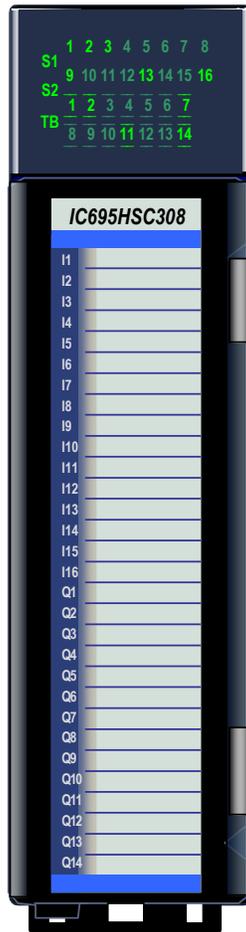# PACSystems™ RX3i

HIGH-SPEED COUNTER MODULES
(IC695HSC304 & IC695HSC308)

EMERSON

Warnings and Caution Notes as Used in this Publication

⚠ WARNING

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

⚠ CAUTION

Caution notices are used where equipment might be damaged if care is not taken.

Note: Notes merely call attention to information that is especially significant to understanding and operating the equipment.

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met during installation, operation, and maintenance. The information is supplied for informational purposes only, and Emerson makes no warranty as to the accuracy of the information included herein. Changes, modifications, and/or improvements to equipment and specifications are made periodically and these changes may or may not be reflected herein. It is understood that Emerson may make changes, modifications, or improvements to the equipment referenced herein or to the document itself at any time. This document is intended for trained personnel familiar with the Emerson products referenced herein.

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Introduction

The PACSystems RX3i High Speed Counter modules provide direct processing of rapid pulse signals up to 1.5 MHz for industrial control applications such as:

- Turbine flowmeter
- Meter proving
- Velocity measurement
- Material handling
- Motion control
- Process control

These modules can sense inputs, process input count information, and control outputs without CPU intervention.

Module IC695HSC304 provides: 8 high-speed inputs, 7 high-speed outputs, and 1 to 4 counters.

Module IC695HSC308 provides: 16 high-speed inputs, 14 high-speed outputs, and 1 to 8 counters.

Standard counter types A, B, C, D, E , Z, and a user-defined type can be combined on a module.

Module features include:

- Hot insertion/extraction
- Terminal Block insertion or removal detection
- Flash memory for future upgrades
- Module fault reporting
- Configurable I/O Interrupts

Select module parameters easily changed without re-configuration.

These modules must be located in an RX3i Universal Backplane.

High-Speed Counter modules can be used with a Box-style (IC694TBB032), Extended Box-style (IC694TBB132), Spring-style (IC694TBS032), or Extended Spring-style (IC694TBS132)) Terminal Block. Extended terminal blocks provide the extra shroud depth needed for shielded wiring. See the PACSystems RX3i System Manual, GFK-2314 revision B or later for more information about Terminal Blocks. Terminal Blocks are ordered separately.

RX3i High-speed Counter Modules can be hot-inserted and removed following the instructions in the PACSystems RX3i System Manual, GFK-2314. When the module is removed from the backplane or power-cycled, it stops counting and accumulated counts are lost.

Specifications: IC695HSC304 and IC695HSC308

Specification	Description
Number of Counter Channels	IC695HSC304: 4 counters (8 inputs and 7 outputs) IC695HSC308: 8 counters (16 inputs and 14 outputs)
High Speed Counter Types	Configurable as Type A, Type B, Type C, Type D, Type E, Type Z, and User-Defined.
Maximum Count Rates	1.5MHz with configurable input filtering, all counter types except 750kHz for Type C or User-Defined when using four counter outputs. (40 MHz internal oversampling). For A-Quad B count mode, 1.5MHz is the maximum overall count rate.
Counting Range	-2147483648 to 2147483647

