GE
Automation & Controls
Programmable Control Products

PACSystems* Controllers Battery and Energy Pack Manual

GFK-2741H
August 2018

For Public Disclosure

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

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Chapter 1 Introduction

Many PACSystems CPUs require a battery, an energy pack or a supercapacitor array to back up volatile memory. This memory is separate from the non-volatile flash memory. This manual covers the technologies used to back up volatile memory on PACSystems RSTi-EP, RX3i and RX7i CPUs, and RXi Controllers. Other manuals and documents published by Automation & Controls may discuss memory retention technologies in passing. However, when it comes to energy sources used by PACSystems to back up volatile memory, this manual should be considered the definitive source.

Other methods of retaining volatile memory, such as real-time clock batteries, are not covered by this manual. Note, however, that RX7i CPUs use the same battery mechanism to back up the calendar clock and user memory.

This manual includes:

- A battery selection guide, information on battery life and usage, disposal instructions, and agency compliance
- RXi Energy Pack specifications, installation, operation, and service and maintenance.
- A list of CPUs which rely on supercapacitor technology.

1.1 Revisions in this Manual

Rev	Date	Description
H	**Aug-2018**	• Updated for CPL410.
G	May 2018	• Added data retention for various modules (Refer Section 2.2).
F	Mar-2018	• Added section on super capacitors. • Updated for CPE302, CPE100, CPE115. • Format update includes captions for figures and table of figures.
E	Dec-2016	• Addition of IC695ACC403.
D	Jun-2015	• Corrections & clarifications.
C	Mar-2015	• Addition of IC695ACC402.

1.2 PACSystems Documentation

PACSystems Manuals

PACSystems RX7i, RX3i and RSTi-EP CPU Reference Manual	GFK-2222

RSTi-EP Manuals

PACSystems RSTi-EP User's Manual*	GFK-2958
PACSystems RSTi-EP EPSCPE100 CPU Quick Start Guide*	GFK-3012
PACSystems RSTi-EP EPSCPE115 CPU Quick Start Guide*	GFK-3039

RX3i Manuals

PACSystems RX3i System Manual*	GFK-2314
PACSystems RX3i Energy Pack IC695ACC400 IPI*	GFK-2724
PACSystems RX3i Energy Pack IC695ACC402 Quick Start Guide*	GFK-2939
PACSystems RX3i Energy Pack IC695ACC403 Quick Start Guide*	GFK-3000

RX7i Manuals

PACSystems RX7i Installation Manual*	GFK-2223

RXi Manuals

PACSystems RXi Distributed IO Controller User's Manual*	GFK-2816

In addition to these manuals, datasheets and product update documents describe individual modules and product revisions. The most recent PACSystems documentation is available on the GE Automation & Controls support website http://geautomation.com/support.

Chapter 2 Batteries

2.1 Battery Selection

2.1.1 Conventional Coin-Cell Lithium Battery (IC698ACC701A, IC698ACC701B)

The conventional coin-cell lithium batteries are relatively small and have the advantage of fitting inside the battery compartment of compatible CPUs. The disadvantages are limited memory retention time, limited CPU compatibility, and no support for low battery detection.

2.1.2 Conventional Auxiliary Battery (IC693ACC302)

The conventional auxiliary battery should be used where maximum memory retention time is desired; no other battery has a better memory retention time. It is compatible with all PACSystems CPUs requiring a battery for memory retention. The disadvantages are that external mounting is required due to battery size and it does not support low battery detection.

2.1.3 Smart Coin-Cell Lithium Battery (IC698ACC701, Revision C and Later)

The smart coin-cell lithium battery is an improvement on the conventional coin-cell lithium battery and adds reliable low battery detection for compatible CPUs at the expense of reduced memory retention time. The improved battery is slightly larger, but is still able to fit into the battery compartment of compatible CPUs. The disadvantages are reduced memory retention time as compared to conventional batteries and limited CPU compatibility. For CPUs that do not support low battery detection, the conventional coin-cell lithium battery may be a better choice as it will provide longer retention time.

2.1.4 Smart Auxiliary Lithium Battery (IC695ACC302)

The smart auxiliary lithium battery is an improvement on the conventional auxiliary lithium battery and adds reliable low battery detection for compatible CPUs at the expense of a slight reduction in memory retention time. The disadvantage is that external mounting is required due to battery size. For CPUs that do not support low battery detection, the conventional auxiliary lithium battery may be a better choice as it will provide longer retention time.

2.1.5 Rechargeable Battery (IC690RBT001)

The rechargeable battery is designed for customer applications that use memory retention on a cyclical basis. Customers who shut down equipment and rely on battery backed memory on a daily or weekly basis should consider the use of this battery. It is compatible with all PACSystems CPUs requiring a battery for memory retention and is slightly larger than the auxiliary lithium batteries. The disadvantages are external mounting is required due to battery and charger size, no support for low battery detection, limited temperature range (0 to 50°C, 32 to 122 °F), and inability to charge in a hazardous location.

2.2 Battery Compatibility and Memory Retention

2.2.1 Estimated Battery Life at 20°C (68 °F) in CPUs hat are Always Powered Down

LIFE (Days)	IC698ACC701A IC698ACC701B	IC698ACC701C & later[2]	IC695ACC302[2]	IC693ACC302	IC690RBT001[3]
CPU[1]↓	TYPE OF BATTERY				
	Coin-Cell	Smart Coin-Cell	Smart Auxiliary	Auxiliary	Rechargeable
IC695CPU310[4]	40	33 (18+15)	200 (185+15)	200	90
IC695CPU315	-	-	23 (8+15)	30	14
IC695CPU320-Ex & Earlier	-	-	23[5]	30	14
IC695CPU320-Fx & later	-	-	23 (8+15)	30	14
IC695CRU320-Bx & earlier	-	-	23[5]	30	14
IC695CRU320-Cx & later	-	-	23 (8+15)	30	14
IC698CPE010	40	30 (15+15)	175 (160+15)	200	90
IC698CPE020	40	30 (15+15)	175 (160+15)	200	90
IC698CRE020	40	30 (15+15)	175 (160+15)	200	90
IC698CPE030-Hx & earlier	-	-	23[5]	30	14
IC698CPE030-Jx & later	-	-	23 (8+15)	30	14
IC698CRE030-Gx & earlier	-	-	23[5]	30	14
IC698CRE030-Hx & later	-	-	23 (8+15)	30	14
IC698CPE040-Hx & earlier	-	-	23[5]	30	14
IC698CPE040-Jx & later	-	-	23 (8+15)	30	14
IC698CRE040-Gx & earlier	-	-	23[5]	30	14
IC698CRE040-Hx & later	-	-	23 (8+15)	30	14

[1] IC695CPE302/CPE305, IC695CPE310 & IC695CPE330 do not appear in this table as they rely on energy packs.

[2] Retention time for smart batteries shows total retention time and sum of expected good and low battery operation. Refer to smart battery operation details.

[3] For the rechargeable battery, the backup time indicated is based on full charge.

[4] Discontinued products as of March 2015.

[5] For CPUs that do not support low battery detection, only the total retention time is provided.

