Operator's Manual

REF 54_
Protection, Monitoring and Control

ABB Network Partner

ABB

Station
Automation

REF 54_
Operator's Manual

1. Safety Instructions

⚠ Dangerous voltages can occur on the connectors, even though the auxiliary voltage is disconnected.

⚠ National and local electrical safety regulations must always be followed.

⚠ The frame of the protection relay has to be carefully earthed.

🛑 Only a competent electrician is allowed to carry out the electrical installation.

2. REF 54_ Protection Relay

The REF 54_ type protection relay is designed to be used for the protection, control, measuring and supervision of medium voltage networks. It can be used with any type of switchgear including single busbar, double busbar and duplex systems. The protection relay includes energizing inputs for conventional current and voltage transformers and current and voltage sensors.

The REF 54_ protection relay is based on a multiprocessor environment that increases performance. Digital signal processing combined with a powerful CPU and distributed I/O handling facilitates parallel operations and improves response times and accuracy. The MMI including an LCD display with different views makes the local use of the REF 54_ safe and easy. The MMI instructs the user how to proceed.

The REF 54_ protection relay is part of the PYRAMID® substation automation for Distribution Automation and extends the functionality and flexibility of the concept further. This is possible due to the state-of-the-art technology used in PYRAMID®.

3. Graphical   The front panel of the protection relay includes:
    MMI/MIMIC
    Features   • a graphical LCD display, with the resolution 128 x 160 pixels, consisting of 19 rows divided
                     into two windows
                   • a main window (17 rows) providing detailed information on MIMIC, objects, events, meas-
                     urements, control alarms, and parameters of the protection relay
                   • an assisting window (2 rows) for protection, relay-dependent indications/alarms and help
                     messages
                   • three push-buttons for object control
                   • eight freely programmable alarm LEDs with different colours according to the configuration
                     (off, green, yellow, red)
                   • indication LED for control interlocking and test mode
                   • three protection indication LEDs
                   • an MMI push-button section with four arrow buttons and buttons for Clear and Enter
                   • an optically isolated serial communication port
                   • backlight and contrast control
                   • freely programmable button (F)
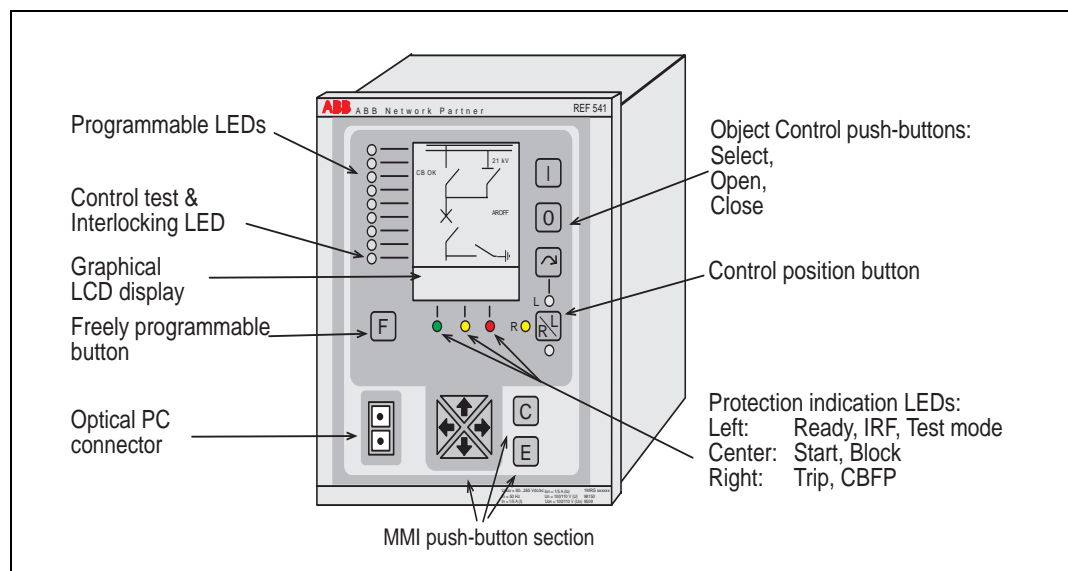   • a button for remote/local control (Control position button)

Fig. 3.-1. Front view of the protection relay

3.1. A Display   In idle mode the MIMIC configuration picture is shown in the main window.
      idle mode

3.1.1. Display   The backlight of the display is normally off. When a button on the MMI is pressed, the back-
        backlight   light automatically turns on. After the preset time-out (backlight time), the backlight goes
                     out if there has been no activity on the panel. At power up, the backlight turns on for the
                     display test and then goes out again (delayed by time-out).

The backlight can also be switched on via a digital input of the REF 54_. When the digital input has been activated, the backlight is lit. For this kind of function, the MMIWAKE function must be included in the relay configuration.

3.1.2.   Display   To obtain optimum readability the contrast can be adjusted in the MIMIC view on the user
           contrast   level and in the Main Menu on the technical level.

Press the E button and the arrow button "UP" to increase contrasts or the arrow button "DOWN" to decrease contrasts.
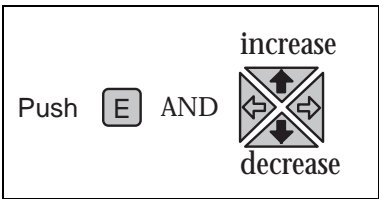

Fig. 3.1.2-1. Adjusting display contrast

The contrast tuning value selected is stored in a non-volatile memory and thus after power cycling of the protection relay, the contrast is automatically adjusted according to set value.

