Allen-Bradley

Bulletin 161
Single Phase
AC Drive

1~ / 200-240V
0.2 – 2.2 kW

User Manual

Table of contents

Attentions and safety guidelines

Before installing the Bulletin 161 drive and putting it into operation, please read this user manual carefully and take note of all the Attentions and safety guidelines. Always keep this product manual near the Bulletin 161 drive so that it is easily accessible.

Definition of the guidelines

⚠ ATTENTION

Failure to comply with these precautions may result in death, serious personal injury or substantial damage to equipment.

General information

Conventions used in this manual

To help differentiate parameter names and selection tags from other text the following conventions will be used:

- parameter names will appear in *italic* (example: *C22, d07*)
- selection tags for inputs and outputs will appear in [brackets] (example: [RS], [CF1])

⚠ ATTENTION

- **This Bulletin 161 drive generates dangerous electrical voltages and controls potentially dangerous rotating mechanical parts. Disregarding the guidelines provided in this manual may result in death, serious personal injury or substantial damage to equipment.**
- **The installation, commissioning and maintenance of these drives may only be carried out by experienced personnel who are thoroughly familiar with the functioning of the equipment and the entire machine.**
- **The devices feature dc-bus capacitors that are live even when the mains supply is switched off. For this reason wait at least 5 minutes after switching off the mains supply before you open the device and start working on it. Take care that you do not touch any live parts.**
- **The drive is intended to be installed with a fix connection to earth. The protective earth only offers protection for the drive, not against personal injury. According to EN 50178 it is not recommended to use the Bulletin 161 drives on protective fault current switches as, due to a possible DC component (rectifier load), the sensitivity of the safety switch will be reduced in the event of a failure. If unavoidable, only type B RCD's should be used. As a precautionary measure, the EN 50178 regulations should be observed. The stop button on the integrated control panel may not be used for emergency purposes. The stop button can be activated via parameter *b87*.**

⚠ ATTENTION

Earth the Bulletin 161 drive at the connections intended for this.

⚠ ATTENTION

- **To prevent any injuries or damage, do not touch any components located within the housing – either with your hands or with any other objects – if mains voltage is applied or if the DC-bus capacitors are not discharged. Do not carry out any work on the wiring or check any signals if mains voltage is applied.**

- **Exercise particular caution if automatic restart is activated. To prevent injuries caused by the automatic restarting of the drive following a power failure, install a switching component at the mains that is deactivated in the event of a power failure and that may only be switched on again on return of the power supply (e.g. contactor etc.). Earth the drive at the connections intended for this.**

⚠ ATTENTION

- **Ensure that the input voltage corresponds to the voltage indicated on the product nameplate. Environmental influences such as high temperatures and high relative humidity are to be avoided as well as dust, dirt and corrosive gases. The mounting location should be well ventilated and not exposed to direct sunlight. Install the device on a non-flammable, vertical wall that does not transmit any vibrations. Attention! Do not apply mains voltage to the output terminals U/T1, V/T2 and W/T3.**

- **Please contact the motor or machine manufacturers if standard motors with frequencies >50 Hz are to be used.**

- **All Bulletin 161 drives are checked for dielectric strength and insulation resistance. Insulation resistance measurements e.g. as part of a check may only be taken between the power terminals and earth. Do not carry out any measurements at the control terminals.**

- **In normal operation apply the START/STOP commands via the control terminals or the control panel and not by disconnection and reapplying input power to the drive or motor contactor. Do not install any capacitors or suppressors to the drive output terminals.**

⚠ ATTENTION

- **To ensure that your Bulletin 161 drive functions safely and reliably, all the pertinent safety regulations, e.g. accident prevention regulations, professional association regulations, EN, VDE regulations etc. must be observed. As these regulations are implemented differently in different countries, the user must observe the regulations that apply for his particular country. Rockwell Automation cannot release the user from complying with the latest relevant safety regulations.**

- **The technical data and descriptions in this user manual have been created to the best of our knowledge and belief. Enhancements to products are being made continually - Rockwell Automation therefore reserves the right to make modifications without previous notice.**

- **In spite of the care taken in producing this manual, Rockwell Automation cannot be held liable for any errors and damage arising from the use of this manual.**

1. Checking the scope of supply

Type description

161S - First Position

Bulletin Number

An “S” in the bulletin Number denotes a single phase input voltage

A Second Position

Voltage Rating

A 200-240V 1∅

A04 Third Position

Current Rating

A01	1.4 A
A02	2.6 A
A03	3.0 A
A04	4.0 A
A05	5.0 A
A07	7.1 A
A10	10.0 A

N Fourth Position

Enclosure Type

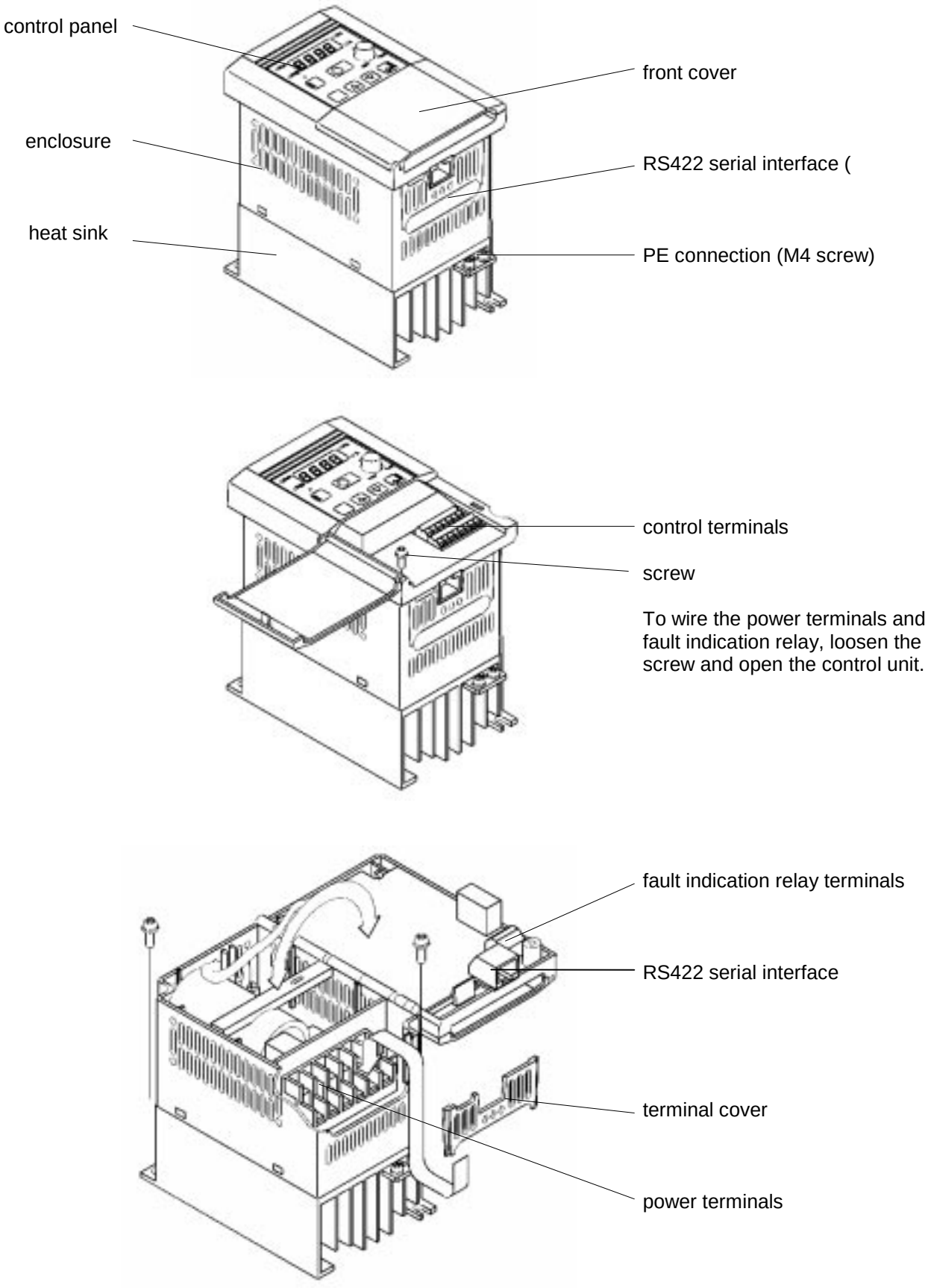
N IP20

PK Fifth Position

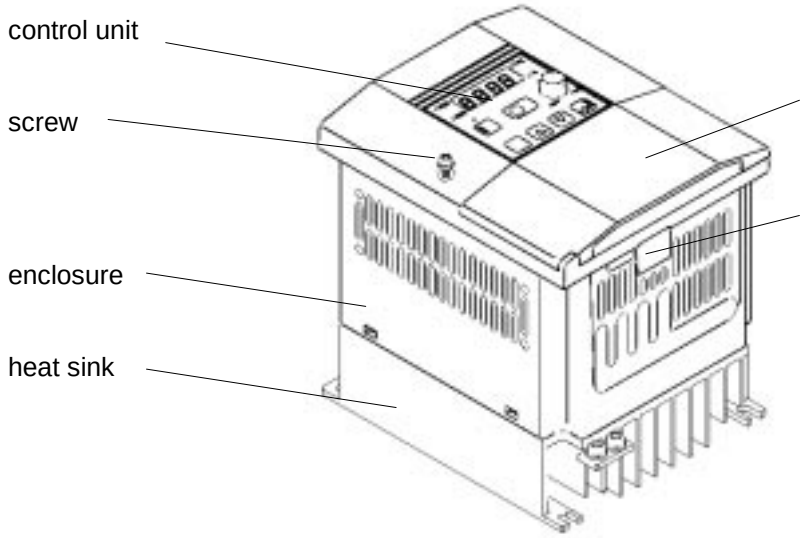
PK Integrated Programmer Keypad

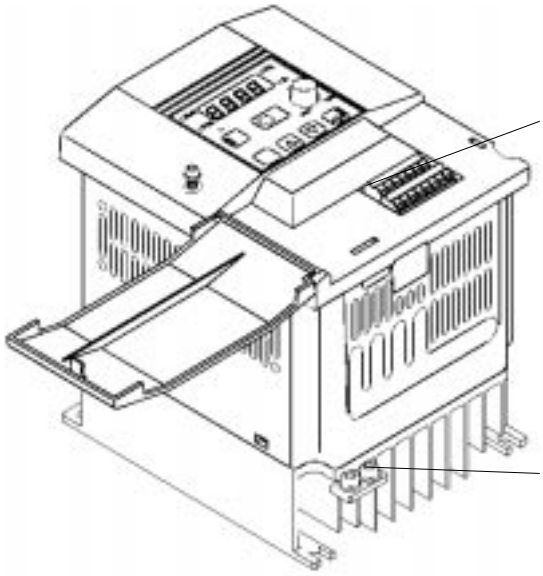
2. Structure of the device

Bulletin 161S-AA01 / AA02

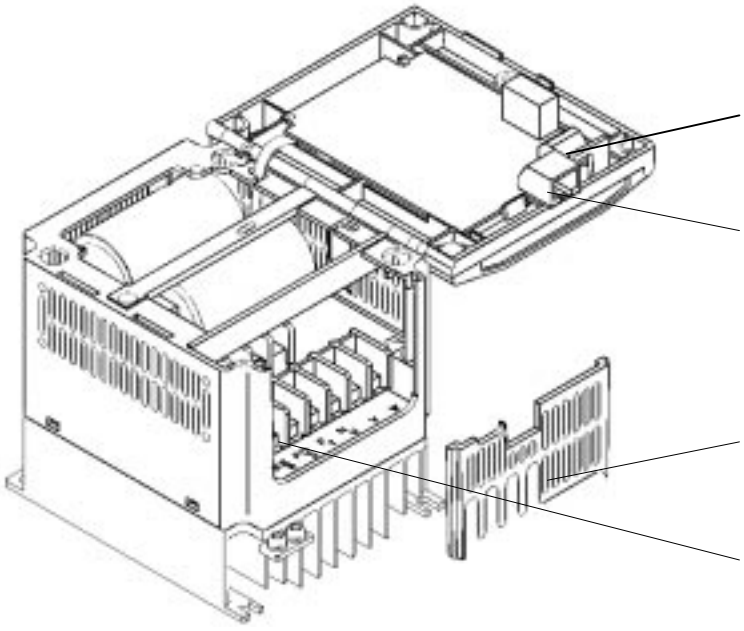


Bulletin 161S-161-AA03 / AA04





To wire the power terminals and fault indication relay, loosen the screw and open the control unit.



