Data Bulletin

Intelligent Motor Control
Using Intelligent Motor Control Centers ... Intelligently
Class 8998

Introduction

Lately, interest in intelligent motor control centers (IMCCs) has increased significantly. But what is an intelligent MCC? To answer the question of intelligence, and to gain insight into the future of IMCCs, we must first take a look back at traditional MCC technology.

Motor Control Center Fundamentals

The role of an MCC is to provide a compact, modular grouping for motor control and electrical distribution components. Think of an MCC as a filing cabinet, with drawers or “buckets” full of combination starters, lighting contactors and other electrical distribution and control products. Historically, MCC units were electromechanical in nature, with basic functions that included a power switching device, short circuit and overload protection, local and remote actuation, and controller state indication.

MCCs Are Popular

MCCs have long been popular in North America for several reasons.

- *Single source for coordination of components*
  Electrical distribution and motor control equipment can be purchased as a pre-assembled, pre-tested system, usually at a less expensive installed cost when compared to separately mounted components.
- *Less line side power wiring than separate controls*
  This makes MCCs easy to install.
- *Space-efficient packaging*
- *Optimum configuration flexibility*
- *Concentrate maintenance to a centralized area*
- *Excellent fault containment*
- *Excellent electrical component isolation*

From Control Evolution to Control Revolution

Motor Control Centers are used where a central control point is needed to remotely operate multiple loads. In commercial and industrial facility applications, the central control point is usually an environmental control system, with an HVAC pump and fan loads. Industrial process applications include many load types, including conveyors, pumps, fans, and mixers. These loads often require coordinated control and can be the source of important process or machine diagnostic information. Distributed control systems (DCS) or programmable logic controllers (PLCs) are used normally to provide this control and data acquisition functionality.

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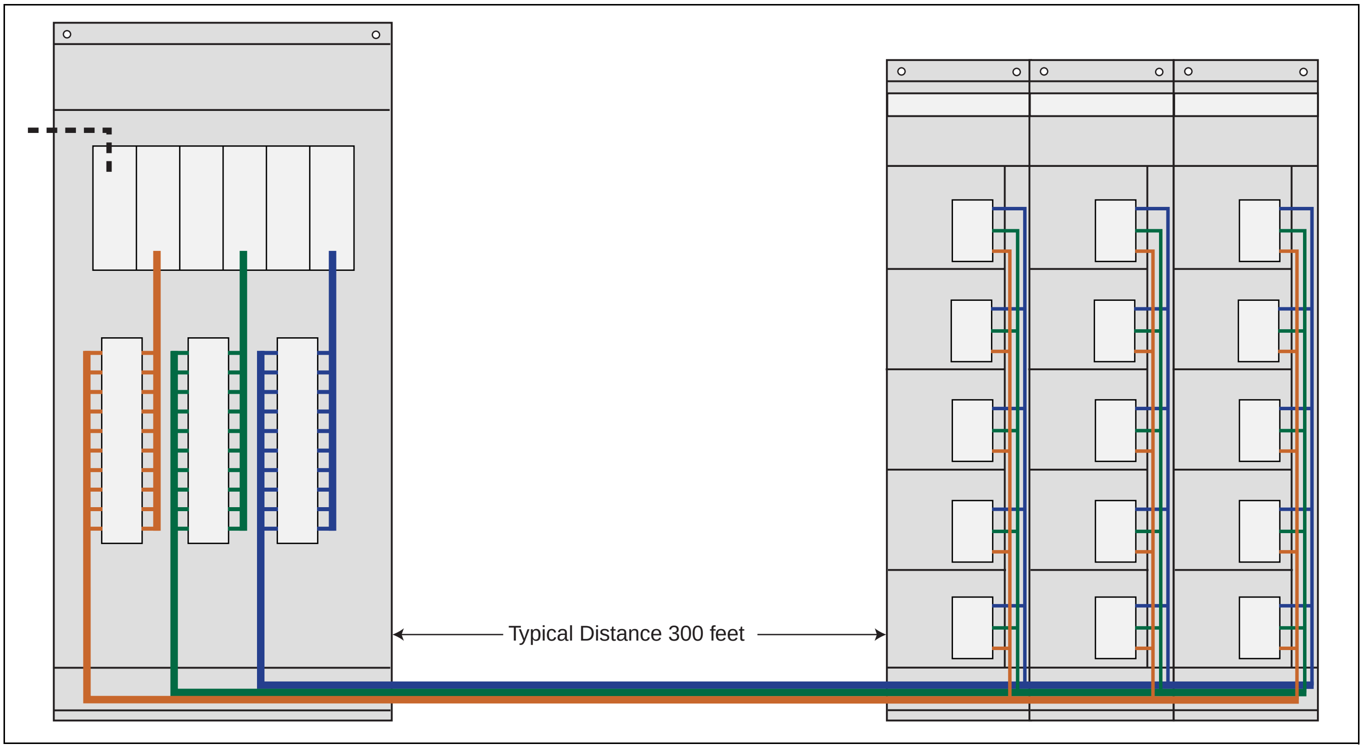
Early MCCs were designed with an input/output (I/O) structure unique to the particular vendor. Often, these I/O systems were centrally located near the point of control and were field wired to the MCC either directly to individual units (NEMA Class I or II, Type B wiring) or to the master terminal compartment (NEMA Class I or II, Type C wiring) (see Figure 1).

