Control Panel Wiring Solutions

*Meeting Today’s Competitive Market Challenges*

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Product Manager, Lean Automation
Poll Question 1

• Please tell us who we have on line today
  • A) Eaton Customer
  • B) Eaton Distributor
  • C) Eaton SE or DSS
  • D) EatonCare
  • E) Other
Situation

• How do you distinguish yourself in the competitive world of OEM sales?
• How do you shift the discussion from price to value?
• How can you create value for your OEM in ways that the competition cannot?
Potential Sales Solutions

• How you can increase your customers’ productivity
• How you can decrease the customers’ time to market for their product offering
• Discover three ways in which you can offer a control panel solution
• How to qualify your prospects and maximize your sales time
Agenda

• Market Challenges
• Problems with Conventional Wiring
• Control Panel Wiring System
• Sample Installations
Today’s Competitive Market Challenges
Tackling Competitive Market Challenges

• How to improve the productivity challenge
  • More output with the same or less resources
• How to decrease the time to market
  • Compressed product development cycles
• Where do turn to get improvements?
Attaining Productivity

• Determine your cost structure breakdown
  • How do you allocate material, engineering, testing and assembly costs?
  • What is the ratio of in-house costs vs site installation and commissioning costs?

• Recognize areas of unaccounted cost
  • What are the pre and post sales costs?
  • How much time is spent helping your customer troubleshoot their system

• Look for methods to improve performance
  • What technologies are available to increase reliability?
  • What technologies enable faster identification and troubleshooting of the system?
Finding Productivity Improvements

- Lower the cost of components
- Use smaller enclosure sizes
- Adopt more standardized layouts
- Replace pilot devices with touchscreens
- Utilize control networks where feasible
- Use spring-cage terminal blocks
Fine-Tuning Productivity Improvements

- Minimize wiring effort and errors
- Use wiring harnesses
- Use automated wire-stripping machines
- Use automated wire-marker machines
- Enforce wiring diagram vs schematic wiring
- Use functional testing vs point-to-point checks
Poll Question 2

• What market challenges are your customers’ biggest challenge today?
  • A) Both productivity and fast time to market
  • B) Primarily improved productivity issues
  • C) Primarily fast time to market needs
  • D) None of the above or other
Problems with Conventional Wiring
Problems with Conventional Wiring

• Is this typical of your control panels?
Problems with Conventional Wiring

• Point-to-point wiring from I/O to devices?
Problems with Conventional Wiring

- Wire bundles to pilot devices on the door?
Problems with Conventional Wiring

• Does this ever happen to your control panels?
Problems with Conventional Wiring

• What if we could reduce the amount of point-to-point wiring in the control cabinet?
  • Assembly time would be less
  • Chances of mis-wiring would be less
  • Chances of loose terminations would be less
  • Quality assurance testing time would be less
  • Time to provide wiring instructions would be less
  • Space for wiring ducts in panel would be less
A Control Panel Wiring System
Yesterday’s Control Panels
Today’s Control Panels
Control Panel without PLC I/O Modules

- Up to 99 devices or nodes per gateway
- Up to 2000-foot-long network
A Control Panel Wiring System

- Low cost connectivity to standard devices
- Easy method for connecting vs traditional hard-wiring
- Cost and time savings during assembly, test, and commissioning
- Reduced overall footprint of control panel layout
- Easy connectivity to industry standard logic networks

Traditional → SmartWire-DT

- Elimination of I/O modules
- Major reduction of control wiring
- Up to 25% space savings in panel
Conventional Wiring versus SmartWire-DT

Saves control wiring…

- Up to 60% time
- Up to 40% space
- Up to 20% engineering time
SmartWire-DT Control Panel

• What if your control panel looked like this?
## SmartWire-DT

### System Overview

<table>
<thead>
<tr>
<th>Network Type</th>
<th>RS485</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Protocol</td>
<td>SmartWire-DT</td>
</tr>
<tr>
<td>Maximum Number of Nodes</td>
<td>99 with CANopen or Ethernet; 58 with PROFIBUS-DP</td>
</tr>
<tr>
<td>Types of Nodes</td>
<td>Contactors, control relays, pushbuttons, pilot devices, selector switches, input/output modules</td>
</tr>
<tr>
<td>Maximum Length</td>
<td>2,000 feet (600 m)</td>
</tr>
<tr>
<td>Maximum Current</td>
<td>2A</td>
</tr>
<tr>
<td>Voltage of Network</td>
<td>15 Vdc</td>
</tr>
<tr>
<td>Addressing</td>
<td>Automatically assigned</td>
</tr>
<tr>
<td>Approvals</td>
<td>UL, CE, CSA</td>
</tr>
</tbody>
</table>
Conventional vs Lean Control Panel

