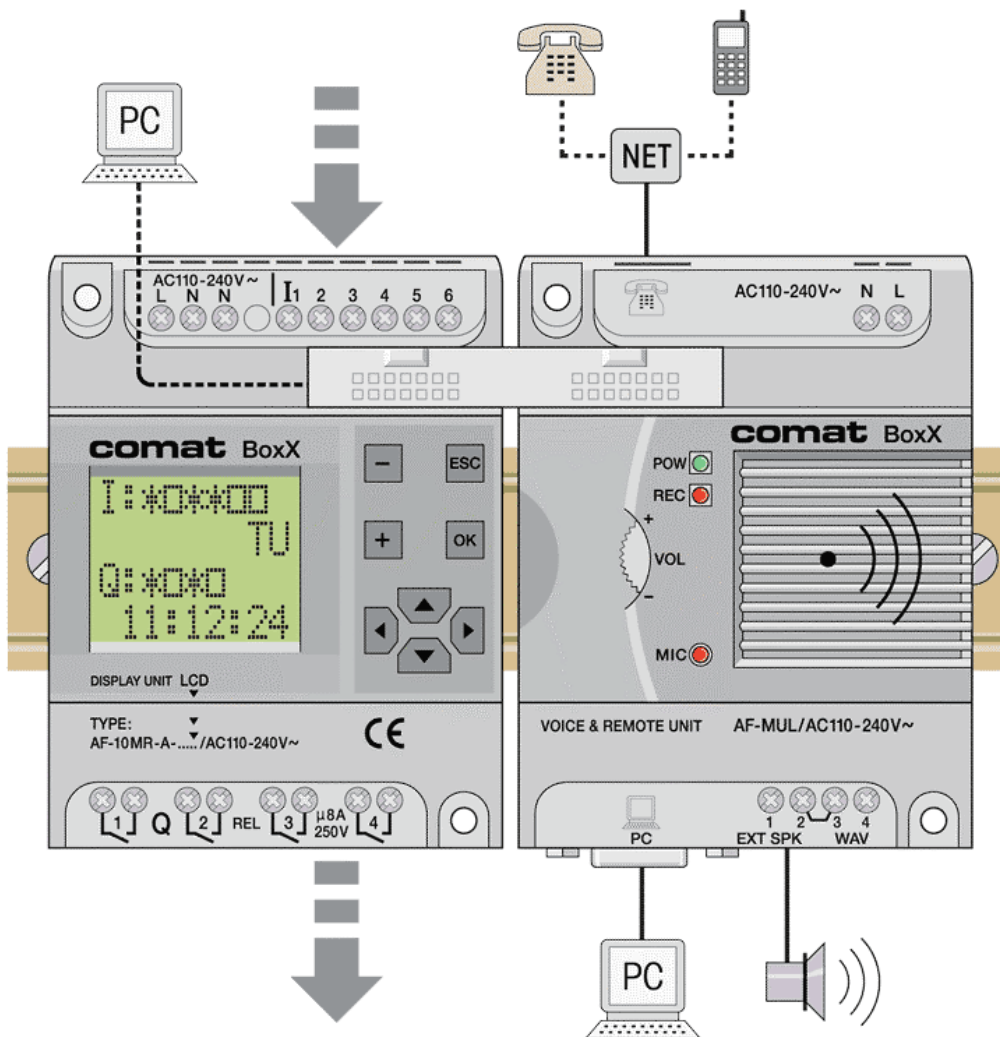**comat|BoxX**

Hardware

User's Manual

Preface

Thank you for purchasing the Comat BoxX series intelligent controller from our company.
Whilst you may have a good knowledge and understanding of these products you are re-quested to take some time to read this manual before operation. This will allow you to utilise the more advantageous benefits of the product.
The Comat BoxX series intelligent controller uses function blocks for programming and a liquid crystal display is provided for manual programming.
In the past the control function of a PLC required large sections of program and instruction sets whereas the Comat BoxX series uses function blocks. When several function blocks are linked together in a specific way then relatively complicated control functions can be implemented so that the programming can be simplified.
The Comat BoxX series intelligent controller can be used very extensively for automation of mechanical equipment, flow control, building management systems and many other fields.
This manual will describe in detail the functional characteristics and operating method of the Comat BoxX series controller.

Note:

(1)   Copyright of this manual and patent of the device are the property of Comat AG.
No reproduction or duplication of all or part of the contents of this manual is permitted without prior consent.

(2)   Our company reserves the right to make changes in design for improvement without notification.

