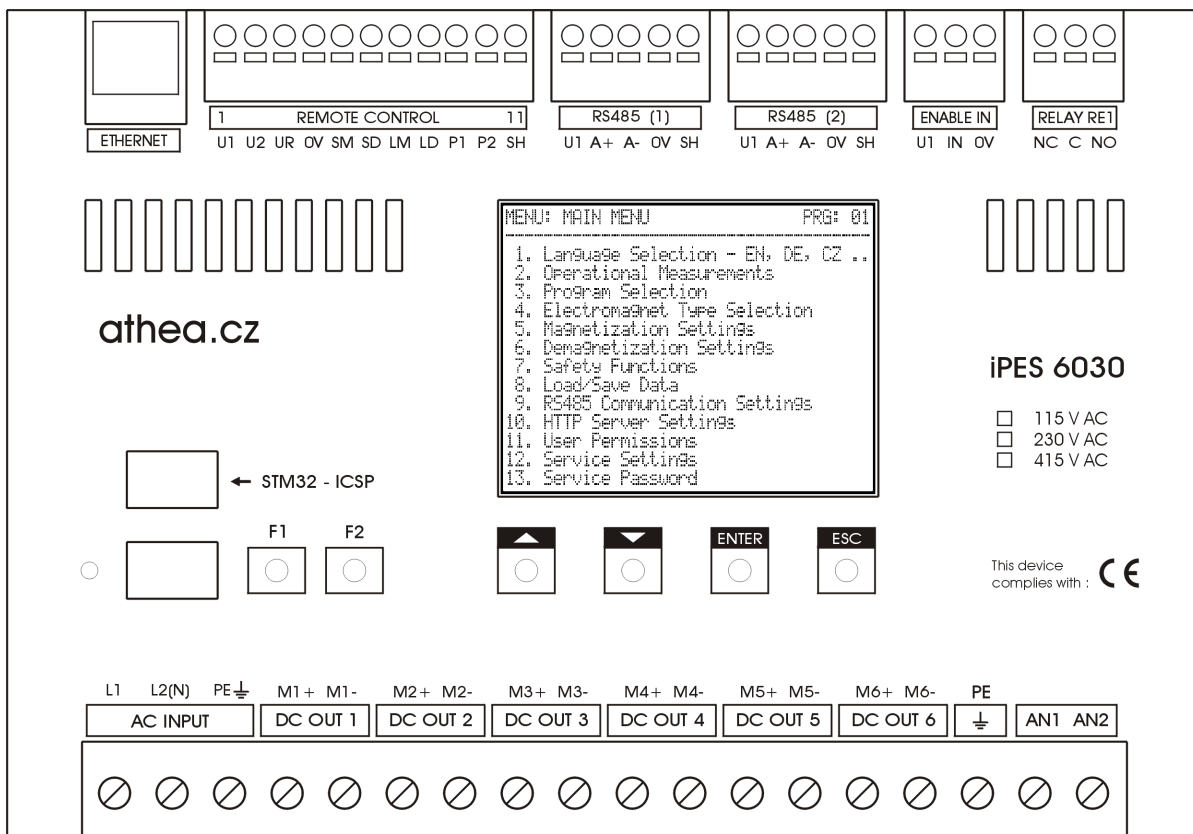


# iPES 6030 - CONTROL UNIT AND POWER SUPPLY FOR ELECTROMAGNETS

- Powerful control system for electromagnetic and electro-permanent chucks
- Continuous output voltage regulation - output current up to 25 A DC
- The control unit is equipped with efficient demagnetization cycles
- The user has the possibility to create his own demagnetization waveforms using the algorithm or by editing individual demagnetization pulses.
- The control unit is designed to power up to 6 electromagnetic chucks
- Ability to operate over an extremely wide range of supply voltages from 115 to 230 VAC. A version for 415 V AC is available.
- Automatic frequency adaptation in the range of 10 Hz to 100 Hz
- Detection of low magnetization level - user adjustable current value
- Damage detection of the supply wire to the magnetic clamping device - RELAY RE1
- ENABLE IN input - designed to block the start of magnetization/demagnetization
- Ability to communicate with common PLC types. RS 485 industrial bus support
- Galvanic isolation of control and power section 1 kV
- Possibility to update the control unit software via the Internet (TCP/IP)

## General Description

The control system is suitable for power supply and impulse control of electromagnetic and electro-permanent chucks. All functions are controlled by a powerful ARM Cortex-M4 microprocessor. The control system automatically adapts to the frequency of the power supply network. The magnetization level (output DC voltage) is continuously adjustable by potentiometer P1 on the control box. The output DC voltage is regulated from 5 to 95 % of the input AC voltage. The control system is equipped with efficient demagnetization cycles, which are designed to remove residual magnetism from workpieces, which can then be easily removed. To increase operator safety, the control system is equipped with a safety contact that indicates a break in the supply wire to the electromagnet and a low level of magnetization.



**Technical data:**

Parameter	Value
AC supply voltage range	110 to 230 V (415 V)
Supply voltage tolerance	±10 %
Supply voltage frequency range	10 - 100 Hz
Power consumption	2 W
Max. continuous DC output current	25 A
Operating temperature range	-20°C to +85°C
Max. input voltage ENABLE IN	30 V DC
Max. switching voltage of RELAY RE1 output	250 V AC
Max. switching current RELAY RE1 output	8 A AC

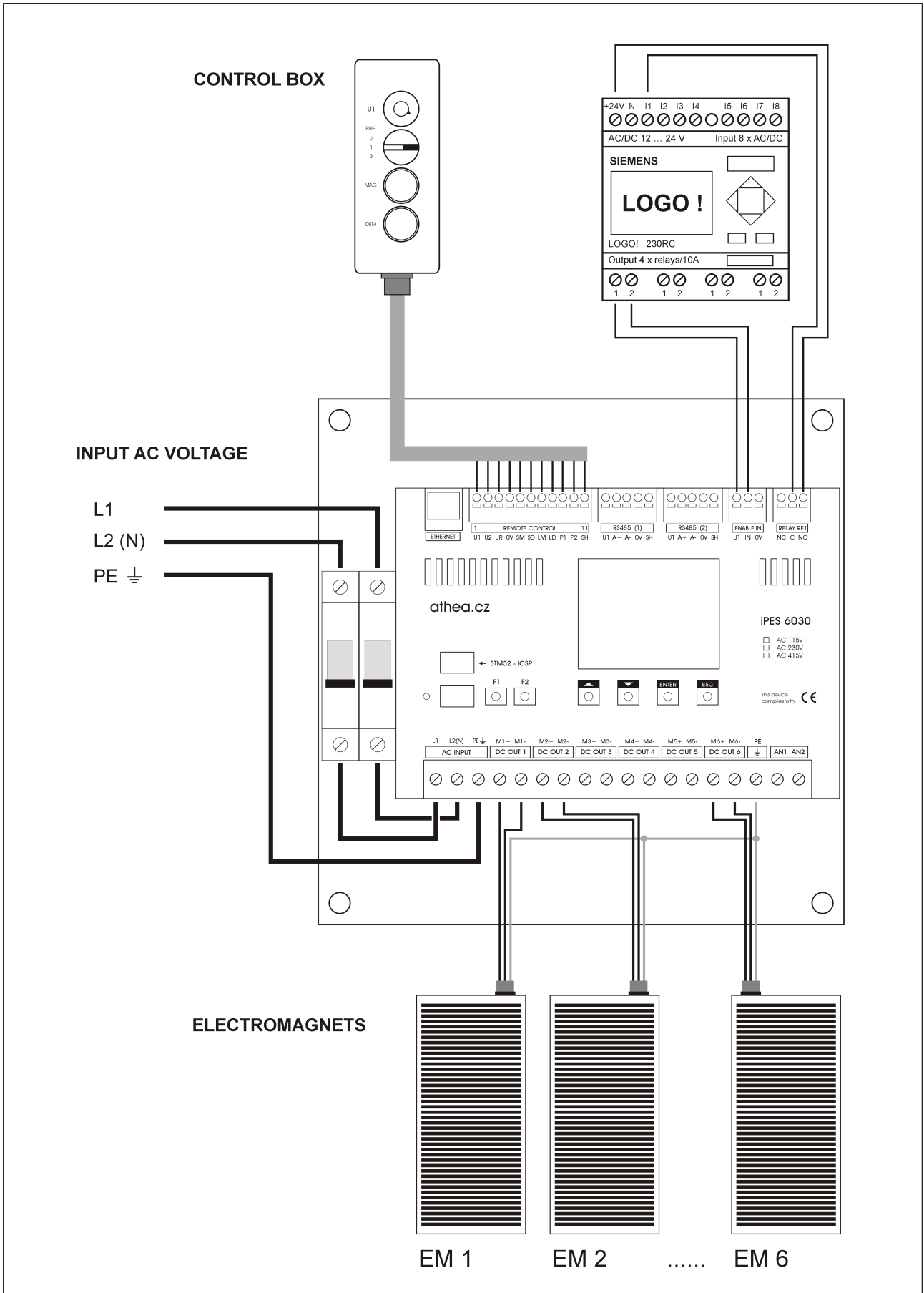
The iPES 6030 control unit has been designed in accordance with EMC and LVD standards.

