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Introduction

L-ION series products are advanced digital controllers designed for heating, ventilating, air-conditioning (HVAC) systems. They have the capability to control process variables using PI control, cascade, compensation, low and high limit functions.

The L-ION's must be configured for the particular application that it will be used in. This is easily achieved using the integral keypad & display. Depending on the installation, one or more process controls can be configured.

Although all systems can be configured from scratch, it is much more practical to select from one of the pre-defined templates and follow these steps:

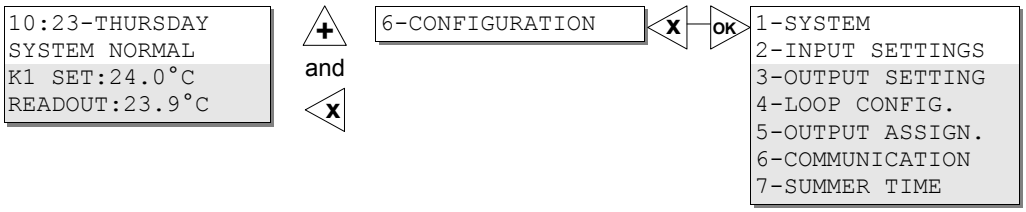
1. Select the template that most closely resembles the desired application from the “L-ION application template.”
2. Check the properties of inputs and outputs and correct any discrepancies.
3. Fine tune the control loop parameters.
4. Check the assignments of outputs to control loops and time schedules
5. Set the time schedules (only on models with schedules.)
6. Set the Modbus parameters, if connecting to a BMS system (Only on models with Modbus.)

This engineering manual gives detailed information on various innovative control functions offered by the multifunction L-ION controllers. All the configurable parameters are explained in detail. Last chapter covers an example of using the templates to configure the system.

In addition to this document, a data sheet, a users manual and template guide is available.

Configuration Menu

In the default screen, pressing the plus and cancel buttons enters the configuration menu.
All the parameters under configuration menus are explained in the following pages.
The main menu items 1-5 are explained in the User's Manual



The time in the default screen and all time related menus are available only in models with timer.

System Menu

This menu covers the general settings for the controller.

1-Alarm Delay Time	Delay time for the controller to declare an input is in alarm condition. (min 1 seconds)
2-Start up Delay	Delay time for the control functions upon energisation. (min 5 seconds) Different delay times in facilities with multiple controllers will provide lighter loads on the supply lines after a power failure.
3-Language	Turkish and English (contact Ontrol for different languages.)
4-Template Type No	Select one of the predefined templates. All the parameters will be set to the factory settings for the selected template. All previous settings (except language and Modbus parameters) will be overwritten.
5-Erase Records?	Erases the records in memory.
6-Calibration	Factory calibration values. Do not change.

Input Settings Menu

Various analog sensors and transmitters as well as two state digital inputs maybe connected directly to inputs. Unlike many similar controllers, no internal jumpers or switches need to be altered. Type of the input connected is software selected.

In order to facilitate configuration of further parameters, the controller will convert the measurement signal (volts or ohms) to the actual physical value and unit. When setting parameters like proportional band, upper / lower limits, actual values like ºC, mBar are going to be used instead of volts. Likewise, actual state names like “Freeze”, “Start”, “Alarm” are going to be used for digital inputs.

All connected inputs should be defined in this section. Some of the following parameters will not be available, based on the input type.

`1-Input Type`

This line allows selection of one of the following input types:

Disabled

- PT1000 (temperature)
- 0-10 VDC
- 2-10 VDC
- Contact
- Potentiometer (setpoint potentiometer, 0-11 kOhm)

Digital inputs only allow contact option. Potentiometer option is available only for the pot input.

`2-Input Name`

Name of the input, selected from predefined list.

`3-Unit`

Unit of the measurement, selected from predefined list. Not available for digital inputs.

`4-Status Text`

Display names for the digital inputs, selected from predefined list. The first text is for open contact, the second text is for activated input. Not available for analog inputs.

