

Altivar AFE

Active Front End

Option for Altivar 61 & Altivar 71

Description of functions

03/2010



General remarks

The following symbols should assist you in handling the instructions:



Advice, tip !



General information, note exactly !

The requirements for successful commissioning are correct selection of the device, proper planning and installation. If you have any further questions, please contact the supplier of the device.

Capacitor discharge !

Before performing any work on or in the device, disconnect it from the mains and wait at least 15 minutes until the capacitors have been fully discharged to ensure that there is no voltage on the device.

Automatic restart !

With certain parameter settings it may happen that the active Active Front End restarts automatically when the mains supply returns after a power failure. Make sure that in this case neither persons nor equipment is in danger.

Commissioning and service !

Work on or in the device must be done only by duly qualified staff and in full compliance with the appropriate instructions and pertinent regulations. In case of a fault contacts which are normally potential-free and/or PCBs may carry dangerous voltages. To avoid any risk to humans, obey the regulations concerning "Work on Live Equipment" explicitly.

Terms of delivery

The latest edition "General Terms of Delivery of the Austrian Electrical and Electronics Industry Association" form the basis of our deliveries and services.

Specifications in this document

We are always anxious to improve our products and adapt them to the latest state of the art. Therefore, we reserve the right to modify the specifications given in this document at any time, particular those referring to weights and dimensions. All planning recommendations and connection examples are non-binding suggestions for which we cannot assume liability, particularly because the regulations to be complied depend on the type and place of installation and on the use of the devices.

All foreign-language translations result from the German or English version. Please consider those in case of unclarity.

Basis of contract

The specifications in text and drawings of this document are no subject of contract in the legal sense without explicit confirmation.

Regulations

The user is responsible to ensure that the device and its components are used in compliance with the applicable regulations. It is not permitted to use these devices in residential environments without special measures to suppress radio frequency interferences.

Trademark rights

Please note that we do not guarantee that the connections, devices and processes described herein are free from patent or trademark rights of third parties.

Copyright


Layout, equipment, logos, texts, diagrams and pictures of this document are copyrighted. All rights are reserved.


Description of functions for the Active Front End

Altivar AFE

Parameters and their settings refer to software version APSavr_A00_11 and higher

Theme	Page	Theme	Page
Basic concept of the Active Front End.....	3	4 Functions.....	49
Operation of the Active Front End.....	6	4.1 Process protection	49
1 Display	26	4.3 Emergency operation	50
1.1 Actual values.....	26	4.6 Bus settings	51
1.2 Counter	28	5 Diagnosis.....	52
1.3 Device identification	29	5.1 Test function	52
1.4 Display configuration	30	5.2 Fault memory.....	53
1.5 Language selection.....	31	5.3 State	56
2 Start-Up	32	6 Service.....	57
2.1 AFE settings.....	33	6.1 Code.....	57
2.2 Control commands	34	6.2 Service AFE	59
2.3 Operating panel	37	Commissioning	60
2.4 External fault	38	Commissioning procedure	60
2.5 Fault configuration.....	40	Factory setting.....	62
3 Input / Output	42	Settings at the inverter	63
3.2 Logic inputs	42	Parameter settings	63
3.3 Analog output	45		
3.4 Logic outputs.....	47		

 The instructions in hand cover the topics operation and parameterization. Moreover, the basic concept of the Altivar 61/71 frequency inverters as well as their functions are explained in detail.

 Use this instructions additionally to the device documentation "Operating instructions" and "Mounting instructions".

 The parameter description of the different fieldbuses is given in the respective fieldbus documentation.

Basic concept of the Active Front End

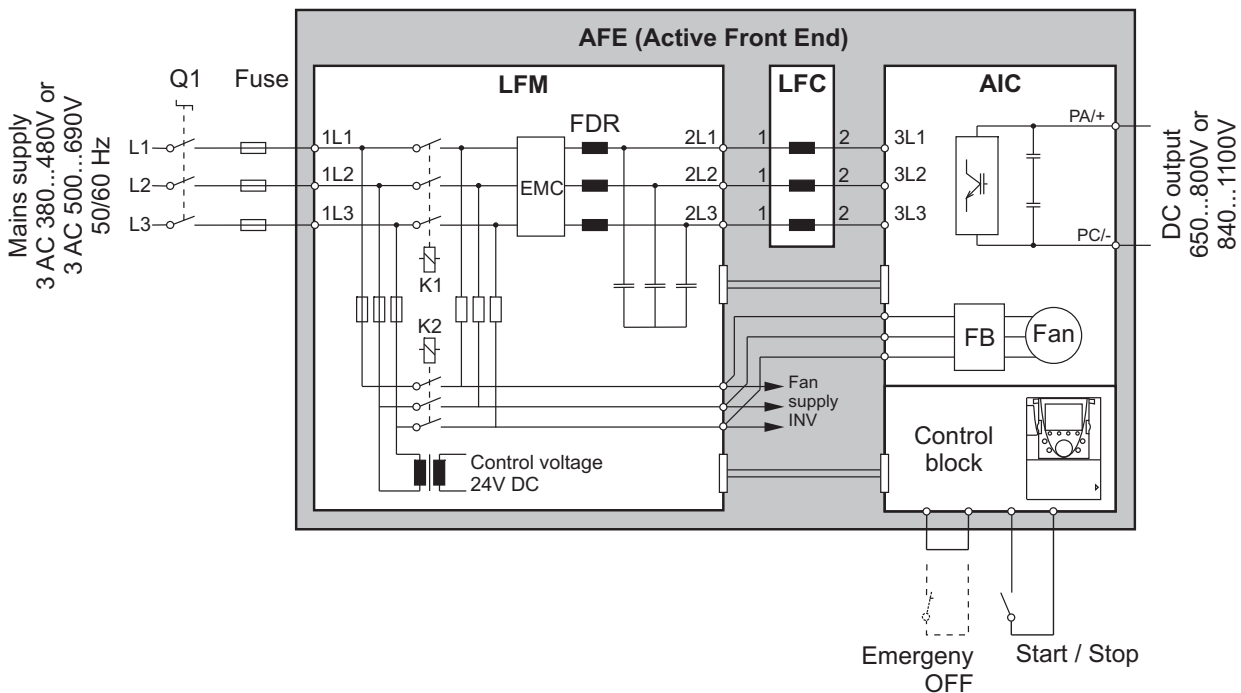
The Active Front End AFE is an option for the frequency inverters Altivar 61/71. With this option it is possible to return the braking energy to the mains. Therefore it enables a 4-quadrant operation of the drive (motor and generator operation in both directions of rotation).

The use of the Active Front End leads to a significant increase of the total system efficiency in the case of crane hoistings, test benches, winches and other drives with frequent generator load. On the other hand not only the environment is conserved but also the operating costs are reduced so that amortisation is often possible after a few months.

The Active Front End operates with high pulse frequency and carries a sinusoidal mains current. Therefore it represents next to the possibility of energy regeneration also an alternative for active and passive filters. By using the Active Front End the THD(i) of the frequency inverter is reduced to a value lower than 4 %.

The Active Front End AFE is connected in front of the frequency inverter and consists of several components:

- Line Filter Module LFM
- Line Filter Choke LFC
- Active Infeed Converter AIC



Already during the development of the individual components of the Active Front End a simple and safe installation and commissioning has been kept in mind. Therefore the line filter module LFM contains in addition to the real filter elements also all components of the charging circuit, the main contactor (= line contactor), the supply of all device fans and the required supply units for the control voltages. For the control connections between the individual components pre-assembled cables and robust connections are available.

Robustness of the Active Front End

Due to a new control concept the Active Front End operates independent of the applied rotary field. At the same time this control concept enables operation without damping resistors, whereby reliability is ensured also in case of distorted mains voltages and also the losses are significantly reduced.

The line filter module is suitable for operation at all mains up to a mains short-circuit current of 100 kA.

An EMC filter with EMC category C3 is integrated. For higher requirements an additional EMC filter can be connected upstream.

Our high degree of quality awareness ranges from the basic requests in the product specification over the development of the cooling system, of the mechanical design, of the electrical circuit diagram and the individual functions up to the production of the device. This quality level is also long-term guaranteed by means of the corresponding quality assurance systems in the individual business processes and is certified every year by independent authorities according to DIN EN ISO 9001:2000 and ISO 14001:2004.

Low harmonic drive – 1:1 application

The Altivar 61/71 standard frequency inverter becomes a "Low Harmonic Drive" by connecting the Active Front End in series. By this way it reaches a THD(i) value smaller than 4 % and fulfills the requirements according to the recommendations in IEEE 519 to reduce the current harmonics in the mains.

Assembling and connecting all components to a complete drive is simply possible by pre-assembled connecting lines and a well-structured concept. Optimal presettings and a very simple control concept are the reason for blindly easy commissioning.

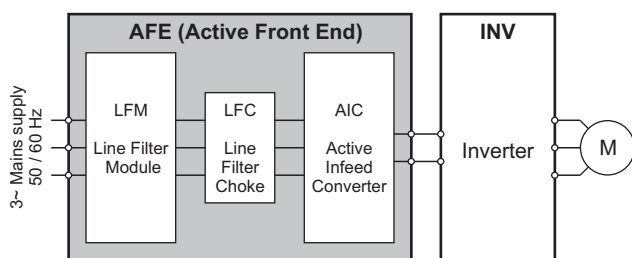
As the inverter and the Active Infeed Converter have similar hardware structure, about 90 % of the spare parts are identical.

No additional fuses are required in the DC link.

4-quadrant single drive – 1:1 application

For the 1:1 application typically **one** Active Front End AFE and **one** inverter INV (= standard frequency inverter Altivar 61/71) of same size are interconnected. Thus they form a fully-fledged 4-quadrant-drive with variable energy and speed direction. The accumulating generator energy e.g. due to lowering a load or braking of a drive is returned to the mains.

Changing from motor to generator operation occurs completely shock-free, with any frequency and duration. For instance, a downhill conveyor often works in a permanent interplay of the load affected by the current load of the conveyor. Also a 24-hours continuous operation in generator power range is no problem for the Active Front End.



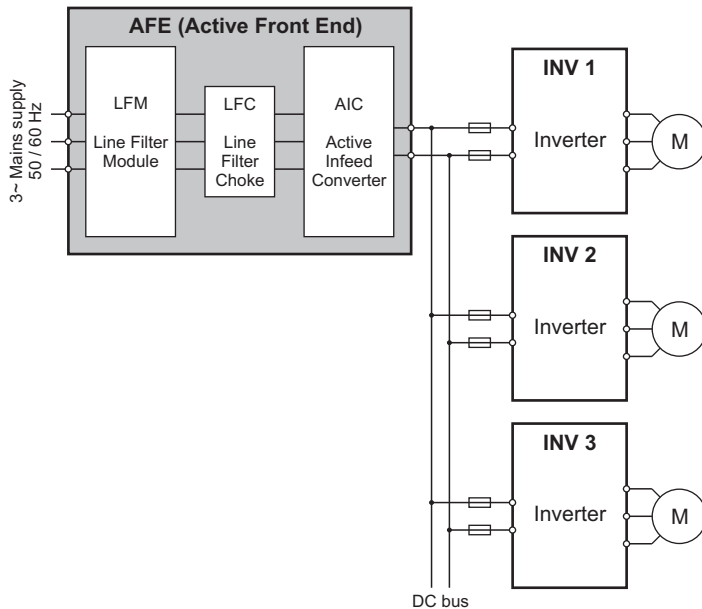
In case of the 1:1 application the Active Infeed Converter is connected with the inverter only via the DC link.

Therefore no additional fuses are required in the DC link.

As the inverter and the Active Infeed Converter have similar hardware structure, about 90 % of the spare parts are identical.

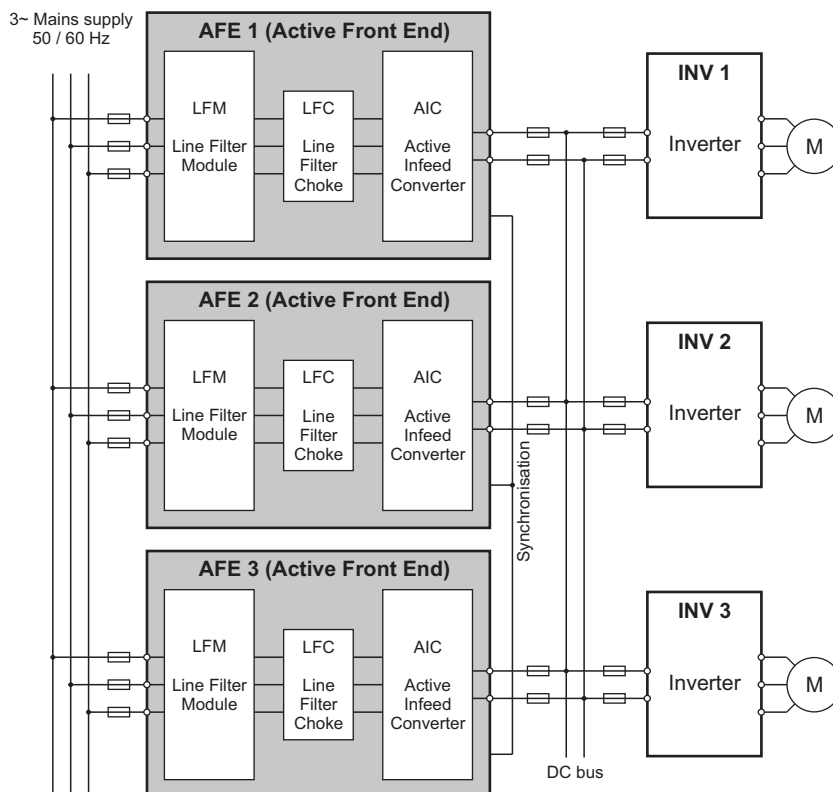
Common DC bus – 1:n application

Additionally to the single drive it is possible to supply several inverters with an Active Front End via a common DC link (1:n configuration). Common applications are e.g. group drives in sheet metal processing machines, roller conveyors and motor test benches. Thereby the Active Front End supplies energy into the DC bus or feeds the accumulating braking energy back into the mains.



The total power of the installed inverters can be higher than the nominal power of the Active Front End. Next to the performance record also the maximum possible load capacity of the line filter module LFM has to be observed when dimensioning the complete configuration.

Active Font End units parallel – n:n application



Due to the special design it is also possible to connect several Active Front End units in parallel (n:n application).

This enables

- a higher supply / regenerating power
- the use of smaller units e.g. adapted to the size of the inverter in order to reduce the spare parts
- an increased reliability due to redundancy.

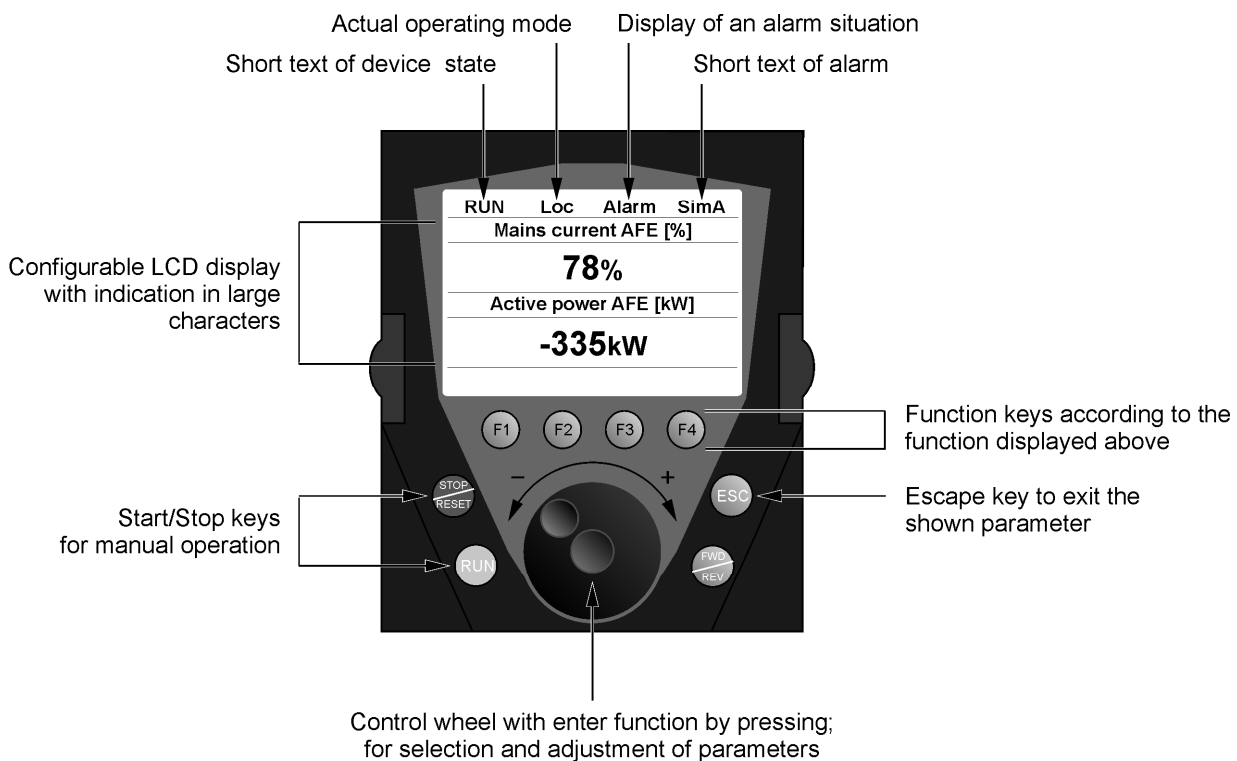
Depending on the power demand individual Active Front End units can be locked or released during operation. However, connection and disconnection must be only executed when there is no voltage!

