Basic Information on Control Panel Design

Changes in the market require handling a wide variety of control panel issues. Control Panel Basics describes OMRON’s wealth of know-how and information and provides easy-to-understand descriptions of the knowledge required to solve these issues through concrete examples.

In volume 3, we provide know-how on Control Panel Design, from Information on UL Certifications, to Differences in Terminals, Display Visibility, and Temperature Controller Applications.
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Types of UL Certification

There are UL Listing and UL Component Recognition for UL certification.

UL certification is required for control panels used in the USA.
Here we describe the difference between certification as a UL listed component (listing) and certification for a UL recognized component (R/C).

Actions Required for New or Revised Components Used in Control Panels for the USA

Industrial control panels used in the USA are required to comply with UL508A.
Of the components used in control panels that comply with UL 508A, there are differences in the requirements depending on the UL certification (UL listed components or UL recognized components).

Using UL Listed Components

Application to the UL is not required.
- New or upgraded components can be used at any time.
- If urgent changes to components become necessary for adjustments or to handle problems, they can be made immediately.

Changes are possible at any time.

Using UL Recognized Components

Application to the UL is required.
- These components must be registered. The documents and data required for registration must be prepared and an application must be made to the UL.
- The UL will check the certification conditions and process the changes, so time will be required to use new or upgraded components.

Component registration is required, which delays application.
There are also differences based on whether the component is directly connected to devices or equipment outside of the control panel.

Example in Final Installation Site of Control Panel

**Point ! For People Who Want to Know More**

**UL Listing**
- In general, this certification applies to end products that are operated by general users, such as machine tools, robots, and other equipment that are directly controlled by an operator.
- Because it is assumed that the equipment will be used by an operator or a general user, there are many restrictions and evaluation tests for designs and configuration components.

**UL Component Recognition**
- This certification applies to components that are built into end products that do not function by themselves or have limited functionality (molded products, wires, PWB, and general-purpose Automation Systems).
- Components for which UL Listing is not required fall under UL Component Recognition.

Recommended UL Listed Components

- **Switch Mode Power Supplies**
  - Reliable and Easy Operation
  - Worldwide Power Supply
  - Resistant in tough environments
  - Easy and fast installation
  - The most compact class on the market
  - **S8VK-G**
  - Search for “OMRON S8VK-G” for details.

- **Switch Mode Power Supplies**
  - (120-W, 240-W, 480-W, and 960-W models)
  - **S8VK-T**
  - Search for “OMRON S8VK-T” for details.

- **Worldwide 3-phase Power Supply**
  - Resistant in tough environments
  - Easy and fast installation
  - The most compact class on the market
  - **S8VK-R**
  - Search for “OMRON S8VK-R” for details.

- **Redundancy Units**
  - Contribute to build high reliable systems
  - Compact and Cost-effective solution for Back-up applications
  - Easy setup for system reliability requirement

- **Worldwide Power Supply**
  - Resistant in tough environments
  - Easy and fast installation
  - The most compact class on the market

Note: There are some exceptions.
Control Panel Efficiency Starts with the Terminals

Change from Tightening Screws to Inserting Wires
You Can Increase Production Efficiency by Rethinking Wiring Work

Wiring Work
Wiring work is essential to manufacturing control panels, and it accounts for the majority of the lead time for control panel manufacturing. Therefore, if you can make wiring work easier and faster, you can dramatically shorten the manufacturing lead time for control panels.

Current Issues
Normally when people hear about wire connection methods, many of them tend to think about securing wires by tightening screws. And in reality, many of the control devices used in control panels use screw terminals, and such devices have become common. Also, screw terminals have a long track record, are the method most recognized by customers, and are therefore considered reliable. However, screw terminals require that you loosen the screw, attach the wire (crimp terminal), and then tighten the screw, which is a lot of work.

New Screwless Connections
Screwless connections, which have recently become common in Europe, eliminate the need to tighten screws to dramatically reduce the work required for wiring and they are gradually becoming popular in control panels around the world. The work of loosening and tightening screws has been replaced by merely inserting wires to complete wiring work, greatly reducing work time. First you need to learn about screwless connections and then experience how efficient this method is.

Terminal Connection Methods

<table>
<thead>
<tr>
<th>Type</th>
<th>Screws</th>
<th>Screwless</th>
</tr>
</thead>
<tbody>
<tr>
<td>Securing method</td>
<td>Phillips screws</td>
<td>Screws</td>
</tr>
<tr>
<td></td>
<td>Slotted screws</td>
<td>Springs</td>
</tr>
<tr>
<td>Terminals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crimp terminals</td>
<td>Forked terminal</td>
<td>Round terminal</td>
</tr>
<tr>
<td>Recommended products</td>
<td>Common Sockets PYF (Socket for MY)</td>
<td>Connector-Terminal Block Conversion Units XW2R Series</td>
</tr>
</tbody>
</table>

Note: Bare wires are also possible.
Push-in Terminals

Push-in terminals are one type of screwless terminal. Wiring is completed simply by inserting a wire with a crimped ferrule. The strength of a spring presses the ferrule against the terminal wall to connect the wire.

