1. Compact Hardware

The Alarm- and Monitoring System, PLC MODICON 984-A120, is a logic programming control system. The System is programming as a "ALARM AND MONITORING SYSTEM" with "CONCEPT" contains Function Block Diagram (FDB) programming languages as well as a subset of data types of the international IEC 1131-3 norm.

The Compact Controllers may be configured, I/O Mapped, and programmed using either: Concept panel software, full feature Modsoft panel software or Modsoft Lite depending upon the model.

Either software package may be installed on the Modicon P230, an IBM AT, or compatible computer. Programming and configuration editors used for “Compact”, are similar to those used or for other 984s, special I/O Map screens have been designed for A120 I/O modules. **Concept (E984 258/265/275/285 Only)**

Concept may be used with the E984 258/265/275/285 models. Concept contains Function Block Diagram (FBD) and Sequential Function Chart (SFC) programming languages as well as a subset of data types of the international IEC 1131-3 norm. Concept features the following:

FBD depicts process data flow typically suited for discrete and continuous control applications.

SFC provides a graphical representation of the process.

Instruction List is a text based Boolean language used to build more complex applications.

EFB is a "C" tool kit that permits you to create custom function blocks.

Structured Text is ideal to implement complex equations.

Ladder Diagram (ladder logic) complies with the IEC 1131-3 ladder diagram specification.

LL984 inside Concept provides the same tools as Modsoft 984 ladder logic.

Concept operates with either: MS Windows 3.1x, Windows 95, or Windows NT.
2. Compact Installation

Attach the module to a hook at the top of the DTA backplane and drop it into the housing. The 20-pin bus connector on the back of the module mates with the 20-receptacle connector on the backplane, and the metal spring loaded wire on the back of the module passes through a hole in the backplane to make ground contact with the DIN rail. Tighten the screw at the bottom of the module to fasten it to the backplane. The cover provides a clear pocket over each I/O slot where the label comes with each module can be insert. The LEDs on the modules remain clearly visible.

A Compact Controller and its associated A120 I/O modules are installed in DTA backplanes which mount on the DIN rail. Three types of backplanes are available: the primary DTA200, and two optional secondary DTA201 and DTA202 backplanes.

The DTA200 Primary Backplanes as a minimum, your drop must have a DTA200 primary backplane. The Compact Controller will reside in the two left most slots in the DTA 200 backplane, it plugs in a 30-pin power supply connector and two 30-receptacle connectors. Three additional 30-receptacle slots available for A120 I/O modules. Only one DTA200 backplane is used in a drop.

The DTA200 is 213.4mm wide x 142mm high x 31mm deep, and Drops on to a DIN 50022 carrier rail two clips at the bottom of the Backplane secure the unit to the DIN rail. On the right side of the DTA200 backplane is a 30-pin I/O bus extension connector that allows you to connect a secondary (DTA201 or DTA202) backplane. Six through holes provide spaces through which mounted units may make contact with functional ground on the DIN rail.

2.1 Special Features of the Compacts

The Compact Controllers deliver 984 architectural consistency and Performance in a small, modular package. Compacts are easy to install, require only a small area for installation. The E984-258/265/275/285 PLCs feature 386EX processors for increased performance and operate using Concept programming panel software. In addition to these features the E984-285 come with a PCMCIA interface for memory backup. The primary sub rack houses the controller with built-in 24 V DC power supply and an additional three slots for I/O modules. Three additional expansion sub racks can be connected, providing up to 18 slots for I/O modules. Sub racks can be mounted side-by-side, with no additional hardware. Or they can be mounted in two tiers by using a single bus extension cable. DIN rail mounting makes for a fast, secure installation.
The 984-285 CPU with two Modbus Communication ports and a Modbus Plus network interface, 1 Meg FLASH RAM based system executive, 1024K SRAM, 32K words of user memory, 64K words-State RAM, 96K words total, 25Mhz CPU operation, PCMCIA Are lease 2.1 type II socket supported and operating
Temperature - 40...+ 70°C.

**LED Indicators**

**LED Indicators on the E984-265/275/285 Controllers**

ready (green): Controller has passed power-up diagnostics - LED is ON in unconfigured, stopped, and start states as long as heal the status is valid; Is OFF when error condition detected by diagnostics.

run (green): Controller has started and is solving logic. (see section NOTAG for the RUN LED error codes)

battery low (red): Battery needs replacing 10 day hold-up from initial indication

Modbus 1 (green): Communications are active on the Modbus port 1

Modbus 2 (green): Communications are active on the Modbus port 2

PC (green): PCMCIA card can be swapped when on.