Operation of the Active Front End

Removable keypad

The Active Front End is equipped with a removable keypad as standard. It combines function and design and thereby fulfils multiple tasks:

- **Display function:**
A good readable, large LCD window displays the latest status of the Active Front End in plain text, two selectable actual values and the currently active control variant.
All displayed texts are changed according to the selected language.
- **Manual operation (panel mode):**
Parameter 2.2.01 Control source enables the switch-over to "Panel control", that means also manual operation with the built-in buttons "RUN" and "STOP/Reset".
Switching the control source is only possible in device state "Stop".
- **Parameterization:**
The desired functions and device characteristics can be set quickly and without any problems due to the well-structured parameters and the parameter descriptions in clear text which are displayed at the same time. The parameterization is started by pressing the control wheel and can be abort at any time with just one press of the function button F4 "HOME".



Basic displays

RDY	IO
Mains current AFE [%]	
Stop	
Active power AFE [kW]	
0 kW	

Display at Ready

Parameter 1.4.01 →

Parameter 1.4.03 →

RUN	IO
Mains current AFE [%]	
78 %	
Active power AFE [kW]	
-335 kW	

Display at Run
(the actual values
which are selected
with paramter 1.4.01
and 1.4.03 are shown)

RUN	IO	Warn	SimA
Mains current AFE [%]			
78 %			
Active power AFE [kW]			
-335 kW			

← Alarm message

Display at Run if an
alarm occurs

Display of trip →

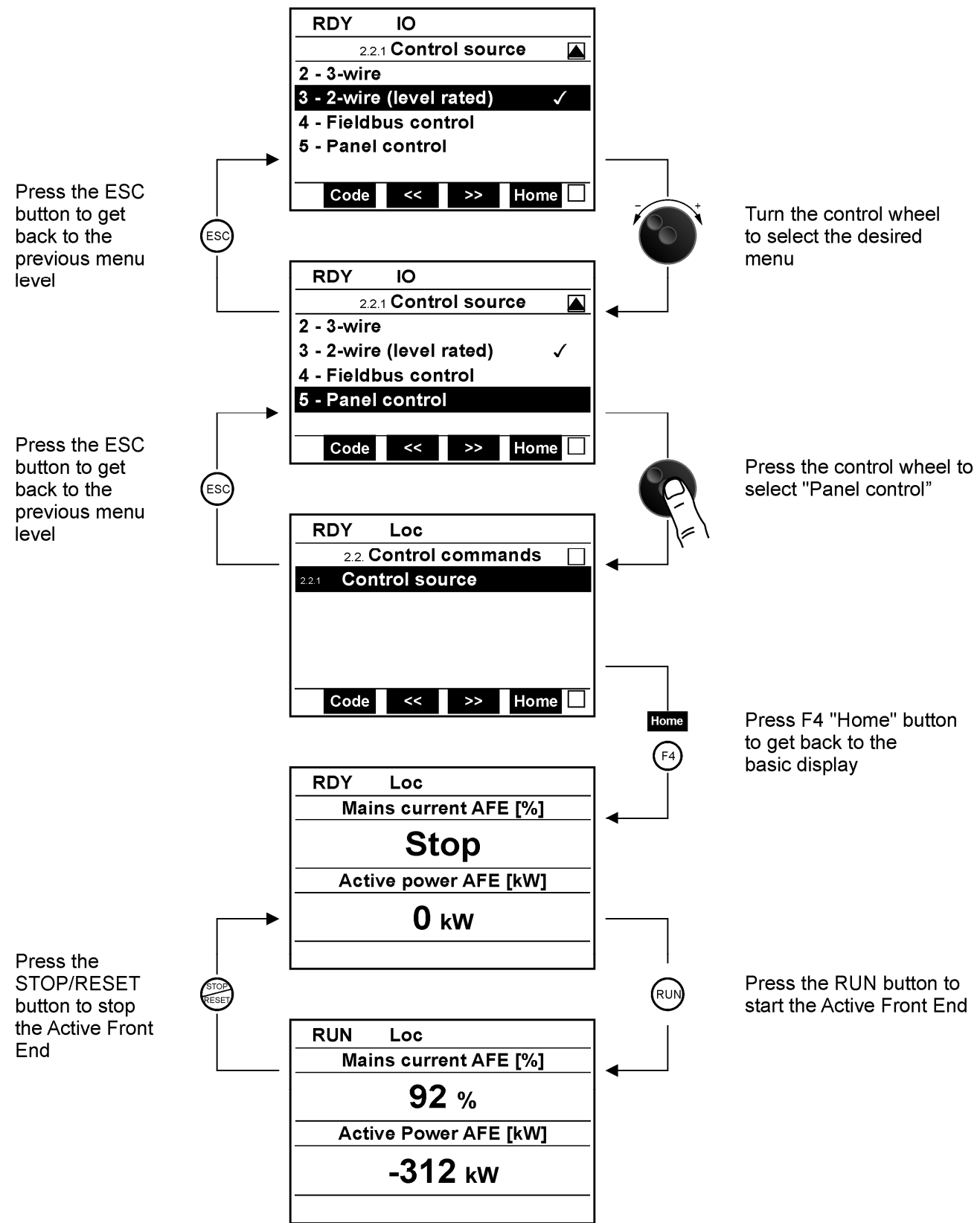
TRIP	Loc	LCF
Mains current AFE [%]		
Störung		
Active power AFE [kW]		
0 kW		
RESET		