**INSTALLATION**

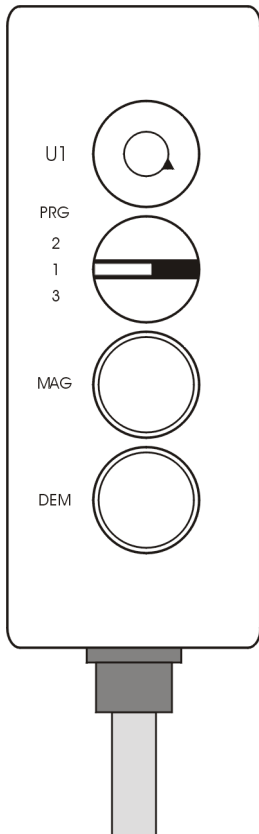
- The iPES series control systems are available with IP20 protection for built-in use or in a stand-alone version with increased IP54 protection. The control system is designed for normal operating environments, in the operating temperature range -20°C to +85°C at a non-condensing maximum relative humidity of 90%.
- Before connecting the control system, it is necessary to check that the mains supply voltage corresponds to the voltage specified on the device.
- It is necessary to connect the protective wire to the PE terminal.
- Input AC supply voltage must be connected to terminals L1 and L2(N) - iPES control systems are designed to operate over an extremely wide range of supply voltages (110 to 230 V AC).
- The electromagnetic clamping plates (or individual coils of the electromagnetic chuck) must be connected to the DC output voltage terminals DC OUT 1 to DC OUT 6.
- The ENABLE IN interlock input terminals can be connected to the master device. If the interlock input is not used, the U1 and IN inputs must be shorted.
- The terminals of the RELAY RE1 safety contact can be connected to a master device (e.g. industrial PLC,...).
- The control box is connected to the control unit by a 10-wire shielded cable - terminals 1 to 11 of the REMOTE CONTROL connector. This conductor must be placed separately from the other (power) conductors. The cable must be protected from environmental influences and mechanical damage.

**The installation of the control system must only be carried out by a person with the appropriate electrical qualifications.**

# Installation of the iPES 6030 control system:



## **CONTROL BOX:**



U1 - potentiometer for setting the clamping force level (output voltage regulation)

PRG - program selection switch

MAG - green illuminated button to start magnetization

DEM – red illuminated button to start demagnetization

### **Recommended operations before clamping workpieces:**

- Clean the workpieces and the surface of the electromagnetic chuck.
- Place the workpieces on the electromagnet over the two poles of the electromagnetic chuck.

## **MAGNETIZATION - CLAMPING:**

- Set potentiometer U1 to the required clamping force.
- Use the PRG switch to select the required MAG/DEM program.
- Press and hold the green illuminated MAG button for at minimum 0.25 seconds.
- The correct level of magnetization is indicated by the light of the green button and the activation of the safety contact RELAY RE1 – it is possible to work fastened objects.

The MAG button flashes to indicate operational or fault conditions:

**Slow flashing** - indicates that the magnetization process has not yet been completed.

**Fast flashing** - indicates that the clamping force has not reached the required level. This condition may occur in the following cases:

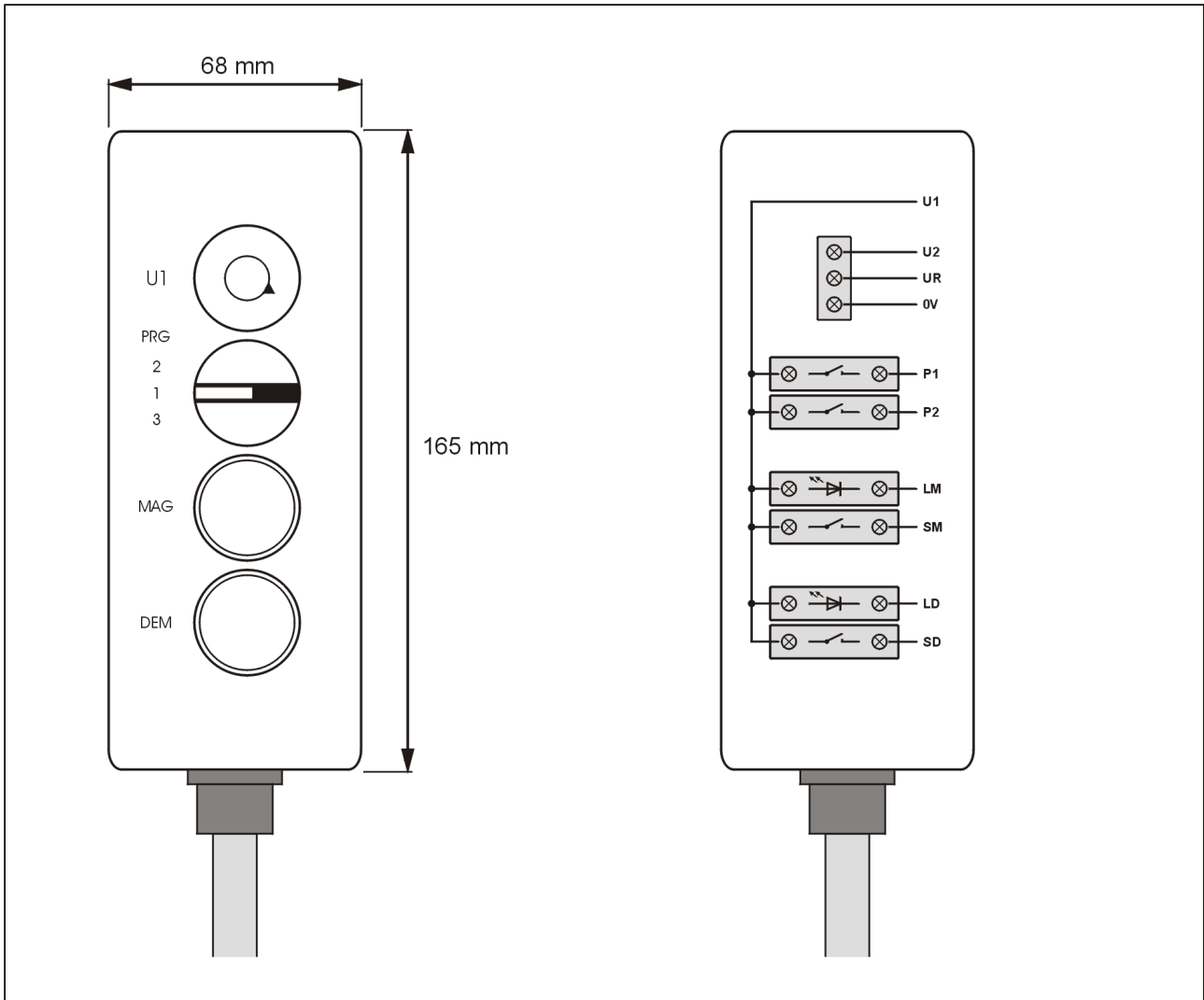
1. Clamping force set too low by potentiometer U1.
2. The safe magnetizing current value is set too high.
3. Little or no current flows through the electromagnetic clamping plate (e.g. due to a damaged electromagnetic clamping plate, interrupted lead wire or damaged iPES controller).

If the green light flashes fast, this is a fault state. The safety contact RELAY RE1 is open - clamped objects must not be machined.

## **DEMAGNETIZATION - RELEASE:**

- Press and hold the red illuminated DEM button for at minimum 0.25 seconds.
- During the demagnetization cycle the red button is flashing slowly - the safety contact RELAY RE1 is open.
- Complete demagnetization cycle is indicated by a continuous lighting of the red button.

