IEC 61499 Function Block Model

Definitions

The IEC 61499 standard defines a distributed model for splitting different parts of an industrial automation process and complex machinery control into functional modules called function blocks. These function blocks can be distributed and interconnected across multiple controllers.

System: A collection of devices interconnected and communicating with each other by means of a communication network consisting of segments and links.

Device: An independent physical entity capable of performing one or more specified functions in a particular context and delimited by its interfaces.

Resource: A functional unit having independent control of its operation, and which provides various services to applications including scheduling and execution of algorithms.

Application: A software functional unit that is specific to the solution of a problem in industrial-process measurement and control. An application may be distributed among devices and may communicate with other applications.

Function block: A software functional unit that is the smallest element of a distributed control system. It utilizes an execution control chart (ECC) state machine to control the execution of its algorithms.

Overview

A Function Block Model represents parts included in a measurement and control function block. Figure 1 shows these parts of a measurement and control function block. Many function blocks are connected together with a data/event interface and are part of an application.

A function block is a functional unit of software comprising an individual instance or copy within a resource. The algorithms contained within a function block are hidden from the outside of the function block and are scheduled according to the Execution Control Chart state machine (ECC).

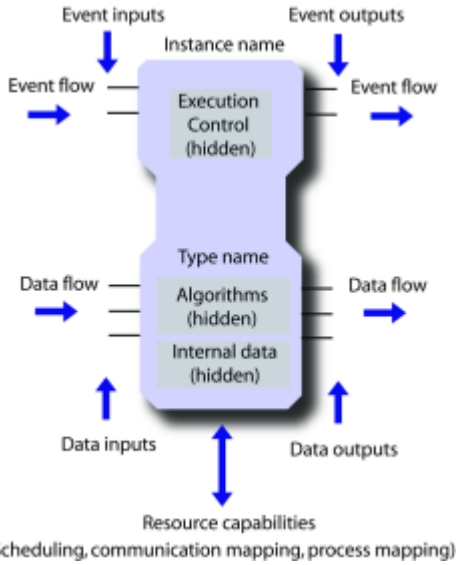

Figure 1: IEC 61499 Function Block Model

Event inputs and outputs are used to synchronize function blocks within an application and to schedule the algorithms within the function block.

Data inputs and outputs are the interface with the external of the function block since internal data is hidden. The data may be part of the algorithms and may also be state information for the Execution Control Chart (ECC).

Function blocks are created by defining their ECC and programming their algorithms. These function blocks are called basic function blocks (see Figure 1). The ECC is a state machine processing events and scheduling algorithms. It defines the behavior of the function block upon receiving events. The algorithms operate on internal variable values, input values, and output values. Each basic function block can run on any resource.

When function block algorithms and the control of their execution are expressed entirely in terms of interconnected function blocks, these are called composite function blocks (see Figure 2). These are created by interconnecting existing basic and composite function blocks. No ECC or algorithm is created. A composite function block runs on

any resource. However, the basic and composite function blocks making up a composite function block run on the same resource as the main composite block.

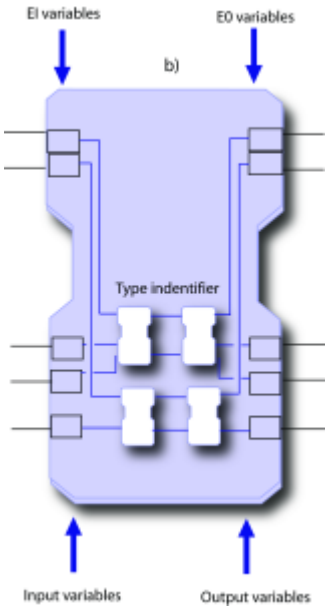

Figure 2: Composite Function Block

An application is defined by function block (Basic and Composite) networks specifying event and data flows throughout function block instances. The event flow determines the scheduling and execution of the function blocks' algorithms. Each function block within the application can be distributed across resources and devices.

In **ISaGRAF**, an application can be created using custom function blocks or function blocks from libraries. Figure 3 shows the basic function block editor. Figure 4 shows the composite function block editor and figure 5 shows the function block model displayed by the **ISaGRAF** toolset.

Figure 3 displays a function block ECC state machine and a function block algorithm from the basic function block editor. The ECC is a state machine built using the SFC editor. Algorithms can use any of the IEC61131-3 programming languages as well as the flow chart language provided in the **ISaGRAF** toolset. The available IEC 61131-3 languages are the following: Sequential Flow Chart (SFC), Function Block Diagram (FBD), Ladder (LD), Instruction List (IL), and Structured Text (ST).

Composite function blocks can also be created in the **ISaGRAF** toolset using the composite function block editor (see Figure 4). **ISaGRAF** enables you to create a composite function block by adding any available basic and composite function block to the function block network.

The newly created function block is available for use in any application and can be configured to run on any resource or device part of the system.