← Trip message

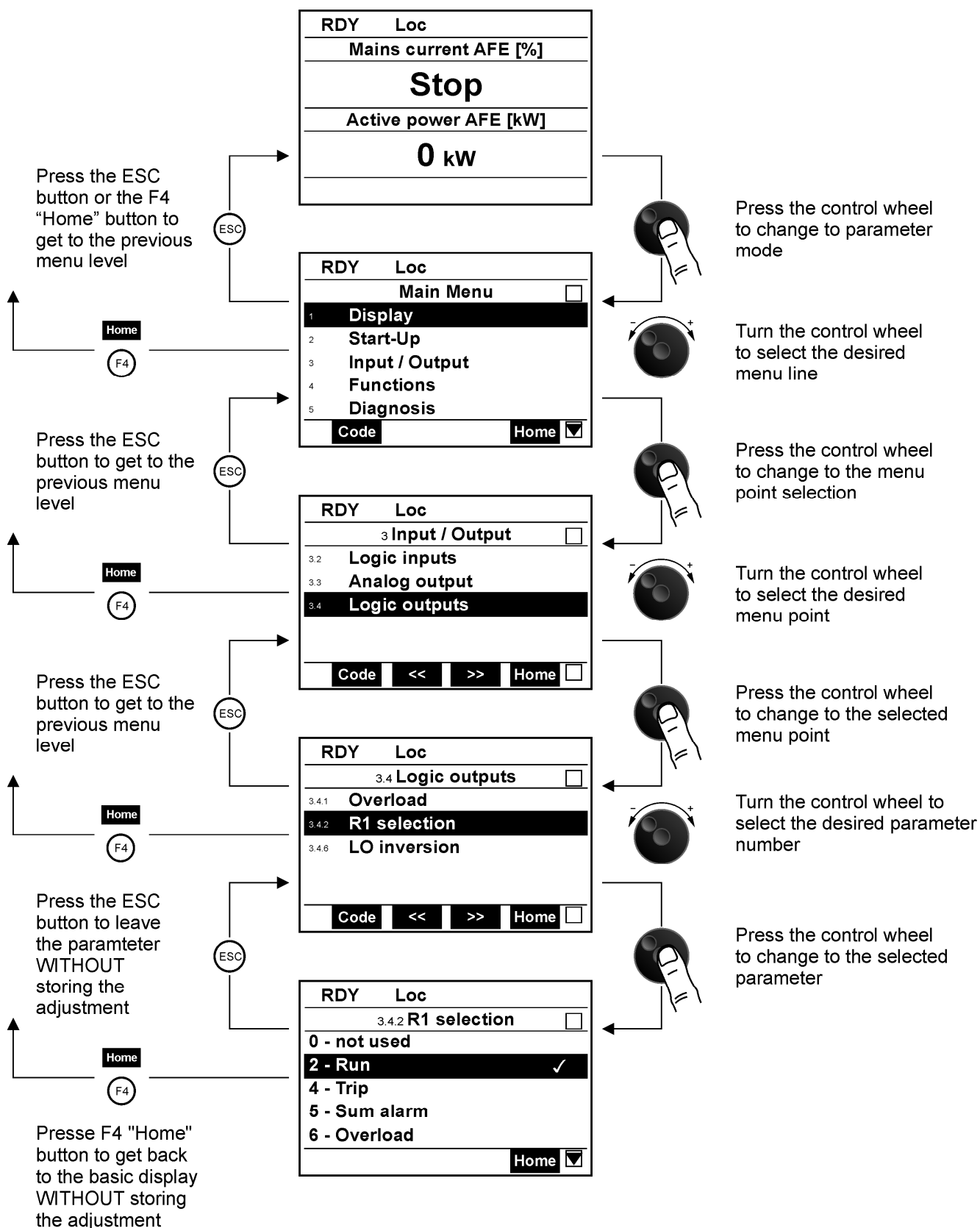


Display at trip;
Press F3 "RESET"
to reset

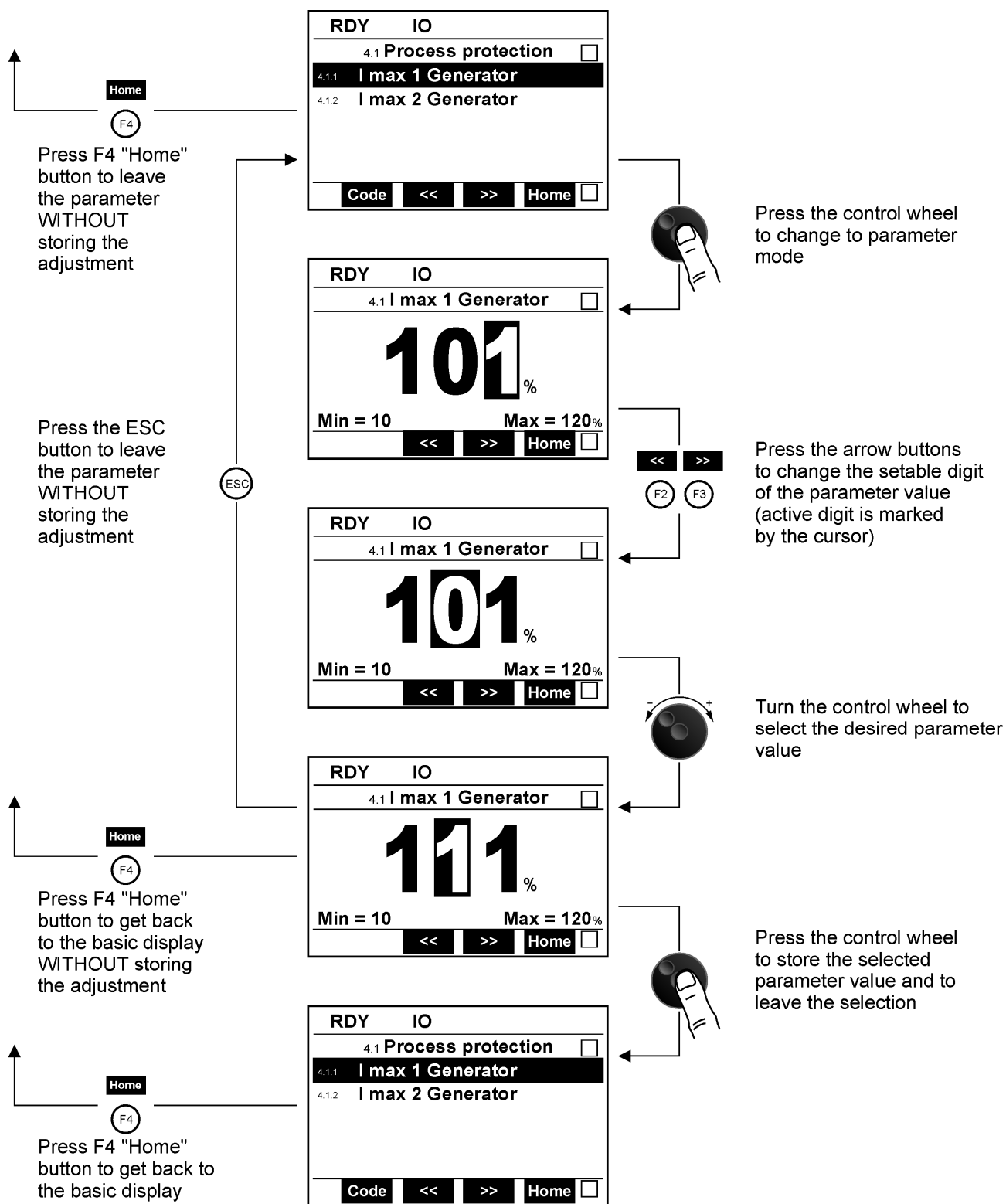
Panel operation



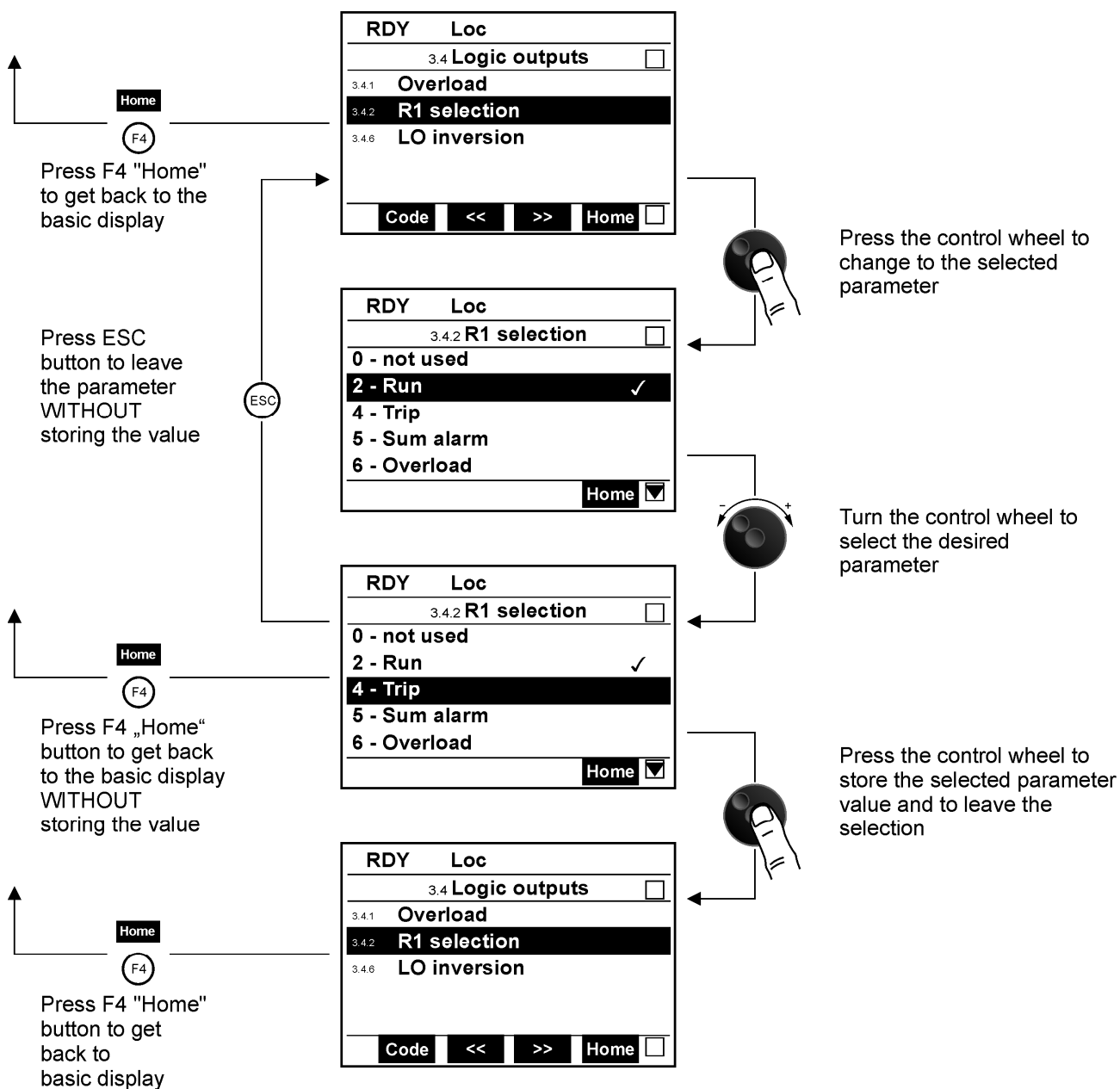
Navigation between the parameters



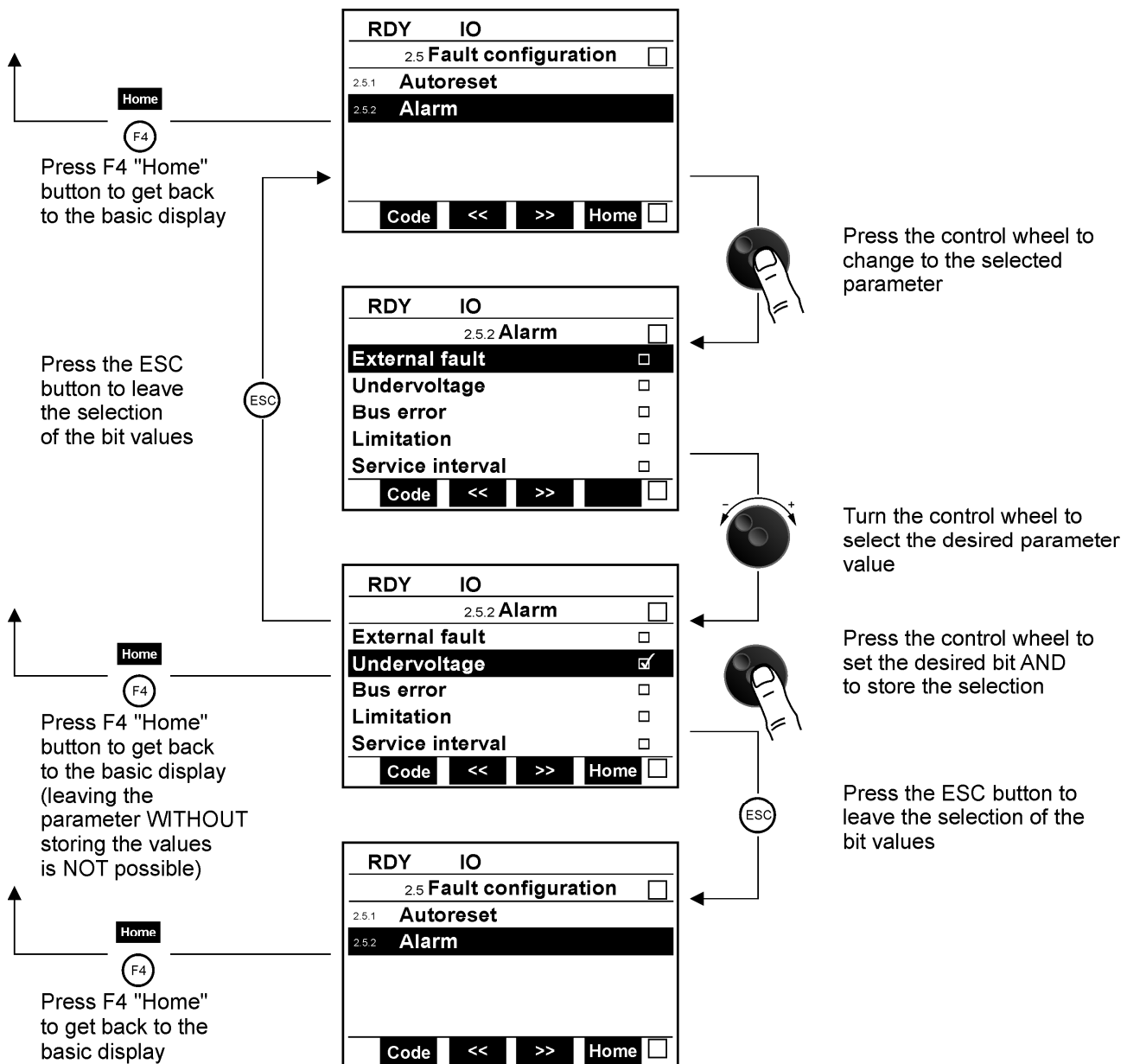
Adjusting a parameter of type "Variable"



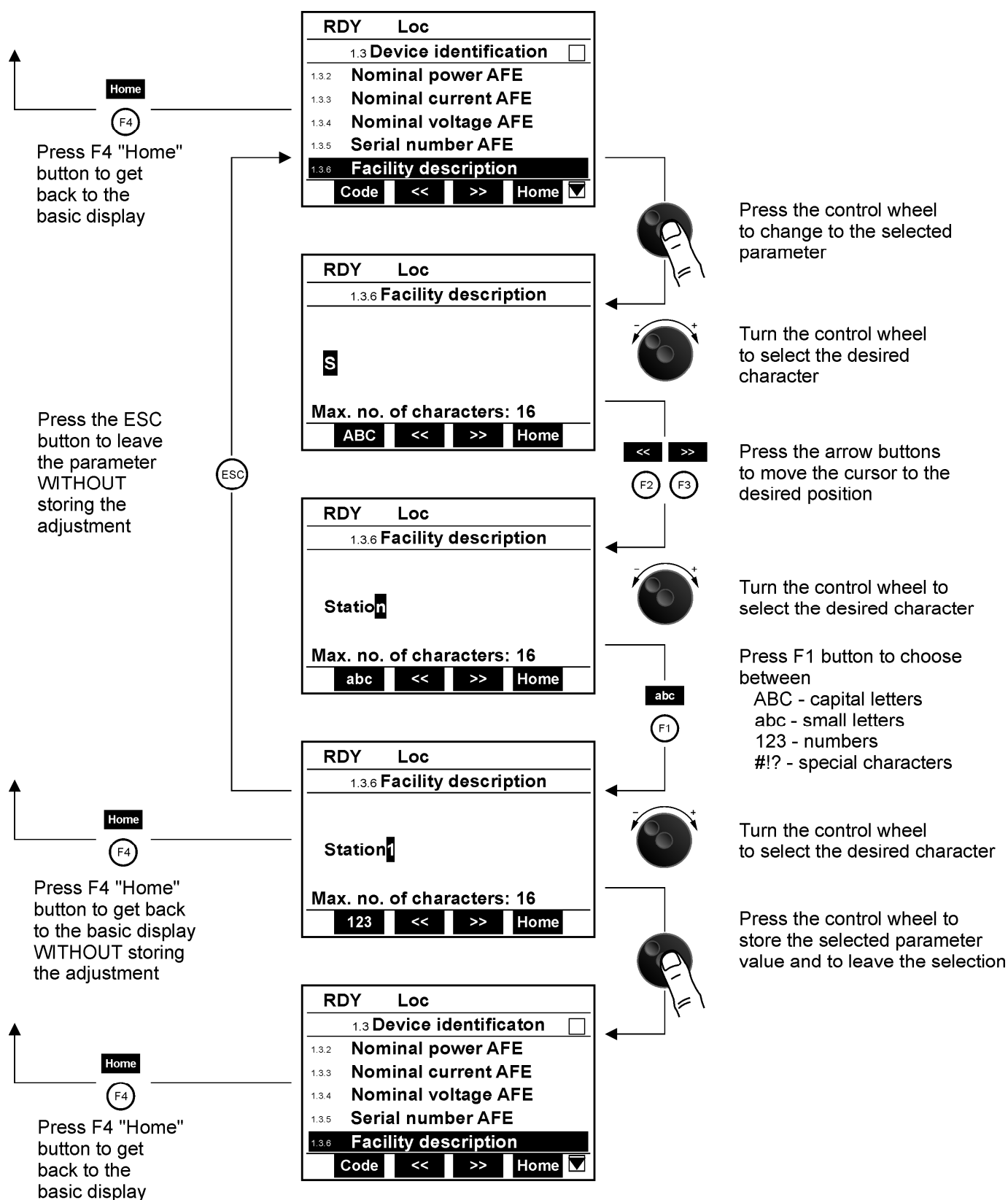
Adjusting a parameter of type "List"



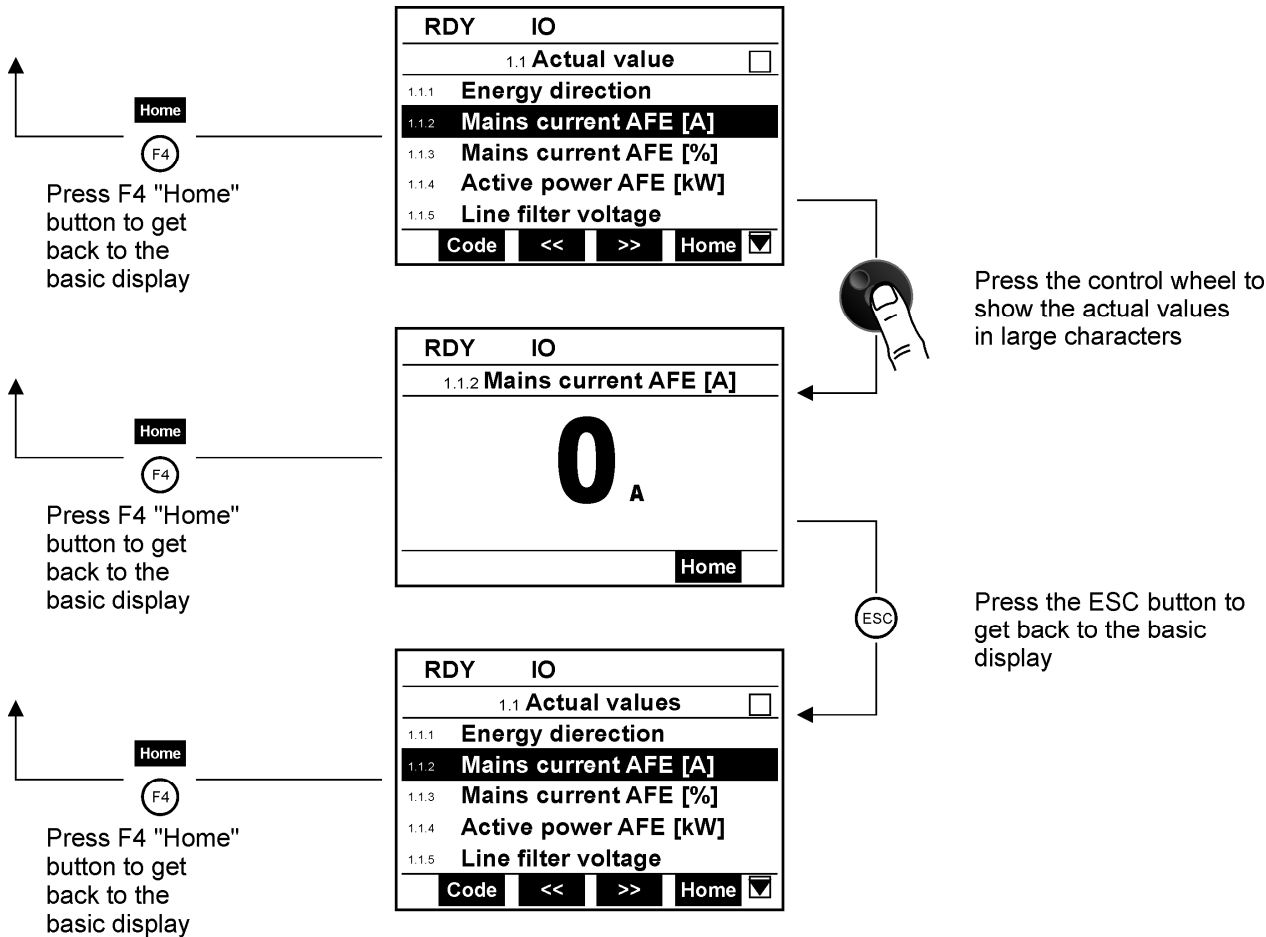
Adjusting a parameter of type "Bit field"



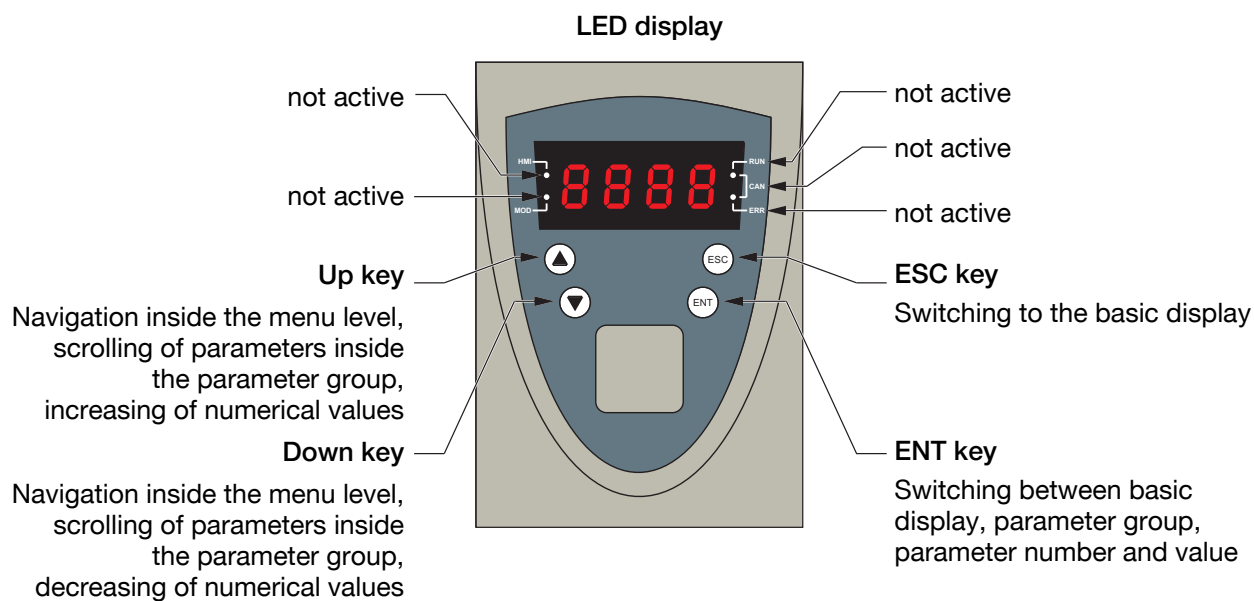
Adjusting a parameter of type "Text"



Display of an "actual value" parameter



Operation by means of the LED keypad



Basic displays

STOP

Display at Ready

92

Display at Run (the actual value
which is selected with parameter
1.4.01 is shown)

1180 A 15

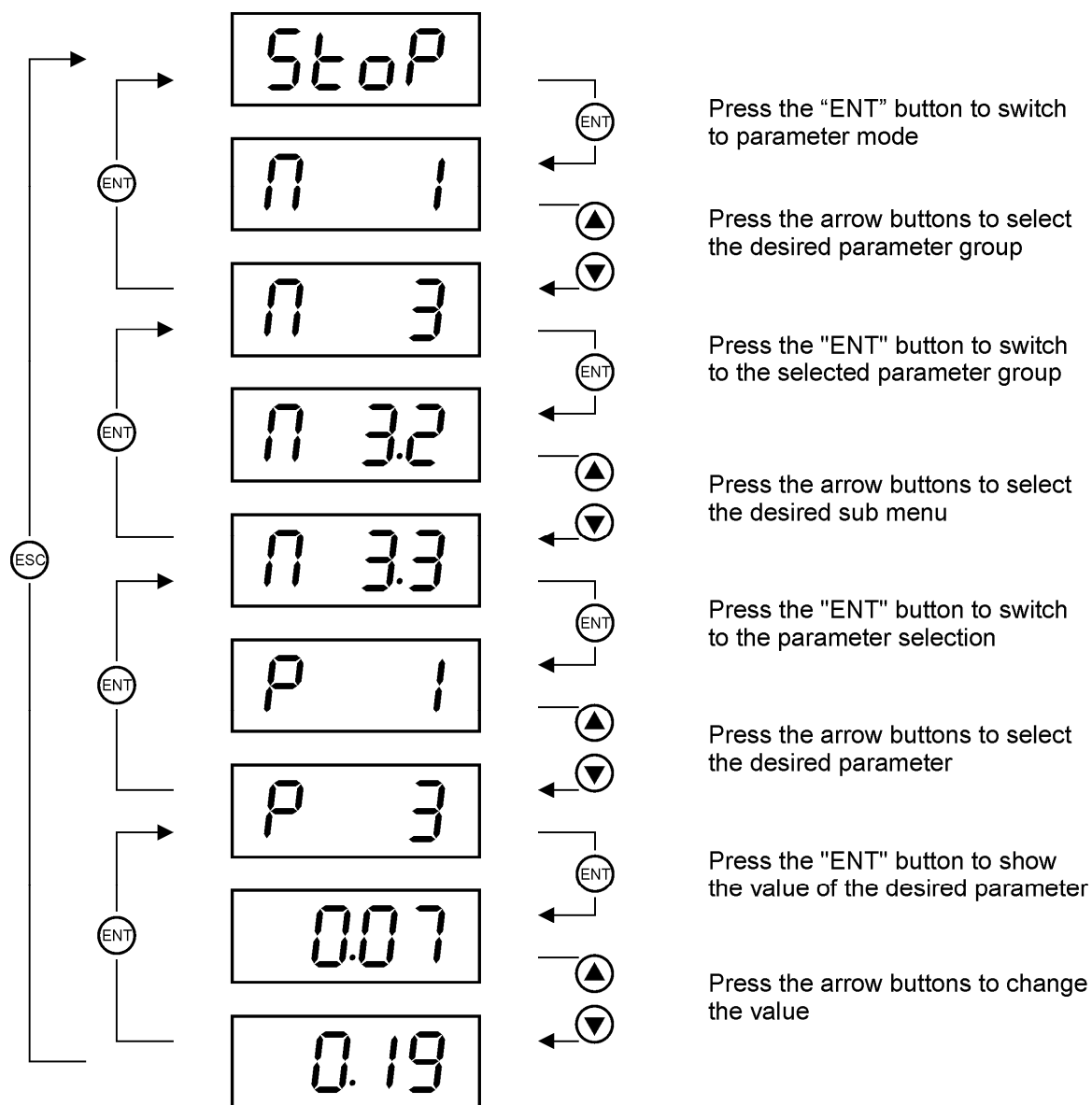
3 s ← → 1 s

Display at Run if an alarm occurs
(the actual value and the code of the
alarm message is shown alternately)

E 58

Display at Trip (the code of the trip
message is flashing)