This wiring could be expensive, limiting the amount of information and control points that economically could be incorporated. Often, only the run command for a given unit was connected to the control system.



Remote host, field wired directly to starter units

Figure 1: Field Wiring

Realizing the limitations, digital control system manufacturers evolved, introducing distributed I/O to reduce installation costs. Although the distributed I/O equipment cost more up front, the total installed cost was less because of reduced field wiring. Distributed control was a significant improvement, but it still tended to be vendor-specific, with significant variations among manufacturers in size, form factor, and functionality.

MCC suppliers or system integrators often mounted distributed I/O directly into the MCC and pre-wired the I/O to the starter units. Unfortunately, where the wiring crossed shipping splits, the connections had to be broken, or the terminal blocks in each unit had to be spooled back into the I/O enclosure before shipment (see Figure 2)

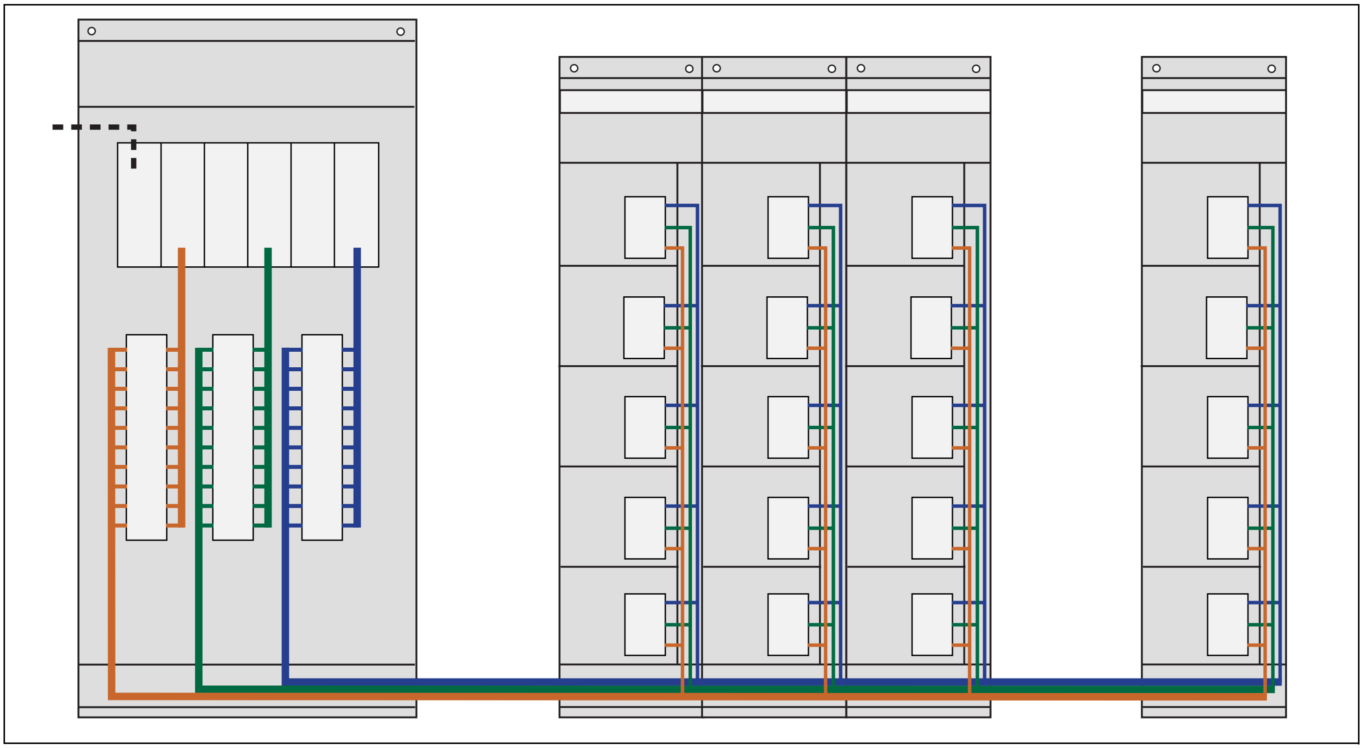
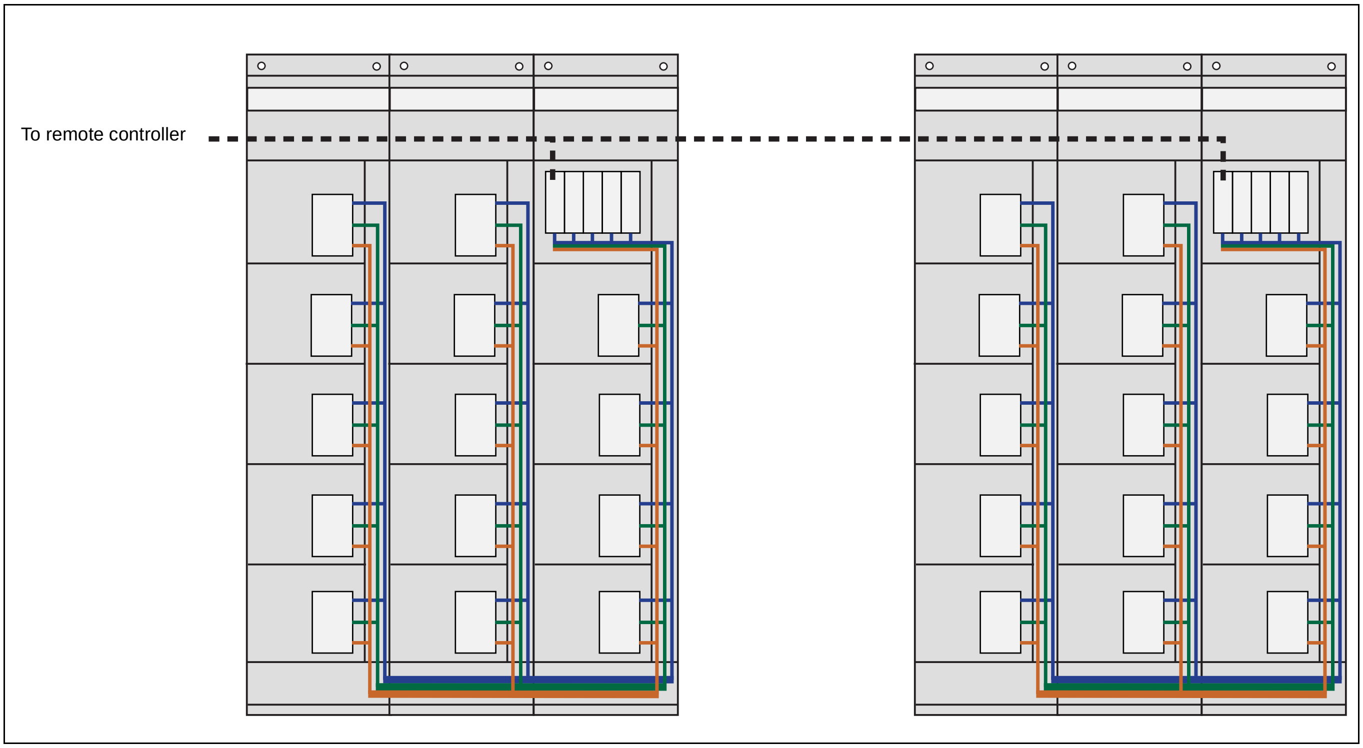


Figure 2: Full Section Mounting

Distributed I/O is installed in MCC relay section and factory wired to starter units. MCC is connected to remote controller via one network connection.