(3)   In the event that something is missing or there are discrepancies in this manual then please contact us and we will endeavour to incorporate your comments in the next revision.
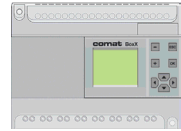
Safety guide

This manual contains the precautions necessary to ensure your personal safety ands for the protection of the product and the connected equipment. These precautions are highlighted with a triangle "WARNING" symbol in this manual and are marked according to the danger levels as follows:

Danger:

This indicates that if appropriate precautions are not taken, serious incidents of personal injuries or death or loss/damage to property may occur.

Caution:

This indicates that if appropriate precaution are not taken then injuries or losses of properties will take place

Warning:

Only qualified personnel are allowed to debug and operate this equipment. The qualified personnel are those who carry out commissioning, grounding according to the current safety practices and standards.

Note:

Reminds you to pay particular attentions to the important information related to the products, disposal of products or the specific part of documents.
Only when this product is transported, stored , and installed in a proper way and operated and maintained according to the recommendations, can it implement the functions and properly reliably.
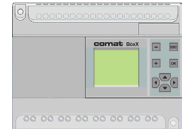
Note:

1. It is prohibited to plug in or pull out the AF-C232 and LCD board when Comat BoxX machine is powered.

2. The default of Comat BoxX password is 0001.

3. The default of Comat BoxX address is 000.

4. The outputs of the function blocks can not be connected together.

Table of contents

Chapter I

Brief introduction to Comat BoxX

1.1 Structure of Comat BoxX

The Comat BoxX intelligent controller is a new type of programmable controller. As it is programmed by means of function blocks. It is simpler and easier to learn the programming of Comat BoxX than conventional PLC programming (ladder diagram and instruction).

In the design concept of the products of the Comat BoxX series, the PLC is combined with a writer where the program can be written directly with the functions keys on the LCD front panel. The product is very compact and lightweight despite the many functions including local and remote communication networking and monitoring.

Also there are telephone control, voice prompting and automatic dial functions by adding the AF-MUL voice block.

At present the Comat BoxX is widely used in various industries in the agricultural and the home automation market and can be used almost anywhere.

1. Input of AC power

2. Input terminal

3. Communication interface

4. Operating keys

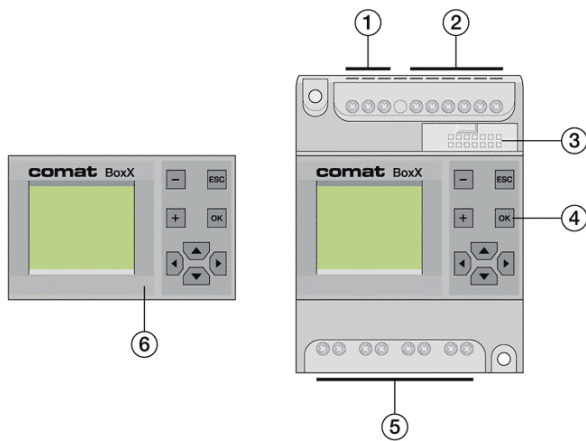5. Output terminal (Output of relays or electronic transistor)
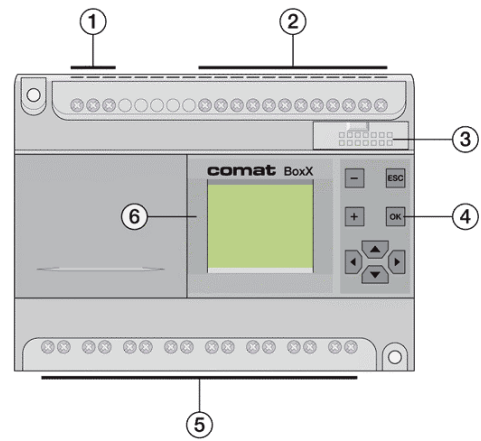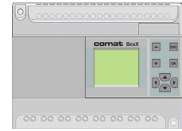
6. LCD display panel

