2006/95/EC (LVD)	EN 61010 (safety)
2004/108/EC (EMC)	EN 61326 (EMC)