Modbus Pl. (green): Communications are active on the Modbus Plus port

### 3.1 BINARY Overview

The DEO 216:

is a 24 V dc, 16 point discrete input module. It senses input signals received from field sensing devices such as push buttons, limit and proximity switches, or other 24 V dc input sources and converts those signals into logic voltage levels that can be used by the controller. Signals are field wired in two groups, eight signals per group. DEO 216 inputs are not opto isolated from the I/O bus.

**LEDs:** the DEO 216 module has one green LED, opposite terminal screw 1, which indicates when ON that power is available to the 16 inputs below it. The module also has 16 red LEDs, eight opposite terminal screws 3 ...10 and eight opposite terminal screws 14 ...21; when any one of these LEDs are ON, it indicates voltage present at the corresponding input.

The DAO 216:

is a discrete output module with 16 independent 24 Vdc output circuits. It can drive relays, motor starters, pilot lamps, valves, solenoids and other similar loads.

The module is structured in one group of 16 outputs. The outputs are not isolated.

The DAO 216 can be installed in any slot in the A120 subracks (DTA200, 201, and 202). The module has bus contacts at the rear and field connections on the front.

The blank label, which fits in the module cover, can be filled in with relevant information (signal values, etc.) in the spaces provided.

**LEDs:** the DAO 216 has 17 LEDs. One green LED opposite terminal screw 1 indicates presence of external working voltage to the 16 output (ON = voltage available; OFF = voltage not available).

There are 16 red LEDs opposite terminal screws 3 ...10 and 14 ...21, indicating when ON that 24 V dc is present at the adjacent discrete output.
3.2 ANALOG Overview

The ADU 204:

is a four channel analog input module without opto isolation.
It performs dual - slope integrating A/D conversions, converting analog values into 12 bit digital values in the recommended range. It may be used in conjunction with either two wire +500 mV sensor field devices or PT100 four wire resistance temperature detector (RTD) field devices.
In RTD applications, the internal precision source forces a 2.5mA current through the resistance.
For a PT 100 RTD, a range of 18.49 ... 390.25 Ohm would correspond to -200 ... +850 degrees C; the values 80.31 Ohm (50 degrees C) to 194 Ohm (+250 degrees C) are in the recommended range.
Consult your RTD data book for the appropriate line a rization equations for your field device. When the module goes out of range either over or under range and then returns to a valid operating range, the module will resume proper operations unless your out of range condition reaches or exceeds the safety range of + 24 V.

Warning! Operation at an extreme out of range voltage at or beyond +24 V will cause permanent damage to the module.

The ADU 204 operates off the 5 V supply voltage provided internally over the I/O bus.

LEDs: The ADU 204 has one green LED opposite terminal screw 1, indicating the presence of the 5 V power supply from the backplane.

RTD Input Capabilities: PT100 RTD Impedance Range 18.49 ... 390.26 Ohm
Temperature Measuring Range -200 ... +850° C
Resolution 0.25° C

The ADU 214:

module is used for measuring analog data, and provides up to 8 non-isolated inputs. The main characteristics of the module are: for 4 wire analog inputs. These inputs can be used for 2-wire measurement’s, thus allowing up to 8 unipolar inputs, 4 bipolar voltage inputs, or combinations of both.
Several measuring ranges that may be individually selected and mixed for each input:

Measuring Ranges
Voltage measurement:

0 ... 0.5, 0 ... 1, 0 ... 5, 0 ... 10 V,
0.1 ... 0.5, 0.2 ... 1, 1 ... 5,
2 ... 10 V, +0.5, +1, +5, +10 V

Current measurement:(External precision resistor required)

0 ... 5, 0 ... 10, 0 ... 20 mA,
1 ... 5, 2 ... 10, 4 ... 20 mA,
+5, +10, +20 mA
RTD Temperature measurement:
-160/-60 ... +160 °C (resolution < 0.02 ° C)
-200 ... +320 °C (resolution < 0.04 ° C)
-200 ... +640 °C (resolution < 0.08 ° C)

Resistance measurement:
0 ... 100, 0 ... 200, 0 ... 500 Ohm
0 ... 1000, 0 ... 2000 Ohm

Broken wire testing of all 4-wire lines and self calibration using built in reference resistances and reference voltages. Measuring ranges for voltage, current, temperature, and resistance can be set individually for each input. Switch selectable 50 ... 60 Hz operation noise suppression

**LEDs:** The ADU 214 has two front panel LEDs:
- One green LED opposite Terminal 1 indicating the module is receiving 24 V power
- One green LED opposite Terminal 12 indicating the module’s processor is running