Oscillator Accuracy over Operating Temperature Range	±100 PPM	
Oscillator Drift Over Time	±5 PPM/year maximum	
Backplane Power Requirements	IC695HSC304:	64mA maximum @ 5V 457 mA maximum @ 3.3V
	IC695HSC308	94mA maximum @ 5V 561mA maximum @ 3.3V
LEDs	Module Status (S1), Field Status (S2), Terminal Block (TB), plus LEDs to indicate state of each input and output point.	
Input Voltages	5VDC nominal: 4.7VDC to 5.5VDC 12 to 24VDC nominal: 10VDC to 26.4VDC	
Peak input voltage	35VDC	
Input Impedance	10K Ohms	
Output Voltage Range	4.7 to 40VDC, V_A/V_B input range	
Output Current Rating	1.5A maximum per channel, 10.5A maximum per module	
Thermal Derating	Number of output points on at the same time depends on ambient temperature and current per point. For module IC695HSC308, thermal derating also depends on distribution of output points on the module. See the charts that follow	
Output Control	Module outputs can be mapped to any number of counter setpoint outputs. Each counter controls up to 4 setpoints with "turn on" and "turn off" values. If multiple setpoint outputs are assigned to the same external module output, the signals are logically ORed. External outputs can optionally be configured for control through output scan bits from PLC memory.	
Surge Current per Point	4.5A < 450uS (Self-protected for overcurrent faults)	
Minimum Load Current	0mA (up to 150mA to satisfy open load detection)	
Maximum On State Voltage Drop/Output	0.35V @ 1.5A	
Maximum Off-State Leakage Current/Output	200µA	
Output Delay time	Off to On: 125uS @ 1.5A On to Off: 85uS @ 1.5A	
Current Limit	4.5A < 450uS, 1.5A continuous	
Reverse Polarity Protection	Outputs protected from reverse wiring	
Isolation, Field to Backplane (optical) and to frame ground.	250 VAC continuous; 2500 VAC for 1 minute	

For product standards and general specifications, refer to the *PACSystems RX3i System Manual*, GFK-2314.

For detailed information on High Speed Counter module installation, configuration, operation, and diagnostics, refer to PACSystems RX3i High-speed Counter Modules User's Manual, GFK-2441.

Output Points versus Temperature

The charts below show thermal deratings for modules IC695HSC304 and IC695HSC308 with maximum loads of 0.75A on each output.

For example, if five outputs are used on module IC695HSC304, at 60C the total current of all outputs would be 3.75 Amps. If smaller loads are used on the outputs, then more output channels can be used at a given temperature.

Figure 1: Output Point vs Temperature

IC695HSC304 with 0.75A Output Loads
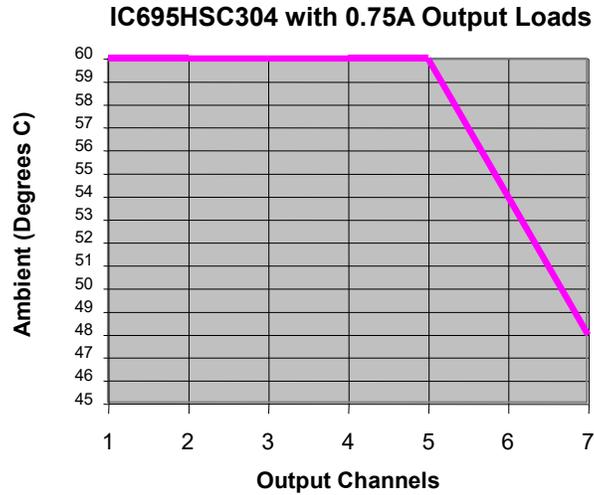
For module IC695HSC308, more output channels can be used at the same time at a given ambient temperature when outputs are evenly distributed into two groups. If outputs are either set up as one output group or unevenly distributed between two output groups, fewer output channels can be used for a given ambient temperature.

For example, if eight outputs are used on module IC695HSC308, and they are equally distributed between two output groups, the total current of all outputs at 60C can be up to 6 Amps. At a given ambient temperature, if smaller loads are used on the outputs, more output channels can be used.