## CONTROL BOX - EXTERNAL DIMENSIONS AND ELECTRICAL WIRING



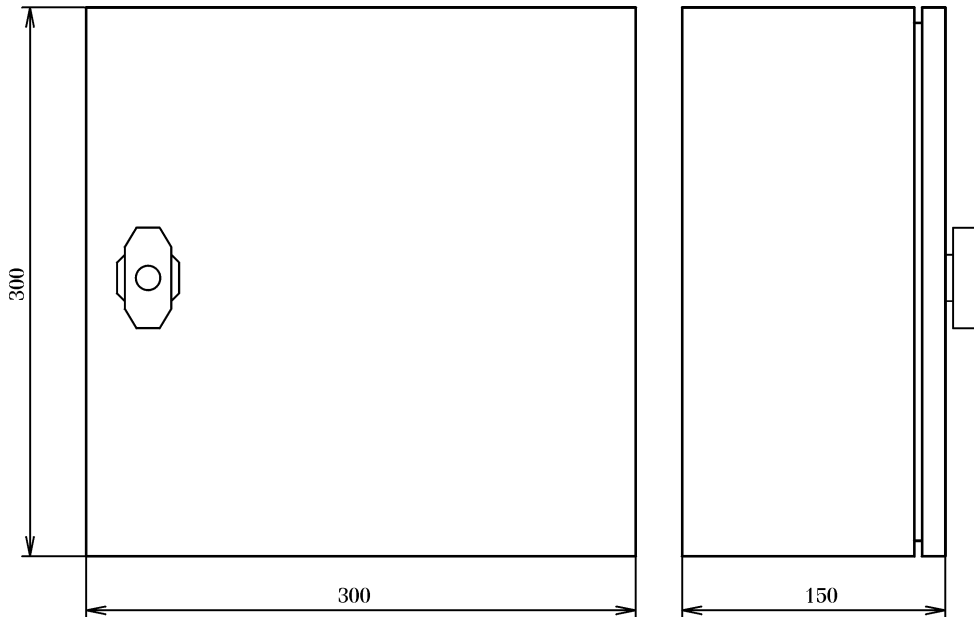
## CONTROL BOX - WIRE DESCRIPTION

Number	Label	Color	Description
1.	U1	Black	Power supply voltage +12 V DC
2.	U2	Brown	Reference voltage for potentiometer +10 V DC
3.	UR	Red	Potentiometer output voltage 0 to +10 V DC
4.	0V	Blue	Power supply voltage 0V (GND)
5.	SM	Yellow	Magnetization start (max. 30 V DC)
6.	SD	Purple	Demagnetization start (max. 30 V DC)
7.	LM	Green	Green LED magnetization light
8.	LD	White	Red LED demagnetization light
9.	P1	Grey	Program switch
10.	P2	Pink	Program switch
11.	SH	<b>Black</b>	Shielding

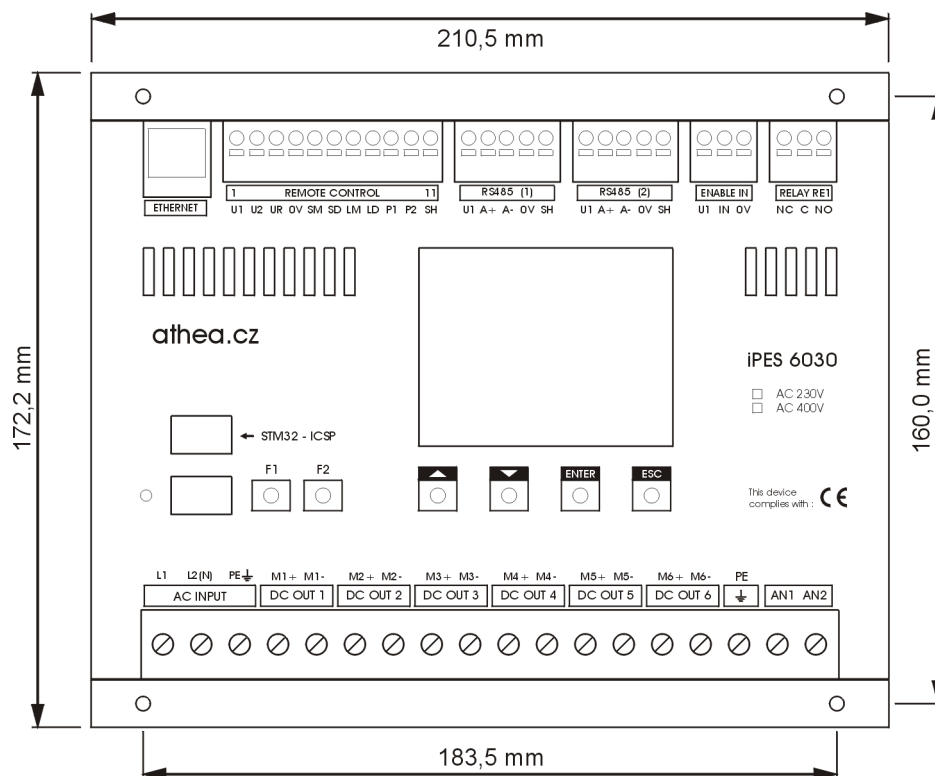
## MECHANICAL CONSTRUCTION OF THE IPES 6030 CONTROL SYSTEM

- IP 54 cover according to EN 60 529
- Certification – LCIE, UL, DNV, BV
- Construction – closed welded box, the front profile in the form of roof gutter made from the double sheet gauge, which secures high consistency of the frame and impermeability of the door
- Door with turning possibility and with the opening angle of 130°
- Colour- polyester powdered composition in the colour shade RAL 7032

### Dimensions of the IPES 6030 control system in IP54 version:



### Dimensions of the iPES 6030 control unit:



## SETTING UP iPES 6030 CONTROL UNIT

iPES 6030 control unit is an industrial power supply used to control electromagnetic and electro-permanent chucks.

If the control unit is not set up by your supplier, you need to set at least the chuck type, magnetization/demagnetization and safety contact parameters according to the connected electromagnet type.

The control unit supports 4 different user programs that can define the magnetization, demagnetization (and many other parameters) depending on the material of the workpiece or the type of electromagnet connected. Programs 1 to 3 can be selected via the **PRG** switch on the control box.

All parameters are set via the LCD display on the front of the control unit. The home screen can be displayed by pressing the **ESC** key. The home screen contains the main MENU, which consists of 13 items:

```
MENU: MAIN MENU                                PRG: 01
-----
1. Language Selection - EN, DE, CZ ..
2. Operational Measurements
3. Program Selection
4. Electromagnet Type Selection
5. Magnetization Settings
6. Demagnetization Settings
7. Safety Functions
8. Load/Save Data
9. RS485 Communication Settings
10. HTTP Server Settings
11. User Permissions
12. Service Settings
13. Service Password
```

Use the up and down arrows to navigate through the menu. The currently selected item is highlighted in red. To select an item, press the **ENTER** key. The **ESC** key allows you to return to the previous item or cancel editing of the selected parameter. All parameters can be edited by long pressing the **ENTER** key. In edit mode, the selected parameter is highlighted in purple. The edited parameter can be confirmed by long pressing the **ENTER** key, or the change can be cancelled by pressing the **ESC** key.

### **Important Notice:**

The currently selected program (PRG: 01-04) is displayed in the upper right corner of the LCD display. Any changes made to the control unit parameters relate only to the currently selected program. Any manipulation of the **PRG** switch on the control box will cause the data of the newly selected program to be read from memory and any unsaved data to be overwritten.

Before manipulating the **PRG** switch, all user edited data must be saved in *MENU 8 - Load/Save Data - Save Current Settings*.

## DESCRIPTION OF MENU ITEMS

### MENU 1 - LANGUAGE SELECTION

```
MENU: LANGUAGE SELECTION          PRG: 01
-----
(*) English
( ) German
( ) Czech
( ) Slovak
```

On this LCD screen it is possible to switch the language used in the menu of the control unit.

Notice:

Other languages can be added by contacting technical support at email: [athea@athea.cz](mailto:athea@athea.cz).

### MENU 2 - OPERATIONAL MEASUREMENT

```
MENU: OPERATIONAL MEASUREMENTS PRG: 01
-----
Input Voltage (U1):                415 [V]
U1 Period - Actual:                 5002 [-]
U1 Period - Set:                    5000 [-]
ADC Current Transformer:            0 [-]
0 A Current Transformer:            2048 [-]
Max. Allowed Output Current:        80 [A]
Max. Measured Output Current:       0 [A]
Electromagnet Temperature:          45.3 [C]
Residual Magnetism:                 0.0 [G]
Set Output Voltage:                 100 [%]
Actual Output Current:               27.5 [A]
```

This LCD screen displays the operating parameters entered by the user or the operating variables measured by the control unit.

All measured values are only approximate and without specified tolerance. Measured values can be calibrated in *MENU 12 - Service Settings*. Calibration can only be performed by users with higher user permissions.

Input voltage (U1) – value shows the supply voltage at the input terminals L1-L2(N) of the control unit. This is an approximate value.

U1 Period - Actual - the current measured value of the input voltage period U1. This value is derived from the frequency of the power supply network. The controller adapts to the supply voltage parameters and is able to operate with both 50 and 60 Hz voltages.

U1 Period - Set - working value of the period. This value is updated each time the controller is connected to the power supply. The controller can operate with a measured or fixed period value. In extremely busy power supply networks, the control unit may not measure the voltage period correctly - in these cases, the period value can be entered manually in *MENU 12 – Service Settings – Period U1 - Constant*.