3. Installation

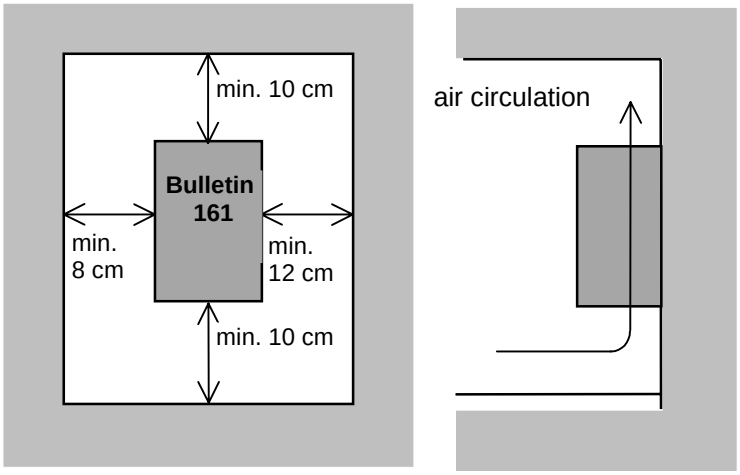
⚠ ATTENTION

- **Environmental influences such as high temperatures and high relative humidity are to be avoided as well as dust, dirt and corrosive gases. The mounting location should be well ventilated and not exposed to direct sunlight. Install the device on a non-flammable, vertical wall that does not transmit any vibrations. Attention! Do not apply mains voltage to the output terminals U/T1, V/T2 and W/T3.**

For heat convection reasons the Bulletin 161 drive must be installed vertically. Observe the specified minimum distances to the side walls or other devices. Objects that come into contact with the inside of the drive may result in the device being damaged.

If installed in normal environmental conditions (max. 40°C ambient) there must be a minimum of 20 mm clearance around all sides of the drive to enable the user or installer to open the front cover to get access to the terminals.

The figure below shows the minimum required clearances in case the Bulletin 161 is installed in an IP54 enclosure.



When carrying out work on the Bulletin 161 drive please ensure that no objects such as cable insulation, metal filings or dust get into the enclosure. This can be avoided by covering up the non-energized AC drive.

Temperatures may not exceed or go below the permissible temperature range from -10 to +40°C (or to +50°C in the following cases: reduction of the reference frequency to 2 kHz; reduction of the output current to 80% Bulletin 161 drive rated current; removal of the top cover). The higher the ambient temperature, the shorter the life of the drive.

Do not install the device in the vicinity of devices that radiate heat.

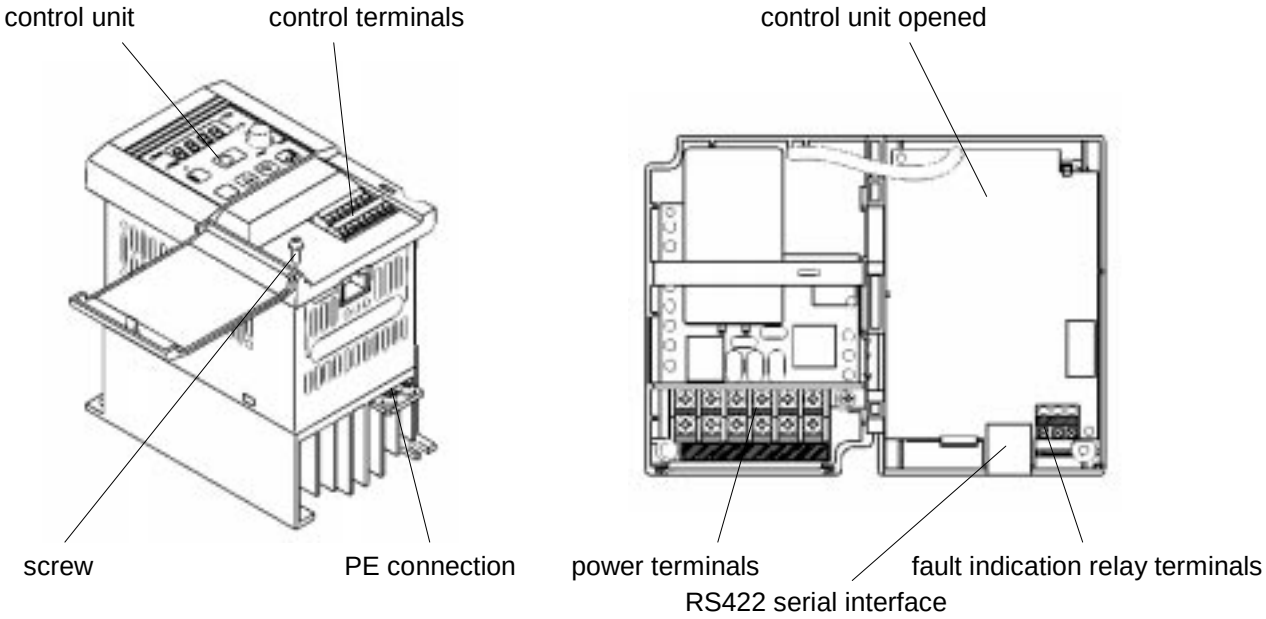
If installing the device in a control cabinet, pay attention to the size and heat transfer capability of the control cabinet. A fan may have to be installed.

4. Wiring

⚠ ATTENTION

- **The installation, commissioning and maintenance of these drives may only be carried out by experienced personnel who are thoroughly familiar with the functioning of the equipment and the entire machine.**
- **The devices feature DC-bus capacitors that are energized even when the mains supply is switched off. For this reason wait at least 5 minutes after switching off the mains supply before you open the device and start working on it. Take care that you do not touch any live parts.**
- **Do not apply mains voltage to the output terminals U/T1, V/T2 and W/T3.**

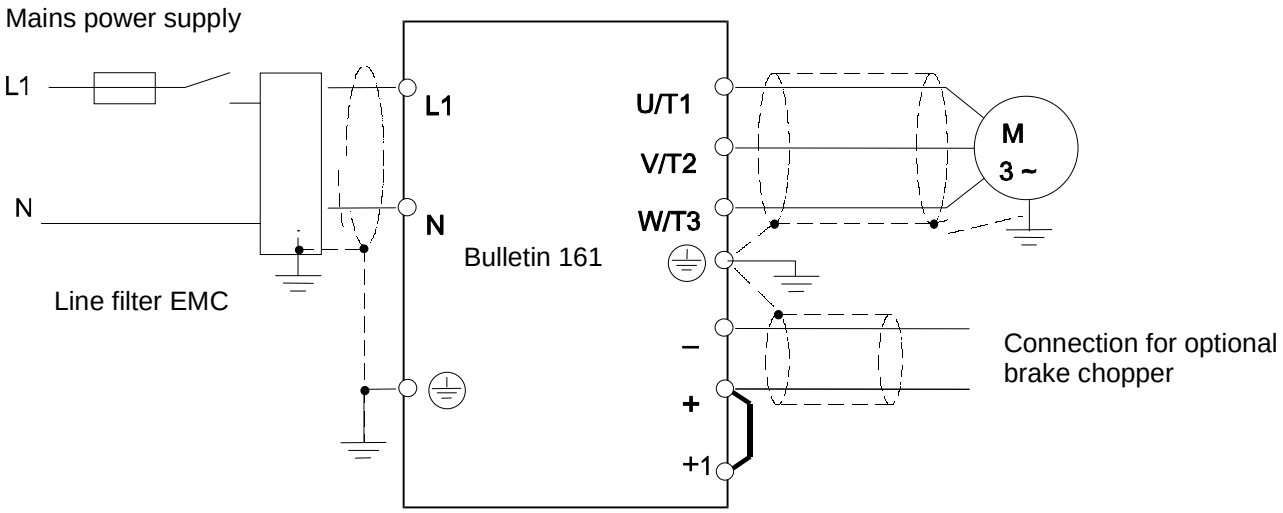
Layout of the power and control terminals



4.1 Connection and description of the power terminals

The control unit must be open in order to be able to wire the power terminals. Do not apply mains voltage to the drive connection terminals U/T1, V/T2, and W/T3 **as this will result in damage to equipment**. The Bulletin 161 drives feature an electronic overload protection to monitor the drive current. In the case of multi-motor operation, thermal contacts or PTC resistors must be used for each motor. In the case of motor lead lengths > 50 m motor reactors should be used.