Figure 2: Output Channel vs Temperature
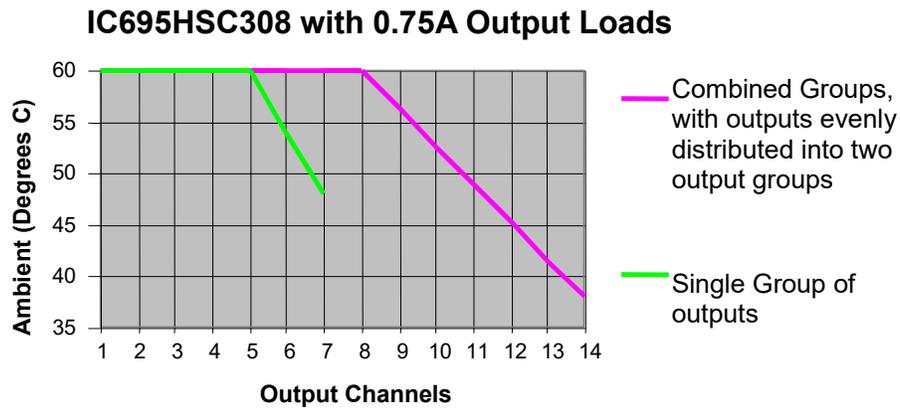
General Installation Requirements
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This product is intended for use with the RX3i system. Its components are considered open equipment [having live electrical parts that may be accessible to users] and must be installed in an ultimate enclosure that is manufactured to provide safety.

The High Speed Counters require an IP54 rated enclosure (IEC60529) providing at least a pollution degree 2 environment.

Installation in Hazardous Areas
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The system containing an RX3i High Speed Counter module must be mounted within an ultimate enclosure that can be accessed only by the use of a tool.

The following information is for products bearing the UL marking for Hazardous Locations or ATEX marking for explosive atmospheres:

⚠ **WARNING**

- EQUIPMENT LABELED WITH REFERENCE TO CLASS I, DIVISION 2, GROUPS A, B, C & D, OR ZONE 2 HAZARDOUS AREAS IS SUITABLE FOR USE IN CLASS I, DIVISION 2, GROUPS A, B, C, D, ZONE 2 OR NON-HAZARDOUS AREAS ONLY

- EXPLOSION HAZARD – SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2 OR ZONE 2;

- EXPLOSION HAZARD – WHEN IN HAZARDOUS AREAS, TURN OFF POWER BEFORE REPLACING OR WIRING MODULES; AND

- EXPLOSION HAZARD – DO NOT CONNECT OR DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NONHAZARDOUS.

Diagnostic and Status Data

For additional information, refer to "Module Data" in the PACSystems RX3i High-speed Counter Modules User's Manual, GFK-2441. Manuals and other user documentation are available for download on the Support website: https://www.emerson.com/Industrial-Automation-Controls/support.

Counter Status Data Format for Each Counter

For each Counter, the Counter Status data has the format shown below. Unused bits are set to 0. Status bits for Preloads (and others) are set if a source triggers an event.