ADC Current Transformer - value of the output current from the A/D converter in the range of 0 to 4095.

0 A Current Transformer - value of the A/D converter current corresponding to the output current 0 A.

Max. Allowed Output Current - maximum permissible value of output current through the electromagnet. This value is set at the factory and cannot be changed.

**It is not permitted to load the control unit with a higher current than the maximum permitted output current - this may cause irreversible damage to the control unit.**

When the maximum permitted current is exceeded, the control unit reacts by disconnecting the contacts of the safety relay RELAY RE1 and this state is stored in the memory of the control unit.



Max. Measured Output Current – maximum value of output current recorded during magnetization.

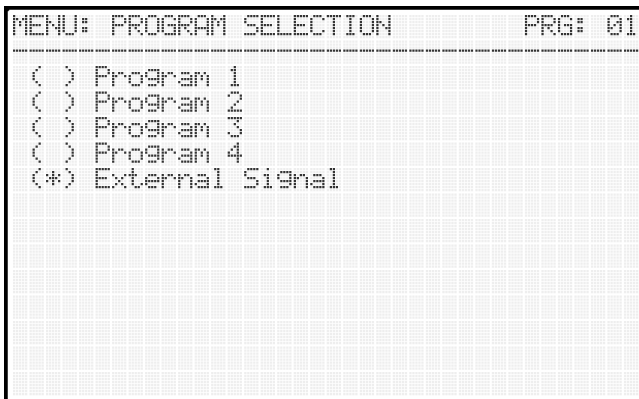
Electromagnet Temperature – the control unit is equipped with circuits for measuring the temperature of the electromagnet. For correct operation, the electromagnet must be equipped with an NTC1000 temperature sensor. This sensor must be connected to terminals AN1 and AN2.

Residual Magnetism - the control unit is able to process data from an external measuring module with a Hall probe. This probe is connected to the RS485 bus. The obtained data are displayed by the control unit in **MENU F2** together with the demagnetization waveform data, which makes it easier for the user to create his own demagnetization waveform.

Set Output Voltage - value from potentiometer P1 on the control box.

Actual Output Current - the measured value of the output current by the electromagnet.

### MENU 3 - PROGRAM SELECTION

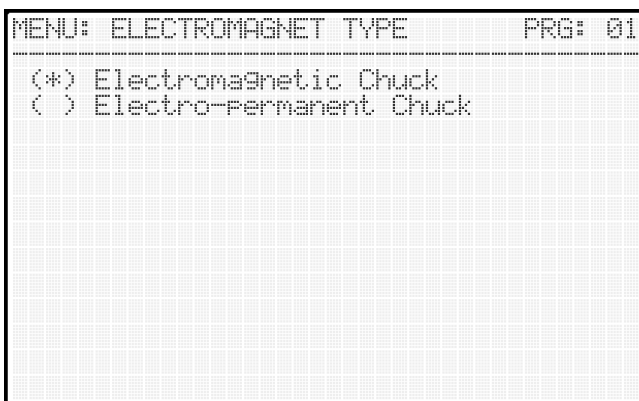


On this LCD screen you can switch between the different programs.

If Program 1-4 is selected, it is not possible to switch programs on the control box.

If External Signal is selected, the switch on the control box is activated. This allows the machine operator to switch programs according to actual requirements.

### MENU 4 - ELECTROMAGNET TYPE



This LCD screen allows to switch the type of electromagnet that is connected to the control unit.

Electromagnetic chuck - in magnetisation mode the electromagnet will be permanently powered all the time during processing.

Electro-permanent chuck - in the magnetization mode the electromagnet will be magnetized by a short electric pulse.

#### Important Notice:

Incorrect setting of the electromagnet type on this LCD screen can cause irreversible damage of the iPES control unit or connected electro-permanent chuck.

## MENU 5 – MAGNETIZATION SETTINGS

```
MENU: MAGNETIZATION SETTINGS PRG: 01
-----
Maximum Voltage:      100.0 %
Minimum Voltage:     25.0 %
Magnetization Time:  1500 ms
Magnetization Delay: 250 ms
Number of Pulse Series: 1 x
Active Outputs: (1)( ) ( ) ( ) ( ) ( ) ( )
```

On this LCD screen you can set the magnetization parameters.

The magnetization setting is different depending on the type of electromagnetic chuck.

The magnetization settings, including examples for each type of electromagnetic chuck, are described in a separate section of this user manual.

Maximum Voltage - maximum output voltage set by potentiometer P1 on the control box. The output voltage must not be higher than the rated voltage of the electromagnetic chuck.

Minimum Voltage – minimum output voltage set by potentiometer P1 on the control box. Low output voltage may cause insufficient workpiece clamping.

Magnetization Time - time of the magnetization pulse series in ms. This value is set only for electro-permanent chucks. For electromagnetic chucks this value is not important - it is not used.

Magnetization Delay – this delay is set only for electro-permanent chuck and is the delay between each series of pulses. This value is only used if the magnetizing cycle contains more than one pulse series.

Number of Pulse Series - setting the number of magnetization pulse series of the magnetization cycle. This value is only used for electro-permanent chucks and in most cases is set to "1 x". For electromagnetic chucks this value is not important - it is not used.

Active Outputs – by setting this value the user defines which outputs will be used for the magnetization cycle.

For electromagnetic chucks, only a combination of outputs 1 and 2 can be selected.

For electro-permanent chucks it is possible to select any combination of outputs - only the selected outputs will be magnetized.

## MENU 6 – DEMAGNETIZATION SETTINGS

```
MENU: DEMAGNETIZATION SETTINGS PRG: 01
-----
Input Parameters: Internal EEPROM [01]
Voltage of the First Series: 100.0 %
Voltage of the Last Series: 25.0 %
Voltage Curve: Linear
Voltage Coefficient: 15
Time of the First Series: 1500 ms
Time of the Last Series: 250 ms
Time Curve: Linear
Time Coefficient: 15
Number of Series: 5
Polarity of the First Series: -
Active Outputs: (1)( ) ( ) ( ) ( ) ( ) ( )
```

On this LCD screen you can set the demagnetization parameters.

The demagnetization setting is different depending on the type of electromagnetic chuck.

The demagnetization settings, including examples for each type of electromagnetic chuck, are described in a separate section of this user manual.

Input Parameters - when setting the demagnetization, it is necessary to select how the data for the demagnetization process will be entered. There are 3 options:

- Internal EEPROM - selecting this item loads the demagnetization program data from the internal memory. This data is fixed in the processor memory - it cannot be viewed or edited and the LCD screen displays the text "Data locked".
- Algorithm - by selecting this item it is possible to define the start and end point of the demagnetization curve. The algorithm is used to calculate the entire curve from these starting points. The demagnetization curve can be linear or non-linear. A nonlinear curve can be defined by a coefficient. The LCD screen displays the demagnetization data. The data cannot be edited in MENU F2, it must be edited in *MENU 6 – DEMAGNETIZATION*.
- User DEM - selecting this item allows the user to manually edit the demagnetization curve - voltage, length and number of demagnetization pulse series in *MENU F2*.

Voltage of the first series - voltage of the first series of demagnetization pulses.

Voltage of the last series - voltage of the last series of demagnetization pulses.

Voltage Curve - the demagnetization voltage curve can be linear or non-linear.

Voltage Coefficient - setting the waveform of the non-linear demagnetization voltage curve.

Time of the First Series - time of the first series of demagnetization pulses.

Time of the Last Series - the time of the last series of demagnetization pulses.

Time Curve - the demagnetization pulse curve can be linear or non-linear.

Voltage Coefficient - setting the waveform of the non-linear demagnetization pulse curve.

Number of Series - the value defines how many times the polarity of the demagnetization pulses will change in the demagnetization procedure.

Polarity of the First Series - setting the polarity of the first series of the demagnetization procedure.

Active Outputs - by setting this value the user defines which outputs will be used for the demagnetization cycle.

For electromagnetic chucks, only a combination of outputs 1 and 2 can be selected.

For electro-permanent chucks it is possible to select any combination of outputs - only the selected outputs will be demagnetized.

