MANUFACTURER DOCUMENT PACKAGE

Manufacturer's Manual

Reference package for procurement and maintenance review

ABB

IMSET01

SEQUENCE-OF-EVENTS TIMING MODULE

Used with the applicable INFI 90 Harmony SOE configuration.

REFERENCE PACKAGE

OFFICIAL DOCUMENT

Selected official manufacturer pages follow this cover.

Source: ABB Distributed Sequence of Events WBPEEUI240768A1; Harmony SOE WBPEEUD240008A2

Trademarks and Registrations

Registrations and trademarks used in this document include:

® INFI 90	Registered trademark of ABB Automation, Inc.

Introduction

Section 1

Overview

The Distributed Sequence of Events (SOE) provides a fully integrated system approach to event monitoring, recording and reporting for the Symphony Enterprise Management and Control System. Digital input transitions are collected and time-stamped at the time of occurrence. All input detection modules are time-synchronized, and coordinated through an external time input (e.g., satellite receiver system (SRS)). This event input data is passed over the network to the INSOE01, Sequence of Events Server Node which is responsible for collecting and sorting event data coming from distributed Harmony control units (HCU). This stored event data is made available to the human system interface for report generation.

The SOE system is comprised of the following Harmony rack modules (Fig. 1-1):

- INSEM01 Sequence of Events Master.
- INTKM01 Time Keeper Master.
- INNIS01 Network Interface.
- IMSET01 Sequence of Events Timing.
- IMSED01 Sequence of Events Digital Input.

The IMSED01 and the IMSET01 modules are I/O modules capable of acquiring 16 digital inputs with one millisecond resolution. The IMSET01 module receives and decodes the time-sync link time information sent by the INTKM01 module. The NTKM01 module provides the time information to the INSEM01 module and to the time-sync link.

The NTST01 unit is a termination unit that interfaces the INTKM01 module and IMSET01 modules with the time-sync link system. The time-sync link allows the sync time information transmission from the INTKM01 module to all IMSET01 modules. The NTST01 unit permits the connection between the INTKM01 module and the receiver.

The INSEM01 module is a Cnet communication module that is responsible for collecting SOE data from the Harmony control unit nodes, detecting triggers and providing event data to the



Table 1-6. IMSED01 Specifications *(continued)*

Property	Characteristic/Value
Response time (typical)	DC fast 1.1 ms DC slow 18 ms AC 5 ms after the first positive half cycle
Surge protection	Meets IEEE-472-1974 surge withstand capability test
Microprocessor CPU Instruction cycle Timer Port	DSP 2101 16 bits running at 10 MHz 100 ns 16 bit interval timer with prescaler 1 bidirectional synchronous serial port
Memory Boot EPROM RAM FIFO Program memory RAM Data memory RAM	 64 kbyte 64 kbyte 512 byte 1 kword 512 word
Communication port IMSET01 (with NTST01)	RS-485

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Table 1-7. IMSET01 Specifications

Property	Characteristic/Value
Power requirements Operating voltage	 +5 VDC, ±5% at 350 mA typical, 500 mA maximum
Digital inputs Voltage Current (typical) Turn-on voltage (minimum) 	 24 VDC (±10%) 48 VDC (±10%) 125 VDC (±10%) 120 VAC (±10%) (only for system control logic) 5 mA at 24 VDC 4 mA at 48 VDC 4 mA at 125 VDC 5 mA at 120 VAC 21.6 V at 24 VDC 43.2 V at 48 VDC 112.5 V at 125 VDC 108 V at 120 VDC

Table 1-7. IMSET01 Specifications *(continued)*

Property	Characteristic/Value
Digital inputs *(continued)* Turn-off voltage (maximum) Maximum input current at minimum turn-on Maximum current off-state (for all DI voltages)	 10 V at 24 VDC 20 V at 48 VDC 50 V at 125 VDC 50 V at 120 VDC 4 mA at 21.6 VDC 4.4 mA at 43.2 VDC 3.2 mA at 112.5 VDC 4 mA at 108 VDC 1.5 mA
Isolation	350 VDC/V_{RMS} channel to channel 1,000 VDC/V_{RMS} channel to system
Response time (typical)	DC fast 1.1 ms DC slow 18 ms AC 5 ms after the first positive half cycle
Surge protection	Meets IEEE-472-1974 surge withstand capability test
Microprocessor CPU Instruction cycle Timer Port	DSP 2101 16 bits running at 10 MHz 100 ns 16 bit interval timer with prescaler 1 bidirectional synchronous serial port
Memory Boot EPROM RAM FIFO Program memory RAM Data memory RAM	 64 kbyte 64 kbyte 512 byte 1 kword 512 word
Communication port IMSET01 (with NTST01)	RS-485

