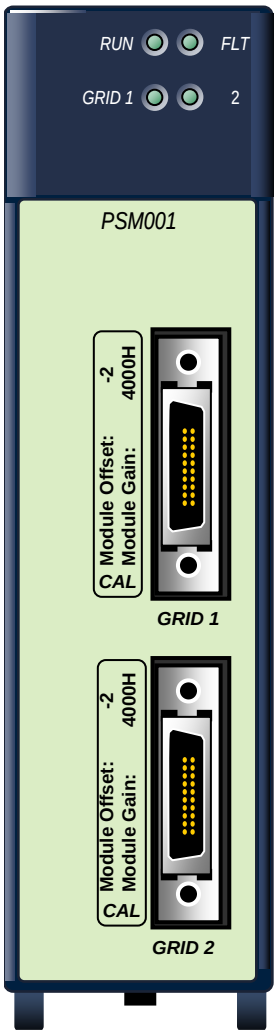
PACSystems* RX3i

GFK-2748C

May 2014

Power Sync and Measurement System
IC694PSM001-AB and IC694ACC200-A



The PACSystems Power Sync and Measurement (PSM) system monitors two independent three-phase power grids. It incorporates advanced digital signal processor (DSP) technology to continuously process three voltage inputs and four current inputs for each grid. Measurements include RMS voltages, RMS currents, RMS power, frequency, and phase relationship between the phase voltages of both grids.

The PSM module performs calculations on each captured waveform, with the DSP processing the data in less than two-thirds of a power line cycle. The PSM module can be used with wye or delta type three-phase power systems or with single-phase power systems.

The PSM system can be used for applications such as:

- Electrical power consumption monitoring and reporting
- Fault monitoring
- Generator control features for generator to power grid synchronization
- Demand penalty cost reduction/load shedding

The PSM system consists of:

- **PSM module** – A standard IC694 module that mounts in an RX3i rack. The PSM module provides the DSP capability.
- **Terminal Assembly –** A panel-mounted unit that provides the interface between the PSM module and the input transformers.
- **Interface cables –** Provide the GRID 1 and GRID 2 connections between the PSM module and the Terminal Assembly.

PSM System Features

- Uses standard, user-supplied current transformers (CTs) and potential transformers (PTs) as its input devices.
- Accurately measures RMS voltage and current, power, power factor, frequency, energy, and total three-phase 15-minute power demand.
- Provides two isolated relays that close when the voltage phase relationships between the two monitored grids are within the specified ANSI 25 limits provided by the RX3i host controller. These contacts can be used for general-purpose, lamp duty or pilot duty loads. Voltage and current ratings for these load types are provided in GFK-2749, *PACSystems RX3i Power Sync and Measurement System User's Manual*.
- Provides a cable monitoring function that indicates when the cables linking the PSM module and Terminal Assembly are correctly installed.
- PSM module and Terminal Assembly are easily calibrated by hardware configuration using the Proficy* Machine Edition (PME) software.

Ordering Information

IC694PSK001	PSM System. Includes a PSM module, a Terminal Assembly and two interface cables
IC694PSM001	Replacement PSM module
IC694ACC200	Replacement Terminal Assembly
IC694CBL200	One replacement 2m (6.56 ft.) interface cable
IC694ACC201	PSM replacement parts: two finger guards four thumb screws one relay connector two grounding lug nuts

Specifications

PSM Module Power Requirements	
Backplane Power Consumption	400 mA max. at 5 VDC
Total Power Dissipation	2.0 W max.
Isolation from Backplane	1500 VDC
Maximum number of PSM modules per RX3i system	No restrictions, as long as the power supply has sufficient capacity
Sync Relay Contacts	
Two isolated relay outputs	General purpose: 125 VAC / 125 VDC maximum at 1 amp Lamp duty: 125 VAC / 125 VDC maximum at 1 amp Pilot duty: 125 VAC / 125 VDC maximum at 0.35 amp
Switching speeds Turn-on time Turn-off time	 20 ms 5 ms
Measurement Specifications	
Three voltage inputs per grid	All voltage data is scaled in 0.1 VAC units.
Impedance:	>1 MΩ
Range Low range High range	 45–150 VAC RMS (120 VAC nominal) 120–690 VAC RMS (600 VAC CAT IV; 690 VAC CAT III)
Frequency	30–70 Hz
Four current inputs per grid	All current data is scaled in 0.001 Amp units.
Impedance	<5 milliohms
Range	0–5 A RMS (5 A nominal)
Frequency	30–70 Hz
Phase difference between grids:	±180^{O}
Measurement Accuracy [1]	
Voltage	0.2%
Current	0.2%
kW, kVAR, kVA	0.4%
kWH, kVARH, kVAH	0.4%
Power factor	1%
Frequency	0.01 Hz
Phase angle	0.1^{O}
Terminal Assembly Input Terminal Ratings	
Current	15 Amps continuous maximum
Voltage	690 VAC RMS
Sync Relay contacts	150 VAC/VDC at 1 Amp Resistive, maximum **Note:** Actual contact ratings depend on load type. Refer to *Sync Relay Contacts* above.

[1] In the presence of severe conducted RF interference (IEC 61000-4-6, 10 volts) accuracy could be degraded by ±2% of full scale.

RX3i CPU Memory Requirement for Automatic Data Exchange	
%I	80 bits
%Q	32 bits
%AI	64 words
%AQ	2 words
Data Exchange Time Between RX3i CPU and PSM	
A complete data exchange between the PSM and RX3i occurs during each controller scan. Minimum scan time is 3.5 ms per PSM module in the backplane. Minimum data update rate is one power line period. Refer to GFK-2749, the sections, *System Operation* and *PSM Status Flags*.	
ANSI Protective Functions	
ANSI 25 – Generator and Public Grid Synchronization	
ANSI 27 – Under-voltage Protection	
ANSI 32 – Reverse Power Protection	
ANSI 47 –Voltage Phase Sequence Protection	
ANSI 50 – Instantaneous Over-current Protection	
ANSI 59 – Over-voltage Protection	
ANSI 60 – Voltage (Current) Imbalance Protection	
ANSI 81U – Under-frequency Protection	
ANSI 81O – Over-frequency Protection	
Power Measurement Configurations	
Four-wire three phase wye systems: 3 PTs and 3 CTs plus Neutral CT (optional) Three-wire three phase delta systems: 2 PTs and 2 CTs Three independent single phase systems: 1 PT and 1 CT for each phase Three-wire single phase systems: 120/240 (2 PTs and 2 CTs)	
Operating Environment	
Enclosure mounting	Required. PSM module and Terminal Assembly must be installed in a NEMA/UL Type 1 enclosure or an IP20 rating providing at least a pollution degree 2 environment. When this system is installed in an area designated as Class 1 Zone 2 in Europe, compliance with the ATEX Directive requires an enclosure with a minimum rating of IP54.

For product standards, general operating sepcifications, and installation requirements, refer to GFK-2749, *PACSystems RX3i Power Sync and Measurement System User's Manual*.

Installation in Hazardous Locations

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

Class 1 Division 2 Groups ABCD

- This equipment shall be installed in an ultimate enclosure suitable for the environment that is only accessible with the use of a tool.
- Suitable for use in Class I, Division 2, Groups A, B, C and D Hazardous Locations, or nonhazardous locations only.

EXPLOSION HAZARD - Substitution of components may impair suitability for class I, division 2.

When in hazardous locations, turn off power before replacing or wiring modules; and

DO NOT connect or disconnect equipment unless power has been switched off or the area is known to be nonhazardous.

ATEX Zone 2

This product must be mounted in an enclosure certified in accordance with EN60079-15 for use in Zone 2, Group IIC and rated IP54. The enclosure shall only be able to be opened with the use of a tool .

Quick Reference Guide

HIGH VOLTAGE; HIGH CURRENT

***DO NOT TOUCH* the connectors or wiring after powering up the PSM system. Hazardous voltages exist, and death or injury may result.**

The Terminal Assembly frame ground connection must always be installed and must be installed before any other wiring is attached.

To reduce risk of electric shock or damage to the attached CTs, always open or disconnect all voltage circuits and apply the shorting bar connections to the current inputs before installing or servicing the connections to the Terminal Assembly.

Never disconnect the GRID 1 or GRID 2 field wiring while power is present. Personal injury or equipment damage may result. Finger guards must be installed on the Terminal Assembly before energizing the field wiring.

User Supplied Equipment

The user must supply the following components depending upon the application. This equipment includes:

- 5 Amp current transformers
- Potential transformers for all installations
- 1 Amp fuses for each of the voltage leads connected to the Terminal Assembly.
- 1 Amp fuse for the common or return line for the voltage lead on the Terminal Assembly.
- A CT shorting block for each current transformer (CT) connection used on the Terminal Assembly when used with external CTs.

Installation

Enclosures

The Terminal Assembly and PSM module are considered open equipment (having live electrical parts that may be accessible to users) and must be installed in a protective enclosure or incorporated into other assemblies manufactured to provide safety. As a minimum, the enclosure or assemblies shall provide a degree of protection against solid objects up to 12 mm (for example, fingers). For Non Hazardous environments, this equates to a NEMA/UL Type 1 enclosure or an IP20 rating providing at least a pollution degree 2 environment.

The enclosure must be able to adequately dissipate the heat generated by all components mounted inside so that no components overheat. Heat dissipation is also a factor in determining the need for enclosure cooling options such as fans and air conditioning.

Installing the PSM Module

The PSM module must be installed in a main (CPU) rack in an RX3i system. For system-level installation information, refer to GFK-2314, *PACSystems RX3i System Manual*. The IC694PSM001 Module can be hot-swapped in an RX3i backplane.

Installing the Terminal Assembly

The Terminal Assembly must be securely installed on a rigid, conductive, 12 – 14 gauge steel panel using four user supplied M4 - M5 or #8 - #10 SAE bolts. The Terminal Assembly should be mounted near the host controller rack containing the PSM module, close enough to accommodate the 2 meter interface cables provided.

For detailed installation and power system connection instructions, refer to GFK-2749, *PACSystems RX3i Power Sync and Measurement Module User's Manual*.

Configuration

The PSM module is configured using the Proficy Machine Edition programming software. For compatible versions, refer to page 12.

Configuration parameters are used to set nominal values for Grid 1 and Grid 2 voltage, current and frequency, and to calibrate the PSM system for specific Potential Transformer and Current Transformer gains, increasing the accuracy of the measured values. Configuration parameters are also used to set ANSI device threshold and delay values.

A Mode Control register, consisting of 32 bits in %Q memory, selects operational and measurement modes. This application must apply initial values to these bits and can change them while the PSM is running.

The application can change a single configuration parameter in run mode by modifying the two-word *Parameter Write* register in %AQ memory.

Mode Control Bits

The RX3i CPU sends 32 %Q bits of Mode Control data to the PSM module every sweep. ***The application logic must apply initial values to these bits on the first RX3i scan.*** The application can change these settings during operation to modify measurement modes in response to changing conditions.

%Q Bit Offset	***Function***
1	**GRID 1 Operation**: 0 = disabled, 1 = enabled If disabled, the PSM module does no measurements for the GRID1 (power grid) inputs. **Note:** Both grid control offset bits (Q1 and Q17) must be enabled in order for the PSM module to operate as a 2-source synchronizer.
2	**GRID 1 Voltage Selection**: 0 = low voltage range (120VAC), 1 = high voltage range (600VAC) ***Caution:*** The voltage range is determined by the physical connections in the power system. Changing this bit to a value that does not match the physical configuration will result in erroneous power system measurements. **Note: Do not change this value in while in RUN mode**.
3	**GRID 1 Grid Operational Mode**: 0 = single phase, 1 = three-phase
4	**GRID 1 Connection mode**: Works with the Grid Operational Mode setting to determine system type. • In single phase mode: 0 = Three single phases ,1 = Three-wire, single phase (120/240) using PTA and PTB • In three-phase mode: 0 = WYE system configuration, 1 = DELTA system configuration
5	**GRID 1 PTA measurement**: 0 = GRID 1 PTA not connected, 1 = GRID 1 PTA connected The PSM module reconstructs the missing variable. Refer to *Reconstructed Variables* in GFK-2749.
6	**GRID 1 CTA measurement**: 0 = GRID 1 CTA not connected, 1 = GRID 1 CTA connected The PSM module reconstructs the missing variable. Refer to *Reconstructed Variables* in GFK-2749.
7	**GRID 1 PTB measurement**: 0 = GRID 1 PTB not connected, 1 = GRID 1 PTB connected The PSM module reconstructs the missing variable. Refer to *Reconstructed Variables* in GFK-2749.
8	**GRID 1 CTB measurement**: 0 = GRID 1 CTB not connected, 1 = GRID 1 CTB connected The PSM module reconstructs the missing variable. Refer to *Reconstructed Variables* in GFK-2749.
9	**GRID 1 PTC measurement**: 0 = GRID 1 PTC not connected, 1 = GRID 1 PTC connected The PSM module reconstructs the missing variable. Refer to *Reconstructed Variables* in GFK-2749.

%Q Bit Offset	Function
10	**GRID 1 CTC measurement**: 0 = GRID 1 CTC not connected, 1 = GRID 1 CTC connected The PSM module reconstructs the missing variable. Refer to *Reconstructed Variables* in GFK-2749.
11	**GRID 1 CTN measurement**: 0 = GRID 1 CTN not connected, 1 = GRID 1 CTN connected The PSM module reconstructs the missing variable. Refer to *Reconstructed Variables* in GFK-2749.
12	**GRID 1 Waveform Capture**: When this bit is transitioned from 0 to 1 by the control logic, the PSM module captures 128 samples of all seven data variables on GRID 1.
13	**GRID 1 Delta Mode**: 0 = B phase is common, 1= C phase is common This bit must be set to 0 if phase B is used as the common connection for the other two voltages (North American standard). If the phase C is used as the common phase in a Delta connection, this bit must be set to 1.
14	**Reserved**
15	**GRID 1 Energy reset**: When set, the accumulated energy values for GRID 1 are reset and held at 0 Wh and 0 VARh. When cleared, the GRID 1 energy values represent the accumulated energy since the last reset.
16	**Relay open**: Works with bit 32 to control the Sync Relay operation. For more information, refer to *Relay Open/Relay Close Operation* in GFK-2749.
17	**GRID 2 Operation**: 0 = disabled, 1 = enabled If disabled, the PSM module does no measurements for the GRID 2 (generator grid) inputs. **Note:** Both grid control offset bits (Q1 and Q17) must be enabled in order for the PSM module to operate as a 2-source synchronizer.
18	**GRID 2 Voltage Selection**: 0 = low voltage range (120VAC), 1 = high voltage range (600VAC) ***Caution:*** The voltage range is determined by the physical connections in the power system. Changing this bit to a value that does not match the physical configuration will result in erroneous power system measurements. **Note: Do not change this value in while in RUN mode**.
19	**GRID 2 Grid Operational Mode**: 0 = single phase, 1 = three-phase
20	**GRID 2 Connection mode**: Works with the Grid Operational Mode setting to determine system type. • In single phase mode: 0 = Three single phases ,1 = Three-wire, single phase (120/240) using PTA and PTB • In three-phase mode: 0 = WYE system configuration, 1 = DELTA system configuration
21	**GRID 2 PTA measurement**: 0 = GRID 2 PTA not connected, 1 = GRID 2 PTA connected The PSM module reconstructs the missing variable. Refer to *Reconstructed Variables* in GFK-2749.
22	**GRID 2 CTA measurement**: 0 = GRID 2 CTA not connected, 1 = GRID 2 CTA connected The PSM module reconstructs the missing variable. Refer to *Reconstructed Variables* in GFK-2749.
23	**GRID 2 PTB measurement**: 0 = GRID 2 PTB not connected, 1 = GRID 2 PTB connected The PSM module reconstructs the missing variable. Refer to *Reconstructed Variables* in GFK-2749.
24	**GRID 2 CTB measurement**: 0 = GRID 2 CTB not connected, 1 = GRID 2 CTB connected The PSM module reconstructs the missing variable. Refer to *Reconstructed Variables* in GFK-2749.
25	**GRID 2 PTC measurement**: 0 = GRID 2 PTC not connected, 1 = GRID 2 PTC connected The PSM module reconstructs the missing variable. Refer to *Reconstructed Variables* in GFK-2749.
26	**GRID 2 CTC measurement**: 0 = GRID 2 CTC not connected, 1 = GRID 2 CTC connected The PSM module reconstructs the missing variable. Refer to *Reconstructed Variables* in GFK-2749.
27	**GRID 2 CTN measurement**: 0 = GRID 2 CTN not connected, 1 = GRID 2 CTN connected The PSM module reconstructs the missing variable. Refer to *Reconstructed Variables* in GFK-2749.
28	**GRID 2 Waveform Capture**: When this bit is transitioned from 0 to 1 by the control logic, the PSM module captures 128 samples of all seven data variables on GRID 2.
29	**GRID 2 Delta Mode**: 0 = B phase is common, 1= C phase is common This bit must be set to 0 if phase B is used as the common connection for the other two voltages (North American standard). If the phase C is used as the common phase in a Delta connection, this bit must be set to 1.
30	**Reserved**
31	**GRID 2 Energy reset**: When set, the accumulated energy values for GRID 1 are reset and held at 0 Wh and 0 VARh. When cleared, the GRID 1 energy values represent the accumulated energy since the last reset.

%Q Bit Offset	*Function*
32	**Relay Close**: Works with bit 16 to control the Sync Relay operation. For more information, refer to *Relay Open/Relay Close Operation* in GFK-2749.

PSM Status Flags

The PSM returns 80 status flag bits to the RX3i controller. Those 80 bits are grouped into five 16-bit words.

- The first status word (%I1 – %I16) contains the overall PSM status flags.
- The following two words (%I17 – %I48) contain the individual grid measurement faults. These flags identify the voltage/current channel experiencing a measurement problem. It can be one or multiple problems related to:
  - Input signal not present, that is, it is indicated as not measured in the corresponding %Q flag bit. If the signal is not measured, it cannot be reconstructed by the PSM module firmware.
  - Input signal is measured but it is clamped due to a higher peak voltage/current value than the maximum value allowed to be applied to the interface unit
- The last two status words (%I49 – %I80) contain the individual grid status flags, including the ANSI alarms.

%I Bit Offset	*Definition*	*Value*	*Status/Alarm Timing* A, B, AB: Refer to the section, *Status/Alarm Timing*	*Alarm[2] Availability*	
				1Ø	*3Ø*
1	PSM HeartBeatBit:	Toggled with every scan/sweep	Updated every scan	ü	ü
2	PSM ConnectionOK:	1 = OK 0 = PSM to Terminal Assembly connection failure	A	ü	ü
3	PSM PhaseShiftOK:	1 = OK 0 = ANSI 25/1 Alarm	A		ü
4	PSM DeltaVoltOK:	1 = OK 0 = ANSI 25/2 Alarm	A		ü
5	PSM DeltaFreqOK:	1 = OK 0 = ANSI 25/3 Alarm	A		ü
6	PSM AllGridAlarmsOK	1 = OK 0 = At least one alarm on either grid is set	AB		ü
7	PSM RelayCloseOK:	1 = OK 0 = Do not close relay	A		ü
8	PSM New Data	1 = The current PLC sweep is the first sweep this power line cycle data is being delivered by the PSM to the PLC. 0 = Data has not changed from previous sweep.	A	ü	ü
9 - 16	Reserved				

[2] Alarm availability: A checkmark indicates whether an alarm is available for use in either the 1-Phase (1ø) or the 3-Phase (3ø) Grid Operational Mode (refer to *Mode Control Bits Sent to PSM Module* in GFK-2749). All alarms are available in 3-Phase mode. An absent checkmark indicates that the value of the bit is indeterminate and the bit should be ignored.

%I Bit Offset	Definition	Value	Status/Alarm Timing A, B, AB: Refer to the section, *Status/Alarm Timing*	Alarm[2] Availability	
				1Ø	3Ø
17	GRID 1 FaultVA	0 = OK 1 = Fault – clamped or not calculated/measured	A	ü	ü
18	GRID 1 FaultIA		A	ü	ü
19	GRID 1 FaultVB		A	ü	ü
20	GRID 1 FaultIB:		A	ü	ü
21	GRID 1 FaultVA/VBA; VB/VAC; VC/VBC		A	ü	ü
22	GRID 1 FaultIC		A	ü	ü
23	GRID 1 FaultIN		A	ü	ü
24-32	Reserved				
33	GRID 2 FaultVA_VCA	0 = OK 1 = Fault – clamped or not calculated/measured	A	ü	ü
34	GRID 2 FaultIA		A	ü	ü
35	GRID 2 FaultVB_VCB		A	ü	ü
36	GRID 2 FaultIB:		A	ü	ü
37	GRID 2 FaultVC:		A	ü	ü
38	GRID 2 FaultIC		A	ü	ü
39	GRID 2 FaultIN		A	ü	ü
40 - 48	Reserved				
49	GRID 1 ClampedFreq	0 = OK 1 = Line Frequency outside the range (30 - 70 Hz)	A	ü	ü
50	GRID 1 ClampedInput:	0 = OK 1 = some inputs have signal clamped	A	ü	ü
51	GRID 1 MixedPolarity	0 = OK 1 = At least one phase PT/CT has wrong polarity	B		ü
52	GRID 1 VoltPhSeqAlarm	0 = OK 1 = ANSI 47 Alarm	B		ü
53	GRID 1 UnderVoltAlarm	0 = OK 1 = ANSI 27 Alarm	B		ü
54	GRID 1 ReversPwrAlarm	0 = OK 1 = ANSI 32 Alarm	B		ü
55	GRID 1 OverCurrAlarm	0 = OK 1 = ANSI 50 Alarm	B	ü	ü

%I Bit Offset	***Definition***	***Value***	***Status/Alarm Timing*** A, B, AB: Refer to the section, *Status/Alarm Timing*	***Alarm[2] Availability***	
				1Ø	***3Ø***
56	GRID 1 OverVoltAlarm	0 = OK 1 = ANSI 59 Alarm	B		ü
57	GRID 1 VIImbalanceAlarm	0 = OK 1 = ANSI 60 Alarm	B		ü
58	GRID 1 UnderFreqAlarm	0 = OK 1 = ANSI 81U Alarm	B	ü	ü
59	GRID 1 OverFreqAlarm	0 = OK 1 = ANSI 81O Alarm	B	ü	ü
60 - 64	Reserved				ü
65	GRID 2 ClampedFreq:	0 = OK 1 = Line Frequency outside the range (30 - 70 Hz)	A	ü	ü
66	GRID 2 ClampedInput:	0 = OK 1 = some inputs have signal clamped	A	ü	ü
67	GRID 2 MixedPolarity	0 = OK 1 = At least one phase PT/CT has wrong polarity	B		ü
68	GRID 2 VoltPhSeqAlarm	0 = OK 1 = ANSI 47 Alarm	B		ü
69	GRID 2 UnderVoltAlarm	0 = OK 1 = ANSI 27 Alarm	B		ü
70	GRID 2 ReversPwrAlarm	0 = OK 1 = ANSI 32 Alarm	B		ü
71	GRID 2 OverCurrAlarm	0 = OK 1 = ANSI 50 Alarm	B	ü	ü
72	GRID 2 OverVoltAlarm	0 = OK 1 = ANSI 59 Alarm	B		ü
73	GRID 2 VIImbalanceAlarm	0 = OK 1 = ANSI 60 Alarm	B		ü
74	GRID 2 UnderFreqAlarm	0 = OK 1 = ANSI 81U Alarm	B	ü	ü
75	GRID 2 OverFreqAlarm	0 = OK 1 = ANSI 81O Alarm	B	ü	ü
76 – 80	Reserved				

Status/Alarm Timing

Timing A – The PSM buffers an entire power line cycle and takes 11 ms to perform calculations on the waveforms. The new status bits are available to the application code after the next PLC input data scan.

Total latency = 1-cycle + 11 ms + (0 to PLC scan time)

Update rate = 1-cycle or the PLC scan rate (whichever is longer)

Timing B – The PSM updates this information every 100 ms. The new status bits are available to the application code after the next PLC input data scan.

Update rate = 100 ms or the PLC scan rate (whichever is longer)

Timing AB – AllGridAlarmsOK follows the timing of the alarm that causes it to be cleared or set.

LEDs

LED	*State*	*Definition*
RUN	Green	The module is operating correctly and communicating with the RX3i.
	Red	The module is operating without backplane communication.
	Off	The module is not operating.
FLT	Green, blinking	During the period when GREEN is ON, Grid 1 can be connected to Grid 2.
	Green, steady	Grid 1 and Grid 2 are connected.
	Red	The module has detected a fault condition.
	Off	The module has not detected a fault and the grids are not synchronized.
GRID 1	Green	Indicates a voltage signal has been detected on Grid 1.
	Red	A frequency out-of-range condition has been detected on Grid 1.
	Off	No zero crossing signal of Grid 1 has been detected during the last 250 ms time period.
GRID 2	Green	Indicates a voltage signal has been detected on Grid 2
	Red	A frequency out-of-range condition has been detected on Grid 2.
	Off	No zero crossing signal of Grid 2 has been detected during the last 250 ms time period.

Field Wiring

Wiring to the PSM consists of:

- the connection cable between the Terminal Assembly and the PSM
- the leads to user-supplied potential and mandatory user-supplied current transformers
- Sync relay output connections, and
- frame ground connections from the Terminal Assembly to the chassis

No CT shorting bars are provided on the PSM Terminal Assembly; these must be supplied by the user.

Requirements for Terminal Assembly Connections

Terminal Assembly connections above 600 VAC require prepared wire ends, such as tinning of the conductors, or use of crimpled or soldered forked connectors or ferrules.

Terminal connections for COM1, COM2, voltage sensing and current sensing terminals

Terminal torque: 1.81 Nm (16 in-lb)

Wiring size/type: 0.823 mm^2– 5.26 mm^2 (18–10 AWG) solid/stranded

Relay output terminal connections

Terminal torque: 0.8 Nm (7 in-lb)

Wiring size/type: 0.205 mm^2– 0.410 mm^2 (24–21 AWG) solid/stranded

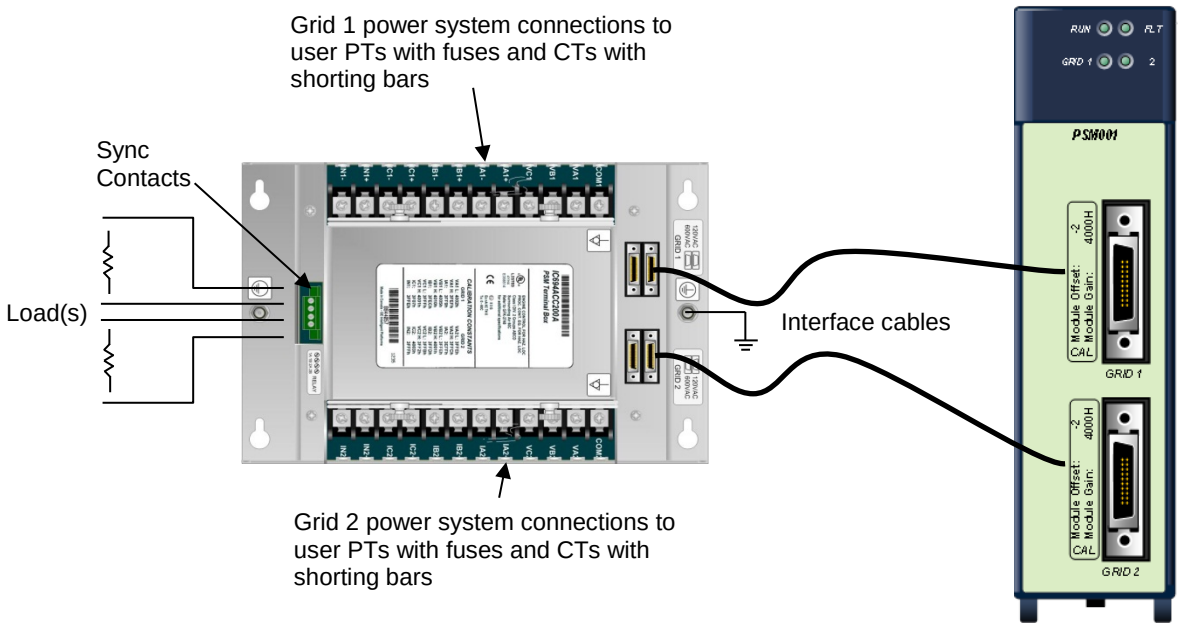
For additional wiring and connectin information, refer to GFK-2749, *PACSystems RX3i Power Sync and Measurement Module User's Manual*.

Warning

The PSM Terminal Assembly connects to hazardous voltages. Before installing, testing, or troubleshooting this module, you should refer to the complete instructions in the *PACSystems RX3i Power Sync and Measurement Module User's Manual,* GFK-2749. Failure to follow the published guidelines may result in personal injury, equipment damage, or both.

Note: Although Grid 1 and Grid 2 are interchangeable, you should connect the most stable source to Grid 1. Between a utility grid and a generator, the utility grid is the best choice for connection to the PSM Grid 1 inputs. This will yield the most accuracy and the least reading-to-reading fluctuation.

Basic PSM System Connections



Release History

Version	Firmware Revision	Date	Comments
IC694PSM001-AB	1.01	January 2013	Enhanced operation of sync relay feature as described below.
IC694PSM001-AA	1.00	December 2012	Initial release

Important Product Information for Release 1.01

New Features and Enhancements

With this release, the PSM accounts for the breaker delay, and the rate of change of the phase shift between the grids, to time the CloseRelayOK status and ACC200 relay outputs to close the sync relay contacts when the phase shift between the grids is 0^0.

This release also adds the special case of Breaker Delay = 0. When the ANSI 25 Breaker Delay parameter is set to 0, the PSM turns off breaker delay calculations and operates in *Classic* sync relay mode. In *Classic* mode, the PSM sets the CloseRelayOK status and the ACC200 relay outputs to On whenever the application requests a sync ***and*** the phase shift between the grids is in the range –Phase Shift Threshold to +Phase Shift Threshold.

Functional Compatibility

Subject	Version Required
Programmer Version Requirements	Proficy Machine Edition Logic Developer 7.50 with SIM 2 or newer or Proficy Machine Edition Logic Developer 7.00 with SIM 12 or newer or Proficy Machine Edition Logic Developer 7.60 or newer
CPU Firmware Version	RX3i CPU firmware versions 7.15, 7.16, 7.17, and 7.18. ***Note:*** The PSM module is ***not*** compatible with IC695CPE305 and C695CPE310 firmware version 7.30. CPU firmware version 7.70 or newer support the IC694PSM001 module on these CPU types: IC695CPE305 IC695CPE310 IC695CPU315 IC695CPU320 IC695CRU320, including –QP (Quad Redundancy) IC695NIU001+

Operational Notes

Subject	Description
Wiring	COM1 and COM2 of the IC694ACC200 must be connected to functional ground (Earth ground). COM1 and COM2 must ***not*** be connected to Neutral in a WYE power system. In certain fault conditions, Neutral can be pulled to the full voltage of any phase. Such a fault condition can pose a danger to personnel and damage the IC694ACC200. See GFK-2749 for wiring diagrams.

Subject	*Description*
Breaker Delay	When the ANSI 25 Breaker Delay parameter is set to a non-zero value, the phase angle difference at which CloseRelayOK (%I offset 7) is set and the IC694ACC200 relay outputs close varies, in direct proportion to the rate of change of the phase angle of Grid 2 relative to Grid 1. Higher rates of phase angle change and larger breaker delays require that the PSM assert CloseRelayOK earlier to ensure that the breaker contacts close within the safe region set by the ANSI 25 Phase Shift Threshold parameter (Phase_Shift_Thr). If the PSM does not receive a request to Sync (%Q offset 16=0 *and* %Q offset 32=1) in time for the relay outputs to close within the Phase Shift Threshold limits, it will not assert CloseRelayOK until the next opportunity.
Breaker Delay = 0 Special Case	When the ANSI 25 Breaker Delay parameter is set to zero, the PSM reverts to *classic* sync relay operation. The PhaseShiftOK bit will be set when *–Phase_Shift_Thr < Phase Shift < +Phase_Shift_Thr*. The PSM will ***not*** adjust its synchronization timing based on either the interval between CloseRelayOK being set and the relay contacts actually closing or the rate of change of the Phase Shift between the two grids. If a request to Sync (%Q offset 16=0 *and* %Q offset 32=1) is active at any time when the Phase Shift is within ±Phase_Shift_Thr, the CloseRelayOK bit and the relay outputs on the IC694ACC200 terminal assembly will be turned On.
Delta Power Configurations	Phase-to-Neutral voltages are not reported in Delta power configurations because there is no Neutral reference.
Nominal Voltage	Nominal Voltage refers to the: *Phase-to-Neutral* RMS voltage in a WYE power system. *Phase-to-Phase* RMS voltage in a Delta power system.
Nominal Current	Setting a negative Nominal Current value implies that the IC694ACC200 grid inputs are connected to a load (drawing power), rather than a power source (producing power). The power and energy values will be reported as negative numbers. The CTs must be wired with the correct polarity to achieve the negative power and energy values. RMS current is necessarily reported as a positive number, due to the RMS calculations.
Scaling for PT and CT Ratios	The IC694PSM001 module reports the voltages and currents measured *at* the IC694ACC200 terminals. Therefore, the application logic must correct for PT and CT ratios to reflect the actual power grid voltages, currents, powers and energies. ***Example:*** Using 480V:120V PTs requires the application logic to multiply the reported voltage values by 4. Using 100:5 CTs requires the application logic to multiply the reported current values by 20. Since power and energy combine voltage and current, the reported power and energy values must *both* be multiplied by 80 (4 x 20).
ANSI Alarm Delays	All ANSI alarm delays apply to both setting and clearing the alarms. A delay of 10 seconds means the grid must be in the alarm state for 10 continuous seconds before the PSM will set the alarm bit; clearing the CloseRelayOK bit and opening the relay outputs(if the grids were synchronized). Once the alarm is set, the alarm condition must be eliminated for 10 continuous seconds for the alarm to be cleared.
Relay Output Options	The isolated, bipolar relay outputs are redundant. Both relay 1 and relay 2 follow the CloseRelayOK %I offset 7 bit from the PSM. They can be connected in parallel to increase the reliability of closing, or in series, to increase the reliability of opening, to suit the needs of the application.
Voltage Configuration	The Voltage Selection in the Proficy Machine Edition Hardware Configuration must match both the physical cable connection to the IC694ACC200 terminal assembly *and* the %Q offset 2 (Grid 1) and %Q offset 18 (Grid 2) configuration bits. Refer to GFK-2749 for proper wiring and configuration information.

Subject	*Description*
Reverse Power Threshold	The Reverse Power Threshold affects Grid 1 and Grid 2 differently: ▪ For Grid 1, the Reverse Power alarm will be triggered if a circuit's active power exceeds the Reverse Power Threshold for a time period longer than Reverse Power Delay. ▪ For Grid 2, the Reverse Power alarm will be triggered if a circuit's active power falls below the Reverse Power Threshold for a time period longer than Reverse Power Delay.
VI Imbalance	The VI Imbalance Alarm compares voltage phases to voltage phases, and current phases to current phases within a grid. No comparison is made between grids. If any voltage varies from the average of all three voltages, or if any current varies from the average of all three currents (by more than the VI Imbalance Threshold) for longer than the VI Imbalance Delay, that grid's VI Imbalance Alarm is set. ***Example 1:*** VI Imbalance is set to 20%, VA1 = 126V, VB1 = 90V, VC1 = 124V The difference between VB1 and the average of the three voltages is greater than 20%, so the VI Imbalance alarm will be set. ***Example 2:*** VI Imbalance is set to 25%, IA2 = 4.2A, IB2 = 3.6A, IC2 = 5.5A The difference between IC2 and the average of the three currents is less than 25%, so the VI Imbalance alarm will not be set.
Setting Programmatic Parameters	Proficy Machine Edition Hardware Configuration parameters are entered as Floating Point numbers in engineering units. Changing the same parameters programmatically (using %AQ offset 1 and 2) requires the use of 16-bit Integers which vary from the Floating Point numbers by factors of 10. Refer to GFK-2749 for details on how to change configuration parameters in Run Mode.
Power Factor	Although the PSM reports power factor information using three decimal places, the information is only accurate to two decimal places.