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**Machine and Unit States:
An Implementation Example of
ISA-88**

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Machine and Unit States: An Implementation Example of ISA-88

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Foreword

The ISA88 committee has defined a batch standard series that provides terminology and a consistent set of concepts and models for batch manufacturing plants and batch control. These standards, however, were not defined in the context of Packaging machines, or machines that perform discrete operations. As the ISA-88 batch standards continue to evolve, the context of the standard models may be extended to include the entire plant, integrating the software definitions of batch, packaging, converting and warehousing. Currently, as noted in this report there is a need to begin consideration of the ISA-88 standards in the context of differing automated machinery.

This is an informative document. This document contains definitive implementation examples of definitions and models in order to establish a common presentation and high level software architecture or layout. **The terms and definitions used in this document are harmonized, as much as possible, with ISA-88; the document is not definitive in this respect.** The models used, and applied, in this document are an extension of the models presented in ISA-88 and are shown how they are applied to differing machine functionality. Discrete machine functionality is expressed graphically in several situations and described. The intent of this document is to propose specific implementation options and indicate a preference for a specific set of machine types.

Abstract

The "standard" method of programming discrete machines is generally considered to be solely dependent on the machine and the software engineer, or control systems programmer. This constant change offers little additional value and generally increases the total costs, from the designing and building of the process to operating and maintaining the system by the end user. This Technical Report on the implementation of ISA-88 in discrete machines breaks this paradigm and demonstrates how to apply the ISA-88 standard to discrete machine states and modes. The implementation of the standard will create a standard programming methodology as well as consistent method to install, communicate, operate, and maintain a piece of unit/machine. This Technical Report gives examples of general and specific machine state models and procedural methods. The report cites real control examples as implementations, and provides specific tag naming conventions; it also cites a number of common terms that are consistent with batch processing and ISA-88.

Key Words

State machine, state model, mode manager, machine state, unit control mode, PackML, state commands, command tags, status tags, administration tags, base state model, state engine, functional programming, modular programming, machine control software, discrete machine software, PackTags, Weihenstephan, Production Data Acquisition, PDA, ISA88, and TR88.

Introduction

When the ISA-88 standard is applied to applications across a plant, there is a need to align the terminologies, models, and key definitions between different process types; continuous, batch, and discrete processes. Discrete processes involve machines found in the packaging, converting, and material handling applications. The operation of these machines is typically defined by the OEM, system integrator, end user, or is industry specific.

A task group with members from technology providers, OEMs, system integrators, and end users was chartered by the OMAC (Open Modular Architecture Control)/ISA Packaging Workgroup. The task group generated the PackML guidelines as a method to show how the ISA-88 concepts could be extended into packaging machinery. This technical report is intended to build upon and formalize the concepts of the PackML guidelines and to show application examples.

The purpose of the technical report is to

- a) Explain functional state programming for automated machines;
- b) Identify definitions for common terminology;
- c) Explain to practitioners how to use state programming for automated machines;
- d) Provide actual implementation examples and templates from automation control vendors;
- e) Identify a common tag structure for automated machines in order to:
 - 1) Provide for Connect & Pack functionality;
 - 2) Provide functional interoperability and a consistent look and feel across the plant floor;
 - 3) Provide consistent tag structure for connection to plant MES and enterprise systems.

Machine and Unit States: An Implementation Example of ISA-88

1 Scope

Since its inception, the OMAC Packaging Machine Language (PackML) group has been using a variety of information sources and technical documents to define a common approach, or machine language, for automated machines. The primary goals are to encourage a common "look and feel" across a plant floor, and to enable and encourage industry innovation. The PackML group is recognized globally and consists of control vendors, OEM's, system integrators, universities, and end users, which collaborate on definitions that endeavour to be consistent with the ISA88 standards and consistent with the technology and the changing needs of a majority of automated machinery. The term "machine" used in this report is equivalent to an ISA88 "Unit".

This has led to the following:

1. A definition of machine/unit state types.
2. A definition of machine/unit control modes.
3. A definition of unit control mode management.
4. State models, State descriptions, and transitions.

2 References

The following documents contain provisions that are referenced in this text. At the time of publication the editions indicated were valid. All documents are subject to revision, and parties to agreements based on this technical report are encouraged to investigate the possibility of applying the most recent editions of the reference documents indicated below.

- ISA-88.00.01-1995,.Batch Control Part 1: Models and Terminologies
- ANSI/ISA-88.00.02-2001 Batch Control Part 2: Data Structures and Guidelines for Languages
- ANSI/ISA-88.00.03-2003 Batch Control Part 3: General and Site Recipe Models and Representation
- ANSI/ISA-88.00.04-2006 Batch Control Part 4: Batch Production Records
- ISA Draft 88.00.05 Batch Control - Part 5: Implementation Models & Terminology for Modular Equipment Control
- IEC 61131-1 Standard for programmable logic controllers (PLCs), General Information
- IEC 61131-3 Standard for programmable logic controllers (PLCs), Programming Languages
- IEC 61131-4 Standard for programmable logic controllers (PLCs), User Guidelines
- PLCopen TC5 Safety Certification
- Weihenstephan Standard – Part 2 Version 2005
http://www.wzw.tum.de/lvt/englisch/Weihenstephaner_Standards_GB.html
- ANSI/ISA-95.00.01-2000 Enterprise-Control System Integration Part 1: Models and Terminologies
- ANSI/ISA-95.00.02-2001 Enterprise-Control System Integration Part 2: Object Model Attributes
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- DIN 8782, Beverage Packaging Technology: Terminology Associated with Filling Plants and their Constituent Machines