Connection example Bulletin 161



AC Line Input fuse ratings or other Line Side Protective Devices:

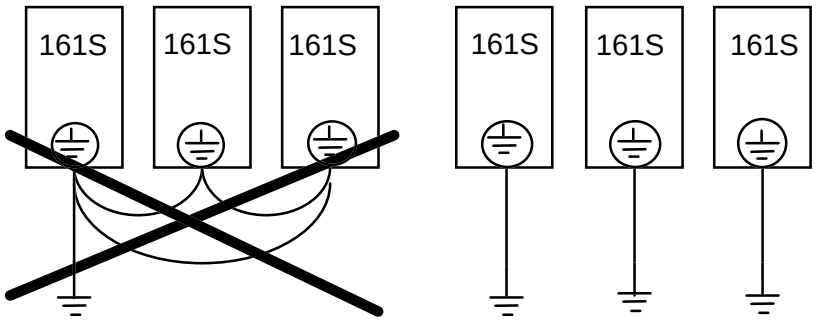
		Fuse Rating	Circuit Breaker Type and Rating
Bulletin 161S-AA01 – AA03	:	10 A time-lag	140-MN-1000 / 140M-D8N-C10
Bulletin 161S-AA04 – AA07	:	16 A time-lag	140-MN-1600 / 140M-D8N-C16
Bulletin 161S-AA10	:	25 A time-lag	140-MN-2500 / 140M-D8N-C25

Terminal	Function	Description
L1, N	Mains connection	1 ~ 200 - 240 V +/- 10%, 50/60 Hz +/- 5%
U/T1 V/T2 W/T3	Motor connection	Star or delta connection of the motor in accordance with the rated voltage
+ –	DC-bus connection	Connection for brake chopper
+ +1	Connection for DC-bus reactor	If an DC-bus reactor is connected, remove the copper bridge. Ensure that the bridge between the terminals + and +1 is installed if there is no DC-bus reactor installed.
⏚	PE conductor connection	

	Terminal type	MinMax Torque (Nm.)
Power terminals	161S-AA01 / AA02: open terminals, M3.5 screw	0.8 Nm, max. 0.9 Nm
	All others: open terminals, M4 screw	1.2 Nm, max. 1.3 Nm
Control terminals	Closed terminals	0.2 Nm, max. 0.25 Nm
Fault indication relay	Closed terminals	0.5 Nm, max. 0.6 Nm
Earth	M4 screw	1.2 Nm, max. 1.3 Nm

Disconnecting or connecting the motor, changing the number of poles in pole-changing motors or changing the direction of rotation by means of an external device (e.g. contactor) is not permitted during operation. Connecting capacitive loads is not permitted. A variety of cable types are acceptable for the drive installation. For many installation, *unshielded* cable is adequate, provided it can be separated from sensitive circuits. If you cannot separate motor cables from sensitive circuits, or if you must run motor cables from multiple drives (more than three) in a common conduit or cable tray, *shielded* motor cable is recommended to reduce system noise. (refer to Appendix A). In the case of motor lead lengths > 50 m, output reactors should be used.

Earth the drive carefully in accordance with the instructions. Avoid the use of shared protective earth conductors if several Bulletin 161 drives are used.



The power factor cos ϕ of the mains power supply must not exceed 0.99. Compensation systems must be tested for reliability to ensure that overcompensation does not occur at any time.

Attention! Input line reactors 3% impedance must be installed under the following conditions:

- The unbalance factor is >3%.
- High mains voltage dips occur.
- The Bulletin 161 drives is operated on a generator.
- Several Bulletin 161 drives are linked via a short common power supply bus bar.
- Switched power factor correction equipment is installed.

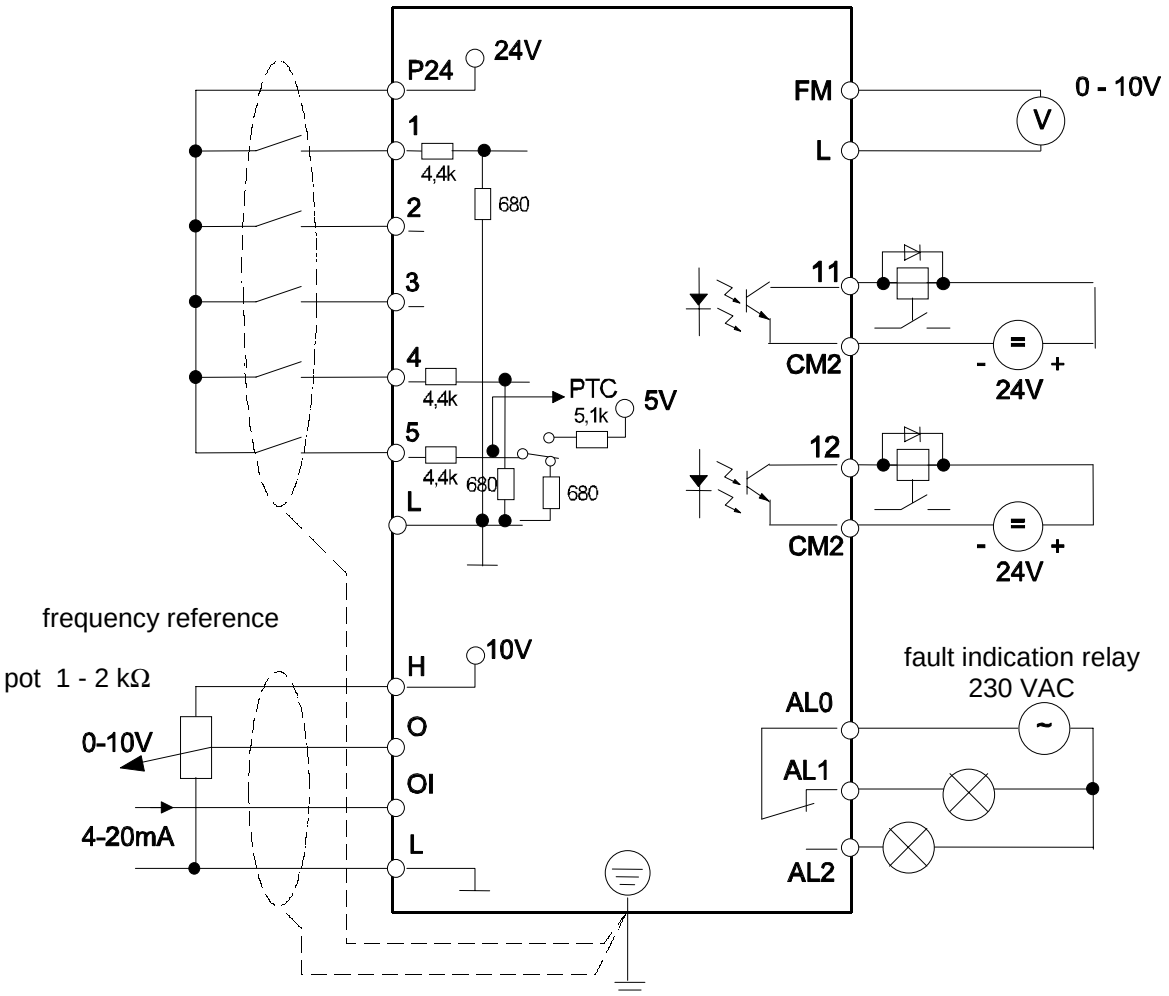
Input line reactors may also be used to improve the power factor.

4.2 Connection and description of the control terminals

When using the transistor outputs 11, 12 - CM2 install a recovery diode parallel to the relay used. Otherwise the switching relay could damage the output. Do not short-circuit the terminals **H and L or P24 and L.**

The control wires must be installed separately from the power lines and motor lines. **They may not exceed 20 m in length. To improve noise immunity, the control wires should be screened** (refer to Appendix A). If unavoidable, transpositions between the power lines or motor lines and the control wires should be installed at right angles.

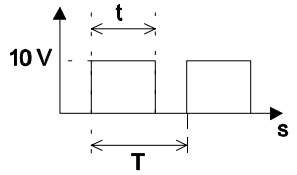
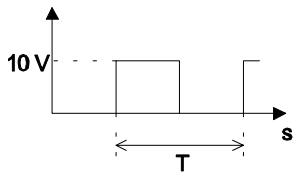
Example of a connection

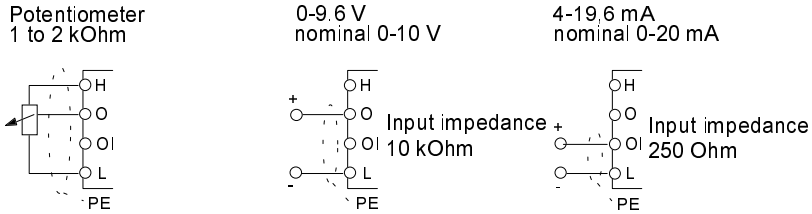
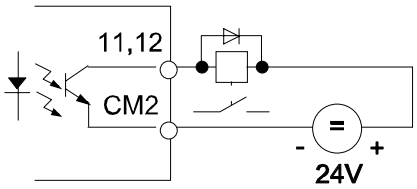


- **Wait at least 2s after turning on the power supply before issuing a start command and do not switch off the mains supply during operation of the device.**
- **Each signal must be applied to the digital inputs 1 …5 for at least 12 ms.**
- **If input 5 is programmed as a PTC resistor (parameter *C05*), terminal L will be the corresponding reference potential.**

⚠ ATTENTION

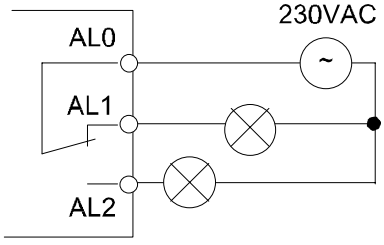
- **If an input is used as [FW] or [RV] and programmed as a Normally Closed (NC) contact, the drive will start as soon as the power supply is switched on – without the input being triggered.**
- **Please note that a start command should not be issued if an input is used as [FW] or [RV] when the power is switched on otherwise the motor will start immediately; wait at least 2s after switching on the power before issuing a start command.**

Terminal	Function		Description
FM	Programmable output Output frequency or Motor current		Analog signal (0-10 V, 1 m A) The output frequency output is available as a pulse signal. In the factory default the frequency is an analog signal (0-10 V), corresponding to 0 Hz to the max. frequency. (Match the signal under parameter *b81*; programming under parameter *C23*). analog signal, frequency or current  pulse signal (frequency) duty cycle approx. 50%  T = 4 ms (const.) **Analog signal**: The relation t/T changes in proportion to the frequency (or to the current). The maximum voltage of 10 V is reached with the max. frequency (or 200% rated current) (100% $I_n \Rightarrow$ 5 V, 200 $I_n \Rightarrow$ 10 V, accuracy approx. +/-5% for the frequency indicator and 20% for drive current indicator. **Pulse signal**: frequency = output frequency x factor of the multiplied frequency indicator (param. *b86*, factory default = 1), max. frequency 3.6 kHz.
L	0 V		0 V potential for output FM
P24	24 V		24 V potential for digital inputs 1, 2, ... , 5 max. load 30 mA
5	Programmable digital inputs	[RS]	Inputs 1 ... 5 are programmable. An overview of the possible functions can be found on pages 11 and 12. This table contains the basic setting for the terminal connections. It is not possible to program two inputs with the same function at the same time (see parameter *C01...C05*) Inputs 1 ... 5 – with the exception of the reset and PTC input may be programmed as either a NC contact or a NO contact (see parameter *C11...C15*).
4		[CF2]	
3		[CF1]	
2		[RV]	
1		[FW]	

<table>
<tr><th>Terminal</th><th>Function</th><th>Description</th></tr>
<tr><td>H</td><td>10 V reference voltage for frequency command default</td><td rowspan="3"> 
</td></tr>
<tr><td>O</td><td>Analog input
Frequency command
0-10 V</td></tr>
<tr><td>OI</td><td>Analog input
Frequency command
4-20 mA</td></tr>
<tr><td>L</td><td>0 V reference potential for frequency command inputs</td><td>For analog input reference adjustment see parameters A11...A16.
Input OI for 4-20 mA is activated when the digital input is set to [AT] (see parameter C01...C05).
If no digital input is programmed as [AT] (switch frequency command 0-10 V / 4-20 mA), the set values are added to O and OI.</td></tr>
<tr><td>CM2</td><td>Reference potential for output 11, 12</td><td>Transistor output, max. 27 VDC, 50 mA
 

The outputs can be programmed as NC contacts or NO contacts under parameter C31 or C32 (factory default: NC contact)</td></tr>
<tr><td>11</td><td>Programmable
Digital output