Conventional Control Panel

Lean Connectivity Control Panel

Results shown are for typical control panels using PLC controls with 100 I/O points. To see if SmartWire-DT is a fit for your applications, please check the SmartWire-DT product application guide and value calculator at www.Eaton.com/SmartWireDT.
## Conventional vs Lean Control Panel

<table>
<thead>
<tr>
<th></th>
<th>Conventional</th>
<th>Lean</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assembly Time</strong></td>
<td>269 minutes</td>
<td>41 minutes</td>
<td>85%</td>
</tr>
<tr>
<td><strong>Engineering Time</strong></td>
<td>115 minutes</td>
<td>35 minutes</td>
<td>70%</td>
</tr>
<tr>
<td><strong>Testing Time</strong></td>
<td>46 minutes</td>
<td>4 minutes</td>
<td>90%</td>
</tr>
</tbody>
</table>

*EATON - Powering Business Worldwide*
What’s This?
SmartWire-DT

Mounting & Crimping Connectors

- Place connector on flat cable
- Shift connector to final position
- Fix connector permanently with crimping tool
- Attach connector to module
SmartWire-DT
Three Ways to Connect

1) Using standard fieldbus gateway
2) Using a HMI-PLC with integrated gateway
3) Using a programmable relay with integrated gateway
**SmartWire-DT Gateways**

- Connects to major field busses
  - Modbus TCP
  - EtherNet/IP
  - PROFIBUS DP
  - CANopen
- Up to 99 SmartWire-DT nodes
- Direct connection to major PLC brands via a field bus scanner card
- Separate 24 volt (V) direct current (DC) supply for gateway and ~30 nodes
Lean Architecture

PROFIBUS-DP Gateway to SmartWire-DT
Lean Architecture

*EtherNet/IP Gateway to SmartWire-DT*
SmartWire-DT
Three Ways to Connect

1) Using standard fieldbus gateway
2) Using a HMI-PLC with integrated gateway
3) Using a programmable relay with integrated gateway
SmartWire-DT
XV HMI-PLC

XV102 HMI/PLC Devices with Integrated SmartWire-DT™ Master
Lean Architecture

HMI-PLC with SmartWire-DT
SmartWire-DT

Three Ways to Connect

1) Using standard fieldbus gateway
2) Using a HMI-PLC with integrated gateway
3) Using a programmable relay with integrated gateway
SmartWire-DT
Easy 802/806 Programmable Relays
Lean Architecture

Programmable Relay with SmartWire-DT
SmartWire-DT Contactor Modules

- Standard XT MMCs (manual motor controllers) are used
- SmartWire-DT contactor modules are connected to contactors up to 20HP
- Features
  - Powers the 24V DC contactor coils
  - Provides feedback from the contactor
  - Two additional inputs (e.g. trip, short circuit, additional auxiliary contact)
- Also available with “Man-0-Auto” switch for direct operation & troubleshooting
SmartWire-DT
Pilot Device Modules

- Fits on standard M22 pilot devices
- Replaces standard contact blocks or LED elements
- Combinations of (multiple) contact elements and LED elements are replaced by a single module
SmartWire-DT
Digital Input and Output Modules

• I/O modules to connect devices without integrated SmartWire-DT interface
  • EU5E-SWD-8DX 8 inputs
  • EU5E-SWD-X8D 8 outputs 24V 0.5A
  • EU5E-SWD-4DX 4 inputs 3-wire with 24V supply
  • EU5E-SWD-4D4D 4 inputs, 4 outputs 24V 0.5A
  • EU5E-SWD-4D2R 4 inputs, 2 relay, 3A
• Mounting on the desired place in the cabinet
• Remaining control wiring is further more reduced
• Direct control of contactors up to 60HP without auxiliary contactors
SmartWire-DT
Analog Input and Output Modules

- EU5E-SWD-4AX
  - 4 analog inputs 0-10V/0-20mA
  - U/I selectable for each input
  - 12 bit resolution

- EU5E-SWD-2A2A
  - 2 analog inputs 0-10V/0-20mA
  - 2 analog outputs 0-10V/0-20mA
  - U/I selectable for each input/output
  - 12 bit resolution

- EU5E-SWD-4PT
  - 4 temperature inputs
  - PT100, 1000, NI1000
  - U/I selectable for each input/output
  - 2/3 wire
  - Temperature range
    - -50 .. +200°C (PT)
    - -50 .. +150°C (Ni)
  - Representation 1/10°C,F,binary value
  - Overrun / Underrun diagnostic
SmartWire-DT
Motor Data Using XTPE Electronic MMPs

- Maximum Current
- Thermal Capacity
- Overload Trip Indication
  - Overload
  - Short Circuit
  - Phase Loss
- Overload Relay FLA Settings
- Overload Relay Class
- XTPE On-Off Status
- Contactor On-Off Status
SWD-Assist Configuration Software
Sample Installations
SmartWire-DT
*Pushbutton Control Console*
SmartWire-DT
Pushbutton Control Console