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Table 1-8. NTST01 Specifications

Property	Characteristic/Value
Power requirements Operating voltage	 ±10% at +24 VDC typical 150 mA, 250 mA maximum
Wire size	22 AWG, 0.32 sq-mm (minimum) 12 AWG, 3.3 sq-mm (maximum)

Table 1-9. Common Specifications *(continued)*

Property	Characteristic/Value
Certification Canadian Standards Association (CSA)	Certified for use as process control equipment in an ordinary (nonhazardous) location
Factory Mutual (FM) (pending for INTKM01, IMSED01, and IMSET01)	Approval for the following categories: Nonincendive for: Class I Division 2, Groups A,B,C,D Class II, Division 2, Groups F,G
CE Mark declaration	This product, when installed in a Symphony cabinet, complies with the following directives and standards for CE marking
EMC96 Directive 89/336/EEC	EN50082-2 Generic Immunity Standard- Part 2: Industrial Environment EN50081-2 Generic Emission Standard- Part 2: Industrial Environment
Low Voltage Directive 73/23/EEC	EN61010-1 Safety Requirements For Electrical Equipment For Measurement, Control And Laboratory Use- Part 1: General Requirements
Cooling requirements	No cooling necessary when used in a standard module mounting unit and operates within stated environmental limits

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE



bus with the controller for exchanging data and information for event synchronization. The IMSET01 module is also connected to the time-sync link by an NTST01 unit. One IMSET01 module and up to 63 IMSED01 modules can be supported by one controller.

Functions

The IMSET01 and IMSED01 modules perform two functions:

- The acquisition of the 16 digital inputs from the field.
- The synchronization of their internal clocks.

The IMSET01 module receives the time information from the time-sync link and keeps the internal clocks synchronized with this time. The two modules are controlled by the controller, and communicate across the I/O expander bus. The controller keeps the IMSED01 modules synchronized by reading the time from the IMSET01 module and writing it to the IMSED01 modules with a broadcast message.

Digital Inputs

The IMSET01 and IMSED01 modules can operate in two distinct modes: DI standard mode and sequence of events mode.

- In DI standard mode the 16 digital inputs are acquired by using dedicated function codes 241 and 242 which control the 16 digital inputs as a function code 84. In DI standard mode the digital inputs have a filter on each input channel. It is possible to select two response times by jumper: fast (1.5 milliseconds) and slow (18 milliseconds).
- In sequence of events mode all digital inputs are acquired every millisecond and compared to the previous value. If there is a change in one or more inputs, the new status is stored internally and placed in a FIFO_out buffer (Fig. 2-2), with its own time-stamp.

A debounce procedure and a delay procedure are processed during acquisition. The debounce procedure ensures the validity of an input state change. A configuration parameter (DBFILT, unique for the 16 DI channels) determines the duration for which an input reading must remain stable to be accepted as a state change. The delay procedure compensates for the delay time in switching from zero to one (T_on) or from

one to zero (T_off) for each channel. T_on and T_off are configuration parameters for each channel.

The delay is the estimated delay between the occurrence of the physical event and the time at which the event has been detected. It is estimated on the basis of characteristics of the acquisition equipment, it can be different for transition from zero to one and for transition from one to zero.

In addition, each digital input can be configured out of scan. A state change of an out of scan digital input is not placed in the FIFO_out.

Time-Synchronization

The sync time information is transmitted every second by the INTKM01 module on the time-sync link. The IMSET01 module receives the time information and uses it to update its internal clock.

IMSED01 Block Diagram

IMSED01 module operations are controlled by a microprocessor (Fig. 2-2). The module also contains devices for the management of I/O operations (I/O expander bus control, DI isolation, DI circuits), and microprocessor auxiliary devices (boot EPROM, RAM, machine fault timer, FIFO_in and FIFO_out).