Counter Reference	Data	Meaning
Address +0 bits	Strobe 1 Status	0 = Strobe Has Not Occurred 1 = Strobe Has Occurred
Address +1	Strobe 2 Status	
Address +2	Strobe 3 Status	
Address +3	Strobe 4 Status	
Address +4	Preload 1 Status	0 = Preload Has Not Occurred 1 = Preload Has Occurred
Address +5	Preload 2 Status	
Address +6	Preload 3 Status	
Address +7	Preload 4 Status	
Address +8	Setpoint 1 Compare Status	0 = Setpoint Is Off 1 = Setpoint Is On
Address +9	Setpoint 2 Compare Status	
Address +10	Setpoint 3 Compare Status	
Address +11	Setpoint 4 Compare Status	
Address +12 to +14	Reserved	Always 0
Address +15	Home Found	0 = Home Not Found, 1 = Home Found
Address +16	Setpoint 1 ON Interrupt Status	0 = Setpoint Interrupt Has Not Occurred 1 = Setpoint Interrupt Has Occurred
Address +17	Setpoint 1 OFF Interrupt Status	
Address +18	Setpoint 2 ON Interrupt Status	
Address +19	Setpoint 2 OFF Interrupt Status	
Address +20	Setpoint 3 ON Interrupt Status	
Address +21	Setpoint 3 OFF Interrupt Status	
Address +22	Setpoint 4 ON Interrupt Status	
Address +23	Setpoint 4 OFF Interrupt Status	
Address +24	Rate of Change	0 = Rate of Change Limit Not Exceeded 1 = Rate of Change Limit Exceeded
Address +25	Under Range	0 = Under Range Has Not Occurred 1 = Under Range Has Occurred
Address +26	Over Range	0 = Over Range Has Not Occurred 1 = Over Range Has Occurred
Address +27	Underflow	0 = Underflow Has Not Occurred 1 = Underflow Has Occurred
Address +28	Overflow	0 = Overflow Has Not Occurred 1 = Overflow Has Occurred

Counter Reference	Data	Meaning
Address +29	Encoder fault	0 = Encoder Fault Has Not Occurred 1 = Encoder Fault Has Occurred
Address +30 and +31	Reserved	Always 0

IO Status Data Format

The I/O Status Data has the format shown below. Reserved bits are always 0.

Reference Address	Data	Meaning
Address +0 to Address + 15	External Inputs IC695HSC304: 8 input bits + 8 reserved IC695HSC308: 16 input bits	0 = External Input is de-asserted (low logic) 1 = External Input is asserted (high logic)
Address +16 to Address + 31	External Input Interrupt Status IC695HSC304: 8 input bits + 8 reserved IC695HSC308: 16 input bits	0 = External Input Interrupt Has Not Been Triggered 1 = External Input Interrupt Has Been Triggered
Address +32 to Address +47	External Outputs [A] IC695HSC304: 7 input bits + 9 reserved IC695HSC308: 14 input bits +2 reserved	0 = External Output is de-asserted (low logic) 1 = External Output is asserted (high logic)
Address +48 to Address +63	Output Fault Status Data IC695HSC304: 7 input bits + 9 reserved IC695HSC308: 14 input bits + 2 reserved	0 = Circuit Fault Condition Not Detected 1 = Circuit Fault Condition Detected

[A]The Output Status bits are set regardless of the source (Module Control data or Setpoints).

Module Status Data

The Module Status data provides the CPU with basic diagnostic information about module operation. For both RX3i High-Speed Counter modules the length of this data is 32 bits. During module configuration, it can be assigned to any available references in %I, %M, or %T memory, or to discrete I/O variables.

Module Reference Address	Data	Meaning
Address +0 bits	Module Ready	0 = Module Not Ready 1 = Module Ready
Address +1	Terminal Block Present	0 = Terminal Block Not Present 1 = Terminal Block Present
Address +2	Field Power Lost	0 = Field Power Not Lost 1 = Field Power Lost
Address +3	Reserved	Always 0
Address +4	Command Error	0 = Command Error Has Not Occurred

		1 = Command Error Has Occurred
Address +5 to Address +15	Reserved	Always 0
Address +16 to Address +31	Error Description	See "Module Data" in the PACSystems RX3i High-speed Counter Modules User's Manual, GFK-2441

LEDs

Individual green LEDs indicate the ON/OFF status of the module's external input and output points. These LEDs are green when the corresponding points are on. They are off when the corresponding points are off. LED positions are illustrated below.

