

FREQUENTLY ASKED QUESTIONS

G9400 2000KVA UPS VALUE ADDED FEATURES
COMPARED TO COMPETING MEGAWATT UPS

UNINTERRUPTIBLE POWER SYSTEMS G9400 Series

Topologies of large Mega Watt Uninterruptible Power Systems (UPS) vary greatly between manufacturers. Some UPS topologies may require the purchase of optional or additional equipment to accomplish the installation site's UPS reliability and redundancy requirements. The following Frequently Asked Questions (FAQ) will help purchasers identify UPS features that increase the redundancy and reliability as well as reduce the total cost of ownership of their large Mega Watt UPS investment.

WHAT HAPPENS WHEN A COOLING FAN FAILS IN A TOSHIBA G9400 MEGA WATT (1200, 1600, OR 2000KVA) UPS COMPARED TO A COOLING FAN FAILURE IN A COMPETITOR'S MEGA WATT UPS?

The Toshiba G9400 UPS control logic will take the failed fan UPS Power Module (UPM) off line while the other Power Modules continue to provide Voltage Frequency Independent (VFI), double conversion, quality power to the load. This VFI quality power flow can continue up to the load capacity of the remaining UPMs on line. When such fan failure occurs on some competitors Mega Watt UPS topologies using parallel UPS Power Modules, the UPS acts like a monolithic UPS and **ALL** of the Power Modules go off line and the UPS operates in static bypass mode. This leaves the critical load unprotected from not only a utility power outage, but also harmful utility voltage spikes and under voltages.

The reason the Toshiba G9400 Mega Watt UPS remains on line is that a **DC isolation contactor (CB2)** is included as a **standard** component in each Toshiba G9400 UPM. CB2 working in conjunction with the UPM's input and output isolation contactors, allows the UPS Power Module with the failed fan to completely isolate itself from rest of the other UPMs. This redundancy in design allows replacement of the failed fan in a controlled, timely manner, all the while protecting the load with VFI double conversion quality power. Other Mega Watt UPS with parallel UPM topologies include such G9400 like **DC isolation contactors (CB2)** as an **OPTION**. Adding the Isolation Contactor option greatly increases the cost and lead-time of the competitors Mega Watt UPS.



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HOW DOES THE TOSHIBA G9400 MEGA WATT (1200, 1600, OR 2000KVA) UPS MEET THE UL 1778 REQUIREMENT OF DISCONNECTING THE ENERGY STORAGE SYSTEM (ESS) POWER FROM THE INTERNAL UPS DC BUS IN THE EVENT OF AN EMERGENCY POWER OFF (EPO) OR ESS OVERCURRENT CONDITION.

The Toshiba G9400 Mega Watt UPS includes as **standard** a **DC isolation contactor (CB2)** in each UPS Power Module (UPM). The CB2 DC isolation contactors disconnects and isolates the UPS DC bus circuit from the ESS DC circuitry in the event of an EPO or ESS overcurrent condition. ESS overcurrent devices (DC Breakers), per the National Electrical Code (NEC), are used only for protecting the cable to and from the G9400 Mega Watt UPS, not for isolating the ESS power from the UPS DC bus.

Many competitors Mega Watt UPS do not include the **DC isolation contactors (CB2)**. To meet the UL 1778 requirement. For their Mega Watt UPS the ESS overcurrent devices (DC Breakers) require an external isolation scheme such as Under Voltage Relays (UVRs) to isolate the ESS DC circuitry from the UPS DC bus.

In addition to the expensive UVR cost to the ESS, the UPS installer is required to add field wiring for the ESS UVR circuitry. Cost of field wiring from the ESS to the UPS is site specific and not calculated in the ESS purchase price. It is a hidden cost to the UPS buyer. Field wiring also creates a potential for miswiring, which may cause damage to the UPS and or the ESS UVR circuitry.

In addition, depending on the DC breaker manufacturer, an external power supply for the UVR circuitry may be required for the UVRs to operate correctly. Cost and complexity of such external power supplies are site and application specific (another hidden cost to the UPS buyer).

Therefore, not having the **DC isolation contactor (CB2)** in the UPS adds cost to the ESS purchased for the UPS as well as adding complexity and potential lower reliability of the UPS system.

DOES THE FACTORY INSTALLED DC ISOLATION CONTACTORS (CB2) IN THE TOSHIBA G9400 MEGA WATT UPS (1200, 1600, OR 2000KVA) ALLOW A FAULTED UPM TO BE SERVICED WHILE THE LOAD IS STILL BEING FED BY THE REMAINING ONLINE UPMS?