## MENU 7 – SAFETY FUNCTIONS

```

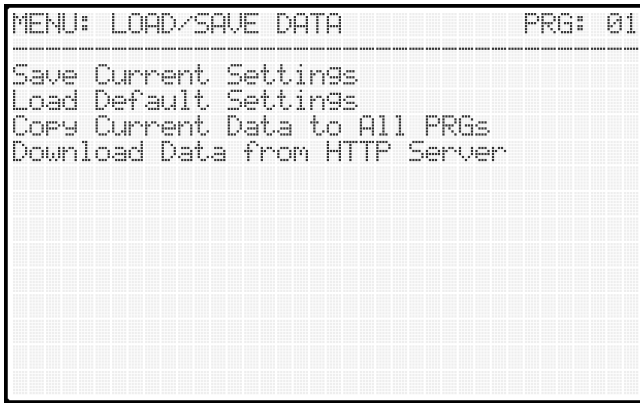
MENU: SAFETY FUNCTIONS          PRG: 01
Switch ON Relay at Current: >  5.0 A
Switch OFF Relay at Current: <  1.5 A
Switch ON Relay at Temper.: <  50.0 oC
Switch OFF Relay at Temper.: >  75.0 oC
Relay RE1 Switch-on Delay:    250 ms
Relay RE1 Switch-off Delay:   0 ms
  
```

On this LCD screen it is possible to set the conditions for switching on/off the safety relay contact (RELAY RE1).

The current measurement is provided by an internal DC current transformer.

For temperature measurement, the connected electromagnetic chuck must be equipped with a temperature sensor.

## MENU 8 – LOAD/SAVE DATA



This LCD screen allows you to read/save data to the internal memory of the control unit.

All settings are stored by the control unit even when the power supply is switched off.

Save Current Settings - selecting this item will save the data for the currently selected program. The currently selected program is displayed in the upper right corner of the LCD display. All saved data relates only to the currently selected program.

No manipulation of the **PRG** switch on the control box is allowed before saving data. Any manipulation of the **PRG** switch on the control box will cause the data of the newly selected program to be loaded from memory and overwrite any unsaved data.

Load Default Settings - selecting this item will load default data - applies only to the currently selected program.

Copy Current Data to All PRGs - selecting this item will copy data from the currently selected program to all other programs. Be careful when selecting this item - it will overwrite the data stored in all programs.

Download Data from HTTP Server - this item allows to update the settings of the control unit via the Internet connection.

For correct function it is necessary to enter the IP address of the server and the communication port in *MENU 10 - HTTP Server Settings*. All details are available on the website [www.iPES6030.com](http://www.iPES6030.com). The update file is generated by the supplier or end customer on the manufacturer's server.

### **To generate the update file, follow these steps:**

1. Connect the iPES6030 control unit to the Internet via the ETHERNET connector.
2. Enter the address [www.ipes6030.com](http://www.ipes6030.com) into an internet browser.
3. Register the control unit by entering the serial number, e-mail address and access password.
4. On the login page, enter the serial number of the control unit, the registered e-mail address and the password.
5. On the displayed page, you can update the parameters of the control unit and generate an update file by pressing the "Generate update file" button.
6. On the iPES6030 controller, in MENU 8 - LOAD/SAVE DATA, select Download Data from HTTP Server.
7. Wait until the message „File downloaded successfully“ is displayed on the iPES6030 control unit LCD.

## MENU 9 – RS485 COMMUNICATION

MENU: RS485 COMMUNICATION	PRG: 01
Address [1=Master]	1
Speed	2400 Bd
Data Bits	8
Parity	None
Stop Bits	1

This LCD screen allows you to enter the parameters of the RS485 communication bus.

This interface is used for connection:

- intelligent control box
- the master control
- Hall probe

Multiple units can be controlled in parallel mode via the RS485 bus.

## MENU 10 – HTTP SERVER SETTINGS

MENU: HTTP SERVER SETTINGS	PRG: 01
IP Address Part 1:	192
IP Address Part 2:	168
IP Address Part 3:	001
IP Address Part 4:	234
Port:	80
ID:	*****
Password:	*****
RSA Key:	rsa.key

This LCD screen allows you to enter the Ethernet network parameters.

These parameters are necessary for the correct function of updating the controller via the internet connection.

The ID, password and RSA key fields are not necessary - they are specified by the manufacturer.

## MENU 11 – USER PERMISSIONS

MENU: USER PERMISSIONS	PRG: 01
(*) Operational Measurements	
(*) Program Selection	
(*) Electromagnet Type	
(*) Magnetization Setting	
(*) Demagnetization Setting	
(*) Safety Function	
(*) Load/Save Data	
(*) RS485 Communication	
(*) HTTP Server Settings	
( ) User Permissions	
( ) Service Settings	

Note: (\*) = Unlocked ( ) = Locked

This LCD screen is available only to users with higher user permissions.

User permission settings are accessible after entering the ID and password in *MENU 13 - Service Password*.

Through these preferences, it can be specified which settings of the control unit will be accessible to the normal user and which will be password protected.

In this way, the control unit settings can be protected to prevent unauthorized changes that could cause damage to the control unit or the electromagnetic chuck.

**Locked items will be inaccessible to unauthorized persons and cannot be read or edited. The supplier has the option to make the magnetization and demagnetization settings unavailable to normal users - these settings may be the subject of studies, experiments or long-term development and will be hidden to unauthorized persons.**

## MENU 12 – SERVICE SETTINGS

MENU: SERVICE SETTINGS	PRG: 01
P1 MIN - Calibration:	10
P1 MAX - Calibration:	4095
Voltage U1 - Calibration:	372
Temperature - Calibration:	20
U1 Period Measurement:	AUTO
ENABLE IN:	YES
Short Circuit Test:	NO
Relay/Contactor Delay:	250 ms
Maximum Current:	100 A
Current Trans. Coefficient:	365
0A Current Transformer:	2048
Period U1 - Constant:	5000
Serial Number:	20210701

This LCD screen is available only to users with higher user permissions.

User permission settings are accessible after entering the ID and password in *MENU 13 - Service Password*.

The service settings are used for calibrating the measuring circuits and control unit optimization.

P1 MIN - Calibration - used for calibration of the A/D converter. It sets the lower limit of the analog signal used for output voltage regulation. Calibration is performed by turning potentiometer P1 to the MIN position and long pressing the **ENTER** key to update the minimum value.

P1 MAX - Calibration - is used to calibrate the A/D converter. It sets the upper limit of the analog signal used to regulate the output voltage. Calibration is performed by turning the P1 potentiometer to the MAX position and long pressing the **ENTER** key to update the maximum value.

By default, the output voltage is regulated by potentiometer P1 on the control box, which outputs a voltage of 0 to 10 V DC (MIN = 0V = 0% and MAX = 10V = 100%). Using this constant, it is possible to recalibrate the analog input e.g. (0V = 0% and 5V = 100%).

Voltage U1 - Calibration - is used to calibrate the value of the Input voltage (U1) displayed in *MENU 2 - OPERATING PARAMETERS*.

Temperature - Calibration - used to calibrate the temperature of the external temperature sensor.

U1 Period Measurement - use this value to set whether the controller will perform a period analysis of the supply voltage (AUTO) at restart or if a fixed constant will be used.

ENABLE IN - this parameter enables or disables the ENABLE IN input, which can be used to block the start of magnetization/demagnetization.

Short Circuit Test - this parameter activates or deactivates the short circuit test function on the controller output when starting magnetization/demagnetization. The control unit must be equipped with an additional card that is not a standard part of the product.

Relay/Contactor Delay - this constant defines the delay of the contactors that switch the polarity of the output voltage and switch the outputs to be magnetized or demagnetized.

Maximum Current - the maximum current allowed through the electromagnet. This value is specified at the factory and cannot be changed. When the maximum permitted current is exceeded, the control unit reacts by disconnecting the contacts of the safety relay RELAY RE1 and this state is stored in the memory of the control unit.

Current Trans. - Coefficient - used for calibration of the DC current transformer. This value is factory set and cannot be changed.

0A Current Transformer - used for calibration of the current transformer. This value is factory set and cannot be changed.

Period U1 - constant - this is a constant that is used when the controller is unable to analyze the input voltage period or this function is disabled. The control unit analyzes the power supply network at each power-up (restart).

Serial Number - this is the serial number of the control unit. This value is specified at the factory and cannot be changed. The serial number of the control unit is also used to log into remote management, which allows updating the control unit settings via the Internet.

## MENU F1 – OPERATIONAL MEASUREMENTS

F1: OPERATIONAL MEASUREMENTS		PRG: 01	
Set Output Voltage (P1):	100,0 [%]		
Output Current:	23,7 [A]		
RELAY RE1 Status:	OFF		
Status Table:			
OUTPUT	FCE	I[A]	STATUS
DC OUT 1	MAG	25,7	OK
DC OUT 2	MAG	0,0	ERROR
DC OUT 3	-	--,-	-
DC OUT 4	-	--,-	-
DC OUT 5	-	--,-	-
DC OUT 6	-	--,-	-

By pressing the **F1** key on the front panel of the control unit it is possible to display the current operating information - the required output voltage, output current through the electromagnet and the status of the RELAY RE1 contacts.