### 4. Function CPU

The central processing unit CPU has the following tasks:
- Producing of the internal processing
- Organization of the internal data processing on the I/O bus between all units
- Processing of the user programs
- Preparing of the binary or analogous signals
- Transformation of the measurements in scaled measured quantities
- Supervision of the limit values
- Transfer of the measured quantities to indicators
- Alarm formation, taking account of time delay and alarm suppressions
- Alarm message for alarm processing instruments via output module
- Alarm group formation
- Communication with alarm tableau and duty alarm system

The front side of the CPU contains the following indications:

- **green LED "ready"
  - indication: power supply available and processor working
  - indication off: power supply not available or processor failure

- **yellow LED "run"
  - indication: user program working
  - indication off: user program failure

- **red LED "bat low"
  - indication: battery under voltage or power supply failure
  - indication off: battery ok

- **green LED "port 1"
  - indication: interface PORT No 1 active
  - indication off: interface PORT No 1 not active

- **green LED "port 2"
  - indication: interface PORT No 2 active
  - indication off: interface PORT No 2 not active
4.1 Supervision Alarm System

The following diodes on the CPU have to be in "ON" position: READY and RUN. If they are not in this position, the voltage has to be switched off and then switched on again. In case of failure, there is a message to the duty alarm system.

5. Recording and Processing of

5.1 Binary Alarms

Each binary alarm has his own alarm input. The system is working in positive logic, that means, the voltage at the INPUT LED corresponds to a logical 1 (LED ON), alarm input is ok.

Connected binary alarms will be cyclically sensed.

Signal process for alarms without inhibition:
Signal change (LED OFF) after adjustable time delay.
Alarm signal to:
  - signal system
  - lamp group panel alarm system
  - visualize system
  - printer
  - alarm group duty alarm system

Signal process for alarms with inhibition:
Signal change (LED OFF) and release inhibition will be at the end of an adjustable time delay.
Alarm signal to:
  - signal system
  - lamp group panel alarm system
  - visualize system
  - printer
  - alarm group duty alarm system

5.2 Analog Measure Values

Analog indicated values are read in cyclically. Scanning the indicated values you can state broken sensor, earth fault, or short circuit at the different transmitters. If a failure is reported, it will be indicated optically and it will also printed. The limit value monitoring is switched off.
Defective Analog measure points can be switched from the alarm panel to “unclear” via password protection.
Sensor which are switched off are indicated on the alarm panel as “unclear” and excluded from limit value monitoring.
Every read-in analog value will be converted to a scaled measure value. In case of limit value deviation there will be a signal to:
  - panel alarm system
  - visualize system
  - printer
  - alarm group duty-alarm system
5.3 Exhaust Gas Temperature Monitoring

For monitoring the exhaust gas temperature of a main engine the temperature of each cylinder are read in and monitored for deviations of tolerable limit values.

Temperature Monitoring Cylinder
A limit value is provided for max cylinder temperature.
It is possible to program different limit values for individual cylinders.
The max cylinder temperature can be change on the panel via password (new building number).

In case of limit value deviation there is a signal to:
  - panel alarm system
  - visualize system
  - printer
  - alarm group duty-alarm system

Exhaust Gas Average Value – Limit Value Spreading
The limit values of the deviation of the exhaust gas temperature is spreaded in the range of lower temperature.
Release of average value deviations can be change on the panel via password (new building number).

Limit Value Spreading No.1
Limit values spreading no.1:
high deviation of average value start with release of min and max deviation from average value to limit value spreading no.2. Changing of limit value spreading no.1 on the panel via password (new building number).

Limit Value Spreading No.2
Limit values spreading no.2:
Low deviation of average value start with release of min and max deviation from average value to limit value spreading no.1. Changing of limit value spreading no.2 on the panel via password (new building number).

Reducing Signal at Max Cylinder Temperature
A reducing signal will be given if the limit value max cylinder temperature has been exceeded for more than 50°C.
This signal can be used for the connection to the main engine remote control or adjustment of propeller.
Temperature Compensation for Thermo Elements
The thermo element is mounted in the same connection box as the thermo elements for exhaust gas temperature monitoring. It is a PT100 and measured the temperature inside the box. This temperature will be considered when processing the measured values are given by the thermo elements. If the transmitter for compensation fails, zero degree will be assumed.