`5-0/2V Value`

`6-10V Value`

Physical values corresponding to the lower measurement range (0 or 2V) and upper measurement range (10V). For example, if a pressure transducer giving an output of 2..10 VDC between 0..300 mbar is connected to an analog input, enter 0 for the lower range (2V) and 300 for the upper range (10V).

For potentiometer inputs, lower and upper limits for the external setpoint should be entered.

Not available for digital inputs.

`7-Offset`

This line allows an offset value to be entered. The controller adds this value to the measurement to correct errors, for example due to cable resistances or transducer calibration errors. Negative values are allowed.

`8-Alarm Condition`

Alarm state of the input. Options are:

- Disabled
- Open contact
- Closed contact
- Open / closed contact (for PT1000 inputs)

irrelevant for voltage type inputs

(also see Alarm Delay Time in System Menu)

`9-Modbus Write`

Allows an external value to be written to an input through the communication port, Modbus If this parameter is set to 1=Yes, the physical value at the input will never be measured and the value from the external system will be used. The default screen will show the input as overwritten.

Only available on models with Modbus

Output Settings Menu

Various final control elements such as motorized valves or damper actuators using 0...10VDC or 2..10 VDC as the control signal may be connected to the outputs. These outputs can also drive a 12 Volt relay to control two state devices such as fans, pumps, etc...

Unlike many similar controllers, no internal jumpers or switches need to be altered. Type of the input connected is software selected.

All connected outputs should be defined in this section. Some of the following parameters will not be available, based on the output type.

`1-Output Type`

This line allows selection of one of the following output types:

- Disabled
- 0-10 VDC
- 2-10 VDC
- Digital

`2-Output Name`

Name of the output, selected from predefined list.

`3-Status Text`

Display names for the digital outputs, selected from predefined list. The first text is for de-energized output, the second text is for energized output. For example, if a pump is connected to a digital output, you can define the Active state name as “Start” and Inactive state name as “Stop”.

Not available for analog inputs. All analog outputs have percentage (%) as unit.

`4-Direct/Reverse`

Defines the direction of analog outputs

Name	Parameter value	%0	%100
Direct	0	0/2 Volt	10 Volt
Reverse	1	10 Volt	0/2 Volt

Not available for floating type outputs

`5-Modbus Write`

Allows an external value to be written directly to an output through the communication port, Modbus If this parameter is set to 1=Yes, the output is always set to the value from the external system will be used. The default screen will show the output as overwritten.

Only available on models with Modbus

`6-Valve ON/OFF Time`

The travel time of the actuator from fully open to fully closed position, in seconds.

Only available for floating type outputs.

Loop Configuration Menu

General

Control loops are defined in this section. Inputs are assigned to each loop, control functions defined, PI parameters adjusted and override functions allocated. Different L-ION controllers have different number of control loops. Select the desired control loop with the arrows and press OK.

`1-Control Name`

Name of the control loop, selected from predefined list.

Inputs

Inputs are assigned to control loops in these menus. Each active loop requires at least the Main Input to be assigned to an input. The secondary input allows limit or cascade control of a second input. Compensation and remote setpoint inputs are also allocated here.

Allocation of inputs to multiple control loops are allowed.

`2-Main Input No`

This line defines the analog input number that the primary sensor of the control loop is connected to. Setting this input number to zero disables the complete process.

`3-Secondary Input No`

Input for the limit, cascade or differential sensor. The function will be defined by another parameter, below. Setting this parameter to zero disables the secondary control functions.

`4-Compensation Input No`

Input for the compensation sensor, usually the outside temperature sensor. Setting this parameter to zero disables the compensation and economy functions.

`5-Setpoint Input No`

If an external potentiometer is used to adjust the setpoint for the process, use this line to set the analog input number the potentiometer is connected to.

Setting this parameter to zero means that the internal setpoint is used and adjustments are made by the user on the panel.

Adjustment range

If the keyboard is selected for user setpoint input in parameter 5, these values will determine the range of user input.

(If an external potentiometer is defined for user setpoint input, use the lower / upper limits in the input menu for the assigned input.)