## MENU F2 – DEMAGNETIZATION SETTINGS

F2: DEMAGNETIZATION SETTINGS		PRG: 01		
SERIE	U[%]	T[ms]	I[A]	AIN[%]
1.	100	1200	--,-	-
2.	80	950	--,-	-
3.	60	700	--,-	-
4.	40	450	--,-	-
5.	20	200	--,-	-
6.	0	0	--,-	-
7.	0	0	--,-	-
8.	0	0	--,-	-
9.	0	0	--,-	-
10.	0	0	--,-	-
11.	0	0	--,-	-

By pressing the **F2** key on the front panel of the control unit, the demagnetization waveform table can be displayed.

The table is divided into 5 columns:

*Series* - order of demagnetization series

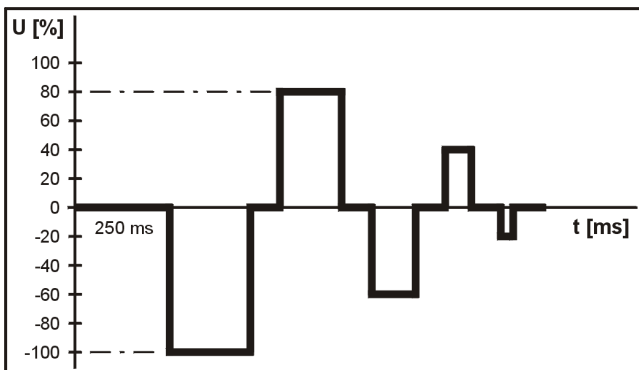
*U[%]* - required output voltage

*T[ms]* - required pulse time

*I[A]* - max. measured output current

*AIN[%]* - measured value of ext. sensor

### Progress of Demagnetization:



The data in the table changes depending on the input data in *MENU 6 – DEMAGNETIZATION*.

### MENU 6 - Demagnetization Settings:

MENU: DEMAGNETIZATION SETTINGS		PRG: 01	
Input Parameters:	Algorithm [Menu 6]		
Voltage of the First Series:	100,0 %		
Voltage of the Last Series:	20,0 %		
Voltage Curve:	Linear		
Voltage Coefficient:	15		
Time of the First Series:	1200 ms		
Time of the Last Series:	200 ms		
Time Curve:	Linear		
Time Coefficient:	15		
Number of Series:	5		
Polarity of the First Series:	-		
Active Outputs:	(1) ( ) ( ) ( ) ( ) ( ) ( ) ( )		

The user defines the voltage and time of the first and last demagnetization pulses. The demagnetization process is automatically calculated depending on the number of series.

The polarity of the 1st series can be changed.

In this case, the control unit will perform demagnetization only on the DC OUT1 output.

## **EXAMPLES OF MAGNETIZATION SETTINGS FOR ELECTROMAGNETIC CHUCKS**

Before setting the magnetization it is always necessary to check that the correct type of electromagnet is set in MENU 4 - ELECTROMAGNET TYPE – electromagnetic chuck.

Standard electromagnetic chucks require a continuous power supply throughout the magnetization process. Electro-permanent chucks are magnetized by a short electrical pulse (approximately 1 sec). Longer magnetization times can damage the electro-permanent chuck.

### **EXAMPLE 1: Magnetization settings for an electromagnetic chuck**

```
MENU: MAGNETIZATION SETTINGS   PRG: 01
-----
Maximum voltage:                60.0 %
Minimum voltage:                5.0 %
Magnetization time:             750 ms
Magnetization delay:            350 ms
Number of pulse series:         1 x
Active outputs: (1)( ) ( ) ( ) ( ) ( )
```

*Maximum Voltage* - output voltage level for potentiometer P1 in the rightmost position.

*Minimum Voltage* - output voltage level for potentiometer P1 in the leftmost position.

*Magnetization Time and Delay* - this parameters are not used in case of electromagnetic chuck. The magnetization time starts by pressing the MAG button and ends by pressing the DEM button on the control box.

*Number of Pulse Series* - for electromagnetic chucks this value is not important - it is not used.

*Active Outputs* - defines which outputs (DC OUT1-6) of the control unit will be used during the magnetizing process.

In this case, the control unit will perform magnetization only on the DC OUT1 output. The maximum output voltage is limited to 60 % in this case. The minimum output voltage is limited to 5 % in this case. When the input voltage of the control unit is 230 V AC and the potentiometer P1 is turned to the rightmost position, the output voltage of the control unit will be approximately 115 V DC. When the potentiometer P1 is turned to the leftmost position, the output voltage of the control unit will be approximately 10 V DC.

### **EXAMPLE 2: Magnetization settings for an electromagnetic chucks**

```
MENU: MAGNETIZATION SETTINGS   PRG: 01
-----
Maximum voltage:                60.0 %
Minimum voltage:                5.0 %
Magnetization time:             750 ms
Magnetization delay:            350 ms
Number of pulse series:         1 x
Active outputs: (1)(2)( ) ( ) ( ) ( )
```

The control unit configured in this way performs magnetization on the DC OUT1 and DC OUT2 outputs. All the other parameters are the same as in Example 1.

### **!!! Important notice !!!**

**All changed parameters must be saved immediately in MENU 8 - LOAD/SAVE DATA - Save Current Settings.**



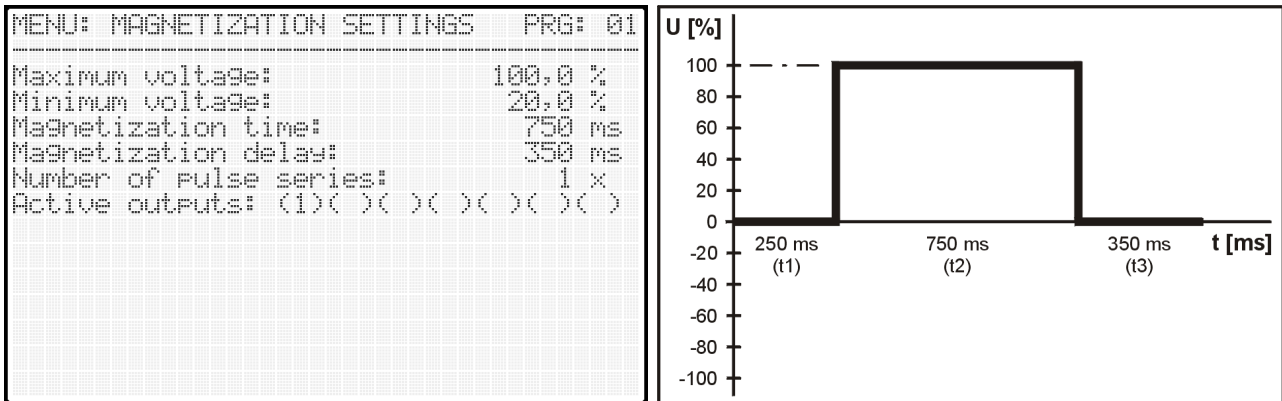
## EXAMPLES OF MAGNETIZATION SETTINGS FOR ELECTRO-PERMANENT CHUCKS

Before setting the magnetization it is always necessary to check that the correct type of electromagnet is set in *MENU 4 - ELECTROMAGNET TYPE – electro-permanent chuck*.

Incorrect setting of the electromagnet type can cause not only irreversible damage to the control unit, but also damage to the connected electro-permanent chuck.

Magnetization of electro-permanent chucks is performed by one or several short electrical pulses.

### EXAMPLE 3: Magnetization settings for electro-permanent chuck - 1 pulse



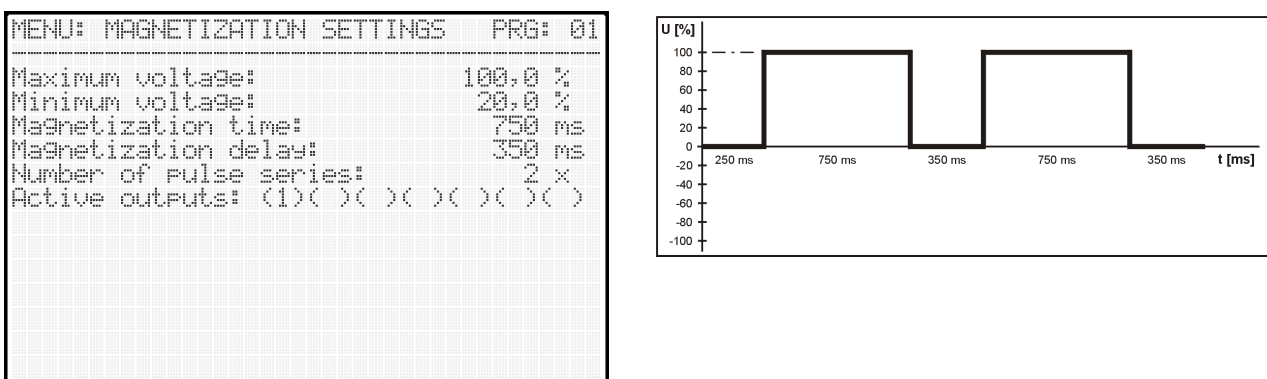
Set up in this way, the control unit performs magnetization of the electro-permanent chuck with a single electrical pulse of 750 ms. The output voltage is regulated by potentiometer P1 on the control box. In the rightmost position of potentiometer P1, the control unit output will be at maximum voltage (100%). In the leftmost position of potentiometer P1, the control unit output will be at a voltage corresponding to 20% of the input AC supply voltage. The control unit will perform a magnetizing cycle only at the DC OUT1 output.