Fig. 1.1   Fig. 1.2

1.2 Specifications and models

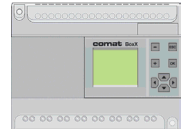| Type	Power	Input	Output
AF-10MR-A	110-230VAC	6AC	4 relay
AF-10MR-D	24VDC	6DC or analog inputs	4 relay
AF-10MT-GD	24VDC	6DC or analog inputs	4 transistor- PNP
AF-20MR-A	110-230VAC	12AC	8 relay
AF-20MR-D	24VDC	12DC or analog inputs	8 relay
AF-20MT-GD	24VDC	12DC or analog inputs	8 transistor-PNP
AF-MUL	110-230VAC	Voice and Remote Unit	
AF-MUL	12-24VDC	Voice and Remote Unit	
AF-LCD	Removable panel for programming with LCD display		
AF-CAP	Comat BoxX cover		
AF-M232	Interface between Comat BoxX and Modem		
AF-C232	Interface between Comat BoxX and PC modem		
AF-BC	Bridge connector between Comat BoxX and AF-MUL		
Quick II	Comat BoxX programming software		
AF-Copy	Copy module		
AF-USB	Interface cable		
AF-AUD	Audio cable for AF-MUL		
AF-ATL	WAV cable for AF-MUL		

1.3 Features of Comat BoxX

1. Removable programming panel with Liquid Crystal Display
    There is an operating panel with LCD display on the front of the Comat BoxX (see note below).
    The program can be edited with the operating keys on the LCD panel.
    This panel can be removed for security purposes and be replaced with a cover (CAP).

⚠ Note:

The LCD panel can be plugged in or removed only after the power has been turned off.

2. Exquisite and compact design
    Comat BoxX is an excellent choice to control your systems. Its performance and compact design, offers you great opportunities of economical control solutions.
    Type AF-10….: 90 x 71 x 58mm
    Type AF-20….: 90 x 126 x 58mm

3. Large storage capacity
    Control functions of Comat BoxX can be implemented with simple function blocks available in a library.
    The 20 pre-defined functions make programming easy and fast. The linking of function blocks allows relatively complex control programs. A Comat BoxX has up to 127 function blocks for program storage. A downloaded program into the EPROM can not be lost and does not require battery backup.

4. Quick II programming software
    QUICK II is a free-of-charge programming software
    By using QUICK II, the program can be edited directly on the LCD panel or on a PC. The program is loaded and written into the memory of Comat BoxX. QUICK II is a very friendly man-machine programming interface. It cannot only edit the function diagrams, but it also can run and analyse the written program. It provides an off-line testing function to the user to avoid inconveniences for on-line testing. QUICK II will not only guide you to implement or edit the control programs, but also performs real-time monitoring for field environment and operation conditions of Comat BoxX.

5. Real-time clock function
    Comat BoxX intelligent controllers have an instant real-time clock function, and can execute timed operations according to various schedules. You can set as many as up to 127 different time intervals which makes the Comat BoxX most suitable for systems which require time control.

6. Digital and Analogue inputs
    In addition to receiving switching inputs (Digital), Comat BoxX can also process analogue inputs. This allows to monitor and control temperature, humidity, pressure, flow, level, etc., The values can be transmitted to a remote to PC for data supervision.

7. Remote programming, supervision and control of data through a MODEM.
    To implement programming, write and modify programs from a distant location, it is only necessary to connect Comat BoxX over a MODEM with a telephone line. It is also possible to perform data acquisition and real-time supervision and control over the MODEM.

8. Security cipher code function
   Comat BoxX is provided with a safety access code for the programs written by you. You can set your own cipher code before you write programs. The programs can be modified only after the correct access code is entered.

9. Telephone function
   Comat BoxX is equipped with telephone and voice function blocks. It is possible to access Comat BoxX directly through the normal telephone line.
   Comat BoxX can dial out automatically, so as to implement notice or alarm functions. Moreover, Comat BoxX can also receive the signals transmitted from a remote location through the telephone line (or a cell phone) in order to control connected devices or machines.

⚠ **Note:**

It is necessary to configure AF-MUL multi-functional voice block for the implementation of telephone and voice function.

10. Voice function
    If connected to the AF-MUL Voice unit, Comat BoxX is able to broadcast alarms or messages either over auxiliary speakers or a telephone line. This unique feature offers many additional possibilities for the automation and control industry.

Chapter II

Installation and wiring of Comat BoxX

2.1 Installation

2.1.1 Installation method

Due to the compact size the device it is suitable for fitting inside machines and installation is quite simple:
1. Use a standard DIN rail for installation of Comat BoxX as shown in Fig. 2.1.
2. Use the screw holes on Comat BoxX for installation onto a flat surface.
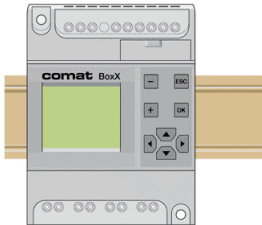