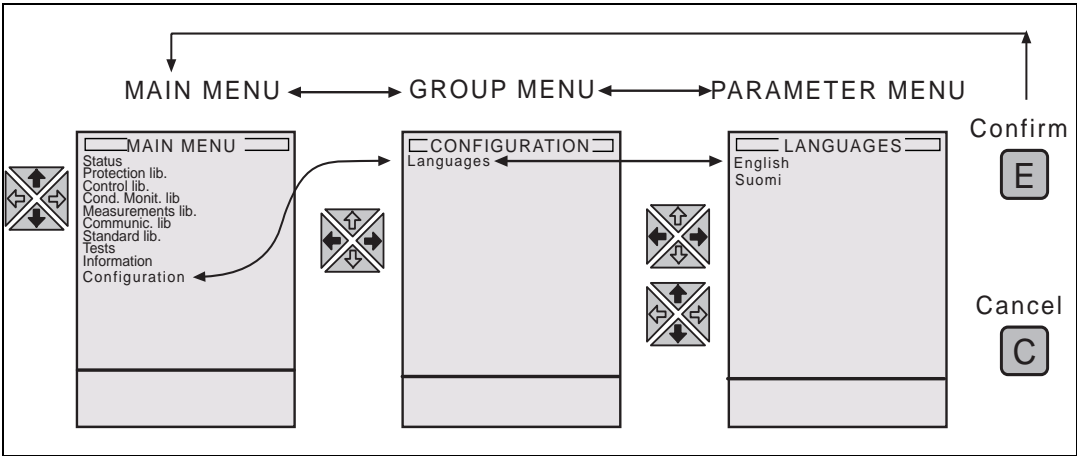3.1.3   Selecting
          language

Fig. 3.1.3-1.Selection of language

Press the E button for 2 seconds and enter the password, if required, to access the technical level. Select Configuration in the Main Menu (last item) and Languages in the Group Menu (first item). Move the cursor to the desired language and confirm the selection by pressing the E button. After that the cursor automatically returns to the main menu.

| 3.1.4 | Main win-dow | The main window informs the user via different views and menus, for example: |

- MIMIC configuration, CB status, disconnector status, etc.
- events
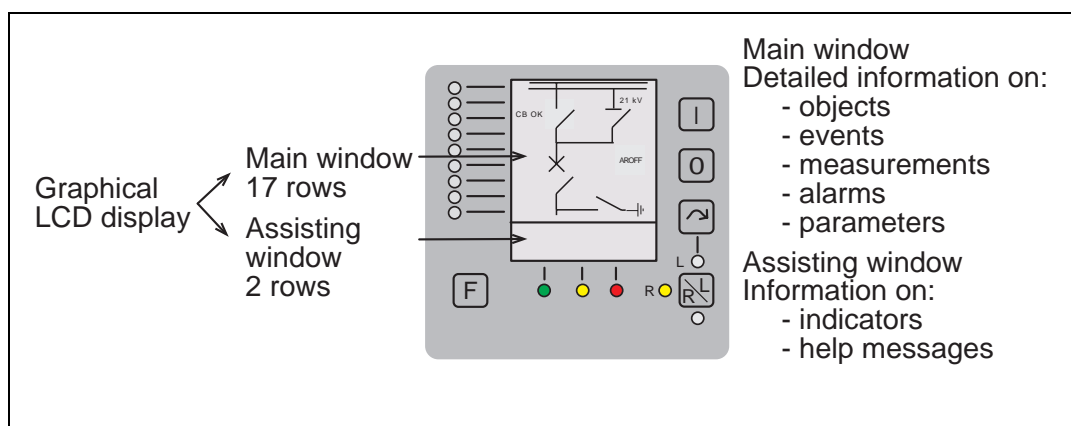- measurements
- alarms
- parameter settings

Fig. 3.1.4-1. Display

In idle mode, the MIMIC picture shows the status of the CB(s) and the disconnectors.

| 3.1.5 | Assisting window | The assisting window assists the user. It indicates two kinds of messages with detailed data of the protection relay itself, protection functions, etc.: |

1. user help messages during operation
2. indication messages

The assisting window is always visible, totally independent of the main window.

| 3.1.6 | Display test at power up | When auxiliary voltage is connected to the protection relay, the backlight goes on and a short display test is run. This display test includes the LEDs and the display: |

- First the nine alarm LEDs are activated simultaneously with different colours (red --> green --> yellow - OFF). At the same time the three protection indication LEDs and the remote/local/disabled/logic LEDs are activated simultaneously for a short time (3 cycles for the indication LEDs).
- The LCD display is tested by inverting the display for a short time.

After the display test, the display panel turns to the normal state (a default MIMIC view) and the backlight turns off after the preset time-out. The test can be stopped at any time by pressing a key.

3.2. Button intro-
duction

The MMI includes push-buttons for manipulating the protection relay.

A quick touch on the up or down arrow button (less than 1 second) is interpreted as one step upwards or downwards in a menu and as the minimum step up or down in the setting mode of parameter (digit, character, enumerator etc.).

- If the cursor is on the topmost row, pressing the up button moves the cursor to the last row.
- If the cursor is on the last row, pressing the down button moves the cursor to the topmost row of the view.
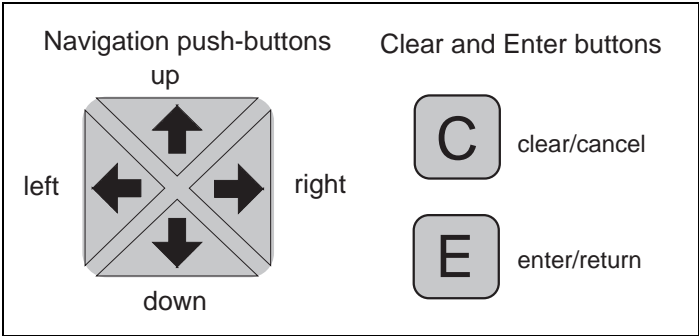

Fig. 3.2.-1. Buttons to be used for navigation

The table below gives a short explanation of the push-buttons and their functions.

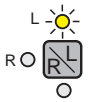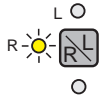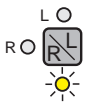| *Up/Down*		These buttons are used for: • moving the cursor either up or down in order to select the desired item of a menu (Main, Group, Subgroup or Parameter). • entering the setting mode of a parameter, or when entering a parameter/password the "active" digit/character is scrolled.
Left/Right		These buttons are used for: • moving between views (left/right) and to select the appropriate hierarchy level (Main, Group, Subgroup or Parameter). • moving from right to left or vice versa when setting a parameter.
Clear/Cancel		On the user level this button is used for: • clearing any active indication message. • clearing events or alarms according to the selected view. On the technical level the button is used for: • cancelling the setting mode. • clearing all kinds of indication messages. Note! If there is an indication message in the assisting window, pressing of the C button for at least two seconds clears the window.

Enter	[E]	On the user level this button is used for: • entering the MAIN MENU on the technical level from the MIMIC view on the user level. This is done by pressing the E button for at least 2 seconds and by entering the password if required. On the technical level this button is used for: • entering the MIMIC view on user level from the MAIN MENU on the technical level, by pressing the button for 2 seconds. • activating parameter setting in the parameter group.
Table 3.2.-1 Push button functions		

3.3. Control buttons

The control position button is used for selecting a control mode according to the following table. For password handling, see "Passwords" on page 14.

When the control mode is changed with the control position button, the selected control position is stored and the text "--Storing--" is shown on the display. See also "Saving parameters" on page 19.

