Event Collector

Part of the Brigger & Associates Event Recorder System

User Manual

for

Allen-Bradley ControlLogix™ PLC's

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ACRONYMS

PLC – programmable logic controller.

PC – Microsoft Windows based personal computer.

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INTRODUCTION

The Event Recorder System is a tool for logging and displaying changes in digital conditions within a PLC program. It consists of 3 software applications:

- Event Collector – Captures events
- Event Logger – Logs events to a PC database
- Event Viewer – Displays logged events

A typical Event Recorder System is shown in the following figure:
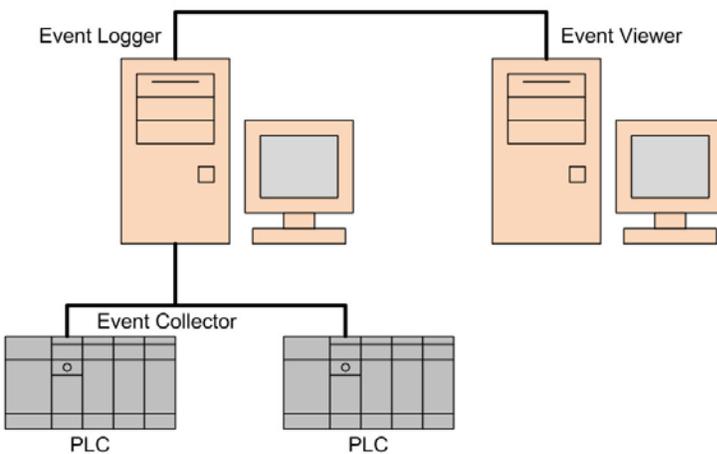
The *Event Collector* is PLC logic that is part of the Brigger & Associates Event Recorder System. It collects events in the PLC and stores them until read by the *Event Logger*. It does this by monitoring the value of specified digital addresses during each PLC scan. When the value changes, an event occurs and the date and time of the event, as well as data identifying the event, are captured. Thus, unlike other data logging software, events that occur only during a single PLC scan are captured.

The *Event Collector* consists of PLC logic and 2 data files - the Event List and the HMI List. The PLC logic is added to the logic of an existing PLC program, referred to as the Host PLC logic.
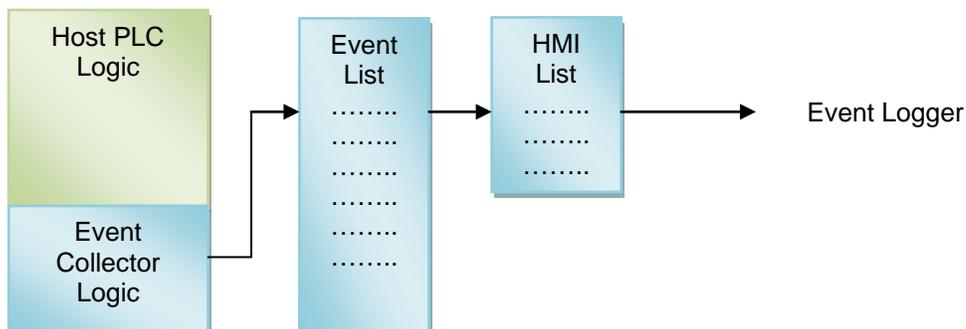
When an event is captured, the date and time of the event, as well as data identifying the event, are written to the Event List. The data from this file is written to the HMI List. The event data in the HMI List is the data that is read by *Event Logger*.

The Event List stores event data until the event data in the HMI List is read by *Event Logger*. After the HMI List is read by *Event Logger*, data from the Event List is written to the HMI List.

Event Collector PLC logic is supplied with the "Event Recorder System" CD.

THEORY OF OPERATION

An event is defined as the change in value of any digital condition. The digital condition is usually a digital address. However, it can also be any condition with a digital result. An example of this would be a measured temperature exceeding a specific value.