For redundancy, the Toshiba G9400 UPS includes as **standard** the **DC isolation contactor (CB2)** in each UPS Power Module (UPM). This allows the G9400 Mega Watt UPS to isolate a faulted

or failed UPM while the other UPMS remain on line in Voltage Frequency Independent (VFI) double conversion mode and protect the load. Many competitor's Mega Watt UPS do not include these **DC isolation contactors (CB2)** to reduce the initial purchase price of the UPS.

Although the faulted G9400 Mega Watt UPS UPM(s) is isolated from the remaining online UPMS providing Voltage Frequency Independent (VFI) double conversion power to the critical load, service on the faulted UPM requires following the National Electrical Code (NEC) and Occupational Safety and Health Administration (OSHA) safety requirements as well as site codes. For the Technicians safety and for possible dropping of the critical load, Data Centers generally do not allow even what is considered "light" service such as taking meter or scope readings on live equipment regardless if the technician is suited up in OSHA mandatory 40 CAL gear. Most Data Centers require the UPS be isolated through a Maintenance Bypass System to even open UPS doors to perform visual checks or perform service on the UPS. This includes opening cabinet doors with "dead fronts" covering all electronic circuits.

MOST LARGE DATA CENTER APPLICATIONS REQUIRE THE UPS TO HAVE A HIGH SHORT CIRCUIT INTERRUPT (KAIC) RATING. HOW DOES THE TOSHIBA G9400 MEGA WATT UPS (1200, 1600, OR 2000KVA) HANDLE THIS REQUIREMENT DIFFERENTLY THAN COMPETITOR'S MEGA WATT UPS?

The Toshiba G9400 Mega Watt UPS includes as **standard** **100kAIC** fuses in the internal Static Bypass circuit. Most competitor's Mega Watt UPS do not include the 100kAIC fuses as standard to the UPS to reduce the initial UPS purchase price. Without the 100kAIC fuses, most Voltage Frequency Independent (VFI) double conversion Mega Watt UPS in the market have a short circuit withstand of about **13.3kAIC**, (dependent on the UPS components active during the short circuit current event). Although the 100kAIC fuses add to the initial cost of the G9400 Mega Watt UPS, Toshiba's position is that adding the 100kAIC fuses in the UPS improves reliability to the overall Data Center system critical protection design without adding costly external componentry to meet 100kAIC interrupt specifications. Therefore, the upfront delta price difference for the G9400 Mega Watt UPS 100kAIC **standard** feature is worth the extra cost. This is especially true if determined the competitor's UPS does not meet the **100kAIC** specification after installed, which causes costly UPS rework or adding expensive external 100kAIC componentry.

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WHAT IS THE BENEFIT FOR INCLUDING SINGLE INPUT COPPER BUS BARS AND TERMINATION HARDWARE TO A DUAL INPUT MEGA WATT UPS?

Over 98% of all Data Center applications are single input, even though most all Mega Watt UPS units are dual input (separate AC Rectifier input and AC Static Bypass input). The Toshiba dual input G9400 Mega Watt UPS (1200, 1600, or 2000kVA) includes as **standard** copper bus bar jumpers to convert the dual input into a single input. A termination hardware kit (bolts, washers, lock washers and nuts) for each 3 phase input, 3 phase output, and DC power cables for NEMA two-hole connectors is also included as **standard**. Many competitor's Mega Watt models do not include single input bus bar jumpers or termination hardware as a standard, offering them as an option or leaving the procurement to the installation contractor (another hidden UPS purchase cost). This often overlooked feature increases UPS purchase price, on-site cabling cost, and may cause site installation delays.

WHAT ARE THE DIFFERENCES BETWEEN THE TOSHIBA G9400 MEGAWATT UPS (1200, 1600, OR 2000KVA) UPS REMOTEYE®4 COMMUNICATION CARD AND OTHER MANUFACTURERS' COMMUNICATION CARDS?