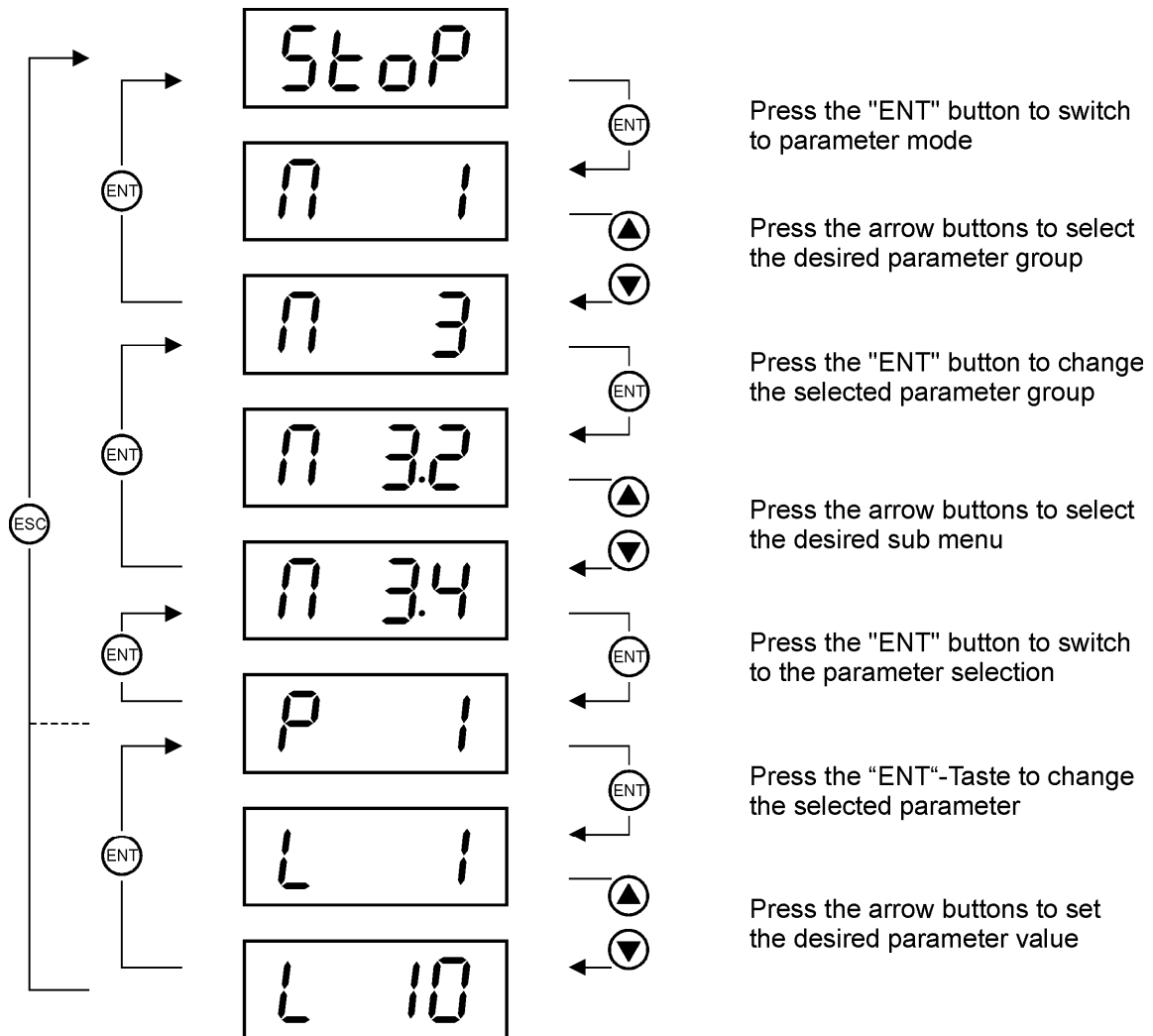
Adjusting a parameter of type "Variable"



Press the "ESC" button to get back to the basic display after changing the parameter.

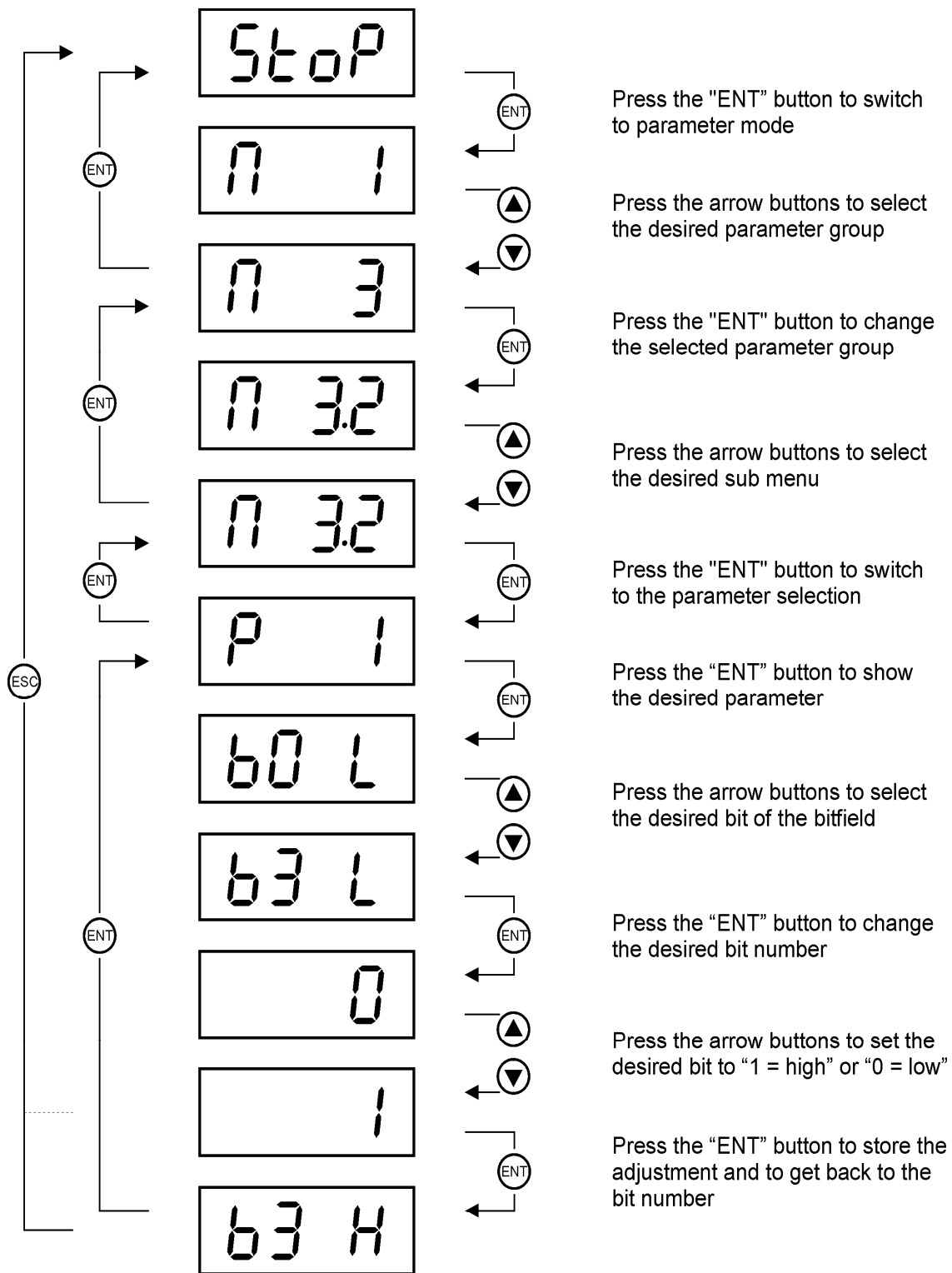
Press the "ENT" button to get back to the basic display step-by-step.

Adjusting a parameter of type "List"



Press the "ESC" button to get back to the basic display after changing the parameter.
Press the "ENT" button to get back to the basic display step-by-step.

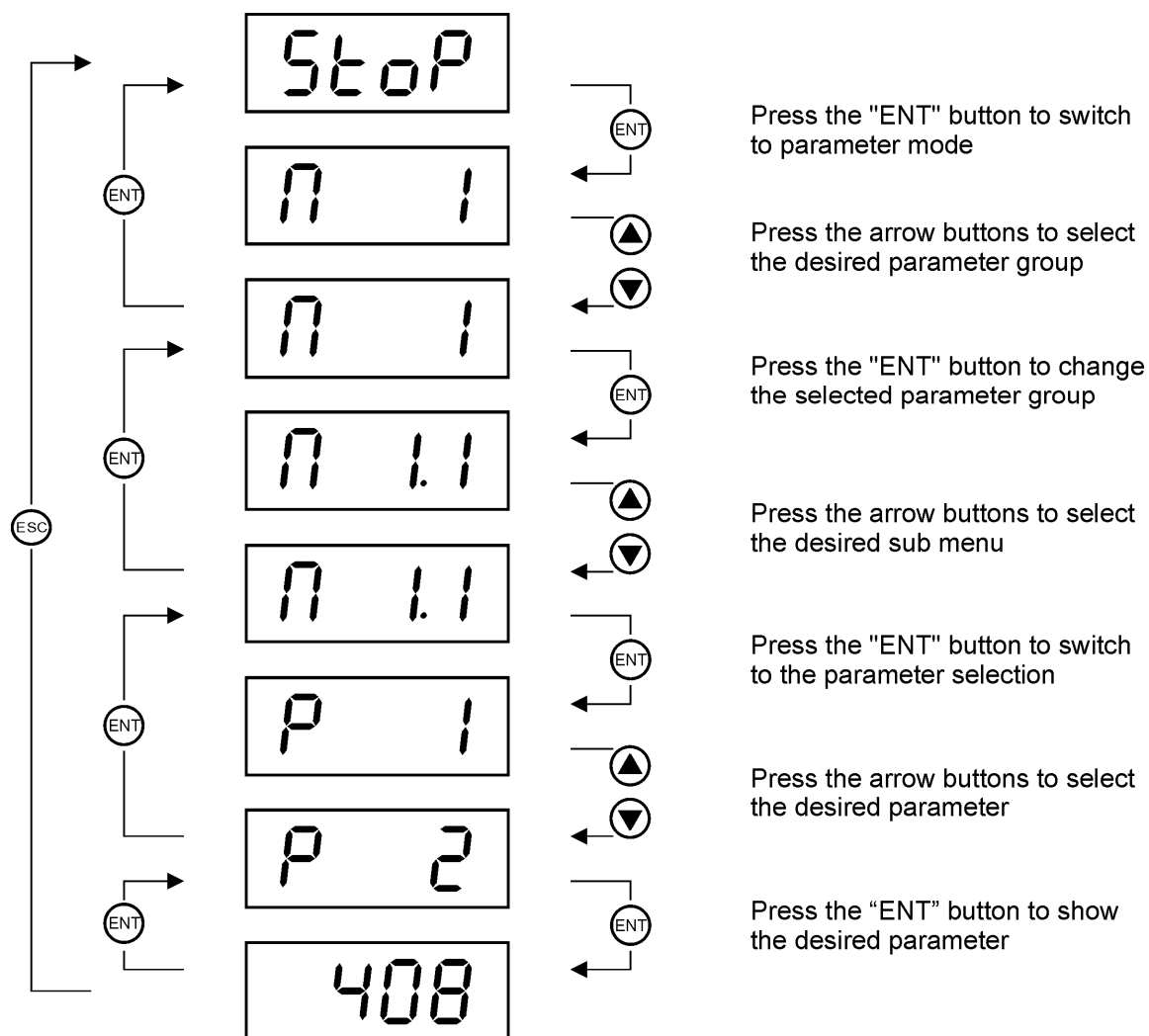
Adjusting a parameter of type "Bit field"



Press the "ESC" button to get back to the basic display after changing the parameter.

Press the "ENT" button to get back to the basic display step-by-step.

Display of an "actual value" parameter



Press the "ESC" button to get back to the basic display after changing the parameter.

Press the "ENT" button to get back to the basic display step-by-step.

Device state

State	Short text	LED keypad	Description
Trip	TRIP		The Active Front End is shut-down on the mains-side due to an occurring fault. The cause of the fault is displayed as short text on the operating panel.
Lock (PWR)	–		The Active Front End is locked and the line contactor in the line filter module LFM is switched off. The locking occurs by the logic input PWR.
Lock	–		The Active Front End is locked and the line contactor in the line filter module LFM is switched off. The locking occurs by the logic input LI5.
Stop	RDY		The Active Front End is released, however no starting command is given (operating panel, terminals or bus control word).
RUN (Display 1.4.01)	RUN	(Display 1.4.01)	When the Active Front End is in RUN state the actual value selected at parameter 1.4.01 "Selection upper field" is displayed instead of the message RUN.
Load	RDY		The pre-charging of the DC link is active.
Mains off	RDY		The Active Front End is disconnected from the supplying mains.
Mains missing	RDY		The supplying mains has broken down. When the voltage returns the drive automatically starts again.

Operating mode

Operating mode	Short text	Description
Local mode	Loc	The control of the device occurs via the operating panel.
Terminals	IO	The control of the device occurs with the digital command of the terminals. The following possibilities of the command logic are available: <ul style="list-style-type: none"> – 3-wire – 2-wire (level rated) See also 2.2.01 Control source.
Modbus	MODB	The control of the device occurs via the control word of the active modbus connection. See 2.2.01 Control source and 4.6 Bus settings.
CANopen	CANO	The control of the device occurs via the control word of the active CANopen fieldbus connection. See 2.2.01 Control source and 4.6 Bus settings.

Alarm/Info messages

Alarm	Short text	LED keypad	Description
Emergency op. active	EMAC	A 02	The Active Front End is switched over to the status "Emergency operation" via a logic input command. See parameter 4.3.02.
External fault	FLT1	A 03	An external fault is signaled via a logic input command (see 2.4.01...2.4.04). It is processed as an alarm message corresponding to the setting of 2.4.02 Ext. fault response.
Undervoltage	USF	A 05	There is an undervoltage situation.
Bus error	BUSF	A 09	According to the setting of 4.6.03 Bus error reaction a bus fault caused by exceeded runtime or a loss of control leads to an alarm message.
Overload	oVLD	A 21	The overload level set with parameter 3.4.06 has been exceeded.
Service AFE	SePO	A 26	The operating hours counter (1.2.05) for the power part of the device (device is supplied with mains voltage) has exceeded the set time interval (1.2.06).
Simulation active	SimA	A 28	The Simulation mode (5.1.02) is activated.
Download active	MaDa	A 29	The PC program executes a parameter download. After transmission it is necessary to confirm or to deny the parameterization on the operating panel in order to return to the regular operating state. Alternatively confirmation is possible by means of the service code 6.1.05 = 33.
IGBT $\vartheta >$	IGBT	A 38	IGBT overtemperature, determined by the thermal mathematical model.
Control requ. missing	BFU	A 46	Control bit (b10) of the bus control word is low.
I-limit active	ILIM	A 51	The actual mains current is limited to the maximum operating current.
PTC/LI (SW2) wrong	SW2	A 58	Switch SW2 is not in position LI.
Sync-Alarm	SYNC	A 59	If an fault occurs during the synchronisation of several Active Front End units connected in parallel, an alarm or a trip takes place depending on the setting of parameter 2.1.02.



Trip messages



Fault	Short text	LED keypad	Description
Overvoltage DC	OBF	E02	The DC link voltage has exceeded the protection level of 825 V. As the fault evaluation only occurs with impulse inhibit, a line overvoltage situation takes place !
Line overvoltage	OSF	E03	The mains voltage set with parameter 2.1.01 does not correspond with the existing mains situation.
MC not ready	CRF	E04	The line control is not ready after the charging process.
Precharging fault	CRF2	E06	Fuse of the charging DC link in the LFM defect
Line fault 1p	PHF1	E08	Loss of one mains phase
Line fault 2-3p	PHF	E09	Loss of two or three mains phases
Overcurrent	SCF	E10	Overcurrent (mains current)
earth fault	GRF	E11	Earth fault at the output
Insulation fault	IGF	E12	The determined DC current is 25 % higher than the nominal current.
switching freq. >>	OCF	E13	Pulse frequency too high
AFE overload	TJF	E14	IGBT overtemperature caused by overload, determined by the thermal mathematical model.
AFE overtemp.	OHF	E19	Overtemperature (cooling problem, fan defect,...)
Unknown MC	MC1	E20	Unknown power part
PTC short circuit	THSC	E21	Monitoring of the internal temperature sensor (short-circuit at a thermistor sensor)
PTC open circuit	THOC	E22	Monitoring of the internal temperature sensor (a thermistor sensor is open)
ASIC Init fault	CPR	E23	Asic on the line control cannot be initialised.
IGBT fault	HwF	E25	The desaturation protection of an IGBT has triggered.
Differential current >>	DCF	E26	The current difference between the power parts connected in parallel is too high. The registration of this fault occurs only at devices with parallel IGBT power parts.
Current measure fault	CMF	E30	Fault of the current transformer, its voltage supply or the evaluation electronics.
MC E ² zones invalid	MC2	E32	Line control EEPROM defect
CPU fault	CPU	E33	Internal electronic fault
ISL fault	ISL	E34	Communication fault on the internal serial link
MTHA fault	MTHA	E35	Asic for time measurement defect (undervoltage time determination)
PWR fault	PRF	E37	No 24 V at the logic input PWR
Opt. comm. fault	ILF	E39	Communication fault at an option card
Wrong option card	INF6	E40	Defect or unknown option card used
Bus error	BUSF	E41	A bus fault occurred due to exceeded run time or loss of control.
Param. config. fault	CFI	E42	Parameter settings invalid
Configuration fault	CFF	E57	EEPROM application software incompatible or changed power part
External fault	FLT1	E58	An external fault is signaled via a logic input (see 2.4.01...2.4.04).
Precharging fault	LCF	E60	Error in the LFM, the control of the LFM or mains voltage missing
Internal SW error	SW	E64	Internal software bug
Power rating fault	PRT	E65	Unclear power part assignment

Fault	Short text	LED keypad	Description
Incompatible MC	INF2	E66	Line control is not compatible to the application software
Flash fault APP	ERR2	E67	Flash Eeprom on the applicative defect
Indus zone fault	ERR3	E68	Value for calibration on the applicative defect
Eeprom fault APP	EFF1	E69	EEPROM on the applicative defect
24V fault	STP	E73	Problem with the external 24 V buffer voltage
AFE overload	OHF2	E81	Protective shut-down due to exceeding the maximum current/time specification.
Sync-Error	SYNC	E86	Faulty parallel connection, fault during synchronisation of the line control or the applicative software



Parameter identification

All parameters described in this documentation are typically represented as follows:


Parameter number	Parameter name	Type of parameter	Adjustability	Factory setting
3.4.06	Overload level			100 %
	0...120 %			
	Setting range min...max			

Parameter number	Parameter name	Type of parameter	Adjustability	Factory setting
2.2.01	Control source			3 .. 2-wire (level rated)
	2 ...3-wire			
	3 ...2-wire (level rated)			
	4 ...Fieldbus control			
	5 ...Panel control			
	Selectable functions			




All parameters are sub-divided into different parameter types according to their use and type of setting.