CAPTURING EVENTS

There are 3 Event Recorder bit addresses associated with each host PLC digital condition that is to be monitored by *Event Collector*. These bits are the New Event bit, the Old Event bit, and the Change bit. The New Event bit is the value of the digital condition for the current PLC scan. The Old Event bit is the value of the digital condition for the last PLC scan. And the Change bit indicates if the value has changed between the two PLC scans. The values of these bits are determined during each PLC scan by the following ladder logic:
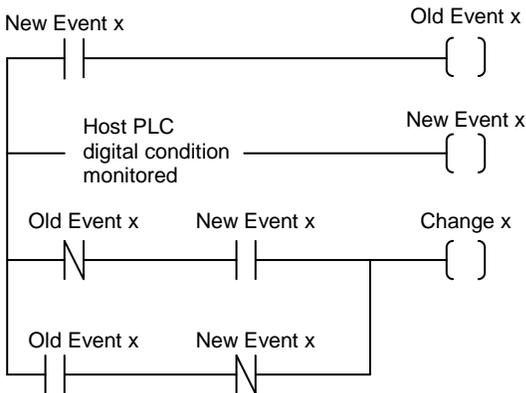
For the *Event Collector* logic, the determination of the values of the Old Event and Change bits are determined on a word basis. In order to do this, the Old Event, New Event, and Change bits are bits in words of 3 separate integer data files, respectively.
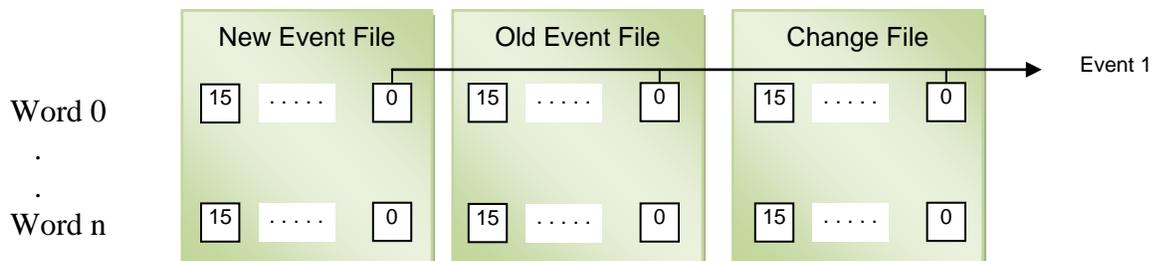
Each possible event, referred hereafter just as an event, is represented by the same word/bit combination in each data file. Thus, the values of the Old Event and Change bits can be determined by the following Boolean equations (where XOR is the exclusive OR function):

Old Event Word = New Event Word
Change Word = Old Event Word XOR New Event Word

EVENT NUMBER

Since each bit in the data files represents a possible event, there are 16 events per word and n x16 total possible events where n is the number of words in each file.

Each event is assigned an event number, starting from 1. If the first word in each file is word 0 and the first bit of any word is bit 0 then the event number for any word and bit combination is given by,

Event Number = (word number x 16) + (bit number + 1)

EVENT PACKETS

For each PLC scan the values of the New Event, Old Event, and Change words are calculated. For each Change word whose value is not 0, one or more events represented by that word have occurred and an "event packet" is created. An event packet consists of the following 7 integer words:

1. (List Position x 100) + Seconds
2. (Hour x 100) + Minute
3. Value of Change word
4. Value of New Event word
5. (Month x100) + Day
6. Year
7. Spare

The List Position identifies the word in the Change word data file, with the first word having a List Position of 1. The Change word and New Event word represent 16 events. Knowing the List Position and the bits in the Change word that have a value of 1, the *Event Logger* determines Event Numbers and the New Event word determines the new value for the bits that changed.

The time and date are current time and date from the PLC's calendar/clock and The spare word is reserved for special applications.

STORING AND TRANSFERRING EVENTS

As Event Packets are created they are stored in the Event List until they can be sent to the HMI List. The Event List is 784 words in length which means it can hold a total of 112 event packets.

The *Event Logger* reads the data in the HMI List. The HMI List is 198 words in length, consisting of 28 event packets (196 words) and two communication words. The PLC driver used by the *Event Logger* can only read 100 words at a time. Therefore, in order to read the entire HMI List, the *Event Logger* reads words 0 to 99 first followed by words 100 to 197.

When data from the Event List are transferred to the HMI List, the first 196 words of the Event List are transferred. Then data in the Event List is then shifted up 196 words.

SYSTEM EVENTS

There are 3 system events – PLC first scan, heartbeat, and event queue full. The PLC first scan event indicates that the PLC was started. The heartbeat event is a 30 minute pulse that indicates that the Event Recorder is working in case no other events occur during that time. And the queue full event indicates that the Event List was full so events after this were not logged. This would occur if the *Event Logger* was not reading the HMI List or events were being logged faster than they could be read by the *Event Logger*.

COMMUNICATION FAULT

The communication between the PLC and the *Event Logger* PC is continuously monitored. If data is in the HMI list but hasn't been read by the *Event Logger* PC, the following PLC bit is set to indicate the loss of communication:

Communication Fault Bit ER.Misc_Bits[11]

This bit should be monitored by the Host PLC program to alert the operator.