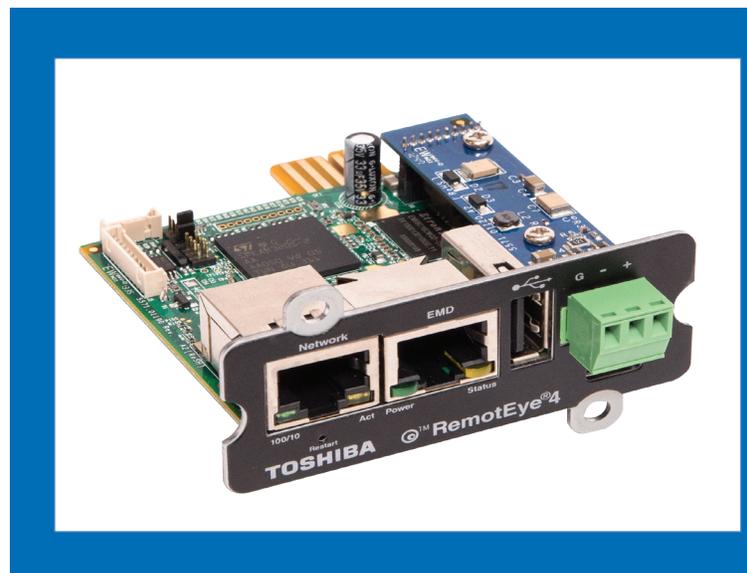
Most Mega Watt UPS units in the market today include some type of internal communication card. The Toshiba G9400 Mega Watt UPS (1200, 1600, or 2000kVA) comes **standard** with the Toshiba RemotEye®4 communication card. Whereas both the Toshiba G9400 Mega Watt UPS RemotEye®4 and the competitor's Mega Watt UPS communication cards allow for communication with the clients Building Management System (BMS), the Toshiba G9400 Mega Watt UPS RemotEye®4 has advanced communication features giving customers flexibility to choose which communication protocol best fits their need. The Toshiba RemotEye®4 can communicate simultaneously on multiple communication protocols such as Modbus and SNMP where other competitor's communication protocols are restricted to one or the other. Toshiba RemotEye®4 also supports a wide variety of industrial BMS communication protocols including the popular BMS Data Center protocol BACnet.

The Toshiba RemotEye®4 has multiple built in security features for Client applications including communicating with virtual machine servers, which prevent data corruption during power outages. Other UPS manufacturer's communication protocols rely solely on the Client's BMS for communication security. Built-

in firewalls, capability to change port numbers, and means to disable non-essential protocols are also unique features of the Toshiba RemotEye®4.

Toshiba RemotEye®4 includes Toshiba RemotRadar® software allowing monitoring of up to 10 On-Premise Toshiba G9400 UPS units. RemotRadar® Cloud software allows for monitoring over 5000 G9400 units globally anywhere, any time. In addition, Toshiba RemotEye®4 can be paired with Toshiba RemotEye® Environmental Monitoring Devices (EMD) for use with the Clients BMS to communicate location temperature and humidity, door openings, and building alarms such as fire or sprinkler alarms. Many competitors' communication cards do not allow pairing nor have capability to pair with Environmental Monitoring Devices.

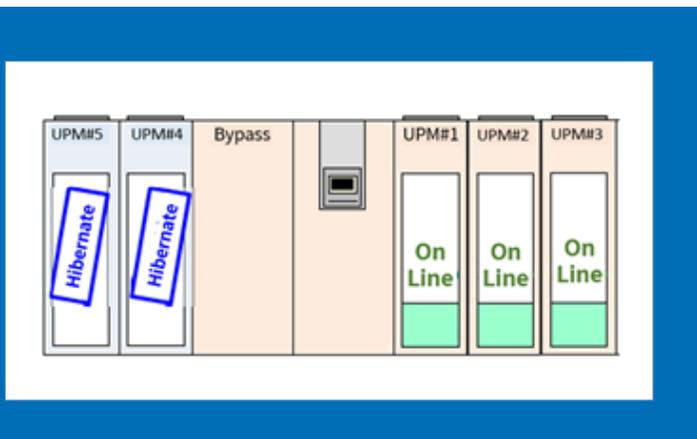
The development team of Toshiba RemotEye®4 can quickly alter or create communication conventions for client specific communication applications. Such development on the competitor's communication cards requires major firmware alterations on both the UPS control and the communication microprocessors, a potentially costly endeavor for the customer.



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BESIDES ADDING REDUNDANCY TO THE TOSHIBA G9400 MEGA WATT UPS (1200, 1600, OR 2000KVA) WHEN THERE IS A FAILED COMPONENT IN A UPS POWER MODULE (UPM), WHAT OTHER ADVANTAGES ARE THERE FOR INCLUDING THE DC ISOLATION CONTACTOR (CB2) IN EACH TOSHIBA G9400 MEGA WATT UPS POWER MODULE OVER THE COMPETITOR'S MODULAR MEGA WAT UPS UNITS THAT DO NOT INCLUDE SUCH DC ISOLATION CONTACTORS?