Fig. 2.1
Use standard DIN rail for installation

The LCD board of Comat BoxX is removable. Gently lever open with a screwdriver and the LCD can easily be unplugged.
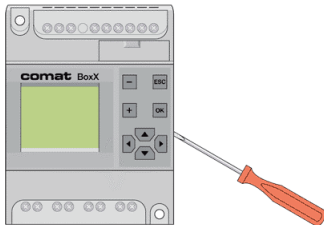
Fig. 2.2
Remove LCD board correctly

⚠ **Caution:**

Do not remove the LCD board with power on, otherwise the device will be damaged or endanger personal safety.
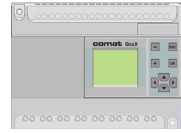
2.1.2 Dimensions
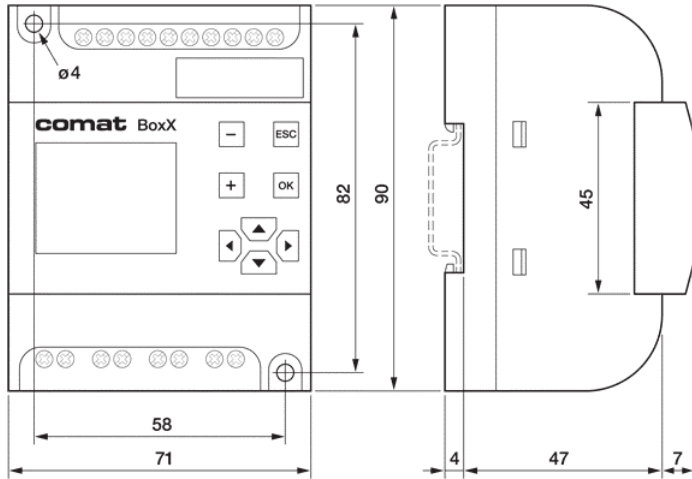
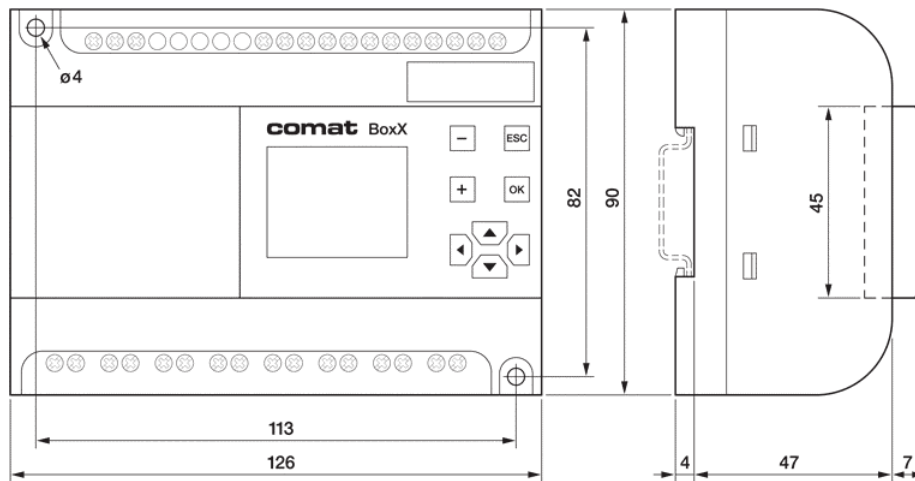Fig. 2.3 AF-10 Series installation dimensions (Unit: mm)

Fig. 2.4 AF-20 Series installation dimensions (Unit: mm)

2.2 Wiring of Comat BoxX

Use a screwdriver with a tip width of 3mm for wiring of Comat BoxX. The cross section of the wires are determined according to the following ratings:
1 x 2.5 mm^2 or 2 x 1.5 mm^2.

2.2.1 Connection of power supply

1. AC Types: Current consumption:
    AF-10MR-A: 110 – 230VAC; 50/60Hz;   26mA at 230VAC
    AF-20MR-A: 110 – 230VAC; 50/60Hz   50mA at 230VAC

2. DC Types:
    AF-10MR-D: 12 - 24VDC
    AF-10MT-GD: 12 - 24VDC
    AF-20MR-D: 12 - 24VDC
    AF-20MT-GD: 12 - 24VDC

Note:

Min. tension for AF-10 = 10.0V
Min. tension for AF-20 = 10.5V

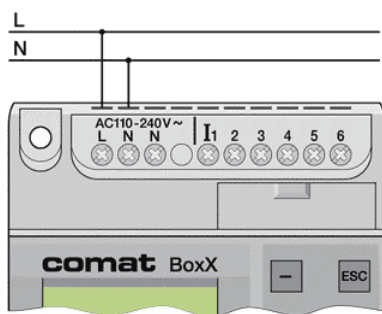3. Connection of power supply according for AC types Fig. 2.5 and DC types Fig. 2.6
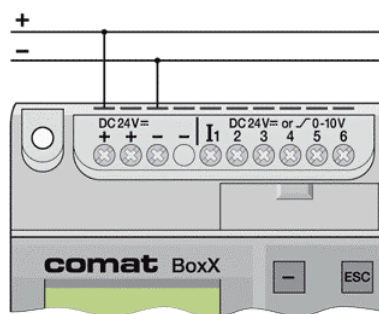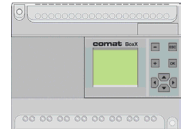

Fig. 2.5 AC power supply   Fig. 2.6 DC power supply

2.2.2 Connecting Comat BoxX input

The inputs to Comat BoxX can be either digital such as on/off switches, photoelectric damper, sunshine switch, etc., or analogue inputs such as pressure, level element, temperature, humidity, flow, etc.

The specific requirements are as follows:

Type ⟍ Demand	AF-10MR-A AF- 20MR-A	AF-10MR-D AF-10MT-GD AF-20MR-D AF-20MT-GD
Switch status 0	< 40VAC	< 5VDC
Input current	> 0.24mA	> 1.5mA
Switch status 1	≥ 80VAC	≥ 15VDC
Input current	Typical 0.24mA	Typical 3mA
Proximity switch type with direct input	2 lines 3 lines 4 lines	2 lines 3 lines 4 lines
Switching of incandescent lamps	Lamps with a power consumption of max. 1000W may be connected directly to the output terminals of the Comat BoxX. Lamps with higher power consumption have to be switched over an additional relay.	
Analog inputs		I1 - I6 / I1 – I12

![Warning symbol] **Note:**

1. AF-10MR-D, AF-10MT-GD, AF-20MR-D and AF-20MT-GD can all receive analogue inputs through all input interfaces (I1-I6 or I1-I12). They are automatically set to analogue or digital input. An analogue signal is recognised when the input terminal is connected to the AN function block. It is important to set analogue inputs first when using SCADA software.

2. The analogue input requires 0V ~ +10V voltage signals and is divided equally in 0.1V increment steps. When programming, all the block parameters related to analogue are based on the minimum precision of class 1.

3. All inputs over 10.0V are recognised as digital inputs.

4. Digital inputs: Change of status from „0" to „1" : Triggering time min. 50ms
                        Change of status from „1" to „0" : Triggering time min. 50ms
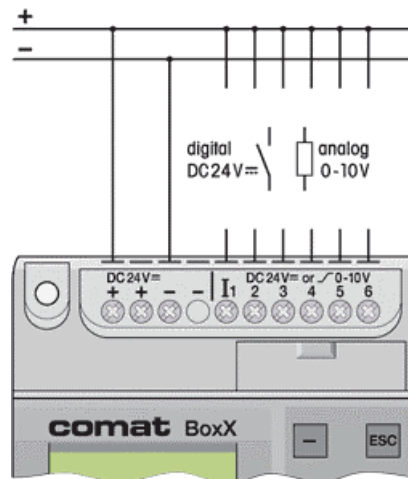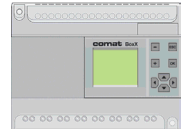
Connection of the units
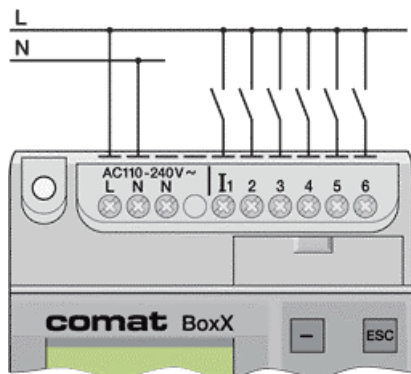
Fig. 2.7
AC types

Fig. 2.8
DC types with analog inputs

2.2.3 Connecting of Comat BoxX output

The AF-10MR-A, AF-10MR-D, AF-20MR-A, AF-20MR-D, all have relay outputs. The contacts are isolated from the power supply and inputs.
The AF-10-MT-GD (PNP), AF-20-MT-GD (PNP) are transistor output types, provided with short circuit and overloading protection.
It is necessary to have a separate power supply for the load.