INSTALLATION OF PLC LOGIC

INTRODUCTION

The PLC logic for the *Event Collector* is provided in the "Event Collector" folder of the "Event Recorder System" CD. The logic is provided as an Allen-Bradley ControlLogix project file, "Event Collector.ACD". A "pdf" copy of this program is also provided.

The PLC logic consists of a "Main" routine and the following four routines:

ER0_Clock_1   This is logic for mapping the PLC dates and times of the host program to variables used by the Event Recorder.

ER0_Clock_2   This is logic to read the date and time of the PLC clock and for setting the clock.

ER1_Logic   This is the logic that captures and store events.

ER2_List   This is the logic that defines the digital conditions to be monitored.

The *Event Collector* assigns a date and time to each event. This date and time comes from the PLC clock/calendar. As shown above, there are two clock routines, ER0_Clock_1 and ER0_Clock_2. Only one of these is used. ER0_Clock_1 is used if the host PLC already reads the PLC clock/calendar. Otherwise, ER0_Clock_2 is used. This routine reads the PLC clock/calendar but it also has the capability to update the clock.

The logic has two user defined data types, "Clock" and "ER".

Clock Data Type		ER Data Type	
Clock_Parameters	DINT[7]	New_Events	DINT[100]
Year	INT	Old_Events	DINT[100]
Month	INT	Change_Words	DINT[100]
Day	INT	Event_List	DINT[784]
Hour	INT	MMI_List	DINT[256]
Minute	INT	List_Position	INT
Second	INT	Event_List_Pointer	INT
		Comm_Counter	INT
		Change_Word_Loop_Printer	INT
		Events_Words	DINT[7]
		Misc_Bits	BOOL[32]
		Timers	TIMER[5]

In addition the following tags are used:

Name	Data Type
ERClock	Clock
ER	ER
AutoSetClock	BOOL
SetClock	BOOL
USER_Day	INT
USER_Month	INT
USER_Year	INT
USER_Hour	INT
USER_Minute	INT
USER_Second	INT

To install the *Event Collector* logic into a host program, the above 4 routines are exported from the "Event Collector.ACD" logic and imported into the host program. The above data types and tags are added to the host program when the routines are imported.
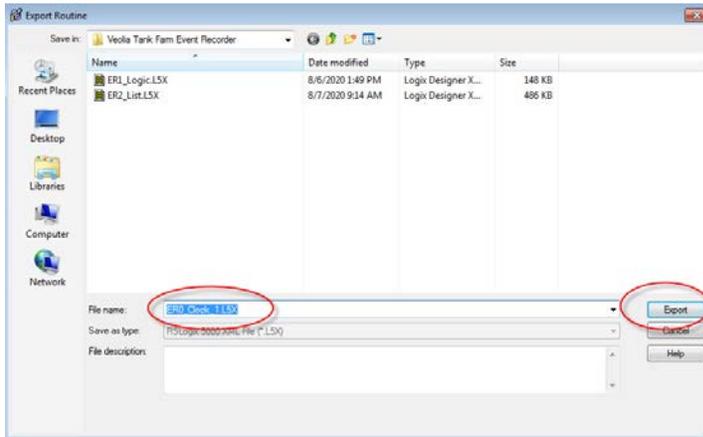
EXPORTING EVENT COLLECTOR ROUTINES

The following steps are to be followed to export the *Event Collector* routines. Note that the routines are exported one at a time.

1. Load the "Event Collector.ACD" program with RSLogix5000 or Studio 5000 software.

2. Right-click the routine in the "Controller Organizer" and select "Export Routine".
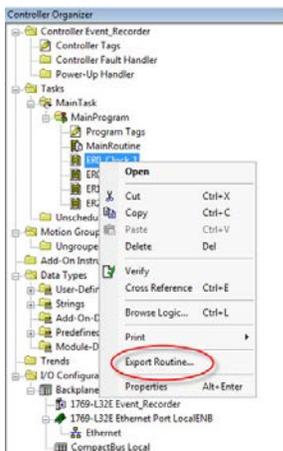
3. In the subsequently displayed window, as shown below, select where to export the routine and then click "Export".

The routine will be saved as an XML file with an extension of ".L5X".

4. Repeat steps 2 and 3 for each routine.

IMPORTING EVENT COLLECTOR ROUTINES

Once the *Event Collector* routines have been exported, they are then imported into the Host PLC per the following steps. Note that the routines are imported one at a time. Only one clock routine is to be imported as described below.