`6-Main Setpoint Value`

Use this line to enter the internal base setpoint for the main sensor of the process. This setpoint can be changed by the user. The unit will be the same as the unit of the main input.

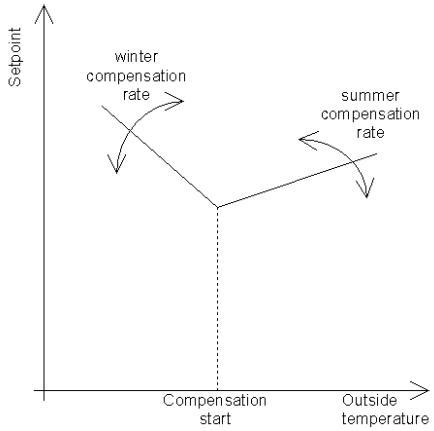
`7-Keyboard Setpoint Minimum`

Minimum value that can be entered from the keyboard for the setpoint

`8-Keyboard Setpoint Maximum`

Maximum value that can be entered from the keyboard for the setpoint

Compensation



The compensation function shifts the user defined setpoint based on a different sensor, typically the outdoor temperature sensor. Two types of compensation are commonly used: Winter and Summer compensation.

In a typical winter compensation application, the controller can increase the flow temperature to the radiators as the outdoor temperature falls.

In a typical summer compensation application, the indoor temperature can be increased as the outdoor temperature becomes warmer.

`9-Compensation Start`

Summer compensation will be effective above this value and winter compensation will be effective below this value

`10-Winter Compensation Rate`

The setpoint will be shifted by this amount for each 1 unit decrease in the compensation temperature. Zero value disables this function.

`11-Summer Compensation Rate`

The setpoint will be shifted by this amount for each 1 unit increase in the compensation temperature. Zero value disables this function.

Control parameters

PI parameters for control loops with single inputs are defined with parameters 13 and 14.

A lot of HVAC applications require the control of a second parameter. Typical example is the limiting of supply air temperature during room temperature control. Two approaches are common:

Limit Control

Used in applications where lower and upper limits for the supply temperature are required. Two independent control loops are calculated for this approach and the output receives the min/max of the calculated values.

Cascade Control

Two control loops are running in series. The calculated output of the first control loop is used as the setpoint for the second control loop. The second loop, using this setpoint and the measured value from secondary input controls the actuator.

In a typical AHU application the first control loop would be the room or return air temperature. This loop would calculate the temperature of the supply air to keep the room temperature constant. The second loop would be control the valves and dampers to keep the supply temperature at the calculated point.

Cascade control inherently covers limiting function.

Differential Control

Control is carried according to the difference of two inputs. Typical application is solar heating controls.

12-2nd Input's Function	Function of the secondary input. Options are Cascade, limit and differential control. Not available if secondary input is not defined.
13-Main Proportional Band	Proportional band for the primary control loop.
14-Main Integral Time	Integral time for the primary control loop. Zero value disables integral function.
15-Low Limit Value	Lower temperature limit for the secondary input.
16-High Limit Value	Higher temperature limit for the secondary input.
17-Secondary Proportional Band	Proportional band for the secondary control loop.
18-Secondary Integral Time	Integral time for the secondary control loop. Zero value disables integral function.

Special functions and Interlocks

19-Compare Time	Economy function compares outside temperature and room temperature to reverse the function of mixing dampers in AHU applications. This parameter defines the delay time for the function to toggle the output.
20-Freeze Input No	The input number the freeze-stat is connected to. The freeze protection overrides are activated when this input is open circuit. Setting this parameter to zero disables the function.
21-System Enable Input No	The input number the main on/off switch is connected to. The loop is activated when this input is closed circuit. Control loop is always active if this parameter is set to zero
22-Emergency Stop No	The input number the emergency stop is connected to. Emergency stop is activated when this input is closed circuit. Setting this parameter to zero disables the function.
23-Fire Input No	The input number the fire contact is connected to. The fire overrides are activated when this input is open circuit. Setting this parameter to zero disables the function.