With the advent of more open industrial control networks, distributed I/O could be produced as an independent modular system. With communication adapters, a distributed I/O system could be incorporated with many different control systems, allowing for standardization of the I/O within the MCC, without limiting the selection of the control vendor. The smaller size and form factor of the latest distributed I/O systems allowed them to be incorporated into a single MCC shipping split (see Figure 3). The granularity of the I/O even allowed individual I/O modules to replace the terminal blocks in each unit.



Installed in each shipping split and factory wired to starter units. Network connection from remote controller is made to communication adapter at unit mounted I/O in each shipping split.

Figure 3: Distributed I/O

This was a network revolution. Not only did it reduce the cost of the basic control points needed for central control or data acquisition, but it also allowed users to gather additional diagnostic information, which was not economically viable to gather previously.

In the 1990s, the revolution took off. The use of electronic components in MCCs grew dramatically. Drives and soft starts offered additional functionality and protective features. Solid state overload relays provided the traditional electromechanical starter with increases in protective and diagnostic features. Today, the most complex systems actually delegate control, diagnostic information acquisition, and advanced protection tasks to these electronic devices. Communications are incorporated directly at the device level.

Intelligent Motor Control Systems

So is the use of open networks, distributed I/O and electronic components what defines an MCC as intelligent? That could be one definition. But to a great extent, intelligence is in the eye of the beholder.

Typically, intelligent systems have three things in common:

- Control is achieved via a microprocessor-based system.
- Network technology is used to replace hardwiring.
- Some degree of enhanced diagnostic or protective functionality is included.

Although many associate these technologies with intelligence, perhaps the better definition has nothing to do with the technology involved. In today's competitive business environment, the definition of an intelligent MCC is: *"An integrated system that provides equivalent or greater functionality more economically than a standard MCC."* In other words, an intelligent MCC is simply an MCC that maximizes the value of the components in a given application.

But how does one determine maximum value? Is it based on the cost of the equipment? Certainly not. The cost to design, specify, purchase, install, commission, operate, maintain, and upgrade an MCC are all factors that affect the total product cost. But “value” is measured differently.

Every person in the chain is likely to define intelligence according to his perception of value. For example, consultants that design and specify equipment are interested in the reliability and performance of the components. A contractor may be primarily concerned with equipment and installation costs. A facility manager is likely to be concerned about the ease of operation and amount of maintenance costs. Operations personnel are focused on the functionality and durability of the entire system.

Regardless of job function, every person’s perception of value regarding MCC intelligence has a common underlying solution: a design that fully optimizes every component of the equipment specific to that function.

Intelligent Motor Control Center Options

Intelligent MCCs typically fall into one of three categories.

Distributed I/O Mounted in the MCC

Locating distributed I/O within each MCC (preferably within each shipping split) reduces installation and commissioning time for a lower installed cost. Construction is common across applications and provides clear segregation between automation and motor control.

This can be important where division of responsibilities, existing spares, and training are overriding issues. Processors can be added to most distributed I/O systems to provide local control capabilities. Integration into PLC-based control schemes is straightforward and distributed I/O is available for all popular networks.

Bit-level Networks Replacing Traditional Hard-wiring
(see Figure 4 on page 6)

Bit-level networked MCCs are characterized by simplicity and usually deliver the lowest installed cost. They allow localization of failures, which improves maintenance and usually provides some additional functionality that is not economically feasible with hard-wired systems.

Installation and commissioning time is significantly improved over traditional MCCs. They do not require extensive system configuration or parameter management and can be maintained by most electricians. Concurrent engineering also is greatly facilitated. Bridges are available to most bit-level or byte-level networks and configuration is straightforward (an entire MCC is typically represented as one node). Computational resource and network bandwidth requirements are low. These systems are easily retrofitted to existing installations and so do not require “intelligent devices” to provide benefits.