Type of parameter	Symbol	Description
Variable		Variables are parameters whose value can be adjusted linear. The possible setting range is limited by a minimum and a maximum value. Typical representatives: 3.4.06 Overload level [%], Setting range 0...120 %
List		List parameters offer the user different selection choices in list form (one below the other). The required function can be selected from the displayed list. Each entry in the list is prefixed with a line number, which is required when the LED-keypad is used. Typical representatives: 2.2.01 Control source 2...3-wire 3...2-wire (level rated) 4...Fieldbus control 5...Panel control

Type of parameter	Symbol	Description										
Bit field	0110	<p>Bit fields are a special type of list parameters that allow multiple selection of settings.</p> <p>Typical representatives:</p> <p>5.3.01 LI state basic device</p> <table><tr><td>0 .. LI 1</td><td><input type="checkbox"/> / <input checked="" type="checkbox"/></td></tr><tr><td>1 .. LI 2</td><td><input type="checkbox"/> / <input checked="" type="checkbox"/></td></tr><tr><td>...</td><td>.....</td></tr><tr><td>5 .. LI 6</td><td><input type="checkbox"/> / <input checked="" type="checkbox"/></td></tr><tr><td>6 .. PWR</td><td><input type="checkbox"/> / <input checked="" type="checkbox"/></td></tr></table>	0 .. LI 1	<input type="checkbox"/> / <input checked="" type="checkbox"/>	1 .. LI 2	<input type="checkbox"/> / <input checked="" type="checkbox"/>	5 .. LI 6	<input type="checkbox"/> / <input checked="" type="checkbox"/>	6 .. PWR	<input type="checkbox"/> / <input checked="" type="checkbox"/>
0 .. LI 1	<input type="checkbox"/> / <input checked="" type="checkbox"/>											
1 .. LI 2	<input type="checkbox"/> / <input checked="" type="checkbox"/>											
...											
5 .. LI 6	<input type="checkbox"/> / <input checked="" type="checkbox"/>											
6 .. PWR	<input type="checkbox"/> / <input checked="" type="checkbox"/>											
Text	txt	<p>Text parameters are freely editable or already prepared alpha-numerical texts of different length, which can be displayed.</p> <p>Typical representatives:</p> <p>1.3.06 Facility description</p> <p>Station 1</p>										

 Different list parameters will cause an automatically processing function during their setting. This special form of list parameters is also called a routine (e.g. software reset).

Independent of the parameter type a distinction is made between three different types of adjustability:

Adjustability	Symbol	Description								
Always adjustable		Parameters with this symbol can be changed independent of the operating state of the Active Front End.								
Adjustable only in case of impulse inhibit		Parameters of this group cannot be adjusted during device state "Run". The Active Front End must be stopped before adjustment.								
Actual value (not adjustable)		<p>Parameters with this symbol can only be read → Actual value parameters.</p> <p>Actual values can be different parameter types.</p> <p>Typical representatives:</p> <table><tr><td>1.1.01 Energy direction</td><td>(List)</td></tr><tr><td>0 .. Motor</td><td></td></tr><tr><td>1 .. Generator</td><td></td></tr><tr><td>1.1.02 Mains current AFE [A]</td><td>(Variable)</td></tr></table>	1.1.01 Energy direction	(List)	0 .. Motor		1 .. Generator		1.1.02 Mains current AFE [A]	(Variable)
1.1.01 Energy direction	(List)									
0 .. Motor										
1 .. Generator										
1.1.02 Mains current AFE [A]	(Variable)									

Hiding parameters

For easy parameter adjustment the visibility of individual parameters or complete parameter groups is adopted specifically to the respective situation.


Parameters which refer to missing hardware options or which belong to non-activated functions, are automatically faded-out.



3.3.01AO1 selection to 2 .. Mains current

3.3.02 AO1 level 3.3.03 AO1 min. value 3.3.04 AO1 max. value
--

These parameters are only displayed, if 3.3.01 AO1 selection is not set set to "0 .. Not used".


1	888	Display	Display of reference and actual values, Configuration of the LCD display
----------	-----	----------------	---

1.1		Actual values	Display of mains specific actual values
------------	---	----------------------	---

1.1.01	Energy direction				
	0...Motor (mains to motor)				
	1...Generator (motor to mains)				



Display of the actual energy direction.

The parameter displays "0 .. Motor" as long as "1 .. Generator" cannot be detected definitely.

1.1.02	Mains current AFE [A]				A
--------	-----------------------	---	--	--	---



Display of the actual mains current (effective value of the fundamental mode) in ampere.

Accuracy: 1.5% (related to nominal current of the device)

1.1.03	Mains current AFE [%]				%
--------	-----------------------	---	--	--	---

Display of the actual mains current in % related to the nominal current of the device.



Accuracy: 1.5% (related to nominal current of the device)

1.1.04	Active power AFE [kW]				kW
--------	-----------------------	---	--	--	----

Display of the effective power in kW, whereas negative values stand for energy regeneration to the mains.



For calculation the characteristic values of mains voltage and mains current are used.

Accuracy: 5 % (related to nominal power of the device)

1.1.05	Line filter voltage				V
--------	---------------------	---	--	--	---



Display of the actual voltage between the line filter module LFM and the line choke LFC in V (effective value of the fundamental mode).

Accuracy: 3%

1.1.06	Mains frequency				Hz
--------	-----------------	---	--	--	----

Display of the actual mains frequency in Hz, whereas negative values correspond with reverse rotating field.

Accuracy: < 1%

1.1.07	DC voltage AFE				V
--------	----------------	---	---	--	---

Display of the actual DC link voltage in V DC.

The value of the DC link voltage depends on the set mains voltage.

Accuracy: < 2 % (related to maximum DC link voltage)









1.1.08	AFE load				%
--------	----------	---	---	--	---

Display of the actual thermal load of the Active Front End AFE.

118% correspond with the maximum approved heat sink temperature of the respective device.

The thermal load is a dimension for the thermal balance which arises from the two factors load (current and time of load) and the cooling conditions (temperature of coolant, fan power).







1.2	528⁹₇ h	Counter	Operating hours meter, energy meter
------------	--------------------------------------	----------------	-------------------------------------

1.2.01	MWh meter mot.			MWh
1.2.02	kWh meter mot.			kWh
1.2.03	MWh meter gen.			MWh
1.2.04	kWh meter gen.			kWh

The supplied and absorbed electrical energy is registered in separated counters and can be presented by means of two parameters.



The kWh counter operates from 0.0...999.9 kW. If the counter exceeds the MW-limit, the kWh counter begins to count from zero again and the MWh counter is incremented accordingly.

Accuracy: 5 % (related to nominal power)

1.2.05	Operating hours AFE			h
1.2.06	Interval operating hours 0...60000 h			0 h
1.2.07	Interval counter			h


The operating hours counter registers that time in which the Active Front End is operated at the mains. It indicates the operating time of the DC link capacitors, the control electronics components and the device fan.

When the operating hours counter reaches the value of parameter 1.2.06 "Interval operating hours", then the alarm message "Service AFE" is set. The alarm can be reset by means of parameter 1.2.08 "Clear interval counter" whereby a new time interval is started. The already elapsed time of a running interval can be seen in parameter 1.2.07 "Interval counter".

1.2.08	Clear interval counter 0...No reset 3...Reset Power On			0 .. No reset
--------	--	---	--	---------------

If an interval has elapsed, the corresponding alarm message is set. This alarm message can be reset by parameter 1.2.08 "Clear interval counter".



 With this resetting of the alarm, a further time interval is started.

 If the counters of operating hours exceed 60,000 hours (approx. 7 years in case of 24 hour operation) the counters are automatically reset and start counting again from zero hours.



1.3		Device identification	Identification of the device, service notice		
------------	---	------------------------------	--	--	--



This parameter group contains information about the identification of the Active Front End (data of the rating plate). Additionally drive-specific texts like the facility description and a service notice of max. 4 lines can be adjusted by the user.



1.3.01	Device type AFE	txt			
--------	-----------------	-----	---	--	--

1.3.02	Nominal power AFE				kW
--------	-------------------	---	---	--	----

Parameter 1.3.02 shows the nominal power of the device.

1.3.03	Nominal current AFE				A
--------	---------------------	---	---	--	---


1.3.04	Nominal voltage AFE				1 .. 3x 380V-480V
	0 ...3x 220V 1 ...3x 380V-480V 2 ...3x 500V-690V 3 ...3x 500V-690V				

1.3.05	Serial number AFE				
--------	-------------------	---	---	--	--

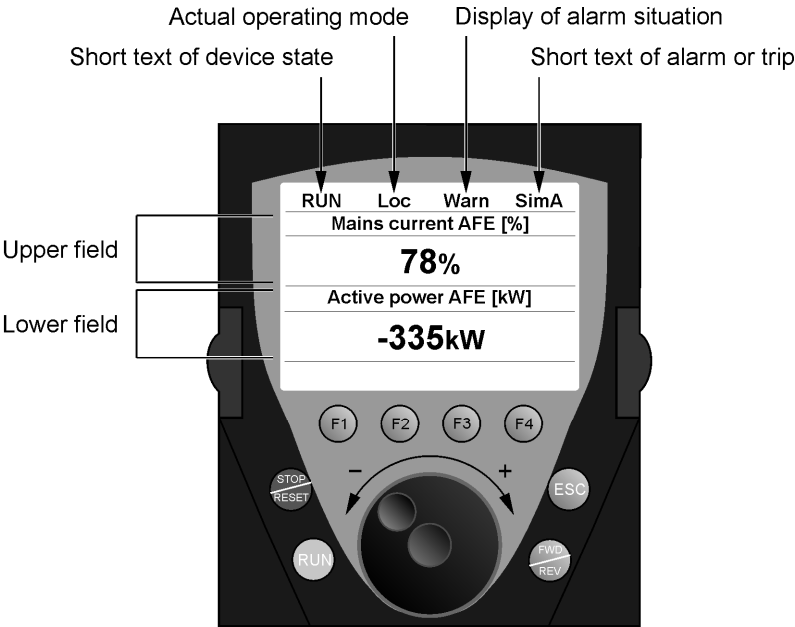
1.3.06	Facility description	txt			
--------	----------------------	-----	---	--	--

1.3.07	APP software AFE	txt			
--------	------------------	-----	---	--	--





APSatvr R **1.1IE01**
└─ Software version
└─ Type of program

1.3.08	Service notice	txt			
--------	----------------	-----	---	--	--

The basic display on the removable operating panel serves to visualise the actual operating state of the Active Front End. The actual device- and operating state as well as two analog actual values can be displayed on it. The two presentable actual values can be selected by means of the parameters 1.4.01 and 1.4.03 corresponding to the user-sided requirements.



The basic display on the removable operating panel enables an easy, readable diagnostic of the actual operating state and operating mode of the Active Front End. It appears automatically when the device is supplied with voltage.

1.4.01	Selection upper field			10 .. Mains current AFE [%]
1.4.03	Selection lower field			2 .. Active power

1 ...Mains current

2 ...Active power

3 ...Line filter voltage

4 ...DC voltage

5 ...Mains frequency

6 ...MWh meter mot.

7... kWh meter mot.

8... MWh meter gen.

9... kWh meter gen.



10 .. Mains current AFE [%]

11 .. AFE load

All active limitation interventions are displayed on the removable keypad. The display occurs as long as the limitation is active, but at least 1 seconds.

The display of limitations is beneficial especially for commissioning and service.

1.5		Language selection	Selection of the desired language
------------	---	---------------------------	-----------------------------------


1.5.01	Language selection				
	0 ...English	5... Chinese			
	1 ...French	6... Russian			
	2 ...German	7... Turkish			
	3 ...Italian				
	4 ...Spanish				


All language-dependent texts in the Active Front End are stored in the removable operating panel.

When an Active Front End with connected operating panel is switched on first-time, all languages that are available in the operating panel are displayed for selection.

The language selected that way is kept when the operating panel is connected to another device.

 The set language can be changed later by means of parameter 1.5.01.

 If the software versions do not correspond between device and operating panel, it can happen that individual parameter texts are missing. However, the parameter number is displayed.

2		Start-Up	Basic system and configuration settings for commissioning
----------	---	-----------------	---

It is absolutely necessary to carry out the following settings for all frequency inverters connected to an Active Front End:

- ***RFE* [Regen. connection]** in menu [1.7 APPLICATION FUNCT.] (FUn-) in submenu [REGEN. CONNECTION] (Olr-) Setting: [Yes] (YES)
Thereby the undervoltage level of the frequency inverter is adapted to the operation with the Active Front End.
Please contact our service team if this parameter is not available in the parameter list of your device!
- ***brR* [Braking balance]** in menu [1.7 APPLICATION FUNCT.] (FUn-) in submenu [RAMP TYPE] (rPt-) Setting: [No] (nO)
- ***dEC* [Deceleration]** in menu [1.7 APPLICATION FUNCT.] (FUn-) in submenu [RAMP TYPE] (rPt-) For dynamic processes a very short deceleration ramp can cause an overload on the DC-bus with an overvoltage fault shut-down.
This can be prevented by an extension or rounding of the deceleration ramp (parameters *LR3* [Begin Dec round]; *LR4* [End Dec round]).
- ***UrES* [Mains voltage]** in menu [1.8 FAULT MANAGEMENT] (FLt-) in submenu [UNDERVOLTAGE MGT.] (USb-) Same setting as the Active Front End.
Thereby the internal voltage levels of the frequency inverter are adapted.
- ***IPL* [Input phase loss]** in menu [1.8 FAULT MANAGEMENT] (FLt-) in submenu [INPUT PHASE LOSS] (OPL-) Setting: [Ignore] (nO)
- ***bUb* [Brake res. fault Mgt]** in menu [1.8 FAULT MANAGEMENT] (FLt-) in submenu [BU PROTECTION] (bUF-) Setting: [Ignore] (nO)
- ***LEL* [2 wire type]** in menu [1.5 INPUTS/OUTPUTS CFG] (I-O-) Setting: [Level] (LEL)
In order to ensure an automatic restart by the AFE after an undervoltage recognition. An automatic restart only possible with 2-wire control.
- **RFI filter**
The integrated RFI filter has to be deactivated (position IT, non-grounded mains) at all devices because there exists no direct mains connection of the frequency inverter in case of operation with an Active Front End.



The 24 V control voltage of the Active Front End AFE can also be used to buffer the control electronics of the frequency inverter.



When the frequency inverter is supplied via the DC link an external supply for the device fans is required!


Via the LFM (line filter module) it is possible to supply the device fans with up to 4 additional inverters (with the same power as the AIC).





In case of applications like hoists and liftings additional connections between the AIC and the inverter INV are required.



Non-observance of these precautions may cause material damage.

2.1		AFE settings	Setting of the mains voltage and the operating mode
------------	---	---------------------	---

2.1.01	Mains voltage			4 .. 480 V – 60 Hz
	1 ...380 V - 50/60 Hz			5... 500 V - 50 Hz
	2 ...400 V - 50/60 Hz			6... 600 V - 60 Hz
	3 ...440 V - 50/60 Hz			7... 690 V - 50/60 Hz
	4 ...480 V - 60 Hz			



The Active Front End is designed as wide-voltage-range device and can be operated in the voltage range of 380...480 V AC or 500...690 V AC.



The correct setting of the mains voltage is absolutely necessary for the adaptation of the internal voltage alarm levels and protection levels. Maladjustment can lead to damage of the device !

DC link voltage depending on the mains voltage

DC link voltage depending on the mains voltage	DC voltage
1 .. 380 V - 50/60 Hz	650 V
2 .. 400 V - 50/60 Hz	650 V
3 .. 440 V - 50/60 Hz	720 V
4 .. 480 V - 60 Hz	770 V
5 .. 500 V - 50 Hz	840 V
6 .. 600 V - 60 Hz	960 V
7 .. 690 V - 50/60 Hz	1100 V

2.1.02	Parallel operation			0 .. No parallel operation
	0 ...No parallel operation			
	1 ...Active / Alarm			
	2 ...Active / Trip			

When two, three or four Active Front End units AFE are operated parallel in order to increase the power or to provide redundancy, the function parallel operation has to be activated (setting "1 .. Active / Alarm" or "2 .. Active / Trip") for all Active Front End units. Thereby the analog output AO1 and the analog input AI2 are activated and the internal synchronisation function starts. Additionally to the parameter adjustment the control wiring between the Active Front End units connected in parallel is required.

By the function "Parallel operation" there is no derating of the device necessary. It prevents internal current flow and thus it ensures the whole performance of the system. But this function is no "load balance" between the Active Front End units. The supply/regenerating power is varying due to the device tolerances and is maybe partitioned very different.



When the parallel operation is deactivated by setting "0 .. No parallel operation", analog output AO1 is set to "0 .. Not used".

The signals to connect and disconnect the Active Front End can occur in different ways.

Basically you can differentiate between the panel control with the removable operating panel and the remote control via the terminals or an integrated fieldbus connection.