Output Assignments Menu

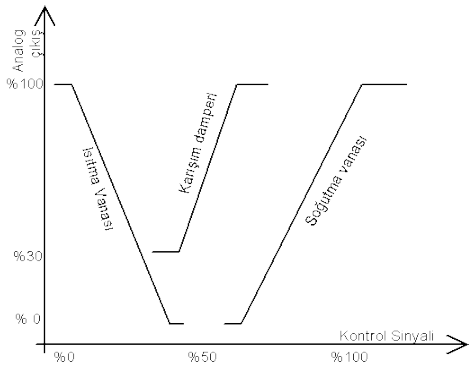
A control signal between 0 and 100% is calculated for each process. Each output can be assigned to any process to operate between any selected range based on this control signal. This menu is used to assign outputs to control loops and/or time schedules.

Select the desired outputs with the arrows and press OK. Only outputs defined in the Output Settings Menu will be available.

If a control loop will drive a single output device, generally the full range of the control signal (0-100%) is assigned to the output. Parameters 7 and 8 are set to 0% and 100%. Parameters 5 and 6 can be used to limit the output to desired min/max values.

If a control loop is to drive multiple output devices, the control signal is to be divided among these outputs. Typical application is the air handling unit with heating coil, cooling coil and mixing damper. Assuming that the control loop is configured to deliver a control signal of 0% at maximum heating demand and increases to 100% with cooling demand. As the control signal rises from 0 to 100, the heating valve will close, mixing dampers close and cooling valve open in sequence. Typical values to realize this process;

	Minimum Output	Maximum Output	Control signal for min output	Control signal for max output
Heating valve	% 0	%100	% 30	% 0
Mixing damper	% 30	% 100	% 31	% 69
Cooling valve	% 0	% 100	% 70	%100



A gap of 1% should be left between control signals of sequential controlled outputs.

`1-Output Name`

Name defined in the Outputs Settings Menu.

`2-Alarm Relay`

Defines the output as general alarm relay.

This relay will activate if there are any alarms in the system. It can be used to light or sound a warning or be connected to a upper supervision system.

Only outputs defined as digital may be assigned as alarm relays.

Outputs assigned as alarm relays will not utilize the following parameters.

`3-Loop No`

The control loop the output is assigned to. The calculated output of the control loop will be used to drive the output.

`4-Schedule No`

The time schedule the output is assigned to.

If the output is assigned to only a time program, the output is activated at scheduled times.

Digital outputs assigned to both a control loop and a time program will be active at scheduled times, unless the control loop receives an override such as freeze, emergency stop or fire. These would override the output.

`5-Minimum Output Value`

The minimum value for this output when the loop is active

`6-Maximum Output Value`

The maximum value for this output when the loop is active

7-Control Signal of Minimum Output	The calculated control signal from the control loop that corresponds to the minimum value for this output
8-Control Signal Of Maximum Output	The calculated control signal from the control loop that corresponds to the maximum value for this output
9-Economy Mode	If enabled, the economy mode will compare the compensation input and the main input, and reverse the output signal if appropriate. This feature is useful for mixing dampers control, where the outdoor air can be used for heating or cooling purposes depending on the conditions.
10-Emergency Value	The value the output will take if the “emergency stop” input for the control loop is activated.
11-Fire Value	The value the output will take if the “fire” input for the control loop is activated.
12-Freeze Value	The value the output will take if the “freeze” input for the control loop is activated.

Communications Menu

The communication protocol can be configured in this menu. Only available on models with such protocols.

These parameters are not reset when a new template is selected.

1-Modbus Address	Modbus address, 1-247. (Default : 1)
2-Modbus Baudrate	1200-2400-4800-9600-19200 baudrate (Default : 19200)
3-Modbus Parity	None, Even, Odd (Default : Odd)
4-Stop Bit Number	1-2 (Default : 1)

Summer Time Menu

Parameters to define summer / winter time change over schedules. These values will not be reset.

1-Summer Time	Active-Inactive (Default : Inactive)
2-Summer Time Starting Month	Month the summer time starts (Europe : 03)
3-Summer Time Ending Month	Month the summer time ends (Europe : 10)

System Configuration Example

Example system: Air handling unit with mixing dampers, heating and cooling valves.