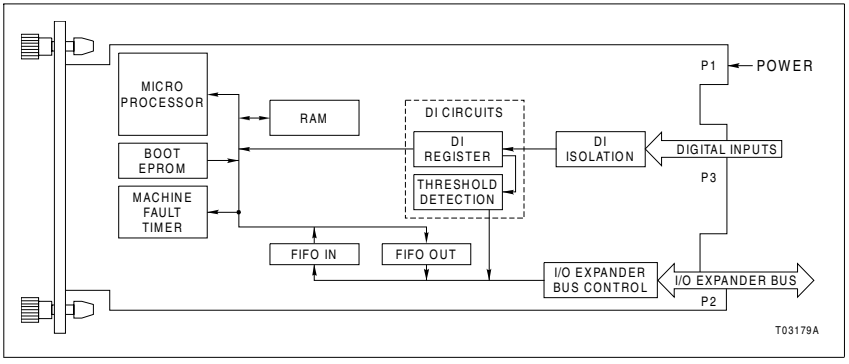


Figure 2-2. IMSED01 Block Diagram

comparator, make it possible to obtain two response times, selectable by a jumper: fast (1.5 milliseconds) and slow (18 milliseconds). The filtered digital inputs are sent to the I/O expander bus.

In the sequence event mode, downstream the optocoupler, in addition to being issued to the filters, the digital inputs are sent to digital input registers, from which they are read by the microprocessor.

The states of the digital inputs are displayed by 16 LEDs on the front panel of the module.

I/O Expander Bus Control

These circuits include the control circuit for the accesses from I/O expander bus and the communication circuit and FIFOs between the processor and a controller. The circuits contain the module address (set in the module address switch), and generate the control signals in the various types of access from I/O expander bus.

Machine Fault Timer

The microprocessor continually retriggers the machine fault timer (MFT). If the microprocessor or the firmware fails, the controller goes in fail state. The controller reads this state and stops module operation.

IMSET01 Block Diagram

The IMSET01 module has the same block diagram of the IMSED01 module, with the addition of the time-sync input to the microprocessor block (Fig. 2-3).

Time-Sync Input

The IMSET01 module receives the time-sync link time information from the NTST01 unit transmitted via the RS-485 standard. The time-sync input circuits convert the received signals and send them to the RX serial port of the microprocessor. If the NTST01 unit is in fault state or is not connected, the IMSET01 module detects the absence of the NTST01 unit.

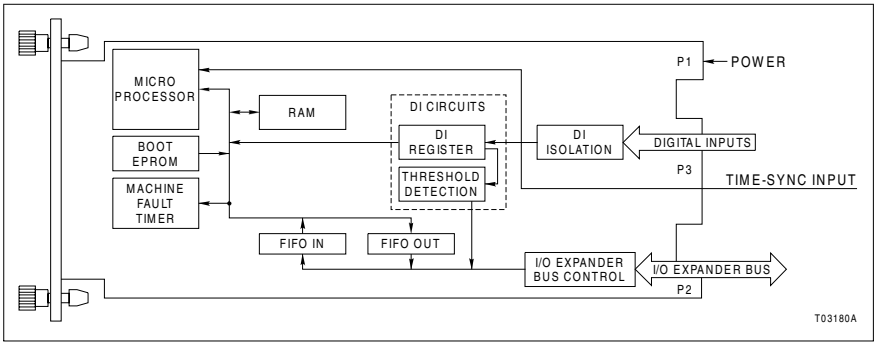


Figure 2-3. IMSET01 Block Diagram

NTST01 Termination Unit

The NTST01 termination unit attaches to a field termination panel with two screws and spacers. Figure 2-4 is the NTST01 block diagram. It is a printed board circuit that consists of:

- Input circuits.
- Output circuits.
- Optical isolators.
- INTKM01/IMSET01 interface.
- Voltage regulators (DC-to-DC converters).
- Bypass circuits.

The input circuits permit the time information reception, when the NTST01 unit is connected to the IMSET01 module. In the INTKM01 connection, these circuits receive the time information coming from the receiver in IRIG-B time code format. In both cases the time information received is sent to the modules connected through the INTKM01/IMSET01 interface.

The output circuits are composed of line drivers used to transmit the time information on the time-sync link.

In the INTKM01 connection, the time information comes from the INTKM01 module through the INTKM01/IMSET01 interface.

In the IMSET01 connection the time information comes from the input circuits. The time information is sent to the P1 connector using the RS-485 standard. The optical isolators

Time-Synchronization Link

The sequence of events time-sync link provides the time synchronization for the system allowing the transmission of dedicated time information sent from INTKM01 modules to the IMSET01 modules connected to the time-sync link. The connection between the modules and the time-sync link is carried out by the NTST01 termination unit.