2.2.2 Estimated Battery Life at 20°C (68 °F) in CPUs that are Never Powered Down

LIFE (DAYS)	Battery→	IC698ACC701A IC698ACC701B			IC698ACC701C & later revisions			IC695ACC302			IC693ACC302		
	Type →	Coin-Cell			Smart Coin-Cell			Smart Auxiliary			Auxiliary		
CPU ↓		Good >2.5V	Low <2.5V	Total	Good >2.5V	Low <2.5V	Total	Good >2.5V	Low <2.5V	Total	Good >2.5V	Low <2.5V	Total
IC695CPU310		-	-	1500	340	340	680	2555	-	2555	-	-	2555
IC695CPU315		-	-	-	-	-	-	2555	-	2555	-	-	2555
IC695CPU320-Ex and earlier		-	-	-	-	-	-	2555	-	2555	-	-	2555
IC695CPU320-Fx and later		-	-	-	-	-	-	2555	-	2555	-	-	2555
IC695CRU320-Bx and earlier IC695CRU320-Cx and later		-	-	-	-	-	-	2555	-	2555	-	-	2555
IC698CPE010		-	-	1500	340	340	680	2555	-	2555	-	-	2555
IC698CPE020		-	-	1500	340	340	680	2555	-	2555	-	-	2555
IC698CRE020		-	-	1500	340	340	680	2555	-	2555	-	-	2555
IC698CPE030-Hx and earlier IC698CPE030-Jx and later		-	-	-	-	-	-	2555	-	2555	-	-	2555
IC698CRE030-Gx and earlier		-	-	-	-	-	-	2555	-	2555	-	-	2555
IC698CRE030-Hx and later		-	-	-	-	-	-	2555	-	2555	-	-	2555
IC698CPE040-Hx and earlier		-	-	-	-	-	-	2555	-	2555	-	-	2555
IC698CPE040-Jx and later		-	-	-	-	-	-	2555	-	2555	-	-	2555
IC698CRE040-Gx and earlier		-	-	-	-	-	-	2555	-	2555	-	-	2555
IC698CRE040-Hx and later		-	-	-	-	-	-	2555	-	2555	-	-	2555

Note: 1. Due to the higher capacity of auxiliary and smart auxiliary battery packs, the estimated life of these battery packs approaches their shelf life (7years) in applications where the CPU is never powered down.

Note 2: Unscheduled power outages and temperature changes will reduce the number of days and should be considered when calculating the duration of the battery life.

2.2.3 Estimated Battery Life at 20°C (68 °F) in CPU's that are Powered Down Only During Weekends

LIFE (DAYS)	Battery→	IC698ACC701A IC698ACC701B			IC698ACC701C & later revisions			IC695ACC302			IC693ACC302		
	Type →	Coin-Cell			Smart Coin-Cell			Smart Auxiliary			Auxiliary		
CPU ↓		Good >2.5V	Low <2.5V	Total	Good >2.5V	Low <2.5V	Total	Good >2.5V	Low <2.5V	Total	Good >2.5V	Low <2.5V	Total
IC695CPU310		-	-	140	63	52	115	648	52	700	-	-	700
IC695CPU315		-	-	-	-	-	-	28	52	80	-	-	105
IC695CPU320-Ex and earlier		-	-	-	-	-	-	-	-	80	-	-	105
IC695CPU320-Fx and later		-	-	-	-	-	-	28	52	80	-	-	105
IC695CRU320-Bx and earlier		-	-	-	-	-	-	-	-	80	-	-	105
IC695CRU320-Cx and later		-	-	-	-	-	-	28	52	80	-	-	105
IC698CPE010		-	-	140	52	52	104	560	52	612	-	-	700
IC698CPE020		-	-	140	52	52	104	560	52	612	-	-	700
IC698CRE020		-	-	140	52	52	104	560	52	612	-	-	700
IC698CPE030-Hx and earlier		-	-	-	-	-	-	-	-	80	-	-	105
IC698CPE030-Jx and later		-	-	-	-	-	-	28	52	80			105
IC698CRE030-Gx and earlier		-	-	-	-	-	-	-	-	80	-	-	105
IC698CRE030-Hx and later		-	-	-	-	-	-	28	52	80	-	-	105
IC698CPE040-Hx and earlier		-	-	-	-	-	-	-	-	80	-	-	105
IC698CPE040-Jx and later		-	-	-	-	-	-	28	52	80	-	-	105
IC698CRE040-Gx and earlier		-	-	-	-	-	-	-	-	80	-	-	105
IC698CRE040-Hx and later		-	-	-	-	-	-	28	52	80	-	-	105

Note 1: Unscheduled power outages and temperature changes will reduce the number of days and should be considered when calculating the duration of the battery life.

Note 2: For CPUs that do not support low battery detection, only the total retention time is provided.

2.3 CPU Support of Low Battery Detection

For low battery detection to work reliably, a smart battery (IC695ACC302 and IC698ACC701 revision C or later) must be used with a CPU that supports low battery detection, such as the following:

- IC695CPU310 all hardware and firmware versions
- IC695CPU315 all hardware and firmware versions
- IC695CPU320-Fx and later hardware revisions with firmware revision 6.02 or later
- IC695CRU320-Cx and later hardware revisions with firmware revision 6.02 or later
- IC698CPE010 all hardware and firmware versions
- IC698CPE020 all hardware and firmware versions
- IC698CRE020 all hardware and firmware versions
- IC698CPE030-Jx and later hardware revisions with firmware revision 6.75 or later
- IC698CPE040-Jx and later hardware revisions with firmware revision 6.75 or later
- IC698CRE030-Hx and later hardware revisions with firmware revision 6.75 or later
- IC698CRE040-Hx and later hardware revisions with firmware revision 6.75 or later

The use of a non-smart battery or a CPU not on this list will result in the low battery detection bits being unreliable.

Low/failed battery conditions are indicated by CPU LED operation and %S status bits. For details, refer to *Diagnostics* in the *PACSystems RX7i & RX3i CPU Reference Manual*, GFK-2222.

2.4 Smart Batteries

2.4.1 Smart Battery Operation

The battery output voltage is > 2.5 V when the battery is operating in its good state. At the end of the battery good period, the battery output drops to < 2.5 V for the battery low state. The period for the battery low state is 15 days for all CPU models. Once battery output voltage drops to < 2.5V, compatible PACSystems CPUs detect this as a battery low condition; a Low Battery fault is logged in the Controller fault table and the red Battery LED on the CPU starts blinking.

Once the low battery state is active, the user has 15 days of accumulative battery backed energy left for CPU RAM retention during power loss. Since the low battery period may start while the PLC is powered down and faults cannot be logged in this state, the low battery fault date is unlikely to indicate the starting point of the 15-day count down. System power shutdowns should not exceed 15 days as the battery voltage may drop to 0 V, resulting in the loss of CPU RAM memory contents.