1. Load the Host program with RSLogix5000 or Studio 5000 software.

2. Select from the menu "File / Import Component / Routine".
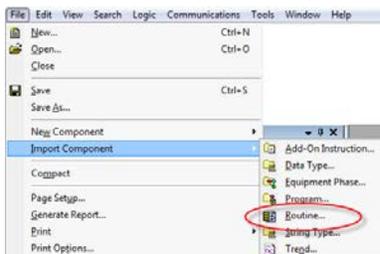
3. In the subsequently displayed window, select the exported routine to be imported. Select where it is to be imported with the "Into" dropdown menu and click "Import".
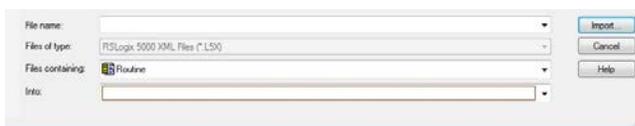
4. Repeat steps 2 and 3 for each ".L5X" file.

5. Add an unconditional call to the "ER1_Logic" routine in the Main program.

CONFIGURING ER0_Clock_1 ROUTINE

This is logic for mapping the PLC dates and times of the Host program to variables used by the *Event Collector*. This is only to be installed if Host PLC reads the PLC clock/calendar and there are already time and date tags in the Host logic.

This routine is configured by replacing the "USER_xxx" tags in the MOV statements with the tags from the Host logic, subject to the following value ranges:

USER_Month	1-12
USER_Day	1-31
USER_Year	20xx
USER_Hour	0-59
USER_Minute	0-59
USER_Second	0-59

If this routine is installed, an unconditional call to this routine must be added to the Main program.

COFIGURING ER0_Clock_2 ROUTINE

If the Host PLC program does not already read the PLC clock/calendar, this is logic that will do that and map the values to *Event Collector* tags. It also can be used to set the PLC clock from an HMI or SCADA terminal. The actual time can be set or the clock can be synchronized at 4:00am each morning. If this routine is installed, an unconditional call to this routine must be added to the Main program.

Setting the Clock
To set the actual time and date, first the HMI or SCADA must write a 1 to the "SetClock" tag in the PLC. Then the time and date must be written to the following PLC tags:

Clock.Day	Current day of the month (1-31)
Clock.Hour	Current hour (0-23)
Clock.Minute	Current minutes (0-59)
Clock.Month	Curent month (1-12)

Clock. Second   Current seconds (0-59)
Clock.Year   Current year (xxxx)

Once the correct date and time has been entered, the "SetClock" tag must be set to 0.

Synchronizing the Clock
The PLC clock is synchronized to the HMI or SCADA clock at 4:00 am by writing a 1 to the PLC "AutoSetClock" tag. This will set the PLC clock to 4:00 am. Note that the date does not change. The "AutoSetClock" tag is automatically reset to 0.

CONFIGURING ER1_Logic ROUTINE

This is the logic that actually captures the events. There is ordinarily no configuration. However, the default number of possible event can be changed and a loss of communication can be monitored.

Changing Default Number of Possible Events
The logic is configured for 1600 events – 100 New Event words, 100 Old Event words, and 100 Change words. The following changes are required if other than 100 event words are to be used:

1. In the "Update Old Events" section (Rung 16), change the "Length" in the COP function from 100 to the new number of words.
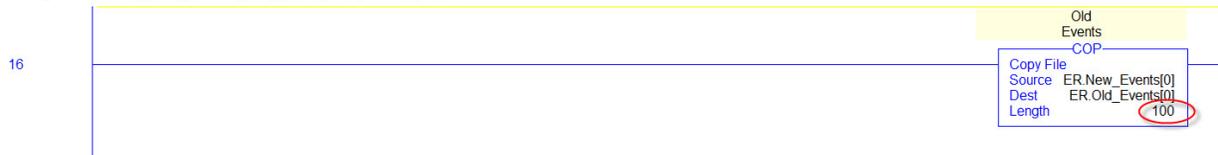
2. In the "Calculate Value of Change Words" section (Rung 24), change the "Source B" in the LES function from 100 to the new number of words.
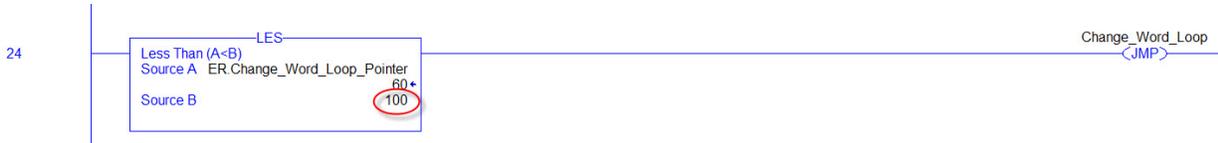
3. In the "Construct Event Packets" section (Rung 27), change the "Source B" in the GEQ function from 100 to the new number of words.