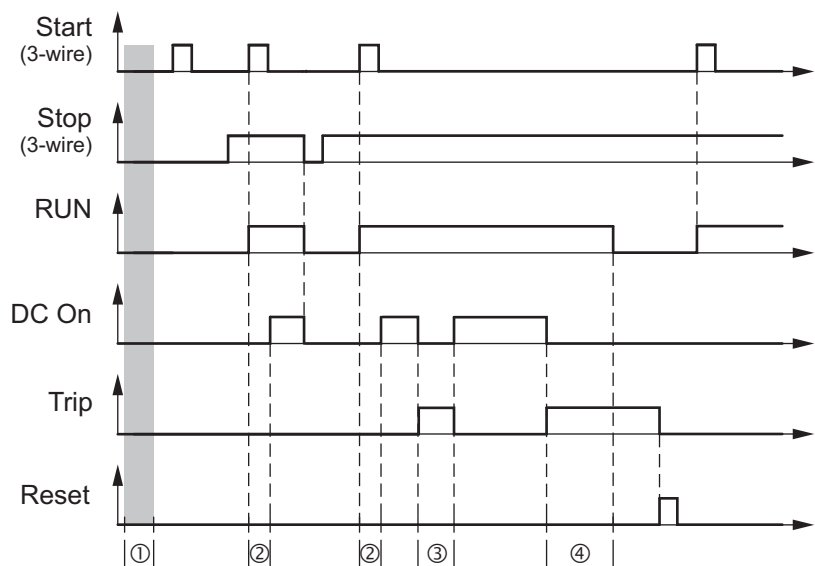
3-wire control

The three wire control is used for the processing of pulse commands. For control, the two logic inputs LI1 "Start (3-wire)" and LI2 "Stop (3-wire)" are to be wired.

A start command is triggered by switching-on the input "Start (3-wire)" for a short time (minimum pulse length 2 ms), if the input "Stop (3-wire)" is closed.

The stop command occurs by opening the stop input for a short time.

After connecting the mains voltage and also after a manual reset of a fault a new start command is necessary in order to reach drive state "Run".

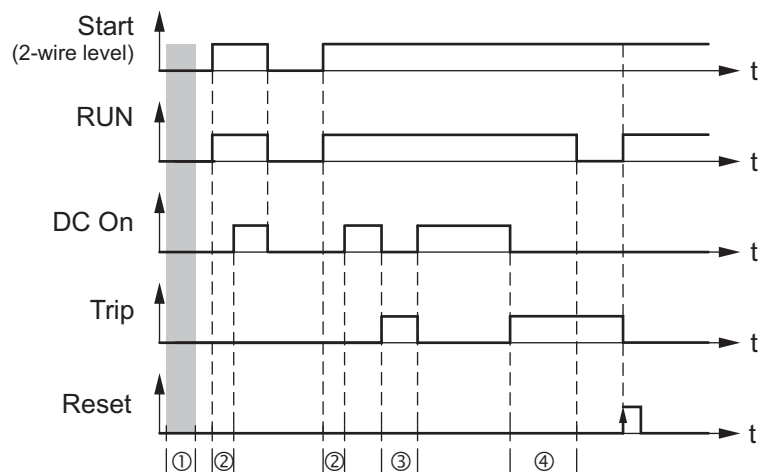


2-wire control (level rated)

This control variant represents the factory-made basic setting. Level rated 2-wire-control also allows control via a fix wire link between +24 V and LI1. With this control variant, only the signal level of the logic input "Start (2-wire)" is evaluated.

A closed input leads to a start command, an open contact leads to a stop command.

The signal states of the terminal signals have top priority so that resetting of an existing fault or connection to the mains leads to an automatic starting of the Active Front End if a start command is given.



① Booting procedure

When voltage is applied to the Active Front End, it needs about 3...5 seconds until the system is booted up.

② Charging time

When a start command is given, the Active Front End is set into operation. The inverter is not in operation until the DC link voltage has not reached its nominal value. This is recognised automatically. A certain charging time is necessary to create the DC line voltage and thus there is a delay until the inverter can be started (or until it starts automatically, when parameterized).

③ Autoreset (successful)

When an undervoltage occurs during operation, a fault takes place. Furthermore autoreset is started, that tries to start the Active Front End within a defined period of time. During this time there is still a Run signal. When the whole mains voltage is available within this time again and autoreset can be executed successfully, the fault is reset and the inverter starts (when parameterised accordingly).

④ Autoreset (not successful)

When a longer undervoltage situation or a mains failure occurs, a fault takes place. Furthermore autoreset is started, that tries to start the Active Front End within a defined period of time. During this time there is still a Run signal. If there is still an undervoltage situation after that time, it is not possible to execute autoreset successfully and Run state is not kept any longer. There is still a fault situation until it is reset manually.



At all control variants, a locking has always highest priority.

Fieldbus

By using the fieldbuses Modbus or CANopen, which are standard integrated, the control of the Active Front End occurs by means of a control word which serves a device internal state machine.

The autoreset function must not be used in case of fieldbus control.



Details of the respective fieldbuses can be found in the belonging documentation.

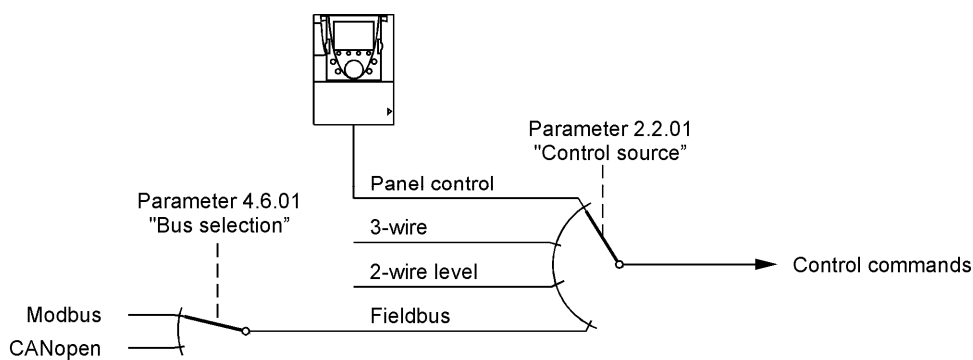
Panel control

The panel control of the device occurs by means of the keys on the removable operating panel. Switching between panel mode and remote mode (terminals or bus) is only possible with parameter 2.2.01.

The autoreset function must not be used in case of panel control.

Selection of the control source:

The internal design of the control path is structured in such a way that it can be switched between terminal control, panel mode and fieldbus control.






The switching of the control source can occur only in case of impulse inhibit.

2.2.01	Control source			3 .. 2-wire (level rated)
<div>2 ...3-wire</div> <div>3 ...2-wire (level rated)</div> <div>4 ...Fieldbus control</div> <div>5 ...Panel control</div>				

Parameter 2.2.01 allocates a control variant to the control source.

The wiring of the logic inputs has to take place according to the selected control source.

2.3		Operating panel	Functionalities of the operating panel
------------	---	------------------------	--



2.3.01	Operat.panel stop button			1 .. Local mode
1 ...Local mode 2 ...always				

Parameter 2.3.01 determines whether the stop key on the operating panel is also active in remote operation.

At setting "2 .. always" a stop command can be initiated also during control of the Active Front End via the terminals or with fieldbus.




The function is not to be used when using the 2-wire control (level-rated) !

2.3.02	Operat.panel monitoring			0 .. Not active
0 ...Not active 1 ...Active --> Stop				

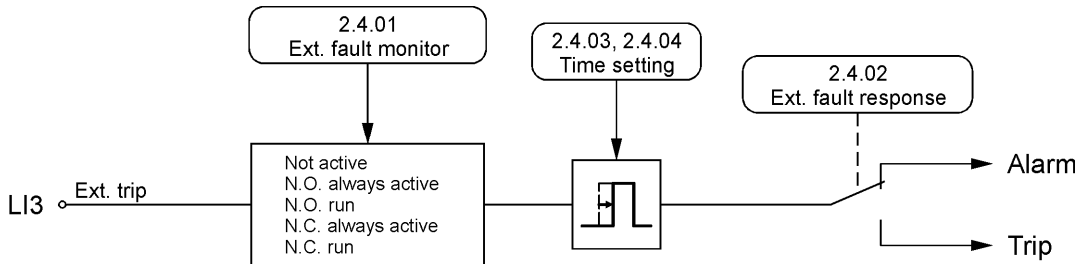
For panel operation, parameter 2.3.02 defines the reaction when the operation panel is disconnected from the AIC.



At setting "0 .. Not active" the operating state remains unchanged but then the Active Front End can be disconnected only by mains disconnection or by means of digital input PWR.

In case of setting "1 .. Active --> Stop" the Active Front End is stopped as soon as the operating panel is disconnected during panel operation.

2.4	Ext. 	External fault	Configuration of the external fault
------------	--	-----------------------	-------------------------------------



Should signals of the drive or the process be integrated in the protection concept of the device, then this occurs with the logic input "Ext. fault". The tripping behaviour and the temporal trigger performance are therefore adjustable to the demands of the system.



2.4.01	Ext. fault monitor				1 .. N.O. always active
0...Not active 1...N.O. always active 3...N.O. run 4...N.C.always active 6...N.C. run					



Parameter 2.4.01 defines the tripping behaviour of the logic input "Ext. fault".
As a result it can be differentiated as follows:

Setting	Logic input external fault initiates fault shut-down when...
0 .. Not active	... never
1 .. N.O. always active	... at closed input, independent from the operating state
3 .. N.O. run	... at closed input in Run state
4 .. N.C.always active	... at open input, independent from operating state
6 .. N.C. run	... at open input in Run state


2.4.02	Ext. fault response				3 .. -Δt- fault
1...-Δt- alarm 2...Alarm -Δt- fault 3...-Δt- fault					



Parameter 2.4.02 defines the behaviour of the Active Front End if the logic input "Ext. fault" triggers.
Depending on the process demands one of the following reactions can be selected:

Setting	Behaviour after trigger of the external fault
1 .. -Δt- alarm	No shut-down of the Active Front End takes place. An alarm message "External fault", which can be delayed, is set.
2 .. Alarm -Δt- fault	Immediate setting of the alarm message "External fault". After an adjustable delay a fault shut-down takes place if the state is still unchanged.
3 .. -Δt- fault	After an adjustable delay a fault shut-down takes place.


2.4.03	Start delay time				0 s
0...600 s					

The start delay time delays the monitoring of the logic input "Ext. fault" after a start command. As a result process-related instabilities can be blanked out after starting.

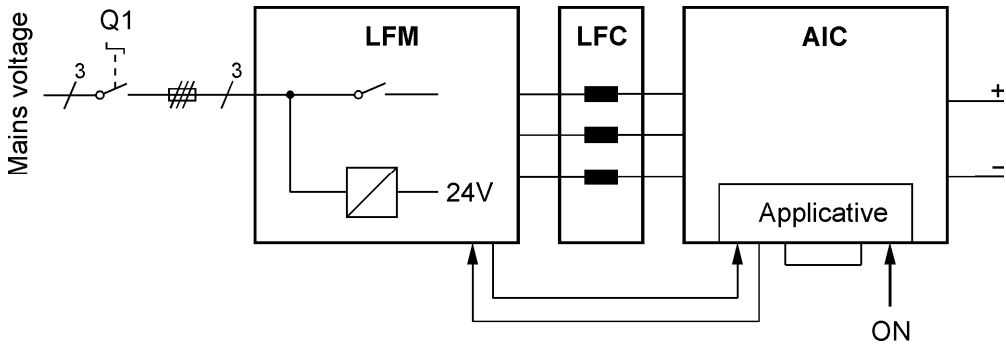
 The Start delay time is only active when selecting 2.4.01 "N.O. run" or "N.C. run".

2.4.04	Time Δt				0 s
0...300 s					

Delay time for the reaction selected with parameter 2.4.02 after the occurrence of a "External fault".



2.5		Fault configuration	Activating and adjustment of general protective functions
-----	---	----------------------------	---

The Active Front End is able to handle mains drops of up to 40 % without interruption of operation. However, the output power is restricted accordingly.



As the Active Front End operates depending on the mains, one- or three-pole phase losses are recognised in a few milliseconds and a fault shut-down takes place. By factory default, the autoreset function starts thereupon. The function tries to reach a normal operating state provided that a start command is still given.


If the mains voltage does not return within ten seconds, the Active Front End remains in fault state.


2.5.01	Autoreset			1 .. Active
0 ...Not active 1 ...Active				


When autoreset is activated, the Active Front End tries to start the system by automatic reset when a fault occurs.

A given start command (2-wire (level rated) or 3-wire) is kept during the autoreset period. When autoreset has not been executed successfully during the defined period of time, the Active Front End remains in fault state. A Reset via the keys at the operating panel or by the logic input LI4 does not lead to an automatic restart in case of 3-wire.


At bus operation there occurs in no case an automatic restart during autoreset.

 If a further fault occurs during the autoreset function is active, it is not displayed.


 When selecting the autoreset function, an automatic restart of the system takes place !


2.5.02	Autoreset selection	0110			
0 ...Line overvoltage	<input type="checkbox"/>	6 .. Line fault 2/3p	<input checked="" type="checkbox"/>		
1 ...AFE overtemp.	<input type="checkbox"/>	13.. External fault	<input type="checkbox"/>		
2 ...AFE overload	<input type="checkbox"/>	15.. switching freq. >>	<input type="checkbox"/>		
4 ...Bus error	<input type="checkbox"/>				
5 ...Line fault 1p	<input checked="" type="checkbox"/>				

By factory setting, only the two phase loss messages lead to an activation of the autoreset function.

2.5.03	Alarm	0110			
0 ...External fault	<input type="checkbox"/>				
2 ...Undervoltage	<input type="checkbox"/>				
4 ...Bus error	<input type="checkbox"/>				
5 ...Sync	<input type="checkbox"/>				
13...Limitation	<input type="checkbox"/>				
15...Service AFE	<input type="checkbox"/>				

With the monitoring and protection concept of the Active Front End it is possible to transfer faults to the superposed control as fault messages or as alarm message.

3		Input / Output	Configuration of the inputs/outputs as well as the fieldbus connection
----------	---	-----------------------	--

3.2		Logic inputs	Configuration of the logic input
------------	---	---------------------	----------------------------------

The logic inputs of the Active Front End AFE are used to adopt commands from upstream control systems. The commands can be executed by connecting +24 V to the terminals.

Switch SW1 has to be in position "source" and switch SW2 in position "LI6".

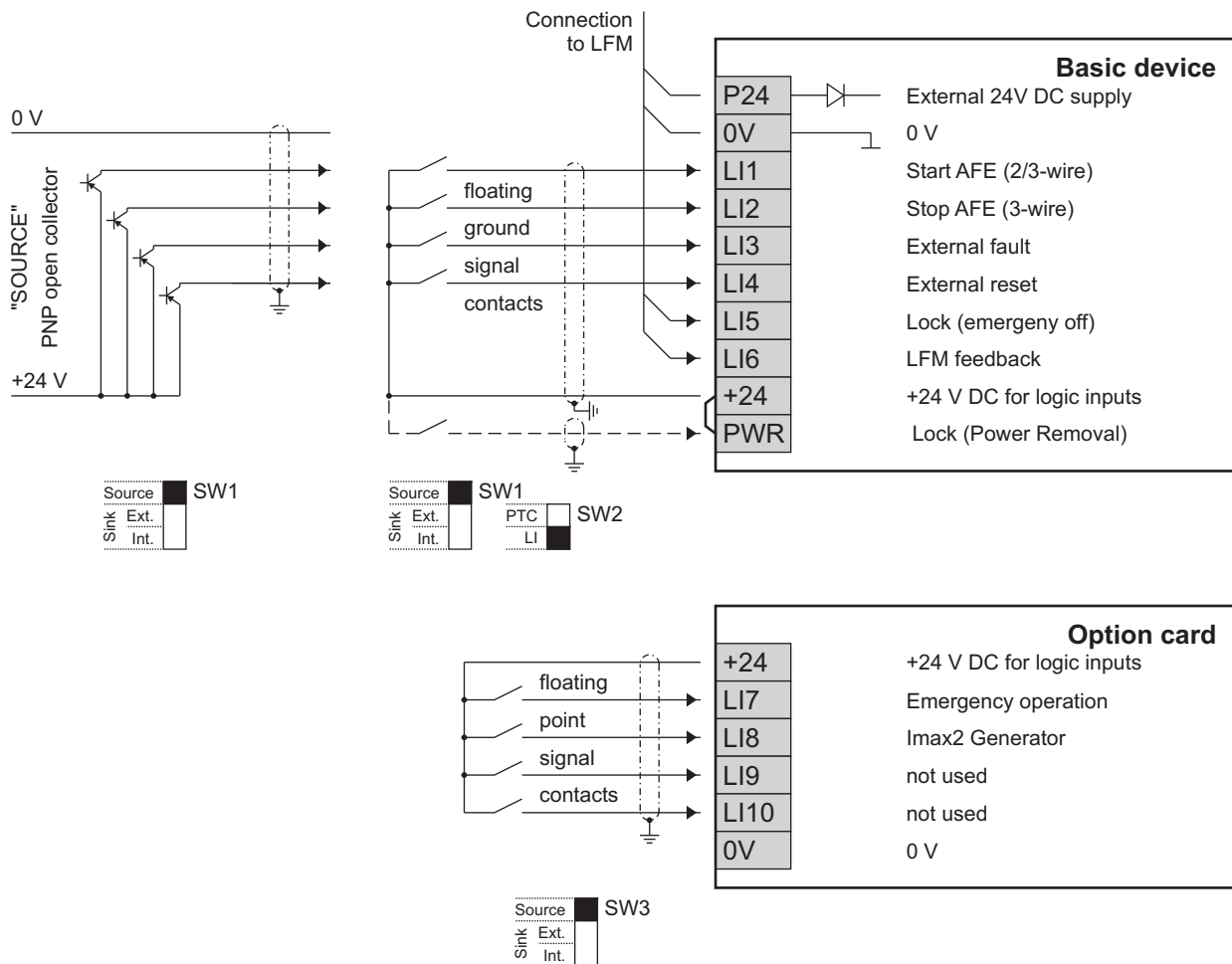
The assignment of the logic inputs is fixed and cannot be changed.