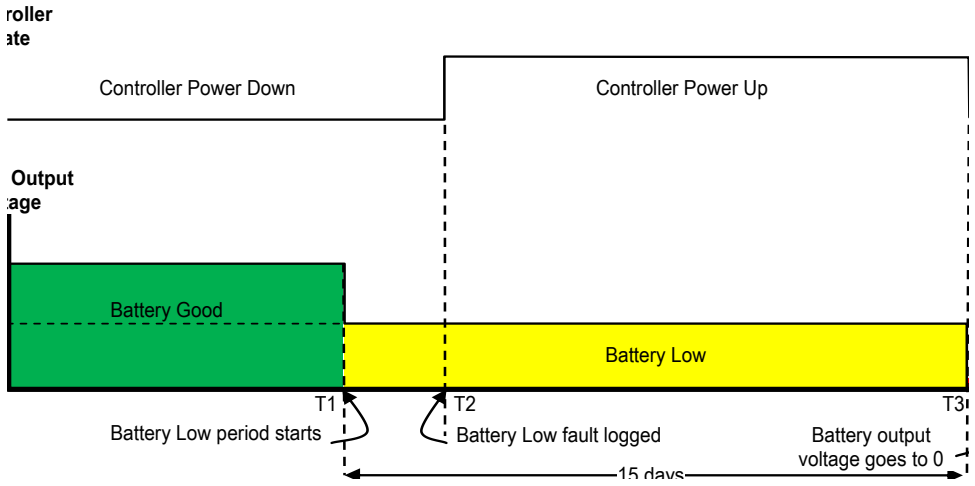

Figure 1: Low Battery Countdown Example

The Battery Low period of 15 days starts at Point T1, but the low battery fault is logged at Point T2, when the controller is powered ON. The user should be aware that the Low Battery fault timestamp does not indicate the start of the 15-day Battery Low period.

2.4.2 IC695ACC302

The IC695ACC302 Auxiliary Smart Battery module is an enhanced version of IC693ACC302. In addition to providing an extended backup time for volatile memory on PACSystems CPUs compared to the standard memory backup battery (IC698ACC701), the smart battery module has a battery monitoring circuit that enables the user to detect the low battery state before it is completely drained. Once an IC695ACC302 Auxiliary Smart Battery module is connected to a CPU model, it must be used with only that specific CPU model for the remainder of its life to insure proper *Low Battery* indication.

Specifications

Parameter	***Specification***
Battery capacity	15.0 amp-hours
Lithium content	5.1 grams (3 cells at 1.7 grams/cell)
Physical dimensions	145.1 long x 65.0 wide x 39.9 high mm (5.713 long x 2.559” wide x 1.571” high in)
Weight	224 grams
Case material	Black, flame-retardant ABS plastic
Connection	60cm (2ft) twisted red/black 22 AWG (0.326mm^2, 0.011 ft^2) cable with female two-pin connector compatible with the battery connector on PAC Systems CPUs.
Operating temperature range	0 to +60°C (32 to 140 °F)
Nominal shelf life	7 years at 20°C (68 °F) without the enabling adapter cable attached

Battery Mounting

With power removed from the equipment, drill four #29 (3.45mm/0.136”) holes in the panel mounting surface, and tap for #8-32 threads, according to the hole pattern shown in the following figure. Use care to keep metal chips from falling into other equipment. Securely attach the Auxiliary Battery Module to the panel mounting surface using four #8-32 x ½” (M4x0.7x12mm) flat head machine screws.

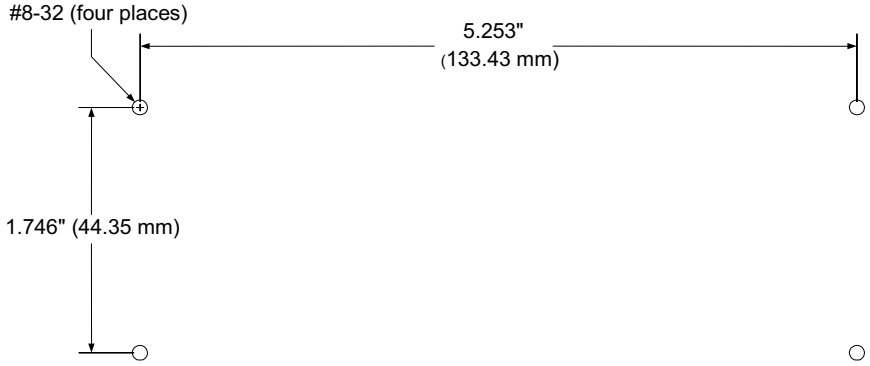

Figure 2: Mounting Diagram for IC695ACC302 Auxiliary Battery Module

2.4.3 IC698ACC701C (& Later Revisions)

The IC698ACC701C smart coin cell battery pack is an enhanced version of the IC698ACC701B battery pack. In addition to providing volatile memory backup for PACSystems CPUs, the smart coin cell battery pack has a battery monitoring circuit that enables the user to detect the low battery state before it is completely drained. Once an IC698ACC701C smart coin cell battery pack is connected to a CPU model, it must be used with only that specific CPU model for the remainder of its life to insure proper *Low Battery* indication

Specifications

Parameter	***Specification***
Battery capacity	3.0 amp-hours
Lithium content	0.87 grams (3 cells at 0.29grams/cell)
Physical dimensions	76.2 long x 26.92 wide x 12.25 high mm (3” long x 1.059” wide x 0.4822” high)
Weight	29.94 grams
Connection	60cm (2 ft) twisted red/black 22 AWG (0.326mm^2) cable with female two-pin connector compatible with the battery connector on PAC Systems CPUs.
Operating temperature range	0 to +60°C (32 to 140°F)
Nominal shelf life	5 years at 20°C (68°F) without the enabling adapter cable attached

2.5 Rechargeable Batteries

2.5.1 IC690RBT001

The IC690RBT001 Rechargeable Battery provides an extended backup time for volatile memory on PACSystems CPUs compared to that of the standard memory backup battery (IC698ACC701).

Specifications

Parameter	***Specification***
Battery capacity	7.0 amp-hours
Battery construction	3-cell, nickel-metal hydride
Lithium content	None
Physical dimensions	175.3 x 80.0 x 46.2mm (6.902” long x 3.150” wide x 1.819” high) ()
Case material	Black, flame-retardant ABS plastic
Connection	60cm (2ft) twisted red/black 22 AWG (0.326mm^2) cable with female two-pin connector compatible with the battery connector on PACSystems CPUs.
Operating temperature range	0 to +50°C (32 to 122°F)
Nominal shelf life	3 years at 20°C (68°F)
Operating life @ 50°C	12 months or 60 charge-discharge cycles
Compatible Charger	IC690CRG001

Nominal Battery Life

The nominal battery life at 50°C (122 °F) is 12 months or 60 charge/discharge cycles. Battery life is negatively affected by higher temperatures, and can be significantly improved by operating closer to room temperature (25°C, 77 °F). When deciding where to mount the battery, consider how the mounting location will affect the battery temperature. For most industrial installations, mounting the battery below the PLC rack will result in a temperature closer to 25°C (77 °F) and will help improve battery life. Do not operate the battery at less than 0°C (32 °F) or greater than 50°C (122 °F).

The battery will continue to operate after 12 months or 60 charge/discharge cycles; however, the battery capacity will decline and the times listed in the *Battery Compatibility and Memory Retention Time in Days at 20°C (68 °F)* chart will no longer be valid.