*Time t1* - this time is set by the manufacturer in *MENU 12 - SERVICE SETTINGS* and the user is not allowed to change this parameter - it is the time of switching ON/OFF of the contactors.

*Time t2* - the magnetization time is set by the customer or supplier according to the type of electro-permanent chuck.

*Time t3* - magnetization delay is used when more than one series of pulses is used for magnetization.

### EXAMPLE 4: Magnetization settings for electro-permanent chuck - 2 pulses



Set in this way, the control unit performs magnetization of the electro-permanent chuck with two electrical pulses of 750 ms. The output voltage is regulated by potentiometer P1 on the control box in the range of 20-100%. Only the DC OUT1 is active.

## EXAMPLE 5: Magnetization settings for electro-permanent chuck with 2 windings

```
MENU: MAGNETIZATION SETTINGS PRG: 01
-----
Maximum voltage: 100,0 %
Minimum voltage: 20,0 %
Magnetization time: 750 ms
Magnetization delay: 350 ms
Number of pulse series: 1 x
Active outputs: (1)(2)( ) ( ) ( ) ( ) ( )
```

Set up in this way, the control unit performs magnetization of the electro-permanent chuck with a single electrical pulse of 750 ms. The output voltage is regulated by potentiometer P1 on the control box in the range of 20-100%.

The control unit performs a magnetizing cycle on the DC OUT1 and DC OUT2 outputs.

## EXAMPLES OF DEMAGNETIZATION SETTINGS

The demagnetization setting is the same for both electromagnetic and electro-permanent chucks. The demagnetization cycle consists of electrical pulses of different polarity, voltage and time.

The control unit contains demagnetization waveforms that are stored by the manufacturer in the internal EEPROM memory - these waveforms cannot be viewed or edited.

The user has the possibility to create his own demagnetization waveforms using the algorithm or by editing individual demagnetization pulses.

## EXAMPLE 6: Selecting a demagnetization waveform from the internal EEPROM

```
MENU: DEMAGNETIZATION SETTINGS PRG: 01
-----
Input Parameters: Internal EEPROM [01]
Voltage of the First Series: 100,0 %
Voltage of the Last Series: 25,0 %
Voltage Curve: Linear
Voltage Coefficient: 15
Time of the First Series: 1500 ms
Time of the Last Series: 250 ms
Time Curve: Linear
Time Coefficient: 15
Number of Series: 5
Polarity of the First Series: -
Active Outputs: (1)( ) ( ) ( ) ( ) ( ) ( )
```

*Input Parameters* - by selecting the "Internal EEPROM" item, data is read from the internal memory of the control unit.

*Polarity of the First Series* - by default it is recommended to start the demagnetization waveform with negative polarity.

*Active Outputs* - by setting this value the user defines which outputs will be used for the demagnetization cycle.

For electromagnetic chucks, only a combination of active outputs 1 and 2 can be selected. For electro-permanent chucks, any combination of active outputs can be selected. Only the electro-permanent chucks on the selected outputs are demagnetized during the demagnetization cycle.

All other parameters have no effect on the resulting demagnetization cycle - they are protected by the supplier.

The generation of custom demagnetization waveforms is described in the following section of the user manual.

## EXAMPLE 7: Creating a custom demagnetization waveform using the algorithm

```

MENU: DEMAGNETIZATION SETTINGS PRG: 01
-----
Input Parameters: Algorithm [Menu 6]
Voltage of the First Series: 100.0 %
Voltage of the Last Series: 20.0 %
Voltage Curve: Linear
Voltage Coefficient: 15
Time of the First Series: 1200 ms
Time of the Last Series: 200 ms
Time Curve: Linear
Time Coefficient: 15
Number of Series: 5
Polarity of the First Series: -
-----
Active Outputs: (1)( )( )( )( )( )
    
```

*Input parameters* - by selecting the "Algorithm" item it is possible to define the starting and ending point of the demagnetization curve. The algorithm is used to calculate the entire curve from these starting points.

The demagnetization curve can be linear or non-linear. A non-linear waveform can be defined by a coefficient.

```

F2: DEMAGNETIZATION SETTINGS PRG: 01
-----
SERIE | U[%] | T[ms] | I[A] | AIN[%]
-----
 1. | 100 | 1200 | --,- | -
 2. | 80 | 950 | --,- | -
 3. | 60 | 700 | --,- | -
 4. | 40 | 450 | --,- | -
 5. | 20 | 200 | --,- | -
 6. | 0 | 0 | --,- | -
 7. | 0 | 0 | --,- | -
 8. | 0 | 0 | --,- | -
 9. | 0 | 0 | --,- | -
10. | 0 | 0 | --,- | -
11. | 0 | 0 | --,- | -
    
```

In **MENU F2** it is possible to display the calculated demagnetization curves - it is not possible to edit the data in this menu.

The parameters of the individual demagnetization pulses are shown in detail in the table.

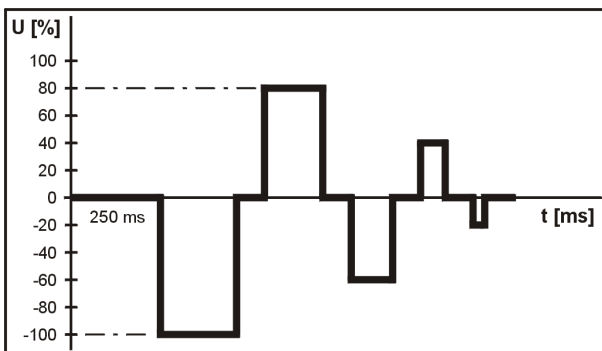
1<sup>st</sup> demagnetization pulse: -100%/1200ms

2<sup>nd</sup> demagnetization pulse: +80%/950ms

3<sup>rd</sup> demagnetization pulse: -60%/700ms

4<sup>th</sup> demagnetization pulse: +40%/450ms

5<sup>th</sup> demagnetization pulse: -20%/200ms



This picture shows the demagnetization cycle according to the specified algorithm.

The demagnetization process contains 5 demagnetization pulses.

The polarity of the first pulse is negative and for the following pulses the polarity alternates.

This is a symmetrical demagnetization which is suitable for standard electromagnetic chucks.

This demagnetization setting works with fixed voltage values of demagnetization pulses.

The following example demonstrates the special **"P1" function**, which allows to dynamically change the voltage of the demagnetization pulses depending on the position of the potentiometer P1 on the control box.

Using the "P1" function, it is possible to ensure that the voltage of the demagnetizing pulses will never be higher than the voltage at which the electromagnetic chuck was magnetized. The electromagnetic chuck is protected from damages due to overvoltage and the control unit from possible overload.

### !!! Important notice !!!

All changed parameters must be saved immediately in **MENU 8 - LOAD/SAVE DATA - Save Current Settings**.

## EXAMPLE 8: Creating a custom demagnetization waveform using the algorithm with the special function "P1"

Using the function "P1" it is possible to ensure that the voltage of the first demagnetization pulse is the same as the voltage at which the electromagnetic chuck was magnetized.

```

MENU: DEMAGNETIZATION SETTINGS PRG: 01
-----
Input Parameters: Algorithm [Menu 6]
Voltage of the First Series: P1
Voltage of the Last Series: 10.0 %
Voltage Curve: Linear
Voltage Coefficient: 15
Time of the First Series: 1200 ms
Time of the Last Series: 200 ms
Time Curve: Linear
Time Coefficient: 15
Number of Series: 5
Polarity of the First Series: -
-----
Active Outputs: (1)( ) ( ) ( ) ( ) ( ) ( ) ( )
    
```

This image shows the activation of the "P1" function.

In the *Input Parameters* item, the value "Algorithm" must be selected and the symbol P1 must be set on the following line *Voltage of the First Series*.