When bit-level network is in place, the cabling is factory connected to the I/O located in each starter unit. The MCC is connected upstream to the host controller by the network of choice (field connection). When intelligent devices are used, the network of choice is field connected to each starter unit.

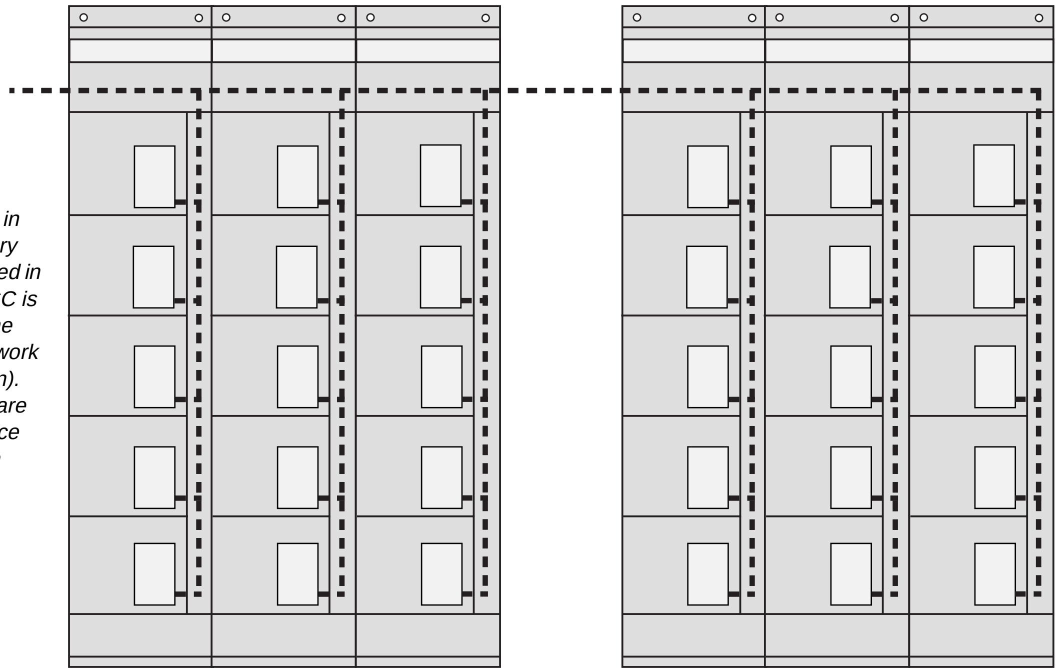


Figure 4: Bit-level Network

Intelligent Devices

Intelligent devices imbedded in the MCC not only provide network communications, but also extensive functionality not available on standard devices, such as network configuration, diagnostics, extensive process information, and advanced protection for each unit. Networks with high bandwidths are used because of the large amount of information available. Significant technical expertise is required, but the systems have excellent life cycle benefits in process applications where the additional information, diagnostics, and protective features easily justify the incremental cost of the equipment.

Making "Intelligent" Decisions

When specifying IMCCs for your application, consider cost, capability, and complexity; assess your capabilities and objectives realistically; and keep in mind that additional functionality usually comes with additional cost or complexity that you may not need.

Before diving in, ask yourself the following questions:

- Will I maximize my return on investment by lowering the installed cost of the MCC equipment or by providing significant additional functionality?
- Will last minute changes be likely?
- Is future expansion or modification likely?
- How valuable is a reduction in installation and commissioning time?
- Can the equipment be integrated into my overall control and information architecture?
- Does my control system or network have enough capacity to handle the data provided?

- Do I have a technical staff capable of maintaining the system?
- What are the cabling and connection requirements of the system?

A good MCC supplier will offer a range of options; one size does *not* fit all.

The manufacturer should be able to help you answer these questions, so you can select the best approach for your application.

The supplier should be able to integrate with multiple networks and existing control systems. He must work with third parties and system integrators that can add value. And he should provide total solution packages where appropriate.

Finally, a complete, functional test of the equipment before shipment is essential to realizing reductions in commissioning time. Be sure the vendor intends to conduct the test by actually energizing the I/O, not with simple point-to-point wiring checks.

So what is an intelligent MCC? It all comes down to an IMCC design that is intelligent in form and function.

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