Battery Mounting

With power removed from the equipment, drill four #29 (0.136") (3.45mm) holes in the panel mounting surface, and tap for #8-32 threads, according to the hole pattern shown in the following figure. Use care to keep metal chips from falling into other equipment. Securely attach the rechargeable battery module to the panel mounting surface using four #8-32 x ½" (M4x0.7x12mm) flat head machine screws.

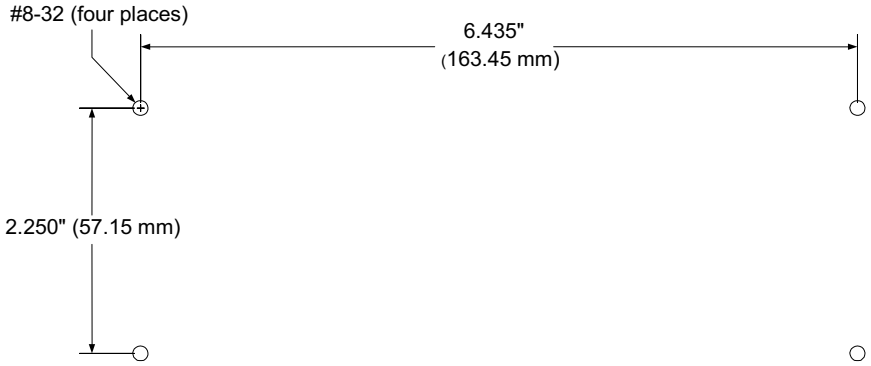

Figure 3: Mounting Diagram for IC690RBT001 Rechargeable Battery

CPU Battery Low Indication

The rechargeable battery will not reliably provide the CPU with a battery low indication. User logic should not rely on any of the battery status bits when using this battery.

Diagnostics

This unit is not user-serviceable. The IC690RBT001 contains a self-resetting thermal protection device that disconnects the battery if the cell temperature exceeds 90°C (194 °F).

2.5.2 IC690CRG001

The IC690CGR001 Battery Charger is intended for use only with the IC690RBT001 rechargeable battery.

Specifications

Parameter	***Specification***
Input Power	100–240Vac, 50–60Hz, 0.35A maximum
Maximum output power	8W
Physical dimensions	90 x 45 x 32mm (3.55” long x 1.77” wide x 1.26” high)
Weight	115 grams
Operating Temperature range	0 to +60°C (32 to 140°F)

Operation

Charging begins when a battery pack is connected to the charger. The LED is initially orange, and changes to red when the fast charge starts. When the cells are fully charged, the charger goes into top-off charge mode before switching to trickle charge mode. During the top-off charge, the LED is green with short, intermittent orange flashes. When the top-off charge is complete, the charger goes into trickle charge mode, and the LED color changes to green.

If the charger detects a fault, the charger will stop the fast charge current and switch to trickle charge mode. The LED will then indicate *error* by blinking green and red. The fault condition can be caused by the battery pack, wiring, or the charger.

If input power is turned off, the charger will reset. The charger starts a new charge cycle when the power is turned back on.

Indicators

LED	***Mode***
Orange	No battery / Initialization
Red	Fast charge
Green/Orange	Top-off charge
Green	Trickle charge (fully charged)
Red/Green	Error

Charger Connection

Warning

Explosion Hazard - Recharge battery only in a non-hazardous location. Do not connect or disconnect the battery charger unless the area is known to be non-hazardous. The IC690CRG001 battery charger is not certified for use in hazardous locations.

Insert the charging jack into the threaded connector on the side of the battery and hand-tighten the screw lock to secure it.

2.6 Legacy Batteries

2.6.1 IC698ACC701A and IC698ACC701B

The IC698ACC701B (and earlier revisions) coin cell battery pack is a simple battery pack that provides backup for volatile memory on PACSystems CPUs. The chemistry used in these batteries does not support the low-battery detection feature. Due to the limited capacity of this battery pack, it is not compatible with all PACSystems CPUs. Refer to the *Battery Compatibility and Memory Retention Time in days at 20°C (68 °F)* chart for CPU compatibility information.

Specifications

Parameter	***Specification***
Battery capacity	3.0 amp-hours
Lithium (Li) content	0.87 grams (3 cells @ 0.29grams/cell)
Physical dimensions	76.2 x 26.92 x 12.25mm (3” long x 1.059” wide x 0.4822” high)
Weight	26.5 grams
Connection	60cm (2ft) twisted red/black 22 AWG (0.326mm^2) cable with female two-pin connector compatible with the battery connector on PAC Systems CPUs.
Operating temperature range	0 to +60°C (32 to 140°F)
Nominal shelf life	5 years at 20°C (68°F)

CPU Battery Low Indication

The legacy batteries will not reliably provide the CPU with a battery low indication. User logic should not rely on any of the battery status bits when using these batteries.

2.6.2 IC693ACC302

The IC693ACC302 Auxiliary Battery module provides an extended backup time for volatile memory on PACSystems CPUs compared to that of the standard memory backup battery (IC698ACC701).

Specifications

Parameter	***Specification***
Battery capacity	15.0 amp-hours
Lithium content	5.1 grams (3 cells @ 1.7 grams/cell)
Physical dimensions	145.1 x 65.0 x 39.9 mm (5.713” long x 2.559” wide x 1.571” high)
Weight	232 grams
Case material	Black, flame-retardant ABS plastic
Connection	60cm (2ft) twisted red/black 22 AWG (0.326mm^2) cable with female two-pin connector compatible with the battery connector on PAC Systems CPUs.
Operating temperature range	0 to +60°C
Nominal shelf life	7 years @ 20°C

Battery Mounting

With power removed from the equipment, drill four #29 (0.136”) (3.45mm) holes in the panel mounting surface, and tap for #8-32 threads, according to the hole pattern shown in the following figure. Use care to keep metal chips from falling into other equipment. Securely attach the Auxiliary Battery module to the panel mounting surface using four #8-32 x ½” (M4x0.7x12mm) flat head machine screws.

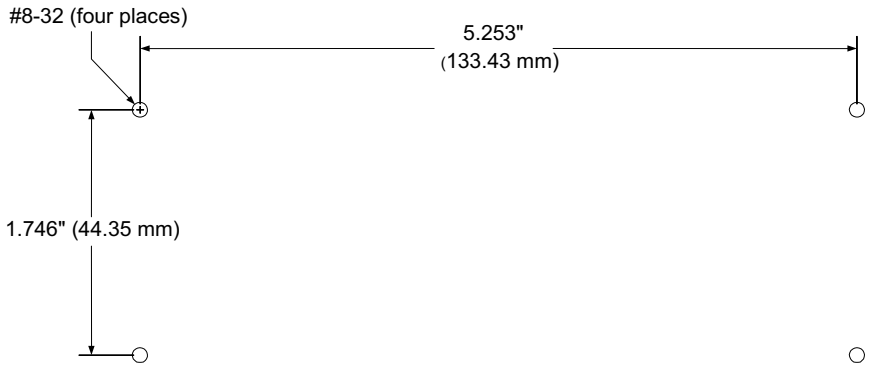

Figure 4: Mounting Diagram for IC693ACC302 Auxiliary Battery Module

CPU Battery Low Indication

The IC693ACC302 Auxiliary Battery module will not reliably provide the CPU with a battery low indication. User logic should not rely on any of the battery status bits when using this battery.