Analog inputs: Return, supply and outside air temperatures

Analog outputs: Heating and cooling valves, damper actuators

Digital inputs: Freeze-stat and fan differential pressure switches

This system can be controlled with a EP33 controller.

With a EP44 controller, filters, fan switch status and commands can be connected, alarms supervised and system controlled by time schedule program.

1- Choose a template

From the L-ION templates list, type number 13 is the most appropriate choice for the above defined system.

From the systems menu, enter the template number 13 and press OK. All the parameters explained in this document will be adjusted to the correct values for this application.

Once a template is selected, all parameters may be modified to fine tune for the actual system. Re-selecting the template will reset all values once more.

2- Check the inputs and outputs

All the inputs and outputs are defined when a template is chosen. Refer to the template sheet for list of inputs and outputs of the selected system.

The defined type of inputs and outputs should be checked against the actual products to be used, and corrected if necessary. (The defaults for temperature sensors are PT1000. Voltage type sensors should be set at the Inputs Menu.)

Analog outputs may be used as digital outputs with the additional RK4 relay module.

If an external setpoint potentiometer (1-11 kOhm) is used, the setpoint range is defined in the Inputs Menu.

3- Fine tune the control loop parameters

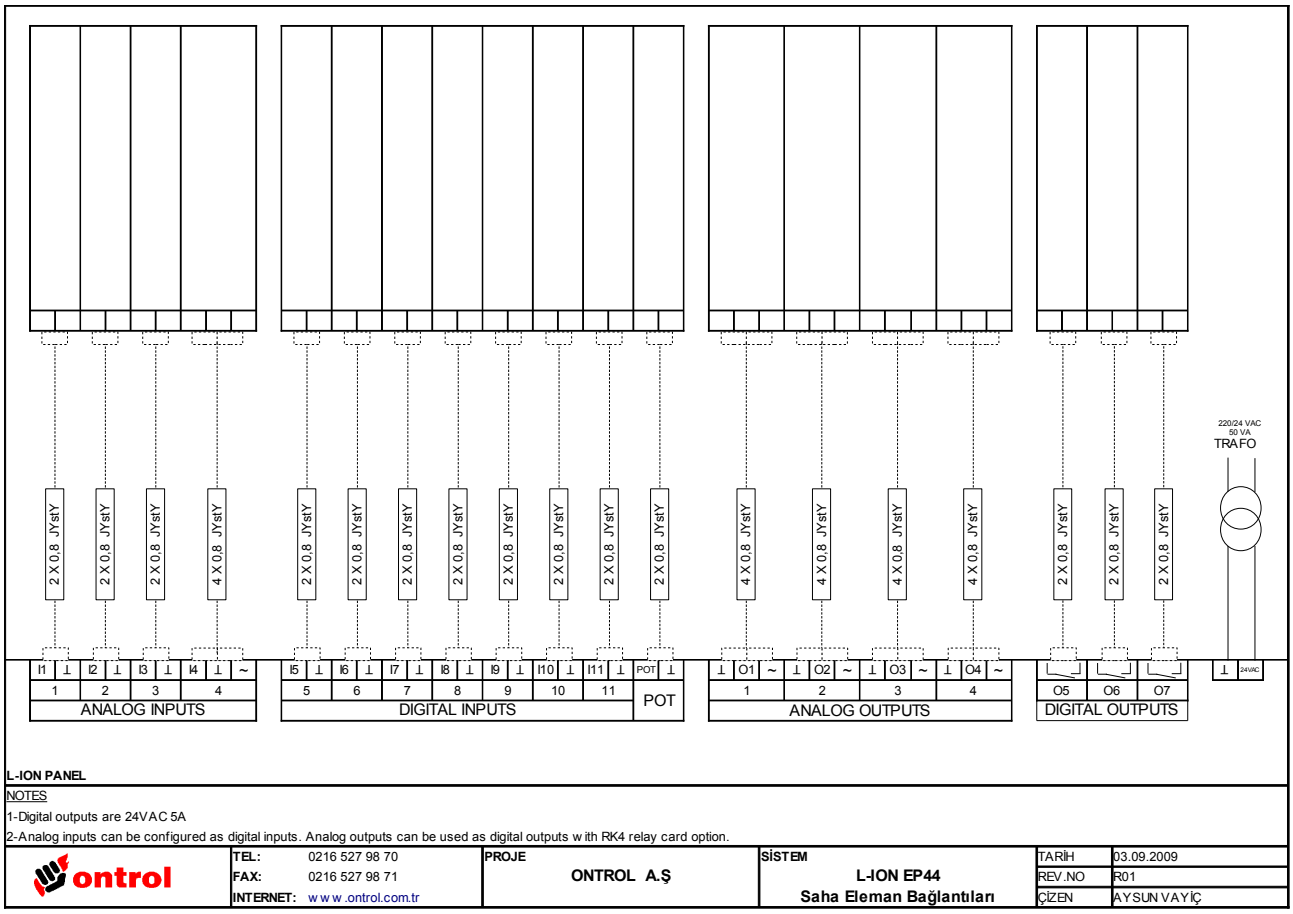
The values set by the templates for control loops should serve most of the standard applications. Advanced users might want to fine tune the PI parameters to optimize the performance of their systems.