Factory default: [FA1]</td><td rowspan="2">The following functions may be programmed under the parameters C21 and C21:
[FA1]: at frequency (Signal when the set value is reached)
[FA2]: above frequency (Signal if output frequencies >/= the frequencies set under parameter C42 or C43).
[RUN]: Running (Signal if output frequency >0 Hz)
[OL]: Motor overload (Signal if the motor current exceeds the value set under parameter C41).
[OD]: PID-deviation (Signal if the deviation between the set value and the actual value returned is greater than the value set under parameter C44 . Only available if the PID controller - parameter A71- is active).
[AL]: Fault (Signal if a fault is indicated. See parameter C21, C22)</td></tr>
<tr><td>12</td><td>Programmable
Digital output

Factory default: [RUN]</td></tr>
<tr><td>AL2</td><td rowspan="3">Relay output
Collective fault</td><td rowspan="3"> 

250 VAC, 2.5 A resistive
0.2 A cos ∅ = 0.4

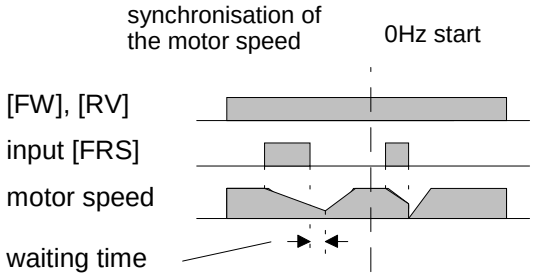
30 VDC, 3.0A resistive
0.7 A cos ∅ = 0.4

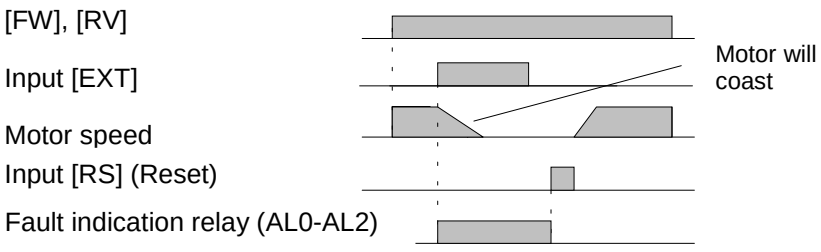
min. 100 VAC, 10 mA
5 VDC 100 mA

Operation: AL0-AL1 closed
Fault, power off: AL0-AL2 closed (parameter C33)
The fault indication relay is set with a time delay of approx. 2 s after the power is switched on.</td></tr>
<tr><td>AL1</td></tr>
<tr><td>AL0</td></tr>
</table>

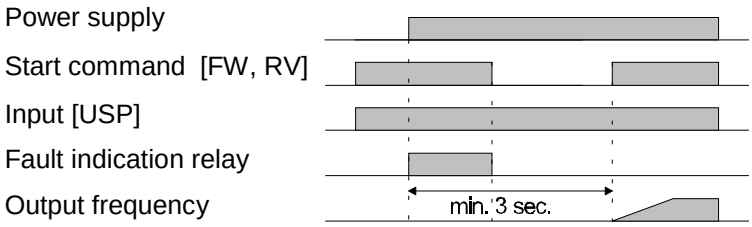
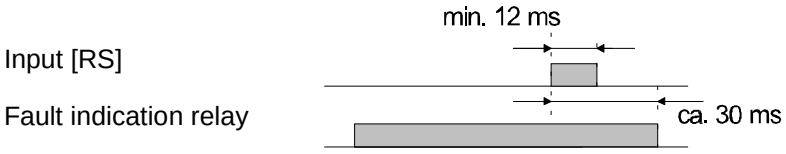
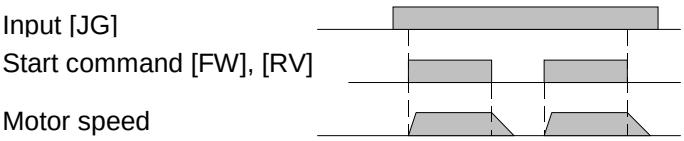
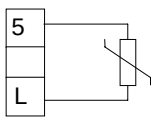
Overview of the functions of the programmable digital inputs 1 - 5

The digital inputs 1 to 5 can be programmed for 15 different functions. With exception of the PTC input (programmable on input 5 only), every input can be programmed for any function. Parameters cannot be programmed for two different inputs at the same time. The various functions are listed and described in the table below. Programming is done via parameters *C01...C15* (parameters *C01...C05* correspond to inputs 1 to 5; programming for normally closed NC contacts or norm. open contacts NO is carried out via parameters *C11...C15*).

<table>
<tr><th>Input / Function</th><th>Function</th><th>Description</th></tr>
<tr><td>[FW]
00</td><td>Forward</td><td>Start/stop forward (see parameter A02)</td></tr>
<tr><td>[RV]
01</td><td>Reverse</td><td>Start/stop reverse (see parameter A02)</td></tr>
<tr><td>[CF1]
02
[CF2]
03
[CF3]
04
[CF4]
05</td><td>Preset frequencies</td><td>The pre-set frequencies may be programmed in two ways:
1.) by entering the frequencies under parameter A21...A35.
2.) by selecting the corresponding digital input [CF1] ... [CF4] and entering the required frequency under parameter F01. Press the ENTER key to store the value entered. Press the SEL key to check that the value entered has been stored.
<table>
<tr><th>Input</th><th colspan="15">Preset Speed</th></tr>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th></tr>
<tr><td>CF1</td><td>ON</td><td></td><td>ON</td><td></td><td>ON</td><td></td><td>ON</td><td></td><td>ON</td><td></td><td>ON</td><td></td><td>ON</td><td></td><td>ON</td></tr>
<tr><td>CF2</td><td></td><td>ON</td><td>ON</td><td></td><td></td><td>ON</td><td>ON</td><td></td><td></td><td>ON</td><td>ON</td><td></td><td></td><td>ON</td><td>ON</td></tr>
<tr><td>CF3</td><td></td><td></td><td></td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td></td><td></td><td></td><td></td><td>ON</td><td>ON</td><td>ON</td><td>ON</td></tr>
<tr><td>CF4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td></tr>
</table>
</td></tr>
<tr><td>[2CH]
09</td><td>2nd Accel/Decel ramp</td><td>2nd acceleration/deceleration time (parameter A92, A93)</td></tr>
<tr><td>[FRS]
11</td><td>Controller lock</td><td>The motor voltage will be switched off immediately – the motor will coast (isolation of motor e.g. emergency).
For [FRS] two operation modes can be selected under parameter b88
1. Synchronisation of the motor speed after the waiting period programmed under parameter b03 is over (enter 01).
2. 0 Hz start after activating [FRS] (enter 00).


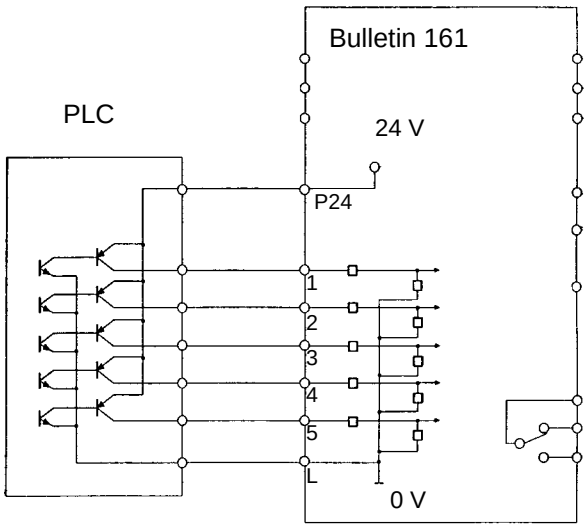
</td></tr>
<tr><td>[EXT]
12</td><td>External fault</td><td>When this input is addressed, a fault indication will be issued (E12, e.g. to be used as the input for thermal contacts)
The fault indication will be cleared with Reset.
Attention! After reset the drive will start again if a start command has been issued ([FW] or [RV]).


</td></tr>
</table>

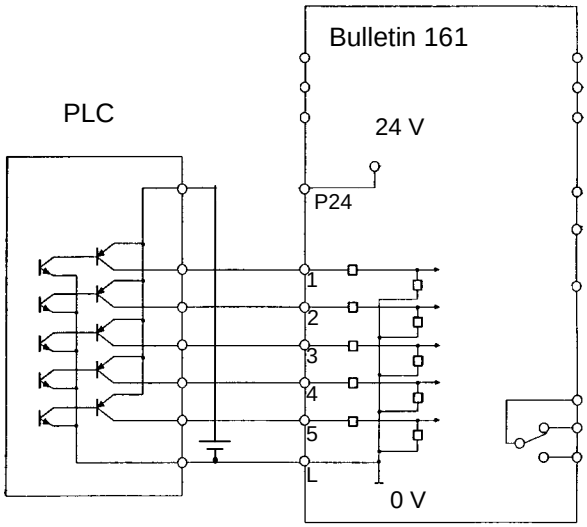
Input / Function	Function	Description
[USP] 13	Restart lock	The restart lock prevents a uncontrolled restart of the Bulletin 161 drive when – after power off – the power supply returns and a start command is issued immediately or straight afterwards. In this case the following fault indication will be given: *E13*  A new start command or a reset will clear the fault indication.
[SFT] 15	Parameter protection	Parameter protection protects parameters entered from being lost by overwriting. If the software protection is activated, no data can be lost (see parameter *b31*).
[AT] 16	Frequency command input OI active (4-20 mA)	In the factory default input O (0-10V) is active. Switching to OI is effected via input [AT]. If there is no digital input programmed as [AT], the frequency command values are added to O and OI (see parameter *A01*).
[RS] 18	Reset	Clearing a fault indication; reset the fault indication relay. If a reset command is given during operation, the terminal stages are switched off and the motor will coast. 
[JG] 06	Jog	Jog control is used e.g. to set up a machine manually. This is done via the inputs [FW] or [RV] if the input [JG] is controlled. When a start command is given, the frequency programmed under parameter *A38* will be switched directly to the motor – the start ramp is not active. For the stop command, three different modes can be selected under parameter *A39*: 1.) The motor will coast 2.) The motor is slowed down at the deceleration ramp 3.) Braking of the motor using the DC brake (see parameter *A54*, *A55*)  Jog control will not be possible if the jog frequency set is less than the start frequency entered under parameter *b82*.
[PTC] 19	PTC input **Only in connection with input 5** **Reference potential is terminal L**	Input 5 can be programmed as a PTC input under parameter *C05*. In this case, terminal L will be the reference potential (in all other cases the reference potential will be at terminal P24). If the PTC resistance exceeds 3 kΩ, the motor will be switched off and the fault indicator *E35* (ERROR PTC) will be issued. 