Figure 3: LED Display
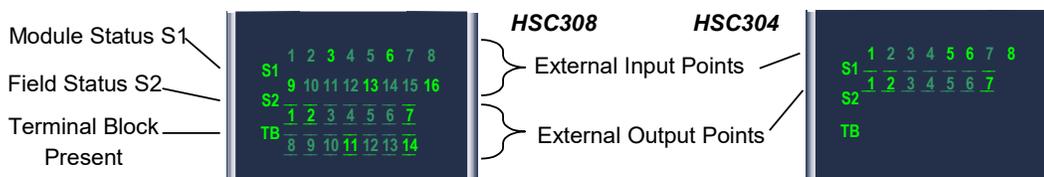
The Module Status (S1) LED indicates the status of the module. Solid green indicates that the module has been configured. Blinking green indicates no configuration. Blinking amber/yellow indicates a fatal module failure.

The Field Status (S2) LED is off if field power is not present. For module IC695HSC308, this LED is off unless power is present on BOTH V_A and V_B. Solid green indicates that field power is present and that no output circuit faults have been detected on circuits for which fault detection has been enabled in the configuration. If S2 is amber/yellow, field power is present but circuit faults exist for one or more outputs.

The module's red/green Terminal Block LED is green when the module's removable terminal block is locked in place. It is red when the terminal block is not locked. The module also sends an *Addition of Terminal Block* or *Loss of Terminal Block* message to the RX3i CPU to report the Terminal Block status.

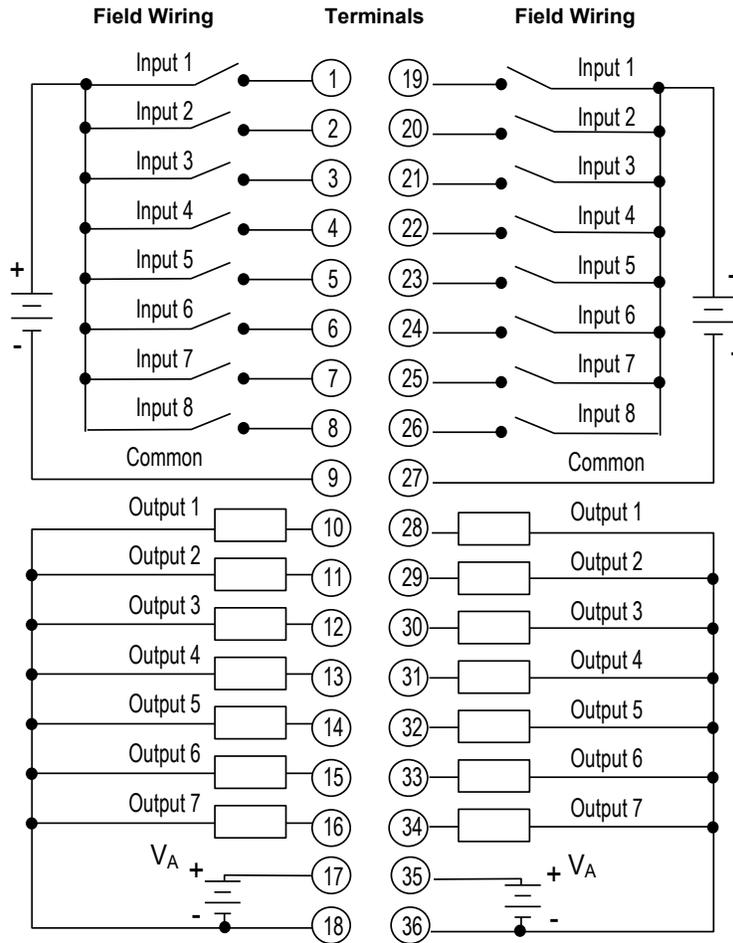During a firmware update, the S1, S2, and TB LEDs blink in a green/off pattern.

Field Wiring: IC695HSC304

Field wiring connections to the module are made to the removable terminal assembly, as described in the RX3i System Manual, GFK-2314. For this module, each row of terminals (eg: 1-18, 19-36) is internally connected. The dual connection points are for wiring convenience; the module cannot be wired for differential inputs. For installations that must meet radiated emissions requirements as in EN 55022, this module's high-speed connections must be made with double-shielded cable. The outside braided shield should be terminated at the entrance to the enclosure and not continue within the enclosure. Both ends of the shielded cable should be grounded. If low-frequency (power line) ground loops are an issue with the application, directly ground one end of the shielded cable and capacitively tie the other end of the shielded cable to ground with approximately 0.01 µf capacitance.