In case of limit value deviation there is a signal to:
- panel alarm system
- visualize system
- printer
- alarm group duty-alarm system

Changing of Limit Values
When the system operates the following data can be changed via password (new building number) input:
- limit values
- time delays
- sensor clear
- sensor unclear

The data are accepted with “ENTER”

Reference to Password Input:
The new building number is the password.
6. Graphic Terminal with keyboard

The Terminal main functions are:

Types of display
- LCD 10.4"
- 640x480 pixels
- Color 10"

Power
- 24VDC Voltage limits: 18 to 30 VDC
- Ripple: 5 % maximum
- Consumption: 35 W

Memories
- Application + protocol: PCMCIA EPROM card: 2 MB -> 10 MB
- 30 to 300 pages of applications, alarms and help according to the memory card in use.
- Alarm log: 500 events

Serial link
- RS232 / RS485 / RS422 asynchronous serial link

Printer
- RS232 asynchronous serial link

Keypad
- Customizable membrane keypad

Indicating
- 1 communication status indicator light
- 1 indicator light per function key
- 1 indicator light per service key
- 1 keypad busy indicator light
6.1 Main Page display

6.2 Application pages MAIN ENGINE Measuring Point List
6.3 Application pages MAIN ENGINE Measuring Point Info List

INPUT INFORMATION TIME DELAY MP101 - MP116

CHANGE TIME DELAY BY PASSWORD

MEASURING POINT MP101 TIME DELAY : 99 sec
MEASURING POINT MP102 TIME DELAY : 99 sec
MEASURING POINT MP103 TIME DELAY : 99 sec
MEASURING POINT MP104 TIME DELAY : 99 sec
MEASURING POINT MP105 TIME DELAY : 99 sec
MEASURING POINT MP106 TIME DELAY : 99 sec
MEASURING POINT MP107 TIME DELAY : 99 sec
MEASURING POINT MP108 TIME DELAY : 99 sec
MEASURING POINT MP109 TIME DELAY : 99 sec
MEASURING POINT MP110 TIME DELAY : 99 sec
MEASURING POINT MP111 TIME DELAY : 99 sec
MEASURING POINT MP112 TIME DELAY : 99 sec
MEASURING POINT MP113 TIME DELAY : 99 sec
MEASURING POINT MP114 TIME DELAY : 99 sec
MEASURING POINT MP115 TIME DELAY : 99 sec
MEASURING POINT MP116 TIME DELAY : 99 sec

PASSW0RD
999

99 ACT1VE TIME FOR PASSWORD

6.4 Application pages MAIN ENGINE Analog Measuring Point

Exhaust Gas / Pressure / Temperature Main Engine

ENGINE LOAD 99.3 %
ENGINE SPEED 992 rpm

9999
AAAAAAA AAAAAAAA LLL
9999
LLLLLLL LLLLLLLLLLLLLLLLLLLLLL LLL
6.5 Application pages MAIN ENGINE Exhaust Gas Temperature

6.6 Application pages MAIN ENGINE Exhaust Gas Deviation Mean Value
6.6 Application pages MAIN ENGINE Exhaust Gas Limit Value

CHANGE LIMIT VALUE BY PASSWORD

Cylinder
Temp. max / Reduce

Turbo
Temp. max / Reduce

PASSWORD
999

ACTIVE TIME FOR PASSWORD

999

ESC
**HOME**: To return to the page displayed when the terminal is switched on.

**SYST**: To access the system pages that contain the maintenance configuration functions.

Status of the indicator lights associated with the SYST key:
- Off: the terminal is in running mode.
- Flashing: PC <-> XBT transfer in progress or no application in the terminal.

**ALARM**: To display the alarms

Status of the indicator light associated with the key:
- Off: the current list of alarms is empty.
- On: the list contains alarms that have already been displayed.
- Flashing: the list of alarms contains new alarms.

**PRINT**: Print command.

Status of the indicator lights associated with each key:
- Off: no printing possible
- On: printing possible (list of alarms, etc.)
- Flashing: printing error.

The left and right arrow keys are used to:
- To select an object in a page.
- To move during an entry in an alphanumeric field.
- To change the cursor position on a switch or a potentiometer.

Status of the indicator lights associated with each key:
- Off: key inactive.
- On: indicates the possibility of moving around in a page from field to field.
- Flashing: indicates the possibility of moving around in the selected alphanumeric field or of changing a cursor position.

The up/down arrow keys are used to:
- To move around in a page.
- To select a value in a list of values.
- To change the cursor position

Status of the indicator lights associated with each key:
- Off: key inactive.
- On: indicates the possibility of moving around in a page from field to field.
- Flashing: indicates the possibility of moving around in the selected alphanumeric variable field, changing the cursor position or selecting a value in a list.