Diagnostics

This unit is not user-serviceable. The unit has a built-in 1-Amp fuse that will open if the unit is subjected to a short circuit or severe overload condition. This fuse is sealed inside the battery pack and is not replaceable.

To test the unit if you suspect that the fuse has opened, turn off PLC power, unplug the battery unit, and carefully check the battery cable connector pins for presence of voltage with a volt meter. If voltage is present, the fuse is not open. If no voltage is present, the internal fuse has probably opened and the unit will have to be replaced. Only perform this check in a non-hazardous environment.

2.7 Battery Installation Instructions

Warning

Explosion Hazard - Do not add, remove, replace or recharge a battery unless the area is known to be non-hazardous.

2.7.1 Installation in Hazardous Areas

Install the CPU in a system that is located ***outside*** the hazardous area.

Apply power to the system and install the battery.

Power the system down.

With the battery still attached, remove the CPU and install it in the system that is in the hazardous area.

2.7.2 Preparation and Mounting

If installing an auxiliary battery (IC693ACC302 or IC695ACC302), securely mount the battery to the panel mounting surface before attempting to connect the battery to the CPU. For mounting instructions, refer to the previous sections in this chapter.

If using a smart battery (IC698ACC701C or later, or IC695ACC302), connect the enabling cable to the battery using the 4-pin connectors.

Note: Disconnect the enabling adapter cable from the battery pack when the battery is not attached to a CPU (when the enabling adapter cable is connected, the battery drains to support the smart circuitry, even if it is not attached to the CPU).

If using the rechargeable battery (IC690RBT001), securely mount the battery and its charger (IC690CRG001) to the panel mounting surface before attempting to connect the battery to the CPU. For mounting instructions, refer to the previous sections in this chapter. Insert the charging jack into the threaded connector on the side of the battery and hand-tighten the screw lock to secure it.

2.7.3 Installation and Replacement

1. Access the battery compartment on the CPU by opening the door (RX3i) or removing the battery cover (RX7i) - (refer to the following battery installation figures).
2. Turn on power and wait for the CPU to complete its initialization. Initialization is complete when the OK LED on the CPU remains on.
3. Connect the battery to either of the battery connectors on the CPU. If replacing an existing battery, connect the new battery to the other connector before disconnecting the old battery (be careful to not disconnect the old battery until the new battery is connected). Properly discard the old battery per disposal instructions (Refer to the section *Safe Handling & Disposal*).
4. For Coin Cell batteries, secure the battery in the compartment and close the compartment door (RX3i) or install the battery cover (RX7i).
5. For auxiliary batteries and the rechargeable battery, route the battery cable through the notch in the base of the battery compartment (RX3i) or the slot in the bottom of the battery cover (RX7i) and close the compartment door (RX3i) or install the battery cover (RX7i).

Be careful not to pinch the battery cable when closing the battery compartment cover.

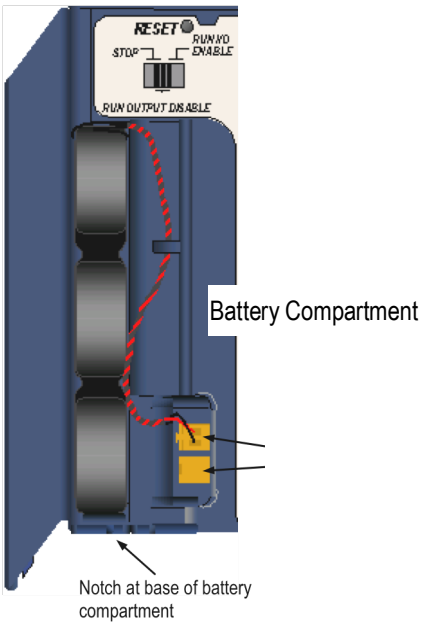

Figure 5: RX3i Battery Installation

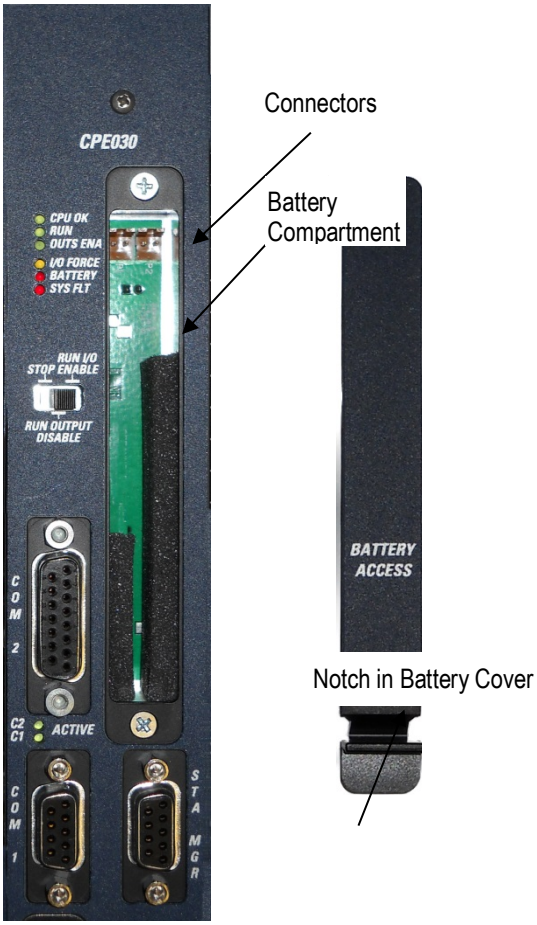

Figure 6:RX7i Battery Installation

Note: An earlier version RX7i CPU may not have a slot in its battery door. For these CPUs, replace the door (supplied with the IC698ACC701 replacement battery).

2.8 Date Code & Shelf Life

2.8.1 Date Code

The date code is located on the product label on the front of the battery. The date code consists of four digits, such as 1234. The first two digits represent the year of manufacture in the 21st century; such as 12 for 2012. The last two digits indicate the fiscal week of manufacture; for example, 34 stands for fiscal week 34.

2.8.2 Shelf Life

Unused battery packs that have exceeded their shelf life should not be used and should be discarded according to the instructions provided in the section *Safe Handling & Disposal*.

Battery	***Catalog#***	***Shelf-Life***
Smart Auxiliary	IC695ACC302	7 years at 20°C (68 °F) without the enabling adapter cable attached
Legacy Coin Cell	IC698ACC701 A & B	5 years @ 20°C (68 °F)
Smart Coin Cell	IC698ACC701 C & later	5 years @ 20°C (68 °F) without the enabling adapter cable attached
Legacy Auxiliary	IC693ACC302	7 years @ 20°C (68 °F)
Rechargeable	IC690RBT001	3 years @ 20°C (68 °F)

2.9 Safe Handling & Disposal

Warning

Batteries may present a risk of fire, explosion, or chemical burn if mistreated. Do not crush, disassemble, short-circuit, or dispose of in fire.

Use of batteries not specified for use with PACSystems products may present a risk of fire or explosion. Refer to Battery Compatibility and Memory Retention (Section 2.2) for details on PACSystem battery Compatibility.

Warning

Lithium Battery Warning

Do not recharge, disassemble, heat or incinerate lithium batteries.