LOCAL	L ☼ R ○ [R L] ○	To be able to control an object with the push-buttons OPEN and CLOSE, the control position has to be LOCAL indicated by the yellow LED marked "L". In this position, any remote control signal via the serial interface is inhibited. Binary inputs and logic controls are valid.
REMOTE	L ○ R ☼ [R L] ○	To be able to select and control an object remotely via the serial communication, the REMOTE mode has to be selected. REMOTE mode is indicated by a yellow LED "R". All local push-buttons are inhibited. Binary inputs and logic controls are valid.
DISABLED	L ○ R ○ [R L] ○	Local and remote operations are inhibited. Binary controls are valid. DISABLED mode is indicated with all LEDs being dark.
DISABLED (LOGIC) mode	L ○ R ○ [R L] ☼	DISABLED (LOGIC) mode is enabled. Binary inputs and PLC logic are used to select between LOCAL, REMOTE and DISABLED modes (Binary controls are valid.) LOGIC mode is indicated with the unmarked LED being lit.

1MRS750500-MUM

LOCAL (LOGIC) mode		LOCAL mode is enabled REMOTE mode is disabled
REMOTE (LOGIC) mode		REMOTE mode is enabled LOCAL mode is disabled
Table 3.3.-1 Control buttons		

⚠ Protection relay configuration has to contain the Control position function element (COLOCAT) to allow LOGIC position to be selected with the control position button.
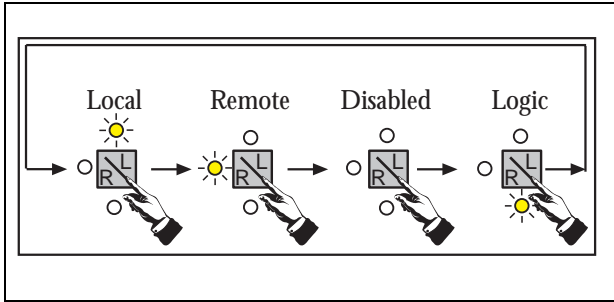

Fig. 3.3.-1. Control position selection sequence, when logic position is selectable (COLOCAT function used in configuration).
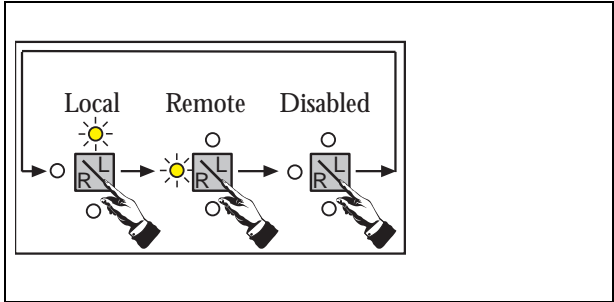

Fig. 3.3.-2. Control position selection sequence, when logic position is not selectable (COLOCAT function not used in configuration).

3.3.1.   Object con-
         trol in the
         MIMIC
         view

Push the SELECT button to step through the available objects until the desired controllable object is inverted. The object remains inverse until a control command is given or the time-out has elapsed. The time-out can be adjusted. The status of corresponding object during the interlocking sequence is shown in the assisting window.

The close and open commands are given with the O (OPEN) and I (CLOSE) push-buttons. Depending on the status of the interlocking function, the command is either executed or the Interlocking LED is lit if the commmand is not allowed.

The length of the control pulses can be adjusted.

Select	⌃	Push the push-button to step through the available objects until the desired object is highlighted.
Close	I	Push the push-button to close the object selected if it is open.
Open	O	Push the push-button to open the object selected if it is closed.
Freely pro-grammable	F	This button can be programmed for different purposes.
Table 3.3.1.-1 Object control		

3.4. Program-
      ming

The front panel of the protection relay is provided with an optical serial communication connector for connecting a PC via a special RS 232 optolink cable, type 1MKC950001-1, to the relay. Additionally, a special PC program is needed for communication between the PC and the protection relay.

4. MMI opera-
   tion levels

The MMI/MIMIC has two main levels: the user level and the technical level. The user level is for measurements and monitoring whereas the technical level is used for protection relay programming and parameterization.
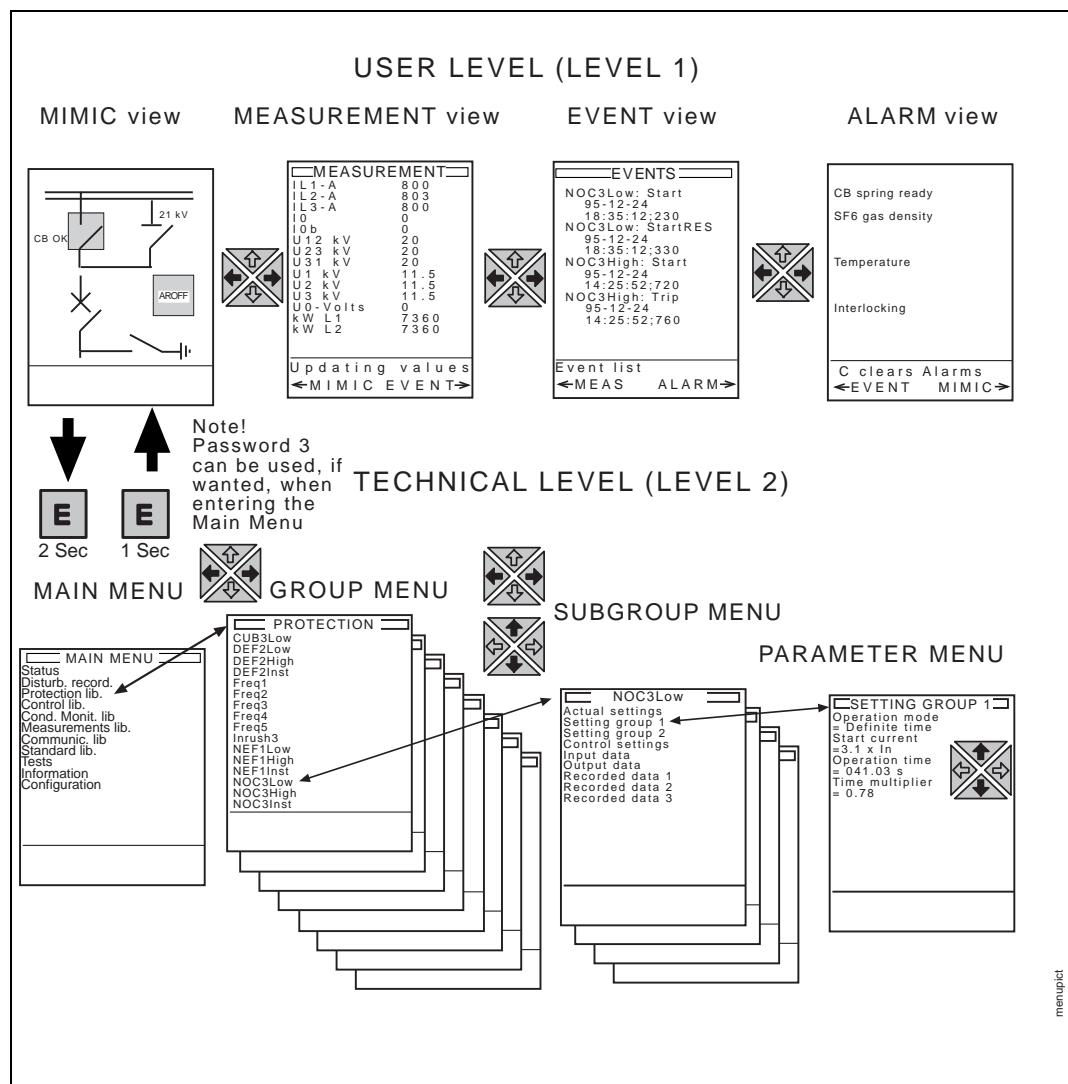