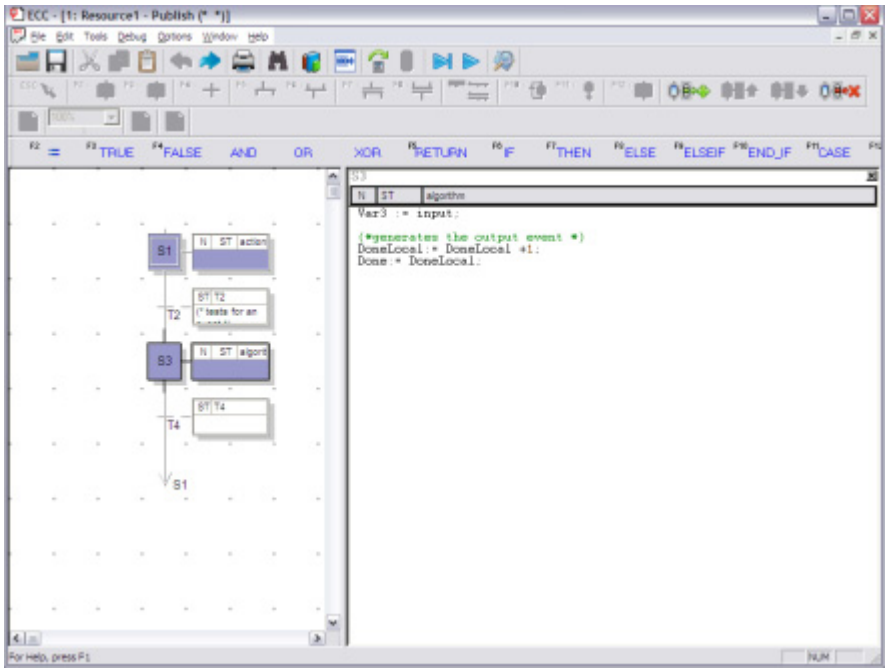

Figure 3: ISaGRAF Basic Function Block Editor

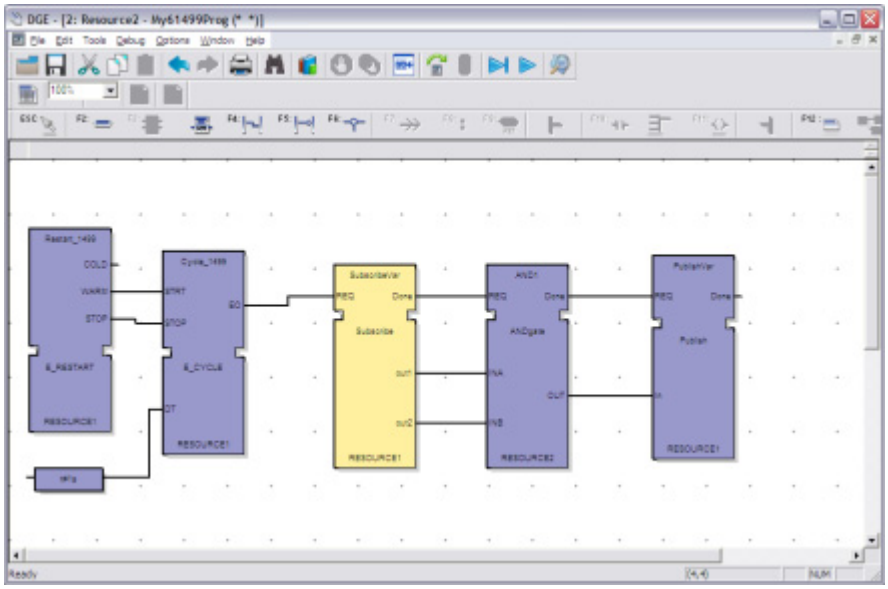

Figure 4: ISaGRAF Composite Function Block Editor

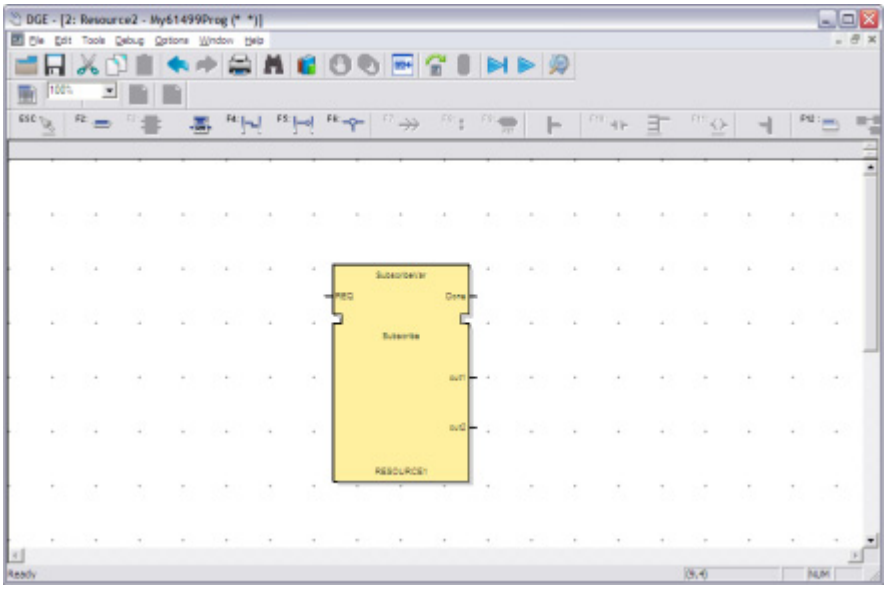

Figure 5: ISaGRAF Function Block Model Viewer

References

International Electrotechnical Commission: Function Blocks Part 1 - Architecture (61499-1 © CEI:200X).

ICS Triplex ISaGRAF Inc.: ISaGRAF User's Guide. November 2005.