Dispose of lithium batteries in accordance with federal, state, and local regulations. Be sure to consult with the appropriate regulatory agencies before disposing of batteries.

2.10 Agency Certifications

To maintain agency certification, batteries must be mounted within a protective enclosure providing a pollution degree 2 environment, IP54 ingress protection, and mechanical impact strength equal to or greater than 3.5 Joules.

Note: Batteries that mount within the housing of a module only need to adhere to the installation requirements of that module.

2.10.1 Batteries

These products are UL Listed Accessories for the PACSystems RX3i and RX7i family of PLCs and have been evaluated to the following standards for use in ordinary and hazardous areas:

- UL 2054
- ANSI/ISA 12.12.0.1 (UL File E157515)
- In addition, IC690RBT001 has been evaluated to IEC62133

2.10.2 Charger: IC690CRG001

This product is a UL Recognized Component and has been evaluated to the following standard for use in ordinary location:

UL 60601-1 (UL file E208921)

Note: Charger has not been evaluated for use in hazardous areas and therefore should not be used in that environment.

Chapter 3 Energy Packs

An Energy Pack is used in conjunction with a Controller to preserve user memory in the Controller during power fluctuations or outages.

If system power is lost, the Energy Pack maintains power long enough for a Controller to write its user memory contents to non-volatile memory. When system power is restored, the user memory is restored if the Controller is configured to power up from RAM.

3.1 Energy Pack Compatibility

The correct Energy Pack must be used with the corresponding controller. Do not attempt combinations except those shown as "compatible" in the table below:

Energy Pack Cap Pack Controller	***ICRXIACCEPK01A ICRXIACCCPK01A***	***IC695ACC400 IC695ACC400***	***IC695ACC402 IC695ACC412***	***IC695ACC403 IC695ACC413***
ICRXICTL000	Compatible	Incompatible	Incompatible	Incompatible
IC695CPE302 IC695CPE305 IC695CPE310	Incompatible	Compatible	Incompatible	Incompatible
IC695CPE330	Incompatible	Incompatible	Compatible	Incompatible
IC695CPE400 IC695CPL410	Incompatible	Incompatible	Incompatible	Compatible

3.2 PACSystems RXi Energy Pack (ICRXIACCEPK01A)

3.2.1 Specifications

ICRXIACCEPK01A	Energy Pack. Includes base, Cap Pack module and Energy Pack to Controller cable
ICRXIACCCPK01A	Replacement Cap Pack module
ICRXIACCCBL01A	Replacement 0.3m (12”) Energy Pack to Controller cable

Functional Specifications

Dimensions	114.05 × 77.47 × 63.75 mm (4.49” × 3.05” × 2.51”)
Input voltage range	20–30 Vdc
Input power, maximum	36 W + connected device power requirement
Output voltage range	18–30Vdc
Output power maximum	45 W
Output current maximum	2.25 A
Backup trip voltage	19 Vdc ±4% (18.24V to 19.76V)
Capacitor Pack life expectancy	5 years

Environmental Specifications

The Energy Pack shall be installed in a location that is not exposed to corrosive gases or liquids, rain, or direct sunlight, and that meets the environmental specifications listed below.

Operating Temperature, surrounding air	-25˚C to 60˚C
Storage Temperature	-40°C to +85°C (-40°F to 185°F)
Humidity	5% to 95%, non-condensing
Environment	*Restricted Access Area* and *Pollution Degree 2 environment* as defined below.

3.2.2 General Installation Environments

In order to maintain the *Agency Certifications* listed below, installation must comply with the following requirements.

Warning

The Energy Pack must be installed in a Restricted Access Area, as defined by:

- Access can only be gained by service persons or by users who have been instructed about the reasons for the restrictions applied to the location and about any precautions that shall be taken; and
- Access is using a tool or lock and key, or other means of security, and is controlled by the authority responsible for the location.

The Energy Pack must be installed in a ***Pollution Degree 2 environment*** as defined by:

- Pollution Degree 2 applies where there is only non-conductive pollution that might temporarily become conductive due to occasional condensation.

3.2.3 Industrial Environment Installations

For use in industrial environments this product is 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. At a minimum, the enclosure shall provide a degree of protection against solid objects up to 12mm (0.5") (e.g. fingers). This equates to a NEMA/UL Type 1 enclosure or an IP20 rating (IEC60529) providing at least a pollution degree 2 environment.

3.2.4 Hardware Installation

The Energy Pack can be mounted on a standard EN50022 DIN rail or an equipment panel. It is designed to be mounted adjacent to the Controller and connected to the Controller using the provided 12" (0.3m) cable (ICRXIACCCBL01A) or a user-supplied cable.

Refer to section on *Grounding* for important grounding instructions.

Mounting the Energy Pack on a DIN Rail

The Energy Pack snaps easily onto the DIN rail. No tools are required.

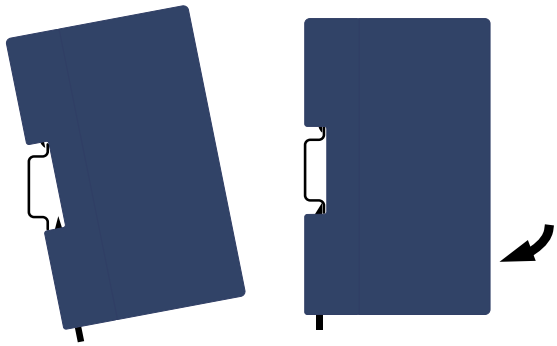

Figure 7: Mount Energy Pack on DIN Rail

Note: To remove the Energy Pack from the DIN rail, use a small flat-blade screwdriver to pull down on the tab on the bottom of the Energy Pack and then lift the module off the DIN rail.

Mounting the Energy Pack Directly on a Panel

Caution

Over tightening the mounting screws could crack the plastic housing.

Heat dissipation: When mounting the Energy Pack on a panel, allow a minimum clearance of 25.4mm (1”) on the four sides of the unit (right, left, top and the bottom).

Recommended fasteners: Four M4-0.7 machine screws with minimum length of 25mm (or 8-32, 1” min. length) and nuts.

1. Drill four mounting holes using the spacing shown in the following drawing.
2. Use the machine screws and nuts to attach the Energy Pack to the panel.