PLC control

Control <u>with internal</u> control voltage



Control with <u>external</u> control voltage



5. Programming

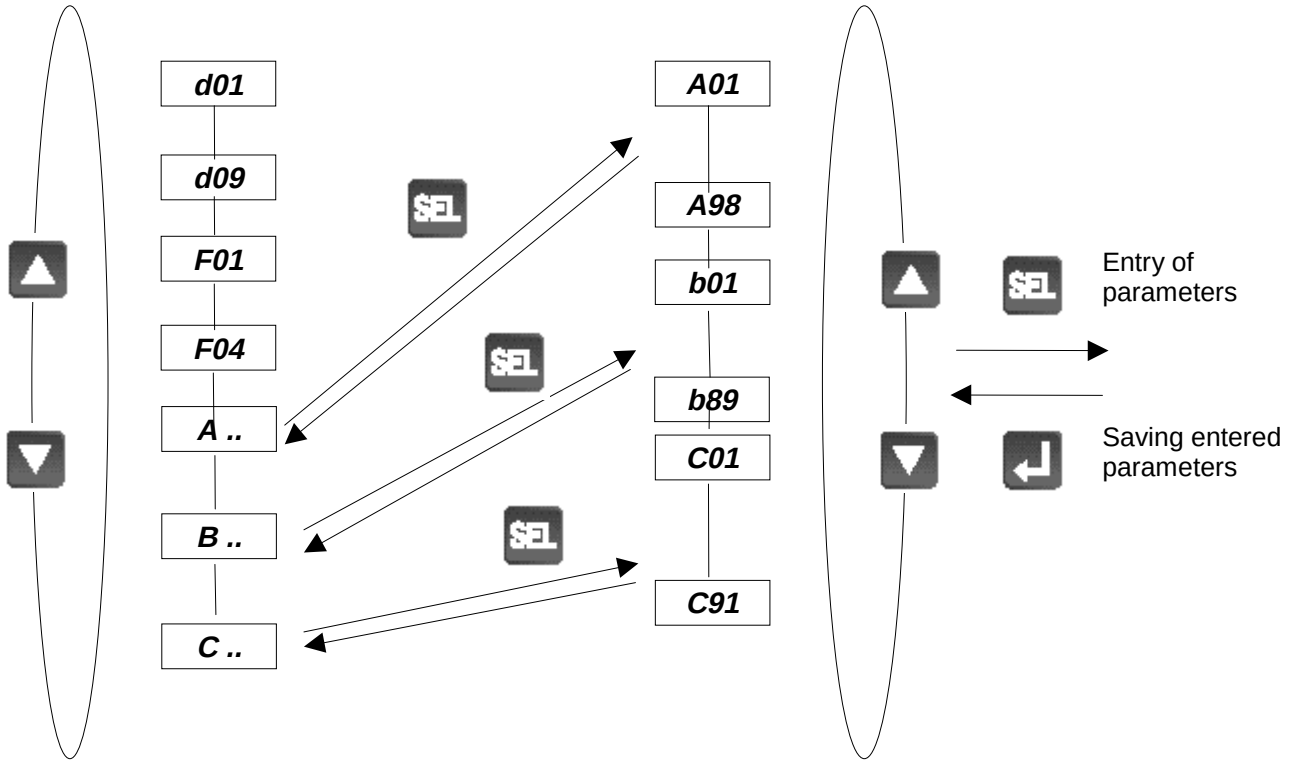
⚠ ATTENTION

Wait at least 6s after programming the Bulletin 161 before issuing a start or rest command, switching off the power supply or pressing any other key on the control panel.

5.1 Description of the control panel

I	The **Start-key** will start operation in the direction of rotation defined under parameter *F04*; not active when control is via the terminal block.		4-position **LED display** to display parameters and operating data.
O	**Stop/Reset-key.** The Stop command (see *b87*) or reset function for clearing fault indications can be used via the control panel or the terminal block.		The **RUN LED** will be lit when the drive is in operation, i.e. if a start command has been given.
SEL	The **SEL key** is used to select and exit input mode.		The **PRG LED** will be lit when the drive is programmed.
↵	The **ENTER key** is used to save the entered data.		The **Hz and A LED** will inform you whether the output frequency or output current is displayed.
▲ ▼	The **arrow keys** are used to select parameters and enter or modify data.		The commanded frequency can be set via the **speed potentiometer.**

Programming guide



⚠ ATTENTION **Before switching on the power supply the following points must be observed:**

- **Check that the mains lines and motor lines are connected properly.**
- **The control wires must be connected at the correct terminals.**
- **The drive must be earthed correctly and must be installed vertically on a wall made from non-flammable material.**
- **All screws and terminals must be tightened.**
- **Check that the connected motor is designed for the frequency range in question, particularly for the maximum frequency.**

5.2 Entering the factory defaults (initialisation)

On supply, all the Bulletin 161 drives are initialized, i.e. they are programmed with the default factory parameters. The devices may however be re-programmed to these basic settings at any time.

- Ensure that the function 01 is stored under parameter *b85* (*01* ⇒ on initialisation the data of the European defaults are loaded).
- Enter function 01 under parameter *b84* and save this by pressing the **ENTER** key.
- Press the ▲ , ▼ and **SEL**-key at the same time.

While you are pressing the keys mentioned above, briefly press the STOP key and wait approx. 2 - 3 s until the following is flashing: *d00*.

- Now release the three keys. During initialisation the following will be displayed:
  EU 0000
- The end of initialisation will be indicated by *00*.

5.3 Putting the device into operation via the integrated control panel

The integrated control panel enables the Bulletin 161 drive to be controlled without the additional use of the control terminals.

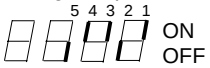
- Enter function 00 under parameter *A01* (set frequency command via the integrated potentiometer) or 02 (enter the frequency under parameter *F01*).
- Program the function 02 under parameter *A02*. The drive can now be started by pressing the START key.
- The required direction of rotation can be selected under parameter *F04* (*00* ⇒ Forward, *01* ⇒ Reverse).

5.4 Clearing faults/Reset

There are three different ways of clearing fault indications:

- Reset input
- Switch off power supply
- Press the STOP key.

5.5 Overview of the parameters

Parameter number	Display function	Remarks
Display and diagnostic functions		
d01	Output frequency [Hz]	
d02	Motor current [A]	
d03	Direction of rotation	*F* : Forward *r*: : Reverse *0* : Stop
d04	Actual value x actual value factor [%] (only available if the PID controller is active)	The actual value factor is set in param. *A75* in the range from 0.01 ... 99.99 The default setting is 1.0.
d05	Status of digital inputs 1 ... 5	Example: Inputs 1, 3, 4 activated Digital inputs 5 4 3 2 1  ON OFF
d06	Signal status of the digital outputs 11, 12 and the fault indication relays AL0-AL2	Example: Output 11 ON, no fault Outputs AL 12 11  ON OFF
d07	Output frequency x frequency factor	The product of frequency factor (parameter *b86*) and output frequency are displayed under this parameter. This parameter can be used e.g. to display the output speed of a drive or the speed of a conveyor. 4-position values: e.g. 1500 ⇒ *1500.* 5-position values: e.g. 15000 ⇒ *1500*
d08	Last fault occurred	The fault indication last shown, as well as the output frequency, motor current and DC-bus voltage at the time of the fault may be called up using the SEL key. The following will be displayed if a fault has not occurred since or if the fault indication has been deleted: _ _ _
d09	Fault indication register	The 2nd and 3rd fault indications last shown can be called up under this parameter by pressing the SEL key. _ _ _ : there is no fault indication stored here

Parameter number	Function	Basic value	Setting range	Input
Basic parameters				
F01	Input/display frequency command	---	0.5 - 360 Hz	
F02	1st acceleration time	10 s	0.1 - 3000 s	
F03	1st deceleration time	10 s	0.1 - 3000 s	
F04	Direction of rotation RUN key	00	00: Forward 01: Reverse	
A - -	Extended function of *A* group setting Can be entered from *A* -- parameter.	*A*-group regards control setting or parameter setting.		
b - -	Extended function of *b* group setting Can be entered from *b* -- parameter.	*b*-group regards protection setting or others.		
C - -	Extended function of *C* group setting Can be entered from *C* -- parameter.	*C*-group regards intelligent terminal setting.		

Parameter number	Function	Basic value	Setting range	Input
Basic parameters				
A01	Frequency command select	01	00: Frequency Pot 01: Input O/OI 02: Param. *F01/A20*	
A02	Start command select	01	01: Input [FW]/[RV] 02: RUN key	
A03	Base frequency	50	50 - 360 Hz	
A04	Maximum frequency	50	50 - 360 Hz	
Analog input reference adjustment				
A11	Frequency at the minimum set value		0 - 360 Hz	
A12	Frequency at the maximum set value	0	0 - 360 Hz	
A13	Analog input minimum	0	0 - 100%	
A13	Analog input maximum	100	0 - 100%	
A15	Start condition	01	00: Minimum speed 01: 0 Hz start	
A16	Analog input filter setting	8	1 (max. filter, slow response) to 8 (min. filter, fast response)	
Pre-set frequencies				
A20	Frequency command if 02 has been entered under parameter *A01*	0.0	0 - 360 Hz	
A21	1. Preset Frequency	0	0 - 360 Hz	
A22	2. Preset Frequency	0	0 - 360 Hz	
A23	3. Preset Frequency	0	0 - 360 Hz	
A24	4. Preset Frequency	0	0 - 360 Hz	
A25	5. Preset Frequency	0	0 - 360 Hz	
A26	6. Preset Frequency	0	0 - 360 Hz	
A27	7. Preset Frequency	0	0 - 360 Hz	
A28	8. Preset Frequency	0	0 - 360 Hz	
A29	9. Preset Frequency	0	0 - 360 Hz	
A30	10. Preset Frequency	0	0 - 360 Hz	
A31	11. Preset Frequency	0	0 - 360 Hz	
A32	12. Preset Frequency	0	0 - 360 Hz	
A33	13. Preset Frequency	0	0 - 360 Hz	
A34	14. Preset Frequency	0	0 - 360 Hz	
A35	15. Preset Frequency	0	0 - 360 Hz	
A38	Jog Frequency	1.0	0.5 – 9.9 Hz	
A39	Jog Stop Mode	00	00: Coast 01: Ramp 02: DC brake	

Parameter number	Function	Basic value	Setting range	Input
V/F characteristics / boost				
A41	Boost select	00	00: Man. boost 01: Auto boost	
A42	Manual boost	11	0 – 99	
A43	Max. boost at % of base frequency	10	0 - 50%	
A44	V/F select	00	00: Constant 01: Variable	
A45	Maximum output voltage	100	50 - 100%	
DC brake				
A51	DC Brake active / inactive	00	00: inactive 01: active	
A52	DC Brake Starting frequency	0.5	0.5 – 10 Hz	
A53	DC Brake Waiting time	0.0	0 - 5 s	
A54	DC Brake Braking torque	0	0 - 100%	
A55	DC Brake Braking time	0.0	0 - 60 s	
Operating frequency range				
A61	Maximum Frequency	0.0	0.5 - 360 Hz	
A62	Minimum Frequency	0.0	0.5 - 360 Hz	
A63	1st Skip Frequency	0	0 - 360 Hz	
A64	1st Skip Frequency Band	0.5	0 - 10 Hz	
A65	2nd Skip Frequency	0	0 - 360 Hz	
A66	2nd Skip Frequency Band	0.5	0 - 10 Hz	
A67	3rd Skip Frequency	0	0 - 360 Hz	
A68	3rd Skip Frequency Band	0.5	0 - 10 Hz	