All outputs on module IC695HSC304 form a single output group.

| Connections	Terminals	Terminals	Connections
Input 1	1	19	Input 1
Input 2	2	20	Input 2
Input 3	3	21	Input 3
Input 4	4	22	Input 4
Input 5	5	23	Input 5
Input 6	6	24	Input 6
Input 7	7	25	Input 7
Input 8	8	26	Input 8
Common	9	27	Common
Output 1	10	28	Output 1
Output 2	11	29	Output 2
Output 3	12	30	Output 3
Output 4	13	31	Output 4
Output 5	14	32	Output 5
Output 6	15	33	Output 6
Output 7	16	34	Output 7
DC+ for Voltage Source A	17	35	DC+ for Voltage Source A
DC- for Voltage Source A	18	36	DC- for Voltage Source A

Figure 4: Firing Wiring - IC695HSC304

Field Wiring: IC965HSC308

Field wiring connections to the module are made to the removable terminal assembly, as described in the RX3i System Manual, GFK-2314. All 16 High-Speed Counter inputs on this module are positive logic (source) type. For installations that must meet radiated emissions requirements as in EN 55022, this module's high-speed connections must be made with double-shielded cable. The outside braided shield should be terminated at the entrance to the enclosure and not continue within the enclosure. Both ends of the shielded cable should be grounded. If low-frequency (power line) ground loops are an issue with the application, directly ground one end of the shielded cable and capacitively tie the other end of the shielded cable to ground with approximately $0.01\,\mu$f capacitance.

Connections	Terminals	Terminals	Connections
Input 1	1	19	Input 9
Input 2	2	20	Input 10
Input 3	3	21	Input 11
Input 4	4	22	Input 12
Input 5	5	23	Input 13
Input 6	6	24	Input 14
Input 7	7	25	Input 15

Connections	Terminals	Terminals	Connections
Input 8	8	26	Input 16
Common	9	27	Common
Output 1	10	28	Output 8
Output 2	11	29	Output 9
Output 3	12	30	Output 10
Output 4	13	31	Output 11
Output 5	14	32	Output 12
Output 6	15	33	Output 13
Output 7	16	34	Output 14
DC+ for Voltage Source A	17	35	DC+ for Voltage Source B
DC- for Voltage Source A	18	36	DC- for Voltage Source B

Figure 5: Field Wiring - IC695HSC308
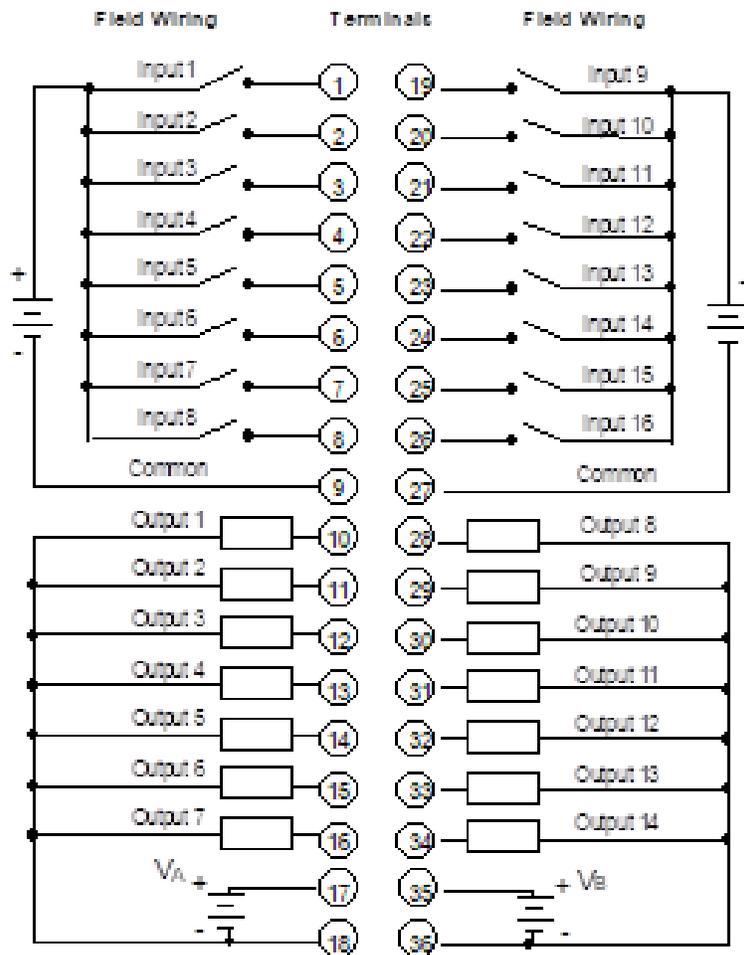
Inputs 1 to 16 form one isolated input group. Outputs 1 to 7 and 8 to 14 form two isolated output groups, each with its own voltage connections. Outputs should be evenly distributed between the two output groups, as discussed under "Output Points versus Temperature".