Mechanism

- Clamp spring
- Conductive fitting

Differences in Wiring Work

<table>
<thead>
<tr>
<th>Wiring</th>
<th>Round terminals</th>
<th>Screw terminals</th>
<th>Forked terminals</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Loosen the screw.</td>
<td>27 s*</td>
<td>2 s*</td>
<td>7.5 s*</td>
</tr>
<tr>
<td>(2) Remove the screw.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) Attach the terminal.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4) Tighten the screw.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No Retightening Work

Note: Test conditions: IEC 60947-7-1

* Based on OMRON demonstration test results.
Display Innovations for On-panel Devices

Increase Visibility by Using White Characters on Black Backgrounds

Control panels always include control amounts (e.g., temperatures or pressures).
The control amounts are important parameters that affect workpiece quality, and displays of the control amounts are generally provided on the fronts of control panels. Although touch panels are becoming popular display methods for high-end models, the cost involved results in many control panels using controllers with displays.

Control panels are installed in various lighting environments, from well-lit to dimly-lit locations. You need on-panel devices with good visibility. The visibility of displays increases with the difference in the brightness of the colors used, so displays with a large difference in color brightness are easily recognized from a distance or in bright or dark locations.

If the background is black, white offers the largest difference in brightness, but the chromatic color yellow draws attention better.

Visibility of Various Colors on Black

![Image of different colors on black background]

Creating Panels with a Good Sense of Design and Good Visibility

By incorporating large display devices with white or yellow characters on a black background into panels, not only is visibility improved, but also panels with a high sense of design are made possible. Also, control panels are not always viewed from directly in front of them, so viewing angles are also important. Consider the visibility from an angle when you select components.

Recommended Controllers with Displays

- Large, white PV displays that are easy to read and provide better visibility.
- Easy to use from model selection to setup and operation.
- A complete range of I/O capacities, functions, and performance.
- Handles more applications.

Digital Temperature Controllers

E5-C Series

Search for “OMRON E5-C” for details.
Temperature Controllers are mainly used for heating control of heaters. The target temperature is set, the manipulated variable is calculated from the difference between the target temperature and the process temperature, and then the manipulated variable is output to turn the heater ON and OFF to control the temperature. However, Temperature Controllers can be used to control more than just temperatures.

### Non-temperature Control Applications

**Applications for Flow Rate Control and Pressure Control**

You can switch a Temperature Controller from a temperature sensor input to a current or voltage input.

- **Current inputs**: 2 types
  - *1. 4 to 20 mA or 0 to 20 mA
- **Voltage inputs**: 3 types
  - *2. 1 to 5 V, 0 to 5 V, or 0 to 10 V

**Applications as Simple Display Devices and Alarms**

For example, if a request is made for the installation of a display device after the panel has been completed or if monitoring is required without any control functions, a Temperature Controller can be used as a display device or an alarm.

**Applications for Control and Signal Conversion**

Some Temperature Controllers have a transfer output for 4 to 20 mA or 1 to 5 V. For example, you could convert a 1 to 5-V analog input to a 4 to 20-mA output to serve as a signal converter for another device.
Controllers & I/O
- Machine Automation Controllers (MAC) • Motion Controllers
- Programmable Logic Controllers (PLC) • Temperature Controllers • Remote I/O

Robotics
- Industrial Robots • Mobile Robots

Operator Interfaces
- Human Machine Interface (HMI)

Motion & Drives
- Machine Automation Controllers (MAC) • Motion Controllers • Servo Systems
- Frequency Inverters

Vision, Measurement & Identification
- Vision Sensors & Systems • Measurement Sensors • Auto Identification Systems

Sensing
- Photoelectric Sensors • Fiber-Optic Sensors • Proximity Sensors
- Rotary Encoders • Ultrasonic Sensors

Safety
- Safety Light Curtains • Safety Laser Scanners • Programmable Safety Systems
- Safety Mats and Edges • Safety Door Switches • Emergency Stop Devices
- Safety Switches & Operator Controls • Safety Monitoring/Force-guided Relays

Control Components
- Power Supplies • Timers • Counters • Programmable Relays
- Digital Panel Meters • Monitoring Products

Switches & Relays
- Limit Switches • Pushbutton Switches • Electromechanical Relays
- Solid State Relays

Software
- Programming & Configuration • Runtime