Fig. 4.-1. Menu level structure.

4.1. User level

On the user level, data is received in four different views:

1. MIMIC view
2. MEASUREMENT view
3. EVENT view
4. ALARM view

The left and right arrow buttons are used for opening the desired view in the main window. Manipulation of the arrow buttons does not affect indications, control of objects or panel status. The views are described closer in the following chapters.

4.1.1. MIMIC view

When the MIMIC view is opened in the main window, the configuration picture of the control unit is shown on the display. The MIMIC view gives the real-time status of objects (disconnectors, circuit breakers, etc.) according to the status of the predetermined binary inputs. The MIMIC view is the default view of the protection relay (at power up, after time-out, etc.).
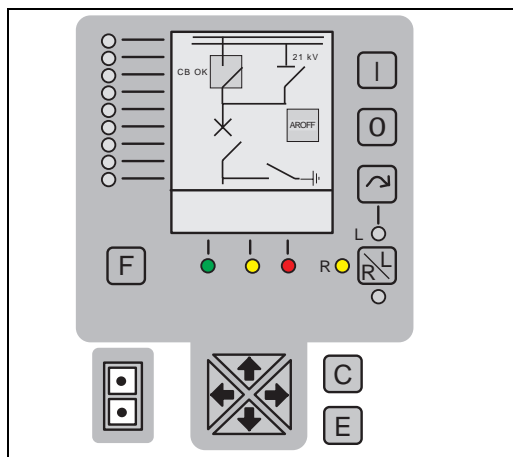
C button functions in the MIMIC view
• Press the C button for 2 s to reset indications.
• Press the C button to cancel password inquiry.

Fig. 4.1.1-1. MIMIC view.

4.1.2. MEASURE-MENT view

When the measurement view is opened to the main window, the values measured by the protection relay will be shown on the display. The up and down arrow buttons are used for scrolling up and down the list in the window.

The assisting window gives general information of how to scroll the display.
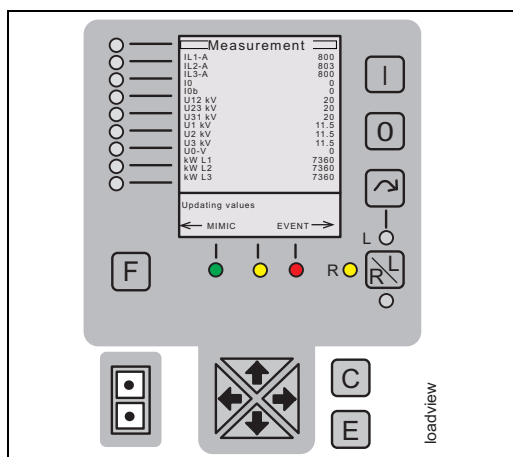
C button functions in the MEASUREMENT view
• If there are active indications, press the C button for 2 s to reset.
• When there are no active indications, press the C button 2 s to reset accumulated energy measurements.

Fig. 4.1.2-1. Measurement view.

4.1.3. EVENT view

The operation event contains the application name, channel number, code, date and time of the last 100 operations. The most recent recorded event is stored on top of the event list.

Fig. 4.1.3-1.EVENT view

C button functions in the EVENT view
- if there are active indications, press the C button for 2 s to reset.
- when there are no active indications press C button 2 s to reset events recorded.

4.1.4. ALARM view

The ALARM view shows all the configured alarms with alarm texts. Active (not acknowledged) control alarms are distinguished from non-active alarms by LEDs and user-defined alarm texts.
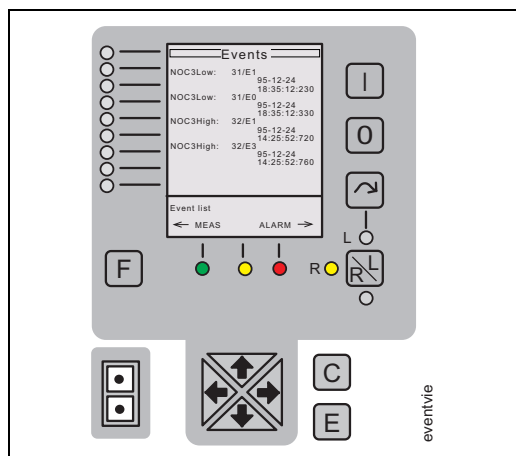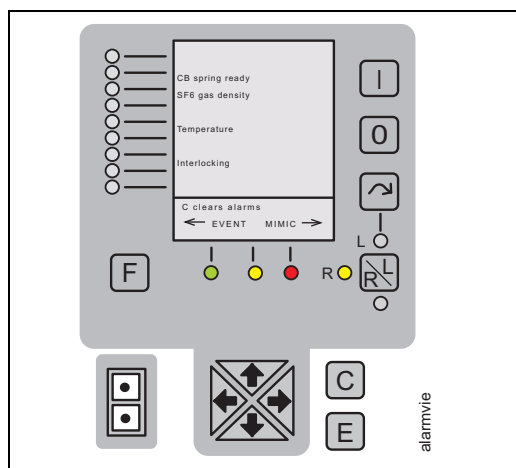

Fig. 4.1.4-1. ALARM view.