The time-sync link can have three different layout schemes:

- Sequential mode - This scheme provides the bypass of a faulty NTST01 unit allowing the forwarding of the time information to the next module (Fig. 2-5).
- Star mode - In this scheme a faulty NTST01 unit breaks the transmission of the time information to all downstream nodes (Fig. 2-6).
- Mixed mode - A combination of sequential and star mode (Fig. 2-7).

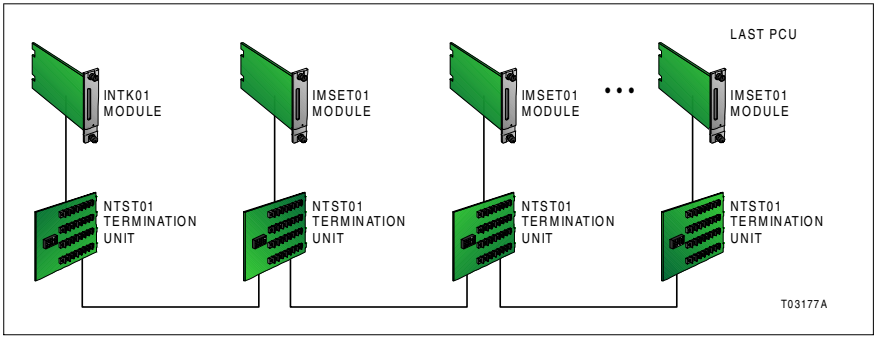


Figure 2-5. Sequential Time-Sync Link Connection

Mounting Hardware

The SOE modules and termination units mount in standard enclosures (CAB-01, CAB-04, CAB-12). The number of modules that can be mounted in a single cabinet varies.

An IEMMU11, IEMMU12, IEMMU21, or IEMMU22 Module Mounting Unit and an NFTP01 Field Termination Panel (FTP)

Installation

Section 3

Introduction

This section explains the procedures required to place the SOE modules into operation. It includes instructions on setting the address selection switch, setup and physical installation, wiring and cable connections. ***Do not*** proceed with operation until this is read, understood and all steps have been completed.

Special Handling

NOTE: Always use the ABB Automation field static kit (part number 1948385A1), consisting of two wrist straps, ground cord assembly, alligator clip, and static dissipating work surface when working with static sensitive devices. The kit is designed to connect the technician and the static dissipating work surface to the same ground point to prevent damage to the static sensitive devices by electrostatic discharge.

Use the static grounding wrist strap when installing and removing modules. Static discharge may damage static sensitive devices on modules in a cabinet. Use grounded equipment and static safe practices when working with static sensitive devices.

1. ***Use Static Shielding Bag.*** Keep the module in its static shielding bag until you are ready to install it in the system. Save the bag for future use.

2. ***Ground Bags before Opening.*** Before opening a bag containing an assembly with static sensitive devices, touch it to the equipment housing or ground to equalize charges.

3. ***Avoid Touching Circuitry.*** Handle assemblies by the edges; avoid touching the circuitry.

4. ***Avoid Partial Connection of Static Sensitive Devices.*** Verify that all devices connected to the modules are properly grounded before using them.

5. ***Ground Test Equipment.***



6. ***Use an Antistatic Field Service Vacuum.*** Remove dust from the cards if necessary.

7. ***Use a Grounded Wrist Strap.*** Connect the wrist strap to the appropriate grounding plug.

8. ***Do Not Use Lead Pencils to Set Dipswitches.*** To avoid contamination of switch contacts that can result in unnecessary circuit board malfunction, do not use a lead pencil to set a dipswitch.

Unpacking and Inspection

1. Examine the hardware immediately to verify it has not been damaged in transit.

2. Notify the nearest ABB sales office of any such damage.

3. File a claim for any damage with the transportation company that handled the shipment.

4. Use the original packing material and container to store the hardware.

5. Store the hardware in an environment of good air quality, free from temperature and moisture extremes.

INSEM01 Installation

Install one INSEM01 module and one INNIS01 module to make a sequence of event server node. Refer to the ***Cnet-to-HCU Communication Interface*** instruction for INNIS01 module setting and installation.

1. Set the INSEM01 switches.

2. Verify dipshunts on the I/O expander bus are installed.

3. Install the module.

The INSEM01 module has four dipswitches. These switches select module operation options, serial port communication characteristics and baud rate. Figure 3-1 shows the component locations.