Input	Function	Position	Signal level	see also parameter group
LI1	Start AFE (2/3 wire)	Basic device	+24 V	2.2
LI2	Stop AFE (3 wire)	Basic device	+24 V	2.2
LI3	External fault	Basic device	+24 V ¹⁾	2.4
LI4	External reset	Basic device	+24 V ¹⁾	2.5
LI5	Lock (Emergency off)	Basic device	+24 V ¹⁾	
LI6	LFM confirmation	Basic device	+24 V ¹⁾	
PWR	Lock (Power removal)	Basic device	+24 V ¹⁾	
LI7	Emergency operation AFE	Option card	+24 V ¹⁾	4.3
LI8	I max 2 generator	Option card	+24 V ¹⁾	4.1
LI9	Not used	Option card	+24 V	
LI10	Not used	Option card	+24 V	

¹⁾ These signals are available on the terminals anyway even if it is switched over to bus operation.




Technical details on the control terminals can be found in the mounting instructions.



3.2.01	LI inversion		0110			
0...LI 1	<input type="checkbox"/> / <input checked="" type="checkbox"/>		6.. LI 7	<input type="checkbox"/> / <input checked="" type="checkbox"/>		
1...LI 2	<input type="checkbox"/> / <input checked="" type="checkbox"/>		7.. LI 8	<input type="checkbox"/> / <input checked="" type="checkbox"/>		
2...LI 3	<input type="checkbox"/> / <input checked="" type="checkbox"/>		8.. LI 9	<input type="checkbox"/> / <input checked="" type="checkbox"/>		
3...LI 4	<input type="checkbox"/> / <input checked="" type="checkbox"/>		9.. LI 10	<input type="checkbox"/> / <input checked="" type="checkbox"/>		
4...LI 5	<input type="checkbox"/> / <input checked="" type="checkbox"/>					
5...LI 6	<input type="checkbox"/> / <input checked="" type="checkbox"/>					

With parameter 3.2.01 individual logic inputs can be inverted.

3.2.02	LI at bus mode active	0110			
0.. LI 1	<input type="checkbox"/> / <input checked="" type="checkbox"/>	6.. LI 7	<input type="checkbox"/> / <input checked="" type="checkbox"/>		
1.. LI 2	<input type="checkbox"/> / <input checked="" type="checkbox"/>	7.. LI 8	<input type="checkbox"/> / <input checked="" type="checkbox"/>		
2.. LI 3	<input type="checkbox"/> / <input checked="" type="checkbox"/>	8.. LI 9	<input type="checkbox"/> / <input checked="" type="checkbox"/>		
3.. LI 4	<input type="checkbox"/> / <input checked="" type="checkbox"/>	9.. LI 10	<input type="checkbox"/> / <input checked="" type="checkbox"/>		
4.. LI 5	<input type="checkbox"/> / <input checked="" type="checkbox"/>				
5.. LI 6	<input type="checkbox"/> / <input checked="" type="checkbox"/>				


When the control source selection (see parameter 2.2.01) is used to switch between terminal and fieldbus operation it might be necessary to have individual logic input functions available on the terminals despite the fact that the control source has been switched to the field bus.

This exception from switch-over can be configured by the appropriate selection with parameter 3.2.02 "LI at bus mode active".

For this reason, the respective logic input in the parameter 3.2.02 "LI at bus mode active" must be marked for logic input commands that shall be effective both in the bus operation as well as the terminal operation.

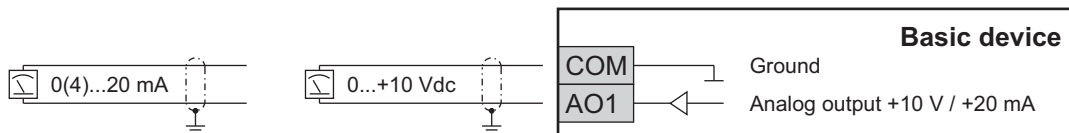


When a control signal is configured both on a free bit at the bus as well as on the terminals which are active during bus operation, the bus command will be preferred.



3.3		Analog output	Configuration of the analog output
------------	---	----------------------	------------------------------------

The Active Front End provides an analog standardized signal output to forward analog information. The size to be issued, their scaling as well as the standardized signal to be used can be freely configured.



Output	Standardized signal	Position	Terminal marking
AO1	0...+10 V, 0...20 mA or 4...20 mA	Basic device	AO1 COM







Process size	Unit	Scaling
1 .. AFE load	%	100 % = Nominal operation
2 .. Mains current	%	100 % = Mains current 1.1.03
3 .. Power	%	100 % = Nominal power 1.1.02
4 .. Power	%	100 % = Nominal power 1.1.02
5 .. Line filter voltage	%	100 % = Mains voltage 1.1.04
6 .. DC voltage	%	100 % = 1000 V DC
7 .. Parallel operation	–	Special function for synchronisation of Active Front Ends working parallel

3.3.01	AO1 selection				2 .. Mains current
	0 ...Not used				5... Line filter voltage
	1 ...AFE load				6... DC voltage
	2 ...Mains current				7... Parallel operation
	3 ...Power				
	4 ... Power				

Selection of the size to be displayed at the analog output.

3.3.02	AO1 level				4 .. 4 ... 20 mA
	1 ...0 ... 10V				
	3 ...0 ... 20 mA				
	4 ...4 ... 20 mA				

3.3.03	AO1 min. value				0 %
	-300...300 %				

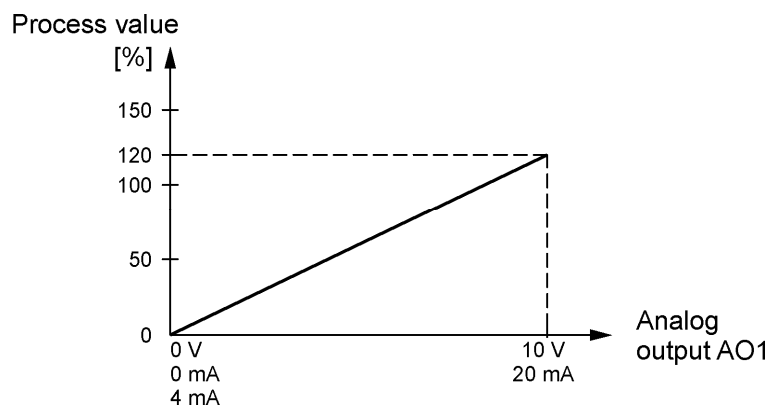
3.3.04	AO1 max. value				150 %
	-300...300 %				

The two parameters "3.3.03 AO1 min. value" and "3.3.04 AO1 max. value" are used for linear scaling of the analog output signal. Parameter 3.3.03 assigns according to the selection of the standardized signal (parameter 3.3.02) a process size to the minimum actual value signal (0 V, 0 mA or 4 mA), parameter 3.3.04 assigns it to the maximum actual value signal (+10 V or 20 mA).

The scaling of the process size and their unit can be seen from the table analog outputs.

Setting example for an unipolar size at analog output AO1:

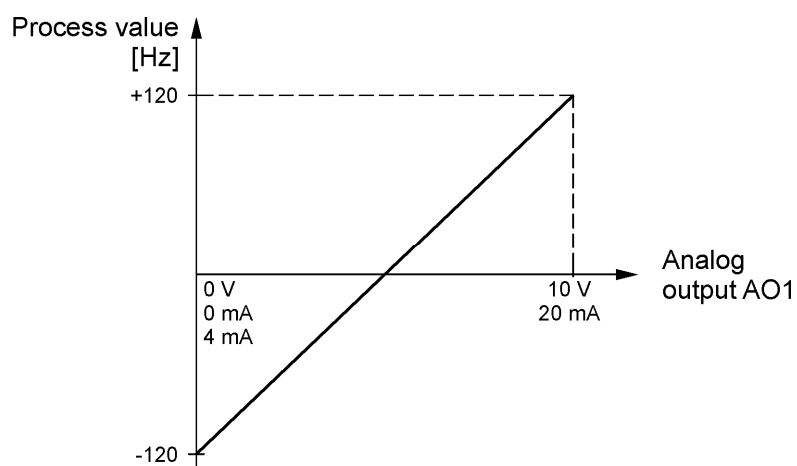
Process size	Scaling	3.3.03 AO1 min. value	3.3.04 AO1 max. value	Scaling of the output signal
1 .. AFE load	100 % = Nominal operation	0 %	120 %	20 mA at 120 %



For process sizes with a possible overload such as load, thermal load etc. it is recommended to set AO1 max. value in such a way that a representation of the overload range is possible.

Settings example for a bipolar size at analog output AO1:

Process size	Scaling	3.3.03 AO1 min. value	3.3.04 AO1 max. value	Scaling of the output signal
3 .. Power	100 % = 120 %	-120 %	+120 %	4 mA at -120 % 20 mA at +120 %



3.4



Logic outputs

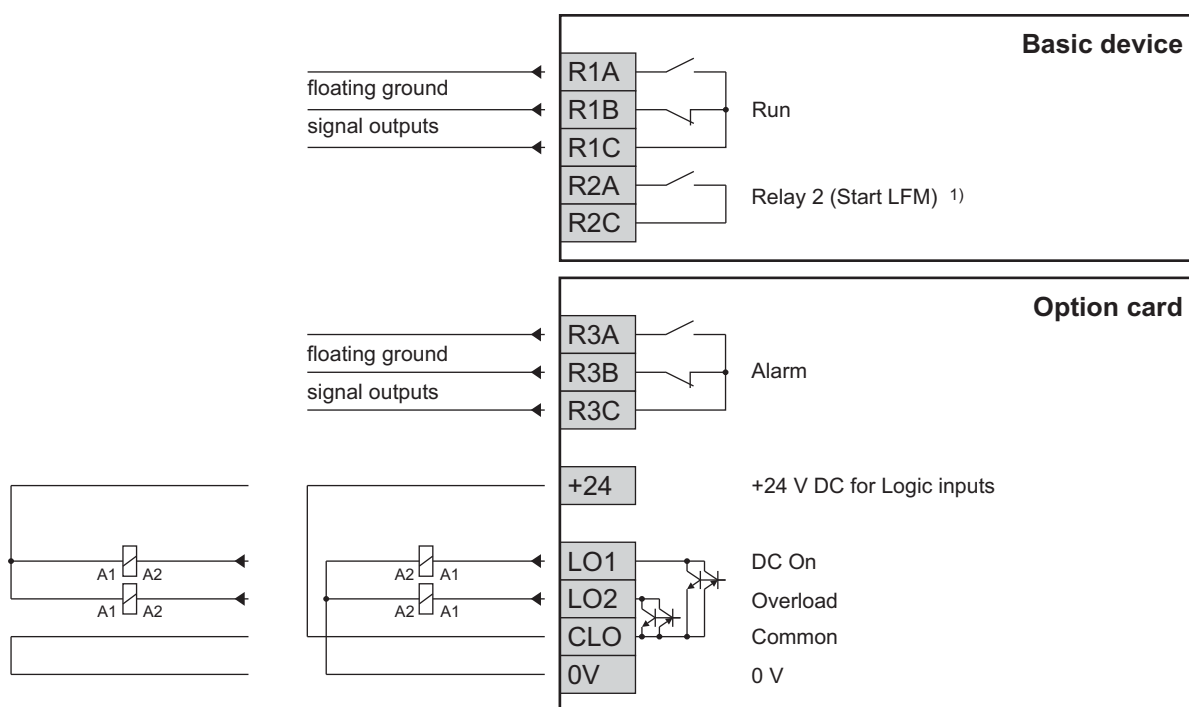
Configuration of the logic outputs

The digital status information on the device or the process that are available in the Active Front End can be issued as messages by means of logic outputs. Floating ground relay outputs and open collector outputs are available.

The signal assignment as well as an inversion of the individual outputs can be freely configured.

The following logic outputs are available at the Active Front End:

Output	Type of output	Position	Terminal marking	Comment
R1	Floating ground relay (N.O./N.C.)	Basic device	R1A R1B R1C	Function adjustable
R2 ¹⁾	Floating ground relay (N.O.)	Basic device	R2A R2B	Is required for control of the LFM
R3	Floating ground relay (N.O./N.C.)	Option card	R3A R3B R3C	Function adjustable
LO1	Open Collector output	Option card	LO1 CDO	Function adjustable Sink/Source selectable
LO2	Open Collector output	Option card	LO1 CDO	



¹⁾ Relay R2 is not available. It is required for control of the LFM.



The 24 V voltage from the Active Front End has a maximum load of 200 mA.

Logic output function	Relay is active... / Logic output active...
0 .. Not used	...never
1 .. Operation	...after the start command has been accepted and during the autoreset function is active.
2 .. DC On	...as long as the DC output voltage has reached the controlled operation and thus the operation of the connected inverter(s) is released.
3 .. Trip	...until an occurring fault is reset. No message is issued for faults that were reset by the Autoreset function.
4 .. Alarm	...as long as a parameterized alarm situation is given (see parameter 2.5.03).
5 .. Overload	...when the mains current is higher than the value set with parameter 3.4.06 or when the thermal load 1.1.08 is higher than 100 %.
6 .. Generator operation	...when the Active Front End operates as a generator.
7 .. Limitation active	...as long as a limitation function is active.
8 .. Charging module ON	...when the charging process of the DC link is completed.
9 .. DC link charged	...when an external charging module should charge the DC bus.
10 .. Sum alarm	...as long as an alarm situation is given.

3.4.01	R1 selection				1 .. Operation
3.4.02	R3 selection				4 .. Alarm
3.4.03	LO1 selection				2 .. DC On
3.4.04	LO2 selection				5 .. Overload


0...Not used	6... Generator operation
1...Operation	7... Limitation active
2...DC On	8... Charging module ON
3...Trip	9... DC link charged
4...Alarm	10 .. Sum alarm
5...Overload	





3.4.05	LO inversion	0110			
	3.. LO 1	<input type="checkbox"/> / <input checked="" type="checkbox"/>			
	4.. LO 2	<input type="checkbox"/> / <input checked="" type="checkbox"/>			

If a selected signal is required in inverted form it can be set with the parameter 3.4.05 "LO inversion" for every logic output separately.

3.4.06	Overload level				100 %
	0...120 %				

4	f_{xx}	Functions	Application-orientated functions
----------	----------	------------------	----------------------------------

4.1		Process protection	Limits
------------	---	---------------------------	--------

4.1.01	I max 1 generator				120 %
4.1.02	I max 2 generator				100 %





10...120 %

By means of the logic input function "I max2 generator" it is possible to switch between the two current limitations 4.1.01 and 4.1.02 during regenerating operation. This can be necessary especially for mains with changing power consumption.




The maximum permissible current overload is limited by the Active Front End AFE. If the duration of the overload is exceeded, a protective shut-down of the Active Front End takes place.

4.3		Emergency operation	Activating the emergency operation for the benefit of human protection
------------	---	----------------------------	--


4.3.01	Enable emergency op.				0 .. Disable
	0 ...Disable 1 ...Enable				
4.3.02	Emergency op. active				0 .. Disable
	0 ...Disable 1 ...Enable				

The function "Emergency operation" enables the operation of the Active Front End with deactivated device protection. This is necessary for plants in which all functions are primarily directed to personal protection in case of an emergency (e.g. tunnel ventilating systems).

The function is activated by a logic input that is parameterized at the function "Emergency operation". As a result all limitations of the Active Front End are switched off, process faults detected by the software are treated as alarms and the autoreset function is approved unlimited.


 By means of the function "Emergency operation" the operation of the Active Front End can also occur outside the specifications. The warranty claim expires in this case !


In order to prevent an unintentional selection of this function, the entry of a service code is necessary before activation or deactivation of the function via parameter 6.1.05 Service code AFE. The service code is mentioned in the service documentation.



4.6		Bus settings	Configuration of the fieldbus connection
------------	---	---------------------	--



The parameter description of the different fieldbuses is given in the respective fieldbus documentation.



5		Diagnosis	Quick diagnosis of operating states
----------	---	------------------	-------------------------------------

5.1		Test function	Test routines, simulation mode
------------	---	----------------------	--------------------------------

5.1.01	Software reset				
1 ...Execute reset					

The software reset aborts all running processes and reboots the control electronics.

The software reset is necessary to accept the slave address of a fieldbus option which has been changed as well as for the activation of the simulation mode.

5.1.02	Simulation mode				
0 ...Not active					
1 ...Active					

When the simulation mode is activated, the whole power part is disconnected from the control and its behaviour is simulated. As a result, a pre-commissioning of the device is possible without produced voltage at the output of the Active Front End.



During simulation mode the charging contactor and the line contactor in the line filter module LFM are not controlled. Thus this mode is only executed with the existing 24 V supply of the control electronics.



In order to set the internal serial connection between power part and control part electronics to a valid state, a software reset (parameter 5.1.01) or a restart of the device via switching off/on is necessary before final activation.

This is also valid for exiting the simulation mode.

5.2



Fault memory

Support for fault diagnostics

The fault memory provides a protocol of the last eight fault shut-downs and therefore it supports you in detecting the cause of the fault. For each fault shut-down a number of operating states are stored and provided for manual evaluation.