C button functions in the ALARM view
- If there are active indications, press the C button for 2 s to reset.
- When there are no active indications, press the C button for 2 s to acknowledge alarms.
- The acknowledgement proceeds according to configuration made by the user.

4.2. Passwords

Three passwords can be used:

- Password 1 (MIMIC) inhibits local/remote/disabled/logic selection.
  Settable: password enabled/non-enabled. Default 100000.
- Password 2 (parameter) inhibits parameter setting.
  This password is always enabled. Default 200000.
- Password 3 (level) inhibits access to the technical level.
  Settable: password enabled/non-enabled. Default 300000.

When using the control position button password 1 has to be given (if enabled). To enter the setting mode, a second password (password 2) is required. This password applies as long as the user stays on the technical level.

To enter the read-only-state of the technical level, the user has to give password 3. The user is able to change all three passwords or just one of them in the Main menu configuration. The maximum length of a password is six characters.

Passwords 1 and 2 are reset after the preset time-out and must therefore be re-entered before using the control position button or setting parameters.
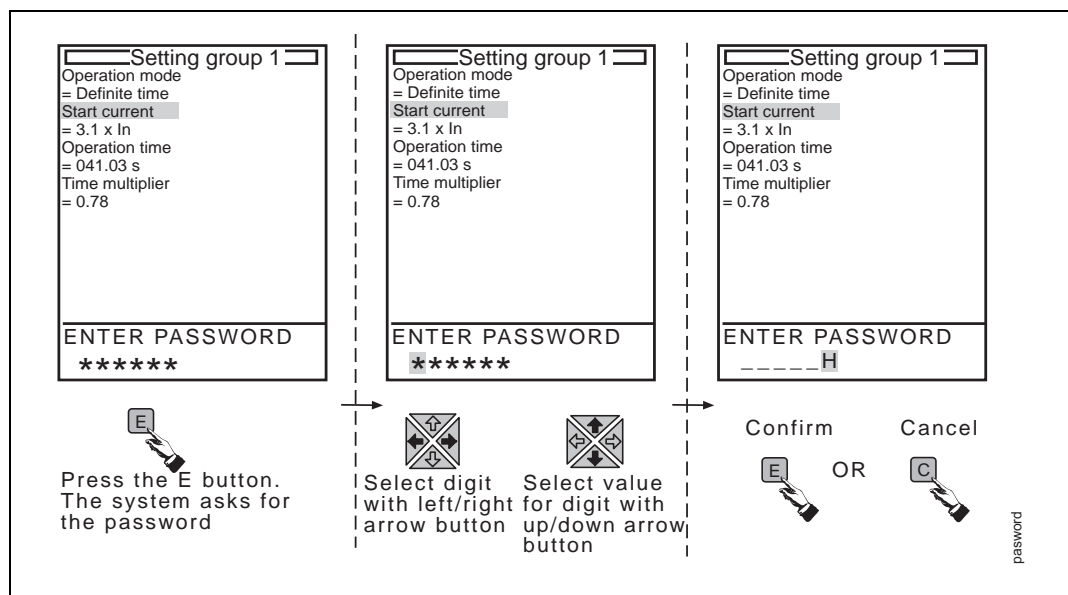
Fig. 4.2.-1. Setting a password.

4.3. Technical level

The menus of the technical level contain information for the programming of the protection relay. The technical level is accessed from the MIMIC view on the user level by pressing the E button for 2 seconds and by entering the password if required. To return to the user level, press the E button for 1 second in the MAIN MENU.
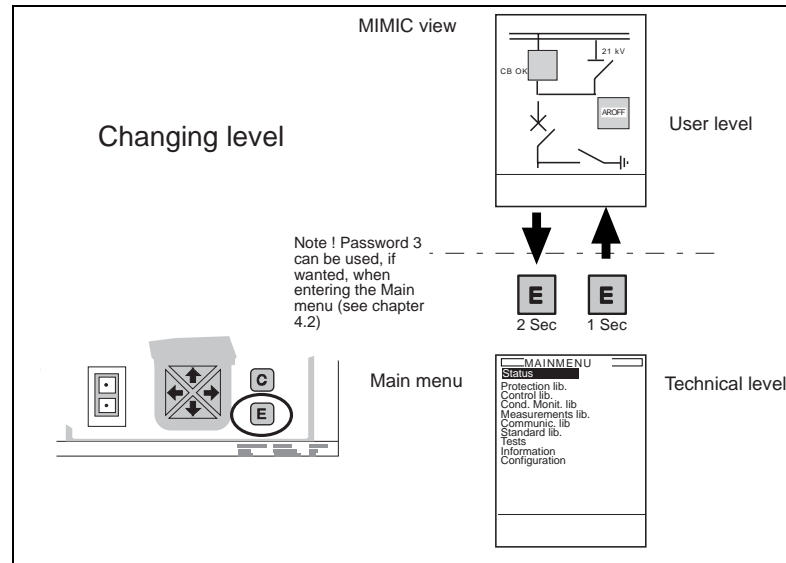
Fig. 4.3.-1. Moving between user level and technical level.

<table>
</table>

<table>
</table>

4.3.1.   Menu sys-
tem of pa-
rameters

The interactive communication between the operator and the MMI is based on menus. Press the E button for 2 seconds to activate the MAIN MENU.

The views are used for reading setting parameters, recorded values, etc. The menu system is divided into three or four levels (depending on the access level):

- MAIN menu
- GROUP menu
- SUBGROUP menu
- PARAMETER menu.

The buttons for object control have no functions in the menu system.

Fig. 4.3.1-1. Menu structure on technical level.

| 4.3.2. | Special sit-uations | If the user is setting a password in the assisting window when a message of high priority appears (other than help messages), the password programming is automatically cancelled and the high-priority message is displayed. Then a new attempt to open the password has to be done. When the password has been opened (or failed), the message reappears in the assisting window. Messages are cleared by pressing the C button for 2 seconds |