**Communication indicator light**
- Off: no cable or incorrect wiring.
- On: cable correct, no exchange with the PLC.
- Flashing: exchanges with the PLC.
Keypad indicator light
- Off: no keys pressed.
- On, green: when pressing any key.
- On, red: the terminal is in standby mode.

Entering data in the various fields
The up/down arrow keys combined with the **SHIFT** key are used to increment or decrement the value in a variable field if the parameter of the object entered has been configured to immediate write (or immediate read/write). The value is entered in the control system each time the **SHIFT** + arrow up/down key is pressed.

Status of the indicator lights associated with each key:
- Off: key inactive.
- Flashing: indicates the possibility of modifying the value of each digit.

To delete the character to the left of the cursor.

Alphanumeric entry keys
- T reverse the sign of the variable field being entered

Alarmsystem
Alarm groups can be configured in order to group together alarm pages in modules.
An alarm group is a set of alarms identified by **different color attributes per group** for the appearance, disappearance and acknowledgment statuses. There are 16 groups numbered 1 to 16. Each group is identified by an 8-character name allowing quick identification by the operator of a part of the machine or of the installation.

In the list of alarms, it is possible to select:
- display of the alarms from a single group out of the 16.
- display of the alarms from the 16 groups.

According to the colors, the user can quickly identify the control system unit in which the fault has occurred (example: cracker1).

The dynamic key associated with the **ACK ALL** icon is used to acknowledge the alarms of the group(s) present on the screen.
Alarm display principle

When an alarm appears:
- The ALARM indicator light flashes.
- The alarm is stored in the alarm list.
- The alarm can be acknowledged by the operator directly on the application page by pressing the ENTER key.
- The alarm relay is closed (if this function is selected).
- The alarm strip is updated.

The alarm can be consulted in the alarm list.

Acknowledging alarms

When designing pages, it is possible to define whether the alarm page should be systematically acknowledged or not. These 2 types of alarms are managed in the following way:

1 - Alarms which must be acknowledged

An alarm which must be acknowledged remains in the list of alarms until it is acknowledged by the operator, even if the cause of the fault is not longer present (the alarm bit is back to 0). Its status is then OFF.

Advantage: transient faults are isolated (instability of a discrete sensor for example).

2 - Alarms with optional acknowledgment

An optional acknowledgment alarm disappears from the list as soon as the cause of the fault is no longer present (the alarm bit is back to 0), whether the alarm has been acknowledged or not.

Advantage: Do not monopolize the screen with faults display that are considered minor for the application.

Alarm acknowledgement from the alarm strip

Press the ENTER key on the terminal the alarm displayed in the alarm strip. The alarm message switches to ACK status. NOTE: The alarm strip can be displayed on alarm pages. Acknowledgement will thus be effective on the strip alarm and not on the alarm displayed.

Alarm acknowledgement from the list of alarms

Press the ENTER key on the terminal to acknowledge the alarm selected in the list. The alarm message switches to ACK status. The dynamic key associated with the ACK ALL icon is used to acknowledge the alarms from the group(s) displayed.
Description of the alarm list

The alarm list includes:
the active alarms which are present but not acknowledged by the operator (ON),
the active alarms acknowledged by the operator (ACK),
alarms with mandatory acknowledgement and which have not been acknowledged but for which the triggering cause is no longer present (OFF).

The alarm list is refreshed whenever an alarm appears or disappears. The alarm list remains displayed awaiting a user action.
9. Printing

The following information can be printed:

**Printing at the operator’s initiative**
- Alarm log
- List of active alarms.
- Form pages,
- Terminal references.

The PRINT key is used to send the command.
The SHIFT+ALT+PRINT keys are used to send the command.

**Printing at the PLC’s initiative**
- Alarm log
- Free format printing
- On-line alarm printing
- Form page printing.

**NOTE:**
The recommended printing format for the “Alarm history printing”,
“On-line alarm printing” and “Alarm list printing” functions is 132 columns.
On a 80-column printer, the “alarm group” and “equipment”
information is not printed out.

10. Power

Power 24V DC
Voltage limits: 18 to 30 VDC
Ripple: 5 % maximum
Consumption: 35 W

11. Acknowledgement of "3-Minutes-Alarm"

The alarm system monitors the time of acknowledgement for attended and unattended
engine room operation.
The monitoring time starts after the acoustic message of an alarm. If the alarm is not
acknowledged after three minutes, there is an acoustic message to all Eng. cabins and the
messrooms.
For stopping the monitoring time, an acoustic acknowledgement is sufficient. The optical
acknowledgement of the accumulated measuring points can be done later.