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TECHNICAL REPORT

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Functional Diagram Usage

Reaffirmed 25 October 2016

ISA-TR5.1.01/ISA-TR77.40.01-2012 (R2016)
Functional Diagram Usage

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Foreword

Functional diagrams were first employed when discrete and electric analog control systems were designed. Associations and professional societies, such as Scientific Apparatus Makers Association (SAMA), ISA, and ISO, provided guidelines as to industry use of functional diagrams. SAMA has ceased to exist, but its popular standard, PMC 22.1-1981, *Functional Diagramming of Instrument and Control Systems*, is currently available through The Measurement, Control and Automation Association as well as ISA. Current ISA standards available for industry use include ANSI/ISA-5.1-2009, *Instrument Symbols and Identification*, and ISA-5.2-1976 (R1992), *Binary Logic Diagrams for Process Operations*. Symbols from SAMA PMC 22.1-1981, *Functional Diagramming of Instrument and Control Systems*, have been incorporated into ANSI/ISA-5.1-2009. The work within this technical report maintains historical practices of the previous and current documents and expands on new algorithms and practices.

Abstract

This technical report is an extension of ANSI/ISA-5.1-2009. The intent of this report is to provide further information and practical examples on the usage of functional diagrams for documenting application software. It is hoped that this report will be a handy reference to design engineers who are directly involved in the generation or review of functional diagrams.

Keywords

functional diagram, function block symbols, application software, control algorithm, cascade controller, multiple input multiple output controller, symbol legend, PID controller

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1 Scope

The scope of this technical report is to expand on and illustrate usage of function block symbols and functions and to prepare examples in development of complex function block symbols and functions.

2 Purpose

The purpose of this technical report is to provide advice and guidance in documenting application software through functional diagrams.

3 Definitions

3.1 alarm:
an audible and/or visible means of indicating to the operator an equipment malfunction, process deviation, or abnormal condition requiring a response [ANSI/ISA-18.2-2016]

3.2 application software:
software specific to a user application that is configurable and in general contains logic sequences, permissive and limit expressions, control algorithms, and other codes required to control the appropriate input, output, calculations, and decisions

3.3 binary:
a term applied to a signal or device that has only two discrete positions or states. When used in its simplest form, as in binary signal (as opposed to analog signal), the term denotes an on-off or high-low state, i.e., one which does not represent continuously varying quantities.

3.4 controller:
any manual or automatic device or system of devices used to regulate a process within defined parameters. If automatic, the device or system responds to variations in a process variable.

3.5 control station:
a manual loading station that provides control-loop switching between manual and automatic control mode. It is also known as an auto-manual station. In addition, the operator interface of a distributed control system may be regarded as a control station.

3.6 converter:
a device that receives instrument signal information in one form and transmits an output signal in another form. An instrument that changes a sensor's output to a standard signal is properly designated as a transmitter, not a converter. Typically, a temperature element (TE) may connect to a transmitter (TT), not to a converter (TY).

3.7 digital:
a term applied to a signal or device that uses binary digits to represent continuous values or discrete states

3.8 distributed control system:
a system that, while being functionally integrated, consists of subsystems that may be physically separate and remotely located from one another

3.9 function:
the purpose of or an action performed by a device