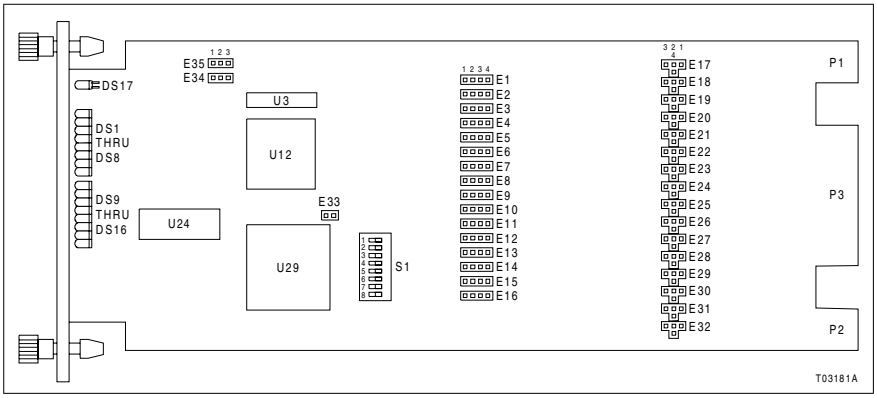


Figure 3-3. IMSET01 and IMSED01 Module Layout

Table 3-8. S1 Address Switch Settings Examples

ADDR	MSB					LSB
	3	4	5	6	7	8
5	0	0	0	1	0	1
15	0	0	1	1	1	1
32	1	0	0	0	0	0

NOTE: 0 = closed, 1 = open

Jumpers (E1 to E16 and E17 to E32)

Jumpers E1 through E16 are used to select the type of filter to be inserted into a digital input channel: fast (1.5 milliseconds) or slow (18 milliseconds). Jumpers E17 through E32 are used to select the supply voltage of a digital input channel. Table 3-9 shows the correspondence between digital input channels and jumpers. Table 3-10 shows the correspondence between filter type, supply voltage and jumper positions.

Table 3-9. IMSET01 and IMSED01 Digital Input Jumpers

Channel	Filter Jumpers	Voltage Jumpers
01	E1	E17
02	E2	E18
03	E3	E19

Table 3-9. IMSET01 and IMSED01 Digital Input Jumpers *(continued)*

Channel	Filter Jumpers	Voltage Jumpers
04	E4	E20
05	E5	E21
06	E6	E22
07	E7	E23
08	E8	E24
09	E9	E25
10	E10	E26
11	E11	E27
12	E12	E28
13	E13	E29
14	E14	E30
15	E15	E31
16	E16	E32

Table 3-10. IMSET01 and IMSED01 Jumper Selections (E1 through E32)

Voltage	E1-E16	E17-E32
120 VAC	1-2	1-2
125 VDC slow	2-3	open (not inserted)
125 VDC fast	3-4	open (not inserted)
48 VDC slow	2-3	2-4
48 VDC fast	3-4	2-4
24 VDC slow	2-3	2-3
24 VDC fast	3-4	2-3

NOTE: DI voltage of 120 VAC is permitted only in standard mode, do not use in sequence of event mode.

Jumpers (E33 to E35)

WARNING **Never operate any SOE module with the machine fault timer circuit disabled. Damage to equipment and injury to personnel could occur.**

The E33 and E34 jumpers are for ABB Automation development personnel only. They are factory set, ***do not*** change these jumper settings. The E33 jumper is used to disable the



machine fault timer circuit. If that function is disabled and a problem arises on the module, the module could generate wrong data to the controller. The E34 jumper is used to set module operation to IMSED01 or IMSET01 module (Table 3-11).

Table 3-11. Jumper E34 Positions

Position	Function
1 - 2	IMSET01 module
2 - 3	IMSED01 module

Table 3-12. Jumper E35 Positions

Position	Function
1 - 2	Diagnostic mode
2 - 3	Normal mode

The E35 jumper is used to change the module operating mode (Table 3-12). The module can operate either in normal mode or in diagnostic mode. If the E35 jumper is set in the diagnostic mode, the microprocessor runs a self-diagnostic program to check the status of the various module devices. Test running and result are displayed by a two-color LED.

The test result is positive if the LED executes the red and green flashing. Should this not occur, it means that the diagnostic program has detected one or more operating errors. In this case the failed module must be replaced.

Module Installation

NOTE: This installation section provides instructions pertaining to the physical installation of the SOE modules only. For complete cable and termination information, refer to the applicable termination unit instruction.