Release History

Release	Date	Comments
IC695HSC308-FA	Feb 2022	Hardware change to address a component obsolescence issue. No change in function, performance, or compatibility.
IC695HSC304-FA	Nov 2021	Hardware change to address a component obsolescence issue. No change in function, performance, or compatibility.
IC695HSC304-EA, IC695HSC308-EA IC695HSC304CA-EA, IC695HSC308CA-EA	Sep 2021	The product's labels have been updated to show compliance with new certifications. For updated certifications, please refer to https://emerson-mas.force.com/communities/en_US/Article/Certifications-and-Agency-Approvals-Landing-Page.
IC695HSC304-EA, IC695HSC308-EA	Sep 2019	Following Emerson's acquisition of this product, changes have been made to apply appropriate branding and registration of the product with required certification agencies. No changes to material, process, form, fit or functionality.
IC695HSC304-DA, IC695HSC308-DA	Mar 2012	Hardware change to address a component obsolesence issue. No change in functions, performance or compatibility.
IC695HSC304-CA, IC695HSC308-CA	Oct 2010	Label change only. No change in functions, performance or compatibility.
IC695HSC304-BA, IC695HSC308-BA	Jul 2009	Hardware update for improved manufacturability.
IC695HSC304-AA, IC695HSC308-AA	Jun 2007	Initial Release

Important Product Information for this Release

Compatibility

CPU	An RX3i CPU with firmware version 3.81 or later is required.
Programmer	Machine Edition **5.50 with Service Pack 2 SIM 3** or later is required for configuration.
Terminal blocks	IC694TBB032E, IC694TBB132E, IC694TBS032E, IC694TBS132E and later

⚠ CAUTION

- IC695HSC304-DA and IC694HSC308-DA and later are compatible only with terminal blocks IC694TBB032E, IC694TBB132E, IC694TBS032E, IC694TBS132E and later. Do not attempt to install earlier versions of these terminal blocks because damage to the module may result.

Restrictions and Open Issues in this Release

Description: In applications that include Timed Interrupts or I/O Interrupts, some IC693****** and IC694****** modules in a PACSystems RX3i main or expansion backplane may occasionally be lost during interrupt processing. A fault is logged in the fault table.

Recommendations: Minimize the time of individual interrupts and the elapsed time of overlapping interrupt blocks. Cycle power to a lost module to restore operation. If the module supports hot-swapping, that will also restore operation.

General Contact Information

Home link: http://www.emerson.com/industrial-automation-controls

Knowledge Base: https://www.emerson.com/industrial-automation-controls/support

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Any escalation request should be sent to: mas.sfdcescalation@emerson.com

Note: If the product is purchased through an Authorized Channel Partner, please contact the seller directly for any support.

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