4-Check the assignments of outputs

All the used outputs are assigned to appropriate control loops when a template is selected. These assignments also define the sequence control of devices such a heating and cooling valves. Advances users might want to fine tune these values.

Time schedule programs are also assigned under these menus.

L-ION EP44M and EP33 Connections



L-ION PANEL

NOTES

1-Digital outputs are 24VAC 5A

2-Analog inputs can be configured as digital inputs. Analog outputs can be used as digital outputs w ith RK4 relay card option.

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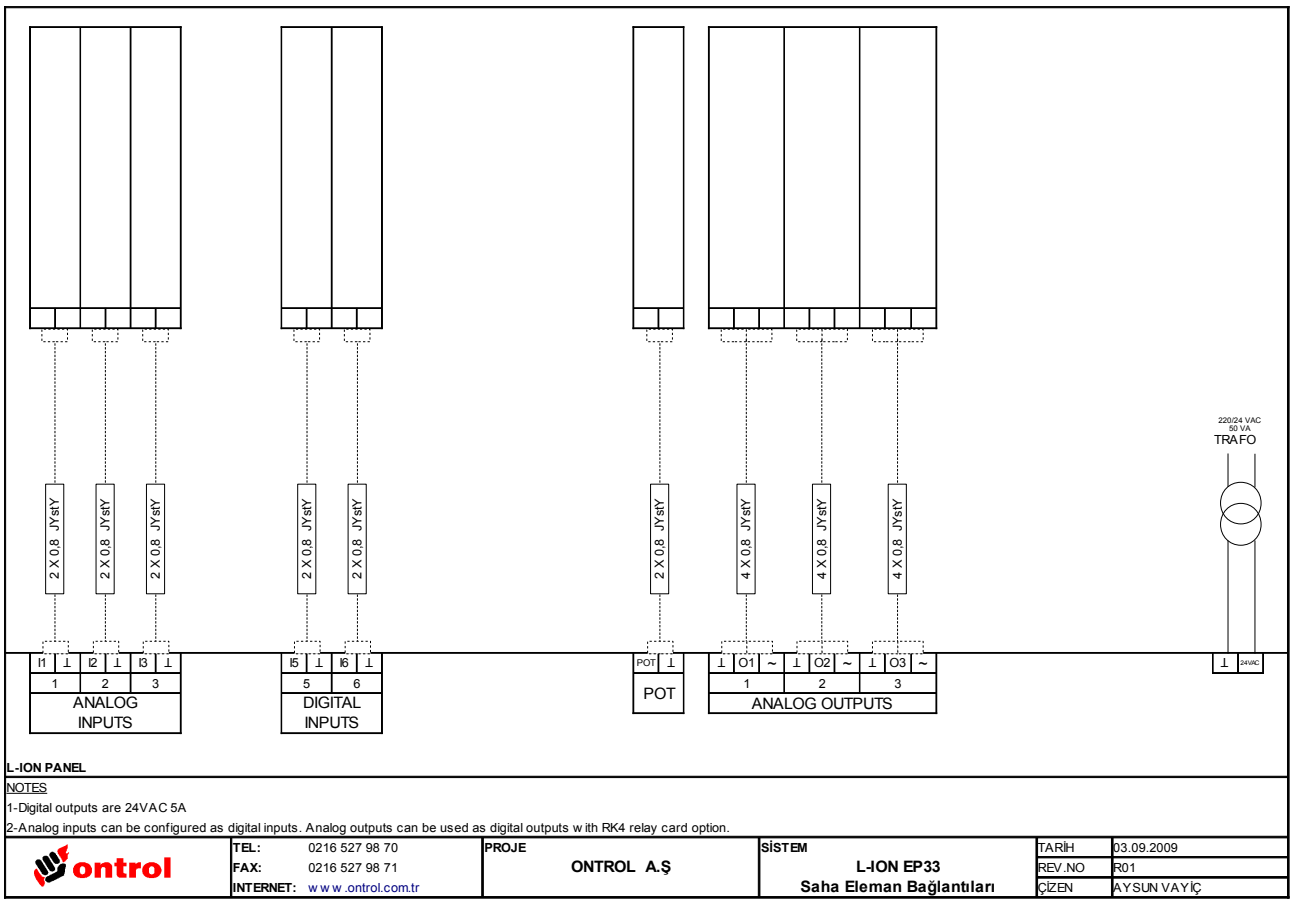