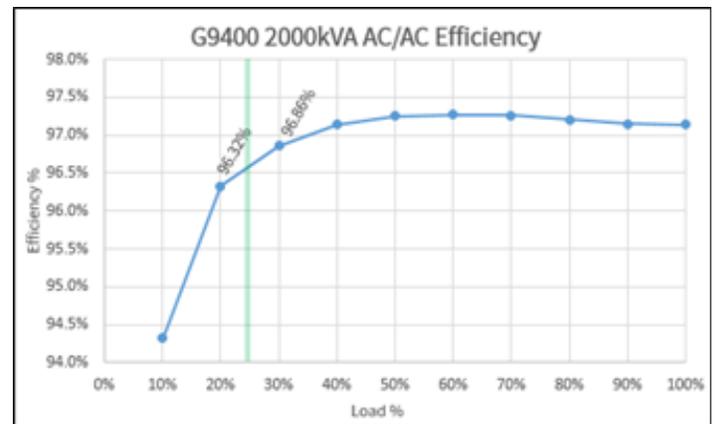
One great “green” advantage for including the **DC isolation contactors (CB2)** is it allows the Toshiba G9400 Mega Watt UPS to incorporate the selectable High Efficiency Hibernate (HEH) feature. The G9400 HEH feature allows one or more UPS Power Modules (UPM) to hibernate when the G9400 Mega Watt UPS load is at low levels (below 50%). When selected, the HEH feature allows for a system efficiency increase of up to 3%, depending on the low load level and kVA model used. The feature is only available when **DC isolation contactors (CB2)** are included in the UPS Power Modules circuitry.



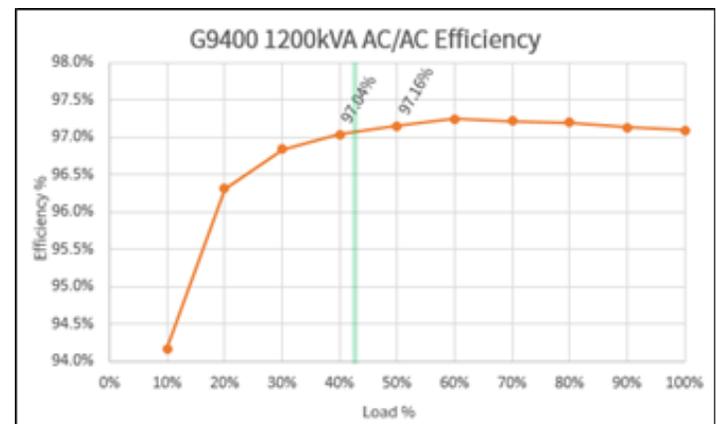
Here is a scenario of how the selectable High Efficiency Hibernate (HEH) feature functions on a Toshiba G9400 2000kW UPS:

Customers critical load is 500kW (25% of total 2000kW capacity), with the HEH feature selected, three of the five 400kW G9400 UPMs will be On Line providing Voltage Frequency Independent (VFI) double conversion backup power while two UPMs will be in hibernation. Note here the High Efficiency Hibernate firmware

always allows one extra UPM to be On Line per the load level to accommodate for increased load steps and redundancy (N+1), with two UPMs being the minimum On Line quantity when the HEH feature is active. Since the efficiency of the Toshiba G9400 2000kW UPS, starts “kneeing” off at approximately 25% load. Hibernating two UPMs allows the total UPS efficiency to be equal to that of a G9400 1200kW UPS. The 500kW load would thus be 42% of the capacity for the three On Line UPMs (1200kW).



G9400 2000kVA UPS with 25% load efficiency = 96.43%



G9400 1200kVA UPS with 42% load efficiency = 97.08%

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If the load were to increase above the capacity of the three On Line G9400 UPMs (1200kW) while the High Efficiency Hibernate feature is operating, the hibernated UPMs “wake up”, go on line, and support the critical load. If the load decreases back to a “low” levels and shows to be stable over a set time, the High Efficiency Hibernate feature reactivates.

Another High Efficiency Hibernate feature of the Toshiba G9400 Mega Watt UPS with DC Isolation contactors (CB2) is allowing the hibernated UPMs to rotate to active / on line mode after a selected amount of days (minimum 30 days). This rotation allows all the UPMs to cycle so they are always fresh and ready when needed.

The HEH feature adds life to the Toshiba G9400 Mega Watt UPS componentry since the components are not active when in hibernation. Altering the hibernation from one UPM to another keeps the life expectancy the same on all the G9400 Mega Watt UPMs circuitry.

Again, the High Efficiency Hibernate feature for increased efficiency at low loads is only available when the DC isolation contactors (CB2) are included in a modular designed UPS. This is a standard feature on the Toshiba G9400 Mega Watt UPS and nonstandard on many competitor’s modular Mega Watt UPSs.