To display the P1 symbol, set the minimum value with the down arrow and confirm this selection by pressing the **ENTER** key.

```

F2: DEMAGNETIZATION SETTINGS PRG: 01
-----
SERIE | U[%] | T[ms] | I[A] | AIN[%]
-----
1. | 60 | 1200 | ---,- | -
2. | 47 | 950 | ---,- | -
3. | 35 | 700 | ---,- | -
4. | 22 | 450 | ---,- | -
5. | 10 | 200 | ---,- | -
6. | 0 | 0 | ---,- | -
7. | 0 | 0 | ---,- | -
8. | 0 | 0 | ---,- | -
9. | 0 | 0 | ---,- | -
10. | 0 | 0 | ---,- | -
11. | 0 | 0 | ---,- | -
    
```

To verify the correct function, it is possible to set the output voltage to a value of e.g. 60% using potentiometer P1 - this value can be displayed in **MENU F1** .

By switching to **MENU F2** it is possible to display the demagnetization data.

The table shows the recalculated voltage of the individual demagnetization pulses.

The voltage of the first demagnetization pulse will always correspond to the specified output voltage according to the rotation of potentiometer P1 and the voltage of the next pulses is always recalculated before starting the demagnetization cycle. The "P1" function can be verified by turning potentiometer P1 to the required position and pressing the F2 key to recalculate the data.

**Using the "P1" function, it is possible to ensure that the voltage of the demagnetizing pulses will never be higher than the voltage at which the electromagnetic chuck was magnetized. The electromagnetic chuck is protected from damages due to overvoltage and the control unit from possible overload.**

### **!!! Important notice !!!**

**All changed parameters must be saved immediately in *MENU 8 - LOAD/SAVE DATA - Save Current Settings*.**

### EXAMPLE 9: Creating a precise demagnetization waveform using the algorithm

```
MENU: DEMAGNETIZATION SETTINGS PRG: 01
-----
Input Parameters: Algorithm [Menu 6]
Voltage of the First Series: 60.0 %
Voltage of the Last Series: 25.0 %
Voltage Curve: Linear
Voltage Coefficient: 15
Time of the First Series: 1200 ms
Time of the Last Series: 100 ms
Time Curve: Linear
Time Coefficient: 15
Number of Series: 10
Polarity of the First Series: -
-----
Active Outputs: (1)( ) ( ) ( ) ( ) ( ) ( ) ( )
```

For precise demagnetization of higher quality materials it is recommended to choose a demagnetization waveform with multiple pulses - in this example 10 demagnetization pulses (series) are used.

It is recommended to demagnetize bigger workpieces with longer demagnetization pulses and higher voltages.

The output voltage should not be higher than the maximum allowed voltage of the electromagnetic chuck.

```
F2: DEMAGNETIZATION SETTINGS PRG: 01
-----
```

SERIE	U[%]	T[ms]	I[A]	AINE[%]
1.	60	1200	---	--
2.	56	1000	---	--
3.	52	960	---	--
4.	48	840	---	--
5.	44	720	---	--
6.	41	600	---	--
7.	37	480	---	--
8.	33	360	---	--
9.	29	240	---	--
10.	25	120	---	--
11.	0	0	---	--

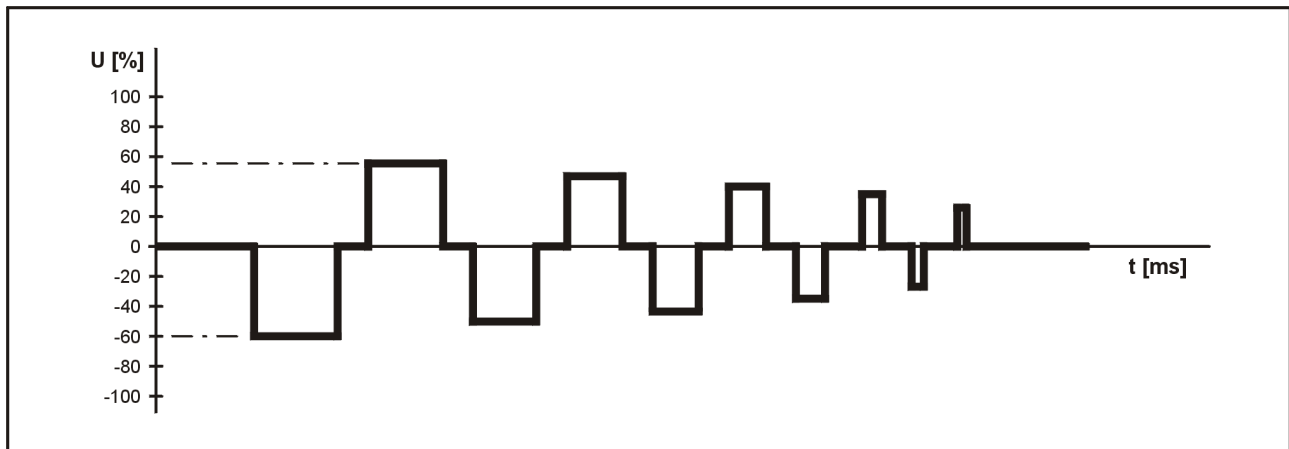
```
-----
```

By switching to **MENU F2**, the demagnetization data can be displayed.

From the displayed table it is evident that the demagnetization waveform consists of 10 pulses.

The first demagnetization pulse is negative - see *Polarity of the First Series*.

The values of voltage and pulse times decrease linearly.



### EXAMPLE 10: Creating a user demagnetization waveform

```
MENU: DEMAGNETIZATION SETTINGS PRG: 01
-----
Input Parameters: User DEM [F2]
Voltage of the First Series: 60.0 %
Voltage of the Last Series: 25.0 %
Voltage Curve: Linear
Voltage Coefficient: 15
Time of the First Series: 1200 ms
Time of the Last Series: 100 ms
Time Curve: Linear
Time Coefficient: 15
Number of Series: 10
Polarity of the First Series: -
-----
Active Outputs: (1)( ) ( ) ( ) ( ) ( ) ( ) ( )
```

This example shows the control unit setup in user demagnetization mode.

In the *Input Parameters* item, it is necessary to select the value "User DEM".

This LCD screen allows you to set the *First Series Polarity* and *Active Outputs*.

All other parameters have no effect on the resulting demagnetization waveform.

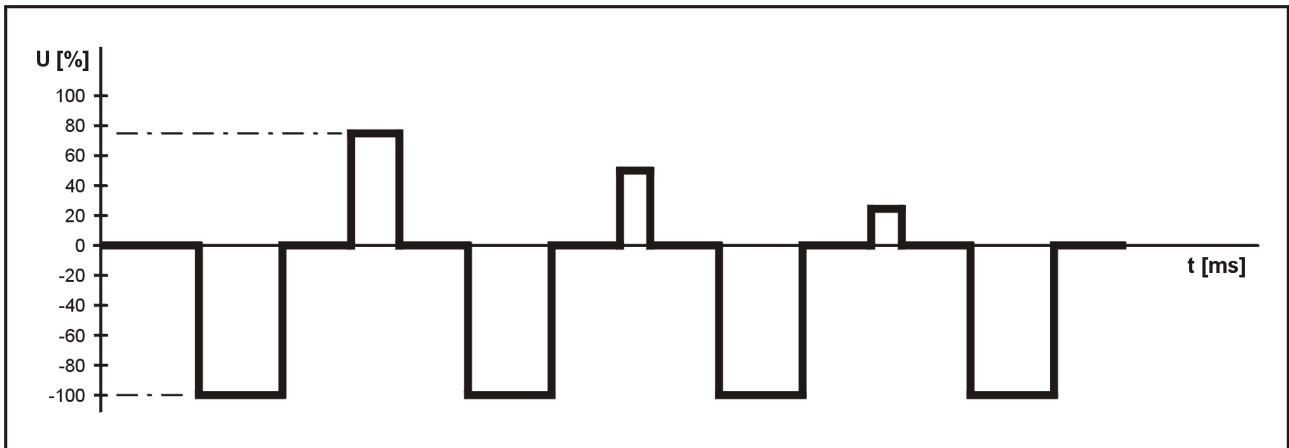
F2: USER DEMAGNETIZATION				PRG: 01
SERIE	U[%]	T[ms]	I[A]	AINC[%]
1.	100	1250	→,-	-
2.	75	750	→,-	-
3.	100	1250	→,-	-
4.	50	500	→,-	-
5.	100	1250	→,-	-
6.	25	250	→,-	-
7.	100	1250	→,-	-
8.	0	0	→,-	-
9.	0	0	→,-	-
10.	0	0	→,-	-
11.	0	0	→,-	-

By switching to **MENU F2** it is possible to VIEW and EDIT the demagnetization data.

From the displayed table it is evident that the demagnetization waveform contains 7 pulses.

The parameters of the individual pulses can be freely edited.

The following picture shows the resulting demagnetization waveform.



By selecting user demagnetization, any demagnetization waveform can be generated.

**!!! Important notice !!!**

**All changed parameters must be saved immediately in *MENU 8 - LOAD/SAVE DATA - Save Current Settings.***

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