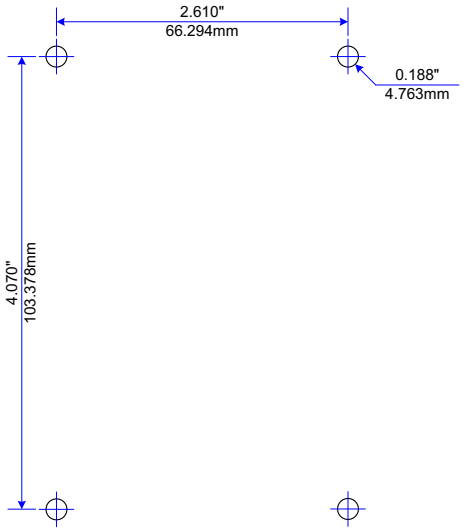

Figure 8: Drilling Pattern for Direct Panel Mounting

3.2.5 Cable Connections

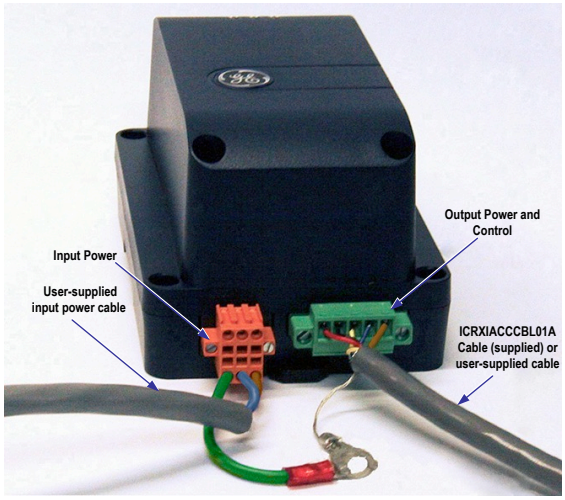

Figure 9: Input Power and Output Power/Control Connections

Connecting Input Power to the Energy Pack

You will need:

- A power cord with 18 AWG (0.82mm^2) copper wires
- An 18 AWG (0.82mm^2) copper wire for frame ground
- An input power terminal block – provided (Weidmüller part number 1748010000)
- A small flat-head screwdriver (such as a 1.4 mm jeweler's screwdriver)
- A 24Vdc, 72 W minimum power supply, that must provide reliable grounding and Secondary Extra Low Voltage (SELV) output or other form of isolating secondary circuit.

Power Supply Requirements

When the Energy Pack is powered by an LPS Class 2, or a Limited Voltage/Current power source, no additional over-current protection is required. Otherwise, power supply branch circuit overcurrent protection of no more than 20 A with a readily accessible disconnect is required, along with supplementary protection ranging from 4 to 7 amps on the output of the power supply.

1. Using the power cord, connect the power supply output to the input power terminal block of the Energy Pack.

To insert the wires in the power terminal block connector, you may need to use the small screwdriver to release the spring clamp on the terminal block.

Recommended wire stripping length is 7mm (0.28 in).

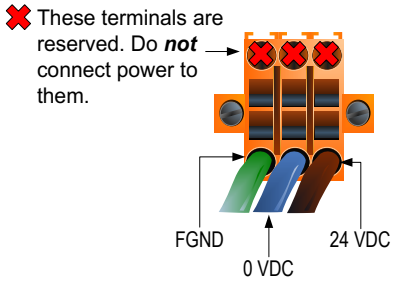

Figure 10: Power Terminal Block Wiring

2. Insert the plug into the Input Power connector of the Energy Pack and securely tighten the attaching screws.

Connecting the Energy Pack to the Controller

Note: Do not attach the Energy Pack to the Controller without first updating the Controller to the minimum required firmware version, as specified in the Controller documentation.

With power to the system turned off, use the supplied cable or a user-supplied cable (1 m maximum length) to connect the output of the Energy Pack (green connector) to the 24Vdc input on the Controller (orange connector).

3.2.6 Grounding

Proper grounding of this device is essential. All ground wires must be as short as possible and terminate at the same grounding point.

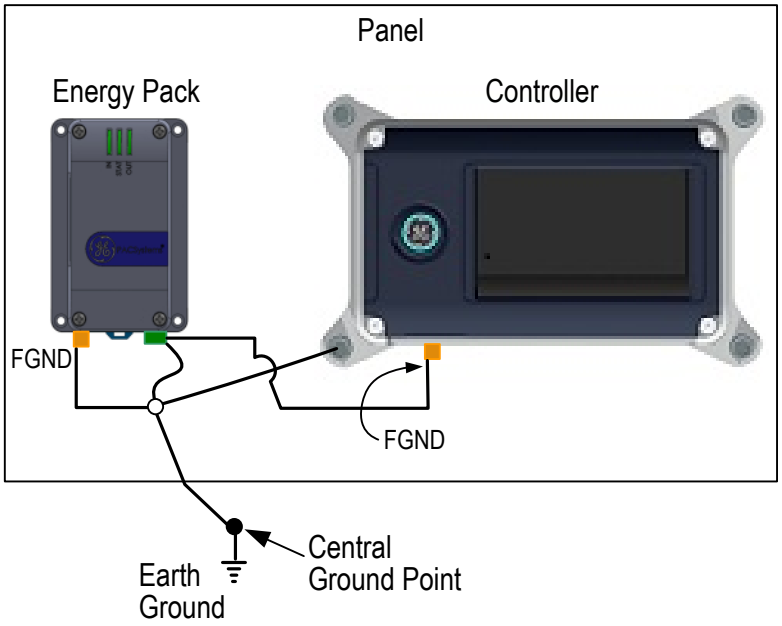

Figure 11: Grounding Connections (Example)

3.2.7 Power-Up

When power is applied to the Energy Pack, the power-up process goes through the following steps:

6. The IN LED turns on green.
7. The Energy Pack performs a self-diagnostic test. If this test passes, output power to the Controller is turned on and the OUT LED turns on green.
8. Charging of the Cap Pack begins and the STAT LED blinks green.
9. When charging of the Cap Pack is complete, the STAT LED turns on solid green and the Energy Pack signals to the controller that it can start run-time operation. The Controller will not start running its application until the Energy Pack signals that it is fully charged.

Figure 12: LEDs on Energy Pack

3.2.8 LED Indications

LED	LED State	Energy Pack Status
IN	Green, solid	Input power is applied and within the specified range.
	Red, solid	Input power is outside the specified range (20–30Vdc).
	Off	Input power is not applied.
STAT	Green, blinking	Charging of Cap Pack is in progress. No fault exists.
	Green, solid	Cap Pack is fully charged and no fault exists.
	Amber, blinking	Cap Pack is nearing end-of-life. The Cap Pack must be replaced soon. Backup is still guaranteed.
	Red, blinking	Internal fault: Cycle power to the Energy Pack. If this does not clear the fault, contact Technical Support and replace the Energy Pack.
	Red, solid	Cap Pack has reached end-of-life. Replace the Cap Pack. Backup is ***not*** guaranteed.
	Off	No power applied.
OUT	Green, solid	Output power is within the specified range.
	Red, solid	Output power is present but is outside the specified range (20–30 Vdc).
	Off	Output power is not present.

LED Indications: Special Cases

All LEDs blinking in unison: See *Firmware Updates*.

3.2.9 Backup Operation

While the Controller is running, if the input voltage to the Energy Pack falls below 20 Vdc, the Energy Pack will immediately switch to backup power and signal the Controller to initiate a memory backup.

The Energy Pack supplies power long enough for the Controller to back up memory and then turns off power to the Controller. When the input voltage to the Energy Pack returns to normal, the power-up routine begins.

3.2.10 Service and Maintenance

Replacing the Cap Pack Module

The Cap Pack is typically removed and replaced while power is applied to the Energy Pack (hot swapped.)

Warning

When replacing the Cap Pack, potentially hazardous energy could be present. Only handle by the plastic case. Do not allow a short across the printed wiring assembly components or connectors.

Caution

When hot swapping Cap Packs, do not cycle power until the new Cap Pack is fully charged and operational. Cycling power before the STAT LED on the Cap Pack is solid green can result in Controller memory not being preserved.

Do not hot remove/insert the Cap Pack during the firmware update process.

1) Loosen the four screws on the Cap Pack and carefully pull the Cap Pack off the base.
2) Install the new Cap Pack on the base, first engaging the module-to-base connectors and then pressing the Cap Pack into place.

Caution

Over tightening the mounting screws could crack the plastic housing.

3) Use the four screws provided to secure the Cap Pack to the base.
4) When the Cap Pack is first inserted, the STAT LED blinks green while the Cap Pack is charging. Do not remove power to the Energy Pack while the Cap Pack is charging because this could result in Controller memory not being preserved.
5) The Energy Pack LEDs and the Controller status bits indicate when charging is complete and the Energy Pack is ready to support backup.
6) To remove a Failed Battery fault and clear battery status bits, clear the Controller fault table.
7) For details on status bit operation, refer to the corresponding Controller user manual.

Firmware Updates

The firmware for the Energy Pack is automatically updated by the Controller. At power-up, the Controller checks the version of Energy Pack firmware to verify compatibility with the Controller firmware. If an update is needed, the Controller performs it automatically.

LED Indications for Firmware Updates

Firmware Update Mode	All three LEDs blink green

3.2.11 Diagnostics

System Version Information

The Controller's web-based home page displays serial number and version information for the Base and Cap Pack. For additional information, refer to the Controller user manual.

Status Information

The Energy Pack provides the following status information to the Controller, which it uses to generate fault and status bit indications. For Controller fault and status bit details, refer to the Controller user manual.

Charging	The Energy Pack is charging; not yet fully charged.
Fault	A hardware fault exists in the Energy Pack.
Low capacitance	The Energy Pack is near its end of life and should be replaced.
Charged	The Energy Pack is fully charged and is ready to support CPU operation.

Energy Pack LEDs

Details on the LED operation for this Energy Pack are listed in *LED Indications*.

3.2.12 Agency Certifications

The following table lists the standards to which the Energy Pack has been certified.

Description	***Agency Standard or Marking***	***Comments***
N.A. Safety for Information Technology Equipment	c UL us LISTED	Certification by Underwriter's Laboratories to UL 60950-1and CSA 60950-1
N.A. Safety for Industrial Control Equipment	c UL us LISTED	Certification by Underwriter's Laboratories to UL 508 and CSA C22.2 No 142 - M1987
Electromagnetic Compatibility Directive European EMC	CE	Self-Declaration in accordance with European Directives; Refer to Technical Support at www.geautomation for EC Declaration of Conformity

Note: The agency approvals listed above and on the Declaration of Conformities are believed to be accurate; however, a product's agency approvals should be verified by the marking on the unit itself.

3.3 PACSystems RX3i Energy Pack (IC695ACC400)

Refer to *PACSystems* RX3i Energy Pack IC695ACC400 IPI*, GFK-2724.

3.4 PACSystems RX3i Energy Pack (IC695ACC402)

3.4.1 Specifications

Part Numbers

IC695ACC402	Energy Pack. Includes base, Cap Pack module and Energy Pack to Controller cable
IC695ACC412	Replacement Cap Pack module
IC695CBL002	Replacement 1.0m (39”) Energy Pack to CPE330 Controller cable

Functional Specifications

Dimensions	114.05 × 77.47 × 63.75 mm (4.49” × 3.05” × 2.51”)
Input voltage range	18–30 Vdc
Input power, maximum	24 W
Output voltage range	18–30Vdc
Output power maximum	45 W
Output current maximum	2.25 A
Backup trip voltage	16.7 Vdc ±4%
Capacitor Pack life expectancy	5 years

Environmental Specifications

The Energy Pack shall be installed in a location that is not exposed to corrosive gases or liquids, rain, or direct sunlight, and that meets the environmental specifications listed below.

Operating Temperature, surrounding air	-25˚C to 60˚C
Storage Temperature	-40°C to +85°C (-40°F to 185°F)
Humidity	5% to 95%, non-condensing

3.4.2 Installation & Operation

Refer to PACSystems* RX3i Energy Pack IC695ACC402 Quick Start Guide, GFK-2939.

3.5 PACSystems RX3i Rackless Energy Pack (IC695ACC403)

3.5.1 Specifications

Part Numbers

IC695ACC403	Energy Pack. Includes base, Cap Pack module and Energy Pack to Controller cable
IC695ACC413	Replacement Cap Pack module
IC695CBL003	Replacement 0.6m (24”) Energy Pack to CPE400 / CPL410 Controller cable

Functional Specifications

Dimensions	114.05 × 77.47 × 63.75 mm (4.49” × 3.05” × 2.51”)
Input voltage range	18–30 Vdc
Input power, maximum	36 W
Output voltage range	18–30Vdc
Output power maximum	45 W
Output current maximum	2.25 A
Backup trip voltage	16.7 Vdc ±4%
Capacitor Pack life expectancy	5 years

Environmental Specifications

The Energy Pack shall be installed in a location that is not exposed to corrosive gases or liquids, rain, or direct sunlight, and that meets the environmental specifications listed below.

Operating Temperature, surrounding air	-40˚C to 70˚C
Storage Temperature	-40°C to +85°C (-40°F to 185°F)
Humidity	5% to 95%, non-condensing

3.5.2 Installation & Operation

Refer to PACSystems* RX3i Energy Pack IC695ACC403 Quick Start Guide, GFK-3000.

Chapter 4 Supercapacitors

Supercapacitors are used in industrial controller technology to provide backup for volatile memory. They provide much higher capacitance than traditional capacitors. They typically store 10 to 100 times more energy per unit volume than electrolytic capacitors. They may be charged up quickly, and can deliver current much more quickly than batteries. They can also withstand repeated charge and discharge cycles.

4.1 CPUs with Supercapacitors

The following CPUs contain supercapacitors:

- RSTi-EP EPSCPE100
- RSTi-EP EPSCPE115

4.2 Replacing Supercapacitors

CPUs which contain supercapacitors are typically designed so that the supercapacitors may be replaced when needed. An alarm is sent to the CPU when the supercapacitors need replacement. The user manual will inform the user where to locate the supercapacitor circuit board, and how to remove and replace it. Please refer to the manual for each CPU, as these details will necessarily be unique for each product.

In non-redundant control systems, shut down the operation or process before removing the CPU.

Caution

Perform all electrical replacements in a suitably clean and dry environment. Clean away all surface contaminants before opening the electrical circuit enclosure.

Protect the exposed circuitry from electrostatic discharge, as this may destroy or disable components. Wear a ground-strap while working on exposed circuitry.

Dispose of electrical circuit waste in accordance with local laws and regulations.

Warning

Supercapacitors retain charge for a significant period. A risk of electrical shock exists while the supercapacitors are charged up. A discharge could cause either personal injury or damage to equipment.

Be sure that the unit under repair has been disconnected from its power source for a number of minutes (consult the relevant user manual). Do not attempt to replace until the supercapacitors have discharged completely.

GE Automation and Controls Information Centers

Headquarters:
1-800-433-2682 or 1-434-978-5100

Global regional phone numbers are available on our web site
www.geautomation.com

Additional Resources

For more information, please visit our web site:

www.geautomation.com

GFK-2741H