1. Requirement for the relay output
   Various loads such as lamps, fluorescent tubes, motors, contactors, etc., can be connected to the outputs of Comat BoxX. The max. ON output current that can be supplied by the Comat BoxX controller is 8A for resistive load. The connection is shown as follows:
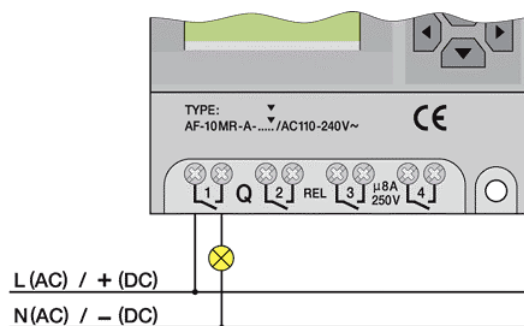
Fig. 2.9 Relay output

2. Requirements for the electronic transistor output
   The maximum switch current should not exceed 2A; when the switch is ON (Q=1).
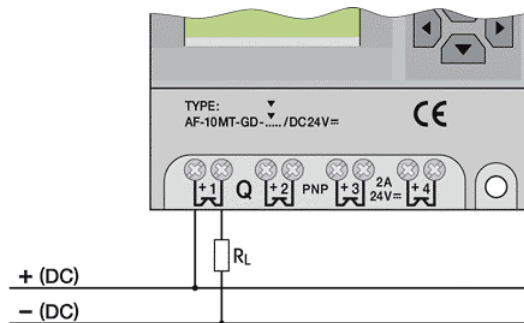   The connection is as the shown below:

Fig. 2.10 Transistor output
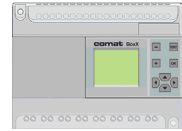
⚠️ **Note:**

Output Q must be on the same potential as input I.

Chapter III

Technical data

3.1 General data

3.1.1 Ambient conditions

Description	Standard	Specification
Ambient temperature working		With display: -25-55°C Without display: 0-55°C
Ambient temperature transport / storage		-40-70° C
Relative humidity	IEC 68-2-30	5-95 % No condensation
Atmospheric pressure		795-1080hPa

3.1.2 Mechanical data

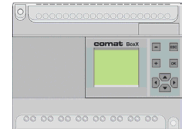| Description	Standard	Specification
Protection	IEC 529	IP 20 (terminals) / IP 30 (electronics)
Vibration	IEC 68-2	10-57Hz, constant amplitude 0.15mm 57-150Hz, constant acceleration 2g
Shock	IEC 68-2-27	18 shocks, half-waves 15g / 22ms
Height of fall	IEC 68-2-31 IEC 68-2-32	Device: Height of fall 50mm Device packed into box: 1m
Dimensions		Dimensions over all Type: AF-10; AF-MUL: B 71mm, T 58mm, H 90mm Typ: AF-20: B 126mm, T 58mm, H 90mm See dimension drawing
Case material		ABS (Acrylnitril Butadien Styren)
Terminals	VDE0609	Power supply, inputs, outputs: Screw terminals with wire protection 2,8mm x 4.4mm for max. 1 x 4mm^2 flex With end spice M3, slotted head screw, Screwdriver No. 1; 0.5Nm
Special terminals		AF-MUL miniature D-Sub 9 pi for RS 232 RJ 12 for telephone line
Fixation	DIN 50022	Top hat rail DIN TS 35 or screw fixing 2 x M3 (diameter of pitch circle 4,0mm)
Weight		AF-MUL: 210g; AF-10MR: 245g; AF-10MT: 210g; AF-20MR: 380g AF-20MT: 320g Total weight complete version with LCD

3.2 Electrical data

3.2.1 Electromagnetic compatibility

Description	Standard	Specification
Static discharge (ESD)	EN 61000-4-2	8kV air 6kV contact
Electromagnetic Field Emission	EN 55022 / 99	ok
Electromagnetic Field Immission	EN 61000-4-8 EN 61000-4-3	Inductive field strength 3A/m ok
Emission on wiring	EN 55011	ok
Surge	EN 61000-4-5	AC 110-240V: Level 3 2kV DC 24V: Level 1 500
Burst	EN 61000-4-4	AC 110-240V: Level 3 2kV DC 24V: Level 1 500V