- 78 pilot devices
- 22 potentiometers
- 4 spares
SmartWire-DT
Improving Productivity

- Wiring time:
  - 1 vs 8 hours
- Engineering & testing time:
  - 1.3 vs 5.5 hours
- Easy addition of spare pushbuttons
- Prevents bypass of the key switches
SmartWire-DT

Improving Productivity & Time to Market

China Automobile

Controls the Transport System in Body Shell Manufacturing

A German premium automobile manufacturer with international operation recently set up a new production line in China. To transfer car bodies to several welding stations, a conveying system had to be developed and integrated into the plant automation structure. Car body production requires the highest level of precision, both in the manufacture of car body parts as well as in the joining of parts at the relevant welding stations. An optimum solution was developed for the project in close collaboration with the Eaton Corporation in Shanghai.

Demanding customer requirements

The extensive arrangement and number of signals to be processed from individual stations were a particular challenge to the automation of the car body production line. To ensure the optimum production process, all the motor drives of the conveying system, as well as all the signals from the relevant welding stations, had to be monitored and controlled centrally. The conveying system also had to be tuned to the complex control algorithms of the quality control on the welding stations.

Other requirements: The motor starters had to be implemented as DOL or reversing starters with motor protection for overloads and short contacts with different contacts for interlocking or signaling tasks, the PKZ was ideal with its wide range of approved accessories for the safe and efficient creation of control systems from the PKZ range. The motor starter assembly module is equipped with plug-in connectors. This thus offered two separate contact systems with a visible contact block, the unambiguous assignment of PKZ protective device and DOL switching device, which can also be later exchanged on an individual basis.

The innovative SmartWire-DT communication and connection system enabled the automation requirements, i.e., the connection of DOL and reversing starter combination to Profinet, to be met with a high level of efficiency.

The particular benefit of SmartWire-DT is the fact that conventional switches, such as DOL contacts, can be incorporated in the system, while the wiring effort on the other hand can be

Over 1600 motor starters

Used 720m of cable instead of 12.6km of wire

Reduced installation time by 22 days
## Wiring Cost Savings

<table>
<thead>
<tr>
<th></th>
<th>Flat Cable</th>
<th>Control Wiring #14 AWG</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Length (Miles)</strong></td>
<td>0.45</td>
<td>7.83</td>
</tr>
<tr>
<td><strong>Length (Feet)</strong></td>
<td>2,362</td>
<td>41,339</td>
</tr>
<tr>
<td><strong>Cost/foot</strong></td>
<td>$0.61</td>
<td>$0.14</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td>$1,441</td>
<td>$5,787</td>
</tr>
<tr>
<td><strong>Savings</strong></td>
<td></td>
<td>$4,346</td>
</tr>
</tbody>
</table>
SmartWire-DT Control Panel Benefits

- **Faster Time To Market**
  - Less engineering, assembly, and testing time
  - Small run wire-harnessing capability

- **Increased Reliability**
  - Less wiring and terminations
  - Reliable vibration resistant connectors
  - Diagnostic LEDs at the component level
SmartWire-DT Control Panel Benefits

- **Intellectual Property (IP) Protection**
  - Protects the integrity & IP of panel wiring
  - Deters unauthorized changes

- **Greater Flexibility**
  - Standardize control panel even with multiple PLC platforms
  - Uses standard components
  - No changes to the existing PLC program

- **Space Savings**
  - Eliminates traditional PLC I/O
  - Reduces wiring and wire ducts
Conclusion

• Only marginal cost reductions from traditional control panel
  • Unless highly engineered and industrialized
• Lean connectivity control panels enable significant cost reductions
  • In a variety of control panel configurations
• Scalable benefits in reducing:
  • Assembly costs
  • Time to market
  • Installation
  • Commissioning
Questions?
SmartWire-DT
System Configuration

1. Gateway
2. Flat cable
3. XT MMCs
4. Power supply module
5. Discrete I/O module
6. Flat cable coupling
7. M22 pilot devices
8. Enclosure feed thru plug
9. Round cable
10. M22 control stations
11. XT contactors
12. Terminating resistor
**SmartWire-DT**

*Flat Cable Configuration*

<table>
<thead>
<tr>
<th>Connection</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+24 V DC</td>
<td>Contactor control voltage</td>
</tr>
<tr>
<td>Earth</td>
<td>Contactor control voltage</td>
</tr>
<tr>
<td>GND</td>
<td>Ground for device supply voltage and data</td>
</tr>
<tr>
<td>Data B</td>
<td></td>
</tr>
<tr>
<td>Data A</td>
<td></td>
</tr>
<tr>
<td>GND</td>
<td>Ground for device supply voltage and data</td>
</tr>
<tr>
<td>SEL</td>
<td>Node selector line</td>
</tr>
<tr>
<td>+15 V DC</td>
<td>Device supply voltage</td>
</tr>
</tbody>
</table>