5.2.01	Number of faults AFE	Last entry in the memory:	15
--------	----------------------	---------------------------	----

5.2.02	Review AFE	Event -2	Last event -1	Last event
--------	------------	----------	---------------	------------

5.2.03	Fault number AFE	13	14	15
5.2.04	Fault cause AFE	PWR fault	External fault	Line fault 2-3p
5.2.05	Operating hours AFE	1362h	1438h	1817h
5.2.06	Min / sec	13.17 m:s	55.32 m:s	2.55 m:s
5.2.07	Energy direction AFE	Motor	Generator	Motorb
5.2.08	Line filter voltage AFE	405 V	400 V	334 V
5.2.09	Mains current AFE	130 A	902 A	245 A
5.2.10	DC voltage AFE	566 V	566 V	732 V
5.2.11	AFE load	13 %	90 %	57 %
5.2.12	Control mode AFE	Terminals	Terminals	Terminals
5.2.13	Operating state AFE	Alarm	I-limit active	Alarm
5.2.14	Alarm message AFE	Simulation active	-	Overload
5.2.15	Device state AFE	RUN	RUN	RUN
5.2.16	Bus STW AFE	007F	007F	007F
5.2.17	Bus ZTW AFE	007F	007F	007F





All diagnostic values correspond to the actual values 10 ms before fault shut-down.


5.2.01	Number of faults AFE				
--------	----------------------	--	--	--	--

5.2.02	Review AFE				0 .. Last event
	0...Last event				
	1...Last event -1				
	2...Event -2				
	3...Event -3				
	4...Event -4				
	5... Event -5				
	6... Event -6				
	7... Event -7				

5.2.03	Fault number AFE				
--------	------------------	--	--	--	--

5.2.04	Fault cause AFE				
	<div> 0...No fault 2...Overvoltage DC 3...Line overvoltage 4...MC not ready 6...Precharging fault 8...Line fault 1p 9...Line fault 2-3p 10...Overcurrent 11...earth fault 12...Insulation fault 13...switching freq. >> 14...AFE overload 19...AFE overtemp. 20...Unknown MC 21...PTC short circuit </div> <div> 22.. PTC open circuit 23..ASIC Init fault 25..IGBT fault 26.. Differential current >> 30.. Current measure fault 32.. MC E² zones invalid 33.. CPU fault 34.. ISL fault 35.. MTHA fault 37.. PWR fault 39.. Opt. comm. fault 40.. Wrong option card 41.. Bus error 42.. Param. config. fault 57.. Configuration fault </div> <div> 58.. External fault 60.. Precharging fault 64.. Internal SW error 65.. Power rating fault 66.. Incompatible MC 67.. Flash fault APP 68.. Indus zone fault 69.. Eprom fault APP 73.. 24V fault 80.. Loss of operat. panel 81.. AFE overload 86.. Sync-Error </div>				
5.2.05	Operating hours AFE				h
5.2.06	Min / sec				m:s
5.2.07	Energy direction AFE				
	0...Motor 1...Generator				
5.2.08	Line filter voltage AFE				V
5.2.09	Mains current AFE				A
5.2.10	DC voltage AFE				V
5.2.11	AFE load				%
5.2.12	Control mode AFE				
	1...Local mode 2...Terminals 3...Modbus 4...CANopen				
5.2.13	Operating state AFE				
	1...Alarm 2...I-limit active				
5.2.14	Alarm message AFE				
	<div> 0...No alarm 2...Emergency op. active 3...External fault 5...Undervoltage 9...Bus error </div> <div> 21.. Overload 26.. Service AFE 28.. Simulation active 29.. Download active 38.. IGBT > </div> <div> 45.. Loss of operat. panel 46.. Control requ. missing 51.. I-limit active 58.. PTC/LI (SW2) wrong </div>				

5.2.15	Device state AFE				
	1 ...Lock (PWR)	15 ..RUN			
	2 ...Trip	16 .. Stop			
	3 ...Load	19 .. Lock			
	4 ...Mains off				
	5 ...Mains missing				
5.2.16	Bus STW AFE	0110			
	0 ...Switch on				
	1 ...OFF 2 (pulse inhibit)				
	3 ...Release operation				
	7 ...Reset				
	10...Control OK				
5.2.17	Bus ZTW AFE	0110			
	0 ...Ready to switch on	6... Lock switching on			
	1 ...Ready to run	7... Alarm			
	2 ...Operation released	9... Control requested			
	3 ...Trip				
	4 ...No OFF 2				


5.3		State	Logic inputs and outputs		
------------	---	--------------	--------------------------	--	--


5.3.01	LI state basic device		0110	<input checked="" type="checkbox"/>		
	0.. LI 1	<input type="checkbox"/> / <input checked="" type="checkbox"/>	4.. LI 5	<input type="checkbox"/> / <input checked="" type="checkbox"/>		
	1.. LI 2	<input type="checkbox"/> / <input checked="" type="checkbox"/>	5.. LI 6	<input type="checkbox"/> / <input checked="" type="checkbox"/>		
	2.. LI 3	<input type="checkbox"/> / <input checked="" type="checkbox"/>	6.. PWR	<input type="checkbox"/> / <input checked="" type="checkbox"/>		
	3.. LI 4	<input type="checkbox"/> / <input checked="" type="checkbox"/>				

5.3.02	LI state option		0110	<input checked="" type="checkbox"/>		
	0.. LI 7	<input type="checkbox"/> / <input checked="" type="checkbox"/>				
	1.. LI 8	<input type="checkbox"/> / <input checked="" type="checkbox"/>				
	2.. LI 9	<input type="checkbox"/> / <input checked="" type="checkbox"/>				
	3.. LI 10	<input type="checkbox"/> / <input checked="" type="checkbox"/>				

5.3.03	LO state basic device		0110	<input checked="" type="checkbox"/>		
	0.. R 1	<input type="checkbox"/> / <input checked="" type="checkbox"/>				
	1.. R 2	<input type="checkbox"/> / <input checked="" type="checkbox"/>				


5.3.04	LO state option		0110	<input checked="" type="checkbox"/>		
	0.. R 3	<input type="checkbox"/> / <input checked="" type="checkbox"/>				
	1.. LO 1	<input type="checkbox"/> / <input checked="" type="checkbox"/>				
	2.. LO 2	<input type="checkbox"/> / <input checked="" type="checkbox"/>				



6		Service	Service-orientated information and functions
----------	---	----------------	--



6.1		Code	Parameter lock, selection of the parameterization station
------------	---	-------------	---

The parameter lock serves as protection against unintentional or unauthorized parameter changes. If a parameter is tried to be changed during active parameter lock, the message "Parameterization locked" appears on the operating panel.


The parameters can be locked with the software by means of a code entry.



 Reading the parameters is possible at any time irrespective of an active lock.

6.1.01	Code AFE				
0...9999					


6.1.02	Code value AFE				
0...9999					



The parameter lock is active as long as parameter 6.1.01 "Code AFE" has another value than parameter 6.1.02 "Code value AFE". The code value itself is readable so that the code cannot be forgotten.

 For devices that have an OEM code, parameter 6.1.02 "Code value AFE" is not readable. In this case, ask the respective service department for the code.

6.1.03	Parametrising station				1 .. Panel control
1 ...Panel control 2 ...Modbus 3 ...CANopen					



The parameterization can be realized from different sources. If a parameterization source wants access to write to one parameter, this parameterization source must be selected first.

 Access to read is possible from all sources.

6.1.04	Lock				0 .. Not active
0 ...Not active 1 ...Active					

Parameter 6.1.04 represents an impulse inhibit which is activated by parameterization. With this function a start of the drive can be prevented (used in case of parameterization of the Active Front End by means of fieldbus connection).

Setting "1 .. Active" leads to an OFF process and locks all ON commands.

6.1.05	Service code AFE				
--------	------------------	---	--	--	--

0...59999



A four-digit service code authorises the service department to perform service activities like calibration and the like.

In case of inappropriate adjustment malfunctions of the device are possible. Therefore the code has to be changed only by the service department !

6.2		Service AFE	Reserved for service department
------------	---	--------------------	---------------------------------



The parameters of this group are used for visualisation and adaptation of device-internal functions and are reserved for the service department.

Commissioning

Commissioning procedure

Check of power wiring

- The mains supply has to be connected to the terminals 1L1 / 1L2 / 1L3 at the Line Filter Module LFM.
- The Line Filter Choke LFC is connected between the Line Filter Module (at the terminals 2L1 / 2L2 / 2L3) and the Active Infeed Converter AIC (at the terminals 3L1 / 3L2 / 3L3).
For 400 V devices from 430 kW (for 500/690 V devices from 540 kW) there are two Line Filter Modules and two Line Filter Chokes connected in parallel.
- The values of the main fuses correspond to the table in chapter "Fuses and cable cross sections" in the mounting instructions.
- Commissioning is only allowed with a connected inverter.
- Check whether there is no reverse polarity, no short circuit and no earth fault in the DC connection between the Active Infeed Converter and the inverter.

Check of control and power wiring

- The fan supply of the Active Infeed Converter AIC is properly connected to the Line Filter Module LFM (terminal strip X1 / terminal 1 / 2 / 3).
- The fan supply between the inverter and the Line Filter Module LFM is established (terminal strip X1 / terminal 4 / 5 / 6).
- The plugs on the "Fan-Supply-Board" of the inverter are connected in the right position (see mounting instructions chapter "Fan supply").
- The control wires (W2 and W3) of the Active Infeed Converter AIC are connected to the Line Filter Module LFM (X2 / X3).
- For parallel operation of Active Front End units the synchronisation line has to be established.

Check of the RFI-filter

- Does the setting of the integrated RFI-filter in the Line Filter Module LFM correspond to the mains situation (TT, TN or IT, Corner Grounded)?
- Is the integrated RFI-filter in the inverter deactivated (position IT mains or corner grounded)?

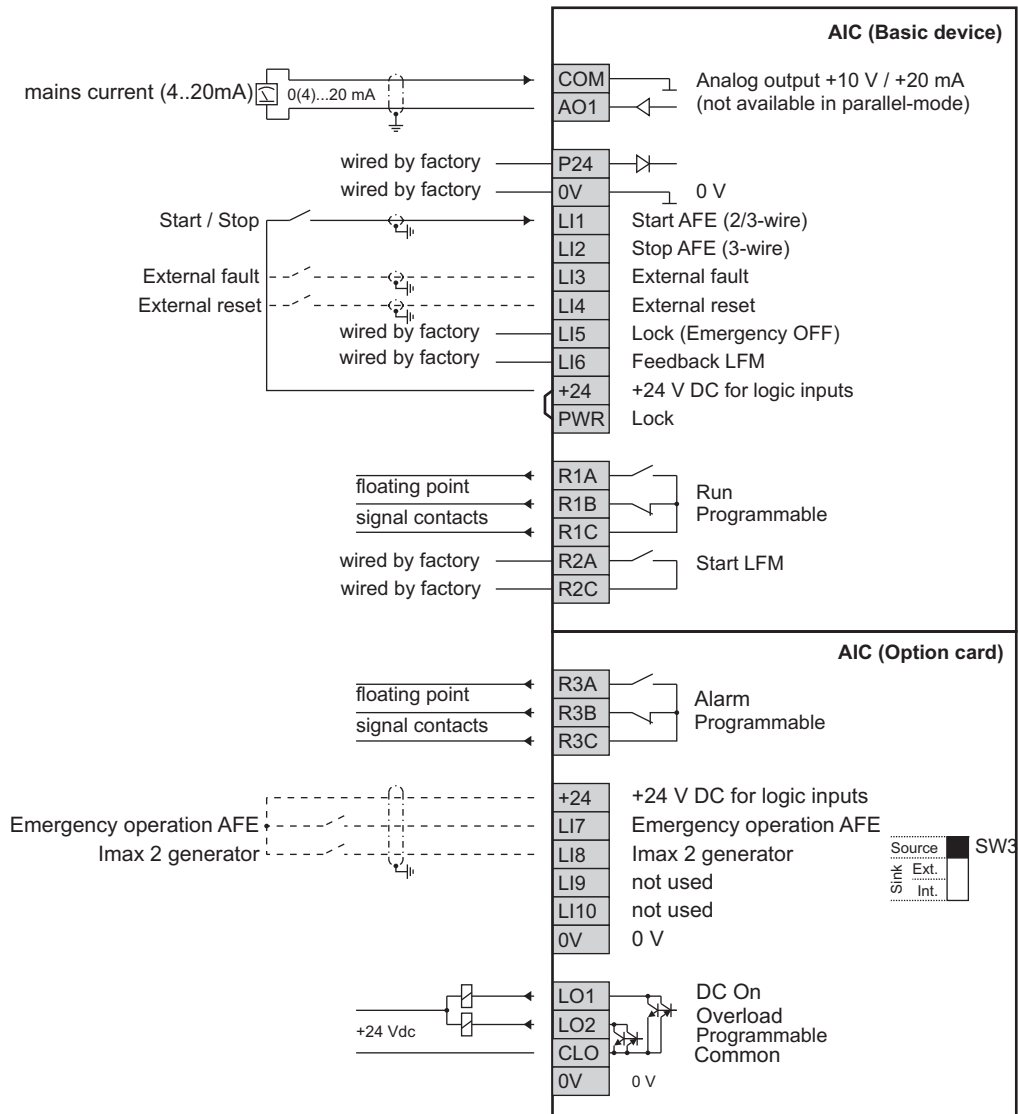
Switch on mains voltage and make control measurements

- Are the three phase voltages available and are they symmetrical?
(observe the regulation "Work on Live Equipment")
- Switch on mains.
- Check the 24 V buffer voltage.
- Adjust the parameter 2.1.01 [Mains voltage] at the Active Infeed Converter according to the used mains voltage.
- Adjust the parameter UrES [Mains voltage] at the inverter (or at the inverters) according to the used mains voltage.
- Activate the parameter AFE [Regen. connection] at the inverter.
- Further settings at the inverter see chapter "Required settings at the inverter", page 63.

Factory setting

The Active Front End is factory-set for the most common operating conditions:

- Supply voltage: 480V – 60Hz / 690V – 60Hz
- Control source: 2-wire (level rated)



- Display
 - Selection upper field: mains current AFE [%]
 - Selection lower field: effective power [kW]
- External fault
 - Ext. fault monitoring: N.O. always active
 - Ext. fault reaction: -Δt-fault
- Fault management
 - Autoreset: active (only for mains failure or input phase loss)
- Parallel operation: no parallel operation

Settings at the inverter

Software

The ATV61/71 frequency inverters with the following software versions are able to operate with an Active Front End. The necessary parameters can be readout only via the graphic display terminal

Altivar 61

Menu [1.11 IDENTIFICATION]

- [APPL. SOFTWARE] = B2.1IE20 or higher
- [MC-SOFTWARE] = A2.3IE34, P1.5IE20 or higher
- [PRODUCT] = V2.1IE23 or higher

Altivar 71

Menu [1.11 IDENTIFICATION]

- [APPL. SOFTWARE] = A3.3IE40 or higher
- [MC-SOFTWARE] = A2.3IE34, P1.5IE20 or higher
- [PRODUCT] = V3.3IE43 or higher

Altivar 71...383

Menu [1.11 IDENTIFICATION]

- [APPL. SOFTWARE] = D3.4IE41 or higher
- [MC-SOFTWARE] = C2.4IE35, P1.5IE20 or higher
- [PRODUCT] = V3.4IE44 or higher

Parameter settings

Required settings at the inverter

It is absolutely necessary to carry out the following settings for all frequency inverters connected to an Active Front End:

- *RFE* [Regen. connection] in menu [1.7 APPLICATION FUNCT.] (FUn-) in submenu [REGEN. CONNECTION] (Olr-) Setting: [Yes] (YES)
Thereby the undervoltage level of the frequency inverter is adapted to the operation with the Active Front End.
Please contact our service team if this parameter is not available in the parameter list of your device!
- *brR* [Braking balance] in menu [1.7 APPLICATION FUNCT.] (FUn-) in submenu [RAMP TYPE] (rPt-) Setting: [No] (nO)

- **dEC** [Deceleration] in menu [1.7 APPLICATION FUNCT.] (FUn-) in submenu [RAMP TYPE] (rPt-)

For dynamic processes a very short deceleration ramp can cause an overload on the DC-bus with an overvoltage fault shut-down.
This can be prevented by an extension or rounding of the deceleration ramp (parameters **LR3** [Begin Dec round]; **LR4** [End Dec round]).
- **UrES** [Mains voltage] in menu [1.8 FAULT MANAGEMENT] (FLt-) in submenu [UNDERVOLTAGE MGT.] (USb-)

Same setting as the Active Front End.
Thereby the internal voltage levels of the frequency inverter are adapted.
- **IPL** [Input phase loss] in menu [1.8 FAULT MANAGEMENT] (FLt-) in submenu [INPUT PHASE LOSS] (OPL-)

Setting: [Ignore] (nO)
- **bUb** [Brake res. fault Mgt] in menu [1.8 FAULT MANAGEMENT] (FLt-) in submenu [BU PROTECTION] (bUF-)

Setting: [Ignore] (nO)
- **LEL** [2 wire type] in menu [1.5 INPUTS/OUTPUTS CFG] (I-O-)

Setting: [Level] (LEL)
In order to ensure an automatic restart by the AFE after an undervoltage recognition. An automatic restart only possible with 2-wire control.
- **RFI filter**

The integrated RFI filter has to be deactivated (position IT, non-grounded mains) at all devices because there exists no direct mains connection of the frequency inverter in case of operation with an Active Front End.



Non-observance of these precautions may cause material damage.



The 24 V control voltage of the Active Front End AFE can also be used to buffer the control electronics of the frequency inverter.



When the frequency inverter is supplied via the DC link an external supply for the device fans is required!

Via the LFM (line filter module) it is possible to supply the device fans with up to 4 additional inverters (with the same power as the AIC).

Schneider Electric Power Drives GmbH

Ruthnergasse 1
A-1210 Vienna
Phone: +43 (0) 1 29191 0
Fax: +43 (0) 1 29191 15

Due to evolution of standards and equipment, the characteristics indicated in texts and images of this document do not constitute a commitment on our part without confirmation.
Design: Schneider Electric Power Drives
Photos: Schneider Electric Power Drives