Parameter number	Function	Basic value	Setting range	Input
PID controller				
A71	PID controller active / inactive	00	00: inactive 01: active	
A72	PID Proportional Gain	1.0	0.2 – 5.0	
A73	PID Integral Gain	1.0	0.0 - 150 s	
A74	PID Differential Gain	0.0	0.0 - 100	
A75	Process reference scale factor	1.0	0.01 – 99.99	
A76	Process analog feedback	00	00: input OI 01: input O	
Automatic voltage regulation (AVR)				
A81	AVR function select	02	00: active 01: inactive 02: not active in deceleration	
A82	Motor voltage / AVR- voltage	230	200 - 240 V	
Second acceleration / deceleration ramp				
A92	2nd Acceleration time	15	0.1 - 3000 s	
A93	2nd Deceleration time	15	0.1 - 3000 s	
A94	Select 2nd acceleration / deceleration ramp	00	00: input set to [2CH] 01: Automatic if freq. programmed in param. *A95 / A96* is reached	
A95	2nd acceleration ramp starting frequency	0.0	0.0 - 360 Hz	
A96	2nd deceleration ramp starting frequency	0.0	0.0 - 360 Hz	
A97	Acceleration Curve	00	00: linear 01: S-curve	
A98	Deceleration Curve	00	00: linear 01: S-curve	

Parameter number	Function	Basic value	Settings range	Input
Automatic start after a fault				
b01	Restart mode select	00	00: Fault indication 01: 0 Hz start 02: Synchr. 03: Synchr. + stop	
b02	Permissible power failure time	1.0	0.3 - 25 s	
b03	Waiting time before restart	1.0	0.3 - 100 s	
Electronic motor protection				
b12	Electronic overload setting	rated current	50 - 120% of rated current	
b13	Electronic overload characteristic	01	00: increased motor protection 01: standard	
Current limit				
b21	Current limit operation mode	01	00: inactive 01: active 02: inactive in accel.	
b22	Current limit setting	rated curr. x 1.25	50 - 150% of rated current	
b23	Current limit decel. rate	1.0	0.3 - 30 s	
Parameter protection				
b31	Selection of Software lock mode	01	00: input [SFT] active, all functions locked 01: input [SFT] active, Speed ref. only 02: all functions locked 03: Speed ref. only	
Current feedback tuning				
b32	Reactive current setting [1]	rated curr. x 0.58	Resolution: 1% of inverter rated current	
Initialisation / adjustment parameters				
b81	Output FM adjustment	--	0 - 255	
b82	Start frequency	0.5	0.5 – 9.9 Hz s	
b83	PWM carrier frequency	5.0	0.5 - 16 kHz	
b84	Factory setting, basic setting (initialisation)	00	00: delete fault indic. register 01: factory default	
b85	Factory defaults parameter	01	01: Europe	
b86	Frequency scale factor (*d07*)	1.0	0.1 – 99.9	
b87	Keypad STOP key select	00	00: STOP key always active 01: STOP key inactive if inp. [FW], [RV] selected	
b88	[FRS] select	00	00: 0 Hz start 01: synchronisation	
b89	Display indicator under F1 Remote Keypad only	01	01: actual freq. 02: motor current 03: dir. of rotation 04: PID act. value 05: digital input 06: digital output 07: freq. x factor	

[1] The set value links with the detection current of output current monitor, electric thermal protection and overload limit.

Parameter number	Function	Basic value	Setting range	Input
Digital inputs 1 – 5				
C01	Digital input 1	00	00: [FW] Forward 01: [RV] Reverse 02: [CF1] Preset. freq. 03: [CF2] Preset freq. 04: [CF3] Preset freq. 05: [CF4] Preset freq. 06: [JG] Jog 09: [2CH] 2nd ramp 11: [FRS] Coast stop 12: [EXT] Ext. trip 13: [USP] unintention. start protection 15: [SFT] Softw. lock 16: [AT] 4-20 mA sel. 18: [RS] Reset 19: [PTC] PTC input (on *C05* only)	
C02	Digital input2	01		
C03	Digital input 3	02		
C04	Digital input 4	03		
C05	Digital input 5	18		
C11	Digital input 1 NO/NC	00	00: NO contact 01: NC contact	
C12	Digital input 2 NO/NC	00		
C13	Digital input 3 NO/NC	00		
C14	Digital input 4 NO/NC	00		
C15	Digital input 5 NO/NC	00		
Outputs 11, 12, FM, AL0-AL1				
C21	Digital output 11	01	00: [RUN] operation 01: [FA1] at frequency 02: [FA2] above freq. 03: [OL] Motor overload alarm 04: [OD] PID deviation 05: [AL] fault	
C22	Digital output 12	00		
C23	Output FM	00	00: [A-F] analog output frequency. 01: [A] Mot. Current 02: [D-F] digital output frequency	
C31	Digital output 11 NO/NC	00	00: NO Contact 01: NC Contact	
C32	Digital output 12 NO/NC	00		
C33	Fault indication relay AL0-AL1	01	00: NO Contact 01: NC Contact	
C41	Overload alarm setting	100	0 - 200%	
C42	Frequency setting for [FA2] in acceleration	0.0	0.0 - 360 Hz	
C43	Frequency setting for [FA2] in deceleration	0.0	0.0 - 360 Hz	
C44	PID controller deviation	3.0	0.0 - 100%	
C91	Debug mode	00	Used only by RA field service personnel	

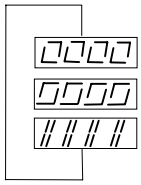
6. Fault indications

The Bulletin 161 drives are provided with protective devices such as protection against excessive current, excessive voltage and under-voltage. When one of the many protection functions is triggered the output voltage will be switched off – the motor will freewheel and the device will remain in the fault indication mode until the fault indication has been cleared.

Fault indication	Description	Cause	Corrective action
E 01	Overcurrent • during running	Is the motor rated current larger than the drive rated current?	Select drive with a higher rating.
		Did a sudden load increase occur or is the motor blocked?	Avoid sudden overloads. Possibly use drive and motor with higher rating.
		Are the motor terminals U/T1, V/T2, W/T3 short-circuited?	Check motor lines and the motor for a short circuit.
E 02	• during deceleration	Is the deceleration time setting too short?	Set a longer deceleration time.
		Are the motor terminals U/T1, V/T2, W/T3 short-circuited?	Check motor lines and the motor for a short circuit
E 03	• during acceleration	Is the acceleration time setting too short?	Increase the acceleration time
		Are the motor terminals short-circuited?	Check motor lines and the motor for a short circuit
		Is the manual boost (parameter *A42*) set too high?	Reduce the boost under parameter *A42*
		Is the motor blocked?	Check the motor load or breakaway torque
E 04	• at a standstill	Is there an earth fault at the output terminals or at the motor?	Check the output lines or the motor for an earth fault
E 05	Triggering of internal motor protection	The internal electronic motor protection has been triggered due to overloading of the connected motor.	Use a motor and converter with a higher rating Check the entry under parameter *b12*
	The drive is overloaded	The output current is greater than the drive rated current	Use drive with a higher rating
E 07	DC-bus overvoltage	The motor was operated oversynchronously (regenerative).	Set a longer deceleration time.
			Inactivate the AVR function for deceleration (parameter *A81*, enter 01 or 02).
			Enter a higher motor voltage under parameter *A82*.
			Use the brake chopper.
E 08	EEPROM error	Is the temperature too high or is the drive exposed to electric noise?	Check the environmental conditions. **Re-enter the programmed parameters.**

Fault indication	Description	Cause	Corrective action
E 09	DC-bus undervoltage	Brief voltage dips occur or the mains voltage is reduced to 150-160V	Check the input voltage.
E 11 E 22	Processor error	Possible influence of electromagnetic fields on the drive?	Examine the environment of the drive and external wiring for causes of the fault (e.g. terminal bar).
		Is the drive defective?	Have the device serviced by customer support.
E 12	External fault	External fault indication at the input [EXT]	Remove the cause of the fault indication in the external wiring.
E 13	Fault cause by triggering of start lock	Has the power supply been switched on while the start lock was active (input [USP])?	Activate the start lock only when the power supply has been switched on.
		Has the mains voltage been interrupted for a short period of time during operation and while the start lock was activated? (input [USP])	Check the mains.
E 14	Earth fault at the motor terminals	Is there an earth fault between U/T1, V/T2, W/T3 and earth?	Remove the earth fault and check the motor.
E 15	Excess mains voltage	If the mains voltage is higher than permitted (see "Technical data"), the drive will be in fault mode	Check the mains voltage.
E 21	Drive overtemperature fault	Is the drive overloaded?	Check the motor current.
		Is the ambient temperature too high?	Check the ambient temperature.
		Are the assembly clearances too small? (see chapter 3 Assembly)	Check the assembly clearances.
E 35	Control of the PTC circuit breaker triggering function	Is the motor overloaded?	Check the motor load.
		Is the self-ventilation of the motor – particularly at low speeds – not sufficient?	Use an external fan if low speeds are often used.

Other displays

Display	Description
	A reset signal has been issued. The Bulletin 161 drive is in standby mode.
- - -	The mains voltage has been switched off.
□□□□	The waiting time before automatic restart has expired (see parameter *b01* - *b03*).
EU	The factory setting has been selected and the drive is in the initialisation phase (see parameters *b84, b85*). The parameters for the European market are loaded
– – –	No data present (e.g. display under *d08*, *d09* if the fault indication register is empty or display under *d04* if the PID controller is not active).

7. Faults and troubleshooting

Fault		Possible cause	Corrective action
The motor does not start.	There is no voltage at terminals U/T1, V/T2, W/T3.	Is there mains voltage at the input terminals L1, N? If so, is the LED display lit?	Check connections L1, N and U/T1, V/T2, W/T3. Switch on the mains voltage.
		Is there a fault indication on the display?	Analyze the cause of the fault indication. Cancel the fault indication with the Reset function.
		Has a start command been issued using the RUN key or via the input [FW], [RV]?	Press the RUN key or issue the start command at the relevant input.
		Has a frequency command been entered using the control panel?	Enter the frequency command under *F01*.
		If the frequency command has been specified via a potentiometer, are the terminals H, O and L wired correctly? If the command has been specified externally, are inputs O or OI properly connected?	Check that the potentiometer is properly connected. Check that the cable for the frequency command signal is properly connected.
		Is the controller lock [FRS] active?	Is the input programmed as [FRS]?
		Has a reset signal been issued?	Check the signal at input 5 (factory default [RS]).
		Has the drive been programmed under parameter *A01* and *A02* in accordance with the frequency command setting and the start command?	Check the setting under parameter *A01* and *A02*.
	Voltage is applied to terminals U/T1, V/T2, W/T3	Is the motor blocked or is the load too high?	Check the motor and the load. For test purposes run the motor without a load.
The direction of rotation of the motor is incorrect.		Are the terminals U/T1, V/T2, W/T3 connected properly? Is the connection of the terminals U/T1, V/T2, W/T3 set up properly for the direction of rotation of the motor?	Correct the wiring of the motor.
		Have the control inputs been wired correctly?	[FW] – Forward [RV] – Reverse
The motor does not accelerate.		A frequency command has not been applied to terminal O or OI.	Check the potentiometer or external frequency command generator and if necessary, replace it.
		Has a Preset Frequency been selected?	Observe the priority sequence; Preset Frequency have priority over the inputs O and OI.
		Is the motor load too high?	Reduce the motor load. If the load is too high the overload restriction function prevents the motor from accelerating to the commanded frequency.