The IMSED01 or IMSED01modules insert into a standard module mounting unit and occupies one slot. To install:

1. Verify the slot assignment of the module.

WARNING	**Disconnect power before installing dipshunts on the MMU backplane. Failure to do so will result in contact with cabinet areas that could cause severe or fatal shock.**

2. Verify that a dipshunt is in the I/O expander bus socket on the module mounting unit backplane between the I/O module and controller.

3. Connect the hooded end of the termination cable (NKSD01 for IMSED01 module and NKST01 for IMSET01 module) from the termination unit to the module mounting unit backplane. To do this, insert the connector into the backplane slot in the same slot as the one assigned to the digital output module. The latches should snap securely into place.

4. Align the module with the guide rails in the module mounting unit. Gently slide the module in until the front panel is flush with the top and bottom of the module mounting unit frame.

5. Push and turn the two captive retaining screws on the module faceplate one half turn to the latched position. It is latched when the slots on the screws are vertical and the open ends face the center of the module.

Installing the module in a module mounting unit connects the card edge connector P1 to logic power necessary to operate the logic circuitry, and the card edge connector P2 to the expander bus. The card edge connector P3 is used to receive the IRIG-B and to transmit the sync time information through the NTST01 unit.

Installing the module in the module mounting unit connects the card edge connector P1 to logic power necessary to operate the logic circuitry, and the card edge connector P2 to the slave expander bus. The card edge connector P3 is used to acquire the 16 digital inputs from NTDI01 unit or NTU-7I1 unit, and the time signal from NTST01 unit for the IMSET01 module.

Cable Connections

Figure 3-4 shows cable connections and terminations related to IMSED01 and IMSET01 modules.

Termination Unit

Refer to Appendix B for the NTST01 termination unit configuration. Refer to Appendix C for the NTU-7I1 termination unit configuration.

Description

Harmony sequence of events (SOE) provides distributed event monitoring, recording, and reporting capabilities for the Symphony™ Enterprise Management and Control System. An SOE event is a transition of a digital signal from either on to off or from off to on. A series of SOE modules collect and time-stamp these digital transition events which are then made available to the system. Figure 1 shows the distributed sequence of events system architecture.