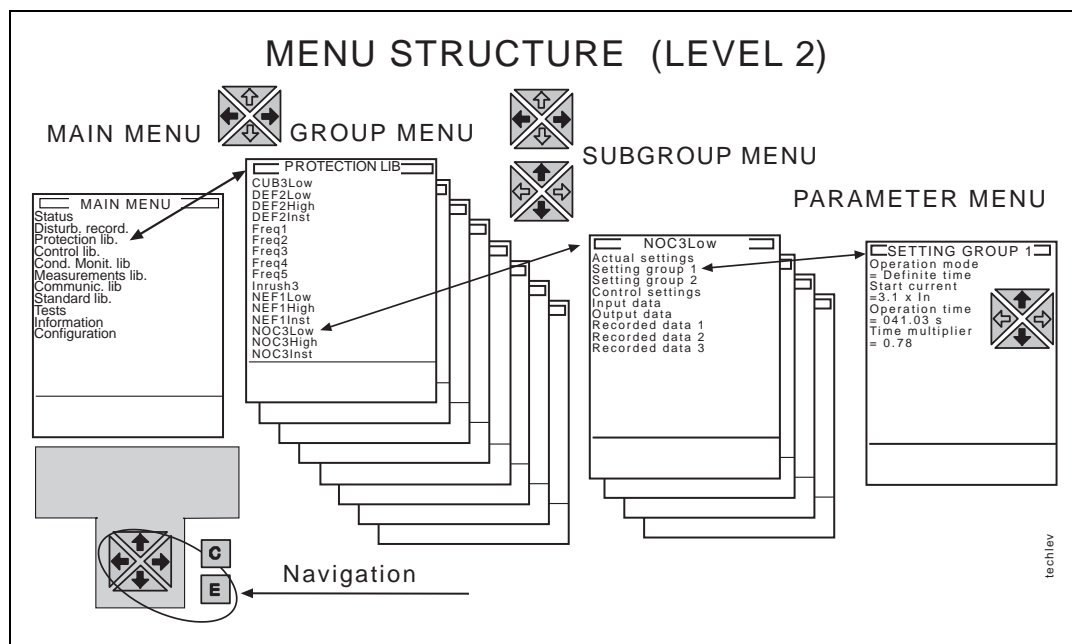⚠ When the C button is pressed during the setting of a password, the setting procedure will be cancelled. In other situations, the C button is used to clear the assisting window.

When a message of high priority is indicated in the assisting window, no help messages are displayed until the window has been cleared.

| 4.3.3. | Menus | The main menu is the main view of the technical level, where the first row is always dedicated for the header text of the main level. The main menu is followed by the group menu and the subgroup menu which form the hierachical structure. |

| 4.3.4. | Parameter menu | One parameter on this level consists of 2 rows: |

- row 1: parameter text
- row 2: "=" sign and setting value including the unit when specified (numeric value, character string, enumerator).

On the parameter level the cursor moves two rows at a time

As on the main level and group level, the first row of the display is dedicated for the header text. The header text is advisory and shows the position of the parameter menu in the menu system in the form of a path (Main menu/Group menu/Subgroup menu/Parameter menu)

If the parameter to be entered is password-protected, the procedure for opening the parameter menu is the same as for the main menu.

| 4.3.5. | Moving in the menus | The arrow buttons up and down are used for moving in the parameter menu. When the appropriate parameter is highlighted, the setting mode is activated by pressing the E button. |

| 4.4. | Setting a parameter | When the setting mode has been activated by pushing the E button, the first digit or character of the setting value/text of the concerned parameter is blinking (in the case of an enumerator, the entire text is blinking). Now the digit/character can be set by using the up/down buttons. |

The next digit/character to be set is activated by pressing the arrow buttons right or left (when setting an enumerator type parameter, the left and right arrows have no function).
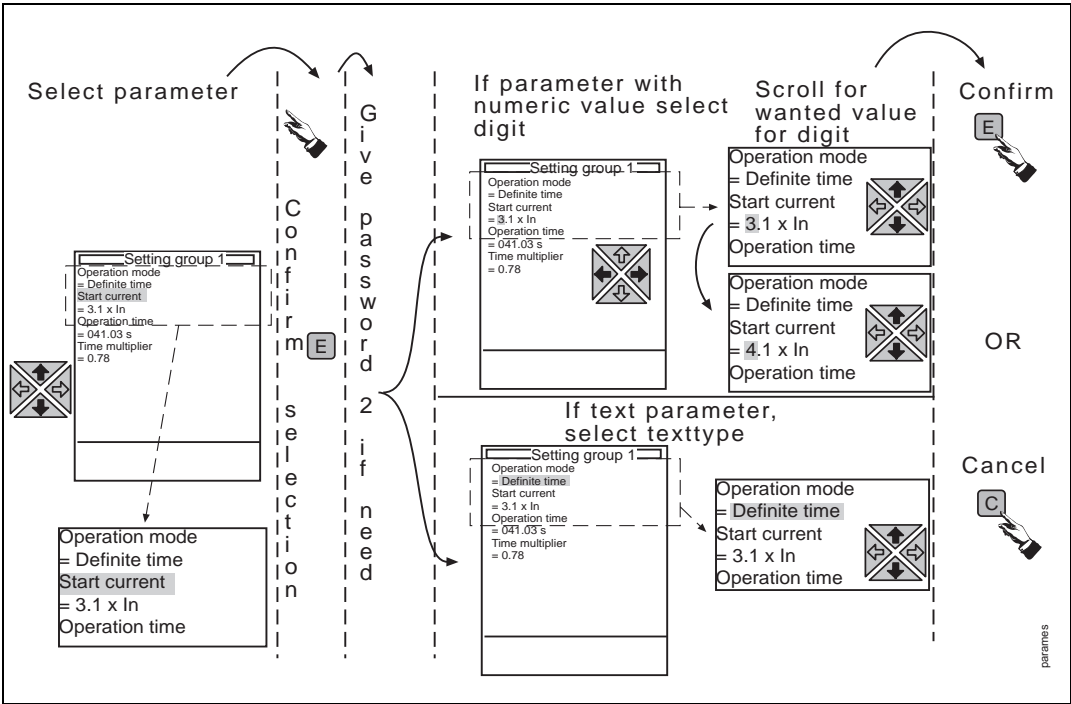

Fig. 4.4.-1. Parameter setting

The setting is confirmed by pressing the E button. Before confirming, the previous setting value can be restored by pressing the C button.

If an illegal setting value is confirmed in the setting mode, a message tells the user that the setting is out of range. The previous parameter value remains unchanged.

4.5.	Saving pa- rameters

Parameters can be saved in three different ways:

1. by executing the following sequence
   • select parameter Store located in Configuration/General (select Restore if you don't want to save the changes, see note below)
   • enter password
   • select Store/Progress with the arrow buttons
   • confirm operation by pressing the E button, the assisting display confirms the storage
2. automatically
   • automatically after eight (8) hours counted from last storage. Then the feeder terminal saves the latest changes.
3. moving from Main menu to the MIMIC view, if a parameter has been changed
   • when changing view "SAVE CHANGES E = yes, C = No" appears in the assisting window
   • Confirm or wait for the time-out to elapse to save changes automatically
   • if Cancel is selected the saving procedure is cancelled momentarily. To restore the previous values the Restore parameter has to be used (described above). If not, the parameters will be saved according to item 2.

Storage of data is indicated by the text "--Storing--" in the assisting window.

Note! At restoring, the relay is reset and restarted.

4.6.	Acknowl- edgement and reset- ting of indi- cators, outputs and registers

The C button is used for acknowledging and resetting of indicators, outputs and registers as follows.

Indicators and outputs of protection functions are acknowledged by pressing the C button and the E button simultaneously for at least 2 seconds. A message in the assisting window confirms the acknowledgement.

Indicators, outputs of functions and registers are acknowledged by pressing the C and the E button simultaneously for at least 5 seconds. A message in the assisting window confirms the acknowledgement.
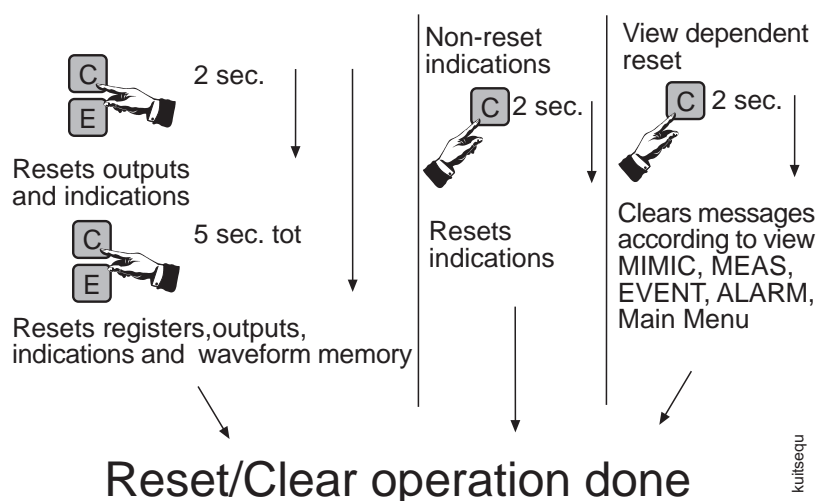

Fig. 4.6.-1. Acknowledgement and resetting.

5. **Protection re-lay indications**

There are two different kinds of indication messages available in the assisting window:

- information about the protection relay functions and the condition of the protection relay (self-diagnosis) together with a LED indication.
- a text message without LED indication. This type of message is generally related to e.g. condition monitoring, alarms and warnings.
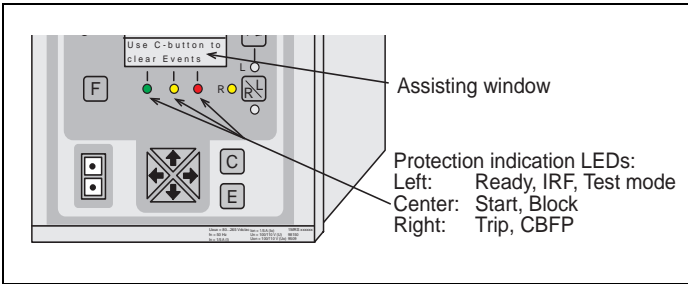

Fig. 5.-1. Protection indicators

5.1. **Priority of indication and help messages**

The messages in the assisting window have a certain priority. If different type of indications are activated simultaneously, the message with the highest priority appears on the display. The priority of the messages:

1. Internal fault
2. Trip, CBFP
3. Start, Block, Supervision
4. Help messages

The first latched and active indication (concerns messages 1 and 2) is shown in the assisting window according to the predetermined priority. The latest latched and active indication (concerns messages 3 and 4) is shown in the assisting window according to the predetermined priority

5.1.1. **Help mes-sages**

Help messages (priority 4) assist the user by displaying hints of the following actions.

| 5.1.2. | Indication messages | Indication messages (priorities 1-4) automatically gives an overview of indications of protection and condition monitoring operations and internal protection relay faults. The indications are shown in a priority order in the assisting window and the indication messages will be active until acknowledged by pressing the C button for two seconds. |

| 5.2. | Protection indications | When one of the protection functions of the protection relay starts, the name of the corresponding protection function and the text ":START" are displayed in the assisting window. In the case of three-phase and two-phase protection functions, also the faulted phases are displayed. Also a yellow indicator LED is lit. |

```
NOC3Low:START
L1, L2, L3
```
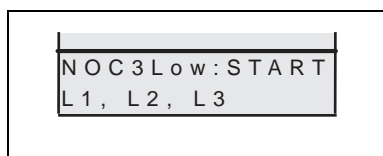
When the protection function started is blocked, the name of the corresponding function and the text ":BLOCK" are displayed in the assisting window. Also a yellow indicator LED is blinking.

```
NOC3Low:BLOCK
```

When the protection function trips, the name of the function and the text ":TRIP" are displayed in the assisting window. Also a red indicator LED is lit. In the case of three-phase and two-phase protection functions also the faulted phases are displayed.

```
NOC3Low:TRIP
L1, L2, L3
```
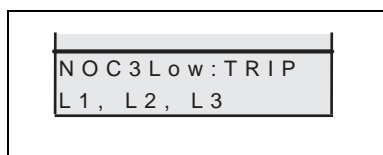
When the protection function delivers a delayed trip for circuit-breaker failure protection, the name of the function and the text ":TRIP" are displayed in the assisting window. Also a red indicator LED is blinking. In the case of three-phase and two-phase protection functions, also the faulted phases are displayed.

```
NOC3Low:TRIP
L1, L2, L3
```
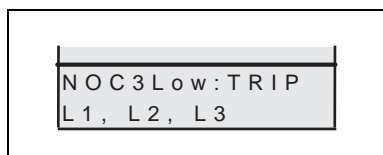
5.3. Self supervision (IRF)

The REF 54_ is provided with an extensive self-supervision system. The self-supervision system handles run-time fault situations in the REF 54_ and informs the user about an existing fault via an MMI and a LON/SPA communication.

The green READY indicator starts to blink when a fault has been detected. At the same time the protection relay delivers a fault signal to the self-supervision output relay of the REF 54_. Additionally, a fault indication text appears on the MMI of the REF 54_. Also, an event E57 is generated to the serial communication (channel 0).

The fault indication text on the MMI consists of two constant rows as shown in the next example.

```
SELF SUPERVISION
*INTERNAL FAULT*
                    assisupv
```
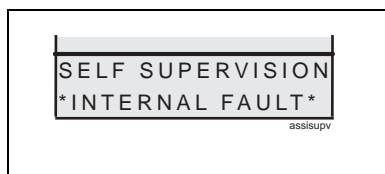
Fault indication has the highest priority on the MMI. Other MMI indications cannot overrun the IRF indication. When the display panel has received a fault indication, the fault indication text remains on the MMI. By pressing the C button for 2 seconds the fault indication text is cleared from the display, but the green LED remains still blinking. Blinking of the green READY indicator cannot be stopped.

In case an internal fault disappears, the fault indication text stays on the display, if it has not been cleared by the C button. The green READY indicator stops blinking and an alarm output IRF is released to normal service state. Also, an event E56 is generated to serial communication (channel 0).

The fault code is stored and can be read from the main menu protection relay Status/General/ IRF code. The IRF code includes the code of the first internal fault detected by the self-supervision system.

The fault code describes the type of internal fault in the REF 54_. When a fault appears, the code should be recorded and given to the authorized repair shop when overhaul is ordered.

5.4. Condition monitoring indication

If the protection relay includes condition monitoring functions that are not directly related to any protection functions of the protection relay or to the internal condition of the protection relay, they are indicated in the assisting window by the message SUPERVISION and an explanatory text.

Example:

```
CMTCS1:SUPERV
Trip circuit sup
                    assisupi
```
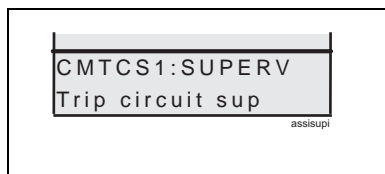
5.5. Test modes

There are various test modes for each of the following four categories:

- Function
- Control
- MIMIC
- I/O test

5.5.1. Function test

It is possible to activate the outputs of the function locally from the MMI or externally via the serial communication. The outputs are activated by using control parameters of the function.

For further details of functions, read the manual "Technical Description of Functions".

5.5.2. Control test

The system provides a general interlocking bypass mode (parameter Control/General/Inter/bypass) that overrides all interlocking signals. Activation of interlocking bypass mode activates the interlocking enable signals of all control objects. Thus all control actions are possible and enable signals of the controllable objects are not checked while the objects are commanded. As long as the mode is active the interlocking LED in the MMI is red and blinking. Additionally the assisting window of the MIMIC view will indicate the special condition.

5.5.3. MIMIC test

The test mode for MIMIC is entered by setting the Panel test parameter to start (1) in Main menu/ Tests/ Mimic [17] directory. The test can be interrupted by pressing any button. Accordingly, the same Panel test is done as at power up (see chapter Display test at power up).

5.5.4. I/O test

The test mode is for testing binary inputs and outputs and their effect on the function of the protection relay. Entering the test mode for the inputs or outputs is done by setting the parameter Test mode to Active in Tests/General at technical level. The user has to enter the test mode before testing or else the changes will not be valid. The test mode can be cancelled by setting the Test mode parameter to Not Active or by power up.

Note! If the user forgets to cancel the test mode, it remains on and the READY LED remains blinking.

5.6. Green indicator LED

Three different functions are embedded in the READY indicator.

Steady LED: READY	The LED is lit when the protection relay is in normal operation, i.e. no internal faults have occurred and an auxiliary voltage is available to the protection relay.
Blinking LED: IRF	An internal protection relay fault (IRF) has occurred but an auxiliary voltage is connected. Also, if the protection relay is in test mode, the LED is blinking. When an internal fault occurs, a message is received in the assisting window, provided the MMI/MIMIC panel is operative.
Non-active LED: OFF	The auxiliary voltage supply to the protection relay has been disconnected ⚠ Check that the auxiliary voltage is disconnected before taking any further action.

Table 5.6.-1 Green indicator LED functions

5.7. Yellow indicator LED

Non-active LED: OFF	Normal operation mode. No function has started.
Steady LED: START	A protection function is activated and the display shows the reason for starting. The start indication can be selected to be latching/non-latching. A non-latching type indicator automatically goes out when the fault disappears (the protection stage resets). A latching type indicator remains lit, although the fault disappears, until cleared by pressing the C button for two seconds. Should several protection stages/functions start in a short time, the last start is indicated on the display.
Blinking LED: BLOCK	The start LED goes on blinking as long as a protection function of the protection relay is blocked. The blocking indication disappears when the blocking is removed or when the protection function in question is no longer started. Should the function still be started when the blocking signal is eliminated, the start indication will be activated. A message telling, which function has been blocked appears on the display. If several protection functions are blocked at the same time, the most recent blocking is indicated on the display. If a protection function is blocked when other protection functions are started, but not blocked, the LED remains blinking (Blocking has higher priority than start)

*Table 5.7.-1 Yellow indicator LED functions*

5.8. Red indica-
tor LED

Non-active LED: OFF	Normal operation mode. No trip function has operated.
Steady LED: TRIP	A protection function has tripped. The trip indication is latching, i.e. the trip indication must be reset by pressing the C button (or via the serial communication). If several protection stages/functions trip in a short time, the first tripping remains on the display.
Blinking LED: TRIP (CBFP)	If the tripping is due to the CBFP (circuit breaker failure protection), the red indication LED is blinking. The indication is reset by pressing the C button for 2 seconds.
Table 5.8.-1 Red indicator LED functions	

5.9. Interlocking

Interlocking is used to inhibit the close or open command for a controllable object in certain situations. The interlocking program of the REF 54_ operates according to the permission principle, i.e. any control operations not enabled by interlocking are inhibited.

When an object is selected with the Select button, the assisting window shows the status of the interlocking program. The downmost LED of the programmable LEDs is reserved for the interlocking function.

Non-active LED: OFF	Neither interlockings nor active test mode
Blinking LED: red	Control test mode active (interlocking bypass)
Steady LED: yellow	Control command has been inhibited (interlocked)
Table 5.9.-1 Green indicator LED functions	
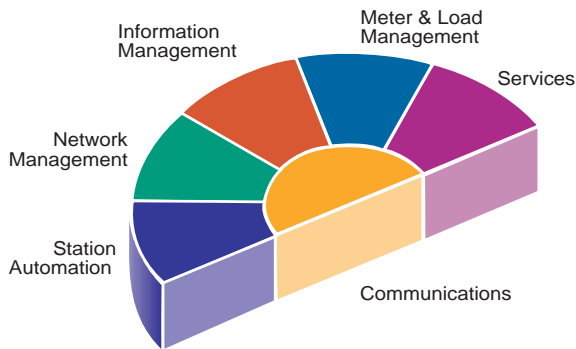
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