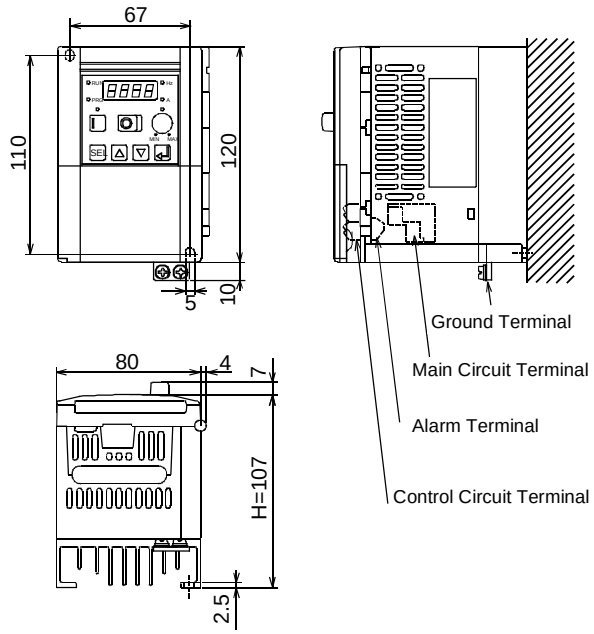
Fault		Possible cause	Corrective action
The motor runs unstable.		Do sudden high load changes occur?	Choose a drive and motor with a higher rating. Reduce sudden load changes.
		Resonant frequencies occur in the motor.	Blank out the frequencies in question with frequency jumps or change the reference frequency.
		The mains voltage is not constant.	Change PWM carrier frequency
The speed of the motor does not match the frequency.		Has the maximum frequency been set correctly?	Check the frequency range entered.
		Has the rated speed of the motor or reduction ratio of the gear been selected correctly?	Check the rated speed of the motor and the reduction ratio of the gear.
The parameters stored do not match the values entered.	The values entered have not been stored.	The mains voltage has been switched off without storing the values entered by pressing the ENTER key.	Enter the parameters again and save each entry.
		When the mains voltage was switched off the entered and saved values were transferred to the power-failure safe EEPROM. Power-off time must be at least 6s.	Enter the parameters again and save each entry. After setting the parameters, switch the power off for at least 6s.
No entries can be made.	The drive can neither be started nor stopped and set points cannot be specified.	Is the control mode been set correctly under *A01* and *A02*?	Check the setting under parameter *A01* and *A02*.
	It is not possible to set any values.	Is parameter protection activated?	Disable parameter protection.
The electronic motor protection (fault indication *E05*) is triggered.		Is the manual boost setting too high? Is the electronic motor protection setting correct?	Check the boost setting and the setting for the electronic motor protection.

8. Technical Data

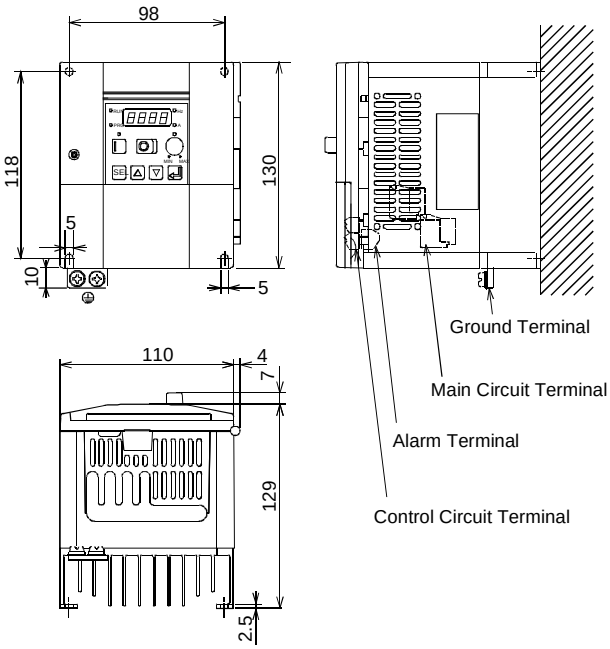
Series	Bulletin 161S-						
Type	**AA01**	**AA02**	**AA03**	**AA04**	**AA05**	**AA07**	**AA10**
Drive rating (kW)	0.2	0.4	0.55	0.75	1.1	1.5	2.2
Input rated current (A)	3.1	5.8	6.7	9.0	11.2	16.0	22.5
Output rated current (A)	1.4	2.6	3.0	4.0	5.0	7.1	10.0
Mass (kg)	0.85	0.85	1.3	1.3	2.2	2.2	2.8
Mains voltage (V)	1 ~ 200 V -10% to 240 V + 5%, 50/60 Hz +/- 5%						
Output voltage	3 ~ 0 - 200 ... 240 V in accordance with the mains voltage						
Type of protection	IP20						
PWM carrier frequency	0.5 - 16 kHz						
V/F characteristics	V/F characteristics for constant torque and variable torque; variable output voltage, Base Frequency and Maximum Frequency.						
Type of control	Voltage-driven, PWM sinus coded, IGBT-Power module						
Output frequency	0.5 - 360 Hz						
Accuracy of frequency command	Digital: +/- 0.01% of max. frequency Analog: +/- 0.2% of max. frequency						
Frequency resolution	Digital: 0.1%, analog: max. frequency/1000						
Overload capacity	150% for 60 s (once in a period of 10 min.), max. 220%						
Starting torque	min. 150% at frequencies >3 Hz						
Braking torque by feeding back into the capacitors	Bulletin 161S-AA01 ... AA04: 100% Bulletin 161S-AA05 ... AA07: 70% Bulletin 161S-AA10: 20%						
DC brake	Starting frequency, braking torque, running time are variable.						
Analog inputs	0 -10 V, input impedance 10 kΩ 4 - 20 mA, input impedance 250 Ω PTC input						
Digital inputs	5 free programmable inputs, 24 V PNP logic, NO contacts or NC contacts						
Analog outputs	1 analog output to either display the output frequency or the motor current. For output frequency can be switched as an impulse output.						
Digital outputs	2 open collector outputs for (for either operation indication, at frequency / above frequency, overload alarm, PID controller deviation exceeded). 1 fault indication relay (change-over contact)						
Protection functions	Overcurrent, overvoltage, under-voltage, electronic motor protection, overtemperature, earth fault, overload etc.						
Other functions	15 preset speeds, PID controller, parameter protection, restart lock, RS422 serial interface, skip frequencies etc.						
Ambient temperature	-10 - +40 °C (up to +50 °C in the case of reduction of reference frequency to < 2 kHz, restriction of output current to 80% and removal of top cover)						
Relative humidity	20 - 90% relative humidity, no condensation						
Vibration/shock	5.9 m/s^2 (0.6 G) 10 - 55 Hz						
Max. installation altitude	1000 m above sea level						
Options	Line filter modules						
Standards	EN 61800-3 EMC guidelines in connection with optional line filter modules in line with installation guidelines, EN 50178 Low-Voltage guideline, UL						

9. Dimensions

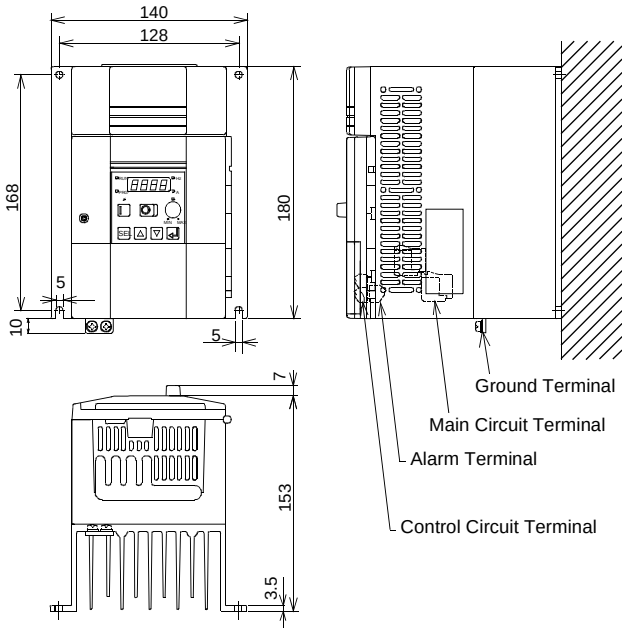
Bulletin 161S-AA01 / AA02



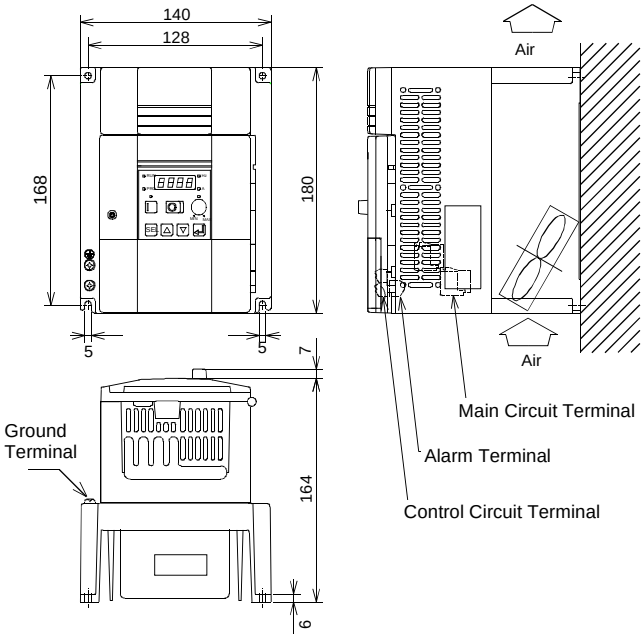
Bulletin 161S-AA03 / AA04



Bulletin 161S-AA05 / AA07



Bulletin 161S-AA10



10. Accessories

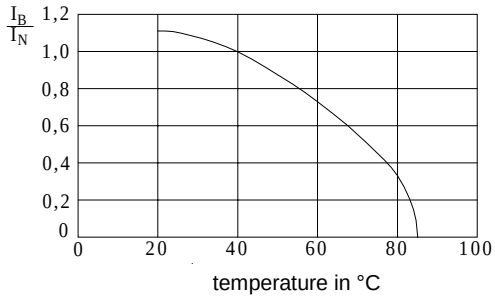
Line Filter Module

Specifications

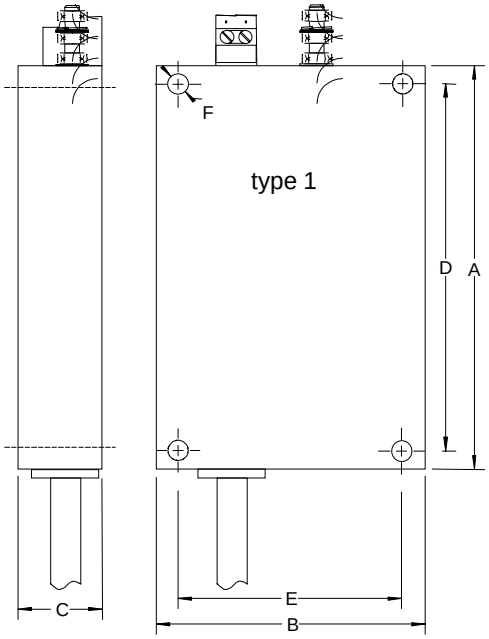
Line Filter Module	Nominal Voltage [V]	Nominal Current at 40°C [A]	Leakage Current at 50 Hz (mA)	Test voltage [VDC for 2s] ph. / ph; ph. / ground	Input wire max. cross section [mm^2]	Output cable cross section [mm^2]	Heat dissipation [W]
161S-RFA-6-A	240 +5%	2 x 6 A	< 3,5	1400 / 2800	(L) 4/4 (N)	3x1.5	5
161S-RFA-9-B	240 +5%	2 x 10 A	< 3,5	1400 / 2800	4/4	3x1.5	6
161S-RFA-22-C	240 +5%	2 x 23 A	< 10	1400 / 1400	4/4	3x2.5	9