3.2.2 Power supply

Description	Specification / Type: AF-10MR-A AF-20MR-A AF-MUL	AF-10MT- GD AF-20MT-GD AF-10MR-D AF-20MR-D
Main voltage nominal	AC 110-240V	DC 24V
Main voltage working range	AC 85V-250V	**AF-10:** DC 10.0V-30V **AF-20:** DC 10.5V-30V **AF-MUL:** DC 18V-30V
Frequency range	50/60Hz 47-63Hz	
Function reserve time (clock)	100hrs	100hrs
Power consumption (with operating panel)	**AF-10:** 5VA/3W // 20-45mA **AF-20:** 8VA/5W // 33-72mA **AF-MUL:** 4VA/1,5W // 16-36mA	3W // 100-166mA 5W // 166-277mA

3.3 Inputs

3.3.1 Digital inputs

Description		Specification / Type:	
		.../AC110-240V	.../ DC24V
Input voltage	0 signal (inactive)	0-40V AC	< 5V DC
	1 signal (active)	80-250V AC	> 15V DC
Input current active		0.25mA/230V AC	3mA/24V DC
Delay time	change from 1 to 0	50ms, typical	
	change from 0 to 1	50ms, typical	

3.3.2 Analog inputs

Description	Specification
Input resistance	50.2kΩ
Analog range	0-10V
Accuracy	1%
Resolution	Equivalent to software 0.1V steps
Analog input used as digital input	
Input voltage 0 signal (inactive)	0-8V DC
1 signal (active)	12-60V DC

3.4 Outputs

3.4.1 Relay outputs

Description	Specification
Output type	Relay μ; 4 x a / 8 x a
Contact material	AgSnO
Switching current	100mA-8A AC1; 8A, 30V DC1
Switching voltage	6V-250V
Switching power	2000VA; ...250W
Total current / device	24A
Contact resistance	100mΩ / 1A, 6V DC
Inrush current	30A / 10ms
Isolation contact / device	4kVrms, 1min
Isolation contact / contact	3kVrms, 1min
Isolation open contact	1kVrms, 1min
Switching frequency	2Hz
Life mechanical cycles	10×10^6
electrical	2×10^5 / 8A, 250V AC1

3.4.2 Transistor outputs

Description	Specification
Output type	PNP (+ potent. switch), FET semiconductor
Switching current	2A DC1 / $\upsilon_u \leq 40°$ C
Inrush current	10A / 10ms
Total current / device	AF-10: 4A; AF-20: 8A
Switching voltage	$5 \div 60$V DC
Forward resistance / voltage drop	0,3Ω / U = I [A] x 0.3Ω =
Leakage current	< 100μA
Switching frequency	10Hz / DC1 load
Insulation	Not galvanically separated
Surge voltage limitation	Integrated / -U_{peak} < 80V
Inductive load	0.5Hz

3.5 Voice unit AF-MUL

| Description	Specification
Receive	CCITT-DTMF
Eingangswiderstand Telefonleitung	270-320Ω
Min. Anruf Signal	30VAC / 25Hz
Min. DTMF signal	≥ 20 dB (55mV/300Ω)
Call	CCITT-DTMF
Sendeleistung DTMF Signal	-12dBm - -4dBm (135mV-345mV/300Ω)
Sprachsendeleistung	-18dBm - -10dBm (70mV-170mV/300Ω)
Recording and replay	Max. 98 record blocks with a total of max. 8min
(Audio) Voice output 8 (loudspeaker)	Terminals 1-2; R_i = 1200Ω, 1mW
WAV recording	Terminals 3-4; 10kΩ
Power consumption	4.5W

Chapter IV

Operations of the keys on the LCD display

There are two methods of programming the Comat BoxX, one is to complete editing of the function diagram directly by the LCD board using the keys, whilst the other is to do the same on the computer using the programming software Quick II . Programming for Comat BoxX can be completed with either of the two methods.

As shown in the following figure, the operation LCD board is a simple man-machine interface and the program editing operation will be completed through the 8 keys on the right: ⊟ ; ⊞ ; ESC ; OK ; ▶ ; ◀ ; ▲ ; ▼ .

The following rules shall be observed for programming operation on this panel:

1. When the cursor appears as an under line („ _ ”), it may be moved:
   Move the cursor along the lines with ▶ ; ◀ ; ▲ and ▼ keys;
   Press OK key to confirm selection of the input/output connection or the function block;
   Press ESC key to exit the programming input.

2. When the cursor appears as „>", the input/output or function block may be selected:
   Select the input/output or function block with ▼ and ▲ keys;
   Press OK key to confirm the selection;
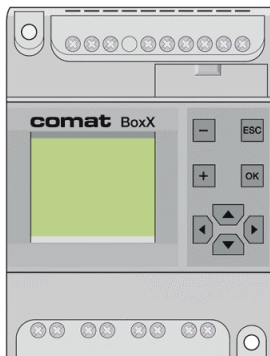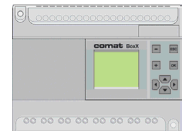   Press ESC key to return to the previous step.