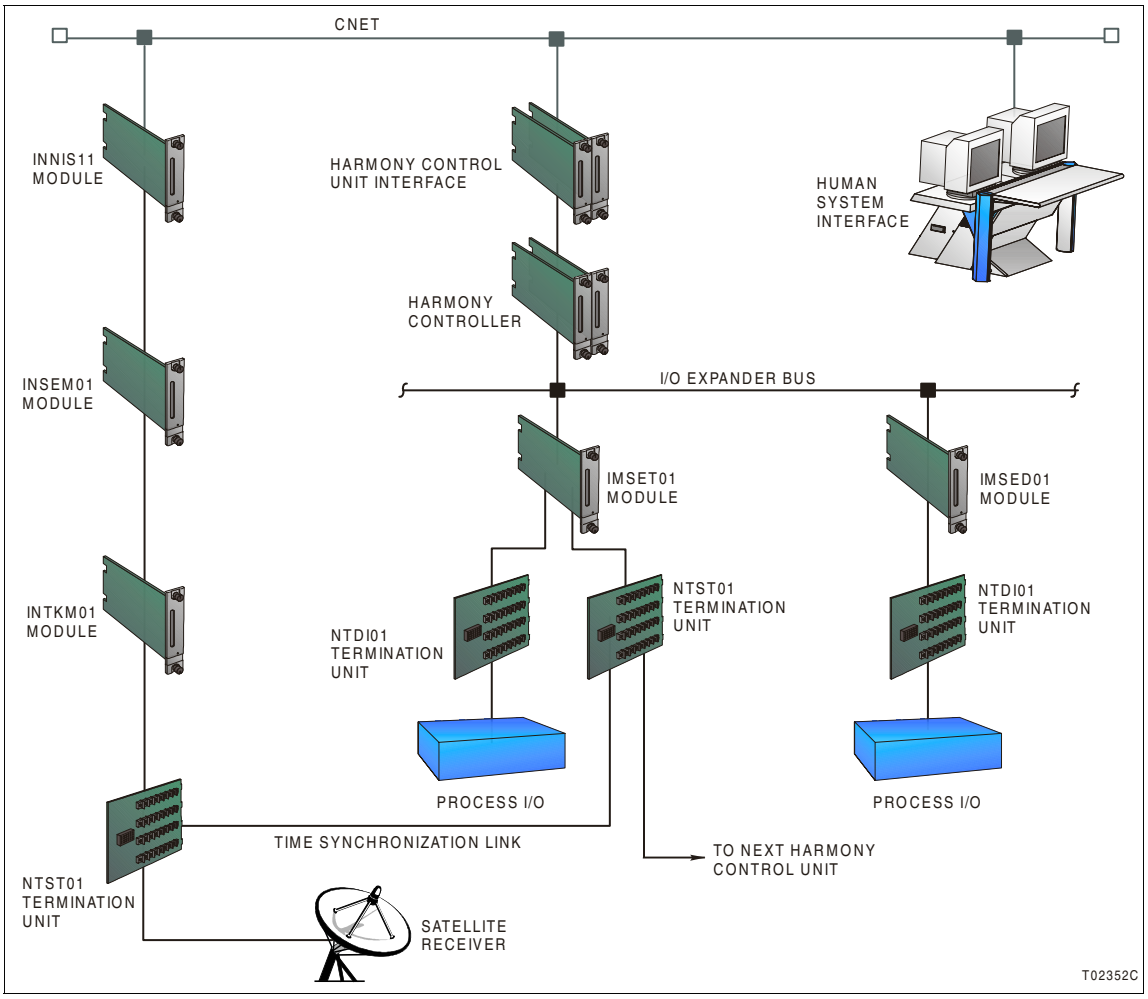


Figure 1. Distributed Sequence of Events System Architecture

An SOE module consists of a single printed circuit board that occupies one slot in a module mounting unit (MMU). In general, jumpers and switches on the printed circuit board and jumpers and dispshunts on the termination unit configure the module and its I/O channels. A cable connects the SOE module to its termination unit. The physical connection points for field wiring are on the termination unit.

Server Node

The INSOE01 Server Node consists of the INNIS11 Network Interface module, the INSEM01 Sequence of Events Master module, and the INTKM01 Time Keeper Master module.

INSEM01

The INSEM01 Sequence of Events Master module communicates with the INNIS11 Network Interface module and the INTKM01 Time Keeper Master module. The INNIS11 module is the front end for all Cnet (control network) communication interfaces and is the intelligent link between a node and Cnet. The INSEM01 module communicates directly with the INNIS11 module. The INSEM01 module is responsible for managing the distributed sequence of events system, which includes managing:

- 1,500 points coming from the SOE I/O modules in up to 1,000 Harmony control units (HCU).
- 256 complex triggers with 16 operands each.
- 3,000 simple triggers.

The INSEM01 module is configured using the following function codes:

- Executive block (FC 243).
- Addressing interface definition (FC 244).
- Input channel interface (FC 245).
- Trigger definition (FC 246).

The INSEM01 module monitors Harmony control units for data on an exception report basis, collects and sorts data it acquires, and provides SOE data to human system interfaces for report presentation after some predefined trigger condition occurs. Digital state transitions are collected at the HCU level by IMSED01 and INSET01 modules, then forwarded to the INSEM01 module. The INSEM01 module records the information and sorts it according to time in an internal database. When a trigger condition occurs, the human system interface is notified and data transfer occurs.

INTKM01

The INTKM01 Time Keeper Master module provides time information to the INSEM01 module and to the rest of the distributed SOE system through the time synchronization link. The INTKM01 module connects to an external receiver using IRIG-B time code link. The module transmits absolute time to the rest of the system using the RS-485 time synchronization link.

The INTKM01 module cable connects to an NTST01 termination unit. In this case, the termination unit provides the connection point for the external receiver signals and also the time synchronization link.

I/O Modules

IMSET01

The IMSET01 Sequence of Events Timing module processes up to 16 digital field inputs, and receives and decodes the time synchronization link information sent by the INTKM01 module for a Harmony controller. The controller utilizes function code 241 (DSOE data interface) to interface SOE data from the IMSET01 module to the INSEM01 module, and function code 242 (SOE digital event interface) to configure and access the IMSET01 module input channels. Each channel is optically isolated, and can be individually programmed for 24 VDC, 48 VDC, 125 VDC, and 120 VAC input.

The module communicates with its Harmony controller over I/O expander bus. Only one IMSET01 module can operate on an I/O expander bus segment. The module cable connects to NTST01 and NTDI01 termination units. The NTST01 unit provides for time synchronization link termination. The NTDI01 unit provides for field wiring termination.