Current:	at 40°C ambient temperature
Overload:	150% I_N for 10 min
Frequency:	50 / 60 Hz
Material:	steel, surface refined
Humidity class:	C
Operation height:	< 1000 m without derating > 1000 m, I_N-2%, for each 1000m
Temperature range:	-25°C to +85°C
Connections	Input terminals IP 20 and PE-screw M5 Load side: cable, unshielded

Dependence of current on ambient temperature



Filter Dimensions (mm):



Line Filter Module	A	B	C	D	E	F
161S-RFA-6-A	120	80	25	110	67	2x6
161S-RFA-9-B	130	110	27	118	98	4x6
161S-RFA-22-C	180	140	29	168	128	4x6

Appendix A: CE Conformity

The Bulletin 161 is CE marked for conformity to the Low Voltage (LV) Directive 73/23/EEC when installed as described. It also has been tested to meet the Council Directive 89/336/EEC Electromagnetic Compatibility (EMC).

The standards used are:

LV		EN50178, EN60204-1, EN60950
EMC	Emissions:	EN61800-3 (EN55011, Group 1, Class B)
	Immunity:	EN61800-3 (Industrial Environment).

Important: The conformity of the drive and filter to any standard does not guarantee that the entire installation or machine will conform. Many other factors can influence the total installation and only direct measurements can verify total conformity. It is therefore the responsibility of the machine manufacturer or end user to ensure that conformity is met.

General Notes and Instructions:

☞ The motor cable should be kept as short as possible in order to avoid electromagnetic emission as well as capacitive currents. The cable length increases the capacitive current and electromagnetic emission.

It is recommended that the motor cable length does not exceed 50 m.

It is always recommended to install output reactors if the cable length exceeds 50 m.

☞ The filters contain capacitors between the phases and the phases to ground as well as suitable discharging resistors. But after switching off the line voltage wait a minimum of 60 seconds before removing protective covers or touching terminals to avoid an electric shock.

☞ The use of ground fault monitoring devices (RCD's) is not recommended. If unavoidable only monitoring devices which are suited for DC-, AC- and HF-ground currents (type B RCD's) should be used. It is recommended to use devices which responsiveness and time characteristics are adjustable, to avoid nuisance tripping during power up the drive.

☞ The thermal capacity of the line filter is guaranteed up to a maximum motor cable length of 50 m.

☞ The line filters have been developed for use in grounded systems. Use in ungrounded systems is not recommended.

Essential requirements for a conforming EMC installation

1. An input line filter module (see table below) must be installed to reduce conducted emissions.

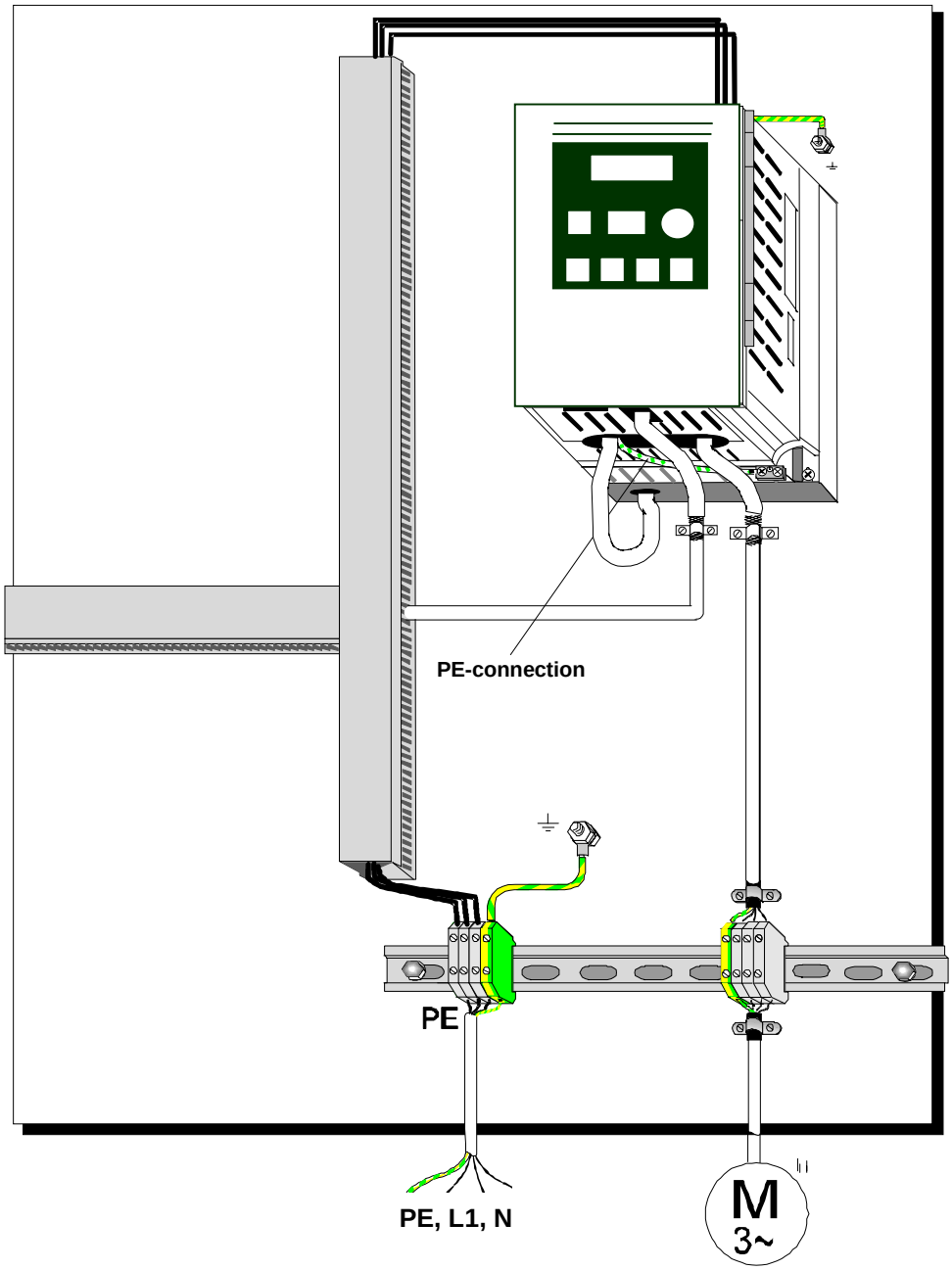
Line Filter Selection Guide

Bulletin 161	Input Voltage	Line Filter Module
161S-AA01NPK	1 ~ 220 V -10% - 240 V +5%	**161S-RFA-6-A**
161S-AA02NPK	1 ~ 220 V -10% - 240 V +5%	**161S-RFA-6-A**
161S-AA03NPK	1 ~ 220 V -10% - 240 V +5%	**161S-RFA-9-B**
161S-AA04NPK	1 ~ 220 V -10% - 240 V +5%	**161S-RFA-9-B**
161S-AA05NPK	1 ~ 220 V -10% - 240 V +5%	**161S-RFA-22-C**
161S-AA07NPK	1 ~ 220 V -10% - 240 V +5%	**161S-RFA-22-C**
161S-AA10NPK	1 ~ 220 V -10% - 240 V +5%	**161S-RFA-22-C**

Compliance of the Bulletin 161 drive to the conducted emissions levels with appropriate line filter module is as follows:

PWM Carrier Frequency	Motor cable length	Limit
<16 kHz	10 m	Class B
<5 kHz	20 m	Class B
<16 kHz	50 m	Class A

2. All motor cables must be shielded cable, or be in grounded metal conduit.
3. All control and signal wiring must use shielded cable or be in grounded metal conduit.
4. Grounding of equipment and cable shields must be solid, with low impedance connections.
5. Ensure that the protective conductor terminal (PE) of the filter is properly connected with the protective conductor terminal of the drive. The filter must be solidly and permanently connected with the ground potential to avoid electric shock.



General instructions for an EMC compliance installation

Enclosure

- Typical IEC metal enclosures are adequate.
- The ground connection of the enclosure must be solidly connected to the PE terminal of the drive. Good conductivity must be assured – grounding must provide a low impedance path for high frequency signals.
- All wiring, except input power leads, must be shielded cable.
- Input power, output power and control wiring inside the enclosure must be physically separated.
- Input power, output power and control wiring outside the enclosure must use separate shielded cables or separate metal conduit.

Cable Clamps

- Use suitable EMC cable clamps.
- The connection area must be 360 degrees around the shielded cables.
- When using conduit, the contact point of metal must be free of paint or non-conductive surfaces and solidly connected with good conductivity to the enclosure.

Motor Cable

- The cable between the drive and motor must be 4-wire shielded cable (three phases and ground).
- Do not exceed the maximum motor cable length for the specific line filter module used.
- Inside the enclosure, shielded motor cable should be used as close to the drive's output terminals as possible.
- Where the shielded motor cable exits the enclosure, an EMC cable clamp, or metal conduit must be used to solidly connect the cable shield to the enclosure.
- The shield on the motor side must be solidly connected to the motor housing with an EMC cable clamp, or conduit, providing good conductivity from the cable shield to the motor housing.

Control Wiring

- Control wiring must use shielded cable or grounded metal conduit.
- The shield must be connected to PE at both ends of the cable.
- Inside the enclosure, shielded control wiring should be connected as close to the drive's control terminals as possible.

Reach us now at www.rockwellautomation.com

Wherever you need us, Rockwell Automation brings together leading brands in industrial automation including Allen-Bradley controls, Reliance Electric power transmission products, Dodge mechanical power transmission components, and Rockwell Software. Rockwell Automation's unique, flexible approach to helping customers achieve a competitive advantage is supported by thousands of authorized partners, distributors and system integrators around the world.

Americas Headquarters, 1201 South Second Street, Milwaukee, WI 53204, USA, Tel: (1) 414 382-2000, Fax: (1) 414 382-4444
European Headquarters SA/NV, avenue Herrmann Debroux, 46, 1160 Brussels, Belgium, Tel: (32) 2 663 06 00, Fax: (32) 2 663 06 40
Asia Pacific Headquarters, 27/F Citicorp Centre, 18 Whitfield Road, Causeway Bay, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Rockwell Automation

Publication 161-5.0EN – May 1999