4. Edit the ER User tag. Change the array size for New_Events, Old_Events, and Change_Words to the new number of words.

		ER
⊟ ER		
⊞ ER.Change_Word_Loop_Pointer		INT
⊞ ER.Change_Words		DINT[100]
⊞ ER.Comm_Counter		INT
⊞ ER.Event_List		DINT[784]
⊞ ER.Event_List_Pointer		INT
⊞ ER.Event_Words		DINT[7]
⊞ ER.List_Position		INT
⊞ ER.Misc_Bits		BOOL[32]
⊞ ER.MMI_List		DINT[256]
⊞ ER.New_Events		DINT[100]
⊞ ER.Old_Events		DINT[100]
⊞ ER.Timers		TIMER[5]

Monitoring a Loss of Communication

If the Event Collector logic detects that the Event Logger is not reading events in the Event List, the bit ER.Misc_Bits[11] is set. This bit should be monitored by the HMI or SCADA to alert the operator. It can also be mapped to a digital output.

CONFIGURING ER2_List ROUTINE

This is the logic that defines the digital conditions to be monitored. Each digital condition to be monitored is mapped to a New Event word bit, ER.New_Events[w].b where w is the word (0-100) and b is the bit (0-15). Events 4 – 96 are preprogrammed with an AFI command in each rung (the first 3 events are reserved):

Replacing the AFI with a digital address or a digital condition will assign that address or condition associated Event address. Rungs must be added for more events to be monitored. Note that "ER.New_Events" is a 16 bit integer array so that after bit 15 a new word with bit 0 is used.

This routine is called from the ER1_Logic so it must NOT be called from the Main program.

A Microsoft Excel workbook titled "PLC Event Address Table" is supplied with the "Event Recorder System" CD in the "Event Collector" folder. It is recommended that this workbook be used for setting up the digital conditions to be monitored. It can then be imported into the *Event Viewer* to provide descriptions for each event.

	A	B	C	D
1	Event	Description	Host	New Event
2	1	EVENT QUEUE FULL		ER.New_Events[0].0
3	2	PLC STARTED		ER.New_Events[0].1
4	3	30 MINUTE PULSE		ER.New_Events[0].2
5	4			ER.New_Events[0].3
6	5			ER.New_Events[0].4
7	6			ER.New_Events[0].5
8	7			ER.New_Events[0].6
9	8			ER.New_Events[0].7
10	9			ER.New_Events[0].8
11	10			ER.New_Events[0].9
12	11			ER.New_Events[0].10
13	12			ER.New_Events[0].11
14	13			ER.New_Events[0].12
15	14			ER.New_Events[0].13

Enter the digital condition to be monitored in the "Host" column and a description in the "Description" column. The "Event" and "New Event" columns must not be edited. There are rows for 100 event words. Excess rows can be deleted. Once this table has been filled in, ER2_List can be programmed. New entries can be made later or existing entries edited.

Any PLC digital address can be monitored. The following are usually monitored as a minimum:
- Digital inputs
- Digital outputs
- Alarms
- Operator commands from an HMI terminal

Digital addresses that represent certain conditions may be monitored, such as a process mode, a control sequence running, etc.

Also, any condition with a digital result can be monitored.

Warning

Monitoring digital conditions that change rapidly and often, such as a flow pulse, can overload the *Event Collector*, resulting in loss of events. This would be indicated by a "Queue Full" event in the *Event Viewer*.

The Host PLC program labels can be used to assist is filling out the "PLC Event Address Table". This can be done through the following steps:

1. Load the Host PLC program in RSLogix5000.

2. Export the labels from the "Tools" menu selection. This will save the labels as a ".csv" file.
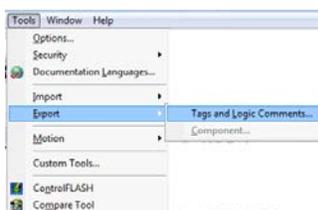
3. Load this file into an Excel worksheet.

4. Delete rows A1 through A6. Delete all columns except for columns D and F, "Description" and "Specifier", respectively. This is a list of descriptions versus PLC address.

5. Delete all rows for PLC addresses not to be monitored. Only digital addresses should remain.

6. Open the "PLC Event Address Table" workbook.

7. Copy and paste rows in the labels worksheet into the worksheet of the "PLC Event Address Table". Start after Event 16. The copied rows do not have to be contiguous. There can be empty event data.

8. Save the "PLC Event Address Table" workbook.

9. Use the "PLC Event Address Table" workbook to enter the logic in the ER2_List routine.