IMSED01

The IMSED01 Sequence of Events Digital Input module is similar to the IMSET01 module except that it only processes up to 16 digital field inputs for the Harmony controller. It does not process time synchronization link information. The controller utilizes function code 242 (SOE digital event interface) to configure and access the IMSED01 module input channels. Up to 63 IMSED01 modules can operate on an I/O expander bus segment along with one IMSET01 module. The NTDI01 termination unit provides for field wiring termination.

Related Documents

Number	Document Title
WBPEEUS240011??	Harmony Rack Input/Output, Overview

Specifications

Property	Characteristic/Value
General	
Mounting	Occupies one slot in a standard module mounting unit.
Environmental	
Ambient temperature	0° to 70°C (32° to 158°F)
Relative humidity	5% to 95% up to 55°C (131°F) (noncondensing) 5% to 45% at 70°C (158°F) (noncondensing) Pollution degree: I
Altitude	Sea level to 3 km (1.86 mi)
Air quality	Noncorrosive
CE mark declaration	This product, when installed in a Symphony cabinet, complies with the following Directives/Standards for CE marking.
EMC96 Directive 89/336/EEC	EN50082-2 Generic Immunity Standard - Part 2: Industrial Environment EN50081-2 Generic Emission Standard - Part 2: Industrial Environment

Property	Characteristic/Value
CE mark declaration *(continued)*	
Low Voltage Directive 73/23/EEC	EN61010-1 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use - Part 1: General Requirements
Certifications	
Canadian Standards Association (CSA)	Certified for use as process control equipment in an ordinary (nonhazardous) location.
Factory Mutual (FM) (pending for INTKM01, IMSED01, IMSET01)	Approval for the following categories: Nonincendive for: Class I Division 2, Groups A,B,C,D Class II, Division 2, Groups F,G
INSEM01	
Power requirements	
Operating voltage	+ 5 VDC, ± 5% at 1.78 A typical
Power dissipation	8.9 W typical
Microprocessor	16 bits running at 10 MHz
Memory	2 Mb RAM 512 kb ROM 512 kb NVRAM
INTKM01	
Power requirements - Operating voltage	5 VDC, ± 5% at 300 mA typical
Microprocessor	16 bits running at 10 MHz
Communication	
Input	IRIG-B in DC level shift format (through NTST01)
Output	RS-485 time synchronization at 62.5 kbaud (through NTST01)
Output time accuracy	
Synchronization time	±10 µsec
Absolute time (to INSEM01)	±1 msec
NTST01	
Voltage isolation between synchro link and IRIG-B input	1,000 VAC at 50 Hz 2,000 V_P 1.2/50 usec pulse
Cable type	Twinaxial
Maximum cable distance between two HCU cabinets	4,000 m (13,123 ft)
Maximum length between INSOE01 server node and farthest HCU cabinet	40,000 m (131,233 ft)
IMSED01/IMSET01	
Power requirements	
Operating voltage	+5 VDC, ±5% at 350 mA typical
Microprocessor	16 bits running at 10 MHz
Memory	64 kb RAM 64 kb ROM
Communication (IMSET01 only)	RS-485 time synchronization
Digital inputs	
Voltage	24 VDC (±10%) 48 VDC (±10%) 125 VDC (±10%) 120 VAC (±10%) (only for system control logic)

Property	Characteristic/Value
Digital inputs *(continued)*	
Current (typical)	5 mA (24 VDC) 4 mA (48 VDC) 4 mA (125 VDC) 5 mA (120 VAC)
Turn on voltage (minimum)	
24 VDC	21.6 VDC
48 VDC	43.2 VDC
125 VDC	112.5 VDC
120 VAC	108 VAC
Turn off voltage (maximum)	
24 VDC	10 VDC
48 VDC	20 VDC
125 VDC	50 VDC
120 VAC	50 VAC
Maximum input current at minimum turn on	4 mA (21.6 VDC) 4.4 mA (43.2 VDC) 3.2 mA (112.5 VDC) 4 mA (108 VAC)
Maximum off-leakage current (for all DI voltages)	1.5 mA
Response time (typical)	
DC fast	1.1 msec
DC slow	18 msec
AC	5 msec after first positive half cycle
Isolation	1,000 VDC/V_{RMS} channel to system 350 VDC/V_{RMS} channel to channel
Surge protection	Meets IEEE-472-1974 surge withstand capability test

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE