Generator Integration with PWRcell

Introduction

See ***Figure 1***. New PWRcell firmware unlocks the ability to integrate a Generac Generator with a PWRcell System. During a utility grid outage, this feature allows a user to run on clean energy from the PWRcell Energy Storage System (ESS); then transition to a Generac generator for additional power and duration. The feature is configurable with three generator control modes so projects can be customized to meet system owner expectations.

Feature Requirements

- PWRcell Inverter model XVT076A03.
- PWRcell M6 Battery.
- Two PWRcell Automatic Transfer Switches (ATS)*.
- PWRcell ATS Controller Upgrade Kit (Model G0080060) installed in the Inverter ATS**.
- Compatible Generac Single Phase Air-cooled Generator***.
- Energy Management to comply with NEC Article 702.4
- See ***Equipment Compatibility*** for additional requirements and information.

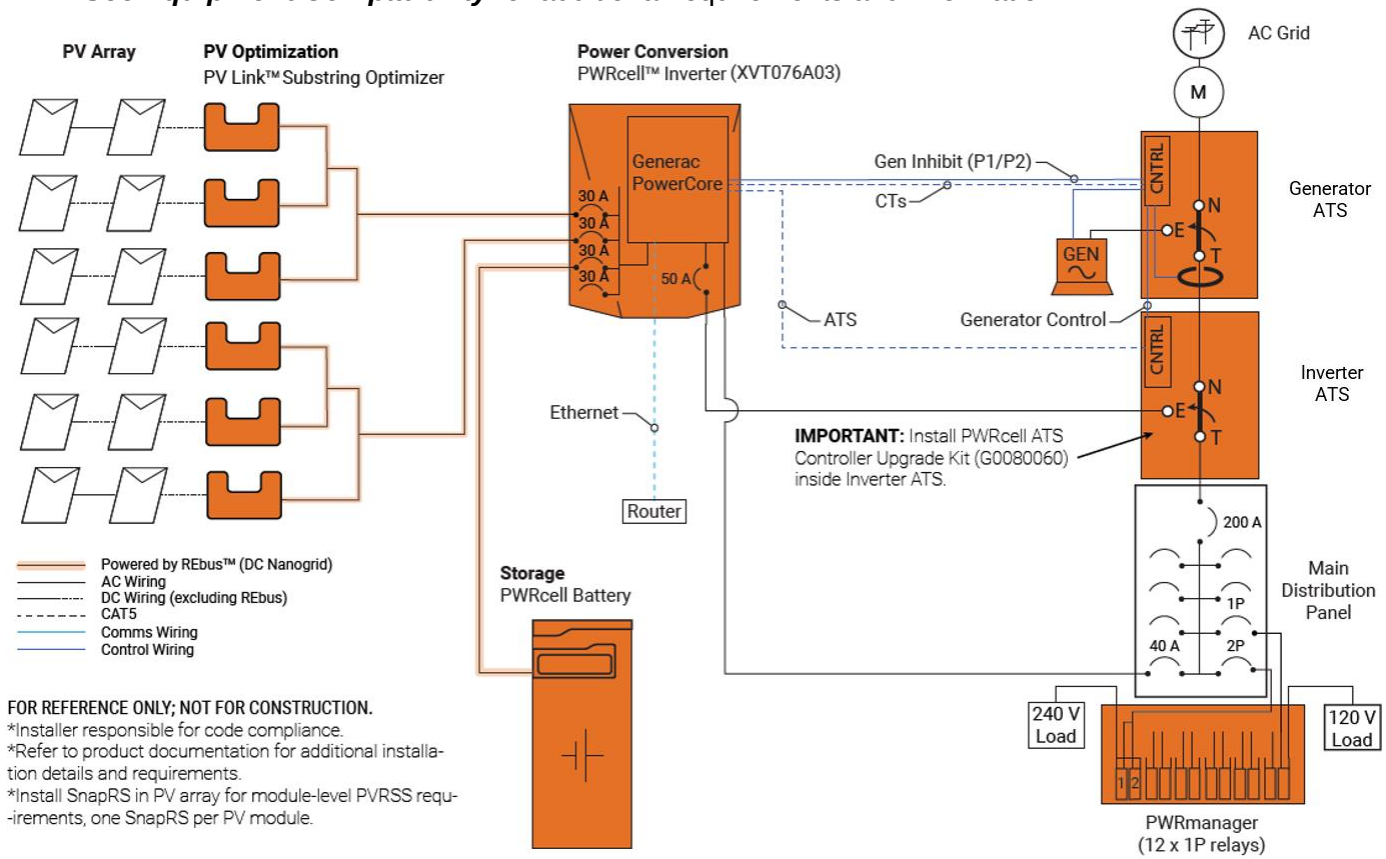

Figure 1. AC Generator Integration with PWRcell

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*See PIB23-02-CE for ATS compatibility.
**See PIB22-12-CE for ATS control board compatibility.
***See PIB23-09-CE for list of compatible generators.

In-Scope Features

- Automatically transition from utility power to backup sources in an outage.
- Automatically transition between the PWRcell ESS and the Generac generator during an outage.
- Charge the battery from the Generac generator.
- Support for Generac generators with Evolution I or II controllers.
- Functional with PWRmanager for dynamic energy management.
- Functional with Smart Management Modules (SMMs) for energy management.

Out of Scope

- Support for Generator Integration using single ATS.
- Installation with less than 6 battery modules.
- Parallel operation with AC-coupled PV.
- Support for Generac/Pika inverter models X7602 or older.
- Support for PWRcell systems with 3Ø inverters.
- Support for multi-inverter systems.
- Installation with other manufactures' transfer switches.
- Installation with Non-Generac generators, portable/manual generators, commercial or industrial generators.
- Backing up services greater than 200 Amps.
- Energy Management with ATS control board SACM relays.

Equipment Compatibility

PWRcell Equipment Hardware and Firmware

- PWRcell Inverter model XVT076A03, 120/240 VAC 1Ø, with firmware version 13794 (or newer).
- PWRcell Inverter Control Module (ICM) firmware version 12522 (or newer).
- PWRcell M6 Battery (6x battery modules) with firmware version 12980 (or newer).

NOTE: Reference the ***PWRcell Inverter Installation and Owner's manual, Section 6: Commissioning*** for guidance on accessing the Installer Configuration Tool to determine product firmware versions in the field.

Automatic Transfer Switches

See PIB23-02-CE in GENservice for a list of compatible Generac ATS models for use with PWRcell. Any compatible ATS that is upgraded with the PWRcell ATS controller upgrade kit (model G0080060) can be used as the Inverter or Generator ATS.

NOTE: The Inverter ATS control board **must** be Part No. A0002532225 from upgrade kit (model G0080060).

Compatible Generators

Generac Single Phase, Air-cooled, Generators 9-26 kW with an Evolution I or II controller are compatible with PWRcell for Generator Integration. See PIB23-09-CE for a list of supported generators.

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Energy Management

See ***Table 1.*** For energy management compatibility with Generator Integration. The ATS Controller SACM relays may not be used. If SACM relays are currently used on an existing generator or inverter installation, transfer those connections to a PWRmanager.

Table 1. Energy Management Compatibility

Energy Management Method	PWRmanager	SMMs	PWRcell ATS Controller
Remote Control	Yes	No	No
Priority Return	Yes	Yes*	No
Lockout Mode	Yes	Yes	No

* When using PWRmanager with SMMs, the SMMs must be set to Lockout Mode.

NOTE: PWRmanager is agnostic and does not require specific settings for Generator Integration.

System Sizing

The generator should be sized following generator sizing guidelines.

Service-rated equipment should be used as needed. Follow all applicable codes and standards for system sizing.

PWRcell system should be sized following Generac's PWRcell System Sizing Tool.

Energy management should be installed to avoid overloading the backup systems in accordance with NEC Article 702.4.

Large loads that would normally be locked out when on generator power should be configured for lockout with PWRmanager or SMMs. Loads that would normally be locked out when on inverter power can be set to priority return with PWRmanager.

Installation and Configuration

Reference the ***PWRcell ATS Installation and Owner's Manual (Part No. A0001501191)*** and the ***PWRcell Inverter Installation and Owner's Manual*** for complete instructions on Generator Integration with PWRcell.

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GENERAC
PWRCELL

Validating the Generator Battery Charging Circuit

Inverter Fuse Replacement

Gen Inhibit Fast Blow Mini Fuses (1 A) in the inverter, located just above the AC terminals, must be replaced with the new (3.15 A) Fast Blow Mini Fuses included with the ATS control board upgrade kit. It is critical to upgrade the fuses to support the battery charging circuit.

⚠WARNING

Electrocution. Potentially lethal voltages are generated by this equipment. Render the equipment safe before attempting repairs or maintenance. Failure to do so could result in death or serious injury.

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To Replace:

1. Disable all devices and de-energize AC power before replacing fuses.
2. Carefully push in and twist counter-clockwise from 2 to 12 o'clock to open the mini fuse holders.
3. Replace fuses and ensure they are seated properly.
4. Push fuse holder in and twist clockwise from 12 to 2 o'clock to close the mini fuse holder.
5. After replacing fuses, check voltage on Gen inhibit wires. L1-L2 should measure 240 VAC. L1-N and L2-N should measure 120VAC. Also check for 240 VAC on the Generator ATS control board terminals P1-P2.

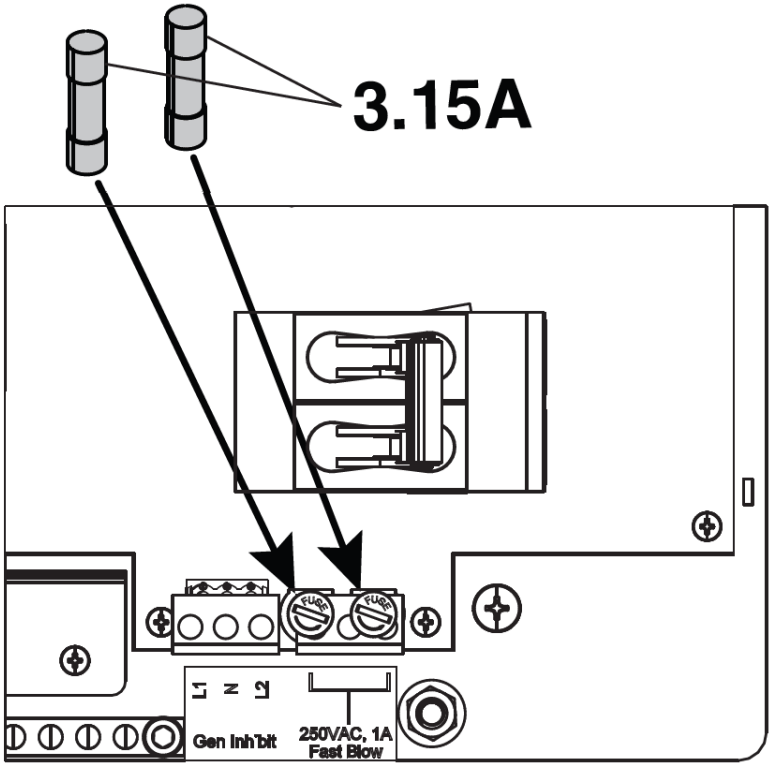

Figure 2. Fast Blow Mini Fuse Location

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T1 – Generator Battery Charger

The generator battery charge circuit T1 has changed on the PWRcell ATS Control Board. The T1 screw terminal is part of a 120 VAC circuit that provides power to the generator's 12 VDC battery charger.

See ***Figure 3***. For installations with Generator Integration, 120 VAC can still be measured from the T1 screw terminal but the source of this voltage will now come from the inverter's Gen Inhibit L1 output, which is connected to the Generator ATS control board P1 screw terminal. P1 is internally routed to the T1 Fuse and then to the T1 screw terminal.

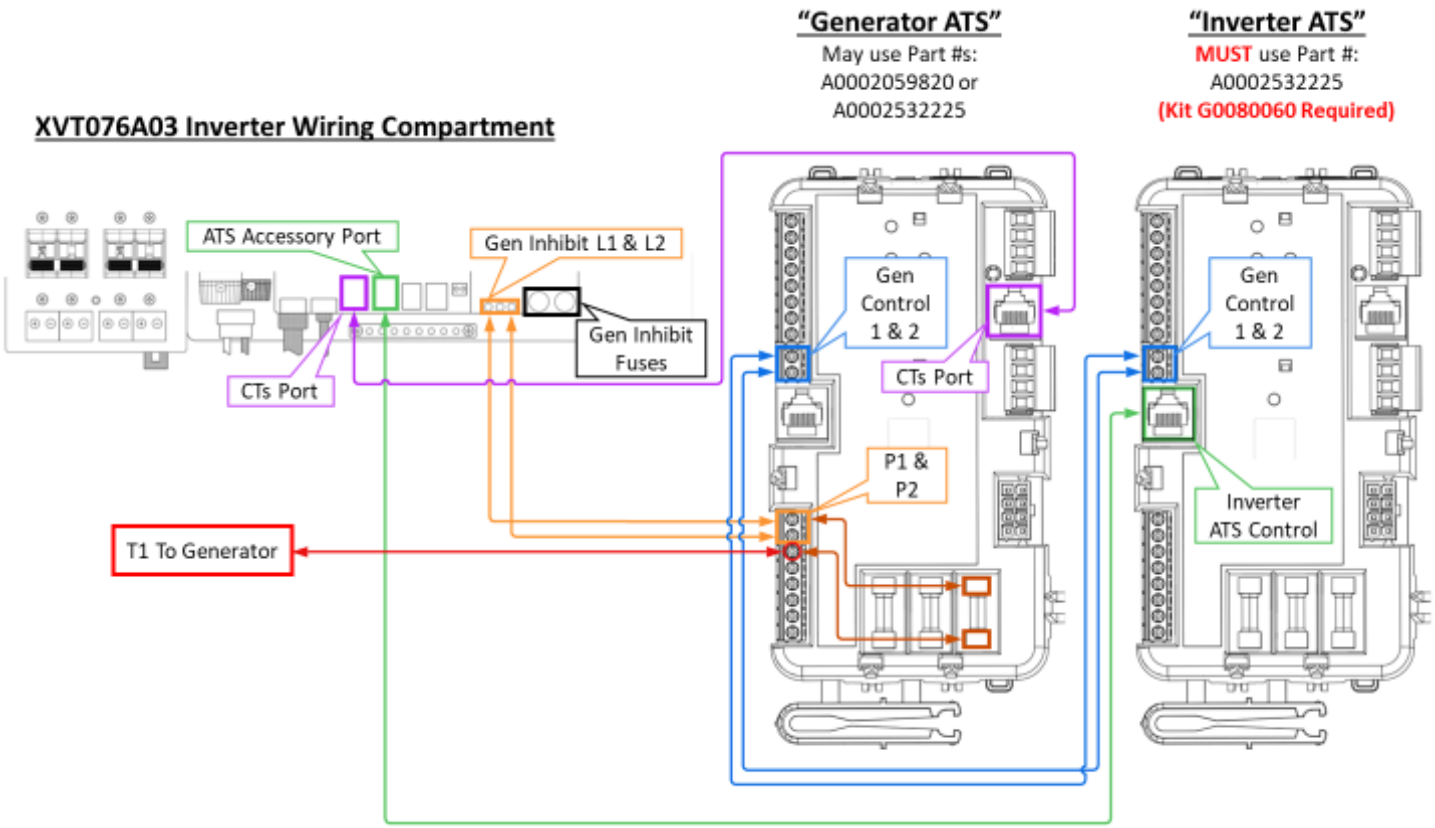

Figure 3. Control Wiring for AC Generator Integration.

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PWRcell Inverter Settings

Reference the ***PWRcell ATS Installation and Owner's Manual (Part No. A0001501191)*** and the ***PWRcell Inverter Installation and Owner's Manual*** for complete instructions regarding inverter settings for Generator Integration with PWRcell.

Observing the Generator from the Inverter

See ***Figure 4***. In Island Mode with the generator inhibited, the inverter will display "Islanding" on the home screen and a status of "islanded" on the inverter device page. Covered loads are powered by the PWRcell system only.

Figure 4. Island Mode with the Generator Inhibited.

See ***Figure 5.*** When the generator is providing power, the home screen will show a generator icon in the lower right corner. The inverter device page will display a status of "gen connected".

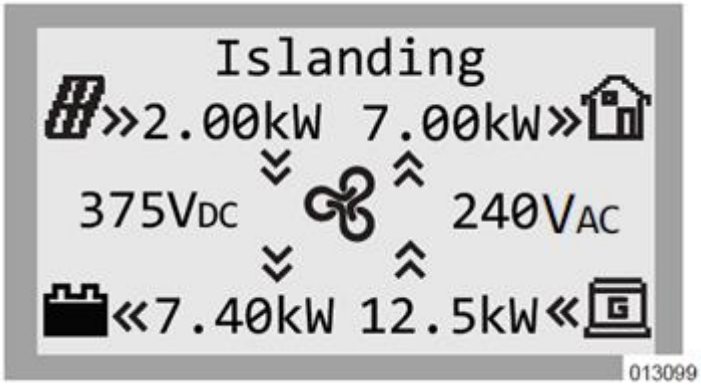

Figure 5. Island Mode with the Generator ON; Battery Charging from PV and Generator.

NOTE: Battery charge rate will vary based on site conditions including battery temperature, State of Charge, available power from generator and available power from PV.

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Detailed Sequence of Operation

The sequence of operations performed by the equipment in response to a utility outage, will depend on the generator control mode selected.

While the utility grid is present, the PWRcell Inverter will operate based on the system mode selected and the Generator will be inhibited until needed during the outage.

Generator Control Mode: Source Cycling

1. When a grid outage occurs, the inverter will disconnect from the grid and the Inverter ATS will transfer to the standby position connecting the inverter Protected Loads terminals to the load panel for backup. At this time, Energy Management devices (e.g. PWRmanager and SMMs) will shed loads set to lockout and the Generator ATS will remain in the utility position.

2. During an outage, the PWRcell system will provide backup power to local loads and inhibit the generator. While the generator is inhibited, the red Gen Inhibit LED on both ATS control boards will be illuminated. To inhibit the generator the following will occur within the system:

    2.1. The inverter will produce a 240 VAC Generator Inhibit signal at the RGM/Gen Inhibit terminals inside the inverter. When loss of grid is sensed by the inverter it will command the Generator ATS control board to switch the generator's Grid Sense input from utility sense wiring (N1-N2) to P1-P2 (RGM/Gen Inhibit). If the generator has 240 VAC on its Grid Sense terminals (from the grid or from the inverter on P1-P2) it will not start.

3. Depending on the house loads at the time of the outage and the PWRcell Battery state of charge (SoC), the Generator may turn on and power loads.

    NOTE: Whenever house load exceeds what can be powered by the PWRcell Battery, the inverter will set an internal 31 minute timer. While this timer is active the generator will supply all backup power regardless of system mode selected, PWRcell Battery SoC, or house loads.

4. If the inverter cannot support the active loads or if the battery SoC falls below 25%, it will cease to inhibit the generator. When the generator starts up, the Generator ATS will transfer to the standby (Generator) position. After 15 seconds, the Inverter ATS will switch to the utility (Generator ATS) position so that the Generator can takeover powering the loads and charging the PWRcell Battery.

5. After the generator has been running, there are two conditions that the system will consider before switching back to inverter power. Both conditions must be true for the system to switch back to inverter power.

    5.1. Can the PWRcell system support the load? If it cannot, the generator will run for 31 minutes.

    5.2. Is the battery SoC >95%?

6. For the duration of the outage, the system will cycle between steps 3 and 5 above.

    6.1. When the system switches back to inverter power, the Inverter ATS will switch to the standby position, the generator will be inhibited, and the Generator ATS will switch to the utility position.

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7. When utility power is restored, the Generator ATS will either be in the utility position (if generator is inhibited and the inverter is powering loads) or it will switch to the utility position. The Inverter ATS will either already be in the utility position (if generator is running) or it will switch to the utility position based on return-to-grid settings determined by the inverter grid profile selected.

Generator Control Mode: Single Transfer

1. When a grid outage occurs, the inverter will disconnect from the grid and the Inverter ATS will transfer to the standby position connecting the inverter Protected Loads terminals to the load panel for backup. At this time, Energy Management devices (e.g. PWRmanager and SMMs) will shed loads set to lockout and the Generator ATS will remain in the utility position.

2. During an outage, the PWRcell system will provide backup power to local loads and inhibit the generator. While the generator is inhibited, the red Gen Inhibit LED on both ATS control boards will be illuminated.

3. Depending on the house loads at the time of the outage and the PWRcell Battery state of charge (SoC), the Generator may turn on and power loads.

4. If the inverter cannot support the active loads or if the battery SoC falls below 25%, it will cease to inhibit the generator. When the generator starts up, the Generator ATS will transfer to the standby (Generator) position. After 15 seconds the inverter ATS will switch to the utility (Generator ATS) position so that the Generator can takeover powering the loads and charging the PWRcell Battery.

5. After the generator starts up, it will remain ON until grid power is restored.

6. When utility power is restored, the Generator ATS will switch to the utility position. The Inverter ATS will already be in the utility position.

Generator Control Mode: Always On

1. When a grid outage occurs, the inverter will disconnect from the grid and the Inverter ATS will transfer to the standby position connecting the inverter Protected Loads terminals to the load panel for backup. At this time, Energy Management devices (e.g. PWRmanager and SMMs) will shed loads set to lockout and the Generator ATS will remain in the utility position.

2. During an outage, the PWRcell system will briefly provide backup power to local loads while the generator starts up. The generator will not be inhibited using the Always On control mode.

3. When the generator completes its warm up cycle, the Generator ATS will transfer to the standby (Generator) position. After 15 seconds the Inverter ATS will switch to the utility (Generator ATS) position so that the Generator can takeover powering the loads and charging the PWRcell Battery.

4. The generator will remain ON until grid power is restored.

5. When utility power is restored, the Generator ATS will switch to the utility position. The Inverter ATS will already be in the utility position.

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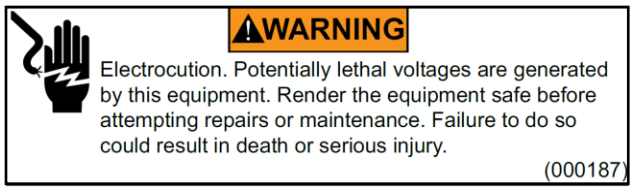
Test Points and State Validation



See ***Table 2*** for a list expected voltages at different test points with various system conditions. When troubleshooting, compare measured voltages to the table. If measured voltages don't match, or the "Gen Inhibit" LED is in the wrong state, further troubleshooting may be necessary.

Table 2. Sequence of Operations - State Validation Table

Grid	Power Source	Generator ATS Position	Inverter ATS Position	Gen Inhibit P1-P2	Generator ATS "Gen N1/N2"	Inverter ATS "Gen N1/N2"	Inverter ATS 23XFER - GND (Transfer)	GEN CTRL	"Gen Inhibit" LED
Present	Grid	Utility	Utility	240 V	240 V	240 V	12 V	12 V	OFF
Outage	Inverter	Utility	Standby	240 V	240 V	0 V	0 V	0 V	ON
Outage	Generator	Standby	Utility	240 V	0 V	240 V	12 V	12 V	OFF

Additional Resources

Additional information about AC Generator Integration can be found in:

- A0001501191 Rev. B – Installation Manual For PWRcell Automatic Transfer Switch
- A0001424068 Rev. H - PWRcell Inverter Installation and Owner's manual
- A0003998388 Rev. A - PIB23-02-CE ATS Compatibility with PWRcell
- A0001783927 Rev. A - PWRcell ATS Controller Kit (G0080060) - Spec Sheet
- A0003346726 Rev. B – PIB22-09-CE Controller Requirements for Dual-ATS Configurations.
- A0004888926 Rev. A - PIB23-09-CE Generator Compatibility List
- Single Line Diagrams (https://www.generac.com/resources-and-tools/ce-installer-resources/system-sizing-tools)
- AC Generator Integration Overview Video (https://youtu.be/a2EPG4dcDEU)

NOTE: Document part numbers and revisions stated above are the latest available at the time of release. Updates to these documents are subject to change without notice.

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