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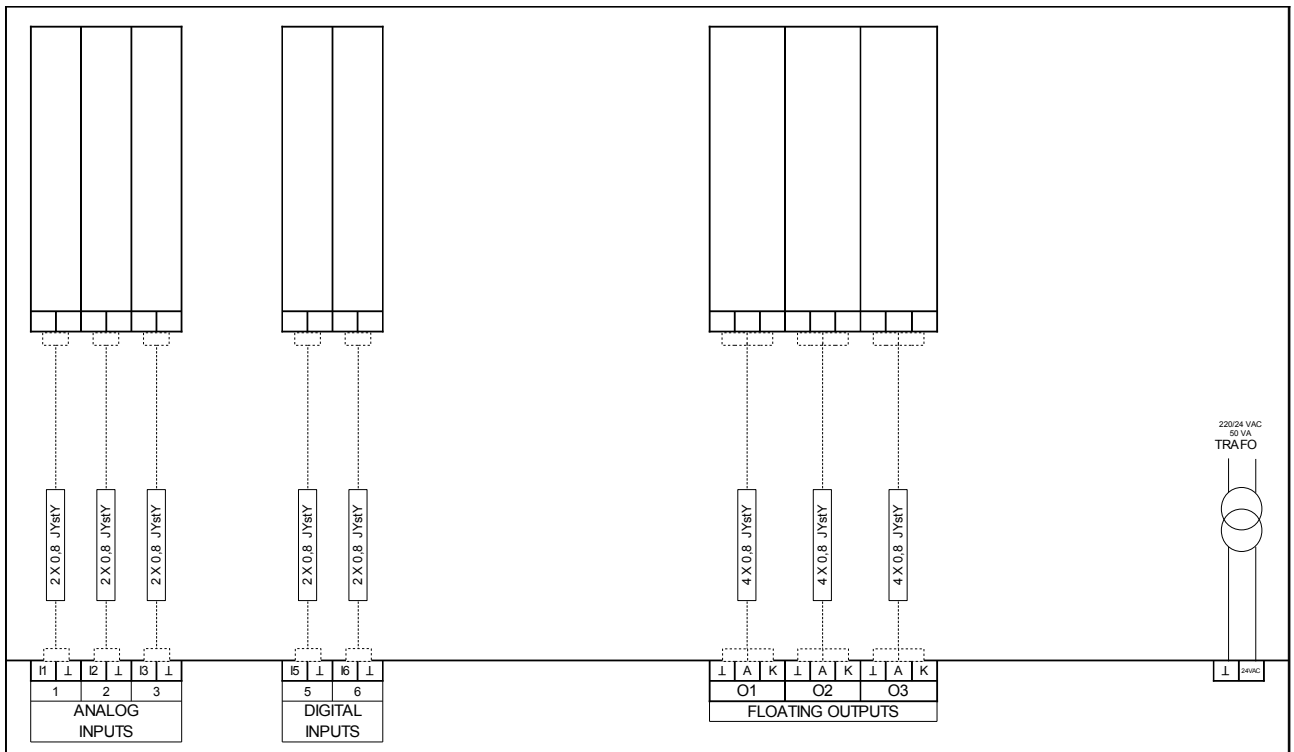
L-ION EF33 ve EF21