 Fig. 4.1

4.1 Display of Comat BoxX status

Connect the power line of Comat BoxX with the method as described in Chapter II.
After power is on, LCD displays a frame, which is the Switch-on Frame.

As shown in Fig. of Comat BoxX. 4.2 (10 points type):

The upper line I contains the status values of inputs I1 – I6 respectively I1 – I12. The lower line Q
contains the status values of outputs Q1 – Q4 respectively
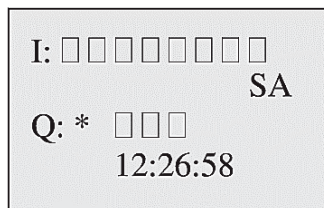Q1 – Q8. (In which „*" indicates ON, i.e. status „1" [] indicates OFF status, i.e. „O".

I: □□□□□□□□
                    SA
Q: *   □□□
        12:26:58   Fig. 4.2 Status Display Frame

4.2 Confirm password

Pressing ESC and OK simultaneously at the Status Display Frame as shown in Fig. 4.2, the user can
enter into the Confirm Password Frame, as shown in Fig. 4.3.

It is required by Comat BoxX to input the password value before the access is permitted. (Password
must contain 4 digits).

The cursor stays at a high digit of the password, where you can change the digit value (0-9)
with ⎯ and + keys (when you initially press ⎯ or + keys, the password value is 0).

Then by using ▼ and ▲ keys to change the password input position and input the password values
of the remaining digits. If a proper password is selected, it will enter the Edition Frame shown in Fig.
4.4. If the password is incorrect, consecutively three times, the Status Display Frame as shown in Fig.
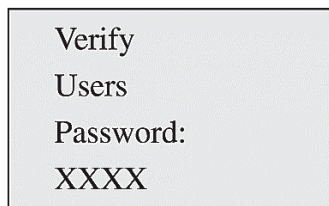4.2 will reappear.

Verify
Users
Password:
XXXX   Fig. 4.3

⚠️ **Note:**

The Ex-works password is «0001».

4.3 Function

Entering the edition frame as shown in Fig. 4.4, the user may use ▼ and ▲ keys to move the arrow ">" on the left.

Press OK key to select the functions, with the following 4 options for selection:

Editor: Make a new program (New Prg)
              Insert Function Blocks (Insert FB)
              Delete Function Blocks (Delete FB)
              Clear the program (Clear Prg)

FAB/Rom: Read program (Rom → FAB) (Edit program)
              Modify address (FAB_Addr)
              Reset Modem (Modem)

Set..:   Setup RTC real time clock, date and password.
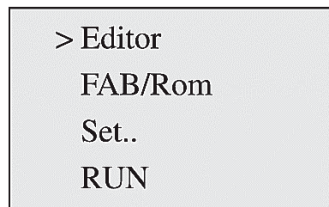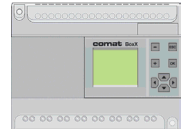
RUN: Start running program.

> Editor
  FAB/Rom
  Set..
  RUN   Fig. 4.4

4.4 Set password, date and time

The SET Frame is shown in Fig. 4.21. The password, the date and the real time clock can be set via this SET Frame. Before you can enter or modify your program you must type in a password. The Ex Work password is "0001". With <SET> you can generate your own password.
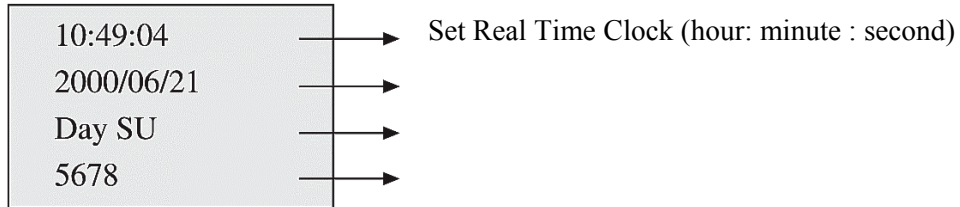
```
10:49:04      ──────▶  Set Real Time Clock (hour: minute : second)
2000/06/21    ──────▶
Day SU        ──────▶
5678          ──────▶
```

Fig. 4.5 Set Password Frame

⚠ **Note:**

The password preset by the manufacture is «0001».