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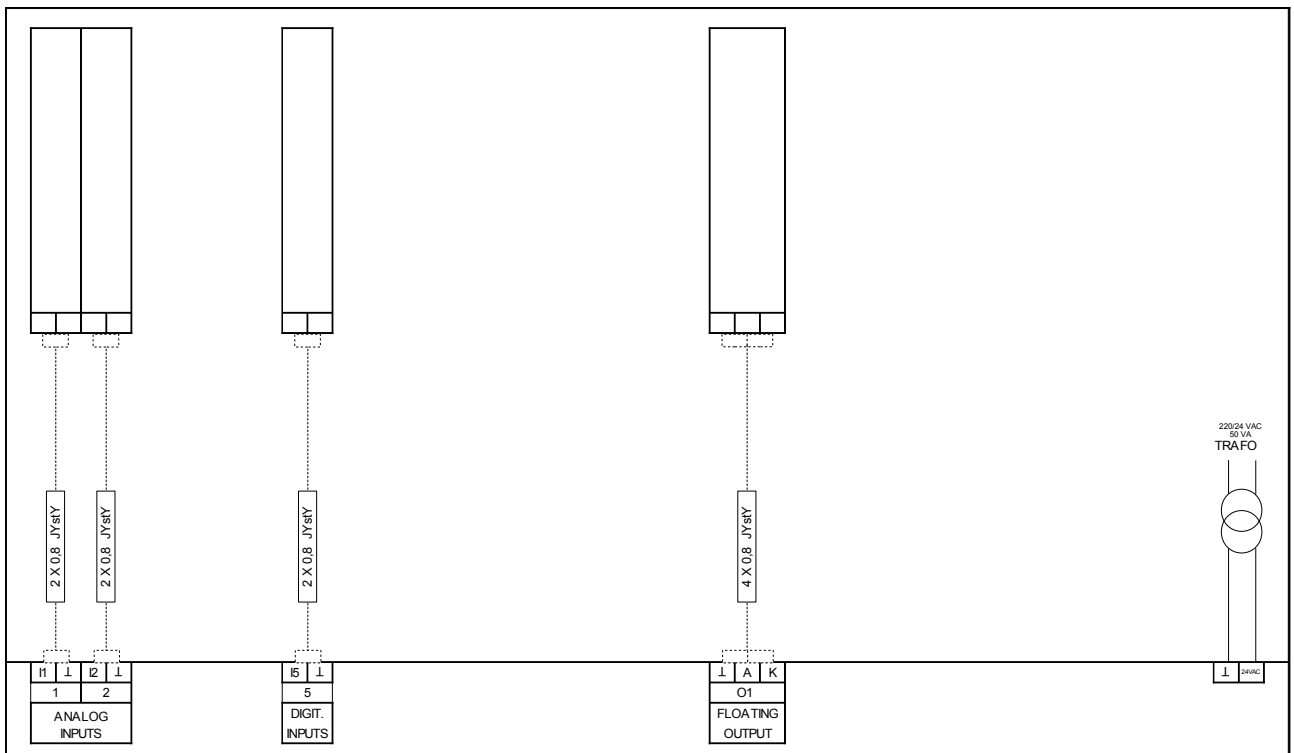

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